
**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

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 3.

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 member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 14554 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14554-1 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

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*

Annex A of this part of ISO 14554 is for information only.

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

Contents

Page

Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Contract and design review	2
5 Sub-contracting	3
6 Welding personnel	4
7 Inspection, testing and examinations personnel	4
8 Equipment	4
9 Welding activities	6
10 Welding electrodes and auxiliaries	6
11 Storage of parent metal	7
12 Heat treatment	7
13 Weld related inspection and testing	7
14 Non-conformance and corrective action	8
15 Calibration	8
16 Identification and traceability	9
17 Quality records	9
Annex A (informative) Summary comparison of welding quality requirements with regard to EN ISO 14554-1 and EN ISO 14554-2	10
Annex ZA (informative) Bibliography	11

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Foreword

The text of EN ISO 14554-1:2000 has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2000, and conflicting national standards shall be withdrawn at the latest by October 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

Annexe A is informative.

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1 Scope

This standard has been prepared such that:

- it is independent of the type of welded construction to be manufactured;
- it defines quality requirements for welding both in production plants and on site;
- it provides guidance for describing a manufacturer's capability to produce welded constructions to meet specified requirements;
- it can also be used as a basis for assessing the manufacturer in respect to his welding capability.

This standard is appropriate when demonstration of a manufacturer's or a sub-contractor's capability to produce welded constructions, fulfilling specified quality requirements, are specified in one or more of the following:

- a contract between involved parties;
- an application standard;
- a regulatory requirement.

The requirements contained within this standard 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 in the following cases:

– Case 1

To provide specific requirements for resistance welding in contracts which require the manufacturer or sub-contractor to have a quality system in accordance with EN ISO 9001 or EN ISO 9002.

– Case 2

To provide specific requirements for resistance welding in contracts which require the manufacturer or sub-contractor to have a quality system other than EN ISO 9001 or EN ISO 9002.

– Case 3

To provide specific requirements for resistance welding as guidance to a manufacturer or sub-contractor developing a quality system.

– Case 4

To provide specific requirements for references in application standards which uses resistance welding as part of its requirements or in a contract between relevant parties. It is however more appropriate for EN ISO 14554-2 to be used in such cases.

For general guidelines for selection and use see EN 729-1 with the exception of Annex B and under consideration that for resistance welding only comprehensive and elementary quality requirements are specified. Annex A in this standard applies for resistance welding.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

ISO 14554-1:2000(E)

EN 719:1994

Welding coordination – Tasks and responsibilities

EN 729-1

Quality requirements for welding – Fusion welding of metallic materials – Part 1: Guidelines for selection and use

EN 1418

Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials

EN ISO 9001

Quality systems – Model for quality assurance in design, development, production, installation and servicing (ISO 9001 : 1994)

EN ISO 9002

Quality systems – Model for quality assurance in production, installation and servicing (ISO 9002:1994)

EN ISO 14554-2

Quality requirements for welding – Resistance welding of metallic materials – Part 2: Elementary quality requirements (ISO 14554-2:2000)

ISO 5182

Welding – Materials for resistance welding electrodes and ancillary equipment

ISO 5184

Straight resistance spot welding electrodes

3 Terms and definitions

For the purposes of this standard terms and definitions listed in EN 729-1 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 carried out by the manufacturer to verify that the contract is within his capability to perform, that sufficient resources are available to achieve delivery schedules and that 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 whilst carrying out his 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 (details see item 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);
- 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 standard. 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, performing and supervising of the welding production according to specified requirements.

6.2 Operators

All operators of resistance welding equipment shall be given introduction courses and task-orientated 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. He 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 proved by sufficient experience, in-house training record, or by a certificate according to EN 1418.

6.4 Welding coordinator

The manufacturer shall have available suitable welding coordinators in order to give the welding personnel the necessary instructions and to perform and supervise the work carefully. Suited in this sense is the person who has a qualification according to the general recommendations in EN 719 applicable to resistance welding (specialist for resistance welding). Annex A of EN 719:1994 is not applicable for resistance welding. The persons 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 persons should be settled beyond doubt.

7 Inspection, testing and examination personnel

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

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 (possibilities 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 postweld 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 (WPS)

The manufacturer shall prepare a welding procedure specification 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 will be 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 ISO identification where appropriate, eg for material ISO 5182, spot electrodes ISO 5184.

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 will not be 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 assure conformity with contract requirements. Location and frequency of such inspection and/or testing will 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, jiggling, clamping and tacking;

ISO 14554-1:2000(E)

- 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.