



Towards mutual recognition of metrological competence

1. Why have internationally recognized measurement capabilities?

Continual improvements to standards of living have led to increased demand for high quality products, safer food and environmentally sound technologies. This in turn has led to higher expectations and requirements for products and services and the associated technical regulations have become an increasing obstacle to free trade.

Technical barriers to trade (TBTs) are the result of different technical regulations and conformity assessment procedures in different markets. An exporter of fruit and vegetables, for example, can only deliver products which conform to threshold concentrations for pesticides allowed in the import market. A motor vehicle can only be introduced into the market

if the admissible level of emissions is not exceeded, while many products such as electronic devices must meet specific technical requirements to ensure the safety of the user.

An important step towards the reduction of technical barriers to trade is mutual recognition of the procedures and certificates that are used in conformity assessments to prove compliance with various technical regulations and standards. However, mutual recognition of conformity assessment procedures and certificates is impossible without a reliable technical basis, i.e. reliable and accepted measurements and analyses to demonstrate compliance. Internationally recognized metrological competence in a country is fundamental to guarantee reliable testing and analyses, and lays the foundation for international acceptance of the results.

However, not all countries need the same level of metrological services. The required competence depends crucially on economic demands and on the goods and services produced. It is reasonable and wise to focus on those competencies best serving a country's economic needs. Independent of the level of accuracy, international recognition of metrological competence is indispensable to effective participation in free trade.

This document describes how mutual recognition of metrological competence can be achieved and the conditions which must be met by an economy for it to be recognized by others as a reliable trading partner.

2. Building mutual recognition of measurement capabilities

The expansion of international trade in the late 1800s created the need and will to establish internationally consistent measurements. The signing of the Metre Convention in 1875 established the International Bureau of Weights and Measures (BIPM) and signaled the beginning of an internationally unified system of measurements. The BIPM and its Member States continue to promote and develop what is now the International System of Units (SI), which has been widely adopted throughout the world.

In 1999, the International Committee for Weights and Measures (CIPM) addressed the need for a mechanism to allow international recognition of technical competence in calibrations and measurements by establishing the CIPM Mutual Recognition Arrangement (CIPM MRA): An arrangement for mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes (NMIs). By August 2014, directors of the national metrology institutes of 53 Member States, 38 Associates and 4 international organizations had signed the CIPM MRA. The BIPM and the "Joint Committee of the Regional Metrology Organizations and BIPM" (JCRB) coordinate the implementation of the CIPM MRA.

The objectives of the CIPM MRA are:

- To provide international recognition of national standards.
- To provide confidence in the measurement capabilities of participating laboratories for all users, including the regulatory and accreditation bodies.
- To provide the technical basis for acceptance of measurements used to support the trade of goods and services.

The core element in the implementation of the CIPM MRA is the recognition of a national metrology institute's calibration and measurement capabilities (CMCs). The recognition of these capabilities is based on a detailed and rigorous review process. The data on the capabilities is then published in a single, world-wide publicly available database

maintained by the BIPM, known as the "key comparison database" (KCDB).

Only those calibration and measurement certificates for which the technical competence is attested through an entry of a calibration and measurement capability in the KCDB are recognized within the scope of the CIPM MRA. The recognition of the calibration and measurement capability is not tied to achieving a specific level of measurement uncertainty: Each national metrology institute (and designated laboratory) declares the calibration and measurement capabilities – including the uncertainty – corresponding to its particular competence and equipment.

3. The steps to mutual recognition

Within the CIPM MRA, certain requirements have to be met by the applicant to register calibration and measurement capabilities in the KCDB.

1. The institute's home country is a Member of the BIPM or a State Associate to the General Conference on Weights and Measures (CGPM).
 - a) Becoming a Member of the International Bureau of Weights and Measures (BIPM)

The procedure to become a party to the Metre Convention (Member of the BIPM) reflects the fact that the Metre Convention is a diplomatic treaty. The government of the State wishing to accede to the Metre Convention formally notifies the Minister of Foreign and European Affairs of the French Republic of its intent by letter delivered through its embassy in Paris. It is not sufficient for the national metrology institute or sponsoring Ministry alone to make the approach directly, although contact beforehand by the national metrology institute with the BIPM helps to ensure that the process runs smoothly. The BIPM can advise on the drafting of such letters and the practical aspects of application. Details describing how to become a Member State are available on the BIPM's website.

- b) Becoming an Associate of the General Conference on Weights and Measures (CGPM)

Associate status is intended as a transitional status to enable those States whose metrology systems are not yet sufficiently advanced to still participate in the CIPM MRA. After five years as an Associate, the CIPM formally reviews the progress against defined criteria, and if sufficient progress has been made the State is formally encouraged to accede and become a Member State. If the State chooses to remain an Associate after having been encouraged, then its subscription is increased in steps over five years until it reaches 90% of what would be paid as a Member State. The increases commence on the 1st January of the second year following the CIPM's decision to encourage an Associate

OVERVIEW: STAGES TO MUTUAL RECOGNITION OF CALIBRATION AND MEASUREMENT CAPABILITIES

Stage	Conditions	Advantages
Associate of the CGPM	<ul style="list-style-type: none"> ■ Payment of annual subscription ■ Member of a RMO 	<ul style="list-style-type: none"> ■ Participation in the CIPM-MRA is possible ■ Participation in regional comparisons is possible (and required for participation in CIPM-MRA)
Member of the BIPM ¹	<ul style="list-style-type: none"> ■ Payment of full contribution (plus a “one off” entry fee equal to the first year contribution) 	<ul style="list-style-type: none"> ■ Participation in the CIPM-MRA ■ Participation in consultative committees (subject to appropriate expertise) ■ Participation and vote in CGPM ■ Free BIPM-calibration services ■ Participation in BIPM/CC key comparisons (subject to appropriate expertise) ■ Right to purchase prototype kilogram
Participant in the CIPM-MRA	<ul style="list-style-type: none"> ■ NMI is defined ■ Member of Associate ■ Intention to develop and declare CMCs 	<ul style="list-style-type: none"> ■ Possibility to publish CMCs recognized by the other NMIs ■ Possibility to designate additional institutions who hold national measurement standards ■ Participation in the NMI directors meetings ■ Trade facilitation by recognition of other NMIs’ measurement capabilities
Registration of CMC entries in the KCDB	<ol style="list-style-type: none"> a) Member of Associate b) Signing of CIPM-MRA c) Traceability to the International System of Units (SI) d) Prove of technical competence e) Review and approval of a quality system 	<ul style="list-style-type: none"> ■ Political independence (independence from other countries; independence from accreditation bodies) ■ Contact to best NMIs, facilitation of transfer of know how ■ Own realization of SI-Units possible ■ Trade facilitation by mutual recognition of measurements made by accredited calibration and testing laboratories

¹ A country can either become Associate of the CGPM first or become Member of BIPM directly without being Associate before.

State to become a Member State. The States that have not made sufficient progress at the time of the review are not subject to this “escalator” until the time their situation changes.

The application to become an Associate should be notified to the BIPM via the Applicant State’s embassy in Paris. Details describing how to become an Associate can be found on the BIPM website, and the BIPM can, on request, provide one-to-one guidance.

2. The national metrology institute is a signatory of the CIPM MRA.

Signing of the CIPM MRA is open to the national metrology institute from those States that have acceded to the Metre Convention (Members of the BIPM) and Associates of the General Conference on Weights and Measures. Unlike membership of the BIPM, the CIPM MRA is not a treaty, but an arrangement between national metrology institutes, and they are the signatories. In some countries, there may be more than one institution holding national standards for different units. In this case the CIPM MRA is signed by a single institute, which is granted signatory status by the appropriate authority in the country. The other institutes, known as design-

nated institutes (DIs), participate through the signatory and their names are attached to the CIPM MRA document. The signatory is usually the national metrology institute.

3. The national metrology institute can prove traceability to the International System of Units (SI).

A national metrology institute or a designated institute has two choices for establishing the traceability of its national standards to the International System of Units (SI):

- via a primary realization or representation of the unit concerned.
- via another national metrology institute or designated institute having relevant calibration and measurement capabilities with appropriate uncertainty published in the KCDB.

Establishing traceability to the International System of Units via any accredited calibration laboratory that is not a national metrology institute or a designated institute is not sufficient within the CIPM MRA.

4. The national metrology institute has proven technical expertise in the field of the submitted calibration and measurement capabilities.

Technical underpinning of the calibration and measurement capabilities concerned is achieved mainly through participation in comparisons. Comparisons are a series of measurements of the same artefact performed by different institutes to compare the performance of the participating institutes.

Unlike proficiency testing schemes, which are used to underpin accreditation, the results of a comparison to prove calibration and measurement capabilities in the context of the CIPM MRA are published in the KCDB and are available to the public. More details on the procedures for comparisons can be found on the BIPM website.

5. The quality system of the national metrology institute is reviewed and approved by the responsible region metrology organization (RMO).

The CIPM MRA requires the participating national metrology institute and designated institute to establish and maintain a quality system. The quality system of a national metrology institute or designated institute should comply with ISO/IEC 17025 (ISO guide 34 for national metrology institutes that produce certified reference materials). All laboratories with declared calibration and measurement capabilities must demonstrate operation of an appropriate quality system.

It is the role of the responsible regional metrology organization to review and approve the quality system operated by their members and to report on their acceptance to the Joint Committee of the Regional Metrology Organizations and the International Bureau of Weights and Measures (JCRB).

When all five requirements are fulfilled, the calibration and measurement capabilities are submitted and the review process starts. The transparent and participative review process for any calibration and measurement capability entry in the KCDB is a reliable and mutually recognized technical foundation on which economic activity can be built. Trading partners are able to fulfill the requirements of import markets and investors can rely on a proven level of technical infrastructure for their products. Participation in the CIPM MRA and achieving recognized calibration and measurement capabilities at whatever level facilitates integration into the world economy.

GLOSSARY

BIPM, International Bureau of Weights and Measures

The International Bureau of Weights and Measures (BIPM), was established in 1875 by the Metre Convention as an inter-governmental organization. The mission of the BIPM is to provide a basis for a single, coherent system of measurements throughout the world, traceable to the International System of Units (SI).

CGPM, General Conference on Weights and Measures

The General Conference on Weights and Measures (CGPM) is the plenary organ of the BIPM and comprises representatives of the Member States of the BIPM. Every four years it meets to approve the work program and budget for the BIPM, and to deliberate and decide on issues of major metrological importance.

RMO, Regional Metrology Organization

A Regional Metrology Organization is an association of national metrology institutes from one region that is created to facilitate collaboration between the national metrology institutes. RMOs play a prominent role within the CIPM MRA as they are responsible for carrying out the calibration and measurement capabilities review process.

At the present time, there are five RMOs:

- Intra-Africa Metrology System (AFRIMETS)
- Asia Pacific Metrology Programme (APMP)
- Euro-Asian Cooperation of National Metrological Institutions (COOMET)
- European Association of Metrology Institutes (EURAMET)
- Inter American Metrology System (SIM)

Both AFRIMETS and SIM operate through sub regional structures.

NMI, National metrology institute

A national metrology institute, NMI, is an institute designated by national decision to develop and maintain national measurement standards for one or more quantities. An NMI represents the views of its home country to the NMIs of other countries, as they relate to the regional metrology organizations and to the BIPM.

DI, Designated Institute

Apart from a national metrology institute, other institutes can be appointed by the national metrology institute or the national government to hold specific national standards. In the context of the CIPM MRA these other institutes are referred to as designated institutes (DIs). Depending on national metrology policy, the number of DIs varies from country to country.