INTERNATIONAL STANDARD

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Specification and qualification of welding procedures for metallic materials — Welding procedure test —

Part 5: Arc welding of titanium, zirconium and their alloys

Descriptif et qualification d'un mode opératoire de soudage pour les matériaux métalliques — Épreuve de qualification d'un mode opératoire de soudage —

Partie 5: Soudage à l'arc sur titane, zirconium et leurs alliages

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15614-5 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification requirements in the field of metal welding*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 15614 consists of the following parts, under the general title *Specification and qualification of welding procedures for metallic materials — Welding procedure test*:

— *Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

— *Part 2: Arc welding of aluminium and its alloys*

— *Part 3: Arc welding of cast irons*

— *Part 4: Finishing welding of aluminium castings*

— *Part 5: Arc welding of titanium, zirconium and their alloys*

— *Part 6: Arc welding of copper and copper alloys*

— *Part 7: Corrosion resistant overlay, cladding restore and hardfacing*

— *Part 8: Welding of tubes to tube-plate joints*

— *Part 9: Arc underwater hyperbaric wet welding*

— *Part 10: Underwater hyperbaric dry welding*

— *Part 11: Electron and laser beam welding*

— *Part 12: Spot, seam and projection welding*

— *Part 13: Resistance butt and flash welding*

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

For the purposes of this part of ISO 15614, the CEN annex regarding fulfilment of European Council Directives has been removed.

Contents

Foreword

This document (EN ISO 15614-5:2004) has been prepared by Technical Committee CEN/TC 121 “Welding”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 44 “Welding and allied processes”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2004, and conflicting national standards shall be withdrawn at the latest by September 2004.

Annex A is informative. Annex ZA is normative.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

All new welding procedure tests are to be in accordance with this standard from the date of its issue.

However, this standard does not invalidate previous welding procedure tests made to former national standards or specifications.

Where additional tests have to be carried out to make the qualification technically equivalent, it is only necessary to do the additional tests on a test piece which should be made in accordance with this standard.

1 Scope

This standard is part of a series of standards, details of this series are given in prEN ISO 15607:2000, annex A.

This standard specifies how a preliminary welding procedure specification is qualified by welding procedure tests.

This standard defines the conditions for the execution of welding procedure tests and the range of qualification for welding procedures for all practical welding operations within the range of variables listed in clause 8.

Tests shall be carried out in accordance with this standard. Additional tests may be required by application standards**.**

This standard applies to the arc welding of titanium, zirconium and their alloys in all product forms.

Arc welding is covered by the following processes in accordance with EN ISO 4063.

131 - metal inert gas welding, MIG welding

141 - tungsten inert gas welding, TIG welding

15 – plasma arc welding

The principles of this standard may be applied to other fusion welding processes.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 439, *Welding consumables – Shielding gases for arc welding and cutting.*

EN 571-1, *Non destructive testing – Penetrant testing – Part 1: General principles.*

EN 895, *Destructive tests on welds in metallic materials – Transverse tensile test.*

EN 910, *Destructive tests on welds in metallic materials – Bend tests.*

EN 970, *Non-destructive examination of fusion welds – Visual examination.*

EN 1321, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds.*

EN 1418, *Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.*

EN 1435, *Non-destructive examination of welds – Radiographic examination of welded joints.*

EN ISO 5817, *Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections (ISO 5817:2003).*

EN ISO 6947, *Welds – Working positions – Definitions of angles of slope and rotation. (ISO 6947:1993).*

EN ISO 9606-5, *Approval testing of welders - Fusion welding - Part 5: Titanium and titanium alloys, zirconium and zirconium alloys (ISO 9606-5:2000).*

prEN ISO 15607:2000, *Specification and approval of welding procedures for metallic materials – General rules. (ISO/DIS 15607:2000).*

CR ISO 15608, *Welding – Guidelines for a metallic material grouping system (ISO/TR 15608:2000).*

prEN ISO 15609-1, *Specification and approval of welding procedures for metallic materials – Welding procedure specification – Part 1 : Arc welding. (ISO/DIS 15609-1:2000).*

prEN ISO 15613, *Specification and approval of welding procedure for metallic materials - Approval by a pre-production test (ISO/DIS 15613:2000).*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in prEN ISO 15607 apply.

4 Preliminary welding procedure specification (pWPS)

The preliminary welding procedure specification shall be prepared in accordance with prEN ISO 15609-1

5 Welding procedure test

The welding and testing of test pieces shall be in accordance with clauses 6 and 7.

The welder or welding operator who undertakes the welding procedure test satisfactorily in accordance with this standard is qualified for the appropriate range of qualification according to EN ISO 9606-5 or EN 1418 providing that the relevant testing requirements are met.

6 Test piece

6.1 General

The welded joint to which the welding procedure will relate in production shall be represented by making a standardized test piece or pieces, as specified in 6.2. Where the production/joint geometry requirements do not represent the standardized test pieces as shown in this standard, the use of EN ISO 15613 shall be required.

6.2 Shape and dimensions of test pieces

6.2.1 General

The length or number of test pieces shall be sufficient to allow all required tests to be carried out.

Additional test pieces, or longer test pieces than the minimum size, may be prepared in order to allow for extra and/or for re-testing specimens (see 7.7).

For all test pieces except branch connections (see Figure 4) and fillet welds (see Figure 8) the material thickness, *t*, shall be the same for both plates/pipes to be welded.

The thickness and/or outside pipe diameter of the test pieces shall be selected in accordance with 8.3.2.1 to 8.3.2.4.

The shape and minimum dimensions of the test piece shall be as follows :

6.2.2 Butt joint in plate with full penetration

The test piece shall be prepared in accordance with Figure 1.

6.2.3 Butt joint in pipe with full penetration

The test piece shall be prepared in accordance with Figure 2.

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

6.2.4 T-joint

The test piece shall be prepared in accordance with Figure 3.

This may be used for fully penetrated butt welds or fillet welds.

6.2.5 Branch connection

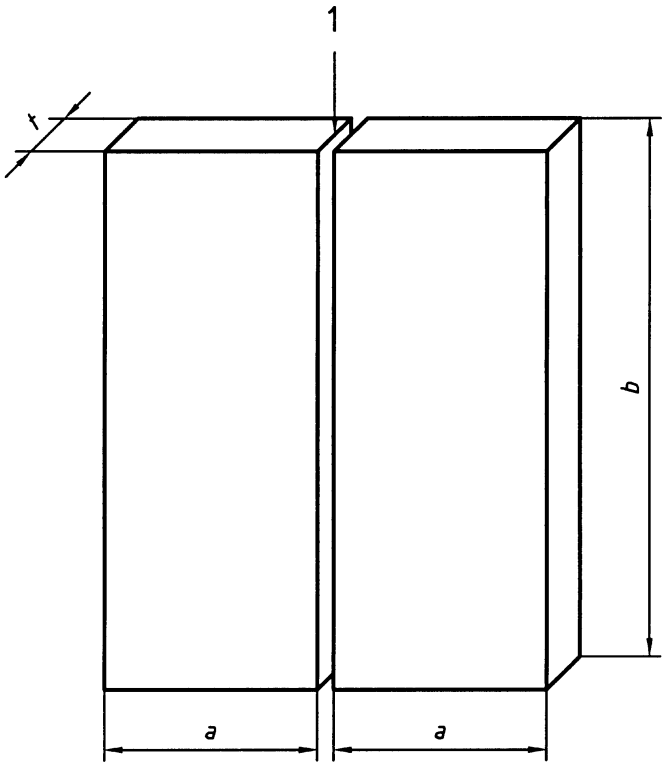
The test piece shall be in accordance with Figure 4. The angle α is the minimum to be used in production.

This may be used for fully penetrated joints (set-on or set-in or set-through joint) and for fillet welds.

6.3 Welding of test pieces

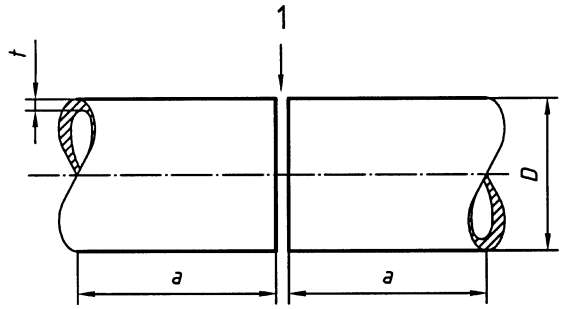
Preparation and welding of test pieces shall be carried out in accordance with the pWPS, and under the general conditions of welding in production which they shall represent. Welding positions and limitations for the angle of slope and rotation of the test piece shall be in accordance with EN ISO 6947. If tack welds are to be fused into the final joint they shall be included in the test piece.

Welding and testing of the test pieces shall be witnessed by an examiner or examining body.



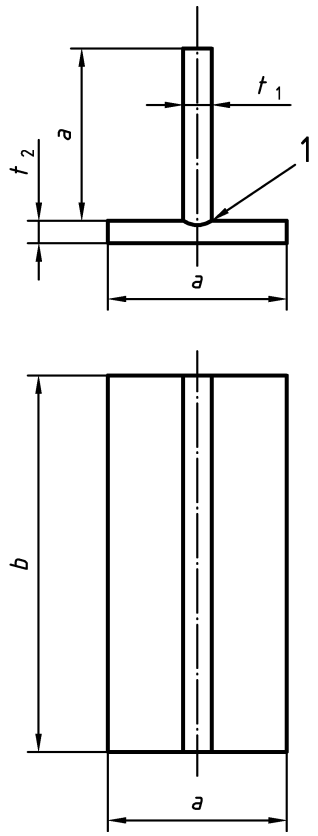
Key
1 Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)
a Minimum value 150 mm
b Minimum value 300 mm
t Material thickness

Figure 1 — Test piece for a butt joint in plate with full penetration



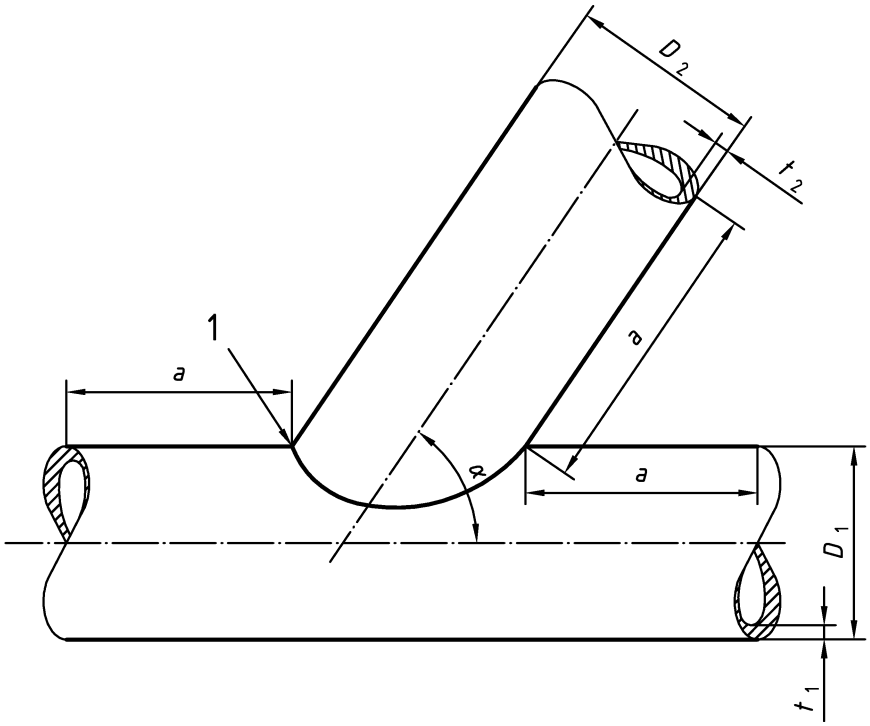
Key
1 Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)
a Minimum value 150 mm
D Outside pipe diameter
t Material thickness

Figure 2 — Test piece for a butt joint in pipe with full penetration



Key
1 Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)
a Minimum value 150 mm
b Minimum value 350 mm
t Material thickness

Figure 3 — Test piece for a T- joint



Key
1 Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)
α Branch angle
a Minimum value 150 mm
D_1 Outside diameter of the main pipe
t_1 Main pipe material thickness
D_2 Outside diameter of the branch pipe
t_2 Branch pipe material thickness

Figure 4 — Test piece for a branch connection

7 Examination and testing

7.1 Extent of testing

Testing includes both non-destructive testing (NDT) and destructive testing which shall be in accordance with the requirements of Table 1.

An application standard may specify additional tests, e.g. :

— longitudinal weld tensile test;

— all weld metal bend test;

— hardness test;

— impact test;

— corrosion tests ;

— chemical analysis.

NOTE Specific service, material or manufacturing conditions may require more comprehensive testing than is specified by this standard in order to gain more information and to avoid repeating the welding procedure test at a later date just to obtain additional test data.

Table 1 — Examination and testing of the test pieces

Test piece	Type of test	Extent of testing	Footnote
Butt joint with full penetration – Figure 1 and Figure 2	Visual Radiographic testing Penetrant testing Transverse tensile test Transverse bend test Macro/microscopic examination	100 % 100 % 100 % 2 specimens 4 specimens 1 specimen	- - - - a b
T- joint with full penetration - Figure 3 Branch connection with full penetration - Figure 4	Visual Penetrant testing Radiographic testing Macro/microscopic examination	100 % 100 % 100 % 2 specimens	c c c b and c
Fillet welds - Figure 3 and Figure 4	Visual Penetrant testing Macro/microscopic examination	100 % 100 % 2 specimens	c c b and c

[a] For bend tests, see 7.4.3.

[b] For microscopic examination, see 7.4.4.

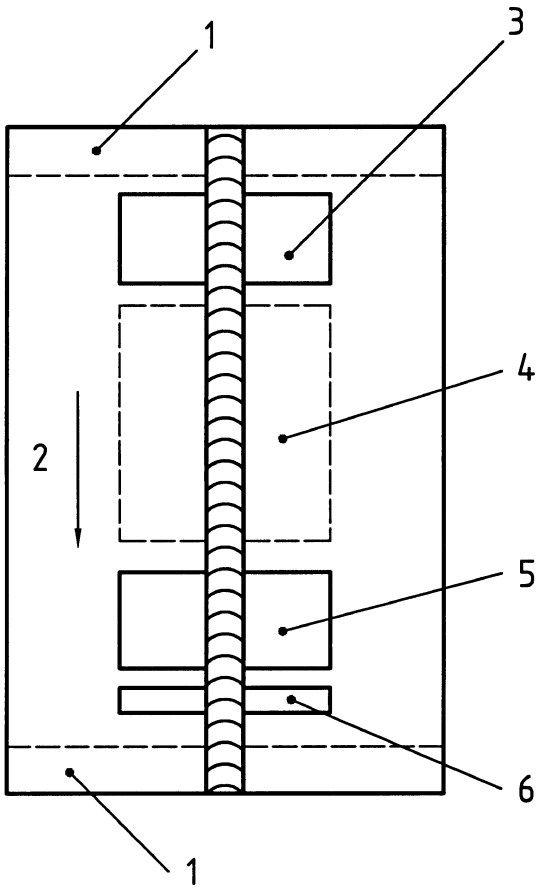
[c] Tests as detailed do not provide information on the mechanical properties of the joint. Where these properties are relevant to the application an additional qualification shall also be held e.g. a butt weld qualification.

7.2 Location and taking of test specimens

Test specimens shall be taken in accordance with Figures 5, 6, 7 and 8.

Test specimens shall be taken after all non-destructive testing (NDT) has been carried out and which has passed the relevant inspection criteria for the NDT method(s) used.

It is acceptable to take the test specimens from locations avoiding areas which have imperfections within the acceptance limits for the NDT method(s) used.



Key

1 Discard 25 mm
2 Welding direction
3 Area for :
- 1 tensile test specimen;
- bend test specimens.

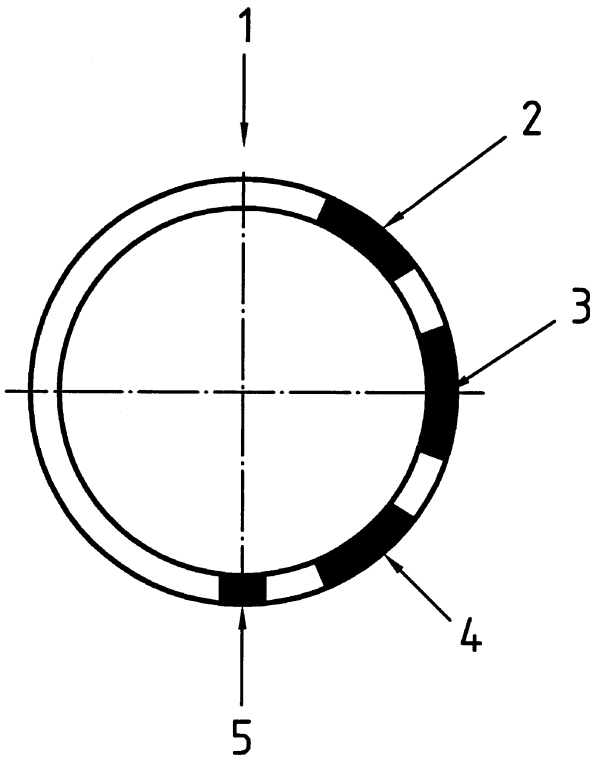
4 Area for :
- impact and additional test specimens if required.

5 Area for :
- 1 tensile test specimen;
- bend test specimens.

6 Area for :
1-macro test specimen;
- 1 hardness test specimen.

NOTE Not to scale.

Figure 5 — Location of test specimens for a butt joint in plate

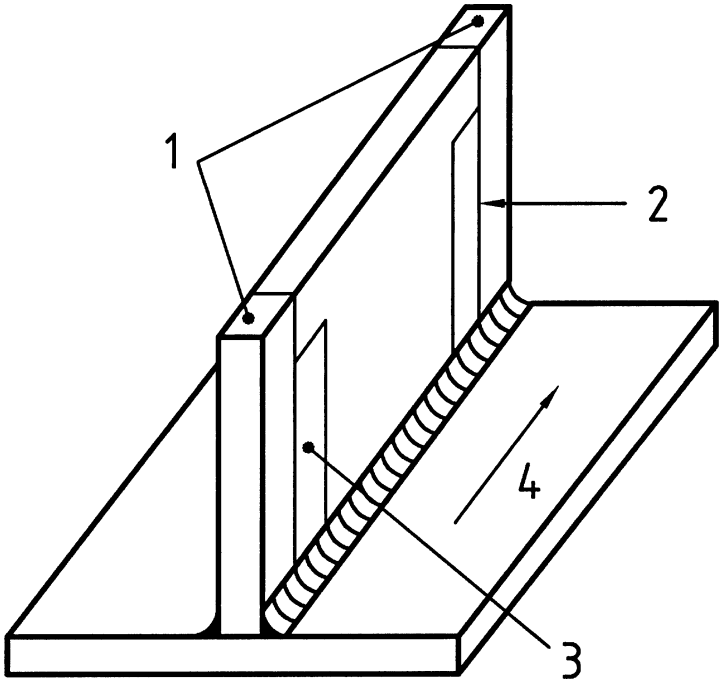


Key

1 Top for fixed pipe
2 Area for :
- 1 tensile test specimen ;
- bend test specimens.
3 Area for :
- additional test ;
specimens if required.
4 Area for :
- 1 tensile test specimen ;
- bend test specimens.
5 Area for :
- 1 macro/micro test specimen.

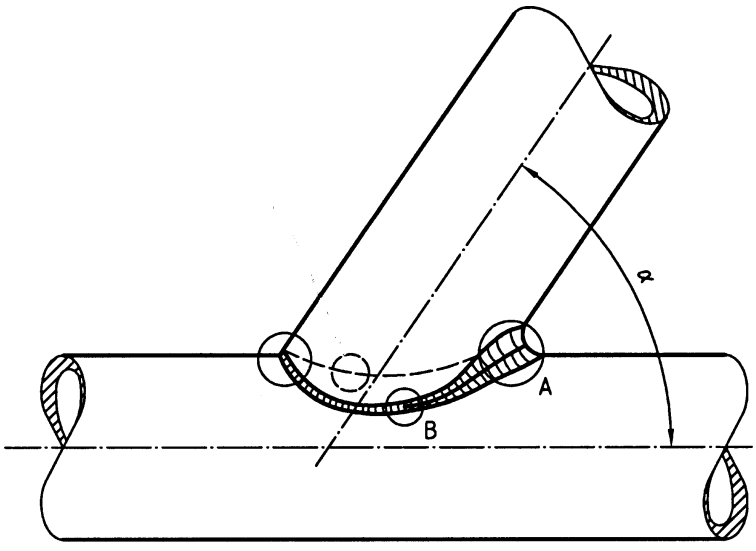
NOTE Not to scale.

Figure 6 — Location of test specimens for a butt joint in pipe



Key
1 Discard 25 mm
2 Macro/micro test specimen
3 Macro/micro test specimen
4 Welding direction

Figure 7 — Location of test specimens in a T- joint



Key
1 Macro and hardness test to be taken (in position A)
2 Macro test specimen in position B
α Branch angle

Figure 8 — Location of test specimens for a branch connection or a fillet weld on pipe

7.3 Non-destructive testing

All non-destructive testing in accordance with 7.1 and Table 1 shall be carried out on the test pieces prior to cutting of the test specimens. Any post-weld heat treatment that is specified shall be completed prior to non-destructive testing.

Depending upon joint geometry, materials and the requirements for work, the NDT shall be carried out as required in Table 1 in accordance with EN 970 (visual examination), EN 1435 (radiographic testing), and EN 571-1 (penetrant testing).

7.4 Destructive testing

7.4.1 General

The extent of testing shall be as required by Table 1.

7.4.2 Transverse tensile test

Specimens and testing for transverse tensile testing for butt joint shall be in accordance with EN 895.

For pipes > 50 mm outside diameter, the excess weld metal shall be removed on both faces to give the test specimen a thickness equal to the wall thickness of the pipe.

For pipes ≤ 50 mm outside diameter, and when full section small diameter pipes are used, the excess weld metal may be left undressed on the inside surface of the pipe.

The tensile strength of the test specimen shall not be less than the corresponding specified minimum value for the parent metal unless otherwise specified prior to testing.

For dissimilar joints the tensile strength shall not be less than the minimum value specified for the parent material having the lowest tensile strength.

7.4.3 Bend test

Specimens and testing for bend testing for butt joints shall be in accordance with EN 910.

For thicknesses <12 mm two root and two face bend test specimens shall be used. For thicknesses ≥12 mm four side bend specimens are recommended instead of root and face bend tests.

For dissimilar metal joints or heterogeneous butt joint in plates, one root and one face longitudinal bend test specimen may be used instead of four transverse bend tests.

The diameter of the former or the inner roller shall be 6 *t* except for material group 51 when 4 *t* shall be used. The bending angle shall be 180° for parent metal with elongation A ≥ 20%. For parent metal with elongation A < 20% the following formula shall apply:

$$d = \frac{(100 \times t_s)}{A} - t_s$$

where

d is the diameter of the former or inner roller

t_s is thickness of the bend test specimen

A is the minimum tensile elongation required by the material specification

The test specimens shall be bent uniformly and the weld, HAZ and parent metal areas shall each conform closely to the radius of the forming tool. This will indicate that any gas pick-up during welding has not reduced the ductility of the weld and that the welding has not adversely affected the formability of the parent metal.

During testing, the test specimens shall not reveal any one single flaw > 3 mm in any direction. Flaws appearing at the corners of a test specimen during testing shall be ignored in the evaluation.

7.4.4 Macro/micro-examination

The test specimen shall be prepared and examined in accordance with EN 1321 on one side to clearly reveal the fusion line, the HAZ and the build up of the runs.

The macroscopic examination shall include unaffected parent material and shall be recorded by at least one macroscopic reproduction per procedure test.

The acceptance levels stated in 7.5 shall apply.

Care should be taken when etching certain alloys in order to avoid producing crack like indications.

7.5 Acceptance levels

A welding procedure is qualified if the imperfections in the test piece are within the specified limits of quality level B in EN ISO 5817 except for imperfection types as follows : excess weld metal, excess convexity, excess throat thickness and excessive penetration, for which quality level C shall apply.

NOTE The correlation between the quality levels of EN ISO 5817 and the acceptance levels of the different NDT techniques are given in EN 12062.

7.6 Coloration

Accepted colours on the weld metal surface: silver and straw. A narrow band of intensive colours close to the limits of the gas shielding is acceptable. Darker brown, purple and blue colours and grey or flaky white are not acceptable.

7.7 Re-testing

If the test piece fail to comply with any of the requirements for visual examination or NDT specified in 7.5, one further test piece shall be welded and subjected to the same examination. If this additional test piece does not comply with the requirements, the welding procedure test has failed.

If any test specimens fails to comply with the requirements for destructive testing in accordance with 7.4 but only due to weld imperfections, two further test specimens shall be obtained for each one that failed. The additional test specimens can be taken from the same test piece if there is sufficient material available or from a new test piece. Each additional test specimen shall be subjected to the same tests as the initial test specimen that failed. If either of the additional test specimens does not comply with the requirements, the welding procedure test has failed.

If a tensile test specimen fails to meet the requirements of 7.4.2, two further test specimens shall be obtained for each one that failed. Both shall satisfy the requirements of 7.4.2.

8 Range of qualification

8.1 General

Each of the conditions given in clause 8 shall be met in order to comply with this standard.

Changes outside of the ranges specified shall require a new welding procedure test.

8.2 Related to the manufacturer

A qualification of a pWPS by a welding procedure test according to this standard obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of the manufacturer.

Welding is under the same technical and quality control when the manufacturer who performed the welding procedure test retains complete responsibility for all welding carried out to it.

8.3 Related to the parent material

8.3.1 Parent material grouping

8.3.1.1 General

In order to minimise the number of welding procedure tests, titanium, zirconium and their alloys are grouped according to CR ISO 15608.

Separate welding procedure qualifications are required for each parent material or parent material combinations not covered by the grouping system.

If one parent material belongs to two material groups or sub-groups, then it shall always be classified in the lower material group or sub-group.

NOTE Minor compositional differences between similar grades arising from the use of national standards do not need re-qualification.

8.3.1.2 Titanium

The ranges of qualification are given in Table 2.

8.3.1.3 Zirconium

The ranges of qualification are given in Table 3.

Table 2 — Range of qualification for titanium groups and sub-groups

Material group(s) of test piece	Range of qualification
51-51	51-51
52-52	52-52
53-53	53-53
54-54	54-54
51-52	51-52, 51-51
51-53	51-53, 51-51
51-54	51-54, 51-51
52-53	52-53, 52-52
52-54	52-54, 52-52
53-54	53-54, 53-53

Table 3 — Range of qualification for zirconium groups

Material group(s) of test joint	Range of qualification
61 - 61	61-61
62 - 62	62-62
61 - 62	61-62, 61-61

8.3.2 Material thickness and pipe diameter

8.3.2.1 General

For single process qualification the material thickness, *t*, shall have the following meanings :

a) For a butt joint :

the parent material thickness.

b) For a fillet weld :

the parent material thicknesses. For each thickness range qualified as in Table 4 there is also an associated range of qualification for throat thicknesses, *a*, for single run fillet welds as given in 8.3.2.3.

c) For a set-on branch connection :

the parent material thicknesses.

d) For a set-in or set-through branch connection :

the parent material thicknesses.

e) For a T-joint in plate with full penetration:

the parent material thickness.

For multi process procedures, the deposited metal thickness of each process shall be used as a basis for the range of qualification for the individual welding process.

8.3.2.2 Range of qualification for butt joints, T- joints and branch connections

The qualification of a welding procedure test on material thickness *t* shall include qualification for thickness in the following ranges given in Table 4.

Dimensions in mm

Table 4 — Range of qualification for thickness

Range of qualification [b]		
Material thickness of the test piece, t [a]	Butt, T-joint and branch connections for single run or single run from both sides	Butt, T-joint and branch connections [b] for multi-run welding and all fillet welds [b]
$t \leq 3$	0,7t to 1,5t	0,7t to 2t
$3 < t \leq 12$	0,7t to 1,3t	3 to 2t
$12 < t$	0,7t to 1,1t	0,5t to 2t

[a] For multi process procedures, the deposited metal thickness of each process shall be used as a basis for the range of qualification for the individual welding process.

[b] For fillet welds and branch connections, the range of qualification shall be applied to both parent materials independently.

8.3.2.3 Range of qualification for throat thickness of single run fillet welds

In addition to the requirements of Table 4, the range of qualification of the throat thickness "*a*" shall be "0,75*a*" to "1,5*a*".

Where a fillet weld is qualified by means of a butt weld test, the throat thickness range qualified shall be based on the thickness of the deposited weld metal.

8.3.2.4 Range of qualification for the diameter of pipes and branch connections

The qualification of a welding procedure test on diameter *D* shall include qualification for diameters in the following ranges given in Table 5.

Qualification given for plates also covers pipes when the outside pipe diameter is > 500 mm or when the diameter is > 150 mm welded in the PA or PC rotated position.

Table 5 — Range of qualification for pipe and branch connection diameters

Diameter of the test piece *D* [a], mm	Range of approval
$D \leq 25$	0,5*D* to 2*D*
$D > 25$	$\geq$ 0,5*D* (25 mm min)
[a] *D* is the outside pipe diameter or outside diameter of the branch pipe.	

8.3.3 Angle of branch connection

A welding procedure test carried out on a branch connection with angle α shall qualify all branch angles α_1 in the range of $\alpha \leq \alpha_1 \leq 90°$.

8.4 Common to all welding procedures

8.4.1 Welding process

Each degree of mechanization shall be qualified independently (manual, partly mechanized, fully mechanized and automatic).

The qualification is only valid for the welding process(es) used in the welding procedure test.

For multi-process procedures the welding procedure qualification may be carried out with separate welding procedure tests for each welding process. It is also possible to make the welding procedure test as a multi-process procedure test. The qualification of such a test is only valid for the process sequence carried out during the multi-process procedure test.

NOTE The use of a multi-process procedure test to qualify any single process should be avoided, unless the test carried out on the process conforms to this standard.

8.4.2 Welding positions

Welding of a test in any one position (pipe or plate) qualifies for welding in all positions (pipe or plate) except for PG and J-L045 where a separate welding procedure is required.

8.4.3 Type of joint / weld

The range of qualification for the type of welded joints is as used in the welding procedure test subject to limitations given in other clauses (e.g. diameter, thickness) and additionally:

a) Butt welds qualify fully and partial penetration butt welds and fillet welds. Fillet weld tests shall be required where this is the predominant form of production welding;

b) Butt joints in pipe also qualify branch connections with an angle ≥ 60°;

c) T joints butt welded only qualify T joints butt welded and fillet welds (see a);

d) Welds made from one side without backing qualify welds made from both sides and welds with backing;

e) Welds made with backing qualify welds made from both sides;

f) Fillet welding qualifies fillet welding only;

g) It is not permitted to change a multi-run deposit into a single run (or single run on each side) or vice versa for a given process.

8.4.4 Filler material, designation

Filler materials cover other filler materials as long as they have equivalent mechanical properties, same nominal composition according to the designation in the appropriate European Standard for the filler material concerned.

8.4.5 Type of current

The qualification is given for the type of current (alternating current (AC), direct current (DC), pulsed current) and polarity used in the welding procedure test.

8.4.6 Interpass temperature

The upper limit of qualification is the highest interpass temperature reached in the welding procedure test.

8.4.7 Post-weld heat treatment

Addition or deletion of post-weld heat treatment is not permitted.

The temperature range validated is the holding temperature used in the welding procedure test ± 20°C unless otherwise specified. Where required, heating rates, cooling rates and holding time shall be related to the product.

8.4.8 Backing gas

Welding without backing gas qualifies for welding with backing gas, but not vice versa.

8.4.9 Welding in a chamber

Welding outside a chamber qualifies for welding in a chamber, but not vice versa.

8.5 Specific to processes

8.5.1 Process 131

8.5.1.1 The qualification given to the shielding, trailing and backing gas are restricted to the symbol of the gas according to EN 439. Shielding gases not covered by EN 439 are restricted to the nominal composition used in the test.

8.5.1.2 The qualification given is restricted to the wire system used in the welding procedure test (e.g. single-wire or multiple-wire system).

8.5.1.3 For solid wires, the qualification using short circuiting transfer (dip) qualifies only short circuiting transfer (dip). Qualification using spray or globular transfer qualifies both spray and globular transfer.

8.5.2 Process 141

8.5.2.1 The qualification given to the shielding, trailing and backing gas are restricted to the symbol of the gas according to EN 439. Shielding gases not covered by EN 439 are restricted to the nominal composition used in the test.

8.5.2.2 Welding with filler material does not qualify for welding without filler material or vice versa.

8.5.3 Process 15

8.5.3.1 The qualification given is restricted to the plasma gas composition used in the welding procedure test.

8.5.3.2 The qualification given to the shielding, trailing and backing gas are restricted to the symbol of the gas according to EN 439. Shielding gases not covered by EN 439 are restricted to the nominal composition used in the test.

8.5.3.3 Welding with filler material does not qualify for welding without filler material or vice versa.

9 Welding procedure qualification record (WPQR)

The welding procedure qualification record (WPQR) is a statement of the results of assessing each test piece including re-tests. The relevant items listed for the WPS in prEN ISO 15609-1 shall be included, together with details of any features that would be rejectable by the requirements of clause 7. If no rejectable features or unacceptable test results are found, a WPQR detailing the welding procedure test piece results is qualified and shall be signed and dated by the examiner or examining body.

A WPQR format shall be used to record details for the welding procedure and the test results, in order to facilitate uniform presentation and assessment of the data.

An example of WPQR-format is shown in annex A.

Annex A
(informative)

Welding Procedure Qualification Record form (WPQR)

Welding procedure qualification - Test certificate

Manufacturer's WPQR No.:
Manufacturer :
Address :
Code/Testing Standard :
Date of Welding :

Examiner or examining body:
Reference No. :

Range of qualification

Welding Process(es) :
Type of joint and weld :
Parent material group(s) or sub group(s):
Parent Material Thickness (mm) :
Weld Metal Thickness (mm) :
Outside Pipe Diameter (mm) :
Filler Material Designation :
Filler Material Make :
Designation of Shielding Gas/Flux :
Designation of Backing gas:
Type of Welding Current and polarity :
Mode of metal transfer:
Welding Positions :
Preheat temperature :
Post-Weld Heat Treatment:
Other Information (see also 8.5) :

Certified that test welds prepared, welded and tested satisfactorily in accordance with the requirements of the code/testing standard indicated above.

.....	.....	.....
Location	Date of issue	Examiner or examining body Name, date and signature

Record of weld test

Location :
Manufacturer's pWPS :
Manufacturer's WPQR No :
Manufacturer :
Welder's Name :
Mode of Metal Transfer :
Joint Type and Weld :

Examiner or examining body :
Method of Preparation and Cleaning :
Parent Material Specification :
Material Thickness (mm) :
Outside Pipe Diameter (mm) :
Welding Position :

Weld Preparation Details (Sketch)* :

Joint Design	Welding Sequences

Welding Details

Run	Welding Process	Size of Filler Material	Current A	Voltage V	Type of current/ Polarity	Wire Feed Speed	Travel Speed*	Heat input*

Filler Material Designation and Make :
Any Special Baking or Drying :
Gas/Flux : Shielding :
Backing :
Gas Flow Rate – Shielding :
Backing :
Tungsten Electrode Type/Size :
Details of Back Gouging/Backing :
Preheat Temperature :
Interpass Temperature :
Post-Weld Heat Treatment :
Time, Temperature, Method :
Heating and Cooling Rates* :

Other information* e.g.:
Weaving (maximum width of run) :
Oscillation : amplitude, frequency, dwell time :
Pulse welding details :
Distance contact tube/ workpiece :
Plasma welding details :
Torch angle :

....

Manufacturer
Name, date and signature

Examiner or examining body
Name, date and signature

* If required

Test results

Manufacturer's WPQR No. :
Examiner or examining body :
Visual Examination :
Reference No. :
Penetrant Testing* :
Radiography* :
Tensile Tests :
Temperature :

Type/No.	Re N/mm^2	Rm N/mm^2	A % on	Z %	Fracture Location	Remarks
Requirement						

Bend Tests
Former Diameter :

Type/No.	Bend Angle	Elongation*	Results

Macroscopic Examination :
Microscopic Examination* :

Other Tests :
Remarks : .....
Tests Carried out in accordance with the requirements of :
Laboratory Report Reference No. :
Test results were acceptable/not acceptable
(Delete as appropriate)
Test carried out in the presence of :

Examiner or examining body
Name, date and signature

* If required

Annex ZA
(normative)

Corresponding International and European Standards for which equivalents are not given in the text

At the time of publication of this part of ISO 15614, the following ISO documents were equivalent to the normative European Standards referenced in the text. Members of ISO and IEC maintain registers of currently valid International Standards.

European standard given in clause 2	ISO standard corresponding	Title of the ISO standard
EN 439	ISO 14175	*Welding consumables — Shielding gases for arc welding and cutting*
EN 895	ISO 4136	*Destructive tests on welds in metallic materials — Transverse tensile test*
EN 910	ISO 5173	*Destructive tests on welds in metallic materials — Bend tests*
EN 970	ISO 17637	*Non-destructive testing of welds — Visual testing of fusion-welded joints*
EN 1321	ISO 17639	*Destructive tests on welds in metallic materials —Macroscopic and microscopic examination of welds*
EN 1418	ISO 14732	*Welding personnel — Approval testing of welding operators for fusion welding and of resistance weld setters for fully mechanized and automatic welding of metallic materials*
EN 1435	ISO 17636	*Non-destructive testing of welds — Radiographic testing of fusion-welded joints*
EN ISO 4063	ISO 4063	*Welding and allied processes – Nomenclature of processes and reference numbers*
EN ISO 5817	ISO 5817	*Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*
EN 12062	ISO 17635	*Non-destructive testing of welds — General rules for fusion welds in metallic materials*

ICS 25.160.10

Price based on 21 pages