
**Welding and allied processes —
Process specification for laser-arc
hybrid welding for metallic materials**

*Soudage et techniques connexes - Descriptif du procédé pour le
soudage hybride laser-arc des matériaux métalliques*

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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Safety	1
5 Welding operator qualification	2
6 Laser-arc hybrid welding equipment	2
7 Shielding gas	3
8 Joint design and preparation	3
9 Wire selection	6
10 Preparation prior to welding	6
10.1 Handling of work piece.....	6
10.1.1 Work piece condition inspection.....	6
10.1.2 Cleaning before welding.....	7
10.2 Assembling and fixturing.....	7
10.3 Equipment status checking.....	7
11 Torch design	7
12 Welding procedure specification and qualification	8
13 Welding parameters	9
14 Weld quality inspection and acceptance	11
15 Weld properties determination and acceptance	11
Bibliography	12

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

Welding and allied processes — Process specification for laser-arc hybrid welding for metallic materials

1 Scope

This document outlines the equipment and operator qualification needed for laser-arc hybrid welding, and recommends butt, fillet and flange joint preparations and consumables suitable for use with this process.

It also gives an overview of the steps to take during equipment set-up, procedure specification, workpiece set-up immediately prior to welding, and after welding once inspecting and testing the welds.

This document applies to laser-arc hybrid welding of steels, aluminium and its alloys.

This document does not apply to hybrid processes where laser beam welding is hybridized with another welding process not using an electric arc as its heat source.

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

ISO 14732:2013, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials*

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 15614-14, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 14: Laser-arc hybrid welding of steels, nickel and nickel alloys*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15607 and ISO 15614-14 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 Safety

The environment condition, operation and protective measures for laser-arc hybrid welding should be in accordance with the requirements of related standards (e.g. ISO 11553-1, ISO 13849-1, IEC 62061, IEC 60825-1 and IEC 60825-4).

5 Welding operator qualification

The welding operator should receive necessary training and education and be competent to his/her job. An operator of an automated laser-arc hybrid welding process can be qualified through one of the different routes referred to ISO 14732:2013, Clause 4, relevant to automatic welding, namely:

- a) qualification based on a welding procedure test in accordance with ISO 15614-14;
- b) qualification based on a pre-production welding test in accordance with ISO 15613, ISO 15609-6 and ISO 15614-14;
- c) qualification based on a production test or production sample test.

In addition, any method of qualification shall be supplemented by a test of the functional knowledge of the welding system, referring to ISO 14732:2013, Annex A.

Furthermore, any method of qualification may be supplemented by a discretionary test of knowledge related to welding technology, referring to ISO 14732:2013, Annex B.

6 Laser-arc hybrid welding equipment

The laser-arc hybrid welding equipment mainly includes laser generator, beam delivery system, arc welding power source and laser-arc hybrid welding head, high precise manipulator, high precise clamping device, seam tracking device, wire feeding unit, etc.

The equipment necessary to perform a laser-arc hybrid weld can include:

- a) laser beam safety enclosure;
- b) laser source;
- c) laser source chiller (commonly needed);
- d) arc power source;
- e) beam delivery means (e.g. optical fibre);
- f) welding wire feeder/delivery means (if the arc welding process uses a consumable wire);
- g) beam focusing optics, and cover slide (an appropriately anti-reflection coated optical flat) and cross jet for protection of those optics;
- h) arc welding torch;
- i) torch cooling (commonly needed);
- j) current return lead(s);
- k) equipment for setting the respective positions of the laser beam focusing optics and the arc welding torch (e.g. torch bracketry);
- l) shielding gas delivery system to weld cap (commonly, through wire feeding delivery system to arc welding torch) and, in case of full penetration welding, weld root;
- m) some form of automatic beam-to-work manipulation device, e.g. a welding robot;
- n) equipment/system controls (optional: seam tracking and/or seam inspection and/or weld process monitoring and/or control devices).

Best practice is that all equipment be the subject of regular scheduled maintenance and calibration checks, irrespective of any other pre-, in- or post-welding monitoring carried out for quality assurance/control purposes.