Measurement Services Update

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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

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Overview: NIST Measurement Services

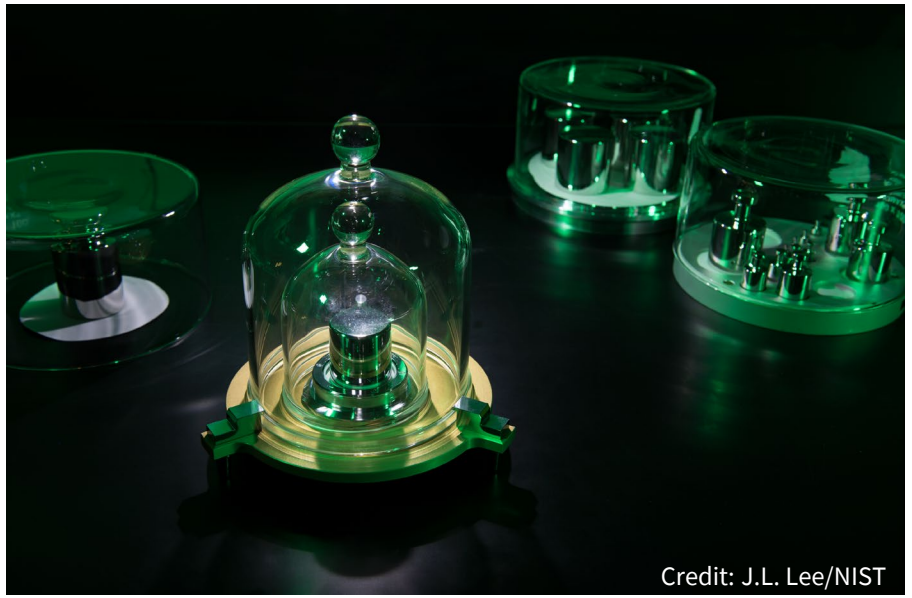
The United States Constitution, Article I, Section 8 gives Congress the power to:

“fix the standard of weights and measurement.”

The measurement services are the most direct way we disseminate the SI

NIST Measurement Services Include:

- Calibrations
- Standard Reference Materials (SRM)
- Standard Reference Data (SRD)
- Office of Weights and Measures (OWM)
- Standard Reference Instruments (SRI)
  (Calibrations + SRM)



Calibrations

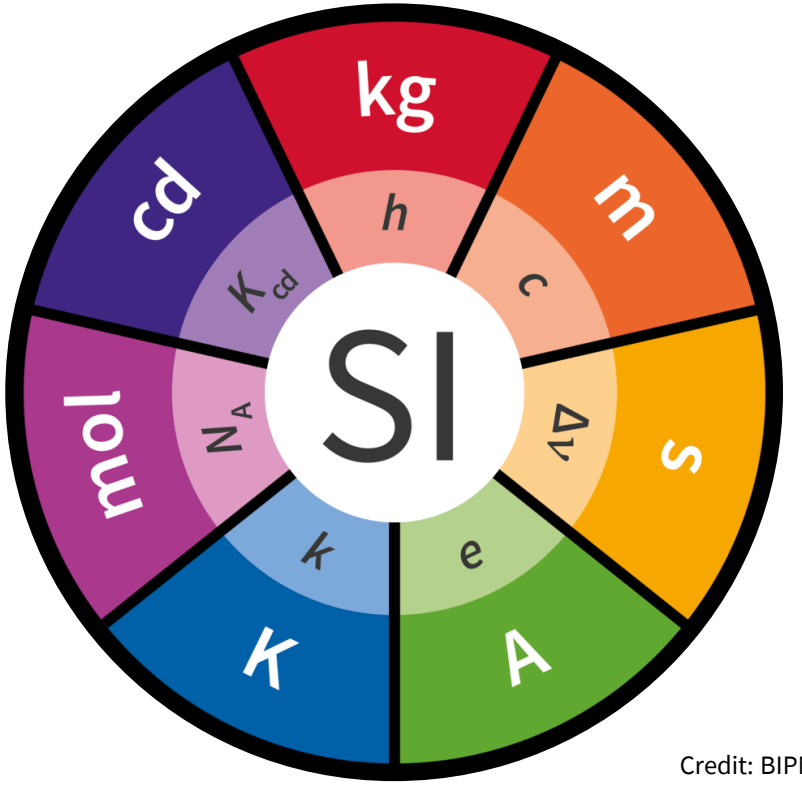
Measurement Services: Calibrations

NIST calibrations are directly traceable to primary realizations of the SI

NIST assures the traceability to the SI, or other standards, of measurement results that NIST itself provides, either directly or through an official NIST program or collaboration.

NIST strives to achieve the highest possible levels of measurement quality

NIST strives for low uncertainty



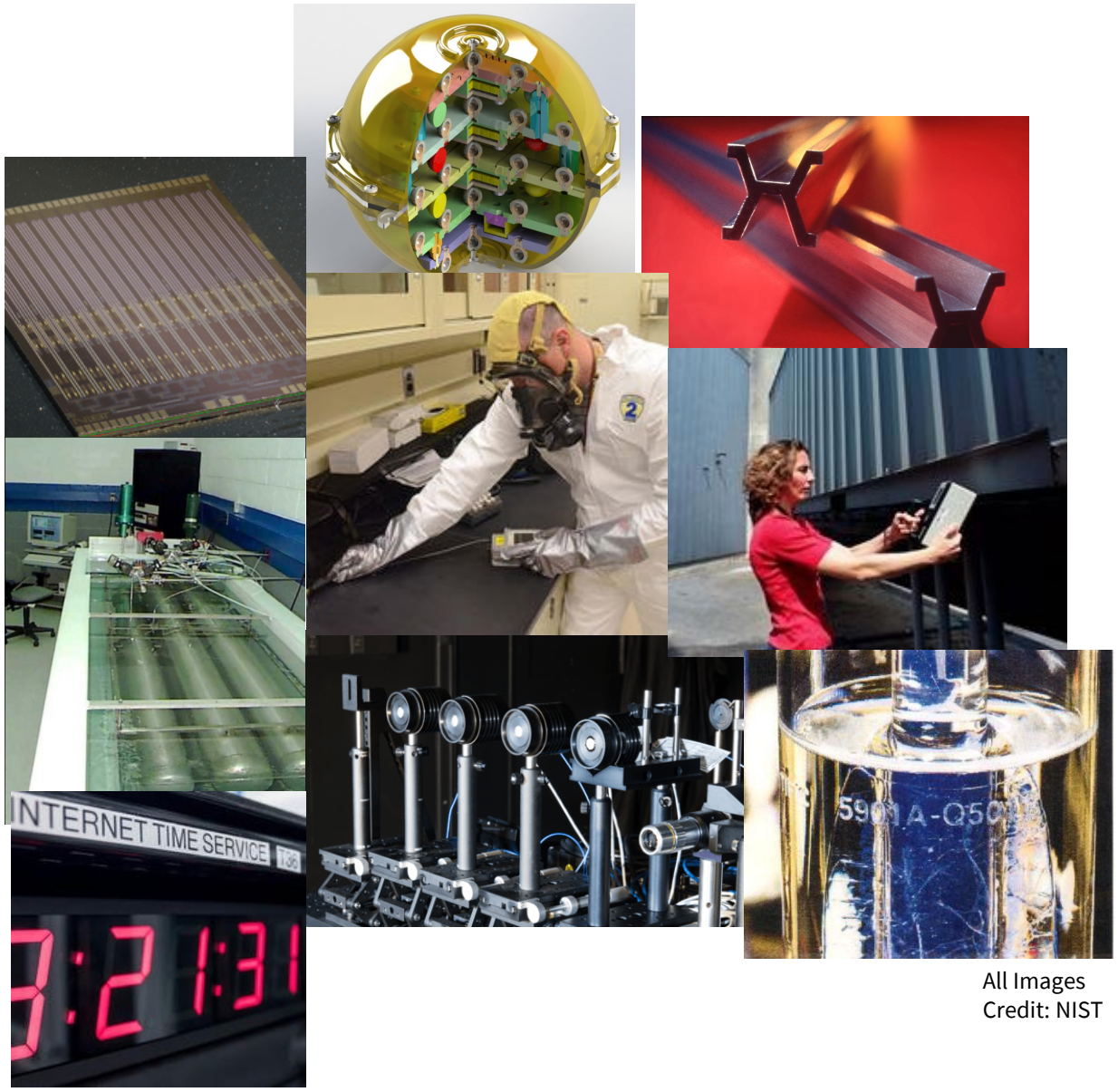
Credit: BIPM

Calibration Services

More than 450 Services

<u>Nine Calibration Areas</u>

- Biomedical
- Dimensional
- Electromagnetic
- Environmental Area
- Ionizing Radiation
- Mechanical
- Optical Radiation
- Thermodynamic
- Time and Frequency



All Images
Credit: NIST

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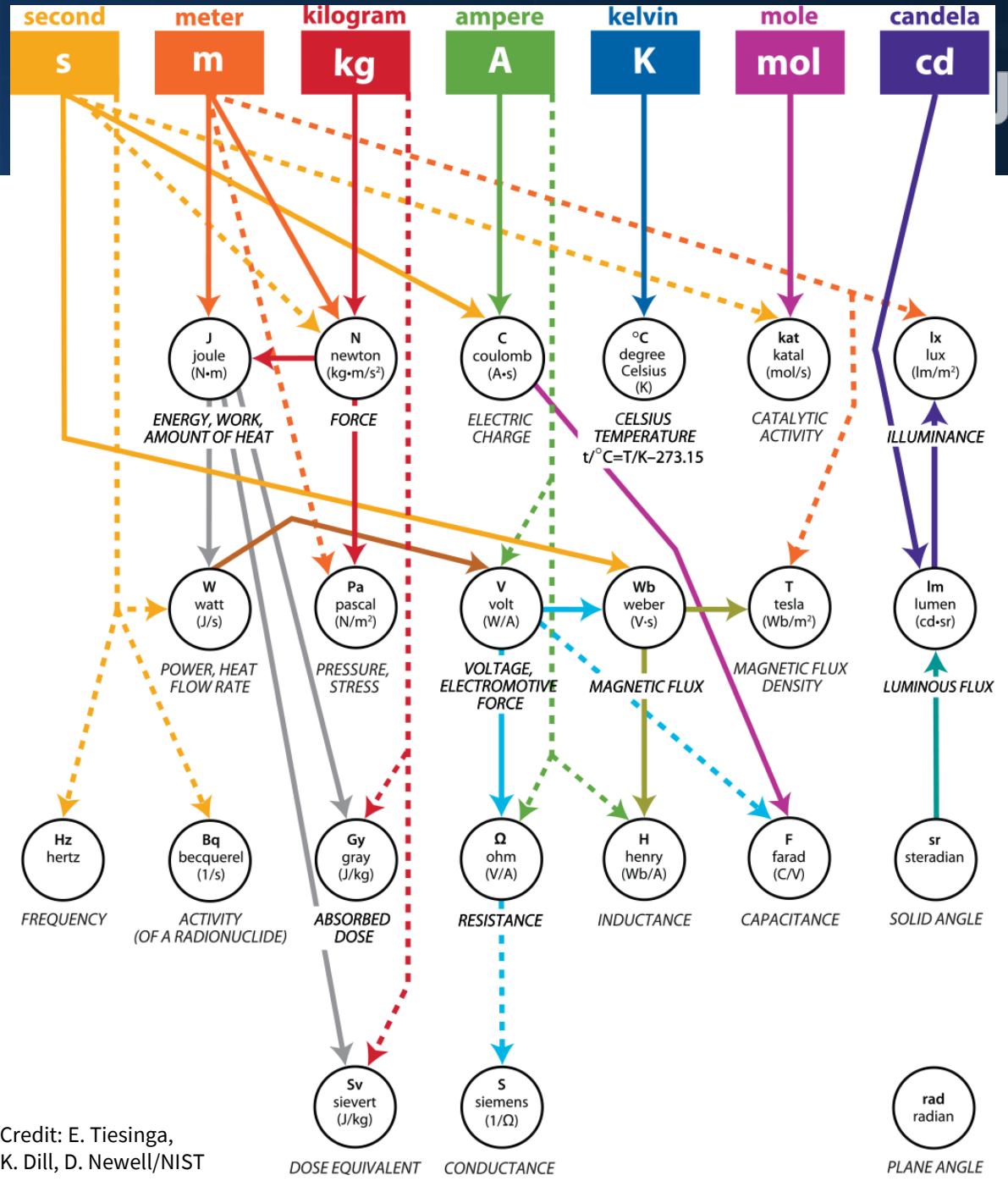
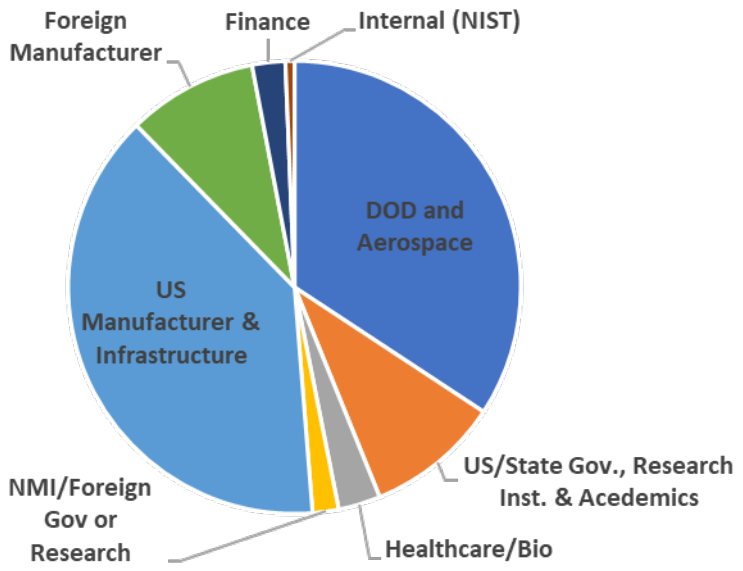


Credit: E. Tiesinga, K. Dill, D. Newell/NIST

Calibrations Market Statistics

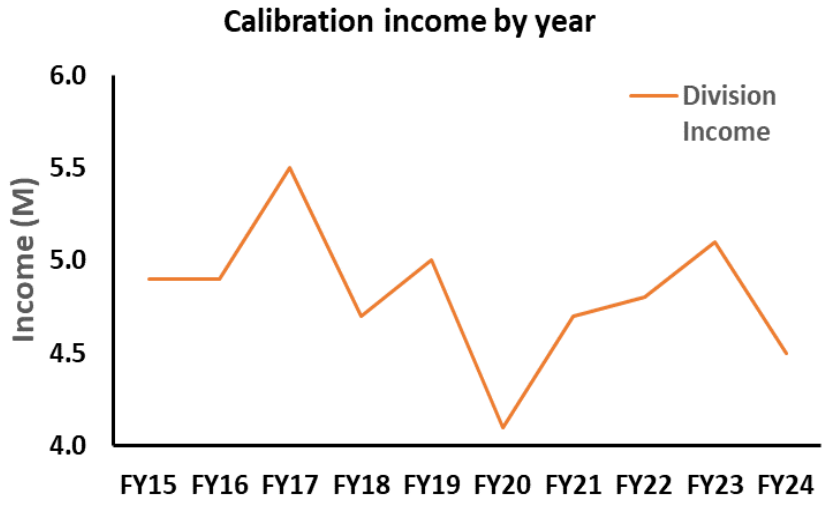
NIST Calibrations per Sector



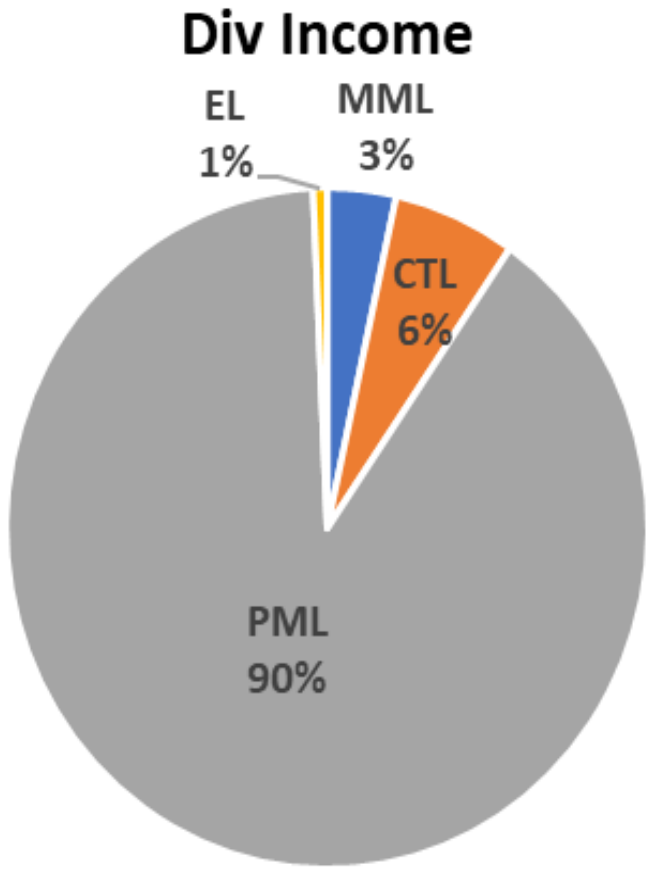
Critical stakeholders

- Defense industry and military
- U.S. manufacturers
- Aerospace industry
- Oil, gas, and power industries

Calibrations Income and Staffing



- Average income (10 Yr): $4.8 M
- Income does not cover maintenance and development of services
- About 150 calibration staff in 2024
- Staff has decreased 25%—50% over the past decade



Modernization and Succession Funds

More than $16M in modernization funding distributed over FY 2023 and FY 2024

- PML supported Measurement Service Modernization proposals at a level of $7.3M for FY 2023 and $9M for FY 2024
- Funded 20 projects
- Opened 4 new calibration metrologist position in FY 2024 for:
  - Precision timing
  - Optical Power
  - DC/AC Power and EVSE
  - Thermometry

<u>Succession Hire Program</u>: In FY 2023, $3.4M set aside for measurement services succession planning.

- Succession hires are mentored by senior metrologists near retirement.
- 13 positions were opened, 12 filled in FY 2024.
- 9 presently filled

The 1980's era Moore CMM is the best in the world, but needs replacement

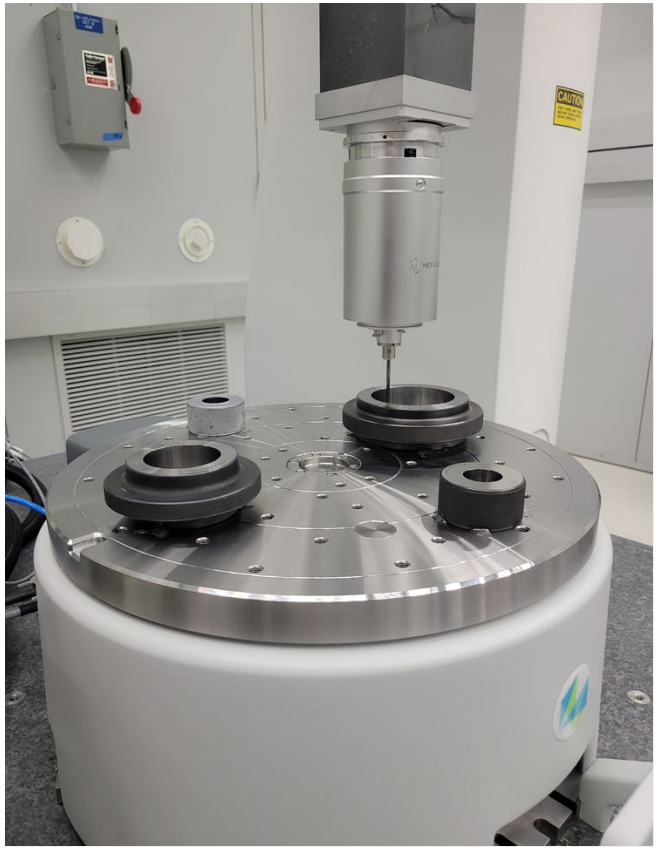
The ITS-90 Thermometry lab was built up in the 1980's to have the lowest uncertainties in the world, but equipment failures over the past decade has crippled the lab

All Images Credit: NIST

Modernization: Dimensional Metrology

Coordinate Measuring Machine (CMM)

- **NIST high-accuracy CMMs** support manufacturing by providing calibrated dimensional standards such as those with complex geometry, step gauges, rings gauges, 2D and 3D artifacts, and line scales
- **The Moore M48 CMM** was acquired in the 1980's and has been a workhorse for dimensional services since 2000, operating 24-7, performing more than 1500 calibrations
- The old M48 is no longer supported and maintenance has gotten difficult
- In 2025 we acquired a Hexagon infinity, a ~$1.5M CMM, ensuring continued support of critical dimensional services
- New hire is helping commission the new CMM



Commissioning the Hexagon Infinity in 2025.

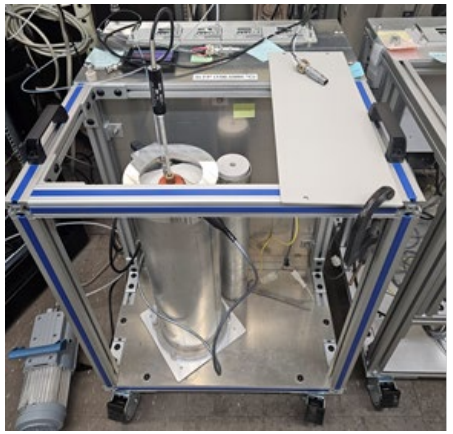
All Images Credit: NIST

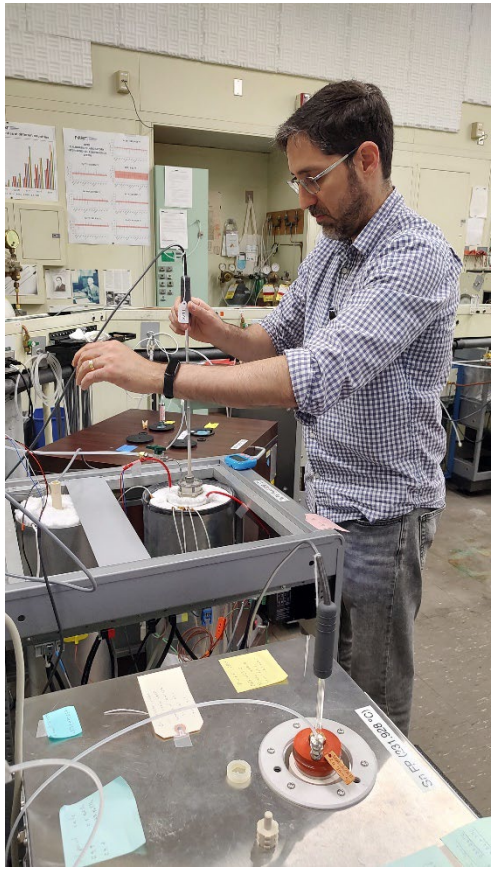
Certain commercial equipment, instruments or materials are identified in this presentation. Such identification is not intended to imply recommendation or endorsement by NIST, nor is it intended to imply that the materials or equipment identified are necessarily the best available for the purpose.

Modernization: Thermometry Calibrations

The ITS-90 Thermometry Lab

- Supports U.S. thermometry customers in the US and abroad
  - Primary realization of the International Thermometry Scale (ITS-90)
- Built in the late 1980s with the lowest uncertainty in the world
- Old, degraded infrastructure and equipment forced the suspension of most services
- In 2024, with new furnaces, software, and fixed points cells, most services re-opened
- Two new hires helped build up new lab





New equipment and hires were needed to revive the thermometry lab

All Images Credit: NIST

Modernization

Volume lab

- Provides traceability for U.S. petroleum transactions worth more than $1 trillion per year.
- Produced more than 1,000 customer calibrations since 1995.
- Outdated infrastructure in serious need of renovation. Lab operations suspended for safety concern in 2024.
- Modernization funds: ~$1M renovation begun in 2024.
- Renewing the service will provide traceability and consistent service for NIST customers for the foreseeable future.

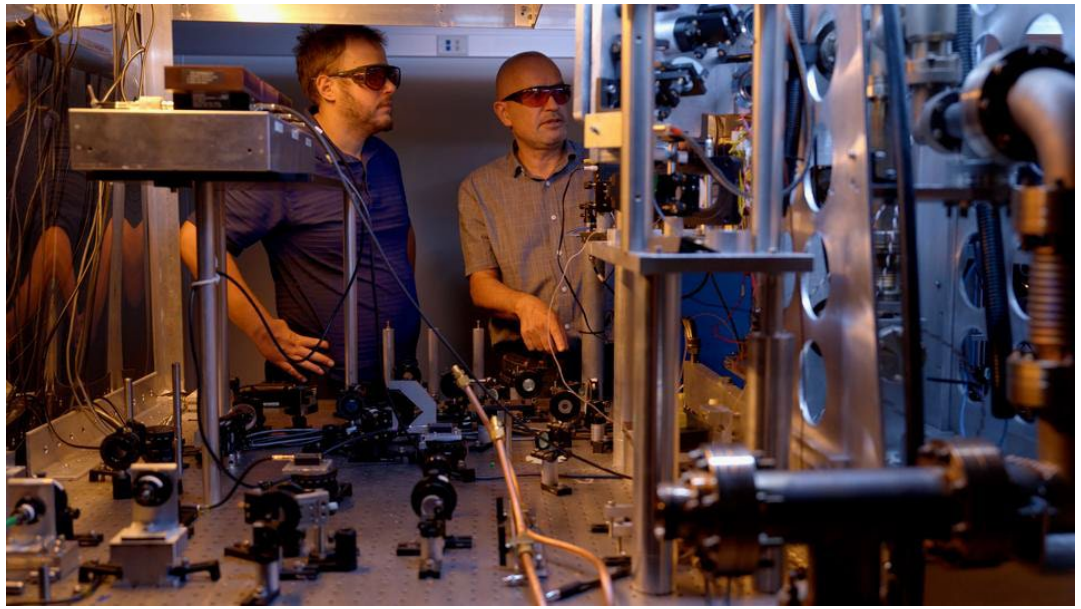
Outdated lab circa 2024

Present space

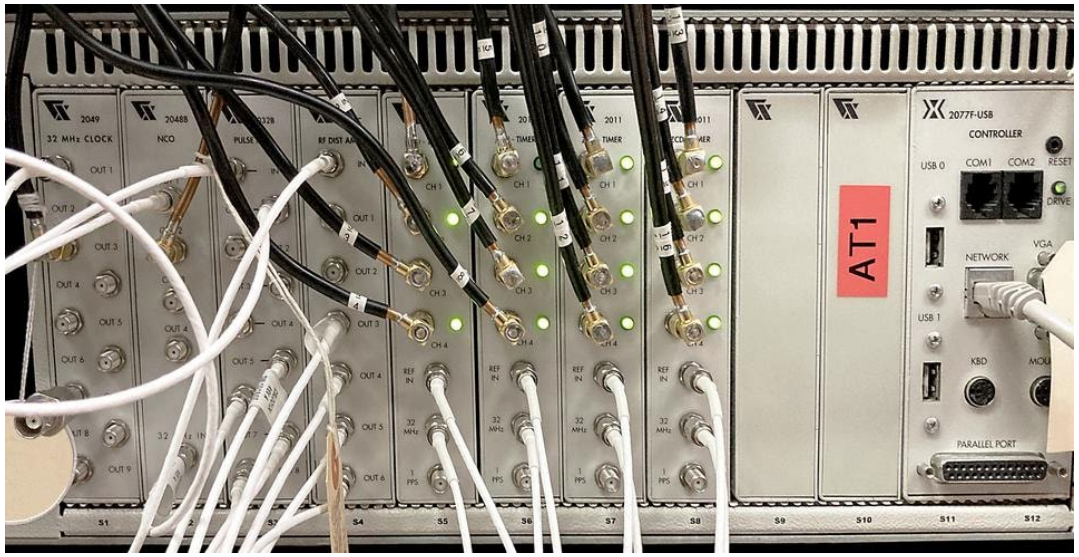
All Images Credit: NIST

Modernization: Time (Realization and Dissemination)

The duration of 9,192,631,770 periods of the radiation corresponding to the transition between two hyperfine levels of the ground state of the cesium-133 atom -- SI Second



NIST-F4 established as a primary frequency standard and foundation for the realization of UTC(NIST).

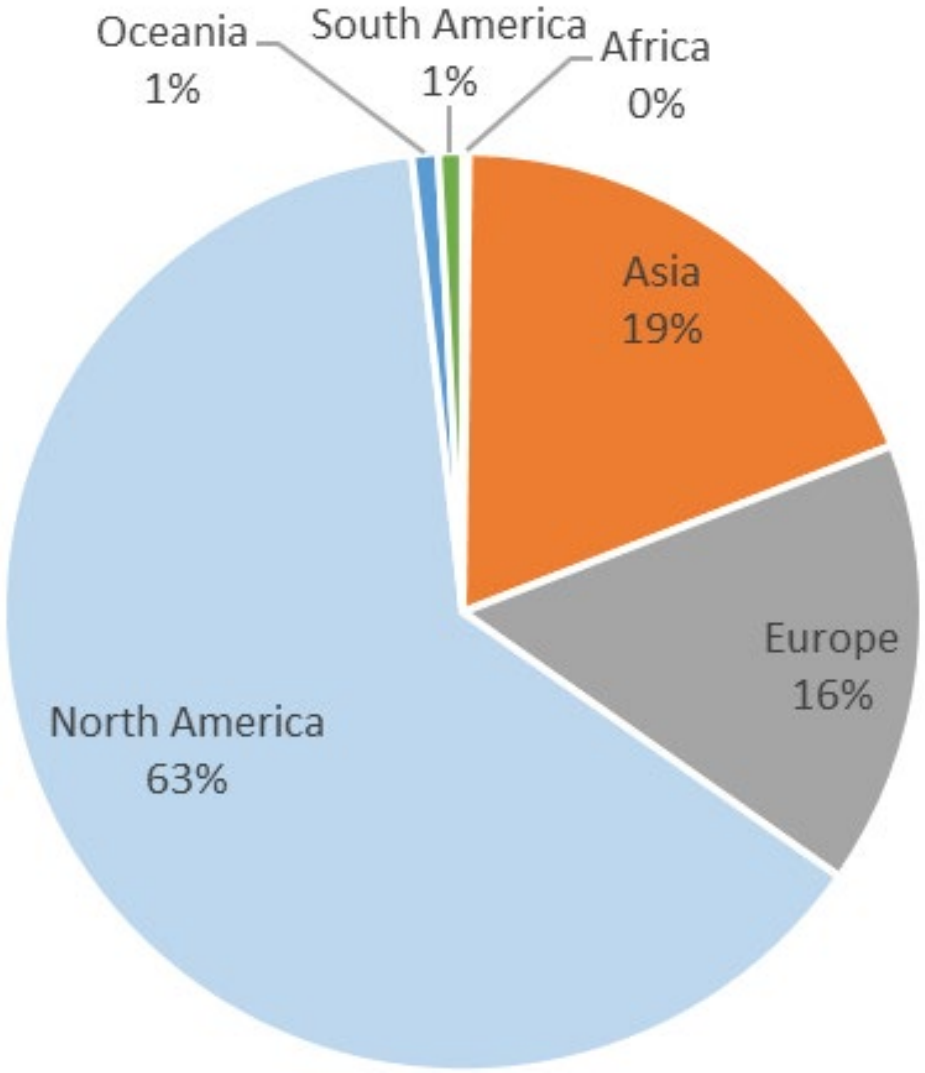


The NIST Internet Time Service (ITS) receives more than a Billion requests a day.

All Images
Credit: NIST

Standard Reference Materials

Standard Reference Material Overview



Top Sellers:

- SRM 2561 Low-Energy Charpy
- SRM 2563 High-Energy Charpy
- *RM 8671 NIST mAb*
- SRM 2098 Super-High-Energy Charpy
- SRM 17g Sucrose Optical Rotation
- SRM 1976c Instr. Response Std for X-Ray Powder
- SRM 1643f Trace Elements in Water
- SRM1196a Cigarette for Ignition Resistance Testing (**EL**)
- SRM 114r Portland Cement Fineness Standards (**EL**)
- SRM 1869 Infant Adult Nutritional Formula
- SRM 841 KHP Primary Standard
- SRM 1950 Metabolites in Frozen Human Plasma

In FY 2024, NIST had ~1100 SRMs and sold 28,713 units ($23.3M)

…but Sales are only part of the story

Credit: Geoffrey Wheeler

High Impact/High Sales: CHARPY

CHARPY specimens are one of NIST's highest selling SRMs, with impacts facilitating verification of over 1,400 machines in 60 countries

Avg sales almost 5k specimen/yr

Cost of material fracture in US $180B/yr

- NIST verification specimens for conformance with ASTM E23 and/or ISO 148
- Sectors: Aerospace, defense, transportation, construction, manufacturing, and energy
- NIST's electronic Charpy specimen evaluation provides faster, streamlined verification (2020)

High Impact/Low Sales: 3100s

SRM 3100 Series Standard Solutions are primary calibrations for 66 chemical elements traceable to the SI

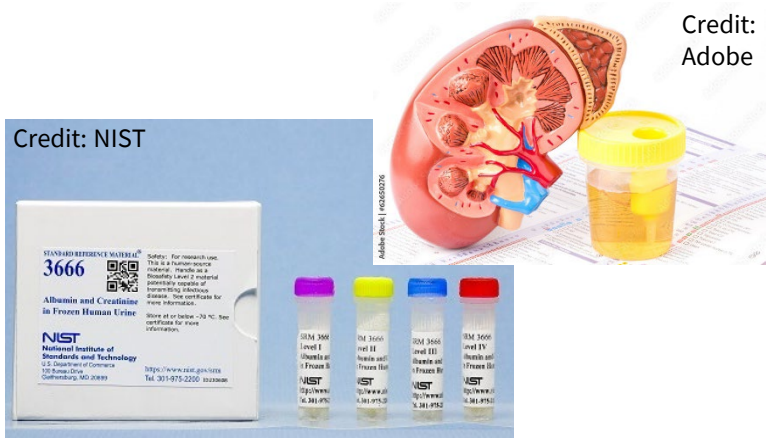
Credit: NIST

Avg. sales of 10/yr; median 7/yr; ~640 units total for series

Enormous leveraging of impact

- Commercial CRM producers of elemental calibration solutions derive their SI-traceability through the 3100 series
- Most of the world depends on the SRM 3100s for their elemental measurements
- Many elemental values assigned for other SRMs trace through the SRM 3100 series

Reference Material Innovations



Non-invasive diagnostics with traceability necessary for insurance claims

Work with Joint Committee on Traceability in Laboratory Medicine

2025 Dept of Commerce Gold Medal

2024 ACS Women Chemists Committee Rising Star

SRM 3666

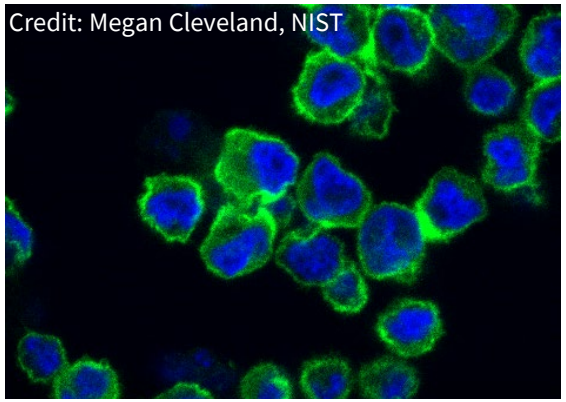
Albumin and Creatinine in Frozen Human Urine

The global **human microbiome** market is projected to reach $4.21 billion by 2030, up from $0.81 billion in 2024

Stakeholders for the fecal RM include healthcare, wastewater monitoring, pharmaceuticals, and planetary science/space exploration

RM 8048

Fecal Material



Credit: NIST

NIMBL

MilliporeSigma

NIST's 1st *living* reference material

CHO cell line engineered to express a non-originator version of NIST mAb (RM 8671)

Enables benchmarking of biomanufacturing technologies from cell growth to antibody production to downstream purification

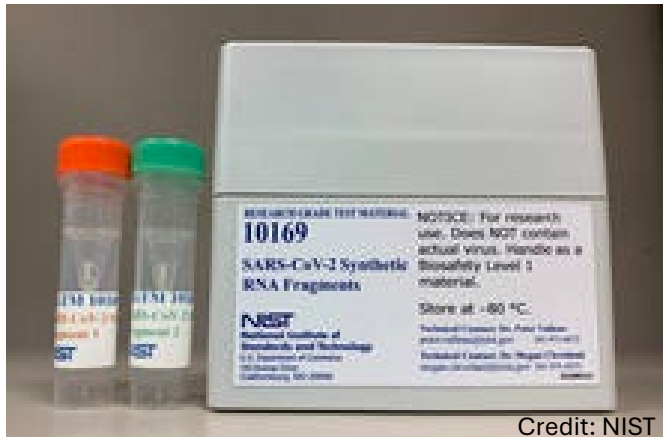
RM 8675

Chinese Hamster Ovary (CHO) Cell Line

Material Business Innovation: RGTMs

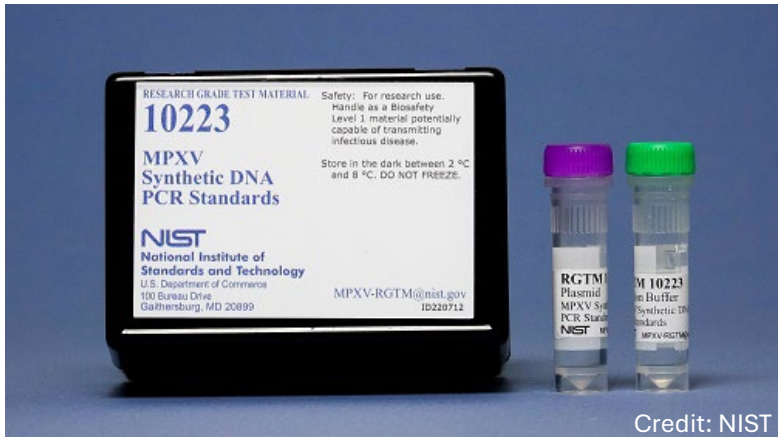
- Research Grade Test Materials (RGTMs) are homogeneous and stable, but not as completely characterized
- Tailored to emerging communities' needs for measurement harmonization, but limited use
- Increase NIST ability for rapid response and stronger pre-RM engagement

SARS-CoV-2



Two unique regions of SARS-CoV-2 RNA fragments supporting diagnostic testing applications.
Pilot ended in May 2023

MPox



Nine PCR assay targets from m-pox genome for the validation of diagnostic assays

Chinese Hamster Ovary Cell Line

CHO cell line engineered to express a non-originator version of NIST mAb **Transferred to RM 8675**

109 RGTMs in some stage of development or sales in FY 2025 …from polymers to PFAS, DNA to cement

NISTCHO RM 8675 Released June 10, 2025

Congrats to the team, especially:

Megan Cleveland
Zvi Kelman
Brad O'Dell
Ioannis Karageorgos

Standard Reference Data

Standard Reference Data

Standard Reference Data

For over 50 years, NIST has developed and distributed Standard Reference Data in Chemistry, Engineering, Fluids and Condensed Phases, Material Sciences, Mathematical and Computer Sciences and Physics.

How to Obtain SRD:

18 SRD products available in a NIST digital storefront
98 product variations; 11 require agreements

5 SRD available through distributors
7 variations; 102 distributors

59 Free SRD products


Credit: Adobe

Two high-impact NIST Data Products:

$8.4M
~5300 u

Mass Spec reference libraries

- >400K compounds / 7500 added annually
- In almost all mass spectrometers sold worldwide
- Pharma, specialty chem, materials, illicit drugs

$1M*
~3000 u

Embedded in process simulation and finite element packages, **REFPROP** is used to guide **ALL** chemical manufacturing and chemical process development in the U.S.

- Natural gas, aerospace, refrigeration, power

*includes TDE and WTT

Data Delivery Innovation

1 Digitizing Certificates

NIST leads Data Digitalization efforts at the CCQM via the “CCQM-Data Digitalization Task Group”

As a representative of CCQM, NIST is an active member of the CIPM Forum for Metrology and Digitalization (Forum-MD)

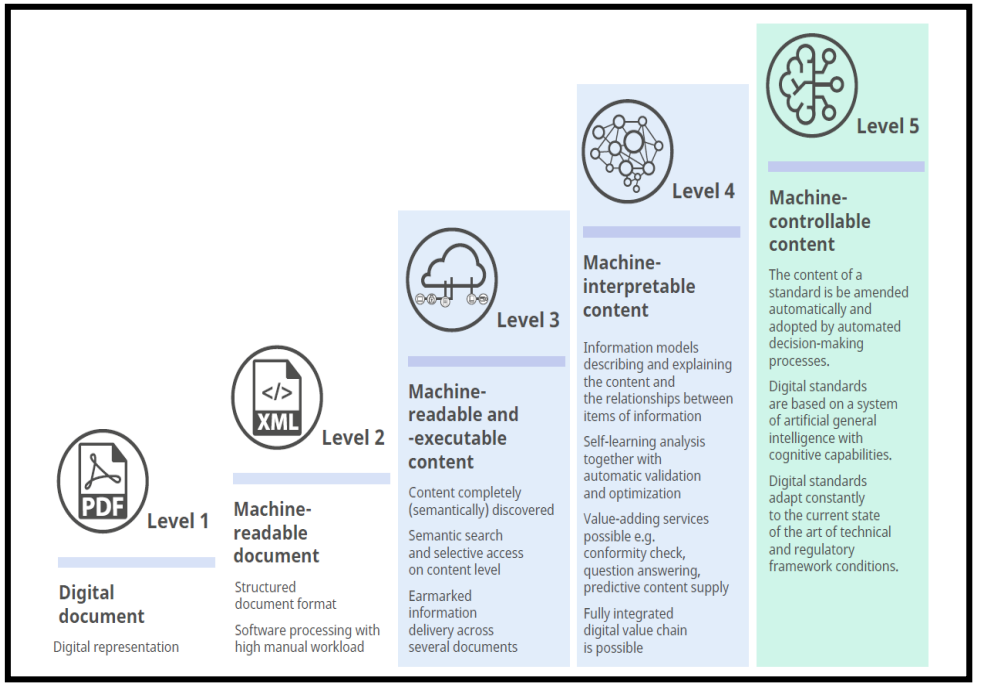
3 Incorporating Emerging Needs

- Illicit Drugs
- Semiconductors
- Food Safety
- Plastics additives/formulation

2 Data *à la carte*

Breaking up large datasets to serve diverse user bases (RefProp, MassSpec)

Better serving SMEs and academic research



Credit: DIN DKE IDiS

Questions?