RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part CS Hull Construction and Equipment of Small Ships

Rules for the Survey and Construction of Steel Ships
Part CS 2019 AMENDMENT NO.1

Rule No.39 14 June 2019
Resolved by Technical Committee on 30 January 2019

ClassNK
NIPPON KAIJI KYOKAI

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

Rule No.39 14 June 2019
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

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

Part CS HULL CONSTRUCTION AND EQUIPMENT OF SMALL SHIPS

Chapter 2 STEMS AND STERN FRAMES

2.2 Stern Frames

2.2.7 Rudder trunk

Sub-paragraph -1 has been amended as follows.

1 Materials, welding and connection to hull

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

The steel used for the rudder trunk is to be of weldable quality, with a carbon content not exceeding 0.23% on ladle analysis ~~and~~ <u>or</u> a carbon equivalent C_{EQ} not exceeding 0.41%.

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

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

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

$r = 0.1 d_l$, without being less than 30, when $\sigma < 40 / K_s$ (N/mm^2)

Where

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

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

K_s: material factor as given in **3.1.2**.

The radius may be obtained by grinding. If disk grinding is carried out, score marks are to be avoided in the direction of the weld. The radius is to be checked with a template for accuracy. Four profiles at least are to be checked. A report is to be submitted to the Surveyor.

Rudder trunks comprising of materials other than steel are to be specially considered by the Society.

Chapter 3 RUDDERS

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

3.6.3 Rudder Main Pieces

Sub-paragraph -3 has been amended as follows.

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

(1) In general, except in way of rudder recess sections where **(2)** applies

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

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

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

Where:

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

(2) In way of the recess for the rudder horn pintle on Type *A* rudder

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

Bending stress: $\sigma_b = 75$ (N/mm^2)

Shear stress: $\tau = 50$ (N/mm^2)

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

Note: The stresses in **(2)** apply equally to high tensile and ordinary steels.

3.7 Connections of Rudder Blade Structure with Solid Parts

Paragraph 3.7.1 has been amended as follows.

3.7.1 Solid Part Protrusions

Solid parts in forged or cast steel, which house the rudder stock or the pintle, are ~~normally~~ to be provided with protrusions, except where not required as indicated below.

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

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

3.9 Couplings between Rudder Stocks and Main Pieces

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

Sub-paragraphs -2 and -3 have been amended as follows.

2 Push-up pressure

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

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

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

Where:

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

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

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 spade rudders) (*N-m*)

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

$$\cancel{p_{perm} = \frac{0.8\sigma_Y(1-\alpha^2)}{\sqrt{3+\alpha^4}}} \quad \underline{p_{perm} = \frac{0.95\sigma_Y(1-\alpha^2)}{\sqrt{3+\alpha^4}} - p_b}$$

$$\underline{p_b = \frac{3.5M_b}{d_m\ell^2}10^3}$$

Where:

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

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

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

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

<u>The outer diameter of the gudgeon is not to be less than 1.25 d_0, with d_0 defined in **Fig. CS3.7**.</u>

3 Push-up length

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

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

Where:

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

$$\cancel{\Delta\ell_2 = \frac{1.6\sigma_Y d_m}{\sqrt{3+\alpha^4}Ec} + \frac{0.8R_{tm}}{c}} \quad \underline{\Delta\ell_2 = \frac{p_{perm} d_m}{E\left(\frac{1-\alpha^2}{2}\right)c} + \frac{0.8R_{tm}}{c}}$$

R_{tm} : Mean roughness (*mm*) taken equal to about 0.01 *mm*
c : Taper on diameter according to ~~**3.9.4-1**~~**3.9.3-1**
E : Young's modulus (N/mm^2), to be taken as 2.06×10^5

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

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

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

The value 0.02 is a reference for the friction coefficient using oil pressure. It varies and depends on the mechanical treatment and roughness of the details to be fixed.
Where due to the fitting procedure a partial push-up effect caused by the rudder weight is given, this may be taken into account when fixing the required push-up length, subject to approval by the Society.

3.10 Pintles

3.10.2 Construction of Pintles

Sub-paragraph -2 has been amended as follows.

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

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

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

Where:
B : As defined in **3.10.1**
d_m, ℓ : As defined in **3.9.4-2**
d_0 : Pintle diameter (*mm*) (*See* **Fig. CS3.7**)

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

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 July 2019.

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

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

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

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

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

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

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

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

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

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

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

Note:
This Procedural Requirement applies from 1 July 2009.