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Quality requirements for fusion welding of metallic materials —

Part 2: Comprehensive quality requirements

Exigences de qualité en soudage par fusion des matériaux métalliques —

Partie 2: Exigences de qualité complète

Reference number
ISO 3834-2:2005(E)

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Contents

Page

Foreword iv
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
4 Use of this part of ISO 3834 1
5 Review of requirements and technical review 2
6 Sub-contracting 3
7 Welding personnel 3
8 Inspection and testing personnel 4
9 Equipment 4
10 Welding and related activities 5
11 Welding consumables 6
12 Storage of parent materials 7
13 Post-weld heat treatment 7
14 Inspection and testing 7
15 Non-conformance and corrective actions 9
16 Calibration and validation of measuring, inspection and testing equipment 9
17 Identification and traceability 9
18 Quality records 10

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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 3834-2 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*.

This second edition cancels and replaces the first edition (ISO 3834-2:1994), which has been technically revised.

ISO 3834 consists of the following parts, under the general title *Quality requirements for fusion welding of metallic materials*:

— *Part 1: Criteria for the selection of the appropriate level of quality requirements*

— *Part 2: Comprehensive quality requirements*

— *Part 3: Standard quality requirements*

— *Part 4: Elementary quality requirements*

— *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*

NOTE A Technical Report ISO/TR 3834-6, *Quality requirements for fusion welding of metallic materials — Part 6: Guidance on implementing ISO 3834* is being prepared.

Requests for official interpretations of any aspect of this part of ISO 3834 should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body, a complete listing which can be found at http://www.iso.org.

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Quality requirements for fusion welding of metallic materials —

Part 2: Comprehensive quality requirements

1 Scope

This part of ISO 3834 defines comprehensive quality requirements for fusion welding of metallic materials both in workshops and at field installation sites.

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

ISO 3834-5:2005, *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.

4 Use of this part of ISO 3834

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

In order to fulfil the quality requirements given in this part of ISO 3834, 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 3834-3 or ISO 3834-4, or where particular operations, such as heat treatment, are not undertaken, the requirements detailed in this part of ISO 3834 may be selectively amended or deleted.

Otherwise, the requirements contained within this part of ISO 3834 shall be adopted in full.

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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, that sufficient resources are available to achieve delivery schedules and that 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 may result.

Items in 5.2 are typically considered at or before the time of the review of requirements review. 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

Aspects to be considered shall include the following:

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

Technical requirements to be considered shall include the following:

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;

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j) sub-contracting;

k) post-weld heat treatment;

l) other welding requirements, e.g. batch testing of consumables, 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 his work as may 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 part of ISO 3834. 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 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 ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 1, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, Table 10, for other fusion welding processes.

7.3 Welding coordination personnel

The manufacturer shall have at his disposal appropriate welding coordination personnel. Such persons 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.

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The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 2, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, 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 may not be required. When a qualification test is not required, competence shall be verified by the manufacturer.

The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 3, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, Table 10, for other fusion welding processes.

9 Equipment

9.1 Production and testing equipment

The following equipment shall be available, when necessary:

— power sources and other machines;

— equipment for joint and surface preparation and for cutting, including thermal cutting;

— equipment for preheating and post-heat treatment including temperature indicator;

— jigs and fixtures;

— cranes and handling equipment used for the production;

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

— ovens, quivers, etc. used for treatment of welding consumables;

— facilities for surface cleaning;

— destructive and non-destructive testing facilities.

9.2 Description of 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:

— maximum capacity of crane(s);

— size of components that the workshop is able to handle;

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— capability of mechanised or automatic welding equipment;

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

— 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 of equipment

The equipment shall be adequate for the application concerned.

NOTE Qualification of the welding and heating equipment is not normally required unless otherwise specified.

9.4 New equipment

After installation of new (or refurbished) equipment, appropriate tests of the equipment shall be performed. The tests shall verify the correct function of the equipment. The tests shall be carried out and documented in accordance with appropriate standards, whenever relevant.

9.5 Equipment maintenance

The manufacturer shall have documented plans for the maintenance of equipment. The plan shall ensure maintenance checks of those items in the equipment which control variables listed in the relevant procedure specifications. The plans may be limited to those items which are essential for assuring the quality of the product.

Examples of these items are as follows:

— condition of guides in equipment for thermal cutting, mechanised fixtures etc.;

— condition of ammeters and voltmeters, flow meters etc. used for the operation of the welding equipment;

— condition of cables, hoses, connectors, etc.;

— condition of control system in mechanised and/or automatic welding unit;

— condition of temperature-measurement instruments;

— condition of wire feeders and conduits.

Defective equipment shall not be used.

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:

— 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);

— identification of the individual processes required to manufacture the construction;

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

— sequence in which the welds are to be made;

— order and timing in which the individual processes are to be performed;

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

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

— identification by batches, components or parts, as appropriate;

— allocation of qualified personnel;

— arrangement for any production test.

10.2 Welding-procedure specifications

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

The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 4, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, 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 ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 5, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, Table 10, for other fusion welding processes.

NOTE Qualification of other procedures may be required in the relevant product standards and/or the specification(s).

10.4 Work instructions

The manufacturer may use the welding-procedure specification directly 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.

10.5 Procedures for preparation and control of documents

The manufacturer shall establish and maintain procedures for the preparation and control of relevant quality documents (e.g. welding-procedure specification, welding-procedure qualification record, welders and welding-operators qualification certificates).

11 Welding consumables

11.1 General

Responsibilities and procedures for control of welding consumables shall be specified.

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11.2 Batch testing

Batch testing of welding consumables shall be required only if specified.

11.3 Storage and handling

The manufacturer shall produce and implement procedures for storage, handling, identification and use of welding consumables which avoid moisture pick-up, oxidation, damage, etc. 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, will not be 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, etc. and shall be in accordance with the product standard and/or specified requirements. A record of the heat treatment shall be made during the process. The record shall demonstrate that the specification has been followed and shall be traceable to the particular product.

The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 6, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, 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 will depend on the contract and/or product standard, the welding process and the type of construction (see 5.2 and 5.3).

NOTE 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:

— suitability and validity of welders' and welding operators' qualification certificates;

— suitability of welding-procedure specification;

— identity of parent material;

— identity of welding consumables;

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

— fit-up, jigging and tacking;

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

— 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:

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

— preheating/interpass temperature;

— cleaning and shape of runs and layers of weld metal;

— back gouging;

— welding sequence;

— correct use and handling of welding consumables;

— control of distortion;

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

The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 7, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, 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:

— by visual inspection;

— by non-destructive testing;

— by destructive testing;

— form, shape and dimensions of the construction;

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

The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 8, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, Table 10, for other fusion welding processes.

14.5 Inspection and test status

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

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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, tested and examined 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 testing equipment

The manufacturer shall be responsible for the appropriate calibration or validation of measuring, inspection and testing equipment. All equipment used to assess the quality of the construction shall be suitably controlled and shall be calibrated or validated at specified intervals.

The ISO documents to which it is required to conform to fulfil the quality requirements are specified in ISO 3834-5:2005, Table 9, for arc welding, electron beam welding, laser beam welding and gas welding, and in ISO 3834-5:2005, 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:

— identification of production plans;

— identification of routing cards;

— identification of weld locations in construction;

— identification of non-destructive testing procedures and personnel;

— identification of welding consumable (e.g. designation, trade name, manufacturer of consumables and batch or cast numbers);

— identification and/or traceability of parent material (e.g. type, cast number);

— identification of location of repairs;

— identification of location of temporary attachments;

— traceability for fully mechanised and automatic welding units to specific welds;

— traceability of welder and welding operators to specific welds;

— traceability of welding-procedure specifications to specific welds.

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18 Quality records

Quality records shall include, when applicable:

— record of requirement/technical review;

— material inspection documents;

— welding consumable inspection documents;

— welding-procedure specifications;

— equipment maintenance records;

— welding-procedure qualification records (WPQR);

— welder or welding-operator qualification certificates;

— production plan;

— non-destructive testing personnel certificates;

— heat-treatment procedure specification and records;

— non-destructive testing and destructive testing procedures and reports;

— dimensional reports;

— records of repairs and non-conformance reports;

— other documents, if required.

Quality records shall be retained for a minimum period of five years in the absence of any other specified requirements.

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