
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part M **Welding**

RULES

2006 AMENDMENT NO.2

Rule No.29 20th March 2006

Resolved by Technical Committee on 3rd February 2006

Approved by Board of Directors on 28th February 2006

Rule No.29 20th March 2006

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

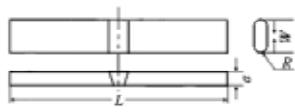
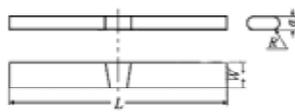
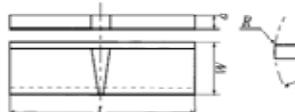
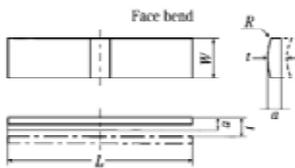
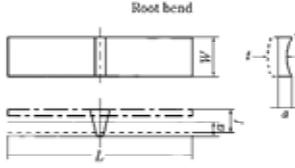
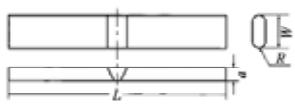
“Rules for the survey and construction of steel ships” has been partly amended as follows:

Part M Welding

Chapter 3 TEST SPECIMENS AND MECHANICAL TESTING PROCEDURE

Table M3.2(a) has been amended as follows.

Table M3.2(a) Size and Dimension of Bend Test Specimens⁽¹⁾

kind	Used for	Size of specimen	Dimensions	Intended for
UB-1	Welding procedure qualification tests	Face and root bend specimen 	$a = t$ $W = 30$ $L \geq 200$ $R = 1 \sim 2$	Test assemblies for butt weld test for plate:
UB-2		Side bend specimen 	$a = 10$ $W = t \text{ } \textcircled{\neq}$ $L \geq 200$ $R = 1 \sim 2$	Test assemblies for butt weld test for plate: $t \geq 12$
B-3		Side bend specimen 	$a = 10$ $W = t \text{ } \textcircled{\neq}$ $L \geq 200$ $R \leq 1.5$	Test assemblies for butt weld test for plate: $t > 20$
B-4		Face and root bend specimen 	$a = t$ $W = 19$ $L \geq 200$ $R \leq 1.5$ For the tube whose D is 34.0 to 60.5, W shall be 19. For the tube having D of 34.0 and under, the width obtained by dividing the tube longitudinally into four equal parts shall be the width of the test piece.	Test assemblies for butt weld test for pipe: $t < 10$
B-5			Face and root bend specimen 	$a = 10$ $W = 40$ $L \geq 200$ $R \leq 1.5$ For the tube having an D of 114.3 and under, W shall be 19.
UB-6		Approval tests and annual inspection for welding consumables Face and root bend specimen 	$a = t$ $W = 30$ $L \geq 200$ $R = 1 \sim 2$ Where the thickness of test assemblies exceeds 25 mm, the thickness of test specimen may be reduced to 25 mm with its surface machined on one side only (compression side).	Butt weld test

Notes:

- (1) The following designations are used:
 a : thickness, W : width, R : edge radius, D : external tube diameter
 t : thickness of test assembly, B : breadth of weld, L : length
- (2) Where the thickness of the side bend specimen exceeds 40mm, the test specimen may be divided to be tested.

Chapter 4 WELDING PROCEDURE AND RELATED SPECIFICATIONS

4.1 General

4.1.1 Application

Sub-paragraph -2 and -3 have been renumbered to -3 and -4 respectively.
Sub-paragraph -2 has been newly added as follows.

- 2** The requirements of this chapter correspondingly apply to the welding procedure and related specifications for the approval of steel castings and steel forgings which is to be weldable quality used for hull structures. However, the impact test may be omitted, upon the approval by the Society.

4.1.3 Execution of Tests

Sub-paragraph -1 has been amended as follows.

- 1** For the approval of welding procedure and related specifications, the tests specified in **4.2** or **4.3** are to be carried out based on the representing conditions, such as the edge preparation, welding parameter, etc., described in the welding procedure specification, with satisfactory results. However, for quenched and tempered high tensile rolled steel for structure, the tests are to be carried out every heat treatment.

Sub-paragraph -2 has been amended as follows.

- 2** Part of or all requirements for the tests provided in preceding **-1** may be dispensed in the case which deemed appropriate by the Society, subject to the approval of the welding procedure specifications.

Sub-paragraph -3 has been amended as follows.

- 3** The addition of tests or test conditions other than those specified in this Chapter for the welding procedure qualification (e.g. design of strength, thickness and temperature, and welding heat input) may be required, where deemed necessary by the Society.

Sub-paragraph -6 has newly added as follows.

- 6** Welding procedure used by dissimilar process (combination welding) may be carried out with separate welding procedure tests for each weld process.

Paragraph 4.1.4 has been amended as follows.

4.1.4 Range of Approval

- 1 The scope of approval of the welding procedure and related specifications of rolled steels for hull and quenched and tempered high tensile rolled steel for structure are in accordance with the following (1) through (5), on the condition that other welding conditions are same. However, the range of approval differing from the requirements specified in this Chapter may be accepted that it is deemed appropriate by the Society.
 - (1) Kind of weld joints
Kind of weld joints is in accordance with in **Table M4.1**. Where the welding procedures for butt welding are approval, the kinds of weld joints include the fillet weld joints, corresponding to the welding position applied for the butt weld joint.
 - (2) Thickness
The range of the thickness is in accordance with in **Table M4.2**.
 - (3) Leg length of fillet welding
The range of the leg length of fillet welding is in accordance with in **Table M4.3**.
 - (4) Kinds of base metal
 - (a) Rolled steels for hull
 - i) Within the same strength level, the welding procedures are considered applicable to lower toughness grade (material with higher specified impact test temperature).
 - ii) In addition to the requirement in i), within the same toughness level, the welding procedures are considered applicable to the same and two lower strength grades (material with the two lower specified yield strength).
 - (b) Quenched and tempered high tensile rolled steel for structure
 - i) Within the same strength level, the welding procedures are considered applicable to lower toughness grade.
 - ii) In addition to the requirement in i), within the same toughness level, the welding procedures are considered applicable to the same and one lower strength grades.
 - (c) Notwithstanding the requirement given in (a) and (b), for the large heat input welding specified in **Note (5) of Table M4.2**, the welding procedures are considered applicable to that toughness grade tested and one strength level below.
 - (5) Kinds of welding consumables
The welding consumables are to be not bland but grade (including all suffixes), except the large heat input specified **Note (5) of Table M4.2**.
- 2 The restriction of welding procedure condition (e.g. heat input welding and preheating) in actual work is to be deemed appropriate by the Society.
- 3 Where deemed necessary by the Society for welding procedure, restrictions on the heat treatment of base metals, carbon equivalent or cold cracking susceptibility and the locations of application of the welding procedure may be imposed.
- 4 The range of approval of materials other than the rolled steels for hull and quenched and tempered high tensile rolled steel for structure are to be deemed appropriate by the Society.

Table M4.1 through Table M4.8 have been renumbered to Table M4.2 through Table M4.9. Table M4.1 has been newly added as follows.

Table M4.1 Range of approval for type of weld joint

Type of weld joint for type of weld joint			Range of approval	
Butt Welding	One side	With backing	A	A, C, D
		Without backing	B	A, B, C, D
	Both side	With gouging	C	C
		Without gouging	D	C, D
Fillet Welding			E	E

Table M4.2 and Table M4.3 have been amended as follows.

Table M4.2 Approved Range of Thickness⁽¹⁾

Thickness of test assemblies t (mm) ^{(2), (3)}	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)

Note:

- (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) If T-joint welds are applied to full penetration, 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 $50kJ/cm$.
- (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 $12mm$, the specified minimum content is not applicable.

Table M4.3 Applicable leg length of fillet welding

Approved range of leg length (mm)	
Single-run technique	Multi-run technique
$0.75f$ to $1.5f$ ⁽¹⁾⁽²⁾	$0.5f$ to $2f$ ⁽¹⁾⁽²⁾

Note:

- (1) f : leg length of test piece

- (2) Where welding in vertical downward position is applied, the approved range of thickness is to be *f*.

4.2 Tests for Butt Welded Joint

4.2.1 Application

In Paragraph 4.2.1, the wording “Table M4.3” in main text has been amended as “Table M4.4”.

4.2.2 Kinds of Test

In Paragraph 4.2.2, the wording “Table M4.3” in main text has been amended as “Table M4.4”.

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),(E) and (F) of **Fig. M4.1**.

Sub-paragraph -7 has newly added as follows.

- 7** The tack welds of test piece are to be the same procedure as actual work.

Table M4.4 have been amended as follows.

Table M4.4 Applicable leg length of fillet welding

Kind and grade of test assembly		Kinds and number of specimens for test ⁽¹⁾							
		Visual inspection	Tensile test	Bend test	Impact test ⁽²⁾	Macro-structure inspection	Hardness test	Non-destructive inspection ⁽³⁾	
Rolled steel for hull	<i>KA, KB, KD, KE</i> <i>KA32, KD32, KE32, KF32, KA36, KD36, KE36, KF36, KA40, KD40, KE40, KF40</i>	Whole length of welding joints	2	4 ⁽⁵⁾	3~8< <i>a,b,c,d,e</i> > ⁽⁷⁾	1	1 ⁽¹⁰⁾	Whole length of welding joints	
	Rolled steels for lower temperature service								<i>KL24A, KL24B, KL27, KL33, KL37, KL2N30, KL3N32, KL5N43</i> <i>KL9N53, KL9N60</i>
Steel pipes for low temperature service	<i>KLPA, KLPB, KLPC, KLP2, KLP3, KLP9</i>		4 ⁽⁴⁾	2 ⁽⁶⁾	5 < <i>A,B,C,D,E</i> > ⁽⁸⁾				—
Quenched and tempered high tensile rolled steel for structure	<i>KA43, KD43, KE43, KF43, KA47, KD47, KE47, KF47, KA51, KD51, KE51, KF51, KA56, KD56, KE56, KF56, KA63, KD63, KE63, KF63, KA70, KD70, KE70, KF70</i>		4 ⁽⁵⁾	4	3~8< <i>a,b,c,d,e</i> > ⁽⁷⁾				1

Rolled stainless steels	<i>KSUS304, KSUS304L, KSUS304N1, KSUS304N2, KSUS304LN, KSUS309S, KSUS310S, KSUS316, KSUS316L, KSUS316N, KSUS316LN, KSUS317, KSUS317L, KSUS317LN, KSUS321, KSUS347</i>		2	(9)	
Stainless steel pipes	<i>K304TP, K304LTP, K309STP, K310STP, K316TP, K316LTP, K317TP, K317LTP, K321TP, K347TP</i>		4		—
Aluminium alloys ⁽¹¹⁾	5000 Series	<i>5754P, 5086P, 5086S⁽¹²⁾, 5083P, 5083S⁽¹²⁾</i>			—
	6000 Series	<i>6005AS⁽¹³⁾, 6061P, 6061S⁽¹³⁾, 6082S⁽¹³⁾</i>			

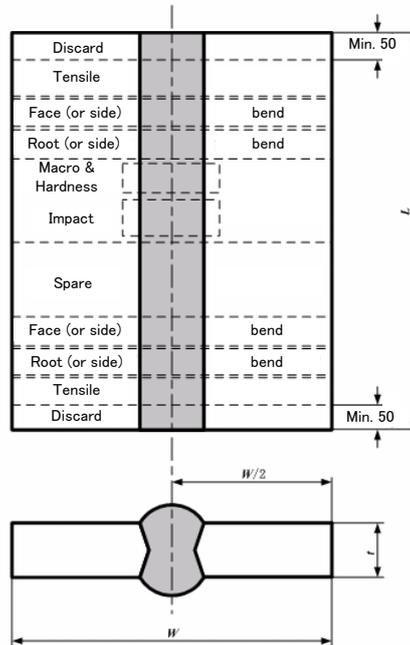
Note:

- (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)**).
- (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**.

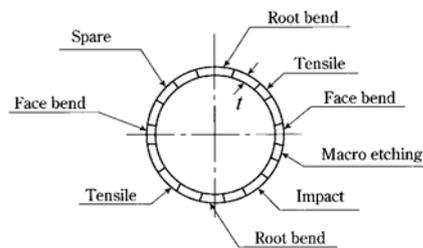
- (9) Where found necessary by the Society, impact tests up to steels specially used for may be required.
- (10) For *KA36*, *KD36*, *KE36*, *KF36*, *KA40*, *KD40*, *KE40* and *KF40*, the tests are to be carried out.
- (11) All temper conditions indicated with grades are to be included (See **Table K8.3**).
- (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.

Fig. M4.1(a) and (b) have been amended as follows.

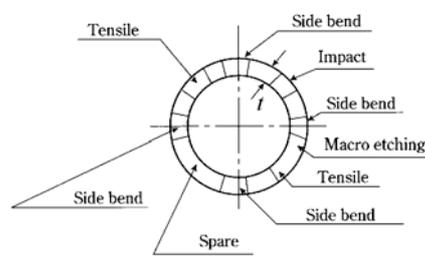
Fig M4.1(a) Welding Procedure Qualification Test assemblies (Unit: mm)



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



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

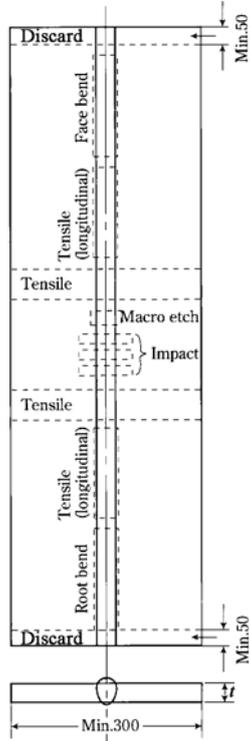


(C) Test Assembly for Pipes over 20mm in Thickness

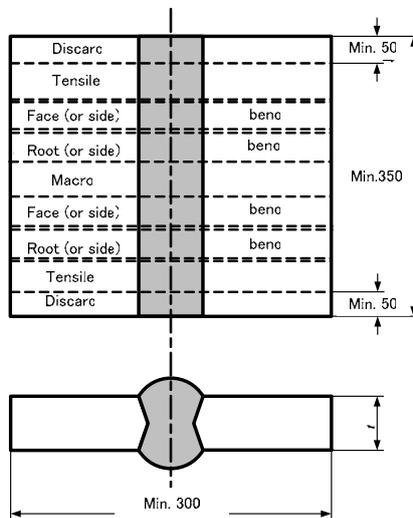
Note:

- (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(b) Welding Procedure Qualification Test assemblies (Unit: mm)



(D) Test Assembly for *KL9N53* or *KL9N60*



(E) Test Assembly for Plates of Rolled Stainless Steel

Table M4.5 has been amended as follows.

Table M4.5 Tensile Test Requirements for Butt Welded Joint

Kind of test assembly	Grade of test assembly	Tensile test	
		Tensile strength (N/mm^2)	0.2% proof stress(N/mm^2)
Rolled steels for low temperature service	<i>KL9N53, KL9N60</i>	590 min ⁽¹⁾	315 min
		630 min ⁽²⁾	—
Steel pipes for low temperature service	<i>KLP9</i>	630 min	—
Aluminium alloys ⁽³⁾	<i>5086P-H112</i> ⁽⁴⁾ <i>5086P-H116</i> <i>5086P-H321</i>	240 min	—
	<i>5083P-H116</i> <i>5083P-H321</i>	275 min	—
	<i>6061P-T6</i> <i>6005AS-T5</i> ⁽⁵⁾ , <i>6005AS-T6</i> ⁽⁵⁾ , <i>6061S-T5</i> ⁽⁵⁾ , <i>6061S-T6</i> ⁽⁵⁾ , <i>6082S-T5</i> ⁽⁵⁾ , <i>6082S-T6</i> ⁽⁵⁾	170 min	—

Note:

- (1) For test specimens in longitudinal direction
- (2) For test specimen in transverse direction
- (3) Grades of aluminium alloys have indication grade showing the temper condition.
- (4) For test assembly thickness not more than 12.5mm
- (5) See **Notes (13)** of **Table M4.4**.

In Sub-Paragraph -2, the wording “Table M4.3” in main text has been amended as “Table M4.4”.

Sub-paragraph -3 has newly added as follows.

- 3 As for the requirements for tensile tests of welded joints of steels of different specified strength, those for joints of steels of lower specified strength are to be applied.

4.2.6 Bend Test

In Sub-Paragraph -1, the wording “Table M4.5” in main text has been amended as “Table M4.6”.

In Sub-Paragraph -2, the wording “Table M4.3” in main text has been amended as “Table M4.4”.

Table M4.6 has been amended as follows.

Table M4.6 Bend Test Requirements for Butt Welded Joint

Kind of test assembly	Grade of test assembly	Radius of plunger (mm) ⁽¹⁾	Bending angle (degree)
Steel pipes for low temperature service	<i>KLP9</i>	$\frac{10}{3}t$	180
High strength quenched and tempered rolled steel plates for structure	<i>KA43, KD43, KE43, KF43</i> <i>KA47, KD47, KE47, KF47</i> <i>KA51, KD51, KE51, KF51</i>	$\frac{5}{2}t$	
	<i>KA56, KD56, KE56, KF56</i> <i>KA63, KD63, KE63, KF63</i> <i>KA70, KD70, KE70, KF70</i>	$3t$	
Aluminium alloys ⁽²⁾	<i>5754P</i>	$\frac{3}{2}t$	
	<i>5086P, 5086S</i> ⁽³⁾	$3t$	
	<i>5083P, 5083S</i> ⁽³⁾		
	<i>6005AS</i> ⁽⁴⁾	$\frac{7}{2}t$	
	<i>6061P, 6061S</i> ⁽⁴⁾		
<i>6082S</i> ⁽⁴⁾			
Other materials		$2t$	

Note:

- (1) *t*: thickness of the test specimen (mm)
- (2) See **Notes (11)** of **Table M4.4**.
- (3) See **Notes (12)** of **Table M4.4**.
- (4) See **Notes (13)** of **Table M4.4**.

4.2.7 Impact Tests

In Sub-Paragraph -1, the wording “Fig. M4.2” in main text has been amended as “Fig. M4.2 to Fig. M4.4”.

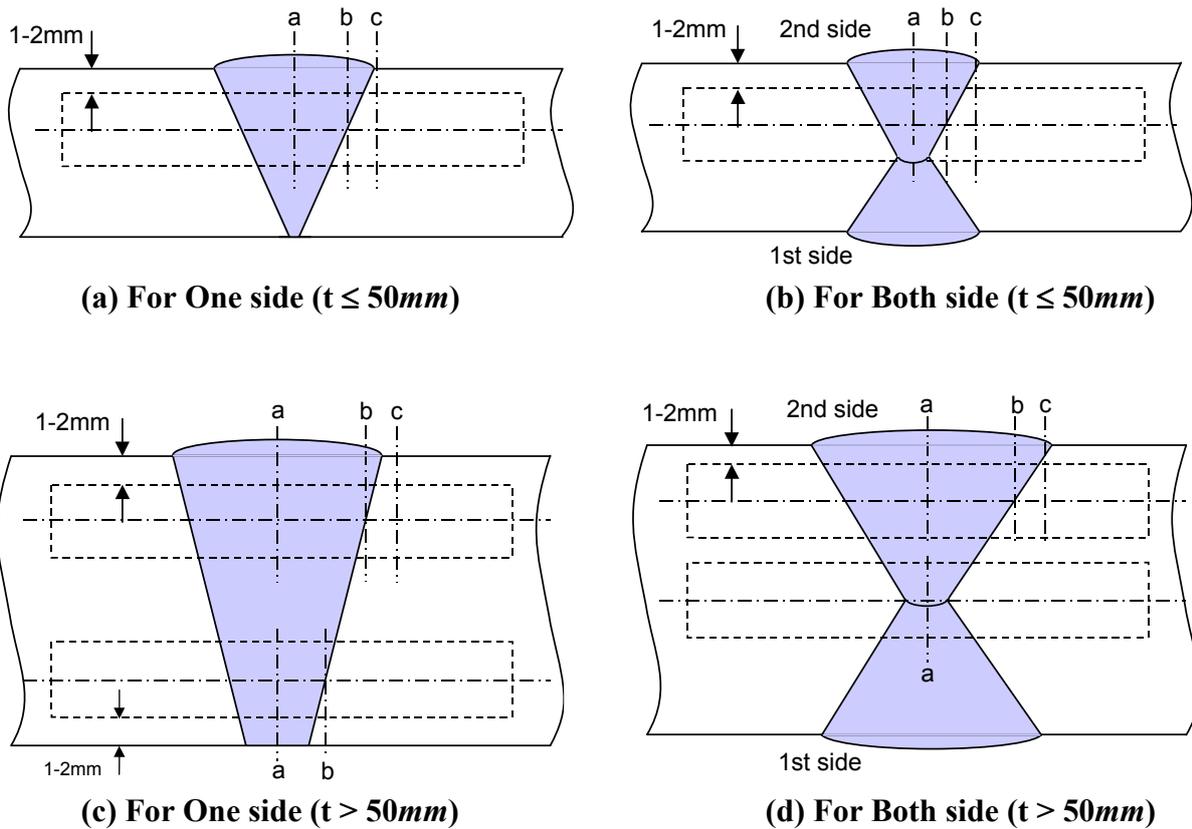
In Sub-Paragraph -2, the wording “Fig. M4.3” in main text has been amended as “Fig. M4.4”.

In Sub-Paragraph -2, the wording “Fig. M4.2” in main text has been amended as “Fig. M4.2 to Fig. M 4.4”.

In Sub-Paragraph -3, the wording “Table M4.6 to Table M4.8” in main text has been amended as “Table M4.7 to Table M4.9”.

Fig M4.3 has been renumbered to Fig M4.6.
 Fig M4.3 has been renumbered to Fig M4.4.
 Fig M4.2, Fig M4.3 and Fig M4.4 has been amended as follows.

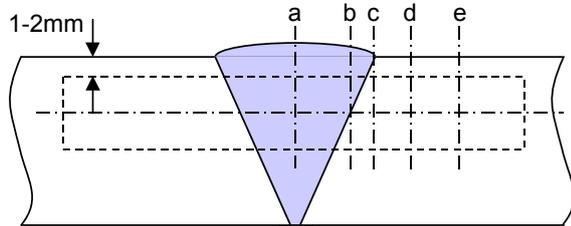
Fig M4.2 Position of Notch for Impact Test Specimen for rolled steels for hull and quenched and tempered high tensile rolled steel for structure (Where welding heat input is not greater than 50kJ/cm, Unit: mm)



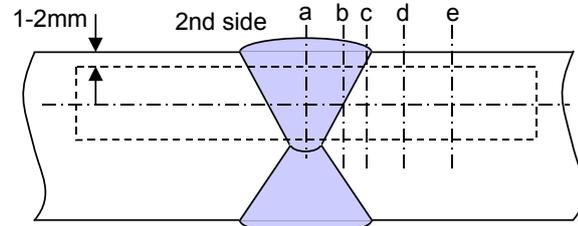
Notch location:
 a: Center of weld “WM”
 b: On fusion line “FL”
 c: In HAZ, 2mm from fusion line

Note:
 For one side single run welding over 20 mm notch location “a” shall be added on root side.

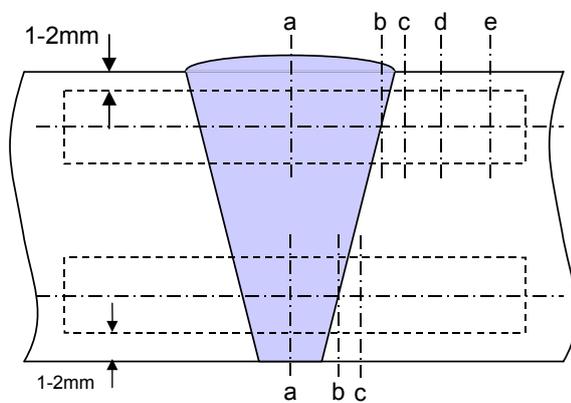
Fig M4.3 Position of Notch for Impact Test Specimen for rolled steels for hull and quenched and tempered high tensile rolled steel for structure (Where welding heat input is greater than 50kJ/cm, Unit: mm)



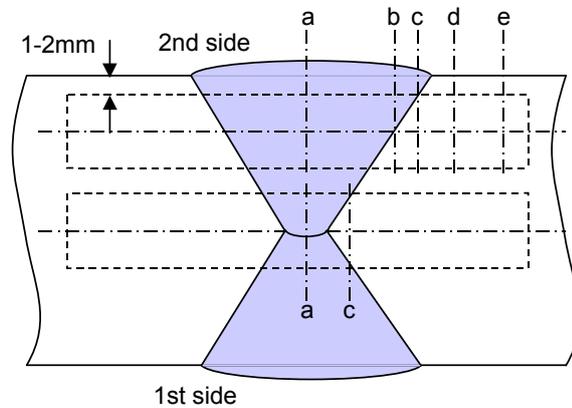
(a) For One side ($t \leq 20mm$)



(b) For Both side ($t \leq 50mm$)



(c) For One side ($t > 20mm$)

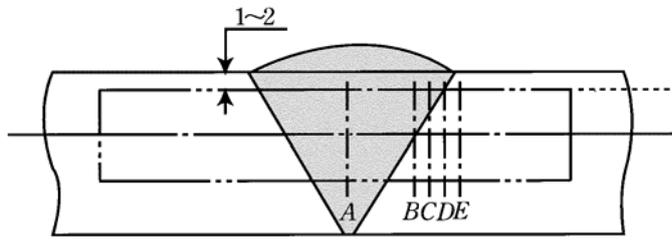


(d) For Both side ($t > 50mm$)

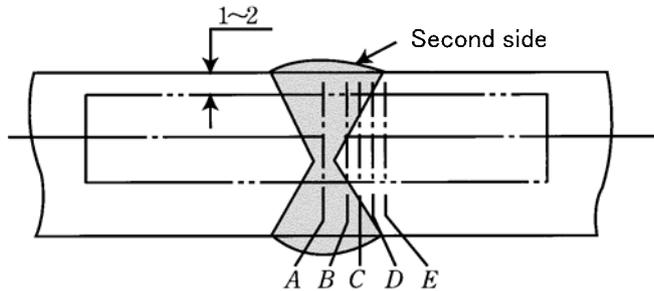
Notch location:

- a: Center of weld "WM"
- b: On fusion line "FL"
- c: In HAZ, 2mm from fusion line
- d: In HAZ, 5mm from fusion line
- e: In HAZ, 10mm from fusion line

Fig M4.4 Positions of Notch for Impact Test Specimens for Rolled Steel for Low Temperature Service and Steel Pipes for Low Temperature Service (Unit: mm)



a) Single-run or Multi-run technique



b) Two-run technique

Notch location:

a: Center of weld “WM”

b: On fusion line “FL”

c: In HAZ, 2mm from fusion line

d: In HAZ, 5mm from fusion line

e: In HAZ, 10mm from fusion line

Table M4.7 have been amended as follows.

Table M4.7 Impact Test Requirements for Butt Weld Joint (Rolled Steel for Hull, where thickness is not greater than 50mm)⁽¹⁾

Grade of steel	Testing temperature (°C)	Value of minimum average absorbed energy (<i>J</i>) ⁽²⁾		
		For manually or semi-automatically welded joints		For automatically welded joints
		Downhand, Horizontal, Overhead	Vertical upward, Vertical downward	
<i>KA</i> ⁽³⁾	20	47	34	34
<i>KB</i> ⁽³⁾ , <i>KD</i>	0			
<i>KE</i>	-20			
<i>KA32</i> , <i>KA36</i>	20			
<i>KD32</i> , <i>KD36</i>	0			
<i>KE32</i> , <i>KE36</i>	-20			
<i>KF32</i> , <i>KF36</i>	-40			
<i>KA40</i>	20	39	39	39
<i>KD40</i>	0			
<i>KE40</i>	-20			
<i>KF40</i>	-40			

Note:

(1) For thickness above 50mm, impact test requirements are to be in accordance with 4.1.3-3 and to be agreed by the Society.

- (2) A set of test specimens is considered to have failed if the value of absorbed energy of more than two test specimens is less than the specified value of minimum mean absorbed energy or if the value of anyone of the test specimens is less than 70% of the specified value of minimum mean absorbed energy.
- (3) Steels average absorbed energy on fusion line and in heat affected zone is to be minimum 27J.

In Table M4.8 Note(1), the wording “Fig M4.2” in main text has been amended as “Fig M4.4”.

Table M4.9 has been amended as follows.

**Table M4.9 Impact Test Requirements for Butt Weld Joint
(Quenched and Tempered High Tensile Rolled Steels for Marine Construction)**

Grade of steel	Testing temperature (°C)	Minimum mean absorbed energy (J) ⁽¹⁾		
		<i>a</i> ⁽²⁾	<i>b, c, d, e</i> ⁽²⁾	
			<i>L</i> ⁽³⁾	<i>T</i> ⁽³⁾
KA43	0	47	42	28
KD43	-20			
KE43	-40			
KF43	-60			
KA47	0	46	31	31
KD47	-20			
KE47	-40			
KF47	-60			
KA51	0	50	50	33
KD51	-20			
KE51	-40			
KF51	-60			
KA56	0	55	55	37
KD56	-20			
KE56	-40			
KF56	-60			
KA63	0	62	62	41
KD63	-20			
KE63	-40			
KF63	-60			
KA70	0	69	69	46
KD70	-20			
KE70	-40			
KF70	-60			

Note:

- (1) A set of test specimens is considered to have failed if the value of absorbed energy of more than two test specimens is less than the specified value of minimum mean absorbed energy or if the value of any one of the test specimens is less than 70% of the specified value of minimum mean absorbed energy.
- (2) Position of notch as shown in **Fig M4.2** and **Fig M4.3**.

(3) *L* (or *T*) indicates that the direction of welding is transverse (or parallel) to the rolling.

4.2.8 Macro-structure Inspection

Main text has been amended as -1.

Sub-paragraph -2 has newly added as follows.

2 Macro examination shall include about 10mm unaffected base metal.

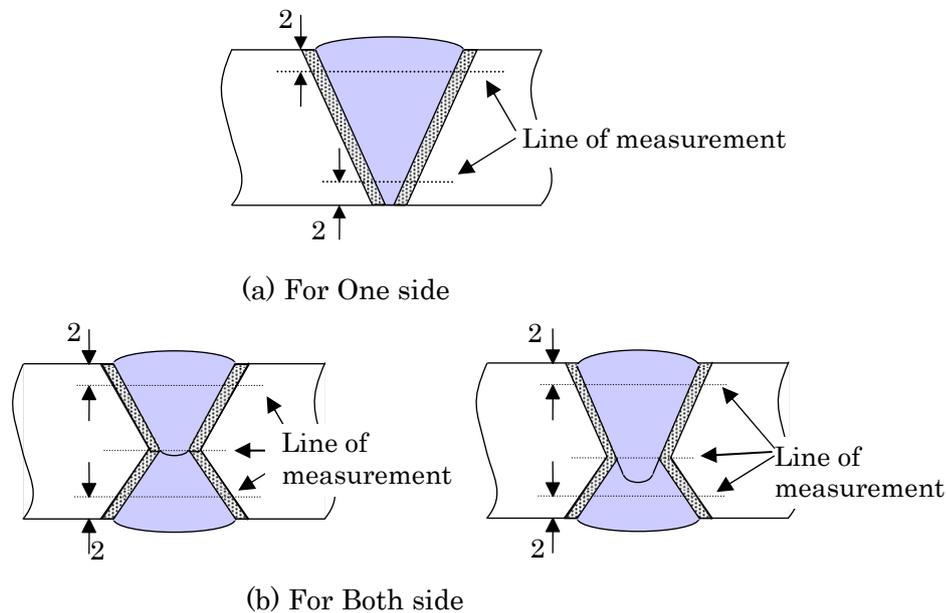
Paragraph 4.2.9 and 4.2.10 have been renumbered to Paragraph 4.2.10 and 4.2.11.

Paragraph 4.2.9 has been newly added as follows.

4.2.9 Hardness test

- 1 Vickers hardness is to be measured at the position shown in **Fig M4.5**. 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 test is to be in accordance with the requirements specified given in **Table M4.4**.

Fig M4.5 Hardness test (Unit: mm)



Note:

- (1) For each row of indentations there shall be a minimum of 3 individual indentations in the weld metal, the heat affected zones (both side) and the base metal (both sides).
- (2) Measuring intervals are to be 1mm on the basis of the bond.
- (3) Measuring load is to be 10kg Vickers.

Table M4.10 has newly added as follows.

Table M4.10 Requirements of hardness test

Kinds of specimen	Vickers hardness (<i>HV</i> 10)
Rolled steels for hull ⁽¹⁾	350 max
Quenched and tempered high tensile rolled steel for structure	420 max

Note:

- (1) For *KA36*, *KD36*, *KE36*, *KF36*, *KA40*, *KD40*, *KE40* and *KF40*, the tests are to be carried out.

Paragraph 4.2.10 has been amended as follows.

4.2.10 Non-destructive Inspection

- 1 Internal inspections by radiographic examination or ultrasonic examination, and surface inspections by magnetic particle examination or liquid penetrant examination are to be carried for whole length of the welding. The result of non-destructive inspection is to show that there are no crack, poor penetration, lack of fusion and other injurious defects.
- 2 In case any post-weld heat treatment is required or specified, non-destructive inspection test is to be performed after heat treatment.
- 3 Quenched and tempered high tensile rolled steel for structure shall be delayed for minimum of 48 hours, unless heat treatment has been carried out.

4.2.11 Retest

Sub-paragraph -1 has been amended as follows.

- 1 Where visual inspection, macro-structure inspection or non-destructive inspection fails to meet the requirements, the new test specimens welded under the same welding conditions, are to be subject to retest and all of these test specimens are to pass the test.

Sub-paragraph -4 has been renumbered to Sub-paragraph -5.

Sub-paragraph -4 has been newly added as follows.

- 4 If there is a single hardness value above the maximum values allowed, additional hardness tests shall be carried out (on the reverse of the specimen or after sufficient grinding of the test surface).

In Sub-Paragraph -5, the wording “preceding -1 through -3” in main text has been amended as “preceding -1 through -4”.

4.3 Tests for Fillet Weld Joints

4.3.1 Application

The wording “Table M4.3” in main text has been amended as “Table M4.4”.

4.3.2 Kinds of Test

Main text has been amended as follows.

Fillet weld joints are to be subjected to finished inspection, macro-structure inspection, hardness test, fracture and non-destructive inspection test. Additional tests may be required if found necessary by the Society.

4.3.3 Test Assemblies and Welding

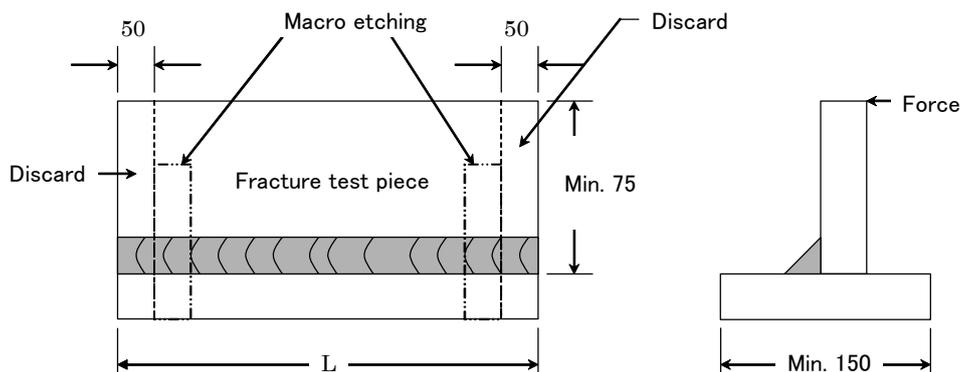
In Sub-Paragraph -2, the wording “Fig. M4.3” in main text has been amended as “Fig. M4.6”.

Sub-Paragraph -6 has newly added as follows.

6 The tack welds of test piece are to be the same procedure as actual work.

Fig. M4.6 has been amended as follows.

Fig. M4.6 Test Assembly for Fillet Weld Joints (Unit: mm)



Note:

- (1) The length of test specimen, L is not less than 350mm for manual welding and semi-automatic welding (including gravity welding) and not less than 1,000mm for automatic welding.

4.3.4 Finished Inspection

Main text has been amended as follows.

Welded surface is to be regular and uniform and is to be free from injurious defects, such as cracks, undercuts, overlaps, etc.

Paragraph 4.3.5 has been amended as follows.

4.3.5 Macro-structure Inspection

- 1 In macro etched specimens showing the transverse section of fillet weld joint, weld joints are to be free from excessive difference between upper and lower fillet lengths, cracks and other injurious defects.
- 2 Macro examination shall include about 10mm unaffected base metal.

Paragraph 4.3.6 through 4.3.8 have been renumbered to Paragraph 4.3.7 through 4.3.9.

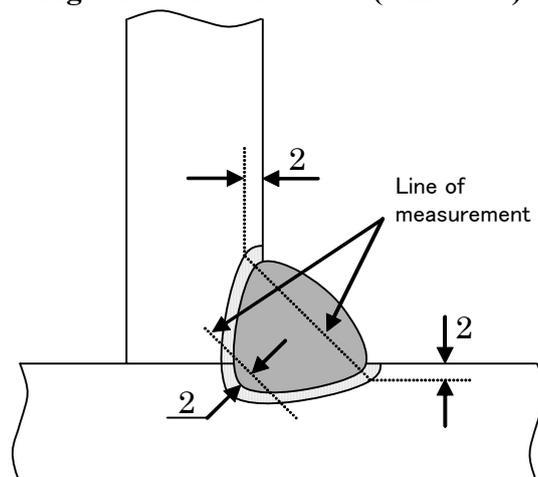
Paragraph 4.3.6 has been newly added as follows.

4.3.6 Hardness test

- 1 Vickers hardness is to be measured at the position shown in **Fig M4.7**. 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 test are to be in accordance with the requirements specified given in **Table M4.4**.

Fig. M4.7 has been newly added as follows.

Fig. M4.7 Hardness test (Unit: mm)



Note:

- (1) For each row of indentations there shall be a minimum of 3 individual indentations in the world metal, the heat affected zones (both side) and the base metal (both sides).

- (2) Measuring intervals are to be 1mm on the basis of the bond.
- (3) Measuring load is to be 10kg Vickers.

Paragraph 4.3.7 has been amended as follows.

4.3.7 Fracture Tests

The remaining test assemblies after the macro-structure specimen has been removed are to be broken by pressing as shown in **Fig. M4.6**, without cracks, poor penetrations, blow holes and injurious defects in the fractured surface. Where, however, the sum of lengths having blow holes (include poor penetrations), except at both ends of the specimen, is not greater than 10% of the total welded length, the test may be regarded as satisfactory.

4.3.8 Non-Destructive Inspection

Main text has been amended as -1.

Sub-Paragraph -1 has been amended as follows.

- 1 Surface inspections by magnetic particle examination or liquid penetrant examination are to be carried for whole length of the welding. The result of non-destructive inspection is to show that there are no crack and other injurious defects.

Sub-Paragraph -2 and -3 have been amended as follows.

- 2 In case any post-weld heat treatment is required or specified, non-destructive inspection test is to be performed after heat treatment.
- 3 Quenched and tempered high tensile rolled steel for structure shall be delayed for minimum of 48 hours, unless heat treatment has been carried out.

Paragraph 4.3.9 has been amended as follows.

4.3.9 Retest

- 1 Where visual inspection, macro-structure inspection, fracture test or non-destructive inspection test fails, the new test specimens welded under the same welding conditions, are to be subject to retest, and all of these test specimens are to pass the test items specified.
- 2 Where the hardness test fails, the retest may be correspondingly applied to the requirement in **4.2.11-4**.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 January 2007.
2. Notwithstanding the amendments to the Rules, the current requirements may apply to the surveys for which the application is submitted to the Society before the effective date.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part M **Welding**

GUIDANCE

2006 AMENDMENT NO.2

Notice No.27 20th March 2006

Resolved by Technical Committee on 3rd February 2006

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

M4 WELDING PROCEDURE AND RELATED SPECIFICATIONS

M4.1 General

Paragraph M4.1.3 has been newly added as follows.

M4.1.3 Execution of Tests

The wording “deemed appropriate by the Society” specified in **4.1.3-2, Part M** of the Rules means the following **(1)** to **(3)**.

- (1) Where the technical documents concerning the welding procedure which deemed appropriate by the Surveyor.
- (2) Where the alteration of procedure are considered by the Surveyor to be not impairing the property of the joint.
- (3) Where the welding conditions of semi-automatic fillet welding, which has already been approved by the Society, are applied to automatic fillet welding (including robotic welding). In this case, the automatic operation is to be confirmed as appropriate by the Surveyor.

M4.1.4 Range of Approval

The main text has been numbered to -4, and sub-paragraphs -1 thorough -3 have been newly added as follows.

- 1** Application of provisory requirement specified in **4.1.4-1, Part M** of the Rules is to be applied to **4.1.4-1(4)(c), Part M** of the Rules and to be in accordance with **Table 4.1.4-1**. In this case, test records which the Surveyor deems appropriate are to be submitted to the Surveyor.
- 2** For **4.1.4-1(2), Part M** of the Rules, even though the test assembly is dispensed with 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.
- 3** The wording “deemed appropriate by the Society” specified in **4.1.4-2, Part M** of the Rules means the following **(1)** to **(3)**.
 - (1) Heat input
Heat input of welding for actual works is to be complied with the requirements specified in the following **(a)** and **(b)**.

- (a) The upper limit of heat input approved is 1.25 times the heat input used in welding the test piece, but not over 55kJ/cm. However, for high heat input processes specified in **Table 4.2 Notes(5), Part M** of the Rules, the upper limit is 1.1 time the heat input used in welding the test piece.
- (b) The lower limit of heat input approved is 0.75 times the heat input used in welding the test piece.
- (2) Preheating and interpass temperature
Preheating and interpass temperature for actual work are to be complied with the requirements specified in the following **(a)** and **(b)**.
 - (a) The minimum preheating temperature is that used in the qualification test.
 - (b) The maximum interpass temperature is that used in the qualification test.
- (3) Post-weld heat treatment
The 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 M4.1.4-1 through Table M4.1.4-4 have been renumbered to Table M4.1.4-2 through Table M4.1.4-5 respectively.

Table M4.1.4-1 has been newly added as follows.

Table M4.1.4-1 Grades

Grade of test assembly ⁽¹⁾	Approval range of grade
<i>KA</i>	<i>KA</i>
<i>KB</i>	<i>KA, KB</i>
<i>KD</i>	<i>KA, KB, KD</i>
<i>KA32</i>	<i>KA, KA32</i>
<i>KD32</i>	<i>KA, KB, KD, KA32, KD32</i>
<i>KA36</i>	<i>KA, KA32, KA36</i>
<i>KD36</i>	<i>KA, KB, KD, KA32, KD32, KA36, KD36</i>
<i>KA40</i>	<i>KA32, KA36, KA40</i>
<i>KD40</i>	<i>KA32, KD32, KA36, KD36, KA40, KD40</i>

Note :

- (1) For thickness above 50 mm, this Table is not applicable.

Sub-paragraph -4 has been amended as follows.

- 4 For the wording “deemed appropriate by the Society” specified in **4.1.4-4, Part M of the Rules**, the approval of welding procedure and related specifications of rolled stainless steel and aluminium alloys are to be complied with the requirements specified in the following **(1)** and **(2)**, provided that the applied welding condition is the same.
 - (1) Rolled Stainless Steel
For rolled stainless steel, **4.1.4-1, Part M of the Rules** and preceding -2 (excluding the requirements of large heat input welding) is to be applied. However, the kind of steel is the same as test assembly. Where the provisory requirement specified in **3.5.5-1, Part K** of the Rules is applied, the steel with the specified minimum proof stress less than that of the tested steels may be included.
 - (2) Aluminium Alloys

The requirements specified in the following (a) through (g) are to be applied.

- (a) Type of welded joints
Type of welded joints is to be as specified in **Table M4.1.4-2**. Where the welding procedures of butt welded joints are approved, the fillet welded joints corresponding to the welding position are to be included.
- (b) Thickness
Range of thickness is to be as specified in **Table M4.1.4-3**.
- (c) Throat thickness of fillet welds
Throat thickness of fillet welds is to be as specified in **Table M4.1.4-4**.
- (d) Kind of aluminium alloys
Kind of aluminium alloys is to be as specified in **Table M4.1.4-5**.
- (e) Kind of welding consumables
Range of approval for welding consumables is to be as specified in the followings.
 - (i) Welding consumables having the same grade as used for the procedure qualification tests.
 - (ii) Welding consumables having the higher specified strength than the welding consumable used for the procedure qualification tests.
- (f) Preheat and interpass temperature
Preceding **-3(2)** is to be applied.
- (g) Joints for combination welding procedure
In the joint welded by dissimilar processes (combination welding), the subsequent process may be excluded, provided the weldings are applied within the approved thickness range and no alteration of the welding sequence from approved condition is made.

Table M4.1.4-2 and Table M4.1.4-3 have been amended as follows.

Table M4.1.4-2 Type of Welded Joint

Type of welded joint for test assembly				Range of approval	
Butt welding	One side	With backing	A	A, C, D	
		Without backing	B	A, B, C, D	
	Both side	With gouging	C	C	
		Without gouging	D	C, D	
Fillet welding			E	E	

Table M4.1.4-3 Thickness

Thickness of test assembly t (mm) ⁽¹⁾	Range of approval		
	Butt welding		Fillet welding
	Single-run	Two-run (Single-run from both sides)	
$t \leq 100$	0.8t to 1.1t		0.5t to 2t ⁽²⁾ (max. 150mm)
$100 < t$	To be in accordance with the discretion of the Society.		

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(2)(g)**).

M4.2 Tests for Butt Welded Joints

Paragraph M4.2.2 has been deleted.

Fig. M4.2.1-1 has been deleted.

Paragraph M4.2.5 has been newly added as follows.

M4.2.5 Tensile Tests

In tensile test specified in **4.2.5, Part M** of the Rules, procedure of approval for tensile test is to be complied with as follows:

- (1) documents for shape of test specimens and test procedure
- (2) documents for strength of weld connections (including microscopic photograph of welding parts)
- (3) tensile tests for deposited metal and heat affected zone of welding

Paragraph M4.2.7 has been newly added as follows.

M4.2.7 Impact Tests

The wording “agreed by the Society” specified in **Table 4.7 Notes (1), Part M** of the Rules is to be complied with the requirements specified in the followings.

- (1) Where the thickness is more than 50mm and not exceeding 70mm, in addition to requirements of impact test specified in **Fig. M4.2** and **Fig. M4.3, Part M** of the Rules, brittle fracture test may be required. In this case, impact test requirements are to be complied with the requirements specified in **Table M4.2.7-1**.
- (2) Where the thickness is exceeding 70mm, impact test and brittle fracture test (or submission of technical documents for brittle fracture test) deemed appropriate by the Society are to be carried out.

Table M4.2.7-1 has been amended as follows.

**Table M4.2.7-1 Impact Test Requirements for Butt Welded Joint
(Rolled Steels for Hull whose thickness is more than 50 mm and not exceeding 70 mm)**

Grade of steel	Testing temperature (°C)	Value of minimum mean absorbed energy (<i>J</i>)		
		For manually or semi-automatically welded joints		For automatically welded joints
		Downhand, Horizontal Overhead	Vertical upward, Vertical downward	
<i>KA</i> ⁽¹⁾	20	47	41	41
<i>KB</i> ⁽¹⁾ , <i>KD</i>	0			
<i>KE</i>	-20			
<i>KA32</i> , <i>KA36</i>	20			
<i>KD32</i> , <i>KD36</i>	0			
<i>KE32</i> , <i>KE36</i>	-20			
<i>KF32</i> , <i>KF36</i>	-40			
<i>KA40</i>	20		46	46
<i>KD40</i>	0			
<i>KE40</i>	-20			
<i>KF40</i>	-40			

Note:

(1) For a bond and heat affected zone, value of minimum mean absorbed energy is to be 34*J*.

M4.3 Tests for Fillet Weld Joints

Paragraph M4.3.2 has been deleted.

Fig. M4.3.1-2 has been deleted.

Paragraph M4.3.3 has been newly added as follows.

M4.3.3 Test Assemblies and Welding

- 1 For 4.3.3-1, Part M of the Rules, shop primer of test assemblies is equivalent to coatings of actual work.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 January 2007.
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.