BS EN ISO 17662:2016

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN ISO 17662:2016. It supersedes BS EN ISO 17662:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/-/1, Briefing committee for welding.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EN ISO 17662

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English Version

Welding - Calibration, verification and validation of equipment used for welding, including ancillary activities (ISO 17662:2016)

Soudage - Étalonnage, vérification et validation du matériel utilisé pour le soudage, y compris pour les procédés connexes (ISO 17662:2016)

Schweißen - Kalibrierung, Verifizierung und Validierung von Einrichtungen einschließlich ergänzender Tätigkeiten, die beim Schweißen verwendet werden (ISO 17662:2016)

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European foreword

This document (EN ISO 17662:2016) has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" in collaboration with Technical Committee CEN/TC 121 “Welding” the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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

Endorsement notice

The text of ISO 17662:2016 has been approved by CEN as EN ISO 17662:2016 without any modification.

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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.

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).

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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: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

This second edition cancels and replaces the first edition (ISO 17662:2005), which has been technically revised.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

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INTERNATIONAL STANDARD ISO 17662:2016(E)

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

1 Scope

This International Standard specifies requirements for calibration, verification and validation of equipment used for

— control of process variables during fabrication, and

— 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 involves process variables influencing the fitness-for-purpose and in particular the safety of the fabricated product.

NOTE 1 This International Standard is based on the lists of process variables stated in International Standards for specification of welding procedures, in particular, but not exclusively in the ISO 15609- series. Future revisions of these International 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 for calibration; verification and validation as part of acceptance testing of equipment used for welding or allied processes.

Requirements to calibrate, verify and validate as part of inspection, testing, non-destructive testing or measuring of final welded products performed in order to verify confirm product compliance are outside the scope of the present International Standard.

The subject of this International Standard is limited to calibration, verification and validation of equipment after installation, as part of the workshops' and site operations for maintenance and/or operation.

It needs to be stressed that this International Standard has nothing to do with manufacture and installation of equipment for welding. Requirements for new equipment are formulated in directives and product codes (standards), as necessary.

Annex C provides information when other parties are involved in calibration, verification and validation activities.

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

ISO 5171, *Gas welding equipment — Pressure gauges used in welding, cutting and allied processes*

ISO 5172:2006, *Gas welding equipment — Blowpipes for gas welding, heating and cutting — Specifications and tests*

ISO 5826, *Resistance welding equipment — Transformers — General specifications applicable to all transformers*

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3 Terms and definitions

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

3.1
accuracy class
class of measuring instruments or measuring systems that meets stated metrological requirements that are intended to keep measurement errors or instrumental measurement uncertainties within specified limits under specified operating conditions

[SOURCE: ISO/IEC Guide 99:2007, 4.25]

3.2
accuracy of measurement
closeness of agreement between a measured quantity value and a true quantity value of a measurand

Note 1 to entry: The term *measurand* is defined by the VIM (ISO/IEC Guide 99:2007, 2.3) as a "quantity intended to be measured".

[SOURCE: ISO/IEC Guide 99:2007, 2.13, modified — Note 1 to entry has been added.]

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

3.4
measurement
process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity

[SOURCE: ISO/IEC Guide 99:2007, 2.1]

3.5
measuring instrument
device used for making measurements, alone or in conjunction with one or more supplementary devices

[SOURCE: ISO/IEC Guide 99:2007, 3.1]

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
set of one or more measuring instruments and often other devices, including any reagent and supply, assembled and adopted to give information used to generate measured quantity values within specified intervals for quantities of specified kinds

[SOURCE: ISO/IEC Guide 99:2007, 3.2]

3.8
repeatability (of results of measurements)
closeness of the agreement between the results of successive measurements of the same measurement carried out under the same conditions of measurement

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3.9
traceability
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

3.10
validation
confirmation through the provision of objective evidence that the requirements for a specific intended use (e.g. client specification) or application (e.g. product standard) have been fulfilled

3.11
verification
confirmation through the provision of objective evidence that specified requirements have been fulfilled

Note 1 to entry: Verification is also interpreted as a confirmation that an available process achieved an expected level of success.

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, for example, required in ISO 9001. Many of the procedures used for demonstration of conformance inspection are covered by standards, which typically include provisions for calibration, verification, or validation. This is, for example, the case for standards for non-destructive testing and/or destructive testing of welds. Further, requirements for 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, for example, 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, for example, 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, for example, recommended in ISO 9004[1)]. However, specifications 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 International Standard.

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

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A key issue of the International 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 for 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 ISO 3834- series and the ISO 14554- series. 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 reliability 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. 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, 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.

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/brazing procedure specification. International Standards for specification of welding/brazing procedures provide comprehensive lists of variables, but not all variables are essential for all applications. The following are some guidelines on relevant requirements for all common welding/brazing processes.

Calibration, verification and validation may be omitted entirely in the following cases.

a) **When verification of the process is not required**

Calibration, verification and validation may 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.

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b) **Mass production**

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

— the 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 may 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;

or the process is supported by a calibrated online-monitoring system for welding parameters.

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

— 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/brazing processes, process data where calibration, verification, or validation are needed are stated in Clause 5. Calibration, verification, or validation is not needed for all other process data.

4.5 Material 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 this International Standard.

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

5 Process data common to more than one welding/brazing process

5.1 Process data common to all welding/brazing processes

The International Standards for specification of welding procedures require some data, which are common to all welding processes. Calibration, verification, or validation requirements are detailed in Table 1 to Table 8.

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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 ISO 17637.
Welding position	Requirements for 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.	See ISO 6947.
Joint preparation	Instruments used for measurement and/or verification of joint dimension and outline shall be validated.	See ISO 17637.

Table 3 — Welding machine

Designation	Need for calibration, verification, or validation	Instruments and techniques
Characteristic dimensions, shape and configuration of welding machine and working conditions such as the following: — number and configuration of wire electrodes; — diameter of shielding gas nozzles and fixtures; — distance contact tip nozzle to the surface of the workpiece; — diameter of electrodes and wire electrodes; — dimensions, shape, position, etc. of back and front support.	Instruments used for measurement and/or verification of dimensions, shape, position, etc. shall be calibrated, verified or validated, as appropriate.	Measuring instruments such as vernier callipers, micrometer callipers, gauge blocks, rulers and straightedges, etc. are covered by several EN-, ISO- and national standards.

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