Introduction to International Metrology

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OUTLINE

- Integrated **National Quality Infrastructure**
- The **Metre Convention** and the **SI**
- The **international** metrology **system**
- BIPM's **global activity**
- Important events

WHY ARE MEASUREMENTS IMPORTANT FOR A COUNTRY?

NATIONAL METROLOGY INFRASTRUCTURE

- The **top priority** of good governance is the protection of the citizen.
- A national quality infrastructure helps protect the citizens from the products and services that they consume.
- A typical national conformity assessment infrastructure has 5 components.
- The international recognition of the components is facilitated by intergovernmental organizations.

THE ORGANIZATIONS WHO COORDINATE ASPECTS OF INTERNATIONAL METROLOGY

BIPM

- It is responsible for the establishment of the International System of Units, the **SI.**
- Maintains a number of **international measurement standards.**
- Helps **coordinate metrology research** at the highest levels.
- Helps ensure the **international equivalence** of measurements and their **traceability** to the SI.
- Provides the means for the **international recognition** of the national metrology programs worldwide.

OIML

- Helps harmonize the national regulations concerned with metrology.
- Helps develop mutual information on metrology.
- Helps develop international systems of certification of instruments and of measurands.
- Helps develop international recognition of regulatory certificates related to metrology.

ILAC

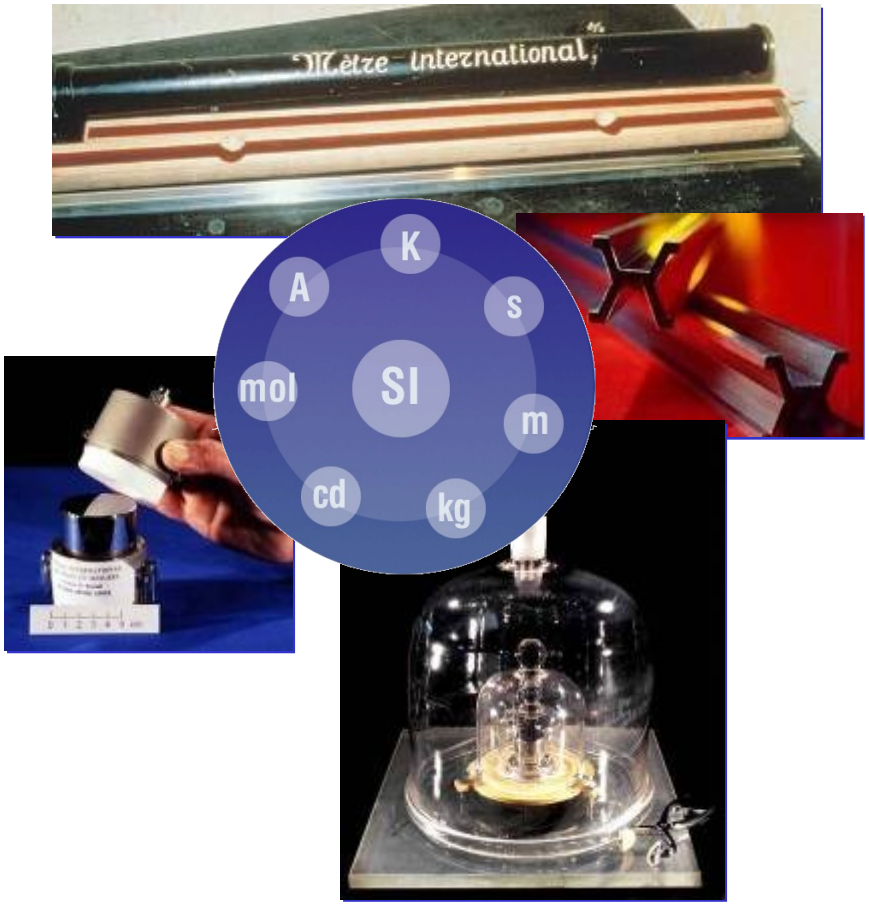
- Coordinates the international accreditation of laboratories.
- Coordinates the activities of the regional cooperation accreditation bodies (RCABs).
- Helps develop the international recognition of tests, measurement standards and reference materials covered by accreditation.

THE METRE CONVENTION AND THE SI

BRIEF HISTORY OF THE METRE CONVENTION AND THE SI

The Metre Convention and the SI

- **20 May 1875** - The Metre Convention was signed in Paris by 17 nations. It established the BIPM which is a permanent organizational structure for member governments to act in common accord on all matters relating to units of measurement.
- **1889** - the international prototypes for the metre and the kilogram, together with the astronomical second as unit of time, create the first international system of units.
- **1954** - the ampere, kelvin and candela are added as base units.
- **1960** - the unit system is named as the International System of Units (SI).
- **1971** - the mole is added as the unit for amount of substance, bringing the total number of base units to seven.



BUREAU INTERNATIONAL DES POIDS ET MESURES

BIPM

- **Headquartered** in Paris, France and **financed** by supporting governments.
- Maintains **scientific laboratories** in areas of: mass, time, electricity, ionizing radiation, and chemistry.

CIPM

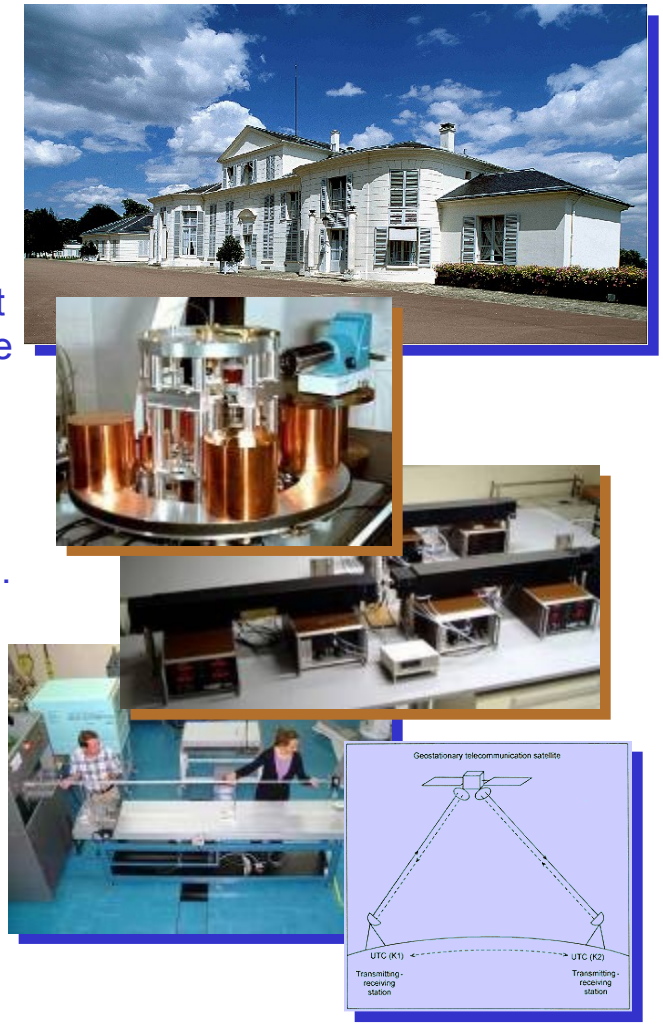
- Made up of **eighteen individuals**, from Member State.
- **Meets annually** to promote worldwide uniformity in units of measurement.
- Is the **management board** for the BIPM.

CGPM

- Made up of **representatives** from Member States.
- **Meets** in Paris **every four years** to discuss the status of international metrology.

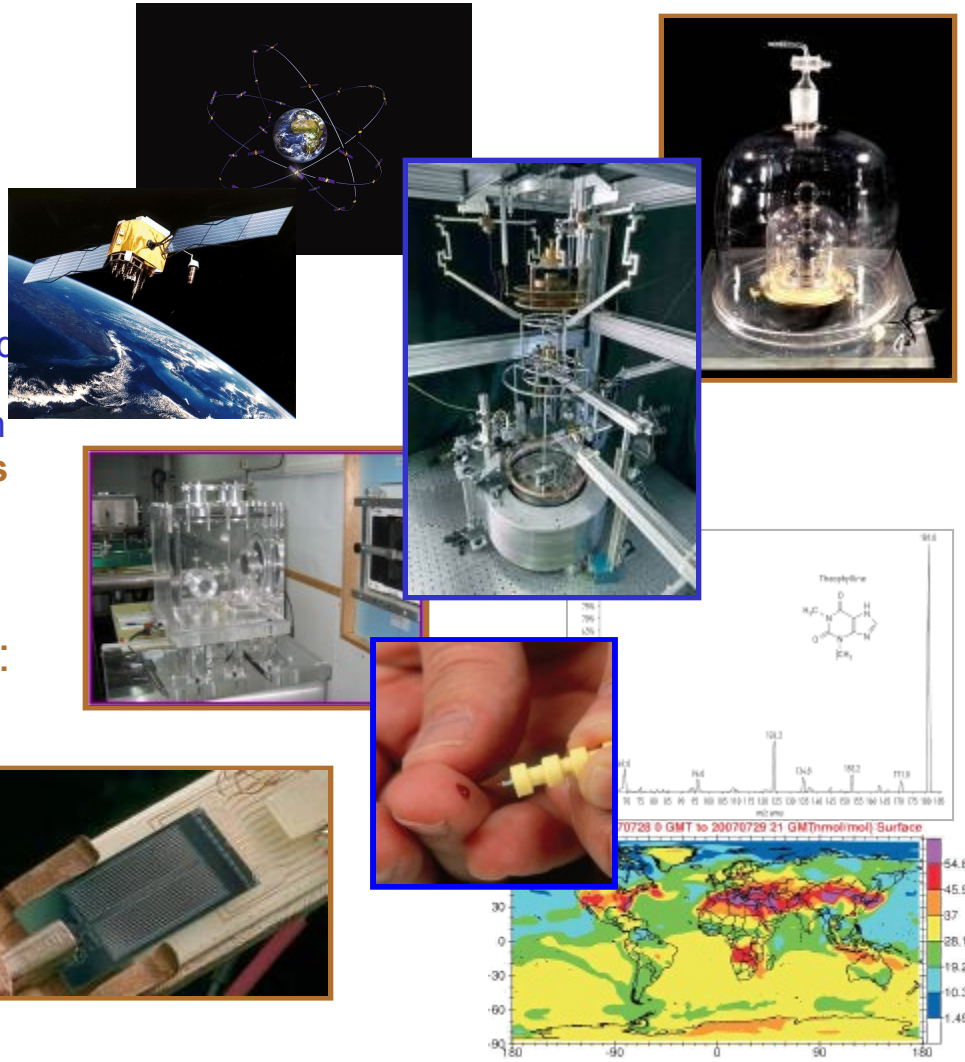
The BIPM

- It has **headquarters** near Paris, France. It is **financed** jointly by the Member States and Associates, and operates under the exclusive **supervision** of the CIPM.
- Its **mandate** is to provide the basis for a single, coherent system of measurements throughout the world, traceable to the International System of Units (SI). This task takes many forms, from **direct dissemination** of units (as in the case of mass and time) to coordination through **international comparisons** of national measurement standards (as in length, electricity and ionizing radiation).
- It maintains **laboratories** in areas of: mass, time, frequency and gravimetry, electricity, ionizing radiation, and chemistry.
- It has an international **staff** of over 70 .
- Its **budget** for 2009 is over eleven million euros.



BIPM SCIENTIFIC PROGRAM

- The **role of the BIPM** scientific programme is:
  - to promote **worldwide compatibility of measurements traceable to the SI** by providing calibrations and facilitating comparisons of measurement standards; and
  - to **perform measurement science** research directed at updating the SI **as per the needs of society**.



- **Current** BIPM scientific **programmes**:
  - **Mass**
  - **Time, Frequency and Gravimetry**
  - **Electricity**
  - **Ionizing Radiation**
  - **Chemistry**

BIPM's MAIN TECHNICAL ROLES

- Maintains the **kilogram** in the near future until replaced, probably by Watt Balances.
- Creates and disseminates **Coordinated Universal Time (UTC)** based on weighted averages of ~ 200 clocks from over 50 National Metrology Institutes worldwide.
- Maintains **unique world reference facilities** e.g., SIR (ionizing radiation and isotopes), ozone spectrophotometers.
- Maintains **travelling standards** to compare fixed national references e.g., Josephson Junctions for the volt, Quantum Hall devices for the ohm, etc.
- Coordinates international **comparisons** and **networks** e.g., organic chemistry reference materials for laboratory medicine.
- **Promotes traceable, accurate measurement** for physical, engineering, chemical and medical quantities worldwide.

BIPM Membership

BIPM Members 53

- Argentina
- Australia
- Austria
- Belgium
- Brazil
- Bulgaria
- Cameroon
- Canada
- Chile
- China
- Croatia
- Czech Republic
- Denmark
- Dominican Republic
- Egypt
- Finland
- France
- Germany
- Greece
- Hungary
- India
- Indonesia
- Iran, Islamic Republic of
- Ireland
- Israel
- Italy
- Japan
- Kazakhstan
- Korea, DPR of
- Korea Republic of
- Malaysia
- Mexico
- The Netherlands
- New Zealand
- Norway
- Pakistan
- Poland
- Portugal
- Romania
- Russian Federation
- Serbia
- Singapore
- Slovakia
- South Africa
- Spain
- Sweden
- Switzerland
- Thailand
- Turkey
- UK
- USA
- Uruguay
- Venezuela

Associates to the CGPM 27

- Albania
- Belarus
- Bolivia
- Chinese Taipei
- Costa Rica
- Cuba
- Ecuador
- Estonia
- Hong Kong (China)
- Georgia
- Jamaica
- Kenya
- Latvia
- Lithuania
- Macedonia, the FYR of
- Malta
- Moldova, Republic of
- Panama
- Paraguay
- Peru
- Philippines
- Slovenia
- Sri Lanka
- Tunisia
- Ukraine
- Vietnam
- CARICOM

2008

2009

MEMBERSHIP AND ASSOCIATE CATEGORY

Member State

- **Benefits**:
  - **Voting rights** in the CGPM.
  - NMIs may be **members** of the CCs if they meet the criteria.
  - NMIs may be signatories of the MRA; may take part in **CC and RMO key comparisons** and contribute to the KCRV.
  - May take part in BIPM Key Comparisons.
  - Entitled to a Pt-Ir kilogram at cost.
  - Free BIPM calibrations.
  - Staff may be guest workers at the BIPM.
  - May attend Directors' Meetings.
- **52 States** are Members.

Associate of the CGPM

- Benefits:
  - May attend the CGPM as an **observer.**
  - NMIs may be **guests** of the CCs if invited.
  - NMIs may be signatories of the MRA and may take part **only in RMO** key and supplementary **comparisons.**
  - Staff may be guest workers at the BIPM.
  - May attend Directors' Meetings.
- 26 States are Associates.

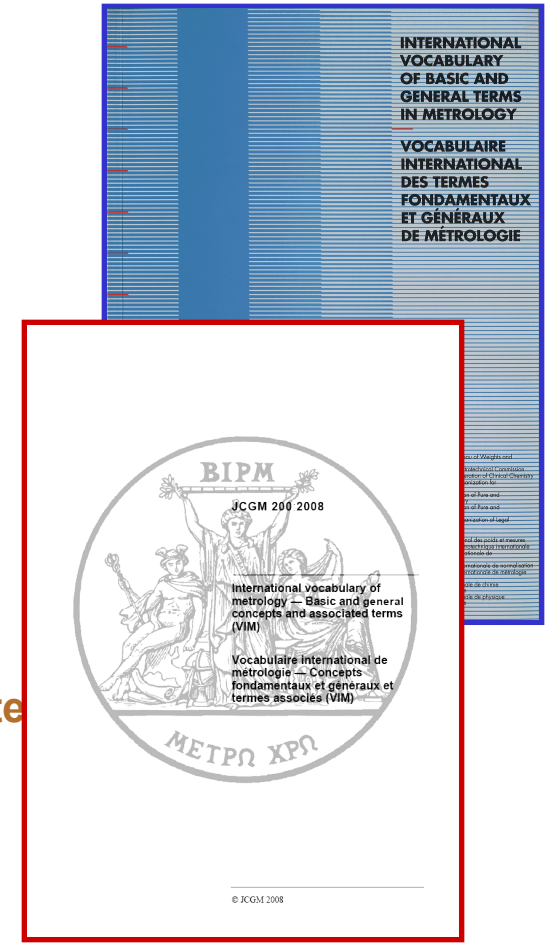
PUBLICATIONS

- **Scientific publications** by the staff on peer-review science journals.
- Metrology awareness-raising publications in NGO and trade publications and BIPM **promotional material.**
- **Publications** aimed at **supporting international metrology** (e.g., the SI Brochure, the GUM and VIM).
- ***Metrologia*** is an international journal dealing with the scientific aspects of metrology.

PUBLICATIONS

International vocabulary of metrology (VIM)
third edition

- A joint publication from: BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML and ILAC under the auspices of the **JCGM-WG2.**
- Contains **over 140 definitions.**
- Text in **English and French.**
- **Paper version** available from **ISO** (ISO/IEC Guide 99:2007).
- **Electronic version** freely available at the **BIPM website**
- Can be translated to other languages with previous permission of the BIPM.

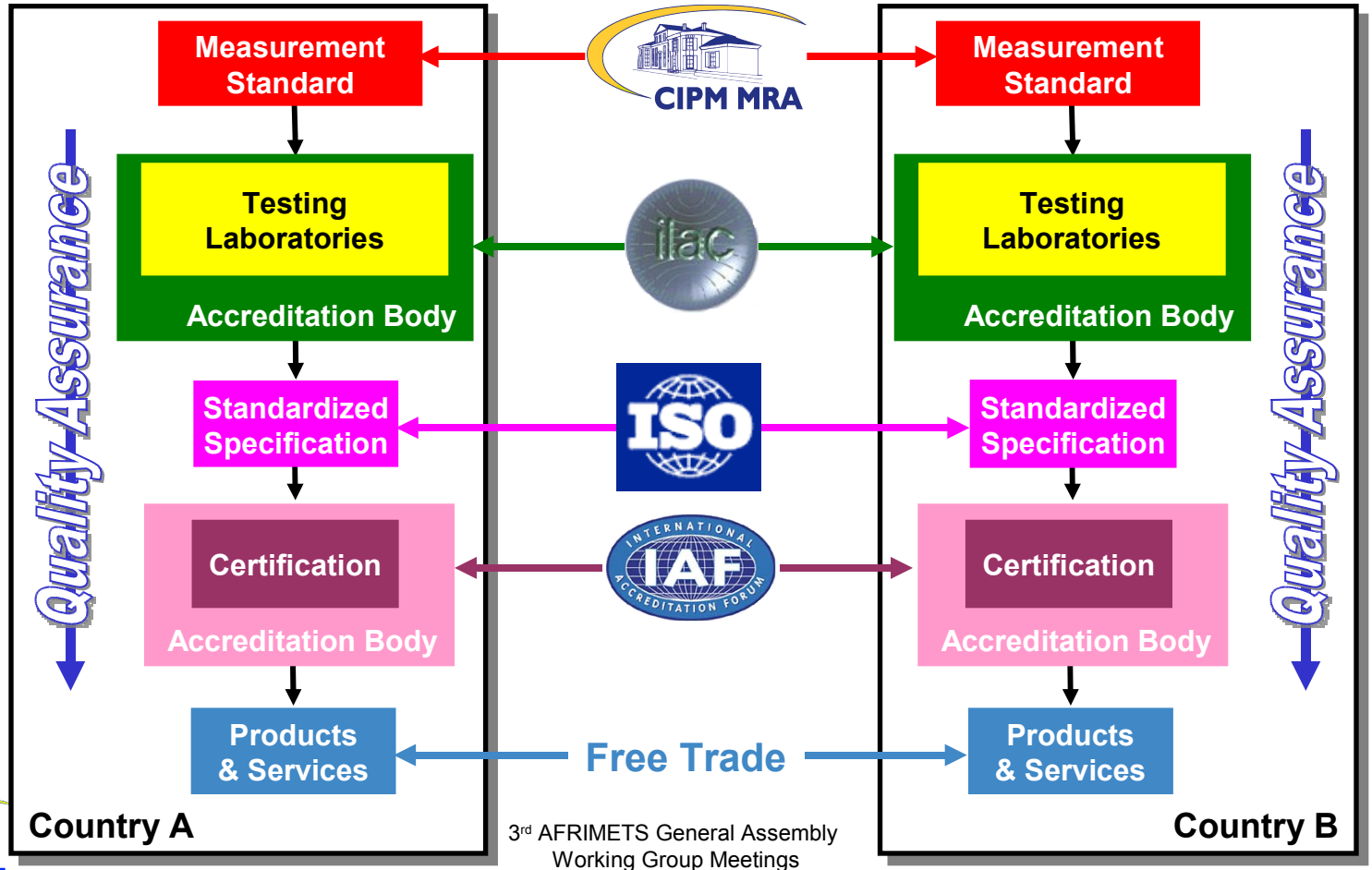


http://www.bipm.org/vim

THE INTERNATIONAL METROLOGY SYSTEM

INTERNATIONAL QUALITY INFRASTRUCTURE

An **internationally recognized national quality infrastructure** provides the **framework** in which suppliers of products and services can demonstrate **compliance with specifications** within an internationally standardized system.



WHAT DO WE WANT FROM AN INTERNATIONAL METROLOGY SYSTEM?

- **Open** to all users.
- Unique **reference standards** for industry, commerce, society.
- **Traceability** of all measurements to unique reference standards.
- **Confidence** that national standards are equivalent.
- A system which **avoids or eliminates barriers to trade** due to measurements made in different countries.
- **Used** by accreditors, regulators, legislators... i.e., by everybody.

THE CIPM MRA

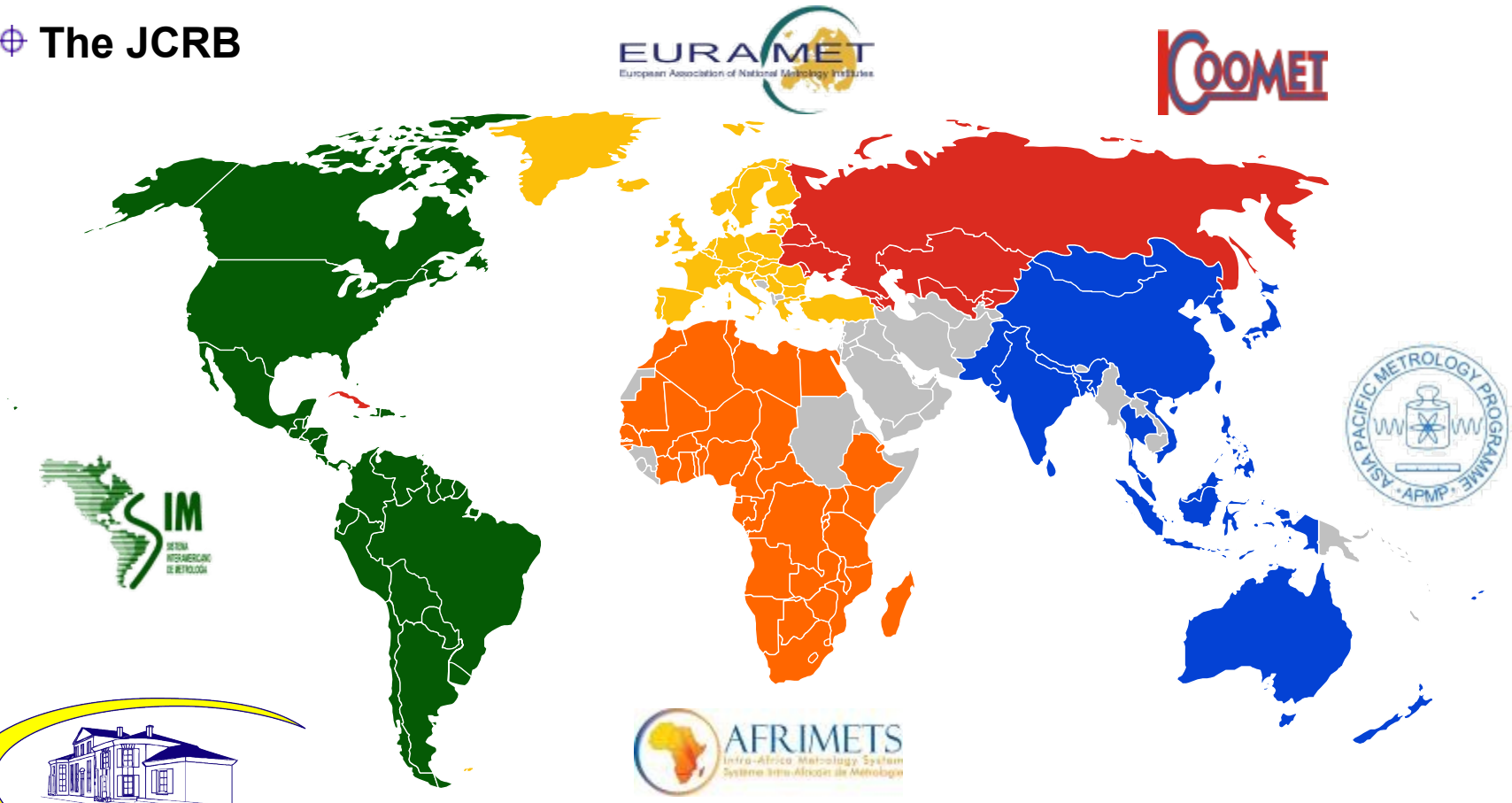
In 1999, and **in support of world trade**, the CIPM established a **Mutual Recognition Arrangement** (MRA) of national measurement standards and of calibration and measurement certificates issued by NMIs. The aim of the MRA is to provide the technical basis for the **worldwide acceptance** of national measurement standards and **calibration and measurement certificates** of NMIs.

Currently, **MRA participants** comprise 74 NMIs and 122 DIs from:

- 46 Member States of the BIPM;
- 2 International Organizations (IAEA and IRMM); and
- 26 States/Economies that are Associates of the CGPM.

Regional Metrology Organizations

- The JCRB



BIPM

THE CIPM MRA

From the moment that the CIPM MRA is signed, the signatory:

- **accepts the process** specified in the CIPM MRA for establishing the **Key Comparison Database**; KCDB
- **recognizes** the results of key and supplementary comparisons as given in the **KCDB**;
- recognizes the CMCs of **other** participating NMIs as given in the **database**.

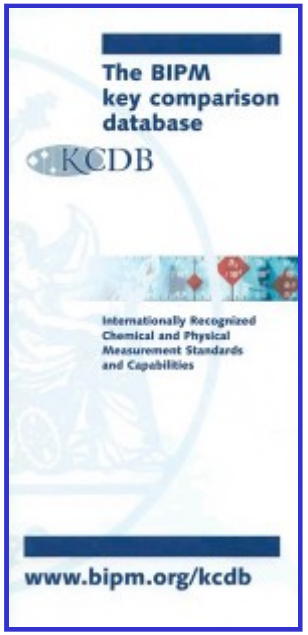
All review by peers

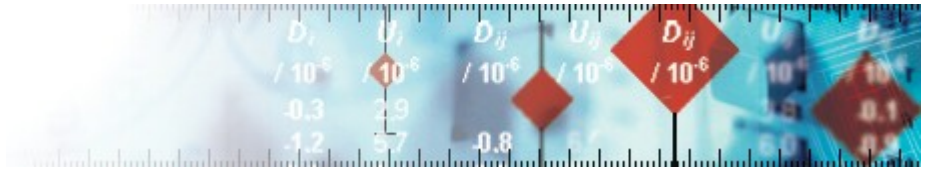
Participating NMIs must meet these criteria:

- Have **technical capability** to perform the measurements;
- participate in **comparisons**;
- have a **quality system** implemented.

kcdb.bipm.org

- Contains **over 20 000 validated calibration measurement capabilities (CMCs)** of national laboratories' services.
- **More than 600 key comparisons** from laboratories that also have to maintain a quality system.
- Provides a **way of seeing who does what** at whatever accuracy is required so a database of accepted measurements for regulators, etc.





BIPM GLOBAL ACTIVITY

AGREEMENTS

- Memorandum of Understanding between the CIPM and ILAC.
- Memorandum of Understanding between the BIPM, OIML and UNIDO.
- Memorandum of Understanding on Cooperation between the BIPM and VAMAS.
- Collaboration between the BIPM and the IAEA.

- **Memorandum of Understanding between the CIPM and the WHO (World Health Organization).**
- **Agreement between the CIPM and the WMO (World Meteorological Organization).**
- **Relations with the Codex Alimentarius Commission and WADA.**
- **Agreement with the CIE (International Commission on Illumination).**

JOINT COMMITTEES

- The Joint Committee on Coordination of Assistance to Developing Countries in Metrology, Accreditation and Standardization (**JCDCMAS**). A forum for sharing information among NGOs aimed at supporting **MAS efforts in developing economies**.

- The Joint Committee for Traceability in Laboratory Medicine (JCTLM) provides a worldwide platform to promote and give guidance on internationally recognized and accepted equivalence of measurements in laboratory medicine and traceability to appropriate measurement standards.

IMPORTANT EVENTS

2009 EVENTS

- **JCDCMAS**
  6 March 2009 – BIPM
- **BIPM QS Presentation**
  16 March 2009
- **22nd JCRB**
  17 - 18 March 2009
- **Forum on Metrology Programs for States in Development**
  19 - 20 March 2009
- **2009 World Metrology Day**
  20 May 2009
- **Special session on the CIPM MRA**
  24 June 2009
  part of the 14th International Congress of Metrology
  22-25 June 2009, Paris (FR)

- **23rd JCRB**
  September 2009 – Kazan
- **2009 Directors' Meeting**
  7 October 2009 – BIPM
- **10-year anniversary of the CIPM MRA**
  8 - 9 October 2009 – BIPM
- **98th CIPM**
  13 - 16 October 2009 - BIPM
- **Measurement Challenges for Global Observation Systems and Climate Change Monitoring**
  March 2010 – WMO, Geneva (CH)

CONCLUSIONS

SUMMARY, WHAT DOES THE BIPM OFFER?

- **Cost shared international reference facilities** which are used by all NMIs for comparisons to help reduce uncertainties at the national level.
- **Top level calibrations**, that link your NMI standards directly to the SI.
- Access to **a committee structure** with the **highest level of technical expertise**.
- An **international resource** for NMIs that provides the link to the **SI independent of political ties**.
- An **intergovernmental body that represents the needs of its members** with other international bodies like WHO, FAO, WTO etc…
- A **framework for the advance of measurement science** in benefit of the economy of its member states.
- **Supports for trade and regulations** through equivalence of national standards.

THANK YOU

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