INTERNATIONAL STANDARD

ISO 17607-5

First edition
2023-12

Steel structures — Execution of structural steelwork —

Part 5: **Welding**

Structures en acier – Exécution des charpentes et ossatures en acier —

Partie 5: Soudage

Reference number
ISO 17607-5:2023(E)

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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 (see www.iso.org/directives).

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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 167, *Steel and aluminium structures*.

This first edition cancels and replaces ISO 10721-2:1999, which has been technically revised.

A list of all parts in the ISO 17607 series can be found on the ISO website.

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.

Introduction

Specific requirements for the achievement of structures that are optimal with respect to safety, the state of the economy, development and general values of a nation are given in the appropriate regional or national standards, if they exist.

Many nations do not have their own standards for structural steelwork. Some reference other national or regional standards. Some permit the project's standard to be selected by the owner, designer or constructor of the structure. Some do not require any standards to be followed.

The ISO 17607 series of standards on the execution of structural steelwork was developed to serve as a means to provide a set of requirements and guidance for projects that are constructed without a governing regional or national standard. The ISO 17607 series can also serve to reduce trade barriers.

Additional requirements to be addressed in the execution of structural steelwork, as structures or as fabricated components, can be found in the other parts of the series:

— ISO 17607-1 (General requirements and terms and definitions);

— ISO 17607-2 (Steels);

— ISO 17607-3 (Fabrication);

— ISO 17607-4 (Erection);

— ISO 17607-6 (Bolting).

Steel structures — Execution of structural steelwork —

Part 5: Welding

1 Scope

This document defines the general requirements for welding in the execution of structural steelwork as structures or as manufactured components in conjunction with ISO 17607-1.

Additional requirements to be addressed in the execution of structural steelwork, as structures or as fabricated components, can be found in other parts of the ISO 17607 series.

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 636, *Welding consumables — Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels — Classification*

ISO 2560, *Welding consumables — Covered electrodes for manual metal arc welding of non-alloy and fine grain steels — Classification*

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 3834 (all parts), *Quality requirements for fusion welding of metallic materials*

ISO 4063, *Welding, brazing, soldering and cutting — Nomenclature of processes and reference numbers*

ISO 5817:2023, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

ISO 6520-1, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding*

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

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 13588, *Non-destructive testing of welds — Ultrasonic testing — Use of automated phased array technology*

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

ISO 13918, *Welding — Studs and ceramic ferrules for arc stud welding*

ISO 14171, *Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels — Classification*

ISO 14174, *Welding consumables — Fluxes for submerged arc welding and electroslag welding — Classification*

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

ISO 14341, *Welding consumables — Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels — Classification*

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

ISO 14731, *Welding coordination — Tasks and responsibilities*

ISO 14732, *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 15610, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables*

ISO 15611, *Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience*

ISO 15612, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure specification*

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 16371-1, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 1: Classification of systems*

ISO 16371-2, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 2: General principles for testing of metallic materials using X-rays and gamma rays*

ISO 16834, *Welding consumables — Wire electrodes, wires, rods and deposits for gas shielded arc welding of high strength steels — Classification*

ISO 17607-1, *Steel structures — Execution of structural steelwork— Part 1: General requirements and vocabulary*

ISO 17660-1, *Welding — Welding of reinforcing steel — Part 1: Load-bearing welded joints*

ISO 17660-2, *Welding — Welding of reinforcing steel — Part 2: Non load-bearing welded joints*

ISO 17632, *Welding consumables — Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels — Classification*

ISO 17635:2016, *Non-destructive testing of welds — General rules for metallic materials*

ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints*

ISO 17638, *Non-destructive testing of welds — Magnetic particle testing*

ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment*

ISO 17652-1, *Welding — Test for shop primers in relation to welding and allied processes — Part 1: General requirements*

ISO 17652-2, *Welding — Test for shop primers in relation to welding and allied processes — Part 2: Welding properties of shop primers*

ISO 18275, *Welding consumables — Covered electrodes for manual metal arc welding of high-strength steels — Classification*

ISO 18276, *Welding consumables — Tubular cored electrodes for gas-shielded and non-gas-shielded metal arc welding of high strength steels — Classification*

ISO 23279, *Non-destructive testing of welds — Ultrasonic testing — Characterization of discontinuities in welds*

ISO 26304, *Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels — Classification*

IIW-2259-15, *Recommendations for Fatigue Design of Welded Joints and Components*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17607-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Execution specification and quality requirements

National standards and documents that provide technically equivalent conditions may be used, in whole or in part, in place of referenced ISO standards or requirements of this document. In these cases, the technically equivalent national standards and documents, and deviations from the requirements of this document, shall be referenced in the execution specification.

The necessary information and technical requirements for execution of each part of the structural steelwork shall be agreed upon and complete before commencement of execution of that part of the structural steelwork. There shall be procedures for making alterations to a previously agreed execution specification.

The execution specification shall consider the following items in Annex A as relevant:

a) additional information, see A.1;

b) options, see A.2;

c) requirements related to execution levels (EXL), see A.3;

5 Constituent products

5.1 General

See ISO 17607-1.

The inspection documents for welding consumables, except for shielding gases, shall be Type 2.2 in accordance with ISO 10474.

For shielding gases, the inspection document shall be a document issued by the manufacturer declaring that the products supplied conform with the specified requirements of the order, without test results.

5.2 Welding consumables

Welding consumables shall be in accordance with Table 1, or, if applicable, the requirements of the national standard or documents.

The type of welding consumables shall be appropriate to the welding process, the material to be welded and the welding procedure.

When welding improved atmospheric corrosion resistant steel, welding consumables shall be selected that will produce welds with atmospheric corrosion resistance at least equivalent to the parent metal. The execution specification shall specify if colour matching is required.

NOTE Selection of welding consumables can be based on welding consumable manufacturer recommendations, steel manufacturer recommendations or the appropriate product standard.

Table 1 — Standards for welding consumables

Welding consumables	Product standard
Shielding gases for arc welding and cutting	ISO 14175
Wire electrodes and deposits for gas-shielded metal arc welding of non-alloy and fine grain steels	ISO 14341
Solid wires, solid wire-flux and tubular cored electrode-flux combinations for submerged arc welding of non-alloy and fine grain steels.	ISO 14171
Covered electrodes for manual arc welding of high strength steels	ISO 18275
Tubular cored electrodes for metal arc welding with and without gas shield of non-alloy and fine grain steels	ISO 17632
Fluxes for submerged arc welding	ISO 14174
Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine grain steels	ISO 636
Covered electrodes for manual arc welding of non-alloy and fine grain steels	ISO 2560
Wire electrodes, wires, rods and deposits for gas-shielded arc welding of high strength steels	ISO 16834
Wire and tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels	ISO 26304
Tubular cored electrodes for gas shielded metal arc welding of high strength steels	ISO 18276

5.3 Stud welding

Studs and ceramic ferrules shall be in accordance with ISO 13918.

The inspection documents for studs shall be Type 3.1 in accordance with ISO 10474.

6 Welding

6.1 General

Welding shall be undertaken in accordance with the relevant part of the ISO 3834 series or, if applicable, the requirements of the national standard or documents.

NOTE Guidelines for implementation of the ISO 3834 series on quality requirements for fusion welding of metallic materials are given in ISO/TR 3834-6.

The welding of reinforcing steel to structural steel shall be performed in accordance with the recommendations given in ISO 17660-1 and ISO 17660-2.

In accordance with the execution level (EXL), the following parts of the ISO 3834 series apply:

— EXL1: ISO 3834-4, Elementary quality requirements;

— EXL2: ISO 3834-3, Standard quality requirements;

— EXL3 and EXL4: ISO 3834-2, Comprehensive quality requirements.

NOTE See ISO 17607-1 for information on execution levels.

6.2 Welding plan

6.2.1 Requirements for a welding plan

A welding plan shall be provided as part of the production planning required by the relevant part of the ISO 3834 series.

6.2.2 Content of a welding plan

For EXL1, the welding plan shall be in accordance with ISO 3834-4.

For EXL2, EXL3 and EXL4, the welding plan shall include as relevant:

a) the welding procedure specifications;

b) measures to be taken to minimize distortion during and after welding, including details of restraints to be applied;

c) the sequence of welding with any restrictions or acceptable locations for start and stop positions, including intermediate stop and start positions where joint geometry is such that welding cannot be executed continuously;

d) requirements for intermediate checking of the welding activities;

e) turning of components in the welding process, in connection with the sequence of welding;

f) measures to control heat input and prevent local hardness issues;

g) measures to be taken to avoid lamellar tearing;

h) treatment and handling of welding consumables (storage, low hydrogen, conditioning);

i) requirements for acceptance criteria of welds in accordance with 6.6;

j) requirements for inspection and test plan in accordance with 7.2;

k) requirements for weld identification;

l) requirements for welding through coatings.

If welding or assembly overlaps or masks previous welds, special consideration shall be given concerning which welds are to be executed first and the possible need to inspect or test a weld before the second weld is executed or before masking components are assembled.

If there are welding requirements related to fatigue or seismic detail categories, these shall be included in the execution specification.

If there are specific requirements related to the inspection, maintenance, and repair of welding equipment, these shall be included in the execution specification.

6.3 Welding processes

Welding shall be performed using the welding processes as defined in ISO 4063, or as permitted by the execution specification.

6.4 Qualification of welding procedures and welding personnel

6.4.1 Qualification of welding procedures

6.4.1.1 General

Welding shall be carried out using qualified welding procedure specifications (WPS) in accordance with Table 2. The method of qualification of the WPS depends on the execution level, the parent metal and the degree of mechanization.

The specification and qualification of welding procedures shall be in accordance with ISO 15607. Although there are no specific requirements for welding procedure specifications to ISO 15607 in ISO 3834-4, the execution specification may specify that, for EXL1, appropriate work instructions that specify the welding process, consumables and welding parameters to be used shall be provided.

Specific conditions for tack welds shall be included in the WPS.

For joints in hollow section lattice structures, the WPS shall define the start and stop zones and the method to be used to address locations where the welds change from a fillet weld to butt around a joint.

6.4.1.2 Qualification to ISO 15613 or ISO 15614-1

The following conditions apply when qualifying WPSs are in accordance with ISO 15613 or ISO 15614-1 (see also Table 2):

a) If impact tests are specified, they shall be carried out at the lowest temperature required for impact testing of the material qualities being joined.

b) For quenched and tempered steels, one specimen for micro-examination is necessary. Photographs of weld metal, fusion line zone and HAZ shall be recorded. Microcracks are not permitted.

NOTE Information on microcracks can be found in ISO 5817.

c) If welding on prefabrication primers, tests shall be carried out on the maximum (nominal + tolerance) accepted layer thickness.

Table 2 — Methods of qualification of welding procedures

Method of qualification	ISO standard	EXL2	EXL3	EXL4
Welding procedure test	ISO 15614-1 ISO 14555 ISO 17660-1 ISO 17660-2	X	X	X
Pre-production welding test	ISO 15613 ISO 14555 ISO 17660-1 ISO 17660-2	X	X	X
Standard welding procedure	ISO 15612	X	X [a]	X [a]
Previous welding experience	ISO 15611 ISO 14555	X	–	–
Tested welding consumables	ISO 15610			