Amendments of the Rules

(External Development Review-External Opinion Inquiry)

Part 4 Hull Equipment

2023.09.

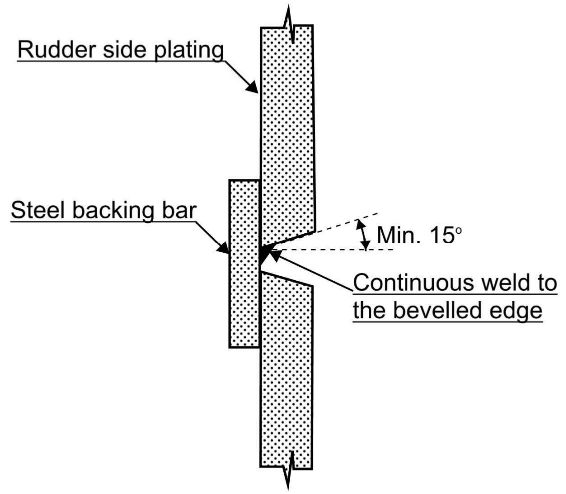
Hull Rule Development Team

Main Amendments

(1) Background of Amendment

1) reflected IACS UR S10 Rev. 7
- Improved side plate welding method (changed to continuous welding on the bevel edge)
- clarify the bending forces and moments for spade rudder with trunk extending inside the rudder
- clarify and improve the push-up pressure and push-up length requirements for pintle cone couplings
- Clarify the requirements of fittings of liners for rudder stocks having diameter less than 200 mm
- editorial changes and renumbering of figures

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 1 RUDDERS **Section 1 General** 101. ~ 105. 〈omitted〉 106. Welding *(2021)* **1.** ~ **4.** 〈omitted〉 **5.** Welds between plates and heavy pieces (solid parts in forged or cast steel or very thick plating) are to be made as full penetration welds. In way of highly stressed areas e.g. cut-out of semi-spade rudder and upper part of spade rudder, cast or welding on ribs is to be arranged. Two sided full penetration welding is normally to be arranged. Where back welding is impossible welding is to be performed against ceramic backing bars or equivalent. Steel backing bars may be used and are to be continuously welded on one side to the heavy piece.	**CHAPTER 1 RUDDERS** **Section 1 General** 101. ~ 105. 〈omitted〉 106. Welding **1.** ~ **4.** 〈same as present〉 **5.** Welds in the rudder side plating subjected to significant stresses from rudder bending and welds between plates and heavy pieces (solid parts in forged or cast steel or very thick plating) are to be made as full penetration welds. In way of highly stressed areas e.g. cut-out of semi-spade rudder and upper part of spade rudder, cast or welding on ribs is to be arranged. Two sided full penetration welding is normally to be arranged. Where back welding is impossible welding is to be performed against ceramic backing bars or equivalent. Steel backing bars may be used and are to be fitted with continuous weld on one side to the bevelled edge, see **Fig 4.1.2**. The bevel angle is to be at least 15° for one sided welding.  Fig 4.1.2 Use of steel backing bar in way of full penetration welding of rudder side plating	IACS UR S10 Rev. 7 1.4.3 -expansion of full penetration welding area -improvement of welding method by continuous weld at the bevelled edge instead of a separate fillet weld at the edge of the steel backing bars

Present	Amendment	Note
107. Equivalence 〈omitted〉 **Section 2 Rudder Force** **201. Rudder force** The rudder force F_R upon which the rudder scantlings are to be based is to be obtained from the following formula, for each of going ahead or astern. However, when the rudder is arranged behind the propeller that produces an especially great thrust, the rudder force is to be appropriately increased. $F_R = 132 K_1 K_2 K_3 A V^2$ (N) where : A = area of rudder plate (m^2). V = speed of ship(Kt) as defined in Pt 3, Ch 1 of the Rules. When the speed is less than 10 *knots*, V is to be replaced by V_{min} obtained from the following formula ; $V_{min} = \frac{V+20}{3}$ (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. 〈omitted〉 h : mean height of rudder (m), which is determined according to the coordinate system in Fig 4.1.2. 〈omitted〉	**107. Equivalence 〈same as present〉** **Section 2 Rudder Force** **201. Rudder force** The rudder force F_R upon which the rudder scantlings are to be based is to be obtained from the following formula, for each of going ahead or astern. However, when the rudder is arranged behind the propeller that produces an especially great thrust, the rudder force is to be appropriately increased. $F_R = 132 K_1 K_2 K_3 A V^2$ (N) where : A = area of rudder plate (m^2). V = speed of ship(Kt) as defined in **Pt 3, Ch 1** of the Rules. When the speed is less than 10 *knots*, V is to be replaced by V_{min} obtained from the following formula ; $V_{min} = \frac{V+20}{3}$ (kt) For the astern condition the maximum astern speed V_a as defined in SOLAS Regulation II-1/3.15 is to be used, however, in no case taken less than: 〈same as present〉 h : mean height of rudder (m), which is determined according to the coordinate system in **Fig 4.1.3.** 〈same as present〉	IACS UR S10 Rev. 7 2.1.1 -Clarify and align definition of astern speed renumbering figure

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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Section 3 Rudder Torque

301. Rudder torque of Type *B* and Type *C* rudders (Rudder without cut-outs)

〈omitted〉

b = mean breadth(m) of rudder determined by the coordinate system in **Fig 4.1.2.**

〈omitted〉

302. Rudder torque of Type *A, D* and *E* rudders (Rudder with stepped contours)

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

〈omitted〉

A_1 and A_2 = areas of respective rectangulars (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 4.1.3.

〈omitted〉

b_1 and b_2 = mean breadth (m) of portions A_1 and A_2, determined by applying Fig 4.1.2 correspondingly.

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Section 3 Rudder Torque

301. Rudder torque of Type *B* and Type *C* rudders (Rudder without cut-outs)

〈same as present〉

b = mean breadth(m) of rudder determined by the coordinate system in **Fig 4.1.3.**

〈same as present〉

302. Rudder torque of Type *A, D* and *E* rudders (Rudder with stepped contours)

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〈same as present〉

A_1 and A_2 = areas of respective rectangulars (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 4.1.4.**

〈same as present〉

b_1 and b_2 = mean breadth (m) of portions A_1 and A_2, determined by applying **Fig 4.1.3** correspondingly.

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renumbering figure

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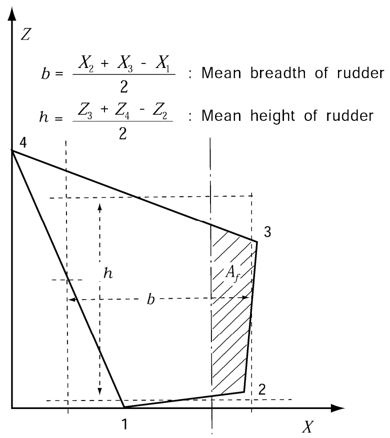
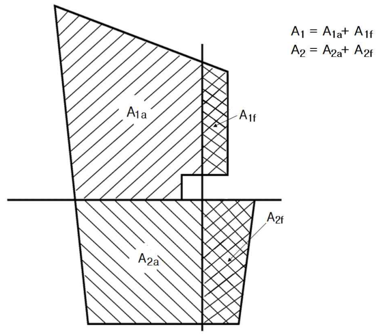
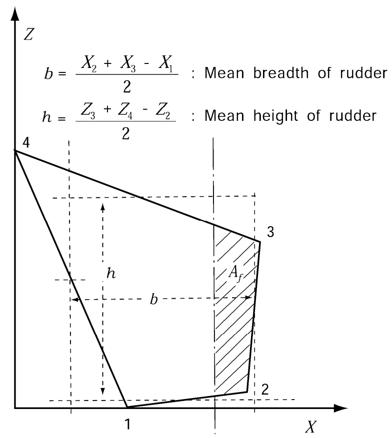
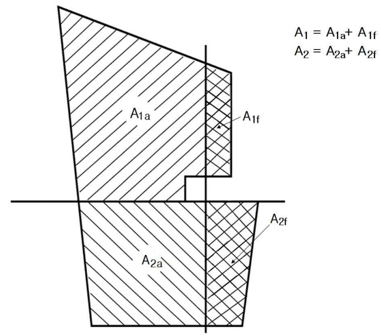
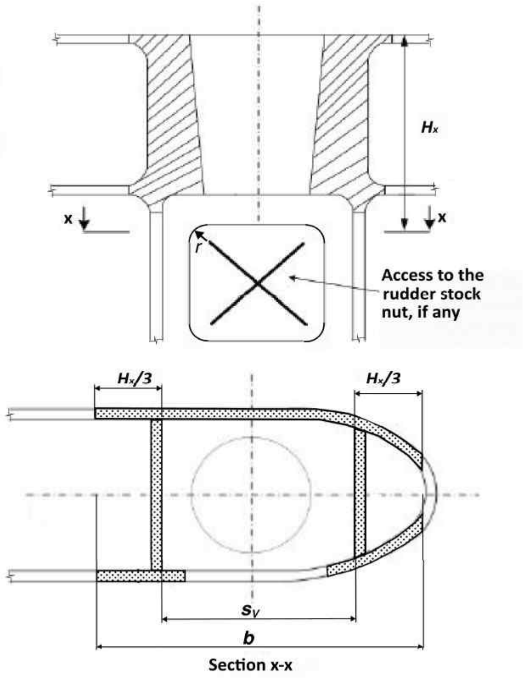
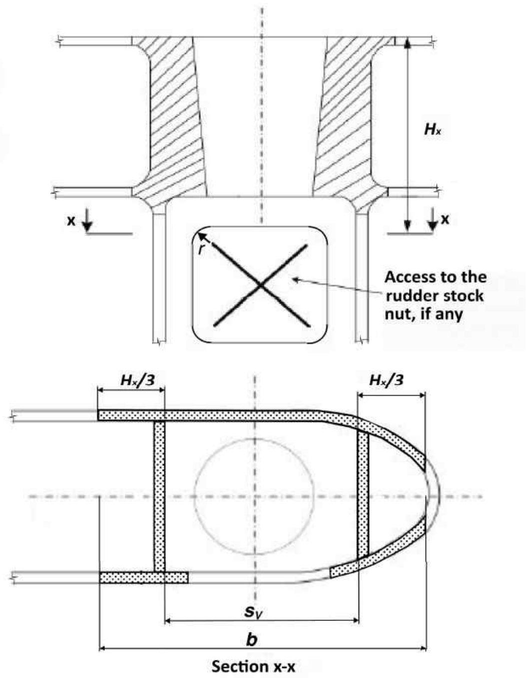
Present	Amendment	Note
 Fig 4.1.2 Coordinate system of rudders  Fig 4.1.3 Division of rudder area	 Fig 4.1.<u>3</u> Coordinate system of rudders  Fig 4.1.<u>4</u> Division of rudder area	renumbering figure
Section 4 Rudder Strength Calculation〈omitted〉 **Section 5 Rudder Stocks** **501. Upper stocks** [See Guidance] 〈omitted〉 **502. Lower stocks** 〈omitted〉	**Section 4 Rudder Strength Calculation〈same as present〉** **Section 5 Rudder Stocks** **501. Upper stocks** [See Guidance] 〈omitted〉 **502. Lower stocks** 〈same as present〉 <u>For a spade rudder with trunk extending inside the rudder, the rudder stock scantlings shall be checked against the two cases defined in Guidance 401.4.</u>	IACS UR S10 Rev. 7 4.2 -clarify the bending forces and moments for spade rudder with trunk extending inside the rudder

Present	Amendment	Note
Section 6 Rudder Plates, Rudder Frames and Rudder Main Pieces **601. Rudder plate** The rudder plate thickness t is not to be less than that obtained from the following formula : $t = 5.5S\beta\sqrt{\left(d + \frac{F_R \times 10^{-4}}{A}\right)K_{pl}} + 2.5 \quad (mm)$ where : A and F_R = as specified in 201. K_{pl} = material factor for the rudder plate as given in 103. d = as specified in Pt 3, Ch 1, 111. of the Rule. 〈omitted〉 **602. ~ 604. 〈omitted〉** **605. Connections 【See Guidance】** **1. ~ 2. 〈omitted〉** **3.** connection with the rudder stock housing (1) 〈omitted〉 (2) The breadth of the rudder plating, in m, to be considered for the calculation of section modulus is to be not greater than: $b = S + \frac{2h_X}{3} \quad (m)$ S = spacing between the two vertical webs (m) h_X = according to (1)	**Section 6 Rudder Plates, Rudder Frames and Rudder Main Pieces** **601. Rudder plate** The rudder plate thickness t is not to be less than that obtained from the following formula : $t = 5.5S\beta\sqrt{\left(d_s + \frac{F_R \times 10^{-4}}{A}\right)K_{pl}} + 2.5 \quad (mm)$ where : A and F_R = as specified in **201.** K_{pl} = material factor for the rudder plate as given in **103.** d = as specified in **Pt 3, Ch 1, 126.** of the Rule. 〈same as present〉 **602. ~ 604. 〈same as present〉** **605. Connections 【See Guidance】** **1. ~ 2. 〈same as present〉** **3.** connection with the rudder stock housing (1) 〈same as present〉 (2) The breadth of the rudder plating, in m, to be considered for the calculation of section modulus is to be not greater than: $b = S + \frac{2h_X}{3} \quad (m)$ S = spacing between the two vertical webs (m) (See **Fig 4.1.5**) h_X = according to (1)	IACS UR S10 Rev. 7 5.2 -clarify the definition of the waterline as scantling draft renumbering figure

Present	Amendment	Note
(3) Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted. **4.** 〈omitted〉  Fig 4.1.4 Connection between rudder structure and rudder stock gudgeon *(2021)* 〈below omitted〉	(3) Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted. **4.** 〈same as present〉  Fig 4.1.5 Connection between rudder structure and rudder stock gudgeon 〈same as present〉	renumbering figure

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Section 7 Couplings between Rudder Stocks and Main Pieces

701. Horizontal flange couplings 【See Guidance】

1. Coupling bolts are to be reamer bolts and at least 6 reamer bolts are to be used in each coupling.
2. Couplings are to comply with the requirements in Table 4.1.8.
3. The welded joint between the rudder stock and the flange is to be made in accordance with Figure 4.1.5 or equivalent.

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Section 7 Couplings between Rudder Stocks and Main Pieces

701. Horizontal flange couplings 【See Guidance】

1. Coupling bolts are to be reamer bolts and at least 6 reamer bolts are to be used in each coupling.
2. Couplings are to comply with the requirements in Table 4.1.8.
3. The welded joint between the rudder stock and the flange is to be made in accordance with Figure 4.1.6 or equivalent.

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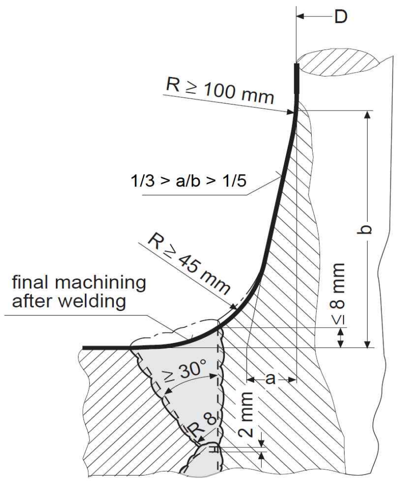

Fig 4.1.5 Welded joint between rudder stock and coupling flange

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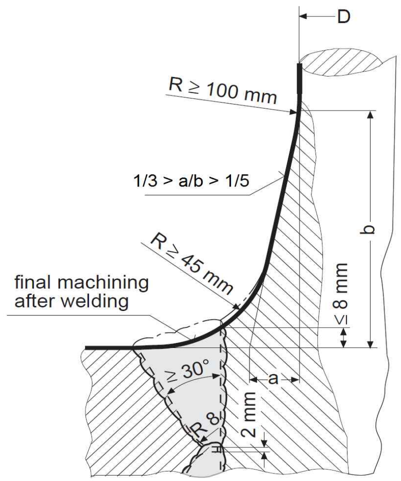

Fig 4.1.6 Welded joint between rudder stock and coupling flange

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702. Vertical flange couplings 【See Guidance】〈omitted〉

703. Cone couplings *(2021)* 【See Guidance】

1. Cone couplings without hydraulic arrangements (oil injection and hydraulic nut, etc.) for mounting and dismounting the coupling are to comply with the following requirements.
   (1) The couplings are to have a taper c on diameters of 1 : 8 ~ 1 : 12 and be secured by the slugging nut. (See **Fig 4.1.6**)

$$c = \frac{d_0 - d_u}{l_c}$$

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702. Vertical flange couplings 【See Guidance】〈same as present〉

703. Cone couplings 【See Guidance】

1. Cone couplings without hydraulic arrangements (oil injection and hydraulic nut, etc.) for mounting and dismounting the coupling are to comply with the following requirements.
   (1) The couplings are to have a taper c on diameters of 1 : 8 ~ 1 : 12 and be secured by the slugging nut. (See **Fig 4.1.7 and Fig 4.1.7b**)

$$c = \frac{d_0 - d_u}{l_c}$$

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<td>renumbering figure</td>
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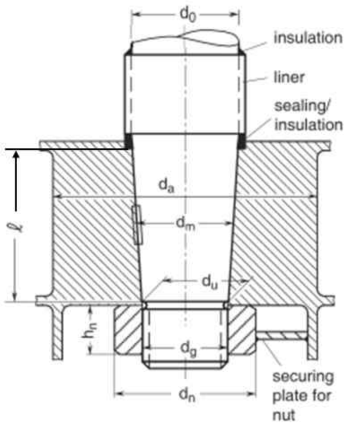
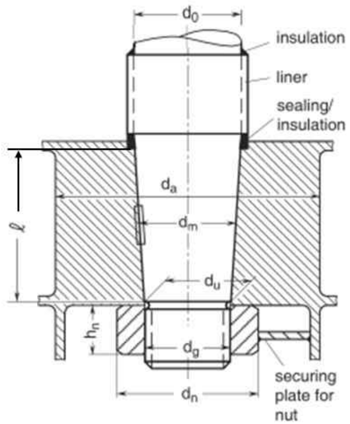
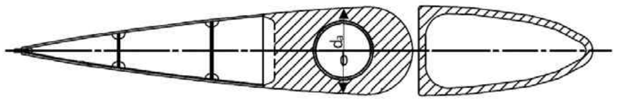
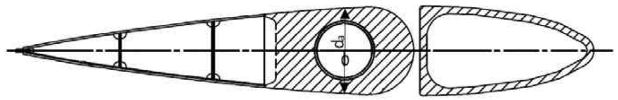
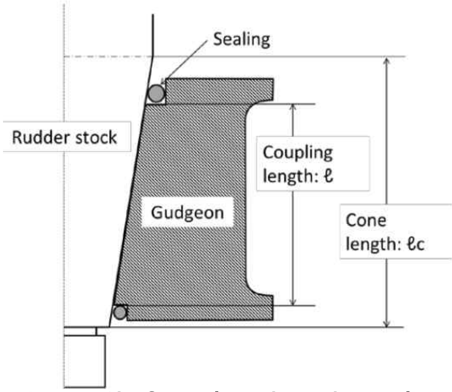
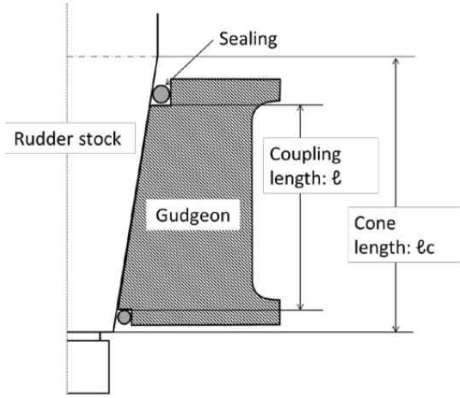
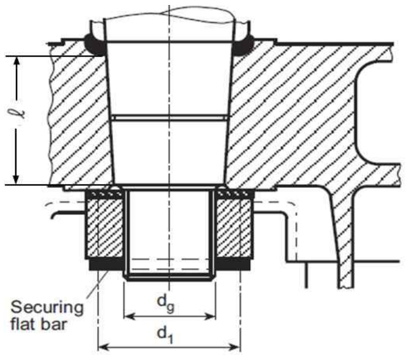
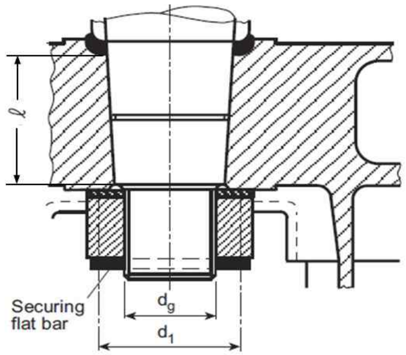
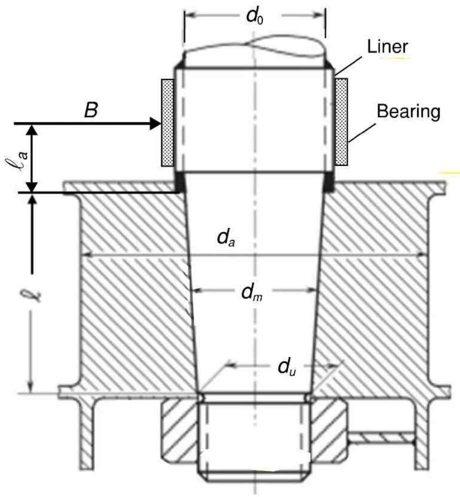
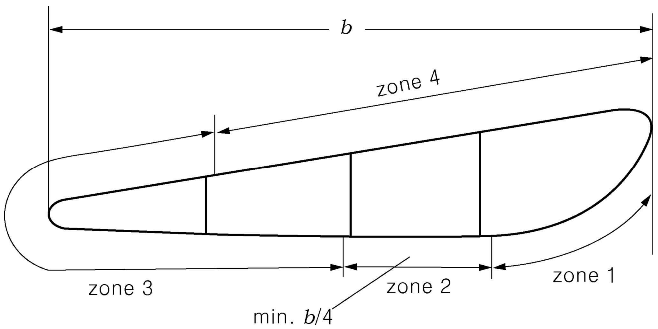
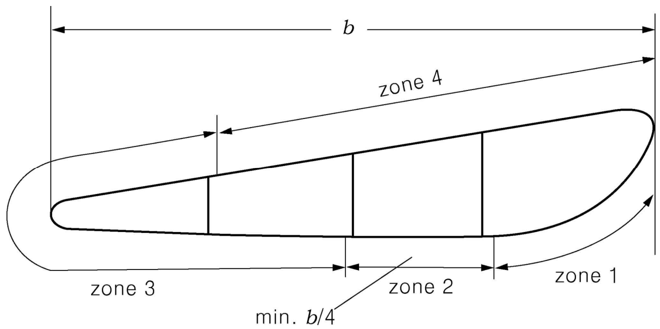
Present	Amendment	Note
d_0 = actual diameter (mm) of rudder stock (See **Fig 4.1.6**) d_u = according to **Fig 4.1.6** l_c = length of cone (mm) (2) ~ (3) 〈omitted〉 (4) The dimensions of the slugging nut as specified in the preceding (1) are to be as follows (*See* **Fig 4.1.6**) : (5) ~ (8) 〈omitted〉	d_0 = actual diameter (mm) of rudder stock (See **Fig 4.1.7**) d_u = according to **Fig 4.1.7** (mm) l_c = length of cone (mm) (See **Fig 4.1.7b**) (2) ~ (3) 〈same as present〉 (4) The dimensions of the slugging nut as specified in the preceding (1) are to be as follows (*See* **Fig 4.1.7**) : (5) ~ (8) 〈same as present〉	renumbering figure add unit renumbering figure
2. (1) ~ (5) 〈omitted〉 (6) The push-up pressure is not to be less than the greater of the two following values: *(2019)* $P = \frac{2M_F}{d_m^2 \ell \pi \mu_0} 10^3 \quad (N/mm^2)$ or $P = \frac{6M_b}{\ell^2 d_m} 10^3 \quad (N/mm^2)$	**2.** (1) ~ (5) 〈same as present〉 (6) The push-up pressure is not to be less than the greater of the two following values: $P = \frac{2M_F}{d_m^2 \ell \pi \mu_0} 10^3 \quad (N/mm^2)$ or $P = \frac{6M_c}{\ell^2 d_m} 10^3 \quad (N/mm^2)$	IACS UR S10 Rev. 7 6.4.2 - change symbol
M_F = design torsional moment (Nm) of rudder stock, as defined in **Par 1** (3) d_m = mean cone diameter (mm) (See **Fig 4.1.6**) ℓ = coupling length (mm) μ_0 = frictional coefficient, equal to 0.15 M_b = bending moment in the cone coupling (e.g. in case of Type C, D and E rudders) (mm)	M_F = design torsional moment (Nm) of rudder stock, as defined in **Par 1** (3) d_m = mean cone diameter (mm) (See **Fig 4.1.7**) ℓ = coupling length (mm) μ_0 = frictional coefficient, equal to 0.15 M_c = bending moment in rudder stock at the top of the cone coupling (e.g. in case of spade rudders), in Nm.	renumbering figure IACS UR S10 Rev. 7 6.4.2
	For spade rudder with trunk extending inside the rudder, the coupling shall be checked against the two cases defined in Guidance 401.4.	IACS UR S10 Rev. 7 6.4.2 -clarify the bending forces and moments for spade rudder with trunk extending inside the rudder
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 P_{perm} (N/mm²), is to be determined by the following formula:	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 P_{perm} (N/mm²), is to be determined by the following formula:	

Present	Amendment	Note
$P_{perm} = \frac{0.95 R_{eH}(1-\alpha^2)}{\sqrt{3+\alpha^4}} - P_b \quad (N/mm^2)$	$P_{perm} = \frac{0.95 R_{eH}(1-\alpha^2)}{\sqrt{3+\alpha^4}} - P_b \quad (N/mm^2)$	
$P_b = \frac{3.5 M_b}{d_m l^2} 10^3$	$P_b = \frac{3.5 M_c}{d_m l^2} 10^3$	IACS UR S10 Rev. 7 6.4.2 - change symbol
R_{eH} = specified minimum yield stress of the material of the gudgeon (N/mm[2]) α = d_m / d_a	R_{eH} = specified minimum yield stress of the material of the gudgeon (N/mm[2]) α = d_m / d_a	
d_a = outer diameter of the gudgeon (See **Fig 4.1.6**)	d_a = outer diameter of the gudgeon (See **Fig 4.1.7 and Fig 4.1.7a**)	renumbering figure
The outer diameter of the gudgeon in mm shall not be less than $1.25 d_0$, with d_0 defined in **Fig 4.1.6**.	The outer diameter of the gudgeon in mm shall not be less than $1.25 d_0$, with d_0 defined in **Fig 4.1.7**.	renumbering figure
(7) The push-up length l is to be accordance with as following. *(2019)*	(7) The push-up length l is to be accordance with as following.	
⟨omitted⟩	⟨same as present⟩	
d_m = mean cone diameter (mm) (See **Fig 4.1.6**) ⟨omitted⟩	d_m = mean cone diameter (mm) (See **Fig 4.1.7**) ⟨same as present⟩	renumbering figure
 **Fig 4.1.6 Cone coupling with key** *(2021)*	 **Fig 4.1.7 Cone coupling with key** *(2021)*	renumbering figure

Present	Amendment	Note
 Fig 4.1.6a Gudgeon outer diameter(da) measurement *(2021)*	 Fig 4.1.7a Gudgeon outer diameter(da) measurement	renumbering figure
 Fig 4.1.6b Cone length and coupling length *(2021)*	 Fig 4.1.7b Cone length and coupling length	renumbering figure
 Fig 4.1.7 Cone coupling without key *(2021)*	 Fig 4.1.8 Cone coupling without key	renumbering figure

Present	Amendment	Note
Section 8 Pintles **801. Diameters of pintles 〈omitted〉** **802. Construction of pintles 【See Guidance】** 1. ~ 4. 〈omitted〉 5. The required push-up pressure for pintle (N/mm²), is to be determined by the following formula. The push up length is to be calculated similarly as in 703. 2 (7), using required push-up pressure and properties for the pintle. *(2019)* $P = 0.4 \frac{Bd_p}{d_m^2 \ell} \quad (N/mm^2)$ B = Supporting force in the pintle (N) d_m, ℓ = according to 703. 2 (6)	**Section 8 Pintles** **801. Diameters of pintles 〈same as present〉** **802. Construction of pintles 【See Guidance】** 1. ~ 4. 〈same as present〉 5. The required push-up pressure for pintle in case of dry fitting (N/mm²), is to be determined by P_{req1} as following formula. The required push-up pressure for pintle in case of oil injection fitting (N/mm²), is to be determined by the maximum pressure of P_{req1} and P_{req2} as following formula. The push up length is to be calculated similarly as in 703. 2 (7), using required push-up pressure and properties for the pintle. $P_{req1} = 0.4 \frac{Bd_0}{d_m^2 \ell} \quad (N/mm^2), \quad P_{req2} = \frac{6M_{bp}}{\ell^2 d_m} 10^3 \quad (N/mm^2)$ B = Supporting force in the pintle(N) e.g. B_1 as defined in Fig 4.1.5 for semi-spade rudder. d_0 = Pintle diameter, in mm (See Fig 4.1.9) M_{bp} = bending moment in the pintle cone coupling to be determined by ; $M_{bp} = B\ell_a \quad (Nm)$ ℓ_a = length between middle of pintle-bearing and top of contact surface between cone coupling and pintle in m, (See Fig 4.1.9) d_m, ℓ = according to 703. 2 (6)	IACS UR S10 Rev. 7 7.2.2 -Addition of push-up pressure formula considering bending moment(clarify the requirements of the push-up pressure for pintles and to align with rudder stock requirements)

Present	Amendment	Note
	 Fig 4.1.9 Pintle cone coupling indicating ℓ_a	add figure
Section 9 Bearings of Rudder Stocks and Pintles **901. ~ 903. 〈omitted〉** **904. Thickness of bush and sleeve** The thickness of any bush or sleeve t is not to be less than that obtained from the following formula. $t = 0.01\sqrt{B}$ (mm) where : B = as specified in **801**. However, t is not to be less than t_{min} as follows ; t_{min} = 8 mm for metallic materials and synthetic materials t_{min} = 22 mm for lignum vitae	**Section 9 Bearings of Rudder Stocks and Pintles** **901. ~ 903. 〈same as present〉** **904. Thickness of bush and sleeve** 1. The thickness of any bush or sleeve t is not to be less than that obtained from the following formula. $t = 0.01\sqrt{B}$ (mm) where : B = as specified in **801.** However, t is not to be less than t_{min} as follows ; t_{min} = 8 mm for metallic materials and synthetic materials t_{min} = 22 mm for lignum vitae 2. For rudder stocks and pintles having diameter less than 200 mm, liners in way of bushes may be provided optionally.	IACS UR S10 Rev. 7 8.1.1 -reflects industry opinion that repairs are easier without a liner

Present	Amendment	Note
Section 10 Rudder Accessories ⟨omitted⟩ **Section 11 Propeller Nozzles** **1101. ~ 1103. ⟨omitted⟩** **1104. Section modulus** (1) The section modulus of the cross section shown in **Fig 4.1.6** around its neutral axis is not to be less than: ⟨omitted⟩  Fig 4.1.6 Propeller zone	**Section 10 Rudder Accessories ⟨same as present⟩** **Section 11 Propeller Nozzles** **1101. ~ 1103. ⟨same as present⟩** **1104. Section modulus** (1) The section modulus of the cross section shown in **Fig 4.1.10** around its neutral axis is not to be less than: ⟨omitted⟩  Fig 4.1.10 Propeller zone	renumbering figure

Main Amendments

(1) Background of Amendment

- Reflected IACS UR S21 Rev.6
  1) Application of buckling requirements based on CSR (Unification of CSR buckling regulations among UR-S)
  2) Harmonize and combine UR S21 and S21A(As the buckling requirements were revised, Hull Panel decided to unify S21 and S21A into a single regulation. Accordingly, it was merged into S21, and S21A was deleted.)
- Reflected IACS UR S26 Rev.5
  1) Clarify except for the application of small hatches on container ship giving access to a cargo hold(non-weathertight hatch covers complying with IACS UI LL64 are excluded from the application of the rule)

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 2 HATCHWAYS AND OTHER DECK OPENINGS **Section 1 General** **101. Application** **1.** The requirements apply to all ships except bulk carriers, SUBC(Self-Unloading Bulk Carrier), ore carriers and combination carriers and are for hatch covers and coaming in position 1 and 2 on weather decks. The requirements in **Ch 9**. apply to steel hatch covers of small hatches fitted on the exposed fore deck. **2.** The construction and means for securing the weathertightness of cargo and other hatchways in position 1 and 2 as defined **102.** shall be equivalent to the requirements of hatchways closed by weather-tight covers of steel or other equivalent materials, unless approved by the Administration. **【See Guidance】**	**CHAPTER 2 HATCHWAYS AND OTHER DECK OPENINGS** **Section 1 General** **101. Application** **1.** The requirements apply to all ships except bulk carriers to which **Part 13** is applied, are for hatch covers and coaming in position 1 and 2 on weather decks. The requirements in **Ch 9**. apply to steel hatch covers of small hatches fitted on the exposed fore deck. **2.** The construction and means for securing the weathertightness of cargo and other hatchways in position 1 and 2 as defined **102.** shall be equivalent to the requirements of hatchways closed by weather-tight covers of steel or other equivalent materials, unless approved by the Administration. **【See Guidance】** **3.** As specified in this chapter, parts of the requirements are for some specific ship types as categorized below: Type-1 ships : including all ships except bulk carriers, self-unloading bulk carriers, ore carriers and combination carriers Type-2 ships : including all bulk carriers, self-unloading bulk carriers, ore carriers and combination carriers	Reflected UR S21 Rev.6 -S21 1.1 -CSR bulk carriers excluded Reflected UR S21 Rev.6 -S21.1.1 -combine Part 4 Ch.2 and Part 7 Ch.9 Sec.18
102. Position of exposed deck openings 【See Guidance】〈omitted〉 **103. Height of hatchway coamings 〈omitted〉** **104. Hatch covers 【See Guidance】〈omitted〉** **105. Material 〈omitted〉** **106. Net scantlings** **1.** Unless otherwise quoted, the scantling of this Chapter are net scantlings. **2.** The net thicknesses are the member thicknesses necessary to obtain the minimum net scantlings required by **Sec 3** and **Sec 4**.	**102. Position of exposed deck openings 【See Guidance】〈omitted〉** **103. Height of hatchway coamings 〈omitted〉** **104. Hatch covers 【See Guidance】〈omitted〉** **105. Material 〈omitted〉** **106. Net scantlings** **1.** Unless otherwise quoted, the scantling of this Chapter are net scantlings. **2.** The net thicknesses are the member thicknesses necessary to obtain the minimum net scantlings required by **Sec 3** and **Sec 4**.	

Present	Amendment	Note
3. The required gross thicknesses are obtained by adding corrosion additions given in **Table 4.2.1**. **4.** Strength calculations using grillage analysis or FEM are to be performed with net scantlings. **107. Corrosion additions** **1.** The corrosion addition for steel hatch covers, hatch coamings is equal to the value specified in **Table 4.2.1**. For structural members made of stainless steel and aluminium alloys, the corrosion addition t_c is to be taken equal to 0 mm. **2. Renewal thickness** Structural drawings for hatch covers and hatch coamings complying with this Chapter are to indicate the renewal thickness ($t_{renewal}$) for each structural elements, given by the following formula in addition to the as built thickness ($t_{as-built}$). If the thickness for voluntary addition is included in the as built thickness, the value may be at the discretion of the Society. $t_{renewal} = t_{as-built} - t_c + 0.5$ (mm) where, t_c : Corrosion addition according to **Table 4.2.1** In case that corrosion addition t_c is 1.0 mm, renewal thickness may be given by the following formula. $t_{renewal} = t_{as-built} - t_c$ (mm)	**3.** The required gross thicknesses are obtained by adding corrosion additions given in **Table 4.2.1**. **4.** Strength calculations using FEM are to be performed with net scantlings. **107. Corrosion additions** **1.** The corrosion addition for steel hatch covers, hatch coamings is equal to the value specified in **Table 4.2.1**. For structural members made of stainless steel and aluminium alloys, the corrosion addition t_c is to be taken equal to 0 mm. **2. Renewal thickness** Structural drawings for hatch covers and hatch coamings complying with this Chapter are to indicate the renewal thickness ($t_{renewal}$) for each structural elements, given by the following formula in addition to the as built thickness ($t_{as-built}$). If the thickness for voluntary addition is included in the as built thickness, the value may be at the discretion of the Society. $t_{renewal} = t_{as-built} - t_c + 0.5$ (mm) where, t_c : Corrosion addition according to **Table 4.2.1** In case that corrosion addition t_c is 1.0 mm, renewal thickness may be given by the following formula. $t_{renewal} = t_{as-built} - t_c$ (mm)	Reflected UR S21 Rev.6 -S21.1.5 -FEM was determined to be the single prescriptive method for hatch cover direct strength analysis.

Present	Amendment	Note
Table 4.2.1 Corrosion additions t_c for hatch covers and hatch coamings Application | Structure | t_c (mm) Container ships, car carriers, paper carriers, passenger vessels | Hatch covers | 1.0 | Hatch coamings | 1.5 All other ship types | Single skin hatch covers | 2.0 | Top plating and bottom plating of double skin hatch covers | 1.5 | Internal structure of double skin hatch covers and closed box girders | 1.0 | Hatch coaming parts including stays and stiffeners | 1.5	Table 4.2.1 Corrosion additions t_c for hatch covers and hatch coamings Application | Structure | t_c (mm) Container ships, car carriers, paper carriers, passenger vessels | Hatch covers | 1.0 | Hatch coamings | 1.5 Type-2 ships | Single skin hatch covers | 2.0 | Top plating and bottom plating of double skin hatch covers | 2.0 | Internal structure of double skin hatch covers | 1.5 | Hatch coamings and coaming stays | 1.5 All other ship types | Single skin hatch covers | 2.0 | Top plating and bottom plating of double skin hatch covers | 1.5 | Internal structure of double skin hatch covers and closed box girders | 1.0 | Hatch coaming parts including stays and stiffeners | 1.5	Reflected UR S21 Rev.6 -S21 7.1 Tab.8 -combine Part 4 Ch.2 and Part 7 Ch.3 906.

Present — Table 4.2.1 Corrosion additions t_c for hatch covers and hatch coamings

Application	Structure	t_c (mm)
Container ships, car carriers, paper carriers, passenger vessels	Hatch covers	1.0
	Hatch coamings	1.5
All other ship types	Single skin hatch covers	2.0
	Top plating and bottom plating of double skin hatch covers	1.5
	Internal structure of double skin hatch covers and closed box girders	1.0
	Hatch coaming parts including stays and stiffeners	1.5

Amendment — Table 4.2.1 Corrosion additions t_c for hatch covers and hatch coamings

Application	Structure	t_c (mm)
Container ships, car carriers, paper carriers, passenger vessels	Hatch covers	1.0
	Hatch coamings	1.5
Type-2 ships	Single skin hatch covers	2.0
	Top plating and bottom plating of double skin hatch covers	2.0
	Internal structure of double skin hatch covers	1.5
	Hatch coamings and coaming stays	1.5
All other ship types	Single skin hatch covers	2.0
	Top plating and bottom plating of double skin hatch covers	1.5
	Internal structure of double skin hatch covers and closed box girders	1.0
	Hatch coaming parts including stays and stiffeners	1.5

Present	Amendment	Note

Present

3. Steel renewal

(1) The treatment in relation to gauged thickness are to be obtained from **Table 4.2.2.**

(2) Where applied protection coating, coating applied in accordance with the coating manufacturer's requirements. Coating is to be maintained in GOOD condition, as defined in **Pt 1, Ch 2, 101. 16** of the Rules.

(3) For the internal structure of double skin hatch covers, thickness gauging is required when hatch cover top or bottom plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Society's surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}. **【See Guidance】**

Table 4.2.2. Treatment in relation to gauged thickness

Treatment	Where $t_c \geq 1.5\,mm$	Where $t_c = 1.0\,mm$
Steel renewal	$t_g < t_{net} + 0.5\ mm$	$t_g \leq t_{net}$
Apply protection coating or annual gauging	$t_{net} + 0.5 < t_g < t_{net} + 1.0\ mm$	$t_{net} < t_g < t_{net} + 0.5\ mm$

Section 2 Design Load

201. Hatch cover and coaming design load 〈omitted〉

202. Vertical weather design load

1. The vertical weather load on the hatch cover panels is given by **Table 4.2.3**.

2. ~ 3. 〈omitted〉

Table 4.2.3 Vertical weather load P_v of weather deck hatches 〈omitted〉

Amendment

3. Steel renewal

(1) The treatment in relation to gauged thickness are to be obtained from **Table 4.2.2.**

(2) Where applied protection coating, coating applied in accordance with the coating manufacturer's requirements. Coating is to be maintained in GOOD condition, as defined in **Pt 1, Ch 2, 101. 20** of the Rules.

(3) For the internal structure of double skin hatch covers, thickness gauging is required when hatch cover top or bottom plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Society's surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}. **【See Guidance】**

Table 4.2.2. Treatment in relation to gauged thickness

Treatment	Where $t_c \geq 1.5\,mm$	Where $t_c = 1.0\,mm$
Steel renewal	$t_g < t_{net} + 0.5\ mm$	$t_g \leq t_{net}$
Apply protection coating or annual gauging	$t_{net} + 0.5 < t_g < t_{net} + 1.0\ mm$	$t_{net} < t_g < t_{net} + 0.5\ mm$

Section 2 Design Load

201. Hatch cover and coaming design load 〈same as the present〉

202. Vertical weather design load

1. The vertical weather load P_v on the hatch cover panels is given by **Table 4.2.3**.

2. ~ 3. 〈same as the present〉

4. For hatch covers of cargo holds designed for carriage of ballast or liquid cargo, the internal lateral pressures are also to be considered in accordance with Pt 3, Ch 15 of the Rules.

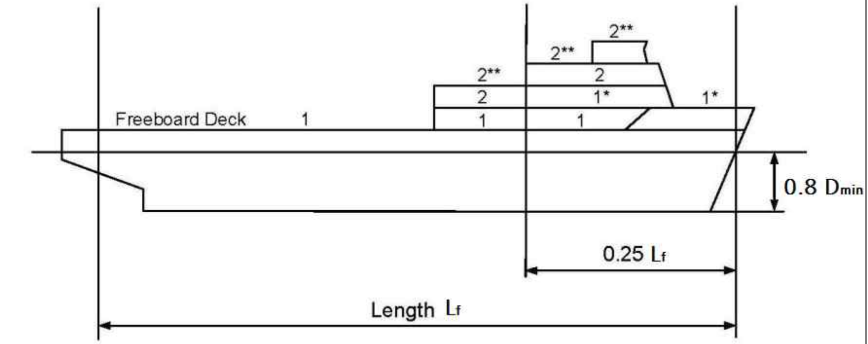
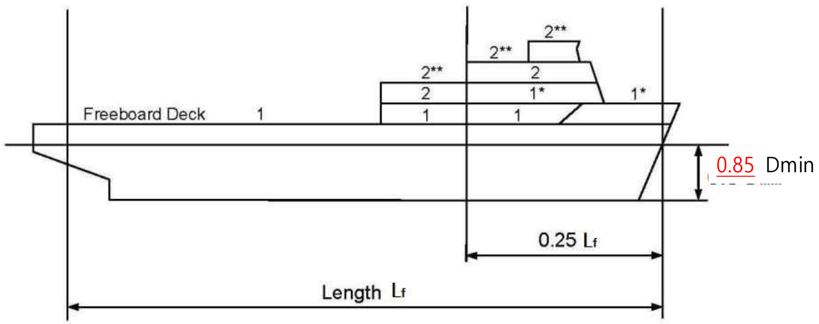
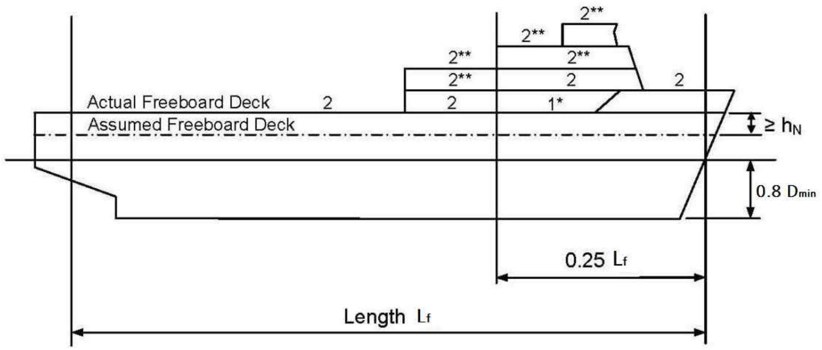
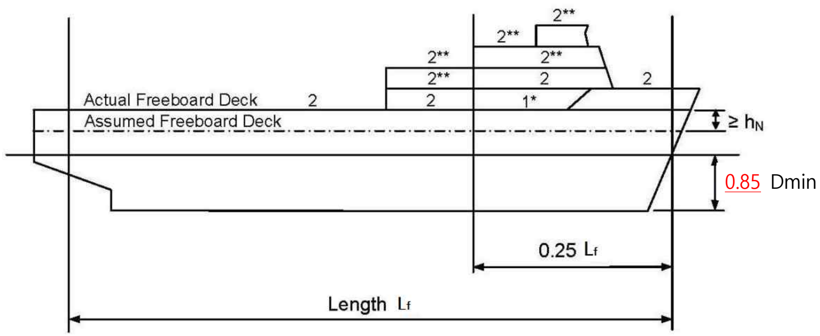
Table 4.2.3 Vertical weather load P_v of weather deck hatches 〈same as the present〉

Note

Amendment of references

Add symbol

Reflected UR S21 Rev.6
-S21 2.1
-add internal pressures due to liquid

Present	Amendment	Note
 * reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck ** reduced load upon exposed superstructure decks of vessels with L_f 〉 100m located at least one superstructure standard height above the lowest Position 2 deck **Fig 4.2.1 Positions 1 and 2**	 * reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck ** reduced load upon exposed superstructure decks of vessels with L_f 〉 100m located at least one superstructure standard height above the lowest Position 2 deck **Fig 4.2.1 Positions 1 and 2**	typo correction
 * reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck ** reduced load upon exposed superstructure decks of vessels with L_f 〉 100m located at least one superstructure standard height above the lowest Position 2 deck **Fig 4.2.2 Positions 1 and 2 for an increased freeboard**	 * reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck ** reduced load upon exposed superstructure decks of vessels with L_f 〉 100m located at least one superstructure standard height above the lowest Position 2 deck **Fig 4.2.2 Positions 1 and 2 for an increased freeboard**	typo correction

Present	Amendment	Note
203. Horizontal weather design load The horizontal weather load is obtained from the following formulae and not to be less than the values given by **Table 4.2.4**. The horizontal weather design load need not be included in the direct strength calculation of the hatch cover, unless it is utilized for the design of sub-structures of horizontal support according to **505**. $P_H = ac(bc_L f - z)$ $f = \frac{L}{25} + 4.1$ for $L < 90$ m $= 10.75 - \left(\frac{300-L}{100}\right)^{1.5}$ for 90 m $\leq L <$ 300 m $= 10.75$ for 300 m $\leq L <$ 350 m $= 10.75 - \left(\frac{L-350}{150}\right)^{1.5}$ for 350 m $\leq L \leq$ 500 m $c_L = \sqrt{\frac{L}{90}}$ for $L <$ 90 m $= 1$ for $L \geq$ 90 m $a = 20 + \frac{L_1}{12}$ for unprotected front coamings and hatch cover skirt plates $a = 10 + \frac{L_1}{12}$ 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 ICLL by at least one standard super-structure height h_N	**203. Horizontal weather design load** 1. Horizontal weather design load The horizontal weather load P_H is obtained from the following formulae and not to be less than the values given by **Table 4.2.4**. $P_H = f_n f_c (f_b c_L C_w - z)$ (kN/m^2) $C_w = \frac{L}{25} + 4.1$ for $L <$ 90 m $= 10.75 - \left(\frac{300-L}{100}\right)^{1.5}$ for 90 m $\leq L <$ 300 m $= 10.75$ for 300 m $\leq L <$ 350 m $= 10.75 - \left(\frac{L-350}{150}\right)^{1.5}$ for 350 m $\leq L \leq$ 500 m $c_L = \sqrt{\frac{L}{90}}$ for $L <$ 90 m $= 1$ for $L \geq$ 90 m $f_n = 20 + \frac{L_1}{12}$ for unprotected front coamings and hatch cover skirt plates $f_n = 10 + \frac{L_1}{12}$ 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 ICLL by at least one standard super-structure height h_N	Reflected UR S21 Rev.6 -S21 2.2.1 -unification of symbols

Present	Amendment	Note
$a = 5 + \frac{L_1}{15}$ for side and protected front coamings and hatch cover skirt plates $a = 7 + \frac{L_1}{100} - 8\frac{x'}{L}$ for aft ends of coamings and aft hatch cover skirt plates abaft amidships $a = 5 + \frac{L_1}{100} - 4\frac{x'}{L}$ for aft ends of coamings and aft hatch cover skirt plates forward of amidships L_1 = length of ship, need not be taken greater than 300 m $b = 1.0 + \left(\frac{x'/L - 0.45}{C_{b1} + 0.2}\right)^2$ for $\frac{x'}{L} < 0.45$ $= 1.0 + 1.5\left(\frac{x'/L - 0.45}{C_{b1} + 0.2}\right)^2$ for $\frac{x'}{L} \geq 0.45$ $0.6 \leq C_{b1} \leq 0.8$, when determining scantlings of aft ends of coamings and aft hatch cover skirt plates for-ward of amidships, C_{b1} need not be taken less than 0.8. x' = distance in m between the transverse coaming or hatch cover skirt plate considered and aft end of the length L. When determining side coamings or side hatch cover skirt plates, the side is to be subdivided into parts of approx-imately equal length, not exceeding 0.15 L each, and x' is to be taken as the distance between aft end of the length L and the centre of each part considered. z = vertical distance in m from the summer load line to the midpoint of stiffener span, or to the middle of the plate field	$f_n = 5 + \frac{L_1}{15}$ for side and protected front coamings and hatch cover skirt plates $f_n = 7 + \frac{L_1}{100} - 8\frac{x'}{L}$ for aft ends of coamings and aft hatch cover skirt plates abaft amidships $f_n = 5 + \frac{L_1}{100} - 4\frac{x'}{L}$ for aft ends of coamings and aft hatch cover skirt plates forward of amidships L_1 = length of ship, need not be taken greater than 300 m $f_b = 1.0 + \left(\frac{x'/L - 0.45}{C_{b1} + 0.2}\right)^2$ for $\frac{x'}{L} < 0.45$ $= 1.0 + 1.5\left(\frac{x'/L - 0.45}{C_{b1} + 0.2}\right)^2$ for $\frac{x'}{L} \geq 0.45$ $0.6 \leq C_B \leq 0.8$, when determining scantlings of aft ends of coamings and aft hatch cover skirt plates for-ward of amidships, C_B need not be taken less than 0.8. x' = distance in m between the transverse coaming or hatch cover skirt plate considered and aft end of the length L. When determining side coamings or side hatch cover skirt plates, the side is to be subdivided into parts of approx-imately equal length, not exceeding 0.15 L each, and x' is to be taken as the distance between aft end of the length L and the centre of each part considered. z = vertical distance in m from the summer load line to the midpoint of stiffener span, or to the middle of the plate field	Reflected UR S21 Rev.6 -S21 2.2.1 -unification of symbols

Present	Amendment	Note

Present

$c = 0.3 + 0.7b'/B'$

b' = breadth of coaming in m at the position considered

B' = actual maximum breadth of ship in m on the exposed weather deck at the position considered.

b'/B' is not to be taken less than 0.25.

Table 4.2.4 Minimum horizontal weather design load $P_{H\min}$

L	$P_{H\min}$ (kN/m^2)	
	unprotected fronts hatch coaming and hatch cover skirt plates	elsewhere
≤ 50	30	15
$50 < L < 250$	$25 + \frac{L}{10}$	$12.5 + \frac{L}{20}$
≥ 250	50	25

Amendment

$f_c = 0.3 + 0.7b'/B'$

b' = breadth of coaming in m at the position considered

B' = actual maximum breadth of ship in m on the exposed weather deck at the position considered.

b'/B' is not to be taken less than 0.25.

Table 4.2.4 Minimum horizontal weather design load $P_{H-\min}$

L	$P_{H-\min}$ (kN/m^2)	
	unprotected fronts hatch coaming and hatch cover skirt plates	elsewhere
≤ 50	30	15
$50 < L < 250$	$25 + \frac{L}{10}$	$12.5 + \frac{L}{20}$
≥ 250	50	25

2. Horizontal weather design load applicable to coamings of Type-2 ships

(1) The pressure P_{coam}, in kN/m^2, on the No. 1 forward transverse hatch coaming is given by:

P_{coam} = 220, where there is a forecastle to which l_F according to **Part 7, Chapter 3, Section 3** is applied

= 290 in the other cases

(2) The pressure P_{coam}, in kN/m2, on the other coamings is given by:

P_{coam} = 220

Note :

The horizontal weather design loads(P_H, P_{coam}) need not be included in the direct strength calculation of the hatch cover, unless it is utilized for the design of substructures of horizontal support according to **505.**

Note

Reflected UR S21 Rev.6
-S21 2.2.1
-unification of symbols

Reflected UR S21 Rev.6
-S21 2.2.2
-reflection of Part 7 Ch.9 904.

edit within 203.

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td>

204. Cargo loads

The load due to cargo load on hatch covers is to be accordance with Par 1, 2 and partial cargo load to be considered with together.

1. Distributed loads

The load on hatch covers due to distributed cargo loads P_L resulting from heave and pitch is to be determined according to the following formula:

$P_L = P_C(1 + a_V)$ $(\mathrm{kN/m^2})$

P_C = uniform static cargo load$(\mathrm{kN/m^2})$

a_V = acceleration addition as follows:

$a_V = 0.11\dfrac{mV_1}{\sqrt{L}}$

$m = m_0 - 5(m_0 - 1)\dfrac{x}{L}$ for $0 \le \dfrac{x}{L} \le 0.2$

$= 1.0$ for $0.2 < \dfrac{x}{L} \le 0.7$

$= 1 + \dfrac{m_0 + 1}{0.3}\left[\dfrac{x}{L} - 0.7\right]$ for $0.7 < \dfrac{x}{L} \le 1.0$

$m_0 = 1.5 + 0.11\,V_1/\sqrt{L}$

V_1 = max. speed of ship,

V_1 is not to be taken less than $\sqrt{L}\,(\mathrm{kN})$

2. Point loads ⟨omitted⟩

205. Container loads

The loads defined in the followings are to be applied where containers are stowed on the hatch cover.

</td><td>

204. Cargo loads

The load due to cargo load on hatch covers is to be accordance with Par 1, 2 and partial cargo load to be considered with together.

1. Distributed loads

The load on hatch covers due to distributed cargo loads P_L resulting from heave and pitch is to be determined according to the following formula:

$P_L = P_{Cargo}(1 + a_V)$ $(\mathrm{kN/m^2})$

P_{Cargo} = uniform static cargo load $(\mathrm{kN/m^2})$

a_V = acceleration addition as follows:

$a_V = F \cdot m$

$F = 0.11\dfrac{v_0}{\sqrt{L}}$

$m = m_0 - 5(m_0 - 1)\dfrac{x}{L}$ for $0 \le \dfrac{x}{L} \le 0.2$

$= 1.0$ for $0.2 < \dfrac{x}{L} \le 0.7$

$= 1 + \dfrac{m_0 + 1}{0.3}\left[\dfrac{x}{L} - 0.7\right]$ for $0.7 < \dfrac{x}{L} \le 1.0$

$m_0 = 1.5 + F$

v_0 = maximum speed at summer load line draught, v_0 is not to be taken less than $\sqrt{L}$ in knots

2. Point loads ⟨same as the present⟩

205. Container loads

The loads defined in the followings are to be applied where containers are stowed on the hatch cover.

</td><td>

Reflected UR S21 Rev.6

-S21 2.3.1

-unification of symbols

</td></tr>
</table>

Present	Amendment	Note
1. ~ 2. 〈omitted〉 3. When strength of the hatch cover structure is assessed by grillage analysis according to **306.**, h_m and z_i need to be taken above the hatch cover supports. Forces B_y does not need to be considered in this case. 4. Values of A_z and B_z applied for the assessment of hatch cover strength are to be shown in the drawings of the hatch covers. 5. It is recommended that container loads A_z, B_z and B_y as calculated above are considered as limit for foot point loads of container stacks in the calculations of cargo securing (container lashing). **6. Partial loading** 〈omitted〉 **7. Mixed stowage of 20' and 40' containers on hatch cover** 〈omitted〉 **206. Loads due to elastic deformations of the ship's hull 〈omitted〉**	**1. ~ 2. 〈same as the present〉** ~~3. When strength of the hatch cover structure is assessed by grillage analysis according to **306.**, h_m and z_i need to be taken above the hatch cover supports. Forces B_y does not need to be considered in this case.~~〈deleted〉 3. Values of A_z and B_z applied for the assessment of hatch cover strength are to be shown in the drawings of the hatch covers. 4. It is recommended that container loads A_z, B_z and B_y as calculated above are considered as limit for foot point loads of container stacks in the calculations of cargo securing (container lashing). **5. Partial loading** 〈same as the present〉 **6. Mixed stowage of 20' and 40' containers on hatch cover** 〈same as the present〉 **206. Loads due to elastic deformations of the ship's hull 〈same as the present〉**	Reflected UR S21 Rev.6 -S21 2.4.3 -grillage anlysis deleted(leave only FEM) Renumbering

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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Section 3 Hatch cover strength criteria

301. General

1. The ordinary stiffeners and primary supporting members of the hatch covers are to be continuous over the breadth and length of the hatch covers, as far as practical. When this is impractical, sniped end connections are not to be used and appropriate arrangements are to be adopted to ensure sufficient load carrying capacity.

2. The spacing of primary supporting members parallel to the direction of ordinary stiffeners is to be not greater than 1/3 of the span of primary supporting members. When strength calculation is carried out by FE analysis using plane strain or shell elements, this requirement can be waived.

3. The breadth of the primary supporting member flange is to be not less than 40 % of their depth for laterally unsupported spans greater than 3 m. Tripping brackets attached to the flange may be considered as a lateral support for primary supporting members. The flange outstand is not to exceed 15 times the gross flange thickness.

302. Permissible stresses and deflections

1. Permissible Stresses

The equivalent stress σ_E in steel hatch cover shall be accordance with the following requirements.
(1) For grillage analysis

$$\sigma_E = \sqrt{\sigma^2 + 3\tau^2} \le 0.8\sigma_Y \qquad (\mathrm{N/mm^2})$$

σ = normal stress $(\mathrm{N/mm^2})$
τ = shear stress $(\mathrm{N/mm^2})$
σ_Y = minimum yield stress of the material $(\mathrm{N/mm^2})$

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Section 3 Hatch cover strength criteria

301. General

1. The ordinary stiffeners and primary supporting members of the hatch covers are to be continuous over the breadth and length of the hatch covers, as far as practical. When this is impractical, sniped end connections are not to be used and appropriate arrangements are to be adopted to ensure sufficient load carrying capacity.

2. Generally, the spacing of primary supporting members parallel to the direction of stiffeners is not to exceed 1/3 of the span of primary supporting members. If sufficient strength based on FE analysis can be verified, this requirement may be waived.

3. The breadth of the primary supporting member flange is to be not less than 40 % of their depth for laterally unsupported spans greater than 3 m. Tripping brackets attached to the flange may be considered as a lateral support for primary supporting members. ~~The flange outstand is not to exceed 15 times the gross flange thickness.~~

302. Permissible stresses and deflections

1. Permissible Stresses

(1) All hatch cover structural members are to comply with the following formulae.

$\sigma_{vm} \le \sigma_a$ for shell elements in general.
$\sigma_{axial} \le \sigma_a$ for rod or beam elements in general.
σ_a : Allowable stress as defined in **Table 4.2.6**
R_{eH} : Specified minimum yield stress, in $\mathrm{N/mm^2}$, of the material
σ_{vm} : Von Mises stress, in $\mathrm{N/mm^2}$, to be taken as follows:

$$\sigma_{vm} = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau_{xy}^2}$$

σ_x : Normal stress, in $\mathrm{N/mm^2}$, in x-direction.
σ_y : Normal stress, in $\mathrm{N/mm^2}$, in y-direction.

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Reflected UR S21 Rev.6
-S21 1.4

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Reflected UR S21 Rev.6
-S21 3.1

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</table>

Present	Amendment	Note
(2) For FEM calculations (A) For vertical weather load according to **202.** $$\sigma_E = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau^2} \le 0.8\sigma_Y \quad (\mathrm{N/mm^2})$$ (B) For other than **202.** $$\sigma_E = \sqrt{\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau^2} \le 0.9\sigma_Y \quad (\mathrm{N/mm^2})$$ σ_x, σ_y = normal stress on each in x-direction, y-direction x, y = coordinates of a two-dimensional Cartesian system in the plane of the considered structural element. (3) In case of FEM calculations using shell or plane strain elements, the stresses are to be read from the centre of the individual element. Where shell elements are used, the stresses are to be evaluated at the mid plane of the element. (4) It is to be observed that, in particular, at flanges of unsymmetrical girders, the evaluation of stress from element centre may lead to non-conservative results. Thus, a sufficiently fine mesh is to be applied in these cases or, the stress at the element edges shall not exceed the allowable stress. (5) Stress concentrations are to be assessed to the satisfaction of the Society. **2. Deflection 〈omitted〉**	τ_{xy} : Shear stress, in $\mathrm{N/mm^2}$, in the $x-y$ plane. σ_{axial} : Axial stress in rod or beam elements, in $\mathrm{N/mm^2}$. Indices x and y are coordinates of a two-dimensional Cartesian system in the plane of the considered structural element. (2) In case of FEM calculations using shell (or plate) elements, the stresses are to be read from the centre of the individual element. It is to be observed that, in particular, at flanges of unsymmetrical girders, the evaluation of stress from element centre may lead to non-conservative results. Thus, a sufficiently fine mesh is to be applied in these cases or, the stress at the element edges shall not exceed the allowable stress. Where shell elements are used, the stresses are to be evaluated at the mid plane of the element. (3) Stress concentrations are to be assessed to the satisfaction of the Society. **Table 4.2.6 Allowable stresses ($\mathrm{N/mm^2}$)** Members of | Subject to | σ_a ($\mathrm{N/mm^2}$) Hatch cover structure | External pressure, as defined in **202.** | $0.80R_{eH}$ Hatch cover structure | Other loads, as defined in **203.** to **206.** | $0.90R_{eH}$, for load combination : S+D; $0.72R_{eH}$, for load combination: S **2. Deflection 〈same as the present〉**	Reflected UR S21 Rev.6 -S21 3.1

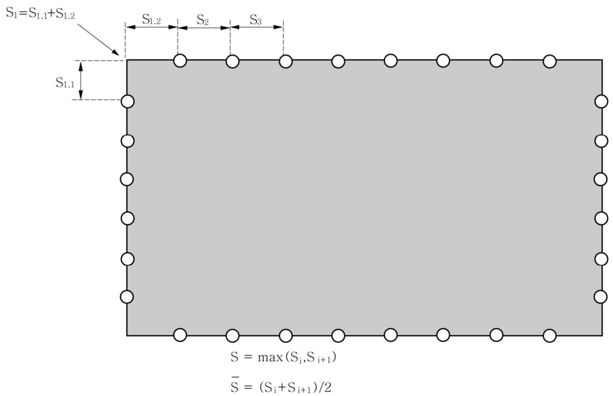
Present	Amendment	Note
303. Net plate thickness of hatch cover 1. The local net plate thickness t(mm) of the hatch cover top plating is not to be less than: $t = 15.8 F_p S \sqrt{\frac{P}{0.95\sigma_Y}}$ (mm) and to be not less than 1 % of the spacing of the stiffener or 6 mm if that be greater. F_p = factor for combined membrane and bending response = 1.5 in general = $1.9\sigma/(0.8\sigma_y)$, for $\frac{\sigma}{\sigma_a} \geq 0.8$ for the attached plate flange of primary supporting members S = stiffener spacing (m) p = pressure P_V and P_L (kN/m^2) as defined in **202.** and 204. 1. σ = normal stress(N/mm^2) of hatch cover top plating as determined by **Fig 4.2.4** **Fig 4.2.4 Determination of normal stress of the hatch cover plating** **〈omitted〉**	**303. Net plate thickness of hatch cover** 1. The local net plate thickness t(mm) of the hatch cover top plating is not to be less than: $t = 0.0158 F_p S \sqrt{\frac{P}{0.95 R_{eH}}}$ (mm) and to be not less than 1 % of the spacing of the stiffener or 6 mm if that be greater. F_p = factor for combined membrane and bending response = 1.5 in general = $1.9\sigma/\sigma_a$, for $\frac{\sigma}{\sigma_a} \geq 0.8$ for the attached plate flange of primary supporting members S = stiffener spacing (mm) P = pressure P_V and P_L (kN/m^2) as defined in **202.** and 204. 1. σ = Maximum normal stress(N/mm^2) of hatch cover top plating as determined by **Fig 4.2.4** σ_a = allowable stress as defined in **Table. 4.2.6** **Fig 4.2.4 Determination of normal stress of the hatch cover plating** **〈same as present〉**	Reflected UR S21 Rev.6 -S21 3.2 -unification of symbols

Present	Amendment	Note
2. For plates under compression buckling strength according to **307.** is to be demonstrated. **3. Lower plating of double skin hatch covers and box girders** (1) The thickness to fulfill the strength requirements is to be obtained from the calculation according to **302. 1** under consideration of permissible stresses according to **306.** (2) The net thickness must not be less than 5 mm when the lower plating is taken into account as a strength member of the hatch cover. (3) When project cargo is intended to be carried on a hatch cover, the net thickness must not be less than the following formulae. Project cargo means especially large or bulky cargo lashed to the hatch cover. Examples are parts of cranes or wind power stations, turbines, etc. Cargoes that can be considered as uniformly distributed over the hatch cover, e.g., timber, pipes or steel coils need not to be considered as project cargo. $t = 6.5S$ (mm) S = stiffener spacing (m) (4) When the lower plating is not considered as a strength member of the hatch cover, the thickness of the lower plating should be determined according to the Society. **【See Guidance】** **4. Local net plate thickness of hatch covers for wheel loading 【See Guidance】** The local net plate thickness of hatch covers for wheel loading have to be derived from the Society.	**2.** For plates under compression buckling strength according to **307.** is to be demonstrated. **3. Lower plating of double skin hatch covers and box girders** (1) The thickness to fulfill the strength requirements is to be obtained from the calculation according to **302. 1** under consideration of permissible stresses according to **306.** (2) The net thickness must not be less than 5 mm when the lower plating is taken into account as a strength member of the hatch cover. (3) When project cargo is intended to be carried on a hatch cover, the net thickness must not be less than the following formulae. Project cargo means especially large or bulky cargo lashed to the hatch cover. Examples are parts of cranes or wind power stations, turbines, etc. Cargoes that can be considered as uniformly distributed over the hatch cover, e.g., timber, pipes or steel coils need not to be considered as project cargo. $t = 6.5s \times 10^{-3}$ (mm) s = stiffener spacing (mm) (4) When the lower plating is not considered as a strength member of the hatch cover, the thickness of the lower plating should be determined according to the Society. **【See Guidance】** **4. Local net plate thickness of hatch covers for wheel loading 【See Guidance】** The local net plate thickness of hatch covers for wheel loading have to be derived from the Society.	Reflected UR S21 Rev.6 -S21 3.2.2 -unification of symbols

Present	Amendment	Note
304. Net scantling of stiffeners 1. The net section modulus Z and net shear area A of hatch cover stiffeners must not be less than. The net section modulus of the stiffeners is to be determined based on an attached plate width assumed equal to the stiffener spacing. (1) For vertical weather load according to **202.** $Z = \frac{104}{\sigma_y} PSl^2$ (cm^3) $A = \frac{10.8\,PSl}{\sigma_y}$ (cm^2) (2) For cargo load according to **204. 1** $Z = \frac{93}{\sigma_y} PSl^2$ (cm^3) $A = \frac{9.6\,PSl}{\sigma_y}$ (cm^2) l = stiffener span (m) to be taken as the spacing of primary supporting members S = stiffener spacing (m) P = pressure P_V and P_L $(\mathrm{kN/m^2})$ as defined in **202.**, **204. 1.**	**304. Net scantling of stiffeners** 1. The net section modulus Z and net shear area A_{shr} of hatch cover stiffeners must not be less than. The net section modulus of the stiffeners is to be determined based on an attached plate width assumed equal to the stiffener spacing. $Z = \frac{Psl^2}{f_{bc}\sigma_a}$ (cm^3) $A_{shr} = \frac{8.7\,Psl}{\sigma_a} 10^{-3}$ (cm^2) l = stiffener span, in m, to be taken as the spacing, in m, of primary supporting members or the distance between a primary supporting member and the edge support, as applicable. When brackets are fitted at both ends of all stiffener spans, the secondary stiffener span may be reduced by an amount equal to 2/3 of the minimum brackets arm length, but not greater than 10% of the unsupported span, for each bracket s = stiffener spacing (mm) P = pressure P_V and P_L $(\mathrm{kN/m^2})$ as defined in **202.**, **204. 1.** f_{bc} = boundary coefficient of stiffener, taken equal to: $f_{bc} = 8$, in the case of stiffener simply supported at both ends or simply supported at one end and clamped at the other end $f_{bc} = 12$, in the case of stiffener clamped at both ends. σ_a = allowable stress as defined in **Table. 4.2.6**	Reflected UR S21 Rev.6 -S21 3.3 -unification of symbols Reflected UR S21 Rev.6 -S21 3.3 -unification of symbols and units -add coefficient

Present	Amendment	Note
2. For stiffeners of lower plating of double skin hatch covers, requirements mentioned above are not applied due to the absence of lateral loads. The requirements of **Par 5, 6** are not applied to stiffeners of lower plating of double skin hatch covers if the lower plating is not considered as strength member.	**2.** For stiffeners of lower plating of double skin hatch covers, requirements mentioned above are not applied due to the absence of lateral loads. The requirements of **Par 5, 6** are not applied to stiffeners of lower plating of double skin hatch covers if the lower plating is not considered as strength member. For double skin hatch covers of holds designed for ballast or liquid cargo, the stiffeners on lower plating are to be considered in accordance with Pt 3, Ch 15 of the Rules.	Reflected UR S21 Rev.6 -S21 3.3
3. The net thickness of the stiffener (except u-beams/trapeze stiffeners) web is to be taken not less than 4 mm.	**3.** The net thickness of the stiffener (except u-beams/trapeze stiffeners) web is to be taken not less than 4 mm.	
4. The flat bar stiffeners and buckling stiffeners shall be accordance with following formulae. $h/t_w < 15\sqrt{(235/\sigma_y)}$ h = height of the stiffener (mm) t_w = net thickness of the stiffener (mm)	~~**4.** The flat bar stiffeners and buckling stiffeners shall be accordance with following formulae.~~ ~~$h/t_w < 15\sqrt{(235/\sigma_y)}$~~ ~~$h$ = height of the stiffener (mm)~~ ~~t_w = net thickness of the stiffener (mm)~~〈deleted〉	Reflected UR S21 Rev.6 -relocate to 307. 2
	4. The net section modulus of the stiffeners is to be determined based on an attached plate width assumed equal to the stiffener spacing.	Reflected UR S21 Rev.6 -S21 3.3
5. Stiffeners parallel to primary supporting members and arranged within the effective breadth according to **305. 1** must be continuous at crossing primary supporting member and may be regarded for calculating the cross sectional properties of primary supporting members.	**5.** Stiffeners parallel to primary supporting members and arranged within the effective breadth according to **305. 1** must be continuous at crossing primary supporting member and may be regarded for calculating the cross sectional properties of primary supporting members.	
6. Where apply to **Par 5**, It is to be verified that the combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures does not exceed the permissible stresses according to **302. 1**.	**6.** Where apply to **Par 5**, It is to be verified that the combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures does not exceed the permissible stresses according to **302. 1**.	
7. For hatch cover stiffeners under compression sufficient safety against lateral and torsional buckling according **307. 5** (3), (4) is to be verified.	**7.** For hatch cover stiffeners under compression sufficient safety against lateral and torsional buckling according to **307.** is to be verified.	Amendment of references
8. For hatch covers subject to wheel loading or point loading stiffener scantlings are to be determined by direct calculations under consideration of the permissible stresses according to **302. 1** or are to be determined according to the Society.	**8.** For hatch covers subject to wheel loading or point loading stiffener scantlings are to be determined by direct calculations under consideration of the permissible stresses according to **302. 1** or are to be determined according to the Society.	

Present	Amendment	Note
305. Net scantling of primary supporting members **1. Primary supporting members** (1) Scantlings of primary supporting members are obtained from calculations according to **306.** under consideration of permissible stresses according to **302. 1.** (2) For all components of primary supporting members sufficient safety against buckling must be verified according to **307.** For biaxial compressed attach plates this is to be verified within the effective widths according to **307. 5.** (2). (3) The net thickness (mm) of webs of primary supporting mem-bers shall not be less than: t = $6.5 \times s$ (mm) t_{min} = 5 mm s = stiffener spacing (m) **2. Skirt plates fo hatch cover** (1) Scantlings of edge girders are obtained from the calculations according to **306.** under consideration of permissible stresses according to **302. 1.** (2) The net thickness, in mm, of the outer edge girders exposed to wash of sea shall not be less than the largest of the follow-ing values: $t = 15.8S\sqrt{\frac{P_H}{0.95\sigma_Y}}$ (mm) t = $8.5S$ (mm) t_{min} = 5 mm P_H = horizontal weather load as defined in **203.** S = stiffener spacing (m)	**305. Net scantling of primary supporting members** **1. Primary supporting members** (1) Scantlings of primary supporting members are obtained from calculations according to **306.** under consideration of permissible stresses according to **302. 1.** (2) For all components of primary supporting members sufficient safety against buckling must be verified according to **307.** For biaxial compressed attach plates this is to be verified within the effective widths according to **307. 5.** (2). (3) The net thickness (mm) of webs of primary supporting mem-bers shall not be less than: t = $6.5s \times 10^{-3}$ (mm) t_{min} = 5 mm s = stiffener spacing (mm) **2. Skirt plates fo hatch cover** (1) Scantlings of edge girders are obtained from the calculations according to **306.** under consideration of permissible stresses according to **302. 1.** (2) The net thickness, in mm, of the outer edge girders exposed to wash of sea shall not be less than the largest of the follow-ing values: $t = 0.0158s\sqrt{\frac{P_H}{0.95R_{eH}}}$ (mm) $t = 8.5s \times 10^{-3}$ (mm) t_{min} = 5 mm P_H = horizontal weather load as defined in **203.** s = stiffener spacing (mm)	Reflected UR S21 Rev.6 -S21 3.4.1 -unification of symbols Reflected UR S21 Rev.6 -S21 3.4.2 -unification of symbols

Present	Amendment	Note
(3) The stiffness of edge girders is to be sufficient to maintain adequate sealing pressure between clamping devices. The moment of inertia of skirt plates is not to be less than: $I = 6 q S_{SD}^{4}$ (cm^4) q = line pressure on gasket (N/mm), minimum 5 N/mm S_{SD} = spacing(m) of clamping devices, but S_{SD} is not to be less than $2.5a_c$(See Fig 4.2.5)  **Fig 4.2.5 Spacing of clamping device**	〈deleted〉	Reflected UR S21 Rev.6 -305.2.(3)→504.4.(2)
3. Primary supporting members and skirt plates of variable cross-section The net section modulus of primary supporting members with a variable cross-section is to be not less than the greater of the value obtained from the following formulae and the use of these formulae is limited to the determination of the strength of primary supporting members in which abrupt changes in the cross-section. (1) Net section modules $Z = Z_{CS}$ (cm^3)	**3. Primary supporting members and skirt plates of variable cross-section** The net section modulus of primary supporting members with a variable cross-section is to be not less than the greater of the value obtained from the following formulae and the use of these formulae is limited to the determination of the strength of primary supporting members in which abrupt changes in the cross-section. (1) Net section modules $Z = Z_{CS}$ (cm^3)	

<table>
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$Z=(1+\frac{3.2\alpha-\psi-0.8}{7\psi+0.4})Z_{CS}$ (cm³)

(2) Net moment of inertia

$I=I_{CS}$ (cm⁴)

$I=(1+8\,\alpha^3(\frac{1-\phi}{0.2+3\sqrt{\phi}}))I_{CS}$ (cm⁴)

Z_{CS} : Net section modules(cm³) of primary surporting stiffener complying with the checking criteria in **Par 1.** (1) **or Par 2.** (1)

$\alpha=\frac{l_1}{l_0}$

$\psi=\frac{Z_1}{Z_0}$

l_1 : Length of the variable section part(m) (see **Fig 4.2.6**)

l_0 : Span measured(m) between end supports (see **Fig 4.2.6**)

Z_1 : Net section modulus at end(cm³) (see **Fig 4.2.6**)

Z_0 : Net section modulus calculated with considering the net thickness at mid-span(cm³) (see **Fig 4.2.6**)

I_{CS} : Net moment of inertia of primary surporting stiffener complying with the checking criteria in **Par 1.** (1) **or Par 2.** (1)

$\phi=\frac{I_1}{I_0}$

I_1 : Net moment of inertia at end (cm⁴) (see **Fig 4.2.6**)

I_0 : Net moment of inertia at mid-span between supports (cm⁴) (see **Fig 4.2.6**)

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$Z=\left(1+\frac{3.2\alpha-\psi-0.8}{7\psi+0.4}\right)Z_{CS}$ (cm³)

(2) Net moment of inertia

$I=I_{CS}$ (cm⁴)

$I=(1+8\,\alpha^3(\frac{1-\phi}{0.2+3\sqrt{\phi}}))I_{CS}$ (cm⁴)

Z_{CS} : Net section modules(cm³) of primary surporting stiffener complying with the checking criteria in **Par 1.** (1) **or Par 2.** (1)

$\alpha=\frac{l_1}{l_0}$

$\psi=\frac{Z_1}{Z_0}$

l_1 : Length of the variable section part(m) (see **Fig 4.2.5**)

l_0 : Span measured(m) between end supports (see **Fig 4.2.5**)

Z_1 : Net section modulus at end(cm³) (see **Fig 4.2.5**)

Z_0 : Net section modulus calculated with considering the net thickness at mid-span(cm³) (see **Fig 4.2.5**)

I_{CS} : Net moment of inertia of primary surporting stiffener complying with the checking criteria in **Par 1.** (1) **or Par 2.** (1)

$\phi=\frac{I_1}{I_0}$

I_1 : Net moment of inertia at end (cm⁴) (see **Fig 4.2.5**)

I_0 : Net moment of inertia at mid-span between supports (cm⁴) (see **Fig 4.2.5**)

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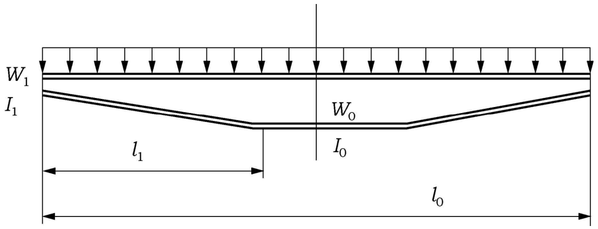
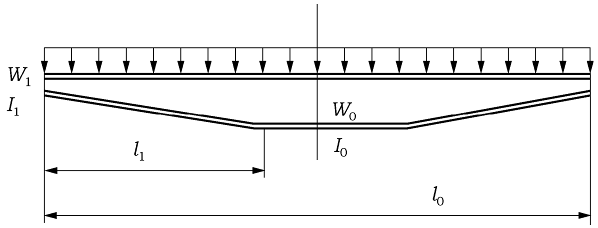
Present	Amendment	Note
 **Fig 4.2.6 Variable cross-section stiffener** **306. Strength calculations** Strength calculation for hatch covers may be carried out by either, using grillage analysis or FEM. Double skin hatch covers or hatch covers with box girders are to be assessed using FEM, refer to **Par 2.** **1. Effective cross-sectional properties for calculation by grillage analysis** (1) Cross-sectional properties are to be determined considering the effective breadth. Cross sectional areas of secondary stiffeners parallel to the primary supporting member under consideration within the effective breadth can be included, refer **Fig 4.2.8.** (2) The effective breadth of plating e_m of primary supporting members is to be determined according to **Table 4.2.6**, considering the type of loading. The intermediate vaule of l/e may be obtained by direct interpolation. The effective breadth of one-sided flanges is to be taken equal to the lesser of the following values. (A) 0.165 times of span between considered primary supporting member (B) Half the distance between the adjacent primary member (3) The effective cross sectional area of plates is not to be less than the cross sectional area of the face plate. (4) 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 **307. 5. (2).** **2. General requirements for FEM calculations** (1) For strength calculations of hatch covers by means of finite elements, the cover geometry shall be idealized as realistically as possible.	 **Fig 4.2.5 Variable cross-section stiffener** **306. Strength calculations** Stress calculation for hatch covers may be carried out by FE analysis. The stress calculation model in this section is to be used for both yielding and buckling strength assessments in accordance with 302. and 307. respectively. The net scantlings as defined in 106. are to be used. **1. General requirements for FEM calculations** (1) For the strength assessments of hatch covers by means of FE analysis, the hatch cover geometry shall be idealized as realistically as possible. (2) In no case shall element width be larger than stiffener spacing. The ratio of element length to width shall not exceed 3. (3) In way of force transfer points and cutouts the mesh is to be refined where applicable. (4) The element size along the height of webs of primary supporting member is not to exceed one-third of the web height. (5) Stiffeners, which support plates subjected to lateral pressure loads, are to be included in the FE model idealization. Stiffeners may be modelled by using beam elements, or shell/plate elements. (6) Buckling stiffeners may be disregarded for the stress calculation. (7) Hatch covers fitted with U-type stiffeners as shown in **Fig. 4.2.6** are to be assessed by means of FE analysis. The geometry of the U-type stiffeners is to be accurately modelled using shell/plate elements. (8) Nodal points are to be properly placed on the intersections between the webs of a U-type stiffener and the hatch cover plate, and between the webs and flange of the U-type stiffener.	Modify the figure number Reflected UR S21 Rev.6 -S21 3.5 -amended by combining Sec.306.1 and 2

Present	Amendment	Note

Present

(2) Element size must be appropriate to account for effective breadth. In no case element width shall be larger than stiffener spacing. The ratio of element length to width shall not exceed 4.

(3) In way of force transfer points and cutouts the mesh has to be refined where applicable.

(4) The element height of webs of primary supporting member must not exceed one-third of the web height.

(5) Stiffeners, supporting plates against pressure loads, have to be modelled. Stiffeners may be modelled by using shell elements, plane stress elements or beam elements.

(6) Buckling stiffeners may be disregarded for the stress calculation.

Table 4.2.6 Effective breadth e_m of plating of primary supporting members

l/e	0	1	2	3	4	5	6	7	≥ 8
e_{m1}/e	0	0.36	0.64	0.82	0.91	0.96	0.98	1.00	1.00
e_{m2}/e	0	0.20	0.37	0.52	0.65	0.75	0.84	0.89	0.90

e_{m1} is to be applied where primary supporting members are loaded by uniformly distributed loads or else by not less than 6 equally spaced single loads

e_{m2} is to be applied where primary supporting members are loaded by 3 or less single loads Intermediate values may be obtained by direct interpolation.

l effective span of primary supporting member

$l = l_0$ for simply supported primary supporting members

$l = 0.6 \cdot l_0$ for primary supporting members with both ends constraint,

where l_0 is the distance between supporting points of the primary supporting member

e width of plating supported, measured from centre to centre of the adjacent unsupported fields

Amendment

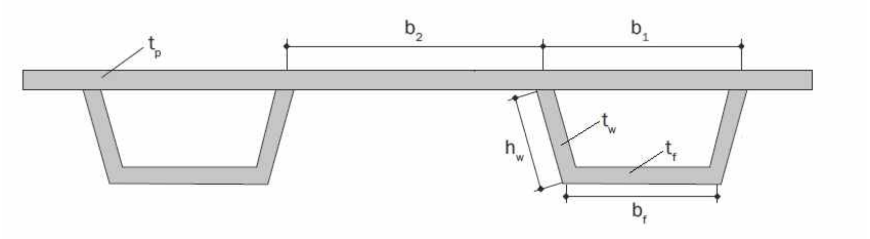


Fig 4.2.6 Example of hatch cover fitted with U-type stiffeners

(9) Wherever applicable the following boundary conditions are to be applied to the FE model :

(A) Boundary nodes in way of a bearing pad on the hatch coamings are to be fixed against displacement in the direction perpendicular to the pad.

(B) Lifting stoppers are to be fixed against displacements in the direction determined by the stoppers.

(C) For a folding type hatch cover, the FE nodes connected through a hinge are to have the same translational displacement in the direction perpendicular to the hatch cover top plating.

307. Buckling strength of hatch cover

1. General

Buckling strength of all hatch cover structures is to be checked. Buckling assessments in accordance with 307. 2. and 3. The net scantlings as defined in 106. are to be used for buckling check.

2. Slenderness requirements

(1) Stiffeners are to comply with the applicable slenderness and proportion requirements given in **Part 13 Sub 1, Ch 8, Sec 2 [3.1.1], [3.1.2]**.

(2) For buckling stiffeners on webs of primary supporting members, the ratio h_w/t_w is to comply with the following formula:

$$\frac{h_w}{t_w} \leq 15\sqrt{\frac{235}{R_{eH}}}$$

(3) The slenderness requirements need not be applied to the lower boundary of double skin hatch covers unless the cargo hold is designed for carriage of ballast or liquid cargo.

Note

Reflected UR S21 Rev.6

-S21 3.6

-introduction of CSR requirements

Present	Amendment	Note
307. Buckling strength of hatch cover **1.** For hatch cover structures sufficient buckling strength is to be demonstrated. **2. Definitions**(refer **Fig 4.2.7**) a = length of the longer side of a single plate field (mm) (x-direction) b = breadth of the shorter side of a single plate field (mm) (y-direction) α = aspect ratio of single plate field = a/b n = number of single plate field breadths within the partial or total plate field t = net plate thickness in mm σ_x, σ_y, τ = membrane stress($\mathrm{N/mm^2}$) in x-direction, y-direction and shear stress($\mathrm{N/mm^2}$) in the x-y plane. Compressive and shear stresses are to be taken positive, tension stresses are to be taken negative. If stresses in the x- and y-direction already contain the Poisson-effect (calculated using FEM), the following modified stress values may be used. Both stresses σ_x^* and σ_y^* are to be compressive stresses, in order to apply the stress reduction according to the following formulae: $\sigma_x = (\sigma_x^* - 0.3 \cdot \sigma_y^*)/0.91$ $\sigma_y = (\sigma_y^* - 0.3 \cdot \sigma_x^*)/0.91$ σ_x^*, σ_y^* = stresses containing the Poisson-effect Where $\sigma_y^* < 0.3\sigma_x^*$, then $\sigma_y = 0$ and $\sigma_x = \sigma_x^*$ Where $\sigma_x^* < 0.3\sigma_y^*$, then $\sigma_x = 0$ and $\sigma_y = \sigma_y^*$	**3. Buckling requirements** (1) Application (A) These requirements apply to the buckling assessment of hatch cover structures subjected to compressive and shear stresses and lateral pressures. (B) The buckling assessment is to be performed for the following structural elements : (i) Stiffened and unstiffened panels, including curved panels and panels stiffened with U-type stiffeners. (ii) Web panels of primary supporting members in way of openings. (C) The procedure and detailed requirements for buckling assessment are given in **Part 13 Sub 1, Ch 8**, including idealization of irregular plate panels, definition of reference stresses and buckling criteria. (2) Panel types and assessment methods (A) The plate panel of a hatch cover structure is to be modelled as stiffened panel (SP) or unstiffened panel (UP). (2) Assessment Method A (-A) and Method B (-B) as defined in **Part 13, Sub 1, Ch 8, Sec 1, [3]** are to be used in accordance with **Table 4.2.7, Figure 4.2.7** and **Figure 4.2.8.** (3) For a web panel with opening, the procedure for opening should be used for its buckling assessment. (4) For a hatch cover fitted with U-type stiffeners, the additional buckling assessment requirements specific for panels with U-type stiffeners in **Part 13, Sub 2, Ch 1, Sec 5, [5.6.4]** are also to be followed.	Reflected UR S21 Rev.6 -S21 3.6 -introduction of CSR requirements

Present	Amendment	Note

Present

E = modulus of elasticity($\mathrm{N/mm^2}$) of the material

= $2.06 \cdot 10^5\ \mathrm{N/mm^2}$ for steel

σ_Y = minimum yield stress($\mathrm{N/mm^2}$) of the material

F_1 = correction factor for boundary condition at the longitudinal stiffeners according to Table. 4.2.7.

Compressive and shear stresses are to be taken positive, tension stresses are to be taken negative.

σ_e = reference stress($\mathrm{N/mm^2}$) taken equal to

$$= 0.9 \cdot E\left(\frac{t}{b}\right)^2$$

Ψ = each edge stress ratio taken equal to

= σ_2/σ_1

where

σ_1 = maximum compressive stress

σ_2 = minimum compressive stress or tension stress

S = safety factor (based on net scantling approach), taken equal to

= 1.25 for hatch covers when subjected to the vertical weather design load according to 202.

= 1.10 for hatch covers when subjected to loads according to 204. to 206.

λ = reference degree of slenderness, taken equal to:

$$= \sqrt{\frac{\sigma_F}{K \cdot \sigma_e}}$$

K = buckling factor according to Table 4.2.9.

Amendment

Table 4.2.7 Structural members and assessment methods

Structural elements	Assessment method(1)(2)	Normal panel definition
Hatch cover top/bottom plating structures, see Fig. 4.2.7		
Hatch cover top/bottom plating	SP-A	Length: between transverse girders Width: between longitudinal girders
Irregularly stiffened panels	UP-B	Plate between local stiffeners/PSM
Hatch cover web panels of primary supporting members, see Fig. 4.2.8		
Web of transverse/longitudinal girder (single skin type)	UP-B	Plate between local stiffeners/face plate/PSM
Web of transverse/longitudinal girder (double skin type)	SP-B(3)	Length: between PSM Width: full web depth
Web panel with opening	Procedure for opening	Plate between local stiffeners/face plate/PSM
Irregularly stiffened panels	UP-B	Plate between local stiffeners/face plate/PSM

Note 1: SP and UP stand for stiffened and unstiffened panel respectively.

Note 2: A and B stand for Method A and Method B respectively.

Note 3: In case that the buckling carlings/brackets are irregularly arranged in the web of transverse/longitudinal girder, UP-B method may be used.

Note

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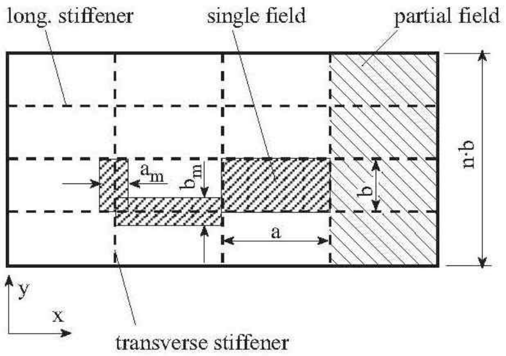
-introduction of CSR requirements

Present	Amendment	Note

Present



longitudinal : stiffener in the direction of the length a
transverse : stiffener in the direction of the breath b

Fig 4.2.7 General arrangement of panel

Table 4.2.7 Correction factor F_1

Stiffeners sniped at both ends	1.00
Guidance values[1] where both ends are effectively connected to adjacent structures	1.05 for flat bars 1.10 for bulb sections 1.20 for angle and tee-sections 1.30 for u-type sections[2] and girders of high rigidity

[1] Exact values may be determined by direct calculations
[2] Higher value may be taken if it is verified by a buckling strength check of the partial plate field using non-linear FEA and deemed appropriate by the Society but not greater than 2.0
[3] An average value of F_1 is to be used for plate panels having different edge stiffeners

Amendment

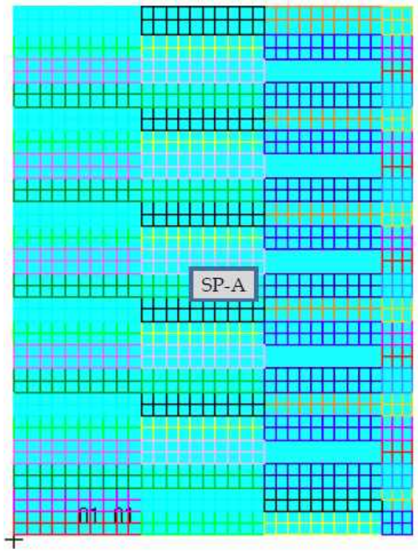


Fig.4.2.7 Hatch cover top/bottom plating structures

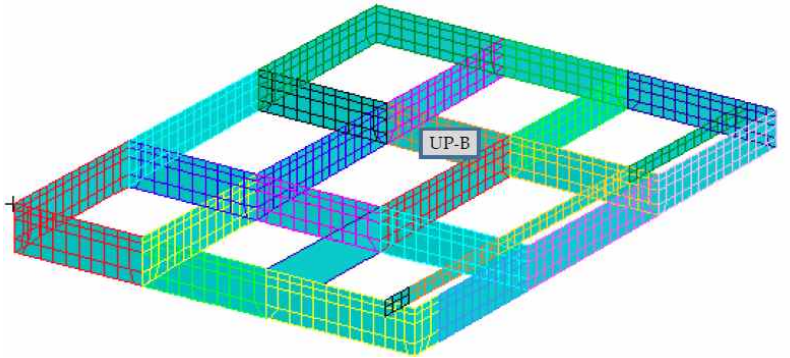


Fig. 4.2.8 Hatch cover webs of primary supporting members

Note

Reflected UR S21 Rev.6
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Present	Amendment	Note
3. Proof of top and lower hatch cover plating Proof is to be provided that the following condition is complied with for the single plate field : $\left(\frac{\lvert\sigma_x\rvert S}{k_x\sigma_Y}\right)^{e_1}+\left(\frac{\lvert\sigma_y\rvert S}{k_y\sigma_Y}\right)^{e_2}-B\left(\frac{\sigma_x\sigma_y S^2}{\sigma_Y^2}\right)+\left(\frac{\lvert\tau\rvert S\sqrt{3}}{\varkappa_\tau\sigma_Y}\right)^{e_3}\le 1.0$ $\left(\frac{\lvert\sigma_x\rvert S}{k_x\sigma_Y}\right)^{e_1}\le 1.0$ $\left(\frac{\lvert\sigma_y\rvert S}{k_y\sigma_Y}\right)^{e_2}\le 1.0$ $\left(\frac{\lvert\tau\rvert S\sqrt{3}}{\varkappa_\tau\sigma_Y}\right)^{e_3}\le 1.0$ $\varkappa_x$, $\varkappa_y$ and $\varkappa_\tau$ = reduction factors are given in Table 4.2.9 Where $\sigma_x \le 0$ (tension stress), $\varkappa_x = 1.0$. Where $\sigma_y \le 0$ (tension stress), $\varkappa_y = 1.0$. $e1$, $e2$, $e3$ and B = according to Table 4.2.8	(3) Applied lateral pressure and stresses The buckling assessment of hatch covers is based on the lateral pressure as defined in **202.** and **203.**, and stresses obtained from FE analysis, refer to **306**. (4) Safety factors For all hatch cover structural members, safety factor $S=1.0$ is to be applied to both of the plating and stiffener buckling capacity formulas as defined in **Part 13, Sub 1, Ch 8, Sec 5, [2.2]** and **Part 13, Sub 1, Ch 8, Sec 5, [2.3]**, respectively. (5) Buckling acceptance criteria A structural member is considered to have an acceptable buckling strength if it satisfies the following criterion : $\eta_{act} \le \eta_{all}$ η_{act} : Buckling utilisation factor based on the applied stress, as defined in **Part 13, Sub 1, Ch 8, Sec 5** and **Part 13, Sub 2, Ch 1, Sec 5 [5.6.4]**. η_{all} : Allowable buckling utilisation factor, taken as givenin **Table 4.2.8**	Reflected UR S21 Rev.6 -S21 3.6 -introduction of CSR requirements

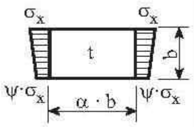
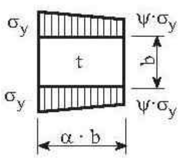
Table 4.2.8 Coefficients e_1, e_2, e_3 and factor B

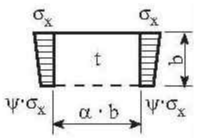
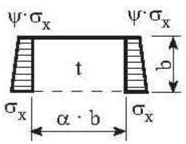
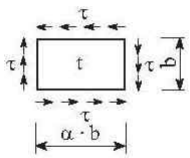
Exponents e_1 - e_3 and factor B	Plate panel
e_1	$1+\varkappa_x^4$
e_2	$1+\varkappa_y^4$
e_3	$1+\varkappa_x \cdot \varkappa_y \cdot \varkappa_\tau^2$
B σ_x and σ_y positive (compression stress)	$(\varkappa_x \cdot \varkappa_y)^5$
B σ_x or σ_y negative (tension stress)	1

Table 4.2.8 Allowable buckling utilisation factors

Structural component	Subject to	Allowable buckling utilisation factor, η_{all}
Plates and stiffeners Web of PSM	External pressure, as defined in Sec 2, 202.	0.80
	Other loads, as defined in Sec 2, 203 to 206.	0.90 for load combination: S+D 0.72 for load combination: S

Present	Amendment	Note
Table 4.2.9 Buckling and reduction factors for plane elementary plate panels	⟨deleted⟩	

Buckling-Load Case	Edge stress ratio Ψ	Asp. ratio $\alpha = a/b$	Buckling factor K	Reduction factor κ
1 	$1 \geq \Psi \geq 0$	$\alpha \geq 1$	$K = \frac{8.4}{\Psi + 1.1}$	$\kappa_x = 1$ for $\lambda \leq \lambda_c$ $\kappa_x = c\left(\frac{1}{\lambda} - \frac{0.22}{\lambda^2}\right)$ for $\lambda > \lambda_c$ $c = (1.25 - 0.12\Psi) \leq 1.25$ $\lambda_c = \frac{c}{2}\left(1 + \sqrt{1 - \frac{0.88}{c}}\right)$
	$0 > \Psi > -1$		$K = 7.63 - \Psi(6.26 - 10\Psi)$	
	$\Psi \leq -1$		$K = (1 - \Psi)^2 \cdot 5.975$	
2 	$1 \geq \Psi \geq 0$	$\alpha \geq 1$	$K = F_1\left(1 + \frac{1}{\alpha^2}\right)^2 \cdot \frac{2.1}{(\Psi + 1.1}$	$\kappa_y = c\left(\frac{1}{\lambda} - \frac{R + F^2(H - R)}{\lambda^2}\right)$ $c = (1.25 - 0.12\Psi) \leq 1.25$ $R = \lambda\left(1 - \frac{\lambda}{c}\right)$ for $\lambda < \lambda_c$ $R = 0.22$ for $\lambda \geq \lambda_c$ $\lambda_c = \frac{c}{2}\left(1 + \sqrt{1 - \frac{0.88}{c}}\right)$ $F = \left(1 - \frac{\frac{K}{0.91} - 1}{\lambda_p^{\ 2}}\right) \cdot c_1 \geq 0$ $\lambda_p^{\ 2} = \lambda^2 - 0.5$ for $1 \leq \lambda_p^{\ 2} \leq 3$ $c_1 = \left(1 - \frac{F_1}{\alpha}\right) \geq 0$ $H = \lambda - \frac{2\lambda}{c\left(T + \sqrt{T^2 - 4}\right)} \geq R$ $T = \lambda + \frac{14}{15\lambda} + \frac{1}{3}$
	$0 > \Psi > -1$	$1 \leq \alpha \leq 1.5$	$K = F_1\left[\left(1 + \frac{1}{\alpha^2}\right)^2 \cdot \frac{2.1(1+}{1.1}\right.$ $\left. - \frac{\Psi}{\alpha^2}(13.9 - 10\Psi)\right]$	
		$\alpha < 1.5$	$K = F_1\left[\left(1 + \frac{1}{\alpha^2}\right)^2 \cdot \frac{2.1(1+}{1.1}\right.$ $- \frac{\Psi}{\alpha^2}\left(5.87 + 1.87\alpha^2\right.$ $\left.\left. + \frac{8.6}{\alpha^2} - 10\Psi\right)\right]$	
	$\Psi \leq -1$	$1 \leq \alpha \leq \frac{3(1 - \Psi)}{4}$	$K = F_1\left(\frac{1 - \Psi}{\alpha}\right)^2 \cdot 5.975$	
		$\alpha > \frac{3(1 - \Psi)}{4}$	$K = F_1\left[\left(\frac{1 - \Psi}{\alpha}\right)^2 \cdot 3.9675\right.$ $\left. + 0.5375\left(\frac{1 - \Psi}{\alpha}\right)^4 + 1.87\right]$	

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td>
Table 4.2.9 Buckling and reduction factors for plane elementary plate panels
<table>
<tr><th>Buckling-Load Case</th><th>Edge stress ratio Ψ</th><th>Asp. ratio $\alpha = a/b$</th><th>Buckling factor K</th><th>Reduction factor $\varkappa$</th></tr>
<tr><td rowspan="2">3
</td><td>$1 \geq \Psi \geq 0$</td><td rowspan="2">$\alpha > 0$</td><td>$K = \frac{4\left(0.425 + \frac{1}{\alpha^2}\right)}{3\Psi + 1}$</td><td rowspan="3">$\varkappa_x = 1$ for $\lambda \leq 0.7$
$\varkappa_x = \frac{1}{\lambda^2 + 0.51}$ for $\lambda > 0.7$</td></tr>
<tr><td>$0 > \Psi \geq -1$</td><td>$K = 4\left(0.425 + \frac{1}{\alpha^2}\right)(1+\Psi) - 5\Psi(1 - 3.42\Psi)$</td></tr>
<tr><td>4
</td><td>$1 \geq \Psi \geq -1$</td><td>$\alpha > 0$</td><td>$K = \left(0.425 + \frac{1}{\alpha^2}\right)\frac{3-\Psi}{2}$</td></tr>
<tr><td rowspan="3">5
</td><td rowspan="3">===</td><td></td><td>$K = K_\tau \cdot \sqrt{3}$</td><td rowspan="3">$\varkappa_\tau = 1$ for $\lambda \leq 0.84$
$\varkappa_\tau = \frac{0.84}{\lambda}$ for $\lambda > 0.84$</td></tr>
<tr><td>$\alpha \geq 1$</td><td>$K_\tau = \left[5.34 + \frac{4}{\alpha^2}\right]$</td></tr>
<tr><td>$0 < \alpha < 1$</td><td>$K_\tau = \left[4 + \frac{5.34}{\alpha^2}\right]$</td></tr>
<tr><td colspan="5">Explanations for boundary conditions: --------- plate edge free plate edge simply supported</td></tr>
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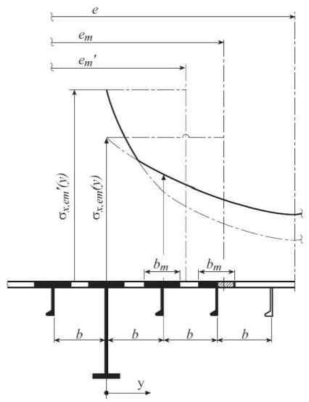
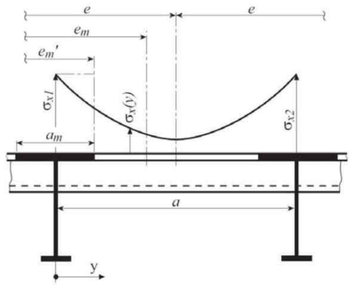
</td><td>〈deleted〉</td><td></td></tr>
</table>

Present	Amendment	Note
4. Webs and face plate of primary supporting members For non-stiffened webs and face plate of primary supporting members sufficient buckling strength as for the hatch cover top and lower plating is to be demonstrated according to **Par 3.** **5. Proof of partial and total fields of hatch covers** (1) Transverse stiffeners of partial and total plate fields comply with the conditions set out in (3) through (4). For u-type stiffeners, the proof of torsional buckling strength according to (4) can be omitted. Single-side welding is not permitted to use for secondary stiffeners except for u-stiffeners. (2) Effective width of top and lower hatch cover plating (A) For demonstration of buckling strength according to (3) through (4) the effective width of plating may be determined by the following formulae. (a) The effective width of plating a_m or b_m may be determined by following formulae(see also **Fig 4.2.7**). But it is not to be taken greater than the value obtained from **306.** $b_m = \varkappa_x \cdot b$ for longitudinal stiffeners $a_m = \varkappa_y \cdot a$ for transverse stiffeners $\varkappa_x, \varkappa_y$ = reduction factor given in **Table 4.2.9** a, b = according to **Par 2.** (b) The effective width e'_m of stiffened plates of primary supporting members may be determined as follows. The a_m and b_m are to be determined for $\Psi = 1$. (i) For stiffening parallel to web of primary supporting member(refer **Fig 4.2.8**). But b equal to a in case of $b \geq e_m$ $b < e_m$ $e'_m = n b_m$ n = integer number of stiffener spacings b inside the effective breadth em according to **306.** $= \text{int}\left(\frac{e_m}{b}\right)$	〈deleted〉	

Present	Amendment	Note
(ii) For stiffening perpendicular to web of primary supporting member(refer Fig 4.2.9). But a equal to b in case of $a < e_m$ $a \geq e_m$ $e'_m = na_m < e_m$ $n = 2.7\frac{e_m}{a} \leq 1$ e = width of plating supported according to **Table 4.2.6**  Fig 4.2.8 Stiffening parallel to web of primary supporting member  Fig 4.2.9 Stiffening perpendicular to web of primary supporting mem	⟨deleted⟩	

Present	Amendment	Note
(B) Scantling of top plates and stiffeners are to be determined as follows. (a) Scantling are in general to be determined according to the maximum stresses $\sigma_x(y)$ at webs of primary supporting member and stiffeners, respectively. (b) For stiffeners with spacing b under compression arranged parallel to primary supporting members no value less than $0.25\sigma_Y$ shall be inserted for $\sigma_x(y=b)$. (c) The stress distribution between two primary supporting members can be obtained by the following formula: $\sigma_x(y) = \sigma_{x1} \cdot \left\{1 - \frac{y}{e}\left[3 + c_1 - 4 \cdot c_2 - 2\frac{y}{e}(1 + c_1 - 2c_2)\right]\right\}$ $c_1 = \frac{\sigma_{x2}}{\sigma_{x1}} \qquad 0 \le c_1 \le 1$ $c_2 = \frac{1.5}{e} \cdot (e''_{m1} + e''_{m2}) - 0.5$ e''_{m1} = proportionate effective breadth e_{m1} or proportionate effective width e'_{m1} of primary supporting member 1 within the distance e, as considered condition e''_{m2} = proportionate effective breadth e_{m2} or proportionate effective width e'_{m2} of primary supporting member 2 within the distance e, as considered condition σ_{x1}, σ_{x2} = normal stresses in plates of adjacent primary supporting member 1 and 2 with spacing e, based on cross-sectional properties considering the effective breadth y = distance of considered location from primary supporting member 1 (d) Shear stress distribution in the plates may be assumed linearly.	〈deleted〉	

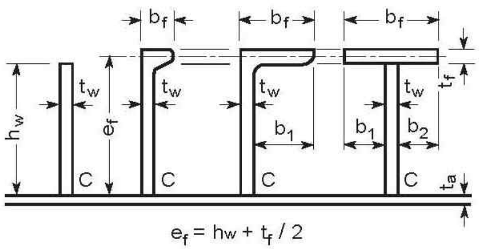
Present	Amendment	Note
(3) Lateral bucking of stiffeners (A) The stiffeners under lateral buckling shall be accordance with following requirements. $$\frac{\sigma_a + \sigma_b}{\sigma_F} S \le 1$$ σ_a = uniformly distributed compressive stress($\mathrm{N/mm^2}$) in the direction of the stiffener axis. $\sigma_a = \sigma_x$ for longitudinal stiffeners $\sigma_a = \sigma_y$ for transverse stiffeners σ_b = bending stress($\mathrm{N/mm^2}$) in the stiffener with $\sigma_x = \sigma_n,\ \tau = \tau_{SF}$ $$\sigma_b = \frac{M_0 + M_1}{Z_{st} 10^3}$$ M_0 = bending moment(Nmm) due to the deformation w of stiffener, taken equal to: $$M_0 = F_{Ki} \frac{p_z \cdot w}{c_f - p_z}$$ with $(c_f - p_z) > 0$ M_1 = bending moment(Nmm) due to the lateral load p equal to follows. n is to be taken equal to 1 for transverse stiffeners. $$M_1 = \frac{P b a^2}{24 \times 10^3}$$ for longitudinal stiffeners $$M_1 = \frac{P a (n b)^2}{8 c_s \times 10^3}$$ for transverse stiffeners P = lateral load($\mathrm{kN/m^2}$) F_{Ki} = ideal buckling force(N) of the stiffener	〈deleted〉	

Present	Amendment	Note
$F_{Kix} = \frac{\pi^2}{a^2} E I_x 10^4$ (N) for longitudinal stiffeners $F_{Kiy} = \frac{\pi^2}{(nb)^2} E I_y 10^4$ (N) for transverse stiffeners I_x, I_y = net moments of inertia(cm^4) of the longitudinal or transverse stiffener including effective width of attached plating according to **307. 5.** (2). I_x and I_y are to comply with the following criteria: $I_x \geq \frac{b\, t^3}{12 \times 10^4}$ $I_y \geq \frac{a\, t^3}{12 \times 10^4}$ P_z = nominal lateral load($\mathrm{N/mm^2}$) of the stiffener due to σ_x, σ_y and τ $p_{zx} = \frac{t}{b}\left(\sigma_{xl}\left(\frac{\pi b}{a}\right)^2 + 2c_y\sigma_y + \sqrt{2}\,\tau_1\right)$ for longitudinal stiffeners $p_{zy} = \frac{t}{a}\left(2c_x\sigma_{xl} + \sigma_y\left(\frac{\pi a}{nb}\right)^2\left(1 + \frac{A_y}{at}\right) + \sqrt{2}\,\tau_1\right)$ for transverse stiffeners $\sigma_{xl} = \sigma_x\left(1 + \frac{A_x}{b\, t}\right)$ c_x, c_y = factor taking into account the stresses perpendicular to the stiffener's axis and distributed variable along the stiffener's length = $0.5(1+\Psi)$ for $0 \leq \Psi \leq 1$ = $\frac{0.5}{1-\Psi}$ for $\Psi < 0$	〈deleted〉	

Present	Amendment	Note
A_x, A_y = net sectional area(mm^2) of the longitudinal or transverse stiffener, respectively, without attached plating $\tau_1 = \left[\tau - t\sqrt{\sigma_F \cdot E\left(\frac{m_1}{a^2} + \frac{m_2}{b^2}\right)}\right] \geq 0$ for longitudinal stiffeners: $\frac{a}{b} \geq 2.0$: $m_1 = 1.47$ $m_2 = 0.49$ $\frac{a}{b} < 2.0$: $m_1 = 1.96$ $m_2 = 0.37$ for transverse stiffeners: $\frac{a}{n \cdot b} \geq 0.5$: $m_1 = 0.37$ $m_2 = \frac{1.96}{n^2}$ $\frac{a}{n \cdot b} < 0.5$: $m_1 = 0.49$ $m_2 = \frac{1.47}{n^2}$ $w = w_0 + w_1$ w_0 = assumed imperfection(mm). For stiffeners sniped at both ends w_0 must not be taken less than the distance from the midpoint of plating to the neutral axis of the profile including effective width of plating. $w_0 \leq \min\left(\frac{a}{250}, \frac{b}{250}, 10\right)$ for longitudinal stiffeners $w_0 \leq \min\left(\frac{a}{250}, \frac{nb}{250}, 10\right)$ for transverse stiffeners	⟨deleted⟩	

Present	Amendment	Note
w_1 = Deformation of stiffener(mm) at midpoint of stiffener span due to lateral load P. In case of uniformly distributed load the following values for w_1 may be used: $w_1 = \frac{Pba^4}{384 \times 10^7 \times EI_x}$ for longitudinal stiffeners $w_1 = \frac{5Pa(nb)^4}{384 \times 10^7 \times EI_y c_s^2}$ for transverse stiffeners c_f = elastic support provided by the stiffener($\mathrm{N/mm^2}$) - For longitudinal stiffeners: $c_{fx} = F_{Kix} \cdot \frac{\pi^2}{a^2} \cdot (1+c_{px})$ $c_{px} = \frac{1}{1+\frac{0.91 \cdot \left(\frac{12 \cdot 10^4 \cdot I_x}{t^3 \cdot b} - 1\right)}{c_{xa}}}$ $c_{xa} = \left[\frac{a}{2b}+\frac{2b}{a}\right]^2$ for $a \geq 2b$ $c_{xa} = \left[1+\left(\frac{a}{2b}\right)^2\right]^2$ for $a < 2b$ - For transverse. stiffeners: $c_{fy} = c_s \cdot F_{Kiy} \cdot \frac{\pi^2}{(n \cdot b)^2} \cdot (1+c_{py})$ $c_{py} = \frac{1}{1+\frac{0.91 \cdot \left(\frac{12 \cdot 10^4 \cdot I_y}{t^3 \cdot a} - 1\right)}{c_{ya}}}$ $c_{ya} = \left[\frac{n \cdot b}{2a}+\frac{2a}{n \cdot b}\right]^2$ for $n \cdot b \geq 2a$ $c_{ya} = \left[1+\left(\frac{n \cdot b}{2a}\right)^2\right]^2$ for $n \cdot b < 2a$	〈deleted〉	

Present	Amendment	Note
c_s = factor accounting for the boundary conditions of the transverse stiffener = 1,0 for simply supported stiffeners = 2,0 for partially constraint stiffeners Z_{st} = net section modulus of stiffener (long. or transverse) (cm^3) including effective width of plating according to (2) (B) If no lateral load p is acting the bending stress σ_b is to be calculated at the midpoint of the stiffener span for that fibre which results in the largest stress value. (C) If a lateral load p is acting, the stress calculation is to be carried out for both fibres of the stiffener's cross sectional area (if necessary for the biaxial stress field at the plating side). (4) Torsional buckling of stiffeners (A) Longitudinal stiffeners The longitudinal stiffeners are to comply with the following criteria: $$\frac{\sigma_x \cdot S}{\varkappa_T \cdot \sigma_F} \leq 1.0$$ $\varkappa_T$ = coefficient taken equal to: $\varkappa_T = 1.0$ for $\lambda_T \leq 0.2$ $\varkappa_T = \frac{1}{\Phi + \sqrt{\Phi^2 - \lambda_T^2}}$ for $\lambda_T > 0.2$ $\Phi = 0.5(1 + 0.21(\lambda_T - 0.2) + \lambda_T^2)$ λ_T = reference degree of slenderness taken equal to: $\lambda_T = \sqrt{\frac{\sigma_F}{\sigma_{KiT}}}$ $\sigma_{KiT} = \frac{E}{I_p}\left(\frac{\pi^2 \cdot I_w \cdot 10^2}{a^2}\varepsilon + 0.385 \cdot I_T\right)$ (N/mm^2)	⟨deleted⟩	

Present	Amendment	Note
I_p = net polar moment of inertia of the stiffener(cm^4) related to the point C of **Fig 4.2.10**. (see **Table 4.2.10**) I_T = net St. Venant's moment of inertia of the stiffener (cm^4) (see **Table 4.2.10**) I_w = net sectorial moment of inertia of the stiffener(cm^6) related to the point C of **Fig 4.2.10**. (see **Table 4.2.10**) ε = degree of fixation taken equal to: $\varepsilon = 1 + 10^{-3}\sqrt{\frac{a^4}{\frac{3}{4}\pi^4 \cdot I_w(b/t^3 + 4h_w/3t_w{}^3)}}$ h_w = web height t_w = net web thickness(cm^4) b_f = flange breadth(cm^4) t_f = net flange thickness(cm^4) A_w = net web area equal to: $A_w = h_w \cdot t_w$ A_f = net flange area equal to: $A_f = b_f \cdot t_f$ $e_f = h_w + \frac{t_f}{2}$ (mm)  **Fig 4.2.10 Dimensions of stiffener**	〈deleted〉	

Present	Amendment	Note
Table 4.2.10 Moments of inertia <table><tr><td>Section</td><td>I_p</td><td>I_T</td><td>I_w</td></tr><tr><td>Flat bar</td><td>$\frac{h_w^3 \cdot t_w}{3 \cdot 10^4}$</td><td>$\frac{h_w \cdot t_w^3}{3 \cdot 10^4}\left(1-0.63\frac{t_w}{h_w}\right)$</td><td>$\frac{h_w^3 \cdot t_w^3}{36 \cdot 10^6}$</td></tr><tr><td>Sections with bulb or flange</td><td>$\left(\frac{A_w \cdot h_w^2}{3}+A_f \cdot e_f^2\right)10^{-4}$</td><td>$\frac{h_w \cdot t_w^3}{3 \cdot 10^4}\left(1-0.63\frac{t_w}{h_w}\right)$ + $\frac{b_f \cdot t_f^3}{3 \cdot 10^4}\left(1-0.63\frac{t_f}{b_f}\right)$</td><td>for bulb and angle sections: $\frac{A_f \cdot e_f^2 \cdot b_f^2}{12 \cdot 10^6}\left(\frac{A_f+2.6A_W}{A_f+A_W}\right)$ for tee-sections: $\frac{b_f^3 \cdot t_f \cdot e_f^2}{12 \cdot 10^6}$</td></tr></table>	〈deleted〉	

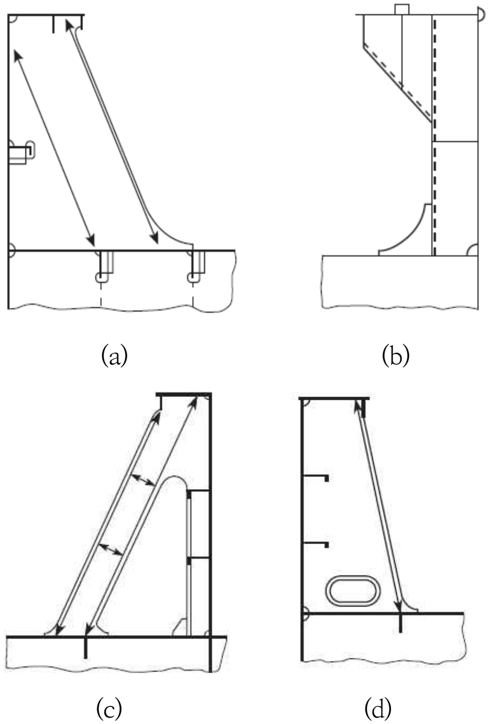
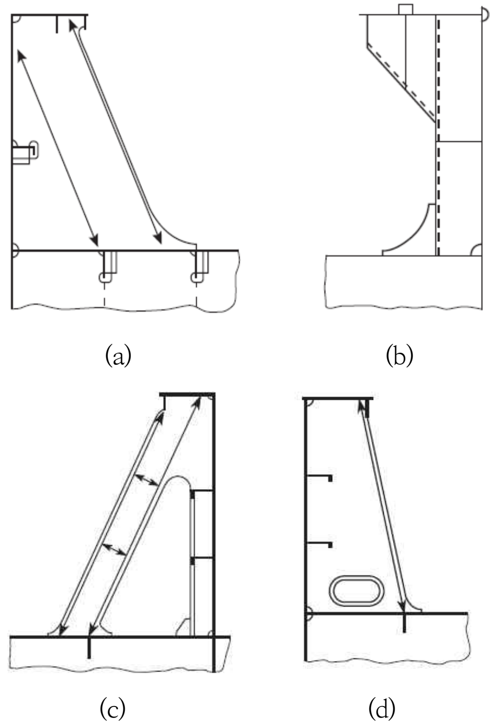
Present	Amendment	Note
(B) Transverse stiffeners For transverse stiffeners loaded by compressive stresses and which are not supported by longitudinal stiffeners, sufficient torsional buckling strength is to be demonstrated analogously in accordance with (A).	〈deleted〉	

Present	Amendment	Note
Section 4 Hatch Coamings strength criteria **401. General 〈omitted〉** **402. Net plate thickness of coamings** **1.** The net thickness of weather deck hatch coamings shall not be less than the larger of the following values and longitudinal strength aspects are to be observed. $t = 14.2S\sqrt{\frac{P_H}{0.95\sigma_y}}$ (mm) $t = 6 + \frac{L}{100}$ (mm) S = stiffener spacing (m) L = length of ship (m), need not be taken greater than 300 m P_H = horizontal weather load according to 203. σ_y = minimum yield stress(N/mm^2) of the material **2.** The gross thickness of the coaming plate at the sniped stiffener end shall not be less than $t = 19.6\sqrt{\frac{P_H S(l - 0.5S)}{\sigma_y}}$ (mm) l = secondary stiffener span, in m, to be taken as the spacing of coaming stays S, P_H, σ_y = according to Par 1	**Section 4 Hatch Coamings strength criteria** **401. General 〈same as the present〉** **402. Net plate thickness of coamings** The net thickness of weather deck hatch coamings shall not be less than the larger of the following values and longitudinal strength aspects are to be observed. **1.** Type-1 ships : $t = 0.0142s\sqrt{\frac{P_H}{0.95R_{eH}}}$ (mm) $t_{min} = 6 + \frac{L_1}{100}$ (mm) P_H = horizontal weather load according to **203. 1** R_{eH}= minimum yield stress(N/mm^2) of the material s = stiffener spacing (mm) L_1 = length of ship (m), need not be taken greater than 300 m **2.** Type-2 ships : $t = 0.016s\sqrt{\frac{P_{coam}}{0.95R_{eH}}}$ (mm) $t_{min} = 9.5$ (mm) P_{coam} = horizontal weather load according to **203.2** s, R_{eH} = according to **Par 1**	Reflected UR S21 Rev.6 -S21 5.1 -Units and symbols unified -reflected Part 7 Ch.9 904.2

Present	Amendment	Note
403. Net scantling of stiffeners of coamings **1.** For stiffeners with both ends constraint the net section modulus Z and net shear area A calculated on the basis of net thickness, must not be less than: $Z = \frac{83}{\sigma_y} P_H S l^2$ (cm³) $A = \frac{10 P_H S l}{\sigma_y}$ (cm²) P_H, l, S, σ_y = according to **402.** **2.** For sniped stiffeners at coaming corners section modulus and shear area have to be 1.35 times of the value determined by **Par 1.**	**403. Net scantling of stiffeners of coamings** **1.** For stiffeners with both ends constraint the net section modulus Z and net shear area A_{shr} calculated on the basis of net thickness, must not be less than: (1) Type-1 ships (A) $Z = \frac{P_H s l^2}{f_{bc} R_{eH}}$ (cm³) $A_{shr} = \frac{P_H s l}{R_{eH}} 10^{-2}$ (cm²) f_{bc} = 12 in general = 8, for the end spans of stiffeners sniped at the coaming corners l = stiffener span, in m, to be taken as the spacing of coaming stays s = stiffener spacing in mm (B) Note that for sniped stiffeners of coaming at hatch corners shear area at the fixed support has to be 1.35 times of the value determined by (A). The gross thickness of the coaming plate at the sniped stiffener end shall not be less than: $t_{gr} = 19.6 \sqrt{\frac{P_H s (l - 0.0005 s)}{1000 R_{eH}}}$ (mm) l, s = according to (A) P_H, R_{eH} = according to **402.1**	Reflected UR S21 Rev.6 -S21 5.1 -Units and symbols unified -reflected Part 7 Ch.9 904.2

Present	Amendment	Note
3. Horizontal stiffeners on hatch coamings, which are part of the longitudinal hull structure are to be have net thickness deducted by corrosion additions specified in **Table 4.2.1** and to be accordance with buckiling strength specified in **Pt 3, Ch 3, 403. 2** of the Rules.	(2) Type-2 ships $Z = 1.21 \frac{P_{coam} s l^2}{f_{bc} c_p R_{eH}}$ (cm^3) f_{bc} = 16 in general = 12, for the end spans of stiffeners sniped at the coaming corners l = span, in m, of stiffeners s = spacing, in mm, of stiffeners P_H = horizontal weather load according to 203.1 P_{coam} = horizontal weather load according to 203.2 c_p = ratio of the plastic section modulus to the elastic section modulus of the stiffeners with an attached plate breadth, in mm, equal to $40t$, where t is the plate net thickness = 1.16 in the absence of more precise evaluation **2.** In addition, for both Type-1 and Type-2 ships, horizontal stiffeners on hatch coamings, which are part of the longitudinal hull structure are to be have net thickness deducted by corrosion additions specified in **Table 4.2.1** and to be accordance with buckiling strength specified in **Pt 3, Ch 3, 403. 2** of the Rules.	Reflected UR S21 Rev.6 -S21 5.2 -Units and symbols unified -reflected Part 7 Ch.9 904.3

Present	Amendment	Note
404. Coaming stays **1. Coaming stay section modulus** (1) The net section modulus Z of coaming stays at the connection with deck shall not be less than: $Z = \frac{526}{\sigma_y} e h_s^2 p_A \quad (\mathrm{cm}^3)$ h_S., e = height and spacing of coaming stays (m) P_H, σ_y = according to 202. (2) For other designs of coaming stays, such as those shown in **Fig. 4.2.11** (c), (d), the stresses are to be determined through a grillage analysis or FEM. The calculated stresses are to be less than the permissible stresses according to **302. 1.** (3) Coaming stays are to be supported by appropriate substructures. Face plates may only be included in the calculation if an appropriate substructure is provided and welding provides an adequate joint.	**404. Coaming stays** **1. Coaming stay section modulus and web thickness** (1) At the connection with deck, the net section modulus Z, in cm^3, and the net thickness t_w, in mm, of the coaming stays designed as beams with flange ((b) and (c) are shown in **Fig. 4.2.9**) are to be taken not less than: $Z = \frac{P s_c H_c^2}{1.9 R_{eH}} \quad (\mathrm{cm}^3)$ $t_w = \frac{2 P s_c H_C}{h R_{eH}} \quad (\mathrm{mm})$ H_c = stay height, in m s_c = stay spacing, in mm h = stay depth, in mm, at the connection with the deck P = pressure on coaming, in $\mathrm{kN/m}^2$ P_H = according to **203.1** P_{coam} = according to **203.2** (2) For other designs of coaming stays, such as those shown in Fig. 4.2.9 (c), (d), the stresses are to be determined through FEM. The calculated stresses are to comply with the permissible stresses according to 302.1. (3) Coaming stays are to be supported by appropriate substructures. For calculating the section modulus of coaming stays, their face plate area is to be taken into account only when it is welded with full penetration welds to the deck plating and adequate underdeck structure is fitted to support the stresses transmitted by it. (4) Double continuous fillet welding is to be adopted for the connections of stay webs with deck plating and the weld throat thickness is to be not less than $0.44 t_w$. (5) For Type-2 ships, toes of stay webs are to be connected to the deck plating with full or partial penetration double bevel welds extending over a distance not less than 15% of the stay width.	Reflected UR S21 Rev.6 -S21 5.3.1 -Units and symbols unified Reflected UR S21 Rev.6 -S21 5.3.1 -wording correction -leave only FEM -re-locate from 405.2 (5)

Present	Amendment	Note
 **Fig 4.2.11 Examples of coaming stays** **2. Web thickness of coaming stays** Web gross thickness at the connection with deck shall not be less than: $$t_W = \frac{2}{\sigma_y}\frac{e h_S P_H}{h_W}$$ h_W = web height of coaming stay at its lower end (m) h_S, e, P_H, σ_y = corrosion addition (mm) according to **Par 1.**	 **Fig 4.2.9 Examples of coaming stays** 〈deleted〉	Reflected UR S21 Rev.6 -S21 5.3.1 -relocate to 404.1

Present	Amendment	Note
3. Coaming stays under friction load For coaming stays, which transfer friction forces at hatch cover supports, sufficient fatigue strength is to be considered according to Society, refer to **507. 2.** **405. Further requirements for hatch coamings** **1. Longitudinal strength 〈omitted〉** **2. Local details** (1) The design of local details is to comply with the requirements in this section for the purpose of transferring the pressures on the hatch covers to the hatch coamings and, through them, to the deck structures below. (2) Hatch coamings and supporting structures are to be adequately stiffened to accommodate the loading from hatch covers, in longitudinal, transverse and vertical directions. (3) The normal stress σ and the shear stress τ (N/mm^2) induced in the underdeck structures by the loads transmitted by stays are to comply with the following formulae : $\sigma \le 0.95\sigma_y$ $\tau \le 0.5\sigma_y$ (4) Unless otherwise stated, weld connections and materials are to be dimensioned and selected in accordance with **Pt 2** and **Pt 3, Ch 1, Sec 4, 5**. (5) Double continuous fillet welding is to be adopted for the connections of stay webs with deck plating and the weld throat thickness is to be not less than 0.44 t_W, where t_W is the gross thickness of the stay web.	**2. Coaming stays under friction load** For coaming stays, which transfer friction forces at hatch cover supports, sufficient fatigue strength is to be considered according to Society, refer to **507. 2.** **405. Further requirements for hatch coamings** **1. Longitudinal strength 〈same as the present〉** **2. Local details** (1) The design of local details is to comply with the requirements in this section for the purpose of transferring the pressures on the hatch covers to the hatch coamings and, through them, to the deck structures below. (2) Hatch coamings and supporting structures are to be adequately stiffened to accommodate the loading from hatch covers, in longitudinal, transverse and vertical directions. (3) The normal stress σ and the shear stress τ (N/mm^2) induced in the underdeck structures by the loads transmitted by stays are to comply with the following formulae : $\sigma \le 0.95 R_{eH}$ $\tau \le 0.5 R_{eH}$ (4) Unless otherwise stated, weld connections and materials are to be dimensioned and selected in accordance with **Pt 2** and **Pt 3, Ch 1, Sec 4, 5**. ~~(5) Double continuous fillet welding is to be adopted for the connections of stay webs with deck plating and the weld throat thickness is to be not less than 0.44 t_W, where t_W is the gross thickness of the stay web.~~	renumbering unification of symbols relocate to 404.1(4)

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td>

3. Stays 〈omitted〉

4. Extend of coaming plates

Coaming plates are to extend to the lower edge of the deck beams or hatch side girders are to be fitted that extend to the lower edge of the deck beams. Extended coaming plates and hatch side girders are to be flanged or fitted with face bars or half-round bars. Fig.4.2.12 gives an example.

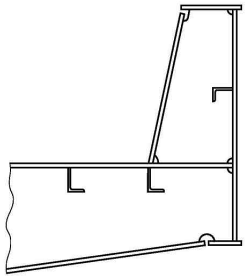


Fig 4.2.12 Example for the extend of coaming plates

5. Coamings of small hatchways 〈omitted〉

</td><td>

3. Stays 〈same as the present〉

4. Extend of coaming plates

Coaming plates are to extend to the lower edge of the deck beams or hatch side girders are to be fitted that extend to the lower edge of the deck beams. Extended coaming plates and hatch side girders are to be flanged or fitted with face bars or half-round bars. Fig.4.2.10 gives an example.

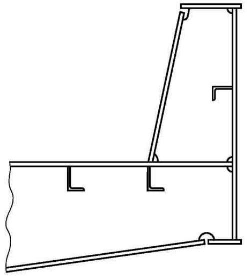
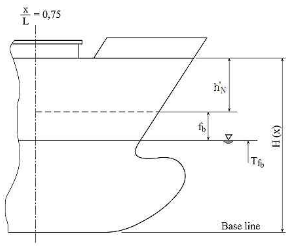
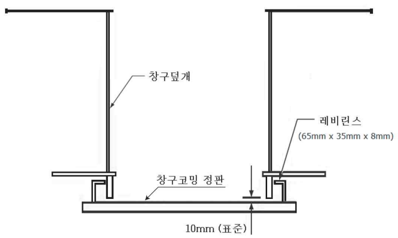
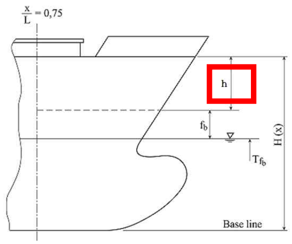
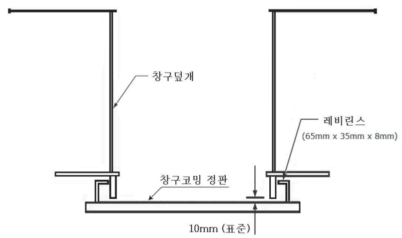


Fig 4.2.10 Example for the extend of coaming plates

5. Coamings of small hatchways 〈same as the present〉

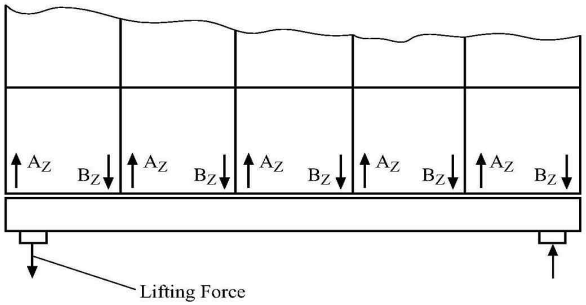
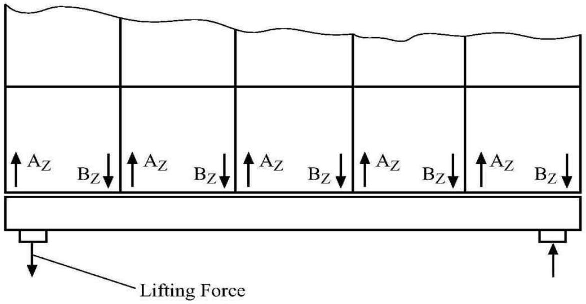
</td><td>renumbering of figure</td></tr>
</table>

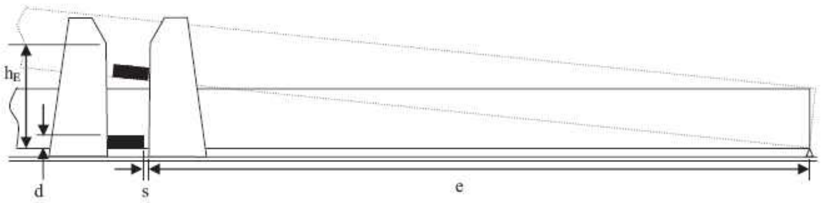
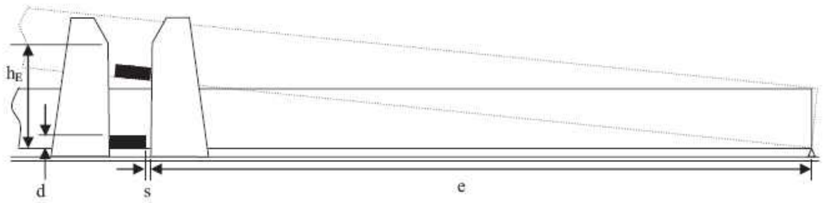
Present	Amendment	Note
Section 5 Hatch cover details – Closing Arrangement, Securing Devices and Stoppers **501. Weathertightness 〈omitted〉** **502. General 〈omitted〉** **503. Gaskets** **1. ~ 9.** 〈omitted〉 **10. Exemption of gaskets** In case of container ship accordance with the following requirements, gaskets may be omitted and clamping devices for steel hatchway covers may be suitably dispensed. (1) The hatchway coamings should be not less than 600 mm in height. (2) The exposed deck on which the hatch covers are located is situated above a depth H(x). H(x) is to be shown to comply with the following criteria: $H(x) \geq T_{fp} + f_b + h'_N$ (m) T_{fp} = draught, in m, corresponding to the assigned summer load line f_b = minimum required freeboard, in m, determined in accordance with **ICLL Reg. 28** as modified by further regulations as applicable h'_N = 4.6 m for $\frac{x}{L_{LL}} \leq 0{,}75$ = 6.9 m for $\frac{x}{L_{LL}} > 0{,}75$	**Section 5 Hatch cover details – Closing Arrangement, Securing Devices and Stoppers** **501. Weathertightness 〈same as the present〉** **502. General 〈same as the present〉** **503. Gaskets** **1. ~ 9.** 〈same as the present〉 **10.** The specification or grade of the gaskets is to be indicated on the drawings. **11. Exemption of gaskets** In case of container ship accordance with the following requirements, gaskets may be omitted and clamping devices for steel hatchway covers may be suitably dispensed. (1) The hatchway coamings should be not less than 600 mm in height. (2) The exposed deck on which the hatch covers are located is situated above a depth $H(x)$. $H(x)$ is to be shown to comply with the following criteria(See **Fig 4.2.11**): $H(x) \geq T_{fb} + f_b + h$ (m) T_{fb} = draught, in m, corresponding to the assigned summer load line f_b = minimum required freeboard, in m, determined in accordance with **ICLL Reg. 28** as modified by further regulations as applicable h = 4.6 m for $\frac{x}{L_{LL}} \leq 0{,}75$ = 6.9 m for $\frac{x}{L_{LL}} > 0{,}75$	Reflected UR S21 Rev.6 -S21 4.2.1 -Add requirements of drawing indications Reflected UR S21 Rev.6 -S21 4.2.2 -unification of symbols

Present	Amendment	Note
(3) The non-weathertight gaps between hatch cover panels should be considered as unprotected openings with respect to the requirements of intact and damage stability calculations. They should be as small as possible commensurate with the capacity of the bilge system and expected water ingress, and the capacity and operational effectiveness of the fire-fighting system and, generally, should not exceed 50 mm. (4) Labyrinths, gutter bars, or equivalents should be fitted proximate to the edges panel in way of the gaps to minimize the amount of water that can enter the container hold from the top surface of each panel. In general, the height of such means is not to be less than 65mm from the top of the coaming and gutter bars or from the top of the panel, and the gaps between hatch cover and the top of the coaming are not to exceed 10mm(See Fig 4.2.14) (5) ~ (7) 〈omitted〉  Fig 4.2.13 Definition of $H(x)$  Fig 4.2.14 Example of Labyrinths	(3) The non-weathertight gaps between hatch cover panels should be considered as unprotected openings with respect to the requirements of intact and damage stability calculations. They should be as small as possible commensurate with the capacity of the bilge system and expected water ingress, and the capacity and operational effectiveness of the fire-fighting system and, generally, should not exceed 50 mm. (4) Labyrinths, gutter bars, or equivalents should be fitted proximate to the edges panel in way of the gaps to minimize the amount of water that can enter the container hold from the top surface of each panel. In general, the height of such means is not to be less than 65mm from the top of the coaming and gutter bars or from the top of the panel, and the gaps between hatch cover and the top of the coaming are not to exceed 10mm(See Fig 4.2.12) (5) ~ (7) 〈same as the present〉  Fig 4.2.11 Definition of $H(x)$  Fig 4.2.12 Example of Labyrinths	Reflected UR S21 Rev.6 -S21 4.2.2 -unification of symbols renumbering figure

Present	Amendment	Note
504. Clamping devices **1. Arrangements 〈omitted〉** **2. Spacing 〈omitted〉** **3. Construction 〈omitted〉** **4. Area of securing devices** (1) The gross cross-sectional area of the clamping devices is not to be less than. Rods or bolts are to have a gross diameter not less than 19 mm for hatchways exceeding 5 m^2 in area. $A = 0.28\, q\, S_{SD} k_l \quad (cm^2)$ q = packing line pressure (N/mm), minimum 5 N/mm S_{SD} = spacing between securing devices (m), not to be taken less than 2 m k_l = $(235/\sigma_y)^e$ σ_Y = minimum yield strength of the material (N/mm^2) but is not to be taken greater than $0.7\sigma_T$, where σ_T is the tensile strength of the material (N/mm^2). e = 0.75 for σ_Y 〉 235 N/mm^2 = 1.00 for $\sigma_Y \leq 235\ N/mm^2$	**504. Clamping devices** **1. Arrangements 〈omitted〉** **2. Spacing 〈omitted〉** **3. Construction 〈omitted〉** **4. Area of securing devices** (1) The gross cross-sectional area of the clamping devices is not to be less than. Rods or bolts are to have a gross diameter not less than 19 mm for hatchways exceeding 5 m^2 in area. $A = 0.28\, q\, S_{SD} k_l \quad (cm^2)$ q = packing line pressure (N/mm), minimum 5 N/mm S_{SD} = spacing between securing devices (m), not to be taken less than 2 m $k_l = (235/R_{eH})^e$ R_{eH} = minimum yield strength of the material (N/mm^2) but is not to be taken greater than $0.7R_m$, where R_m is the tensile strength of the material (N/mm^2). e = 0.75 for R_{eH} 〉 235 N/mm^2 = 1.00 for $R_{eH} \leq 235\ N/mm^2$ (2) The stiffness of edge girders is to be sufficient to maintain adequate sealing pressure between clamping devices. The moment of inertia, in cm^4, of edge girders is not to be less than 【See Guidance】: $I = 6\, q\, S_{SD}^4$ q, S_{SD} = according to (1)	Reflected UR S21 Rev.6 -S21 6.1.4 -unification of symbols Reflected UR S21 Rev.6 -S21 6.1.4 -relocation (305.2.(3)→504.4.(2))

Present	Amendment	Note
(2) Clamping devices of special design in which significant bending or shear stresses occur may be designed as anti-lifting devices according to 506. and the load shall be obtained from the following formulae. $P = q \times S_{SD}$ (kN) q, S_{SD} = according to (1)	(3) Clamping devices of special design in which significant bending or shear stresses occur may be designed as anti-lifting devices according to 506. and the load shall be obtained from the following formulae. $P = q \times S_{SD}$ (kN) q, S_{SD} = according to (1)	renumbering
505. Stoppers **1.** For the design of the stopper against shifting the horizontal mass forces $F = ma$ are to be calculated with the following accelerations. The accelerations in longitudinal direction and in transverse direction do not need to be considered as acting simultaneously. $a_x = 0.2g$ in longitudinal direction $a_y = 0.5g$ in transverse direction m = Sum of mass of cargo lashed on the hatch cover and mass of hatch cover **2.** ~ **3.** 〈omitted〉	**505. Stoppers** **1.** For the design of the stopper against shifting the horizontal mass forces $F_h = ma$ are to be calculated with the following accelerations. The accelerations in longitudinal direction and in transverse direction do not need to be considered as acting simultaneously. $a_x = 0.2g$ in longitudinal direction $a_y = 0.5g$ in transverse direction m = Sum of mass of cargo lashed on the hatch cover and mass of hatch cover **2.** ~ **3.** 〈same as the present〉	Reflected UR S21 Rev.6 -S21 6.2.1 -unification of symbols
	4. Specifically for Type-2 ships, the following additional requirements are to be complied with: (1) Hatch covers are to be effectively secured, by means of stoppers, against the transverse forces arising from a pressure of 175 kN/m^2. (2) With the exclusion of No.1 hatch cover, hatch covers are to be effectively secured, by means of stoppers, against the longitudinal forces acting on the forward end arising from a pressure of 175 kN/m^2. (3) No. 1 hatch cover is to be effectively secured, by means of stoppers, against the longitudinal forces acting on the forward end arising from a pressure of 230 kN/m^2. But this pressure may be reduced to 175 kN/m^2 where there is a forecastle to which l_F according to **Part 7 Ch. 3 Sec. 13** is applied.	Reflected UR S21 Rev.6 -S21 6.2.3 -reflection of Part 7 Ch.3 Sec.9 905.2

Present	Amendment	Note
	(4) The equivalent stresses in stoppers and their supporting structures, and calculated in the throat of the stopper welds are not to exceed the allowable value of $0.8R_{eH}$.	
506. Anti lifting devices **1.** When cargo is loaded on hatch covers, the securing devices are to be provided for anti lifting by the lifting forces resulting from loads according to **205.**, refer **Fig 4.2.15.** **2.** Under these loadings of **Par 1** the equivalent stress in the anti lifting devices is not to exceed: $\sigma_E = 150/k_l$ (N/mm^2) k_l = according to **504. 4** (1)  Fig 4.2.15 **Lifting forces at a hatch cover** **3.** Anti lifting devices are to be omitted in the case in which the height h_E(mm) of the transverse cover guides is not less than that obtained from the following formula but shall be not less than the height of skirt plate + 150mm.(See Fig 4.2.16) $h_E = 1.75\sqrt{(2se + d^2)} - 0.75d$	**506. Anti lifting devices** **1.** When cargo is loaded on hatch covers, the securing devices are to be provided for anti lifting by the lifting forces resulting from loads according to **205.**, refer **Fig 4.2.13.** **2.** Under these loadings of **Par 1** the equivalent stress in the anti lifting devices is not to exceed: $\sigma_{vm} = 150/k_l$ (N/mm^2) k_l = according to **504. 4** (1)  Fig 4.2.13 **Lifting forces at a hatch cover** **3.** Anti lifting devices are to be omitted in the case in which the height h_E(mm) of the transverse cover guides is not less than that obtained from the following formula but shall be not less than the height of skirt plate + 150mm.(See Fig 4.2.14) $h_E = 1.75\sqrt{(2se + d^2)} - 0.75d$	Reflected UR S21 Rev.6 -S21 6.1.5 -unification of symbols Modify figure number

Present	Amendment	Note
e = Largest distance(mm) from he inner edges of the transverse cover guides to the ends of the cover edge plate s = Total clearance(mm), $10 \leq s \leq 40$ d = Distance between the upper edge of transverse stop-per and the hatch cover supports  Fig 4.2.16 **Height of transverse cover guides** **507. Hatch cover supports** **1.** For the transmission of the support forces resulting from the load cases specified in **Sec. 2** and of the horizontal mass forces speci-fied in **505. 1**, supports are to be provided which are to be de-signed such that the nominal surface pressures in general do not exceed the following values: $p_{n\max} = d\,p_n$ $(\mathrm{N/mm^2})$, But for metallic supporting surfaces not subjected to relative displacements the nominal surface pressure applies $p_{n\max} = 3p_n$ $(\mathrm{N/mm^2})$ d = $3.75 - 0.015L$ $d_{\max}$ = 3.0 $d_{\min}$ = 1.0 in general = 2.0 for partial loading conditions p_n = see Table 4.2.11 **2.~ 3. 〈omitted〉**	e = Largest distance(mm) from he inner edges of the transverse cover guides to the ends of the cover edge plate s = Total clearance(mm), $10 \leq s \leq 40$ d = Distance between the upper edge of transverse stop-per and the hatch cover supports  Fig 4.2.14 **Height of transverse cover guides** **507. Hatch cover supports** **1.** For the transmission of the support forces resulting from the load cases specified in **Sec. 2** and of the horizontal mass forces speci-fied in **505. 1**, supports are to be provided which are to be de-signed such that the nominal surface pressures in general do not exceed the following values: $p_{n\max} = d\,p_n$ $(\mathrm{N/mm^2})$, But for metallic supporting surfaces not subjected to relative displacements the nominal surface pressure applies $p_{n\max} = 3p_n$ $(\mathrm{N/mm^2})$ d = $3.75 - 0.015L$ $d_{\max}$ = 3.0 $d_{\min}$ = 1.0 in general = 2.0 for partial loading conditions p_n = see **Table** 4.2.9 **2.~ 3. 〈same as the present〉**	Modify figure number

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
<tr><td>

Table 4.2.11 Permissible nominal surface pressure p_n (2019)

Support material	p_n(N/mm^2) when loaded by	
	Vertical force	Horizontal force (on stoppers)
Hull structural steel	25	40
Hardened steel	35	50
Lower friction materials	50	-

4. The substructures of the supports must be of such a design, that a uniform pressure distribution is achieved.

5. Irrespective of the arrangement of anti lifting devices, the supports must be able to transmit the following force F in the longitudinal and transverse direction:

$$F = \mu \frac{P_V}{\sqrt{d}}$$

P_V = vertical supporting force on related supports

μ = frictional coefficient, the value equal to 0.5 in general, For non-metallic, low-friction support materials on steel, the friction coefficient may be reduced but not to be less than 0.35 and to the satisfaction of the Society.

d = according to Par 1

6. ~ 7. 〈omitted〉

508. Container foundations on hatch covers 〈omitted〉

509. Drainage 〈omitted〉

</td><td>

Table 4.2.9 Permissible nominal surface pressure p_n

Support material	p_n(N/mm^2) when loaded by	
	Vertical force	Horizontal force (on stoppers)
Hull structural steel	25	40
Hardened steel	35	50
Lower friction materials	50	-

4. The substructures of the supports must be of such a design, that a uniform pressure distribution is achieved.

5. Irrespective of the arrangement of anti lifting devices, the supports must 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 on related supports

μ = frictional coefficient, the value equal to 0.5 in general, For non-metallic, low-friction support materials on steel, the friction coefficient may be reduced but not to be less than 0.35 and to the satisfaction of the Society.

d = according to Par 1

6. ~ 7. 〈same as the present〉

508. Container foundations on hatch covers 〈omitted〉

509. Drainage 〈omitted〉

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Modify table number

Reflected UR S21 Rev.6

-S21 6.2.2

-unification of symbols

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Present	Amendment	Note

Present

Section 6 Hatch ways closed by Portable Hatch Cover and weathertighted by Tarpaulins and Battens

601. Application 〈omitted〉

602. Hatch Covers

1. The width of each supporting surface for hatch covers shall be at least 65 mm and shall be inclined as necessary to complete close.

2. For steel portable beam of **604.** and steel pontoon cover of **605.** according to the requirement of this section shall be designed with consider the design loads and allowable stress as following and shall be accordance with (3).

(1) The design loads P are defined in Table 4.2.12

Table 4.2.12 Design loads P

L_f	Position 1	Position 2
$L_f = 24.0\ m$	19.6 kN/m2	14.7 kN/m2
$L_f \geq 100.0\ m$	34.3 kN/m2	25.5 kN/m2
In cases, L_f at intermediate lengths shall be obtained by liner interpolation.		

(2) The allowable stress are to be accordance with following formulae.

$\sigma_a = 0.68\sigma_y$ (N/mm2)

σ_y = minimum yield strength of the material (N/mm^2)

(3) The deflection δ of portable beams and pontoon covers shall be less than the value obtained from following formulae.

$\delta = 0.0044 l_g$ (m)

l_g = longest span of spans between supporting point of primary stiffener.

〈omitted below〉

Amendment

Section 6 Hatch ways closed by Portable Hatch Cover and weathertighted by Tarpaulins and Battens

601. Application 〈omitted〉

602. Hatch Covers

1. The width of each supporting surface for hatch covers shall be at least 65 mm and shall be inclined as necessary to complete close.

2. For steel portable beam of **604.** and steel pontoon cover of **605.** according to the requirement of this section shall be designed with consider the design loads and allowable stress as following and shall be accordance with (3).

(1) The design loads P are defined in Table 4.2.10

Table 4.2.10 Design loads P

L_f	Position 1	Position 2
$L_f = 24.0\ m$	19.6 kN/m2	14.7 kN/m2
$L_f \geq 100.0\ m$	34.3 kN/m2	25.5 kN/m2
In cases, L_f at intermediate lengths shall be obtained by liner interpolation.		

(2) The allowable stress are to be accordance with following formulae.

$\sigma_a = 0.68 R_{eH}$ (N/mm^2)

R_{eH} = minimum yield strength of the material (N/mm^2)

(3) The deflection δ of portable beams and pontoon covers shall be less than the value obtained from following formulae.

$\delta = 0.0044 l_g$ (m)

l_g = longest span of spans between supporting point of primary stiffener.

〈same below as the present〉

Note

Modify table number

unification of symbols

<table>
<tr><th>Present</th><th>Amendment</th><th>Note</th></tr>
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CHAPTER 9 STRENGTH AND SECURING OF SMALL HATCHES, FITTINGS AND EQUIPMENT ON THE FORE DECK

Section 1 Application and Implementation

101. Application

1. For ships that are contracted for construction on or after 1 January 2004 on the exposed deck over the forward $0.25L$, applicable to:

All ship types of sea going service of length 80 m or more, where the height of the exposed deck in way of the hatch is less than $0.1L$ or 22 m above the summer load waterline, whichever is the lesser.

2. For ships that are contracted for construction prior to 1 January 2004 only for hatches on the exposed deck giving access to spaces forward of the collision bulkhead, and to spaces which extend over this line aft-wards, applicable to:

Bulk carriers, general dry cargo ships (excluding container vessels, vehicle carriers, Ro-Ro ships and woodchip carriers), and combination carriers (e.g. OBO ships, Ore/Oil Carriers, etc.), of length 100 m or more.

〈omitted below〉

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CHAPTER 9 STRENGTH AND SECURING OF SMALL HATCHES, FITTINGS AND EQUIPMENT ON THE FORE DECK

Section 1 Application and Implementation

101. Application

1. For ships that are contracted for construction on or after 1 January 2004 on the exposed deck over the forward $0.25L$, applicable to:

All ship types of sea going service of length 80 m or more, where the height of the exposed deck in way of the hatch is less than $0.1L$ or 22 m above the summer load waterline, whichever is the lesser.

2. For ships that are contracted for construction prior to 1 January 2004 only for hatches on the exposed deck giving access to spaces forward of the collision bulkhead, and to spaces which extend over this line aft-wards, applicable to:

Bulk carriers, general dry cargo ships (excluding container vessels, vehicle carriers, Ro-Ro ships and woodchip carriers), and combination carriers (e.g. OBO ships, Ore/Oil Carriers, etc.), of length 100 m or more.

3. This chapter does not apply to small hatches on container ship giving access to a cargo hold which comply with UI LL64 except the requirement of clause 4 & 5. Such hatch covers are considered non-weathertight regardless of whether it is actually weathertight or not. However, for scantlings of small hatches, the strength requirements in **202.** of this chapter UR could be applied instead of clause 6 of UI LL64.

〈same below as the present〉

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Reflected UR S26 Rev.5

-S26 2.5
-Clarification of application

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Main Amendments

(1) Background of Amendment

1) reflected IACS Rec. 10 Rev. 5 (addition of LDBF definition reflecting MSC.1/Circ.1619)

2) reflected MSC.1/Circ. 1362 Rev.2 (add application details for SOLAS II-1 Reg.3-8.7/8)

- addtion of supplement with towing and mooring arrangements plan

(2) Effective date (circular will be issued)

1) for which the building contract is placed on or after 1 January 2024; or

2) in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after 1 July 2024; or

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

Present	Amendment	Note
CHAPTER 10 SHIPBOARD EQUIPMENT, FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING **Section 1 Definitions and Scope of Application** **101. Application *(2018)* 〈omitted〉** **102. Definitions *(2018)*** 1. ~ 6. 〈omitted〉 **Section 2 Towing and Mooring** **201. Towing ~ 202. Mooring 〈omitted〉** **203. Towing and mooring arrangements plan *(2018)*** **1.** The SWL and TOW for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master. It is to be noted that TOW is the load limit for towing purpose and SWL that for mooring purpose. If not otherwise chosen, for towing bitts it is to be noted that TOW is the load limit for a towing line attached with eye-splice. **2.** Information provided on the plan is to include in respect of each shipboard fitting.	**CHAPTER 10 SHIPBOARD EQUIPMENT, FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING** **Section 1 Definitions and Scope of Application** **101. Application *(2018)* 〈same as the present〉** **102. Definitions *(2018)*** 1. ~ 6. 〈same as the present〉 **7.** Line design break force(LDBF) means the minimum force at which a new, dry, spliced mooring line will break at. This is for all synthetic cordage material. This value is declared by the manufacturer on each line's mooring line certificate and is stated on a manufacturer's line data sheet. LDBF of a line should be 100%-105% of the ship design minimum breaking load(MBL_{SD}). **Section 2 Towing and Mooring** **201. Towing ~ 202. Mooring 〈omitted〉** **203. Towing and mooring arrangements plan *(2018)*** **1.** The SWL and TOW for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master. It is to be noted that TOW is the load limit for towing purpose and SWL that for mooring purpose. If not otherwise chosen, for towing bitts it is to be noted that TOW is the load limit for a towing line attached with eye-splice. **2.** Information provided on the plan is to include in respect of each shipboard fitting.	reflected Rec.10 Rev. 5 (Rec.10 2.1) -Added as required by MSC.1 Circ.1619.

Present	Amendment	Note
(1) Location on the ship (2) Fitting type (3) SWL/TOW (4) Purpose (mooring / harbour towing / other towing) (5) Method of applying load of towing or mooring line including limiting fleet angle i.e. angle of change in direction of a line at the fitting. Item (3) with respect to items (4) and (5), is subject to approval by the Society. *(2022)* Furthermore, information provided on the plan is to include: (1) The arrangement of mooring lines showing number of lines (N) (2) The ship design minimum breaking load (MBL_{SD}) *(2022)* (3) The acceptable environmental conditions refer for minimum conditions to IACS Recommendation No. 10 "Anchoring, Mooring and Towing Equipment" for the recommended ship design minimum breaking load for ships with Equipment Number EN 〉 2000: *(2022)* (A) 30 second mean wind speed from any direction.(v_w or v_w^* according to IACS Recommendation No. 10) (B) Maximum current speed acting on bow or stern (±10°).	(1) Location on the ship (2) Fitting type (3) SWL/TOW (4) Purpose (mooring / harbour towing / other towing) (5) Method of applying load of towing or mooring line including limiting fleet angle i.e. angle of change in direction of a line at the fitting. Item (3) with respect to items (4) and (5), is subject to approval by the Society. *(2022)* Furthermore, information provided on the plan is to include: (1) The arrangement of mooring lines showing number of lines (N) (2) The ship design minimum breaking load (MBL_{SD}) *(2022)* (3) The acceptable environmental conditions refer for minimum conditions to IACS Recommendation No. 10 "Anchoring, Mooring and Towing Equipment" for the recommended ship design minimum breaking load for ships with Equipment Number EN 〉 2000: *(2022)* (A) 30 second mean wind speed from any direction.(v_w or v_w^* according to IACS Recommendation No. 10) (B) Maximum current speed acting on bow or stern (±10°). (4) For ships of less than 3,000 gross tonnage engaged in international voyages and contracted for construction on or after 1 January 2024, the following shall be additionally included on the plan and provided on board; (A) Maximum brake holding load; (B) Technical specification document of the mooring lines (including manufacturers' recommended minimum diameter D of each fitting in contact with the mooring lines and the Line Design Break Force (LDBF) of the mooring lines); and (C) Properties of mooring lines related to LDBF and bend radius (D/d ratio)[(1)](including warning that the wear rate of lines may be higher for lower diameter(ref. Par. 5.6 of MSC.1/Circ.1620) (5) For ships of 3,000 gross tonnage and above engaged in international voyages and contracted for construction on or after 1 January 2024, the following shall be included in addition to those specific under Par. (4) and provided on board; (A) A document shall be provided by the designer for information and as a supplement to the towing and mooring arrangements plan, confirming that MSC.1/Circ.1619 has been considered. The document shall explicitly state that the deviations compared to MSC.1/Circ.1619, if any, were unavoidable;	reflected MSC.1/Circ. 1362 Rev.2 (par.3) reflected MSC.1/Circ. 1362 Rev.2 (par.4)

Present	Amendment	Note
3. The information as given in **2.** is to be incorporated into the pilot card in order to provide the pilot proper information on harbour and other towing operations.	(B) Deviations shall be recorded, if any, (Par. 6.1 of MSC.1 Circ./1619), justification and suitable safety measures shall be provided (Par. 6.2 of MSC.1/Circ.1619) in the supplement to the towing and mooring arrangements plan. A reference to the supplement shall be included in the towing and mooring arrangements plan (Par. 6.3 of MSC.1/Circ.1619); (C) If deviations are not found necessary, and the supplement is not needed, then this shall be mentioned explicitly in the towing and mooring arrangements plan; and (D) The mooring maximum brake holding load shall be less than 100% of the Ship Design Minimum Breaking Load (MBL_{SD}) (Par. 5.2.3.3 and 5.2.4 of MSC.1/Circ.1619). The winches shall be fitted with brakes that allow for the reliable setting of the brake rendering load. (Notes) [(1)] Bend radius (D/d ratio) means the diameter, D, of a mooring fitting divided by the diameter, d, of a mooring line that is led around or through the fitting. (ref. Par.2.1 of MSC.1/Circ.1620) **3.** The information as given in **2.** is to be incorporated into the pilot card in order to provide the pilot proper information on harbour and other towing operations.	

Main Amendments

(1) Background of Amendment
- reflected in accordance with IACS UR A1 Rev. 8
  1) clarify the applicable subject for anchoring equipment
  2) addition of applicable alternative methods for selection of anchoring equipment for ships less than 90 m in length
  3) clarification for use of wire rope in place of chain cable
  4) addition of wire rope condition instead of chain cable(Anchor weight increased by 25% when wire rope is applied)
     - The anchoring force is equal when the wire rope is about 2 to 3 times the length of the anchor chain, but it is difficult to apply. So, instead of increasing the length by 1.5 times, the loss is compensated by increasing the weight of the anchor.

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 8 EQUIPMENT NUMBER AND EQUIPMENT **Section 1 General** **101. General and application 【See Guidance】** **1.** All ships, according to their equipment number of provisions in **Sec 2,** are to be provided with anchors, chain cables, ropes, etc. which are not less than given in **Table 4.8.1.**	**CHAPTER 8 EQUIPMENT NUMBER AND EQUIPMENT** **Section 1 General** **101. General and application 【See Guidance】** **1.** All ships, according to their equipment number of provisions in **Sec 2,** are to be provided with anchors, chain cables, ropes, etc. which are not less than given in **Table 4.8.1.**	
	2. The anchoring equipment required by Sec. 1 through 6 applies to vessels with unrestricted service. The requirements given in Sec. 1. 101. 5. (1) B, 101. 5. (6), Sec. 2, Sec. 3 apply to vessels with restricted service area. Unrestricted service means a vessel engaged on international voyages, and not bounded by any limitations on operating environment reflected in vessel class notation.	UR A1 Rev.8 (A1.1.9, A1.1.10) - clarify the applicable subject for anchoring equipment
2. The anchors, chain cables and ropes (hereinafter referred to as "equipment") which are required to be tested and inspected to be used for ships classed with the Society are to comply with the requirements of this Chapter.	**3.** The anchors, chain cables and ropes (hereinafter referred to as "equipment") which are required to be tested and inspected to be used for ships classed with the Society are to comply with the requirements of this Chapter.	renumbering
3. The equipment other than those prescribed in this Chapter may be used where specially approved in connection with the design and use. In such case, the detailed data relating to the process of manufacture of the equipment are to be submitted for approval.	**4.** The equipment other than those prescribed in this Chapter may be used where specially approved in connection with the design and use. In such case, the detailed data relating to the process of manufacture of the equipment are to be submitted for approval.	
4. All ships are to be provided with suitable appliances for handling of anchors as follows. 〈below omitted〉	**5.** All ships are to be provided with suitable appliances for handling of anchors as follows.	

Present	Amendment	Note
Section 2 Equipment Number **201. Equipment number *(2022)* 【See Guidance】〈omitted〉** **202. Mass of anchors 〈omitted〉** **203. Chain cables and stream lines** **1. ~ 4. 〈omitted〉** **5.** Wire rope may be used in place of chain cable on ships with less than 40 m in length and subject to the following conditions: *(2022)* (1) The length of the wire rope is to be equal to 1.5 times the corresponding tabular length of chain cable (**Table 4.8.1**) and their strength is to be equal to that of tabular chain cable of Grade 1 (**Table 4.8.8**). (2) A short length of chain cable is to be fitted between the wire rope and anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less. (3) All surfaces being in contact with the wire need to be rounded with a radius of not less than 10 times the wire rope diameter (including stem). **204. Tow lines and mooring lines 〈omitted〉**	**Section 2 Equipment Number** **201. Equipment number *(2022)* 【See Guidance】〈same as the present〉** **202. Mass of anchors 〈same as the present〉** **203. Chain cables and stream lines** **1. ~ 4. 〈same as the present〉** **5.** Wire rope may be used in place of chain cable on ships subject to the following conditions: (1) with less than 90 m in length and which will need an anchor for emergency purposes, i.e., not intended to use their anchor in normal temporary anchoring operation, or (2) with the anchoring equipment used for positioning with a minimum of 4 points anchoring, e.g., for cable or pipe laying. **6.** Use of wire rope is subject to the following conditions: (1) The length of the wire rope is to be equal to 1.5 times the corresponding tabular length of chain cable (**Table 4.8.1**) and their strength is to be equal to that of tabular chain cable of Grade 1 (**Table 4.8.8**). (2) The anchor weight shall be increased by 25 % compared to anchor associated with chain cable according to **Table 4.8.1**. (3) A short length of chain cable is to be fitted between the wire rope and anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less. (4) All surfaces being in contact with the wire need to be rounded with a radius of not less than 10 times the wire rope diameter (including stem). (5) Steel wire shall be selected to fit for purpose based on the manufacturer recommendation and shall be provided with guidance for maintenance and inspection. **204. Tow lines and mooring lines 〈same as the present〉**	UR A1 Rev.8 (A1.5.1.2, A1.5.1.3) - clarification for use of wire rope in place of chain cable - addition of wire rope condition instead of chain cable

Present	Amendment	Note

Present

Table 4.8.1 Bower anchors, chain cables and ropes *(2018)*

Equipment letter	Equipment number		Stockless bower anchors		Stud link chain cables for bower anchors				Tow line			Mooring line			
			Number	Mass per anchor (kg)	Total length (m)	Diameter (mm)			Length per line (m)	Ship design minimum breaking load		Number	Length per line (m)	Ship design minimum breaking load	
	Exceeding	Not exceeding				Grade 1	Grade 2	Grade 3		(kN)	(kg)			(kN)	(kg)
A1	-	70	2	180	220	14	12.5		180	98	10000	3	80	37	3750
A2	70	90	2	240	220	16	14		180	98	10000	3	100	40	4100
A3	90	110	2	300	247.5	17.5	16		180	98	10000	3	110	42	4300
A4	110	130	2	360	247.5	19	17.5		180	98	10000	3	110	48	4900
A5	130	150	2	420	275	20.5	17.5		180	98	10000	3	120	53	5400

〈omitted below〉

NOTES :

1. Length of chain cables may be that including shackles for connection
2. Tow line and mooring line are not a condition of Classification, but is listed in this table only for guidance. Side projected area of deck cargo as given by the nominal capacity condition is to be taken into account for calculation of equipment number.(For detail, refer to IACS Rec.10 Anchoring, Mooring and Towing Equipment 2.1 and 2.2) *(2022)*
3. The mooring lines for ships with Equipment Number EN ≦ 2000 are taken this table, for ships with an Equipment Number EN 〉 2000 are to be in accordance with the Guidance relating to the Rules specified by the Society.

Amendment

Table 4.8.1 Bower anchors, chain cables and ropes

Equipment letter	Equipment number		Stockless bower anchors		Stud link chain cables for bower anchors				Tow line			Mooring line			
			Number	Mass per anchor (kg)	Total length (m)	Diameter (mm)			Length per line (m)	Ship design minimum breaking load		Number	Length per line (m)	Ship design minimum breaking load	
	Exceeding	Not exceeding				Grade 1	Grade 2	Grade 3		(kN)	(kg)			(kN)	(kg)
A1	-	70	2	180	220	14	12.5		180	98	10000	3	80	37	3750
A2	70	90	2	240	220	16	14		180	98	10000	3	100	40	4100
A3	90	110	2	300	247.5	17.5	16		180	98	10000	3	110	42	4300
A4	110	130	2	360	247.5	19	17.5		180	98	10000	3	110	48	4900
A5	130	150	2	420	275	20.5	17.5		180	98	10000	3	120	53	5400

〈omitted below〉

NOTES :

1. Length of chain cables may be that including shackles for connection
2. Tow line and mooring line are not a condition of Classification, but is listed in this table only for guidance. Side projected area of deck cargo as given by the nominal capacity condition is to be taken into account for calculation of equipment number.(For detail, refer to IACS Rec.10 Anchoring, Mooring and Towing Equipment 2.1 and 2.2) *(2022)*
3. The mooring lines for ships with Equipment Number EN ≦ 2000 are taken this table, for ships with an Equipment Number EN 〉 2000 are to be in accordance with the Guidance relating to the Rules specified by the Society.
4. For ships of length less than 90m, alternative methodology described in Annex 4-4 may be used.

Note

UR A1 Rev.8 (A1.2.4)
-addition of applicable alternative methods based on current and wind for ships less than 90 m in length

Amendments of the Guidance relating to the Rules

(External Development Review-External Opinion Inquiry)

Part 4 Hull Equipment

2023.09.

Hull Rule Development Team

Main Amendments

(1) Background of Amendment

1) reflected IACS UR S10 Rev. 7
- clarify the requirement regarding sealing equipment (considered watertight seals as equivalent to stuffing boxes)
- clarify the bending forces and moments for spade rudder with trunk extending inside the rudder(added equations for moment calculations of partially submerged spade rudders)

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 1 RUDDERS **Section 1 ~ Section 3 〈omitted〉** **Section 4 Rudder Strength Calculation** **401. Rudder strength calculation** 【See Rule】 **1. General** The bending moment, shear force, and supporting force acting on the rudder and rudder stock may be evaluated using the basic rudder models as outlined in **3** to **7.** **2. Moments and forces to be evaluated** The bending moment M_R and the shear force Q_1 acting on the rudder body, the bending moment M_b acting on the bearing, and the bending moment M_s acting on the coupling between the rudder stock and rudder main piece and the supporting force B_1, B_2, B_3 are to be obtained and to be used for analyzing the stresses in accordance with the **Pt 4, Ch 1** of the Rules. **3. Type C rudders(Spade rudder)** (1) General data The data on the spade rudder models is as follows(See **Fig 4.1.2** of the Guidance): $\ell_{10} \sim \ell_{30}$ = Lengths of the individual girders of the system (m) $I_{10} \sim I_{30}$ = Moments of inertia of these girders (cm^4) Load of rudder body $P_R = \dfrac{F_R}{1000\,\ell_{10}}$ (kN/m) F_R : as specified in **Pt 4, Ch 1, Sec 2** of the Rules (2) The moments and forces may be determined by the following formulae:	**CHAPTER 1 RUDDERS** **Section 1 ~ Section 3 〈same as present〉** **Section 4 Rudder Strength Calculation** **401. Rudder strength calculation** 【See Rule】 **1. General** The bending moment, shear force, and supporting force acting on the rudder and rudder stock may be evaluated using the basic rudder models as outlined in **3** to **7.** **2. Moments and forces to be evaluated** The bending moment M_R and the shear force Q_1 acting on the rudder body, the bending moment M_b acting on the bearing, the bending moment M_c acting on the top of the cone coupling and the bending moment M_s acting on the coupling between the rudder stock and rudder main piece and the supporting force B_1, B_2, B_3 are to be obtained and to be used for analyzing the stresses in accordance with the **Pt 4, Ch 1** of the Rules. **3. Type C rudders(Spade rudder)** (1) General data The data on the spade rudder models is as follows(See **Fig 4.1.2** of the Guidance): $\ell_{10} \sim \ell_{30}$ = Lengths of the individual girders of the system (m) $I_{10} \sim I_{30}$ = Moments of inertia of these girders (cm^4) Load of rudder body $P_R = \dfrac{F_R}{1000\,\ell_{10}}$ (kN/m) F_R : as specified in **Pt 4, Ch 1, Sec 2** of the Rules (2) The moments and forces may be determined by the following formulae:	IACS UR S10 Rev. 7 Annex S10.2

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$M_b = F_R[\ell_{20} + \frac{\ell_{10}(2x_1 + x_2)}{3(x_1 + x_2)}]$ (N-m)

$B_2 = F_R + B_3$ (N)

$B_3 = \frac{M_b}{l_{30}}$

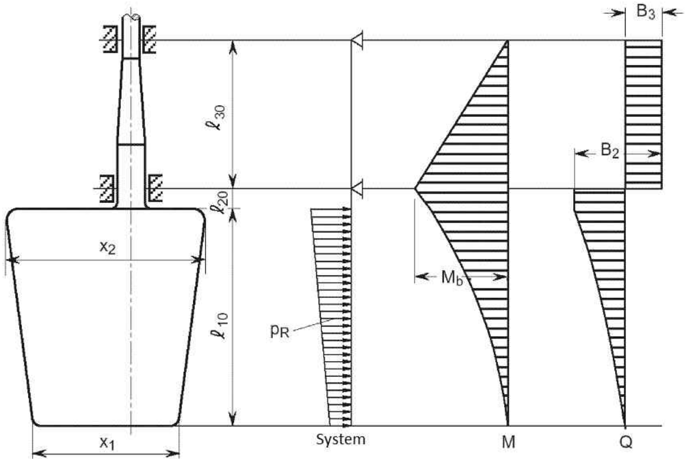

Fig 4.1.2 Type C rudder (Spade rudder)

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$M_b = F_R[\ell_{20} + \frac{\ell_{10}(2x_1 + x_2)}{3(x_1 + x_2)}]$ (N-m)

$B_2 = F_R + B_3$ (N)

$B_3 = \frac{M_b}{l_{30}}$

The maximum moment, M_c, in top of the cone coupling as shown in **Fig 4.1.2** is applicable for the connection between the rudder and the rudder stock.

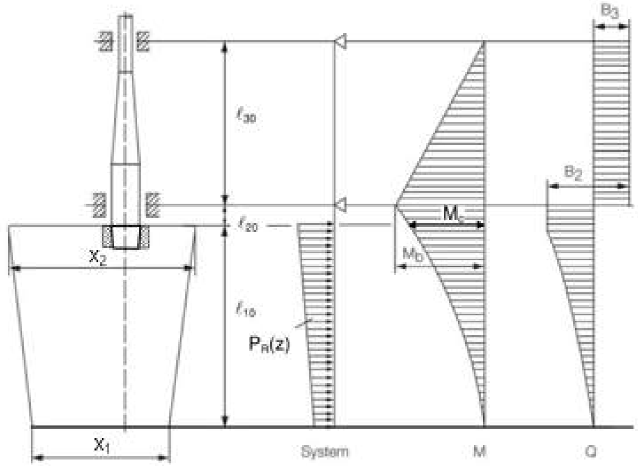

Fig 4.1.2 Type C rudder (Spade rudder)

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Present	Amendment	Note
4. Spade rudder with trunk (1) General data The data on the spade rudder with trunk models is as follows(See **Fig 4.1.3** of the Guidance): $\ell_{10} \sim \ell_{30}$ = Lengths of the individual girders of the system (m) $I_{10} \sim I_{30}$ = Moments of inertia of these girders (cm^4) Load of rudder body $P_R = \frac{F_R}{1000(\ell_{10} + \ell_{20})}$ (kN/m) F_R : as specified in **Pt 4, Ch 1, Sec 2** of the Rules (2) For spade rudders with rudders trunks the moments and forces may be determined by the following formulae: *(2019)* M_R is the greatest of the following values: $M_{FR1} = F_{R1}(CG_{1Z} - \ell_{10})$ (N-m) $M_{FR2} = F_{R2}(\ell_{10} - CG_{2Z})$ (N-m) F_{R1} : Rudder force over the rudder blade area A_1 F_{R2} : Rudder force over the rudder blade area A_2 CG_{1Z}: Vertical position of the centre of gravity of the rudder blade area A_1 from base CG_{2Z}: Vertical position of the centre of gravity of the rudder blade area A_2 from base $F_R = F_{R1} + F_{R2}$ (N) $B_2 = F_R + B_3$ (N) $B_3 = (M_{FR2} - M_{FR1})/(\ell_{20} + \ell_{30})$ (N)	**4. Spade rudder with trunk** (1) General data The data on the spade rudder with trunk models is as follows(See **Fig 4.1.3(a) and Fig 4.1.3(b)** of the Guidance): $\ell_{10} \sim \ell_{30}$ = Lengths of the individual girders of the system (m) $I_{10} \sim I_{30}$ = Moments of inertia of these girders (cm^4) Load of rudder body $P_R = \frac{F_R}{1000(\ell_{10} + \ell_{20})}$ (kN/m) F_R : as specified in **Pt 4, Ch 1, Sec 2** of the Rules (2) For spade rudder with trunk extending inside the rudder, the strength shall be checked against the following two case ; a) pressure applied on the entire rudder area b) pressure applied only on rudder area below the middle of neck bearing. The moments and forces for the two cases defined above may be determined according to **Fig 4.1.3(a) and Fig 4.1.3(b)**, respectively.	IACS UR S10 Rev. 7 Annex S10.3 -clarify the bending forces and moments for spade rudder with trunk extending inside the rudder

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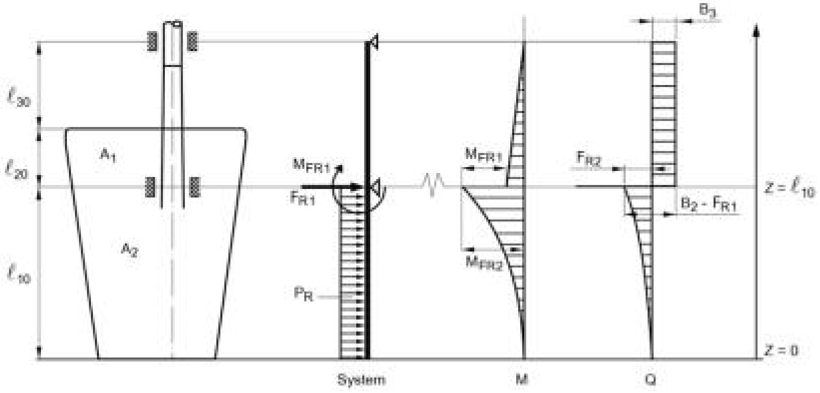

Fig 4.1.3 Spade rudder with trunk *(2019)*

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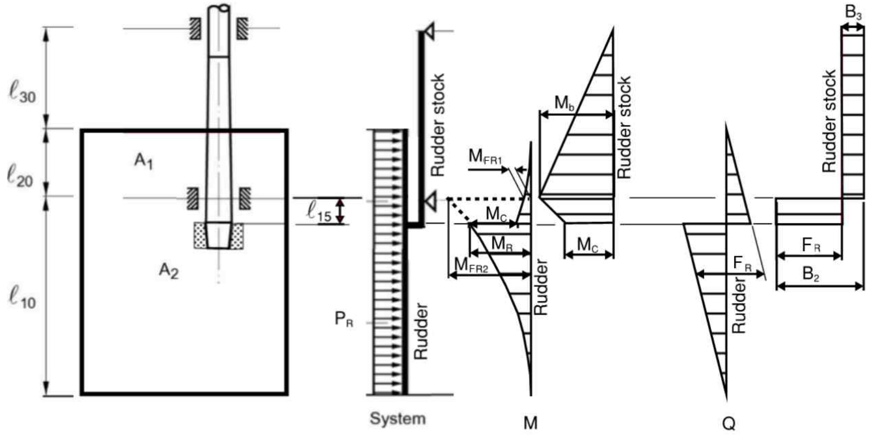

Fig 4.1.3(a)
Full rudder force $F_R = F_{R1} + F_{R2}$ and total rudder torque $T_R = T_{R1} + T_{R2}$ with rudders stock bending moment $M_b = M_{FR2} - M_{FR1}$

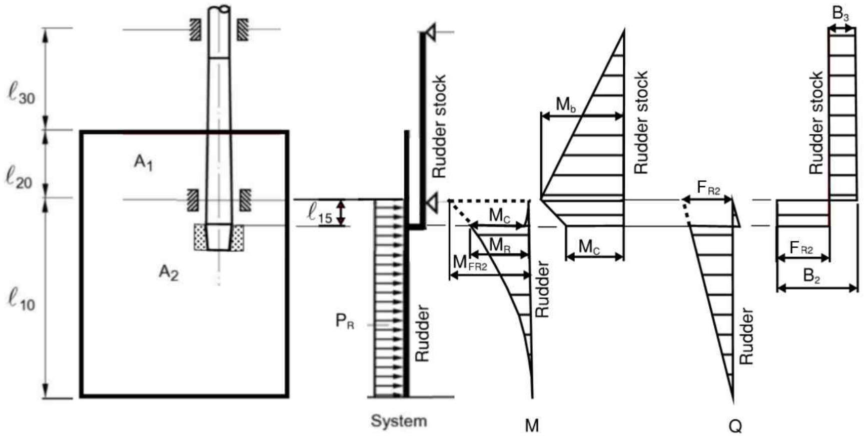

Fig 4.1.3(b)
Rudder force F_{R2} corresponding to rudder torque T_{R2} acting at rudder blade area A_2 with rudders stock bending moment $M_b = M_{FR2}$

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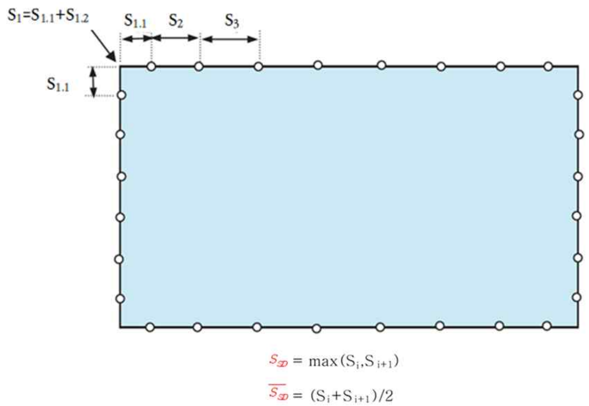
Present	Amendment	Note
⟨omitted⟩	$M_{FR1} = F_{R1}(CG_{1Z} - \ell_{10})$ (N-m) $M_{FR2} = F_{R2}(\ell_{10} - CG_{2Z})$ (N-m) F_{R1} : Rudder force over the rudder blade area A_1 F_{R2} : Rudder force over the rudder blade area A_2 CG_{1Z}: Vertical position of the centre of gravity of the rudder blade area A_1 from base CG_{2Z}: Vertical position of the centre of gravity of the rudder blade area A_2 from base $F_R = F_{R1} + F_{R2}$ (N) $B_2 = F_R + B_3$ (N) $B_3 = (M_{FR2} - M_{FR1})/(\ell_{20} + \ell_{30})$ (N) ⟨same as present⟩	
Section 5 ~ Section 9 ⟨omitted⟩ **Section 10 Rudder Accessories**	**Section 5 ~ Section 9 ⟨same as presnet⟩** **Section 10 Rudder Accessories**	
1001. Rudder carriers 【See Rule】 **1. Materials of rudder carriers and intermediate bearings ⟨omitted⟩** **2. Thrust bearing of rudder carrier ⟨omitted⟩** **3. Watertightness of rudder carrier part**	**1001. Rudder carriers 【See Rule】** **1. Materials of rudder carriers and intermediate bearings ⟨same as present⟩** **2. Thrust bearing of rudder carrier ⟨same as present⟩** **3. Watertightness of rudder carrier part**	
(1) In rudder trunks which are open to the sea, a seal or stuffing box is to be fitted above the deepest load waterline to prevent water from entering the steering gear compartment and the lubricant from being washed away from the rudder carrier. If the top of the rudder trunk is below the deepest waterline two separate stuffing boxes are to be provided. ⟨omitted below⟩	(1) In rudder trunks which are open to the sea, a seal or stuffing box is to be fitted above the deepest load waterline to prevent water from entering the steering gear compartment and the lubricant from being washed away from the rudder carrier. If the top of the rudder trunk is below the waterline at scantling draught (without trim), two separate watertight seals or stuffing boxes are to be provided. ⟨same as present⟩	IACS UR S10 Rev.7 1.2.3 -Improvement of clarity of requirement S10.1.2.3 related to sealing arrangement (seals and stuffing boxes as equivalent, clarification of waterline definition)

Main Amendments

(1) Background of Amendment

- Reflected IACS UR S21 Rev.6
  1) relocate Rule figure 4.2.5 to Guidance figure 4.2.1

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 2 HATCHWAYS AND OTHER DECK OPENINGS **Section 5 Hatch cover details – Closing Arrangement, Securing Devices and Stoppers** 502. General 【See Rule】〈omitted〉	**CHAPTER 2 HATCHWAYS AND OTHER DECK OPENINGS** **Section 5 Hatch cover details – Closing Arrangement, Securing Devices and Stoppers** 502. General 【See Rule】〈same as the present〉 504. Clamping devices 4. Area of securing devices (2) S_{SD}(m) is maximum of the distances, S_i, between two consecutive securing devices, measured along the hatch cover periphery (see Fig. 4.2.1), not to be taken as less than $2.5S_c$(m). $S_c = \max(S_{1.1}, S_{1.2})$ (m)  Fig 4.2.1 Spacing of clamping device	relocation from Rule to Guidance (305.2.(3)→504.4.(2)) -refer to Rec.14 4.2.3

Main Amendments

(1) Background of Amendment

- reflected in accordance with IACS UR A1 Rev. 8
  1) clarify the applicable subject for anchoring equipment
  2) addition of anchoring equipment use
  3) changed anchor requirement for tugboat (to take into account that tugboats operate only near ports or coastal area)

- reflected in accordance with IACS Rec. 10 Rev. 5
  1) addition of alternative calculation methods for determining anchors and chain cable for ships s less than 90m

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 8 EQUIPMENT NUMBER AND EQUIPMENT **Section 1 General** **101. General and application 【See Rule】** **1. Consideration for restricted navigation area** (1) Ships assigned with class notation "Smooth water service" may be provided the equipment in accordance with the equipment letter of equipment number which is one grade lower class of equipment letter. (2) In case of the above (1), the provisions of the used material may not be considered. **2. ~ 3. 〈omitted〉** **4. Design of the anchoring equipment** ***(2018)*** (1) The anchoring equipment required herewith is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc. **Annex 4-3** may be referred to for recommendations concerning anchoring equipment for ships in deep and unsheltered water. *(2019)* (2) The Equipment Number (EN) formulae for anchoring equipment as given in **201.** of the Rules are based on an assumed maximum current speed of 2.5 m/s, maximum wind speed of 25 m/s and a minimum scope of chain cable of 6, the scope being the ratio between length of chain paid out and water depth. For ships with an equipment length greater than 135 m, alternatively the required anchoring equipment can be considered applicable to a maximum current speed of 1.5 m/s, a maximum wind speed of 11 m/s and waves with maximum significant height of 2 m. (3) It is assumed that under normal circumstances a ship will uses only one bow anchor and chain cable at a time.	**CHAPTER 8 EQUIPMENT NUMBER AND EQUIPMENT** **Section 1 General** **101. General and application 【See Rule】** 1. The anchoring equipment required herewith applies to self-propelled vessels over 100GT, except for: (1) inland navigation vessels, (2) military vessels, (3) government ships operated for non-commercial purposes, (4) high speed and light crafts, (5) yachts **2. ~ 3. 〈same as the present〉** **4. Design of the anchoring equipment** (1) The anchoring equipment required herewith is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc. **Annex 4-3** may be referred to for recommendations concerning anchoring equipment for ships in deep and unsheltered water. *(2019)* (2) The Equipment Number (EN) formulae for anchoring equipment as given in **201.** of the Rules are based on an assumed maximum current speed of 2.5 m/s, maximum wind speed of 25 m/s and a minimum scope of chain cable of 6, the scope being the ratio between length of chain paid out and water depth. For ships with an equipment length greater than 135 m, alternatively the required anchoring equipment can be considered applicable to a maximum current speed of 1.5 m/s, a maximum wind speed of 11 m/s and waves with maximum significant height of 2 m. (3) It is assumed that under normal circumstances a ship will uses only one bow anchor and chain cable at a time. (4) In addition to planned anchoring for normal operations, anchoring equipment should be ready to use for ship safety in emergency situations such as loss of manoeuvrability, unscheduled repairs and other unexpected situations.	UR A1 Rev.8 (A1.1.8) -clarify the applicable subject UR A1 Rev.8 (A1.1.7) -addition of anchoring equipment use

Present	Amendment	Note
104. Tests and inspections 【See Rule】〈omitted〉	104. Tests and inspections 【See Rule】〈same as the present〉	
Section 2 Equipment Number	**Section 2 Equipment Number**	
201. Equipment number 【See Rule】	201. Equipment number 【See Rule】	
1. The equipment number of tug boat is to be following formula; *(2022)*	1. Equipment for tugs (1) The equipment number is to be following formula;	editorial change
$E = \Delta^{\frac{2}{3}} + 2.0(aB + \sum h_i b_i) + \frac{A}{10}$	$E = \Delta^{\frac{2}{3}} + 2.0(aB + \sum h_i b_i) + \frac{A}{10}$	
Δ, a, h_i, A = as specified in 201. of the Rules. b_i = widest breath of superstructure or deckhouse of each tier having a breadth greater than B/4 (m).	Δ, a, h_i, A = as specified in 201. of the Rules. b_i = widest breath of superstructure or deckhouse of each tier having a breadth greater than B/4 (m).	
	(2) For tugs under 45 m in length intended for towing service only, one anchor may be used onboard provided that the second anchor and its relevant chain cable holds readily available to be installed. In case of loss of anchor, the tug is to remain in port until replace anchor equipment is installed onboard.	UR A1 Rev.8 (A1.3.1) -amended to take into account that tugboats operate only near ports or coastal area
2. ~ 7. 〈omitted〉	2. ~ 7. 〈same as the present〉	

Present	Amendment	Note
	Annex 4-4 Direct force calculation for anchoring equipment In application of **Ch 8, Sec 2, Table 4.8.1 Notes 4** of the Rules, the details are as follows. **1. Total force F_{EN}** The total force (static + dynamic) F_{EN}, in kN, induced by wind and current acting on monohull in anchoring condition as defined in **Ch 8, Sec 1, 101** of the Rules may be calculated as follows: $F_{EN} = 2(F_{SLPH} + F_{SH} + F_{SS})$ F_{SLPH} : Static force on wetted part of the hull due to current, as specified in (1) F_{SH} : Static force on hull due to wind, as specified in (2) F_{SS} : Static force on superstructures due to wind, as specified in (3) (1) Static force on wetted part of hull $F_{SLPH}(kN)$ $F_{SLPH} = \frac{1}{2}\rho C_f S_m V_c^2 10^{-3}$ ρ : Water density, equal to 1025 kg/m^3 C_f : Coefficient equal to: $C_f = (1+k)\frac{0.075}{(\log R_e - 2)^2}$ With R_e, Reynolds number: $R_e = \frac{(V_c L_{WL})}{1.054 * 10^{-6}}$	IACS Rec.10 Appendix B

Present	Amendment	Note
	k : Coefficient equal to: $$k = 0.017 + 20\frac{C_{bWL}}{L_{WL}^{2} T^{-0.5} B_{WL}^{-1.5}}$$ With C_{bWL}, block coefficient at waterline: $$C_{bWL} = \frac{\Delta}{1.025 L_{WL} B_{WL} T}$$ Δ : Moulded displacement at waterline T, in m^3 S_m : Total wetted surface of the part of the hull under draught, in m^2 The value of Sm is to be given by the Designer. When this value is not available, S_m may be taken equal to $S_m = 6 * \Delta^{2/3}$ V_C : Speed of the current, in m/s, as specified in **Ch 8, Sec 1, 101.4** of the Guidance (2) Static force on hull $F_{SH}(kN)$ $$F_{SH} = \frac{1}{2}\rho(C_{hfr} S_{hfr} + 0.02 S_{hlat}) V_W^2 10^{-3}$$ ρ : Air density, equal to 122 kg/m^3 V_W : Speed of the wind, in m/s, as specified in Ch 8, Sec 1, 101.4 of the Guidance S_{hfr} : Front surface of hull and bulwark if any, in m^2, projected on a vertical plane of the ship situated aft of the aft end of the ship and perpendicular to the longitudinal axis of the ship S_{hlat} : Partial lateral surface of one single side of the hull and bulwark if any, in m^2, through the overall length of the ship, projected on a vertical plane parallel to the longitudinal axis of the ship and delimited according to **Figure 1** $C_{hfr} = 0.8 * \sin\alpha$, with α defined in **Figure 1.** B is the breadth of the hull, in m. The upper part of the hull is the part extending from side to side to the uppermost continuous deck extending over the ship length.	

Present	Amendment	Note

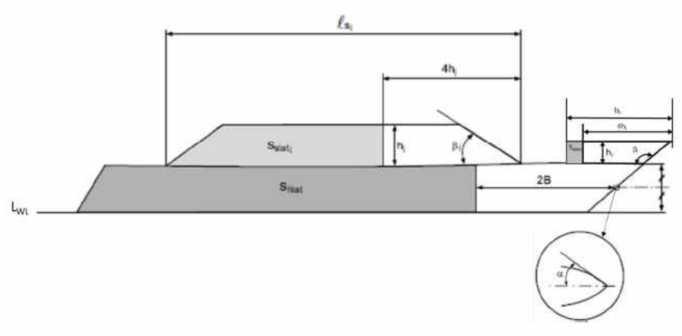


Figure 1.

(3) Static force $F_{SS}(kN)$ on superstructures and deckhouses

(A) The theoretical static force induced by wind applied on the superstructures and deckhouses, in kN, is defined as the sum of the forces applied to each superstructure and deckhouse tier according to the following formula:

$$F_{SS} = \frac{1}{2}\rho\Sigma\left(C_{sfr_i}S_{sfr_i} + 0.08S_{slat_i}\right)V_W^2 10^{-3}$$

ρ, V_W : according to (2)

S_{sfr_i} : Front surface of tier i (superstructure or deckhouse, including bulwark if any), in m^2, projected on a vertical plane of the ship situated aft of the aft end of the ship and perpendicular to the longitudinal axis of the ship

S_{slat_i} : Partial lateral surface of one single side of tier i (superstructure or deckhouse, including bulwark if any), in m^2, projected on a vertical plane parallel to the longitudinal axis of the ship and delimited according to Figure 1

When $4h_i \geq l_{si}$, S_{slat_i} is to be taken equal to 0

$C_{sfr_i} = 0.8*\sin\beta_i$, with β_i defined in Figure 1 without being greater than 90°

Present	Amendment	Note
	(B) When superstructures are located in the front of the hull with front and side walls of superstructures in the continuity of the side shell, the static force induced by wind applied on these superstructures, in kN, is defined as the sum of the forces applied to each superstructure tier according to the following formula: $F_{SS} = \frac{1}{2}\rho\Sigma(C_{hfr_i}S_{hfr_i} + 0.08S_{slat_i})V_W^2 10^{-3}$ ρ, V_W, S_{slat_i} : according to (A) S_{hfr_i} : Front surface of tier i of the superstructure, in m^2, projected on a vertical plane of the ship situated aft of the aft end of the ship and perpendicular to the longitudinal axis of the ship $C_{hfr_i} = 0.8*\sin\alpha_s$, with α_s as defined for α in Figure 1 and measured at mid height of the superstructure tier located in the front of the hull. The static force is to be added to the static force calculated for the other superstructures and deckhouses according to (A). **2. Anchor weight** The individual mass of anchor, in kg, is to be at least equal to: (1) for ordinary anchor: $P = (F_{EN}/7)*10^2$ (2) for high holding power anchor: $P = (F_{EN}/10)*10^2$ (3) for very high holding power: $P = (F_{EN}/15)*10^2$ **3. Chain cable** (1) Stud link chain cable scantling Chain cable diameters are to be selected from **Ch 8, Sec 4, Table 4.8.8** of the Rules, based on the minimum breaking load BL and proof load PL of steel grades, in kN, calculated according to the following formulae: (A) for steel Grade 1: $BL = 6*F_{EN}$ $PL = 0.7*BL$ (B) for steel Grade 2: $BL = 6.8*F_{EN}$ $PL = 0.7*BL$	

Present	Amendment	Note
	(C) for steel Grade 3: $BL = 7.5 * F_{EN}$ $PL = 0.7 * BL$ The chain cable scantling is to be consistent with the mass of the associated anchor. In case the anchor on board is heavier by more than 7% from the mass calculated in **Par. 2**, the value of $F_{EN}(kN)$ to take into account in the present **Par.** for the calculation of BL and PL is to be deduced from the actual mass of the anchor according to the formulae in **Par. 2.** (2) Length of individual chain cable The length of chain cable L_{CC}, in m, linked to each anchor is to be at least equal to: (A) When $P < 180$ $L_{CC} = 30\ln(P) - 42$ (B) When $P \geq 180$ L_{CC} to be selected according to **Ch 8, Sec 1, Table 4.8.1** P : Anchor weight, in kg, defined in **Par. 2.** for an ordinary anchor according to the considered case.	

Main Amendments

(1) Background of Amendment

1) Rudder carrier and bearing materials have been amended to reflect the current state of the industry.

2) The phrases related to jumping stopper spacing have been amended to clarify that these are standard values for reference only.

(2) Effective date : ships contracted for construction on or after 1 July 2024

Present	Amendment	Note
CHAPTER 1 RUDDERS **Section 1 ~ Section 9 〈omitted〉** **Section 10 Rudder Accessories** **1001. Rudder carriers 【See Rule】** **1. Materials of rudder carriers and intermediate bearings** Rudder carriers and intermediate bearings are to be of steel. They are not to be of cast iron. **2. ~ 6. 〈omitted〉**	**CHAPTER 1 RUDDERS** **Section 1 ~ Section 9 〈same as present〉** **Section 10 Rudder Accessories** **1001. Rudder carriers 【See Rule】** **1. Materials of rudder carriers and intermediate bearings** When metallic materials are applied to rudder carrier and inter-mediate bearings, they are not to be of cast iron. **2. ~ 6. 〈omitted〉**	- Rudder carrier and bearing materials have been amended to reflect the current state of the industry.
1002. Jumping stoppers 【See Rule】 The clearance between the jumping stopper and the rudder carrier is to be 2 mm as a standard.	**1002. Jumping stoppers 【See Rule】** The clearance between the jumping stopper and the rudder carrier is considered to be 2 mm as a standard and the recommended val-ues given by manufacturer may be accepted.	- Amended to clarify that it is a standard value, and modified to accept the value given by the manufacturer.