RULES
FOR THE CLASSIFICATION OF
SHIPS

Part 29 – POLAR CLASS SHIPS AND ICE CLASS SHIPS
January 2019

Amendments No. 1
January 2021

CROATIAN REGISTER OF SHIPPING

Hrvatska (Croatia) • 21000 Split • Marasovića 67 • P.O.B. 187
Tel.: (...) 385 (0)21 40 81 11
Fax.: (...) 385 (0)21 35 81 59
E-mail: tech.coord@crs.hr
web site: www.crs.hr

By the decision of the General Committee of Croatian Register of Shipping,

Amendments No. 1 to the

RULES FOR THE CLASSIFICATION OF SHIPS

Part 29 – POLAR CLASS SHIPS AND ICE CLASS SHIPS

have been adopted on 22nd December 2020 and shall enter into force on 1st January 2021

INTRODUCTORY NOTES

These amendments shall be read together with the requirements in the Rules for the Classification of Ships, Part 29 – Polar Class Ships and Ice Class Ships, edition January 2019.

Table 1 contains review of amendments, where items changed or added in relating to previous edition are given, with short description of each modification or addition. All major changes throughout the text are shaded.

This Part of the Rules includes the requirements of the following international Organisations:

International Maritime Organization (IMO)

Conventions: International Convention for the Safety of Life at Sea 1974 (SOLAS 1974), Ch. XIV, as adopted by resolution MSC.386(94)

Codes: International Code for Ships Operating in Polar Waters (Polar Code), as adopted by resolutions MSC.385(94) and MEPC.264(68)

Circulars: MSC/Circ.504, MSC.1/Circ.1519

International Association of Classification Societies (IACS)

Unified Requirements (UR):
I1 (Rev.2, 2016), I2 (Rev.4, 2019), I3 (Rev.1, Corr.1, 2007), S6 (Rev.9, 2018)

Other requirements:
Finnish-Swedish Ice Class Rules, 2017
Guidelines for the Application of the Finnish - Swedish Ice Class Rules, 14 November 2017

TABLE 1 – REVIEW OF AMENDMENTS

This review comprises amendments in relation to the Rules for the Classification of Ships, Part 29 – Polar Class Ships and Ice Class Ships, edition January 2019.

ITEM	*DESCRIPTION OF THE AMENDMENTS*
SECTION 1 – GENERAL	
item 1.2.27	is added
item 1.2.28	is added
SECTION 2 – MATERIALS AND WELDING	
Table 2.1.1	is amended
Table 2.1.4	is amended
SECTION 3 – SHIP STRUCTURE AND HULL EQUIPMENT	
Figure 3.2.1.1	is amended
item 3.2.1.4	is amended
item 3.2.1.7	is amended
item 3.3.2.1.3	is amended
item 3.3.2.1.4	is amended
item 3.3.2.2.1	is amended
item 3.9.2.1	is amended
Figure 3.9.2.1-1	is replaced
Figure 3.9.2.1-2	title of the figure is renamed and the figure is replaced
item 3.9.3.1	is amended
item 3.9.4.1	is amended
item 3.9.4.2	is amended

1 GENERAL

■ **Head 1.2 DEFINITIONS,** item 1.2.27 is added and should be read as follows:

1.2.27 **The length L_{UI}** is the distance, in [m], measured horizontally from the fore side of the stem at the intersection with the upper ice waterline (UIWL) to the after side of the rudder post, or the centre of the rudder stock if there is no rudder post. L_{UI} is not to be less than 96%, and need not be greater than 97%, of the extreme length of the upper ice waterline (UIWL) measured horizontally from the fore side of the stem. In ships with unusual stern and bow arrangement the length L_{UI} will be specially considered.

■ **Head 1.2 DEFINITIONS,** item 1.2.28 is added and should be read as follows:

1.2.28 **The ship displacement D_{UI}** is the displacement, in [kt], of the ship corresponding to the upper ice waterline (UIWL). Where multiple waterlines are used for determining the UIWL, the displacement is to be determined from the waterline corresponding to the greatest displacement.

2 MATERIALS AND WELDING

■ **Head 2.1 MATERIALS,** Table 2.1.1 Material classes for structural members has ben changed and should be read as follows:

Table 2.1.1 - Material classes for structural members

Structural members	Material class
Shell plating within the bow and bow intermediate icebelt hull areas (B, BIi)	II
All weather and sea exposed SECONDARY and PRIMARY, as defined in Table 1.4.2.3 of the *Rules of the classification of ships, Part 2 – Hull*, structural members outside 0.4 L_{UI} amidships	I
Plating materials for stem and stern frames, rudder horn, rudder, propeller nozzle, shaft brackets, ice skeg, ice knife and other appendages subject to ice impact loads	II
All inboard framing members attached to the weather and sea-exposed plating, including any contiguous inboard member within 600 mm of the plating	I
Weather-exposed plating and attached framing in cargo holds of ships which by nature of their trade have their cargo hold hatches open during cold weather operations	I
All weather and sea exposed SPECIAL, as defined in Table 1.4.2.3 of the *Rules of the classification of ships, Part 2 – Hull*, structural members within 0.2 L_{UI} from FP	II

■ **Head 2.1 MATERIALS,** Table 2.1.4 Steel grades for weather exposed plating has ben changed and should be read as follows:

Table 2.1.4 - Steel grades for weather exposed plating [1)]

Thickness, t [mm]	Material class I				Material class II				Material class III					
	PC1-5		PC6&7		PC1-5		PC6&7		PC1-3		PC4&5		PC6&7	
	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
t ≤ 10	B	AH	B	AH	B	AH	B	AH	E	EH	E	EH	B	AH
10 < t ≤ 15	B	AH	B	AH	D	DH	B	AH	E	EH	E	EH	D	DH
15 < t ≤ 20	D	DH	B	AH	D	DH	B	AH	E	EH	E	EH	D	DH
20 < t ≤ 25	D	DH	B	AH	D	DH	B	AH	E	EH	E	EH	D	DH
25 < t ≤ 30	D	DH	B	AH	E	EH [2)]	D	DH	E	EH	E	EH	E	EH
30 < t ≤ 35	D	DH	B	AH	E	EH	D	DH	E	EH	E	EH	E	EH
35 < t ≤ 40	D	DH	D	DH	E	EH	D	DH	Ø	FH	E	EH	E	EH
40 < t ≤ 45	E	EH	D	DH	E	EH	D	DH	Ø	FH	E	EH	E	EH
45 < t ≤ 50	E	EH	D	DH	E	EH	D	DH	Ø	FH	Ø	FH	E	EH
Ø Not applicable														

Notes to Table 2.1.4:

[1)] Includes weather-exposed plating of hull structures and appendages, as well as their outboard framing members, situated above a level of 0,3 m below the lowest ice waterline.

[2)] Grades D, DH are allowed for a single strake of side shell plating not more than 1,8 m wide from 0,3 m below the lowest ice waterline.

3 SHIP STRUCTURE AND HULL EQUIPMENT

■ **Head 3.2 HULL AREAS,** Figure 3.2.1.1 Hull area extents has been replaced:

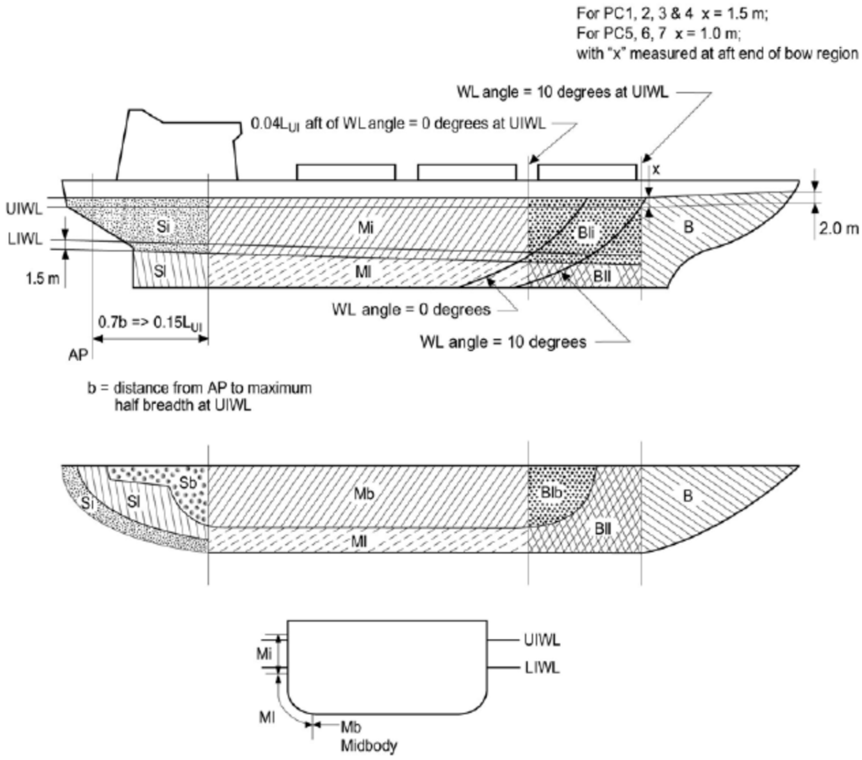

Figure 3.2.1.1 Hull area extents

■ **Head 3.2 HULL AREAS,** item 3.2.1.4 is partly changed and should be read as follows:

3.2.1.4 Fig. 3.2.1.1 notwithstanding, the aft boundary of the Bow region need not be more than 0.45 L_{UI} aft of the fore side of the stem at the intersection with the upper ice waterline (UIWL).

■ **Head 3.2 HULL AREAS,** item 3.2.1.7 is partly changed and should be read as follows:

3.2.1.7 Figure 3.2.1.1 notwithstanding, if the ship is as-signed the additional notation "Icebreaker", the forward boundary of the stern region is to be at least 0.04 L_{UI} forward of the section where the parallel ship side at the upper ice waterline (UIWL) ends.

■ **Head 3.3 DESIGN ICE LOADS,** item 3.3.2.1.3 is partly changed and should be read as follows:

3.3.2.1.3 The Bow area load characteristics for bow forms defined in 3.3.1.5 are determined as follows:

(a) Shape coefficient, fa_i, is to be taken as

fa_i = minimum ($fa_{i,1}$; $fa_{i,2}$; $fa_{i,3}$)

where:

$fa_{i,1} = (0.097 - 0.68\,(x / L_{UI} - 0.15)^2) \cdot \alpha_i / (\beta'_i)^{0.5}$

$fa_{i,2} = 1.2 \cdot CF_F / (\sin(\beta'_i) \cdot CF_C \cdot D_{UI}^{0.64})$

$fa_{i,3} = 0.60$

(b) Force, F_i:

$F_i = fa_i \cdot CF_C \cdot D_{UI}^{0.64}$, [MN]

(c) Load patch aspect ratio, AR_i:

$AR_i = 7.46 \cdot \sin(\beta'_i) \geq 1.3$

(d) Line load, Q_i:

$Q_i = F_i^{0.61} \cdot CF_D / AR_i^{0.35}$, [MN/m]

(e) Pressure, P_i:

$P_i = F_i^{0.22} \cdot CF_D^2 \cdot AR_i^{0.3}$, [MPa]

where:

i = sub-region considered

L_{UI} = length as defined in 1.2.7 [m]

x = distance from the fore side of the stem at the intersection with the upper ice waterline (UIWL) to station under consideration, [m]

α = waterline angle, [°], see Fig. 3.3.2.1.1

β' = normal frame angle, [°], see Fig. 3.3.2.1.1

D_{UI} = displacement as defined in 1.2.8, not to be taken less than 5 [kt]

CF_C = crushing failure class factor from Table 3.3.2-1

CF_F = flexural failure class factor from Table 3.3.2-1

CF_D = load patch dimensions class factor from Table 3.3.2-1

■ **Head 3.3 DESIGN ICE LOADS,** item 3.3.2.1.4 is partly changed and should be read as follows:

3.3.2.1.4 The Bow area load characteristics for bow forms defined in 3.3.1.6 are determined as follows:

(a) Shape coefficient, fa_i, is to be taken as:

$fa_i = \alpha_i / 30$

(b) Force, F:

$F_i = fa_i \cdot CF_{CV} \cdot D_{UI}^{0.47}$, [MN]

(c) Line load, Q:

$Q_i = F_i^{0.22} \cdot CF_{QV}$, [MN/m]

(d) Pressure, P:

$P_i = F^{0.56} \cdot CF_{PV}$, [MPa]

where:

i = sub-region considered

α = waterline angle [°], see Fig. 3.3.2.1.1;

D_{UI} = displacement as defined in 1.2.8, not to be taken less than 5 [kt];

CF_{CV} = crushing failure class factor from Table 3.3.2-2;

CF_{QV} = line load class factor from Table 3.3.2-2;

CF_{PV} = pressure class factor from Table 3.3.2-2.

■ **Head 3.3 DESIGN ICE LOADS,** item 3.3.2.2.1 is partly changed and should be read as follows:

3.3.2.2.1 In the hull areas other than the bow, the force (F_{NonBow}) and line load (Q_{NonBow}) used in the determination of the load patch dimensions (b_{NonBow}, w_{NonBow}) and design pressure (P_{avg}) are determined as follows:

(a) Force, F_{NonBow}:

$F_{NonBow} = 0.36 \cdot CF_C \cdot DF$, [MN]

(b) Line Load, Q_{NonBow}:

$Q_{NonBow} = 0.639 \cdot F_{NonBow}^{0.61} \cdot CF_D$, [MN/m]

where:

CF_C = crushing force class factor from Table 3.3.2-1

DF = ship displacement factor

$= D_{UI}^{0.64}$, if $D_{UI} \leq CF_{DIS}$

$= CF_{DIS}^{0.64} + 0.10 \cdot (D_{UI} - CF_{DIS})$, if $D_{UI} > CF_{DIS}$

D_{UI} = displacement as defined in 1.2.8, not to be taken less than 10 [kt]
CF_{DIS}= displacement class factor from Table 3.3.2-1
CF_D = load patch dimensions class factor from Table 3.3.2-1

■ **Head 3.9 LONGITUDINAL STRENGTH,** item 3.9.2.1 is partly changed and should be read as follows:

3.9.2.1 The design vertical ice force at the bow,
F_{IB}, is to be taken as
F_{IB} = minimum ($F_{IB,1}$; $F_{IB,2}$) , [MN]
where:
$F_{IB,1} = 0.534 \cdot K_I^{0.15} \cdot \sin^{0.2}(\gamma_{stem}) \cdot (D_{UI} \cdot K_h)^{0.5} \cdot CF_L$, [MN]
$F_{IB,2} = 1.20 \cdot CF_F$, [MN],
K_I = indentation parameter = K_f / K_h,
a) for the case of a blunt bow form
$K_f = (2 \cdot C \cdot B_{UI}{}^{1-eb} / (1 + e_b))^{0.9} \cdot \tan(\gamma_{stem})^{-0.9 \cdot (1 + eb)}$
b) for the case of wedge bow form ($\alpha_{stem} < 80°$)
e_b = 1 and the above simplifies to
K_f = $(\tan \alpha_{stem}) / \tan^2(\gamma_{stem}))^{0.9}$
K_h = $0.01 \cdot A_{wp}$, [MN/m],
CF_L = longitudinal strength class factor from Table 3.1.2.1
e_b = bow shape exponent which best describes the waterplane (see Fig. 3.9.2.1-1 and 3.9.2.1-2)
= 1.0 for a simple wedge bow form
= 0.4 to 0.6 for a spoon bow form
= 0 for a landing craft bow form
An approximate e_b determined by a simple fit is acceptable.
γ_{stem} = stem angle to be measured between the horizontal axis and the stem tangent at the upper ice waterline, [°], (buttock angle as per Fig. 3.3.2.1.1 measured on the centreline)
α_{stem} = waterline angle measured in way of the stem at the upper ice waterline (UIWL), [°], (see Fig. 3.9.2.1-1)
C = $1 / (2 \cdot (L_B / B_{ui})^{eb})$
B_{UI} = moulded breadth corresponding to the upper ice waterline (UIWL), [m]
L_B = bow length used in the equation
$y = B_{UI} / 2 \cdot (x/L_B)^{eb}$, [m], (see Fig. 3.9.2.1-1 and 3.9.2.1-2)
D_{UI} = displacement as defined in 1.2.8 not to be taken less than 10 [kt]
A_{wp} = waterplane area corresponding to the upper ice waterline (UIWL), [m²]
CF_F = flexural failure class factor from Table 3.1.2.1

■ **Head 3.9 LONGITUDINAL STRENGTH,** Figure 3.9.2.1-1 is changed:

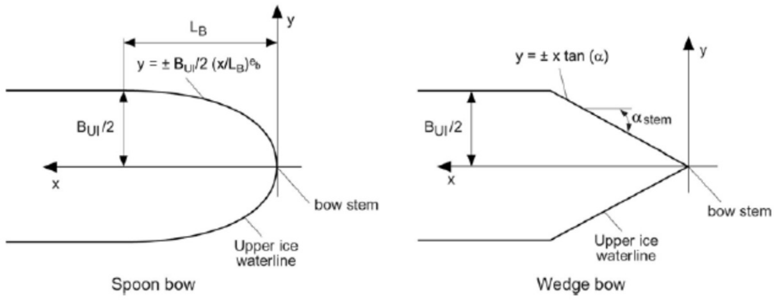

Figure 3.9.2.1-1 Bow shape definition

■ **Head 3.9 LONGITUDINAL STRENGTH,** title of the Figure 3.9.2.1-2 is renamed as be read as follows:

Figure 3.9.2.1-2 Illustration of eb effect on the bow shape B_{UI} = 20 and Lb = 16

■ **Head 3.9 LONGITUDINAL STRENGTH,** Figure 3.9.2.1-2 has been changed:

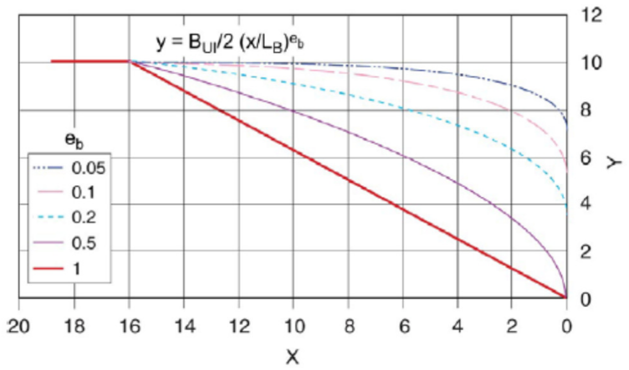

Figure 3.9.2.1-2 Illustration of eb effect on the bow shape B_{UI} = 20 and Lb = 16

■ **Head 3.9 LONGITUDINAL STRENGTH,** item 3.9.3.1 is partly changed and should be read as follows:

3.9.3.1 The design vertical ice shear force, F_I, along the hull girder is to be taken as:

$F_I = C_f \cdot F_{IB}$, [MN]

where:

C_f = longitudinal distribution factor to be taken as follows:

(a) Positive shear force

C_f = 0.0 between the aft end of L_{UI} and 0.6 L_{UI} from aft

C_f = 1.0 between 0.9 L_{UI} from aft and the forward end of L_{UI}

(b) Negative shear force

C_f = 0.0 at the aft end of L_{UI}

C_f = 0.5 between 0.2 L_{UI} and 0.6 L_{UI} from aft

C_f = 0.0 between 0.8 L_{UI} from aft and the forward end of L_{UI}

Intermediate values are to be determined by linear interpolation.

■ **Head 3.9 LONGITUDINAL STRENGTH,** item 3.9.4.1 is partly changed and should be read as follows:

3.9.4.1 The design vertical ice bending moment, M_I, along the hull girder is to be taken as:

$M_I = 0.1 \cdot C_m \cdot L_{UI} \cdot \sin^{-0.2}(\gamma_{stem}) \cdot F_{IB}$, [MNm]

where:

L_{UI} = length as defined in 1.2.7, [m]

γ_{stem} = as given in 3.9.2.1

F_{IB} = design vertical ice force at the bow, [MN]

C_m = longitudinal distribution factor for design vertical ice bending moment to be taken as follows:

C_m = 0.0 at the aft end of L_{UI}

C_m = 1.0 between 0.5 L_{UI} and 0.7 L_{UI} from aft

C_m = 0.3 at 0.95 L_{UI} from aft

C_m = 0.0 at the forward end of L_{UI}

Intermediate values are to be determined by linear interpolation.

■ **Head 3.9 LONGITUDINAL STRENGTH,** item 3.9.4.2 is partly changed and should be read as follows:

3.9.4.2 The applied vertical bending stress, σ_a, is to be determined along the hull girder in a similar manner as in Section 4.6.4.1 of the *Rules for the classification of ships, Part 2 - Hull*, by substituting the design vertical ice bending moment for the design vertical wave bending moment. The ship still water bending moment is to be taken as the permissible still water bending moment in sagging condition.