

TESCO METERING

PRINCIPALS OF NIST AND TRACEABILITY

TESCO's Meter School
TESCOOL
July 20-23, 2025

Carson Scaccetti



National Institute of Standards
and Technology

USA National Metrological
Institute

Department of Commerce

Gaithersburg Maryland

March 3rd, 1901



U.S. Congress founded NBS on March 3, 1901



January 16, 1905 First National Conference of Weights and Measures (NCWM)



1906 First Standard Reference Material



1913 Correcting Rail Freight



1915 National electrical safety code



June 17, 1928 First full-scale fire test

1932 Helped establish First FBI crime lab

January 6, 1949 the First Atomic Clock

1958 invented the diamond anvil cell

1970 developed a truly unbiased military draft

1985 Creation of the 1 volt standard JJA

2005 World Trade Center 1 and 2 reports

2014 release of *Framework for improving Critical Infrastructure Cybersecurity*



Mission

To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life



Vision

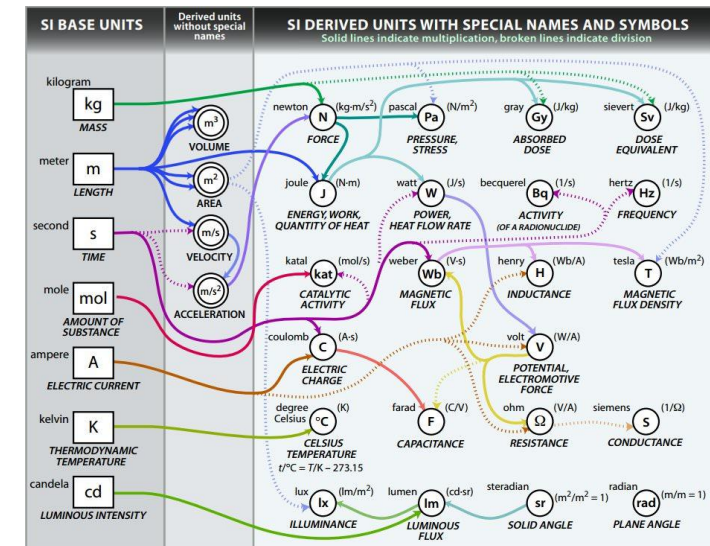
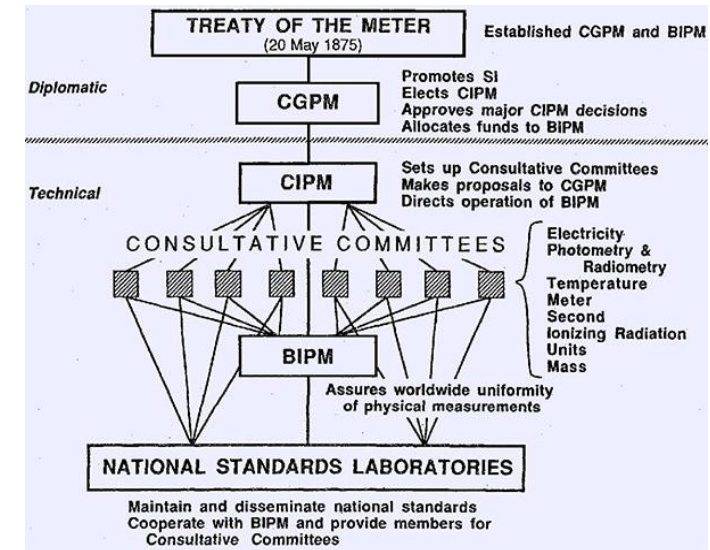
NIST will be the world's leader in creating critical measurement solutions and promoting equitable standards. Our efforts stimulate innovation, foster industrial competitiveness, and improve the quality of life.



Core Competencies

Measurement science
Rigorous traceability
Development and use of standards

- SI – The International System of Units
 - International Bureau of Weights and Measures (BIPM)
 - General Conference on Weights of Measures (CGPM)
 - International Committee for Weights and Measures (CIPM)

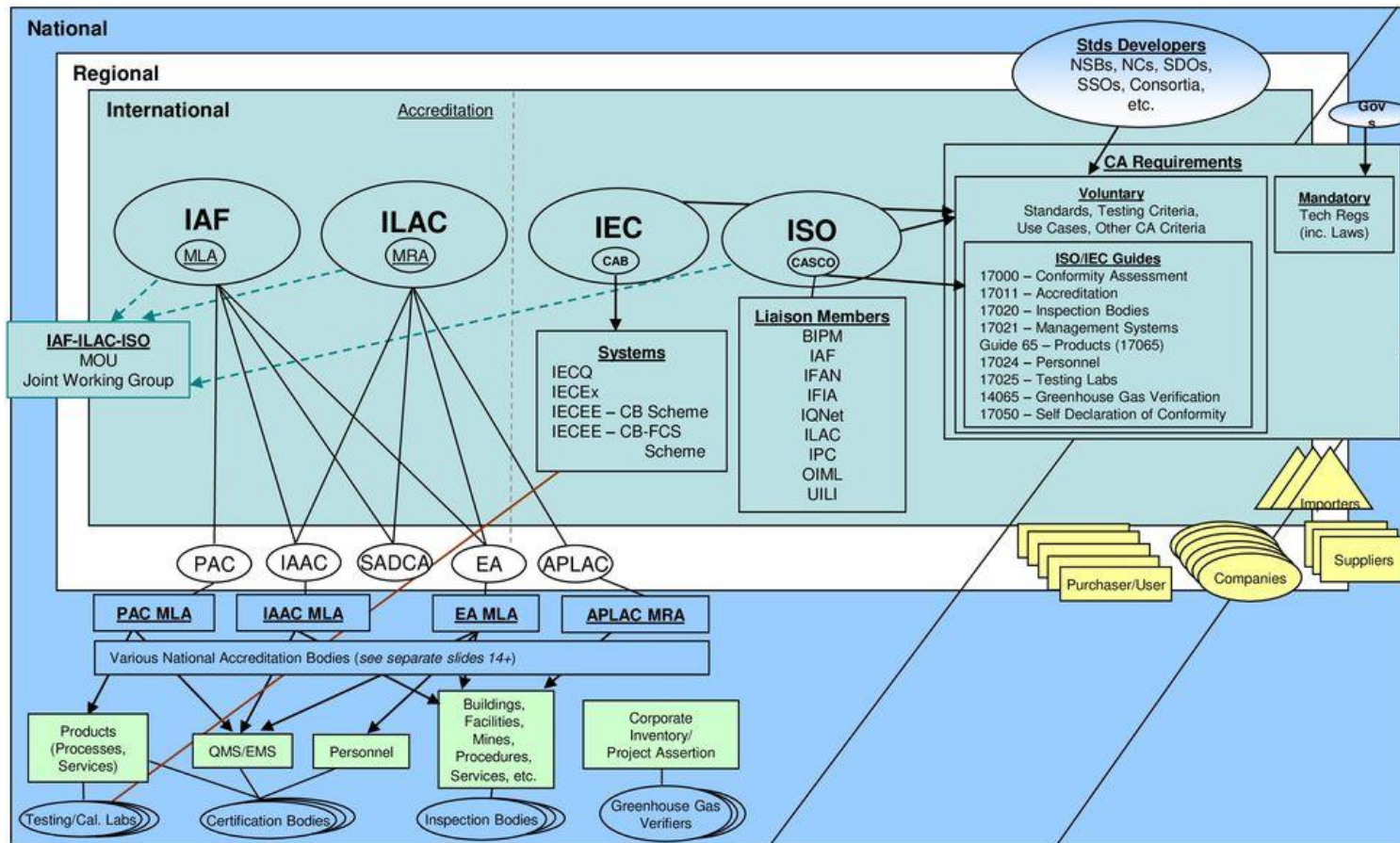


- 1955, The International Organization of Legal Metrology founded (OIML)
- International Accreditation Forum (IAF)
- International Laboratory Accreditation Cooperation (ILAC)
- International Organization for Standardization (ISO)
- Mutual Recognition Agreement(MRA)
- Multilateral Recognition Agreement (MLA)

INTERNATIONAL CONFORMITY ASSESSMENT SYSTEM



Snapshot of the International Conformity Assessment System with relationships to regional and national systems



3rd Party:

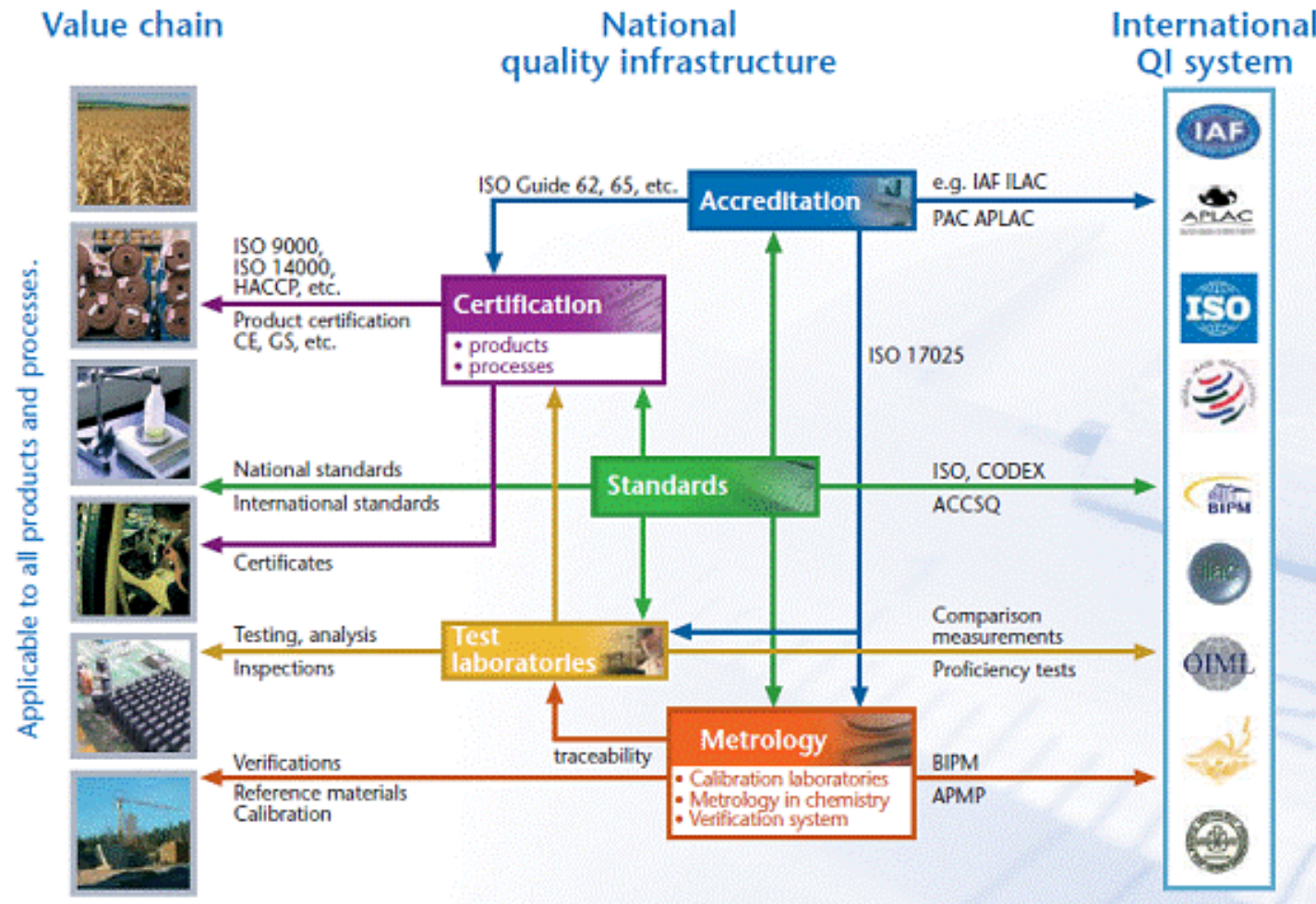
Independent Party testing, inspection, certification, etc.

2nd Party:

Buyer testing, etc.

1st Party:

Producer and Supplier testing, etc.

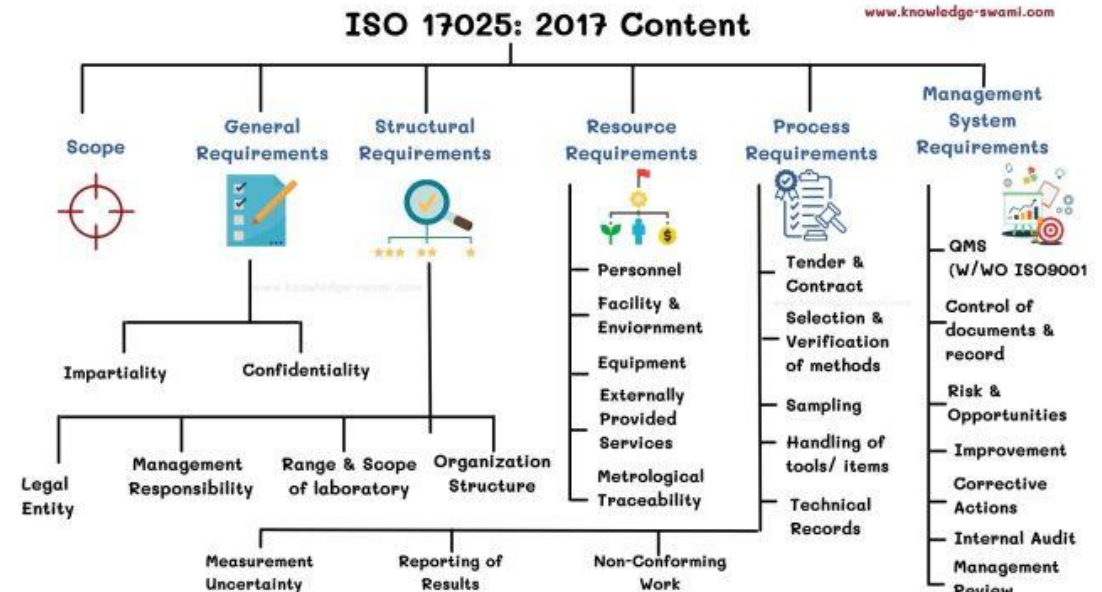




- TESCO is ISO 9001:2015 certified
 - DEKRA – Conformity Assurance Body (CAB)
 - ANSI National Accreditation Board (ANAB)
 - Inter-American Accreditation Cooperation MLA (IAAC)
 - IAF
- TESCO's Laboratory is ISO/IEC 17025: 2017 Accredited
 - PJLA – Accreditation Body
 - ILAC MRA



- ISO/IEC 17025:2017 – General requirements for the competence of testing and calibration laboratories
- Repeatable, verifiable, impartial, assured, recognizable results
- Hallmarks of 17025
 - Evaluation of Measurement Uncertainty
 - Selection, verification, and validation of methods
 - Reporting of Results
 - Metrological Traceability



2.41 Metrological Traceability

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**

NOTE 1 For this definition, a 'reference' can be a definition of a **measurement unit** through its practical realization, or a **measurement procedure** including the measurement unit for a **non-ordinal quantity**, or a **measurement standard**.

NOTE 2 Metrological traceability requires an established **calibration hierarchy**.

NOTE 3 Specification of the reference must include the time at which this reference was used in establishing the calibration hierarchy, along with any other relevant metrological information about the reference, such as when the first calibration in the calibration hierarchy was performed.

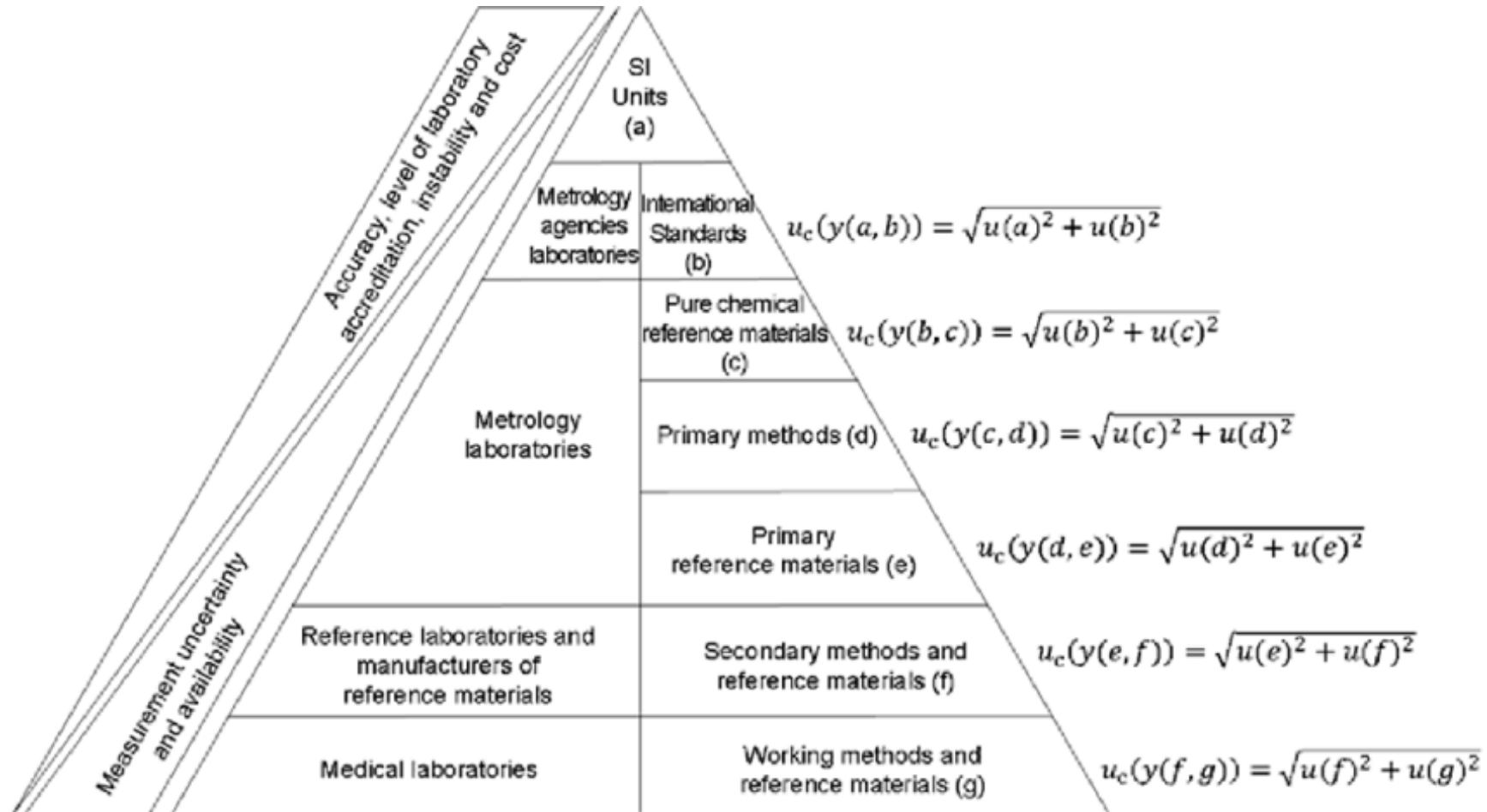
NOTE 4 For **measurements** with more than one **input quantity in the measurement model**, each of the input **quantity values** should itself be metrologically traceable and the calibration hierarchy involved may form a branched structure or a network. The effort involved in establishing metrological traceability for each input quantity value should be commensurate with its relative contribution to the measurement result.

NOTE 5 Metrological traceability of a measurement result does not ensure that the measurement uncertainty is adequate for a given purpose or that there is an absence of mistakes.

NOTE 6 A comparison between two measurement standards may be viewed as a calibration if the comparison is used to check and, if necessary, correct the quantity value and measurement uncertainty attributed to one of the measurement standards.

NOTE 7 The ILAC considers the elements for confirming metrological traceability to be an unbroken **metrological traceability chain** to an **international measurement standard** or a **national measurement standard**, a documented measurement uncertainty, a documented measurement procedure, accredited technical competence, metrological traceability to the SI, and calibration intervals (see ILAC P-10:2002).

NOTE 8 The abbreviated term "traceability" is sometimes used to mean 'metrological traceability' as well as other concepts, such as 'sample traceability' or 'document traceability' or 'instrument traceability' or 'material traceability', where the history ("trace") of an item is meant. Therefore, the full term of "metrological traceability" is preferred if there is any risk of confusion.



2.42 METROLOGICAL TRACEABILITY CHAIN

metrological traceability where the reference is the definition of a **measurement unit** through its practical realization

NOTE The expression "traceability to the SI" means 'metrological traceability to a measurement unit of the **International System of Units**'.

sequence of **measurement standards** and **calibrations** that is used to relate a **measurement result** to a reference

NOTE 1 A metrological traceability chain is defined through a **calibration hierarchy**.

NOTE 2 A metrological traceability chain is used to establish **metrological traceability** of a measurement result.

NOTE 3 A comparison between two measurement standards may be viewed as a calibration if the comparison is used to check and, if necessary, correct the **quantity value** and **measurement uncertainty** attributed to one of the measurement standards.

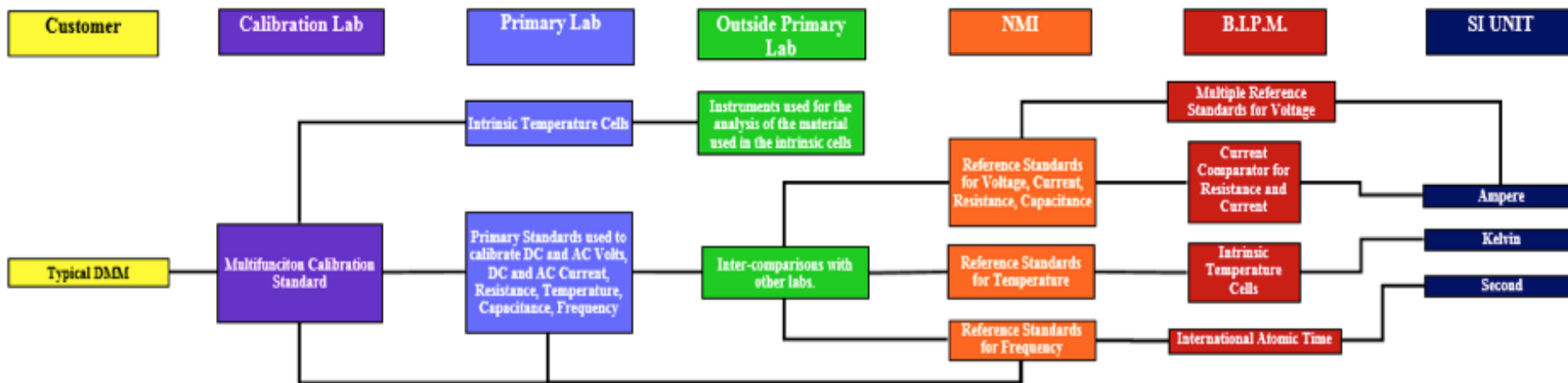
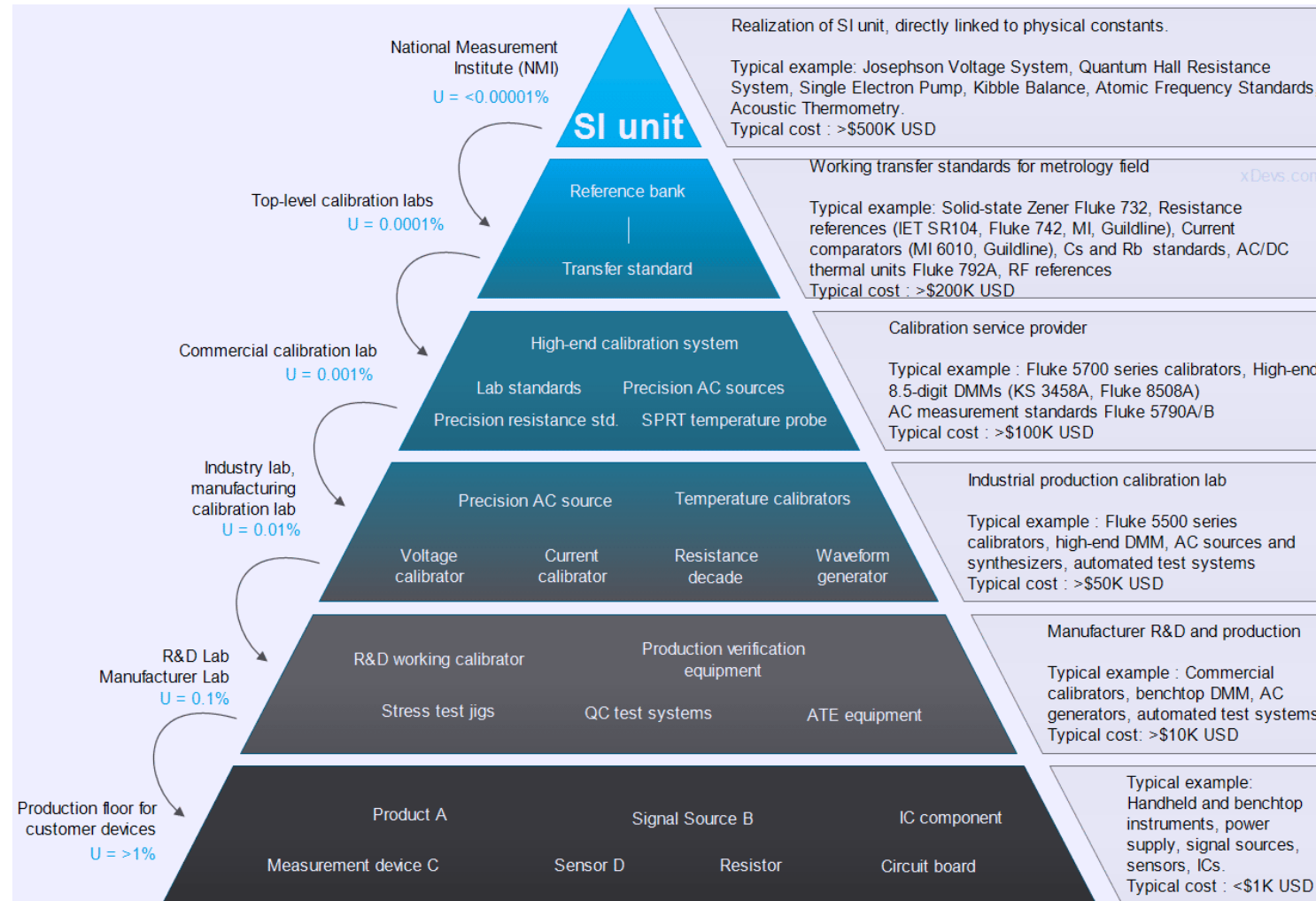


Figure 1: Very simple illustration of a traceability chain.



- Why is it that the Industry requires “NIST traceability”?
 - NAVY
 - MIL-SPEC
 - ANSI Z540.1
- Risk Mitigation
- Measurement veracity
- Where do I find this information?
 - Calibration Certificate – Traceability statement
 - Guaranteed on a 17025 Cal report/certificate
 - Look for the Logo/stamp
- Traceable to the International System of Units (SI), through National Metrology Institutes e.g. NIST, NRC, NPL, etc.), via ratiometric techniques, or natural physical constants.
 - “Traceable to SI”



COMMENTS, QUESTIONS, DISCUSSION

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- https://www.unido.org/sites/default/files/2014-02/2_NMI_highres_0.pdf
- https://www.iso.org/sites/JCGM/VIM/JCGM_200e_FILES/MAIN_JCGM_200e/05_e.html
- <https://www.nist.gov/timelinelist>
- [https://www.ri.se/en/national-metrology-center#:~:text=National%20metrology%20institutes%20\(NMIs\)%20have,traceability%20for%2032%20physical%20quantities.](https://www.ri.se/en/national-metrology-center#:~:text=National%20metrology%20institutes%20(NMIs)%20have,traceability%20for%2032%20physical%20quantities.)
- <https://www.nist.gov/image/nist-logo-blue>
- <https://www.nist.gov/pml/history-nist-quantum-voltage-standards/1980s-history-nist-quantum-voltage-standards>
- <https://www.nist.gov/about-nist>
- <https://safetyculture.com/topics/iso-17025/>

- <https://share.ansi.org/Shared%20Documents/Standards%20Activities/International%20Standardization/Standards%20Alliance/Handbook/StandardsAlliance-Handbook-2022-SECTION1.pdf>
- https://www.bipm.org/documents/20126/2071204/JCGM_100_2008_E.pdf
- <https://iaf.nu/en/about-iaf-mla/>
- https://en.wikipedia.org/wiki/Metre_Convention
- <https://www.oiml.org/en/about/mou/ilac-iaf>
- <https://www.iso.org/about-us.html#:~:text=SI%20%2D%20International%20System%20of%20Units&text=In%201960%2C%20ISO%20publishes%20the,and%20the%20second%20for%20time>
- [https://anab.ansi.org/about-anab/faq#:~:text=ANAB%20is%20a%20signatory%20of,Pacific%20Accreditation%20Cooperation%20\(APAC\)](https://anab.ansi.org/about-anab/faq#:~:text=ANAB%20is%20a%20signatory%20of,Pacific%20Accreditation%20Cooperation%20(APAC))
- https://www.researchgate.net/figure/A-metrological-traceability-chain-of-measurement-results-in-a-medical-laboratory-test_fig2_303289783