IACS Unified Requirements Regarding Steel Forgings and Steel Castings

Amended Rules and Guidance

Rules for the Survey and Construction of Steel Ships Part K
Guidance for the Survey and Construction of Steel Ships Parts C, and K
Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

Reason for Amendment

IACS Unified Requirements (UR) W7 and W8 specify requirements related to the machinery properties and test procedures, etc. for steel forgings (UR W7) and steel castings (UR W8) respectively, and ClassNK has already incorporated these requirements into its Rules for the Survey and Construction Steel Ships.

Since URs W7 and W8 have not been fundamentally revised since 2004, IACS reviewed and amended the URs in consideration of current industry rules and standards. The amended versions of the URs were then respectively adopted as UR W7 (Rev. 4) in February 2022, and as UR W8 (Rev. 3) in March 2022.

Accordingly, relevant requirements are amended in accordance with UR W7 (Rev. 4) and UR W8 (Rev. 3). In addition, relevant requirements related to forgings made by upsetting are amended in order to ensure quality.

Outline of Amendment

(1) The main contents of the amendment for steel castings related to UR W8 (Rev.3) are as follows:
  (a) Amends requirements related to collection procedures and size for test specimens of steel castings.
  (b) Amends requirements related to chemical composition and machinery properties for steel castings.
  (c) Specifies requirements related to impact tests for steel castings.
  (d) Amends requirements related to weld repairs for steel castings.

(2) The main contents of the amendment for steel forgings related to UR W7 (Rev.4) are as follows:
  (a) Amends requirements related to collection procedures for test specimens of steel forgings.
  (b) Specifies requirements related to collection procedures for test specimens of hollow ring forgings.
  (c) Amends requirements related to chemical composition and machinery properties steel forgings.
  (d) Specifies requirements related to impact tests for steel forgings.
  (e) Amends requirements related to weld repairs for steel forgings to specify steel forgings subjected to torsional fatigue are not to be weld repaired.
  (f) Specifies that ingots are to be compressed using anvils whose cross-sections are larger than that of the ingot when upsetting.

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

Part K MATERIALS

Chapter 3 ROLLED STEELS

3.7 Rolled Steel Bars for Machine Structures

Table K3.26 has been amended as follows.

Table K3.26 Grades of Steel Bars

Kind	Grade
Rolled carbon steel bars	The grade of steel bars is to be indicated by suffixing a letter "*R*" to the grade "*KSF*" specified in **Table K6.3(a)** (*ex*. ~~*KSFR41*~~ *KSFR*440-*M*)
Rolled low alloy steel bars	The grade of steel bars is to be indicated by suffixing a letter "*R*" to the grade "*KSFA*" specified in **Table K6.3(a)** (*ex*. ~~*KSFAR60*~~ *KSFAR*600-*M*)

Paragraph 3.7.12 has been amended as follows.

3.7.12 Markings

Steel bars which have satisfactorily complied with the required tests are to be marked with the identification mark in accordance with the requirements in **1.5.1**. For steel bars to which the requirements given in **6.1.6-2** have been applied, the value corresponding to the required tensile strength employed is to be ~~used~~ suffixed to ~~the~~ their respective grade markings~~.~~ (~~ex~~ e.g. ~~W~~where the required tensile strength employed is ~~460~~ 440 N/mm^2, "~~*KSFR47*~~ *KSFR*440-*M*" is to be indicated)

Chapter 5 CASTINGS

5.1 Steel Castings

5.1.2 Manufacturing Process

Sub-paragraph -5 has been added as follows.

5 Steel castings are to be manufactured from killed steel.

5.1.4 Chemical Composition

Sub-paragraphs -1 and -2 have been amended as follows.

1 Steel castings are to have the chemical composition given in **Table K5.1**. Steel castings for welded construction are to have a chemical composition deemed appropriate by the Society.
2 For carbon steel castings intended for welded construction, the carbon content is generally not to exceed 0.23 %. For carbon steel castings complying with this requirement~~s~~, "~~W~~*W*" is to be suffixed to ~~the~~ their respective grade markings (e.g. *KSC440W*).

Table K5.1 has been amended as follows.

Table K5.1 Chemical Composition

Kind	Chemical composition (%)										
	C	*Si*	*Mn*	*S*	*P*	*Cu*	*Cr*	*Ni*	*Mo*	~~*W*~~	Total residual elements
Carbon steel castings	0.40 max.	0.60 max.	0.50-1.60	~~0.040~~ 0.035 max.	~~0.040~~ 0.035 max.	0.30 max.(1)	0.30 max.(1)	0.40 max.(1)	0.15 max.(1)	~~—~~	0.80 max.
~~Low-alloy~~Alloy steel castings	~~0.25~~ 0.45 max.	0.60 max.	0.50-~~0.80~~ 1.60	0.030 max.	~~0.030~~ 0.035 max.	~~0.50 max.(1)~~ 0.30 min.(2)	~~0.30-1.50(2)~~ 0.40 min.(2)	~~0.50 max.(1)~~ 0.40 min.(2)	~~0.15-1.20(2)~~ 0.15 min.(2)	~~0.10 max.(1)~~ —	~~1.00 max.~~ —

Notes:
(1) Elements ~~are~~ considered to be as residual elements. Residual elements are not to be intentionally added to the steel.
(2) ~~Depending on the kind of steel, if one of these elements which complies with the limit is used, the lower limit of the other element need not be considered.~~ One or more of the elements is to comply with the minimum content.

5.1.5 Heat Treatment

Sub-paragraphs -1 and -2 have been amended as follows.

1 For ensuring greater grain refining of the metal crystal, better removal of residual stresses and required mechanical properties, steel castings are to be annealed, normalized, normalized and tempered, or quenched and tempered at proper stages of the manufacturing process; however, alloy steel castings are not to be delivered immediately after annealing. ~~The t~~Tempering temperature is to exceed 550 °C~~.~~, and manufacturers are responsible for selecting heat treatment methods that are appropriate for obtaining the required mechanical properties.

2 Steel castings, which were locally heated or subjected to any cold work after heat treatment, are to be stress-relieved by ~~the~~ approved methods. Castings for components such as crankshafts and engine bedplates, where dimensional stability and freedom from internal stresses are important, are to be given a stress relief heat treatment. This is to be carried out at a temperature of not less than 550 °C followed by furnace cooling to 300 °C or lower. Manufacturers are to strictly control this temperature in order to avoid any detrimental effects to the final heat treatment and resultant microstructure and mechanical properties of the castings.

Table K5.2 has been amended as follows.

Table K5.2 Mechanical Properties of Steel Castings

Kind	Grade	Tensile strength (N/mm^2)	Yield point or proof stress (N/mm^2)	Elongation ($L = 5.65\sqrt{A}$) (%)	Reduction of area (%)
Carbon steel castings	*KSC*42	410 min.	205 min.	24 min.	38 min.
	*KSC*46	450 min.	225 min.	22 min.	29 min.
	*KSC*49	480 min.	240 min.	20 min.	27 min.
	*KSC*53	520 min.	260 min.	18 min.	25 min.
	*KSC*57	560 min.	300 min.	15 min.	20 min.
	*KSC*61	600 min.	320 min.	13 min.	20 min.
Low alloy steel castings	*KSCA*45	440 min.	245 min.	22 min.	40 min.
	*KSCA*49	480 min.	275 min.	17 min.	35 min.
	*KSCA*56	550 min.	340 min.	16 min.	35 min.

Table K5.2 Mechanical Properties of Steel Casting

Kind		Grade	Tensile strength [1] (N/mm^2)	Yield point or proof stress (N/mm^2)	Elongation ($L = 5.65\sqrt{A}$) (%)	Reduction of area (%)	Charpy V-notch impact test [2]	
							Test temperature (°C)	Minimum average energy (J)
Steel castings not intended for welding	Carbon steel castings	*KSC*400	400 min.	200 min.	25 min.	40 min.	*AT*[3]	27
		*KSC*440	440 min.	220 min.	22 min.	30 min.		
		*KSC*480	480 min.	240 min.	20 min.	27 min.		
		*KSC*520	520 min.	260 min.	18 min.	25 min.		
		*KSC*560	560 min.	300 min.	15 min.	20 min.		
		*KSC*600	600 min.	320 min.	13 min.	20 min.		
	Alloy steel castings	*KSCA*550	550 min.	340 min.	16 min.	35 min.		
		*KSCA*600	600 min.	400 min.	16 min.	35 min.		
		*KSCA*650	650 min.	450 min.	14 min.	32 min.		
		*KSCA*700	700 min.	540 min.	12 min.	28 min.		
Steel castings intended for welding	Carbon steel castings	*KSC*400*W*	400 min.	200 min.	25 min.	40 min.	0	
		*KSC*440*W*	440 min.	220 min.	22 min.	30 min.		
		*KSC*480*W*	480 min.	240 min.	20 min.	27 min.		
		*KSC*520*W*	520 min.	260 min.	18 min.	25 min.		
		*KSC*560*W*	560 min.	300 min.	15 min.	20 min.		
		*KSC*600*W*	600 min.	320 min.	13 min.	20 min.		
	Alloy steel castings	*KSCA*550*W*	550 min.	355 min.	18 min.	30 min.		
		*KSCA*600*W*	600 min.	400 min.	16 min.	30 min.		
		*KSCA*650*W*	650 min.	450 min.	14 min.	30 min.		
		*KSCA*700*W*	700 min.	540 min.	12 min.	28 min.		

Notes:

(1) A tensile strength range of 150 N/mm^2 may additionally be specified.

(2) Special consideration may be given to alternative requirements for Charpy V-notch impact tests, depending on design and application, and subject to Society approval.

(3) *AT* refers to the ambient temperature specified in *ISO* 148-1:2016 (i.e. 23 °C±5 °C).

5.1.7 Mechanical Tests

Sub-paragraph -3 has been added as follows.

3 Where the results of impact tests do not conform to the requirements, additional impact tests are to be carried out in accordance with **3.1.10-3**.

Paragraph 5.1.8 has been amended as follows.

5.1.8 Selection of Test Specimens

1 ~~The t~~Test specimens for steel castings are, after final heat treatment, to be taken from the test ~~assembly~~ block cast integral with the body of casting. However, test blocks may be separated from the body of the casting before final heat treatment in cases where deemed appropriate by the Society. At least one test block is to be provided for each casting, and one set of test specimens is to be taken from each test block. The "one set of test specimens" referred to above includes one tensile test specimen and three shock test specimens.

2 The number of test ~~specimens~~ blocks is to be as given in the following **(1)** through **(4)** ~~of the following requirements~~:

(1) Except where specified otherwise ~~specifically specified~~ by the Society, one ~~tensile~~ test ~~specimen~~ block is to be taken from each steel casting. In cases where the mass of one steel casting (as heat treated, hereinafter referred to as the "mass") is more than ten tons, two test ~~specimens~~ blocks are to be taken from each steel casting from the heaviest section, located as far as practicable from each other.

(2) In cases where the mass of one casting is one ton and under one test ~~specimen~~ block is to be taken from every one group of steel castings cast from the same charge and heat treated simultaneously in the same furnace. In cases where the total mass of one group of steel casting exceeds two tons, two test ~~specimens~~ blocks are to be taken.

(3) In cases where a number of steel castings of similar form and size are cast from the same charge and ~~each~~ the mass for ~~the~~ each casting~~s~~ is less than 500 *kg*, test ~~coupons~~ blocks may be separately cast under ~~the~~ Surveyor~~'s~~ approval regardless of the requirements in **-1** and ~~-~~**2** **(2)** above. In this case, ~~one test specimen is to be taken from~~ the test ~~coupon which is~~ blocks are to be heat treated simultaneously with the body of the steel casting in the same furnace.

(4) In cases where one steel casting is made from two or more casts, which are not mixed in a ladle prior to pouring, one ~~tensile~~ test ~~specimen~~ block is to be taken from each charge regardless of the requirements in **(1)** or **(2)** above.

3 ~~The test specimens are to be taken from test assembly having a thickness of not less than 30 *mm*.~~ Test block size is to be in accordance with the following **(1)** through **(3)**:

(1) Test block thickness (t_S) is not to be less than the ruling section of the casting or 30 *mm*, whichever is larger.

(2) The t_S of very thick castings for uses other than stern tubes, stern frames, anchors or rudder horns may be 150 *mm* or less. In such cases, test block length and width are normally to be at least three times t_S, unless otherwise deemed appropriate by the Society (*See* **Fig. K5.1**).

(3) For castings for stern tubes, stern frames, anchors and rudder horns, t_S is to represent the ruling section.

4 Except where specified otherwise by the Society, test specimens are to be taken from test blocks in accordance with the following (*See* **Fig. K5.1**):

(1) For test blocks with thicknesses of 56 *mm* or less, the longitudinal axis of test specimens is to be located at least 14 *mm* from the surface in the thickness direction.

(2) For test blocks with thicknesses more than 56 *mm*, the longitudinal axis of test specimens is to

be located at least t_S /4 from the surface in the thickness direction.

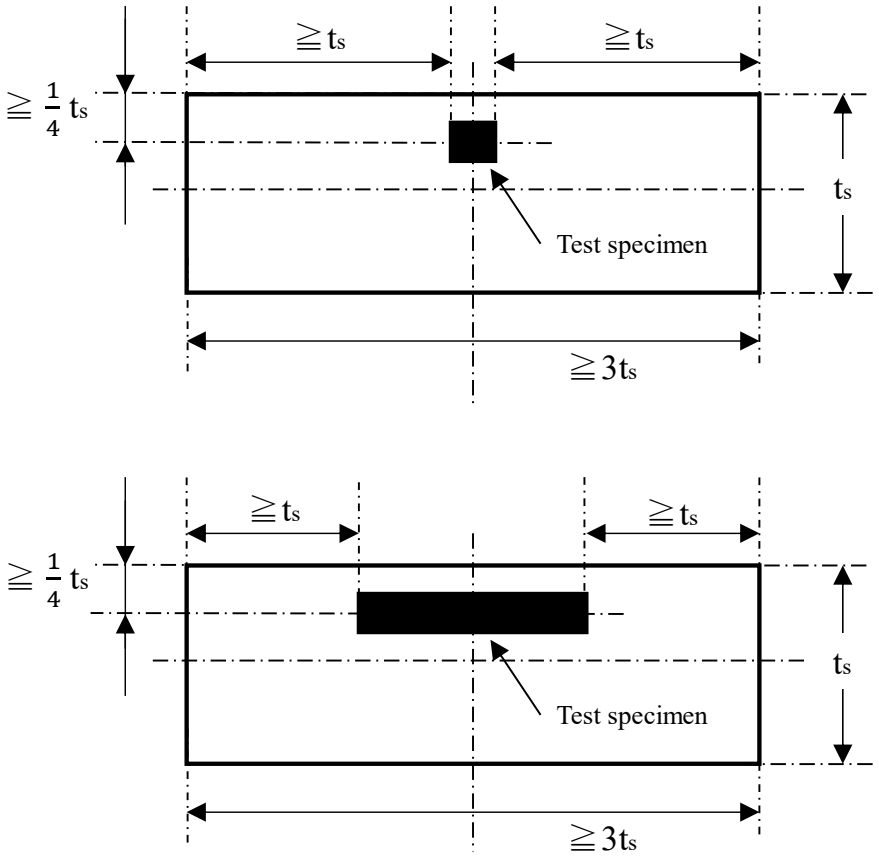
(3) Test specimens are to be taken in such a way that no part of the gauge length is machined from material closer than t_S to any of the other surfaces.

(4) All impact test specimens are to comply with **(1)** and **(2)** above.

5 For alloy steel castings, manufacturers are to propose dimensions for test blocks and are to demonstrate the representative nature of said test block mechanical properties with respect to castings.

Fig. K5.1 has been added as follows.

Fig. K5.1 Test Specimen Positions Relative to Test Block



Note:
The upper figure shows the view from the length direction, and the lower figure shows the view from the width direction.

Paragraph 5.1.11 has been amended as follows.

5.1.11 Repair of Defects*

1 Where castings are to be repaired, manufacturers are to exercise robust control over all repair operations with respect to dimensions, heat treatment, inspection and quality control.

~~**1**~~**2** In the event of finding defects and unacceptable indications considered harmful for the intended use ~~in~~ of the steel casting, the defects are to be removed by a grinder~~, etc~~ or other means. Thermal methods of metal removal of defects and weld repair are to be allowed only before the final heat treatment. All grooves are to have a bottom radius of approximately three times the groove depth and are to be smoothly blended to the surface area with a finish equal to that of the

adjacent surface. After removing the defects, magnetic particle tests or liquid penetrant tests ~~is~~ are to be carried out to ensure that all defects have been completely removed.

~~2~~3 Where ~~the~~ steel castings from which defects were removed are used in that condition, an approval of the Surveyor is to be obtained for confirming ~~the~~ casting adequacy. ~~The s~~Steel castings from which defects were removed may be permitted ~~the~~ to be used without weld repairs provided that ~~they~~ the depth of the defect removal is not over 15 *mm* or 10 % of wall thickness, whichever is less, and will cause no appreciable reduction in the strength of the casting or affect its intended use. ~~The p~~Portions of castings from which defects were removed ~~of defect~~ are to be finished smoothly ~~for~~ to avoid~~ing~~ stress concentration.

~~3~~4 Where ~~the~~ steel castings from which defects were removed are repaired by welding, ~~an~~ the welding consumables used are to be of an appropriate composition, giving weld deposits with mechanical properties similar and in no way inferior to those of the parent castings. In addition, surveyor approval ~~of the Surveyor~~ is to be obtained in advance as to the scope of repairs, welding and heat treatment ~~The Society may request the~~, and welding procedure tests are to be carried out to ~~confirm the~~ demonstrate that satisfactory mechanical properties ~~at~~ can be obtained after the heat treatment of the portion of welded repair.

~~4~~5 ~~The~~ On completion of heat treatment, the portions repaired by welding and adjacent material are to be ground smooth and confirmed that they are free from harmful defects by ~~adequate non-destructive testing~~ magnetic particle or liquid penetrant testing.

~~5~~6 (Omitted)

7 In addition to **-1** to **-6** above, weld repairs for carbon steel castings are to be in accordance with the following **(1)** through **(3)**. Furthermore, weld repairs for carbon alloy steel castings are to be approved by the Society.

(1) Major weld repairs are to be in accordance with the following **(a)** and **(b)**. The term "major weld repairs" refers to those where the depth is greater than 25 % of the wall thickness or 25 *mm*, whichever is less, or the total weld area on a casting exceeds 0.125 m^2 of the casting surface; however, in cases where the distance between two welds is less than their average width, they are to be considered the same weld.
   (a) They are to be carried out before the final delivery heat treatment condition.
   (b) They are to be in accordance with **1.4.3-1**.

(2) Minor weld repairs are to be in accordance with the following **(a)** and **(b)**. The term "minor weld repairs" refers to those other than the major weld repairs described in **(1)** above, except in cases where the Society determines minor repairs for critical areas are to be treated as major repairs.
   (a) They are to be carried out before the final delivery heat treatment condition.
   (b) They may be carried out without prior approval by the Society, except for alloy steels or minor weld repairs that are to be treated as major repairs.

(3) Both major and minor weld repairs are to be in accordance with the following **(a)** through **(d)**.
   (a) All alloy steel castings and all castings for crankshafts are to be suitably pre-heated prior to welding. Carbon steel castings may also require pre-heating depending on their chemical composition as well as the dimensions and positions of the weld repairs.
   (b) Welding procedures are to be approved and match the delivery condition of the casting. Approval for welding procedures is to be in accordance with rules and standards deemed appropriate by the Society.
   (c) Welding is to be done at well ventilated positions free from adverse weather conditions by qualified welders under adequate supervision. As far as possible, all welding is to be carried out in the downhand position.
   (d) After welding has been completed, castings are to be given either a suitable heat treatment in accordance with **5.1.5** or a stress relieving heat treatment at a temperature of

not less than 550 °C for carbon steel castings. For alloy steel castings, the heat treatment is to be agreed with the Society. The type of heat treatment employed is to be dependent on the chemical composition of the casting and the dimensions, positions and nature of the repairs, and is not to affect the properties of the casting. However, where deemed appropriate by the Society, special consideration may be given to the omission of post weld heat treatment or to the acceptance of local stress-relieving heat treatment, where the repaired area is small and machining of the casting has reached an advanced stage.

5.5 Gray Iron Castings

5.5.8 Selection of Test Specimens

Sub-paragraph -2 has been amended as follows.

2 ~~The t~~Test samples are to be cast from the same ladle as the one for castings in the moulds of the same type of material as the one for the moulds ~~for~~ of the castings and are not to be stripped from the moulds until the metal temperature is below 500 °C. ~~The t~~Test samples are to be in the form of bars 30 *mm* in diameter and of a suitable length. When two or more test samples are cast simultaneously in a single mould, the bars are to be at least 50 *mm* apart from each other~~:~~ (*See* **Fig.K5.~~1~~2**).

Fig. K5.1 has been renumbered to Fig. K5.2.

Fig. K5.~~1~~2 Test Sample Shapes ~~of Test Sample~~ (Units: *mm*)
(Fig. is omitted.)

Chapter 6 STEEL FORGINGS

6.1 Steel Forgings

6.1.2 Manufacturing Process*

Sub-paragraph -6 has been amended as follows.

6 Steel forgings are to be subjected to hot work to give ~~enough~~ sufficient forging ratios ~~and~~ that are not less than those ~~given~~ in **Table K6.1**. The requirements, however, may be suitably modified at the discretion of the Surveyor according to the size or form or the use for which they are intended, except for compression deformations of steel ingots or forging materials in the longitudinal direction (i.e. upsetting).

Sub-paragraph -9 has been added as follows.

9 When upsetting, ingots are to be compressed in the axial direction using anvils whose cross-sections are larger than that of the ingot in order to have sufficient internal forging effects (e.g. uniform deformation of internal portions) on the ingot. Forging ratios are to be described on mill sheets.

6.1.4 Chemical Composition

Sub-paragraphs -2 to -4 have been amended as follows.

2 Where carbon steel forgings are not intended for welded constructions, ~~the~~ carbon content ~~is not to exceed 0.23% in consideration of the weldable quality~~ is not to exceed 0.65 %. ~~However, the~~The ~~e~~Carbon content may be increased ~~subject to~~ in cases where the carbon equivalent (C_{eq})~~, which is~~ specified in **1.5.2-2(6)**~~,~~ is ~~to be~~ less than 0.41~~%~~ %.

3 Where ~~low~~ alloy steel forgings are intended for welded constructions, ~~the~~ chemical composition is to be ~~obtained an approval~~ approved by the Society.

4 For steel forgings complying with ~~the requirements in~~ **-2** or **-3** above, "*W*" is to be suffixed to their respective grade markings~~.~~ (~~example :~~ e.g. ~~*KSF*45*W*~~ *KSF*440*W* and *KSFA*600*W-H*).

Table K6.2 has been amended as follows.

Table K6.2 Chemical Composition

Kind	Chemical Composition (~~%~~%) (1)									
	C	*Si*(2)	*Mn*	*P*	*S*	*Cr* (3)	*Mo* (3)	*Ni* (3)	*Cu* (3)	Total residual elements
Carbon steel forgings	~~0.65~~ 0.23 max.	~~0.15~~ 0.45 max.	0.30～1.50	~~0.030~~ 0.035 max.	0.035 max.	0.30~~(3)~~ max.	0.15~~(3)~~ max.	0.40~~(3)~~ max.	0.30~~(3)~~ max.	0.85 max.
~~Low alloy~~Alloy steel forgings	0.45 max. (5)	~~0.15~~ 0.45 max	0.30～1.00 (5)	~~0.030~~ 0.035 max.	~~0.030~~ 0.035 max.	0.40~~~~ ~~3.50~~ min. (4)(5)	0.15~~~~ ~~0.70~~ min. (4)(5)	0.40~~~~ ~~3.50~~ min. (4)(5)	0.30~~(3)~~ max.	—

Notes:

(1) Where other elements ~~are added~~ approved by the Society are added, their contents are to be described ~~on~~ in the test results.

(2) Where ~~the~~ a special deoxidation practice is applied, the value of *Si* may be reduced in cases where approved by the Society.

(3) Elements ~~are~~ considered ~~as~~ to be residual elements except in cases where a minimum value is indicated. Residual elements are not to be intentionally added to the steel. The contents of residual elements are to be described in the test results.

(4) ~~Depending on the kind of steel, if one of these elements which complies with the limit is used, the lower limits of the other elements need not be considered.~~ One or more of the elements is to comply with the minimum content.

(5) For alloy steel forgings for hulls, regardless of the values in the table, specifications are to be submitted to the Society for approval.

6.1.5 Heat Treatment*

Sub-paragraph -1 has been amended as follows.

1 Steel forgings are to be annealed, normalized and tempered, or quenched and tempered at a proper stage of manufacturing process for the purpose of grain refining of the metal crystal, removal of residual stress and of obtaining necessary mechanical properties; however, alloy steel forgings are not to be delivered immediately after annealing. ~~The t~~Tempering temperatures of steel forgings ~~is~~ are not to be less than 550 °C~~.~~, and manufacturers are responsible for selecting heat treatment methods appropriate for obtaining the required mechanical properties. However, where forgings for gearing are not intended for surface hardening, lower tempering temperatures may be allowed.

Sub-paragraph -3 has been amended as follows.

3 Steel forgings which are locally reheated or subjected to cold work involving an excessive degree of straightening are to be stress relieved accordingly. Manufacturers are to strictly control this temperature in order to avoid any detrimental effects to the final heat treatment and resultant microstructure and mechanical properties of the forgings.

6.1.6 Mechanical Properties*

Sub-paragraph -1 has been amended as follows.

1 The mechanical properties of steel forgings are to ~~conform to the requirements given~~ be in

accordance with **Tables K6.3(a) and K6.3(b)**. However, the mechanical properties of low alloy steel forgings for which ~~are applied~~ the following apply may be as deemed appropriate by the Society.

(1) Where the value of yield point or proof stress of the forgings is ~~differed to~~ different from the values ~~of~~ in **Tables K6.3(a) and K6.3(b)**.

(2) (Omitted)

Table K6.3 has been amended as follows.

Table K6.3 Mechanical Properties of Steel Forgings

Kind	Grade	Tensile strength (N/mm^2)	Yield point or proof stress (N/mm^2)	Elongation ($L = 5.65\sqrt{A}$) (%)		Reduction of area (%)	
				L	*T*	*L*	*T*
Carbon steel forgings	*KSF*41	400～520	200 min.	26 min.	19 min.	50 min.	35 min.
	*KSF*45	440～560	220 min.	24 min.	18 min.	50 min.	35 min.
	*KSF*50	490～610	245 min.	22 min.	16 min.	45 min.	30 min.
	*KSF*55	540～660	270 min.	21 min.	15 min.	43 min.	29 min.
	*KSF*60	590～710	295 min.	19 min.	13 min.	40 min.	27 min.
	*KSF*65	640～790	320 min.	17 min.	12 min.	40 min.	27 min.
	*KSF*70	690～840	345 min.	16 min.	12 min.	35 min.	24 min.
	*KSF*75	740～890	370 min.	15 min.	11 min.	35 min.	24 min.
	*KSF*78	760～910	380 min.	14 min.	10 min.	35 min.	24 min.
Low alloy steel forgings	*KSFA* 60	590～740	355 min.	18 min.	14 min.	50 min.	35 min.
	KSFA 65	640～790	385 min.	17 min.	13 min.	50 min.	35 min.
	KSFA 70	690～840	415 min.	16 min.	12 min.	46 min.	31 min.
	KSFA 75	740～890	445 min.	15 min.	11 min.	45 min.	30 min.
	KSFA 80	780～930	470 min.	14 min.	10 min.	42 min.	28 min.
	KSFA 85	830～980	525 min.	13 min.	9 min.	40 min.	27 min.
	KSFA 90	880～1030	600 min.	13 min.	9 min.	40 min.	27 min.
	KSFA 95	930～1130	650 min.	12 min.	8 min.	36 min.	25 min.
	*KSFA*100	980～1180	685 min.	12 min.	8 min.	35 min.	24 min.
	*KSFA*105	1030～1230	720 min.	11 min.	7 min.	35 min.	24 min.
	*KSFA*110	1080～1280	755 min.	11 min.	7 min.	35 min.	24 min.

Notes:

(1) Letters "*L*" and "*T*" in the Table signify the direction of the specimen taken from longitudinal and tangential to the product respectively.

(2) The requirement for carbon steel forgings in above Table are applicable to those annealed, normalized, normalized and tempered or quench and tempered.

(3) The requirement for low alloy steel forgings is applicable to those quenched and tempered. Where they are normalized and tempered, the mechanical properties are to be approved by the Society.

Table K6.3(a) Mechanical Properties of Machinery Steel Forgings

Kind		Grade	Tensile strength [1] (N/mm^2)	Yield point or proof stress (N/mm^2)	Elongation ($L = 5.65\sqrt{A}$) (%)		Reduction of area (%)		Brinell hardness[2] *HBW*	Charpy V-notch impact test [6]		
					L	*T*	*L*	*T*		Test temperature (°C)	Minimum average energy (*J*)[3]	
											L	*T*
For machinery[7]	Carbon steel forgings	*KSF*400-*M*	400 min.	200 min.	26 min.	19 min.	50 min.	35 min.	110～150	*AT*[8]	27	18
		*KSF*440-*M*	440 min.	220 min.	24 min.	18 min.	50 min.	35 min.	125～160			
		*KSF*480-*M*	480 min.	240 min.	22 min.	16 min.	45 min.	30 min.	135～175			
		*KSF*520-*M*	520 min.	260 min.	21 min.	15 min.	45 min.	30 min.	150～185			
		*KSF*560-*M*	560 min.	280 min.	20 min.	14 min.	40 min.	27 min.	160～200			
		*KSF*600-*M*	600 min.	300 min.	18 min.	13 min.	40 min.	27 min.	175～215			
		*KSF*640-*M*	640 min.	320 min.	17 min.	12 min.	40 min.	27 min.	185～230			
		*KSF*680-*M*	680 min.	340 min.	16 min.	12 min.	35 min.	24 min.	200～240			
		*KSF*720-*M*	720 min.	360 min.	15 min.	11 min.	35 min.	24 min.	210～250			
		*KSF*760-*M*	760 min.	380 min.	14 min.	10 min.	35 min.	24 min.	225～265			
	Alloy steel forgings	*KSFA*600-*M*	600 min.	360 min.	18 min.	14 min.	50 min.	35 min.	175～215			
		*KSFA*700-*M*	700 min.	420 min.	16 min.	12 min.	45 min.	30 min.	205～245			
		*KSFA*800-*M*	800 min.	480 min.	14 min.	10 min.	40 min.	27 min.	235～275			
		*KSFA*900-*M*	900 min.	630 min.	13 min.	9 min.	40 min.	27 min.	260～320			
		*KSFA*1000-*M*	1000 min.	700 min.	12 min.	8 min.	35 min.	24 min.	290～365			
		*KSFA*1100-*M*	1100 min.	770 min.	11 min.	7 min.	35 min.	24 min.	320～385			

Notes:

(1) For steel forgings whose specified minimum tensile strength is less than 900 N/mm^2, a tensile strength range of 150 N/mm^2 may additionally be specified. For steel forgings whose specified minimum tensile strength is 900 N/mm^2 or more, a tensile strength range of 200 N/mm^2 may additionally be specified.

(2) Hardness values are standard and are given for information purposes only.

(3) The letters "*L*" and "*T*" refer to longitudinal and tangential respectively and indicate the direction in which the specimen is to be taken with respect to the product.

(4) The requirement for carbon steel forgings is applicable to those annealed, normalized, normalized and tempered, or quench and tempered.

(5) The requirement for low alloy steel forgings is applicable to those quenched and tempered. In cases where they are normalized and tempered, their mechanical properties are subject to Society approval.

(6) Special consideration may be given to alternative requirements for Charpy V-notch impact test, depending on design and application, and subject to Society approval.

(7) For steel forgings complying with the table, "-*M*" is to be suffixed to their respective grade markings (e.g.: *KSF*400-*M*and *KSFA*600*W*-*M*)

(8) *AT* refers to the ambient temperature specified in *ISO* 148-1:2016 (i.e. 23 °C±5 °C).

Table K6.3(b) Mechanical Properties of Hull Steel Forgings

Kind		Grade	Tensile strength [1] (N/mm^2)	Yield point or proof stress (N/mm^2)	Elongation ($L = 5.65\sqrt{A}$) (%)		Reduction of area (%)		Charpy V-notch impact test [5]		
					L	*T*	*L*	*T*	Test temperature (°C)	Minimum average energy (*J*)[2]	
										L	*T*
For hull[6]	Carbon steel forgings	*KSF*400-*H*	400 min.	200 min.	26 min.	19 min.	50 min.	35 min.	0	27	18
		*KSF*440-*H*	440 min.	220 min.	24 min.	18 min.	50 min.	35 min.			
		*KSF*480-*H*	480 min.	240 min.	22 min.	16 min.	45 min.	30 min.			
		*KSF*520-*H*	520 min.	260 min.	21 min.	15 min.	45 min.	30 min.			
		*KSF*560-*H*	560 min.	280 min.	20 min.	14 min.	40 min.	27 min.			
		*KSF*600-*H*	600 min.	300 min.	18 min.	13 min.	40 min.	27 min.			
	Alloy steel forgings	*KSFA*550-*H*	550 min.	350 min.	20 min.	14 min.	50 min.	35 min.			
		*KSFA*600-*H*	600 min.	400 min.	18 min.	13 min.	50 min.	35 min.			
		*KSFA*650-*H*	650 min.	450 min.	17 min.	12 min.	50 min.	35 min.			

Notes:

(1) For steel forgings whose specified minimum tensile strength is less than 600 N/mm^2, a tensile strength range of 120 N/mm^2 may additionally be specified. For steel forgings whose specified minimum tensile strength is 600 N/mm^2 or more, a tensile strength range of 150 N/mm^2 may additionally be specified.

(2) The letters "*L*" and "*T*" refer to longitudinal and tangential respectively and indicate the direction in which the specimen is taken with respect to the product.

(3) The requirement for carbon steel forgings is applicable to those annealed, normalized, normalized and tempered, or quench and tempered.

(4) The requirement for low alloy steel forgings is applicable to those quenched and tempered. In cases where they are normalized and tempered, their mechanical properties are subject to Society approval.

(5) Special consideration may be given to alternative requirements for Charpy V-notch impact test, depending on design and application, and subject to Society approval.

(6) For steel forgings complying with the table, "*-H*" is to be suffixed to their respective grade markings (e.g. *KSF*400-*H* and *KSFA*600*W-H*)

6.1.7 Mechanical Test

Sub-paragraph -3 has been amended as follows.

3 For propeller shafts used for ~~the~~ ships with ice class notation (except *ID* class ships), Charpy V-notch impact testing is to be carried out for all steel types at ~~-~~ −10~~℃~~ °C and the average energy value is to be minimum ~~27~~20 *J* (using a set of three *U*4 test specimen for longitudinal test). Where the energy values of two or more specimens among a set of specimens are less than ~~27~~20 *J* or where one individual value is less than 70~~%~~ % of ~~27~~20 *J*, the test is considered to have been failed. ~~Additional tests may be carried out in accordance with the requirements specified in **3.1.10-3.**~~

Sub-paragraph -4 has been added as follows.

4 Where the results of impact tests do not conform to the requirements, additional impact tests are to be carried out in accordance with **3.1.10-3**.

Paragraph 6.1.8 has been amended as follows.

6.1.8 Selection of Test Specimens

(-1 and -2 are omitted.)

3 Unless otherwise agreed, the longitudinal axis of test specimens is to be positioned as follows:

(1) For thicknesses (*t*) or diameters (*D*) ~~up to maximum~~ of 50 *mm* or less, the axis is to be at ~~the mid-thickness or the centre of the cross section~~ a distance of *t*/2 or *D*/2 below the heat treated surface.

(2) For thicknesses (*t*) or diameters (*D*) of greater than 50 *mm*, the axis is to be at ~~one quarter thickness~~ *t*/4 or *D*/4 (mid-radius) or 80 *mm*, whichever is less, below any heat treated surface as shown in **Fig. K6.1**.

(3) For ring and disc forgings for which the thickness is 25 *mm* or less, tangential test specimens are to be taken at a distance of *t*/2 below the heat treated surface in both the vertical and horizontal directions.

(4) For ring and disc forgings for which the thickness is greater than 25 *mm*, tangential test specimens are to be taken at a distance of 12.5 *mm* below the heat treated surface in both the vertical and horizontal direction. No part of the test specimen is to be closer than 12.5 *mm* to any heat treated surface, as shown in **Fig. K6.1**.

4 Notwithstanding **-3** above, where manufacturers demonstrate that a proposed testing location or orientation is more representative of the required mechanical properties of a component, this location or orientation may allowed by the Society. In such cases, the heat treatment process, the proposed testing location or orientation, and technical justification are to be submitted to the Society for approval.

~~4~~5 The ~~N~~number of test specimens is to be ~~as given~~ in accordance with the following **(1)** through **(4)** ~~of the following requirement~~. In ~~this~~ such cases, "~~O~~one set of specimens" means one tensile test specimen and one set of three impact test specimens~~. However, "One set of specimens" means one tensile test specimen and one set of three impact test specimens for propeller shafts used for the ships with ice class notation~~:

(1) ~~Where a~~For steel forgings ~~is~~ more than 4 *tons* ~~and over~~ in mass and 3 *m* in length as heat treated (hereinafter referred to as "mass" and "length"), one set of test specimens is to be taken from both ends of the steel forging.

(2) ~~Where~~ For steel forgings more than 4 *tons* in mass and 3 *m* or less in length or for ~~a~~ steel forgings ~~is~~ 500 *kg* ~~up to~~ or greater but 4 *tons* ~~(exclusive)~~ or less in mass, one set of test

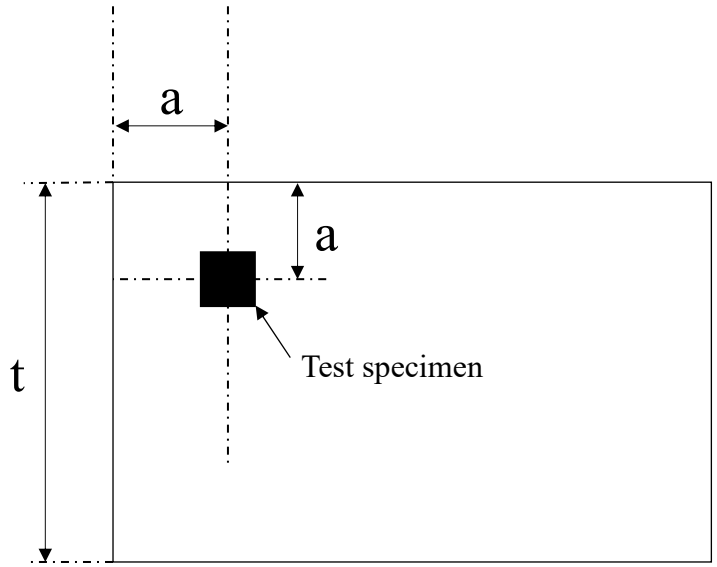
specimens is to be taken from one end of the forging in a longitudinal direction; however, the alternative directions or positions shown in **Fig. K6.2** thorough **Fig. K6.4** may be used at manufacturer discretion.

((3) and (4) are omitted.)

~~5~~**6** (Omitted)

Fig.K6.1 to Fig.K6.4 have been added as follows.

Fig. K6.1 Test Specimen Position



Note:

"*t*" is the thickness of the steel forging, and "*a*" is the distance from the test specimen to heat treated surface based on **6.1.8-3(2)** and **(4)**.

Fig. K6.2 Alternative Directions or Position of the Test Specimen for Plain Shaft

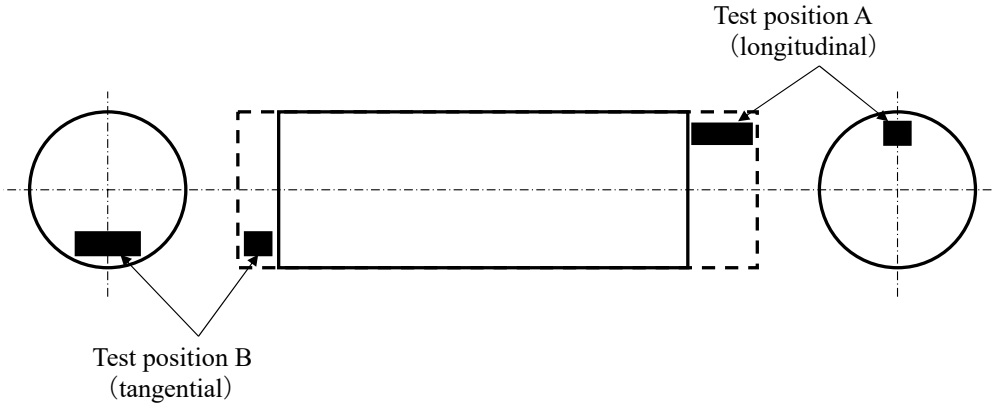


Fig. K6.3 Alternative Directions or Positions for the Test Specimens for Flanged Shafts

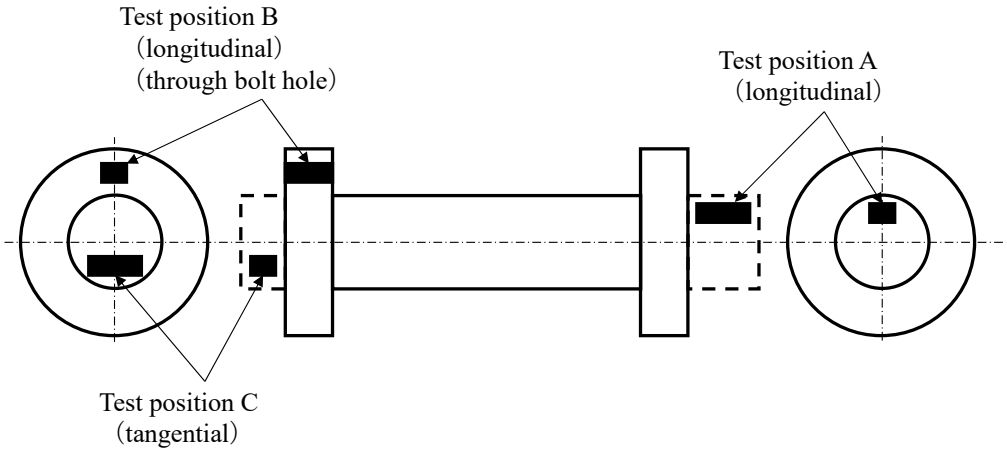
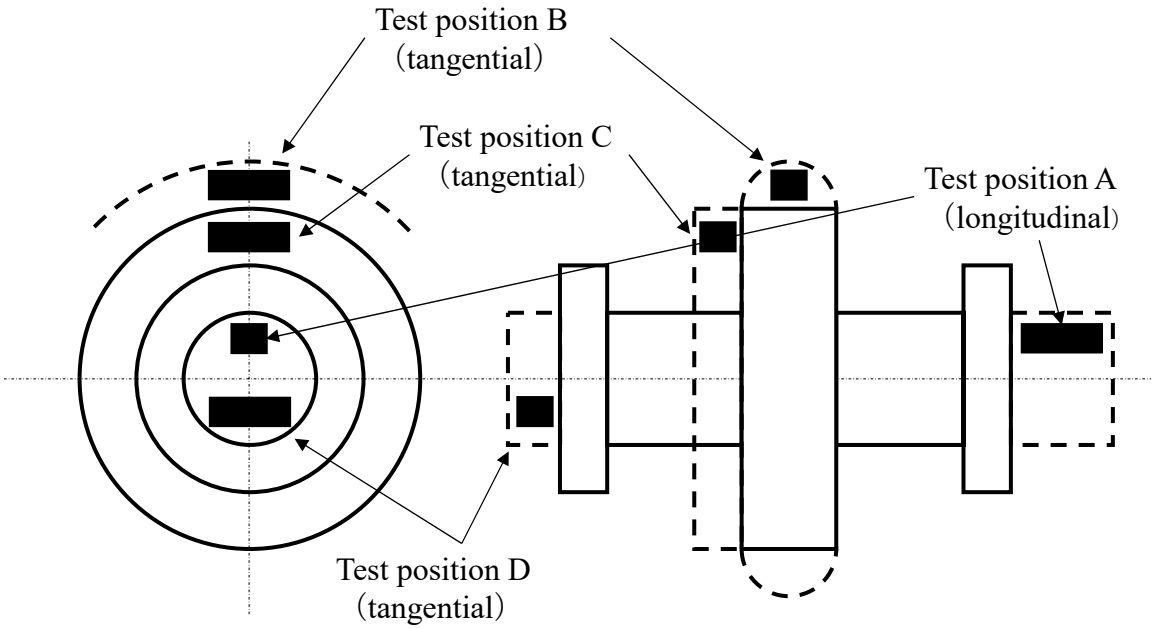


Fig. K6.4 Alternative Directions or Positions for the Test Specimen for Flanged Shafts with Collars



6.1.10 Non-destructive Testing*

Sub-paragraphs -6 and -7 have been added as follows.

6 Where advanced ultrasonic testing methods are applied (e.g. *PAUT* or *TOFD*), they are to be in accordance with requirements specified otherwise by the Society.

7 Where forgings are supplied in the "as forged" condition for machining at separate works and it is physically or technically difficult to conduct ultrasonic examinations (e.g. probes cannot be fitted onto forgings during machining), manufacturers are to conduct suitable ultrasonic examinations in accordance with procedures deemed appropriate by the Society.

6.1.11 Repair of Defects*

Sub-paragraph -4 has been amended as follows.

4 Repair welding of forgings except those subjected to torsional fatigue, such as crankshaft forgings and propeller shaft forgings, may be permitted subject to Society approval ~~of the Society~~. In such cases, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted to the Society for ~~the~~ approval.

6.1.14 Additional Requirements for Turbine Rotors

Sub-paragraph -1 has been amended as follows.

1 ~~The t~~Test specimens for turbine rotors are to be taken in accordance with the following **(1)** and **(2)** ~~of the following requirements~~:

(1) Where ~~the~~ turbine rotors ~~is~~ are greater than 3 *tons* in mass, one set of longitudinal test specimens is to be taken from each end of the shaft portion and one set of tangential test specimens is to be taken in the tangential direction from the body portion ~~respectively.~~ (*See* **Fig. K6.~~1~~5**).

(2) (Omitted)

Sub-paragraph -2 has been amended as follows.

2 For each turbine disc, one set of tangential test specimens in the tangential direction is to be taken from the boss portion~~.~~ (*See* **Fig. K6.~~2~~6**).

Fig. K6.1 and Fig. K6.2 have been renumbered to Fig. K6.5 and Fig. K6.6.

Fig. K6.~~1~~5 Selection of Test Specimens for Turbine Rotors
(Fig. is omitted.)

Fig. K6.~~2~~6 Selection of Test Specimens for Turbine Discs
(Fig. is omitted.)

Paragraph 6.1.15 has been amended as follows.

6.1.15 Additional Requirements for Reduction Gears*

1 Pinions intended for reduction gears are to conform to ~~items~~ the following **(1)** through **(4)** ~~of the following requirements~~:

(1) Where the finished diameter over the portion where teeth will be cut ~~is~~ does not exceed~~ing~~ 200 *mm*, one set of longitudinal test specimens is to be taken from one end of the journal~~.~~ (*See* **Fig. K6.~~3~~7**).

(2)

(a) Where the ~~above~~ finished diameter is greater than 200 *mm* and ~~the mass of one piece is~~

~~greater than 3 *tons*~~ the length of one piece is greater than 1.25 *m*, one set of tangential test specimens is to be taken from each end of the adjacent portion where the teeth will be cut (~~s~~*See* **(A)** in **Fig. K6.4~~8~~**). In the case of pinions where the diameter of journal precludes the preparation of test specimens from this portion, ~~above~~ tangential test specimens may be taken from the ends of the journal (~~s~~*See* **(B)** in **Fig. K6.4~~8~~**). Where the finished journal diameter ~~is~~ does not exceed~~ing~~ 200 *mm*, one set of longitudinal test specimens may be taken from each end of the journals (~~s~~*See* **(C)** in **Fig. K6.4~~8~~**).

(b) Where the finished diameter is greater than 200 *mm* and ~~the mass is not exceeding 3 *tons*~~ the length of one piece is greater than 1.25 *m*, one set of test specimens is to be taken from one end of the pinion in accordance with **(a)**.

(3) Where the pinions are so designed that the tooth body is inserted in the shaft, one set of tangential test specimens in the tangential direction is to be taken from the ends of the tooth body. Where the finished length is greater than 1.25 *m*, one set of test specimens is to be taken from each end.

(4) (Omitted)

2 Rims intended for reduction gears are to conform to ~~items~~ the following **(1)** through **(3)** ~~of the following requirements~~:

(1) Where the finished diameter of a rim exceeds 2.5 ~~*metres*~~ *m* or the mass exceeds 3 *tons*, one set of tangential test specimens is to be taken from each end of the rim at ~~the positions~~ diametrically ~~opposed~~ opposite positions (~~s~~*See* **Fig. K6.~~5~~10**). In cases where the finished width of the rim ~~is~~ does not exceed~~ing~~ 1 *m*, one set each test specimens may be taken from either ~~one~~ end of the rim at ~~the positions~~ diametrically ~~opposed~~ opposite positions. The mechanical properties are to conform to the requirements applicable to ~~the~~ cases ~~of~~ where test specimens are taken ~~is~~ in the direction parallel to the forging direction.

((2) and (3) are omitted.)

3 For gear wheels, one set of tests is to be taken from each forging in a tangential direction (*See* **Fig. K6.11**).

~~3~~**4** (Omitted)

4 The gears specified in **-1** to **-~~3~~4** are to be subjected to the following hardness tests:

((1) to (3) are omitted.)

Paragraph 6.1.16 has been added as follows.

6.1.16 Forged Rings (such as slewing rings)

Test specimens for forged rings (such as slewing rings) are to be taken in accordance with the following **-1** and **-2** (*See* **Fig. K6.12**):

1 Where the finished diameter is 2.5 *m* or less, one set of test specimens is to be taken from each forging in a tangential direction.

2 Where the finished diameter is greater than 2.5 *m* or the mass is greater than 3 *tons*, two sets of test specimens are to be taken at diametrically opposite positions.

Fig. K6.3, Fig. K6.4 and Fig. K6.5 have been renumbered to Fig. K6.7, Fig. K6.8 and Fig. K6.10, and Fig. K6.9, Fig. K6.11 and Fig. K6.12 have been added as follows.

Fig. K6.~~3~~7 Selection of Test Specimens for Pinions Not Exceeding 200 *mm* in Finished Diameter

(Fig. is omitted.)

Fig. K6.~~4~~8 Selection of Test Specimens for Pinions Greater Than 200 *mm* in Finished Diameter
(Fig. is omitted.)

Fig. K6.9 Selection of Test Specimens for Pinion Sleeves

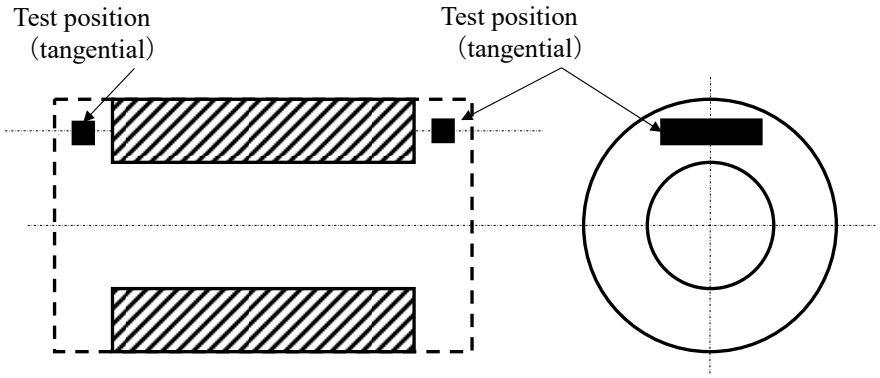


Fig. K6.~~5~~10 Selection of Test Specimens for Rim
(Fig. is omitted.)

Fig. K6.11 Selection of Test Specimens for Gear Wheel

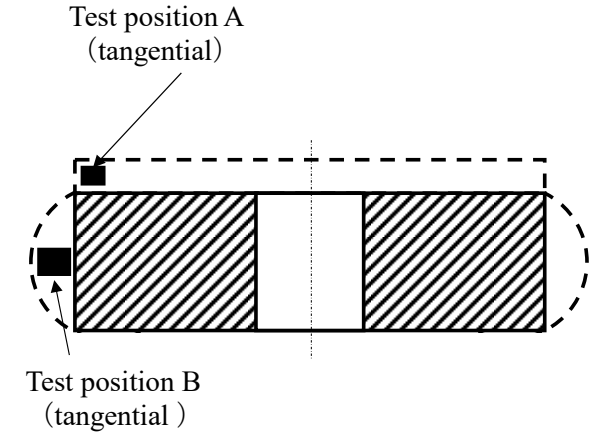
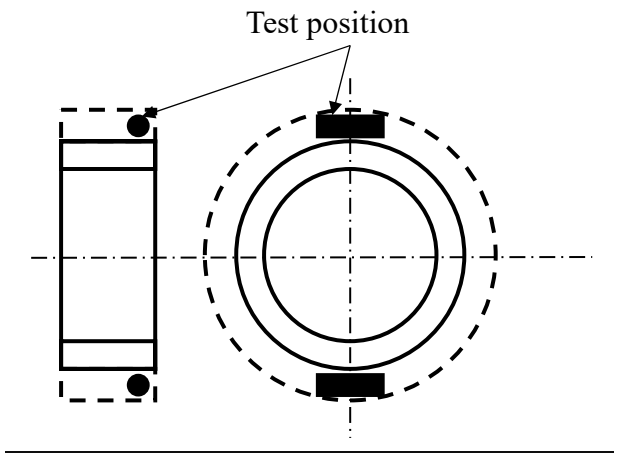
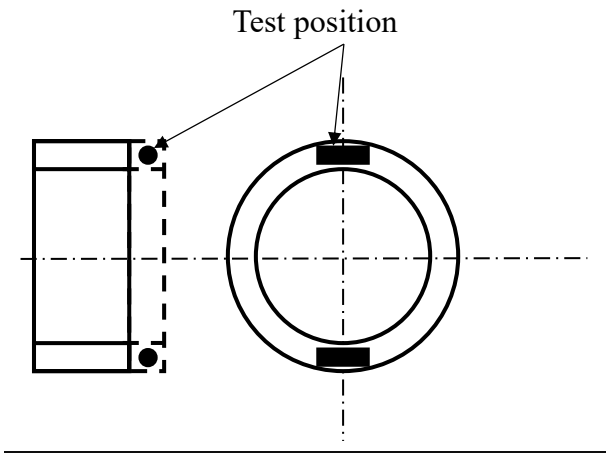


Fig. K6.12 Selection of Test Specimens for Forged Rings

(a) Where extended portion is fitted on the circumferential surface



(b) Where extended portion is fitted on the axial surface



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

Part C HULL CONSTRUCTION AND EQUIPMENT

Part 1 GENERAL HULL REQUIREMENTS

C13 RUDDERS

C13.2 Rudders

C13.2.1 General

C13.2.1.2 Materials

Sub-paragraph -2 has been amended as follows.

2 Rolled bar steel (~~*KSFR45*~~*KSFR*440-*M*) may be treated in the same way as ~~*KSF45*~~*KSF*440-*M*.

Part K MATERIALS

K5 CASTINGS

K5.1 Steel Castings

Paragraph K5.1.8 has been added as follows.

K5.1.8 Selection of Test Specimens

1 The wording "when deemed appropriate by the Society" specified in **5.1.8-1, Part K of the Rules** means the cases for which the Society approves test blocks separated from the body of casting be heat treated simultaneously with the body of the steel casting in the same furnace, and the test specimens taken from such test blocks represent the microstructure and mechanical properties of the steel casting.

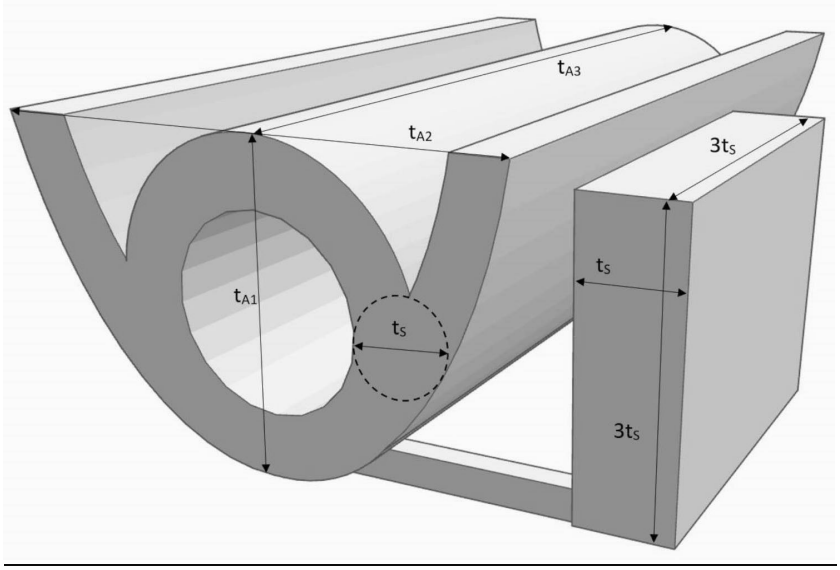
2 For the wording "ruling section" specified in **5.1.8-3(1), Part K of the Rules,** reference is to be made to *ISO* 683-1:2018 and *ISO* 683-2:2018.

3 Shorter width or length may be accepted for test blocks where actual casting width or length (t_A) is in the range between t_S and $3t_S$.

Example 1) For a general casting with dimensions 140 *mm* × 160 *mm* × 1250 *mm*, the required test block size would typically be 140 *mm* × 160 *mm* × 420 *mm* (that is $t_S \times t_A \times 3t_S$).

Example 2) For a stern tube casting with dimensions 1000 *mm* × 600 *mm* × 1800 *mm* (width t_{A1} × height t_{A2}× length t_{AS}) and ruling section t_S = 170 *mm*, the required test block size would typically be 170 *mm* × 510 *mm* × 510 *mm* (that is $t_S \times 3t_S \times 3t_S$) (*See* **Fig. K5.1.8-1**).

Fig. K5.1.8-1 Test Block Gated to Stern Tube Casting



K5.1.11 Repair of Defects

Sub-paragraphs -4 and -5 have been added as follows.

4 The wording "the rules and standards deemed appropriate by the Society" specified in **5.1.11-7(3)(b), Part K of the Rules** means **Chapter 4, Part M of the Rules** or *ISO* 11970:2016.
5 For steels with carbon contents of 0.23 % or more, or for which the carbon equivalent (C_{eq}) specified in **1.5.2-2(6), Part K of the Rules** is 0.45 % or more, welding procedure qualification tests (*WPQT*) on which welding procedure tests (*WPS*) are based are recommended to be carried out using base materials having a C_{eq} as follows:

The C_{eq} of the base material is not to fall below more than 0.02 % of the material to be welded; for example, the WPQT for a material with an actual C_{eq} = 0.50 % may be tested using a material with $C_{eq} \geq$ 0.48 %.

K6 STEEL FORGINGS

K6.1 Steel Forgings

K6.1.10 Non-destructive Testing

Sub-paragraphs -3 and -4 have been added as follows.

3 The wording "other non-destructive tests considered adequate by the Society" specified in **6.1.10-3, Part K of the Rules** means, for example, test procedures in accordance with the IACS Recommendation No. 68.
4 The wording "requirements specified otherwise by the Society" specified in **6.1.10-6, Part K of the Rules** means **Chapter 9, Part M of the Rules**.

Annex K5.1.11(1) GUIDANCE FOR REPAIRS BY WELDING FOR CAST STEEL CRANK THROWS

Section 1.1 has been amended as follows.

1.1 General

(1) Where defects are discovered in the crank throws of cast steel crankshafts under manufacture (including full built-up crank webs: hereafter called, the crank throws), repairs by welding may be carried out in accordance with the following standards. However, where the depth of the depression from which all defects have been removed is ~~less than 0.05*t* (*t* is the web's thickness)~~ not over 15 *mm* or 10 % of wall thickness, whichever is less, and will cause no appreciable reduction in the strength of the casting or affect its intended use, it is recommended that no repairs by welding be carried out. In this case, the finishing of the base part of the depression ~~shall~~ is to be such that the rounding ~~there~~ is over ~~twice~~ three times the depth of the depression~~, and~~ the angle between it and surface is sufficiently rounded up, and it is equal to smoothness of the adjacent surface.

((2) and (3) are omitted.)

(4) Where castings are to be repaired, manufacturers are to exercise robust control over all repair operations with respect to dimensions, heat treatment, inspection and quality control.

Annex K5.1.11(3) GUIDANCE FOR REPAIRING OF HULL STEEL CASTINGS

1.1 Application

Sub-paragraph -2 has been amended as follows.

2 In ~~either~~ case<u>s</u> where, after removing defects, ~~the~~ steel castings are <u>either</u> used as they are or repair weldings are ~~carried out~~ <u>made</u>, <u>surveyor</u> approval ~~of the Surveyor~~ is to be obtained. In case<u>s</u> where the depth of the recess after removing ~~the~~ defects is not larger than 15 *mm* (or 10 <u>%</u> of the thickness of the steel castings, whichever is smaller) and the length is not more than 100 *mm*, the steel castings may be used without repair welding. <u>In such cases, however, there is to be no appreciable reduction in the strength of the casting and its intended use is not to be affected.</u>

1.2 Methods of Repairing

~~The d~~<u>D</u>efects are to be completely removed either by scarfing, gouging, chipping, grinding or machining, and to be repaired by either of the following methods:

Sub-paragraph -1 has been amended as follows.

1 In <u>the</u> case of no repair welding being carried out

~~The p~~<u>P</u>ortions ~~required~~ <u>requiring</u> no repair welding~~s~~ after removing defects~~,~~ are to be finished with a grinder~~, etc.~~ <u>or other means</u> in accordance with the following:

(1) The bottom of the groove is to be rounded with a radius greater than ~~twice~~ <u>three times</u> the depth.

"Guidance for the approval and type approval of materials and equipment for marine use" has been partly amended as follows:

Part 1 METALLIC MATERIALS

Chapter 1 APPROVAL OF MANUFACTURING PROCESS OF ROLLED STEELS

1.4 Approval Test

Table 1.1-2 has been amended as follows.

Table 1.1-2 Approval Test Items for Rolled Steels

Rolled steels		Kind of test (See Note(1))																								
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)
(Omitted)																										
Rolled carbon steel bars	*KSFR*41~*KSFR*78 *KSFR*400-*M*~ *KSFR*760-*M*	○	○			○	○		○	○		○													○
Rolled low alloy steel bars	*KSFAR*60~*KSFAR*110 *KSFAR*600-*M*~ *KSFAR*1100-*M*	○	○			○	○		○	○		○													○
(Omitted)																										

(Notes are omitted.)

Chapter 3 APPROVAL OF MANUFACTURING PROCESS OF STEEL CASTINGS AND STEEL FORGINGS

3.1 General

Table 1.3-1 has been amended as follows.

Table 1.3-1 Kinds of Materials and Finished Products

Material classification		Product classification
Castings	Carbon steel castings*	(Omitted)
	~~Low-alloy~~Alloy steel castings	
	Stainless steel castings	
	Steel castings for low temperature services	
	Spheroidal graphite iron castings	
	Grey iron castings	
Forgings	Carbon steel forgings*	
	~~Low-alloy~~Alloy steel forgings	
	Stainless steel forgings	
	Steel forgings for low temperature services	

(Notes are omitted.)

3.4 Approval Test

Paragraph 3.4.3 has been amended as follows.

3.4.3 Details of Test

Details of the tests for those listed in **3.4.1(1)** are as follows.

(1) Kinds of Steel

~~The t~~Tests are to be carried out for each kind of steel~~s~~ as the standard practice. Even within the category of steel forgings, normalized steels (including annealed steels or annealed steels after normalization) and quenched and tempered steels are to be considered different kinds of steels. However, for example, in case where approval for carbon steel forgings in both ~~*KSF*50~~ *KSF*550-*M* and ~~*KSF*60~~ *KSF*600-*M* is applied, tests on ~~*KSF*60~~ *KSF*600-*M* which has a higher tensile strength are to be carried out as the standard practice.

The same principle is to be applied in dealing with *Cr*-*Mo* steel forgings and *Ni*-*Cr*-*Mo* steel forgings.