RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part K Materials

2021 AMENDMENT NO.1

Rule No.29 30 June 2021

Resolved by Technical Committee on 27 January 2021

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

Rule No.29 30 June 2021
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

Chapter 5 CASTINGS

5.7 Stainless Steel Propeller Castings

5.7.1 Application

Sub-paragraph -3 has been added as follows.

1 The requirements specified in **5.7** apply to the stainless steel castings intended to be used for propellers and propeller blades (hereinafter referred to as "steel propeller castings" in **5.7**).
2 Steel propeller castings with characteristics differing from those specified in **5.7** are to comply with the requirements in **1.1.1-3**.
3 Manufacturers are responsible for ensure that effective quality, process and production controls within the manufacturing specifications are adhered during manufacturing.

Paragraph 5.7.3 has been amended as follows.

5.7.3 Chemical Composition
1 The chemical composition of steel propeller castings is to comply with the requirements specified in **Table K5.12**.
2 Manufacturers are to maintain records of the chemical analyses of the production casts, and these records are to be made available to Surveyor.

Paragraph 5.7.7 has been amended as follows.

5.7.7 Selection of Test Specimens
1 The test specimens for steel propeller castings are to be taken from the integrally cast test samples attached to the propeller castings. The test samples separately cast from the steel propeller castings are subject to the prior approval.
2 The dimensions of test samples attached to blades are to be deemed appropriate by the Society.
~~**2**~~**3** The test samples attached to~~on~~ blades are to be located in an area between 0.5*R* to 0.6*R*, where *R* is the radius of the propeller, and not to be detached from the castings until the final heat treatment has been carried out. Removal is to be by non-thermal procedures.
~~**3**~~**4** At least one test sample is to be made on material representing each steel propeller casting. Where a number of small propellers of about the same size, and less than 1 *m* in diameter, are made from one cast and heat treated in the same furnace charge, a batch testing procedure may be adopted using separately cast test samples of suitable dimensions. In this case, at least one test sample is to be made for each multiple of five castings in the batch.
~~**4**~~**5** Mechanical tests are to be carried out with one test specimen and one set of test specimens for tensile test and impact test respectively.

Paragraph 5.7.8 has been amended as follows.

5.7.8 Surface and Dimensional Inspection*

1 ~~The steel propeller castings are to be subjected to visual inspection on zone A, B and C shown in **Fig. K7.1**, in the finished condition. The inspection may also be required at other proper processing stages if necessary~~ A general visual examination is to be carried out by the Surveyor. All finished castings are to be 100 % visually inspected by the manufacturer.

2 All castings are to be free from imperfections which would be prejudicial to their proper application in service.

~~2~~3 The dimensional inspections of steel propeller castings are to be performed by the manufacturer. Where straightening of a bent blade is carried out, the approval by the Society is to be obtained in advance. The procedure for the straightening is to be deemed appropriate by the Society.

4 Dimensional inspection reports are to be submitted to Surveyor, and surveyors may require checks be made in their presence when deemed necessary.

Paragraph 5.7.9 has been amended as follows.

5.7.9 Non-destructive Inspection*

1 The steel propeller castings are to be subjected to the penetrant test deemed appropriate by the Society. Magnetic particle tests deemed appropriate by the Society may be used in lieu of liquid penetrant tests for examinations of *KSCP*1, *KSCP*2 and *KSCP*3. In such cases, the magnetic particle test procedure is to be submitted to the Society.

2 The ultrasonic or radiographic test is to be required, if deemed necessary by the Society. The ultrasonic test procedure is to be approved by the Society.

3 Qualification of non-destructive inspection operators is to comply with **7.3.2** to **7.3.4**, **Part M of the Rules**.

Paragraph 5.7.10 has been amended as follows.

5.7.10 Repair of Defects*

1 The defects which would be prejudicial to the proper application of steel propeller castings in service, are to be removed by grinding, etc., and the contour of the ground depressions are to be as smooth as possible. ~~Adequate non-destructive inspection is~~ Liquid penetrant tests or magnetic particle tests in accordance with **5.7.9-1** are to be carried out on the repaired areas to ensure that all defects have been completely removed to the Surveyor's satisfaction. Notwithstanding the zones, welds having area less than 5 cm^2 are to be avoided.

2 Weld repairs for the parts where defects were removed are to comply with the following requirements according to the zones for the non-destructive inspection shown in **Fig. K7.1**:

(1) The zones where weld repairs are allowed are to be as follows:
Zone A : Weld repairs are not allowed.
Zone B : Weld repairs are subject to the approval.
Zone C : Weld repairs are allowed.

(2) Prior to the weld repair on zone B or C mentioned in **(1)** above, the extent of the repair, a repair plan including welding procedures, welding consumables, edge preparations for weld repair after removing defects and heat treatment is to be submitted and approved by the Society.

(3) ~~An adequate non-destructive inspection is~~ Liquid penetrant tests on welded areas are to be carried out ~~on the welded areas~~ in the presence of a surveyor to ensure that no defect exists.

3 The welding procedures are to be as deemed appropriate by the Society. The welding procedures and related specifications approved by the Society are valid for welding work in all shops and sites belonging to the yard under the same facility and control system.

4 Foundries are to maintain records of inspections, welding, and any subsequent heat treatments, traceable to each casting.

Paragraph 5.7.11 has been amended as follows.

5.7.11 Marking and Test Certificate

1 Marking for steel propeller castings is to comply with the requirements specified in ~~**5.1.12**~~**7.2.12-1**.

2 Test certificate for steel propeller castings is to comply with the requirements specified in **7.2.12-2**.

Chapter 7 COPPER AND COPPER ALLOYS

Section 7.2 has been amended as follows.

7.2 Copper Alloy Castings

7.2.1 Application

1 The requirements specified in **7.2** are to apply to the copper alloy casting to be used for propellers and propeller blades (hereinafter referred to as "propeller castings" in **7.2**).

2 Propeller castings having characteristics differing from those specified in **7.2** are to comply with the requirements in **1.1.1-3**.

3 Manufacturers are responsible for ensuring that effective quality, process and production controls within the manufacturing specifications are adhered to during manufacturing.

~~**3**~~**4** Copper alloy castings to be used for important parts other than propeller castings are to conform to the requirements given in *JIS* or equivalent thereto. In this case, testing and inspection may not require the presence of the Society's Surveyor except where special requirements are given in connection with the design.

7.2.3 Chemical Composition

1 The chemical composition of propeller castings is to comply with the requirements specified in **Table K7.4**. Moreover, for *KHBsC*1 and *KHBsC*2, they are also to comply with the following **(1)** or **(2).**

(1) The zinc equivalent as specified below does not exceed 45 %.

Zinc equivalent (%)$= 100 - \frac{100 \times Cu(\%)}{100+A}$

where

$A = Sn + 5Al - 0.5Mn - 0.1Fe - 2.3Ni$ (%)

(2) Each tensile test specimen is examined metallographically, and the proportion of alpha-phase determined from an average of five counts is not less than 25 %.

2 Manufacturers are to maintain records of the chemical analyses of the production casts, and these records are to be made available to the Surveyor.

Table K7.4 Chemical Composition (%)

Grade	*Cu*	*Al*	*Mn*	*Zn*	*Fe*	*Ni*	*Sn*	*Pb*
*KHBsC*1	52～62	0.5～ 3.0	0.5～ 4.0	35～40	0.5～2.5	1.0 max.	1.5 max.	0.5 max.
*KHBsC*2	50～57	0.5～ 2.0	1.0～ 4.0	33～38	0.5～2.5	2.5～8.0	1.5 max.	0.5 max.
*KAℓBC*3	77～82	7.0～11.0	0.5～ 4.0	1.0 max.	2.0～6.0	3.0～6.0	0.1 max.	0.03 max.
*KAℓBC*4	70～80	6.5～ 9.0	8.0～20.0	6.0 max.	2.0～5.0	1.5～3.0	1.0 max.	0.05 max.

7.2.4 Manufacturing Process

1 Pouring is to be carried out into dried moulds using degassed liquid metal.

2 Pouring is to be controlled to avoid turbulences of flow.

3 Special devices or procedures are to be employed to prevent slag from flowing into moulds.

7.2.4~~5~~5 Heat Treatment

Where propeller castings are heat treated, detailed procedure for the heat treatment is to be submitted for approval before the heat treatment is started.

7.2.5~~6~~6 Mechanical Properties

The mechanical properties of propeller castings are to comply with the requirements specified in **Table K7.5**.

Table K7.5 Mechanical Properties

Grade	Proof stress (N/mm^2)	Tensile strength (N/mm^2)	Elongation(%) (L=5d)
*KHBsC*1	175 min.	440 min.	20 min.
*KHBsC*2	175 min.	440 min.	20 min.
*KAℓBC*3	245 min.	590 min.	16 min.
*KAℓBC*4	275 min.	630 min.	18 min.

Notes:

(1) The requirements specified in this Table apply to specimens cut from separately-cast samples, where specimens cut from propeller casting itself, the requirements are to be deemed appropriate by the Society.

(2) The requirements concerning proof stress apply to cases where proof stress is required by the Society in relation with design.

7.2.6~~7~~7 Mechanical Tests

1 Mechanical tests on propeller castings are to be tensile test, and to be carried out in compliance with the requirements specified in **Chapter 2**.

2 Where any test result from the first test specimen selected fails to meet the requirements, additional tests may be conducted according to the requirements given in **1.4.4**. The test specimens for the additional tests are to be taken from the same sample from which the first test specimen is taken or from other test samples representative of the propeller castings.

7.2.7~~8~~8 Selection of Test Specimens*

1 The test samples for propeller castings are to be separately cast from the propeller castings. In addition to complying with **5.7.7-3**, test specimens to be taken from integrally cast test samples are to as deemed appropriate by the Society.

2 The test samples are to be cast in moulds made of the same material as the mould for the propeller castings and they are to be cast under the same condition as the propeller castings. The shapes and dimensions of the test samples are to be deemed appropriate by the Society.

3 The test samples are to be cast from the same ladle of metal used for the propeller castings except the cases where special requirements are given by the Society. Where more than one ladles of metal are used for propeller castings without mixing before pouring, one test sample is to be

provided for each ladle.

4 When propellers are to be subjected to heat treatment, their test samples are to be heat treated together with them.

~~4~~5 One test specimen is to be taken from each test sample.

7.2.~~8~~9 Surface and Dimensional Inspection*

1 ~~The propeller castings are to be subjected to visual inspection on zone A, B and C shown in **Fig. K7.1** in the finished condition. The inspection may also be required at other proper processing stages if necessary.~~ All finished castings are to be 100 % visually inspected by the manufacturer. A general visual examination is to be carried out by the Surveyor.

2 Castings are to be free from cracks, hot tears, or other imperfections which (due to their nature, degree or extent) will interfere with the use of the castings.

~~2~~3 The dimensional inspections of propeller castings are to be conducted by the manufacturer. Where straightening of a bent blade is carried out, the procedure for the straightening is to be deemed appropriate by the Society.

4 Dimension inspection reports are to be submitted to Surveyor, and Surveyor may require checks to be made in their presence when deemed necessary.

7.2.~~9~~10 Non-destructive Inspection*

1 The propeller castings are to be subjected to the penetrant test deemed appropriate by the Society.

2 The ultrasonic or radiographic test is to be required if deemed necessary by the Society. The ultrasonic test procedure is to be approved by the Society.

3 Qualification of non-destructive inspection operators is to comply with **7.3.2** to **7.3.4**, **Part M of the Rules**.

7.2.1~~0~~1 Repair of Defects*

1 In event of finding defects which would be prejudicial to the proper application of propeller castings in service, the defects are to be removed by grinding, etc., and the surfaces of the ground depressions are to be as smooth as possible. ~~Adequate non-destructive inspection is~~ Liquid penetrant tests are to be carried out to the repaired areas to ensure that all defects have been completely removed, and the repaired propeller casting is to be approved by the Society's surveyor upon the use in service.

2 Repair weldings for the parts where defects were removed are to comply with the following requirements according to the zones for non-destructive inspection shown in **Fig. K7.1**. Notwithstanding the zones, welds having areas less than 5 cm^2 are to be avoided.

(1) The areas according to **Fig. K7.1** where repair weldings are acceptable are to be as follows:
Zone A : Repair weldings are not allowed
Zone B : Repair weldings are allowed provided that prior approval was given by the Society
Zone C : Repair weldings are allowed

(2) Prior to the weld repair on zone B or C mentioned in **(1)** above, the extent of the repair, a repair plan including welding procedures, welding consumables, edge preparations for weld repair after removing defects and heat treatment is to be submitted and approved by the Society.

(3) ~~An adequate non-destructive inspection is~~ Liquid penetrant tests on welded areas are to be carried out ~~on the welded areas~~ in the presence of a surveyor to ensure that no defect exists.

3 The welding procedures are to be as deemed appropriate by the Society. The welding procedures and related specifications approved by the Society are valid for welding work in all shops and sites belonging to the yard under the same facility and control system.

4 Foundries are to maintain records of inspections, welding, and any subsequent heat treatments, traceable to each casting.

7.2.1~~1~~2 Marking and Test Certificate

1 ~~Marking for~~ In addition to **5.1.12**, propeller castings ~~is~~ are to ~~comply~~ be marked with the ~~requirements given in~~ ~~**5.1.12**~~ following **(1)** through **(3)** particulars:

(1) Date of final inspection

(2) Ice class symbol, where applicable

(3) Skew angle for high skew propellers.

2 In addition to **1.5.2**, test certificate for propeller castings is to contain the following **(1)** through **(11)** particulars:

(1) Purchaser, order number and shipbuilding project number, if known

(2) Description of the casting with drawing number

(3) Diameter, number of blades, pitch, direction of turning

(4) Grade of alloy and chemical composition of each heat

(5) Heat or casting number

(6) Final weight

(7) Results of non-destructive tests and details of test procedure where applicable

(8) Portion of alpha-phase for *KHBsC*1 and *KHBsC*2 alloys

(9) Results of the mechanical tests

(10) Casting identification number

(11) Skew angle for high skew propellers

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 July 2021.

2. Notwithstanding the amendments to the Rules, the current requirements apply to propeller castings other than propeller castings that fall under any of the following:

(1) propeller castings being used on ships for which the date of contract for construction* is on or after the effective date; or

(2) propeller castings for which the application for inspection is submitted to the Society on or after effective date; or

(3) propeller castings for which the application for approval is submitted to the Society on or after effective date.

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

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

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

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

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

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

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

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

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

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

Note:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part K Materials

2021 AMENDMENT NO.1

Notice No.28 30 June 2021

Resolved by Technical Committee on 27 January 2021

Notice No.28 30 June 2021
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

K1 GENERAL

K1.4 Testing and Inspection for Materials

Paragraph K1.4.1 has been amended as follows.

K1.4.1 Execution of Testing and Inspection

1 To implement the surveys specified in **1.4.1-1, Part K of the Rules**, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.

2 The wording "Where the quality of materials and the quality control system of manufacturer are deemed appropriate by the Society" ~~specified~~ in **1.4.1-5**, **Part K of the Rules**, means that the quality of materials and the quality control system of manufacturer are approved by the Society according to **Rules for Approval of Manufacturers** or deemed equivalent thereto.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 1 July 2021.

Amendment 1-2

K5 CASTINGS

K5.7 Stainless Steel Propeller Castings

Paragraph K5.7.7 has been added as follows.

K5.7.7 Selection of Test Specimens

The wording "to be deemed appropriate by the Society" in **5.7.7-2**, **Part K of the Rules** means to be in accordance with either *JIS G* 0307 or an equivalent standard approved by the Society. The aforementioned standards, in principle, refer to the most recent version published.

Paragraph K5.7.9 has been amended as follows.

K5.7.9 Non-destructive Inspection

1 The wording "the penetrant test deemed appropriate by the Society" in **5.7.9-1**, **Part K of the Rules** means those specified in **Annex K7.2.9** "GUIDANCE FOR THE PENETRANT TEST OF PROPELLER CASTINGS".

2 The wording "magnetic particle test deemed appropriate by the Society" means to be in accordance with *ISO* 9934-1, *JIS Z* 2320-1 or an equivalent standard approved by the Society. The aforementioned standards, in principle, refer to the most recent version published.

3 The acceptance criteria or applied quality levels for ultrasonic or radiographic tests are to be agreed upon between the manufacturer and the Society in accordance with a recognized standard.

Table K5.7.8-1 Temperature of Hot Straightening

Grade	Temperature (°C)
*KSCSP*1	～700(1)
*KSCSP*2	590～620(1)
*KSCSP*3	
*KSCSP*4	Ambient Temperature(2)

Notes:

(1) Stress relieving may be omitted if the temperature of hot straightening is maintained for an hour after the straightening is completed.

(2) In case where work hardening is excessive, solution treatment is to be carried out.

Paragraph K5.7.10 has been amended as follows.

K5.7.10 Repair of Defects

The wording "to be as deemed appropriate by the Society" in **5.7.10-3**, **Part K of the Rules** means the followings:

(1) The position of welding is, in principle, to be flat.

(2) The welders are to be qualified as deemed appropriate by the Society.

(3) The recommended temperature of the preheating and stress relieving heat treatment after welding is given in **Table K5.7.10-1**. The martensitic steel propeller castings are to be furnace re-tempered after welding repairs except for the case of local stress relieving for minor repairs subject to the prior approval

(4) Welding grooves are to be prepared in a manner that allows good fusion of the groove bottom.

(~~4~~5) The welding procedure qualification tests are to be carried out in the presence of a Surveyor as follows:

(a) Tests for butt welding

i) Test sample

The minimum dimensions of the test sample are to be as shown in **Fig.K5.7.10-1**. ~~The edge preparation is, in principle, to be V-shape and the bevel angle is to be not less than 60 degrees.~~

ii) ~~Visual~~ Non-destructive inspection

Test assemblies are to be examined by visual and liquid penetrant tests prior to the cutting of test specimens. Magnetic particle tests may be used in lieu of liquid penetrant tests for examinations of *KSCP*1, *KSCP*2 and *KSCP*3. The welded surface is to be regular and uniform and free from prejudicial defects such as cracks and undercuts. In cases where post-weld heat treatment is carried out, non-destructive inspections are to be performed after the heat treatment.

iii) Macro-etching test

~~The number of the macro-etching specimens is to be two~~ Three test specimens are to be prepared and etched on one side to clearly reveal the weld metal, the fusion line and the *HAZ*. No pores greater than 3 *mm* and cracks in welded sections is permitted.

iv) Tensile test

The shapes and dimensions of the tensile test specimens are to be of kind *U*2*A* or *U*2*B* given in **Table M3.1**, **Part M of the Rules**. The tensile test is to be carried out with two test specimens. The tensile strength is to meet the required values of the base metal. The location of fracture (i.e. the weld metal, *HAZ* or base material) is to be reported.

v) Bend test

The shapes and dimensions of the ~~tensile~~ bend test specimens are to be of kind *UB*-~~2~~1 given in **Table M 3.2~~(a)~~**, **Part M of the Rules**. ~~The bend test is to be carried out with two test specimens.~~ Two root and two face bend specimens are to be tested. For thicknesses of 12 *mm* and over, four side bend specimens may alternatively be tested. In such cases, the shapes and dimensions of the side bend test specimens are to be of kind *UB*-2 given in **Table M 3.2**, **Part M of the Rules**. There is to be no crack nor any other defects greater than ~~2~~3 *mm* in length in any direction on the surface of bent specimen. The diameter of the former is to be 4 times the thickness for martensitic stainless steel propeller castings and 3 times the thickness for austenitic stainless steel propeller castings. The bending angle is to be 180 degrees.

vi) Impact test

Impact test is required, except where the test is not required for the base metal. The shapes and dimensions of the tensile test specimens are to be of kind *U*4 given in **Table K2.5**, **Part K of the Rules**. Two sets (i.e. total six specimens) are to be tested. One set (i.e. three specimens) of them is to have the notch positioned in the center of the weld and the other set is to have the notch positioned in ~~the fusion line~~ *HAZ*(*FL*+1*mm*), respectively. The test temperature and impact energy are to comply with the requirements specified for the base material.

vii) Hardness testing

One of the macro-sections is to be used for hardness testing. The hardness of the weld metal, the heat-affected zones (both sides) and the base material (both sides) are to be reported for information. Test force is to be 98.07 *N*.

(b) Test of mold cavity welding

i) Test piece

The dimensions of the test piece are to be as shown in **Fig. K7.2.10-2**.

ii) Macrostructure test

The cross section of welded part is to be free from defects such as cracks.

iii) Microstructure test
The microstructures of the welded metal, base metal and heat-affected zones are to be in satisfactory condition.

iv) Hardness test
The deviation among the hardness of the welded metal, base metal and heat-affected zones is not to be significant.

(6) Where the tests specified in the preceding **(5)** fail, retests are to be in accordance with **4.2.12**, **Part M of the Rules**.

(7) The scope of approval of the welding procedures and related specifications of steel propeller castings are to be in accordance with the following **(a)** through **(h)**, on the condition that the other welding conditions are same.

(a) Base metal
Range of approval for steel cast propeller is limited to steel grade tested.

(b) Thickness
Range of thickness is to be in accordance with **Table K5.7.10-2**.

(c) Welding position
Approval for a test made in any position is restricted to that position.

(d) Welding process
Approval is only valid for the welding process used in the welding procedure test. Single run is not qualified by a multi-run butt weld test.

(e) Filler metal
Approval is only valid for the filler metal used in the welding procedure test.

(f) Heat input
The upper limit of heat input approved is 15 % greater than that used in welding the test piece. The lower limit of heat input approved is 15 % lower than that used in welding the test piece.

(g) Preheating and interpass temperature
The minimum preheating temperature is not to be less than that used in the qualification test. The maximum interpass temperature is not to be higher than that used in the qualification test.

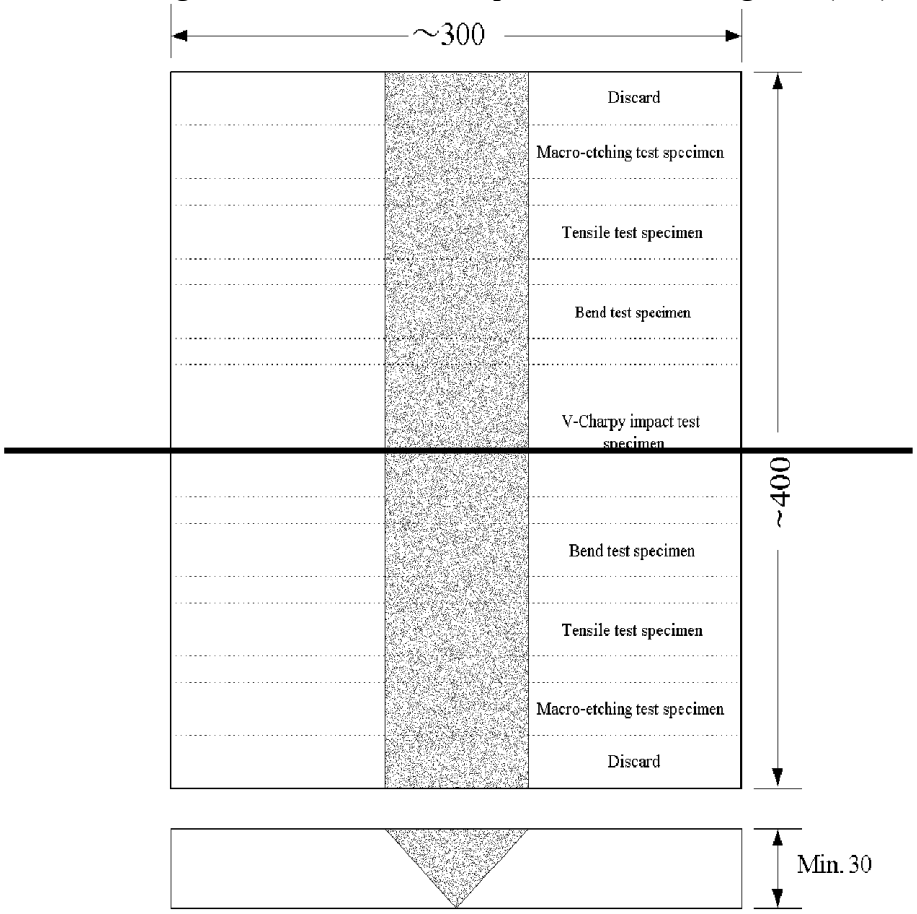
(h) Post-weld heat treatment
Heat treatment used in the qualification test is to be maintained during actual work. Holding time may be adjusted as a function of thickness.

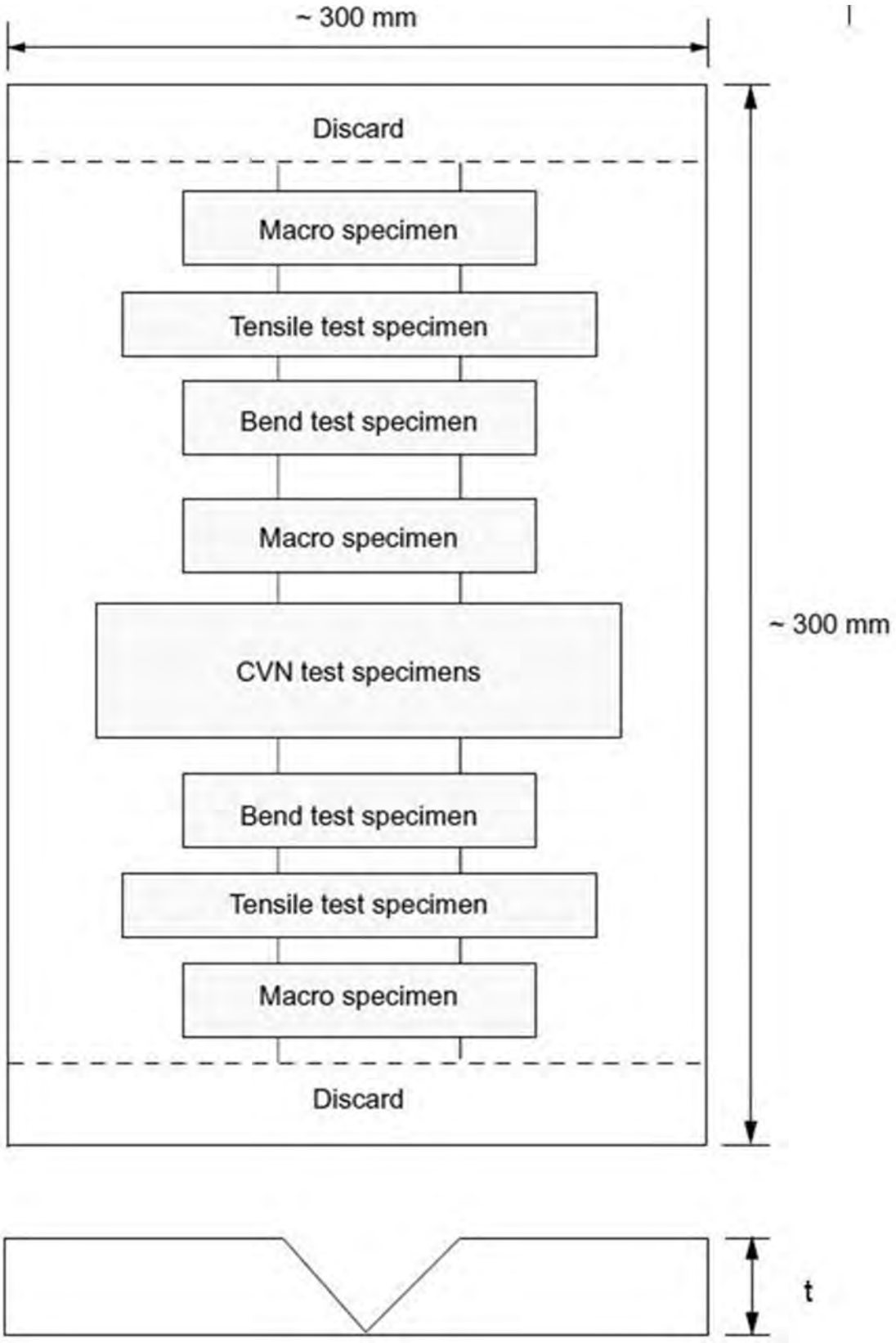
Table K5.7.10-1 Temperature for Heat Treatment

Grade	Preheat temperature (℃)	Interpass Temperature (℃)	Stress relief Temperature (℃)
*KSCSP*1	100～200	350	680～730
*KSCSP*2	100～200	300	590～620
*KSCSP*3	20～100	200	590～620
*KSCSP*4	Not applicable	Not applicable	Not applicable

Fig. K5.7.10-1 has been amended as follows.

Fig. K5.7.10-1 Test Sample for Butt Welding Test (*mm*)





Note: Joint preparation and fit-up as detailed in the preliminary welding procedure specification

Table K5.7.10-2 has been added as follows.

Table K5.7.10-2 Approval range of thickness

Thickness of the test sample, t (*mm*)	Approval range
$15 < t \leq 30$	3 *mm* to 2 t
$30 < t$	0.5 t to 2 t or 200 *mm*, whichever is the greater

K7 COPPER AND COPPER ALLOYS

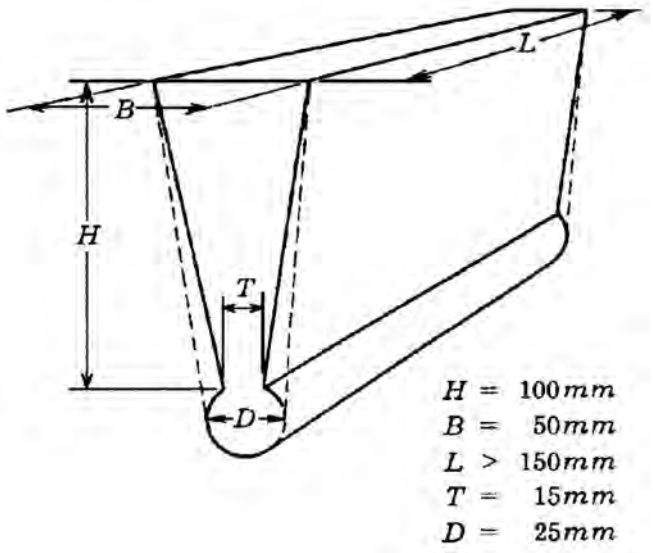
Section K7.2 has been amended as follows.

K7.2 Copper Alloy Castings

K7.2.~~7~~8 Selection of Test Specimens

The wording "to be deemed appropriate by the Society" in **7.2.~~7~~8-2, Part K of the Rules** means that the shapes and dimensions of the test samples are to comply with those given in **Fig. K7.2.~~7~~8-1**. The shape given by the dotted lines shown in the figure, however, may be acceptable.

Fig. K7.2.~~7~~8-1 Shapes and Dimensions of the Test Samples



K7.2.~~8~~9 Surface and Dimensional Inspection

1 The wording "to be deemed appropriate by the Society" in the **Note (4)** of **Fig. K7.1, Part K of the Rules** means to comply with **Fig. K7.2.~~8~~9-1**.

2 The wording "to be deemed appropriate by the Society" in **7.2.~~8~~9-2, Part K of the Rules** means that the procedure for the straightening is to comply with the following~~s~~.

(1) Loading used for straightening purposes is to be static.

(2) In case of hot straightening, the uniform heating is to be conducted to a sufficient area, and

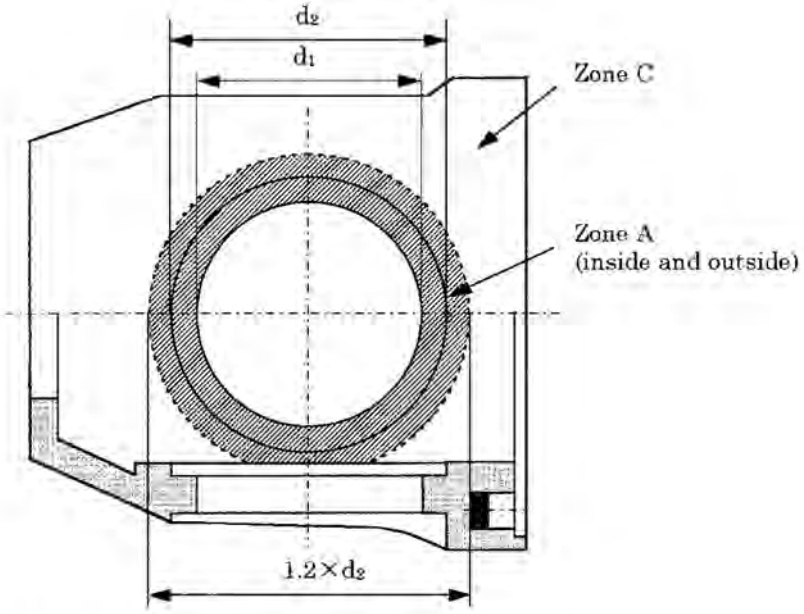
the temperature is to be measured by a suitable instrument. The temperature is to be maintained within the range given in **Table K7.2.~~8~~9-1** during the straightening operation. Weld repaired areas may be subject to hot straightening, provided it can be demonstrated that the weld properties are not impaired by the hot straightening operations and it is approved by the Society.

(3) Cold straightening is to be restricted to the case of minor repairs of tips and edges. Cold straightening is to be followed by a stress relieving heat treatment except *KAlBC*3. The heat treatment is to be conducted in accordance with the requirement of **K7.2.1~~0~~1(3).**

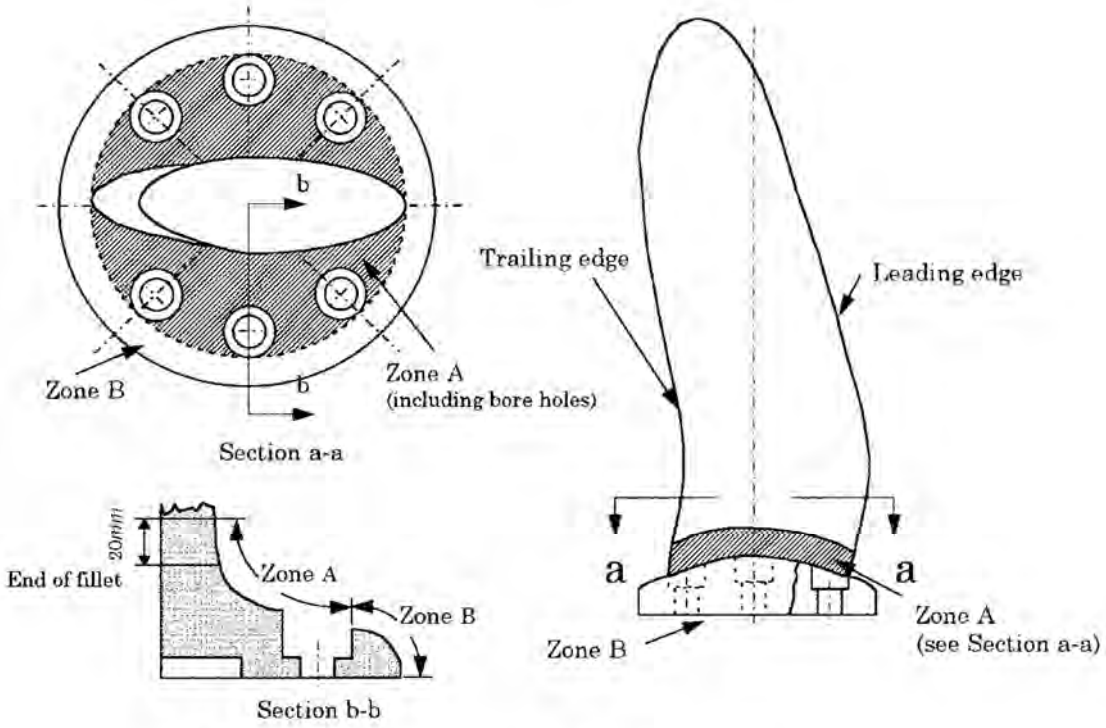
Table K7.2.~~8~~9-1 Temperature for Hot Straightening

Grade	Temperature (℃)
*KHBsC*1	500～800
*KHBsC*2	500～800
*KAlBC*3	700～900
*KAlBC*4	700～850

Fig. K7.2.~~8~~9-1 The Zones for Non-destructive Inspection in the Root Areas of the Controllable Pitch or Build up Propeller Blades and Controllable Pitch Propeller Bosses



(a) Zones for Non-destructive Inspection for Controllable Pitch Propeller Boss



(b) The zones for non-destructive inspection on the root areas of the of controllable pitch or build up propeller blades (for remaining surface of the propeller blades, see **Fig. K7.1, Part K** of the Rules)

K7.2.~~9~~10 Non-destructive Inspection

1 The wording "the penetrant test deemed appropriate by the Society" in **7.2.~~9~~10-1, Part K of the Rules** means to that the penetrant test which complies with the **Annex K7.2.~~9~~10** "GUIDANCE FOR THE PENETRANT TEST OF PROPELLER CASTINGS".

2 The acceptance criteria or applied quality levels are to be agreed upon between the manufacturer and the Society in accordance with a recognized standard.

K7.2.1~~0~~1 Repair of Defects

The wording "to be as deemed appropriate by the Society" in **7.2.1~~0~~1-3, Part K of the Rules** means to comply with the following~~s~~.

(1) The kinds of weldings are to be either *MIG* or *TIG* welding, and the position of welding is, in principle, to be flat. The welding consumables are, in principle, to be aluminium bronze or the common metals.

(2) The welders are to have qualifications deemed appropriate by the Society.

(3) The preheating and stress relieving heat treatment following the repair weldings are to be in accordance with the requirements given in **Table K7.2.1~~0~~1-1** and **K7.2.1~~0~~1-2**.The area to be heat treated is to be as large as possible.

(4) Welding grooves are to be prepared in a manner that allows good fusion of the groove bottom.

(~~4~~5) The welding procedure qualification tests are to be carried out in the presence of a Surveyor as follows:

(a) Tests for butt welding

i) Test sample

The minimum dimensions of the test sample are to be as shown in **Fig.K7.2.1~~0~~1-1**. ~~The edge preparation is, in principle, to be V-shape and the bevel angle is to be not less than 60 degrees.~~

ii) ~~Visual~~ Non-destructive inspection

Test assemblies are to be examined by visual and liquid penetrant tests prior to the cutting of test specimens. The welded surface is to be regular and uniform and free from prejudicial defects such as cracks and undercuts. In cases where post-weld heat treatment is carried out, non-destructive inspections are to be performed after the heat treatment. Imperfections detected by liquid penetrant tests are to be assessed in accordance with **Annex K7.2.10** "GUIDANCE FOR THE PENETRANT TEST OF PROPELLER CASTINGS".

iii) Macro-etching test

~~The number of the macro etching specimens is to be three.~~ Three test specimens are to be prepared and etched on one side to clearly reveal the weld metal, the fusion line and the *HAZ*. No pores greater than 3 *mm* and cracks in welded sections are to be permitted.

iv) Tensile test

The shapes and dimensions of the tensile test specimens are to be of kind *U*2*A* or *U*2*B* given in **Table 3.1, Part M of the Rules**. The number of tensile test specimens is to be two. The tensile strength is to be in compliance with **Table K7.2.1~~0~~1-3**.

(b) Test of mold cavity welding

i) Test piece

The dimensions of the test piece are to be as shown in **Fig.K7.2.1~~0~~1-2**.

ii) Macrostructure test

Macrostructure tests are to confirm that no any defects such as crack exist in the cross sections of weld parts.

iii) Microstructure test

Microstructure tests are to confirm that the microstructures of the deposit metal,

base metal and heat-affected zones are in satisfactory condition.

iv) Hardness test

Hardness tests are to confirm that there is no unacceptable fluctuation in hardness between the deposit metal, base metal and heat-affected zones.

(6) Where the tests specified in the preceding **(5)** fail, retests are to be in accordance with **4.2.12**, **Part M of the Rules**.

(7) The scope of approval of the welding procedures and related specifications of propeller castings are to be in accordance with the following **(a)** through **(h)**, on the condition that the other welding conditions are same.

(a) Base metal

Range of approval for propeller castings is limited to be in accordance with **Table K7.2.11-4**.

(b) Thickness

Range of thickness is to be in accordance with **Table K7.2.11-5**.

(c) Welding position

Approval for a test made in any position is restricted to that position.

(d) Welding process

Approval is only valid for the welding process used in the welding procedure test. Single run is not qualified by a multi-run butt weld test.

(e) Filler metal

Approval is only valid for the filler metal used in the welding procedure test.

(f) Heat input

The upper limit of heat input approved is 25 % greater than that used in welding the test piece. The lower limit of heat input approved is 25 % lower than that used in welding the test piece.

(g) Preheating and interpass temperature

The minimum preheating temperature is not to be less than that used in the qualification test. The maximum interpass temperature is not to be higher than that used in the qualification test.

(h) Post-weld heat treatment

Heat treatment used in the qualification test is to be maintained during actual work. Holding time may be adjusted as a function of thickness.

Table K7.2.1~~0~~1-1 Temperature for Heat Treatment

Grade	Preheat temperature (℃)	Interpass temperature (℃)	Stress relief temperature (℃)
*KHBsC*1	150 min.	300 max.	350～500
*KHBsC*2	150 min.	300 max.	350～550
*KAlBC*3	50 min.	250 max.	450～550
*KAlBC*4	100 min.	300 max.	450～600

Notes:

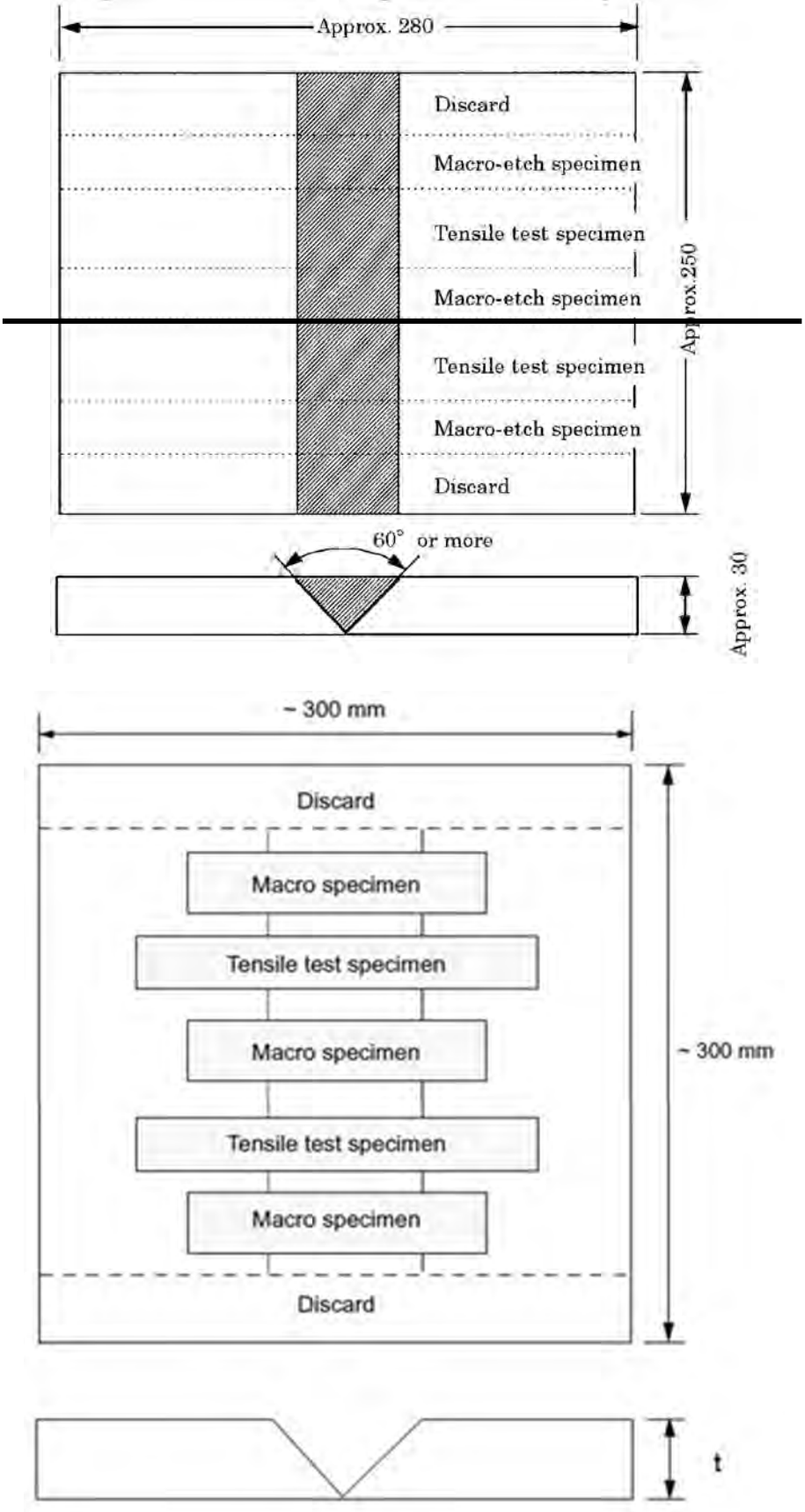
(1) The cooling rate after any stress relieving heat treatment is , in principle, not to exceed 50 ℃/*h* until the temperature reaches 200 ℃.

(2) Stress relieving for *KAlBC3* may be dispensed with.

Table K7.2.1~~0~~1-2 Soaking Times for Stress Relief Heat Treatment

Stress relief temperature (℃)	*KHBsC1* and *KHBsC2*		*KAlBC3* and *KAlBC4*	
	Hours per 25 *mm* thickness	Maximum soaking times (*h*)	Hours per 25 *mm* thickness	Maximum soaking times (*h*)
350	5	15	—	—
400	1	5	—	—
450	1/2	2	5	15
500	1/4	1	1	5
550	1/4	1/2	1/2	2
600	—	—	1/4	1

Fig. K7.2.1~~0~~1-1 Test Sample for Butt Welding Test (*mm*)



Note: Joint preparation and fit-up as detailed in the preliminary welding procedure specification

Fig. K7.2.1~~0~~1-2 Test Piece for Mold Cavity Welding (*mm*)

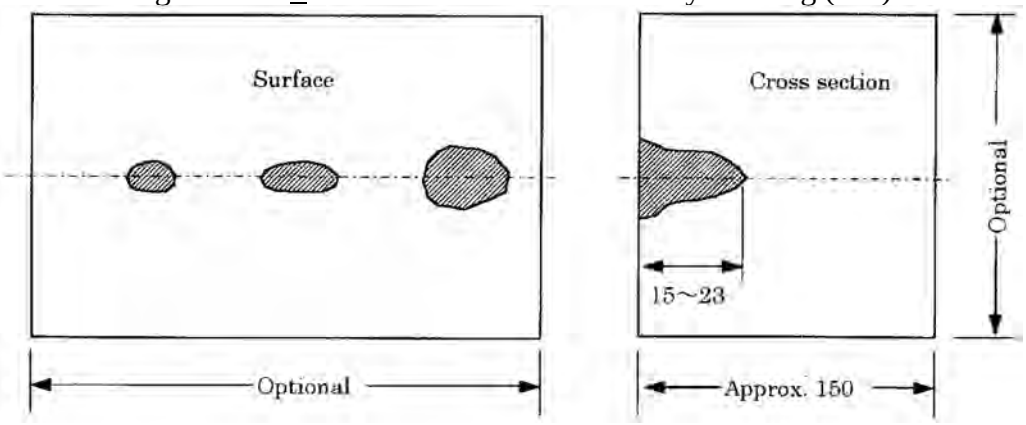


Table K7.2.1~~0~~1-3 Tensile Strength for Butt Welding Test

Grade	Tensile strength (N/mm^2)
*KHBsC*1	400 min.
*KHBsC*2	400 min.
*KAlBC*3	520 min.
*KAlBC*4	550 min.

Table K7.2.11-4 Approval range of base metal

Grade of the test sample	Approval range
*KHBsC*1	*KHBsC*1
*KHBsC*2	*KHBsC*1, *KHBsC*2
*KAlBC*3	*KAlBC*3
*KAlBC*4	*KAlBC*4

Table K7.2.11-5 Approval range of thickness

Thickness of the test sample, *t* (*mm*)	Approval range
$30 \leq t$	≥ 3 *mm*

Annex K7.2.9 has been amended as follows.

Annex K7.2.9 GUIDANCE FOR THE PENETRANT TEST OF PROPELLER CASTINGS

1.1 Application

This guidance applies to the penetrant test of propeller castings.

1.2 Methods of Testing

The methods of the testing are to conform to the standard of *ISO* 3452-1, *JIS Z* 2343 or equivalent thereto. The aforementioned standards, in principle, refer to the most recent version published. Where indications of defects appear, the type of the defects and the size of the indications are to be recorded in detail. These records are to be presented to the Surveyor. For reference, the true size of the defects are also to be confirmed.

1.3 Areas of Test

The areas of test are classed to Zones A, B and C as specified in Fig. **K7.1, Part K of the Rules**. The test on Zone A is to be carried out in the presence the Surveyor. The test on Zones B and C is to be performed by the manufacturer and may be witnessed by the Surveyor upon his request. ~~However, taking the quality of the products of the manufacturer into account, the test on zones B and C may be substituted by the visual inspection.~~

1.4 Types of Defects

The defects detected by the penetrant test are divided into following types of **(1)** to **(4)** (see **Fig. 1**).

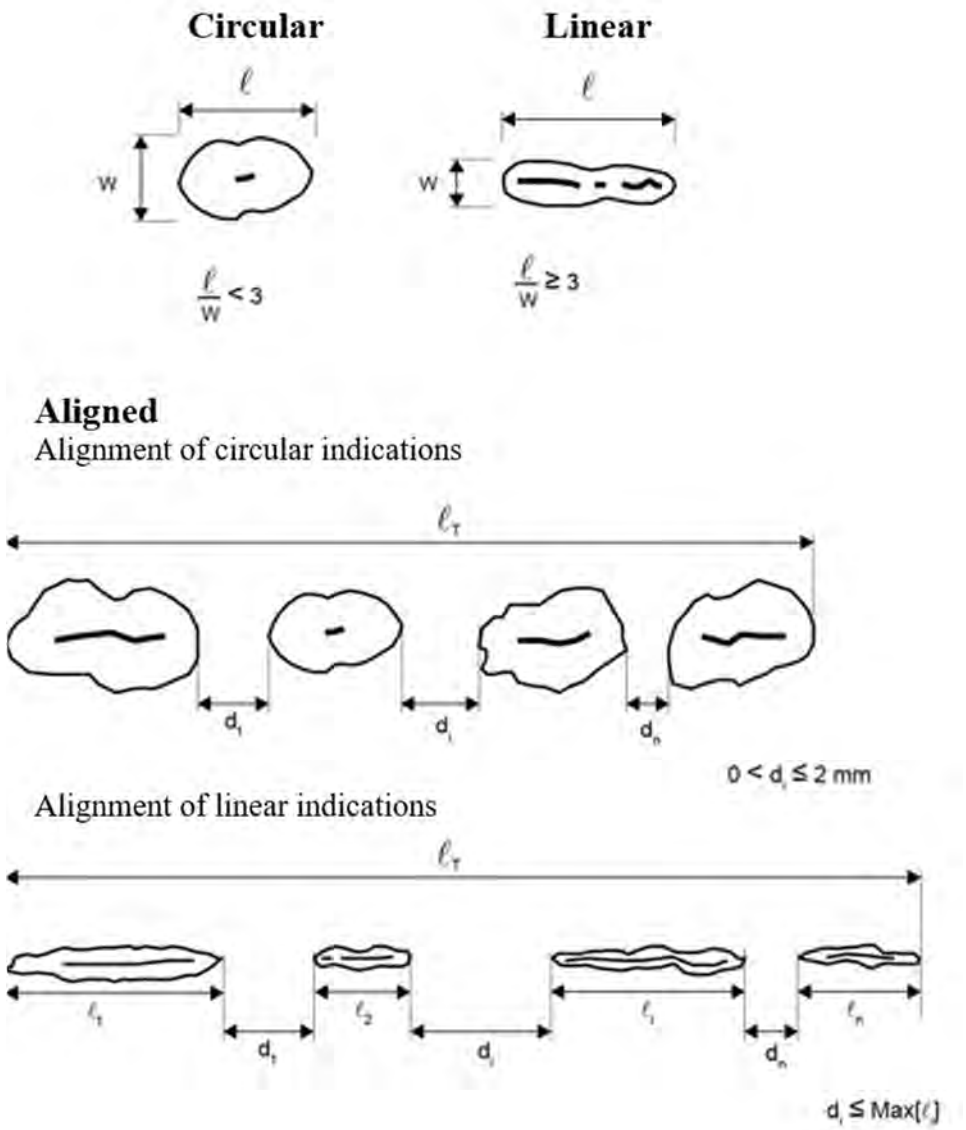
(1) Cracks: the defects regarded as crack.

(2) Circular defects: the defects other than crack, in which the length (*l*) is less than 3 times the width (*w*).

(3) Linear defects: the defects other than crack, in which the length (*l*) is equal to or greater than 3 times the width (*w*).

(4) Aligned defects: Aligned defects consisting of ~~two~~ three or more ~~linear or~~ circular defects which are almost aligned and the spacings (*d*) between them are not exceed 2 *mm*. In addition, aligned defects consisting of two or more linear defects which are almost aligned and the spacing (*d*) between them does not exceed the longest indications of defects. The length of an aligned defect is to be as the sum of the lengths of all individual defects and all spacings between them.

Fig. 1 Shapes of indications of defects



1.5 Acceptance Criteria

The defects to be evaluated are to be indications of defects which the length exceeds 1.5 *mm*. Where cracks or other defects which do not meet the acceptance criteria given in **Table 1** are detected by the penetrant test, the defects are to be repaired in accordance with the requirements in **7.2.10, Part K of the Rules**. Areas which are prepared for welding are always to be assessed according to zone A regardless of their location.

Table 1 Acceptance Criteria

Area of Test	Type of Defect (excluding crack)	Acceptance Criteria		
		Max. total number of all defects (I)	Defects of same type	
			Max. number of each type (II)	Max. size for each indication (III) (*mm*)
Zone A	Circular	7	5	4
	Linear		2	3
	Aligned		2	3
Zone B	Circular	14	10	6
	Linear		4	6
	Aligned		4	6
Zone C	Circular	20	14	8
	Linear		6	6
	Aligned		6	6

Notes:

(1) The defects are to be repaired when they do not meet the one or more criteria of (I) through (III) in this table.

(2) The counting of the number of defects is to be conducted to the most unfavourable location relative to the indication being evaluated. The area of a reference zone is to be 100 cm^2. Each reference area may be square or rectangular with the major dimension not exceeding 250 *mm*.

(3) Singular circular indications less than 2 *mm* for zone A and less than 3 *mm* for other zones may be disregarded.

(4) Where only circular defects were detected, all defects are to be counted for the judgement.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2021.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to propeller castings other than propeller castings that fall under any of the following:

(1) propeller castings being used on ships for which the date of contract for construction* is on or after the effective date; or

(2) propeller castings for which the application for inspection is submitted to the Society on or after effective date; or

(3) propeller castings for which the application for approval is submitted to the Society on or after effective date.

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

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

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

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

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

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

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

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

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

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

Note:
This Procedural Requirement applies from 1 July 2009.