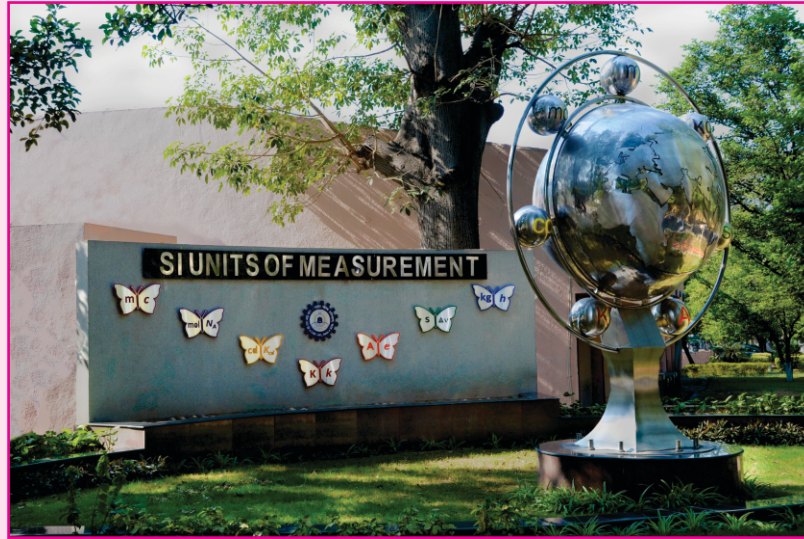


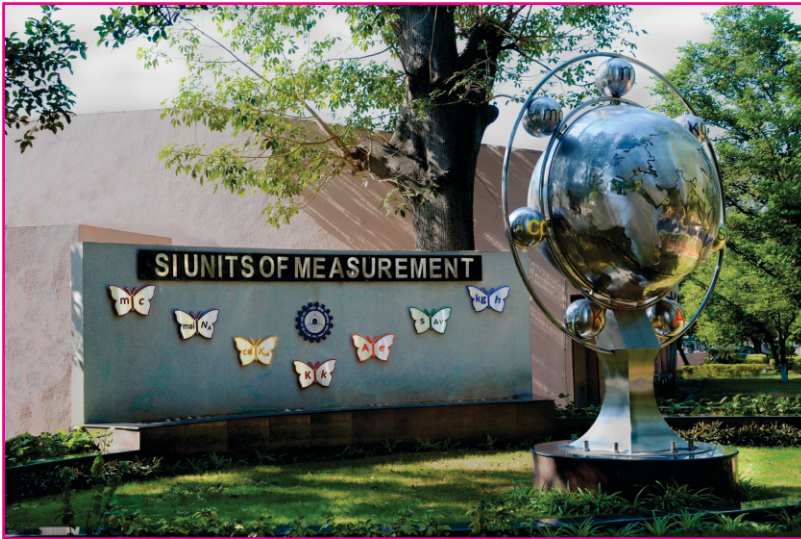
NPL POLICY ON METROLOGICAL TRACEABILITY



सी एस आई आर - राष्ट्रीय भौतिक प्रयोगशाला
CSIR-NATIONAL PHYSICAL LABORATORY

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PREAMBLE

The CSIR-National Physical Laboratory, New Delhi has documented a Policy on Metrological Traceability which stipulates its role as National Metrology Institute (NMI) in India in establishing, maintaining, upgrading and disseminating national standards of measurements through unbroken chain of traceability to SI units. The policy and supported reference documents are for intended use within CSIR-NPL and also to serve its clients / customers. The policy document addresses many of the frequently asked queries and doubts raised by customers.

1. Introduction

CSIR-National Physical Laboratory (CSIR-NPL), a constituent laboratory of Council of Scientific and Industrial Research (CSIR), New Delhi was established by Act of Parliament in 1950 with a clear mandate to be the custodian of National Measurement Standards as National Metrology Institute (NMI) of India and to disseminate the measurement standards through need based traceable testing and calibration services to industry and users across the country to pave the way for utilizing science and technology as a means for industrial growth and development, as well as to give fillip to the fledgling Indian industries. CSIR-NPL also maintains global compatibility and excellence of measurement standards through participation in international key comparisons and publishing key comparison reports; and Calibration and Measurement Capabilities (CMCs) on BIPM website. Therefore, the role of CSIR-NPL is extremely vital to drive the growth engines of the nation and improve quality of life, which in turn, would save precious lives, resources and time.

The quality infrastructure of a country relies on metrology, standards, accreditation, conformity assessment and market surveillance. In India, the premier organizations responsible for existing quality infrastructure are NPL (for scientific and industrial metrology); Bhabha Atomic Research Centre, BARC (for nuclear radiation metrology), Mumbai; Department of Weight and Measure, now Legal Metrology Department (for legal metrology), New Delhi; Bureaus of Indian Standards, (BIS), New Delhi (for documentary standards for products and services) and Quality Council of India, (QCI), New Delhi (for accreditation and certification).



Fig. 1: Metrological Traceability Pyramid at NPL

2. Scope

The main purpose of the NPL Policy on Metrological Traceability is to state the NPL role in the establishment of unbroken chain of metrological traceability.

The policy defines the metrological traceability used by NPL and its role along with its beneficiaries in achieving traceability of measurement results for measurements performed within the laboratory and for the services being rendered to NPL clients. NPL is also the signatory of CIPM Mutual Recognition Arrangement (CIPM-MRA) through which NPL demonstrates the international equivalence of its measurement standards and the calibration and international acceptability of measurement certificates it issues.

In addition to the above, NPL Policy on Metrological Traceability assists its beneficiaries in establishment of traceability of their measurement results and to assess the claims of traceability made by others. This is done directly through the apex level calibration services provided by NPL, through the provision of NPL measurement-related products and technologies, certified reference materials (CRM), proficiency testing, consultancy services and collaboration with organizations, through the development and dissemination of technical information on traceability and through conducting industrial training programs, skill development programs on metrology and coordinated outreach programs. This policy document is intended to communicate the role of NPL in metrological traceability for the overall growth of the nation and to focus its efforts to the metrology related training and activities. This policy, along with supplementary documents and publications are aimed to assist NPL staff and beneficiaries in their understanding, interpretation, and implementation of the policy, and to serve as a resource for the customers.

The CSIR-National Physical Laboratory, New Delhi has documented this Policy on Metrological Traceability which stipulates its role as NMI in India in establishing, maintaining, upgrading and disseminating national standards of measurements through unbroken chain of traceability to SI units. The policy and supported reference documents are for intended use within CSIR-NPL and also to serve its clients/customers. The policy document addresses many of the frequently asked queries and doubts raised by customers.

The normative documents^[1-3] are referred and used in the text in such a way that some or all of their content constitutes requirements of this document.

3. Terms and definitions

3.1 Act of parliament — The Legal Metrology (National Standards) Rules (2011), Chapter III 'National Standard', section 23(1) states that "the work relating to the realisation, establishment, custody, maintenance, determination, reproduction and updating of national standards of weights and measures shall, on the commencement of these rules, be the responsibility of the National Physical Laboratory"^[4].

3.2 Beneficiaries/Clients/Customers — These terms are used in the policy to indicate industries, laboratories and academic institutes or any other user which produce or utilize the products or services of NPL with traceable measurements.

- 3.3 Bhabha Atomic Research Centre (BARC)** — BARC is India's premier nuclear research organisation which also maintains the national standards for nuclear radiation as Designated Institute^[5].
- 3.4 Bhartiya Nirdeshak Dravya (BND)** — A reference material produced by NPL or a commercial supplier with a well-defined traceability to NPL established via specific criteria and protocols defined and documented by NPL and tailored to meet the needs of the beneficiaries / clients / customers^[6].
- 3.5 Bureau of Indian Standards (BIS)** — BIS is the National Standard Body of India established for the harmonious development of the activities of standardization, marking and quality certification of goods and for matters connected there with or incidental thereto^[7].
- 3.6 Calibration** - Set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or reference material, and the corresponding values realized by standards. (International vocabulary of metrology - Basic and general concepts and associated terms^[1], definition 2.39).
- 3.7 Calibration and Measurement Capabilities (CMC)** — "In the context of the CIPM MRA and ILAC Arrangement, and in relation to the CIPM-ILAC Common Statement, the following shared definition is agreed upon: A CMC is a calibration and measurement capability available to customers under normal conditions:
- (a) as published in the BIPM key comparison database (KCDB) of the CIPM MRA; or
 - (b) as described in the laboratory's scope of accreditation granted by a signatory to the ILAC Arrangement"^[8].
- 3.8 Certificates** — It is a documented result of a calibration. Sometimes it is called a calibration certificate or a calibration report. In case of certified reference material, this certificate can also refer to the document stating one or more property values and their uncertainties, and confirming that the necessary procedures have been carried out to ensure their validity and traceability^[1,3,9].
- 3.9 Certified reference material (CRM)** — A reference material (RM) characterized by a metrological valid procedure for one or more specified properties, accompanied by a certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability. The concept of value includes qualitative attributes such as identity or sequence. Uncertainties for such attributes may be expressed as probabilities^[9].
- 3.10 International Key Comparisons** — As per CIPM-MRA, "a key comparison

is one of the set of comparisons selected by a Consultative Committee to test the principal techniques and methods in the field. Key comparisons may include comparisons of representations of multiples and sub-multiples of SI base and derived units as well as comparisons of artefacts"^[10].

- 3.11 Legal Metrology Department** — Legal Metrology Department, earlier called Weights and Measures Department is a part of Ministry of Consumer Affairs, Govt. of India. The department works in relation to the mandatory technical and legal requirements which have the objects of ensuring public guarantee from the point of view of security and accuracy of the weights and measurements^[11].
- 3.12 Measurement result** — According to the VIM: set of quantity values being attributed to a measurand together with any other available relevant information, generally expressed as a single measured quantity value and a measurement uncertainty. The concept of traceability covers both measurement results of quantity values and of nominal property values such as chemical identity and sequence^[1] (definition 2.9).
- 3.13 Measurement uncertainty** — Non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used^[1] (definition 2.26 (3.9)).
- 3.14 National Metrology Institute (NMI)** — National Metrology Institute (NMI) of a country realise SI units, establish, maintain, upgrade and disseminate national standards of measurements and conducts research and developmental activities in the field of scientific metrology. An NMI also provides metrological traceability to international standards. As per CIPM-MRA, CSIR-National Physical Laboratory is a signatory NMI of India^[12].
- 3.15 National or international standards** — Measurement standards (national) recognized by national authority to serve in the country; measurement standards (international) recognized by signatories to an international agreement and intended to serve worldwide^[1].
- 3.16 Proficiency testing** — As per ISO/IEC 17025: 2017 "evaluation of participant performance against pre-established criteria by means of inter-laboratory comparisons"^[2] (definition 3.5).
- 3.17 Quality Council of India (QCI)** — It is an accreditation body in the country to establish internationally acceptable mechanism for recognition of conformity assessment of results^[13].
- 3.18 Quality Infrastructure** — The system comprising the organizations (public and private) together with the policies, relevant legal and regulatory framework, and practices needed to support and enhance the quality, safety and environmental soundness of goods, services and processes^[14].

- 3.19 RMP outreach program** — Here meaning a NPL program or collaboration, liasoning with external reference material producing groups^[6].
- 3.20 Unbroken chain of calibrations** — Here it means that the traceability is obtained with successively linked chain of calibrations each with documented uncertainty and finally linked to SI units with the help of national or international standards.

4. Statement of policy

In order to achieve its mandate and to establish the quality in measurement while ensuring that the use of NPL name, products, and services is within the ambit of its authority and responsibility, NPL;

- 4.1** Accepts the definition of metrological traceability provided in the International vocabulary of metrology - Basic and general concepts and associated terms (VIM): "property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty."^[1] for own use and endorses for use by others;
- 4.2** Follows the Quality System as per IS/ISO/IEC 17025:2005 or any updated version, consciously and effectively;
- 4.3** Establishes metrological traceability to SI units by providing apex level calibration, certification and dissemination of standards compatible to the international standards through the continuous research and development;
- 4.4** Asserts, in cases where the metrological traceability to SI units is not possible directly, it establishes the metrological traceability by using the certified reference materials, *e.g.* Bhartiya Nirdeshak Dravya (BND) developed in-house or provided by the accredited reference material producers through RMP outreach program;
- 4.5** Takes the responsibility of metrological traceability of measurement results certified by NPL, while assessing the validity of such a claim is the responsibility of the user of that result;
- 4.6** Confirms, especially in the conflict of interest regarding the claim that NPL does not define, state, guarantee, or certify metrological traceability of the results of measurements except those that certified by NPL itself, either directly or through official collaborations;
- 4.7** Cooperates on formulation of standard definitions, its clarifications, and recommended procedure with national and international organizations bearing the responsibility for defining, stating, assuring, or certifying metrological traceability; and
- 4.8** Prepares and disseminates technical information on metrological traceability through industrial training programs, skill development programs on metrology and coordinated outreach programs.

ANNEXURE – A

Frequently Asked Questions (FAQs)

This section is aimed to address most of the Frequently Asked Questions (FAQs) which are generally raised by the customers regarding the metrological related terms and NPL's role in it.

1. What is metrological traceability?

The definition of traceability provided in the International vocabulary of metrology — basic and general concepts and associated terms (VIM): "property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty"^[1] for own use and endorses for use by others.

As clear from the definition, the metrological traceability is a property of the measurement result, not of an instrument, lab or report (figure 2).

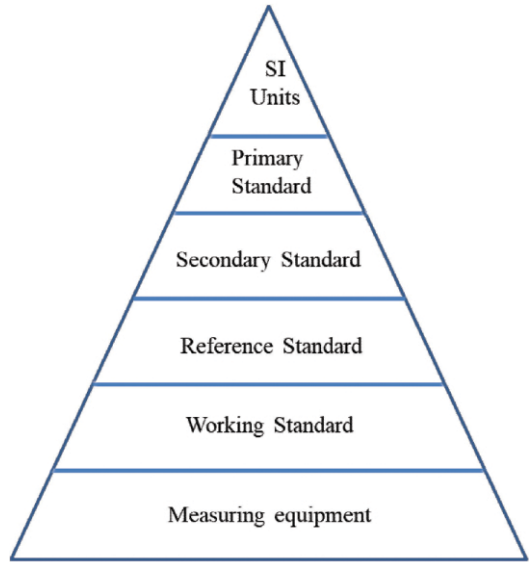


Fig. 2: Metrological Traceability Pyramid

2. What is NPL?

CSIR-National Physical Laboratory (NPL) is mandated to be India's "National Measurement Institute" (NMI) by an act of Parliament (The Gazette of India) and also legal metrology rules associating with it. Being the custodian of the National Standards of Measurements, NPL is responsible for the realization, establishment, up-gradation, maintenance and dissemination of standards at par to international level, providing metrological traceability across the country.

The mandate of NPL is to ensure the realizations of SI units as national standards and to transfer the values of the standards to the national measurement system through calibrations, testing and other measurement related services. The customers who are the direct beneficiaries of NPL make their measurements results traceable to those of NPL, and hence to the SI units. These companies, in turn, use their standards to provide measurement services to their customers hence assuring quality in the measurements across the country.

3. What is the CIPM MRA and what is its importance in metrological traceability?

The CIPM Mutual Recognition Arrangement (CIPM MRA) is the framework through which NMI's demonstrate the international equivalence of their

measurement standards and the calibration and measurement certificates they issue. The mutual recognition of calibration and measurement certificates requires that each NMI participate in the activities of the BIPM (including key measurement comparisons) and have a suitable way of assuring quality in the results of its measurement services. The results of the key comparisons and specific statements of the calibration and measurement capabilities (CMCs) of the signatory NMI are entered in CIPM MRA Key Comparison Data Base (KCDB)^[15].

4. I want my measurement results to be traceable to SI units through NPL. What do I have to do?

To achieve traceability of measurement results to SI units through standards maintained by NPL, you need to trace your measurement results through an unbroken chain of calibrations, including determining the uncertainties at each step, to NPL standards as the specified references. One can also obtain traceability directly from NPL or can obtain traceability from laboratories/industries which have their measurement results traceable to NPL through unbroken chain of calibrations with documented uncertainty calculation at each step.

5. How does NPL establish the traceability of its own measurement results?

NPL establishes its traceability following the definition of the metrological traceability as per International vocabulary of metrology - Basic and general concepts and associated terms (VIM). NPL realizes the SI units of measurements through internationally accepted procedure and perform international intercomparisons with other NMIs of the world to authenticate its results. NPL maintains the national measurement standards of India.

6. Is NPL NABL (National accreditation board for Testing and Calibration Laboratories) accredited or not?

Most of the NMIs, NPL in case of India, are internationally peer reviewed and are signatories of the CIPM MRA. Hence such NMIs, (NPL in case of India) do not require accreditation from national bodies like NABL. For details please refer ISO/IEC 17025:2017, A.3.1^[2].

7. Does NPL provide Certified Reference Materials?

Yes. The Certified Reference Materials provided by NPL are called Bhartiya Nirdeshak Dravya (BND). BND is a registered trademark name of NPL. NPL's BND programme is introduced very recently. Although, it has started Certified Indian Reference Material program way back in 1986. NPL has released several BNDs recently and Government of India has supported NPL to strengthen its BND program by developing BNDs in the area of AYUSH, Materials, Nanotechnology, Medicine, Food & Agriculture and Biologics^[6].

8. If I purchase a BND, does that make my measurement results traceable to NPL?

Merely purchasing BND does not automatically make the customer's measurement results traceable to reference standards developed and maintained

by NPL. A claim of traceability to reference standards developed and maintained by NPL can be asserted by proper use of appropriate BNDs and reference to the certified values and uncertainties provided by a NPL Certificate along with the purchased BND.

9. Can NPL provide me certificate with validity of four years or more?

We provide calibration certificates with next recommended date based on the long research experience, trends of data, types and handling of the particular type of instruments. However, the decision of the validity of the calibration intervals lies with the users and which can be ascertained based on the guidelines given in OIML D10 (2007)^[16].

10. Who is responsible for establishing the traceability of measurement results?

The responsibility for establishing the traceability of measurement result is with the provider of the result. If NPL is providing the measurement results then NPL takes the responsibility for the measurement traceability. Same is the case with other organizations.

11. Is there a need to re-examine the metrological traceability periodically?

Metrological traceability depends upon several factors e.g. the measurement requirements, the needs of the clients, the dependability of the equipment and standards, the environmental effects, etc. So there is a need to re-examine the metrological traceability on a regular basis to ensure its integrity and continuity^[17].

12. Does NPL provide the metrological traceability for the ionizing radiation?

No, as per CIPM-MRA, Bhabha Atomic Research Centre (BARC), Mumbai, a designated institute, is responsible for providing the metrological traceability for ionizing radiation parameters in India^[12]. NPL, New Delhi, being NMI of India^[12] is responsible for providing metrological traceability for all other parameters.

13. Does NPL provide the metrological traceability for the health instruments / equipment?

Yes, NPL provides metrological traceability to health instruments. The NPL has further strengthened its metrology programme for proving metrological traceability to wide range of medical instruments/equipment.

14. Does NPL provide any training/certification course in the field of metrology and metrological traceability?

Yes, NPL provides training in metrology on regular basis. NPL has formulated many training programs/courses in different measurement parameters like mass, length, temperature etc. for industries, public and private organizations and research laboratories. The annual training calendar is uploaded /available on NPL website (www.nplindia.org). NPL also provides one year certification course on 'Precision Measurements and Quality Control (PMQC)'.

There is also a provision for short term training programs especially for post-graduate students. NPL is also planning to launch e-Learning modules for such training courses.

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