

W32 Qualification scheme for welders of hull structural steels

(Sept
2016)

1. Scope

1.1 This document gives requirements for a qualification scheme for welders intended to be engaged in the fusion welding of steels as specified in UR W7, W8, W11 and W31 for hull structures.

1.2 This qualification scheme does not cover welders engaged in oxy-acetylene welding.

1.3 This qualification scheme does not cover welding of pipes.

2. General

2.1 Those welders intended to be engaged in welding of hull structures in shipyards and manufacturers shall be tested and qualified in accordance with this scheme and issued with a qualification certificate endorsed by the Society.

2.2 The welding operator responsible for setting up and/or adjustment of fully mechanized and automatic equipment, such as submerged arc welding, gravity welding, electro-gas welding and MAG welding with auto-carriage, etc., must be qualified whether he operates the equipment or not. However a welding operator, who solely operates the equipment without responsibility for setting up and/or adjustment, does not need qualification provided that he has experience of the specific welding work concerned and the production welds made by the operators are of the required quality.

The qualification test and approval range of the welding operator are left to the discretion of the Society with reference to ISO 14732.

2.3 This document is applicable to welding of hull structures both during new construction and the repair of ships.

Note:

1. This UR is to be applied by IACS Societies to applications for welder or welding operator qualification (initial or renewal) dated on or after 1 January 2018.
2. This document does not invalidate welder's qualifications issued and accepted by the Classification Society before 1 January 2018 provided the welder's qualifications are considered by the Classification Society to meet the technical intent of this UR. These qualifications are to be renewed in accordance with this UR latest by 31 December 2020.
3. Certificates that expire after 1 January 2018 are to be renewed in accordance with this UR.
4. The welder's or welding operator's qualifications which have not been required by the Society's Rules before 1 January 2018, are to be initially issued in accordance with this UR by the 31 December 2020 at the latest.

W32
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2.4 The training of welders, control of their qualification and maintenance of their skills are the responsibility of shipyards and manufacturers. The Society Surveyor is to verify and be satisfied that the welders are appropriately qualified.

2.5 Welders or welding operators qualified in accordance with national or international welder qualification standards may also be engaged in welding of hull structures at the discretion of the Society provided that the qualification testing, range of approval and revalidation requirements are considered equivalent to this UR.

3. Range of qualification of welders

3.1 A welder is to be qualified in relation to the following variables of welding:

- a) base metal
- b) welding consumables type
- c) welding process
- d) type of welded joint
- e) plate thickness
- f) welding position

3.2 Base metals for qualification of welders or welding operators are combined into one group with a specified minimum yield strength $R_{eH} \leq 460 \text{ N/mm}^2$. The welding of any one metal in this group covers qualification of the welder or welding operator for the welding of all other metals within this group.

3.3 For manual metal arc welding, qualification tests are required using basic, acid or rutile covered electrodes. The type of covered electrodes (basic, acid or rutile) included in the range of approval is left at the discretion of the Society.

Welding with filler material qualifies for welding without filler material, but not vice versa.

3.4 The welding processes for welder's qualification are to be classified in Table 1 as,

M - Manual welding

S - Semi-automatic welding/Partly mechanized welding

T - TIG welding

Each testing normally qualifies only for one welding process. A change of welding process requires a new qualification test.

W32 (cont)

Table 1 - Welding processes for welder's qualification

Symbol	Welding process in actual welding works		ISO 4063
M	Manual welding	Manual metal arc welding (metal arc welding with covered electrode)	111
S	Partly mechanized welding	Metal inert gas (MIG) welding	131
		Metal active gas (MAG) welding Flux cored arc (FCA) welding	135, 138 ¹ 136 ²
T	TIG welding	Tungsten inert gas (TIG) welding	141

Note:

The Society may require separate qualification for solid wires, metal-cored wires and flux-cored wires as follows:

- ¹ A change from MAG welding with solid wires (135) to that with metal cored wires (138), or vice versa is permitted.
- ² A change from a solid or metal cored wire (135/138) to a flux cored wire (136) or vice versa requires a new welder qualification test.

3.5 The types of welded joint for welder's qualification are to be classified as shown in Table 2 in accordance with the qualification test.

Table 2 - Types of welded joint for welder's qualification

Type of welded joint used in the test assembly for the qualification test				Type of welded joint qualified
Butt weld	Single sided weld	With backing	A	A, C, F
		Without backing	B	A, B, C, D, F
	Double sided weld	With gouging	C	A, C, F
		Without gouging	D	A, C, D, F
Fillet weld	----	----	F	F

Welders engaged in full/partial penetration T welds shall be qualified for butt welds for the welding process and the position corresponding to the joints to be welded.

3.6 For fillet welding, welders who passed the qualification tests for multi-layer technique welding can be deemed as qualified for single layer technique, but not vice versa.

3.7 The qualified plate thickness range arising from the welder qualification test plate thickness is shown in Table 3.

Table 3 - Plate thicknesses for welder's qualification

Thickness of test assembly T (mm)	Qualified plate thickness range t (mm)
$T < 3$	$T \leq t \leq 2T$
$3 \leq T < 12$	$3 \leq t \leq 2T$
$12 \leq T$	$3 \leq t$

W32 (cont)

3.8 The welding positions qualified as a result of the actual welding position used in a satisfactory welder's qualification test, are shown in Table 4 and Table 5. Diagrams showing the definitions of weld position used in Table 4 and Table 5 are shown in Figure 1.

Table 4 - Qualified welding positions when testing with butt welding

Qualification Test Position with butt weld	Qualified welding positions in actual welding works	
	Butt welds	Fillet welds
PA	PA	PA, PB
PC	PA, PC	PA, PB, PC
PE	PA, PC, PE	PA, PB, PC, PD, PE
PF	PA, PF	PA, PB, PF
PG	PG	PG

Table 5 - Qualified welding positions when testing with fillet welding

Qualification Test Position with fillet weld	Qualified welding positions in actual welding works
	Fillet welds
PA	PA
PB	PA, PB
PC	PA, PB, PC
PD	PA, PB, PC, PD, PE
PE	PA, PB, PC, PD, PE
PF	PA, PB, PF
PG	PG

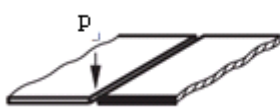
The Society may require a qualification test with fillet welding for welders who are employed to perform fillet welding only. Welders engaged in welding of T joints with partial or full penetration are to be qualified for butt welding.

3.9 A welder qualified for butt or fillet welding can be engaged in tack welding for the welding process and position corresponding to those permitted in his certificate.

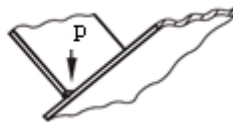
Alternatively, welders engaged in tack welding only can be qualified on the test assemblies shown in Figure 5 or Figure 6.

W32

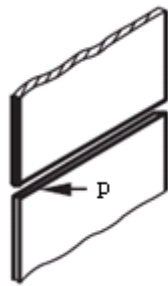
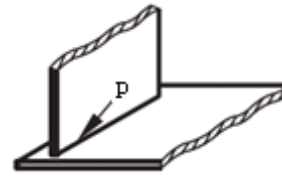
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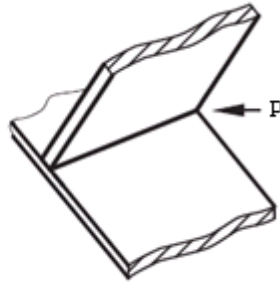
a) PA: flat position



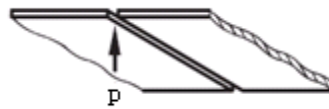
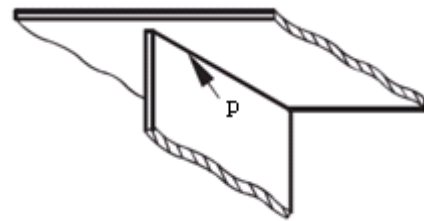
b) PB: horizontal vertical position



c) PC: horizontal position



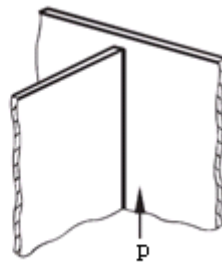
d) PD: horizontal overhead position



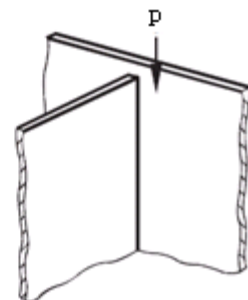
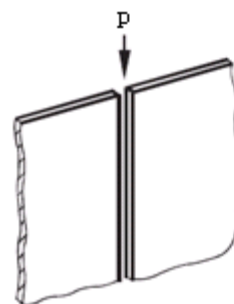
e) PE: overhead position



f) PF: vertical up position



g) PG: vertical down position



Note: p is the welding position.

Figure 1 Welding positions

W32

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4. Qualification test

4.1 General

4.1.1 Welding of the test assemblies and testing of test specimens shall be witnessed by the Surveyor.

4.2 Test assemblies

4.2.1 Test assemblies for butt welds and for fillet welds are to be prepared as shown in Figure 2, Figure 3 and Figure 4 in each qualification test.

4.2.2 Test assemblies for butt tack welds and for fillet tack welds are to be prepared as shown in Figure 5 and Figure 6.

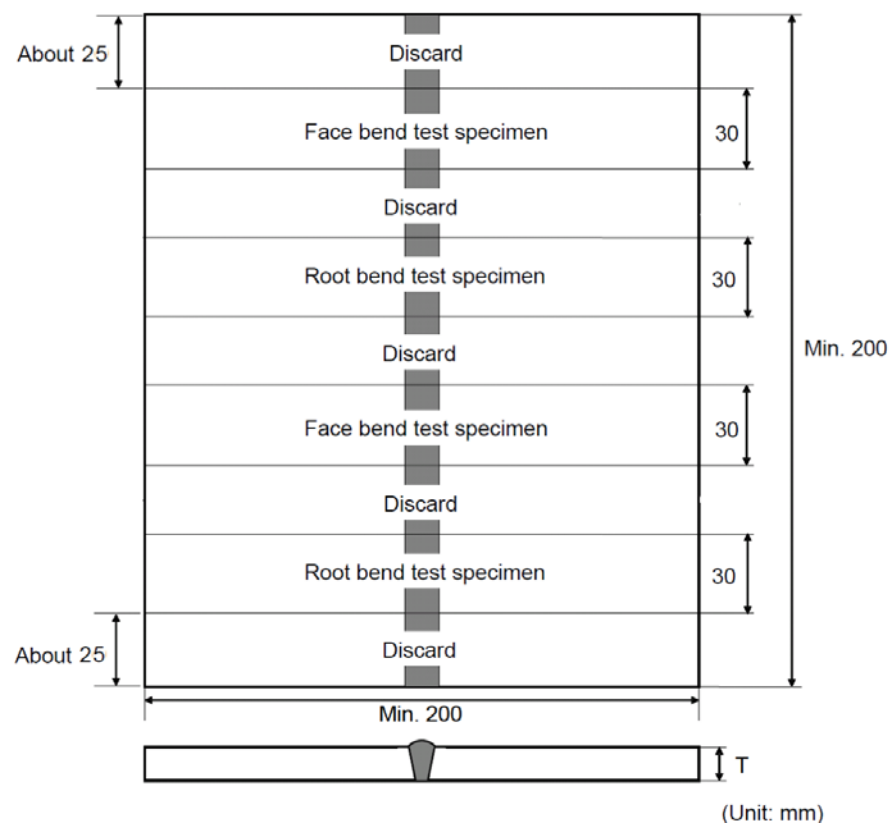


Figure 2 Dimensions and types of test assembly for butt welds ($T < 12\text{mm}$)

W32
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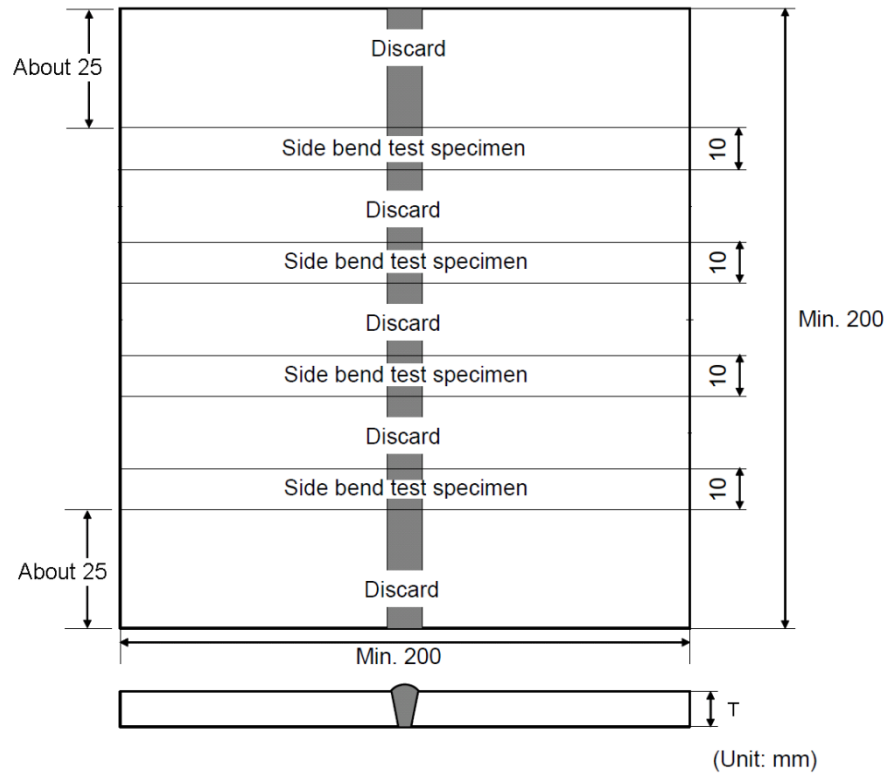


Figure 3 Dimensions and types of test assembly for butt welds ($T \geq 12\text{mm}$)

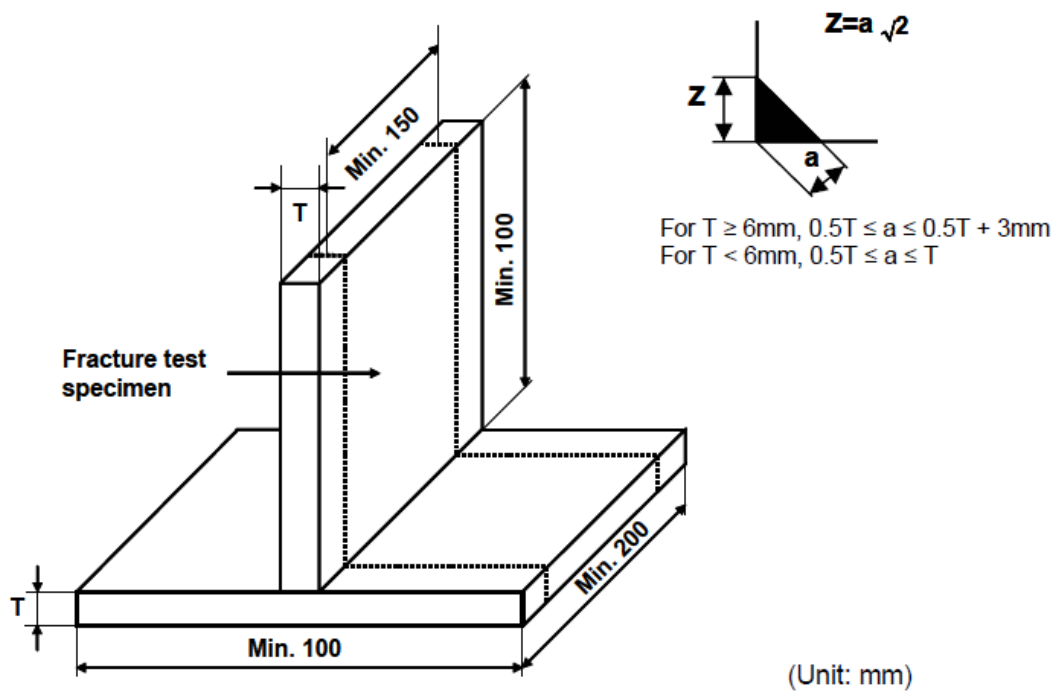


Figure 4 Dimensions and types of test assembly for fillet welds

W32
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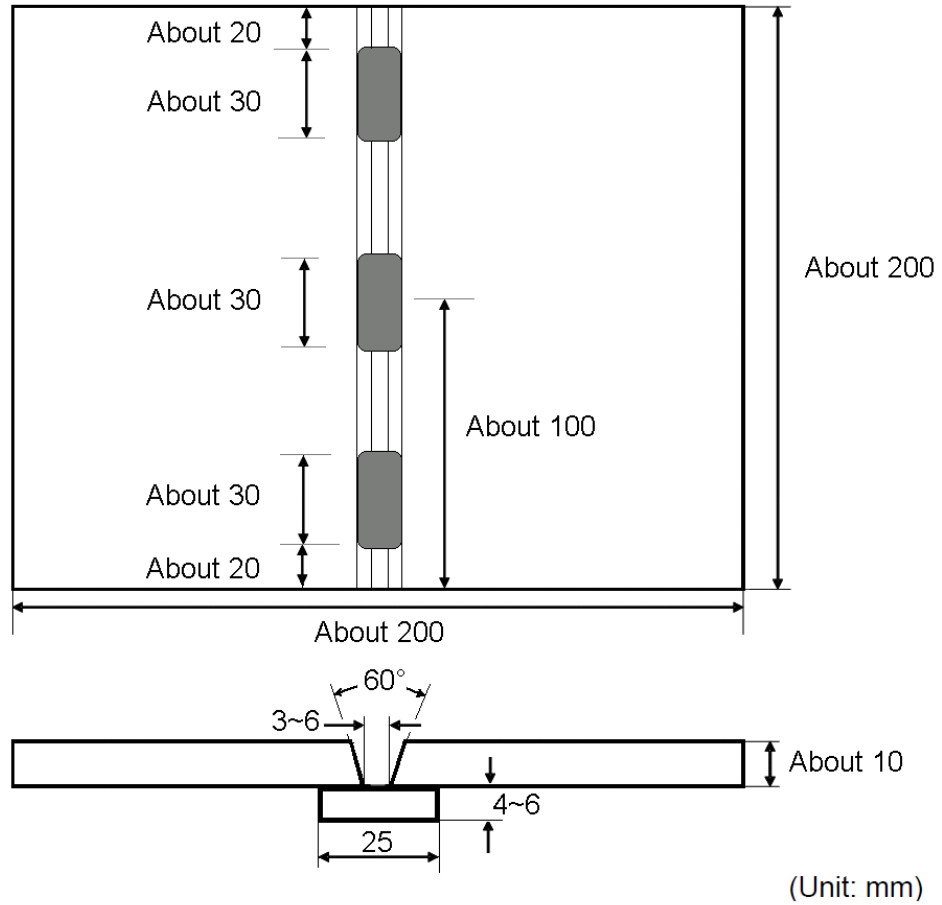


Figure 5 Dimensions and types of test assembly for tack butt welds

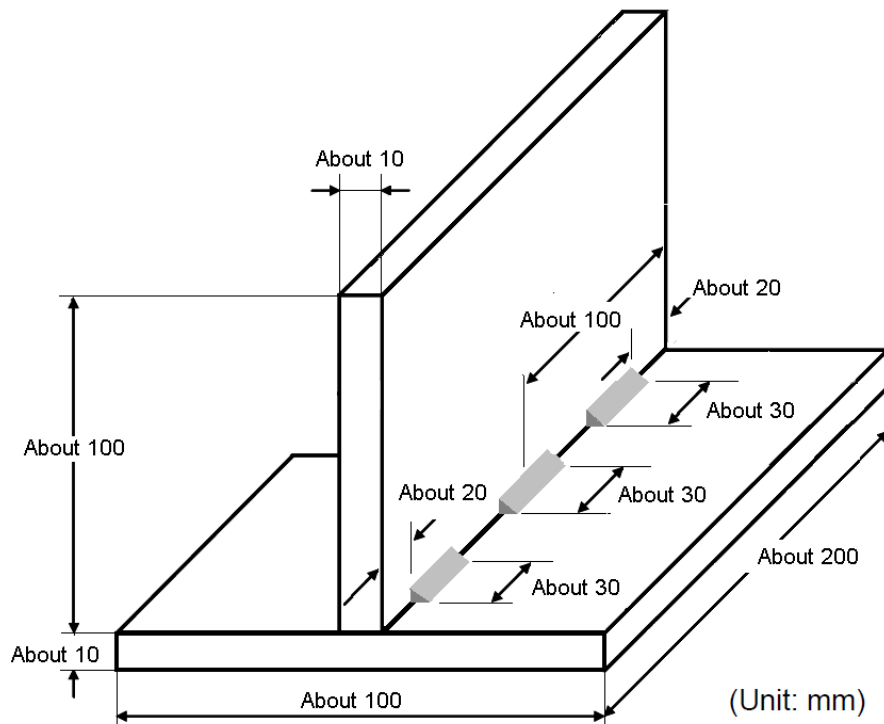


Figure 6 Dimensions and types of test assembly for tack fillet welds

W32
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4.2.3 Testing materials and welding consumables shall conform to one of the following requirements or to be of equivalent grade approved by the Society.

- a) Testing materials
 - Hull structural steels specified in UR W11
 - Hull structural forged steels specified in UR W7
 - Hull structural cast steels specified in UR W8
 - Hull structural steels with specified minimum yield point 460 N/mm² specified in UR W31
- b) Welding consumables
 - Consumables for hull structural steels specified in UR W17
 - Consumables for YP47 steels specified in UR W31

4.2.4 The welder qualification test assembly is to be welded according to a welding procedure specification (WPS or pWPS) simulating the conditions in production, as far as practicable.

4.2.5 Root run and capping run need each to have a minimum of one stop and restart. The welders are allowed to remove minor imperfections only in the stop by grinding before restart welding.

4.3 Examination and test

4.3.1 The test assemblies specified in 4.2 shall be examined and tested as follows:

- a) For butt welds
 - Visual examination
 - Bend test

Note: Radiographic test or fracture test may be carried out in lieu of bend test except the gas-shielded welding processes with solid wire or metal cored wire.

- b) For fillet welds
 - Visual examination
 - Fracture test

Note: Two macro sections may be taken in lieu of the fracture test.

- c) For tack welds
 - Visual examination
 - Fracture test

Additional tests may be required, at the discretion of the Society.

W32
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4.3.2 Visual examination

The welds shall be visually examined prior to the cutting of the test specimen for the bend test and fracture test. The result of the examination is to show the absence of cracks or other serious imperfections.

Imperfections detected are to be assessed in accordance with quality level B in ISO 5817, except for the following imperfection types for which level C applies;

- Excess weld metal
- Excess penetration
- Excessive convexity
- Excessive throat thickness

4.3.3 Bend test

Transverse bend test specimens are to be in accordance with UR W2.

The mandrel diameter to thickness ratio (i.e. D/T) is to be that specified for welding consumable (UR W17 and W31) approvals +1.

Two face bend test and two root bend test specimens are to be tested for initial qualification test, and one face and one root bend test specimens for extension of approval. For thickness 12mm and over, four side specimens (two side specimens for extension of approval) with 10 mm in thickness may be tested as an alternative.

At least one bend test specimen shall include one stop and restart in the bending part, for root run or for cap run.

The test specimens are to be bent through 180 degrees. After the test, the test specimens shall not reveal any open defects in any direction greater than 3mm. Defects appearing at the corners of a test specimen during testing should be investigated case by case.

4.3.4 Radiographic test

When radiographic testing is used for butt welds, imperfections detected shall be assessed in accordance with ISO 5817, level B.

4.3.5 Fracture test (Butt welds)

When fracture test is used for butt welds, full test specimen in length is to be tested in accordance with ISO 9017. Imperfections detected shall be assessed in accordance with ISO 5817, level B.

4.3.6 Fracture test (Fillet welds)

The fracture test is to be performed by folding the upright plate onto the through plate. Evaluation shall concentrate on cracks, porosity and pores, inclusions, lack of fusion and incomplete penetration. Imperfections that are detected shall be assessed in accordance with ISO 5817, level B.

W32
(cont)**4.3.7 Macro examination**

When macro examination is used for fillet welds, two test specimens are to be prepared from different cutting positions; at least one macro examination specimen shall be cut at the position of one stop and restart in either root run or cap run. These specimens are to be etched on one side to clearly reveal the weld metal, fusion line, root penetration and the heat affected zone.

Macro sections shall include at least 10mm of unaffected base metal.

The examination is to reveal a regular weld profile, through fusion between adjacent layers of weld and base metal, sufficient root penetration and the absence of defects such as cracks, lack of fusion etc.

4.4 Retest

4.4.1 When a welder fails a qualification test, the following shall apply.

- a) In cases where the welder fails to meet the requirements in part of the tests, a retest may be welded immediately, consisting of another test assembly of each type of welded joint and position that the welder failed. In this case, the test is to be done for duplicate test specimens of each failed test.

All retest specimens shall meet all of the specified requirements.

- b) In cases where the welder fails to meet the requirements in all parts of the required tests or in the retest prescribed in 4.4.1 a), the welder shall undertake further training and practice.
- c) When there is specific reason to question the welder's ability or the period of effectiveness has lapsed, the welder shall be re-qualified in accordance with the tests specified in 4.2 and 4.3.

4.4.2 Where any test specimen does not comply with dimensional specifications due to poor machining, a replacement test assembly shall be welded and tested.

5. Certification

5.1 Qualification certificates are normally issued when the welder has passed the qualification test by the Society. Each Shipyard and Manufacturer shall be responsible for the control of the validity of the certificate and the range of the approval.

5.2 The following items shall be specified in the certificate:

- a) Range of qualification for base metal, welding processes, filler metal type, types of welded joint, plate thicknesses and welding positions.
- b) Expiry date of the validity of the qualification.
- c) Name, date of birth, identification and the photograph of the welder.
- d) Name of shipbuilder / manufacturer.

W32
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5.3 When a certificate is issued, the relative documents such as test reports and/or re-validation records shall be archived as annexes to the copy of certificate according to the rules of the Society.

5.4 The status of approvals of each individual qualification is to be demonstrated to the Classification Society when requested.

6. Period of Validity**6.1 Initial approval**

6.1.1 Normally the validity of the welder's approval begins from the issue date of qualification certificate when all the required tests are satisfactorily completed.

The certificate is to be signed at six-month intervals by the shipyards/manufacturers personnel who is responsible for production weld quality provided that all the following conditions are fulfilled:

- a) The welder shall be engaged with reasonable continuity on welding work within the current range of approval. An interruption for a period no longer than six months is permitted.
- b) The welder's work shall in general be in accordance with the technical conditions under which the approval test is carried out.
- c) There shall be no specific reason to question the welder's skill and knowledge.

6.1.2 If any of these conditions are not fulfilled, the Society is to be informed and the certificate is to be cancelled.

The validity of the certificate may be maintained in agreement with the Society as specified in 6.2. The maintenance scheme of qualification is in accordance with 6.2.1 a) or b).

6.2 Maintenance of the approval

6.2.1 Revalidation shall be carried out by the Society. The skill of the welder shall be periodically verified by one of the following:

- a) The welder shall be tested every 3 years.
- b) Every 2 years, two welds made during the last 6 months of the 2 years validity period shall be tested by radiographic or ultrasonic testing or destructive testing and shall be recorded. The weld tested shall reproduce the initial test conditions except for the thickness. These tests revalidate the welder's qualifications for an additional 2 years.

6.2.2 The Society has to verify compliance with the above conditions and sign the maintenance of the welder's qualification certificate.

Annex: Example of Welder's qualification certificate

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:		Date of birth:	Photograph
Cert. No.:		Sex:	
Identification No.			
Employer's name and address			
WPS/pWPS No.			
Date of initial approval			
This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of [the Society], and is qualified to undertake welding operation specified in range of qualification of this certificate.			
Items	Test piece	Range of qualification	
Welding process			
Base metal			
Filler metal type			
Plate thickness			
Type of welded joint			
Welding position			
Other details			

This certificate is issued at _____ [place], and valid until _____ [DD/MM/YYYY].

Signature/seal of examiner: _____ Issued on _____ [DD/MM/YYYY].

	Report No. to be reviewed	Date of report	Signature of Employee	Date of signature
1				
2				
3				
4				
5				
6				

W32
(cont)**TEST RECORD**

Type of test	Performed and accepted	Not required
Visual examination		
Radiographic examination		
Surface examination		
Macro examination		
Fracture test		
Bend test		
Additional tests		

- * At the discretion of the Society, this page can be as the back page of a certificate, and also can be as a separate file.

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