
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part K Materials

2010 AMENDMENT NO.2

Rule No.83 15th October 2010

Resolved by Technical Committee on 6th July 2010

Approved by Board of Directors on 27th July 2010

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

Part K MATERIALS

Amendment 2-1

Chapter 3 ROLLED STEEL

3.5 Rolled Stainless Steels

Table K3.18 has been amended as follows.

Table K3.18 Grades and Chemical Composition of Stainless Steels

Grade	Chemical composition (%)											
	<i>C</i>	<i>Si</i>	<i>Mn</i>	<i>P</i>	<i>S</i>	<i>Ni</i>	<i>Cr</i>	<i>Mo</i>	<i>N</i>	Others		
<i>KSUS304</i>	0.08max.	1.00max.	2.00 max.	0.045 max.	0.030 max.	8.00~10.50	18.00~20.00	—	—	—		
<i>KSUS304L</i>	0.030max.					9.00~13.00						
<i>KSUS304N1</i>	0.08max.		2.50 max.	7.00~10.50		0.10~0.25						
<i>KSUS304N2</i>			7.50~10.50	0.15~0.30		<i>Nb</i> ≤ 0.15						
<i>KSUS304LN</i>	0.030max.		2.00 max.	8.50~11.50		17.00~19.00	0.12~0.22	—				
<i>KSUS309S</i>	0.08max.		1.50max.	12.00~15.00		22.00~24.00	—					
<i>KSUS310S</i>				19.00~22.00		24.00~26.00						
<i>KSUS316</i>	0.030max.			1.00max.		10.00~14.00	16.00~18.00		2.00~3.00			
<i>KSUS316L</i>				12.00~15.00 10.00~14.00		—	—					
<i>KSUS316N</i>				10.00~14.00					0.10~0.22			
<i>KSUS316LN</i>				0.030max.		10.50~14.50	16.50~18.50		0.12~0.22			
<i>KSUS317</i>	0.08max.			0.030max.		—	—		11.00~15.00	18.00~20.00	3.00~4.00	—
<i>KSUS317L</i>	0.10~0.22											
<i>KSUS317LN</i>												
<i>KSUS321</i>	0.08max.	0.040 max.		0.045 max.	9.00~13.00	17.00~19.00	—		—	<i>Ti</i> ≥ 5 × <i>C</i>		
<i>KSUS329J3L</i>	0.030max.				4.50~6.50	21.00~24.00	2.50~3.50		0.08~0.20	—		
<i>KSUS347</i>	0.08max.				9.00~13.00	17.00~19.00	—		—	<i>Nb</i> ≥ 10 × <i>C</i>		

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 15 October 2010.
2. Notwithstanding the amendments to the Rules, the current requirements may apply to materials other than those for which the application for survey is submitted to the Society on and after the effective date.

Chapter 3 ROLLED STEELS

3.1 Rolled Steels for Hull

Paragraph 3.1.8 has been amended as follows.

3.1.8 Surface Inspection and Verification of Dimensions

1 Surface inspection and verification of dimensions are the responsibility of the steel manufacturer.

2 The minus tolerance in the nominal thickness of plates is to be in compliance with the requirements specified in **Table K3.7**. However, the average thickness of plates is not to be less than the nominal thickness.

3 The procedure and the records of measurements are to be made available to the Surveyor and copies provided on request.

~~**3.4**~~ Any requirements regarding the minus tolerance except for the minus tolerance in the nominal thickness is left to the discretion of the Society.

5 The above -2 may not need to be applied, when deemed appropriate by the Society.

Table K3.7 has been amended as follows.

Table K3.7 Verification of Dimensions

Products ⁽¹⁾	Minus tolerance (mm)
Steel plates	0.3 and under ⁽²⁾
Others	At the discretion of the Society

Notes:

(1) Steel plates are included flat bars of which width are not less than 150mm.

~~(2) The thickness is to be measured at random locations whose distance from a longitudinal edge shall be at least 10mm. However, local surface depressions resulting from imperfections (such as an affected part of shearing) and ground areas resulting from the elimination of defects may be disregarded.~~

3.2 Rolled Steel Plates for Boilers

Paragraphs 3.2.9 and 3.2.10 have been renumbered to Paragraphs 3.2.10 and 3.2.11 respectively, and Paragraph 3.2.9 has been added as follows.

3.2.9 Quality and Repair of Defects

Surface defects may be removed by local grinding, provided that the thickness is not reduced from nominal thickness to a degree that exceeds the minus tolerance specified in **3.2.8** under any circumstances.

3.3 Rolled Steel Plates for Pressure Vessels

Paragraphs 3.3.9 to 3.3.11 have been renumbered to Paragraphs 3.3.10 to 3.3.12 respectively, and Paragraph 3.3.9 has been added as follows.

3.3.9 Quality and Repair of Defects

Surface defects may be removed by local grinding, provided that the thickness is not reduced from nominal thickness to a degree that exceeds the minus tolerance specified in 3.3.8-2 under any circumstances.

3.4 Rolled Steels for Low Temperature Service

Paragraphs 3.4.9 and 3.4.10 have been renumbered to Paragraphs 3.4.10 and 3.4.11 respectively, and Paragraph 3.4.9 has been added as follows.

3.4.9 Quality and Repair of Defects

Surface defects may be removed by local grinding, provided that the thickness is not reduced from nominal thickness to a degree that exceeds the minus tolerance specified in 3.4.8-2 under any circumstances.

3.5 Rolled Stainless Steels

Paragraph 3.5.10 has been renumbered to Paragraph 3.5.11, and Paragraph 3.5.10 has been added as follows.

3.5.10 Quality and Repair of Defects

Surface defects may be removed by local grinding, provided that the thickness is not reduced from nominal thickness to a degree that exceeds the minus tolerance specified in 3.5.9-2 under any circumstances.

3.8 High Strength Quenched and Tempered Rolled Steel Plates for Structures

Paragraph 3.8.8 has been amended as follows.

3.8.8 Surface Inspection and Verification of Dimensions

The requirements specified in 3.1.8 are to apply to surface inspection and verification of dimensions are to be specified in 3.1.8. ~~The minus tolerance in the nominal thickness of steel plates is to be not more than 0.25mm.~~

Paragraphs 3.8.9 and 3.8.10 have been renumbered to Paragraphs 3.8.10 and 3.8.11 respectively, and Paragraph 3.8.9 has been added as follows.

3.8.9 Quality and Repair of Defects

Quality and repair of defects are to comply with the requirements of 3.1.9.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2011.
2. Notwithstanding the amendments to the Rules, the current requirements may apply to materials for which the application for survey is submitted to the Society before the effective date, or materials used for 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.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part K **Materials**

GUIDANCE

2010 AMENDMENT NO.2

Notice No.94 15th October 2010

Resolved by Technical Committee on 6th July 2010

AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

“Guidance for the survey and construction of steel ships” has been partly amended as follows:

Part K MATERIALS

Amendment 2-1

K3 ROLLED STEELS

K3.12 Additional Requirements for Brittle Crack Arrest Properties

Paragraph K3.12.2 has been amended as follows.

K3.12.2 Brittle Crack Arrest Properties etc.

1 In **3.12.2-1, Part K of the Rules**, “the discretion of the Society” can be regarded as **Annex K3.12.2-1 “GUIDANCE FOR BRITTLE CRACK ARREST TOUGHNESS K_{ca} TEST METHOD”** in the case of temperature gradient ESSO tests.

2 For **3.12.2-1** and **3.12.4-4, Part K of the Rules**, test specifications plan, containing information on the items mentioned below, are to be submitted for approval of the Society.

~~(1) Dimensions and types of the assembly~~

~~(2) Test procedure~~

~~(3) Determination of the Brittle Crack Arrest Toughness Value for evaluation temperature~~

(1) Testing machine specifications (including testing machine capacity and distance between pins)

(2) Details of test specimen (including types and dimensions of test specimen and method of joint with tab plate)

(3) Types, dimensions and mechanical properties of tab plate and load jig

(4) Measurement specifications (including whether dynamic measurements are necessary and positions on which the thermocouples, strain gauges and crack gauges are fitted)

(5) Test conditions (including how to generate a brittle crack, impact energy, temperature of test specimen, temperature gradient, preload stress and test stress)

Annex K3.12.2-1 has been added as follows.

Annex K3.12.2-1 GUIDANCE FOR BRITTLE CRACK ARREST TOUGHNESS
 K_{ca} TEST METHOD

1.1 Scope

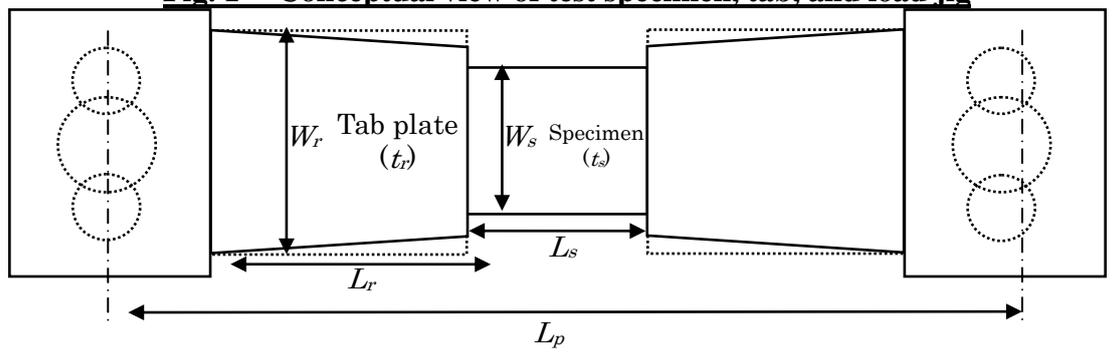
This test method is used to estimate the brittle crack arrest toughness value K_{ca} of rolled steel plates for hull of thicknesses of 90 mm or less. The brittle crack arrest toughness value K_{ca} of rolled steel plates for hull of thicknesses more than 90 mm is left to the discretion of the Society.

1.2 Symbols

Table 1 Symbols used and their meanings

<u>Symbol</u>	<u>Unit</u>	<u>Meaning</u>
t_s	mm	Thickness of test specimen
W_s	mm	Width of test specimen
L_s	mm	Length of test specimen
t_r	mm	Thickness of tab plate
W_r	mm	Width of tab plate
L_r	mm	Length of tab plate
L_p	mm	Distance between pins
a	mm	Length of crack projected on surface normal to the line of load
a_a	mm	Maximum crack length at brittle crack arrest position
T	°C	Temperature of test specimen
dT/da	°C/mm	Temperature gradient of test specimen
σ	N/mm ²	Gross stress in tested part (load/ $W_s \cdot t_s$)
K_{ca}	N/mm ^{3/2}	Brittle crack arrest toughness value

Fig. 1 Conceptual view of test specimen, tab, and load jig

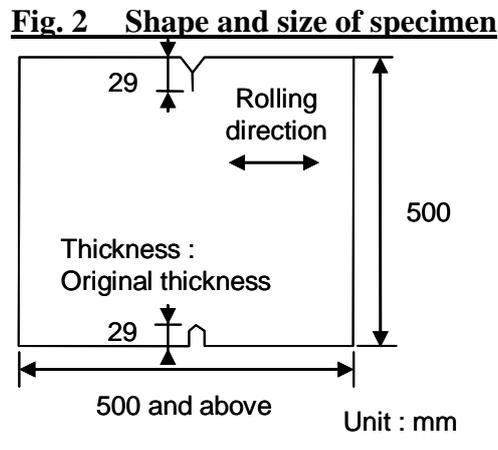


1.3 Purpose

The purpose of this test is to encourage the performance of a standard test for assessment of brittle crack arrest toughness with temperature gradient and to obtain the corresponding brittle crack arrest toughness value K_{ca} .

1.4 Standard test specimen

1 Fig. 2 shows the shape and size of the standard test specimen.



2 The thickness and width of the test specimen are to be in accordance with Table 2.

Table 2 Thickness and width of test specimen

Thickness, t_s	90mm and below
Width of test specimen, W_s	500mm

Note:

If the width of the test specimen cannot be made at 500 mm, it may be taken as 600 mm.

3 The test specimens are to be taken from the same steel plate.

4 Test specimens are to be taken in such a way that the axial direction of the load is parallel to the rolling direction of the steel plate.

5 The thickness of the test specimen is to be the same as the thickness of the steel plate.

1.5 Test equipment

The test equipment to be used is to consist of pin load type hydraulic test equipment capable of tensile tests. The distance between the pins is to be not less than 2,000 mm. The distance between pins refers to the distance between the centers of the pin diameters. Drop weight type or air gun type impact equipment may be used for the impact energy required for generating brittle cracks. The wedge is to have an angle greater than the upper notch of the test specimen, and an opening force is to be applied on the notch.

1.6 Test preparations

1 The test piece is to be fixed directly to the pin load jig or by means of weld joint through the tab plate. The overall length of the test specimen and tab plate is to be not less than $3W_s$. The thickness and width of the tab plate are to be in accordance with Table 3.

Table 3 Allowable dimensions of tab plate

	Thickness, t_r	Width, W_r
Dimensions of tab plate	$0.8 t_s^{(1)(2)} \leq t_r \leq 1.5 t_s$	$W_s^{(3)} \leq W_r \leq 2 W_s$

Note:

(1) t_s : Thickness of test specimen

(2) If the tab plate has a thickness smaller than the test specimen, the reflection of stress wave will be on the safer side for the assessment; therefore, considering the actual circumstances for conducting the test, the lower limit of thickness is taken as $0.8t_s$.

(3) W_s : Thickness of test specimen

- 2 Thermocouples are to be fitted at 50 mm pitch on the notch extension line of the test specimen.
- 3 If the brittle crack is estimated to deviate from its presumed course, thermocouples are to be fitted at two points separated by 100 mm on the line of load from the notch extension line at the center of width of the test specimen.
- 4 If dynamic measurements are necessary, strain gauges and crack gauges are to be fitted at specific locations.
- 5 The test specimen is to be fixed to the testing machine together with the tab plate after welding and the pin load jig.
- 6 The impact equipment is to be mounted. The construction of the impact equipment is to be such that the impact energy is correctly transmitted. An appropriate jig is to be arranged to minimize the effect of bending load due to the impact equipment.

1.7 Test method

- 1 To eliminate the effect of residual stress or correct the angular deformation of tab welding, a preload less than the test load may be applied before cooling.
- 2 Cooling and heating may be implemented from one side on the side opposite the side on which the thermocouple is fitted, or from both sides.
- 3 The temperature gradient is to be controlled in the range of 0.25 °C/mm to 0.35 °C/mm in the range of width from 0.3 W_s to 0.7 W_s at the central part of the test specimen.
- 4 When the specific temperature gradient is reached, the temperature is to be maintained for more than 10 minutes, after which the specified test load may then be applied.
- 5 After maintaining the test load for at least 30 seconds, a brittle crack is to be generated by impact. The standard impact energy is taken as 20 to 60 J per 1 mm plate thickness. If the brittle crack initiation characteristics of the base metal are high, and it is difficult to generate a brittle crack, the impact energy may be increased to the upper limit of 120 J per 1 mm plate thickness.
- 6 Loading is stopped when the initiation, propagation, and arrest of crack have been confirmed. Normal temperature is restored, and if necessary, the ligament is broken by gas cutting and forcibly the specimen is broken by using the testing machine. Or, after the ductile crack has been propagated to an adequate length with the testing machine, the ligament is broken by gas cutting.
- 7 After forcing the fracture, photos of the fractured surface and the propagation route are to be taken, and the crack length is to be measured.

1.8 Test results

- 1 The distance from the top of the test specimen including the notch to the maximum length in the plate thickness direction of the arrested crack tip is to be measured. If the crack surface deviates

from the surface normal to the line of load of the test specimen, the projected length on the surface normal to the line of load is to be measured. In this case, if the trace of brittle crack arrest is clearly visible on the fractured surface, the first crack arrest position is taken as the arrest crack position.

2 From the results of thermocouple measurement, the temperature distribution curve is to be plotted, and the arrest crack temperature is to be measured corresponding to the arrest crack length.

3 The brittle crack arrest toughness value (K_{ca} value) of each test is to be determined by using the following formula:

$$K_{ca} = \sigma \sqrt{\pi a} \sqrt{\left(\frac{2W_s}{\pi a} \right) \tan(\pi a / 2W_s)}$$

1.9 Report

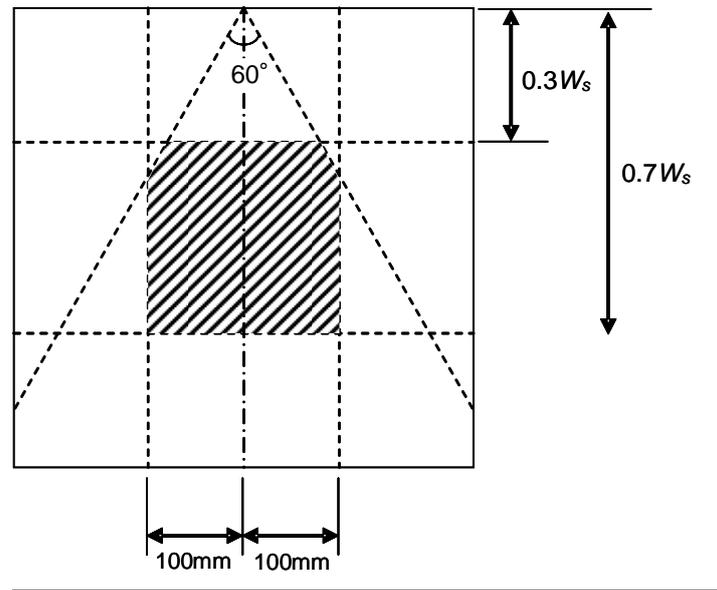
1 The following items are to be report:

- (1) Testing machine specifications; testing machine capacity, distance between pins (L_p)
- (2) Load jig dimensions; tab plate thickness (t_r), tab plate width (W_r), test specimen length including tab plate (L_s+2L_r)
- (3) Test specimen dimensions; plate thickness (t_s); test specimen width (W_s) and length (L_s)
- (4) Test conditions; preload stress, test stress, temperature distribution (figure or table); impact energy
- (5) Test results; crack arrest length (a_a), temperature gradient at arrest position, brittle crack arrest toughness (K_{ca})
- (6) Dynamic measurement results (if measurement is carried out); crack growth rate, strain change
- (7) Test specimen photos; fracture route, fractured surface

2 If the conditions below are not satisfied, the test results are to be treated as reference values.

- (1) The brittle crack arrest position is to be in the range of the hatched part shown in **Fig. 3**. In this case, if the brittle crack arrest position is more than 50 mm away from the center of the test specimen in the longitudinal direction of the test specimen, the temperature of the thermocouple at the ± 100 mm position is to be within ± 3 °C of the thermocouple at the center.
- (2) The brittle crack should not have a distinct crack bifurcation while it propagates.

Fig. 3 Necessary conditions of arrest crack position



3 From effective test results measured at more than 3 points, the linear approximation equation is to be determined on the Arrhenius plot, and K_{ca} at the desired temperature is to be calculated. In this case, data should exist on both sides, that is, the high temperature and low temperature sides around the assessed temperature.

EFFECTIVE DATE AND APPLICATION (Amendment 2-1)

1. The effective date of the amendments is 15 October 2010.
2. Notwithstanding the amendments to the Guidance, the current requirements may apply to materials other than those for which the application for survey is submitted to the Society on or after the effective date.

K3 ROLLED STEELS

K3.1 Rolled Steels for Hull

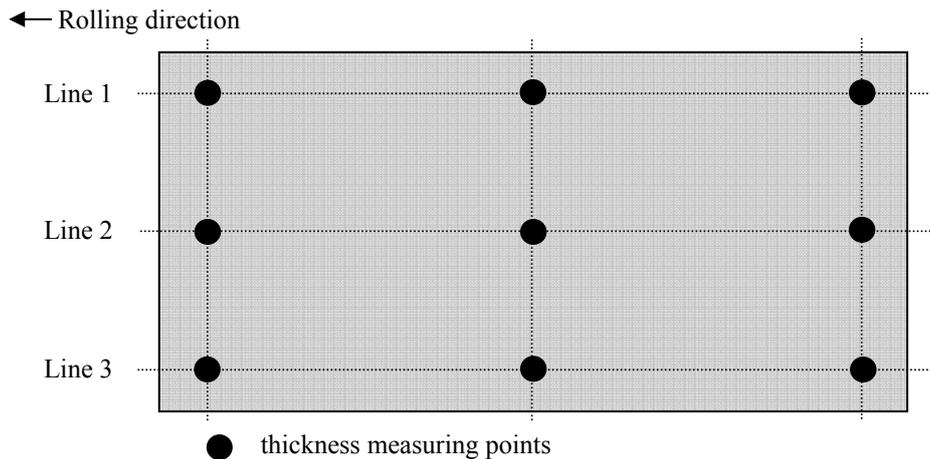
Paragraph K3.1.8 has been added as follows.

K3.1.8 Surface Inspection and Verification of Dimensions

The treatment of the requirements in **3.1.8, Part K of the Rules** is to be as follows:

- (1) In the application of 3.1.8-2, Part K of the Rules, thickness measuring locations are to comply with the following:
 - (a) At least two lines among Line 1, Line 2 or Line 3, as shown in Fig. K3.1.8-1, are to be selected for the thickness measurements and at least three points on each selected line, as shown in Fig. K3.1.8-1, are to be selected for thickness measurement. If more than three points are taken on each line the number of points is to be equal on each line.
 - (b) For automated methods, the measuring points at sides are to be located not less than 10 mm but not greater than 300 mm from the transverse or longitudinal edges of the product.
 - (c) For manual methods, the measuring points at sides are to be located not less than 10 mm but not greater than 100 mm from the transverse or longitudinal edges of the product.
- (2) The average thickness of plates specified in 3.1.8-2, Part K of the Rules is defined as the arithmetic mean of the measurements made in accordance with the requirements of (1) above.
- (3) “When deemed appropriate by the Society” specified in 3.1.8-5, Part K of the Rules, means that plates comply with requirements for Class C of ISO 7452.

Fig. K3.1.8-1 Locations of Thickness Measuring Points



K3.2 Rolled Steel Plates for Boilers

Paragraph K3.2.8 has been added as follows.

K3.2.8 Tolerance for Thickness

Thickness is to be measured at random locations whose distance from a longitudinal edge is to be at least 10 mm. However, local surface depressions resulting from imperfections (such as an affected part of shearing) and ground areas resulting from the elimination of defects may be disregarded.

Paragraph K3.2.10 has been renumbered to Paragraphs K3.2.11.

K3.3 Rolled Steel Plates for Pressure Vessels

Paragraph K3.3.8 has been added as follows.

K3.3.8 Surface Inspection and Verification of Dimensions

Thickness is to be measured at random locations whose distance from a longitudinal edge is to be at least 10 mm. However, local surface depressions resulting from imperfections (such as an affected part of shearing) and ground areas resulting from the elimination of defects may be disregarded.

Paragraph K3.3.10 has been renumbered to Paragraphs K3.3.11.

Section K3.4 has been added as follows.

K3.4 Rolled Steels for Low Temperature Service

K3.4.8 Surface Inspection and Verification of Dimensions

Thickness is to be measured at random locations whose distance from a longitudinal edge is to be at least 10 mm. However, local surface depressions resulting from imperfections (such as an affected part of shearing) and ground areas resulting from the elimination of defects may be disregarded.

K3.5 Rolled Stainless Steels

Paragraph K3.5.9 has been added as follows.

K3.5.9 Surface Inspection and Verification of Dimensions

Thickness is to be measured at random locations whose distance from a longitudinal edge is to be at least 10 mm. However, local surface depressions resulting from imperfections (such as an affected part of shearing) and ground areas resulting from the elimination of defects may be disregarded.

EFFECTIVE DATE AND APPLICATION (Amendment 2-2)

1. The effective date of the amendments is 1 January 2011.
2. Notwithstanding the amendments to the Guidance, the current requirements may apply to materials for which the application for survey is submitted to the Society before the effective date, or materials used for 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.