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

Part 5:

**Arc welding of titanium, zirconium and
their alloys**

iTeh STANDARDS PREVIEW
(standards.iteh.ai)

*Descriptif et qualification d'un mode opératoire de soudage pour les
matériaux métalliques — Épreuve de qualification d'un mode opératoire
de soudage* — 5:2004

<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81ba-8b508765ed41/iso-15614-5-2004>

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



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 15614-5:2004](https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004)

<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>

© ISO 2004

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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.

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...”.

standards.iteh.ai
ISO 15614-5:2004

ISO 15614 consists of the following parts, under the general title *Specification and qualification of welding procedures for metallic materials — Welding procedure test* — ISO 15614-5:2004

- *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

Page

Foreword.....	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	2
4 Preliminary welding procedure specification (pWPS)	2
5 Welding procedure test.....	2
6 Test piece.....	2
6.1 General.....	2
6.2 Shape and dimensions of test pieces.....	2
6.2.1 General.....	2
6.2.2 Butt joint in plate with full penetration	2
6.2.3 Butt joint in pipe with full penetration	3
6.2.4 T-joint	3
6.2.5 Branch connection	3
6.3 Welding of test pieces	3
7 Examination and testing	6
7.1 Extent of testing.....	6
7.2 Location and taking of test specimens	7
7.3 Non-destructive testing.....	11
7.4 Destructive testing.....	11
7.4.1 General.....	11
7.4.2 Transverse tensile test	11
7.4.3 Bend test.....	11
7.4.4 Macro/micro-examination	12
7.5 Acceptance levels	12
7.6 Coloration	12
7.7 Re-testing.....	12
8 Range of qualification	12
8.1 General.....	12
8.2 Related to the manufacturer	12
8.3 Related to the parent material	13
8.3.1 Parent material grouping	13
8.3.2 Material thickness and pipe diameter	14
8.3.3 Angle of branch connection	15
8.4 Common to all welding procedures.....	15
8.4.1 Welding process	15
8.4.2 Welding positions	15
8.4.3 Type of joint / weld.....	15
8.4.4 Filler material, designation	16
8.4.5 Type of current.....	16
8.4.6 Interpass temperature	16
8.4.7 Post-weld heat treatment	16
8.4.8 Backing gas	16
8.4.9 Welding in a chamber.....	16
8.5 Specific to processes.....	16
8.5.1 Process 131	16
8.5.2 Process 141	17
8.5.3 Process 15	17
9 Welding procedure qualification record (WPQR).....	17
Annex A (informative) Welding Procedure Qualification Record form (WPQR)	18
Annex ZA (normative) Corresponding International and European Standards for which equivalents are not given in the text.....	21

iTeh STANDARD PREVIEW
(standards.itech.ai)

ISO 15614-5:2004

<https://standards.itech.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>

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.

ITeH STANDARD PREVIEW
(standards.iteh.ai)

[ISO 15614-5:2004](https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004)

<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 15614-5:2004](https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004)

<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

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).*

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.

(standards.iteh.ai)

6 Test piece

[ISO 15614-5:2004](https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004)

6.1 General

<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>

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.

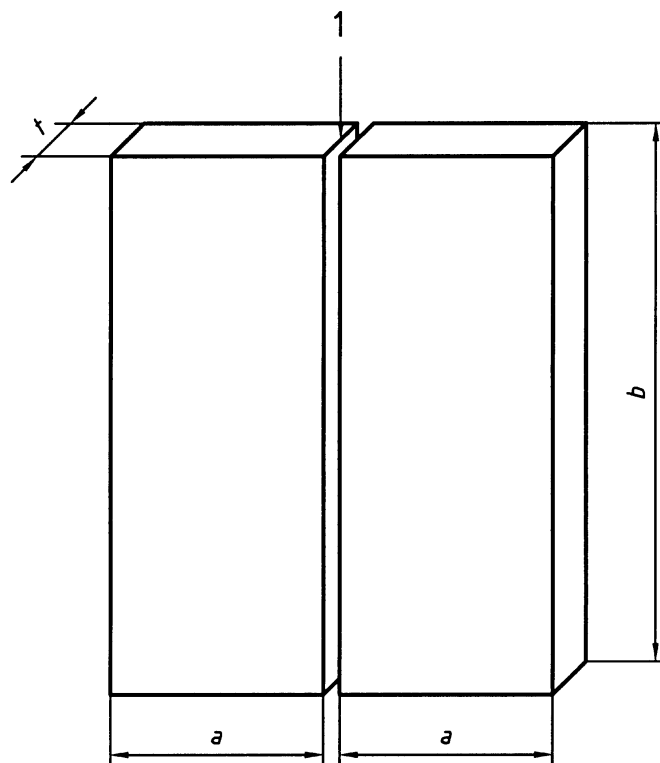
This may be used for fully penetrated joints (set-on or set-in or set-through joint) and for fillet welds.

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.

ITeCh STANDARD PREVIEW
(standards.iteh.ai)
ISO 15614-5:2004
<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>



iTeh STANDARD PREVIEW
(standards.iteh.ai)

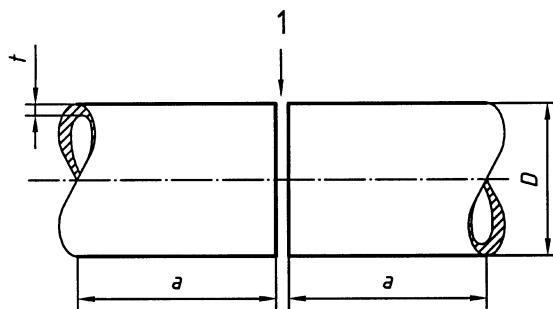
[ISO 15614-5:2004](https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004)

<https://standards.iteh.ai/catalog/standards/sist/2668290b-a934-4383-81be-8b508765ed41/iso-15614-5-2004>

Key

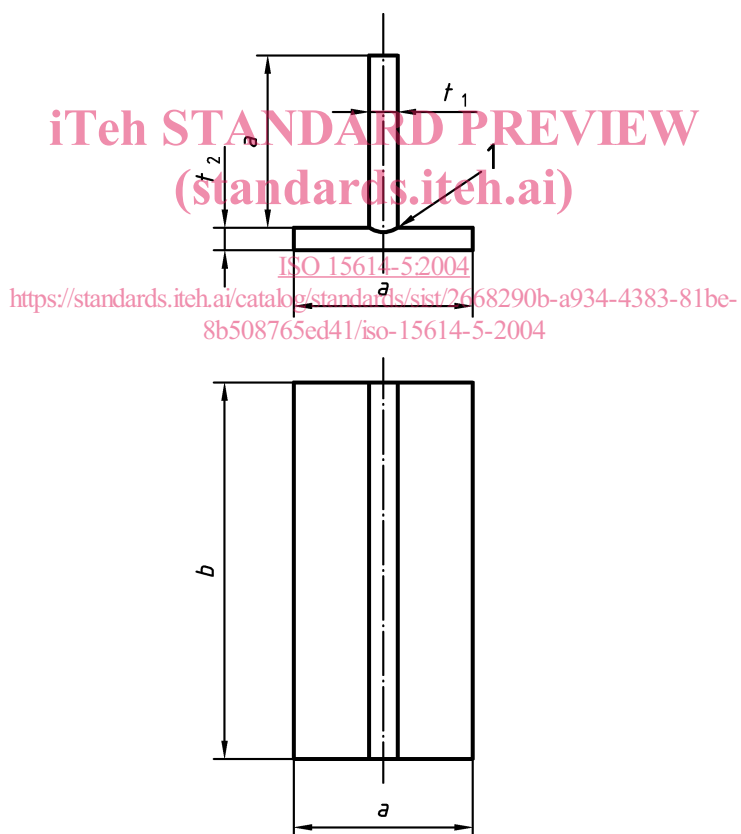
- 1 Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS)
- a* Minimum value 150 mm
- b* Minimum value 300 mm
- t* Material thickness

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