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

**Part 3:
Electron beam welding**

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

Partie 3: Soudage par faisceau d'électrons

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 15609-3 was prepared by the European Committee for Standardization (CEN) 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).

This first edition cancels and replaces ISO 9956-10:1996 which has been technically revised.

Throughout the text of this document, read “...this European Standard...” to mean “...this International Standard...”.

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ISO 15609 consists of the following parts, under the general title *Specification and qualification of welding procedures for metallic materials — Welding procedure specification*:

- *Part 1: Arc welding*
- *Part 2: Gas welding*
- *Part 3: Electron beam welding*
- *Part 4: Laser beam welding*
- *Part 5: Resistance welding*

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Foreword

This document (EN ISO 15609-3:2004) has been prepared by Technical Committee CEN /TC 121, "Welding", the secretariat of which is held by DIN, in collaboration with ISO/TC 44 "Welding and allied processes".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

This document supersedes EN ISO 9956-10:1996.

Annex A is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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1 Scope

This standard specifies requirements for the content of welding procedure specifications for electron beam welding.

This standard is part of a series of standards, details of this series are given in EN ISO 15607:2003, annex A.

Variables listed in this standard are those influencing the quality and properties of the welded joint.

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.

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers* (ISO 4063:1998).

EN ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation* (ISO 6947:1993).

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules* (ISO 15607:2003).

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3 Terms and definitions

[ISO 15609-3:2004](https://standards.itech.ai/catalog/standards/sist/9ea3ab90-b7ef-4c4c-b6d8-77504e734f7/iso-15609-3-2004)

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For the purposes of this European Standard, the terms and definitions given in EN ISO 15607:2003 and the following apply.

3.1

slope up

controlled increase of the beam power at the beginning of welding

3.2

slope down

controlled decrease of the beam power at the end of welding. The slope down region is the region on the workpiece in which the effects of slope down occur. It can consist of one or two areas, depending on the selected welding mode:

- a) in full penetration welding:
 - a region where beam penetration is still complete;
 - a region where penetration is partial or decreasing.
- b) in partial penetration welding:
 - a region where penetration decreases continuously.

3.3
working distance
distance between the surface of the workpiece and a standard reference point of the equipment which is traceable to the true focusing lens centre

NOTE This is a practical reference distance only.

3.4
tacking pass
pass made to hold the parts to be welded in proper alignment until the final welds are made

NOTE This may be produced by a continuous or discontinuous pass with partial penetration.

3.5
welding pass
pass ensuring fusion to the required depth

3.6
cosmetic pass
pass for superficial remelting of the weld in order to enhance its appearance

NOTE This pass is made with a defocused or oscillating beam.

3.7
overlap
portion of the welding pass remelted prior to the slope down

3.8
back or front support
plate placed against the workpiece on either the back or front face of the joint in order to retain the molten weld metal

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3.9
beam current
value of the electric current in the beam

3.10
beam current pulsing
intentional periodic variation of the beam current

3.11
focusing lens current
current passing through the focusing lens coil

3.12
beam deflection
electromagnetic deflection of the beam from the gun axis

3.13
beam oscillation
an intentional periodic deflection of the beam, achieved by electromagnetic forces

NOTE An oscillation is defined by:

- signal shape e.g. circular, transversal, longitudinal,... ;
- the signal amplitude;
- the frequency;
- the orientation in relation to the welding direction.

4 Technical content of welding procedure specification (WPS)

4.1 General

The welding procedure specification (WPS) shall provide all information required to make a weld.

Welding procedure specifications may cover a certain range of thicknesses of the joined parts and may also cover a range of parent metals and even filler metals. Some manufacturers may additionally prefer to prepare work instructions for each specific job as part of the detailed production planning.

Information listed below is adequate for most welding operations. For some applications it may be necessary to supplement or reduce the list. The relevant information shall be specified in the WPS.

Ranges and tolerances, according to the manufacturer's experience, shall be specified when appropriate.

An example of a typical WPS format is shown in annex A.

4.2 Welding process

The welding process number is 51 in accordance with EN ISO 4063.

4.3 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.

4.4 Equipment used

- Electron beam welding equipment, unique identification:
 - electron gun type;
 - cathode type.
- Filler material(s) feeding system (if any): a description (schematic) showing design, position of the filler material(s) feeding system in relation to joint, welding direction and welding point shall be provided.

4.5 Related to the parent materials

4.5.1 Parent material type/grade

- Designation of the material(s) and any backing plates or supports used and any reference standard(s);
- identification of the type of product (e.g. forged, cast, rolled, extruded).

A WPS may cover a group of materials.

4.5.2 Dimensions of materials

- Thickness range of the joint;
- for circular workpieces the range of outside diameters.