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**Specification and qualification of  
welding procedures for metallic  
materials — Welding procedure test —  
Part 8:  
Welding of tubes to tube-plate joints**

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

*Partie 8: Soudage de tubes sur plaques tubulaires*  
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## Foreword

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

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

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

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

This second edition cancels and replaces the first edition (ISO 15614-8:2002), which has been technically revised.

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: 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 9: Underwater hyperbaric wet welding*
- *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*

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

Requests for official interpretations of any aspect of this International Standard 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](http://www.iso.org).

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## Introduction

All new welding procedure tests are to 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 or previous issues of this part of ISO 15614.

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

## Part 8: Welding of tubes to tube-plate joints

### 1 Scope

This part of ISO 15614 specifies requirements for the qualification testing of welding procedures for the arc welding of tube to tube-plate joints in metallic materials by manual, partly mechanized, fully mechanized, or automatic processes.

This part of ISO 15614 is a part of a series of standards. Details of this series are given in ISO 15607, Annex A.

Qualification by tube to tube-plate joint tests can be used for all joints even if they are fully loaded or only seal welded as required in application standards.

This part of ISO 15614 applies to fusion welding of metallic materials for tube to tube-plate joints with a remaining gap between the tube and the tube-plate for some length of the tube-plate thickness. This part of ISO 15614 does not apply to tube-sheets with forged end connections with welded tubes (external/internal bore welds).

For welding of tube to tube-plate joints with mechanical expansion which is load bearing, welding procedure test is to be defined.

For other applications and/or requirements, this part of ISO 15614 can be used if required by the specification.

Repair welding is to be considered in the welding procedure test.

### 2 Normative references

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

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

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

ISO 6520-1, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding*

ISO 9015-1, *Destructive tests on welds in metallic materials — Hardness testing — Part 1: Hardness test on arc welded joints*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*

ISO 9606-3, *Approval testing of welders — Fusion welding — Part 3: Copper and copper alloys*

ISO 9606-4, *Approval testing of welders — Fusion welding — Part 4: Nickel and nickel alloys*

## ISO 15614-8:2016(E)

ISO 9606-5, *Approval testing of welders — Fusion welding — Part 5: Titanium and titanium alloys, zirconium and zirconium alloys*

ISO 9692-1, *Welding and allied processes — Types of joint preparation — Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels*

ISO 14175, *Welding consumables — Gases and gas mixtures for fusion welding and allied processes*

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

ISO 15614-1, *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*

ISO 17636-1, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film*

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

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

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

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### 3 Terms and definitions

ISO 15614-8:2016

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

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### 4 Symbols and abbreviated terms

$a$	throat thickness (mm) (in this case, the minimal distance between root point and weld surface)
$b$	width of the weld reinforcement (mm)
$d_p$	pore size (mm)
$d_a$	tube-outside diameter (mm)
$d_1$	minimum distance between two pipes (mm)
$g$	gap between tube and tube plate (mm)
$h$	height or width of imperfection (mm)
$s_p$	starting point of the root run
$t$	tube-wall thickness (mm)
$t_1$	cladding thickness (mm)
$t_2$	tube-plate thickness (mm)
$x$	overlap (mm)

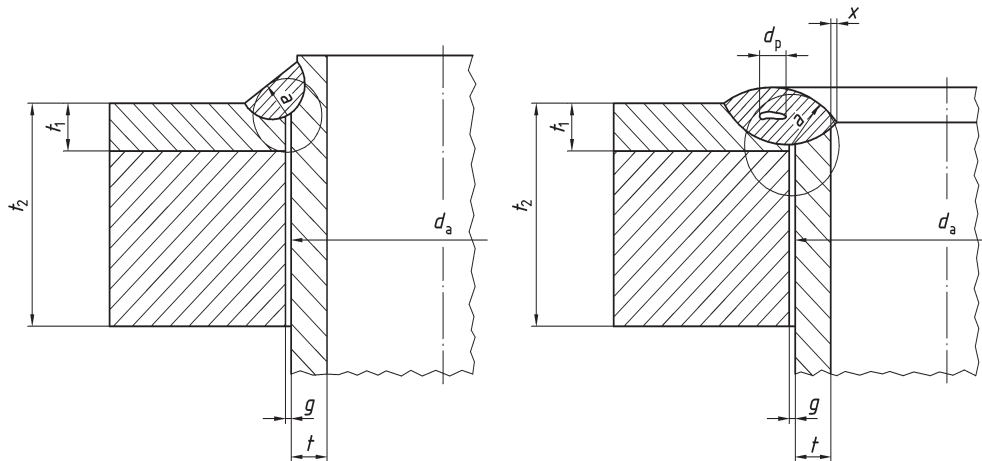


Figure 1 — Presentation of symbols in an example

## 5 Preliminary welding procedure specification (pWPS)

### 5.1 General

The qualification for tube to tube-plate welding tests shall be based on a pWPS in accordance with ISO 15609-1. It shall specify the relevant parameters listed in 5.2 and 5.3.

### 5.2 Parameters for all welding process

Details relating to the following parameters shall be recorded for all welding processes:

- welding process, or processes, when more than one is used in making a complete joint;
- tube-plate specification and thickness and details of any cladding and its thickness;
- tube specification, thickness, and outside diameter;
- pitch type (square or triangular) and distance between pipes;
- joint geometry, actual borehole, diameter and fit-up tolerances (sketch);
- cleaning and degreasing (time during the fabrication steps and type);
- jigging or tacking, tacking position, and expansion (before welding);
- tube-plate and welding position;
- type and/or trade name of welding consumables;
- size (diameter) and wire feed speed or rate of wire addition per run;
- pre-heating and interpass temperature, including method of control;
- if necessary, travel speed;
- number and arrangement of runs, starting points of runs, and weld dimensions (sketch);
- welding sequence;
- post-weld heat treatment, including method of control;