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Second edition
2019-08

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

Part 1: Arc welding

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

Partie 1: Soudage à l'arc

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.

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).

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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 Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

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.

This second edition cancels and replaces the first edition (ISO 15609-1:2004), which has been technically revised. It also incorporates the Corrigendum ISO 15609-1:2004/Cor.1:2005.

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

— Clause 2 has been updated;

— editorial changes have been made;

— the former Note 1 in 4.1 has been moved to regular text;

— surface conditions have been added in 4.4.4;

— Subclause 4.4.10 has been technically revised;

— arc energy has been added in 4.4.17;

— Annex A has been revised.

A list of all parts in the ISO 15609 series can be found on the ISO website.

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Introduction

All new welding procedure specifications need to be prepared in accordance with this document from the date of its issue. However, this document does not invalidate previous welding procedure specifications made to former standards or specifications or previous editions of this document.

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

Part 1: Arc welding

1 Scope

This document specifies requirements for the content of welding procedure specifications for arc welding processes.

Details of the ISO 15609 series are given in ISO 15607. The variables listed in this document are those influencing the quality of the welded joint.

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

ISO 6848, *Arc welding and cutting — Nonconsumable tungsten electrodes — Classification*

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

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

ISO/TR 18491, *Welding and allied processes — Guidelines for measurement of welding energies*

ISO/TR 20172, *Welding — Grouping systems for materials — European materials*

ISO/TR 20173, *Welding — Grouping systems for materials — American materials*

ISO/TR 20174, *Welding — Grouping systems for materials — Japanese materials*

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 ISO 15607 and ISO/TR 25901 (all parts) 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/

4 Technical content of welding procedure specification (WPS)

4.1 General

A preliminary welding procedure specification/welding procedure specification (pWPS/WPS) shall provide all the necessary information required to make a weld. The information required in a pWPS/WPS is given in 4.2 to 4.5.

For some applications, it can be necessary to supplement or reduce the list.

Welding procedure specifications cover all certain range of necessary information to make a weld. Some manufacturers prefer additionally to prepare work instructions for each specific job as part of detailed production planning.

Ranges and tolerances, according to the relevant standard (see ISO 15607) and to the manufacturer's experience, shall be specified where appropriate.

An example of the WPS-format is shown in Annex A.

4.2 Related to the manufacturer

— Identification of the manufacturer.

— Identification of the WPS.

— Reference to the welding procedure qualification record (WPQR) or other documents as required (see ISO 15607).

4.3 Related to the parent material

4.3.1 Parent material type

— Designation of the material(s), and reference standard(s).

— Number(s) of the group(s) as given in ISO/TR 20172, ISO/TR 20173 or ISO/TR 20174. If the material is not assigned in those, ISO/TR 15608 shall be used. A WPS may cover a group of materials.

4.3.2 Material dimensions

— Thickness ranges of the materials.

— Outside diameter ranges for pipes.

4.4 Common to all welding procedures

4.4.1 Welding process

Welding process(es) used in accordance with ISO 4063.

4.4.2 Joint design

— A sketch of the joint design/configuration and dimensions or reference which provide such information.

— Weld run sequence given on the sketch if essential for the properties of the weld.

4.4.3 Welding position

Applicable welding positions in accordance with ISO 6947.

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4.4.4 Joint preparation

— Surface condition, cleaning, degreasing, including methods to be used.

— Jigging, fixtures and tack welding.

4.4.5 Welding technique

— Weaving if applicable;

  a) For manual welding and partly mechanized maximum width of the run.

  b) For fully mechanized and automatic welding, maximum weaving or amplitude, frequency and dwell time of oscillation.

— Torch, electrode and/or wire angle (if required).

4.4.6 Back gouging

— The method to be used.

— Depth and shape.

4.4.7 Backing

The type of backing, e. g. material backing, gas backing or flux backing.

4.4.8 Welding consumables

— Designation, make (manufacturer and trade name).

— Dimensions (size).

— Handling (e.g. drying, holding in a heated quiver).

4.4.9 Electrical parameters

— Type of current [alternating current (AC) or direct current (DC)] and polarity.

— Pulse welding details (machine settings, programme selection and all pertinent information of the process) if applicable.

— Current range.

— Voltage range (if applicable).

— Wire speed feed range for mechanized and automatic welding.

4.4.10 Mechanized and automatic welding

— Travel speed range.

— Wire/strip feed speed range.

If the equipment does not permit control of one of either variable, the machine settings shall be specified instead. The range of application for the WPS shall then be limited to equipment of that particular type. This applies to 4.4.9 and 4.4.10.

4.4.11 Preheating temperature

4.4.11.1 General

The minimum temperature applied at the start of welding and during welding.

4.4.11.2 Work piece temperature

If preheating is not required the lowest work piece temperature prior to welding.

4.4.12 Interpass temperature

Maximum and if necessary minimum interpass temperature.

4.4.13 Preheat maintenance temperature

The minimum temperature in the weld zone which shall be maintained if welding is interrupted.

See ISO 13916 for application of 4.4.11, 4.4.12 and 4.4.13.

4.4.14 Postheating for hydrogen release

— Temperature range.

— Minimum holding time.

4.4.15 Post-weld heat treatment

The minimum time and temperature range for post-weld heat treatment or ageing shall be specified or reference shall be made to other standards which specify this information.

4.4.16 Shielding gas

Designation in accordance with ISO 14175 and, where applicable, the composition, manufacturer and trade name.

4.4.17 Heat input / Arc energy

Range of heat input or arc energy (if specified) in accordance with ISO/TR 18491.

4.5 Specific to a group of welding processes

4.5.1 Process 111 (Manual metal arc welding)

The run-out length of electrode consumed or travel speed.

4.5.2 Process 12 (Submerged arc welding)

— For multiple electrode systems, the number and configuration of wire electrodes and polarity.

— Distance contact tube/work piece: the distance from contact tip nozzle to the surface of the work piece.

— Flux: designation, manufacturer and trade name.

— Additional filler material.

— Arc voltage range.

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4.5.3 Process 13 (Gas-shielded metal arc welding)

— Shielding gas flow rate and nozzle diameter.

— Number of wire electrodes.

— Additional filler material.

— The distance from the contact tip/contact tube to the surface of the work piece.

— Arc voltage range.

— Mode of metal transfer.

4.5.4 Process 14 (Gas-shielded welding with non-consumable electrode)

— Tungsten electrode: the diameter, and codification in accordance with ISO 6848.

— Shielding gas flow rate and nozzle diameter.

— Additional filler materials.

4.5.5 Process 15 (Plasma arc welding)

— Plasma gas parameters, e.g. composition, nozzle diameter, flow rate.

— Shielding gas flow rate and nozzle diameter.

— Type of torch.

— Distance contact tube/work piece: the distance from the nozzle to the surface of the work piece.

Annex A
(informative)

Welding Procedure Specification (WPS)

The user of this form is allowed to copy this form.

Welding Procedure Specification:

WPQR No.:

Manufacturer:

Mode(s) of metal transfer:

Joint type and weld type:

Throat thickness (mm)[2]:

Deposited weld metal

Weld preparation details (Sketch)[1]

Method of preparation and cleaning:

Parent material designation(s):

Material thickness (mm)[2]:

Outside diameter (mm)[2]:

Degree of mechanization:

Welding position:

Joint design	Welding sequences

Welding details

Run	Welding process	Size of filler material	Current[2] A	Voltage[2] V	Type of current/polarity	Wire feed speed[2]	Run out length[1,2]/ travel speed[1]	Arc energy[1,2]/ Heat input[1,2]

Filler material designation and make:

Any special baking or drying:

Designation gas/flux: – shielding:

– backing:

Gas flow rate – shielding:

– backing:

Tungsten electrode type/size:

Details of back gouging/backing:

Preheating temperature:

Interpass temperature:

Postheating:

Pre-heat maintenance temperature:

Post-weld heat treatment and/or ageing:

Time, temperature, method:

Heating and cooling rates[1]:

Other information[1], e.g.:

Weaving (maximum width of run):

Oscillation: amplitude, frequency, dwell time:

Pulse welding details:

Distance contact tube/work piece:

Plasma welding details:

Torch angle:

.....

Manufacturer

(name, signature, date)

[1] If required.

[2] Range.

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Bibliography

[1] ISO 13916, *Welding — Measurement of preheating temperature, interpass temperature and preheat maintenance temperature*

ICS 25.160.10