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Office of Weights and Measures – Laboratory Metrology Program Overview

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There are often questions about what each program at the National Institute of Standards and Technology, (NIST), Office of Weights and Measures (OWM) does and what the program responsibilities are (sometimes even from within our office!). In fact, the OWM Laboratory Metrology Program held a Proficiency Testing Workshop in December 2012, and metrologists, who have been around for quite a while, had questions about how everything the OWM does fit together! Thus, we are providing this article about the OWM Laboratory Metrology Program.

FOUR INTERRELATED PROGRAM AREAS

There are four key areas of responsibility in the OWM Laboratory Metrology Program: Laboratory Recognition, Proficiency Testing, Training, and Documentary Standards for weights and measures (Figure 1). Each functional area has a set of guiding documents as well as international documentary standards used for benchmarking to enhance program recognition and credibility.

All four program areas are interrelated with each of the other four areas, but all four are also related to support for the weights and measures system. For example, laboratories that are recognized often support the weights and measures program requirements to ensure that measurement results have demonstrated metrological traceability while the Handbook 105-series *(Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures*) documentary standards are often required by the weights and measures program for enforcement applications. To be recognized, the laboratory must successfully complete both training and proficiency testing requirements, in addition to all other published requirements that follow the ISO/IEC 17025 standard for calibration laboratories. Training on both proficiency testing and laboratory Recognition requirements is available. Then, proficiency testing is used not only to assess laboratory competency for Recognition and Accreditation, but also to assess the level of application of training concepts and its impact.

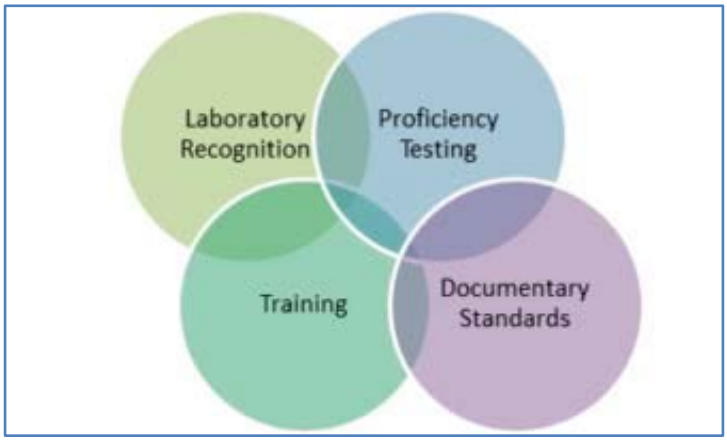

Figure 1. Laboratory Metrology Program Areas.

PROGRAM AREA DESCRIPTIONS

Laboratory Recognition

The Laboratory Recognition area is very narrow in scope and only supports weights and measures laboratories in the United States. Laboratory Recognition is provided for the weights and measures laboratories to help demonstrate evidence of metrological traceability that is required in the state and local jurisdictions. The model weights and measures laws in Handbook 130*, Uniform Laws and Regulations in the Areas of Legal*

Metrology and Engine Fuel Quality, or alternative laws, as adopted in the jurisdictions, often state that weights and measures programs are required to ensure metrological traceability to NIST or the International System of Units (SI). The latest model laws indicate that laboratory Recognition or Accreditation provides the demonstrated evidence of metrological traceability. One value-added impact of the OWM Laboratory Recognition over Accreditation alone is that we can target specific technical areas each year when and where problems have been identified as well as conduct national-level analysis to consider system-wide laboratory quality system documents, internal audits, and management reviews, along with technical audits and measurement data. These annual assessments are conducted for all laboratories, and resources are periodically posted on the NIST website related to these annual assessments. Example technical audits that have provided national level summary assessments in the past few years include: facility audits, software verification and validation, succession planning, measurement assurance, uncertainties, and metrological traceability. Identified national or regional problems provide input into the training area.

The OWM Laboratory Metrology Program also interfaces with the NIST National Voluntary Laboratory Accreditation Program (NVLAP) for those state laboratories that are accredited. Within NVLAP, the current primary contact for state laboratories is Ms. Barbara Belzer. The primary contacts in OWM for Laboratory Recognition are Georgia Harris and Elizabeth Gentry.

Training

Hands-on training includes both courses that are taught at NIST in the OWM Demonstration and Training Laboratory as well as regionally in the Regional Measurement Assurance Program (RMAP) annual training sessions (Figure 2). The current core laboratory metrology courses that are offered include: Fundamentals of Metrology, Mass Metrology, Volume Metrology, and Advanced Mass Metrology. These courses were developed and updated from 2010 to 2012 as a part of a training redesign project to ensure that all training requirements needed by the laboratories are covered as well as to integrate more activities and adult learning concepts into the courses as a part of our goal in having an accredited training program. Previous courses (Basic Metrology for States, Intermediate Metrology) are no longer available.

In addition to the traditional hands-on training courses, the OWM Laboratory Metrology Program has developed an extensive series of two-hour webinars on a variety of high interest topics. Webinar tuition is funded by the OWM and provided free to U.S. weights and measures officials and metrologists to enhance legal metrology uniformity. These courses are held throughout the year, and include a special "week of webinars" held in June that was first offered in 2012.

Specific training and personnel competency requirements to support Laboratory Recognition are published in Handbook 143, *State Weights and Measures Laboratories Program Handbook,* Training at the RMAP sessions is selected each year based on training needs assessments with input gathered through laboratory requests and inquiries, assessments of annual submissions from the laboratories, and through an assessment of the reasons for proficiency testing failures. Numerous supplementary courses are taught throughout the year via webinar, covering many topics related to implementing content from Handbook 143, or to address training needs between other seminars that are scheduled. Registration for all courses is done through the NIST, OWM contact database, which also makes transcripts readily available to students. The primary contacts for Training are Val Miller and Georgia Harris from a program perspective, Yvonne Branden from an administrative perspective, and Isabel Chavez for the OWM contact database. Val Miller, Georgia Harris, and Elizabeth Gentry, plus qualified contract instructors from working laboratories provide course instruction at NIST and at the RMAP training sessions.

Figure 2. Regional Measurement Assurance Program (RMAP) Groups

Proficiency Testing

The Proficiency Testing area is primarily coordinated through the annual RMAP training sessions. Because laboratories are required to have a four-year plan of proficiency testing as a condition of Recognition or Accreditation, a four-year plan is developed within each RMAP group. The planning, analysis, and reporting takes place at each annual meeting, where laboratories are given opportunities to help create the plan to meet the needs of their measurement Scopes. An added benefit of group management of proficiency tests is the minimization of overall program costs through the use of volunteers to coordinate and analyze data. Program tools used in this area are also used by many other laboratories outside the program and outside the United States. Val Miller is the primary contact for Proficiency Testing.

Documentary Standards

Ideally, documentary standards would be reviewed on a periodic basis and updated as appropriate. This area of the program receives the least overall attention, but standards are selected for updates when issues arise indicating a need. At this time, an update to NIST Handbook 105-1 for field standard weights and Handbook 105-7 for small volume provers are in the development process. A new documentary standard is being considered for master meters. The program also participates with

ASTM, USP, and OIML in standards development. Val Miller is currently the primary contact for Handbook 105-1 updates and Georgia Harris for the volumetric standards.

Program References

An intentional effort that has been made by the OWM Laboratory Metrology Program over the years (at least since the 1980s) is to adopt and use international standards and references to gain program credibility. For example, when NIST

Handbook 143 was first published in 1986, it referenced ISO Guide 25, *General Requirements for the Competence of Calibration and Testing Laboratories,* and NBS Handbook 145, *Handbook for Quality Assurance of Metrological Measurements,* procedures referenced Mil-Std-45662A, *Military Standard: Calibration Systems Requirements*. Both ISO Guide 25 and Mil-Std-45662A were the internationally and nationally accepted standards at that time. Yet, full implementation of these and their current standard counterparts has taken time. The first documented guidance in the Proficiency Testing area followed ISO Guide 43, *Proficiency Testing by Interlaboratory Comparisons,* which has since become a formal standard rather than a guide.

Program Area	**Reference Documents**
Laboratory Recognition	NIST Handbook 143, Program Handbook (based on ISO/IEC 17025:2005)
Training	ANSI/IACET Standard for Continuing Education and Training Laboratory Procedures: NBS Handbook 145 (length), NISTIR 5672 (mass dissemination), NISTIR 6969 (mass), NISTIR 7383 (volume)
Proficiency Testing	ISO/IEC 17043, ISO 13528 (applicable portions) NISTIR 7082, Proficiency Testing Policy NISTIR 7214, Proficiency Testing Quality Manual
Documentary Standards	NIST Handbooks 105-1 through 105-8 for field standards used in weights and measures

Internal Processes and Strategic Assessments

Each OWM Laboratory Metrology Program area has documented internal processes that are followed to ensure consistency on an ongoing basis. At a high level, the Office of Weights and Measures conducts annual strategic planning and selects specific strategic and operational objectives. The Laboratory Metrology Program conducts an annual SWOT analysis (identifying strengths, weaknesses, threats, and opportunities) within each program area. This method has also been used to gather input from metrologists at the annual RMAP training sessions to ensure customer input is considered and that program efforts are responsive to current and emerging national needs.

Measuring Results

Specific concepts are used to measure results in each Laboratory Metrology Program area. At one time, the majority of the measures were output measures. These included a count of how many laboratories were recognized, how many students attended training, and how many courses were held, how many proficiency tests were conducted and in what measurement areas, along with the status of how many 105-series handbooks were published or in the process of being updated. Gradually, these measures have moved to include outcome measures where improvements are tracked, especially quality and impact. For example, the maps published in the periodic laboratory workload survey show how many laboratories are recognized by OWM and accredited by NVLAP. In addition, a scoring model was instituted to assess all of the laboratories against standardized criteria to track whether or not improvements (or declines) are seen from year to year in the overall national quality of the laboratories.

In the Training area, a Kirkpatrick-type course evaluation system is used to measure satisfaction, learning, application, and impact related to a training experience. In the Proficiency Testing area, pass-fail statistics are tracked and a periodic evaluation of the resulting follow-up corrective actions made by the laboratories is conducted. In the Documentary Standards area, the level of application and adoption within the weights and measures programs is considered.

If you have questions or comments about any of these program areas or the OWM Laboratory Metrology Program, please feel free to contact Georgia Harris at gharris@nist.gov.