

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

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

The European Standard EN ISO 15614-5:2004 has the status of a
British Standard

ICS 25.160.10

National foreword

This British Standard is the official English language version of EN ISO 15614-5:2004. It is identical with ISO 15614-5:2004.

The UK participation in its preparation was entrusted to Technical Committee WEE/36, Approval testing of welding procedures and welders, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, pages 2 to 26, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 8 April 2004

© BSI 8 April 2004

ISBN 0 580 43641 1

ICS 25.160.10

English version

Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 5: Arc welding of titanium, zirconium and their alloys (ISO 15614-5:2004)

Descriptif et qualification d'un mode opératoire de soudage pour les matériaux métalliques - Epreuve de qualification d'un mode opératoire de soudage - Partie 5: Soudage à l'arc sur titane, zirconium et leurs alliages (ISO 15614-5:2004)

Anforderung und Qualifizierung von Schweißverfahren für metallische Werkstoffe - Schweißverfahrensprüfung - Teil 5: Lichtbogenschweißen von Titan, Zirkonium und ihren Legierungen (ISO 15614-5:2004)

This European Standard was approved by CEN on 3 November 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of 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.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

	Page
Foreword.....	3
Introduction	4
1 Scope	5
2 Normative references	5
3 Terms and definitions.....	6
4 Preliminary welding procedure specification (pWPS)	6
5 Welding procedure test	6
6 Test piece.....	6
6.1 General.....	6
6.2 Shape and dimensions of test pieces.....	6
6.2.1 General.....	6
6.2.2 Butt joint in plate with full penetration	6
6.2.3 Butt joint in pipe with full penetration	7
6.2.4 T-joint	7
6.2.5 Branch connection	7
6.3 Welding of test pieces	7
7 Examination and testing	10
7.1 Extent of testing.....	10
7.2 Location and taking of test specimens	11
7.3 Non-destructive testing.....	15
7.4 Destructive testing.....	15
7.4.1 General.....	15
7.4.2 Transverse tensile test	15
7.4.3 Bend test.....	15
7.4.4 Macro/micro-examination	16
7.5 Acceptance levels.....	16
7.6 Coloration	16
7.7 Re-testing.....	16
8 Range of qualification	16
8.1 General.....	16
8.2 Related to the manufacturer	16
8.3 Related to the parent material	17
8.3.1 Parent material grouping	17
8.3.2 Material thickness and pipe diameter.....	18
8.3.3 Angle of branch connection	19
8.4 Common to all welding procedures	19
8.4.1 Welding process	19
8.4.2 Welding positions	19
8.4.3 Type of joint / weld.....	19
8.4.4 Filler material, designation	20
8.4.5 Type of current.....	20
8.4.6 Interpass temperature	20
8.4.7 Post-weld heat treatment	20
8.4.8 Backing gas	20
8.5 Specific to processes	20
8.5.1 Process 131	20
8.5.2 Process 141	21
8.5.3 Process 15	21
9 Welding procedure qualification record (WPQR)	21
Annex A (informative) Welding Procedure Qualification Record form (WPQR)	22
Record of weld test.....	23
Test results	24
Annex ZA (informative) Corresponding International and European Standards for which equivalents are not given in the text.....	25
Annex ZB (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC	26

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.

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).

For relationship with EU Directive(s), see informative annex ZB which is an integral part of this document.

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).*

EN ISO 15614-5:2004 (E)

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

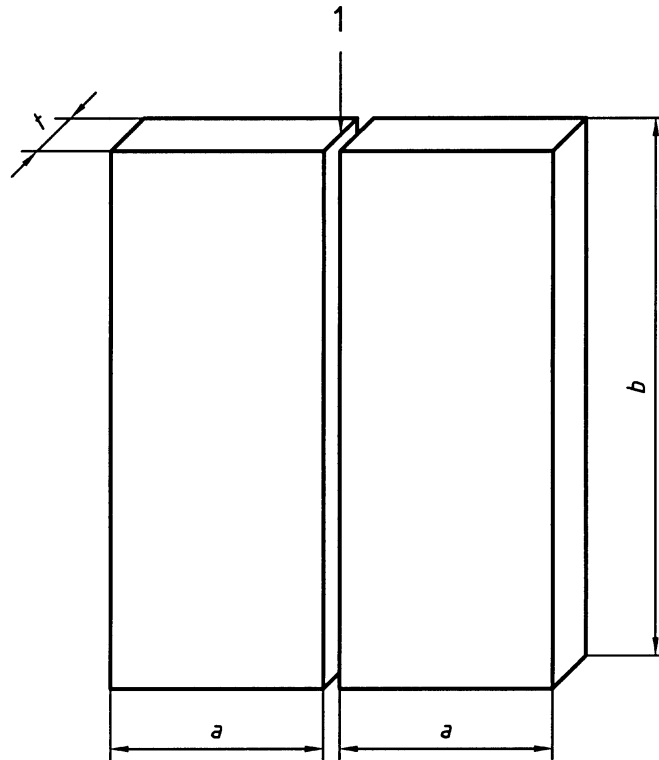
The test piece shall be in accordance with Figure 4. The angle α is the minimum to be used in production.

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.

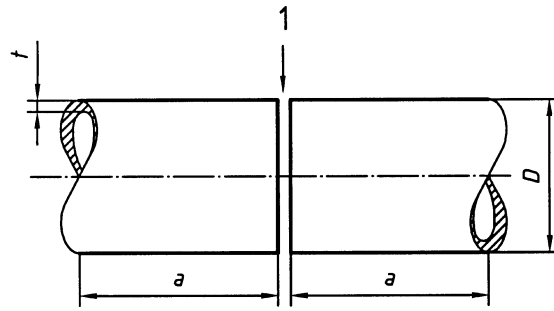
Welding and testing of the test pieces shall be witnessed by an examiner or examining body.



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

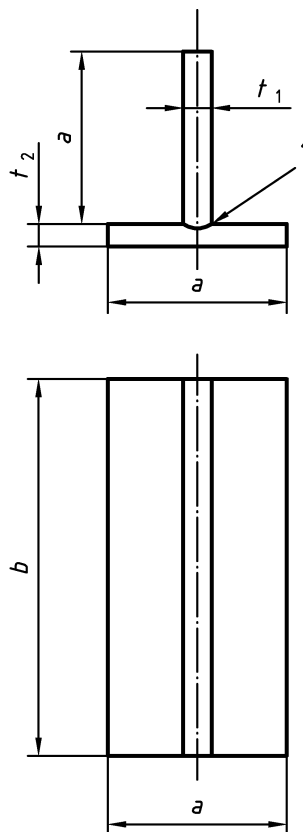
Figure 1 — Test piece for a butt joint in plate with full penetration



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

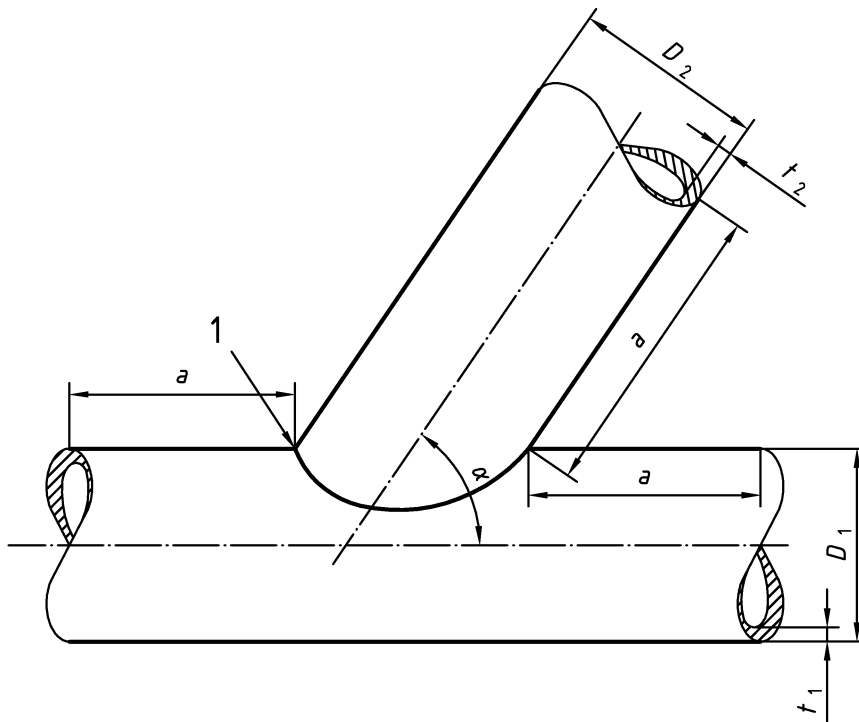
Figure 2 — Test piece for a butt joint in pipe with full penetration



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

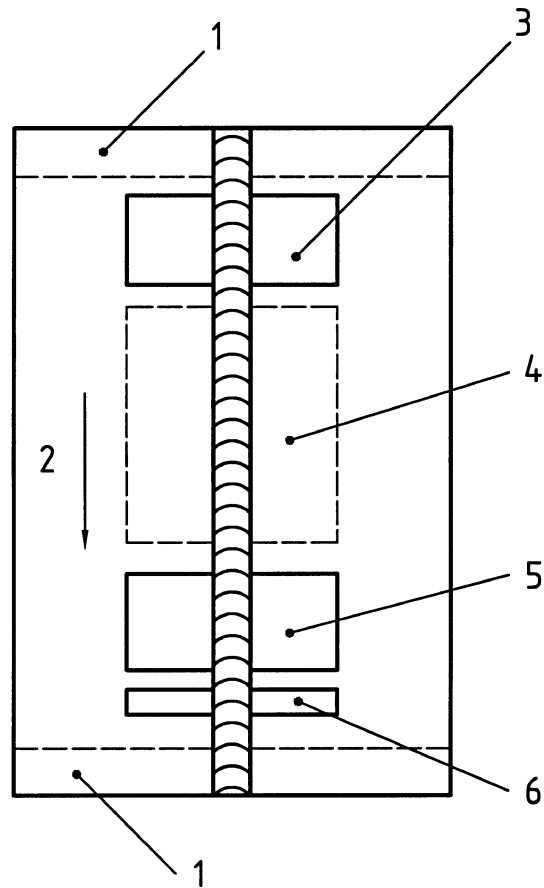
Test piece	Type of test	Extent of testing	Footnote
Butt joint with full penetration – Figure 1 and Figure 2	Visual	100 %	-
	Radiographic testing	100 %	-
	Penetrant testing	100 %	-
	Transverse tensile test	2 specimens	-
	Transverse bend test	4 specimens	a
	Macro/microscopic examination	1 specimen	b
T-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

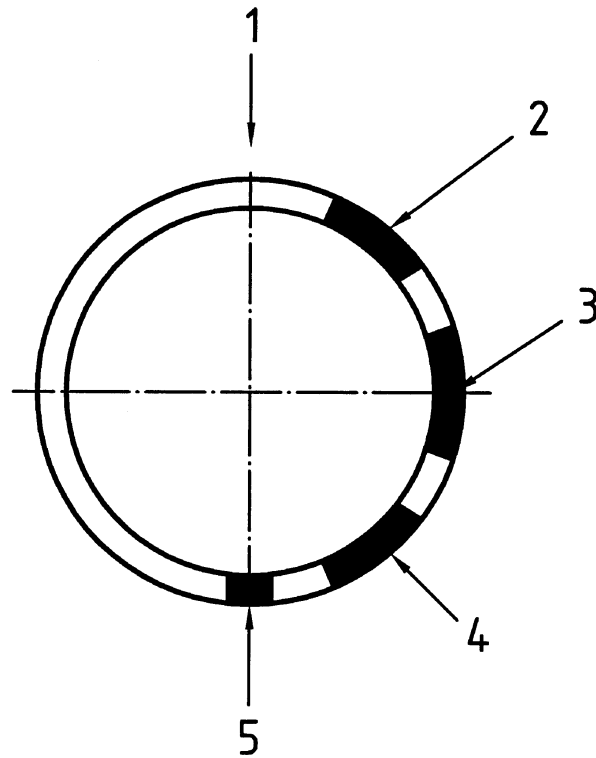


Key

- 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.

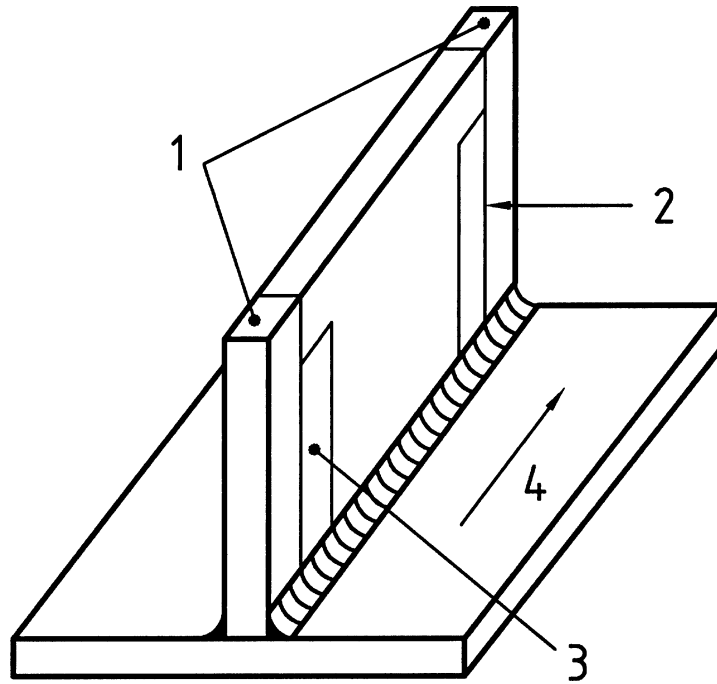
Figure 5 — Location of test specimens for a butt joint in plate

**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.

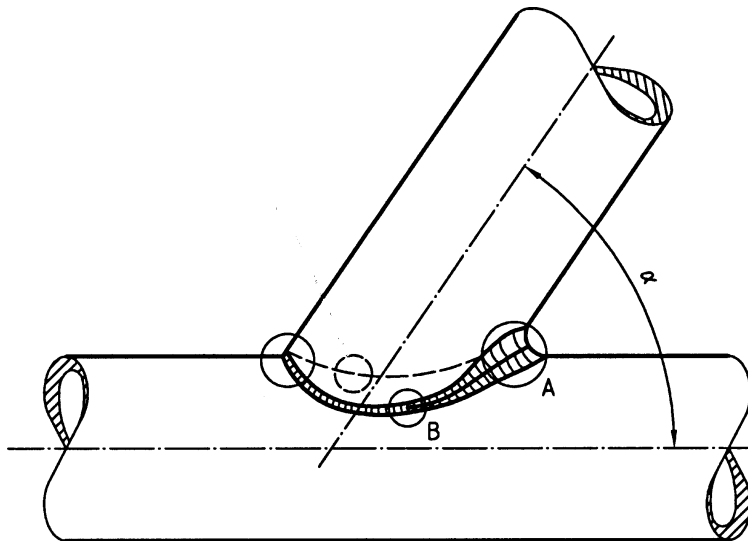
Figure 6 — Location of test specimens for a butt joint in pipe



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.

EN ISO 15614-5:2004 (E)

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 <i>D</i> ^a , mm	Range of approval
$D \leq 25$	0,5 <i>D</i> to 2 <i>D</i>
$D > 25$	$\geq 0,5D$ (25 mm min)
^a <i>D</i> 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 $\alpha \leq \alpha_1 \leq 90^\circ$.

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:

EN ISO 15614-5:2004 (E)

- 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 $\geq 60^\circ$;
- 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 $\pm 20^\circ\text{C}$ 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.

Record of weld test

Location :
 Manufacturer's pWPS :
 Manufacturer's WPQR No :
 Manufacturer :
 Welder's Name :
 Mode of Metal Transfer :
 Joint Type and Weld :
 Weld Preparation Details (Sketch)* :

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

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

EN ISO 15614-5:2004 (E)

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 :

Examiner or examining body
Name, date and signature

Laboratory Report Reference No. :

Test results were acceptable/not acceptable
(Delete as appropriate)

Test carried out in the presence of :

* If required

Annex ZA
(informative)
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 editions of the following documents were valid. Members of ISO and IEC maintain registers of currently valid International Standards.

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

Annex ZB
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in table ZB confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZB.1 – Correspondence between this European Standard and Directive 97/23/EC

Clause(s)/sub-clause(s) of this EN	Essential requirement (ERs) of Directive 97/23/EC	Qualifying remarks/Notes
All clauses	Annex I, 3.1.2	Permanent joining

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at <http://www.bsi-global.com>.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at <http://www.bsi-global.com/bsonline>.

Further information about BSI is available on the BSI website at <http://www.bsi-global.com>.

Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

Details and advice can be obtained from the Copyright & Licensing Manager. Tel: +44 (0)20 8996 7070. Fax: +44 (0)20 8996 7553. Email: copyright@bsi-global.com.