

INTERNATIONAL
DOCUMENT

OIML D 8

Edition 2004 (E)

Measurement standards. Choice, recognition, use,
conservation and documentation

Étalons de mesure. Choix, reconnaissance, utilisation,
conservation et documentation



Contents

<i>Foreword</i>	3
0 Introduction	4
1 Scope	4
2 Terminology	4
3 Choice of a standard	4
4 Recognition of a standard	6
5 Use of a standard	6
6 Conservation of a standard	7
7 Documentation for a standard	8
Appendix Example of the documentation for a measurement standard	10
Bibliography	13

Foreword

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

- **International Recommendations (OIML R)**, which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;
- **International Documents (OIML D)**, which are informative in nature and intended to improve the work of the metrology services.

OIML Draft Recommendations and Documents are developed by Technical Committees or Subcommittees which are formed by Member States. Certain international and regional institutions also participate on a consultation basis.

Cooperative agreements are established between OIML and certain institutions, such as ISO and the IEC, with the objective of avoiding contradictory requirements; consequently, manufacturers and users

of measuring instruments, test laboratories, etc. may simultaneously apply OIML publications and those of other institutions.

International Recommendations and Documents are published in French (F) and English (E) and are subject to periodic revision.

This publication - reference OIML D 8, Edition 2004 (E) - was developed by the OIML Technical Committee TC 4 *Measurement standards and calibration and verification devices*. This version supersedes OIML D 6 *Documentation for measurement standards and calibration devices* (Edition 1983) and OIML D 8 *Principles concerning choice, official recognition, use and conservation of measurement standards* (Edition 1984). It was approved for final publication by the International Committee of Legal Metrology in 2004.

OIML Publications may be downloaded from the OIML web site in the form of PDF files. Additional information on OIML Publications may be obtained from the Organization's headquarters:

International Bureau of Legal Metrology
11, rue Turgot - 75009 Paris - France
Telephone: 33 (0)1 48 78 12 82
Fax: 33 (0)1 42 82 17 27
E-mail: biml@oiml.org
Internet: www.oiml.org

Measurement standards.

Choice, recognition, use, conservation and documentation

0 Introduction

This Document deals with the basic questions concerning the choice, recognition, use and conservation of measurement standards that are directly concerned with the verification of measuring instruments in fields that are regulated by law, but also may be used in unregulated fields. This Document sets out principles for the preparation of the documentation that should be provided with each measurement standard (hereafter referred to as “standard”).

Requirements and documentation for a standard also apply to devices that form part of a standard, depending on the requirements for its use and on the way quantity value(s) is (are) transferred from the standard to other measuring instruments.

1 Scope

The purpose of this Document is to define:

- a) The general requirements concerning the choice, recognition, use and conservation of standards used in the field of legal metrology; and
- b) Principles concerning the preparation of the documentation for these standards in order to ensure traceability of measurement results.

This Document concerns reference and working standards, and is in conformity with ISO/IEC 17025 *General requirements for the competence of testing and calibration laboratories* [1].

This Document does not concern primary standards, national standards, international standards, or any special standards and may also be used by calibration laboratories.

2 Terminology

In this Document the terminology of the *International Vocabulary of Basic and General Terms in Metrology* (VIM) [2], the *International Vocabulary of Terms in Legal Metrology* (VIML) [3] and the *Guide to the Expression of Uncertainty in Measurement* (GUM) [4] are used.

2.1 Documentation for a standard

Set of documents concerning the choice, recognition, use and conservation of a particular standard.

2.2 Recognition of a standard

Formal approval performed by the national (legal) metrology body (depending on national legislation), that the metrological and technical characteristics of a standard meet the statutory requirements for its intended use.

3 Choice of a standard

3.1 In choosing a standard (measuring equipment such as a measuring instrument, material measure or reference material) for use in the role of a reference or working standard, the metrological, technical and economic requirements should be taken into consideration.

Note: Individual metrological, technical and economic requirements should also be taken into account in choosing auxiliary devices to a standard.

3.2 Metrological requirements

Metrological requirements refer to the following metrological characteristics of a standard including its accessories:

- a) Quantity and unit(s);
- b) Nominal value(s) or measuring range of a quantity for which the standard is applicable;
- c) Conventional true value(s) of a quantity reproduced by the standard (determined by its calibration) or systematic error of the standard;
- d) Expanded uncertainty of measurement from the calibration of the standard corresponding to a coverage probability of approximately 95 % and coverage factor k (usually $k = 2$), or combined standard uncertainty;
- e) Recalibration interval;
- f) Stability of the relevant quantity of the standard during the recalibration interval;
- g) Information concerning methods and means of calibration, if necessary;
- h) Reference conditions and operating environment, respectively;
- i) Other important metrological requirements (linearity, hysteresis, sensitivity, repeatability, characteristics of dynamic metrological properties, etc.).

Notes:

- a) *The systematic error of a standard is determined on the basis of its comparison with a standard of a higher metrological level by calibration. If the systematic error (including non-linearity) is known and documented, correction can be carried out for this error. So either correction shall be made for the systematic error or this error shall be taken into account in the determination of the uncertainty.*
- b) *The uncertainty of measurement from the calibration of a standard is a basic parameter (determined together with the conventional true value(s) of a quantity reproduced by the standard) necessary for the determination of measurement uncertainty on verification of a measuring instrument. Components of uncertainty influencing the results of verification shall be specified and determined for calculation of the measurement uncertainty. The determination of the uncertainty of measurement shall be made in accordance with the GUM [4].*
- c) *Information concerning methods and means of calibration refer to:*

- *Methods used for the calibration of a standard and methods used for the transfer of values from a standard to the measuring instrument(s);*
- *Method used for the evaluation of the measurements results obtained when using a standard;*
- *Recognized traceability chain for a standard.*

3.3 Technical requirements

Technical requirements mainly refer to:

- a) Technical suitability for the intended use of a standard;
- b) The ease of use and conservation of a standard and its technical reliability;
- c) The ease of transport, installation, connection, supervision, calibration and maintenance of a standard including its accessories;
- d) Reliable protection against damage, means of protection against environmental degradation, unauthorized manipulation, etc. during use and conservation of a standard;
- e) Special accessories (devices) required during use and conservation of a standard (power supplies, stabilization of working conditions).

3.4 Economic requirements

Economic requirements are mainly based on the following:

- a) Cost of a standard including its accessories;
- b) Cost of operation and conservation of a standard;
- c) Cost of calibration;
- d) Cost related to the recalibration interval (depending on the stability and other properties of the individual instrument and the desired accuracy);
- e) Cost related to possibility of repair and service life of a standard and its accessories;
- f) Cost related to laboratory premises where a standard is maintained and used;
- g) Cost related to the number of staff and their required qualifications;
- h) Cost related to transportation and special facilities for transportation.

4 Recognition of a standard

4.1 The national (legal) metrology body (depending on national legislation) shall set the following conditions for recognition of a standard:

- a) Documented traceability of the value(s) of a standard;
- b) A standard shall be identified and its metrological and technical characteristics documented;
- c) The existence of conditions for the long-term operation of a standard and documented rules of its use and conservation;
- d) Adequate uncertainty of measurement from the calibration of a standard for its intended use.

Extra confidence can be gained by subjecting a standard to interlaboratory comparisons (national or international).

4.2 Traceability of the value(s) of a standard may be provided by calibrating it, and documented by a calibration certificate.

Calibration of a standard shall be performed by the National Metrology Institute or by another calibration laboratory that can demonstrate the appropriate competence and traceable measurement capability (e.g. by accreditation).

Note:

For certain types of standards and applications, depending on national regulations, verification of a standard is possible as an alternative to calibration provided that it is carried out only according to a valid national regulation that comprises at least the following essential requirements:

- *The types of standards and applications for which verification can be performed instead of calibration are clearly defined;*
- *The metrological characteristics of a standard and its verification method are defined, so that there is confidence to justify its recognition as a standard;*
- *A standard meets all the prescribed requirements;*
- *The verification is carried out by a recognized competent body according to the specific national regulations in force;*
- *The maximum permissible error for the verification shall not exceed the required uncertainty for application of a standard.*

4.3 The recognition of a standard used in the field of legal metrology should be confirmed by a document issued by the national (legal) metrology body (depending on national legislation).

4.4 Instead of the document referred to in subclause 4.3, a standard may be recognized by the licence for verification of certain categories of legally controlled measuring instruments issued by national legal metrology body.

4.5 The fulfillment of conditions for recognition of a standard should be confirmed on the basis of an independent, expert and objective assessment performed by the national legal metrology body or person (organization) authorized by the body.

4.6 The recognition of a standard used in the field of legal metrology is no longer valid if one or more of the specifications that formed the basis for its recognition have changed (as a result of damage, depreciation, repair, reconstruction, etc.). In such a case, the user of a standard shall immediately withdraw it from use and inform the national (legal) metrology body that has issued the recognition document for it.

5 Use of a standard

5.1 Regarding the use of a standard, the following general principles apply:

- a) A standard shall be used for the calibration and/or verification of measuring instruments and for interlaboratory comparisons only and for no other purposes, unless it can be shown that its performance as a standard would not be invalidated;
- b) The use of a standard shall be restricted only to qualified personnel, with a person designated as being in charge of it;
- c) A standard may be used only in places where the operating conditions regarding the location and the environment are fully met;
- d) Only validated and recognized procedures and methods are allowed for the calibration of a standard;

- e) Procedures concerning the use of a standard shall be specified;
- f) A standard is regularly calibrated with a recalibration interval determined according to its characteristics;
- g) A standard shall be withdrawn from use whenever there are any doubts regarding the metrological characteristics and the correct performance according to specifications. It may be put into service again only after repair or reconstruction (as appropriate) and recalibration;
- h) Records regarding the calibration, use, repair, upgrading and recalibration of a standard shall be kept.

5.2 The principles concerning the use of a standard aim to ensure that the following are avoided:

- a) Malfunction owing to interaction between a standard and the measuring instrument being calibrated or verified, or to any other external effects;
- b) Incorrect results of calibration or verification;
- c) Damage, of any kind, to a standard and its accessories;
- d) Damage, of any kind, to the measuring instrument being calibrated or verified;
- e) Danger to persons using a standard
- f) Unacceptable levels of pollution of the environment (noise, vibration, electromagnetic and ionizing radiation, chemical products, etc.) resulting from a standard itself or its use;
- g) Unacceptable levels of environmental pollution that can influence the performance of a standard or the instrument being verified or inspected (noise, vibration, wind, electromagnetic and ionizing radiation, chemical products, etc.).

Note:

The principles concerning the use of a standard may also contribute to increased efficiency of verification of measuring instruments, longer life of the standard, greater economy in the use of energy and materials, etc.

5.3 Specific rules for the use of a standard laid down in general regulations regarding the calibration of a standard and the verification of measuring instruments should cover especially:

- a) The documentation of a standard including its accessories;
- b) Requirements regarding the premises and environmental conditions;
- c) Installation, adjustment and preparation for the use of a standard;
- d) Validated calibration and measurement methods, including evaluation of results and uncertainty calculation;
- e) Procedures for use of a standard and its accessories and for recording the measurement and calibration data;
- f) Procedures for regular maintenance, checking the proper operation and safety precautions of a standard and its accessories.

6 Conservation of a standard

6.1 General principles concerning the conservation of a standard include its storage, maintenance and transport and are as follows:

- a) A standard, even when not in use, is kept in a specified place;
- b) A standard is regularly maintained in accordance with the written procedure, taking into account the manufacturer's recommendations. The maintenance of a standard and its accessories depends on the frequency and conditions of its use;
- c) Calibration of a standard and its accessories are carried out at determined intervals (dependent on the frequency and conditions of its use);
- d) The manner and means of transport (for a standard which is transported with regard to its use) are determined;
- e) Admissible exchanges of parts of a standard (e.g. power supplies, recording and data processing devices, etc.) are specified;
- f) Periodic controls of the conditions for conservation of a standard are carried out;
- g) The person or persons in charge of the conservation of a standard is (are) appointed (usually the same person(s) is (are) also in charge of its use).

6.2 Principles and procedures for the conservation of a standard shall be documented.

Note:

The principles and procedures concerning the conservation of a standard may be considered analogous to the principles concerning the use of a standard. They are general principles valid for all standards. The individual provisions concerning the conservation of a given standard comprise all the information valid for standards of a particular type, the manufacturer and method of use. Repairs of a standard are not part of the conservation of the standard; these should be controlled by special principles and regulations.

7 Documentation for a standard

7.1 The documentation for a standard serves informative and evidence purposes, mainly for national legal metrology bodies, laboratories and their customers regarding the technical and metrological characteristics of a standard, its use, conservation and recognition (for standards used in a regulated field).

7.2 The documentation for a standard is a set of the following recommended types of documents concerning the given standard:

- a) Legal documents (e.g. documents on the recognition of a standard, issued by the national legal metrology body, etc.);
- b) Metrological documents (documents on the metrological characteristics of a standard, calibration certificates, reports concerning interlaboratory comparisons, local traceability chain, control charts for demonstrating stability, etc.);
- c) Technical documents (documents on technical characteristics, manuals and rules for use and conservation of a standard, maintenance plan, instructions, list of accessories, etc.);
- d) Record card of a standard;
- e) Records on installation, maintenance, use, functional check, intermediate checks, concerning revision of a standard, etc.;
- f) An overview of the (authorized) user(s) of a standard.

7.3 Documents concerning a standard should contain the following basic information:

- a) Name and address of the user (organization, laboratory, person);
- b) Title of the document and its identification;
- c) Name of the standard and its identification (type, serial number, etc.);
- d) Manufacturer/supplier of the standard;
- e) Date of purchase and/or the date the standard was put into service;
- f) Quantity, nominal value or measurement range reproduced by the standard;
- g) Accuracy or accuracy class, uncertainty of measurement including information on the evaluation thereof;
- h) Recalibration interval with the reference to the document/method for the determination thereof;
- i) Person in charge;
- j) Current location, where appropriate;
- k) Classification of the standard (reference, working).

7.4 Additional information created during the use of a standard may be as follows:

- a) History of the standard and reports concerning interlaboratory comparison of the standard;
- b) Records concerning stability of the standard;
- c) Records of maintenance and repair;
- d) Other documents concerning the mode and extent of use of the standard, if necessary.

Notes:

Standards used for the same purpose (which usually have the same identification mark) and making up a set may be documented together as a set of standards.

The review of documents for the standard and their structure is given in the Appendix.

7.5 The person in charge of a standard (according to 7.3 i)) is responsible for complete and true data in the documentation for that standard, and for the conservation and proper handling of the documentation thereof. The documentation shall be controlled as required in [1] (approval, issue, changes, reviews, control of data, control of records, etc.).

7.6 The documents may be on various media, whether hard copy or electronic, and they may be digital, analog, photographic or written.

7.7 When using a standard, the user (person/officer) shall have access to key data relating to it, in particular:

- a) Directions for use;
- b) Measuring range(s);
- c) Accuracy class or uncertainty;

d) Systematic error(s) in case corrections have to be made for these error(s);

e) Due date(s) for recalibration and maintenance.

7.8 The user (person/officer) is responsible for using a standard only when its calibration status is valid.

Note:

It is recommended that the list of documents for a standard be attached to the documentation.

Appendix

Example of the documentation for a measurement standard (Informative)

Introduction

To clarify the documentation characteristics and the principles for the preparation of the documentation mentioned in a general way in this International Document, an example of one possible structure of documentation and its content is given in this Appendix, which contains examples of various documents with their information content. The choice of the structure of the documentation and its information content depends on the structure of the metrological organization, the quality system, particular requirements, practice and needs.

A.1 Record (card) of a standard

The record (card) of a standard is the document that contains the essential information and history of all the important events concerning that standard. It makes possible the identification of the standard and its actual state, gives the basic metrological characteristics, etc. The record may contain the following information:

- a) Name and address of the user of the standard;
- b) Name of the standard and its identification (manufacturer, type, serial number, etc.);
- c) Quantity, nominal value or measurement range reproduced by the standard;
- d) Accuracy or accuracy class, uncertainty of measurement;
- e) Recalibration interval;
- f) Person in charge;
- g) Current location;
- h) Classification of the standard (reference, working);
- i) Intended use of the standard;

- j) Manufacturer and/or supplier;
- k) Date received and date put into service;
- l) Traceability of the value of the standard (name of laboratory where calibration was carried out, date of calibration, number of calibration certificate);
- m) List of documents.

Notes:

The record shall contain all the updated records and changes introduced by the person in charge. Documents of evidence of records shall be attached.

It is advisable to have the original record at the location of the person in charge and a copy directly available to the user (at the location of the standard).

A.2 Documents concerning technical parameters, traceability and metrological characteristics of a standard include:

- a) Description of the standard (assembly, description of the standard as a whole, all component parts, and standard devices in the assembly);
- b) Calibration certificate (or equivalent document describing the traceability of the value assigned to the standard, including measurement results);
- c) Records on installation, maintenance, use, functional check, intermediate checks, concerning revision of the standard, etc.;
- d) Records on interlaboratory comparisons;
- e) Other documents for recognition of the standard, if necessary.

A.3 The document on recognition of a standard issued by the national (legal) metrology body (or authorized person or organization) may contain data as follows:

- a) Name and address of the body which issued the document;
- b) Name of the document, its number and date of issue;
- c) Name of the standard, type, quantity and measurement range;
- d) Intended use of the standard;
- e) Identification of the standard (manufacturer, type, serial number, etc.);
- f) Name and address of the user of the standard;
- g) Location and environmental conditions, if appropriate;
- h) Name and signature of a representative of the issuing body.

A.4 The rules concerning the use and conservation of a standard are contained in a document that sets out the procedures to be followed when using the standard, precautions to be taken when working with it and the environmental conditions in which the standard is maintained. These rules contain especially:

- a) The name of the standard and its identification data;
- b) Appropriate required environmental conditions for the use and conservation of the standard:
 - Temperature and permissible temperature variations (time and spatial gradient of temperature) during the use and conservation of the standard;
 - Humidity and permissible humidity variations;
 - Light intensity;
 - Permissible electromagnetic disturbances and ways of protecting the standard against these disturbances;
 - Permissible levels of radiation;
 - Permissible variations in the power supply voltage;
 - Permissible level of vibrations, infrasound and noise in acoustical band or of ultrasound and means of protection;
 - Cleanness of the air where the standard is used and conserved (e.g. the method of air filtration);
 - Measures to be taken to prevent destruction of the standard (e.g. by fire, water) or its theft;

- Measures for permanent assurance of optimal conditions for the operation of the standard;
 - Maximum time the standard may be without power in case it is temporarily out of use;
 - Storage when temporarily out of use (for instance special containers).
- c) Requirements for personnel use and conservation of the standard:
 - Number of persons required;
 - Required qualifications;
 - Duties of personnel.
 - d) Safeguarding measures:
 - Measures to be taken in the event of the standard being moved, including in an emergency;
 - Measures to be taken in the event of the standard being out of service for an extended period.
 - e) Procedures for the use of the standard:
 - Description of procedures for calibration of working standards and verification of measuring instruments, including methods of processing of measured data and evaluation of measurement uncertainties;
 - Safety precautions to be taken when working with the standard.

A.5 Records concerning the use of a standard (history of the standard) serve for recording all operations which were made with the standard. These records may contain the following information:

- a) Name of the standard and its identification data;
- b) Period of use of the standard (e.g. date, time from ... to ...);
- c) Number of calibrations or verifications made using the standard;
- d) Records on experimental measurements made using the standard;
- e) Records on interlaboratory comparisons of the standard;

- f) Remarks concerning the behavior of the standard during its use;
- g) Name and signature of the person who worked with the standard.

A.6 Records concerning the control of a standard serve as a review of the results of the controls of the technical state and conditions of conservation of the standard. These records may contain especially the following data:

- a) Name of the standard and its identification data;
- b) Date on which the inspection took place;
- c) Type of control (technical check, internal metrological control between two calibrations, interlaboratory comparison, etc.);
- d) Results of controls, including measurement results.

A.7 The record on maintenance of a standard specifies all activities related to the maintenance

carried out according to manufacturer recommendations, experience gained from its operation, etc. Information is recorded in a maintenance book.

The record of the repair of a standard may refer to all documents issued in connection with repairs. These documents should be attached.

Any measures taken for the renewal of the function of the standard are of great importance (e.g. calibration, interlaboratory comparison, recognition, etc.).

A.8 Technical documents contain important information concerning the standard, e.g.:

- a) Description of the operation of the standard;
- b) Technical characteristics of the standard, drawings, tables, graphs;
- c) Manual for use;
- d) Assembly of the standard;
- e) Maintenance manual (prepared by the manufacturer of the standard).

Bibliography

- [1] ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories. ISO, Geneva, 1999
- [2] International Vocabulary of Basic and General Terms in Metrology (VIM). BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML. Second Edition, ISO, Geneva, 1993
- [3] International Vocabulary of Terms in Legal Metrology (VIML). OIML, Edition 2000
- [4] Guide to the Expression of Uncertainty in Measurement (GUM). BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML. ISO, Geneva, 1993, corrected and reprinted in 1995

