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National Metrology Systems

The framework for States to participate in the globalization of trade and services that depend on measurement-based requirements

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Critical national and international goals such as economic growth, innovation, energy and the environment, good health, food security and fairness of consumer transactions in the marketplace depend on accurate and trusted measurements of physical, chemical and biological quantities. It is important that a country has an efficient and appropriately funded metrological infrastructure because none of these quantities can be correctly and consistently measured without it. The science of measurement and its application is known as metrology; metrology includes all theoretical and practical aspects of measurement, whatever the measurement accuracy and field of application.

States which participate successfully in the global marketplace, and which have a thriving and diverse national economy that supports their businesses and consumers, have a formalized national metrology system (NMS).

A national metrology system comprises the:

- **organizations (public and private)**
- **policies**
- **appropriate legal and regulatory framework, and**
- **practices**

needed to support and enhance the metrology activities undertaken within their country or economy.

The benefits of a national metrology system are that:

Governments can be confident that the measurements made throughout their economy are 'right', and that they gain access to the technical and legal framework, which constitutes a trusted and solid foundation for wider agreements related to international trade, commerce and regulatory affairs. The interdependent world economy requires an open, transparent, and comprehensive scheme that demonstrates equivalence between technical and legal requirements of measurement capability, regulated instrumentation, and prepackaged products.

Business, industry and manufacturers have the possibility to produce goods and services of ever higher quality and added value, and can be assured that products and services involving metrologically traceable measurements will gain acceptance in national and international markets. They can be assured that manufactured parts imported from foreign suppliers will meet national standards and be of dependable quality, reducing duplication of measurements. Measurement science enables and drives industrial innovation in advanced production and instrumentation. Parties searching for measurement solutions can choose the optimal source, based on delivery time, cost and level of uncertainty, regardless of whether the source is inside or outside the country.

Regulators can be confident of conformity assessment outcomes by utilizing the scientific and legal metrology systems and furthermore, by recognizing the associated international agreements and standards avoid creating technical barriers to trade. This is a sound approach at all stages, for example, with regard to policy advice, conformity assessment and verification. They can rely on the knowledge within their national metrology system when implementing regulations. Decisions will be based on reliable and objective results.

Citizens interests are protected; they are directly and indirectly the beneficiaries of metrology in many ways, including public health, safety, protection of the environment and the consumer, the levying of taxes and duties as well as fair trade. They can be confident that purchases of measured items in the marketplace (for example, a litre of petrol or milligram of medicine) will be fair, safe and have the expected quality. They can be confident that laws intended to protect them or impose a sanction (such as infringements of the blood alcohol level of machine operators) will be enforced fairly.

The role of the government in a national metrology system

The role is to provide society with the necessary means to establish confidence in measurement results. Countries provide these protections through their legal systems, so they need a legal framework that covers how measurements and measuring instruments are to be treated in a legally acceptable manner. This requires governments to undertake a number of activities to promote metrology, to develop appropriate infrastructures, to support research and development in metrology, and to protect both individuals and companies against possible measurement-related fraud. The importance of metrology for social and economic development calls for a comprehensive and coherent policy on metrology for which laws must take account of all the issues concerning consumers, enterprises, education, health, safety and security of the population.

International aspects of national metrology systems

Many aspects of measurement are global in nature, so the legal framework of the NMS should take account of this interconnectedness. International mutual recognition of the measurement capabilities of a country is critical to the removal of technical barriers to trade and, therefore, to participation in multilateral trade agreements such as those of the World Trade Organization. As part of their national metrology system, countries are strongly encouraged to take part in both the key international (OIML, BIPM, ILAC, ISO) and regional organizations, and the mutual recognition agreements or arrangements which they provide. The institutional and legal framework in a country needs to facilitate participation in these organizations, and dedicated resources need to be provided for that participation.

Assessing metrology needs that support national priorities

One of the first tasks of a government in establishing the NMS is to develop a national metrology policy. Developing a national metrology policy begins with assessing the specific needs and priorities of the country as they relate to the economic sectors, technological infrastructure, scientific capability, population size and geography; and then mapping those priorities against already existing metrological capabilities. Such analysis should also consider how the economy is likely to develop in the future. It is important to identify the scope of the legal metrology regulations on those areas that the government considers necessary to protect. This should include an economic analysis of the resources required for implementing and operating the NMS. Consideration should be given to the specific institutions and legal and regulatory framework proposed in the NMS. The evaluation of the status and goals should utilize national expert bodies and/or international experts.

Policy implementation options for governments

In addition to determining the needs and goals of the NMS, it is important to consider practical implementation aspects in order for the NMS to be a benefit to the state. Broadly, these will include the form of the institutions where metrology activity will occur, how the institutions coordinate activities among themselves, what regulatory and enforcement options will be implemented, and how the NMS will be funded.

Legislation for metrology

Once the status of metrology has been assessed and the decision taken to develop a national metrology system, a "law on metrology" should be written and passed. Annex B of the BIPM and OIML joint publication - *"National metrology systems - Developing the institutional and legislative framework" (OIML D 1:2020)* sets out a possible model law, which provides preferred logical structure and minimum elements to include. This model law was developed based on the experience of many countries in developing their NMS. The elements should be tailored from the model law, taking into account the legislative drafting practice and cultural needs of the country, whilst maintaining their simplicity and clarity. Elements which governments need to consider include:

1. obligation by the law of what is mandatory and what is forbidden
2. enforcement practices
3. necessary sanctions
4. notifications
5. status of public bodies participating in the infrastructure.

Responding to a changing world

The economies and societies, which national metrology systems support, are constantly changing and developing. Some recent changes, and future developments that will affect metrology systems include: continued introduction of digitalization in all areas; redefinition of the SI and the increased availability of intrinsic standards and self-calibrating instruments; the proliferation of sensors and the "internet of things"; introduction of new technologies, such as electric vehicles and GPS-based distance measurement, that will require new measurement traceability and verification methods. If metrology systems are to be responsive to these changes, it is important that flexibility be built into them, in terms of policy development, institutional structures, legislative arrangements, personnel training, and engagement with the public and society.

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This brochure has been developed from the BIPM and OIML joint publication - ***"National metrology systems - Developing the institutional and legislative framework" (OIML D 1:2020)***.

For more complete information, please refer to this document and its references. The document is available through the BIPM and OIML websites.

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Glossary of acronyms

BIML	International Bureau of Legal Metrology
BIPM	International Bureau of Weights and Measures
CGA	Central Government Authority
CIPM	International Committee for Weights and Measures
CIPM MRA	CIPM Mutual Recognition Arrangement
FAIR	Findable, Accessible, Interoperable, and Reusable
GUM	Guide to the expression of uncertainty in measurement
IEC	International Electrotechnical Commission
ILAC	International Laboratory Accreditation Cooperation
ILAC MRA	ILAC Mutual Recognition Arrangement
ISO	International Organization for Standardization
JCGM	Joint Committee for Guides in Metrology
KCDB	BIPM Key Comparison Database
NMI	National Metrology Institute
NMS	National Metrology System
NQI	National Quality Infrastructure
OIML	International Organization of Legal Metrology
OIML-CS	OIML Certification System
QMS	Quality Management System
RMO	Regional Metrology Organization
RLMO	Regional Legal Metrology Organization
SI	International System of Units, also referred to as the metric system
VIM	International Vocabulary of Metrology

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