
**Specification and qualification of
welding procedures for metallic
materials — General rules**

*Descriptif et qualification d'un mode opératoire de soudage pour les
matériaux métalliques — Règles générales*

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Published in Switzerland

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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).

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).

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by ISO Technical Committee 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 15607:2003), which has been technically revised. It also incorporates the Technical Corrigendum ISO 15607:2003/Cor.1:2005.

The main changes compared to the previous edition are as follows:

- ISO 3834 is no longer referenced;
- titles of referenced documents have been corrected and some references have been moved to the Bibliography;
- references to International Standards for laser-arc hybrid welding, friction stir welding and production welding of steel castings have been added.

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 TC 44 documents, where they exist, are available from this page: <https://committee.iso.org/sites/tc44/home/interpretation.html>.

Introduction

Welding procedure specifications (WPSs) are needed in order to provide a well-defined basis for planning of the welding operations and for quality control during welding. Welding is considered a special process in the terminology of standards for quality systems. Standards for quality systems usually require that special processes be carried out in accordance with written procedure specifications.

Preparation of a welding procedure specification provides the necessary basis for, but does not in itself ensure that the welds fulfil the requirements. Some deviations, notably imperfections and distortions, can be evaluated by non-destructive methods on the finished product.

However, metallurgical deviations constitute a special problem because non-destructive evaluation of the mechanical properties is impossible at the present level of non-destructive technology. This has resulted in the establishment of a set of rules for qualification of the welding procedure prior to the release of the specification to actual production. This document defines these rules.

Qualification of a preliminary welding procedure specification (pWPS) by more than one method is not recommended.

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Specification and qualification of welding procedures for metallic materials — General rules

1 Scope

This document is part of a series of standards dealing with specification and qualification of welding procedures. [Annex A](#) gives details of this series of standards, [Annex B](#) gives a table for the use of these standards, and [Annex C](#) gives a flow diagram for the development and qualification of a WPS.

This document defines general rules for the specification and qualification of welding procedures for metallic materials. This document also refers to several other standards as regards detailed rules for specific applications.

This document is applicable to manual, partly mechanized, fully mechanized and automated welding.

Welding procedures are qualified by conforming to one or more welding procedure qualification records (WPQR). The use of a particular method of qualification is often a requirement of an application standard.

It is assumed that welding procedure specifications are used in production by competent welders, qualified in accordance with the relevant part of ISO 9606 or by competent operators qualified in accordance with ISO 14732.

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 15609 (all parts), *Specification and qualification of welding procedures for metallic materials — Welding procedure specification*

ISO 15610, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables*

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

ISO 15612, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure specification*

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

ISO 15614 (all parts), *Specification and qualification of welding procedures for metallic materials — Welding procedure test*

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

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

manufacturer

<welding> person or organization responsible for the welding production

4 Welding procedure specification format

The ISO 15609 series provides the technical content that shall be included in welding procedure specifications for the following welding processes:

- arc welding;
- gas welding;
- electron beam welding;
- laser beam welding;
- laser-arc hybrid welding;
- resistance welding.

WPS for other welding processes and for special applications can be covered by specific standards, for example:

- for stud welding, see ISO 14555;
- for friction welding, see ISO 15620;
- for friction stir welding (FSW), see ISO 25239-4;
- for friction stir spot welding (FSSW), see ISO 18785-4.

A WPS shall be classified as a pWPS until qualified using an appropriate method in accordance with [Clause 5](#).

5 Development and qualification of welding procedures

5.1 General

Qualification of welding procedures shall be performed prior to actual welding in production.

The manufacturer shall prepare a pWPS and shall ensure that it is applicable for the actual production, using experience from previous productions and the general fund of knowledge of welding technology.

Each pWPS shall be used as a basis for establishment of WPQR qualified in accordance with one of the methods listed in [Table 1](#).

If the qualification involves welding of test pieces, then the test pieces shall be welded in accordance with the pWPS.

The WPQR shall comprise all variables (essential and non-essential) as well as the specified ranges of qualification given in the appropriate standard. On basis of the WPQR, the WPS for production welding is developed under the responsibility of the manufacturer unless otherwise required (see [Annex B](#)).

Table 1 — Methods of qualification

Method based on	Application
Welding procedure test (see 5.2)	Can always be applied, unless the procedure test does not adequately correspond to the joint geometry, restraint, accessibility of the actual welds.
Tested welding consumables (see 5.3)	Application is limited to welding procedures using consumables. The testing of the consumables shall cover the parent material used in production. Further limitations as regards material and other parameters are specified in ISO 15610.
Previous welding experience (see 5.4)	Application is limited to procedures used previously for a large number of welds in comparable items, joints and materials. Requirements are specified in ISO 15611.
Standard welding procedure (see 5.5)	Similar to welding procedure test but in accordance with the limitations specified in ISO 15612.
Pre-production welding test (see 5.6)	Can always be applied in principle but requires manufacture of a test piece under production conditions. Suitable for mass production. Requirements are specified in ISO 15613.
NOTE For the choice of a particular method, see Annexes A and B.	

5.2 Qualification based on welding procedure test

This method specifies how a welding procedure can be qualified by the welding and testing of a standardized test piece.

A welding procedure test may be required whenever the properties of the material in the weld metal and the heat-affected zone are critical for the application.

The ISO 15614 series defines the welding procedure tests for the following welding processes:

- arc welding;
- gas welding;
- electron beam welding;
- laser beam welding;
- laser-arc hybrid welding;
- resistance welding;

Welding procedure tests for other welding processes and for special applications can be covered by specific standards, for example:

- for stud welding, see ISO 14555;
- for friction welding, see ISO 15620;
- for friction stir welding, see ISO 25239-4;
- for friction stir spot welding, see ISO 18785-4;
- for production welding of steel castings, see ISO 11970.

5.3 Qualification based on tested welding consumables

This method specifies how a welding procedure can be qualified by using tested welding consumables.

Some parent materials do not deteriorate significantly in the heat-affected zones. In this case, this method of qualification may be used.

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ISO 15610 defines the method of qualification by using tested welding consumables for the following welding processes:

- arc welding;
- gas welding.

Qualification by this method for other welding processes and for special applications can be covered by specific standards.

This method is limited to specific material groups and to a maximum material thickness.

NOTE ISO 15610:2003 has the following limits:

- parent materials to ISO/TR 15608 Groups 1.1, 8.1, 21, 22.1 and 22.2;
- material thickness from 3 mm to 40 mm maximum;
- fillet welds throat thickness, $a \geq 3$ mm;
- pipe diameter, $D > 25$ mm.

5.4 Qualification based on previous welding experience

This method specifies how a welding procedure can be qualified by demonstration of previous satisfactory welding ability.

A manufacturer may have a pWPS qualified by referring to previous experience in welding on condition that he can prove by appropriate documentation that he has previously satisfactorily welded the type of joint and materials in question.

Only welding procedures known from experience to be reliable should be used in such cases.

ISO 15611 defines the method of qualification by reference to previous welding experience for the following welding processes:

- arc welding;
- gas welding;
- electron beam welding;
- laser beam welding;
- laser-arc hybrid welding;
- resistance welding.

Qualification by this method for other welding processes and for special applications can be also covered by specific standards, for example:

- for stud welding, see ISO 14555;
- for friction welding, see ISO 15620.

5.5 Qualification based on a standard welding procedure

ISO 15612 specifies how a manufacturer may adopt a welding procedure specification qualified and published as a standard welding procedure specification (SWPS) for arc and gas welding by a different organization.

The SWPS shall specify the ranges for all the relevant variables in accordance with the relevant part of ISO 15609. The organization may specify additional requirements in a SWPS it believes are necessary to follow to ensure suitable production joint weld quality.

This method is limited to specific material groups and to a maximum material thickness.

NOTE ISO 15612 limits parent materials to ISO/TR 15608 Groups 1.1, 1.2, 1.3, 11.1, 8.1, 21, 22.1 and 22.2 and material thickness to 50 mm maximum.

The manufacturer is responsible for the appropriate selection and application of the SWPS.

5.6 Qualification based on a pre-production welding test

This method specifies how a welding procedure can be qualified by pre-production welding tests.

This method is the only reliable method of qualification for some welding procedures, in which the resulting properties of the weld strongly depend on certain conditions such as component, special restraint conditions, heat sinks, which cannot be reproduced by standardized test pieces.

Qualification by a pre-production welding test may be used where the shape and dimensions of standardized pieces do not adequately represent the joint to be welded, e.g. attachment weld to thin pipe. In such cases, one or more special test pieces shall be made to simulate the production joint in all essential features. The test shall be carried out prior and under the conditions to be used in production.

Inspection and testing of the test piece shall be carried out in accordance with the appropriate standard for procedure testing, but this testing can need to be supplemented or replaced by special tests according to the nature of the joint in question. ISO 15613 defines the method of qualification by pre-production welding tests for the following welding processes:

- arc welding;
- gas welding;
- electron beam welding;
- laser beam welding;
- laser-arc hybrid welding;
- resistance welding.

Qualification by this method for other welding processes and for special applications can be also covered by specific standards.

6 Validity

A qualification is valid indefinitely for the ranges qualified unless otherwise specified.

Annex A (informative)

Details of standards dealing with specification and qualification of welding procedures

For details of applicable standards, see [Table A.1](#).

Table A.1 — Standards dealing with specification and qualification of welding procedures

Process	Arc welding	Gas welding	Beam welding	Laser-arc hybrid welding	Resistance welding	Stud welding	Friction welding	Friction stir welding
General rules	ISO 15607							
Materials grouping system	ISO/TR 15608 (ISO/TR 20172, ISO/TR 20173 and ISO/TR 20174)		Not applicable	ISO/TR 15608 (ISO/TR 20172, ISO/TR 20173 and ISO/TR 20174)		Not applicable	ISO/TR 15608 (ISO/TR 20172, ISO/TR 20173 and ISO/TR 20174)	
WPS	ISO 15609-1	ISO 15609-2	ISO 15609-3: Electron beam welding ISO 15609-4: Laser beam welding	ISO 15609-6	ISO 15609-5	ISO 14555	ISO 15620	ISO 25239-4: FSW ISO 18785-4: FSSW
Tested welding consumables	ISO 15610		Not applicable					
Previous welding experience	ISO 15611					ISO 15611 ISO 14555	ISO 15611 ISO 15620	Not applicable
Standard welding procedure	ISO 15612		Not applicable					
Pre-production test	ISO 15613					ISO 15613 ISO 14555	Not applicable	ISO 25239-4: FSW ISO 18785-4: FSSW

Table A.1 (continued)

Process	Arc welding	Gas welding	Beam welding	Laser-arc hybrid welding	Resistance welding	Stud welding	Friction welding	Friction stir welding
Welding procedure test	ISO 15614-1: Steel/Nickel ISO 15614-2: Aluminium ISO 15614-3: Cast iron ISO 15614-4: Finishing welding of aluminium castings ISO 15614-5: Titanium/zirconium ISO 15614-6: Copper ISO 15614-7: Overlay welding ISO 15614-8: Tube to tube-plate ISO 15614-9: Wet hyperbaric ISO 15614-10: Dry hyperbaric ISO 11970: Production welding of steel castings	ISO 15614-1: Steel ISO 15614-3: Cast iron ISO 15614-6: Copper ISO 15614-7: Overlay welding	ISO 15614-7: Overlay welding ISO 15614-11: Electron beam/Laser beam	ISO 15614-14: Laser-arc hybrid welding of steels, nickel and nickel alloys	ISO 15614-12: Spot, seam and projection ISO 15614-13: Flash and butt	ISO 14555	ISO 15620	ISO 25239-4: FSW ISO 18785-4: FSSW

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Annex B (informative)

Different phases in welding procedure qualification

See [Table B.1](#).

Table B.1 — Different phases in welding procedure qualification

Activity	Result	Party involved
Development of the procedure	pWPS	Manufacturer ^a
Qualification by any method	WPQR including the range of validity based on the relevant standard of qualification	Manufacturer ^a and, if applicable, examiner/examining body ^b
Finalization of the procedure	WPS based on this WPQR	Manufacturer ^a
Release for production	Approved WPS or work instruction	Manufacturer
^a An organization other than the manufacturer can be involved in the case of the qualification of a SWPS. ^b In certain cases, an external independent examiner/examining body can be required.		