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Quality requirements for welding — Resistance welding of metallic materials —

Part 1: Comprehensive quality requirements

Exigences de qualité en soudage — Soudage par résistance des matériaux métalliques —

Partie 1: Exigences de qualité complète

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Foreword

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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

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: http://www.iso.org/iso/home/standards_development/resources-for-technical-work/foreword.htm

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding and allied mechanical joining*.

This second edition cancels and replaces the first edition (ISO 14551-1:2000), of which it constitutes a minor revision.

ISO 14554 consists of the following parts, under the general title *Quality requirements for welding — Resistance welding of metallic materials*:

— *Part 1: Comprehensive quality requirements*

— *Part 2: Elementary quality requirements*

Requests for official interpretations of any aspect of this part of ISO 14554 should be directed to the Secretariat of ISO/TC 44/SC 6 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Quality requirements for welding — Resistance welding of metallic materials —

Part 1: Comprehensive quality requirements

1 Scope

This part of ISO 14554 specifies requirements for the demonstration of the capability of a manufacturer or a sub-contractor to produce welded constructions, fulfilling specified quality requirements, in one or more of the following:

— a contract between involved parties;

— an application standard;

— a regulatory requirement.

The requirements contained within this part of ISO 14554 can be adopted in full or can be selectively deleted by the manufacturer if not applicable to the construction concerned. They provide a flexible framework for the control of welding by providing specific requirements for:

— Case 1 — resistance welding in contracts which require the manufacturer or sub-contractor to have a quality system in accordance with ISO 9001;[4]

— Case 2 — resistance welding in contracts which require the manufacturer or sub-contractor to have a quality system other than ISO 9001;[4]

— Case 3 — resistance welding as guidance to a manufacturer or sub-contractor developing a quality system;

— Case 4 — references in application standards which use resistance welding as part of their requirements or in a contract between relevant parties, although it is more appropriate for ISO 14554-2 to be used in such cases.

This part of ISO 14554:

— is independent of the type of welded construction to be manufactured;

— defines quality requirements for welding both in production plants and on site;

— provides guidance for describing the capability of a manufacturer to produce welded constructions to meet specified requirements;

— can also be used as a basis for assessing the manufacturer in respect to his welding capability.

For general guidelines for selection and use, see ISO 3834-1, while being aware that only comprehensive and elementary quality requirements are specified for resistance welding. Annex A gives a summary comparison of specific quality requirements for resistance welding in this part of ISO 14554 and ISO 14554-2.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

3 Terms and definitions

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

4 Contract and design review

4.1 General

The manufacturer shall review the contractual requirements and the design data provided by the purchaser or in-house data for construction designed by the manufacturer. This is to ensure that all information necessary to carry out the fabrication operations is available prior to the commencement of the work. The manufacturer shall affirm his capability to meet all welding contract requirements and ensure adequate planning of all quality-related activities.

Contract review is performed by the manufacturer to verify that: the contract is within his capability to carry out; sufficient resources are available to achieve delivery schedules; and documentation is clear and unambiguous. The manufacturer should ensure any variations between the contract and previous tender documentation are identified and the purchaser notified of any programme, cost or engineering changes that may result.

The items in 4.2 are typically considered at or before the time of the contract review. The items in 4.3 usually form part of the design review and should be taken into account during the contract review if the design is not carried out by the manufacturer. It shall be ensured that all relevant information has been supplied by the purchaser.

When a contract does not exist, e.g. items made for stock, the manufacturer is required to take into consideration the requirements of 4.2 while carrying out its design review (see 4.3).

4.2 Application — Contract review

Contractual requirements to be considered should include:

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

b) inspection and testing;

c) the specification of welding procedures, destructive and non-destructive examination procedures and heat treatment procedures;

d) the approach to be used for welding procedure approval;

e) the approval of personnel;

f) heat treatment (for details, see Clause 12);

g) selection, identification and/or traceability, e.g. for materials, welding equipment, welders and welds (see Clause 16);

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

i) other welding requirements, e.g. surface condition of the sheets, coatings, fit up of the parts;

j) environmental conditions, e.g. main voltage conditions, very high/low ambient temperatures, high humidity (see ISO 669[1]);

k) sub-contracting;

l) handling of non-conformances.

4.3 Application — Design review

Design requirements to be considered should include:

a) welding process or welding process variable;

b) welding equipment and welding electrodes;

c) use of special methods, e.g. welding with backing electrode, welding with shielding gas or shielding fluids, welding with intermediate electrode;

d) location, accessibility, and sequence of all welds;

e) surface finish and the geometry of the welded joint, e.g. excessive electrode indentation or in the case of mash welding excessive thickness of the weld;

f) parent metal(s) specification and welded joint properties;

g) welds which are to be made in production plants or on site;

h) initial and final dimensions of the welded component, any special surface or edge preparation;

i) quality and acceptance requirements;

j) other special requirements, e.g. surface finishing, heat treatment, interweld adhesives, sealants, primer.

5 Sub-contracting

When a manufacturer intends to use sub-contracted services (e.g. welding, inspection, heat treatment), all relevant specifications and 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.

Any sub-contractor shall work as instructed by, and be responsible to, the manufacturer and shall fully comply with all relevant requirements of this part of ISO 14554. The manufacturer shall ensure that the sub-contractor can comply with the quality requirements of the contract.

The information to be provided by the manufacturer to the sub-contractor shall include all relevant data from the contract review (see 4.2) and the design review (see 4.3). Additional requirements may need to be specified if the design of a structure is to be sub-contracted.

6 Welding personnel

6.1 General

The manufacturer shall have at his disposal sufficient and competent personnel for the planning, performance, and supervision of the welding production according to specified requirements.

6.2 Operators

All operators of resistance welding equipment shall be given introduction courses and task-oriented training.

6.3 Resistance weld setter

The resistance weld setter is the person who is competent for setting up resistance welding equipment according to specified welding procedures. This person has the required knowledge and skill for carrying out the work for quality assurance in the field of resistance welding.

The required competence may be demonstrated by sufficient experience, in-house training record or a certificate according to an appropriate standard.

6.4 Welding coordinator

The manufacturer shall have available suitable welding coordinators in order to give welding personnel the necessary instructions and to perform and supervise the work carefully. Suited in this sense are people who have a qualification according to the general recommendations of ISO 14731[5] applicable to resistance welding (specialist for resistance welding). ISO 14731:2006,[5] Annex A is not applicable to resistance welding. The people responsible for quality work shall be sufficiently authorized to take all the necessary steps. The duties, interrelations, and limits of the spheres of responsibility of those people should be settled beyond doubt.

7 Inspection, testing, and examination personnel

To satisfy the specified requirements, the manufacturer shall have at its disposal sufficient and competent personnel for planning and performance, for supervision, inspection of the welds, as well as testing and examination of the welding production.

8 Equipment

8.1 Production and testing facilities

The following equipment shall be available, when applicable, in the appropriate version:

— spot, projection, roller seam welding equipment, butt welding equipment including welding tools;

— equipment for the preparation of the parts to be joined;

— equipment for heat treatment (see Clause 12);

— welding fixtures for clamping and positioning;

— workpiece transfer systems, handling equipment (robots and others) and other transfer devices for welding production;

— personnel protective equipment and other safety equipment directly associated with welding;

— cleaning facilities, e.g. for spatter removal;

— equipment for electrode dressing;

— equipment for destructive and non-destructive testing;

— equipment for welding process monitoring and control.

8.2 Description of facilities

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

— characteristics and capability of the welding equipment;

— characteristics and capability of the workpiece transfer systems, robots, etc.;

— size of components the production plant is able to handle;

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

— characteristics of the equipment for forming, flanging, bending, and cutting;

— characteristics of system controllers.

8.3 Approval of facilities

The equipment shall be adequate for the application concerned. Approval of the equipment for welding is not required unless specified in the contract.

8.4 Installation of new or refurbished equipment

After installation of new or refurbished equipment (see 8.1), appropriate tests shall be performed. The tests shall ensure fitness-for-purpose of the equipment. The tests shall be carried out in accordance with appropriate standards, whenever relevant. Records shall be maintained of such tests.

8.5 Maintenance

The manufacturer shall have documented plans for the maintenance of equipment. The plans shall ensure the maintenance checks on those features of the equipment essential for assuring the quality of the welded structure.

Examples of such features are:

— condition of the electrode-force-system on spot, projection, and roller seam welding equipment, welding guns, etc.;

— condition of the welding controllers, transformers (including secondary circuit), closed-loop control systems, etc. required for the operation of the welding equipment;

— condition of positioners, clamping fixtures etc. for workpiece pick-up;

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

— condition of the workpiece transfer and handling systems;

— condition of the supply systems (e.g. pneumatic, hydraulic, electric, cooling water);

— condition of the equipment for electrode dressing (milling cutter, scraper, etc.).

Defective equipment shall be repaired before using it again or replaced.

9 Welding activities

9.1 Production planning

The manufacturer shall carry out adequate production planning, compatible with facilities as in 8.1. This 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;

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

— sequence in which the welds are to be made, if relevant;

— 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;

— item identification by batches, components or parts as appropriate.

9.2 Welding procedure specification

The manufacturer shall prepare a WPS and shall ensure that this is used correctly in production.

9.3 Welding procedure approval

Welding procedures shall be approved prior to production and in accordance with the appropriate standard. The method of approval shall be in accordance with the relevant application standards or as stated in the contract.

Other procedures, e.g. procedure for heat treatment, should only be approved if stated in the relevant application standards and/or stated in the contract.

9.4 Work instructions

The manufacturer shall use the welding procedure specification specified for use in production for the purpose of instructing the operator.

9.5 Documentation

The manufacturer shall establish and maintain procedures for the control of relevant quality documents, e.g. welding procedure specification, welding procedure approval record.

10 Welding electrodes and auxiliaries

10.1 General

Responsibilities and procedures involved in the control of welding electrodes and welding auxiliaries shall be specified by the manufacturer.

10.2 Batch testing

Batch testing of welding electrodes and auxiliaries are required only if stated in the contract.

10.3 Welding electrodes

To maintain the pre-determined weld quality, the use of suitable electrodes, their maintenance and cooling are highly important. Therefore, the following data shall be given in the welding procedure specifications:

— electrode material;

— electrode shape and dimensions;

— criteria for electrode dressing or changing frequency;

— quantity of cooling water, minimum flow rate and maximum water inlet temperature.

10.4 Marking of the welding electrodes

The welding electrodes shall be identified in such a way that any risk of a mix-up — including the material type — is excluded.

The welding electrodes shall be marked using International Standard identification where appropriate, e.g. for materials, in accordance with ISO 5182;[2] for spot electrodes, in accordance with ISO 5184.[3]

The marking shall not be impaired by any dressing which may be carried out.

Marking shall be maintained during storage.

11 Storage of parent metal

Storage shall be such that the material is not adversely affected. Marking shall be maintained during storage.

12 Heat treatment

For welding of materials with critical transformation behaviour or with high cracking susceptibility, welding equipment and process controls shall allow suitable weld heat treatment.

13 Weld-related inspection and testing

13.1 General

Inspection and testing shall be implemented at appropriate points in the manufacturing process to ensure conformity with contract requirements. Location and frequency of such inspection and/or testing depend on the contract and/or application standard, the welding process and the type of construction (see 4.2 and 4.3).

13.2 Inspection and testing before welding

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

— suitability of welding personnel;

— welding procedure specification;

— identity of parent material;

— joint preparation, shape, dimensions, and surface condition;

— thickness and type of adhesive, sealant or primer;

— fit-up, jigging, clamping, and tacking;

— any special requirements in welding procedure specification, e.g. prevention of distortion;

— arrangement for any production test;

— suitability of working conditions for welding, including environment.

13.3 Inspection and testing during production

During production, the following shall be checked at suitable intervals or continuously controlled or monitored:

— essential welding parameters;

— welding sequence and position of the welds;

— quality, e.g. dimensions;

— condition of welding electrodes (e.g. wear);

— condition of secondary circuit and connections;

— condition of cooling system and filters.

13.4 Inspection and testing after welding

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

— by visual inspection according to relevant agreed standards;

— by non-destructive testing according to relevant agreed standards;

— by destructive testing according to relevant agreed standards;

— form, shape and dimensions of the welded construction;

— results and records of post-weld operations, e.g. grinding.

13.5 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.

14 Non-conformance and corrective action

Measures shall be implemented to control items which do not conform to specified requirements in order to prevent their inadvertent use. When repair and/or rectification is undertaken by the manufacturer, appropriate procedures shall be available at all workstations where repair or rectification is performed. When repair or rectification is carried out, the items shall be re-inspected, tested, and examined in accordance with the original requirements. Measures shall also be implemented to ensure that conditions adverse to quality of the welded construction are promptly identified and corrected.

15 Calibration

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

16 Identification and traceability

Where specified, identification and traceability shall be maintained throughout the whole manufacturing process.

Documented systems to ensure identification and traceability should include details of:

— production planning;

— routing cards;

— records of weld locations in construction (specifications, drawings, etc.);

— traceability in relation to the location of, and the equipment used for, particular welds from appropriate process sheets;

— procedure approvals;

— procedure and personnel for non-destructive and destructive testing;

— welding auxiliaries, e.g. type, batch or cast numbers;

