Bureau International des Poids et Mesures

BIPM update

to the WTO TBT Committee

March 2024

1. A general introduction to the BIPM

The International Bureau of Weights and Measures/Bureau international des poids et mesures (BIPM) is the international organization established by the Metre Convention in 1875, through which Member States and Associates act together on matters related to measurement science and measurement standards. It is the home of the International System of Units (SI) and the international reference time scale (UTC).

The objectives of the BIPM are:

- to represent the world-wide measurement community, aiming to maximize its uptake and impact;
- to be a centre for scientific and technical collaboration between Member States, providing capabilities for international measurement comparisons on a shared-cost basis;
- to be the coordinator of the world-wide measurement system, ensuring it gives comparable and internationally accepted measurement results.

In order to meet its objectives, the BIPM works to

- liaise with relevant intergovernmental organizations and other international bodies in order to develop opportunities for the application of metrology to global challenges;
- coordinate international comparisons of national measurement standards agreed to be of the highest priority;
- establish and maintain appropriate reference standards for use as the basis of key international comparisons at the highest level and provide selected calibrations from them;
- coordinate activities between the NMIs of Member States and the RMOs, including the provision of technical services to support the CIPM MRA and the infrastructure for the development and promotion of the SI.

To fulfil its mission and objectives, the BIPM maintains work programmes concerning:

- capacity building, which aims to achieve a global balance between the metrology capabilities in Member States and Associates;
- knowledge transfer, which ensures that our work has the greatest impact;
- the digital transformation of metrology, particularly in the development and establishment of a world-wide uniform, unambiguous and secure data exchange format based on the SI.

2. BIPM SCIENTIFIC AND TECHNICAL ACTIVITIES supporting the global measurement system

The BIPM undertakes scientific work at the highest level on a selected set of physical and chemical quantities for which it has its own laboratories: time metrology, radiation dosimetry, radionuclide metrology, mass metrology, electrical metrology, gas analysis and organic analysis.

The rapid growth of global trade necessitates the mutual recognition of measurement and test results to prevent redundant measurements and tests in both exporting and importing nations. This not only saves costs but also reduces delays and minimizes the potential for disputes regarding these results. Given that an increasing number of manufactured products comprise components from various countries, universally accepted measurements play a pivotal role in facilitating manufacturing and commerce. The BIPM addresses this imperative by:

- ensuring traceability to multiple SI units through the provision of calibration services.
- coordinating high-level scientific comparisons that assist participants in gaining international recognition for their measurement capabilities.
- maintaining publicly accessible online resources like the CIPM MRA database (known as the KCDB). The KCDB offers users dependable quantitative information on the comparability of national metrology services, forming the technical foundation for broader agreements related to international trade, commerce and regulatory affairs.
- providing support and coordination for the development of significant metrological documents, including the Guide to the Expression of Uncertainty in Measurement (referred to as the GUM) and the International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (known as the VIM). The GUM and VIM are two highly influential resources made accessible by the BIPM, which are referenced in the ISO/IEC 17025 standard, making them indispensable for over 60 000 calibration laboratories worldwide.

Time metrology, through the Coordinated Universal Time (UTC) provided by the BIPM, plays a vital role in international trade. It ensures the smooth operation of global commerce, from civil timekeeping and electricity distribution to communication and financial transactions, essential for modern society's functioning.

In the light of the technological progress of the last 10 years, and to support continued scientific advancement, the redefinition of the SI unit of time, the second, is being considered by the Consultative Committee for Time and Frequency (CCTF). The adoption of the redefinition is anticipated in 2030 or later, depending on the fulfilment of the mandatory criteria detailed in the CCTF roadmap.

The BIPM and the International Telecommunication Union Radiocommunication Sector (ITU-R) are enhancing the collaboration to progress towards a continuous UTC. Together with NMI representatives, the BIPM has successfully negotiated several important outcomes for the global time metrology community at the ITU World Radiocommunication Conference 2023, which was held in Dubai (United Arab Emirates) in December 2023.

Mass metrology is crucial in global trade, ensuring fairness, accuracy and trust. It's vital for assessing product quantity and quality worldwide, from bulk commodities like grains to verifying accurate labeling of pre-packaged goods. The BIPM's technical services related to mass metrology and its ongoing research and development efforts addressing the core challenges in mass measurements exemplify the BIPM's foundational support for this specific field.

The BIPM provides calibration services to Members States in mass metrology, promoting world-wide compatibility in mass measurements. It also organizes key comparisons to determine the level of agreement between kilogram realizations from different NMIs. Research and development are carried out in several areas in order to improve services and understanding of the fundamental problems of mass determinations at the kilogram level.

The BIPM's organic analysis laboratory supports measurement services and reference materials from National Metrology Institutes ensuring the safety and quality of various products and services, ranging from clinical chemistry and food analysis to environmental testing, forensics and pharmaceuticals. These are essential components of local, regional and global trade, where accurate measurements are needed to evaluate nutritional content and product safety. Food safety and authenticity depend on rigorous chemical analysis. This can involve confirming that contaminants are

below maximum permitted levels and even determining isotopic composition to verify the origin of premium products like honey and wine. By organizing interlaboratory comparisons for national metrology institutes worldwide, the BIPM contributes to the provision of accurate measurements to ensure safe food and feed, free of chemical contaminants such as pesticide and antibiotic residues and mycotoxins.

The BIPM coordinates an ongoing series of comparisons to support and benchmark NMI technical capabilities for content assignment of pure compounds and calibration solutions, enabling them to demonstrate consistency at levels required to support national health and food priorities.

To enhance the use of fluorine-based quantitative nuclear magnetic resonance methods for purity assignment, the BIPM collaborated with experts from National Metrology Institutes in Brazil, Germany, Argentina, and Japan. The resulting standard reference document ensures the quality and reliability of organofluorine compounds in pharmaceuticals, agriculture, cosmetics, biomolecule analysis, and functionalized materials.

Mycotoxins, toxic compounds produced by moulds on cereals, dried fruits, nuts, and spices, pose health risks. Chemically stable, they survive food processing, causing severe and immediate or long-term illnesses. Worldwide regulations rigorously govern permissible mycotoxin levels in foods. Accurate measurements, reliant on well-characterized materials, ensure compliance.

Initiated in 2016, the BIPM program collaborates with National Metrology Institutes globally. Focused on key mycotoxins (zearalenone, aflatoxin B1, deoxynivalenol, patulin), the project includes interlaboratory comparisons and guidelines for mycotoxin reference materials.

3. INTERNATIONAL LIAISON AND COMMUNICATION

The BIPM works in close cooperation with many other international organisations concerned with different aspects of metrology and continues to develop new contacts where a closer relation might help strengthen the use of the International System of Units (SI), and in due course lead to greater interaction between the BIPM and its stakeholders.

A joint initiative of the BIPM and OIML, World Metrology Day celebrations on May 20 commemorate the anniversary of the signing of the Metre Convention in 1875. Across the world, national metrology institutes advance measurement science by developing and validating new measurement techniques at the required level of sophistication. World Metrology Day recognizes and celebrates their ongoing efforts. The project provides the community with a central resource to promote their activities to raise awareness about the importance of metrology among decision-makers, industry leaders, scientists, etc. Each year, a new theme is chosen, reflecting the current global challenges that require metrological innovation and presenting avenues for developmental exploration. Previous World Metrology Day themes have emphasized the role of measurements in topics that are directly related to the basic science and engineering disciplines, and were related to light, energy, safety, chemistry, science and technology, trade, transport, environment, sport, health and digitalization.

The UNESCO General Conference ratified at its 42nd session in November 2023, the decision of the UNESCO Executive Board. 20 May is now proclaimed as a UNESCO International Day. The endorsement by UNESCO, to be observed annually on 20 May, will significantly enhance global awareness of metrology's role in everyday life and will enhance BIPM's actions in capacity-building with developing economies.

The first celebration of World Metrology Day under the auspices of UNESCO is planned for May 2024.

For the first time a delegation of BIPM staff attended the United Nations Climate Change Conference demonstrating BIPM's commitment to promote the importance of metrology with key stakeholders. Dring the mission, the delegation laid a foundation for collaboration with various liaison organizations at future COP conferences.

4. THE CIPM MRA

The CIPM Mutual Recognition Arrangement (CIPM MRA) is a framework through which national metrology institutes demonstrate the international equivalence of their national measurement standards and calibration and measurement certificates. The CIPM MRA database (known as the KCDB) underpins the CIPM MRA activities and publishes internationally recognized Calibration and Measurement Capabilities (CMCs) for services provided by participating institutes and technical comparisons supporting these CMCs.

Currently in the KCDB are registered:

- 250 CIPM MRA participants
- 1859 comparisons
- 25 870 Calibration and Measurement Capabilities covering 9 metrology areas

5. CAPACITY BUILDING AND KNOWLEDGE TRANSFER PROGRAMME

The **BIPM Capacity Building and Knowledge Transfer (CBKT) Programme** aims to increase the effectiveness with which Member States and Associates engage in the world-wide coordinated metrological system. It is delivered through theoretical (workshops), practical (laboratory placement), remote (online) activities.

- **Capacity Building** covers areas of vital importance to Member States and the BIPM. It also addresses topics of specific interest for Member States and Associates.
- **Knowledge Transfer** takes many forms, involving the BIPM staff, visiting scientists from NMIs/DIs and groups of experts from around the world.

The BIPM hosted the CBKT Programme Forum "Supporting RMO Secretariats," from 27 to 29 September 2023, welcoming 21 staff members from Regional Metrology Organizations' secretariats. The forum's objective was to enhance the secretariats' understanding of the BIPM's activities and services, empowering them to participate effectively in front-line tasks related to the international aspects of metrology. As an outcome of the forum, the BIPM launched a "Toolbox" indexing various BIPM and RMO interactions.

The **BIPM e-learning platform**, launched in 2021, is now shared with all six Regional Metrology Organizations. An essential CBKT tool, it offers a wide range of training materials relevant to the metrology community, including calibration guidelines, data analysis, uncertainty evaluation, administrative reporting and quality aspects.

At present, 22 courses are available around the clock and accessible on any device. The platform grows continually, having already attracted 1100 users from around the world.

6. DIGITAL TRANSFORMATION OF THE BIPM METROLOGICAL SERVICES

The BIPM strategy for digital transformation aims to:

- support the development of a FAIR* SI Digital Framework and other initiatives addressing the digital transformation of global measurements
- support the development of the metrology community by building the global capacity for digital transformation
- provide an international repository for FAIR metrological data

*FAIR principles: Findable, Accessible, Interoperable, Reusable

In February 2024 the BIPM has launched a beta version of the SI Reference Point, the authoritative digital reference for the International System of Units (SI). The SI Reference Point is fully FAIR, and usable by both humans and machines. It provides Permanent Digital Identifiers (PIDs) for the named SI units, SI prefixes, and defining constants, and a parsing tool for interpreting compound units. In the next phase of the project, the identifiers of the SI Reference Point will be introduced into the CIPM MRA database to enhance the "FAIR"ness of the data underpinning the worldwide measurement system.

This is the third service that the BIPM has launched on the SI Digital Framework at si-digital-framework.org. The identifiers for the SI supplement those already made available for CMCs and Service Categories (initially those in PHYSICS). All the services are currently in beta version, and user feedback is encouraged. Over the coming months, the SI Reference Point will be used to enhance the "FAIR"ness of the data in the CIPM MRA database. The BIPM has also developed application programming interfaces for its time data, and for information on the standard frequencies approved for practical realizations of the metre and secondary representations of the second.

The BIPM is signatory to a *Joint Statement of Intent on the digital transformation in the international scientific and quality infrastructure*. Nine international organizations have joined so far: CIE, CODATA, IEC, ILAC, IMEKO, ISC, ISO, NCSLI, OIML. The statement provides the signatory organizations with a platform for indicating their support to the development, implementation and promotion of the SI Digital Framework. A joint workshop "Towards Digital Quality Infrastructure" organized by the signatories will be held at the BIPM headquarters on 5 and 6 March 2024, followed by the first plenary meeting of the CIPM's new Forum on Metrology and Digitalization, on 7 and 8 March.

The mission of the Forum is to advise the CIPM on the SI Digital Framework and the wider implications of the global digital transformation for metrology and for the international Quality Infrastructure, to harmonize internal processes related to digitalization between NMIs, the Consultative Committees, Regional Metrology Organizations, and BIPM headquarters, and to act as a forum to exchange information and create synergies and opportunities for collaboration in this field, including liaison with international QI organizations and relevant industry associations.

ANNEX

64 Member States

(as of March 2024)

Argentina
Australia
Austria
Belarus
Belgium
Brazil
Bulgaria
Canada
Chile
China
Colombia
Costa Rica
Croatia
Czechia
Denmark
Ecuador
Egypt
Estonia
Finland
France
Germany
Greece
Hungary
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Japan
Kazakhstan
Kenya
Korea (Republic of)
Lithuania
Malaysia
Mexico
Montenegro
Morocco
Netherlands
New Zealand
Norway
Pakistan
Poland
Portugal
Romania
Russian Federation
Saudi Arabia
Serbia
Singapore
Slovakia
Slovenia
South Africa
Spain
Sweden
Switzerland
Thailand
Tunisia
Turkey
Ukraine
United Arab Emirates
United Kingdom
United States of America
Uruguay

36 Associates of the CGPM (States and Economies*)

(as of March 2024)

Albania
Azerbaijan
Bangladesh
Bolivia
Bosnia and Herzegovina
Botswana
Cambodia
CARICOM*
(11 members:
Antigua and Barbuda
Barbados
Belize
Dominica
Grenada
Guyana
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Suriname
Trinidad and Tobago)
Chinese Taipei*
Ethiopia
Georgia
Jamaica
Kuwait
Hong Kong (China)*
Ghana
Latvia
Luxembourg
Malta
Mauritius
Moldova
Mongolia
Namibia
North Macedonia
Oman
Panama
Paraguay
Peru
Philippines
Qatar
Sri Lanka
Syrian Arab Republic
Tanzania
Uzbekistan
Viet Nam
Zambia

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