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**Qualification testing of welders for  
underwater welding —**

**Part 1:  
Hyperbaric wet welding**

*Épreuve de qualification des soudeurs pour le soudage sous l'eau —  
Partie 1: Soudage hyperbare en pleine eau*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html)

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 11, *Qualification requirements for welding and allied processes personnel*.

This second edition cancels and replaces the first edition (ISO 15618-1:2001), which has been technically revised.

ISO 15618 consists of the following parts, under the general title *Qualification testing of welders for underwater welding*:

- *Part 1: Hyperbaric wet welding*
- *Part 2: Diver-welders and welding operators for hyperbaric dry welding*

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 11 via your national standards body. A complete listing of these bodies can be found at [www.iso.org](http://www.iso.org).

## **Introduction**

This part of ISO 15618 covers the principles to be observed in the qualification testing of welder-diver performance for the fusion welding of steels in a hyperbaric wet environment.

The ability of the welder-diver to follow verbal or written instructions and testing of his skill are therefore important factors in ensuring the quality of the welded product.

Testing of skill to this part of ISO 15618 depends on welding methods in which uniform rules and test conditions are complied with, and standard test pieces are used.

The principle of this part of ISO 15618 is that a qualification test qualifies a welder-diver not only for the conditions used in the test, but also for all other conditions which are considered easier to weld in accordance with this part of ISO 15618. It is presumed that the welder-diver has received training and/or has industrial practice within the range of qualification.

This part of ISO 15618 is intended to provide the basis for the mutual recognition by examining bodies for qualification relating to the welder-diver's competence in the various fields of application. Tests are to be carried out in accordance with this part of ISO 15618 unless additional tests are specified by the relevant application standard when these should be applied.

The welder-diver's skill and job knowledge continue to be approved only if the welder-diver is working with reasonable continuity on welding work within the extent of qualification.

# Qualification testing of welders for underwater welding —

## Part 1: Hyperbaric wet welding

### 1 Scope

This part of ISO 15618 specifies essential requirements, ranges of qualification, test conditions, acceptance requirements and certification for the qualification testing of welder-diver performance.

This part of ISO 15618 is applicable for hyperbaric wet welding on steel.

The recommended format for the certificate of qualification testing is given in [Annex A](#).

During the qualification test, the welder-diver may be required to show adequate job knowledge of the welding processes, materials and safety requirements for which he is to be qualified. Information on these aspects is given in [Annex B](#).

The welding processes referred to in this part of ISO 15618 include those fusion welding processes which are designated as manual or partly mechanised welding. It does not cover fully mechanised and fully automatic processes (see [5.2](#)).

This part of ISO 15618 applies to all new qualifications from the date of issue.

However, this part of ISO 15618 does not invalidate previous welder-diver qualifications made to former national standards or specifications, providing the intent of the technical requirements is satisfied and the previous qualifications are relevant to the application and production work on which they are employed.

The certificate of qualification testing is issued under the sole responsibility of the examiner or examining body.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers*

ISO 5173, *Destructive tests on welds in metallic materials — Bend tests*

ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

ISO 6947, *Welding and allied processes — Welding positions*

ISO 9017, *Destructive tests on welds in metallic materials — Fracture test*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding*

ISO 17636 (all parts), *Non-destructive testing of welds — Radiographic testing*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

## ISO 15618-1:2016(E)

ISO 17639, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment*

ISO/TR 15608, *Welding — Guidelines for a metallic materials grouping system*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15609-1 and the following apply.

#### 3.1 welder-diver

person who performs the welding under hyperbaric conditions

#### 3.2 hyperbaric wet welding

process of welding in a wet environment in excess of surface pressure with no mechanical barrier between the arc and the water

#### 3.3 examiner

person appointed to verify compliance with the applicable standard

Note 1 to entry: A certified examiner or certified bodies according to national or international standards/regulations.

Note 2 to entry: In certain cases, an external independent examiner can be required.

[SOURCE: ISO/TR 25901:2007, 2.119, modified — Note 1 to entry added.]

#### 3.4 examining body

organization appointed to verify compliance with the applicable standard

Note 1 to entry: In certain cases, an external independent examining body can be required.

[SOURCE: ISO/TR 25901:2007, 2.120]

### 4 Symbols and abbreviations

#### 4.1 General

Where the full wording is not used, the following symbols and abbreviations shall be used when completing the test certificate (see [Annex A](#)).

#### 4.2 Test piece

<i>a</i>	design/throat thickness
BW	butt weld
<i>D</i>	outside pipe diameter
FW	fillet weld
P	plate
<i>s</i>	penetration depth



<i>t</i>	material thickness of test piece (plate or wall thickness)
T	pipe
<i>z</i>	leg length of fillet weld

### 4.3 Filler materials and fluxes

A	acid covering
B	basic covering or electrode core — basic
R	rutile covering
RA	rutile — acid covering
RB	rutile basic covering
RC	rutile cellulosic covering
RR	rutile thick covering
Z	electrode core

Other filler materials and fluxes may be used by agreement.

### 4.4 Miscellaneous

bs	welding from both sides
gg	back gouging or back grinding of welds
mb	welding with backing material
ml	multi-layer
sl	single-layer
ss	single-side welding
wd	water depth
sw	salt water
fw	fresh water
as	aqueous solution

## 5 Essential variables for qualification testing

### 5.1 General

The criteria specified in this clause shall be examined in order to identify the ability of the welder-diver in these areas. Each criterion is considered to be a significant factor in the qualification testing. The welder-diver qualification test shall be carried out on standard test pieces.

Welder-divers shall be qualified according to a welding procedure specification (see ISO 15609-1).

### 5.2 Welding processes

Welding processes are defined in ISO/TR 25901-3 and reference numbers of welding processes for symbolic representation are listed in ISO 4063.

This part of ISO 15618 covers the following welding processes applicable in hyperbaric wet environment:

- 111 manual metal arc welding (metal arc welding with covered electrode);
- 114 self-shielded tubular-cored arc welding.

Other fusion welding processes may be used by agreement.

### 5.3 Joint types (butt and fillet welds)

Test pieces shall be produced for butt weld (BW) and fillet weld (FW) in plates (P) or pipes<sup>1)</sup> (T) for qualification tests in accordance with [7.3](#).

### 5.4 Material groups

The designation of steel groups of material as defined in ISO/TR 15608 shall apply.

This part of ISO 15618 primarily applies to the following material groups according to ISO/TR 15608: 1 and 8.

Other steel groups may be used by agreement.

### 5.5 Filler materials and fluxes

In most qualification tests, the filler metal is similar to the parent metal. When a welder-diver test has been carried out using a filler material/flux combination suitable for a certain material group, this test will only confer qualification of the welder-diver to use those consumables (filler material/flux combination) for other materials from the same material group.

Only electrodes designed for hyperbaric wet welding shall be used.

NOTE Certified filler materials for wet welding according to national/international standards may apply.

If there is no national/international standard for wet welding filler material available, the filler material shall be qualified according to a customer approved WPS for hyperbaric wet welding.

### 5.6 Dimensions

The welder-diver qualification test shall be based on the thickness of the material (i.e. plate thickness or wall thickness of pipe) and pipe diameters which the welder-diver will use in production. A range of qualification is listed for each of the ranges of plate thickness and pipe wall thickness or pipe diameter as specified in [Tables 1](#) and [2](#).

The thicknesses and diameters given in [Table 1](#) and [2](#) are nominal values and not intended to be measured precisely.

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1) The word “pipe”, alone or in combination, is used to mean “pipe”, “tube” or “hollow section”.

**Table 1 — Test piece thickness (plate or pipe) and range of qualification**

Test piece thickness, $t$ mm	Range of qualification for butt welds	Range of qualification for fillet welds
$t < 6$	$\geq t$ (max. 6 mm)	$\geq t$ (max. 6 mm)
$6 \leq t < 12$	$0,8 t$ to $2 t$ (min. 6 mm)	$\geq 6$ mm
$t \geq 12$	$0,5 t$ to $1,5 t$	

**Table 2 — Test piece diameter and range of qualification**

Test piece diameter, $D^a$ mm	Range of qualification
$D \leq 100$	$0,7 D$ to $2 D$
$100 < D \leq 300$	$0,5 D$ to $2 D$ (min. 75 mm)
$D > 300$	$>0,5 D$

<sup>a</sup> For structural hollow sections, "D" is the dimension of the smallest side.

## 5.7 Welding positions

The welding positions shall be as detailed in ISO 6947.

## 5.8 Hyperbaric environment

The welder-diver qualification test shall be carried out under actual or simulated hyperbaric conditions in fresh water (fw) or salt water (sw). The type of water (fw or sw) is a non-essential variable.

For other aqueous solutions, the welder-diver shall be qualified based on a welding procedure specification (see ISO 15609-1).

## 5.9 Visibility

The visibility during the qualification test shall be equal to or greater than 300 mm.

If the visibility under water during production is less than 300 mm, an additional onsite confirmation test weld shall be performed. The confirmation test weld (fillet weld or butt weld) shall be agreed between the contracting parties and shall meet the visual inspection criteria of this part of ISO 15618.

If the qualification test is performed with a visibility less than 300 mm, the welder-diver is qualified for the actual visibility and greater.

## 6 Range of qualification

### 6.1 General

The range of qualification for each type of test is given in the relevant subclauses and tables. In these tables, the range of qualification is indicated in the same horizontal line.

### 6.2 Welding process

Each test approves one welding process. A change of welding process requires a new qualification test.

### 6.3 Joint types

Depending on the test piece, the range of welds for which the welder-diver is approved is shown in [Table 3](#). The following additional criteria are applicable:

- a) butt welds qualify fillet welds but not vice versa;
- b) welds on pipes qualify welds on plates;
- c) qualification for welds in plates cover welds on pipes having an outside diameter  $\geq 600$  mm in the qualified welding position and joint type;
- d) butt welds made from one side with backing qualify welds from both sides with back gouging and vice versa;
- e) fillet welds made from one side qualify fillet welds from both sides;
- f) butt welds in pipes qualify branch joints with an angle  $\geq 60^\circ$ . The range of qualification is based on the outside diameter of the branch.

For applications where the type of weld cannot be qualified by means of either a butt or fillet, or for branch connections of less than  $60^\circ$ , a specific test piece should be used to qualify the welder-diver, when specified (e.g. by the product standard).

**Table 3 — Range of qualification for tests (details of weld type)**

Details of weld type		Range of qualification			
		Butt welds		Fillet welds	
		welded from one side (ss) with backing (mb)	welded from both sides (bs) with back gouging (gg)	plate	pipe
<b>Butt welds</b>	welded from one side (ss) with backing (mb)	x	x	x	x <sup>a</sup>
	welded from both sides (bs) with back gouging (gg)	x	x	x	x
<b>Fillet welds</b>	plate	—	—	x	x <sup>a</sup>
	pipe	—	—	x	x
<sup>a</sup> See <a href="#">6.3 c</a> ). x Indicates those welds for which the welder-diver is approved. — Indicates that for what the welder-diver is not approved.					

### 6.4 Material groups

According to the material group of the test piece specified in [5.4](#), the welder-diver is only approved for this material group.

For any other steel group, the welder-diver shall be qualified based on a welding procedure specification (see ISO 15609-1).

## 6.5 Filler materials

The manufacturer's guidelines should be followed.

Any change in the following essential variables shall require a requalification:

- a) manufacturer;
- b) manufacturer's trade name;
- c) diameter;
- d) methods of underwater transport, storage or exposure time;
- e) addition, deletion or change of any supplementary coatings or waterproofing.

## 6.6 Dimensions

The range of qualification according to plate thickness or wall thickness of pipe and/or pipe diameter is shown in [Tables 1](#) and [2](#).

## 6.7 Welding positions

The range of qualification for each welding position is given in [Table 4](#). The welding positions refer to ISO 6947.

Other test positions may be used by agreement.

## 6.8 Hyperbaric environment

The welder-diver qualification test shall be carried out under actual or simulated hyperbaric conditions at the appropriate water depth.

The range of qualification of water depth is defined in accordance with the welding procedure specification (WPS).

**Table 4 — Range of qualification for production according to welding position**

Welding position of test piece		Range of qualification for production																								
		Plate											Pipe													
		Butt welds					Fillet welds						Butt welds					Fillet welds								
PA	PC	PG	PE	PF	PA	PB	PG	PC	PD	PE	PF	PA	PC	PJ	PE	PH	PA	PB	PD	PJ	PH					
(1G)	(2G)	(3G Down)	(4G)	(3G Up)	(1F)	(2F)	(3F Down)	(-)	(4F)	(-)	(3F Up)	(1G)	(2G)	(5G Down)	(4G)	(5G Up)	(1F)	(2F)	(4F)	(5F)	(5F Up)					
Plate	Butt welds	PA (1G)	x										x <sup>a</sup>					x <sup>a</sup>	x <sup>a</sup>							
	PC (2G)	x	x										x <sup>a</sup>	x <sup>a</sup>				x <sup>a</sup>	x <sup>a</sup>							
	PG (3G Down)	x		x											x <sup>a</sup>			x <sup>a</sup>	x <sup>a</sup>		x <sup>a</sup>					
	PE (4G)	x			x					x			x <sup>a</sup>			x <sup>a</sup>		x <sup>a</sup>	x <sup>a</sup>	x <sup>a</sup>						
	PF (3G Up)										x						x <sup>a</sup>					x <sup>a</sup>				
	Fillet welds	PA (1F)																					x <sup>a</sup>			
	PB (2F)																						x <sup>a</sup>	x <sup>a</sup>		
	PC (-)																								x	
	PG (3F Down)																							x <sup>a</sup>		
	PD (4F)																							x <sup>a</sup>	x <sup>a</sup>	x <sup>a</sup>
	PE (-)																									
	PF (3F Up)																									x <sup>a</sup>
	Pipe	Butt welds	PA (1G)	x										x					x	x						
PC (2G)		x	x										x	x				x	x							
PJ (5G Down)		x		x									x		x	x		x	x	x	x					
PH (5G Up)																	x						x			
J-L045 (6G)		x	x	x									x	x	x	x		x	x	x	x					
Fillet welds		PB (2F)																						x	x	
PD (4F)																								x	x	x
PJ (5F)																								x	x	x
PH (5F Up)																									x	

<sup>a</sup> See 6.3 c).

## 7 Examination and testing

### 7.1 General

Only qualified commercial divers or equivalent according to national or international standards/regulations can be qualified according to this part of ISO 15618.

### 7.2 Witnessing

The welding of test pieces shall be witnessed by the examiner or examining body. The testing shall be verified by the examiner or examining body.

The examiner shall confirm that the essential variables are in compliance with this part of ISO 15618 and a welding procedure specification (WPS).

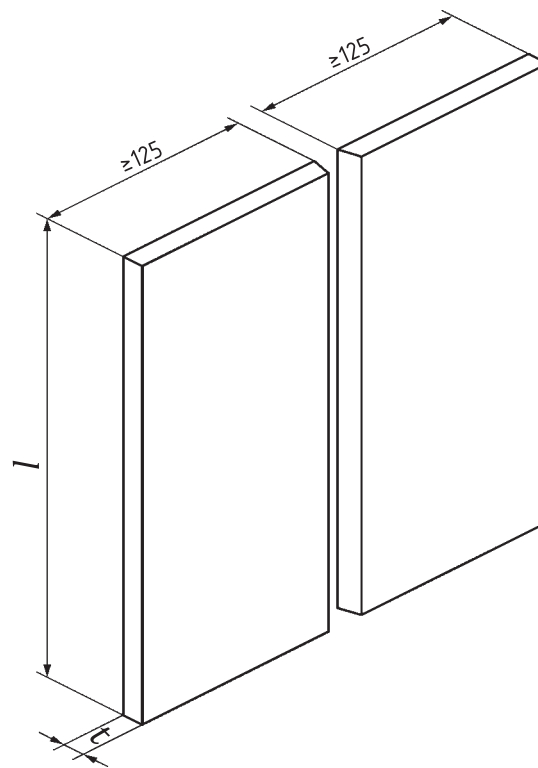
The test pieces shall be marked with the identification of the examiner and the welder-diver prior to welding. Additionally, welding positions for all test pieces shall be marked on the test piece and, for fixed pipe welds, the 12 o'clock welding position shall also be marked.

The examiner or examining body may stop the test if the welding conditions are non-conforming or if it appears that the welder-diver does not have the skill to fulfil the requirements, e.g. where there are excessive and/or systematic repairs.

### 7.3 Shapes and dimensions of test pieces

The shape and dimensions of test pieces required (see 5.6) are shown in Figures 1 to 4. For single-side butt-welds, backing is normally required.

Dimensions in millimetres



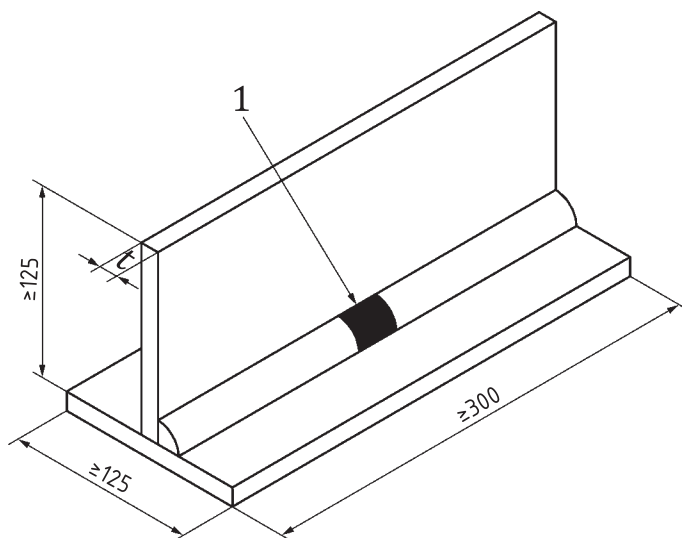
#### Key

$l$  length [see Figure 5 a) and b)]

$t$  material thickness of test piece

**Figure 1 — Dimensions of test piece for a butt weld in plate**

Dimensions in millimetres



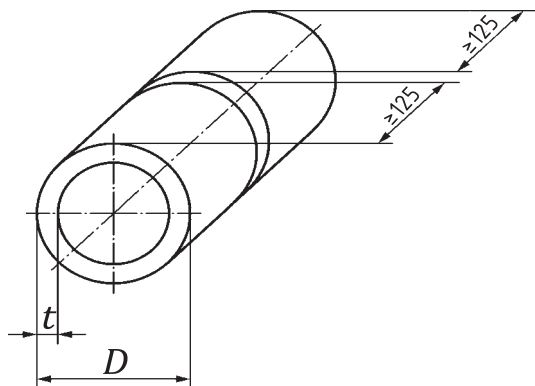
**Key**

- 1 stop and restart area
- $t$  material thickness of test piece

NOTE For  $t \geq 6$  mm,  $a \leq 0,7 t$ ; for  $t < 6$  mm,  $0,5 t \leq a \leq t$ .

**Figure 2 — Dimensions of test piece for fillet weld(s) on plate (T joint)**

Dimensions in millimetres

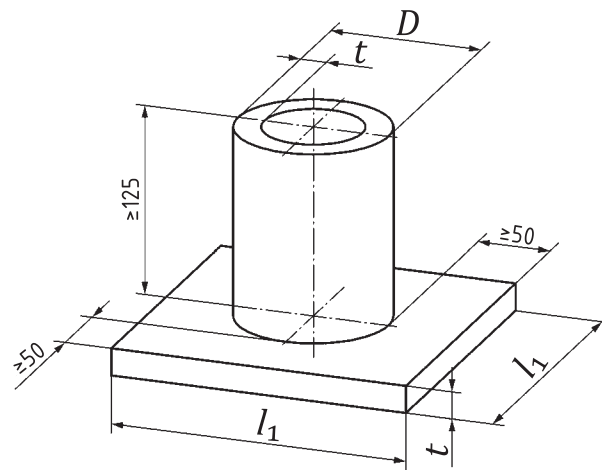


**Key**

- $D$  outside pipe diameter
- $t$  material thickness of test piece (wall thickness)

**Figure 3 — Dimensions of test piece for a butt weld in pipe**



**Key**

- $D$  outside pipe diameter  
 $l_1$  length of plate  
 $t$  material thickness of test piece (plate or wall thickness)

NOTE 1 The parent material can be of dissimilar thickness for the pipe and plate.

NOTE 2 For  $t \geq 6$  mm,  $a \leq 0,7 t$ ; for  $t < 6$  mm,  $0,5 t \leq a \leq t$ .

**Figure 4 — Dimensions of test piece for fillet weld in pipe**

#### 7.4 Welder-diver qualification test criteria

The qualification test of welder-divers shall follow a welding procedure specification (WPS) prepared in accordance with ISO 15609-1. The required throat thickness of the fillet weld test piece shall be defined in the welding procedure specification (WPS) used for the test.

The following conditions shall apply:

- each test piece shall be clearly identified and traceable to the welder-diver (according to 7.2);
- the test piece shall have at least one stop and one restart in the root run and in the top capping run and be identified in the inspection length to be examined;
- the welder-diver shall be allowed to remove imperfections, while the test piece is *in situ*. Generally, the capping runs shall not be ground with the exception of the removal of single isolated imperfections;
- the test shall be carried out under actual or simulated hyperbaric conditions.

#### 7.5 Test methods

After welding, the test piece shall be tested in accordance with Table 5.

If the weld fails to meet the acceptance criteria of one test method, no further testing in accordance with Table 5 needs to be carried out.

When material backing is used in the qualification test, it shall be removed prior to destructive testing (except for macroscopic examination) and need not be removed before non-destructive testing (NDT).

The test specimen for macroscopic examination shall be prepared and etched on one side to clearly reveal the cross section of the weld.

Table 5 — Test methods

Test method	Butt weld (in plate or pipe)	Fillet welds
Visual testing according to ISO 17637	Mandatory	Mandatory
Radiographic testing according to ISO 17636	Mandatory <sup>a</sup>	Not mandatory
Bend test according to ISO 5173	Mandatory	Not applicable
Fracture test according to ISO 9017	Not applicable	Mandatory <sup>b</sup>
Macroscopic examination according to ISO 17639	Not mandatory	Mandatory <sup>c d</sup>
<sup>a</sup> The radiographic testing may be replaced by ultrasonic testing according to ISO 17640 for thicknesses $\geq 8$ mm on material group 1. <sup>b</sup> The fracture tests on pipes may be replaced by radiographic testing. <sup>c</sup> For fillet welds on plate, two sections are examined. <sup>d</sup> For fillet welds on pipe, four sections are examined.		

## 7.6 Test pieces and test specimens

### 7.6.1 General

In 7.6.2 and 7.6.3 details of the type, dimensions and preparation of test pieces and test specimens are given. In addition, the requirements for mechanical tests are indicated.

The plate shall be welded for the entire length, but for examination purposes, the last 25 mm at each end shall be discarded.

### 7.6.2 Butt welds in plate and pipe

#### 7.6.2.1 General

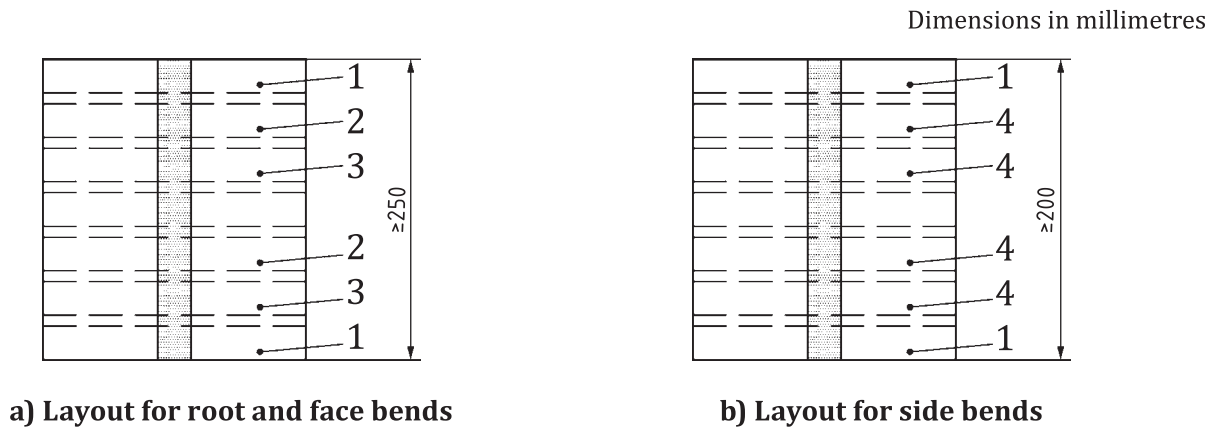
When radiographic examination is used, the whole inspection length of the weld in the test piece shall be radiographed in the as-welded condition in accordance with ISO 17636.

#### 7.6.2.2 Bend tests

Bend tests shall be performed in accordance with ISO 5173 and the following conditions shall apply.

For thicknesses  $t < 12$  mm, two root and two face bend test specimens shall be taken from the test piece in accordance with [Figure 5](#).

For thicknesses  $t \geq 12$  mm, four side-bend test specimens shall be taken from the test piece in accordance with [Figure 5](#).

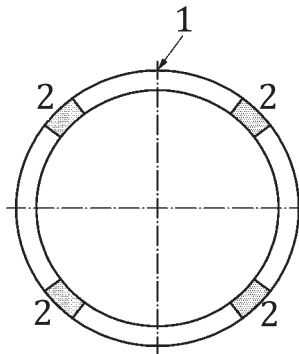


**Key**

- 1 discard (25 mm)
- 2 root bend
- 3 face bend
- 4 side bend

**Figure 5 — Type and location of bend test specimens for plate**

For pipe butt welds, the four specimens shall be equally spaced in accordance with [Figure 6](#).



**Key**

- 1 top of pipe for positions PJ (5G Down), PH (5G Up) and J-L045 (6G)
- 2 bend test specimen

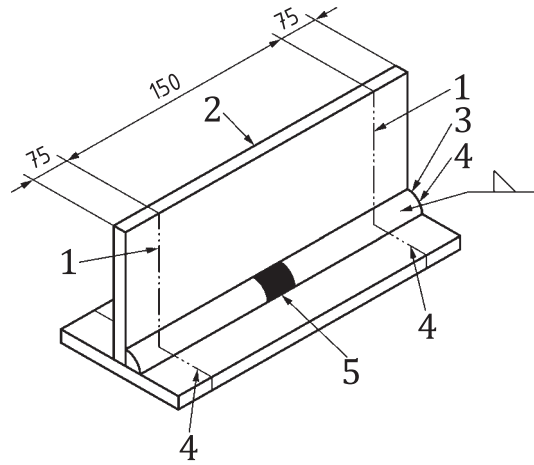
**Figure 6 — Type and location of bend test specimens for pipe**

**7.6.3 Fillet welds on plate and pipe**

**7.6.3.1 General**

The test piece prepared for the fracture test and the macroscopic examination shall be cut in accordance with [Figure 7](#) for plate and [Figure 8](#) for pipe.

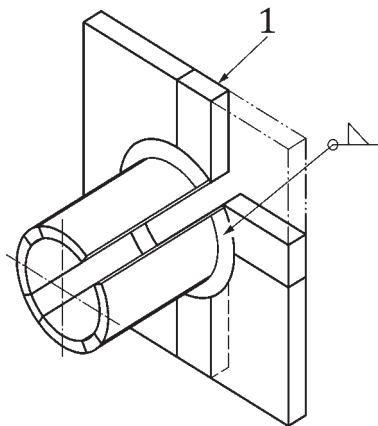
The test specimens shall be cut mechanically (cold cut, e.g. sawing, milling, cooled abrasive).



**Key**

- 1 cutline
- 2 fillet weld break specimen
- 3 fillet weld
- 4 macroetch specimen (etch interior face)
- 5 stop and restart welding near centre

**Figure 7 — Type and location of fracture test specimens for plate**



**Key**

- 1 four test specimens cut from test weld at 90°

**Figure 8 — Type and location of fracture test specimens for pipe**

**7.6.3.2 Fracture test**

The fracture specimens shall be loaded in such a way that the root of the weld is in tension until the specimen fractures.

For fillet welds on plate, the fracture test piece should be fractured as one specimen, but if necessary, the test piece can be cut into several test specimens of equal width and fractured.

In fracture testing, the test specimens may be longitudinally notched in the centre of the weld in order to achieve a fracture in the weld. All notch preparations shall be in accordance with ISO 9017.

For fillet welds on pipe, four specimens with a width of 35 mm each shall be fractured from the test piece. The test specimen shall be taken from the 12 o'clock position, 3 o'clock position, 6 o'clock position and 9 o'clock position.

### 7.6.3.3 Macroscopic examination

The macroscopic examination shall be performed in accordance with ISO 17639.

For fillet welds on plate, the macroscopic examination shall be carried out on the inner faces of the two cut off specimen.

For fillet welds on pipe, the macro etch can be taken from the fracture specimen prior to fracture or from a specimen from one of the adjacent sides after the fracture specimen had been removed. Four sections shall be examined.

## 7.7 Test report

The results of all testing shall be documented in accordance with the relevant test standard.

## 8 Acceptance requirements for test pieces

Test pieces shall be assessed according to the acceptance requirements specified for relevant types of imperfections.

The acceptance requirements for imperfections found by test methods performed according to this part of ISO 15618 shall, unless otherwise specified, be assessed in accordance with ISO 5817. A welder-diver is qualified if the imperfections are within ISO 5817, quality level B, except for the following imperfection types for which level C shall apply: excess weld metal (502), excessive convexity (503), excessive throat thickness (5214), excessive penetration (504) and undercut (501).

NOTE In agreement between the contracting parties, an alternative level in accordance with ISO 5817 or other standards may apply.

If the imperfections in the welder-diver's test piece exceed the permitted maximum specified, then the welder-diver shall not be qualified.

Reference should also be made to the corresponding acceptance level for non-destructive examination. Specified procedures shall be used for all destructive and non-destructive testing.

## 9 Re-tests

If any test fails to comply with the requirements of this part of ISO 15618, the welder-diver may be given the opportunity to repeat the qualification test once without further training.

If it is established that failure cannot be directly attributed to the welder-diver's lack of skill, a re-test shall be allowed and this test piece shall be ignored.

## 10 Period and confirmation of validity

The validity of the welder-diver qualification begins from the date when all the required tests are satisfactorily completed.

A welder-diver qualification shall remain valid for a period of two years subject to the following:

- a) confirmation every six months by the welder-diver's employer, welding supervisor or welding coordinator that the welder-diver has welded within the qualification range within the previous six months. Confirmation shall be recorded on the test certificate and prolongs validity of the qualification for a further six months up to a maximum of two years;

## ISO 15618-1:2016(E)

- b) where a qualified welder-diver has not welded within the qualification range at any time during the previous six months or more (within the two-year validity period), a confirmation weld shall be completed in accordance with the initial qualification. The weld shall, as a minimum, meet the visual acceptance criteria of this part of ISO 15618 (in accordance with ISO 17637, see also [Table 5](#)) and shall be recorded on the certificate.

### 11 Revalidation of welder-diver qualification

The welder-diver shall be re-tested every two years.

### 12 Welder-diver qualification test certificate

It shall be verified that the welder-diver has successfully passed the qualification test. All essential variables shall be recorded on the certificate. If the test piece(s) fail(s) any of the required tests, no certificate shall be issued.

The certificate shall be issued under the sole responsibility of the examiner or examining body. A recommended format is detailed in [Annex A](#). If any other form of welder-diver qualification test certificate is used, it shall contain the information required in [Annex A](#). The examiner or examining body is responsible for verifying that all essential variables are addressed in this certificate.

For each test piece, a separate welder-diver qualification test certificate shall be issued.

The practical test and the examination of job knowledge (see [Annex B](#)) shall be designated by “Accepted” or “Not tested”.

Each change of the essential variables for the qualification testing beyond the permitted ranges requires a new test and a new qualification certificate.

### 13 Designation

The designation of a welder-diver qualification shall comprise the following items in the order given:

- a) reference to this part of ISO 15618 (i.e. ISO 15618-1)
- b) the essential variables;
- 1) welding processes, refer to [5.2](#) and ISO 4063;
  - 2) semi-finished product: plate (P), pipe (T), refer to [5.3](#);
  - 3) joint type: butt weld (BW), fillet weld (FW), refer to [5.3](#);
  - 4) material group: refer to [5.4](#);
  - 5) consumables: refer to [5.5](#);
  - 6) dimension of test piece: thickness ( $t$ ) and pipe diameter ( $D$ ), refer to [5.6](#);
  - 7) welding positions: refer to [5.7](#) and ISO 6947;
  - 8) details of the weld type: refer to [6.3](#) and [Table 3](#), for abbreviations to [4.4](#);
  - 9) water depth and type of water: refer to [5.8](#), for abbreviation to [4.4](#).

DESIGNATION EXAMPLE:

**Welder-diver qualification ISO 15618-1 111 P BW 1 RR t09 PG ss mb wd6 sw**

## Explanation:

Welding process: metal arc welding with covered electrode	111
Plate	P
Butt weld	BW
Material group: low carbon non alloyed steel	1
Filler metal: rutile thick covering	RR
Dimension of test piece: thickness 9 mm	t09
Welding position: butt weld on plate, vertical downwards	PG

## Details of the weld type:

— single side	ss
— with backing	mb
Water depth: 6 m	wd6
Type of water: salt water	sw

NOTE For explanation of abbreviations used in the designation examples, see [Clause 4](#).

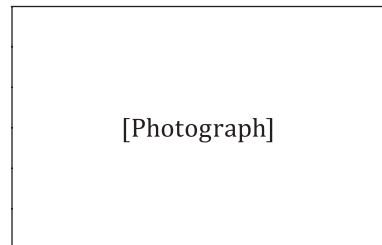
## Annex A (informative)

### Welder-diver qualification test certificate for hyperbaric wet welding

Designation:.....  
 Manufacturer's welding procedure specification reference no.  
 (if applicable):.....  
 Welder-diver's name:.....  
 Identification number:.....  
 Method of identification:.....  
 Date and place of birth:.....  
 Employer:.....  
 Code/Testing standard:.....

Examiner/examining body:

Reference no. ....



Job knowledge:     Acceptable     Not tested

	Weld test details	Range of qualification
Welding process		
Joint type		
Material group(s)		
Electrode manufacturer/trade name		
Electrode diameter		
Test piece thickness (mm)		
Pipe outside diameter (mm)		
Welding position		
Joint details		
Gouging/backing		
Water depth		
Type of water		
Visibility		



Additional information is available on attached sheet and/or welding procedure specification no.:

Type of test	Acceptable	Not required
Visual		
Radiography		
Magnetic particle		
Penetrant		
Macro		
Fracture		
Bend		
Ultrasonic		
Additional tests <sup>a</sup>		

<sup>a</sup> Append separate sheet if required.

Name, date and signature: .....

Examiner or examining body: .....

Date of issue: .....

Location: .....

Validity of qualification until: .....

Confirmation of the validity by employer/welding coordinator for the following six months.

Date	Signature	Position or title

## **Annex B** **(informative)**

### **Job knowledge**

#### **B.1 General**

The test of job knowledge is recommended, but it is not mandatory.

However, some countries may require that the welder-diver undergoes a test of job knowledge. If the job knowledge test is carried out, it should be recorded on the welder-diver's certificate.

This annex outlines the job knowledge that a welder-diver should have to ensure that procedures are followed and common practices are complied with. The job knowledge indicated in this annex is only pitched at the most basic level.

Owing to different training programmes in various countries, it is only proposed to standardize general objectives or categories of job knowledge. The actual questions used should be drawn up by the individual country, but should include questions on areas covered in [B.2](#), relevant to the welder-diver qualification test.

The actual tests of a welder-diver's job knowledge may be given by any of the following method or combinations of these methods:

- a) written objective tests (multiple choice);
- b) oral questioning following a set of written questions;
- c) computer testing;
- d) demonstration/observation testing following a written set of criteria.

The test of job knowledge is limited to the matters related to the welding process used in the test.

#### **B.2 Requirements**

##### **B.2.1 Welding equipment for arc welding**

- a) Identification and assembly of essential components and equipment
- b) Type of welding current
- c) Connection of the welding return cable

##### **B.2.2 Welding process**

###### **B.2.2.1 Metal-arc welding with covered electrode (111)**

- a) Handling of electrodes
- b) Different electrodes

**B.2.2.2 Self-shielded tubular cored arc welding (114)**

- a) Types and size of electrodes
- b) Type, size and maintenance of nozzles/contact tip

**B.2.3 Parent metals**

- a) Identification of material

**B.2.4 Filler materials/consumables**

- a) Identification of consumables
- b) Storage, handling and conditions of consumables
- c) Selection of correct size
- d) Cleanliness of electrodes and flux-cored electrodes
- e) Control of wire spooling

**B.2.5 Safety and accident prevention****B.2.5.1 General**

- a) Safe assembly, setting up and closing down procedures
- b) Personal protection
- c) Hazards
- d) Welding in confined spaces
- e) Awareness of welding environment

**B.2.5.2 All arc processes**

- a) Environment of increase hazard of electric shock

**B.2.6 Welding sequences/procedures**

- a) Appreciation of welding procedure requirements and the influence of welding parameters

**B.2.7 Joint preparation and weld representation**

- a) Conformance of joint preparation to welding procedure specification (WPS)
- b) Cleanliness of fusion faces

**B.2.8 Weld imperfections**

- a) Identification of imperfections
- b) Causes
- c) Effects of arc strike
- d) Prevention and remedial action

**B.2.9 Welder-diver qualification**

The welder-diver shall be aware of the range of the qualification.

## Bibliography

- [1] ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*
- [2] ISO/TR 25901:2007, *Welding and related processes — Vocabulary*<sup>2)</sup>
- [3] ISO/TR 25901-3:2016, *Welding and allied processes — Vocabulary Part 3: Welding processes*
- [4] ISO 857-1, *Welding and allied processes — Vocabulary — Part 1: Metal welding processes*<sup>3)</sup>

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2) Withdrawn and replaced by the ISO/TR 25901 series.

3) Withdrawn and replaced by ISO/TR 25901-3.

