



Metrology Traceability Standards

Week One



What is metrology and why is it important?

Metrology is the science and study of measurement.

Metrology covers three main activities:

1. The definition of internationally accepted units of measurement, e.g. the metre.
2. The realization of units of measurement by scientific methods, e.g. the realization of a metre through the use of lasers.
3. The establishment of traceability chains by determining and documenting the value and accuracy of a measurement and disseminating that knowledge,

Correct measurements and a system of agreed upon measuring units are essential for:

- Scientific and technological advances
- Business innovation
- Manufacturing
- Fair trade in goods and services
- Economic prosperity.

All areas of metrology were formed on the basis of dimensional measurements.

We can see this in:

- Temperature
- Flow
- Pressure
- Electrical
- Vibration
- Optical, etc.

What are the determinants in dimensional measurements?

- The standard used to compare size must be able to be related back to the NIST definition of the unit.
- Temperature is also a determinant.

What happens when your inch isn't an inch?
What could cause your inch not to be an inch?

National Institute of Standards and Technology

- Since 1901 - 121 years of existence
- Started as the National Bureau of Standards - responsible for providing standard weight and measures
- The Bureau would define physical artifacts which were considered the standard
- Now, many standards are no longer physical:
 - **Meter Bar:** Until 1960, the SI standard of length was disseminated using platinum-iridium meter bars.
 - **Today's Meter:** The meter (m) is defined by taking the fixed numerical value of the speed of light in vacuum c to be 299,792,458 when expressed in the unit m s^{-1} , where the second is defined in terms of $\Delta\nu_{\text{Cs}}$.

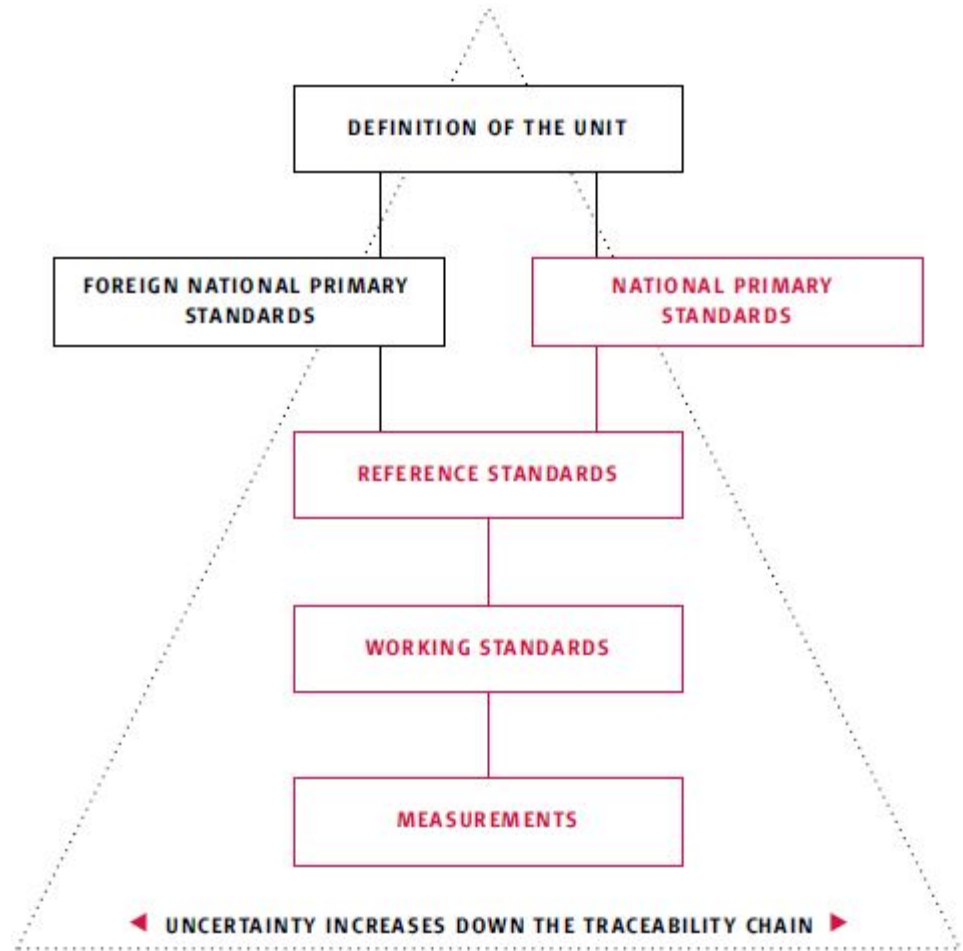
What is a standard?

A NIST determined baseline.

In practice, our standards are NIST-**traceable** - this means that our standards have a direct lineage to the NIST defined standard units.

Traceability - is basically a flow map that shows degrees of separation from NIST standards. We use these maps to gage how closely our standards (and our equipment) match those standards.

Traceability Chain



What is calibration?

A basic tool in ensuring the traceability of a measurement is the calibration of a measuring instrument, measuring system or reference material. Calibration determines the performance characteristics of an instrument, system or reference material. It is usually achieved by means of a direct comparison against measurement standards or certified reference materials.

Four main reasons for having an instrument calibrated:

1. To establish and demonstrate traceability.
2. To ensure readings from the instrument are consistent with other measurements.
3. To determine the accuracy of the instrument readings.
4. To establish the reliability of the instrument i.e. that it can be trusted.