



Examples of reference materials

JCTLM Working Group for Traceability: Education and Promotion (WG-TEP)

Area 2: Mini-presentations to explain scientific concepts



What are reference materials?

- Reference materials (RM) play a critical role in analytical chemistry and clinical analysis.
- Since most analytical instrumentation is comparative, the use of a sample of a well known composition, the RM, is required for accurate calibration.
- Reference materials are produced under controlled manufacturing procedures and values are assigned based on fitness for purpose.



Uses of reference materials

- Calibration of values indicated by a measuring system or of another reference material;
- Validation or control of trueness of measured values in a given laboratory, or in a group of laboratories;
- Evaluation of the performance of a new measurement procedure.



Types of reference materials

Reference Material	Usage
Primary Reference Standard	Certified standard with the highest metrological order. A calibrator with certified purity traceable to the SI unit with associated uncertainty.
Primary Reference Material	Material used for verification of a primary reference method, traceable to the primary reference standard. This material may also be used for verification of a routine method if shown to be commutable.
Secondary Reference Material	Material used for verification of a secondary reference method, traceable to the primary reference standard. This material may also be used for verification of a routine method if shown to be commutable.

It is important to confirm the certification for each certified reference material to ensure it is fit for purpose in the method of choice

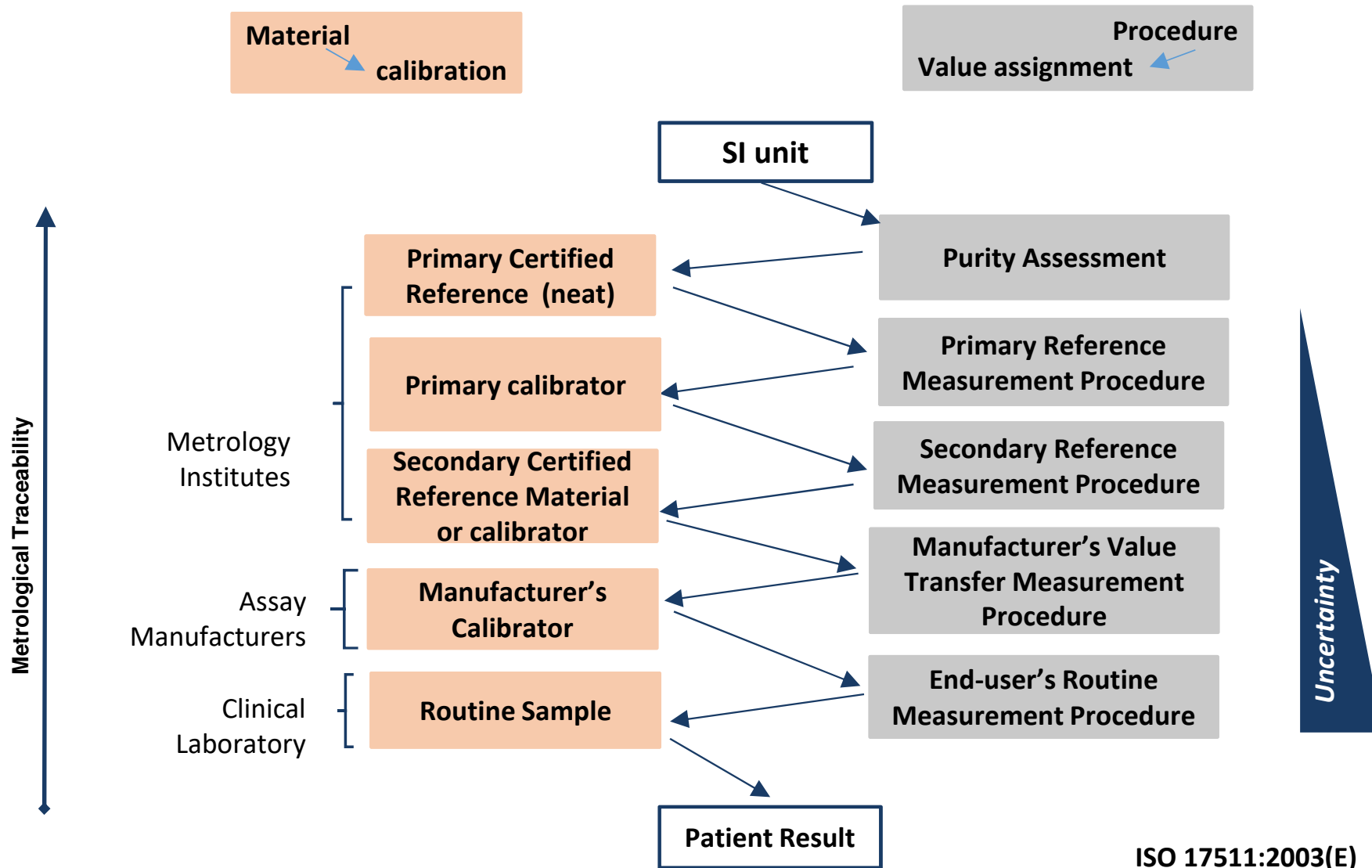


Definitions of Reference Materials

- **Reference Material (RM):** material, sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties [VIM:1993, 5.13]
- **Certified Reference Material (CRM):** reference material, accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceabilities, using valid procedures [VIM:1993,5.14]
- **Standard Reference Material (SRM):** *Certified Reference Material (CRM)* issued by the National Institute of Standards and Technology (NIST)
 - Homogeneous, stable material well-characterized for one or more chemical and/or physical properties
 - Assist laboratories worldwide in validating analytical measurements of chemical composition



The Role of Reference Materials in Measurement Traceability



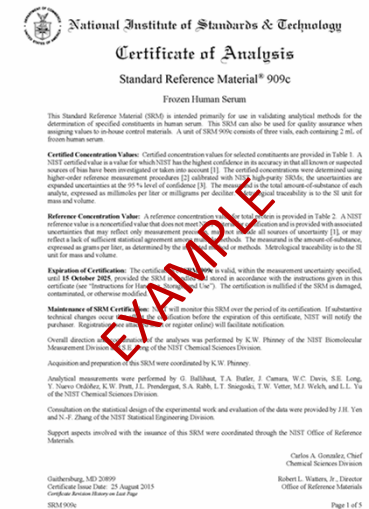
Definitions

- Primary measurement standard
 - Measurement standard whose quantity value and measurement uncertainty are established using a primary measurement procedure
 - Example: NIST SRM 911c, Cholesterol of known purity.
- Secondary measurement standard
 - Measurement standard whose quantity value and measurement uncertainty are assigned through calibration with respect to a primary measurement standard for a quantity of the same kind.
 - Example: NIST SRM 1951c, Lipids in Frozen Human Serum, is a secondary measurement standard that is calibrated using NIST SRM 911c, Cholesterol of known purity.



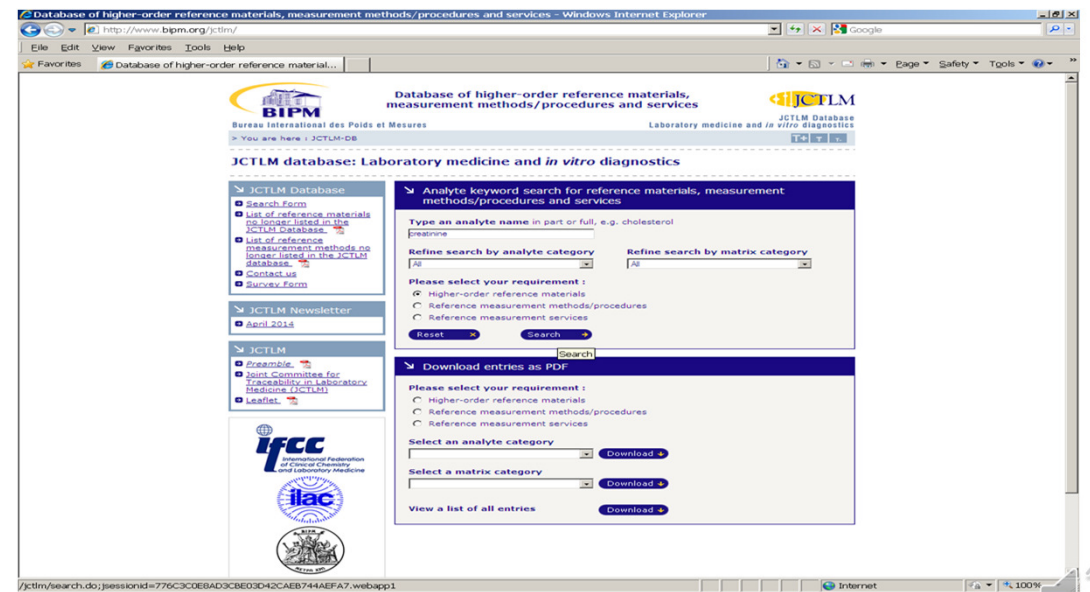
Reference Material Certificate

- Document accompanying a certified reference material 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. (ISO Guide 30: 1992)
- Should include items specified in ISO Guide 31. As a minimum, it shall include:
 - Name of the material;
 - Producer and producer's identification code for the CRM with a lot identification
 - General description of the material;
 - Intended use, including information on the commutability of the material
 - Information about transport, storage, correct handling, and stability;
 - Safety instructions;
 - Instructions for proper use;
 - Certified property values, with a statement of measurement uncertainty
 - Any indicative values or recommended values;
 - Measurement procedure(s) used to obtain property values;
 - Date of certification and period of validity
 - Reference to any certification report.



Sources of Certified Reference Material and Methods

- JCTLM website hosted by BIPM (<http://www.bipm.org/jctlm/>)
 - Reference Materials
 - Reference Measurement Methods
 - Reference Measurement Services



Sources of Certified Reference Material and Methods

JCTLM website hosted by BIPM (<http://www.bipm.org/jctlm/>)

Various Reference Materials for Creatinine

The screenshot shows the JCTLM website search results for creatinine. The page title is "Database of higher-order reference materials, measurement methods/procedures and services". The search criteria are: "Higher-order reference materials; Analyte: creatinine; Analyte category: ; Matrix category:". The results table lists 8 items:

Select	Analyte	Analyte category	Matrix/Material	Organization
<input type="checkbox"/>	creatinine	metabolites and substrates	creatinine crystalline material	NIST
<input type="checkbox"/>	creatinine	metabolites and substrates	creatinine crystalline material	NMIJ
<input type="checkbox"/>	creatinine	metabolites and substrates	frozen human serum	CENAM
<input type="checkbox"/>	creatinine	metabolites and substrates	human serum	IRMM
<input type="checkbox"/>	creatinine	metabolites and substrates	human serum	LGC
<input type="checkbox"/>	creatinine	metabolites and substrates	human serum	NIST
<input type="checkbox"/>	creatinine	metabolites and substrates	frozen human serum	HSA

At the bottom of the page, there is a footer with the BIPM logo and the text: "BIPM - Pavillon de Breteuil F-92312 Sèvres Cedex FRANCE" and "Copyright © BIPM all rights reserved".



Creatinine: reference standard material

Information specific to each material: quantity, purity, uncertainty etc

The screenshot shows a web browser window displaying the BIPM/JCTLM database. The page title is "Database of higher-order reference materials, measurement methods/procedures and services". The search results are for "creatinine in creatinine crystalline material" from the National Institute of Standards and Technology (NIST), United States. The results table includes the following information:

Name of the reference material	Quantity
SRM 914a, creatinine	Mass fraction
Analyte certified/assigned value	99.7 %
Expanded uncertainty (level of confidence 95 %)	0.3 %
Reference(s) on commutability	Not applicable: A high-purity material used as a primary calibrator for higher order reference methods
Traceability	SI
CRM listing	List 1

Additional information provided includes contact details for NIST (Phone: +1 301 975 6776, Email: srinfo@nist.gov, Web: http://www.nist.gov/srm) and a note that the material has been reviewed for compliance with ISO 15194:2003 but not against ISO 15194:2009. The page also features navigation links like "Save as PDF", "Modify your selection", and "Printable version".



Suppliers of Reference Materials



Reference
Material
Producers



Producer and
distributor

LGC Standards



Material distributors
from NIST, ERM,
NMIJ etc.



Reference Material Requirements

- Measurand clearly defined
- Readily available
- Known purity with associated uncertainty (for 1° reference standards)
- A stated measurement result, demonstrated traceability with associated uncertainty (CRM)
- Stable under defined storage conditions
- Homogeneous
- Commutable
- Detailed Certificate outlining usage restrictions, reference methods as appropriate etc.
- Meet the requirements of ISO 15194 (required for JCTLM database listing)





Accurate results
for patient care

