RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part M Welding

2016 AMENDMENT NO.1

Rule No.40 30th June 2016

Resolved by Technical Committee on 5th February 2016

Approved by Board of Directors on 22nd February 2016

Rule No.40 30th June 2016
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 M WELDING

Chapter 4 WELDING PROCEDURE AND RELATED SPECIFICATIONS

4.1 General

4.1.4 Range of Approval

Table M4.2 has been amended as follows.

Table M4.2 Approved Range of Thickness(1), (8)

Thickness of test assemblies t (*mm*) (2), (3), (4)	Approved range of thickness (*mm*)			
	Butt welding(4)			Fillet welding
	Multi-run technique	Single-run technique or Two-run technique	Large heat input welding process(5)	
$t \leq 100$	0.5t to 2t (6), (7) (100 max)	0.7t to 1.1t (6), (7) (100 max)	0.7t to t	0.5t to 2t (6), (7) (100 max)

Notes:

(1) Welding procedure used by dissimilar process (combination welding) is to be correspondingly applied to **Table M4.2**. In this case, thickness or throat thickness of each welding method is to be *t*.

(2) For unequal plate thickness of butt welds the lesser thickness is ruling dimension.

(3) For fillet welds, the range of approval shall be applied to the web thickness and flange thickness of test piece.

(4) For T-joints with full penetration, *t* is the thickness of test assembly on the open edge side and the requirements are correspondingly applied to the requirements of butt welding.

(5) Large heat input welding means the welding with a welding heat input of not less than 50*kJ/cm*.

(6) For the vertical-down welding, the test piece thickness *t* is always taken as the upper limit of the range of application.

(7) For test assembly thickness not more than 12*mm*, the specified minimum content is not applicable.

(8) For the kinds of test assemblies specified in **Table M4.10**, even though the test specimen has passed the hardness test specified in **4.2.9**, **4.3.6** and **4.4.6**, the upper limit of the thickness range of approval is to be restricted to the thickness of the test assembly when three or more of the hardness values in the heat affected zone are less than 25*HV* lower than the values specified in **Table M4.10**.

4.2 Tests for Butt Welded Joints

4.2.1 Application

Table M4.4 has been amended as follows.

Table M4.4 Kinds of Butt Welded Joint Test and Number of Specimens

Kind and grade of test assembly			Kinds of test and number of specimens[1]						
			Visual inspection	Tensile test	Bend test	Impact test (sets) [2]	Macro-Structure inspection	Hardness test	Non-destructive inspection[3]
Rolled steel for hull	*KA*, *KB*, *KD*, *KE* *KA*32, *KD*32, *KE*32, *KF*32, *KA*36, *KD*36, *KE*36, *KF*36, *KA*40, *KD*40, *KE*40, *KF*40		Whole length of welding joints	2	4[5]	3～8<*a*,*b*,*c*,*d*,*e*>[7]	1	1[10]	Whole length of welding joints
	*KE*47					4～8<*a*,*b*,*c*,*d*,*e*>[7]			
Rolled steels for lower temperature service	*KL*24*A*, *KL*24*B*, *KL*27, *KL*33, *KL*37, *KL*2*N*30, *KL*3*N*32, *KL*5*N*43			4[4]	2[6]	5 <*A*,*B*,*C*,*D*,*E*>[8]		—	
	*KL*9*N*53, *KL*9*N*60							1[14]	
Steel pipes for low temperature service	*KLPA*, *KLPB*, *KLPC*, *KLP*2, *KLP*3, *KLP*9			2	4				
Quenched and tempered high tensile rolled steel for structure	*KA*420, *KD*420, *KE*420, *KF*420, *KA*460, *KD*460, *KE*460, *KF*460, *KA*500, *KD*500, *KE*500, *KF*500, *KA*550, *KD*550, *KE*550, *KF*550, *KA*620, *KD*620, *KE*620, *KF*620, *KA*690, *KD*690, *KE*690, *KF*690				4[5]	3～8<*a*,*b*,*c*,*d*,*e*>[7]		1	
Rolled stainless steels	*KSUS*304, *KSUS*304*L*, *KSUS*304*N*1, *KSUS*304*N*2, *KSUS*304*LN*, *KSUS*309*S*, *KSUS*310*S*, *KSUS*316, *KSUS*316*L*, *KSUS*316*N*, *KSUS*316*LN*, *KSUS*317, *KSUS*317*L*, *KSUS*317*LN*, *KSUS*321, *KSUS*329*J*1, *KSUS*329*J*3*L*, *KSUS*329*J*4*L*, *KSUS*347					[9]		—	
Stainless steel pipes	*K*304*TP*, *K*304*LTP*, *K*309*STP*, *K*310*STP*, *K*316*TP*, *K*316*LTP*, *K*317*TP*, *K*317*LTP*, *K*321*TP*, *K*329*J*1*TP*, *K*329*J*3*LTP*, *K*329*J*4*LTP*, *K*347*TP*				4				
Aluminium alloys [11]	5000 Series	5754*P*, 5086*P*, 5086*S*[12], 5083*P*, 5083*S*[12] 5383*P*, 5383*S*[12], 5059*P*, 5059*S*[12], 5456*P*			4[5]	—			
	6000 Series	6005*AS*[13], 6061*P*, 6061*S*[13], 6082*S*[13]							

Notes:

(1) Where found necessary by the Society, deposited metal tensile test, microscopic test and tests other than those may be required.

(2) In this Table, the mark in < > specifies position of notch given in **Fig. M4.2** through **Fig. M4.4**.

(3) Internal inspections by radiographic examination or ultrasonic examination and surface inspections by magnetic particle examination or liquid penetrant examination are to be carried out.

(4) Two specimens are to be taken longitudinally and transversely respectively. (See **Fig. M4.1(D)**)

(5) Two specimens are to be taken from root bend and face bend respectively. (See **Fig. M4.1(A)**~~,~~ and **(E)**~~ and (F)~~)

(6) The specimens are to be taken longitudinally. (See **Fig. M4.1(D)**).

(7) The specimens are to be taken in accordance with **Fig. M4.2** and **M4.3**.

(8) The position of notch for the specimen is to be shown in **Fig. M4.4**.

(9) Where found necessary by the Society, impact tests up to steels specially used for may be required.

(10) For *KA*36, *KD*36, *KE*36, *KF*36, *KA*40, *KD*40, *KE*40, *KF*40 and *KE*47 the tests are to be carried out.

(11) All temper conditions indicated with grades are to be included (See **Table K8.3**).

(12) Rolled products which have the same grade and temper condition may be used.

(13) Other rolled aluminium alloys of 6000 series with tensile strength 260 N/mm^2 and above may be used.

(14) The test is to be applied to *KL*37, *KL5N*43, *KL9N*53, *KL9N*60 and *KLP*9.

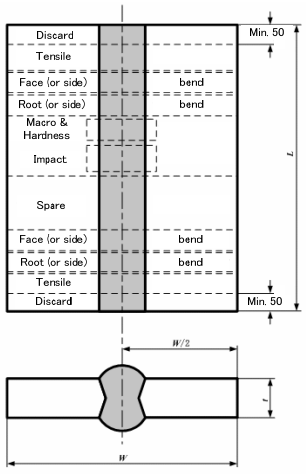
4.2.3 Test Assemblies

Sub-paragraph -2 has been amended as follows.

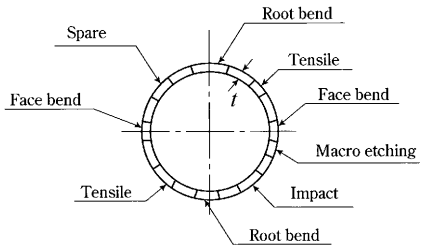
2 The dimensions and types of test assembly are to be as indicated in (A), (B), (C), (D)~~,~~ and (E) ~~and (F)~~ of **Fig. M4.1**

Fig. M4.1 has been amended as follows.

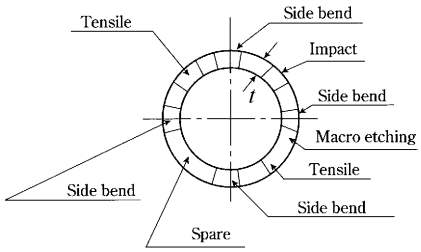
Fig. M4.1 Welding Procedure Qualification Test assemblies (Unit: *mm*)



(A) Test Assembly for Plates (materials indicated in **(D)**~~,~~and **(E)** ~~and (F)~~ are excluded)



(B) Test Assembly for Pipes up to 20*mm* in Thickness



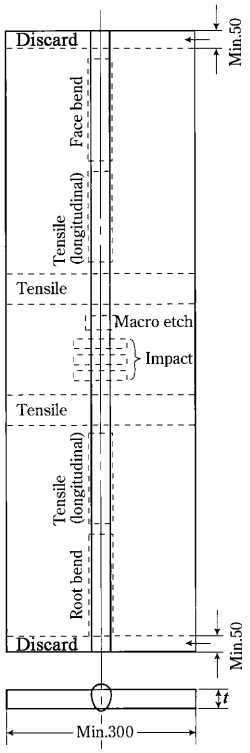
(C) Test Assembly for Pipes over 20*mm* in Thickness

Notes:

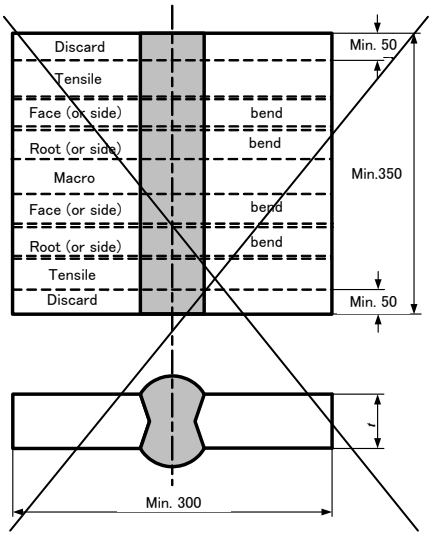
(1) In **Fig.(A)**, width (W) and length (L) of test specimens are as follows.
Manual welding and semi-automatic welding: $W \geq 300mm$, $L \geq 350mm$
Automatic welding: $W \geq 400mm$, $L \geq 1000mm$

(2) The root and face bends may be substituted by 4 side bends for $t \geq 12mm$.

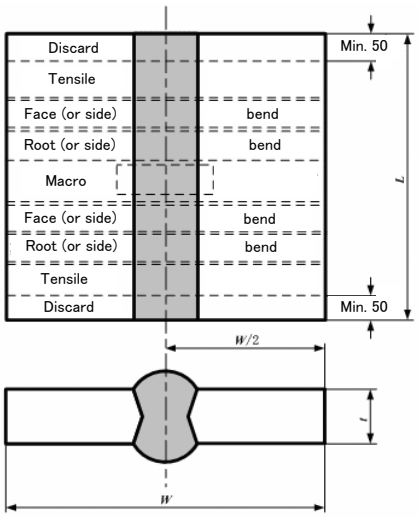
Fig. M4.1 Welding Procedure Qualification Test assemblies (Unit: *mm*) (continued)



(D) Test Assembly for *KL9N*53 or *KL9N*60



~~(E) Test Assembly for Plates of Rolled Stainless Steel~~



(~~F~~E) Test Assembl~~y~~ies for ~~Plates of~~ Rolled Stainless Steel and Aluminium Alloy Plates

Notes:

(1) In **Fig. (~~F~~E)**, width (W) and length (L) of test assembly are as follows.
Manual welding and semi-automatic welding: $W \geq 300mm$, $L \geq 350mm$
Automatic welding: $W \geq 400mm$, $L \geq 1000mm$

(2) The root and face bends may be substituted by 4 side bends for $t \geq 12mm$.

(3) For butt joint of dissimilar alloy material, longitudinal bend tests may be required by the Society.

4.2.9 Hardness Test

Table M4.10 has been amended as follows.

Table M4.10 Requirements of hardness test

~~Kinds of specimen~~	~~Vickers hardness (*HV*10)~~
~~Rolled steels for hull~~[~~(1)~~]	~~350 max~~[~~(2)~~]
~~Quenched and tempered high-tensile rolled steel for structure~~	~~420 max~~

~~Notes:~~

~~(1) For *KA*36, *KD*36, *KE*36, *KF*36, *KA*40, *KD*40, *KE*40 and *KF*40, the tests are to be carried out.~~

~~(2) For *KE*47, Vickers hardness is not to be more than 380.~~

Kinds of test assembly		Vickers hardness (*HV*10)
Rolled steels for hull	*KA*36, *KD*36, *KE*36, *KF*36 *KA*40, *KD*40, *KE*40, *KF*40	350 max
	*KE*47	380 max
Quenched and tempered high tensile rolled steel for structure		420 max
Rolled steels for low temperature service	*KL*37	350 max
	*KL*5*N*43, *KL*9*N*53, *KL*9*N*60	420 max
Steel pipes for low temperature service	*KLP*9	420 max

4.4 Tests for T-joints with Full Penetration

4.4.6 Hardness Test

Sub-paragraph -2 has been amended as follows.

1 Vickers hardness is to be measured at the position shown in **Fig. M4.9**. The kinds of specimens for Vickers hardness are to be in accordance with the requirements specified given in **Table M4.10**.
2 The number of specimens for hardness tests ~~are~~ is to be ~~one.~~ in accordance with the requirements specified in **Table M4.4**.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 30 December 2016.
2. Notwithstanding the amendments to the Rules, the current requirements may apply to welding procedure for which the application for approval is submitted to the Society before the effective date.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part M Welding

GUIDANCE

2016 AMENDMENT NO.1

Notice No.39 30th June 2016
Resolved by Technical Committee on 5th February 2016

Notice No.39 30th June 2016
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 M WELDING

Amendment 1-1

M2 WELDING WORKS

M2.4 Welding Process

Paragraph M2.4.3 has been amended as follows.

M2.4.3 Preheating, etc.

The control standards for short bead, preheating and line heating in the processing and welding of rolled steels for hulls and rolled steels for low temperature service are to be in accordance with **Table M2.4.3-1**.

Table M2.4.3-1 has been amended as follows.

Table M2.4.3-1 Control Standards for the Processing and Welding ~~for~~ of Rolled Steels for Hulls and Rolled Steels for Low Temperature Service

Items for control standard		Mild steel		High tensile steels[1]							Rolled steels for low temperature service[13]		
				Conventional type[2]			*TMCP* type						
		Grade	Control standard	Grade	Control standard		Grade	Carbon equivalent for steel C_{eq} [3][4][5]	Control standard		Carbon equivalent for steel C_{eq} [3][4][5]	Control standard	
Length of short bead [6]	Tack and repair weld of scar	*KE*	30 *mm* or over	*KA*32 *KD*32 *KE*32 *KA*36 *KD*36 *KE*36	50*mm* or over[12]		*KA*32 *KD*32 *KE*32 *KA*36 *KD*36 *KE*36	0.36% or below[7]	10 *mm* or over[8]		More than 0.36%	50 *mm* or over	
											0.36% or below	10 *mm* or over	
	Repairing of welded bead								30 *mm* or over		More than 0.36%	50 *mm* or over	
											0.36% or below	30 *mm* or over	
Preheating in working	Temperature need preheating [9]	*KA* *KB* *KD* *KE*	-5°C or below	*KA*32 *KD*32 *KE*32 *KA*36	5°C or below[10][12]		*KA*32 *KD*32 *KE*32 *KA*36	0.36% or below[7]	0°C or below [10]		More than 0.36%	5°C or below	
											0.36% or below	0°C or below	
	Preheating temperature		20°C or over	*KD*36 *KE*36	50°C or over		*KD*36 *KE*36		20°C or over		More than 0.36%	50°C or over	
											0.36% or below	20°C or over	
Line heating (Thermal fairing)	Maximum heating temperature of steel Surface	*KA* *KB* *KD* *KE*	[11]	*KA*32 *KD*32 *KE*32 *KA*36	Water cooling just after heating	650°C or below	*KA*32 *KD*32 *KA*36 *KD*36	0.38% or below	Water cooling just after heating	1000°C or below	—	Air cooling after heating	900°C or below
				*KD*36 *KE*36	Air cooling after heating	900°C or below			Air cooling after heating				
					Air cooling and subsequent water cooling after heating	900°C or below (Starting temperature of water cooling is to be 500°C or below)	*KE*32 *KE*36	0.38% or below	Water cooling just after heating	900°C or below	More than 0.36%	Air cooling and subsequent water cooling after heating	900°C or below (Starting temperature of water cooling is to be 500°C or below)
									Air cooling after heating		0.36% or below		900°C or below (Starting temperature of water cooling is to be 550°C or below)

Notes:

(1) In *KA*40, *KD*40, *KE*40 and *KE*47, the control standards for the conventional high tensile steels are applied except for the case specially approved by the Society. *KF*32, *KF*36 and *KF*40 are to be as deemed to appropriate by the Society.

(2) The conventional type is the high tensile steel of which grades of heat treatment specified in **Notes (3)** of **Table K3.3**, as other than the *TMCP* type.

(3) C_{eq} is to be calculated by the following formula and is to be rounded to two decimal places.

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

(4) The control standards when the value of C_{eq} exceeds the value in this Table, in principle, are to be applied as conventional type.

(5) When there are differences in C_{eq} of the steel materials, the control standard corresponding to the higher value of C_{eq} is to be applied.

(6) The length of bead is to be measured from the starting point of weld to the centre of the crater at the termination of the weld.

(7) Where cold cracking susceptibility P_{cm} is substituted for C_{eq}, the control standards are to be as deemed to appropriate by the Society. P_{cm} is to be calculated by the following formula and is to be rounded to two decimal places.

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

(8) It is recommended that for *KE*32 and *KE*36 to be not less than 30*mm*.

(9) Even in cases where the temperature exceeds the value given in this Table, preheating may be required depending on the thickness of steel materials, degree of restrain and welding heat input.

(10) Electrodes are to be of the low hydrogen electrodes. However, in horizontal butt welding, overhead fillet welding, etc., extremely low hydrogen electrodes (the quantity of hydrogen measured by the glycerine replacement method is not more than 0.03 cm^3/g) is to be used, or in cases the temperature exceeds the value in this Table. Preheating is to be carried out.

(11) It is recommended that the conventional control standards for the conventional high tensile steels are applied to *KE*.

(12) For *KE*47, in the cases where P_{cm} is less than or equal to 0.19, 25*mm* of short bead length and air temperature of 0°C or below may be adopted where approved by the Society.

(13) These control standards apply to *KL*24*A*, *KL*24*B*, *KL*27, *KL*33 and *KL*37. The standards for other grades are to be as deemed appropriate by the Society.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 30 June 2016.

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

Amendment 1-2

M4 WELDING PROCEDURE AND RELATED SPECIFICATIONS

M4.1 General

M4.1.4 Range of Approval

Sub-paragraph -3 has been deleted, and Sub-paragraphs -4 and -5 have been renumbered to Sub-paragraphs -3 and -4.

~~**3** For **4.1.4-1(2)**, **Part M** of the Rules, even though the test assembly has passed the hardness test specified in **4.2.9** and **4.3.6**, **Part M** of the Rules, thickness of range of approval is to be restricted to the thickness of test assembly if three of the hardness values in the heat affected zone are exceed 325HV for Rolled Steels for Hull and 395HV for High Strength Quenched and Tempered Rolled Steel Plates for Structure.~~

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

~~**5**~~**4** (Omitted)

Table M4.1.4-4 has been amended as follows.

Table M4.1.4-4 Thickness

Thickness of test assembly t (mm)(1)	Range of approval
$t \leqq 3$	0.5mm to 2t(2)
$3 < t \leqq 20$	3mm to 2t(2)
$t > 20$	0.8t and above

Notes:

(1) In case of joints between dissimilar thickness, thickness t is to be in accordance with the followings.
Butt joints: t is the thickness of the thinner plate
Fillet joints: t is the thickness of the thicker plate

(2) For combination welding procedure, maximum thickness is to be t (See **M4.1.4-~~5~~4(2)(h)**).

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 30 December 2016.

2. Notwithstanding the amendments to the Guidance, the current requirements may apply to welding procedure for which the application for approval is submitted to the Society before the effective date.