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Quality requirements for fusion welding of metallic materials —

Part 3: Standard quality requirements

Exigences de qualité en soudage par fusion des matériaux métalliques —

Partie 3: Exigences de qualité normale

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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).

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,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 3834-3:2005), of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

— editorial revisions;

— update of references to the latest edition of ISO 3834-5;

— rewrite of Clause 16 on calibration and validation of measuring, inspection and test equipment.

A list of all parts in the ISO 3834 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.

Official interpretations, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

Quality requirements for fusion welding of metallic materials —

Part 3: Standard quality requirements

1 Scope

This document defines standard quality requirements for fusion welding of metallic materials both in workshops and at field installation sites.

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 3834-1, *Quality requirements for fusion welding of metallic materials — Part 1: Criteria for the selection of the appropriate level of quality requirements*

ISO 3834-5:—,[1] *Quality requirements for fusion welding of metallic materials — Part 5: Documents with which it is necessary to conform to claim conformity to the quality requirements of ISO 3834-2, ISO 3834-3 or ISO 3834-4*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3834-1 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 Use of this document

For general information on the use of this document, ISO 3834-1 shall be used.

In order to fulfil the quality requirements given in this document, the conformity to relevant documents given in ISO 3834-5 shall be verified.

In certain situations, e.g. where manufacturing is more suited to ISO 3834-4, or where particular operations, such as heat treatment, are not undertaken, the requirements detailed in this document may be selectively amended or deleted.

Otherwise, the requirements contained within this document shall be adopted in full.

1) Under preparation. (Stage at the time of publication: ISO/DIS 3834-5:2021).

5 Review of requirements and technical review

5.1 General

The manufacturer shall review the contractual requirements and any other requirements, together with any technical data provided by the purchaser or in-house data when the construction is designed by the manufacturer. The manufacturer shall establish that all information necessary to carry out the manufacturing operations is complete and available prior to the commencement of the work. The manufacturer shall affirm its capability to meet all requirements and shall ensure adequate planning of all quality-related activities.

The review of requirements is carried out by the manufacturer to verify that:

— the work content is within its capability to perform;

— sufficient resources are available to achieve delivery schedules; and

— documentation is clear and unambiguous.

The manufacturer shall ensure that any variations between the contract and any previous quotation are identified and the purchaser notified of any programme, cost or engineering changes that can result.

Items in 5.2 are typically considered at or before the time of the review of requirements. Items in 5.3 usually form part of the technical review and are considered during the initial planning stage.

When a contract does not exist, e.g. items made for stock, the manufacturer is required to take into consideration the requirements of 5.2 while carrying out the technical review (see 5.3).

5.2 Review of requirements

The following aspects shall be considered:

a) the product standard to be used, together with any supplementary requirements;

b) statutory and regulatory requirements;

c) any additional requirement determined by the manufacturer;

d) the capability of the manufacturer to meet the prescribed requirements.

5.3 Technical review

The following technical requirements shall be considered:

a) parent material(s) specification and welded joint properties;

b) quality and acceptance requirements for welds;

c) location, accessibility and sequence of welds, including accessibility for inspection and for non-destructive testing;

d) the specification of welding procedures, non-destructive testing procedures and heat treatment procedures;

e) the approach to be used for the qualification of welding procedures;

f) the qualification of personnel;

g) selection, identification and/or traceability (e.g. for materials, welds);

h) quality-control arrangements, including any involvement of an independent inspection body;

i) inspection and testing;

j) sub-contracting;

k) post-weld heat treatment;

l) other welding requirements, e.g. ferrite content of weld metal, ageing, hydrogen content, permanent backing, use of peening, surface finish, weld profile;

m) use of special methods (e.g. to achieve full penetration without backing when welded from one side only);

n) dimensions and details of joint preparation and completed weld;

o) welds which are to be made in the workshop, or elsewhere;

p) environmental conditions relevant to the application of the process (e.g. very low-temperature ambient conditions or any necessity to provide protection against adverse weather conditions);

q) handling of non-conformances.

6 Sub-contracting

When a manufacturer intends to use sub-contracted services or activities (e.g. welding, inspection, non-destructive testing, heat treatment), information necessary to meet applicable requirements shall be supplied by the manufacturer to the sub-contractor. The sub-contractor shall provide such records and documentation of her/his work as can be specified by the manufacturer.

A sub-contractor shall work under the order and responsibility of the manufacturer and shall fully comply with the relevant requirements of this document. The manufacturer shall ensure that the sub-contractor can comply with the quality requirements as specified.

The information to be provided by the manufacturer to the sub-contractor shall include all relevant data from the review of requirements (see 5.2) and the technical review (see 5.3). Additional requirements may be specified as necessary to assure sub-contractor compliance with technical requirements.

7 Welding personnel

7.1 General

The manufacturer shall have at her/his disposal sufficient and competent personnel for the planning, performing and supervising of the welding production according to specified requirements.

7.2 Welders and welding operators

Welders and welding operators shall be qualified by an appropriate test.

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 1, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

7.3 Welding coordination personnel

The manufacturer shall have at her/his disposal appropriate welding coordination personnel. Such people having responsibility for quality activities shall have sufficient authority to enable any necessary action to be taken. The tasks and responsibilities of such persons shall be clearly defined.

The documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:—, Table 2, for arc welding, electron-beam welding, laser-beam welding and gas welding, and in ISO 3834-5:—, Table 10, for other fusion welding processes.

8 Inspection and testing personnel

8.1 General

The manufacturer shall have at his disposal sufficient and competent personnel for planning, performing, and supervising the inspection and testing of the welding production according to specified requirements.

8.2 Non-destructive testing personnel

The non-destructive testing personnel shall be qualified. For visual testing, a qualification test is not always required. When a qualification test is not required, competence shall be verified by the manufacturer.

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 3, for arc welding, electron beam-welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

9 Equipment

9.1 Production and test equipment

The following equipment shall be available, when necessary:

a) power sources and other machines;

b) equipment for joint and surface preparation and for cutting, including thermal cutting;

c) equipment for preheating and post-weld heat treatment including temperature indicator;

d) jigs and fixtures;

e) cranes and handling equipment used for the production;

f) personal protective equipment and other safety equipment, directly associated with the applicable manufacturing process;

g) ovens, quivers used for treatment of welding consumables;

h) facilities for surface cleaning;

i) facilities for destructive and non-destructive testing.

9.2 Description of production equipment

The manufacturer shall maintain a list of essential equipment, used for the production. This list shall identify items of major equipment, essential for an evaluation of workshop capacity and capability. This includes, for example:

a) maximum capacity of crane(s);

b) size of components that the workshop can handle;

c) capability of mechanised or automatic welding equipment;

d) dimensions and maximum temperature of furnaces for post-weld heat treatment;

e) capacities of rolling, bending and cutting equipment.

Other equipment only needs to be specified by approximate total numbers which cover each general type (e.g. total number of power sources for the different processes).

9.3 Suitability and maintenance of equipment

The equipment shall be adequate for the application concerned and properly maintained. Records of maintenance are recommended.

10 Welding and related activities

10.1 Production planning

The manufacturer shall carry out adequate production planning.

Items to be considered shall include at least:

a) specification of the sequence by which the construction shall be manufactured (e.g. as single parts or sub-assemblies, and the order of subsequent final assembly);

b) identification of the individual processes required to manufacture the construction;

c) reference to the appropriate procedure specifications for welding and allied processes;

d) sequence in which the welds are to be made, if required;

e) specification for inspection and testing, including the involvement of any independent inspection body;

f) environmental conditions (e.g. protection from wind and rain);

g) identification of components or parts, as appropriate;

h) allocation of qualified personnel;

i) arrangement for any production test.

10.2 Welding procedure specifications

The manufacturer shall prepare the welding procedure specification(s) and ensure that they are used correctly in production.

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 4, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

10.3 Qualification of the welding procedures

Welding procedures shall be qualified prior to production. The method of qualification shall be in accordance with relevant product standards or as stated in the specification.

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 5, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

NOTE Qualification of other procedures can be required in the relevant product standards and/or the specifications.

10.4 Work instructions

The manufacturer may use the welding procedure specification directly in the workshop for instruction purposes. Alternatively, dedicated work instructions may be used. Such dedicated work instructions shall be prepared from a qualified welding procedure specification and do not require separate qualification.

11 Storage and handling welding consumables

The manufacturer shall produce and implement procedures for storage, handling, identification and use of welding consumables, which avoid moisture pick-up, oxidation and damage. The procedures shall be in accordance with the supplier's recommendations.

12 Storage of parent materials

Storage shall be such that the material, including material supplied by the client, is not adversely affected. Identification shall be maintained during storage.

13 Post-weld heat treatment

The manufacturer shall be fully responsible for the specification and the performance of any post-weld heat treatment. The procedure shall be compatible with the parent material, welded joint, construction. It shall be in accordance with the product standard and/or specified requirements. A record of the heat treatment shall be kept during the process. The record shall demonstrate that the specification has been followed.

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 6, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

14 Inspection and testing

14.1 General

Applicable inspections and tests shall be implemented at appropriate points in the manufacturing process to assure conformity with contract requirements. Location and frequency of such inspections and/or tests depend on the contract and/or product standard, the welding process and the type of construction (see 5.2 and 5.3).

The manufacturer may carry out additional tests without restriction. Reporting of such tests is not required.

14.2 Inspection and testing before welding

Before the start of welding, the following shall be checked:

a) suitability and validity of welders' and welding operators' qualification documents;

b) suitability of welding procedure specification;

c) identity of parent material;

d) identity of welding consumables;

e) joint preparation (e.g. shape and dimensions);

f) fit-up, jigging and tacking;

g) any special requirements in the welding procedure specification (e.g. prevention of distortion);

h) suitability of working conditions for welding, including environment.

14.3 Inspection and testing during welding

During welding, the following shall be checked at suitable intervals or by continuous monitoring:

a) essential welding parameters (e.g. welding current, arc voltage and travel speed);

b) preheating/interpass temperature;

c) cleaning and shape of runs and layers of weld metal;

d) back gouging;

e) welding sequence;

f) correct use and handling of welding consumables;

g) control of distortion;

h) any intermediate examination (e.g. checking of dimensions).

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 7, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

14.4 Inspection and testing after welding

After welding, the compliance with relevant acceptance criteria shall be checked:

a) by visual testing (VT);

b) by non-destructive testing (NDT);

c) by destructive testing;

d) form, shape and dimensions of the construction;

e) results and records of post-weld operations (e.g. post-weld heat treatment, ageing).

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 8, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

14.5 Inspection and test status

Measures shall be taken, as appropriate, to indicate the status of inspection and test of the welded construction, e.g. by marking of the item or a routing card.

15 Non-conformance and corrective actions

Measures shall be implemented to control items or activities which do not conform to specified requirements in order to prevent their inadvertent acceptance. When repair and/or rectification is undertaken by the manufacturer, descriptions of appropriate procedures shall be available at all workstations where repair or rectification is performed. When repair is carried out, the items shall be re-inspected and re-tested in accordance with the original requirements. Measures shall also be implemented to avoid recurrence of non-conformances.

16 Calibration and validation of measuring, inspection and test equipment

The manufacturer shall be responsible for the appropriate calibration or validation of measuring, inspection or test equipment.

Compliance with the welding procedure specification shall be verified by using validated measuring, inspection and test equipment. Calibration or validation of welding equipment does not relieve the manufacturer from the responsibility of verification of working in accordance with the WPS.

The documents to which it is required to conform to fulfil the quality requirements are specified in:

— ISO 3834-5:—, Table 9, for arc welding, electron-beam welding, laser-beam welding and gas welding; and

— ISO 3834-5:—, Table 10, for other fusion welding processes.

17 Identification and traceability

Identification and traceability shall be maintained throughout the manufacturing process, if required.

Documented systems to ensure identification and traceability of the welding operations shall include, if required:

a) identification of production plans;

b) identification of weld locations in construction;

c) identification of non-destructive testing procedures and personnel;

d) identification of welding consumable (e.g. designation, trade name, manufacturer of welding consumables);

e) identification of parent material (e.g. type);

f) identification of location of repairs;

g) traceability of welder and welding operators to specific welds;

h) traceability of welding procedure specifications to specific welds.