

NIST Laboratory Programs and the National Voluntary Laboratory Accreditation Program



*Working to
Strengthen the
U.S. Economy*



NIST

National Institute of
Standards and Technology
U.S. Department of Commerce

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Working to Strengthen the U.S. Economy

This document describes the collaborations, partnerships, and working relationships between the NIST Laboratory Programs and the National Voluntary Laboratory Accreditation Program (NVLAP) in accrediting public and private laboratories.

“As NIST takes this opportunity to better align itself with its vision and future, we in NVLAP want to take the opportunity to recognize those in the Laboratory Programs with whom we have had the pleasure of collaborating.”

*- Sally Bruce,
Chief, National Voluntary Laboratory
Accreditation Program*



C. Cameron Miller, Optical Technology Division, in front of the NIST 2.5 m integrating sphere for LED measurements. Besides providing expertise and guidance on lighting proficiency testing, and selected on-site technical assessments, Dr. Miller is a technical expert assessor and coauthor of NVLAP's NIST Handbook 150-1 Energy Efficient Lighting Products.

What Is Laboratory Accreditation?

Laboratory Accreditation is the recognition by an accreditation body (AB) that a laboratory is capable and competent to provide scientifically sound and valid calibration or testing services as documented on its scope of accreditation and on the calibration certificates or test reports that it issues.

Why Is Accreditation Important?

The goal of any business is to sell its products and services in the marketplace. More and more often, this requires that the business demonstrates (often to regulatory federal, state and local agencies) that its products and services conform to standards of performance in order to ensure that its products and services are “fit for use” or “safe” to buy.

But how is a customer or regulatory government agency to know whether the measurements or test results are valid? A growing means of assuring the validity of the measurements is through the use of accredited laboratories to make the measurements and then compare the results with the appropriate standards.

Val Miller in the Weights and Measures Division's Training Laboratory showing how to set up weights in front of a high-accuracy balance for what is called a "weighing design." Georgia Harris from this division provided the technical criteria for mass and volume for inclusion in the original draft of NIST Handbook 150-2, Calibration Laboratories Technical Guide, and other technical support and guidance. Ms. Harris and Mr. Miller also assisted with the technical revision of NIST Handbook 150-2G, Calibration Laboratories Technical Guide for Mechanical Measurements (2004), and have been contributing to the current revision of this handbook. Proficiency testing in mass, volume, tapes/rules, tuning forks, and stopwatches is provided to NVLAP laboratories by request and through participation in the Weights and Measures Regional Measurement Assurance Programs (RMAPs).

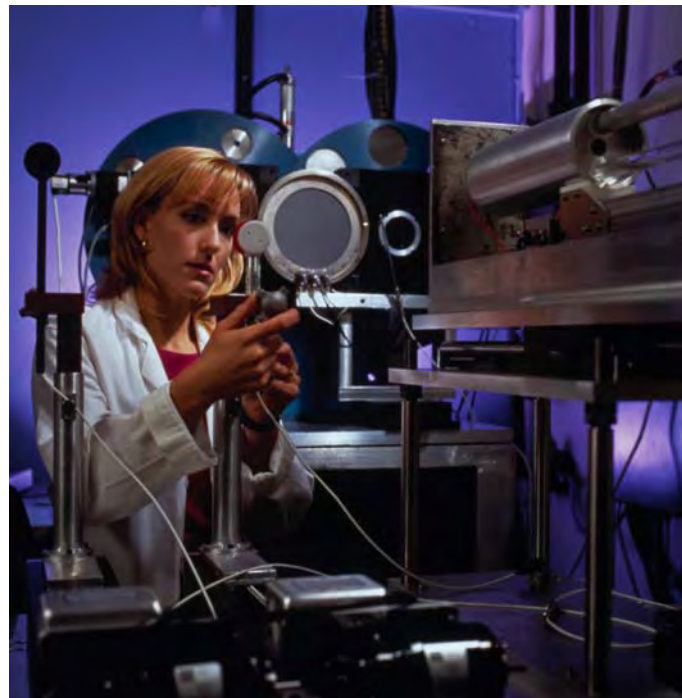
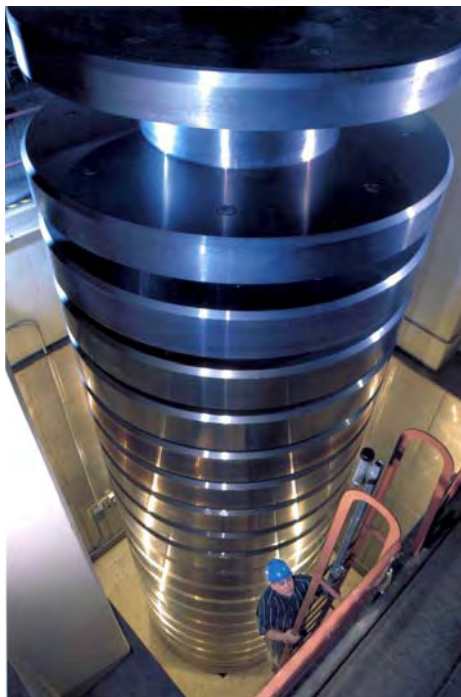


U.S. federal, state and local governments rely increasingly on measurements and tests from accredited laboratories to make decisions that affect safety, security, health and the environment. In turn, accreditation eliminates redundant audits by customers, reduces costs, and improves acceptance of products in U.S. and world markets.

What Is the National Voluntary Laboratory Accreditation Program (NVLAP)?

NVLAP is part of the National Institute of Standards and Technology (NIST), the national metrology institute (NMI) of the United States. While part of NIST, NVLAP is an independent, self-contained program. NVLAP acts as an unbiased third party to accredit calibration and testing laboratories in response to legislative actions or requests from government agencies or private-sector entities. In response to requests, NVLAP will consult with interested parties through public workshops and other means, and analyze each request to determine that there is a need to establish a Laboratory Accreditation Program.

Sam Ho, Manufacturing Metrology Division, climbing out of the weight pit of the 4.45 MN (1000000 lbf) deadweight force standard machine at NIST – the largest of its kind in the world. This system is used to calibrate force transducers. Rick Seifarth of the division has performed on-site assessments and provided proficiency testing in force measurements.



C. Michelle O'Brien, Ionizing Radiation Division, shown adjusting a transfer chamber for NIST mammographic x-ray instrument calibration. She and other staff from this division have provided NVLAP technical expertise for ionizing radiation dosimetry and radiation calibration laboratories.



Sam Low, Metallurgy Division, in front of the primary Rockwell hardness reference machine for the United States. Sam Low is the Metallurgy Division's Quality Manager, and has provided continuing technical guidance in the area of hardness for both the NVLAP Calibration and the Fasteners and Metals Laboratory Accreditation Program.

NIST is a non-regulatory agency, and NVLAP issues accreditations through a completely voluntary framework. However, many U.S. regulatory agencies require that testing and calibration be provided by accredited laboratories, and some require NVLAP accreditation specifically.

What Are the NIST Laboratory Programs?

NIST Laboratory Programs, located in Gaithersburg, MD, Boulder, CO, and Charleston, SC, conduct research in a wide variety of physical, chemical, engineering and computer sciences. They respond to government and industry needs for measurement standards, methods, tools, data, and technology. Researchers from NIST collaborate with colleagues in other government agencies, industry, and academia.



Robert Zarr, Building Environment Division, shown at the 1-meter guarded hot-plate apparatus that measures thermal conductivity of building insulation. This facility provides for absolute measurement of thermal resistance of thick and low-density test specimens used as transfer standards. These standards are used to calibrate heat-flow-meter apparatus (ASTM C 518) or verify guarded-hot-plate apparatus (ASTM C177). The division has provided technical support to NVLAP for the Thermal Insulation Materials Lab Accreditation Program.

How Do NIST Laboratory Programs and NVLAP Complement Each Other?

International and National Measurement Systems

Measurements made by NIST Laboratory Programs and other NMIs form the foundation of the international measurement system and the International System (SI) of Units. “Traceability” to the SI from NIST or other NMIs in an unbroken chain to measurements emanating from laboratories other than NMIs provides an uninterrupted measurement pedigree assuring measurement users that the measurement is accurate within a stated uncertainty.

Anyone can claim that their measurements are traceable, but traceability verified by measurements emanating from an accredited laboratory is an especially valued asset, since the traceability of the measurements has been verified by an unbiased third party.

Traceable measurements made by accredited laboratories provide confidence to prospective public- and private-sector customers so that they may rely on the measurements or tests they use to verify that products and services meet standards, specifications, or other requirements.



The Process Measurements Division at NIST Gaithersburg, MD, is in charge of realizing, maintaining, and disseminating the International Temperature Scale of 1990 (ITS-90). The Standard Platinum Resistance Thermometer (SPRT) Calibration Laboratory of the NIST Thermometry Group realizes the ITS-90 from the argon triple point (Ar TP, 189.3442 °C) to the silver freezing point (Ag FP, 961.78 °C) for the calibration of SPRTs. Michal Chojnacky, NIST physicist, is shown pulling the Tin Freezing Point cell out of its bath. Dean Ripple, Gregory Strouse, Karen Garrity and C. Dawn Cross from the division have all assisted NVLAP with calibration traceability, proficiency testing, calibration handbooks, and on-site technical assessment for those labs claiming the highest accuracies.



Andrew Novick, Time and Frequency Division, teaching a seminar at the Measurement Science Conference. The Time and Frequency Division maintains the standard for frequency and time interval for the United States, provides official time to the United States, and carries out a broad program of research and service activities in time and frequency metrology. Michael Lombardi, Donald Sullivan and David Howe of the division assisted with NVLAP's NIST Handbook 150-2C, Calibration Laboratories Technical Guide for Time and Frequency Measurements.



Leticia Pibida uses a hand-held radiation detection device to check the cargo of a truck trailer. She is coauthor of NVLAP's NIST Handbook 150-23 Homeland Security Applications: Radiation Detection Instruments.

Photo: Copyright Robert Rathe

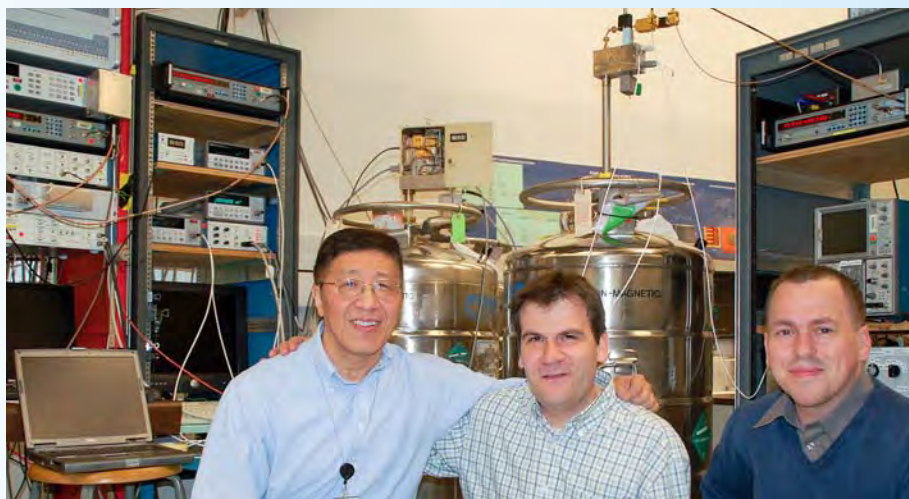
Accreditation of Calibration Laboratories

NVLAP directly supports the U.S. physical measurement infrastructure by accrediting eligible calibration laboratories outside NIST that provide measurement results traceable to national and international standards.

Many of these NVLAP-accredited calibration laboratories rely on NIST Laboratory Programs' services directly for the calibration of their own equipment and standards. In addition, at NVLAP request, NIST Laboratory Program staff are often actively involved in the development and maintenance of NVLAP technical requirements for accreditation programs, and often act as NVLAP on-site technical assessors for those laboratories that are at the highest echelons of accuracy. NIST Laboratory Program staff also have been asked to provide guidance on the delivery of proficiency testing for NVLAP-accredited calibration laboratories. In some instances, NVLAP requires that accredited calibration laboratories participate in interlaboratory comparisons provided by NIST Laboratory Programs as part of their proficiency testing to obtain or maintain accreditation.

A beneficial byproduct of this continual interaction between NVLAP and the NIST Laboratory Programs is a particularly robust transfer of technology from the U.S. NMI to outside calibration laboratories.

Yi-hua Tang, Quantum Electrical Metrology Division, Stéphane Solve and Régis Chayramy, both of BIPM, in front of the 10 V Josephson voltage standard (JVS) comparison conducted between NIST and BIPM at Gaithersburg, MD in 2009. The 10 V JVS serves as the cornerstone for dc voltage dissemination. The key comparison with BIPM provides proof for the calibration and measurement capability (CMC) claimed by the United States.



NVLAP-accredited calibration laboratories include those operated by

- Federal agencies, such as the Department of Defense and the Department of Energy;
- Metrology laboratories that provide regulatory support in their respective commonwealths, jurisdictions, or states;
- Major manufacturers of physical measurement standards and test equipment; and
- Other calibration-service laboratories working across a broad spectrum of sectors including aerospace, automotive, computing, electronic, and energy, as examples.

Gina Kline, Process Measurements Division, recording observations and data over the 34-L Pressure, Volume, Temperature, and Time (PVTt) primary gas flow standard. The division assisted with the technical criteria for volume, flow, pressure, and vacuum for NVLAP's NIST Handbook 150-2G Calibration Laboratories Technical Guide for Mechanical Measurements and is assisting with its update.





Nathaniel Waters, Office of Law Enforcement Standards (OLES), examines a bullet-resistant vest being tested. With funding from the National Institute of Justice (NIJ), OLES develops test methods and standards for the performance of equipment used by police, corrections officers and first responders. At the request of NIJ, NVLAP established a personal body armor testing laboratory accreditation program.

Photo: Copyright Robert Rathe.

A Robust International Measurement System Demands International Equivalence of Calibration Measurement Data

NIST has signed the Comité International des Poids et Mesures (CIPM) Mutual Recognition Arrangement (MRA). This MRA provides for the mutual recognition of national measurement standards and of calibration and measurement certificates issued by NMIs. The technical basis of this arrangement has two components. First, the signatory parties recognize the degree of equivalence between the national standards derived from the results obtained through key comparisons published by the International Bureau of Weights and Measures (BIPM) and maintained in its key comparison database (KCDB). The second part is the recognition of the validity of the NMI's calibration and measurement certificates by other participating institutes for the quantities and ranges found in Appendix C of the MRA. For more details on the CIPM MRA, the key comparison database, and the calibration and measurement capabilities (CMCs), please see <http://www.bipm.org/en/convention/mra/>.

As a part of its policy on measurement traceability, NVLAP requires that accredited laboratories provide measurement results and uncertainties based on an established path of traceability through an NMI to the SI units. The CIPM MRA furthers the acceptance of calibration laboratory measurements showing traceability to differing NMIs signatories to the MRA.

Accreditation of Testing Laboratories

Calibration laboratories make measurements in comparison with physical measurement standards, such as length, time, mass, etc. There is another type of standard, the “documentary” standard, which specifies test methods and the characteristics of products, processes, or systems.



Shown in photo on the left are 3200 sample boxes of Coarse Aggregate to be shipped to participating laboratories as proficiency test samples. On the right, John Ardinger, AASHTO Materials Reference Laboratory (AMRL), is weighing out samples. More than 17,500 AMRL samples are sent out on an annual basis. About 1500 laboratories subscribe to the proficiency testing program of the Cement and Concrete Reference Laboratory (CCRL) and they ship about 7400 samples annually. The CCRL and the AMRL are Research Associate Programs located in the NIST Building and Fire Research Laboratory. CCRL is sponsored by ASTM and AMRL is sponsored by the American Association of State Highway and Transportation Officials (AASHTO). CCRL and AMRL operate proficiency sample programs that are required by NVLAP's Construction Materials Testing Laboratory Accreditation Program.

Testing laboratories make measurements in accordance with documentary standards. NVLAP accredits testing laboratories separately from calibration laboratories.

So, as is the case with calibration laboratory accreditation, federal, state and local governments sometimes require accreditation of test laboratories and sometimes, specifically by NVLAP. For example, the Asbestos Hazard Emergency Response Act specifically requires that laboratories that analyze asbestos insulation samples from public and private elementary and secondary schools be accredited by NVLAP.

Federal agencies including the Nuclear Regulatory Commission (Ionizing Radiation Dosimetry); Department of Housing and Urban Development (Carpet and Carpet Cushion); National Security Agency (Common Criteria); Department of Justice National Institute of Justice (Personal Body Armor); and Department of Homeland Security (Radiation Detection Instruments and Biometrics) have requested testing laboratory accreditation programs from NVLAP.

A Robust International Measurement System Demands Mutual Recognition of Laboratory Accreditations

One of the major reasons that laboratories seek accreditation is to reduce the need for each of their customers to assess them. To reduce the need for ABs external to the U.S. to perform assessments of NVLAP-accredited laboratories, and to reduce trade barriers for U.S. businesses across national borders, NVLAP is signatory to the:

- International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement for calibration and testing;
- Asia Pacific Laboratory Accreditation Cooperation (APLAC) Mutual Recognition Arrangement for calibration and testing; and
- InterAmerican Accreditation Cooperation (IAAC) Multilateral Recognition Arrangement for calibration and testing.

As a signatory to these MRAs, NVLAP helps facilitate the ILAC goal of “one test, accepted everywhere.”

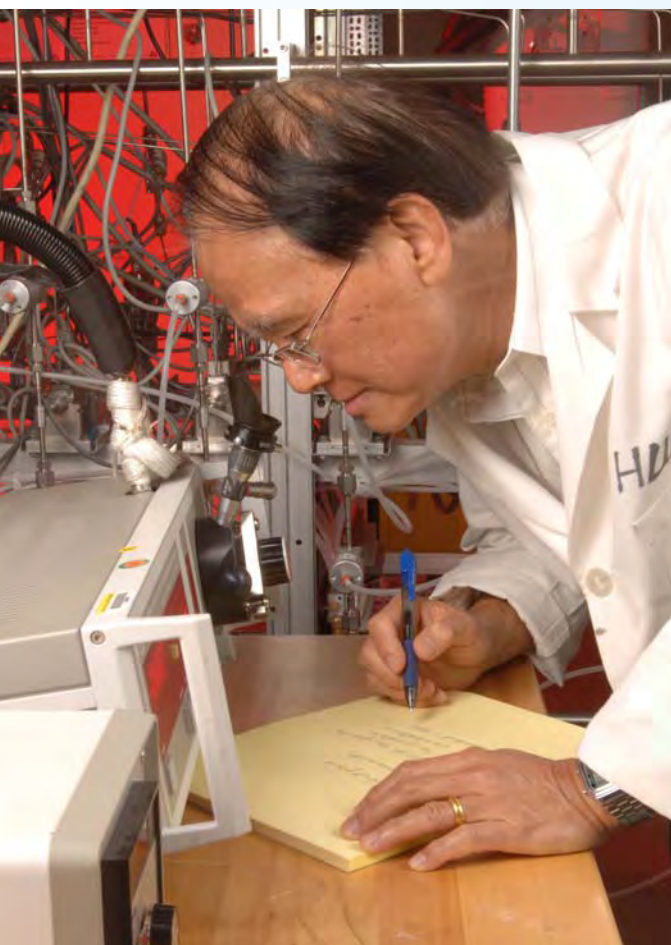


The Cryptographic Module Validation Program (CMVP) and the Cryptographic Algorithm Validation Program (CAVP), both located in the Computer Security Division, validate the tests performed by NVLAP-accredited Cryptographic and Security Testing Laboratories. Randy Easter, Director of the CMVP, seated left, Sharon Keller, Director of the CAVP, seated right. Standing left to right: Beverly Trapnell, James Fox, and Caroline Scace, all of the Computer Security Division. Michaela Iorga of the division coauthored the current NVLAP NIST handbook for Cryptographic and Security Testing with guidance from Mr. Easter, Magdalena Benitez, Hildegard Ferraiola, Peter Mell, William MacGregor, and Ray Snouffer. A new revision is being authored by Ms. Keller, Tim Hall, Mr. Easter, Ms. Trapnell, Mr. Fox, Ms. Scace, Kim Schaffer, John Banghart, Ms. Ferraiola, and Ramaswamy Chandramouli, all of the Computer Security Division, and Claudia Popa, Ken Lu and Jean Campbell of the Communications Security Establishment Canada.

How Does NVLAP Collaborate with NIST Laboratory Programs in the Development and Maintenance of a Laboratory Accreditation Program?

Today, NVLAP's programs are developed mainly in response to legislative mandates or other agency requests related to critical safety, security, health and environmental issues, and in support of international trade activities.

Peter Huang, Process Measurements Division, is shown in front of the multiplexer that is part of the primary humidity generation standard, the Hybrid Humidity Generator at NIST. Dr. Huang provided technical guidance on the NVLAP NIST Handbook 150-2H, Calibration Laboratories Technical Guide for Thermodynamic Measurements and has been contributing to its revision.



NVLAP collaborates with the NIST Laboratory Programs in at least three different ways:

- When a new Laboratory Accreditation Program (LAP) is being considered, NVLAP may request the participation of the appropriate NIST Laboratory Program in public meetings with affected or interested industry, government, and laboratory representatives.
- Once NVLAP has decided to proceed with a LAP, NVLAP requests the participation of knowledgeable NIST Laboratory Program staff to develop the technical criteria that will be used to assess laboratory expertise. These criteria are published in program-specific handbooks (see <www.nist.gov/nvlap> for a complete list of handbooks).
- After a LAP has been established, NVLAP often requests the participation of NIST Laboratory Program staff to serve as Technical Assessors at laboratory on-site assessments and to provide technical expertise as laboratory proficiency testing is conducted.

What is the Value of NIST Laboratory Programs to NVLAP?

Absolutely invaluable to NVLAP, NIST Laboratory Program experts have brought their passion for the science of metrology, and the applications of measurement science in today's technology to the NVLAP accreditation process. Their measurement expertise has contributed greatly to the significant successes of NVLAP accreditation programs.

Indeed, an especially coveted byproduct cited by NVLAP-accredited calibration laboratory staffs is their ability to interact with NIST Laboratory Program experts.

What is the Value of NVLAP to the NIST Laboratory Programs?

Likewise, NIST Laboratory Program experts cite how their participation in NVLAP LAPs has strengthened their appreciation and commitment to quality systems as they operate within the NMI.

In addition, NIST Laboratory Program personnel cite their involvement in accreditation activities as an additional access point to high-level laboratories that use the measurement standards that NIST develops. These firsthand observations have provided NIST Laboratory Program staff with valuable feedback that can be utilized to better serve NIST customers overall, revealing related needs that can trigger more useful research in the future. For example, improvements in documentary standards in several areas have been made because of data available from proficiency testing results.

How Can NIST Laboratory Programs Meet the Ever Increasing Needs of Their Customers?

NIST Laboratory Programs' science and technology has long benefited:

- Industry innovation;
- Improved process and quality control in business and research; and
- Government provision of:
 - o consumer protection and environmental regulation;
 - o food safety;
 - o homeland and international military security;
 - o medical diagnosis and treatment; and
 - o forensic evidential results.

A myriad of organizations, especially other federal agencies, put constant pressure on NIST Laboratory Programs to use their unique expertise to solve measurement problems and tackle shifting measurement priorities.



John Wack and John Rhodes, Software and Systems Division, and Sharon Laskowski, Information Access Division, demonstrating some usability issues on a voting machine. The Help America Vote Act (HAVA) of 2002 directs NIST to chair the Technical Guidelines Development Committee to develop voluntary voting system guidelines. The Information Technology technical divisions at NIST have conducted research on data storage and security in voting systems, protection of voter privacy, the role of human factors, and methods to detect and prevent fraud. NVLAP accredits voting system testing laboratories for the Election Assistance Commission (EAC). The EAC certifies voting systems for use in elections.

The continuous demands to contribute to business and government research and technology issues require that NIST Laboratory Programs transfer their measurement expertise whenever possible to others in the United States so that they can take on new tasks and develop new and better measurement capabilities and systems.

When NVLAP requests the technical expertise of NIST Laboratory Program staff in a LAP, one of the value-added benefits from this collaboration and interaction is the opportunity for robust technology transfer with assurance that measurements made outside NIST are valid. This confidence permits NIST Laboratory Programs' management to focus its attention on new measurement areas, ultimately freeing up resources for new research and technological explorations.

Even though the NIST Laboratory Programs and NVLAP each have their own missions, the symbiotic relationship between them leads to a stronger measurement system and improved trade, health, and safety for everyone.



Michaela Iorga, Fernando Podio, and Hildegard Ferraiolo, Computer Security Division, examining the results of a Personal Identity Verification (PIV) card. Ms. Iorga is coauthor of NVLAP's NIST Handbook 150-25 for Biometrics Testing. Mr. Podio is chairman of Technical Committee M1 - Biometrics under the InterNational Committee for Information Technology Standards (INCITS) and Subcommittee 37 - Biometrics of the ISO/IEC Joint Technical Committee 1 (ISO/IEC JTC 1) and was a technical advisor on standards to the NVLAP Technical Working Group on biometrics testing. Ms. Ferraiolo is part of the NIST Personal Identity Verification Program (NPIVP) validating PIV system components required by Federal Information Processing Standard (FIPS) 201 using NVLAP-accredited testing laboratories.

