Rules for the Classification of Steel Ships Revision

(Part 4 Hull Equipment)

- Main Amendments -

(1) Enter into force on 1 January 2021 (the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules
- To reflect UR S10 Rev.6

Present

CHAPTER 1 RUDDERS

Section 1 General

101. ~ 102. <omit>

103. Materials

1. Rudders stocks, pintles, coupling bolts, keys and cast parts of rudders are to be made of rolled steel, steel forging or carbon steel casting conforming to the requirements in Pt 2, Ch 1 of the Rules. For rudder stocks, pintles, coupling bolts and keys, the minimum yield stress is not to be less than 200 (N/mm^2). The requirements in this Chapter are based on a material's yield stress of 235 (N/mm^2). If material is used having a yield stress differing from 235 (N/mm^2) the material factor K is to be determined by Table 4.1.1.

2. ~ 3. <omit>

Table 4.1.1 Material factor K (for steel forging and carbon steel casting)

σ_y (N/mm^2)	K
$\sigma_y > 235$	$K = \left(\frac{235}{\sigma_y}\right)^{0.75}$
$\sigma_y \leq 235$	$K = \left(\frac{235}{\sigma_y}\right)^{1.0}$
σ_y = yield stress(N/mm^2) of material used, and is not to be taken greater than $0.7\sigma_T$ or 450(N/mm^2), whichever is smaller value. σ_T = minimum tensile strength of material used (N/mm^2).	

104. ~ 105. <omit>

Amendment

CHAPTER 1 RUDDERS

Section 1 General

101. ~ 102. <same as the present Rules>

103. Materials

1. Rudders stocks, pintles, coupling bolts, keys and cast parts of rudders are to be made of rolled steel, steel forging or carbon steel casting conforming to the requirements in Pt 2, Ch 1 of the Rules. For rudder stocks, pintles, coupling bolts and keys, the specified minimum yield stress is not to be less than 200 (N/mm^2). The requirements in this Chapter are based on a material's specified minimum yield stress of 235 (N/mm^2). If material is used having a specified minimum yield stress differing from 235 (N/mm^2) the material factor K is to be determined by Table 4.1.1.

2. ~ 3. <same as the present Rules>

Table 4.1.1 Material factor K (for steel forging and carbon steel casting)

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σ_y = yield stress(N/mm^2) of material used, and is not to be taken greater than $0.7\sigma_T$ or 450(N/mm^2), whichever is smaller value. σ_T = specified minimum tensile strength of material used (N/mm^2).	

104. ~ 105. <same as the present Rules>

Present

106. Welding

1. ~ 3. <omit>

4. In way of the rudder horn recess of Type A, Type D and Type E rudders the radii in the rudder plating are not to be less than 5 times the plate thickness, but in no case less than 100 mm. Welding in side plate are to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.

5. <omit>

107. Equivalence <omit>

Amendment

106. Welding

1. ~ 3. <same as the present Rules>

4. In way of the rudder horn recess of Type A, Type D and Type E rudders the radii in the rudder plating except in way of solid part in cast steel are not to be less than 5 times the plate thickness, but in no case less than 100 mm. Welding in side plate are to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.

5. <same as the present Rules>

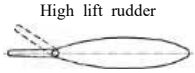
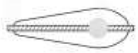
107. Equivalence <same as the present Rules>

Present

Section 2 Rudder Force

201. Rudder force

Table 4.1.3 Factor K_2

Profile type	K_2	
	Ahead condition	Astern condition
NACA-00 Göttingen profiles 	1.1	0.80
Hollow profiles 	1.35	0.90
Flat side profiles 	1.1	0.90
High lift rudder 	1.70	to be specially considered; if not known: 1.30
Fish tail 	1.40	0.80
Single plate 	1.00	1.00
Mixed profiles(e.g. HSVA)	1.21	0.90

Amendment

Section 2 Rudder Force

201. Rudder force

Table 4.1.3 Factor K_2

Profile type	K_2	
	Ahead condition	Astern condition
NACA-00 Göttingen profiles 	1.1	0.80
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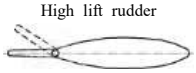
High lift rudder 	1.70	1.30
Fish tail 	1.40	0.80
Single plate 	1.00	1.00
Mixed profiles(e.g. HSVA)	1.21	0.90

Present

Section 3 Rudder Torque

301. <omit>

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

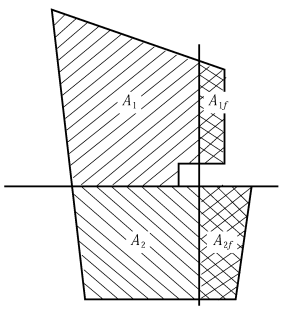


Fig 4.1.3 Division of rudder area

Amendment

Section 3 Rudder Torque

301. <same as the present Rules>

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

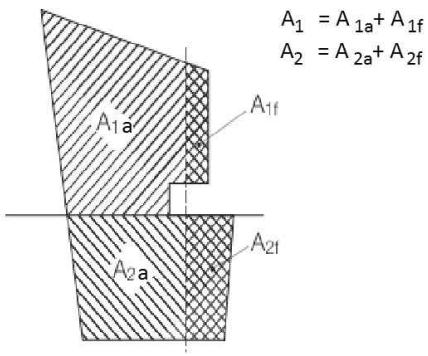


Fig 4.1.3 Division of rudder area

Present	Amendment
Section 6 Rudder Plates, Rudder Frames and Rudder Main Pieces	**Section 6 Rudder Plates, Rudder Frames and Rudder Main Pieces**
601. ~ 604. <omit>	**601. ~ 604. <same as the present Rules>**
605. Connections	**605. Connections**

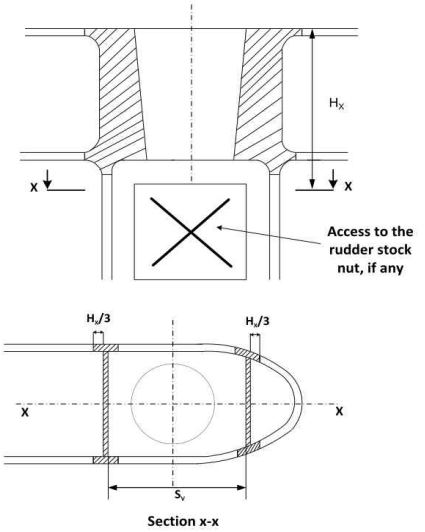
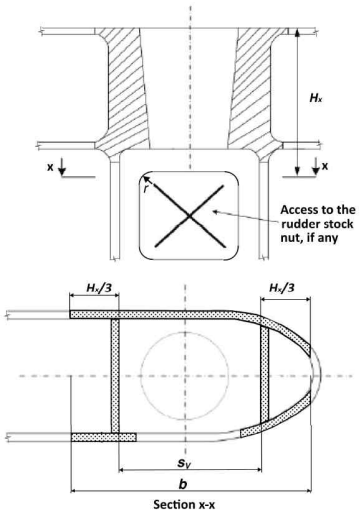

	

Fig 4.1.4 Connection between rudder structure and rudder stock gudgeon	**Fig 4.1.4 Connection between rudder structure and rudder stock gudgeon**

Present	Amendment
Section 7 Couplings between Rudder Stocks and Main Pieces	**Section 7 Couplings between Rudder Stocks and Main Pieces**
701. ~ 702. <same as the present Rules>	**701. ~ 702. <same as the present Rules>**
703. Cone couplings	**703. Cone couplings**
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. 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)	(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)
$c = \frac{d_0 - d_u}{l}$	$c = \frac{d_0 - d_u}{l_c}$
d_0 = actual diameter (mm) of rudder stock (*See* Fig 4.1.6)	d_0 = actual diameter (mm) of rudder stock (*See* Fig 4.1.6)
d_u = according to Fig 4.1.6	d_u = according to Fig 4.1.6
l = length of coupling (mm)	l_c = length of cone (mm)
(2) The cone shapes are to fit exactly. The coupling length l is to be, in generally, not to be less than 1.5 *times* the rudder stock diameter d_0 at the top of the rudder.	(2) The cone shapes are to fit exactly. The coupling length l is to be, in generally, not to be less than 1.5 *times* the rudder stock diameter d_0 at the top of the rudder.
(3) For the couplings between stock and rudder, a key is to be provided. And the scantling of the key is to be accordance with as follows. (A) The shear area of a key in not to be less than :	(3) For the couplings between stock and rudder, a key is to be provided. And the scantling of the key is to be accordance with as follows. (A) The shear area of a key in not to be less than :
$A_k = \frac{17.55 M_F}{d_k \sigma_{k1}}$ (cm^2)	$A_k = \frac{17.55 M_F}{d_k R_{eH}}$ (cm^2)
M_F = design torsional moment of rudder stock (Nm)	M_F = design torsional moment of rudder stock (Nm)

Present	Amendment
$M_F = 0.02664 \frac{d_u^3}{K_s}$ d_u = diameter of upper rudder stock as defined in **501**. Where the actual diameter d_0 is greater than the calculated diameter d_u is to be used. However the value need not be taken greater than $1.145 d_u$. K_s = material factor for the rudder stock as given in **103.** d_k = mean diameter (mm) of the conical part of the rudder stock at the key σ_{k1} = minimum yield stress of the key material (N/mm^2)	$M_F = 0.02664 \frac{d_u^3}{K_s}$ d_u = diameter of upper rudder stock as defined in **501**. Where the actual diameter d_0 is greater than the calculated diameter d_u is to be used. However the value need not be taken greater than $1.145 d_u$. K_s = material factor for the rudder stock as given in **103.** d_k = mean diameter (mm) of the conical part of the rudder stock at the key R_{eH} = specified minimum yield stress of the key material (N/mm^2)

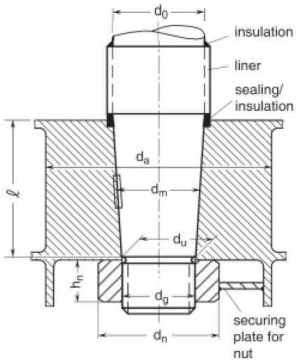
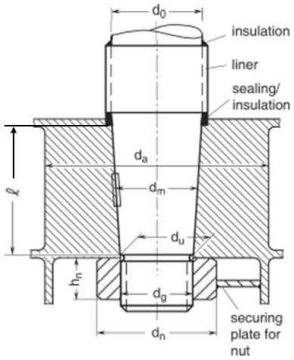
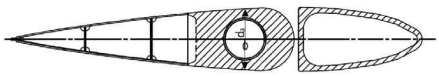
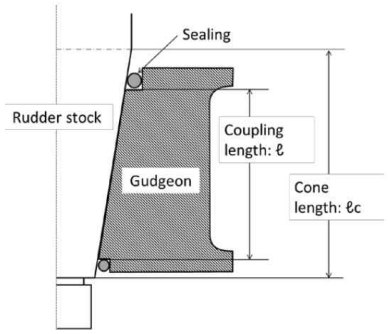
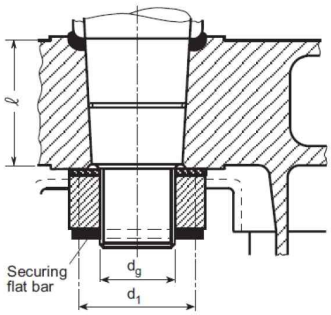
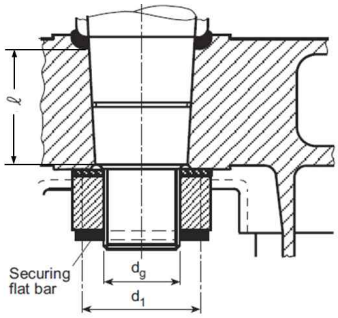

	

Fig 4.1.6 Cone coupling with key	Fig 4.1.6 Cone coupling with key

Present	Amendment
	
	Fig 4.1.6a Gudgeon outer diameter(da) measurement
	
	Fig 4.1.6b Cone length and coupling length

Present	Amendment
 Fig 4.1.7 Cone coupling without key	 Fig 4.1.7 Cone coupling without key
(4) ~ (8) <same as the present Rules>	(4) ~ (8) <same as the present Rules>
2. Cone couplings with hydraulic arrangements (oil injection and hydraulic nut, etc.) for mounting and dismounting the coupling are to comply with the following requirements. (1) Where the stock diameter exceeds 200 mm, the press fit is recommended to be effected by a hydraulic pressure connection. In such cases the cone is to be more slender, c 1 : 12 ~ 1 : 20. (2) The nuts fixing the rudder stocks are to be provided with efficient locking devices. However, a securing plate for securing nut against the rudder body is not to be provided. (3) Couplings of rudder stocks are to be properly protected from corrosion. (4) The dimensions of the securing nuts are to be as specified Par 1 (4). (5) For the safe transmission of the torsional moment by the coupling between rudder stock and rudder body the push-up force and the push-up length are to be determined according to (6) ~ (8). (6) The push-up pressure is not to be less than the greater of the two following values:	2. Cone couplings with hydraulic arrangements (oil injection and hydraulic nut, etc.) for mounting and dismounting the coupling are to comply with the following requirements. (1) Where the stock diameter exceeds 200 mm, the press fit is recommended to be effected by a hydraulic pressure connection. In such cases the cone is to be more slender, c 1 : 12 ~ 1 : 20. (2) The nuts fixing the rudder stocks are to be provided with efficient locking devices. However, a securing plate for securing nut against the rudder body is not to be provided. (3) Couplings of rudder stocks are to be properly protected from corrosion. (4) The dimensions of the securing nuts are to be as specified Par 1 (4). (5) For the safe transmission of the torsional moment by the coupling between rudder stock and rudder body the push-up force and the push-up length are to be determined according to (6) ~ (8). (6) The push-up pressure is not to be less than the greater of the two following values:

Present	Amendment
$P = \frac{2M_F}{d_m^2 \ell \pi \mu_0} 10^3 \quad (N/mm^2)$ or $P = \frac{6M_b}{\ell^2 d_m} 10^3 \quad (N/mm^2)$ 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 = ~~cone~~ 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) 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: $P_{perm} = \frac{0.95 R_{eH}(1-\alpha^2)}{\sqrt{3+\alpha^4}} - P_b \quad (N/mm^2)$ $P_b = \frac{3.5 M_b}{d_m l^2} 10^3$ R_{eH} = minimum yield stress of the material of the gudgeon (N/mm²) α = d_m/d_a d_a = outer diameter of the gudgeon (*See* 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 4.1.6. (7) ~ (8) <same as the present Rules>	$P = \frac{2M_F}{d_m^2 \ell \pi \mu_0} 10^3 \quad (N/mm^2)$ or $P = \frac{6M_b}{\ell^2 d_m} 10^3 \quad (N/mm^2)$ 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) 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: $P_{perm} = \frac{0.95 R_{eH}(1-\alpha^2)}{\sqrt{3+\alpha^4}} - P_b \quad (N/mm^2)$ $P_b = \frac{3.5 M_b}{d_m l^2} 10^3$ R_{eH} = specified minimum yield stress of the material of the gudgeon (N/mm²) α = d_m/d_a d_a = outer diameter of the gudgeon (*See* 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 4.1.6. (7) ~ (8) <same as the present Rules>

Present

Section 9 Bearings of Rudder Stocks and Pintles

901. Minimum bearing surface [See Guidance]

Table 4.1.9 Allowable surface pressure q_a

Bearing material	q_a (N/mm^2)
Lignum vitae	2.5
White metal (oil-lubricated)	4.5
Synthetic materials with hardness ~~between 60 and 70~~, Shore D [(1)(2)]	5.5
Steel [(3)], bronze and hotpressed bronze-graphite materials	7.0

NOTES :

(1) Indentation hardness test at the temperature of 23°C and humidity of 50 %, according to a recognized standard. Synthetic bearings are to be of approved type.

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

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

Amendment

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901. Minimum bearing surface [See Guidance]

Table 4.1.9 Allowable surface pressure q_a

Bearing material	q_a (N/mm^2)
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White metal (oil-lubricated)	4.5
Synthetic materials with hardness greater than 60 Shore D [(1)(2)]	5.5
Steel [(3)], bronze and hotpressed bronze-graphite materials	7.0

NOTES :

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