INTERNATIONAL STANDARD

ISO 14732

Second edition
2013-08-01

Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials

Personnel en soudage — Épreuve de qualification des opérateurs soudeurs et des régleurs en soudage pour le soudage mécanisé et le soudage automatique des matériaux métalliques

Reference number
ISO 14732:2013(E)

ISO copyright office
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

Published in Switzerland

Contents

Page

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. 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. 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.

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 11, *Qualification requirements for welding and allied processes personnel*.

This second edition cancels and replaces the first edition (ISO 14732:1998), of which it constitutes a technical revision.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 11 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Introduction

This International Standard is intended to provide the basis for the mutual recognition by examining bodies of qualification related to the competence of welding operators and weld setters in the various fields of application. Tests shall by carried out in accordance with this International Standard unless more severe tests are specified by the relevant application standard, when these shall be applied.

The welding operator's or weld setter's ability and job knowledge continue to be approved only if the welding operators or weld setters are working with reasonable continuity on welding work within the extent of qualification. However, a functional knowledge test is mandatory.

It is presumed that the welding operator or weld setter has received training or has industrial practice within the range of qualification.

All new qualifications are to be in accordance with this International Standard from the date of issue.

At the end of its period of validity, the existing and valid qualification testing of welding operators and weld setters in accordance with the requirements of a national standard may be revalidated in accordance with this International Standard. The new range of qualification will be interpreted in accordance with the requirements of this International Standard.

Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials

1 Scope

This International Standard specifies requirements for qualification of welding operators and also weld setters for mechanized and automatic welding.

This International Standard does not apply to personnel exclusively performing loading or unloading of the automatic welding unit.

This International Standard is applicable when qualification testing of welding operators and weld setters is required by the contract or by the application standard.

The requirements for testing of stud welding operators and setters are given in ISO 14555. The qualification and revalidation is in accordance with this International Standard.

Annex A dealing with functional knowledge forms an integral part of this International Standard. Annex B dealing with welding technical knowledge, Annex C outlining the qualification test certificate and the Bibliography are informative.

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.

ISO 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements*

ISO 3834-3, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements*

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

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*

ISO 9606-3, *Approval testing of welders — Fusion welding — Part 3: Copper and copper alloys*

ISO 9606-4, *Approval testing of welders — Fusion welding — Part 4: Nickel and nickel alloys*

ISO 9606-5, *Approval testing of welders — Fusion welding — Part 5: Titanium and titanium alloys, zirconium and zirconium alloys*

ISO 14555, *Welding — Arc stud welding of metallic materials*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding*

ISO 15609-3, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 3: Electron beam welding*

ISO 15609-4, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 4: Laser beam welding*

ISO 15609-5, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding*

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

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

ISO 15614-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys*

ISO 15614-5, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 5: Arc welding of titanium, zirconium and their alloys*

ISO 15614-6, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 6: Arc and gas welding of copper and its alloys*

ISO 15614-7, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 7: Overlay welding*

ISO 15614-8, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 8: Welding of tubes to tube-plate joints*

ISO 15614-11, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 11: Electron and laser beam welding*

ISO 15614-13, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 13: Upset (resistance butt) and flash welding*

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 following terms and definitions apply.

3.1
automatic welding
welding in which all operations are performed without welding operator intervention during the process

Note 1 to entry: Manual adjustment of welding variables by the welding operator during welding is not possible.

3.2
mechanized welding
welding where the required welding conditions are maintained by mechanical or electronic means but may be manually varied during the process

3.3
pre-production welding test
welding test having the same function as a welding procedure test, but based on a non-standard test piece, representative of the production conditions

3.4
production test
welding test carried out in the production environment with the welding unit, on actual products or on simplified test pieces, before production or during an interruption in normal production

3.5
production sample testing
testing of actual welded products sampled from a continuous production

3.6
programming
incorporation of the approved welding procedure specification and/or the specified movements of the welding unit into a programme

3.7
setting-up
correct adjustment of the welding unit before welding, if required by entering the robot programme

3.8
welding operator
person who controls or adjusts any welding parameter for mechanized or automatic welding

3.9
weld setter
person who sets up welding equipment for mechanized or automatic welding

3.10
welding unit
welding installation including auxiliary apparatus such as jigs and fixtures, robot manipulators and rotating devices

3.11
welding unit operation
starting and, if necessary, stopping of the production cycle, including loading and unloading the work pieces

3.12
examiner
person who has been appointed to verify compliance with the applicable standard

Note 1 to entry: In certain cases, an external independent examiner can be required.

3.13
examining body
organization that has been appointed to verify compliance with the applicable standard

Note 1 to entry: In certain cases, an external independent examining body can be required.

3.14
welding equipment
individual apparatus used in welding, such as a power source or wire feeder

4 Qualification

4.1 Methods of qualification

The qualification test for welding operators and weld setters shall follow a preliminary welding procedure specification (pWPS) or welding procedure specification (WPS) prepared in accordance with the relevant part of ISO 15609.

Welding operators or weld setters shall be qualified by one of the following methods:

a) qualification based on a welding procedure test in accordance with the relevant part of ISO 15614;

b) qualification based on a pre-production welding test in accordance with ISO 15613;

c) qualification based on a test piece in accordance with the relevant part of ISO 9606;

d) qualification based on a production test or production sample test.

For arc welding processes when using methods c) or d), the testing and acceptance criteria shall be in accordance with the relevant part of ISO 9606 for butt or fillet welds or ISO 15614-8 for tube to tube-plate welds, unless otherwise specified by an application standard.

For arc welding processes using methods a), c) and d) and for method b) which refers to ISO 15614, the qualification test for overlay welding based on ISO 15614-7 shall require visual testing, surface (magnetic particle/liquid penetrant) testing and bend testing only when a qualified WPS is used by the welding operator.

For other welding processes when using methods c) or d), the qualification of the weld setter and welding operator shall be in accordance with the relevant standard. Where the relevant standard does not specify testing and acceptance requirements, then as a minimum the test piece shall be visually tested and at least one macro-section shall be taken or, for butt welds, volumetric testing shall be carried out. The acceptance criteria shall be specified as for the relevant international welding procedure specification.

Any method of qualification may be supplemented by a test of knowledge related to welding technology. Such a test is not mandatory. Annex B includes a recommendation for such a test.

Any method of qualification shall be supplemented by a test of the functional knowledge appropriate to the welding unit, see Annex A.

The essential variables and the range of qualification are specified in the appropriate subclauses of 4.2 and the period of validity in Clause 5.

4.2 Essential variables and the range of qualification

4.2.1 General

Provided that the welding operator or weld setter works according to a qualified WPS, there are no limitations on the range of qualification other than those specified in 4.2.2 and 4.2.3.

4.2.2 Automatic welding

The following changes require re-qualification:

— change of the welding process (except variants within welding process 13 as defined in ISO 4063);

— welding with or without arc sensor and/or joint sensor;

— change from single-run-per-side technique to multi-run-per-side technique (but not *vice versa*);

— change of type of welding unit (including change in the robot control system).

— change from welding with arc sensor and/or joint sensor to welding without arc sensor and/or joint sensor (but not *vice versa*).

4.2.3 Mechanized welding

The following changes require re-qualification:

— change of the welding process (except variants within welding process 13 as defined in ISO 4063);

— change from direct visual control to remote visual control and *vice versa*;

— deletion of automatic arc length control;

— deletion of automatic joint tracking;

— addition of welding positions other than those already qualified in accordance with ISO 9606-1;

— change from single-run-per-side technique to multi-run-per-side technique (but not *vice versa*);

— deletion of backing;

— deletion of consumable inserts.

5 Period of validity

5.1 Initial qualification

The welding operator or weld setter qualification begins from the date of welding of the test piece(s), provided that the required testing has been carried out and the test results obtained were acceptable. Each certificate needs to be confirmed every six months, otherwise it becomes invalid.

The validity of a certificate may be extended as specified in 5.3. The method chosen for the extension of qualification, 5.3 a), b) or c), shall be stated on the certificate at the time of issue.

5.2 Confirmation of validity

The qualifications of a welding operator or weld setter for a process shall be confirmed every six months by the person responsible for welding activities or examiner/examining body. This confirms that the welding operator or weld setter has worked within the range of qualification and extends the validity of the qualification for a further six-month period.

This subclause is applicable to all the options for revalidation given in 5.3.

5.3 Revalidation of qualification

Revalidation shall be carried out by an examiner/examining body.

The competence of the welding operator or weld setter shall be periodically verified by one of the following methods:

a) The welding operator or weld setter shall be retested every six years.

b) Every three years, two welds made during the last six months of the validity period shall be tested by radiographic or ultrasonic testing or destructive testing and the results shall be recorded. The acceptance levels for imperfections shall be as specified in the application standards. The weld tests shall reproduce the original test conditions. These tests revalidate the qualification for an additional three years.

c) A qualification for any certificate shall be valid as long as it is confirmed in accordance with 5.2 and provided all the following conditions are fulfilled:

   — the welding operator or weld setter is working for the same manufacturer for whom he or she qualified and who is responsible for the manufacture of the product;

   — that the manufacturer's ISO 3834-2 or ISO 3834-3 quality requirements have been proven by verification;

   — that the manufacturer has documented that the welding operator or weld setter has produced welds of acceptable quality based on application standards.

5.4 Revocation of qualification

When there is a specific reason to question a welding operator's or weld setter's ability to make welds that meet the product standard quality requirements, the qualifications that support the welding he or she is doing shall be revoked. All other qualifications not questioned shall remain valid.

6 Certificate

If the results of the test are satisfactory, the examiner or examining body shall certify that the welding operator or weld setter has successfully passed the qualification test. All relevant test conditions shall be recorded on the certificate. If the welding operator or weld setter fails any of the prescribed tests, no certificate shall be issued.

The certificate shall be issued under the sole responsibility of the examiner or examining body. A suggested certificate format is provided in Annex C.

The manufacturer's pWPS or WPS shall be as shown in the relevant part of ISO 15609 and also in ISO 15614-11 or ISO 14555.

Any change of the essential variables for the qualification testing beyond the permitted ranges requires a new test and a new certificate.

7 Documentation

Certificates and test reports/records of welding tests and prolongations shall be kept on file.

Annex A
(normative)

Functional knowledge appropriate to the welding unit

A.1 General

This annex outlines the functional knowledge appropriate to the welding unit that a welding operator or weld setter shall have in order to ensure that procedures are followed and common practices are complied with.

A.2 Welding sequences/procedures in the relevant process

Appreciation of welding procedure requirements and the influence of welding parameters.

A.3 Joint preparation and weld representation in the relevant process

a) Conformance of joint preparation to the WPS.

b) Cleanness of fusion faces.

A.4 Weld imperfections in the relevant process

a) Identification of weld imperfections.

b) Causes.

c) Prevention and remedial action.

A.5 Welding operator's or weld setter's qualification

The welding operator or weld setter shall be aware of the range of the qualification.

A.6 Process operation

a) Knowledge of programming (if relevant).

b) Knowledge of the control system and the signals given by this system.

c) Moving system.

d) Auxiliary equipment.

e) Jigs and fixtures and set-up.

f) Parameters and adjustments within the given procedures.

g) Safety regulations and precautions.

h) Start-stop procedures.

Annex B
(informative)

Knowledge of welding technology

B.1 General

The test of job knowledge is recommended, but is not mandatory. However, some countries might require that the welding operator or weld setter undergo a test of job knowledge. If the job knowledge test is carried out, it should be recorded on the welding operator's or weld setter's certificate.

This annex outlines the job knowledge that a welding operator or weld setter should have to ensure that procedures are followed and common practices are complied with. The job knowledge indicated in this annex is only pitched at the most basic level.

Owing to different training programmes in various countries, it is only proposed that general objectives and categories of job knowledge be standardized. The actual questions used should be drawn up by the individual country, but should include questions on areas, covered in Clause B.2, relevant to the welding operator's or weld setter's qualification test.

The actual test of a welding operator's or weld setter's job knowledge can be given by any of the following methods or combinations of these methods:

a) a written objective test (multiple choice);

b) oral questioning following a set of written questions;

c) computer testing;

d) demonstration/observation testing following a written set of criteria.

The test of job knowledge is limited to the matters related to the welding process used in the test.

B.2 Requirements

B.2.1 Welding equipment

B.2.1.1 Arc welding

a) Identification of gas cylinders.

b) Identification and assembly of essential components.

c) Selection of correct nozzles and welding torches.

d) Wire feed control method.

B.2.1.2 Beam welding

a) Electron beam welding equipment.

b) Laser beam welding equipment.

B.2.1.3 Pressure welding

a) Types and equipment.

b) Identification and assembly of essential components.

B.2.1.4 Resistance welding

a) Identification and assembly of essential components.

b) Selection of correct electrodes.

c) Cooling system.

d) Maintenance of the equipment.

B.2.2 Welding processes

B.2.2.1 **Shielded metal-arc welding** (processes 114, 13, 14 and 15 of **ISO 4063**)

a) Procedures.

b) Type and size of electrodes.

c) Identification of shielding gas and flow rate (without process 114).

d) Type, size and maintenance of nozzles/contact tip.

e) Selection and limitation of mode of metal transfer.

f) Protection of the welding arc from draughts.

B.2.2.2 **Submerged arc welding** (process 12 of **ISO 4063**)

a) Procedures.

b) Drying, feeding and correct recovery of flux.

c) Correct alignment and travel of welding head.

d) Single-wire or multi-wire process.

e) Influence of welding current and voltage.

B.2.2.3 **Electron beam welding** (process 51 of **ISO 4063**)

a) Procedures.

b) Parameters and their influence on the welding process.

c) Focusing system.

d) Parameter control.

e) Preparation of parent material.

f) Vacuum system, including leak test.

B.2.2.4 **Laser beam welding** (process 52 of **ISO 4063**)

a) Procedures.

b) Parameters and their influence on the welding process.

c) Focusing system.

d) Parameter control.

e) Preparation of parent material.

f) Choice of relevant gases.

g) Processing in/on different types of laser.

h) Type of mode for operation.

B.2.2.5 **Pressure welding** (process 4 of **ISO 4063**)

a) Procedures.

b) Type of equipment.

c) Surface preparation.

d) Control system.

B.2.2.6 **Resistance welding** (process 2 of **ISO 4063**)

a) Procedures.

b) Surface preparation.

c) Parameters.

d) Material and shape of electrodes, contact area and fixing of electrodes.

e) Method of welding.

f) Control and surveillance system.

g) Causes of defects.

h) Test methods.

B.2.2.7 **Electroslag welding** (process 72 of **ISO 4063**)

B.2.3 Parent metals

a) Identification of material.

b) Methods and control of pre-heating.

c) Control of interpass temperature.

B.2.4 Consumables

a) Identification of consumables.

b) Storage, handling and conditioning of consumables.

c) Selection of correct size.

d) Cleanliness of wire electrodes and flux-cored electrodes.

e) Control of wire spooling.

f) Control and monitoring of gas flow rates and quality.

g) Principles of welding without consumables.

B.2.5 Safety and accident prevention

B.2.5.1 General

a) Electrical risk.

b) Mechanical risk.

c) Risk of welding fumes and gases.

d) Noise risk.

e) Risk in radiographic application (if relevant).

B.2.5.2 All arc processes

a) Environment of increased hazard of electric shock.

b) Radiation from the arc.

c) Effects of stray arcing.

d) Effects of poor earthing.

B.2.6 Visual testing of welds

Knowledge of visual testing.