INTERNATIONAL STANDARD

ISO 15614-14

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

Part 14:
Laser-arc hybrid welding of steels, nickel and nickel alloys

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

Partie 14: Soudage hybride laser-arc des aciers, du nickel et des alliages de nickel

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Foreword

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

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 15614-14 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*.

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

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— *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*

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— *Part 3: Fusion welding of non-alloyed and low-alloyed cast irons*

— *Part 4: Finishing welding of aluminium castings*

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

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

— *Part 7: Overlay welding*

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

— *Part 10: Hyperbaric dry welding:*

— *Part 11: Electron and laser beam welding*

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

— *Part 13: Upset (resistance butt) and flash welding*

— *Part 14: Laser-arc hybrid welding of steels, nickel and nickel alloys*

Requests for official interpretations of any aspect of this part of ISO 15614 should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

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Introduction

It is intended that all new welding procedure tests be carried out in accordance with this part of ISO 15614 from the date of its issue.

However, this part of ISO 15614 does not invalidate previous welding procedure tests made to former national standards or specifications.

Also, where additional tests shall be carried out to make the qualification technically equivalent, it is only necessary to do the additional tests on a test piece made in accordance with this part of ISO 15614.

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

Part 14: Laser-arc hybrid welding of steels, nickel and nickel alloys

1 Scope

This part of ISO 15614 specifies how a preliminary welding procedure specification is qualified by welding procedure tests.

This part of ISO 15614 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.

NOTE 1 It is possible that additional tests are required by applications standards.

NOTE 2 The various parts of ISO 15614 comprise, in their turn, a series of International Standards on welding, details of which are given in ISO 15607:2003, Annex A.

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2 Normative references

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

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ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 4136, *Destructive tests on welds in metallic materials — Transverse tensile test*

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

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

ISO 9016, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination*

ISO 12932, *Welding — Laser-arc hybrid welding of steels, nickel and nickel alloys — Quality levels for imperfections*

ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials*

ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules*

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

ISO 15609-6, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 6: Laser-arc hybrid welding*

ISO 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test*

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

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

ISO 17638, *Non-destructive testing of welds — Magnetic particle testing*

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

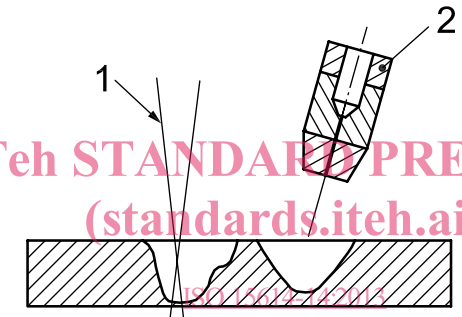
ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15607 and the following apply.

3.1
hybrid welding
welding in which two or more welding processes are used simultaneously in the same weld pool

Note 1 to entry: Hybrid welding is different than combinations of processes where at least two melt pools exist which are completely separated by a solid component in the solidification phases. Examples of a combined process (a) and a laser-arc hybrid welding process (b) are given in Figure 1 by using a laser beam and the additional energy source of an arc.



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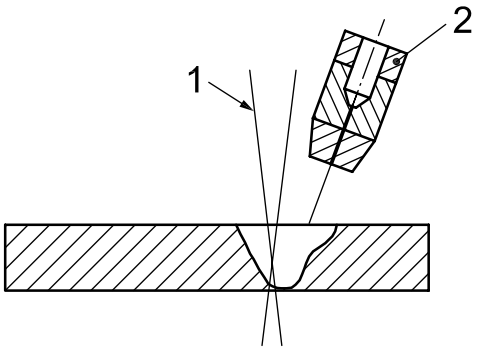
a) Combined process



b) Hybrid process

Key
1 laser beam
2 torch

Figure 1 — Combination of welding processes

4 Preliminary welding procedure specification

The preliminary welding procedure specification (pWPS) shall be prepared in accordance with ISO 15609-6.

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5 Welding procedure test

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

The welding operator who undertakes the welding procedure test satisfactorily in accordance with this part of ISO 15614 shall be qualified for the appropriate range of qualification in accordance with ISO 14732 provided the relevant testing requirements are met.

6 Test piece

6.1 General

The welded joint to which the welding procedure relates 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 piece as shown in this part of ISO 15614, the use of ISO 15613 shall be required.

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, can be prepared in order to allow for extra or for re-testing specimens (see 7.6). Application standards can require larger test pieces.

If required by the application standard, the direction of plate rolling shall be marked on the test piece when impact tests are required to be taken in the heat-affected zone (HAZ).

The plate thickness or pipe outside diameter and wall thickness of the test pieces shall be selected in accordance with 8.3.2.1 to 8.3.2.3.

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6.2 Shape and dimensions of test pieces

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6.2.1 Butt joint in plate

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

It may be used for fully and partially penetrated butt welds.

6.2.2 Butt joint in pipe

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

It may be used for fully and partially penetrated butt welds.

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

6.2.3 T-joint

The test piece shall be prepared in accordance with Figure 4.

It may be used for fully and partially penetrated butt welds or fillet welds.

6.2.4 Corner joint

The test piece shall be prepared in accordance with Figure 5.

It may be used for fully and partially penetrated butt welds or fillet welds.

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6.2.5 Branch connection

The pipe to pipe test piece shall be prepared in accordance with Figure 6. The angle α is the minimum to be used in production.

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

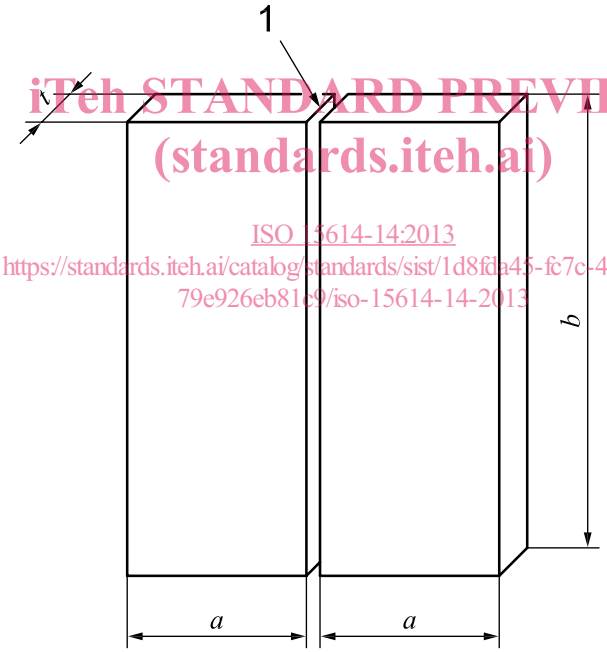
The pipe to plate test piece shall be prepared in accordance with Figure 7. The angle α is the minimum to be used in production.

It may be used for fully and partially 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 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 an examining body.



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Key

1 joint preparation and fit-up as detailed in the pWPS

t material thickness

a Minimum width 150 mm.

b Minimum length 350 mm.

Figure 2 — Test piece for a butt joint in plate

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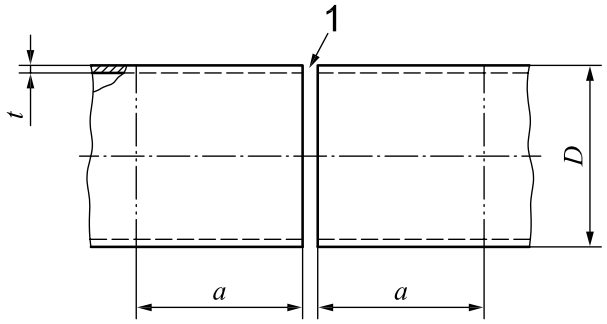
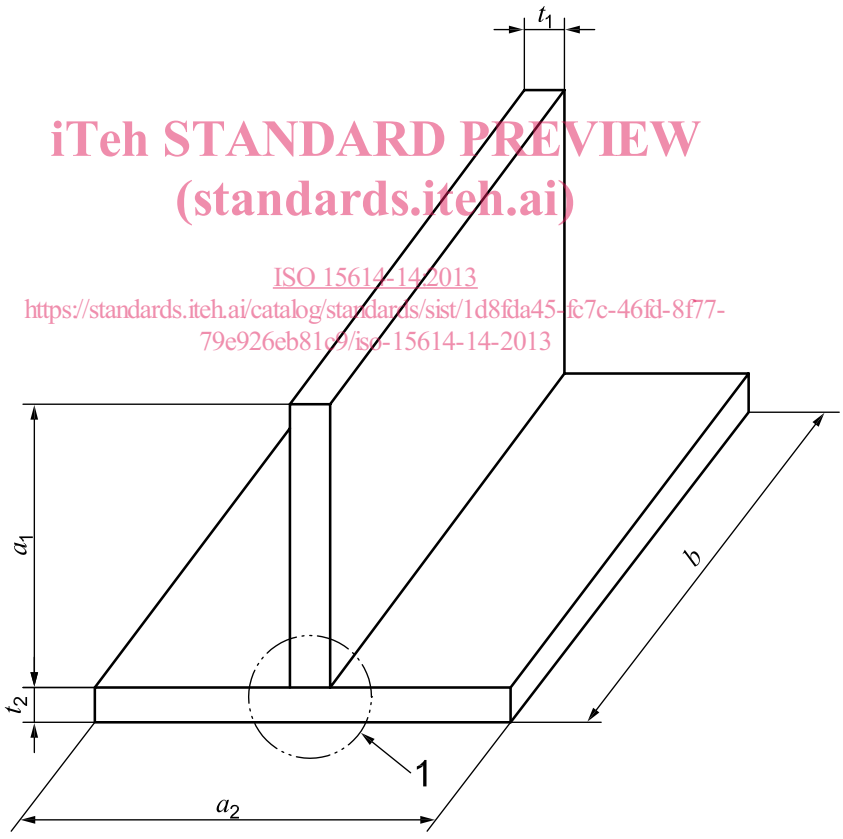


Key

1 joint preparation and fit-up as detailed in the pWPS
a minimum length 150 mm
D outside pipe diameter
t material thickness

Figure 3 — Test piece for a butt joint in pipe



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Key

1 joint preparation and fit-up as detailed in the pWPS
a_1, a_2 minimum width 150 mm
b minimum length 350 mm
t_1 material thickness, plate 1
t_2 material thickness, plate 2

Figure 4 — Test piece for a T-joint

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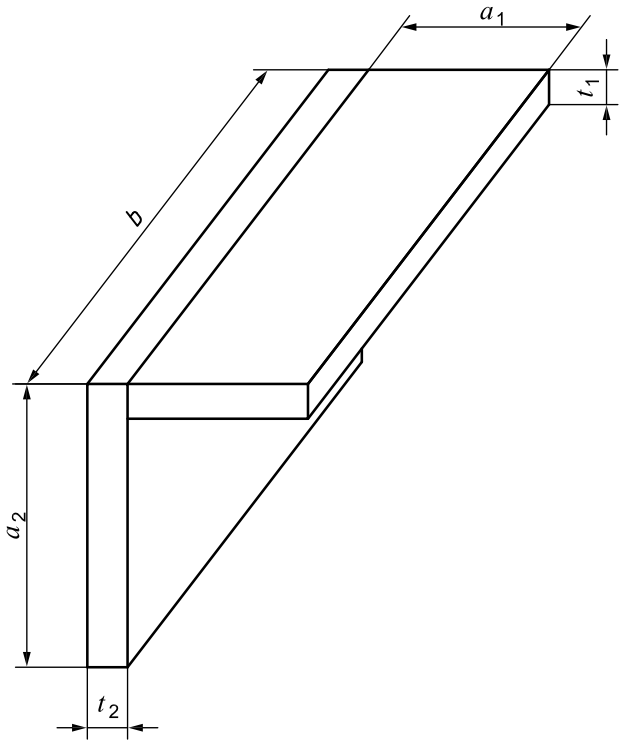

Key

1	joint preparation and fit-up as detailed in the pWPS
a_1, a_2	minimum width 150 mm
b	minimum length 350 mm
t_1	material thickness, plate 1
t_2	material thickness, plate 2

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Figure 5 — Test piece for a corner joint

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