RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part K Materials

2017 AMENDMENT NO.1

Rule No.29 1st June 2017

Resolved by Technical Committee on 30th January 2017

Approved by Board of Directors on 20th February 2017

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

Rule No.29 1st June 2017
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 K MATERIALS

Amendment 1-1

Chapter 1 GENERAL

1.4 Testing and Inspection for Materials

1.4.2 Standard for Testing and Inspection*

Sub-paragraph -4 has been amended as follows.

4 The Society may request additional test items, tests under different conditions or different kind of tests specified in this Part in consideration of the intended service condition of the materials.

1.5 Marking and Test Certificate

1.5.1 Marking

Sub-paragraph -1 has been amended as follows.

1 Every materials complying with the requirements is to be clearly stamped with the Society's brand ~~NK~~ including the marks deemed appropriate by the Society and material grade mark, and marked with the following particulars in at least one position by the maker.
(1) Name or mark to identify the maker.
(2) Number or mark to identify the piece.
(3) Condition of heat treatment (if **Chapter 3** of this Part applies, except for "as rolled" steel)
(~~3~~4) Name, order number or other identification marks (if required by the purchaser)

1.5.2 Test Certificate*

Sub-paragraph -2 has been amended as follows.

2 The test certificate specified in **-1** are to contain, in addition to the dimensions, mass, etc., of the steel material, at least items **(1)** through **(~~9~~11)** of the following particulars:
(1) Purchaser's order number and if known the ship number which the material is intended;
(2) Identification number or symbol;
(3) Identification of manufacturer;
(4) Identification of grade of material (including the brand name in the case of the corrosion resistant steel for cargo oil tanks specified in **3.13**);

(5) Chemical Composition (ladle analysis on elements specified in the requirement and added when necessary) (including additive elements for improving corrosion resistance in the case of the corrosion resistant steel for cargo oil tanks specified in **3.13**);

(6) Carbon equivalent (C_{eq}) or cold cracking susceptibility (P_{cm}) calculated from the following formula using ladle analysis <u>except where otherwise specified</u> (only in such a case as specified in this Part.);

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad (\%)$$

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B \quad (\%)$$

(7) Mechanical test results (including any standards, in cases where standards differing from those specified in this Part are used);

(8) Condition of heat treatment (~~e.g. normalized or controlled roll~~ <u>if **Chapter 3** of this Part applies,</u> except for <u>"</u>as rolled<u>" steel</u>); and

(9) Deoxidation practice is to be stated (rimed steel only).

<u>(10) Results of surface inspections (if **Chapters 3**, **5**, and **6** of this Part apply, specify results only)</u>

<u>(11) Results of ultrasonic tests (if **Chapters 3**, **5**, and **6** of this Part apply, specify results only)</u>

Chapter 3 ROLLED STEELS

3.1 Rolled Steels for Hull

Paragraph 3.1.9 has been amended as follows.

3.1.9 Quality and Repair of Defects*

1 Verification of internal soundness is the responsibility of the manufacturer.

~~**1**~~**2** The steel is to be reasonably free from segregations and non-metallic inclusions. The finished steel is to be free from internal or surface defects prejudicial to the use of steel for the intended application.

~~**2**~~**3** The surface defects may be removed by local grinding, provided that the thickness is in no place reduced to less than 93% of the nominal thickness, but in no case by more than 3 *mm*. Such local grindings are to be carried out in the presence of the Surveyor unless otherwise approved by the Society.

~~**3**~~**4** Surface defects which cannot be dealt with as above may be repaired by chipping or grinding followed by welding, subject to the approval by the Society, in the presence of the Surveyor unless otherwise approved by the Society, provided:

(1) That after removal of the defect, and before welding, the thickness of the piece is in no place reduced by more than 20% of the nominal thickness;

(2) That the welding is to be carried out by an approved procedure, by the welder qualified by the Society, with approved electrodes, and that welding is ground smooth to the correct nominal thickness; and

(3) That subsequent to the finish grinding, the piece may be required to be normalized or otherwise heat treated at the Surveyor's discretion.

Title of Section 3.8 has been amended as follows.

3.8 High Strength ~~Quenched and Tempered~~ Rolled Steels ~~Plates~~ for Offshore Structures

Paragraphs 3.8.1 to 3.8.7 have been amended as follows.

3.8.1 Application

1 The requirements given in **3.8** are to apply to the high strength ~~quenched and tempered~~ rolled steels for marine or offshore structures ~~not exceeding 70 *mm* in thickness~~ intended for mobile offshore units, tanks of liquefied gas carriers or ships using low-flashpoint fuels, and process pressure vessels, etc. (hereinafter referred to as "steels" in **3.8**).

~~**2** The requirements other than those specified in section **3.8** are to apply to **3.1**.~~

~~**3** Any requirements regarding the steels over 70 *mm* in thickness are left to the discretion of the Society.~~

~~**4**~~**2** Steel plates having characteristics differing from those specified in **3.8** are to comply with the requirements in **1.1.1-**~~**2**~~**3**.

3.8.2 Kinds*

1 The steels ~~plates~~ are classified into the grade~~s~~ of steels as given in **Table K3.27**.

2 Maximum thickness according to type of products and heat treatment is to comply with the requirements given in **Table K3.28.**

3 The requirements for steels whose thicknesses exceed values given in **Table K3.28** are at the discretion of the Society.

3.8.3 Steel Making Processes, Deoxidation Practice and Chemical Composition*

1 Steel making processes are to comply with the requirements given in **1.2.1-1**. However, the steels listed in the following **(1)** and **(2)** are to be vacuum degassed.

(1) Steels subject to the requirements given in **3.11** related to the improvement of thickness properties.

(2) Steels whose strength level is *K*690, *K*890 or *K*960.

~~1~~2 The deoxidation practice and chemical composition of steels are to comply with the requirements given in **Table K3.27**. Where subjected to the approval of the Society, other elements than specified in the Table may be added at the option of the manufacturer.

~~**2** Notwithstanding the requirements given in **-1**, where heat treatment has been conducted according to *TMCP*, the requirement on the chemical composition of the steel may be modified subject to the special approval by the Society.~~

3 The steel is to be fine grain treated using an appropriate process.

4 The carbon equivalent value is to comply with the requirements given in **Table K3.29**. The value is to be calculated using ladle analysis with the formula specified in **1.5.2**.

5 Notwithstanding the requirements given in **-4**, for *TMCP* or *QT* heat-treated steels whose carbon contents does not exceed 0.12%, cold cracking susceptibility (P_{cm}) for evaluating weldability may be used instead of the carbon equivalent. The cold cracking susceptibility (P_{cm}) is to be calculated using ladle analysis with the formula specified in **1.5.2** and is to comply with the requirements given in **Table K3.29**.

3.8.4 Heat Treatment

1 The heat treatment of each grade is to comply with the requirements given in **Table K3.~~28~~27**.

2 The reduction ratio of the steel is to be not less than three except in cases where approved by the Society.

3.8.5 Mechanical Properties

~~1~~ The steels are to conform to the requirements given in **Table K3.~~28~~30** as to mechanical properties. ~~The application of requirements differing from those given above may be allowed, subject to the special approval by the Society.~~

~~**2** Where deemed necessary by the Society, other tests on notch-toughness and weldability may be required in addition to the tests specified in **-1**.~~

3.8.6 Selection of Test Samples

1 ~~One~~ For the test samples from which tensile test specimens are selected, steels (belonging to the same charge, with the same heat treatment, and of the same thickness) not greater in weight than 25 *tonnes* are to be treated as one lot, and one test sample is to be selected from each lot. ~~is to be taken from each steel which is rolled directly from one slab, ingot, etc. and is simultaneously heat treated in the same furnace including continuous furnace~~. ~~When *TMCP* is used as heat treatment, one test sample is to be taken from each steel which is rolled directly from one slab, ingot, etc.~~

2 For the test samples from which impact test specimens are selected, the following **(1)** to **(3)** are to be complied with according to condition of heat treatment and type of product.

(1) For *N*/*NR* or *TMCP* heat-treated steels (including flat bars not less than 600 *mm* in width), steels rolled directly from a single slab, ingot, etc. are to be treated as one lot, and one test sample is to be selected from each lot.

(2) For *QT* heat-treated steels (including flat bars not less than 600 *mm* in width), steels rolled directly from a single slab, ingot, etc. and simultaneously heat treated in the same furnace are to be treated as one lot, and one test sample is to be selected from each lot.

(3) For steels (including flat bars less than 600 *mm* in width, sections, bars and tubulars) regardless of condition of heat treatment, steels (belonging to the same cast, with the heat

treatment and of the same thickness) not greater in weight than 25 *tonnes* are to be treated as one lot, and one test sample is to be selected from each lot.

3 Notwithstanding the requirements given in **-1** and **-2**, where simultaneous heat treated is applied, a frequency of selection of test sampling differing from those given above may be allowed in cases where approved by the Society.

~~**2**~~**4** The requirements specified in **3.1.6-4** are to be applied to the selection of the test samples. However, the selection of the test samples for tubers is to be as deemed appropriate by the Society.

3.8.7 Selection of Test Specimens

1 Under no circumstances are test specimens to be heat treated separately from the product.

~~**1**~~**2** Tensile test specimens are to be taken according to the following requirements ~~specified in **3.1.7-2**~~.

(1) One test specimen is to be taken from a test sample.

(2) Test specimens are to be taken with their longitudinal axis transverse to the final direction of rolling. For sections, bars, and flat bars not exceeding 600 *mm* in width, tubulars or in cases approved by the Society, however, test specimens may be taken with their longitudinal axis parallel to the final direction of rolling.

(3) Flat test specimens of full product thickness are generally to be used. However, round test specimens may be used for bars as alternatives to flat test specimens.

(4) When the flat test specimens are used, the specimens are to be prepared in such a manner as to maintain the rolling scale at least on one side.

(5) When round test specimens are taken from any steel except bars, they are to be taken at a portion where the axis of the test specimen corresponds to approximately 1/4 of the thickness (1/6 of the diameter for bars) from the surface. An additional 1/2 of the thickness is to be taken when product thickness exceeds 100 *mm*.

~~**2**~~**3** Impact test specimens are to be taken according to the following requirements ~~specified in **3.4.7-2**~~.

(1) A set of test specimens is to be taken from one test sample.

(2) Test specimens are to be taken with their longitudinal axis transverse (the *T* direction) to the final direction of rolling. For sections, bars, and flat bars not exceeding 600 *mm* in width and tubulars, however, test specimens are to be taken with their longitudinal axis parallel (the *L* direction) to the final direction of rolling.

(3) When product thickness does not exceed 50 *mm*, test specimens are to be cut with their edges within 2 *mm* from the "as rolled" surface. When product thickness exceeds 50 *mm*, test specimens are to be taken at a portion where the axis of the test specimen corresponds to approximately 1/4 and 1/2 of the thickness (1/6 of the diameter for bars) from the surface.

Paragraph 3.8.11 has been amended as follows.

3.8.11 Marking

Steels ~~plates~~ which have satisfactorily complied with the required tests are to be marked with identification mark in accordance with the requirements in **1.5.1**. ~~In addition, for steels to which the requirements given in the provision to **3.8.5-1** have been applied, "-*M*" is to be suffixed to the marking (Example: *KA*620-*M*)~~ In addition, for steels to which the requirements given in the provisions to **Notes (5)** and **(6)** in **Table K3.30** have been applied, "-*YP* [new yield point or proof stress value] *M* " is to be suffixed to the marking in cases where the yield point (proof stress) value is changed, and "-*TS* [new tensile point value] *M* " is to be suffixed to the marking in cases where the tensile point value is changed. (Example: *KA*620-*YP*620*M*-*TS*700*M*)

Table K3.27 has been amended as follows.

~~Table K3.27 Grades, Deoxidation Practice and Chemical Composition of Steels~~

~~Grade~~	~~Deoxidation~~	~~Chemical composition(%)~~												~~Cold cracking Susceptibility (%)~~	
		~~C~~	~~Si~~	~~Mn~~	~~P~~	~~S~~[1]	~~Cu~~	~~Ni~~	~~Cr~~	~~Mo~~	~~V~~	~~B~~	~~N~~	~~Thickness t (mm)~~	
														~~$t \leq 50$~~	~~$50 < t \leq 70$~~
~~KA420~~	~~Fully killed and fine grain treated~~	~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~	~~These elements may be added when necessary subject to approval of the Society.~~						~~max.~~	~~0.25 max.~~	~~0.27 max.~~
~~KD420~~ ~~KE420~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF420~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~									
~~KA460~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~								~~0.26 max.~~	~~0.28 max.~~
~~KD460~~ ~~KE460~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF460~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~									
~~KA500~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~								~~0.26 max.~~	~~0.28 max.~~
~~KD500~~ ~~KE500~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF500~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~									
~~KA550~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~								~~0.28 max.~~	~~0.30 max.~~
~~KD550~~ ~~KE550~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF550~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~									
~~KA620~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~	~~0.50 max.~~	~~—~~	~~1.00 max.~~	~~0.60 max.~~	~~0.10 max.~~	~~0.006 max.~~	~~0.020 max.~~	~~0.29 max.~~	~~0.31 max.~~
~~KD620~~ ~~KE620~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF620~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~									
~~KA620N~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~		~~0.30 – 1.30~~	~~0.70 max.~~						
~~KD620N~~ ~~KE620N~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF620N~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~		~~0.30 – 2.00~~							
~~KA690~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~		~~—~~	~~1.20 max.~~					~~0.30 max.~~	~~0.32 max.~~
~~KD690~~ ~~KE690~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF690~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~									
~~KA690N~~		~~0.21 max.~~	~~0.55 max.~~	~~1.70 max.~~	~~0.035 max.~~	~~0.035 max.~~		~~0.30 – 1.50~~	~~0.80 max.~~						
~~KD690N~~ ~~KE690N~~		~~0.20 max.~~			~~0.030 max.~~	~~0.030 max.~~									
~~KF690N~~		~~0.18 max.~~		~~1.60 max.~~	~~0.025 max.~~	~~0.025 max.~~		~~0.30 – 2.20~~							

~~Note:~~

~~(1) For steels complying with the requirements specified in **3.11** the maximum content of sulphur is to be 0.008% determined by the ladle analysis.~~

Table K3.27 Grade of Steel, Heat Treatment and Chemical Composition

Deoxidation practice	Killed and fine grain treatment					
Heat treatment(1)	*N* /*NR*		*TMCP*(2)		*QT*	
Grade of steel / Chemical composition (3)	*KA*420 *KD*420 *KA*460 *KD*460	*KE*420 *KE*460	*KA*420 *KD*420 *KA*460 *KD*460 *KA*500 *KD*500 *KA*550 *KD*550 *KA*620 *KD*620 *KA*690 *KD*690 *KA*890	*KE*420 *KF*420 *KE*460 *KF*460 *KE*500 *KF*500 *KE*550 *KF*550 *KE*620 *KF*620 *KE*690 *KF*690 *KD*890 *KE*890	*KA*420 *KD*420 *KA*460 *KD*460 *KA*500 *KD*500 *KA*550 *KD*550 *KA*620 *KD*620 *KA*690 *KD*690 *KA*890 *KA*960	*KE*420 *KF*420 *KE*460 *KF*460 *KE*500 *KF*500 *KE*550 *KF*550 *KE*620 *KF*620 *KE*690 *KF*690 *KD*890 *KE*890 *KD*960 *KE*960
C (%)	0.20 max.	0.18 max.	0.16 max.	0.14 max.	0.18 max.	
Mn (%)	1.0~1.70		1.0~1.70		1.70 max.	
Si (%)	0.60 max.		0.60 max.		0.80 max.	
P (%)(4)	0.030 max.	0.025 max.	0.025 max.	0.020 max.	0.025 max.	0.020 max.
S (%)(4) (5)	0.025 max.	0.020 max.	0.015 max.	0.010 max.	0.015 max.	0.010 max.
Al (%)(6)	0.02 min.		0.02 min.		0.018 min.	
Nb (%)(7)	0.05 max.		0.05 max.		0.06 max.	
V (%)(7)	0.20 max.		0.12 max.		0.12 max.	
Ti (%)(7)	0.05 max.		0.05 max.		0.05 max.	
Ni (%)	0.80 max.		2.00 max.(8)		2.00 max.(8)	
Cu (%)	0.55 max.		0.55 max.		0.50 max.	
Cr (%)(7)	0.30 max.		0.50 max.		1.50 max.	
Mo (%)(7)	0.10 max.		0.50 max.		0.70 max.	
N (%)	0.025 max.		0.025 max.		0.015 max.	
O (*ppm*)(9)	—		—	50 max.	—	30 max.

Notes:

(1) Symbols used to indicate heat treatment are as follows. The kinds and definitions of heat treatment are to be as deemed appropriate by Society.
N : Normalizing (*N*)
NR : Controlled Rolling (*CR* / *NR*)
TMCP : Thermo-Mechanical Controlled Processing (*TMCP*)
QT : Quenching and Tempering (*QT*)

(2) Direct quenching thermos-mechanical rolling (*TMR*) followed by tempering may be considered equivalent to *TMCP* only when the requirements in this section are applied.

(3) In cases where adding *B*, the maximum of the *B* content is not to be higher than 0.005%, and the analysis result is to be reported.

(4) For sections, the *P* and *S* content may be 0.005% higher than the value specified in the table.

(5) For steels complying with the requirements specified in **3.11**, the maximum of *S* content is to be 0.008%.

(6) The total *Al* to *Ni* ratio is to be a minimum of 2:1. When other nitrogen binding elements are used, the minimum *Al* value and *Al*/*N* ratio do not apply

(7) Total *Nb*, *V*, *Ti* content is not to exceed 0.26% and total *Mo*, *Cr* content is not to exceed 0.65%. This does not apply to *QT* steels.

(8) The maximum of the *Ni* content may exceed 2.00% in cases where approved by the Society.

(9) The requirement for maximum *O* content is only applicable to *KD*890, *KE*890, *KD*960 and *KE*960.

Table K3.28 has been amended as follows.

Table K3.28 Heat Treatment and Mechanical Properties

Grade	Heat treatment	Tensile test			Impact test(3)(4)(5)		
		Yield point or proof stress (N/mm^2)	Tensile strength (N/mm^2)	Elongation ($L = 5.65\sqrt{A}$) (%)(2)	Testing temperature (°C)	Minimum mean absorbed energy(J)	
						L	T
*KA*420	Quenched and tempered(1)	420 min.	530–680	18 min.	0	42	28
*KD*420					–20		
*KE*420					–40		
*KF*420					–60		
*KA*460		460 min.	570–720	17 min.	0	46	31
*KD*460					–20		
*KE*460					–40		
*KF*460					–60		
*KA*500		500 min.	610–770	16 min.	0	50	33
*KD*500					–20		
*KE*500					–40		
*KF*500					–60		
*KA*550		550 min.	670–830	16 min.	0	55	37
*KD*550					–20		
*KE*550					–40		
*KF*550					–60		
*KA*620, *KA*620*N*		620 min.	720–890	15 min.	0	62	41
*KD*620, *KD*620*N*					–20		
*KE*620, *KE*620*N*					–40		
*KF*620, *KF*620*N*					–60		
*KA*690, *KA*690*N*		690 min.	770–940	14 min.	0	69	46
*KD*690, *KD*690*N*					–20		
*KE*690, *KE*690*N*					–40		
*KE*690, *KF*690*N*					–60		

Notes:

(1) Heat treatment may be conducted according to *TMCP*, instead of quenching and tempering, subject to the approval by the Society.

(2) The minimum elongation for *U*1 test specimen is to be in compliance with requirements given in **Table K3.29**.

(3) *L* (or *T*) denotes that the longitudinal axis of the test specimen is arranged parallel (or transverse) to the final direction of rolling.

(4) When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified minimum mean absorbed energy or when the absorbed energy of a single test specimen is less in value than 70% of the specified minimum mean absorbed energy, the test is considered to be failed.

(5) Impact test for steels specified in **Part N** is given in **Table K3.30**.

Table K3.28 Maximum Thickness According to Type of Product and Heat Treatment

Type of product / Heat treatment	Maximum thickness (*mm*) [1]			
	Plate/Flat bar	Section	Bar	Tubular
N	250	50	250	65
NR	150		[2]	
TMCP	150	50	–	–
QT	150	50	–	50

Notes:

(1) For bars, "thickness" is to be read as either "radius" or "length of one side"

(2) As deemed appropriate by the Society. However, maximum thickness is not to exceed that of *N* products.

Table K3.29 and Table K3.30 have been added as follows.

TableK3.29 Maximum Carbon Equivalent and Cold Cracking Susceptibility Values

Grade of steel and heat treatment		Carbon equivalent (%)(1)							Cold cracking Susceptibility (%)
		C_{eq}						*CET*	P_{cm}
		Thickness (*mm*)(2)							
		Plate/Flat bar			Section	Bar	Tubular		
		$t \leq 50$	$50 < t \leq 100$	$100 < t \leq 250$	$t \leq 50$	$t \leq 250$ or $d \leq 250$	$t \leq 65$		
*KA*420 *KD*420 *KE*420 *KF*420	*N/NR*	0.46	0.48	0.52	0.47	0.53	0.47	—	—
	TMCP	0.43	0.45	0.47	0.44	—	—	—	—
	QT	0.45	0.47	0.49	—	—	0.46	—	—
*KA*460 *KD*460 *KE*460 *KF*460	*N/NR*	0.50	0.52	0.54	0.51	0.55	0.51	0.25	—
	TMCP	0.45	0.47	0.48	0.46	—	—	0.30	0.23
	QT	0.47	0.48	0.50	—	—	0.48	0.32	0.24
*KA*500 *KD*500	*TMCP*	0.46	0.48	0.50	—	—	—	0.32	0.24
*KE*500 *KF*500	*QT*	0.48	0.50	0.54	—	—	0.50	0.34	0.25
*KA*550 *KD*550	*TMCP*	0.48	0.50	0.54	—	—	—	0.34	0.25
*KE*550 *KF*550	*QT*	0.56	0.60	0.64	—	—	0.56	0.36	0.28
*KA*620 *KD*620	*TMCP*	0.50	0.52	—	—	—	—	0.34	0.26
*KE*620 *KF*620	*QT*	0.56	0.60	0.64	—	—	0.58	0.38	0.30
*KA*690 *KD*690	*TMCP*	0.56	—	—	—	—	—	0.36	0.30
*KE*690 *KF*690	*QT*	0.64	0.66	0.70	—	—	0.68	0.40	0.33
*KA*890 *KD*890	*TMCP*	0.60	—	—	—	—	—	0.38	0.28
*KE*890	*QT*	0.68	0.75	—	—	—	—	0.40	—
*KA*960 *KD*960 *KE*960	*QT*	0.75	—	—	—	—	—	0.40	—

Notes:

(1) For steel grades *K*460 and higher, *CET* may be used instead of C_{eq}. In such cases, *CET* is to be calculated according to the following formula.

$$CET = C + \frac{(Mn + Mo)}{10} + \frac{(Cr + Cu)}{20} + \frac{Ni}{40}$$

(2) For bars, "thickness" is to be read as either "radius" or "length of one side"

TableK3.30 Mechanical Properties

Grade of steel and heat treatment		Yield point or Proof stress (N/mm^2)			Tensile strength (N/mm^2) [3]		Elongation $L_0=5.65\sqrt{S_0}$ (%) [1] [2]		Impact test [7] [8]		
		Thickness (mm) [4]			Thickness (mm) [4]				Testing temperature	Minimum mean absorbed energy (J) [2]	
		$3< t \leq 50$	$50< t \leq 100$ [5]	$100< t \leq 250$ [5]	$3< t \leq 100$	$100< t \leq 250$ [6]	*T*	*L*	(°C)	*T*	*L*
*KA*420	*N*/*NR* *TMCP* *QT*	420 min.	390 min.	365 min.	520~680	470~650	19	21	0	28	42
*KD*420									-20		
*KE*420									-40		
*KF*420									-60		
*KA*460	*N*/*NR* *TMCP* *QT*	460 min.	430 min.	390 min.	540~720	500~710	17	19	0	31	46
*KD*460									-20		
*KE*460									-40		
*KF*460									-60		
*KA*500	*TMCP* *QT*	500 min.	480 min.	440 min.	590~770	540~720	17	19	0	33	50
*KD*500									-20		
*KE*500									-40		
*KF*500									-60		
*KA*550	*TMCP* *QT*	550 min.	530 min.	490 min.	640~820	590~770	16	18	0	37	55
*KD*550									-20		
*KE*550									-40		
*KF*550									-60		
*KA*620	*TMCP* *QT*	620 min.	580 min.	560 min.	700~890	650~830	15	17	0	41	62
*KD*620									-20		
*KE*620									-40		
*KF*620									-60		
*KA*690	*TMCP* *QT*	690 min.	650 min.	630 min.	770~940	710~900	14	16	0	46	69
*KD*690									-20		
*KE*690									-40		
*KF*690									-60		
*KA*890	*TMCP* *QT*	890 min.	830 min.	–	940~1100	–	11	13	0	46	69
*KD*890									-20		
*KE*890									-40		
*KA*960	*QT*	960 min.	–	–	980~1150	–	10	12	0	46	69
*KD*960									-20		
*KE*960									-40		

Notes:

(1) For steels whose strength levels are *K*420 to *K*960, *U*1 test specimens may be used. In such cases, the minimum elongation for the *U*1 test specimen is to comply with the requirements given in **Table K3.29**.

(2) The direction of the longitudinal axis of the test specimen to the direction of final rolling is denoted by *L* for parallel or *T* for transverse.

(3) For steels complying with the requirements specified in **3.11**, the results of tensile tests in the through thickness direction are not to be less than 80% of specified minimum tensile strength.

(4) For bars, "thickness" is to be read as "radius" or "length of one side"

(5) For plates, flat bars and sections, the values in the thickness range of $3< t \leq 50$ are to applied regardless of thickness in cases where the design requires that tensile properties are maintained throughout the thickness.

(6) For plates, flat bars and sections for applications, values in the thickness range of $3< t \leq 100$ are to applied regardless of thickness in cases where the design requires that tensile properties are maintained throughout the thickness.

(7) When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified minimum mean absorbed energy or when the absorbed energy of a single test specimen is less in value than 70% of the specified minimum mean absorbed energy, the test is considered to be failed.

(8) Impact tests for nominal thicknesses of less than 6 *mm* may be omitted.

Table K3.29 has been amended as follows.

Table K3.~~29~~31 Minimum Elongation for *U*1 Specimen (%)

Grade of steel	Thickness *t* (*mm*)						
	$t \leq 10$	$10 < t \leq 15$	$15 < t \leq 20$	$20 < t \leq 25$	$25 < t \leq 40$	$40 < t \leq 50$	$50 < t \leq 70$
*KA*420, *KD*420, *KE*420, *KF*420	11	13	14	15	16	17	18
*KA*460, *KD*460, *KE*460, *KF*460	11	12	13	14	15	16	17
*KA*500, *KD*500, *KE*500, *KF*500	10	11	12	13	14	15	16
*KA*550, *KD*550, *KE*550, *KF*550	10	11	12	13	14	15	16
*KA*620, *KD*620, *KE*620, *KF*620~~, *KA620N, KD620N, KE620N, KF620N~~~~~~	9	11	12	12	13	14	15
*KA*690, *KD*690, *KE*690, *KF*690~~, *KA690N, KD690N, KE690N, KF690N~~~~~~	9	10	11	11	12	13	14

Note:

(1) *U*1 test specimens are to be taken with their longitudinal axis transverse to the final direction rolling.

3.11 Additional Requirements for Through Thickness Properties

3.11.1 Application

Sub-paragraph -2 has been amended as follows.

2 The requirements are to apply to hull structural rolled steels and high strength ~~quenched and tempered~~ rolled steels for offshore structures for plates and wide flats with thickness of 15 *mm* and over.

3.11.2 Through Thickness Properties

Table K3.35 has been amended as follows.

Table K3.35 Through Thickness Properties

Kinds of Steel	Suffix	Tensile test in the through thickness direction	
		Reduction of area (%)	
		Average value of three specimens	One individual value (1)
Rolled ~~S~~steels for ~~H~~hulls	Z25	25 min.	15 min.
High ~~S~~strength ~~Quenched and Tempered R~~rolled ~~S~~steels for offshore ~~S~~structures	Z35	35 min.	25 min.

Note:

(1) If two or more individual results are less than the specified average value, the test is considered to be failed.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 July 2017.

2. Notwithstanding the amendments to the Rules, the current requirements apply to high strength rolled steel for offshore structures (hereinafter referred to as "steels") for which the application for survey is submitted to the Society before 1 July 2017 or steels being used on marine and offshore structures for which the date of contracts for construction* is before 1 July 2017.

* "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.

Amendment 1-2

Chapter 3 ROLLED STEEL

3.6 Round Bars for Chains

Paragraph 3.6.5 has been amended as follows.

3.6.5 Grain Size

1 The austenitic grain size of grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5 is to be 6 or finer in accordance with *ASTM E*112 or an equivalent grain size index in accordance with *ISO* 643 or to be deemed as equivalent by the Society.

2 Measurements of grain size are to be taken at a depth of 1/3 radius from the surface.

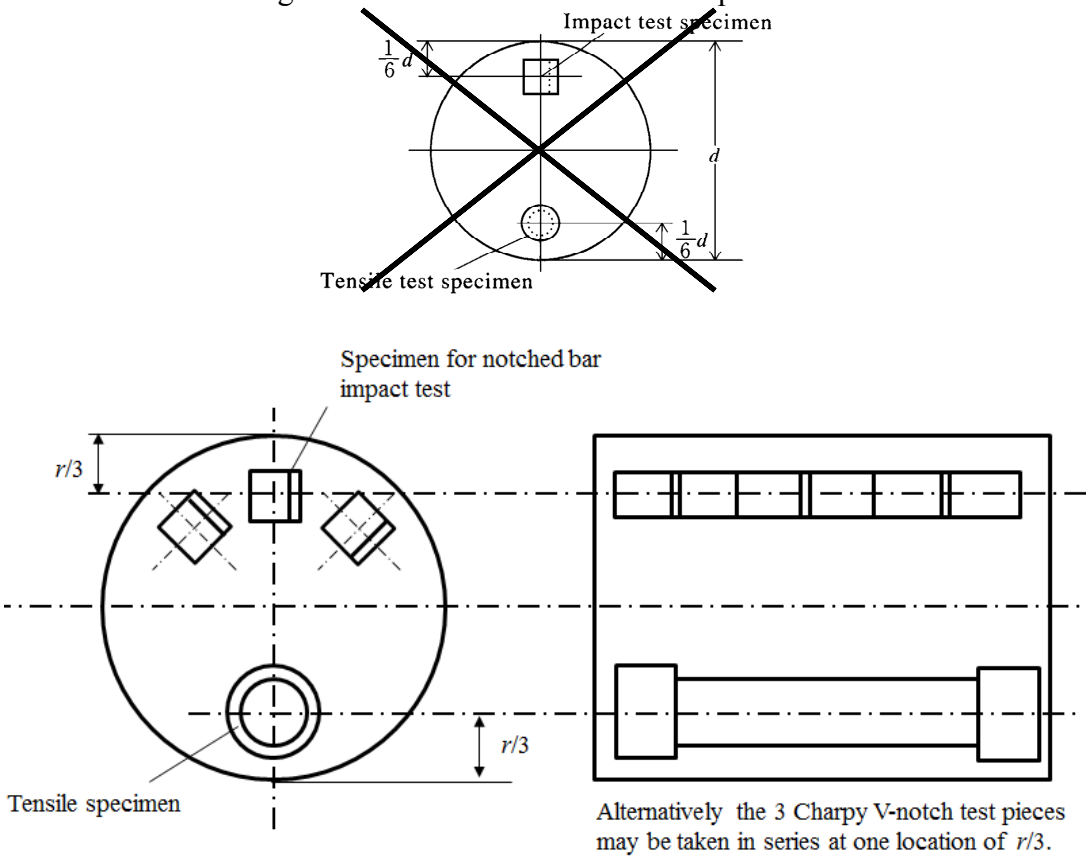
3.6.8 Selection of Test Specimens*

Sub-paragraph -4 has been amended as follows.

4 The tensile and impact test specimens are to be taken from the test sample in the longitudinal direction at a depth of 1/~~6~~3 ~~diameter~~radius *r* from the surface or as close as possible to this position (See **Fig. K3.2**).

Fig. K3.2 has been amended as follows.

Fig. K3.2 Selection of Test Specimens



Paragraph 3.6.10 has been amended as follows.

3.6.10 Surface Inspection, Non-destructive Test, ~~and~~ Verification of Dimensions and Repair of Defects*

1 Surface inspection for all grades is to be carried out it is to be confirmed that there is no harmful defect.

2 For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, the entire bar material is to be examined by a magnetic particle test, an eddy current test or a magnetic leakage flux test in accordance with standards deemed appropriate by the Society and it is to be confirmed that there are no harmful defects.

3 For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, the entire bar material supplied in a machined (peeled) condition is to be visually inspected and it is to be confirmed that there are no harmful defects. In cases where deemed necessary, the Society may require 10% of the material be inspected by the non-destructive tests specified in **-2** to confirm there are no longitudinal imperfections. The maximum depth of peeling is to be agreed upon with the offshore chain manufacturer.

~~**2**~~**4** For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, ~~all~~the entire bar material~~s are~~ is to be subjected to an ultrasonic ~~examination~~test at an appropriate stage of ~~the~~ manufacture~~r~~ing and it is to be confirmed that there ~~is~~ are no harmful defects.

5 In the case specified in **-4** above, the area to be removed is to be agreed upon with the offshore chain manufacturer in cases where the end lengths of bar materials which are not subjected to ultrasonic tests are to be removed from the ends.

~~**3** For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, one hundred persent of bar material is to be examined by magnetic particle or eddy current methods and it is to be confirmed that there is no harmful defect.~~

~~**4**~~**6** Notwithstanding the requirements of **-2** ~~and~~to **-~~3~~4** above, the frequency of non-destructive test may be reduced where approved by the Society considering quality control of bar manufacturer is consistently achieved. However, non-destructive test to the test samples required by **3.6.7** is to be carried out in any case.

~~**5**~~**7** With respect to **-2** ~~and~~to **-~~3~~4** above, non-destructive ~~examination~~test procedures, together with rejection/acceptance criteria are to be submitted to the Society.

~~**6**~~**8** With respect to **-2** ~~and~~to **-~~3~~4** above, non-destructive ~~examination~~test operators are to be appropriately qualified in performing non-destructive ~~examination~~test.

~~**7**~~**9** Dimensional tolerance of round bars refers to **Table K3.25**.

10 For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, repair of bars by welding is not permitted.

Table K3.25 has been amended as follows.

Table K3.25 Dimensional Tolerance

Nominal diameter (mm) [(1)]	Tolerance on diameter (mm)	Tolerance on roundness ($d_{max.} - d_{min.}$) (mm)[(2)]
$d < 25$	-0 ～+1.0	0.60 max.
$25 \leq d \leq 35$	-0 ～+1.2	0.80 max.
$36 \leq d \leq 50$	-0 ～+1.6	1.10 max.
$51 \leq d \leq 80$	-0 ～+2.0	1.50 max.
$81 \leq d \leq 100$	-0 ～+2.6	1.95 max.
$101 \leq d \leq 120$	-0 ～+3.0	2.25 max.
$121 \leq d \leq 160$	-0 ～+4.0	3.00 max.
$161 \leq d \leq$ ~~210~~222	-0 ～+5.0	4.00 max.

Notes:

(1) For bar materials of nominal diameter which ~~more than 211~~exceeds 222 *mm*, dimensional tolerance is to be as deemed appropriate by the Society.

(2) $d_{max.}$ and $d_{min.}$ are the maximum and minimum diameter of a single bar material.

Paragraph 3.6.13 has been amended as follows.

3.6.13 Submission of Data*

1 For grades *KSBCR*4*S* and *KSBCR*5, the following information for each heat is to be submitted by the bar manufacturer to the ~~mooring~~offshore chain manufacturer.

(1) The results of the microscopic examinations for non-metallic inclusions.

(2) The results of macro etched examinations in order to confirm that there is no injurious segregation or porosity.

(3) The results of ~~Jominy~~ hardenability tests.

2 For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, the maximum depth of peeling specified in **3.6.10-3.**

3 For grades *KSBCR*3, *KSBCR*3*S*, *KSBCR*4, *KSBCR*4*S* and *KSBCR*5, the end lengths of the bar materials which are not subjected to the ultrasonic tests specified in **3.6.10-5.**

Chapter 5 CASTINGS

5.2 Steel Castings for Chains

Paragraph 5.2.4 has been amended as follows.

5.2.4 Grain Size

1 The austenitic grain size of grades *KSCCR*3, *KSCCR*3*S*, *KSCCR*4, *KSCCR*4*S* and *KSCCR*5 is to be 6 or finer in accordance with *ASTM E*112 or an equivalent grain size index in accordance with *ISO* 643 or to be deemed as equivalent by the Society.

2 Measurements of grain size for circular sections are to be taken at a depth of 1/3 radius from the surface. Measurements of grain size for non-circular sections are to be taken at a depth of 1/4 thickness from the surface.

Title of Paragraph 5.2.5 has been amended as follows.

5.2.5 Chemical Composition, Deoxidation Practice and Vacuum Degasification Process

Sub-paragraph -3 has been added as follows.

3 For grades *KSCCR*3, *KSCCR*3*S*, *KSCCR*4, *KSBCR*4*S* and *KSBCR*5, all steel castings are to be killed and fine grain treated.

Paragraph 5.2.8 has been deleted.

~~**5.2.8 Surface Inspection**~~

~~After the heat treatment of steel castings is finished, surface inspection is to be carried out.~~

Paragraph 5.2.9 has been renumbered to Paragraph 5.2.8.

5.2.~~9~~8 Quality

Steel castings are to be of uniform quality and free from harmful defects.

Paragraph 5.2.10 has been amended as follows.

5.2.~~10~~9 Surface Inspection and Non-destructive Test*

1 For grades *KSCC*50 and *KSCC*70, surface inspections are to be carried out and it is to be confirmed that there are no harmful defects after the heat treatment of the steel castings is finished.

2 For grades *KSCCR*3, *KSCCR*3*S*, *KSCCR*4, *KSCCR*4*S* and *KSCCR*5, steel castings are to be examined by magnetic particle tests in accordance with standards deemed appropriate by the Society and it is to be confirmed that there are no harmful defects after the heat treatment of the castings is finished.

~~**1**~~**3** For grades *KSCCR*3, *KSCCR*3S, *KSCCR*4, *KSCCR*4*S* and *KSCCR*5, ~~all~~ the entire steel casting~~s are~~is to be subjected to an ultrasonic ~~examination~~test at an appropriate stage of ~~the~~ manufacture in accordance with standards deemed appropriate by the Society and it is to be confirmed that there ~~is~~are no harmful defect~~s~~.

~~**2**~~**4** For grades *KSCC*50 and *KSCC*70, a suitable non-destructive test such as an ultrasonic ~~examination~~test may be required where deemed necessary by the Society.

~~**3**~~**5** With respect to ~~-1~~**2** and **-3** above, non-destructive ~~examination~~test procedures, together with

rejection/acceptance criteria are to be submitted to the Society.

~~4~~**6** With respect to **-~~1~~2** and **-3** above, non-destructive ~~examination~~test operators are to be appropriately qualified in performing non-destructive ~~examination~~tests.

Paragraph 5.2.11 has been amended as follows.

5.2.~~11~~10 Repair of Defects

~~Repair of defects for steel castings is generally to be carried out in accordance with the requirements specified in **5.1.11**.~~

1 The surface defects on non-machined surfaces may be removed by grinding to a depth of 5% of the nominal diameter. Grinding is not permitted on machined surfaces, except for slight inspection grinding on plane surfaces to a maximum depth of 0.8 *mm* in order to repair any spurious indications.

2 In cases where the repair entails removal of more than 5% of the diameter or thickness, the defective area is to be repaired by welding. The excavations are to be suitably shaped to allow good access for welding and the resulting grooves are to be subsequently ground smooth.

3 In addition to **-2** above, complete elimination of defects is to be verified by non-destructive test prior to any repairs by welding.

4 The repairing procedures (extent and location of the repair by welding (including photographs or sketches)) are to be submitted and approved by the Society in cases where the groove depth prepared for welding exceeds 25% of the diameter/thickness or 25 *mm*, whichever is smaller.

5 In cases where repairs by welding are carried out in accordance with **-4** above, a post weld heat treatment or a repeat of the heat treatment of castings specified in **5.2.3** are to be carried out.

6 Repairs by welding are to be recorded in sketches or photographs to show the extent and positions of the repairs.

7 All repairs by welding are to be carried out by qualified welders using **Chapter 5, Part M of the Rules** or standards deemed appropriate by the Society.

8 All repairs by welding are to be carried out in accordance with the welding procedure specification approved in accordance with **Chapter 4, Part M of the Rules** or standards deemed appropriate by the Society. For welding procedure qualification tests, impact tests whose notch locations are in central region of weld metal, fusion line and 2 *mm* and 5 *mm* from the fusion line are to be carried out.

Paragraph 5.2.12 has been renumbered to Paragraph 5.2.11.

5.2.~~12~~11 Additional Tests before Rejection

Where the tensile test or impact test on the selected first test specimens fails to meet the requirements, additional tests may be conducted according to the requirements given in **3.6.11**.

Paragraph 5.2.13 has been renumbered to Paragraph 5.2.12.

5.2.~~13~~12 Marking

Steel castings which have satisfactorily complied with the required tests are to be marked with identification mark in accordance with the requirements in **5.1.12**.

Paragraph 5.2.14 has been amended as follows.

5.2.~~14~~13 Submission of Data*

For grades *KSCCR*4*S* and *KSCCR*5, the following information for each heat is to be submitted by the bar manufacturer to the ~~mooring~~offshore chain manufacturer.

(1) The results of the microscopic examinations for non-metallic inclusions.
(2) The results of macro etched examinations in order to confirm that there is no injurious segregation or porosity.
(3) The results of ~~Jominy~~ hardenability tests.

Chapter 6 STEEL FORGINGS

6.3 Steel Forgings for Chains

Paragraph 6.3.4 has been amended as follows.

6.3.4 Grain Size

1 The austenitic grain size of grades *KSFCR*3, *KSFCR*3*S*, *KSFCR*4, *KSFCR*4*S* and *KSFCR*5 is to be 6 or finer in accordance with *ASTM E*112 or equivalent grain size index in accordance with *ISO* 643 or to be deemed as equivalent by the Society.

2 Measurements of grain size for circular sections are to be taken at a depth of 1/3 radius from the surface. Measurements of grain size for non-circular sections are to be taken at a depth of 1/4 thickness from the surface.

6.3.7 Selection of Test Specimens

Sub-paragraph -5 has been added as follows.

5 For grades *KSFCR*3*S*, *KSFCR*4, *KSFCR*4*S* and *KSFCR*5, two tensile test specimens having a diameter of 20 *mm* are, in principle, to be subject to hydrogen embrittlement tests. In such cases, the test specimens are to be taken from the central regions of steel forgings which are heat treated according to the following **(1)** or **(2)**.

(1) In the case of continuous casting, test samples representing both the beginning and the end of the charge are to be taken.

(2) In the case of ingot casting, test samples representing two different ingots from the same charge are to be taken.

Paragraph 6.3.8 has been amended as follows.

6.3.8 ~~Surface Inspection~~Hydrogen Embrittlement Test*

~~Surface inspection for all grades is to be carried out and it is to be confirmed that there is no harmful defect.~~

1 Hydrogen embrittlement tests are to be carried out in accordance with the following procedure:

(1) One specimen is to be tested either within a maximum of 3 *hours* after machining, or within a period not exceeding 5 *days* after it has been cooled to -60°C immediately after machining and then maintain at that temperature until tested.

(2) The other specimen is to be tested after baking at 250°C for 4 *hours*.

(3) A slow strain rate (i.e., a strain rate less than 0.0003 s^{-1}) is to be used during the entire test, as far as practicable, and tensile strength, elongation and reduction of area are to be measured.

2 The test result is to comply with the following formula.

$$Z_{(1)} / Z_{(2)} \geq 0.85$$

$Z_{(1)}$ is the reduction of area measured by the test specified in **-1(1)**

$Z_{(2)}$ is the reduction of area measured by the test specified in **-1(2)**

Paragraph 6.3.9 has been amended as follows.

6.3.9 Surface Inspection and Non-destructive Test*

1 For grades *KSFC*50 and *KSFC*70, surface inspections are to be carried out and it is to be confirmed that there are no harmful defects after the heat treatment of the steel forgings is finished.

2 For grades *KSFCR*3, *KSFCR*3*S*, *KSFCR*4, *KSFCR*4*S* and *KSFCR*5, the steel forgings are to be examined by magnetic particle tests in accordance with standards deemed appropriate by the Society and it is to be confirmed that there are no harmful defects after the heat treatment of the forgings is finished.

~~1~~**3** For grades *KSFCR*3, *KSFCR*3*S*, *KSFCR*4, *KSFCR*4*S* and *KSFCR*5, the entire ~~all~~ steel forging~~s are~~is to be subjected to an ultrasonic ~~examination~~test at an appropriate stage of ~~the~~ manufacture~~e~~ing in accordance with standards deemed appropriate by the Society and it is to be confirmed that there ~~is~~are no harmful defects.

~~2~~**4** With respect to ~~-1~~**2** and **-3** above, non-destructive ~~examination~~test procedures, together with rejection/acceptance criteria are to be submitted to the Society.

~~3~~**5** With respect to ~~-1~~**2** and **-3** above, non-destructive ~~examination~~test operators are to be appropriately qualified in performing non-destructive ~~examination~~tests.

Paragraph 6.3.10 has been added as follows.

6.3.10 Repair of Defects

1 For grades *KSFCR*3, *KSFCR*3*S*, *KSFCR*4, *KSFCR*4*S* and *KSFCR*5, repairs by welding are not permitted.

2 The surface defects on non-machined surfaces may be removed by grinding to a depth of 5% of the nominal diameter. Grinding is not permitted on machined surfaces, except for slight inspection grinding on plane surfaces to a maximum depth of 0.8 *mm* in order to repair any spurious indications.

Paragraph 6.3.10 has been renumbered to Paragraph 6.3.11.

6.3.~~10~~11 Additional Tests before Rejection

Where the tensile test or impact test on the selected first test specimens fails to meet the requirements, additional tests may be carried out according to the requirements given in **3.6.11**.

Paragraph 6.3.11 has been renumbered to Paragraph 6.3.12.

6.3.~~11~~12 Marking

Steel forgings which have proved satisfactory compliance with the required tests are to be marked with identification marks in accordance with the requirements in **1.5.1**.

Paragraph 6.3.12 has been amended as follows.

6.3.~~12~~13 Submission of Data*

For grades *KSFCR*4*S* and *KSFCR*5, the following information for each heat is to be submitted by the bar manufacturer to the ~~mooring~~offshore chain manufacturer.

(1) The results of the microscopic examinations for non-metallic inclusions.
(2) The results of macro etched examinations in order to confirm that there is no injurious segregation or porosity.
(3) The results of ~~Jominy~~ hardenability tests.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2017.

2. Notwithstanding the amendments to the Rules, the current requirements apply to offshore mooring chains and accessories for offshore mooring chains (hereinafter referred to as "offshore chains and accessories") for which the application for survey is submitted to the Society before 1 July 2017 or offshore chains and accessories being used on offshore structures and single-point mooring systems for which the date of contracts for construction* is before 1 July 2017.

* "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.

Amendment 1-3

Chapter 3 ROLLED STEEL

3.3 Rolled Steel Plates for Pressure Vessels

3.3.3 Chemical Composition

Table K3.12 has been amended as follows.

Table K3.12 Chemical Composition

Grade	Chemical composition (%)						Carbon equivalent C_{eq}(*JIS*) (%)(1)(2)				
							Quenched and tempered		*TMCP*		
	C		*Si*	*Mn*	*P*	*S*	50 *mm* and under in thickness	Over 50 *mm* and up to 75 *mm* in thickness	50 *mm* and under in thickness	Over 50 *mm* and up to 100 *mm* in thickness	Over 100 *mm* and up to 150 *mm* in thickness
*KPV*24	100 *mm* and under in thickness	0.18 max	0.35 max.	1.40 max.	~~0.030~~ 0.020 max.	~~0.030~~ 0.020 max.	–	–	–	–	–
	Over 100 *mm* in thickness	0.20 max									
*KPV*32	0.18 max.		0.55 max.	1.60 max.			–	–	0.39 max.	0.41 max.	0.43 max.
*KPV*36	0.20 max.		0.55 max.				–	–	0.40 max.	0.42 max.	0.44 max.
*KPV*42	0.18 max.		0.75 max.				–	–	0.43 max.	0.45 max.	–
*KPV*46	0.18 max.		0.75 max.				0.44 max.	0.46 max.	–	–	–
*KPV*50	0.18 max.		0.75 max.				0.45 max.	0.47 max.	–	–	–

Notes:

(1) The carbon equivalent C_{eq}(*JIS*) is to be obtained using ladle analysis from the following formula, regardless of the requirements in **1.5.2-2(6)**.

$$C_{eq}(JIS) = C + \frac{Mn}{6} + \frac{Si}{24} + \frac{Ni}{40} + \frac{Cr}{5} + \frac{Mo}{4} + \frac{V}{14} \quad (\%)$$

(2) Carbon equivalent C_{eq}(*JIS*) is not specified where plates are as-rolled, controlled-rolled or normalized.

EFFECTIVE DATE AND APPLICATION (Amendment 1-3)

1. The effective date of the amendments is 1 December 2017.

2. Notwithstanding the amendments to the Rules, the current requirements apply to the surveys is for which the application is submitted to the Society before the effective date.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part K Materials

2017 AMENDMENT NO.1

Notice No.27 1st June 2017

Resolved by Technical Committee on 30th January 2017

Notice No.27 1st June 2017
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 1-1

K3 ROLLED STEELS

K3.1 Rolled Steels for Hull

Paragraph K3.1.4 has been amended as follows.

K3.1.4 Heat Treatment

The kind and definition of heat treatment referred to in Remarks **(3)** in **Table K3.3, Part K of the Rules** are as follows: (Refer to **Fig. K3.1.4-1** and **-2**)

(1) As Rolled (*AR*) involves the rolling of steel at high temperature followed by air cooling. The rolling and finishing temperature are typically in the austenite recrystallization region and above the normalizing temperature.

(2) Normalizing (*N*) involves heating rolled steel above the critical temperature, *Ac*3, and in the lower end of the austenite recrystallization region followed by air cooling.

(3) Quenching and Tempering (*QT*) involves heating rolled steel in the austenite recrystallization region followed by rapid cooling, and shortly thereafter involves heating rolled steel under the critical temperature, *Ac*1, followed by air cooling. The wording "direct quenching after rolling" in **Fig. K3.1.4-1** means that the quenching is rapidly carried out.

(4) Controlled Rolling (*CR*) (Normalizing Rolling (*NR*)) is one of heat treatment methods in which heating temperature, rolling temperature and rolling reduction are controlled to fine steel structure and improve mechanical properties. The rollings are generally finished in low austenite temperature range between normalizing temperature and *Ar*3 transition temperature.

(5) Thermo-Mechanical Controlled Processing (*TMCP*) is a kind of heat treatment being based on the strict control of both the steel temperature and rolling reduction and is divided into the following two categories.

(a) Thermo-Mechanical Rolling: *TMR*
A kind of controlled rolling, generally a high proportion of rolling reduction is carried out close to or below the *Ar*3 transition temperature. The rolling towards the lower end of ~~the temperature range *Ar*1 transition temperature of~~ the austenite-ferrite intercritical duplex phase region may be included into *TMR*.

(b) Accelerated Cooling Processing: *AcC*
After completion of ~~controlled rolling~~ thermo-mechanical rolling, homogeneous cooling was made with adequate cooling speed faster than air cooling in the range of *Ar*3 transition temperature or below.

Fig. K3.1.4-1 and Fig. K3.1.4-2 have been amended as follows.

Fig. K3.1.4-1 Kind of Heat Treatment

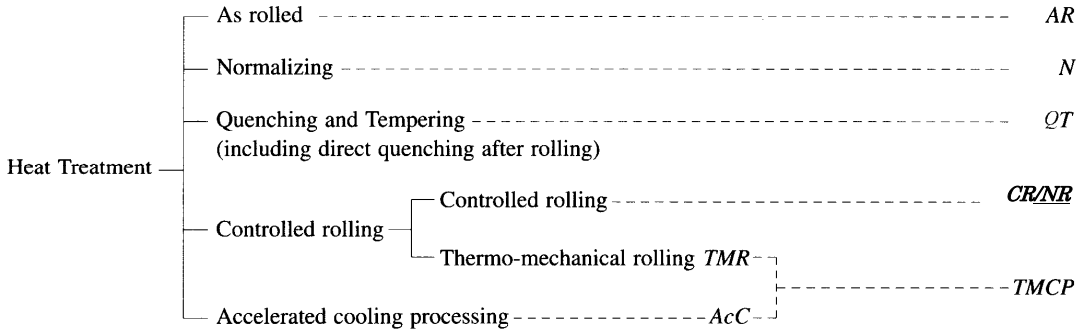
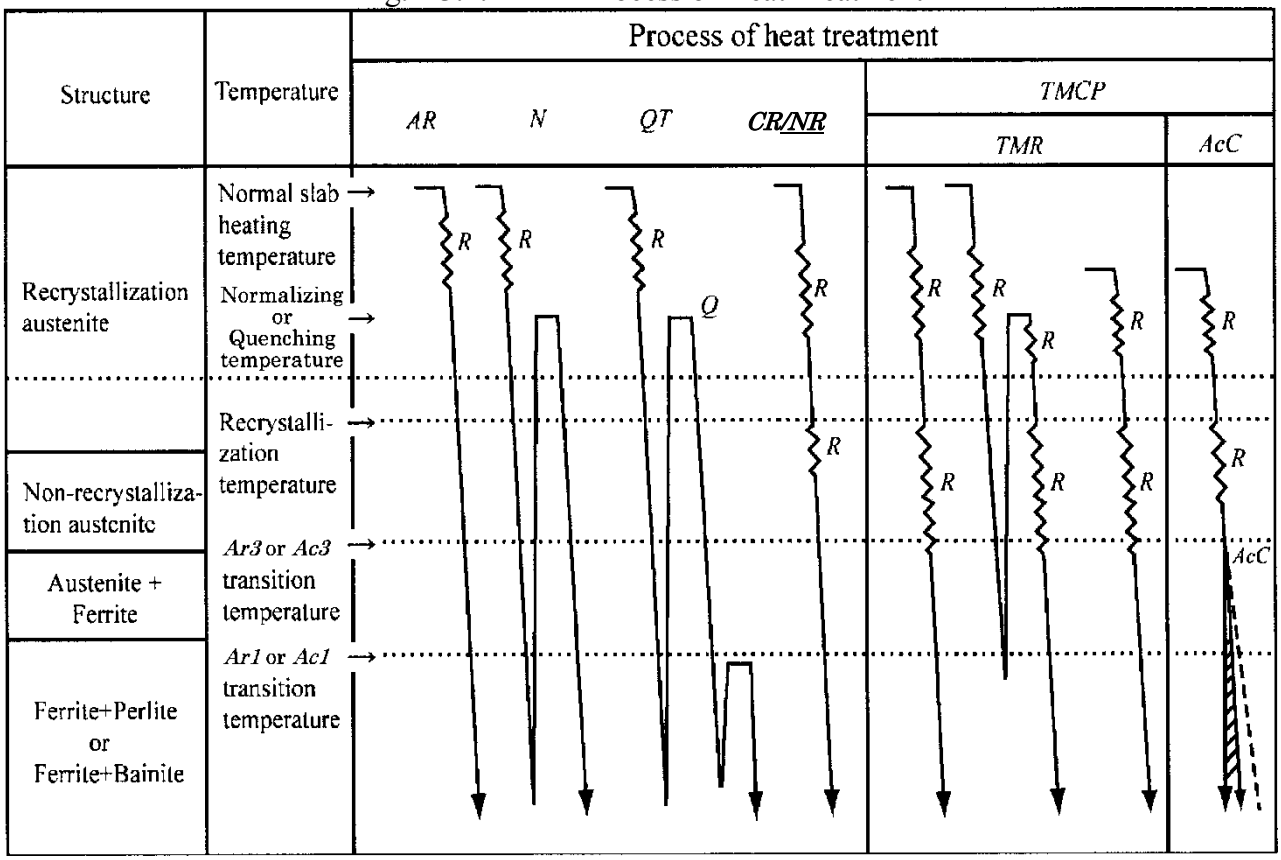


Fig. K3.1.4-2 Process of Heat Treatment



Note:
R : Reduction
Q : Quenching

Paragraph K3.1.9 has been amended as follows.

K3.1.9 Quality and Repair of Defects

Before repair works prescribed in **3.1.9-~~3~~4, Part K of the Rules**, the following documents are to be submitted to the Society for approval.

(1) Specifications of repairing procedure which state about kind of surface defects, the way of chipping, grinding and welding, etc.

(2) Reports on results of tensile test, bend test, impact test, macro-structure inspection and hardness test on test samples repaired according to the procedure specified in above **(1)**

Section K3.8 has been added as follows.

K3.8 High Strength Rolled Steels for Offshore Structures

K3.8.2 Kind

The wording "to be as deemed appropriate by Society" in **Note (1) for Table K3.27, Part K of the Rules** means to comply with the provisions of **K3.14**.

K3.8.3 Steel Making Processes, Deoxidation Practice and Chemical Composition

A fine grain structure is to have an index of 6 or finer as standard which is to be determined by micrographic examination in accordance with *ISO* 643 or an equivalent test standard deemed appropriate by the Society.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 July 2017.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to high strength rolled steel for offshore structures (hereinafter referred to as "steels") for which the application for survey is submitted to the Society before 1 July 2017 or steels being used on marine and offshore structures for which the date of contracts for construction* is before 1 July 2017.

* "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.

Amendment 1-2

K3 ROLLED STEELS

K3.6 Round Bars for Chains

Paragraph K3.6.10 has been amended as follows.

K3.6.10 Surface Inspection, Non-destructive Test, ~~and~~ Verification of Dimensions and Repair of Defects

1 The wording "~~The~~ harmful defects" specified in **3.6.10-1** to **-3, Part K of the Rules** means the depth of the defect~~s~~ in the surface exceeds 1% of the nominal diameter of the bar material~~s~~. In cases where the depth of the defect in the surface does not exceed 1% of the nominal diameter of the bar material, the defect may be removed by the grinding or another suitable method. In such cases, the bar material is to be repaired smoothly in the longitudinal direction and the dimension tolerance for the bar material is also to comply with the requirements in **3.6.10-7, Part K of the Rules** after completion of the repair work.

~~**2** Where the depth of the defects in surface does not exceed 1% of the nominal diameter of bar materials, the defects may be removed by the grinding or suitable methods. In this case, bar materials are to be repaired smoothly on longitudinal direction, and the dimension tolerance for bar materials is also to be complied with the requirements in **3.6.10-7, Part K of the Rules** after completion of repair work.~~

2 The wording "standards deemed appropriate by the Society" specified in **3.6.10-2, Part K of the Rules** means the following standards or the equivalent thereto.

(1) Magnetic particle test: *ASTM E*1444 or *ISO* 9934

(2) Magnetic leakage flux test: *JIS Z*2319

(3) Eddy current test: *ISO* 15549

3 In applying the requirements in **3.6.10-4, Part K of the Rules**, phased array ultrasonic tests may be accepted in cases where approved by the Society.

~~**3**~~**4** The wording **"**to be appropriately qualified in performing non-destructive ~~examination~~tests" specified in **3.6.10-~~6~~8, Part K of the Rules**, means those qualified ~~Level~~*Level* II or higher in accordance with *ISO* 9712, *ACCP* or an equivalent qualification deemed appropriate by the Society.

5 Non-destructive test operator qualification according to an employer or responsible agency qualification scheme based on SNT-TC-1A may be accepted if the employer's written practice is reviewed and found acceptable and the Level III is *ASNT Level* III, *ISO* 9712 *Level* III or *ACCP* Professional *Level* III and certified in the applicable method. In such cases, notwithstanding the requirements in **-4** above, the wording "to be appropriately qualified in performing non-destructive tests" specified in **3.6.10-8, Part K of the Rules** means those qualified Level II or higher.

Paragraph K3.6.13 has been amended as follows.

K3.6.13 Submission of Data

1 The results of the microscopic examinations for non-metallic inclusions specified in **3.6.13-1(1), Part K of the Rules** are to conform to national/international standards.

~~**1**~~**2** The macro etched examination specified in **3.6.13-1(2), Part K of the Rules** is to conform to *ASTM E*381 or other standard as deemed appropriate by the Society.

~~**2**~~**3** The ~~Jominy~~ hardenability test specified in **3.6.13-1(3), Part K of the Rules** is to conform to *ASTM A255* or other standard as deemed appropriate by the Society.

K5 CASTINGS

K5.2 Steel Castings for Chains

Paragraph K5.2.10 has been amended as follows.

K5.2.~~10~~9 Surface Inspection and Non-destructive Test

1 The wording "standards deemed appropriate by the Society" specified in **5.2.9-2** and **-3, Part K of the Rules** means the following standards or the equivalent thereto.

(1) Magnetic particle test: wet continuous magnetization technique specified in *ASTM E*709

(2) Ultrasonic test: *ASTM A*609 or *ISO* 13588

2 The wording "to be appropriately qualified in performing non-destructive ~~examination~~tests" specified in **5.2.~~10~~9-6, Part K of the Rules**, means those qualified ~~Level~~*Level* II or higher in accordance with *ISO* 9712, *ACCP* or an equivalent qualification deemed appropriate by the Society.

3 Non-destructive test operator qualification according to an employer or responsible agency qualification scheme based on SNT-TC-1A may be accepted if the employer's written practice is reviewed and found acceptable and the Level III is *ASNT Level* III, *ISO* 9712 *Level* III or *ACCP* Professional *Level* III and certified in the applicable method. In such cases, notwithstanding the requirements in **-2** above, the wording "to be appropriately qualified in performing non-destructive tests" specified in **5.2.9-6, Part K of the Rules**, means those qualified Level II or higher.

Paragraph K5.2.10 has been added as follows.

K5.2.10 Repair of Defects

1 The wording "standards deemed appropriate by the Society" specified in **5.2.10-7, Part K of the Rules** is conform to *ISO* 9606, *ASME* IX, *ASTM A*488 or the equivalent thereto.

2 The wording "standards deemed appropriate by the Society" specified in **5.2.10-8, Part K of the Rules** is conform to *ISO* 15614, *ASME* IX, *ASTM A*488 or the equivalent thereto.

Paragraph K5.2.14 has been amended as follows.

K5.2.~~14~~13 Submission of Data

1 The results of the microscopic examinations for non-metallic inclusions specified in **5.2.13 (1), Part K of the Rules** are to conform to national/international standards.

~~1~~2 The macro etched examination specified in **5.2.~~14~~13(2), Part K of the Rules** is to conform to *ASTM E*381 or other standard as deemed appropriate by the Society.

~~2~~3 The ~~Jominy~~ hardenability test specified in **5.2.~~14~~13(3), Part K of the Rules** is to conform to *ASTM A255* or other standard as deemed appropriate by the Society.

K6 STEEL FORGINGS

K6.3 Steel Forgings for Chains

Paragraph K6.3.7 has been added as follows.

K6.3.7 Selection of Test Specimens

1 The tensile test specimens whose diameters are 20 *mm* specified in **6.3.7-5, Part K of the Rules**, means a proportional test specimen such as the *U*14*A* tensile test specimen specified in **Chapter 2, Part K of the Rules**.

2 If the loading capacity of the testing machine is not sufficient, the tensile test specimen may be a *U*14*A* tensile specimen instead of the 20 *mm* tensile test specimen specified in **-1** above.

Paragraph K6.3.8 has been added as follows.

K6.3.8 Hydrogen Embrittlement Test

In cases where hydrogen embrittlement test specimens are *U*14*A* tensile test specimens instead of 20 *mm* tensile specimens in accordance with **K6.3.7-2**, the hydrogen embrittlement test is to be carried out in accordance with the following procedures and the test results are to be comply with **6.3.8-2, Part K of the Rules**.

(1) One specimen is to be tested either within a maximum of 3 *hours* after machining, or within a period not exceeding 5 *days* after it has been cooled to -60°C immediately after machining and then maintain at that temperature until tested.

(2) The other specimen is to be tested after baking at 250°C for 4 *hours*.

(3) A slow strain rate (i.e., a strain rate less than 0.0003 s^{-1}) is to be used during the entire test, as far as practicable, and tensile strength, elongation and reduction of area are to be measured.

Paragraph K6.3.9 has been amended as follows.

K6.3.9 Surface Inspection and Non-destructive Test

1 The wording "standards deemed appropriate by the Society" specified in **6.3.9-2** and **-3, Part K of the Rules** means the following standards or the equivalent thereto.

(1) Magnetic particle test: wet continuous magnetization technique specified in *ASTM A*275 or *EN*10228-1

(2) Ultrasonic test: *EN*10228-3, *ASTM A*388 or *ISO*13588

2 The wording "to be appropriately qualified in performing non-destructive ~~examination~~tests" specified in **6.3.9-5, Part K of the Rules**, means those qualified ~~Level~~*Level* II or higher in accordance with *ISO* 9712, *ACCP* or an equivalent qualification deemed appropriate by the Society.

3 Non-destructive test operator qualification according to an employer or responsible agency qualification scheme based on *SNT-TC*-1*A* may be accepted if the employer's written practice is reviewed and found acceptable and the Level III is *ASNT Level* III, *ISO* 9712 *Level* III or *ACCP* Professional *Level* III and certified in the applicable method. In such cases, notwithstanding the requirements in **-2** above, the wording "to be appropriately qualified in performing non-destructive tests" specified in **6.3.9-5, Part K of the Rules**, means those qualified Level II or higher.

Paragraph K6.3.12 has been amended as follows.

K6.3.~~12~~13 Submission of Data

1 The results of the microscopic examinations for non-metallic inclusions specified in **6.3.13(1),**

Part K of the Rules are to conform to national/international standards.

~~1~~**2** The macro etched examination specified in **6.3.~~12~~13(2), Part K of the Rules** is to conform to *ASTM E*381 or other standard as deemed appropriate by the Society.

~~2~~**3** The ~~Jominy~~ hardenability test specified in **6.3.~~12~~13(3), Part K of the Rules** is to conform to *ASTM A*255 or other standard as deemed appropriate by the Society.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2017.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to offshore mooring chains and accessories for offshore mooring chains (hereinafter referred to as "offshore chains and accessories") for which the application for survey is submitted to the Society before 1 July 2017 or offshore chains and accessories being used on offshore structures and single-point mooring systems for which the date of contracts for construction* is before 1 July 2017.

* "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.