
**Welding — Calibration, verification and
validation of equipment used for welding,
including ancillary activities**

*Soudage — Étalonnage, vérification et validation du matériel utilisé
pour le soudage, y compris pour les procédés connexes*

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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 17662 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/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 document, read “...this European Standard...” to mean “...this International Standard...”.

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

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Foreword

This document (EN ISO 17662:2005) has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DIN, 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 September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

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

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1 Scope

This standard specifies requirements to calibration, verification and validation of equipment used for:

– control of process variables during fabrication,

or

– control of the properties of equipment used for welding or welding allied processes,

where the resulting output cannot be readily or economically documented by subsequent monitoring, inspection and testing. This regards process variables influencing the fitness-for-purpose and in particular the safety of the fabricated product.

NOTE 1 The standard is based on the lists of process variables stated in standards for specification of welding procedures, in particular, but not exclusively on the EN ISO 15609 series of standards. Future revisions of these standards can result in addition or deletion of parameters considered necessary to specify.

Some guidance is, in addition, given in annex B as regards requirements to calibration; verification and validation as part of acceptance testing of equipment used for welding or allied processes.

Requirements to calibration, verification and validation as part of inspection, testing, non-destructive testing or measuring of final welded products performed in order to verify product compliance are outside the scope of the present standard.

The subject of the standard is limited to calibration, verification and validation of equipment after installation, as part of the workshops' schemes for maintenance and/or operation.

NOTE 2 It should be stressed that the standard has nothing to do with manufacture and installation of equipment for welding. Requirements to new equipment are formulated in directives and product codes (standards), as necessary.

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2 Normative references

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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.

EN 562, *Gas welding equipment — Pressure gauges used in welding, cutting and allied processes*

EN 729-1, *Quality requirements for welding — Fusion welding of metallic materials — Part 1: Guidelines for selection and use*

EN 729-2, *Quality requirements for welding — Fusion welding of metallic materials — Part 2: Comprehensive quality requirements*

EN 729-3, *Quality requirements for welding — Fusion welding of metallic materials — Part 3: Standard quality requirements*

EN 729-4, *Quality requirements for welding — Fusion welding of metallic materials — Part 4: Elementary quality requirements*

EN 970, *Non-destructive examination of fusion welds — Visual examination*

EN 1321, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

CR 12361, *Destructive tests on welds in metallic materials — Etchants for macroscopic and microscopic examination*

EN 13134, *Brazing — Procedure approval*

ENV 50184, *Validation of arc welding equipment*

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EN ISO 14554-1, *Quality requirements for welding — Resistance welding of metallic materials — Part 1: Comprehensive quality requirements (ISO 14554-1:2000)*

EN ISO 14554-2, *Quality requirements for welding — Resistance welding of metallic materials — Part 2: Elementary quality requirements (ISO 14554-2:2000)*

EN ISO 14555, *Welding — Arc stud welding of metallic materials (ISO 14555:1998)*

EN ISO 14744-5, *Welding — Acceptance inspection of electron beam welding machines — Part 5: Measurement of run-out accuracy (ISO 14744-5:2000)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15609-2, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 2: Gas welding (ISO 15609-2:2001)*

EN ISO 15609-3, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 3: Electron beam welding (ISO 15609-3:2004)*

EN ISO 15609-4, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 4: Laser beam welding (ISO 15609-4:2004)*

EN ISO 15609-5, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 5: Resistance welding (ISO 15609-5:2004)*

EN ISO 15620, *Welding — Friction welding of metallic materials (ISO 15620:2000)*

ISO 669, *Resistance welding — Resistance welding equipment — Mechanical and electrical requirements*

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3 Terms and definitions

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For the purposes of this document, the following terms and definitions apply.

3.1

accuracy class

class of measuring instruments that meet certain metrological requirements that are intended to keep errors within specified limits

[1]

3.2

accuracy of measurand

closeness of the agreement between the result of a measurement and a true value of the measurement

[1]

3.3

calibration

set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards

[1]

3.4

measurement

set of operations having the object of determining a value of a quantity

[1]

3.5

measuring instrument

device intended to be used to make measurements, alone or in conjunction with supplementary device(s)

[1]

3.6**material measure**

device intended to reproduce or supply, in a permanent manner during its use, one or more known values of a given quantity

3.7**measuring system**

complete set of measuring instruments and other equipment assembled to carry out specified measurements

[1]

3.8**repeatability (of results of measurements)**

closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement

[1]

3.9**reproducibility (of results of measurement)**

closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement

[1]

3.10**tractability**

property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties

[1]

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3.11**validation**

confirmation, through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled

[EN ISO 9000:2000]

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3.12**verification**

confirmation, through the provision of objective evidence that specified requirements have been fulfilled

[EN ISO 9000:2000]

4 General requirements**4.1 General**

Measuring, inspection and test equipment are used for many purposes and as part of many work operations during welding fabrication. However, the purposes can be grouped as follows:

- 1) demonstration of conformance of product to specified requirements;
- 2) control of processes where the resulting output cannot be readily or economically verified by subsequent monitoring, inspection and testing;
- 3) general process control.

Measuring, inspection and test equipment used for demonstration of conformance of product to specified requirements (1) should be properly calibrated, verified or validated. This is e.g. required in EN ISO 9001. Many of the procedures used for demonstration of conformance inspection are covered by standards, which typically include provisions for calibration, verification and validation. This is e.g. the case for standards for non-destructive testing and destructive testing of welds. Further, requirements to documentation of such quality characteristics (e.g. non-destructive testing) are stated in application standards and/or contracts. Calibration, verification and validation of measuring devices used for this category of application are not covered by this standard, apart from a few

comments on welding inspection and visual examination. The relevant standards for inspection and testing shall be consulted.

However, some quality characteristics (also related to safety) cannot be inspected or tested on the finished structure or product. This is e.g. the case for the materials properties of weld metals and to the heat-affected zones adjacent to welds. Such quality characteristics have to be documented indirectly by proper documentation of the fabrication process (2). The guidance given in this standard is limited mainly to calibration, verification and validation of measuring devices used for such indirect documentation of quality characteristics, influenced by welding. The measuring, inspection and test equipment can be separate measuring instruments or built-in instruments in e.g. the power sources used for welding.

Measuring, inspection and test equipment used for general process control may also have to be calibrated, verified or validated (3). This is, e.g. recommended in EN ISO 9004¹. However, specification of such requirements are left entirely to the discretion of the manufacturer, the requirements cannot be standardized and they are not covered by the present standard.

A key issue of the standard is discussions of the influence of various process variables on the resulting output and in particular of the possibilities of verification of the output by subsequent monitoring, inspection and testing. The distinction between process variables in group (2) and group (3) is not always easy but essential for the interpretation of contractual and/or legal requirements. The main basis for selection of the relevant variables is the standards for specification of welding procedures.

The specific requirements to calibration, verification and validation of a particular instrument shall be derived from the required performance and shall be compatible with the permissible range as specified in the welding procedure specification (WPS) for the variable(s) in question. Many types of instruments used for control of welding such as ammeters, voltmeters, thermocouples, stop-watches etc. are also used for non-welding purposes. It should be noted that the requirements to accuracy, when used for welding purposes might be less stringent than for other applications of the instruments. "Normal" (standardized) procedures for calibration, verification and validation of the instruments can be too stringent and costly, if applied for welding purposes.

The formal requirements to calibration, verification and validation as regards control of welding and allied processes are specified in the EN 729 series of standards and the EN ISO 14554 series of standards. Some more specific supplementary requirements can, however, be found in structural codes and/or as contractual requirements.

4.2 Frequency

When a need for calibration, verification or validation of equipment has been identified then calibration, verification or validation shall be carried out once a year, unless otherwise specified. Where there is a proven record of repeatability and liability the frequency of calibration, verification and validation can be reduced. It can, however, be necessary to re-calibrate, re-verify or re-validate at more frequent intervals, depending upon the recommendation of the manufacturer of the instrument, the requirements of the user, or where there is reason to believe that the performances of the equipment have deteriorated. However, equipment shall be isolated and calibration, verification or validation carried out before the equipment is put back in use after the following cases:

- whenever there are indications that an instrument does not register properly;
- whenever the equipment has been visibly damaged and the damage can have influenced the function of one or more instruments;
- whenever the equipment has been misused, subject to severe stress (overloads, traffic accidents, etc.), or subject to any other event which can have resulted in damage to one or more instrument;
- whenever the equipment has been rebuilt or repaired.

¹ It should be noted that EN ISO 9004 is not intended for certification, regulatory or contractual use.

4.3 Requirements

Calibration, verification and validation shall, in principle, be carried out for all the instruments used for control of the welding process variables specified in the welding procedure specification. However, standards for specification of welding procedures provide comprehensive lists of variables but not all variables are essential for all applications. The following paragraphs give for all common welding processes some guidelines on relevant requirements.

Calibration, verification and validation can be omitted entirely in the following cases:

- a) When verification of the process is not required.

Calibration, verification and validation can be omitted for all processes where there is no legal or contractual requirement for verification or validation of the process.

NOTE 1 This is usually the case for processes such as flame or plasma cutting and air arc gouging.

- b) Mass production

Calibration, verification and validation can be omitted provided all the following conditions are fulfilled:

- production is controlled by pre-production testing, followed by testing of samples from the actual production at regular intervals;
- the control is supported by an adequate system for statistical quality control;
- the process is reasonably stable during the interval between testing of samples;
- pre-production testing and sampling are performed separately for each production line (welding cell).

- c) Series and single piece production

Calibration, verification and validation can be omitted provided all the following conditions are fulfilled:

- the procedures are approved by procedure testing;
- the actual production is carried out by the same welding machine used during procedure testing.

NOTE 2 The manufacturer can, for managerial reasons, wish to perform much more comprehensive calibration, verification and validation. The main reasons are:

- more efficient control of processes resulting in higher productivity and more economical operation;
- possibility of transferring procedures from one equipment to another without adjustments, maintaining an uninterrupted production;
- higher process stability and therefore increased economic efficiency;
- control data becomes compatible with different types of equipment.

4.4 Process data

For all welding processes, process data where calibration, verification or validation are needed are stated below. Calibration, verification or validation is not needed for all other process data.

4.5 Materials properties

Several kinds of materials are used in connection with production involving welding or ancillary activities. This includes parent metals and filler metals but also shielding gases, materials used for backing, etc. Occasionally incoming inspection and testing or check of stored materials may have to be performed, e.g. in order to identify a material. Such activities involve instruments and procedures for chemical analysis, positive material identification, etc. Provisions for calibration of instruments used for such purposes are outside the scope of the present standard.

Gas backing purity can be measured prior to welding, however, and is an exception.

5 Process data common to more than one welding process

5.1 Process data common to all welding processes

The standards for specification of welding procedures require some data, which are common to all welding processes. Calibration, verification or validation can be needed for the process data stated in Table 1 to Table 8.

Table 1 — Related to the parent material and filler metals

Designation	Need for calibration, verification or validation	Instruments and techniques
Material dimension	Instruments used for measurement and/or verification of material dimensions shall be calibrated, as necessary. Requirements depend on the specified tolerances, etc.	Measuring instruments such as vernier callipers, micrometer callipers, gauge blocks, rulers and straightedges, etc. are covered by several EN-, ISO- and national standards.

Table 2 — Related to the joint

Designation	Need for calibration, verification or validation	Instruments and techniques
Joint design	Instruments used for measurement and/or verification of joint dimension shall be validated.	See EN 970.
Welding position	Requirements to determination of welding position are, as a general rule, not very exacting. Instruments used for measurement and/or verification of welding position (e.g. spirit levels and instruments used for measurements of angles) do not have to be calibrated, verified or validated unless damaged, and after having been repaired.	Relevant instruments are covered by a number of standards.
Joint preparation	Instruments used for measurement and/or verification of joint dimension shall be validated.	See EN 970.