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

**Part 4:
Laser 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 4: Soudage par faisceau laser

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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 15609-4 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 of ISO 15609-4 cancels and replaces ISO 9956-11:1996, 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*

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

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Foreword

This document (EN ISO 15609-4:2004) has been prepared by Technical Committee CEN /TC 121, "Welding", the secretariat of which is held by DS, 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 9956-11:1996.

Annex A is informative. Normative references to International Standards are listed in annex ZA.

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 laser beam welding processes.

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 439, *Welding consumables — Shielding gases for arc welding and cutting*.

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 11145:2001, *Optics and optical instruments — Lasers and laser-related equipment — Vocabulary and symbols (ISO 11145:2001)*.

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 15607:2003 and in EN ISO 11145:2001 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 or mirror 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

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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

3.9

focal length

in a lens or lens system, the distance from the principal plane, the surface at which the projection of entering and exiting rays intersect, to the focal spot

NOTE In a thick lens or system of lenses, the principal plane is often inside the lens. For set-up purposes, operators often use the 'back focal length', which is the distance from the front surface of a focusing lens or mirror system to the focal spot.

3.10

focal spot

part of the beam beyond the focusing system where the beam comes to a minimum cross-sectional area

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 is 52 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

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4.4.1 General

Identification of any equipment.

4.4.2 Laser welding equipment

- Type (for example YAG or CO₂), model, make;
- nominal power;
- continuous wave or pulsed;
- number of lasers combined;
- manufacturer's or measured values for the following parameters:
 - 1) beam mode;
 - 2) beam divergence ;
 - 3) wave length ;
 - 4) beam polarisation and orientation.