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

Part 2: Arc welding of aluminium and its alloys

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

Partie 2: Soudage à l'arc de l'aluminium et de ses alliages

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 15614-2:2005), which has been technically revised. It also incorporates the Technical Corrigenda ISO 15614-2:2005/Cor. 1:2005 and ISO 15614-2:2005/Cor. 2:2009.

The main changes are as follows:

— aligned with ISO 15614-1 as far as practicable;

— text from Clause 1 moved to the Introduction;

— process 142 added (autogenous TIG);

— references updated;

— Clauses 5, 6, 7 and 8 and associated tables and figures revised and/or updated;

— NDT and mechanical testing standards references updated.

A list of all parts in the ISO 15614 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

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Introduction

Qualification of welding procedures serves to demonstrate that production operations fully comply with the agreed welding procedure, including preliminary and subsequent treatment.

Before a particular welding procedure is used in a production operation, the manufacturer should determine and document the suitability of the welding procedure specification (WPS) to produce a weld of the required quality.

In this document, the term “welding procedure specification” comprises all the activities which influence the welding result, such as preparation, welding parameters, post treatment and reworking.

All new welding procedure tests are intended to be carried out in accordance with this document from the date of its issue.

Specification and qualification of welding procedures that were made in accordance with previous editions of this document can be used for any application for which the current edition is specified. In this case, the ranges of qualification of previous editions remain applicable.

It is also possible to create a new WPQR range of qualification in accordance with this edition based on the existing qualified WPQR, provided the technical intent of the testing requirements of this document has been satisfied. Where additional tests are to be carried out to make the qualification technically equivalent, only the additional tests on a test piece need to be performed.

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

Part 2:
Arc welding of aluminium and its alloys

1 Scope

This document specifies how a preliminary welding procedure specification (pWPS) is qualified by welding procedure tests.

This document applies to production welding, repair welding and build-up welding.

This document 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 qualification of this document.

This document applies to the arc welding of wrought and cast aluminium and its alloys. In this document the term aluminium stands for aluminium and for aluminium alloys.

This document does not apply to finishing welding of aluminium castings, which is addressed in ISO 15614-4.

Arc welding of aluminium is covered by the following welding processes in accordance with ISO 4063:2023:

131 — MIG welding with solid wire electrode;

141 — TIG welding with solid filler material (wire/rod);

142 — Autogenous TIG welding;

15 — plasma arc welding.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2107, *Aluminium and aluminium alloys — Wrought products — Temper designations*

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

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

ISO 9017, *Destructive tests on welds in metallic materials — Fracture test*

ISO 10042:2018, *Welding — Arc-welded joints in aluminium and its alloys — Quality levels for imperfections*

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ISO 10863, *Non-destructive testing of welds — Ultrasonic testing — Use of time-of-flight diffraction technique (TOFD)*

ISO 13588, *Non-destructive testing of welds — Ultrasonic testing — Use of automated phased array technology*

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

ISO 15607, *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 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test*

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

ISO 17636-2, *Non-destructive testing of welds — Radiographic testing — Part 2: X- and gamma-ray techniques with digital detectors*

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

ISO 25901 (all parts), *Welding and allied processes — Vocabulary*

ISO 18273, *Welding consumables — Wire electrodes, wires and rods for welding of aluminium and aluminium alloys — Classification*

ISO 18491[1)], *Welding and allied processes — Measurement of arc energies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15607, the ISO 25901 series and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
finishing welding
welding carried out during production of castings in order to remove defects and core openings to ensure the agreed quality

Note 1 to entry: Finishing welding is not included in the scope of this document, see Clause 1 and ISO 15614-4.

3.2
examiner
person who has been appointed to verify conformity to the applicable standard

Note 1 to entry: In certain cases, an external independent examiner can be required.

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3.3
examining body
organization appointed to verify conformity to the applicable standard

Note 1 to entry: In certain cases, an external independent examining body can be required.

4 Preliminary welding procedure specification

The pWPS shall be prepared in accordance with ISO 15609-1. It shall specify the tolerance for all the relevant parameters.

NOTE Guidance on welding of aluminium is given in ISO/TR 17671-1 and ISO/TR 17671-4.

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 document is qualified according to the national or international standard being applied, provided that the relevant testing requirements of that standard 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 or joint geometry requirements do not represent the standardized test pieces as shown in this document, ISO 15613 shall be used.

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.

When extra testing and/or re-testing specimens are required then additional test pieces or longer test pieces shall be prepared in accordance with 7.6.

For all test pieces except branch connections (see Figure 4) and T-joints (T-butt weld or fillet weld; see Figure 3), the material thickness, t, and the diameter, D, shall be the same for both plates and pipes on the required length of the test piece to be welded. If required by the application standard, the direction of working, for example for extrusion, shall be marked on the test piece.

The material thickness and/or pipe outside 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 given in 6.2.2 to 6.2.5.

6.2.2 Butt joint in plate with full penetration

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

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