

BIPM update

to the WTO TBT Committee

June 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 National Metrology Institutes (NMIs) of Member States and the Regional Metrology Organizations (RMOs), including the provision of technical services to support the CIPM Mutual recognition Arrangement (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 Consultative Committee for Time and Frequency (CCTF) and the Ultrasonic, Ferroelectrics, and Frequency Control Society (a part of the Institute of Electrical and Electronics Engineers) have initiated a capacity-building project aimed at enhancing the capabilities of Time and Frequency laboratories. The first outcome of the project, available on the BIPM e-learning platform, is designed to impart knowledge and skills related to time transfer measurements.

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 NMIs 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 NMIs 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 NMIs 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 NMIs 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, NMIs 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 theme of the 2024 World Metrology Day is Sustainability. The focus for World Metrology Day in 2024 is therefore on the numerous measurement opportunities that contribute to the establishment of a sustainable global economy and environment. This year also marks the official recognition by UNESCO of 20 May each year as a UNESCO International Day. This designation opens

new avenues to promote metrology, aligning with UNESCO's mission to construct a better world through science and education.

The 2024 poster was designed in association with EURAMET (European Association of NMIs/RMO) and TÜBİTAK UME, Türkiye. The resource website additionally provides access to the Press Release, the Directors' Message, and the official posters in both English and French.

The first celebration of World Metrology Day following the formal proclamation by UNESCO was organized in partnership with UNESCO and the OIML on 14 May 2024. Keynote speeches highlighted the pivotal role of metrology in advancing global endeavours toward establishing a sustainable economy and environment for future generations. The presentations featured various initiatives at both national and regional levels, offering insights into how metrology facilitates sustainable development.

More information on 20 May - World Metrology Day can be found at:

<https://www.worldmetrologyday.org/>

<https://www.unesco.org/en/days/metrology>

<https://www.unesco.org/en/articles/world-metrology-day-launch-event?hub=103298>

4. THE CIPM MRA

The CIPM MRA is a framework through which NMIs demonstrate the international equivalence of their national measurement standards and calibration and measurement certificates. The CIPM MRA database (known as the KCDB) provides technical support for operation of the CIPM MRA processes and publishes internationally recognized Calibration and Measurement Capabilities (CMCs) for services provided by participating institutes and scientific comparisons underpinning these CMCs.

Currently in the KCDB are registered:

251 CIPM MRA participants

1866 comparisons

25 908 Calibration and Measurement Capabilities covering 9 metrology areas

The BIPM provides support to the CIPM MRA user community through the various Capacity Building and Knowledge Transfer Programme initiatives.

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 RMOs. 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.

5.1. Young metrologists' 2050+ vision to shape the future of metrology

The BIPM, in collaboration with RMOs, is conducting a foresighting exercise to trigger and facilitate visionary ideas for future opportunities and challenges through workshops, debates and interviews among groups of young metrologists. The results of this exercise will complement the CIPM Strategy 2030+.

The first stage of the exercise – a series of online discussion workshops with all six RMOs have now been completed. Young metrologists working at NMIs were able to discuss the changes in this dynamic area, including emerging trends and technologies that could impact metrology in 2050 and beyond. They were also bringing to the discussions the societal, economic and environmental factors that may drive these changes and how they may influence the future of metrology.

The next stage will be the consolidation workshop, which will include online interviews with the young metrologists who submitted the best responses.

6. DIGITAL TRANSFORMATION OF THE BIPM METROLOGICAL SERVICES

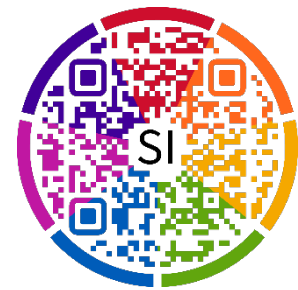
The BIPM strategy for digital transformation aims to:

- 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

There are currently three digital services available on the SI Digital Framework (see <https://si-digital-framework.org>). These are all in beta-testing phase and user feedback is warmly encouraged.

A cornerstone of the SI Digital Framework is the SI Reference Point, which is usable by both humans and machines and designed to be the authoritative digital reference for the International System of Units (SI). 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 collaboration with the CIPM's Consultative Committees the BIPM is now preparing the introduction of these and other PIDs into the CIPM MRA database, to enhance the "FAIR"ness of the data underpinning the world-wide measurement system.



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.

The Forum on Metrology and Digitalization, which held its first plenary meeting in March 2024, has for mission 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, RMOs 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.

A number of Working Groups (on strategy, coordination between CIPM Consultative Committees and RMOs) and *ad hoc* Task Groups (on the SI Digital Framework, FAIR for Metrology, Data Quality in Metrology, etc.) of the Forum are now in place, the terms of reference for which will soon be published on the BIPM website.

ANNEX

64 Member States

(as of June 2024)

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

36 Associates of the CGPM (States and Economies*)

(as of June 2024)

Albania	Kuwait
Azerbaijan	Hong Kong (China)*
Bangladesh	Ghana
Bolivia	Latvia
Bosnia and Herzegovina	Luxembourg
Botswana	Malta
Cambodia	Mauritius
CARICOM* (11 members: <i>Antigua and Barbuda</i> <i>Barbados</i> <i>Belize</i> <i>Dominica</i> <i>Grenada</i> <i>Guyana</i> <i>Saint Kitts and Nevis</i> <i>Saint Lucia</i> <i>Saint Vincent and the Grenadines</i> <i>Suriname</i> <i>Trinidad and Tobago</i>)	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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