



## The IPIAB Policy on Metrological Traceability of Measurement Results

### 1. Introduction and scope

**1.1.** Reliable measurements are the Key issues in terms of providing products and services with high quality. The importance of measurements is reflected in relevant standards by the requirement that measurements must be “traceable” to national or international standards of measurement. Metrological traceability is defined by the International Vocabulary of Metrology (VIM) as the property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations to stated references, each contributing to the measurement uncertainty. Metrological traceability of measurement results is a key subject for which a harmonized policy is necessary if the market is to have confidence in any accredited service provided by IPIAB.

**1.2.** Metrological traceability is needed for all equipment used for tests and/or calibrations, including equipment for ancillary measurements (e.g., for environmental conditions) with a significant effect on the accuracy or validity of the result of the test, calibration, or sampling. Calibration may not be needed for subsidiary equipment where the result is not affected or where the equipment is monitored by calibrated equipment during the measurement.

**1.3.** For calibrations performed by an organization in order to establish metrological traceability for its own activities, and which are not a part of its scope of accreditation, the policy in Section 2 is applicable too. Such internal calibrations are sometimes known as “in-house” calibrations.

**1.4.** This document describes the IPIAB policy with regard to the metrological traceability requirements in testing and calibration laboratories. It also encompasses and amplifies the policies contained within ILAC document ILAC-P10<sup>1</sup>.

**Note:** *Metrological traceability pertains to reference quantity values of measurement standards and measurement results.*

<sup>1</sup> International Laboratory Accreditation Cooperation, ILAC P10:01/2013, ILAC Policy on the Traceability of Measurement Results



**The IPIAB Policy on Metrological  
Traceability of Measurement Results**

## 2. IPIAB Policy on Metrological Traceability of Measurement Results

When metrological traceability is required, IPIAB policy is that the measuring equipment shall be calibrated by:

**2-1)** A National Metrology Institute (NMI) whose service is suitable for the intended use and is covered by the International Committee for Weight and Measures Mutual Recognition Arrangement (CIPM MRA). Services covered by the CIPM MRA can be viewed in the Bureau International des Poids et Mesures Key Comparison Database (BIPM KCDB) which includes CMCs for each listed service.

**Note 1:** *Some NMIs may also indicate that their service is covered by the CIPM MRA by including the CIPM MRA logo on their calibration certificates, however the fixing of the logo is not mandatory and the BIPM KCDB remains the authoritative source of verification.*

**Note 2:** *NMIs from Member States participating in the Meter Convention may take metrological traceability directly from measurements made at the BIPM. The KCDB provides an automatic link to the relevant BIPM calibration services (including the range and uncertainty). Individual calibration certificates issued by the BIPM are also listed.*

**Note 3:** *NMCI (National Metrology Center of IRAN) in some items is traceable to international chain*

**2-2)** An accredited calibration laboratory whose service is suitable for the intended use (i.e., the scope of accreditation specifically covers the appropriate calibration)

**Note 3:** *Only certificates bearing the accreditation symbol or a text reference to the accreditation of the calibration laboratory can benefit fully from the recognition that the ILAC MRA and its regional counterparts bring.*

*Calibration laboratories can indicate that their service is covered by ILAC Arrangement by including on the calibration certificate:*

- *The combined ILAC MRA mark, or*
- *The accreditation mark of the Accreditation Body (that is signatory to ILAC Arrangement) or the reference to its accreditation status.*
- *The accreditation mark of IPIAB.*

*these three options can be taken as evidence of metrological traceability (ILAC P8[6]).*



**The IPIAB Policy on Metrological  
Traceability of Measurement Results**

**2-3)** An NMI whose service is suitable for the intended use but not covered by the CIPM MRA or a laboratory whose calibration service is suitable for the intended use but not covered by the ILAC Arrangement or by Regional Arrangements recognized by ILAC, in this case:

- It is emphasized that the extent of the calibration obtained should be sufficient in terms of quantities and coverage to demonstrate properly the performance of the equipment, otherwise traceability of results may not be assured.
- Furthermore, these choices are not services that have been subject to peer review or recognized accreditation. Consequently, an organization using such services must therefore ensure that appropriate evidence for claimed traceability and measurement uncertainty is available. IPIAB will assess such evidence and the organization's ability to evaluate it. Such evidence may include, but is not limited to, the following:
  - a) Copies of the technical procedures and records of calibration method validation;
  - b) Procedures for evaluation of uncertainty and copies of the associated uncertainty budgets;
  - c) Documentation for traceability of measurement results;
  - d) Evidence of staff competence and authorization;
  - e) Documentation for assuring the validity of calibration results and the associated outcome;
  - f) Documentation for accommodation and environmental conditions;
  - g) On-site assess the calibration laboratory.

Accredited Organizations that have demonstrated metrological traceability of their measurements results through the use of calibration services offered according to 2-1 or 2-2 above have made use of services that have been subject to relevant peer review or accreditation. In the situation where 2-3 applies, this is not the case, so these routes should only be applicable when 2-1 or 2-2 are not possible for a particular calibration.

Accredited Organizations must therefore ensure that appropriate evidence for claimed metrological traceability and measurement uncertainty is available and the IPIAB will assess this evidence. Further guidance is found in Appendix A.

The IPIAB policy in regard to metrological traceability provided by Reference Material Producers (RMPs) through Certified Reference Materials (CRMs) is that the certified values assigned to CRMs are considered to have established valid metrological traceability when:



## The IPIAB Policy on Metrological Traceability of Measurement Results

**2-4)** CRMs are produced by NMIs using a service that is included in the BIPM KCDB.

or

**2-5)** CRMs are produced by an accredited RMP under its scope of accreditation and the Accreditation Body is covered by the ILAC Arrangement or by Regional Arrangements recognized by ILAC.

Recognizing that the accreditation of RMPs is still developing and CRMs may not be available from accredited RMPs, where CRMs are produced by non-accredited RMPs, Accredited Organizations shall demonstrate that CRMs have been provided by a competent RMP and that they are suitable for their intended use.

When metrological traceability to the SI is not technically possible, it is the responsibility of the Accredited Organization to:

**2-6a)** Choose a way to satisfy metrological traceability requirements by using certified values of certified reference materials provided by a competent producer.

or

**2-6b)** Document the results of a suitable comparison to reference measurement procedures, specified methods, or consensus standards that are clearly described and accepted as providing measurement results fit for their intended use. Evidence of this comparison shall be assessed by the IPIAB.

**Note 4:** *When metrological traceability to solely SI units is not appropriate or applicable to the application, a clearly defined measurand should be selected. Establishing metrological traceability therefore includes both the proof of identity of the property measured and the comparison of the results to an appropriate stated reference. The comparison is established by ensuring the measurement procedures are properly validated and/or verified, that measuring equipment is appropriately calibrated and that conditions of measurement (such as environmental conditions) are under sufficient control to provide a reliable result.*

**Note 5:** *Surplus test materials are often available from proficiency testing (PT) providers. It should be checked whether the PT provider can provide additional stability information to demonstrate the ongoing stability of the property value and matrix of the test material. If this cannot be provided, these test materials should not be considered as an alternative way to ensure the validity of results.*

### 3. Maintenance of traceability

3.1. In order to maintain traceability on a continuous basis, reference standards and measuring equipment shall be subject to further calibrations on an ongoing basis, hence the establishment of a calibration program is necessary. The intervals between calibrations will depend on various factors, including but not limited to:

a) The measurement uncertainty required;



**The IPIAB Policy on Metrological  
Traceability of Measurement Results**

- b) The past history of the equipment, including the results of calibrations and frequency of any necessary maintenance;
- c) The frequency of use of the equipment;
- d) The frequency of cross-checking against other equipment or of intermediate checks;
- e) The recommendations of the manufacturer;
- f) The environmental conditions to which the equipment is exposed, including any effects due to transportation;

3.2. When a fresh calibration has been obtained the data provided should be reviewed in order to confirm that the declared performance is still met. It may be necessary to reconsider the calibration interval or the suitability of the equipment in accordance with the outcome of such a review. Furthermore, in the case of a calibration laboratory, the CMCs may be affected; in such cases IPIAB shall be informed.

## **Annex A:**

### **Guidelines for considerations when metrological traceability is not established through the CIPM MRA and the ILAC Arrangement**

When metrological traceability is established through either **2-3** of the policy, appropriate evidence for the technical competence of the calibration service supplier and claimed metrological traceability is likely to include but not be restricted to the following: (numbers refer to clauses in ISO/IEC17025:2017):

- Records of calibration method validation (7.2.2.4)
- Procedures for evaluation of measurement uncertainty (7.6)
- Documentation and records for metrological traceability of measurement results (6.5)
- Documentation and records for ensuring the validity of results (7.7)
- Documentation and records for competence of personnel (6.2)
- Records for equipment which can influence laboratory activities (6.4)
- Documentation and records for facilities and environmental conditions (6.3)
- Audits of the calibration laboratory (6.6 and 8.8)



**The IPIAB Policy on Metrological  
Traceability of Measurement Results**

## **Annex B:**

**The definition of metrological traceability contained within the Vocabulary of Metrology (VIM) is as follows:**

### **1. Accreditation Body (AB) (ISO/IEC 17000 clause 2.6):**

Authoritative body that performs accreditation.

### **2. Bureau International des Poids et Mesures (BIPM)**

The task of the BIPM is to make sure world-wide harmonization of measurements and their traceability to the International System of Units (SI). It does this with the authority of the Convention of the Metre, a diplomatic treaty between fifty-five nations, and it operates through a series of Consultative Committees, whose members are the national metrology laboratories of the signatory States, and through its own laboratory work. The BIPM carries out measurement-related research. It takes part in, and organizes, international comparisons of national measurement standards, and it carries out calibrations for Member States.

### **3. Conformity Assessment Body (CAB):**

A body that performs conformity assessment services and that can be the object of accreditation.

### **4. International Committee for Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA):**

National Metrology Institutes have been collaborating and carrying out international comparisons of their national measurement standards for more than one hundred years.

### **5. BIPM Key Comparison Database (KCDB)**

Supports the Mutual Recognition Arrangement of the [CIPM](#) (CIPM MRA) of national measurement standards and of calibration and measurement certificates issued by national metrology institutes. The technical basis of the arrangement is the set of results obtained in the course of time through key comparisons carried out by the [Consultative Committees](#) of the CIPM, the BIPM and the regional metrology organizations ([RMOs](#)), and published by the BIPM and maintained in the [key comparison database](#).

### **6. National Metrology Institute (NMI) (Derived from Joint BIPM, OIML, ILAC and ISO Declaration on Metrological Traceability: 11/09/2011):**





## The IPIAB Policy on Metrological Traceability of Measurement Results

A national laboratory that is tasked with the realization, maintenance, improvement and dissemination of the SI units via traceable calibration and measurement services based on their Calibration and Measurement Capabilities (CMCs) for the metrology activities (ex. fundamental metrology, applied, technical or industrial metrology and legal metrology) within a particular country. This includes designated institutes that are empowered by an NMI for specified functions.

### 7. Reference Material (VIM4)

Material, sufficiently homogeneous and stable with reference to one or more specified properties, which has been established to be fit for its intended use in measurement or in examination.

### 8. Certified Reference Material (ISO Guide 34:2009):

Reference material, characterized by a metrologically valid procedure for one or more specified properties, accompanied by a certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability.

### 9. Calibration

Operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

#### 9.1. In-house Calibration

The calibration of an IPIAB Accredited CAB's own reference standards or measuring and test equipment by the laboratory's own staff for which the calibration measurement parameters are not included on their scope of accreditation.

*Note 1: In-house calibration can be performed by testing and/or calibration laboratories.*

#### 9.2. Internal Calibration:

The calibration of an IPIAB-Accredited CAB's own reference standards or measuring and test equipment by the laboratory's own staff for which the calibration measurement parameters ARE included on their scope of accreditation.



**The IPIAB Policy on Metrological  
Traceability of Measurement Results**

**10. Metrological Traceability<sup>2</sup> (VIM 3 clause 2.41):** Property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty.

Implicit within this definition is that each calibration certificate in the traceability chain must contain a statement of uncertainty (or, exceptionally, a statement of compliance with an identified specification) otherwise the results presented therein do not represent metrological traceability. Acceptable sources of traceability are described in Section 2.



**11. Metrological Traceability Chain (VIM 3 clause 2.42):**

Sequence of measurement standards and calibrations that are used to relate a measurement result to a reference.

**12. Metrological Traceability to a Measurement Unit (VIM 3 clause 2.4.3):**

Metrological traceability where the reference is the definition of a measurement unit through its practical realization.

VIM Note: The expression of “traceability to the SI” means ‘metrological traceability to a measurement unit of the International System of Units’.

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<sup>2</sup> metrological traceability is an attribute of the **result** of a measurement. Consequently, commonly used expressions such as “the equipment is traceable” are **incorrect**.

