INTERNATIONAL STANDARD

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

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

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

Partie 3: Soudage par fusion des fontes non alliées et faiblement alliées

Reference number
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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 15614-3 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding*, in collaboration with Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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.

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 10: Hyperbaric dry welding*

— *Part 11: Electron and laser beam welding*

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

— *Part 13: Resistance butt and flash welding*

Introduction

Details of International Standards dealing with specification and qualification of welding procedures are given in ISO 15607:2003, Annex A.

Welding procedure tests for flash welding are presented in ISO 15614-13 and for friction welding in ISO 15620.

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

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

1 Scope

This part of ISO 15614 specifies how a preliminary welding procedure specification (pWPS) for production and repair welding of non-alloyed and low-alloyed cast irons is qualified by fusion welding procedure tests.

This part of ISO 15614 defines the conditions for execution of the welding procedure tests and the range of qualification for welding procedures for all practical welding operations within the range of a defined list of variables.

This part of ISO 15614 is applicable to all new welding procedures. However, it 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 made in accordance with this part of ISO 15614.

Additional tests may be required by application standards.

This part of ISO 15614 is applicable to welding non-alloyed and low-alloyed grey cast iron castings according to: EN 1561; EN 1562; EN 1563; and EN 1564.

The principles of this part of ISO 15614 are also applicable for welding cast iron to steel or to other unalloyed and low-alloyed cast iron materials.

2 Normative references

The following referenced documents are indispensable for the application 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 783, *Metallic materials — Tensile testing at elevated temperature*

ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation*

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

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 15609-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding*

ISO 15611, *Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience*

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

EN 571-1, *Non destructive testing — Penetrant testing — Part 1: General principles*

EN 970, *Non-destructive examination of fusion welds — Visual examination*

EN 1011-1, *Welding — Recommendations for welding of metallic materials — Part 1: General guidance for arc welding*

EN 1011-8:2004, *Welding — Recommendations for welding of metallic materials — Part 8: Welding of cast irons*

EN 1321, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

EN 1561, *Founding — Grey cast irons*

EN 1562, *Founding — Malleable cast irons*

EN 1563, *Founding — Spheroidal graphite cast irons*

EN 1564, *Founding — Austempered ductile cast irons*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

3 Terms and definitions

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

3.1
production welding
any welding carried out during manufacture before final delivery to the end user

3.2
joint welding
production welding used to join components together

3.3
finishing welding
production welding carried out in order to remove casting defects to ensure the required quality of castings

3.4
repair welding
any welding carried out after delivery to the end user, i.e. after the product has been in service

4 Welding processes

Welding is covered by the following welding processes in accordance with ISO 4063:

111 manual metal arc welding (metal arc welding with covered electrode); shielded metal arc welding (USA);

114 self-shielded tubular-cored arc welding;

121 submerged arc welding with one wire electrode;

131 metal inert gas welding, MIG welding; gas metal arc welding (USA);

135 metal active gas welding, MAG welding; gas metal arc welding (USA);

136 tubular-cored metal arc welding with active gas shield; flux cored arc welding (USA);

141 tungsten inert gas welding; TIG welding; gas tungsten arc welding (USA);

15 plasma arc welding;

311 oxy-acetylene welding; oxyacetylene welding (USA).

5 Preliminary welding procedure specification (pWPS)

The pWPS shall be prepared in accordance with ISO 15609-1 or ISO 15609-2.

6 Welding procedure test

The welding and testing of test pieces shall be in accordance with Clauses 7 and 8.

The welder or welding operator, who undertakes the welding procedure test satisfactorily in accordance with this part of ISO 15614, is qualified to weld within the range of qualification according to Clause 9.

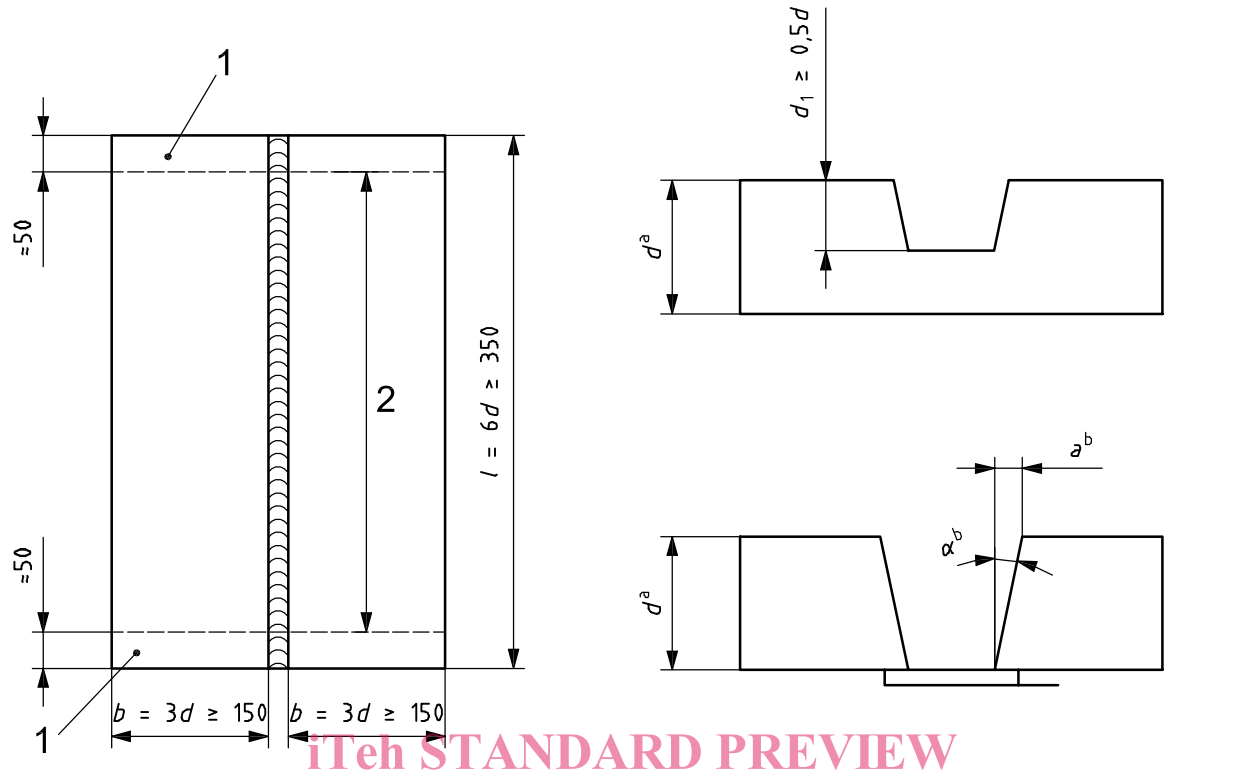
7 Test piece

7.1 General

The test piece shall comply with the requirements of 7.2, 7.3, and Figure 1. It can be cast separately or removed from the casting/component. Preparation of sufficiently large test pieces is by machining.

When the standardized test pieces as shown in this part of ISO 15614 do not represent the production/joint geometry, the use of ISO 15611 or ISO 15613 shall be required.

Dimensions in millimetres



Key

1 discard

2 inspection length

The dimensions shown are for information only and may be adjusted to meet production and testing requirements. The edges of the groove should be smooth rounded. Edge preparation of the groove and fit-up shall be as detailed in the pWPS.

a In accordance with Table 3 or Table 4.

b $a = 5$ mm to 15 mm or $\alpha = 5°$ to 20°.

Figure 1 — Test piece

7.2 Shape and dimensions of test piece

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 retesting test specimens (see 8.5).

The thickness of the test pieces shall be selected in accordance with 9.3.2.

7.3 Welding of test piece

Preparation and welding of test piece(s) shall be carried out in accordance with a 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.

Unless otherwise specified in the purchase order or contract review, welding and testing of the test piece(s) shall be witnessed by an examiner (or examining body).

The welds are preferably to be made in flat position (PA). Other welding positions shall be specified. Implementation of the welding should preferably take account of the recommendations in EN 1011-8:2004, Annex B.

8 Examination and testing

8.1 Extent of testing

Testing includes both non-destructive testing (NDT) and destructive testing which shall be in accordance with the requirements of Table 1. Before welding, the grooves shall be subject to visual examination and tested for surface cracks.

An application standard may specify additional tests, e.g.:

— longitudinal weld tensile test;

— bend test;

— corrosion tests;

— chemical analysis;

— impact test;

— radiography or ultrasonic testing;

— hardness test.

NOTE It is possible that specific service, material or manufacturing conditions require more comprehensive testing than is specified by this part of ISO 15614 in order to gain more information and to avoid repeating the welding procedure test at a later date just to obtain additional test data.

Implementation of the tests as well as assessment of the test results are to be undertaken according to the appropriate applicable standards.

Table 1 — Examination and testing of test pieces

Type of test	**Material group according to ISO/TR 15608**			
	72	71	73	74
	Spheroidal graphite cast iron	Grey cast iron	Malleable cast iron	Austempered ductile cast iron
Visual examination according to EN 970	X	X	X	X
Penetrant testing according to EN 571-1	X	X	X	X
Tensile test at ambient temperature according to EN 10002-1 and ISO 783 with round samples according to EN 10002-1 transverse to the weld (requirement: determination of tensile strength, R_m); other types of sample can be agreed	X	X	X [a]	X
Macroscopic examination transverse to the weld	X	X	X	X
Tensile test at ambient temperature according to EN 10002-1 and ISO 783 with round samples according to EN 10002-1 from the parent metal or according to agreement	X	X	X	X

[a] If applicable.