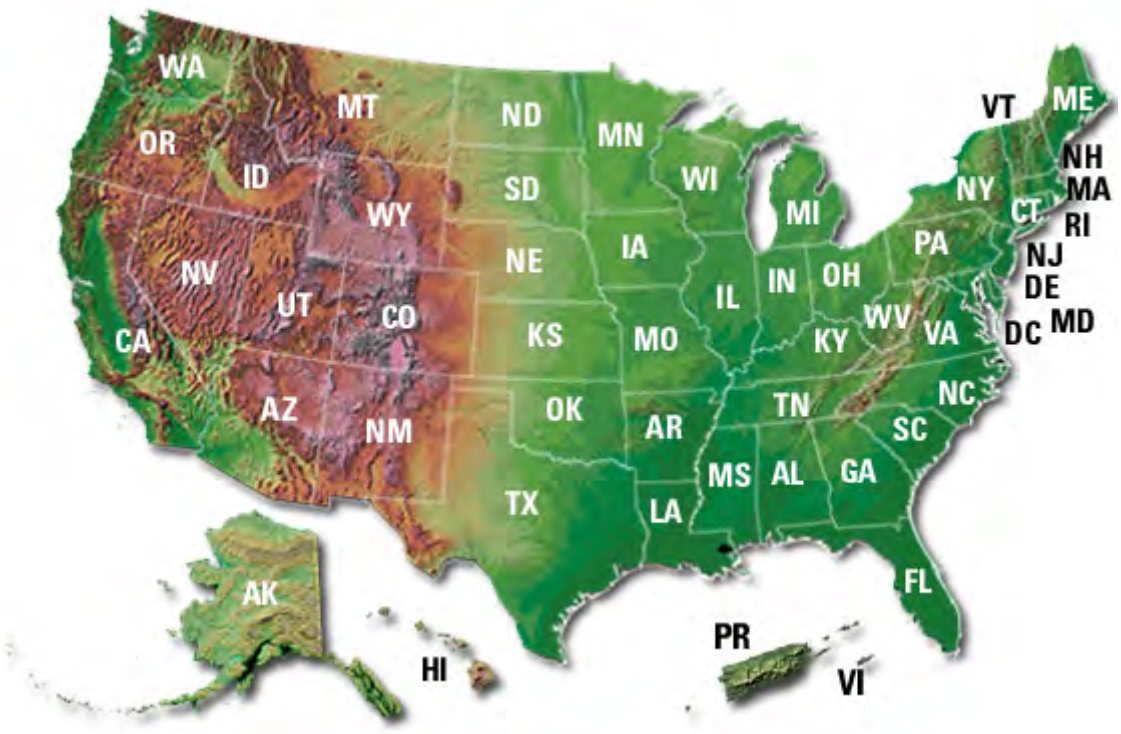
2016

State Laboratory Program Workload Survey



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Acknowledgements

This report was prepared with the help of the members of the NCSL International Committee 156 - Legal Metrology Committee. Special thanks must be given to the metrology professionals working in the State Laboratory Program who have generously given their time to complete the 2016 State Program Workload Survey thus providing the data essential to make this report possible. Thanks also go to the staff of the National Institute of Standards and Technology, Office of Weights and Measures who have provided considerable support in collecting data and preparing and publishing this report.

It is our sincere hope that this biannual report continues to be a valuable resource to the State Laboratory Program laboratories and to those who rely on the service that these laboratories provide.

Objectives and History

Historically there has been inconsistency between survey titles and the year which the data represents. Starting in 2008 the survey team adopted the convention of naming the report based upon the year that the data used to prepare the survey report represents rather than the year that the report was published. For example, the report titled “2016 State Laboratory Program Workload Survey" represents data collected during the 2016 calendar year. Table 1 correlates historical workload surveys to the year(s) during which the data was collected.

Survey Title	Year represented
1996 State Laboratory Program Workload Survey	1996
1999 State Laboratory Program Workload Survey	1998
2000 State Laboratory Program Workload Survey	1999
2001 State Laboratory Program Workload Survey	2000
2003 State Laboratory Program Workload Survey	2002
2005 State Laboratory Program Workload Survey	2004
2005 & 2006 State Laboratory Program Workload Survey	2005&2006
2008 State Laboratory Program Workload Survey	2008
2010 State Laboratory Program Workload Survey	2010
2012 State Laboratory Program Workload Survey	2012
2014 State Laboratory Program Workload Survey	2014
2016 State Laboratory Program Workload Survey	2016

Table 1: Historical survey titles and the year represented by each.

In 1996, the National Conference on Weights and Measures (NCWM) Metrology Subcommittee surveyed the State Laboratory participants to quantify the workload of the State Laboratory Program (SLP) and document its impact on the United States economy. From the survey analysis, it was clear that the workload statistics were dynamic and only provided a snapshot of the workload at the time. Therefore, the Metrology Subcommittee circulated a revised survey April 16, 1999 to update program statistics and to investigate trends in the National workload. The subcommittee has since recommended that the survey be conducted on a regular basis and that the core survey be kept standardized in order for state labs to develop databases that could automatically generate the information for the survey.

Survey data is used not only to quantify the impact of the SLP on the United States economy, but also to plan and maximize its effectiveness. Training and inter-laboratory comparisons are designed to meet real needs of the workload. Ultimately, the survey information increases the efficiency of the entire SLP and maximize the benefits to the National Economy. The results of previous surveys have been used extensively at NIST to gain support and attention for the State Laboratories and have been helpful in putting together budget proposals. The information from the survey is also useful in identifying the diversities of the workload on a national level.

Collection, Presentation, and Analysis of Data:

SLP laboratories submitted their data using a standardized Microsoft Excel spreadsheet or Microsoft Word document. This was done to accommodate as many of the participants as possible. The Microsoft Word version of the 2016 survey is reprinted in this report beginning on page 172.

The data was copied from each individual completed survey forms into a master data spreadsheet for analysis. The copy process is automated using Excel macros in order to expedite the process and to minimize the potential for random data transcription errors. Surveys submitted using the Microsoft Word version of the survey are manually transcribed into the Excel based form by the survey team prior to analysis.

The overall survey is presented in the following order;

1. The NIST Office of Weights and Measures (OWM) provides an initial report of workload data from the NIST Measurement Services Division summarizing calibration work done for State laboratories covering a range measurements including mass, volume, temperature, pressure, etc. This report generally presents the leveraging effect that the SLP provides for the NIST Measurement Services Division. The NIST report begins with "Impact and Leveraging of NIST Calibrations" on page 14.
2. The NIST OWM then provides an overview of the SLP which;
    - details program metrics NIST OWM uses to track member laboratories,
    - reports on the accreditation status of each of the member laboratories,
    - reports on training provided by NIST OWM for the member laboratories,
    - reports on proficiency testing conducted within the SLP,
    - reports on documentary standards used by the SLP,
    - details each member laboratory's measurement scope as recognized by the NIST OWM.
3. Individual laboratories participating in the survey are identified by name location, age, size, and number of customers served beginning on page 33. Current contact information for the individual SLP laboratories and their NIST OWM Certificate of Measurement Traceability can be found on the NIST Office of Weights and Measures website:

    https://www.nist.gov/pml/weights-and-measures/resources/state-laboratories-c.
4. Each laboratory's prior survey participation in previous surveys is reported from 1996 through 2016 beginning on page 38.
5. The SLP workload portion of the survey is broken down into four broad measurement categories; mass, length, volume, and other. Each category is further subdivided into three sub-categories identifying the type of customer for whom measurements are performed; laboratory, weights and measures enforcement, and external.

    The data is presented in the form of both choropleth maps, color coded to illustrate the distribution of work across the entire SLP, and bar charts, ordered from high to low displaying the number of tests performed by each member laboratory. Summary pie graphs are included to report totals across the entire SLP by customer type.

    Summary data from previous workload surveys are included for each measurement category covered in this survey for comparison purposes. Mass testing data begins on page 42, Length on page 56, Volume on page 62, and all other tests begin on page 82.
6. A report of fees charged for the various services provided by each member lab begins on page 93. Fee estimates for a range of routine measurement services are presented using bar graphs detailing individual laboratory fee estimates. Historical averages are included for each measurement service where the data is available.
7. A report of laboratory staffing begins on page 122. This report includes;
    - Position titles;
    - Salary ranges; and

- a detailed list of metrologists employed in the SLP at the time of the survey. The data includes specific calibration authorizations, experience in years, and the approximate dates each person is eligible for full retirement.

8. A report on calibration acceptance on page 146. Member laboratories often have a regulatory duty with respect to service personnel who are normally required to submit measurement equipment for calibration on a regular basis. The acceptance matrix identifies from whom a service company can purchase a calibration certificate which will then be given legal recognition within that member laboratory's jurisdiction.
9. A report of supplementary question responses begins on page 148.
10. Survey comments are listed in this report beginning on page 163.
11. A reprint of the Microsoft Word version of the 2016 survey begins on page 172.

Additional Comments:

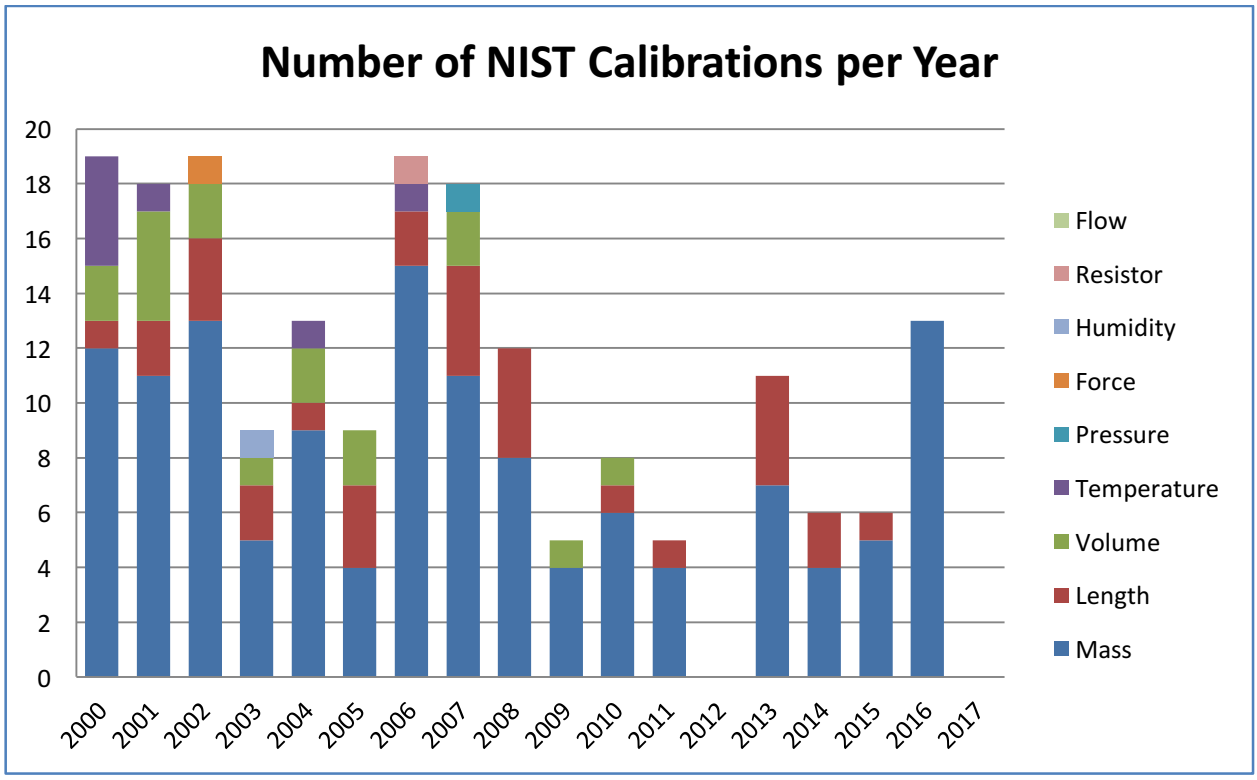
Caution should be used when comparing one state's data with data to another. It was determined in the 1996 survey that laboratory workload is influenced by industrial and population densities that vary by geographical location. Thus, low numbers for a lab may simply reflect low local demand for a laboratory's service. Variance in the number of devices tested, staffing, and facilities between individual laboratories are normal and cannot legitimately be used to rate the quality of any laboratory program.

No attempt was made to analyze the change in the workload of individual laboratories due to cyclic nature of the work. For example, a member laboratory may measure their volumetric glassware on a two-year calibration interval with the majority of these standards calibrated in sync with each other. The consequence being that few are tested in the following twelve-month period. This does not indicate that the workload is decreasing, it is just a reflection of the calibration interval assigned to those standards.

Impact and Leveraging of NIST Calibrations

(Information provided by NIST/OWM)

Calibration data for State laboratories was obtained from the NIST Measurement Services from 2000 through 2016. One of the measures of impact of NIST calibrations is to quantify the number and impact of downstream calibrations. How many additional calibrations are made by other laboratories using these calibrations? The answer to this question is a measure of the national impact of NIST calibration services and training. This leveraging of NIST calibrations to industry by the State weights and measures laboratories contributes greatly to the economy of the United States.



Data in the current survey includes measurements and calibrations performed at NIST in non-traditional measurement areas (e.g., those outside of mass, length, and volume).

State weights and measures laboratories account for a small portion of NIST's annual calibrations. Given data obtained in the SLP surveys in the 1990's, about half of the customer workload in the state laboratories was for industry and other government agencies (i.e., not weights and measures enforcement efforts). Many of these customers are the same customers who in other countries must obtain calibrations from a National Metrology Institute (NMI) such as NIST.

Economic statistics indicate that weights and measures enforcement, supported by these leveraged State weights and measures laboratory calibrations, affects more than half of the $18.56 trillion (2016) Gross Domestic Product (GDP). Since nearly half of the State weights and measures laboratory workload does not affect weights and measures enforcement, the economic impact of these calibrations influences virtually all of the U.S. GDP. Accurate measurements ensure product quality for practically every product manufactured, are required for other regulatory functions (EPA, FDA, DOD, DOE, DOT), and are requisite for international trade.

One question that might be asked in looking at this kind of leveraging data is "are enough calibrations being obtained from NIST by the States?" One responsibility of the NIST Office of Weights and Measures (OWM) is to coordinate the Laboratory Metrology Program. Each state laboratory that is recognized by OWM or accredited by NVLAP is required to have calibrations from acceptable sources, which are most often from NIST or other accredited laboratories. OWM Recognition or NVLAP Accreditation ensures that enough calibrations are obtained

from NIST by the State weights and measures laboratories and that the State metrologists are trained adequately. Furthermore, metrologists must prove their competency/proficiency and have specified calibration intervals for laboratory standards to ensure the ongoing ability to provide calibration results that are traceable to SI units or international and national standards. The number one corrective action following failed PTs/ILCs is that of obtaining updated calibrations for laboratory reference standards. It is estimated that better than 96 % of the laboratory standards are calibrated in a timely manner according to established calibration intervals. A special assessment to catalog and document calibration standards and intervals was completed during the 2011 assessment cycle as a part of a "traceability evaluation" project and will be completed during the 2017 assessment as well. The goal of the 2017 annual submission assessment will identify the number of calibration sources State laboratories are using in addition to those provided directly by NIST.

Metrological traceability and its assessment is required to comply with seven essential elements to ensure traceability to the International System of Units (SI) – typically, though not always through NIST. The seven essential elements are 1) a documented unbroken chain of comparisons (calibrations), 2) documented measurement uncertainties, 3) use of documented procedures, 4) demonstrated (accredited) technical competence/proficiency, 5) reference to the SI, 6) suitable and up to date calibration intervals, and 7) an acceptable measurement assurance system. In addition, State laboratories are required to comply with State laws regarding traceability to the National Institute of Standards and Technology and through adoption of NIST publications like NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices - Current Edition, and NIST Handbook 130: Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality - Current Edition, they also must ensure compliance of measurement standards to appropriate/suitable specifications and tolerances for use in legal metrology.

Handbook 130 uniform laws allow for obtaining calibrations from suitable suppliers, as an alternative to direct NIST calibrations, when there is acceptable evidence of recognition and/or accreditation, suitable calibration and measurement capabilities (measurement, range, uncertainties) to ensure compliance with technical requirements of metrological traceability.

NIST Office of Weights and Measures (OWM)
Laboratory Metrology Program Overview

Note: This section was submitted by NIST OWM. Portions of this section were previously published as an article in the OWM W&M Newsletter and updated for the 2016 workload survey.

There are often questions about what each program in the NIST Office of Weights and Measures and does and what the program responsibilities are. One of NIST's primary responsibilities is to ensure that uniform standards are available to support the nation's measurement infrastructure. State laboratories provide the foundation for over 400,000 calibrations as a critical part of the U.S. measurement infrastructure. Approximately half of these calibrations support commercial weights and measures with the remaining supporting measurements needed by industry and other government agencies. NIST will be successful if measurement results from State laboratories are accurate, traceable, defensible in support of enforcement actions, and widely accepted (both nationally and internationally.)

Four Interrelated Program Areas

There are four key areas of responsibility in the OWM Laboratory Metrology Program: Laboratory Recognition, Proficiency Testing, Training, and Field 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 areas are interrelated with the other areas. 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 documentary standards are often required by the weights and measures program for enforcement applications. The Laboratory Recognition area is very narrow in scope and only supports weights and measures laboratories in the United States. 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 assesses the level of impact and application of training concepts.

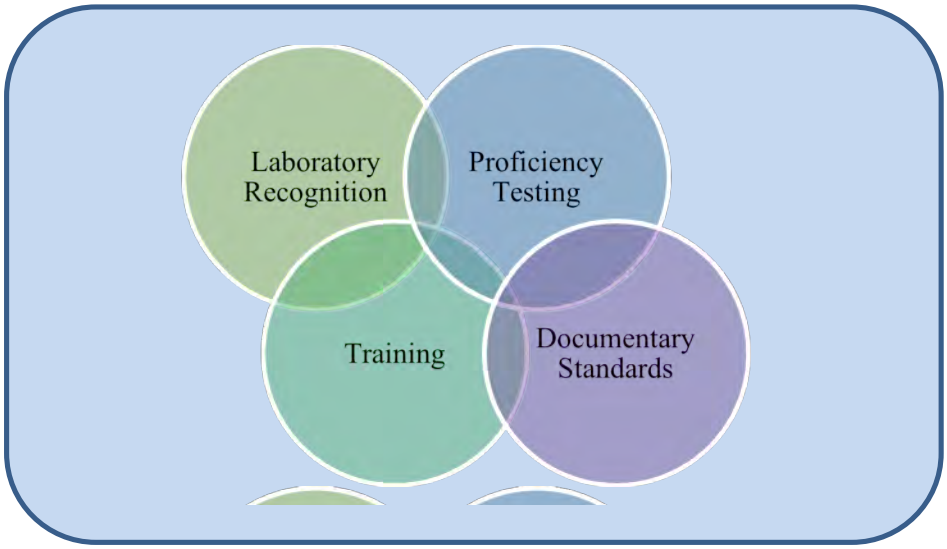


Figure 1. Laboratory Metrology Program Areas.

Program Measures:

Program measures for the four areas include the following items to assess ongoing program improvements (or declines and areas for needed focus). Graphic examples are included in each section to present the association measures.

1. Number of laboratories Recognized by the Office of Weights and Measures according to NIST Handbook 143, Program Handbook (2007).
2. Laboratory Scoring Model measures changes in the national system over time with a key INDEX value according to elements of the Program Handbook.
3. Number of laboratories Accredited by (NIST Handbook 150, 2016) NVLAP (third-party independent assessment of compliance to ISO/IEC 17025 criteria) to NIST Handbook 150, NVLAP Program Handbook.
4. Number of staff completing training requirements as noted in NIST Handbook 143, Program Handbook and supplemental memoranda.
5. Percentage of acceptable/passing proficiency test results and increasing percentage of effective follow up action (improvement, preventive, and corrective).
6. Updated publications.

Program Area Descriptions

Laboratory Recognition

Laboratory Recognition is provided for the weights and measures laboratories to help demonstrate evidence of metrological traceability that is required in the States and local jurisdictions. Handbook 130, model weights and measures 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 needs assessments. Annual assessments are conducted for all laboratories and periodic resources are posted on the NIST website related to annual assessments. Example technical assessments that have provided national level assessments in the past few years include: facility assessments, software verification and validation, succession planning, measurement assurance, uncertainties, and metrological traceability. Identified problems provide input into the Training area.

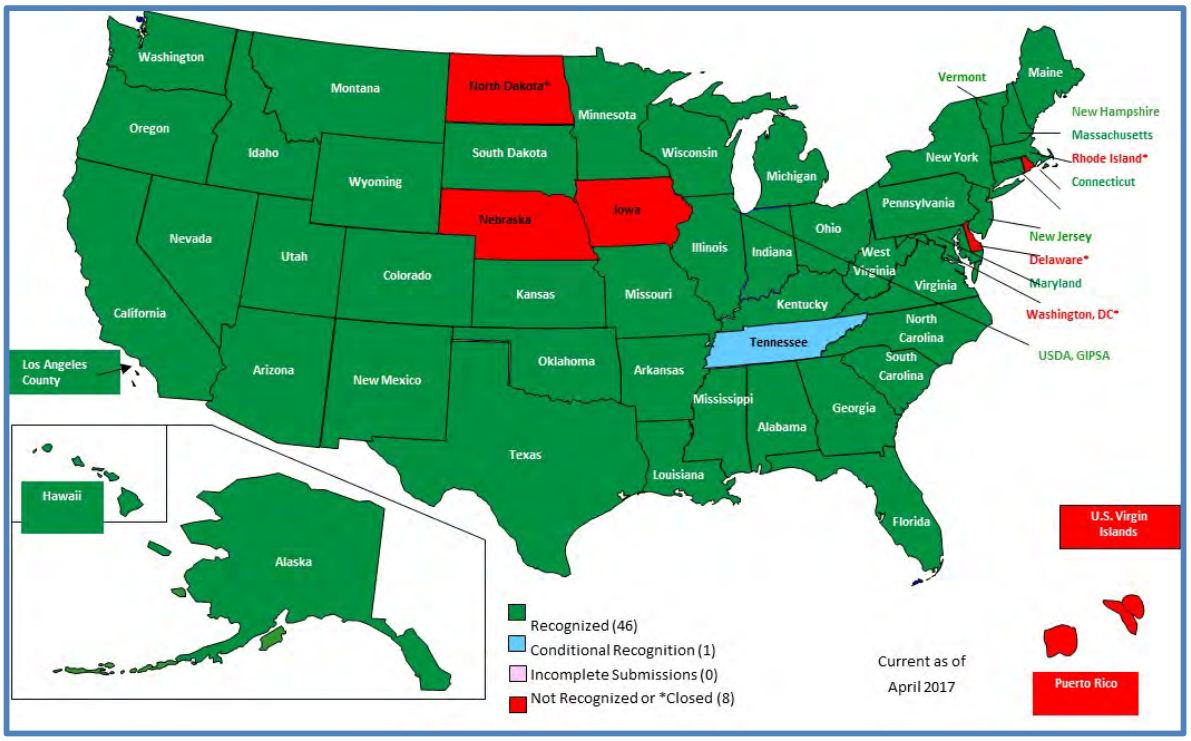


Figure 2. Laboratory Recognition by OWM (NIST Handbook 143, 2017 Apr).

Laboratory Scoring Model

A laboratory scoring model was developed in 2006 and is based on assigning numerical values to each laboratory in a number of categories that correspond to NIST Handbook143. Points are awarded in the following categories to each laboratory:

- Quality Management System
- Administrative Procedures
- Facility
- Equipment
- Standards
- Staff
- Management Support
- Proficiency Tests (PTs)
- Extra Credit – Timely Submissions
- Multipliers (NVLAP accreditation with 2 year OWM Recognition, 2.5; NVLAP Accreditation with 1 year OWM Recognition, 2.25; OWM, 2 year recognition, 2; OWM, 1 year recognition, 1.5; OWM, 1 year conditional recognition, 1; No recognition,

0.5; Lab Closed, 0)

The model is intended to provide a quality index to the overall laboratory program. The scoring model was updated in 2008 based on laboratory feedback and the first two years of use. The scoring model is used internally at NIST to identify where resources and efforts will be allocated. The current “top score” possible (success goal) is 275. Laboratories that are fully successful with OWM 2-year Recognition generally score between 140 and 220.

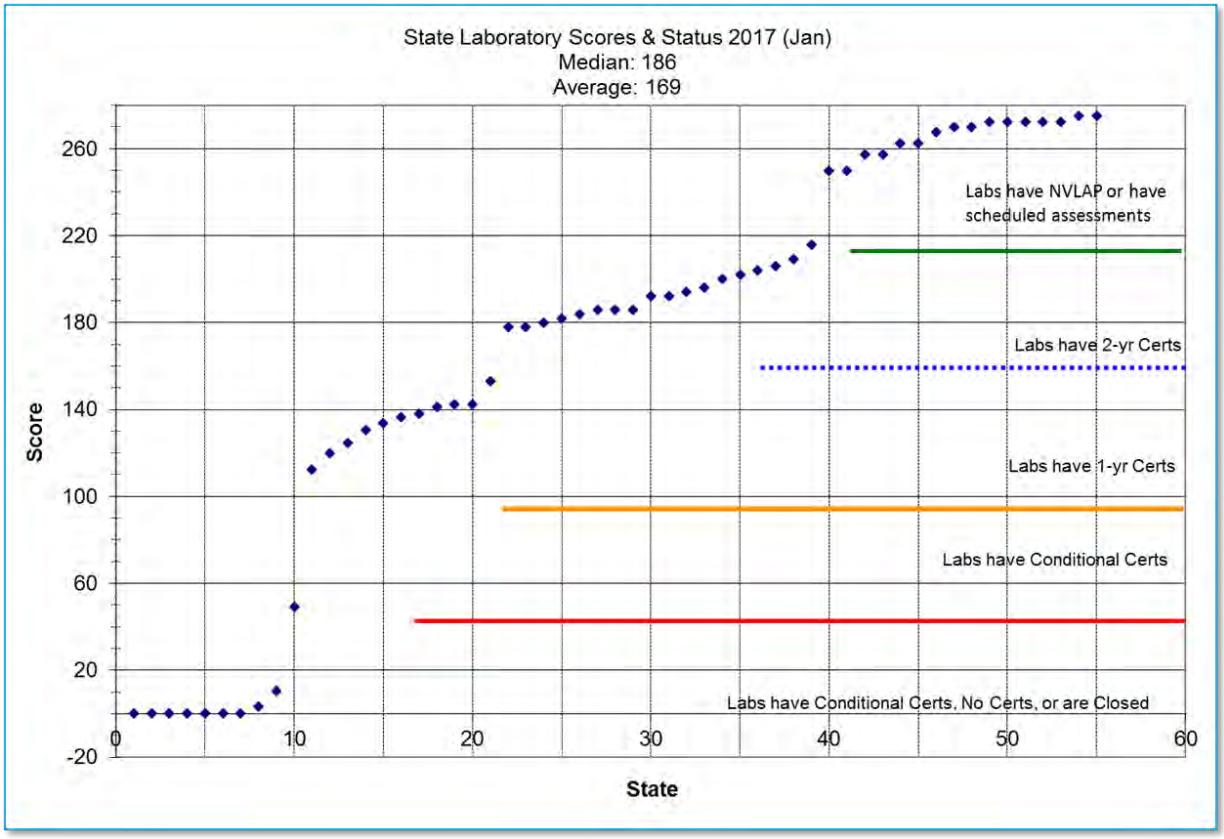


Figure 3. Laboratory Scoring Model (2017 Apr).

Scoring Model Trends

The OWM goal is to see the laboratory scores increase (or at least remain stable). Note: At this time, specific coding is not provided for identifying laboratories. In the latest assessment, we noted that several laboratories that were previously Recognized and Accredited have lost staff and not had adequate succession planning in place to keep laboratory Recognition and/or Accreditation in place or in place at the levels prior to staffing changes.

Table 2. Laboratory Scoring Model Trends.

Year	Median	Mean
Successful Goals	140 to 220	140 to 220
Accreditation Goals	220+	220+
2006	97.5	130
2007	140	140
2008	172	156
2009	172	156
2010	168	154
2012	168	156
2014 (end)	143	149
2016	186	169

Laboratory Accreditation

The last measure of assessment in the Recognition area that is presented here is the laboratory Accreditation status through the NIST National Voluntary Laboratory Accreditation Program (NVLAP). The OWM Laboratory Metrology Program interfaces with the NIST National Voluntary Laboratory Accreditation Program (NVLAP) for those state laboratories that are accredited.

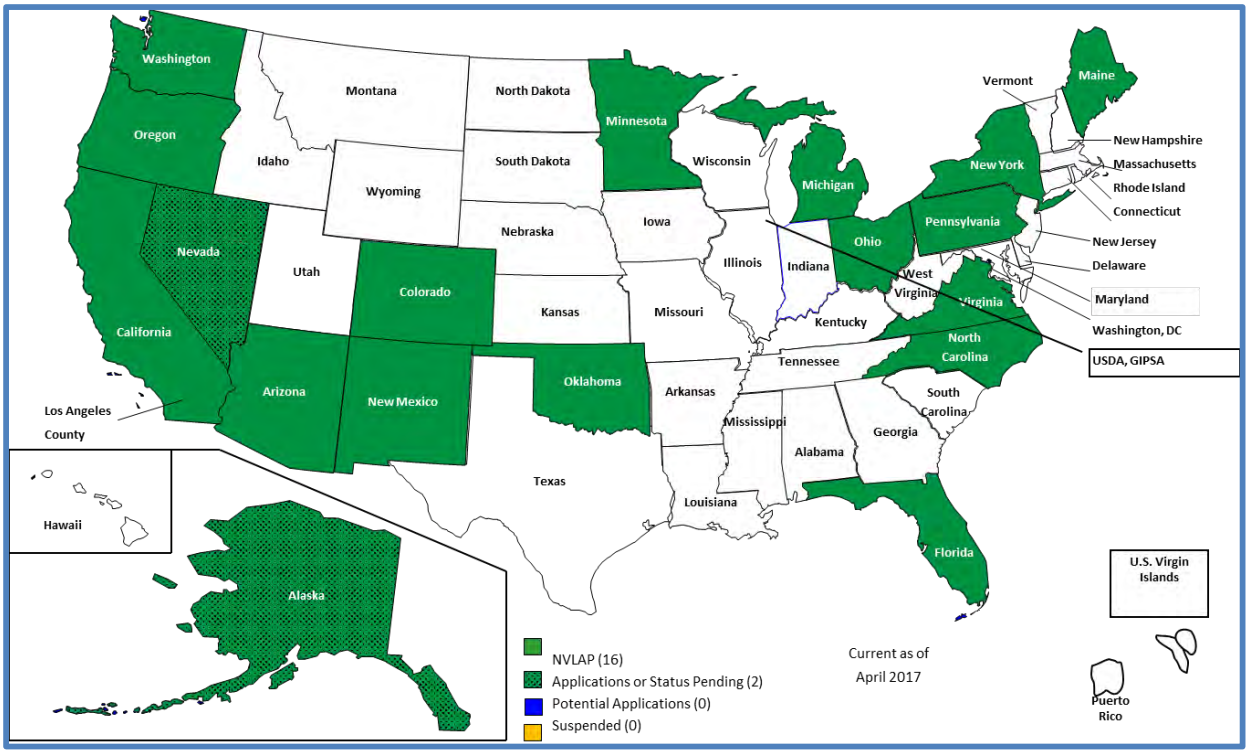


Figure 4. NVLAP Accreditation of State W&M Laboratories (2017 Apr.)

Within NVLAP, the current primary contact for state laboratories is Barbara Belzer. The primary contacts in OWM for this area are Georgia Harris and Elizabeth Gentry.

Training

Training includes both courses that are taught at NIST in the OWM Demonstration and Training Laboratory as well as regionally at the Regional Measurement Assurance Program (RMAP) annual training sessions (Figure 5).

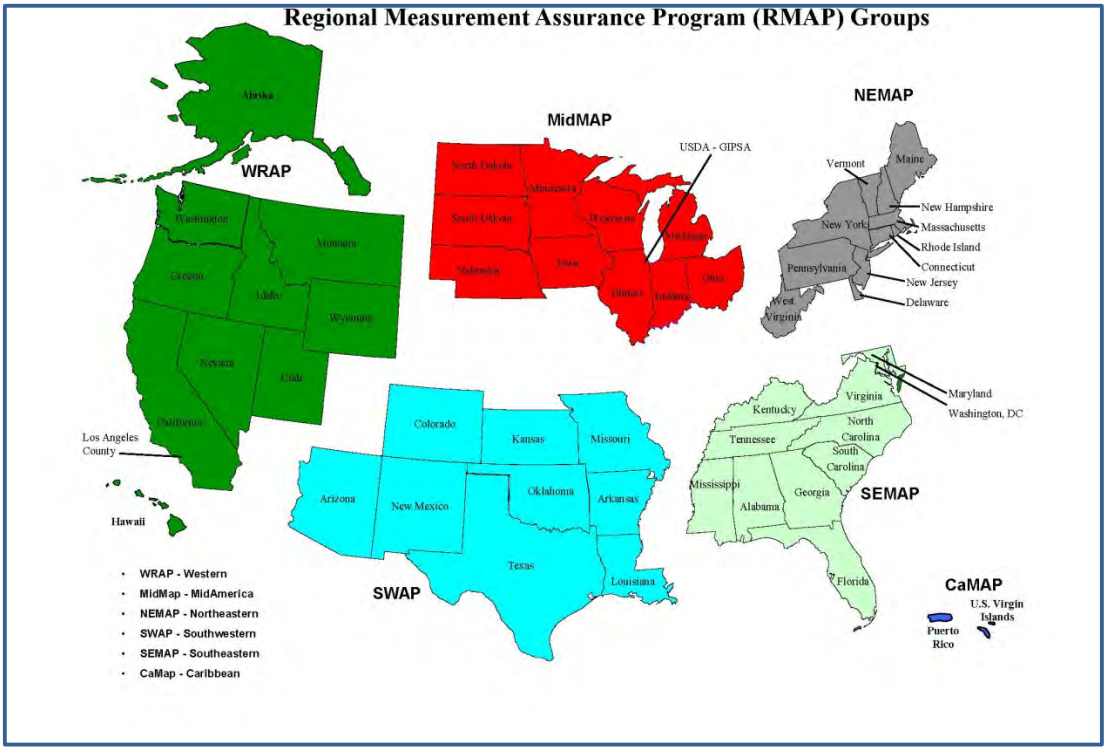


Figure 5. Regional Measurement Assurance Program (RMAP) Groups.

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 over the past three years 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 a series of 2 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. Figure 6 compares the old training course structure and the new.

Specific training and personnel competency requirements to support laboratory Recognition are published in Handbook 143 with interim updates published on the NIST website. 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 assessment of reasons for proficiency testing failures.

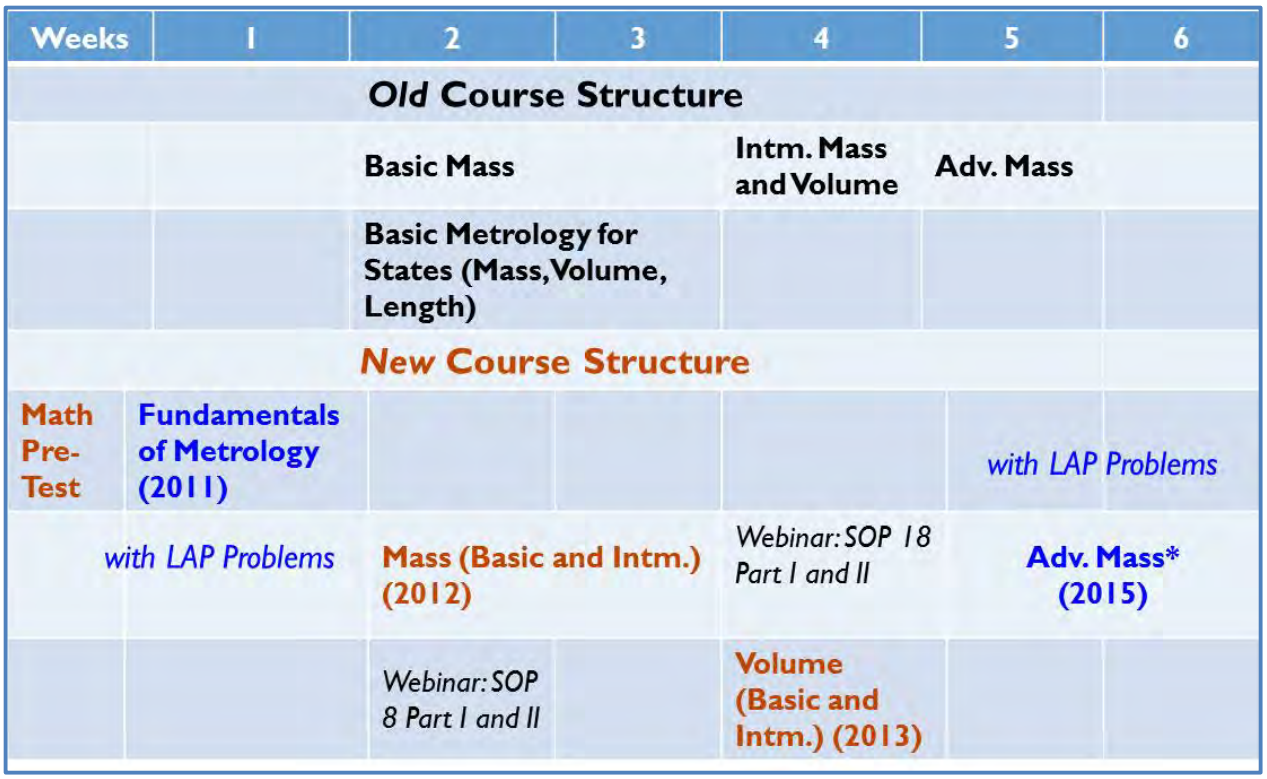


Figure 6. Metrology Training Redesign (2009 to 2015).

Numerous supplementary courses are taught throughout the year as webinars 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 Management System database with transcripts readily available to students. The primary contacts for this area are Georgia Harris and Val Miller from a program perspective, Yvonne Branden from an administrative perspective, and Isabel Chavez for the OWM database. Val Miller, Georgia Harris, and Elizabeth Gentry, plus contract instructors from working laboratories who have completed training requirements provide course instruction at NIST and at the RMAP training sessions.

Training courses (seminars and webinars) for 2011 through 2016 in metrology are summarized in Figure 7. New in 2016 were the addition of "Laboratory Metrology Info Hour" (LMIH) sessions. These are short, 1-hour, recorded sessions, no pre-work, no post-work, no certificates, to provide updated news and current events. These are sessions for weights and measures staff only and can support up to 98 participants per session.

LMIH Sessions held in 2016:

- January: Training Requirements (Table 2)
- February: Procedure Updates (NISTIR 6969, 7383)
- March: PT Best Practices (from 2015 Submissions)
- April: Weight Classes and Echelons for Recognition (HB 143 Review and Selection of Suitable Standards)
- May: Uncertainty Best Practices (from 2015 Submissions)
- August: Quality Management Systems (for 2016 Submissions)

LMIH Sessions held in 2017 (to April 2017):

- January: ISO/IEC 17025 - 2017 Updates, (With Warren Merkel, NIST – co-convener of the ISO/IEC 17025 Working Group)
- February: Risk Assessments and the New 17025
- March 21, Class: 5482: Risk Assessments for the Essentials of Traceability

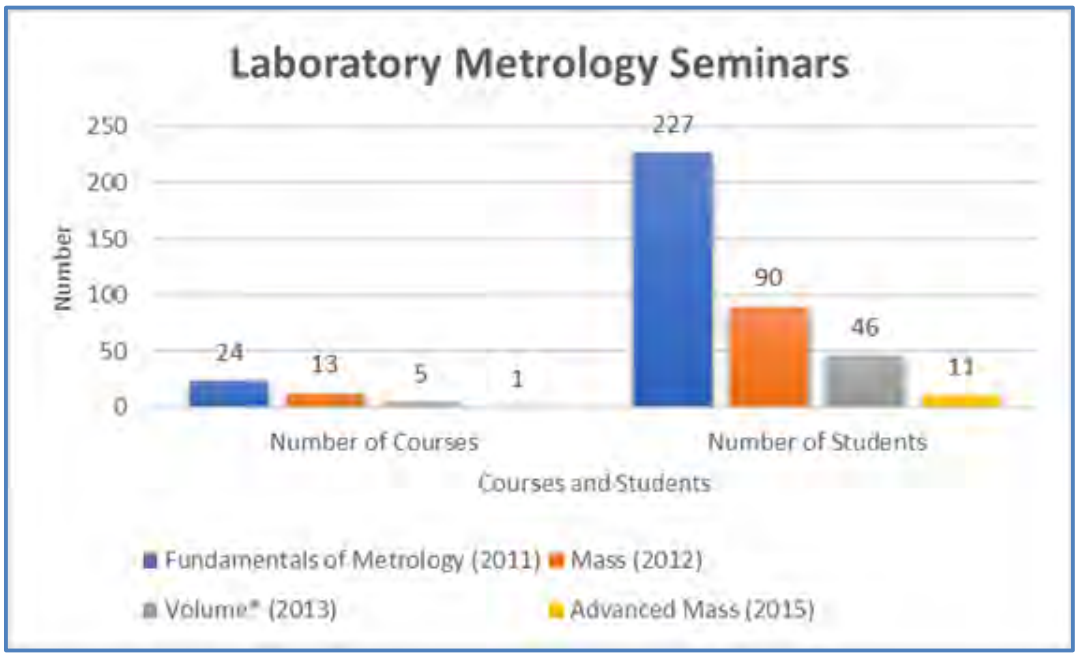


Figure 7. Laboratory Metrology Seminars for 2011 through 2016.

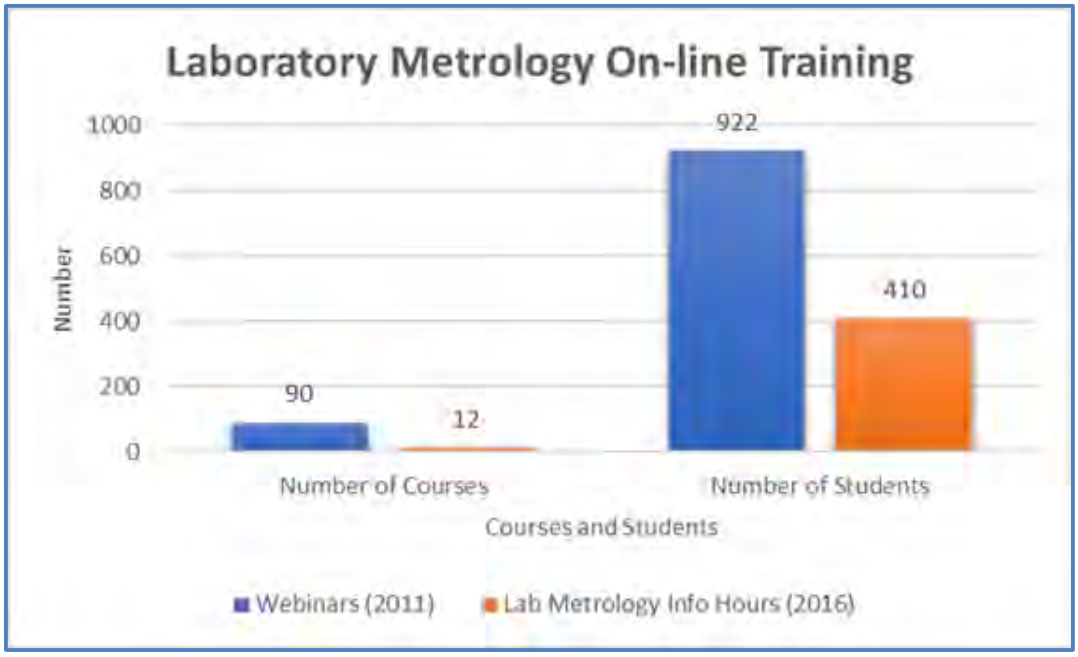


Figure 8. Laboratory Metrology On-line Training for 2011 through 2016.

Recognition of OWM Laboratory Metrology Instructors

The OWM team responsible for laboratory metrology seminars are all passionate about teaching and are devoted to high quality instruction. With the most recent NIST Associate's award to Jose Torres, all the OWM team members who regularly teach or oversee seminars/webinars have been recognized with education and training awards or plaques of recognition. These instructors have pursued ongoing professional development in adult learning methodologies and train the trainer efforts in addition to maintaining their knowledge and skills in the technical areas in which they provide instruction.

Some of the team, their training awards and plaques are shown in the photo in Figure 9. Highlights for the team include the following:

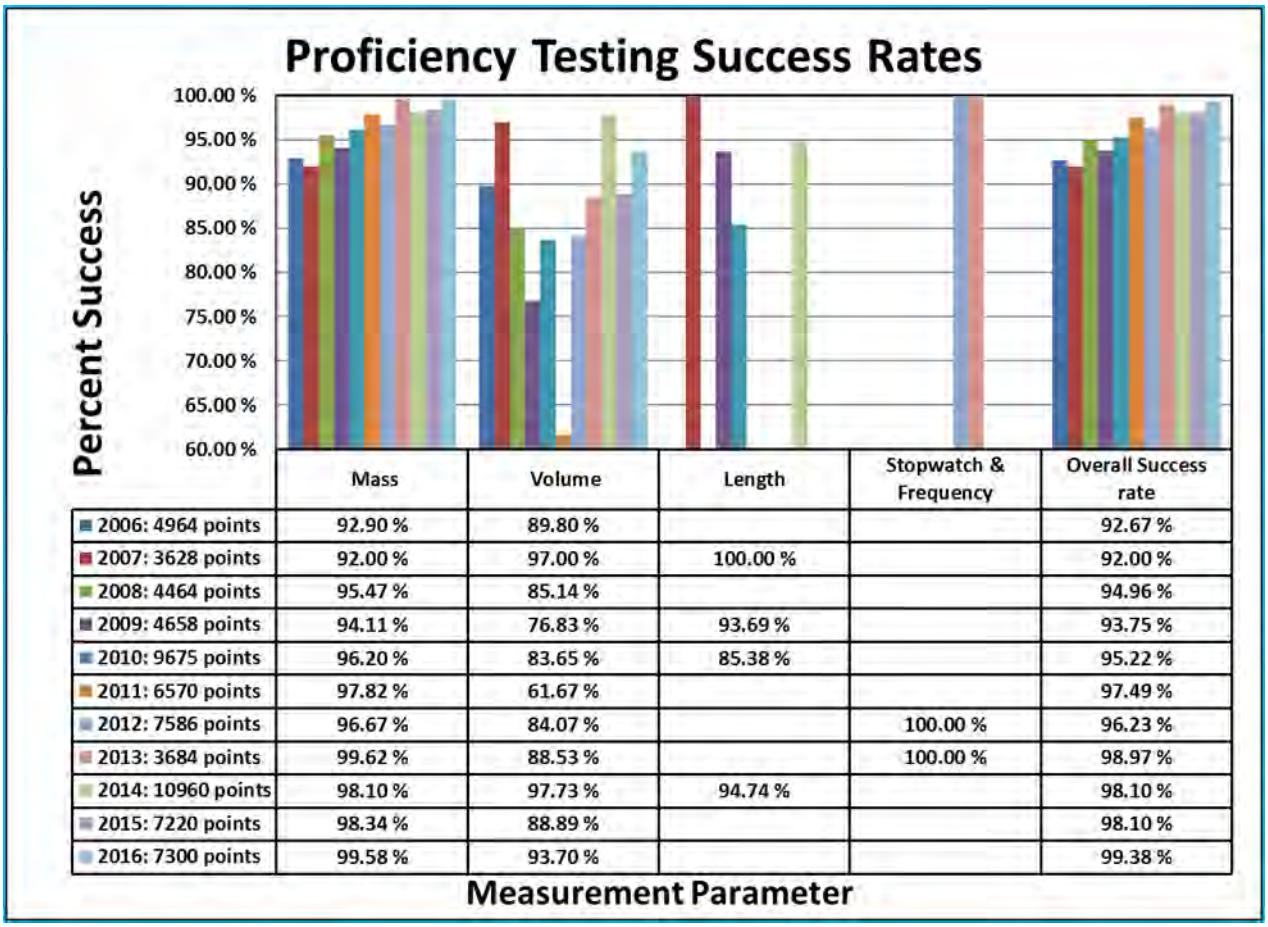
- Jose A. Torres Ferrer, NIST Associates Award, 2017. Jose has been teaching with OWM since the early 1990's and has been an instructor for 140 seminars and nearly 1500 students. Courses Jose Torres Ferrer has taught have included: Basic Mass Metrology Seminar (English and Spanish), Basic Length/Volume Metrology Seminar, Fundamentals of Metrology (English and Spanish), Intermediate Metrology Seminar, Volume Metrology Seminar, NIST Handbook 133 - Checking the Net Contents of Packaged Goods – Basic, Introduction to Electronic Weighing and Measuring Systems, Introduction to Handbook 44, and Vehicle and Axle-Load Scales. Jose has also travelled on behalf of NIST to provide training in Colombia, South America on basic uncertainty concepts.
- Val Miller, NCSLI Award Plaque. Val has conducted numerous tutorials at MSC and NCSLI with Mark Ruefenacht on Balance Calibrations and Uncertainties. Val has conducted training for over 160 seminars/webinars and nearly 2000 students since 2000 primarily in Mass Metrology, Volume Metrology, and Advanced Mass Metrology. In addition to metrology training, Val also has been the key driver in presenting laboratory safety topics at regional training for State weights and measures metrologists.
- Elizabeth Gentry, NCSLI Education and Training Award, 2012. Elizabeth joined NIST in 2006 and immediately began assisting in course improvements and in teaching the Laboratory Administration workshops along with many of the OWM webinars that address ISO/IEC 17025 Quality Management Systems. Elizabeth is also the U.S. Metric Coordinator and OWM Metric outreach champion and Metrology Ambassador within OWM. Thousands of teachers, students, parents, and other Metrology Ambassadors have participated in Elizabeth's Metric Estimation Game and received metric resources for teachers and outreach events! See the W&M Connection article from August 28, 2012 for more information about Elizabeth's NCSLI Education and Training Award.
- Mark Ruefenacht, NCSLI Education and Training Award, 2016. Mark has also received several award plaques for teaching over 15 Balance and Scale Calibration and Uncertainty tutorials with Val Miller at NCSLI and MSC. Mark has taught over 35 courses and over 450 students on-site at NIST since he began teaching for OWM in 2008. He has also conducted numerous seminars and webinars for the forensic community and the American Society for Crime Laboratory Directors ASCLD), Laboratory Accreditation Board where he provided instruction to forensic scientists on topics and concepts on metrological traceability, measurement uncertainty, and measurement assurance.
- Georgia Harris, NCSLI Education and Training Award, 2015. Georgia has been conducting seminars at NIST and at regional training sessions since 1990. All the laboratory metrology seminar and webinar topics, have been conducted by Georgia at one time or another and includes over 280 learning events and over 3700 students. She has also conducted numerous train the trainer seminars and webinars and has a passion for training design and trainer development. Georgia has conducted seminars throughout the U.S., and in Mexico and Colombia.

Figure 9. OWM Metrology Instructors (L to R and F to B: Jose Torres, Mark Ruefenacht, Val Miller, Elizabeth Gentry, Georgia Harris)

Additional State metrologists and retired metrologists have participated in course design, regional training, occasional instruction at NIST, and one-on-one mentoring in State laboratories. These instructors have also participated in train the trainer activities and continual improvement activities associated with the OWM metrology training. Current team members include: Tim Osmer (NH), Van Hyder (NC), Jeremy Nading (OK), Aaron Aydelotte (OR), Kelleen Larson (AZ, retired), L.F. Eason (NC, retired), and Carol Hockert (NIST, retired).

Proficiency Testing

The Proficiency Testing area is primarily coordinated through the annual RMAP training sessions. A 4-year plan is developed within each RMAP group to support the need for laboratories to have a 4-year plan and comply with Recognition and Accreditation policies. The planning, analysis, and reporting takes place at each meeting, where laboratories are given opportunities to help create the plan to meet the needs of their measurement Scopes as well as providing an opportunity to minimize overall program costs through volunteering to coordinate and analyze data.



	Mass	Volume	Length	Stopwatch & Frequency	Overall Success rate
2006: 4964 points	92.90 %	89.80 %			92.67 %
2007: 3628 points	92.00 %	97.00 %	100.00 %		92.00 %
2008: 4464 points	95.47 %	85.14 %			94.96 %
2009: 4658 points	94.11 %	76.83 %	93.69 %		93.75 %
2010: 9675 points	96.20 %	83.65 %	85.38 %		95.22 %
2011: 6570 points	97.82 %	61.67 %			97.49 %
2012: 7586 points	96.67 %	84.07 %		100.00 %	96.23 %
2013: 3684 points	99.62 %	88.53 %		100.00 %	98.97 %
2014: 10960 points	98.10 %	97.73 %	94.74 %		98.10 %
2015: 7220 points	98.34 %	88.89 %			98.10 %
2016: 7300 points	99.58 %	93.70 %			99.38 %

Figure 10. Proficiency Testing Success Rates (2006 to 2016).

Proficiency testing and interlaboratory comparisons (PTs/ILCs) have been conducted in the Regional Measurement Assurance Program (RMAP) regions since the early 1980's. NIST has captured the number and types of PTs/ILCs since that time. However, measures for evaluating proficiency testing results have been modified since 2006. Over 70,000 status points have been collected since pass/fail data has been collected. NIST began capturing pass/fail statistics for all PT/ILC results and compiling them by measurement parameter. This allows NIST to evaluate the effectiveness of training efforts and use of uniform calibration procedures among laboratories and to see improvements (or declines) over time. It also provides information on where to dedicate effort and resources in additional training and follow-up efforts.

Further assessments can be observed based on the data. For example, in the area of volume, special training efforts were conducted on gravimetric volume calibrations in 2005 and 2006 at the 5 gal level, reflecting overall improvements in the proficiency testing results. However, glass flasks were included for gravimetric calibrations in 2008, demonstrating the need for additional follow up for all gravimetric calibrations.

A four-year assessment of follow-up and corrective actions was conducted by NIST in 2007 and again in 2009 with a summary report circulated to all laboratories. The top 5 lab actions that were identified from periodic reviews in 2007 and 2009 included the need for:

1. Obtaining or calibrating standards
2. Obtaining updated equipment or service for existing equipment
3. Revising uncertainty analyses
4. Training on problem areas and review of procedures
5. Implementing better measurement assurance methods

Overall, based on the four-year assessment in 2007, laboratories completed a total of 245 follow-up actions from 85 PTs/ILCs. The success goals are 100 % passing rates and 100 % completed follow-up when needed. Examples of ongoing corrective action were incorporated into the training plan. Additional assessments were planned for this area in 2015. When the 2015 assessment was completed, it was followed by sharing of best practices from many laboratories and included an overview of the examples that were shared during a Laboratory Metrology Info Hour session.

Program planning, analysis and reporting tools used in this area are used by many other laboratories outside the program and outside the United States. Val Miller is the primary contact in this area.

Documentary Standards

Ideally, documentary standards would be reviewed at least every five years 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 field standard weights and Handbook 105-7 for small volume provers are in the development process. A new standard is being considered for master meters. Handbook 105-4, for LPG provers was updated in 2016. The program also participates with ASTM, USP, and OIML standards development. Val Miller is currently the primary contact for Handbook 105-1, ASTM, and USP updates and Georgia Harris with 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 1980's) 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 and Handbook 145 procedures referenced Mil-Std-45662A. 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, which has since become a formal standard rather than a guide.

Table 3. Program Area Reference Documents.

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

As noted throughout this section, 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 show how many laboratories are Recognized by OWM and Accredited by NVLAP. In addition, the scoring model shows the big picture assessment of 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, OWM obtained IACET Accreditation in 2013 and a formal Kirkpatrick-type course evaluation system is used to assess measure satisfaction with a training experience, learning, application, and impact. In the Proficiency Testing area, pass-fail statistics are tracked as well as a periodic evaluation of the resulting follow-up corrective actions made by the laboratories. 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.

State Laboratory Program - Calibration Scope Summary

State Laboratory	Certificate Date	Comments	Mass I	Mass II	Mass III	Weight Carts, Wheel-Load Weighers & Railroad Test Cars	Volume I, Gravimetric	Volume II, Transfer	Length, Tapes, & Rigid Rules	Temperature	Time	Frequency, Tuning Forks	Grain Moisture	AC Energy-Watthour Calibration	Special
Alabama	2016				25 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz			1500 gal to 5 gal							
Alaska	2015 to 2016				25 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 4000 lb to 3000 lb Wheel-Load Weighers 40 000 lb to 10 000 lb	25 gal to 5 gal	1000 gal to 5 gal Field Calibrations 500 gal to 5 gal				7000 Hz to 1000 Hz			
Arizona	2015 to 2016	NVLAP		30 kg to 1 mg 50 lb to 0.001 lb 8 oz to 0.03125 oz	500 kg to 1 mg 5000 lb to 0.001 lb 100 oz to 0.03125 oz	Weight Carts 5000 lb to 2000 lb	100 gal to 1 gal SVP 20 gal	500 gal to 1 gal 100 gal to 20 gal LPG							
Arkansas	2016 to 2017				25 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz			5 gal							
California	2016	NVLAP		2 kg to 1 mg	30 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.01 oz Field Calibrations 50 lb to 25 lb		20 L to 100 mL 5 gal to 1 gill	1000 gal to 5 gal 100 gal to 25 gal LPG Field Calibrations 500 gal to 5 gal 100 gal to 25 gal LPG	Steel tapes Tape to Tape 100 ft to 1 ft Steel tapes, Bench 25 ft to 1 ft	65.56 °C to 0 °C 150 °F to 32 °F	Stopwatches 3 h			120 V to 240 V Range 250 mA to 50 A (0° Phase Angle)	
Colorado	2015 to 2016	NVLAP		10 kg to 1 mg	30 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 5000 lb to 2000 lb		100 gal to 5 gal 100 gal to 25 gal LPG	Steel Tapes, Bench, Tapes 200 ft to 1 ft Rigid Rules 18 in to 1 in			Tuning Forks ≤ 80 mph	≤ 20 %		
Connecticut	2016				25 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Wheel-Load Weighers 40 000 lb to 10 000 lb		200 gal to 5 gal			Stopwatches 3 h				
District of Columbia	CLOSED														
Delaware	CLOSED														
Florida	2016 to 2017	NVLAP		30 kg to 1 mg 50 lb to 0.001 lb 8 oz to 0.03125 oz	500 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 5000 lb to 2500 lb		1500 gal to 5 gal 100 gal to 25 gal LPG							
Georgia	2015 to 2016			20 kg to 1 mg	500 kg to 1 mg 1000 lb to 0.001 lb 4 oz to 0.03125 oz	Weight Carts 5000 lb to 3000 lb		500 gal to 5 gal 500 gal to 25 gal LPG					Corn 21 % to 14 % Wheat 18 % to 13 % Soy Bean 17 % to 12 %		
Hawaii	2015 to 2016		1 kg to 1 mg 2 lb to 0.001 lb 8 oz to 0.03125 oz	20 kg to 1 mg 1000 lb to 500 lb 50 lb to 0.001 lb	500 kg 20 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz		2 L to 50 mL 25 gal to 2 fl oz	1000 gal to 5 gal			Stopwatches ≤ 24 hr				
Idaho	2016 to 2017			30 kg to 1 mg 1000 lb to 1 µlb 8 oz to 0.03125 oz	30 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 3000 lb to 2000 lb	5 gal	750 gal to 5 gal 100 gal to 20 gal LPG							
Illinois	2015 to 2016		5 kg to 1 mg	5 kg to 1 mg	30 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 5000 lb to 2500 lb		1500 gal to 1 gal 100 gal to 20 gal LPG							
Indiana	2016 CONDITIONAL (2016-06-30)	Conditional Recognition will be issued only to meet weights and measures requirements and limitations will be stated in writing. Facility has inadequate environmental controls. Laboratory lacks adequate quality management system documentation.			1000 kg to 1 mg 2000 lb to 0.001 lb 2 oz to 0.03125 oz 50 oz t to 0.1 dwt	Weight Carts 6000 lb to 3000 lb		1000 gal to 5 gal 100 gal LPG	Tape to Tape 100 ft to 1 ft		Stopwatches 3 h				
Iowa	CLOSED (2014-06-30)														
Kansas	2015 to 2016			30 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	500 kg to 1 mg 5000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 8000 lb to 2000 lb	5 gal	1000 gal to 5 gal 100 gal to 20 gal LPG							

State Laboratory Program - Calibration Scope Summary

State Laboratory	Certificate Date	Comments	Mass I	Mass II	Mass III	Weight Carts, Wheel-Load Weighers & Railroad Test Cars	Volume I, Gravimetric	Volume II, Transfer	Length, Tapes, & Rigid Rules	Temperature	Time	Frequency, Tuning Forks	Grain Moisture	AC Energy-Watthour Calibration	Special
Kentucky	2015 to 2016				2 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz			100 gal to 5 gal							
Los Angeles County	2016				25 kg to 100 g 1000 lb to 1 lb 8 oz to 4 oz			5 gal							
Louisiana	2016				25 kg to 1 mg 3000 lb to 0.001 lb 8 oz to 0.03125 oz			5 gal							
Maine	2016	NVLAP		30 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	100 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 7000 lb to 2000 lb Wheel Load Weighers 40 000 lb to 5000 lb	200 L to 5 L 100 gal to 5 gal	5000 L to 19 L 1500 gal to 5 gal 300 gal to 20 gal LPG							Shellfish 6 in to 1 in
Maryland	2016				20 kg to 1 mg 50 lb to 0.001 lb 8 oz to 0.005 oz			300 gal to 5 gal							
Massachusetts	2016 to 2017				30 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz 12 oz ap to 0.1 gr 50 oz t to 0.005 oz t			100 gal to 5 gal							
Michigan	2016 to 2017	NVLAP	20 kg to 1 mg	20 kg to 1 mg 50 lb to 1 μlb 8 oz to 0.03125 oz	500 kg to 1 mg 5000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 6000 lb to 3000 lb Wheel-Load Weighers ≤ 20 000 lb	2 L to 100 mL 25 gal to 0.5 pt SVP 30 gal to 5 gal	2000 gal to 5 gal 100 gal to 20 gal LPG							
Minnesota	2016 to 2017	NVLAP		50 kg to 1 mg 1000 lb to 0.001 lb 4 oz to 0.03125 oz	50 kg to 1 mg 5000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 10 000 lb to 2000 lb Wheel-Load Weighers 20 000 lb to 2000 lb Railroad Test Cars 110 000 lb to 80 000 lb	20 L to 10 mL 100 gal to 0.25 qt	1500 gal to 5 gal 100 gal to 25 gal LPG							
Mississippi	2016 to 2017				20 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 5000 lb		100 gal to 5 gal							
Missouri	2016			30 kg to 1 mg 50 lb to 0.001 lb 4 oz to 0.03125 oz	250 kg to 1 mg 6500 lb to 0.001 lb 4 oz to 0.03125 oz	Weight Carts 6500 lb to 2000 lb Railroad Test Cars 110 000 lb to 80 000 lb		1500 gal to 5 gal 100 gal to 25 gal LPG					19 % to 8 %		
Montana	2016				30 kg to 1 mg 3000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 5000 lb to 2000 lb		1500 gal to 5 gal 100 gal to 25 gal LPG							
Nebraska	NONE														
Nevada	2016				25 kg to 1 mg 50 lb to 0.001 lb 4 oz to 0.03125 oz		5 gal	5 gal							
New Hampshire	2016 to 2017	NVLAP	30 kg to 1 mg 50 lb to 0.001 lb	30 kg to 1 mg 50 lb to 0.001 lb 8 oz to 0.01 oz	50 kg to 1 mg 100 lb to 0.001 lb 8 oz to 0.01 oz		20 L 5 gal	5 gal							
New Jersey	2016 to 2017				30 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Wheel-Load Weighers ≤ 20 000 lb		1500 gal to 1 gal 100 gal to 20 gal LPG	Steel Tapes, Bench 500 ft to 1 ft		Stopwatches ≤ 24 h	Tuning Forks ≤ 9000 Hz			
New Mexico	2016	NVLAP		30 kg to 1 mg 50 lb to 0.5 lb	500 kg to 1 mg 5000 lb to 0.001 lb 8 oz to 0.03125 oz 100 oz t to 1 oz t 500 gr to 1 gr 20 N to 1 N	Weight Carts 5000 lb to 1000 lb	1 L 5 gal to 2 fl oz	20 L 25 gal to 5 gal							

State Laboratory Program - Calibration Scope Summary

State Laboratory	Certificate Date	Comments	Mass I	Mass II	Mass III	Weight Carts, Wheel-Load Weighers & Railroad Test Cars	Volume I, Gravimetric	Volume II, Transfer	Length, Tapes, & Rigid Rules	Temperature	Time	Frequency, Tuning Forks	Grain Moisture	AC Energy-Watthour Calibration	Special
New York	2015 to 2016 CONDITIONAL (2016-06-30)	NVLAP Scope does not cover calibrations at remote locations		25 kg to 1 mg 50 lb to 0.1 µlb	1000 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.03125 oz Lottery Balls 80 g to 3 g	Weight Carts 5000 lb to 2000 lb	200 gal to 2 fl oz	3785 mL to 118 mL 2000 gal to 1 gill 300 gal to 25 gal LPG Dry Measures ≤ 3ft^3	Bench 200 ft to 1 ft Rigid Rules 16 ft to 1 in		3 h				
North Carolina	2016 to 2017	NVLAP	30 kg to 1 mg	30 kg to 1 mg 2500 lb to 500 lb	1000 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.03125 oz Lottery Balls 2.65 g	Weight Carts 6000 lb to 3000 lb	400 L to 100 mL 100 gal to 1 gill 10 ft^3 to 0.5 ft^3 SVP 30 gal to 15 gal	650 L to 20 L 2000 gal to 1 gal 500 gal to 25 gal LPG	Length Lottery Balls 1.4 in to 1.5 in	Thermometry 230 °C to -30 °C 446 °F to -22 °F					
North Dakota	NONE														
Ohio	2016 to 2017	NVLAP		50 kg to 1 mg 1000 lb to 0.001 lb	1000 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.015625 oz	Weight Carts 5000 lb to 3000 lb		100 gal to 5 gal 100 gal LPG	Tapes ≤ 100 ft Rigid Rules 72 in to 1 in		Stopwatches ≤ 24 h				
Oklahoma	2016	NVLAP	30 kg to 1 mg	1200 kg to 1 mg 2500 lb to 1 µlb	500 kg to 1 mg 6000 lb to 0.001 lb 100 oz to 0.015625 oz 20 oz t to 1 oz t	Weight Carts 5500 lb to 2000 lb	100 gal to 5 gal	375 gal to 5 gal							
Oregon	2016 to 2017	NVLAP	30 kg to 1 mg 50 lb to 1 µlb 4 oz to 0.03125 oz	1 kg to 1 mg 8 oz to 0.03125 oz	500 kg to 1 mg 5000 lb to 0.001 lb 4 oz to 0.03125 oz		5 gal	1000 gal to 5 gal		III, IV TPW 0.01 °C Ga 29.7646 °C					
Pennsylvania	2016 to 2017	NVLAP		30 kg to 1 mg 50 lb to 0.001 lb	2500 kg to 1 mg 5000 lb to 0.001 lb 8 oz to 0.03125 oz 200 oz t to 0.005 oz t	Weight Carts 6000 lb to 2000 lb Wheel-Load Weighers ≤ 40 000 lb	500 L to 5 L 100 gal to 1 gal	5000 L to 5 L 1500 gal to 5 gal	Steel Tapes ≤ 200 ft		Stopwatches ≤ 24 h				Force ≤ 50 lbf only
Puerto Rico	NONE														
Rhode Island	CLOSED														
South Carolina	2016 to 2017		30 kg to 1 mg	50 kg to 1 mg 1000 lb to 0.001 lb 8 oz to 0.015625 oz	1000 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.015625 oz	Weight Carts 6000 lb to 2500 lb Wheel-Load Weighers 36 000 lb to 12 000 lb	20 L to 100 mL 5 gal to 1 gal	20 L to 1 L 1500 gal to 1 gal 100 gal to 20 gal LPG					23 % to 13 %		
South Dakota	2016				30 kg to 100 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 4000 lb to 2000 lb		5 gal							
Tennessee	2016 CONDITIONAL	Conditional Recognition will be issued only to meet weights and measures requirements and limitations will be stated in writing. Facility has inadequate environmental controls. Laboratory lacks adequate quality management system documentation.			100 g to 1 mg 1000 lb to 0.001 lb 8 oz to 0.03125 oz			5 gal							
Texas	2015 to 2016				1000 kg to 1 mg 3750 lb to 0.001 lb 12 oz to 0.03125 oz	Weight Carts 6000 lb to 2500 lb		1000 gal to 5 gal 300 gal to 25 gal LPG							
USDA/GIPSA	2015 to 2016				(Limited Availability) 10 000 lb 1000 lb 50 lb 25 lb	Weight Carts 6000 lb to 4000 lb Railroad Test Cars 112 000 lb to 80 000 lb									

State Laboratory Program - Calibration Scope Summary

State Laboratory	Certificate Date	Comments	Mass I	Mass II	Mass III	Weight Carts, Wheel-Load Weighers & Railroad Test Cars	Volume I, Gravimetric	Volume II, Transfer	Length, Tapes, & Rigid Rules	Temperature	Time	Frequency, Tuning Forks	Grain Moisture	AC Energy-Watthour Calibration	Special
Utah	2016 to 2017				25 kg to 1 mg 1000 lb to 0.001 lb 4 oz to 0.03125 oz			100 gal to 5 gal							
Vermont	2016 to 2017				30 kg to 1 g 1000 lb to 0.001 lb 8 oz to 0.03125 oz			10 gal to 5 gal							Hydrometers Brix Braume
Virgin Islands	NONE														
Virginia	2016 to 2017	NVLAP		20 kg to 1 mg	25 kg to 1 mg 2500 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 6000 lb to 3000 lb		10 gal to 5 gal				10 KHz to 1 KHz			
Washington	2016 to 2017	NVLAP	30 kg to 1 mg 50 lb to 0.001 lb	30 kg to 1 mg 1000 lb to 0.001 lb 4 oz to 0.03125 oz	30 kg to 1 mg 4000 lb to 0.001 lb 4 oz to 0.03125 oz	Weight Carts 4000 lb to 2000 lb	500 mL to 100 mL 5 gal to 2 fl oz	1000 gal to 1 gal 200 gal to 20 gal LPG			Stopwatches, Timers ≤ 24 h				
West Virginia	2016 CONDITIONAL	Conditional Recognition will be issued only to meet weights and measures requirements and limitations will be stated in writing. Laboratory has unresolved corrective actions related to facility and environment.			25 kg to 1 mg 1000 lb to 0.001 lb 4 oz to 0.03125 oz	Weight Carts 5000 lb to 3000 lb		200 gal to 1 gal 100 gal to 5 gal LPG							
Wisconsin	2016 to 2017				500 kg to 1 mg 5000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 6000 lb to 2000 lb		1000 gal to 5 gal 100 gal to 25 gal LPG							
Wyoming	2016 to 2017				3000 lb to 0.001 lb 8 oz to 0.03125 oz	Weight Carts 5000 lb to 2000 lb		1000 gal to 5 gal 100 gal to 25 gal LPG							

NOTES:

A one to year Conditional Certificate of Measurement Traceability may be granted when multiple nonconformities exist in the facilities, equipment, standards, staff, or overall laboratory operations, and the laboratory has provided ongoing evidence that it is working to meet criteria in this Handbook. Conditional Recognition will be issued ONLY to meet weights and measures requirements and limitations will be stated in writing (NIST HB 143:2007, Section 3.6.3).

Recognized State laboratories may have reciprocity with other Recognized or accredited State Laboratories as a part of voluntary registration program for service agents. Reciprocal acceptance of calibration reports should be limited to laboratories that have maintained full (not Conditional) Recognition with the Office of Weights and Measures (OWM) or formal accreditation. Calibration reports from laboratories that have failed to maintain Recognition, formal accreditation, or are Conditionally Recognized, should be refused (NIST HB 143:2007, Section 2.9.6).

Participants

The SLP is comprised of 55 metrology laboratories. There are 50 state laboratories and 5 other government laboratories (Puerto Rico, Washington DC, Los Angeles County, USDA-GIPSA –identified as 'DA' in the survey–, and U.S.-Virgin Islands). Of these 55 laboratories, 6 are not operational. Washington DC, Delaware, U.S.-Virgin Islands, Rhode Island, North Dakota, and Iowa metrology laboratories were closed during the 2016 reporting period of the survey.

Notes and Comments:

- 49 metrology laboratories provided data for the 2016 State Program Workload Survey.
- Table 4 provides basic information summarizing the ages and sizes of the facilities in which the SLP conducts its work. It also summarizes the number of customers typically served by each laboratory.
- Office space is the overall size of the space in the laboratory devoted to administrative work. This includes space for workstations, filing, etc. In general, this category may include all of the space devoted to the laboratory not specifically dedicated to measurement work.
- Laboratory space is that space in the laboratory devoted to measurement work. This may include space where measurements are performed, space devoted to storing measurement standards and equipment, space used for material handling, space used for shipping and receiving of customer equipment, etc.
- Customers is a count of all distinct customers who received measurement services from the laboratory regardless of the reason or application.

SLP laboratories frequently provide measurement services for a fee regardless of whether the customer is regulated or not. This new category provides a measure of the number of customers using SLP laboratory services who are not otherwise required to do so.

In 2016, a new category was introduced into this section titled "Non-Service Agent Customers". SLP laboratories are frequently tasked with evaluating measurement equipment used by those service agents regulated by traditional Weights and Measures programs. These service agents provide calibration and repair services for measuring equipment used in commercial applications. They generally have a legal obligation to have their measure and test equipment periodically evaluated by one of the SLP member laboratories.

	Age (Years)	Office Space (Sq. Ft.)	Lab Space (Sq. Ft.)	Customers	Non-Service Agent Customers
Average	29	749	3203	183	66
Minimum	2	0	525	0	0
Maximum	89	3045	12200	717	553

Table 4: Summary of lab space, age, and customers served.

Location	Address	Contact	Website	Age (Years)	Office Space (Sq. Ft.)	Lab Space (Sq. Ft.)	Customers	Non-Service Agent Customers
State of Alaska Metrology Laboratory	12050 Industry Way Bldg. O #6, Anchorage, AK 99515	Phone: 907.365.1233 Fax: N/A	www.dot.state.ak.us/mscve	2	350	1740	37	33
Alabama Dept. of Agriculture	1445 Federal Dr., Montgomery, AL 36107	Phone: 334-240-3729 Fax: 334-240-7175	www.alabama.gov.	44	314	588	185	0
Arkansas Bureau of Standards	4608 W 61st, Little Rock, AR 72209	Phone: 501-570-1191 Fax:	www.plantboard.arkansas.gov	50	400	1500	90	0
Arizona Dept Agriculture Weights and Measures Metrology Laboratory	4425 W Olive Ave Ste 134, Glendale, AZ	Phone: (602) 771-4938 Fax: (623) 463-0440		17	500	5500	172	62
State of California Metrology Laboratory	6790 Florin Perkins Road, Suite 100, Sacramento, CA 95828	Phone: (916) 229-4858 Fax: (916) 229-3064	WWW.cdfa.ca.gov/DMS	12	309	3903	141	4
Colorado Metrology Laboratory	3125 Wyandot St, Denver, CO 80211	Phone: 303-867-9244 Fax: 303-477-4248	www.colorado.gov/pacific/aginspection/metrology-laboratory	45	1979	1927	185	47
CT Metrology Lab	9 Windsor Avenue, Windsor, CT 06095	Phone: 860-713-6165 Fax: 860-706-1236	http://www.ct.gov/dcp	4	130	1862	49	14
Florida Metrology Laboratory	3125 Conner Blvd Lab 2, Tallahassee, FL 32399	Phone: 850-921-1580 Fax: 850-921-1547	www.freshfromflorida.com	47	620	3500	260	65
Georgia Metrology Laboratory	3150 U.S. Highway 41 South, Tifton, GA 31794	Phone: 229-386-3601 Fax: 229-386-3365	http://agr.georgia.gov/weights-measures.aspx	6			73	0
USDA/GIPSA/FGIS Master Scale Depot	5800 W. 69th Street, Chicago, IL 60638	Phone: 708-458-0655 Fax: 708-458-0749	www.gipsa.usda.gov	89	500	2000	17	10
Hawaii Measurement Standards Laboratory	1851 Auiki St., Honolulu, HI 96819	Phone: (808) 832-0682 Fax: (808) 832-0683	http://hawaii.gov/hdoa/qad/ms	15	3045	2602	42	17
ISDA Metrology Laboratory	2216 Kellogg Lane, Boise, ID 83701	Phone: 208-332-8691 Fax: 208-334-2378	www.agril.idaho.gov	49	720	1900	70	46
Illinois Department of Agriculture Metrology Laboratory	801 Sangamon Avenue East, Springfield, IL 62702	Phone: 217-785-8480 Fax: 217-785-3136		39	1200	3220	323	122

Location	Address	Contact	Website	Age (Years)	Office Space (Sq. Ft.)	Lab Space (Sq. Ft.)	Customers	Non-Service Agent Customers
Indiana State Dept of Health/Division of Weights and Measures Metrology Lab	2525 N Shadeland Ave Ste D3, Indianapolis, IN 46219	Phone: (317) 356-7078 x229 Fax: (317) 351-2877		18	2000	3258	40	7
Kansas Metrology Laboratory	6531 SE Forbes Ave, Ste B, Topeka, KS 66619	Phone: 785-296-2938 Fax: 785-296-8298	http://agriculture.ks.gov/divisions-programs/weight-measures/metrology-lab	18	213	3574	157	52
Kentucky Department of Agriculture	107 Corporate Dr, Frankfort, KY 40601	Phone: 502-573-0282 Fax: 502-573-0303	www.kyagr.com	16	400	2395	64	5
Louisiana Dept. of Agriculture	5825 Florida Blvd. Suite 5000, Baton Rouge, LA 70806	Phone: 225 9221380 Fax: 225 9234877		25	300	1550	115	67
Los Angeles County	11012 Garfield Ave, South Gate, CA 90280	Phone: 562-622-0419 Fax: 562-861-0278	http://acwm.lacounty.gov	42	168	2922	29	4
Massachusetts Division of Standards Metrology Laboratory	661 (rear) Highland Avenue, Needham Heights, MA 02494	Phone: 781-444-0219 Fax: 781-444-0891		6	160	2192	142	4
Md Dept of Agriculture, Weights & Measures Laboratory	50 Harry S Truman Pkwy, Annapolis, MD 21401	Phone: 410-841-5790 Fax: 410-841-2765	www.mda.maryland.gov	26	930	4870	8	0
Maine Metrology Laboratory	333 Cony Road, Augusta, ME 04330	Phone: 207-287-7587 Fax: 207-624-5040	http://www.maine.gov/dacf/qar/laboratory_testing/metrology.shtml	54	285	11500	155	20
State of Michigan	940 Venture Lane, Williamston, MI 48895	Phone: 517-655-8202 Fax: 517-655-8303	http://www.michigan.gov/wminfo	18	2000	12200	167	80
State of Minnesota	14305 Southcross Dr #150, Burnsville, MN 55306	Phone: 651-539-1555 Fax: 952-435-4040	https://mn.gov/commerce/industries/scales-meters/metrology-lab.jsp	10	1120	4706	250	118
Missouri Metrology Lab	1616 Missouri Blvd, Jefferson City, MO 65109	Phone: 573-751-9487 Fax: 573-751-0281	http://agriculture.mo.gov/	27	385	2433	596	9
Mississippi	1000 ASU Dr., Lorman, MS 39096	Phone: 601-877-3802 Fax: 601-877-3872		16	320	3752	130	130
Montana Bureau of Weights and Measures	2801 North Cooke Street, Helena, MT 59601	Phone: (406)449-2582 Fax: (406)4438163	http://bsd.dli.mt.gov/weights-and-measures	40	2000	800	72	15

Location	Address	Contact	Website	Age (Years)	Office Space (Sq. Ft.)	Lab Space (Sq. Ft.)	Customers	Non-Service Agent Customers
NCDA&CS Standards Laboratory	1051 Mail Service Center, Raleigh, NC 27699	Phone: 919-733-4411 Fax: 919-733-8804	www.ncstandards.org	31	2700	4800	450	6
Nebraaska Standards Laboratory	3721 west Cuming St. , Lincoln, Ne 68524	Phone: 402-417-2087 Fax:	nda.nebraska,gov	36			0	0
New Hampshire Metrology Laboratory	25 Capitol St., Concord, NH 03301	Phone: 603-271-0894 Fax: 603-271-1109	http://agriculture.nh.gov/divisions/weights_measures/metrology.htm	44	0	700	69	15
State of New Jersey, Office of Weights and Measures	1261 Routes 1 & 9 South, Avenel, NJ 07001	Phone: (732)815-7821, (201)919-5163 Fax: (732)382-5298		27	200	2700	572	542
New Mexico Department of Agriculture	PO Box 30005, MSC 3170, Las Cruces, NM 88003	Phone: 575 646 1616 Fax: 575 646 2361		43	171	2335	414	279
Nevada Metrology Laboratory	2150 Frazier Avenue, Sparks, NV 89431	Phone: 775-353-3794 Fax: 775-353-3798	http://agri.nv.gov/Protection/Weights_and_Measures/Metrology_Lab/	43	170	1200	45	22
NYS W&M Metrology Lab	6 Harriman Campus Rd., Albany, NY 12206	Phone: 518-457-3146 Fax: 518-457-2552	www.agriculturs.ny.gov	4	975	4240	83	33
State of Ohio Metrology Laboratory	8995 E Main St, Bldg 5, Reynoldsburg, OH 43068	Phone: 614-728-6290 Fax: 614-728-6424	http://www.agri.ohio.gov/divs/weights/weights.aspx	58	2500	3047	220	68
Oklahoma Bureau of Standards	2800 N. Lincoln Blvd., Oklahoma City, OK 73105	Phone: 405-522-0567 Fax: 405-522-5457	http://www.ag.ok.gov/lab/bos.htm	8	400	5807	197	131
Oregon Department of Agriculture	635 Capitol St NE, Salem, OR 97301	Phone: 503-986-4669 Fax: 503-986-4784	https://www.oregon.gov/ODA/programs/ISCP/Pages/Metrology.aspx	18	367	2038	75	38
Pennsylvania Standards Laboratory	2221 Forster Street, Room G-44A, Harrisburg, PA 17125	Phone: 717-787-4707 Fax: 717-705-0882	www.dgs.pa.gov	19	1568	3780	706	213
Puerto Rico Weights and Measures Laboratory	140 Federico Costa ST. , San Juan, PR 00918	Phone: 1-787-725-4414 Fax: 787-723-3491	daco.gobierno.pr/servicios/Pages/Pesas-y-Medidas.aspx	4	2125	2915	90	0
SC Department of Agriculture	237 Catawba Street, Columbia, SC 29201	Phone: 803-253-4052 Fax: 803-253-4052	agriculture.sc.gov	30	208	3500	717	553

Location	Address	Contact	Website	Age (Years)	Office Space (Sq. Ft.)	Lab Space (Sq. Ft.)	Customers	Non-Service Agent Customers
South Dakota Metrology Laboratory	118 West Capitol Avenue, Pierre, SD 57501	Phone: 605-773-3170 Fax:	http://dps.sd.gov/licensing/weights_and_measures/metrology_laboratory.aspx	40	0	525	62	12
Tennessee Weights and Measures Laboratory	430 Hogan Road, Nashville, TN 37220	Phone: 615-837-5159 Fax: 615-837-5015		89	256	837	170	0
Texas Dept of Agriculture - Giddings Metrology Laboratory	1258 CR 226 / P.O. Box 1518, Giddings, TX 78942	Phone: 979.542.3231 Fax: 888.205.7741	www.texasagriculture.gov	14	1200	11077	203	0
Utah Metrology Lab	350 North Redwood Rd, Salt Lake City, UT 84116	Phone: 801-538-7153 Fax: 801-538-4949	ag.utah.gov	35	150	1350	62	0
VA State Metrology	600 4TH Street, Richmond, VA 23219	Phone: 804-786-0479 Fax: 804-371-0206		15	0	1840		0
Vermont W&M Metrology Lab	322 Industrial Lane, Berlin, VT 05641	Phone: 802-828-2426 Fax: 802-828-5983	www.Agriculture.Vermont.gov	5	200	1600	72	30
WA St. Dept. of Agriculture Metrology Laboratory	PO Box 42560, Olympia, WA 98504	Phone: 360-753-5042 Fax: 360-586-4728	http://agr.wa.gov/Inspection/WeightsMeasures/metrologylab/metrologylab.aspx	39	230	2734	251	88
Wisconsin Weights and Measures Laboratory	3601 Galleon Run, Madison, WI 53718	Phone: (608) 224-4913 Fax: (608) 224-4912	https://datcp.wi.gov/Pages/Programs_Services/MetrologyLab.aspx	10	550	3700	405	216
West Virginia Weights & Measures Metrology Laboratory	570 MacCorkle Ave W, St. Alabns, WV 25177	Phone: 304-722-0602 Fax: 304-722-0605	www.wvlabor.com	46	231	1769	275	59
Wyoming Department of Agriculture	6607 Campstool Rd, Cheyenne, WY 82002	Phone: 307-777-7556 Fax: 307-777-1943	agriculture.wy.gov	5	650	1660	53	10

Table 5: Listing of the SLP laboratories including location, age[1], size, and total number of customers served as of the 2016 calendar year.

[1] Laboratory age is not indicative of laboratory condition. Many facilities have been significantly renovated in recent years.

Laboratory Survey Participation

Survey Participation Matrix													
Lab Code/Year	1996	1998	1999	2000	2002	2004	2005	2006	2008	2010	2012	2014	2016
AK	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AL	Yes				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
AZ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CO	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DE	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
FL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HI	Yes	Yes	Yes	(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IA	Yes	Yes	Yes		(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	(inactive)	(inactive)
ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
KS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
KY	Yes	Yes	Yes	Yes	Yes	(inactive)	(inactive)	Yes	Yes	Yes	Yes	Yes	Yes
LA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MA	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
MD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ME	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MO	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MS	Yes	Yes		(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MT	Yes	Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes
NC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ND	Yes	Yes	Yes	Yes	Yes	(inactive)	Yes	Yes	Yes		(inactive)	(inactive)	(inactive)
NE	Yes	Yes			Yes	Yes	Yes	Yes			Yes	Yes	Yes
NH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NJ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NV	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Lab Code/Year	1996	1998	1999	2000	2002	2004	2005	2006	2008	2010	2012	2014	2016
OH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RI	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
SC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SD	Yes	Yes			(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TN	Yes	Yes	Yes	Yes	Yes	(inactive)	Yes	Yes	Yes		Yes	Yes	Yes
TX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
UT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WY	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
USDA-GIPSA	Yes					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wash. DC	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
Virgin Islands	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
Puerto Rico	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LA County	Yes	Yes	Yes	Yes	Yes	(inactive)	(inactive)	(inactive)	Yes	Yes	Yes	Yes	Yes
TOTAL	51	46	45	44	48	47	46	49	50	47	48	49	49

Table 6: Listing of SLP member laboratories and their participation status in previous surveys (blanks indicate non-participation).

Grand Total

In order to give a very high-level overview of the measurement work performed by the SLP program the survey team added the number of measurements reported by all of the laboratories for each measurement procedure surveyed to come up with a grand total. This total does not factor in time or effort required in performing individual measurements. The reader is referred to the supplementary section of the 2014 edition of the SLP Workload Survey for data on the time required to complete individual measurements.

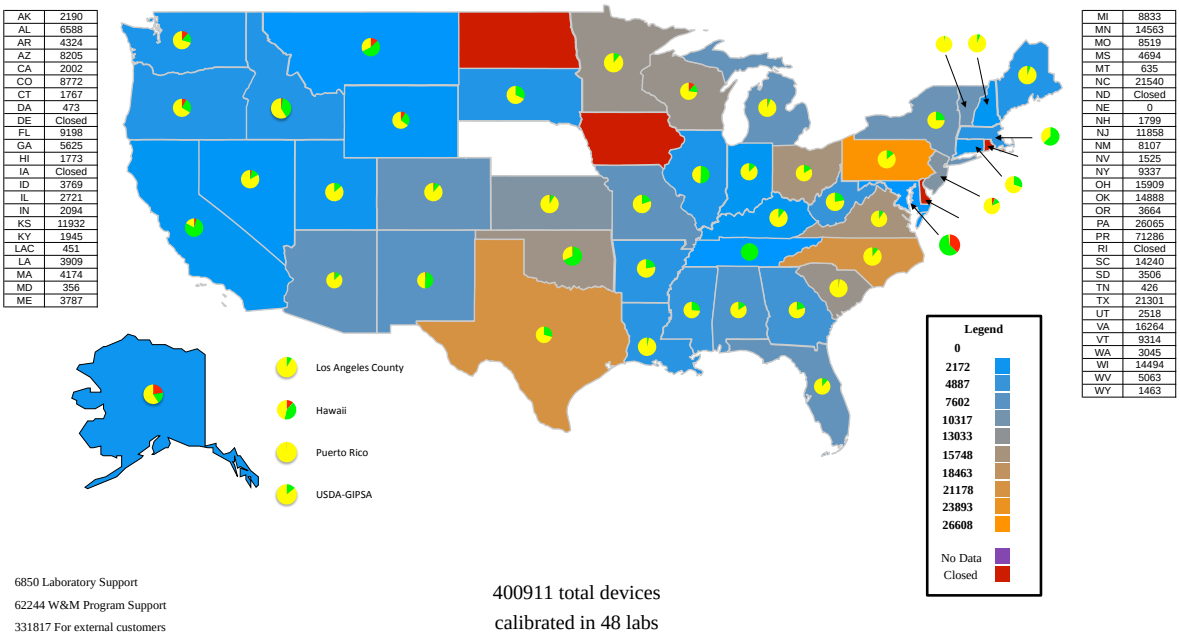
Survey	Labs	Total Devices	Lab Average
1996	51	322,472	6,323
1998	46	320,931	6,977
1999	45	352,274	7,828
2000	45	361,600	8,036
2002	48	375,411	7,821
2004	47	355,986	7,574
2005	46	361,054	7,849
2006	49	365,004	7,449
2008	50	367,336	7,347
2010	47	368,333	7,837
2012	47	305,728[2]	6,505
2014	49	336,858	6,875
2016	49	400,911[3]	8,182

Table 7: Summary of all measurements reported on prior surveys.

[2] The dip in SLP measurement production reported in 2012 is attributed in large part to the absence of a survey response from Puerto Rico. Puerto Rico routinely reports testing approximately 30,000 lottery balls

[3] In 2016 the metrology laboratory in Puerto Rico reported testing 69,800 lottery balls. This number is a little over double what has been historically reported by this laboratory. This accounts for a large portion of the increase in measurement production reported by the SLP this year.

Grand Total

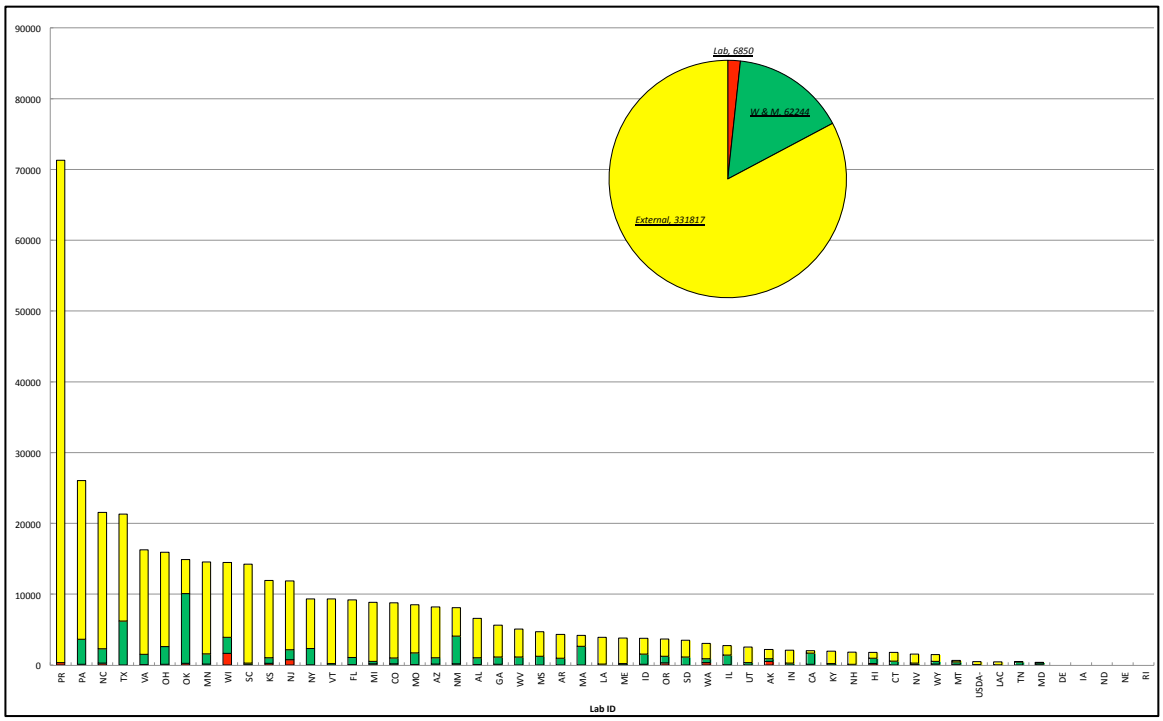


AK	2190
AL	6588
AR	4324
AZ	8205
CA	2002
CO	8772
CT	1767
DA	473
DE	Closed
FL	9198
GA	5625
HI	1773
IA	Closed
ID	3769
IL	2721
IN	2094
KS	11932
KY	1945
LAC	451
LA	3909
MA	4174
MD	356
ME	3787

MI	8833
MN	14563
MO	8519
MS	4694
MT	635
NC	21540
ND	Closed
NE	0
NH	1799
NJ	11858
NM	8107
NV	1525
NY	9337
OH	15909
OK	14888
OR	3664
PA	26065
PR	71286
RI	Closed
SC	14240
SD	3506
TN	426
TX	21301
UT	2518
VA	16264
VT	9314
WA	3045
WI	14494
WV	5063
WY	1463

6850 Laboratory Support
62244 W&M Program Support
331817 For external customers

400911 total devices
calibrated in 48 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 11: Total of all measurements reported.

Mass

Mass weighing procedures are broken into several categories based on measurement procedures and the category of mass standard measured for the purpose of this report.

Echelon I weighing procedures are those mass calibrations which use calibration designs, such as those detailed in the NIST SEMATECH Engineering Statistics Handbook and NIST Technical Note 952, that are solved using numerical least squares approximations, and correct for air buoyancy when inter-comparing weights of unequal volume. These calibrations are typically associated with, but are not limited to high precision weight standards such as those specified in ASTM E617 Class 0 or OIML E1. Masscode is the industry standard software used to analyze data collected for an echelon I calibration. Any calibration for which a laboratory used Masscode to analyze the primary data is considered to be an echelon I calibration for this survey.

Echelon II weighing procedures are typically used when high tolerance class calibrations are requested. These typically involve many redundant measurements in order to reduce the overall measurement uncertainty to an acceptable level. Unlike Echelon I, conventional mass corrections of the laboratory standards are typically used in lieu of performing air buoyancy corrections. Examples of echelon II mass calibration procedures may be found in NIST Internal Report 6969 (Harris, NIST IR 6969, "Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations", 2014), SOP 4 and SOP 7 (Harris, NIST IR 6969, "Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations", 2014).

Echelon III weighing procedures are essentially everything else with the exception of measurements performed on weight carts, railroad test cars, and railroad specific weight carts. A typical echelon III procedure is SOP 8 found in NIST Internal Report 6969 (Harris, NIST IR 6969, "Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations", 2014). Most mass standards tested in SLP metrology lab fall into this category (91%)[4]

Weight Carts are motorized carts used to transport a load of field test weights to facilitate the field testing of larger capacity scales. Weight carts are often subject to the specifications and tolerances found in NIST Handbook 105-8 (NIST Handbook 105-8 "Specifications and Tolerances for Field Standard Weight Carts", 2003) are typically tested using echelon III procedures. They are, never the less, treated separately herein as they are distinct from field test weights.

Railroad Test Cars are certified mass standards built for AAR interchange service used to facilitate the testing of railroad track scales. Specifications for these field standards are published by The Association of American Railroads (AAR Scale Handbook 2013 Edition, 2013). Certification of these mass standards is typically done using a master scale facility certified by the USDA Grain Inspection, Packers and Stockyard Association (GIPSA).

Railroad Specific Weight Carts are certified mass standards used to facilitate testing of railroad track scales. Unlike railroad test cars these devices by themselves are not suitable for AAR interchange service. Unlike traditional weight carts these devices are designed transport 80,000 lb or more of test weight short distances on rail. Certification of these mass standards is typically done using a master scale facility certified by the USDA Grain Inspection, Packers and Stockyard Association (GIPSA) as these carts can weigh 10,000 lb or more. Additional weights loaded onto the cart are standard cast iron field test weights and are covered under Echelon III weighing procedures.

[4] by count of mass standards tested only. The time required to complete a test is outside the scope of this survey.

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Mass Echelon I

Description

The graphs on the following page represent the total number of Mass Echelon I standards evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 11 labs tested a total of 1,845 mass standards

Comparison of previous surveys

Year	# Labs	Total Devices
1998	10	2,667
1999	15	5,985
2000	16	5,227
2002	15	5,288
2004	14	3,707
2005	14	3,103
2006	14	3,025
2008	17	2,216
2010	19	2,309
2012	12	2,493
2014	13	2,980
2016	11	1,845

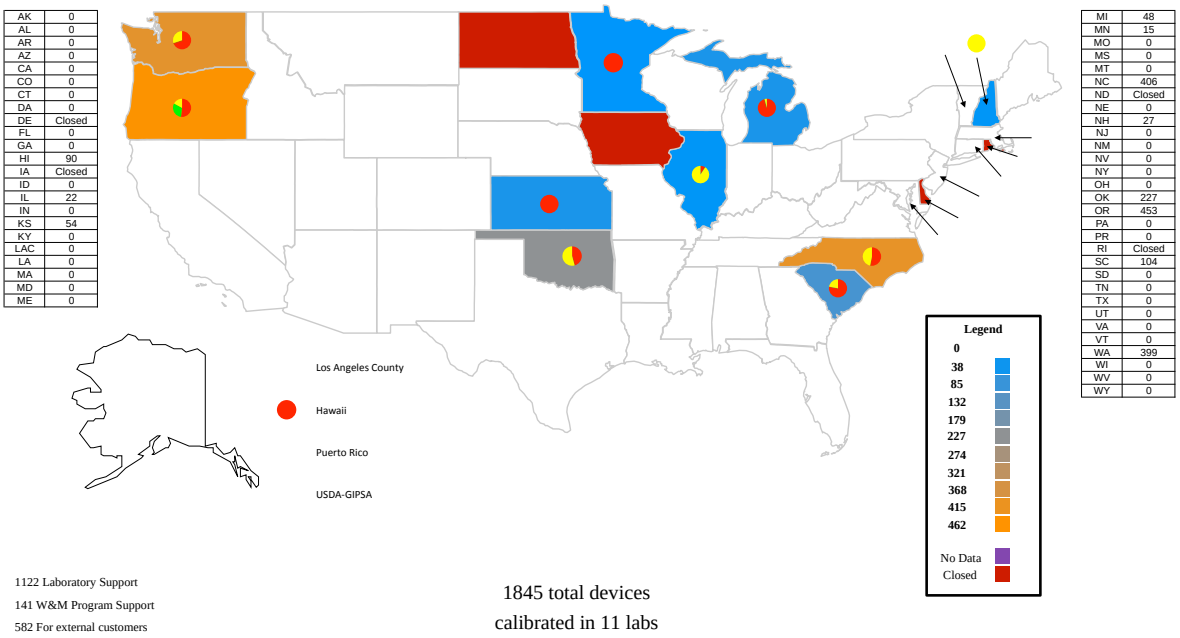
Table 8: Summary of echelon I tests reported on previous surveys.

Results for Mass I cannot be compared to the 1996 survey as it did not use Mass Echelon I as a category. ‘Precision Mass’ was used as the category and it included both Mass Echelon I and Mass Echelon II calibrations.

Notes and Comments

- 61 % of all Mass I standards were calibrated for internal use by the laboratory.
- 8 % of all Mass I standards were calibrated for the weight and measures program.
- 32 % of all Mass I standards were calibrated for external customers.

Mass Echelon I

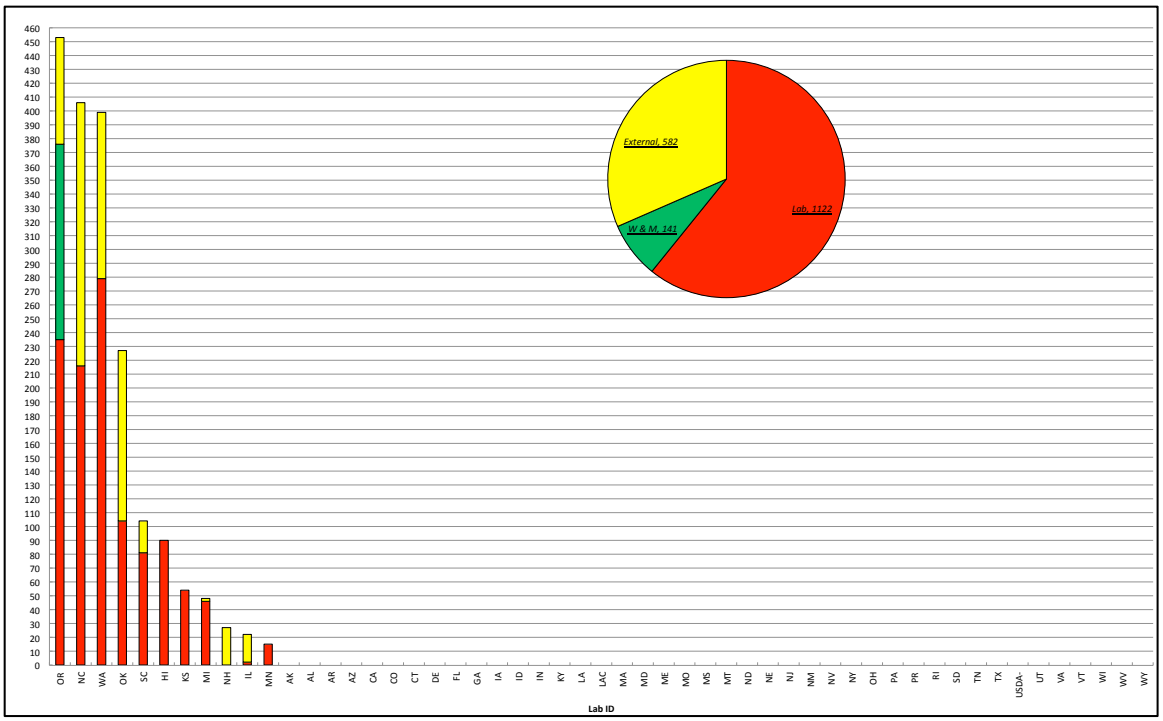


AK	0
AL	0
AR	0
AZ	0
CA	0
CO	0
CT	0
DA	0
DE	Closed
FL	0
GA	0
HI	90
IA	Closed
ID	0
IL	22
IN	0
KS	54
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0

MI	48
MN	15
MO	0
MS	0
MT	0
NC	406
ND	Closed
NE	0
NH	27
NJ	0
NM	0
NV	0
NY	0
OH	0
OK	227
OR	453
PA	0
PR	0
RI	Closed
SC	104
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	399
WI	0
WV	0
WY	0

1122 Laboratory Support
141 W&M Program Support
582 For external customers

1845 total devices
calibrated in 11 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 12: Mass Echelon I tests.

Mass Echelon II

Description

The graphs on the following page represent the total number of Mass Echelon II standards evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 27 labs tested a total of 11,723 mass standards

Comparison of previous surveys

Year	# Labs	Total Devices
1996	38	37,662
1998	36	24,926
1999	35	25,807
2000	38	26,428
2002	37	25,847
2004	32	21,714
2005	32	20,541
2006	33	22,352
2008	32	25,371
2010	34	23,316
2012	30	18,222
2014	26	16,832
2016	27	11,723

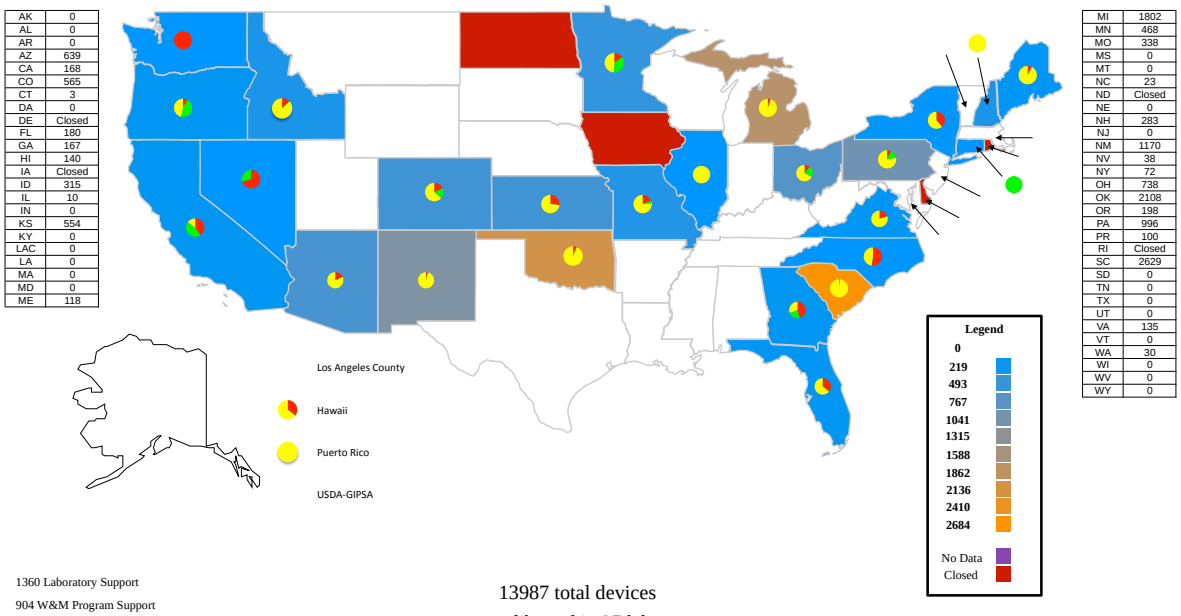
Table 9: Echelon II tests reported on previous surveys.

Results for Mass II cannot be compared to the 1996 survey as it did not use Mass Echelon II as a category. ‘Precision Mass’ was used as the category and it included both Mass Echelon I and Mass Echelon II calibrations.

Notes and Comments

- 10 % of all Mass II standards were calibrated for internal use by the laboratory.
- 6 % of all Mass II standards were calibrated for the weight and measures program.
- 84 % of all Mass II standards were calibrated for external customers.

Mass Echelon II

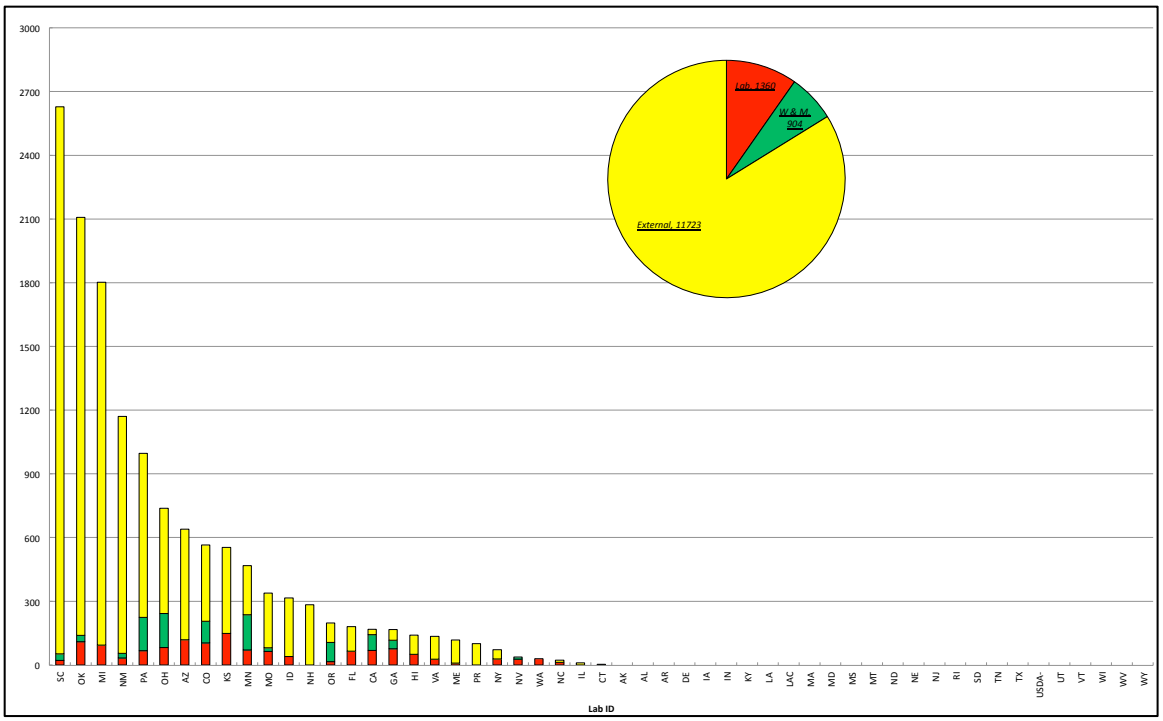


AK	0
AL	0
AR	0
AZ	639
CA	168
CO	565
CT	3
DA	0
DE	Closed
FL	180
GA	167
HI	140
IA	Closed
ID	315
IL	10
IN	0
KS	554
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	118

MI	1802
MN	468
MO	338
MS	0
MT	0
NC	23
ND	Closed
NE	0
NH	283
NJ	0
NM	1170
NV	38
NY	72
OH	738
OK	2108
OR	198
PA	996
PR	100
RI	Closed
SC	2629
SD	0
TN	0
TX	0
UT	0
VA	135
VT	0
WA	30
WI	0
WV	0
WY	0

1360 Laboratory Support
904 W&M Program Support
11723 For external customers

13987 total devices
calibrated in 27 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 13: Mass Echelon II tests.

Mass Echelon III

Description

The graphs on the following page represent the total number of Mass Echelon III standards evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 48 labs tested a total of 261,823 mass standards

Comparison of previous surveys

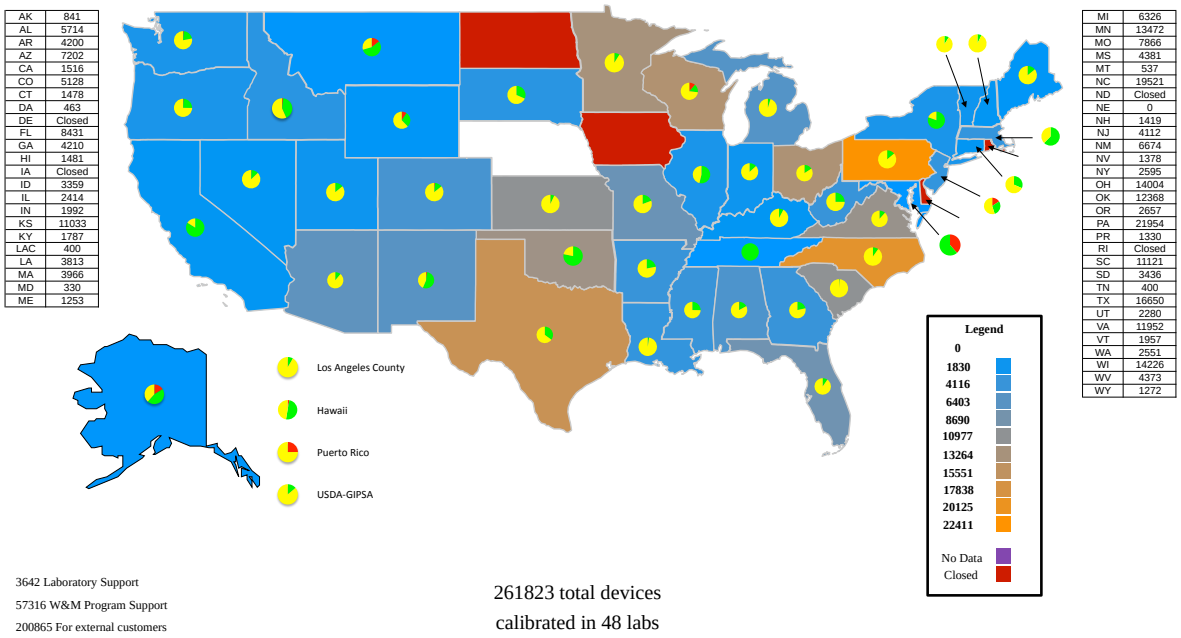
Year	# Labs	Total Devices
1996	51	259,713
1998	46	259,166
1999	45	257,938
2000	45	260,072
2002	47	267,240
2004	47	248,117
2005	46	248,650
2006	49	256,844
2008	50	254,221
2010	47	256,094
2012	47	256,094
2014	47	244,985
2016	48	261,823

Table 10: Echelon III tests reported on previous surveys.

Notes and Comments

- 1 % of all Mass III standards were calibrated for internal use by the laboratory.
- 22 % of all Mass III standards were calibrated for the weight and measures program.
- 77 % of all Mass III standards were calibrated for external customers.

Mass Echelon III

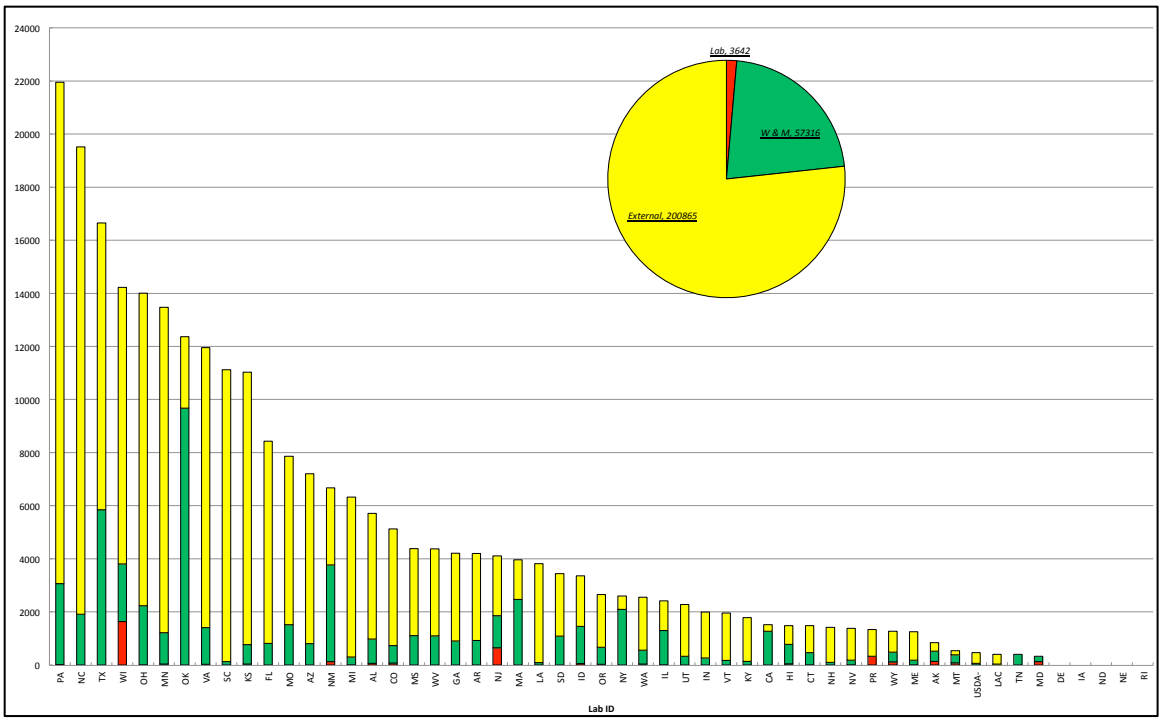


AK	841
AL	5714
AR	4200
AZ	7202
CA	1516
CO	5128
CT	1478
DA	463
DE	Closed
FL	8431
GA	4210
HI	1481
IA	Closed
ID	3359
IL	2414
IN	1992
KS	11033
KY	1787
LAC	400
LA	3813
MA	3966
MD	330
ME	1253

MI	6326
MN	13472
MO	7866
MS	4381
MT	537
NC	19521
ND	Closed
NE	0
NH	1419
NJ	4112
NM	6674
NV	1378
NY	2595
OH	14004
OK	12368
OR	2657
PA	21954
PR	1330
RI	Closed
SC	11121
SD	3436
TN	400
TX	16650
UT	2280
VA	11952
VT	1957
WA	2551
WI	14226
WV	4373
WY	1272

3642 Laboratory Support
57316 W&M Program Support
200865 For external customers

261823 total devices
calibrated in 48 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 14: Mass Echelon III tests.

Weight Carts

Description

The graphs on the following page represent the total number of weight carts evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 31 labs tested a total of 572 weight carts

Comparison of previous surveys

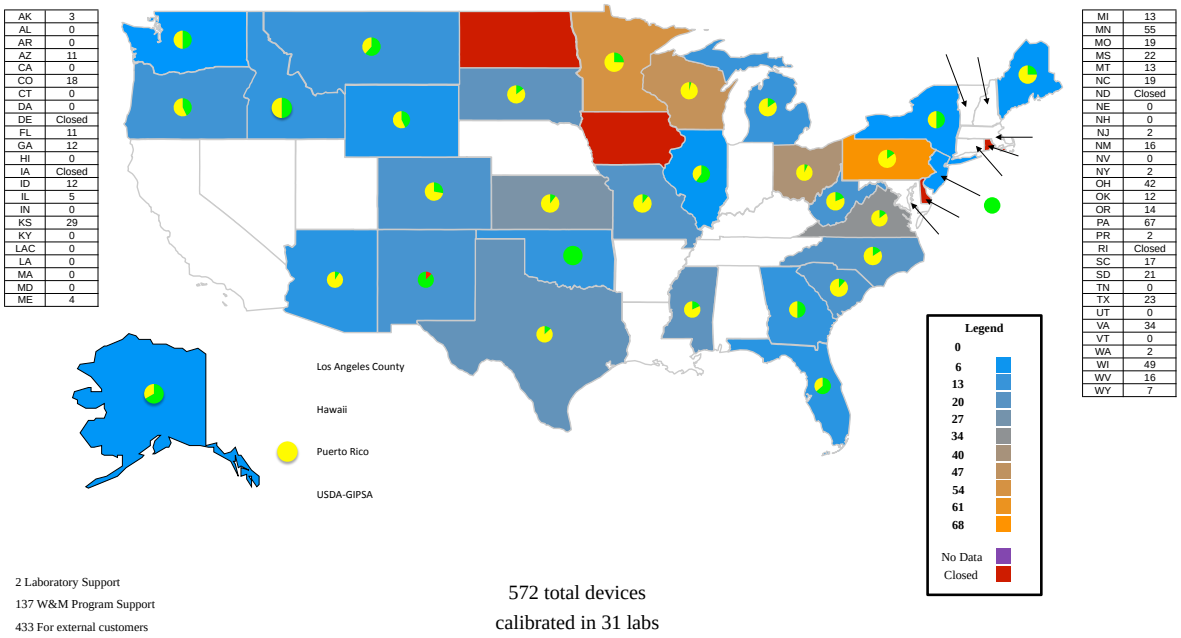
Year	# Labs	Total Devices
1998	30	297
2000	27	344
2002	29	388
2004	33	365
2005	30	410
2006	31	388
2008	32	445
2010	35	468
2012	31	433
2014	30	517
2016	31	572

Table 11: Weight Cart tests reported on previous surveys.

Notes and Comments

- < 1 % of all weight carts were calibrated for internal use by the laboratory.
- 24 % of all weight carts were calibrated for the weight and measures program.
- 76 % of all weight carts were calibrated for external customers.

Weight Carts

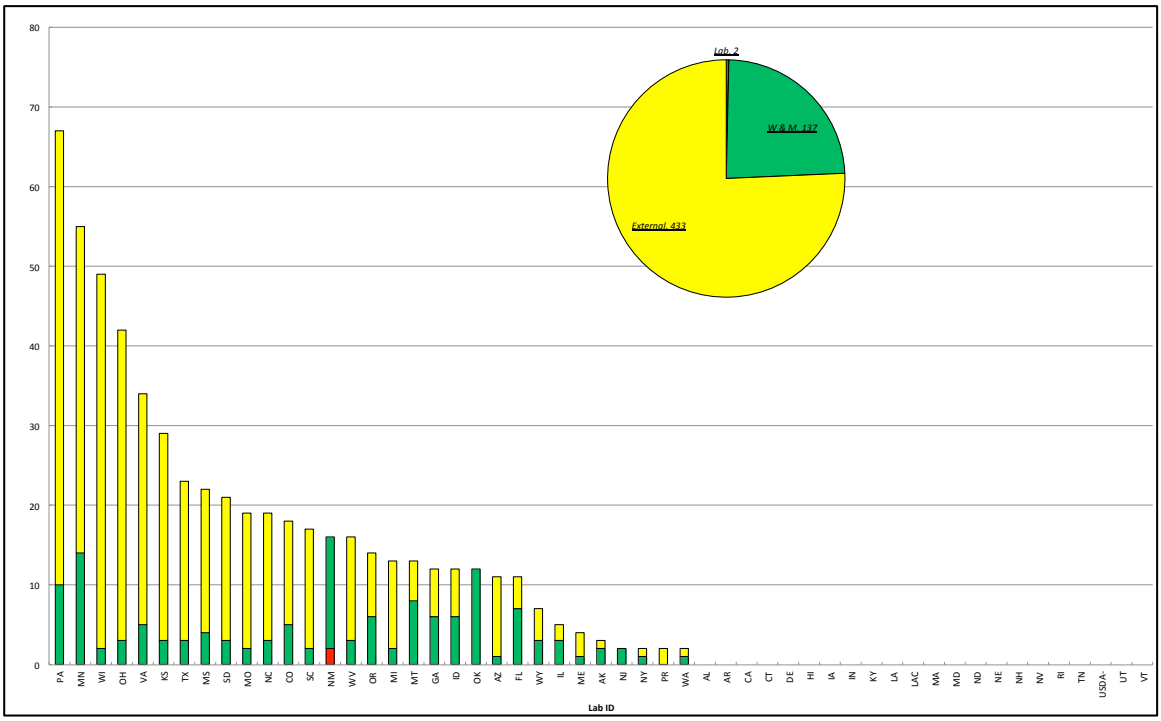


AK	3
AL	0
AR	0
AZ	11
CA	0
CO	18
CT	0
DA	0
DE	Closed
FL	11
GA	12
HI	0
IA	Closed
ID	12
IL	5
IN	0
KS	29
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	4

MI	13
MN	55
MO	19
MS	22
MT	13
NC	19
ND	Closed
NE	0
NH	0
NJ	2
NM	16
NV	0
NY	2
OH	42
OK	12
OR	14
PA	67
PR	2
RI	Closed
SC	17
SD	21
TN	0
TX	23
UT	0
VA	34
VT	0
WA	2
WI	49
WV	16
WY	7

2 Laboratory Support
137 W&M Program Support
433 For external customers

572 total devices
calibrated in 31 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 15: Weight Cart tests.

Railroad Test Cars

Description

(New for the 2016 survey)

The graphs on the following page represent the total number of railroad test cars evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 5 labs tested a total of 43 railroad test cars

Comparison of previous surveys

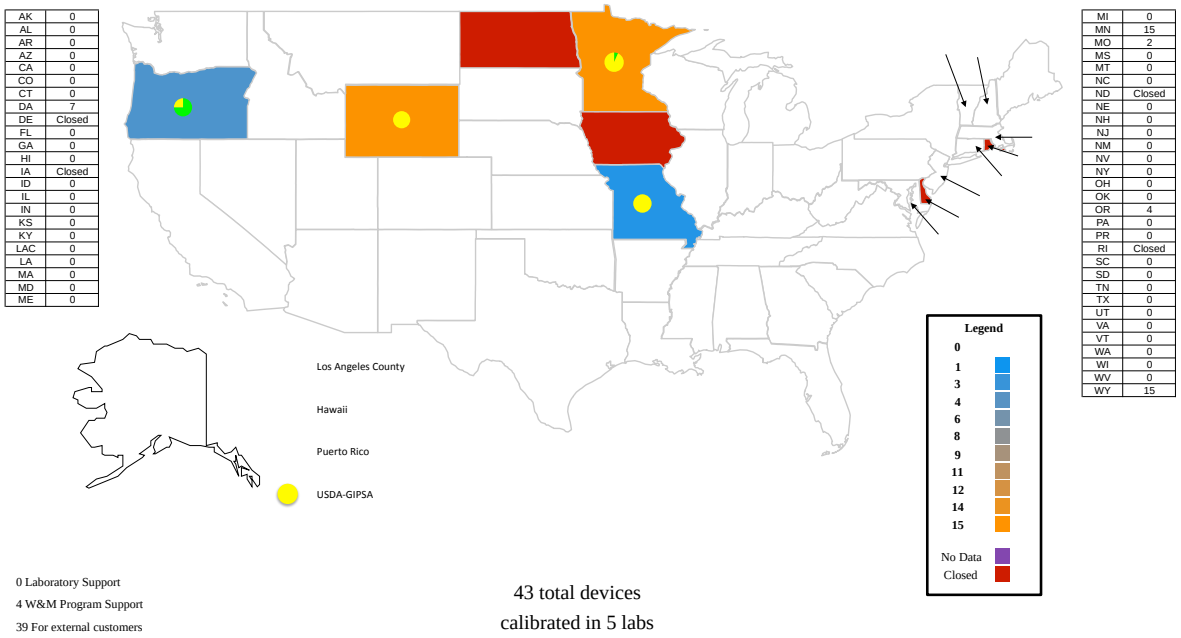
Year	# Labs	Total Devices
2016	5	43

Table 12: Railroad Test Car tests reported on previous surveys.

Notes and Comments

- 0 % of all weight carts were calibrated for internal use by the laboratory.
- 9 % of all weight carts were calibrated for the weight and measures program.
- 91 % of all weight carts were calibrated for external customers.

Railroad Test Cars



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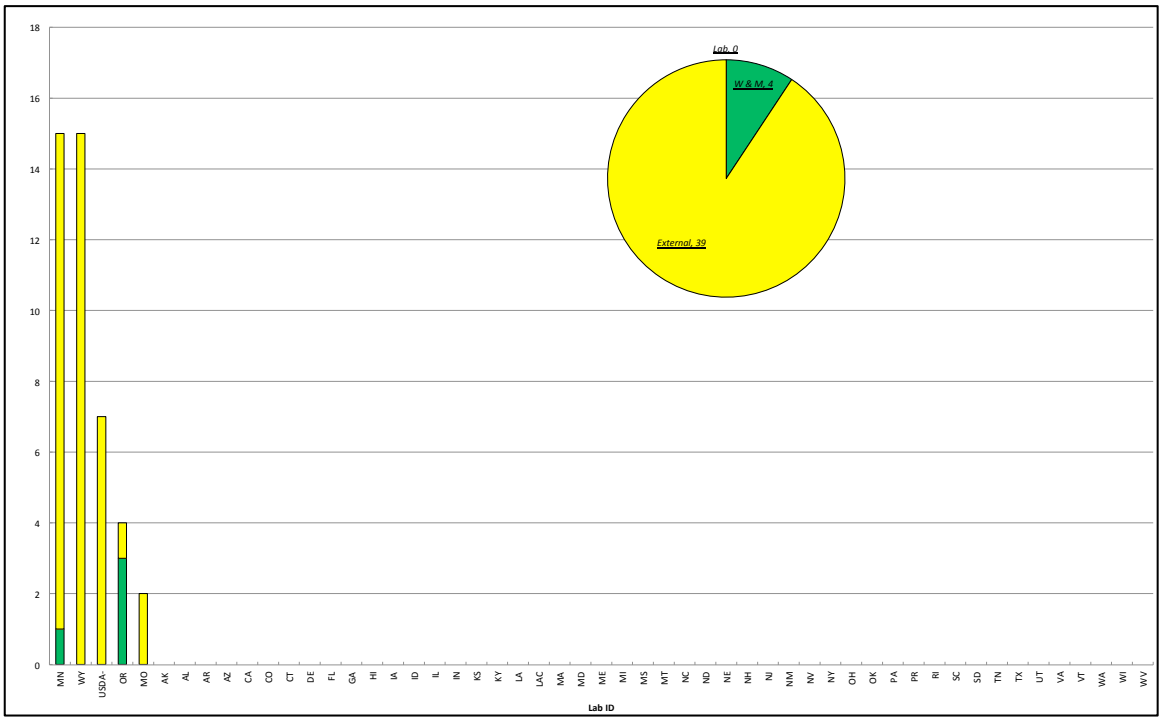
AL	0
AR	0
AZ	0
CA	0
CO	0
CT	0
DA	7
DE	Closed
FL	0
GA	0
HI	0
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0

MI	0
MN	15
MO	2
MS	0
MT	0
NC	0
ND	Closed
NE	0
NH	0
NJ	0
NM	0
NV	0
NY	0
OH	0
OK	0
OR	4
PA	0
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	0
WI	0
WV	0
WY	15

0 Laboratory Support
4 W&M Program Support
39 For external customers

43 total devices
calibrated in 5 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 16: Weight Cart tests.

Railroad Specific Weight Carts

Description

(New for the 2016 survey)

The graphs on the following page represent the total number of railroad specific weight carts evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 5 labs tested a total of 13 railroad specific weight carts

Comparison of previous surveys

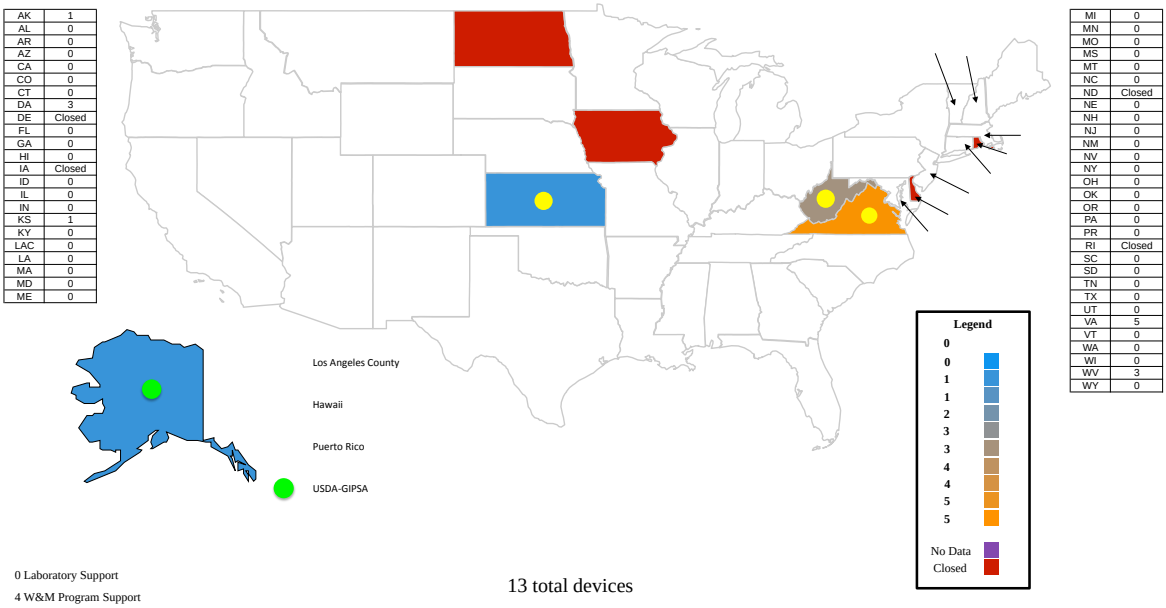
Year	# Labs	Total Devices
2016	5	13

Table 13: Railroad Specific Weight Carts tests reported on previous surveys.

Notes and Comments

- 0 % of all weight carts were calibrated for internal use by the laboratory.
- 31 % of all weight carts were calibrated for the weight and measures program.
- 69 % of all weight carts were calibrated for external customers.

Railroad Specific Weight Carts



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AL	0
AR	0
AZ	0
CA	0
CO	0
CT	0
DA	3
DE	Closed
FL	0
GA	0
HI	0
IA	Closed
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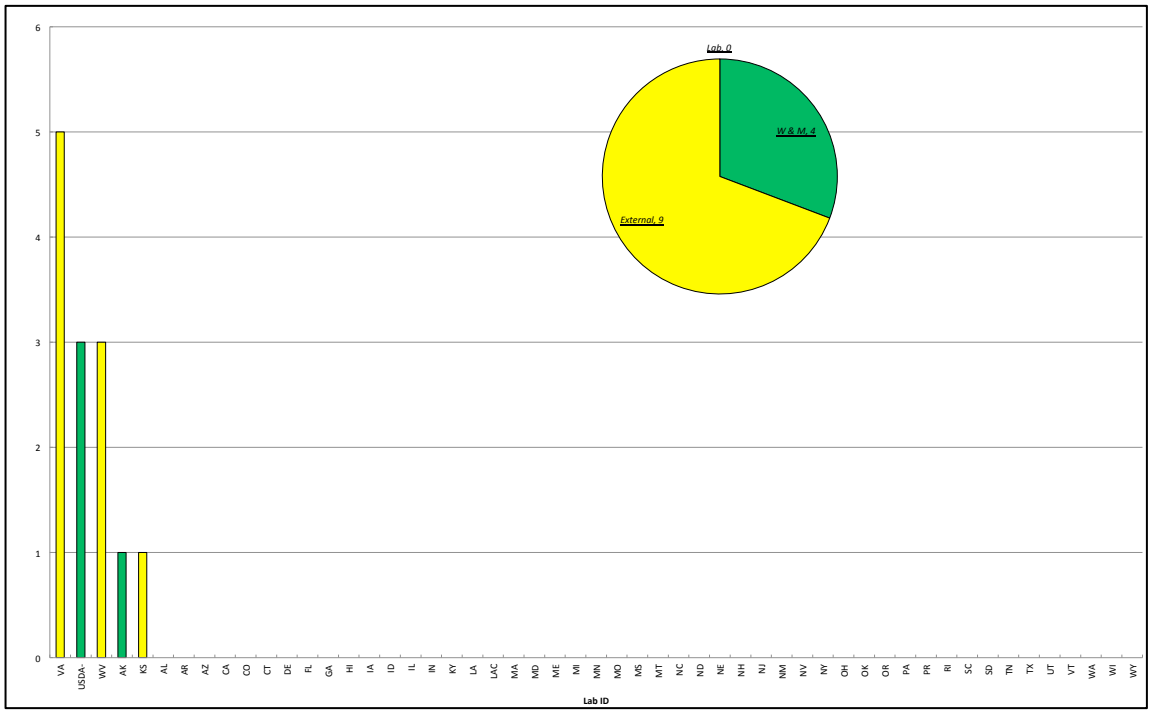
IL	0
IN	0
KS	1
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0

MI	0
MN	0
MO	0
MS	0
MT	0
NC	0
ND	Closed
NE	0
NH	0
NJ	0
NM	0
NV	0
NY	0
OH	0
OK	0
OR	0
PA	0
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	5
VT	0
WA	0
WI	0
WV	3
WY	0

0 Laboratory Support
4 W&M Program Support
9 For external customers

13 total devices
calibrated in 5 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 17: Railroad Specific Weight Cart tests.

Length

SLP Laboratories normally test two distinct classes of length standards, steel tape measures (surveyor's tapes or pi tapes for example) and rigid steel rules.

A typical measurement procedure for calibrating a rigid steel rule involves the side by side comparison of two rigid steel rules with the aid of a microscope. Two measurement procedures are commonly employed by the SLP laboratories to test steel tape measures. One involves the direct comparison of two flat steel tapes the other a direct comparison of a surveyor tape to a fixed length bench calibrated at 1 ft intervals out to 16 ft. Measurement procedures may be found in NISTIR 8028, 2014, *Selected Laboratory and Measurement Practices and Procedures for Length Calibrations, Jose A. Torres, Georgia L. Harris.*

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Steel Tape Measures

Description

The graphs on the following page represent the total number of tape measures evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 7 labs tested a total of 319 tape measures

Comparison of previous surveys

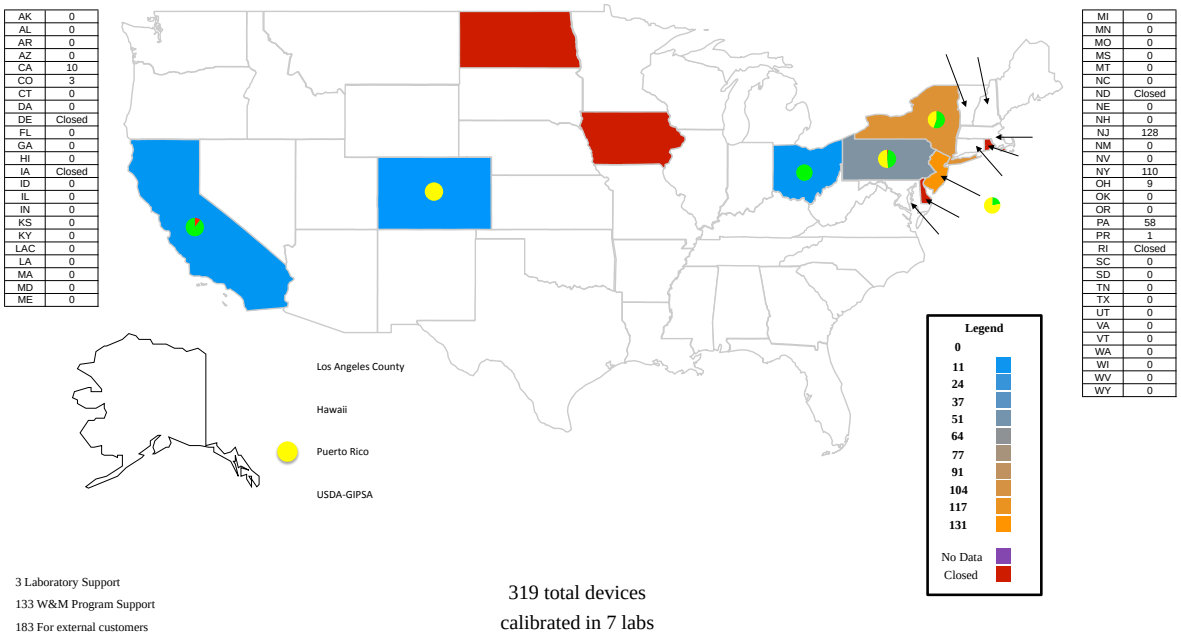
Year	# Labs	Total Devices
1996	27	707
1998	29	537
1999	21	566
2000	22	487
2002	21	584
2004	21	319
2005	19	304
2006	18	339
2008	17	425
2010	15	310
2012	12	353
2014	9	323
2016	7	319

Table 14: Tape measure tests reported on previous surveys.

Notes and Comments

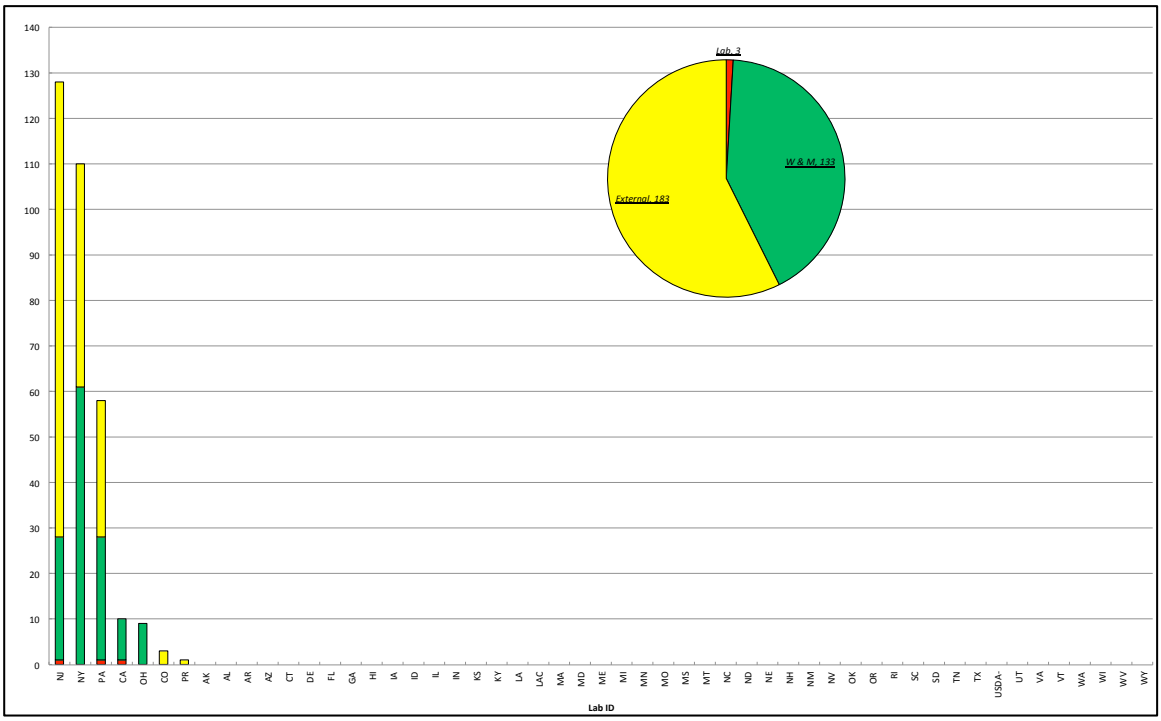
- 1 % of all tape measures were tested for internal use by the laboratory.
- 42 % of all tape measures were tested for the weight and measures program.
- 57 % of all tape measures were tested for external customers.

Tapes



3 Laboratory Support
133 W&M Program Support
183 For external customers

319 total devices
calibrated in 7 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 18: Tape Measure tests.

Rigid Rules

Description

The graphs on the following page represent the total number of rigid rules evaluated by the 49 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 2 labs tested a total of 36 rigid rules.

Comparison of previous surveys

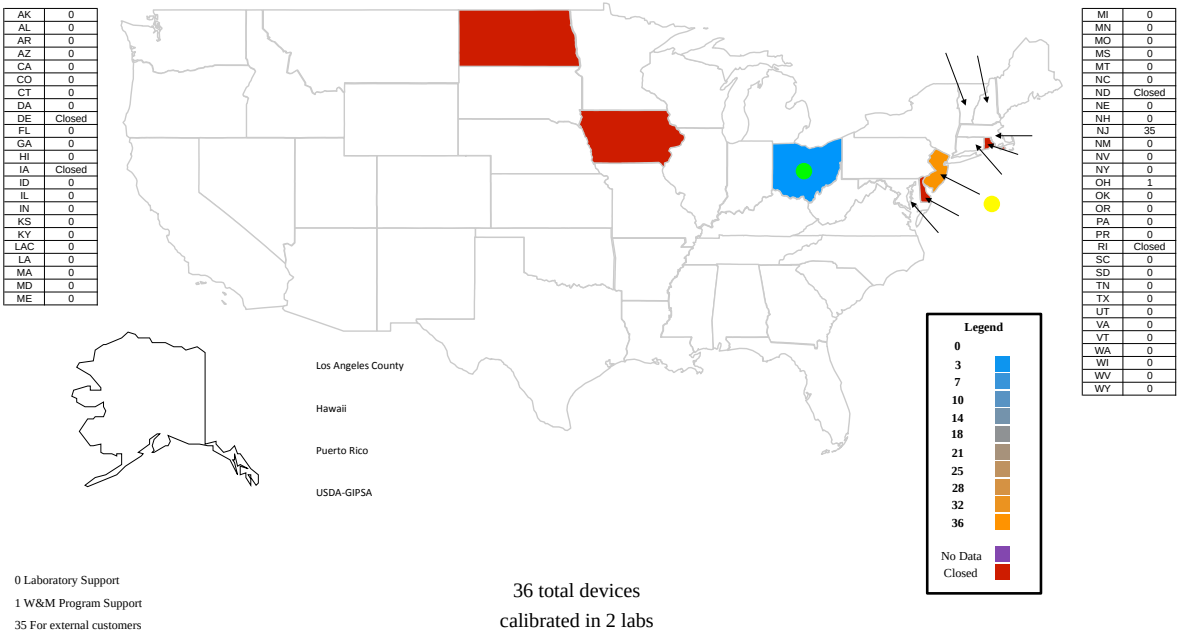
Year	# Labs	Total Devices
1996	26	582
1998	29	269
1999	20	413
2000	16	169
2002	14	138
2004	12	98
2005	11	85
2006	11	122
2008	11	88
2010	8	89
2012	3	85
2014	3	54
2016	2	36

Table 15: Rigid rule tests reported in previous surveys.

Notes and Comments

- 0 % of all rigid rules were tested for internal use by the laboratory.
- 3 % of all rigid rules were tested for the weight and measures program.
- 97 % of all rigid rules were tested for external customers.

Rigid Rules



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HI	0
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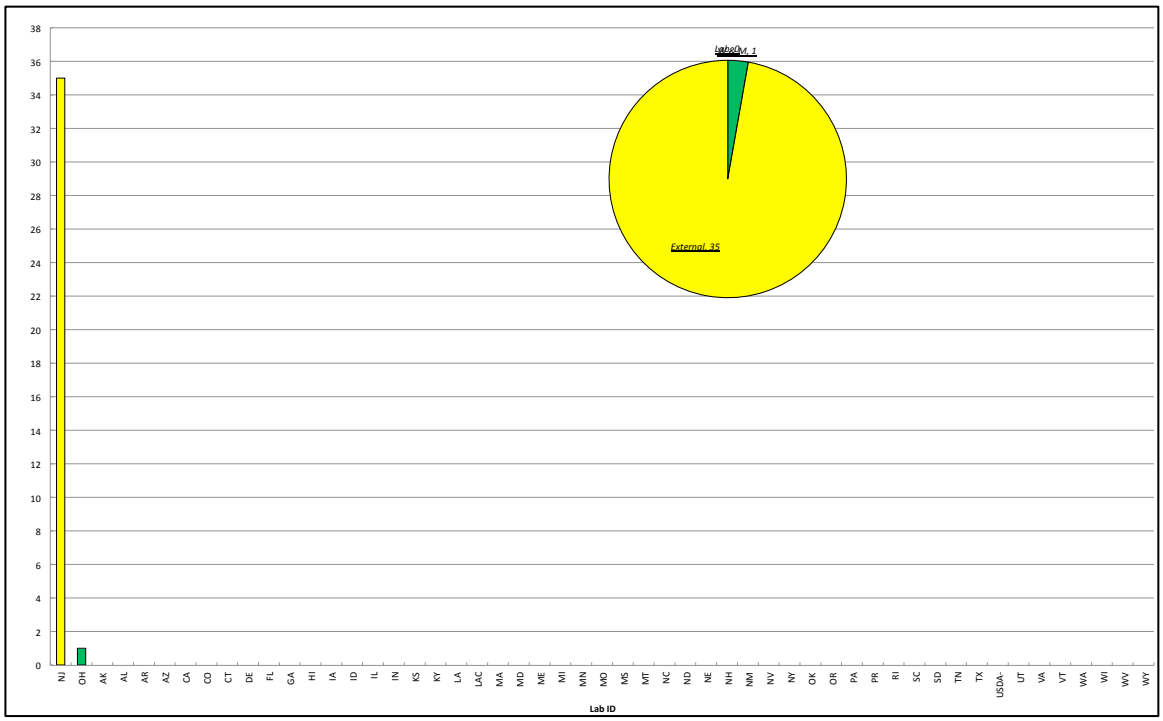
NV	0
NY	0
OH	1
OK	0
OR	0
PA	0
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	0
WI	0
WV	0
WY	0

0 Laboratory Support
1 W&M Program Support
35 For external customers

36 total devices
calibrated in 2 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 19: Rigid rule tests.

Volume

Volume measurement service are the 2nd most commonly performed by the SLP laboratories next to mass measurement. Volume measurement is broken down into distinct categories based upon the type of volumetric standard tested. The categories are glassware, volume test measures (≤ 5 gallons), medium volume provers (>5 gallons and ≤ 100 gallons), and large volume provers (> 100 gallons).

Examples of Volumetric Standards include but may not be limited to the following;

- laboratory glassware (see for example ASTM E288) and field measuring flasks (see NIST Handbook 105-2).
- steel graduated neck test measures as described in NIST Handbook 105-3 and in American Petroleum Institute's Manual of Petroleum Measurement Standards (Chapter 4). These include the steel 5 gallon capacity test measures commonly used by weights and measures officials to test retail motor fuel dispensers.
- pressurized Liquefied Petroleum Gas (LPG) Provers as described in NIST Handbook 105-4.
- slicker plate standards. These devices are similar to volumetric provers with the exception that they do not have a graduated neck. A slicker plate is used to skim off the meniscus formed at the top of the vessel when filled.

Volume measurements are further subdivided into two measurement categories. Volume standards are calibrated either by;

- transferring a known quantity of liquid (usually clean water) into them (See SOP's 16, 18, and 19 of NIST Internal Report 7383) –Volumetric Calibration–, or
- by filling it with a well characterized liquid (typically distilled water) and weighing it (See SOP 14 of NIST Internal Report 7383) –Gravimetric Calibration–.

Glassware

Description

The graphs on the next two pages represent the total number of volume measurements performed on glassware by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 49 reporting laboratories, 1 labs performed a total of 6 volume transfer tests.
- Of the 49 reporting laboratories, 9 labs performed a total of 75 gravimetric volume tests.

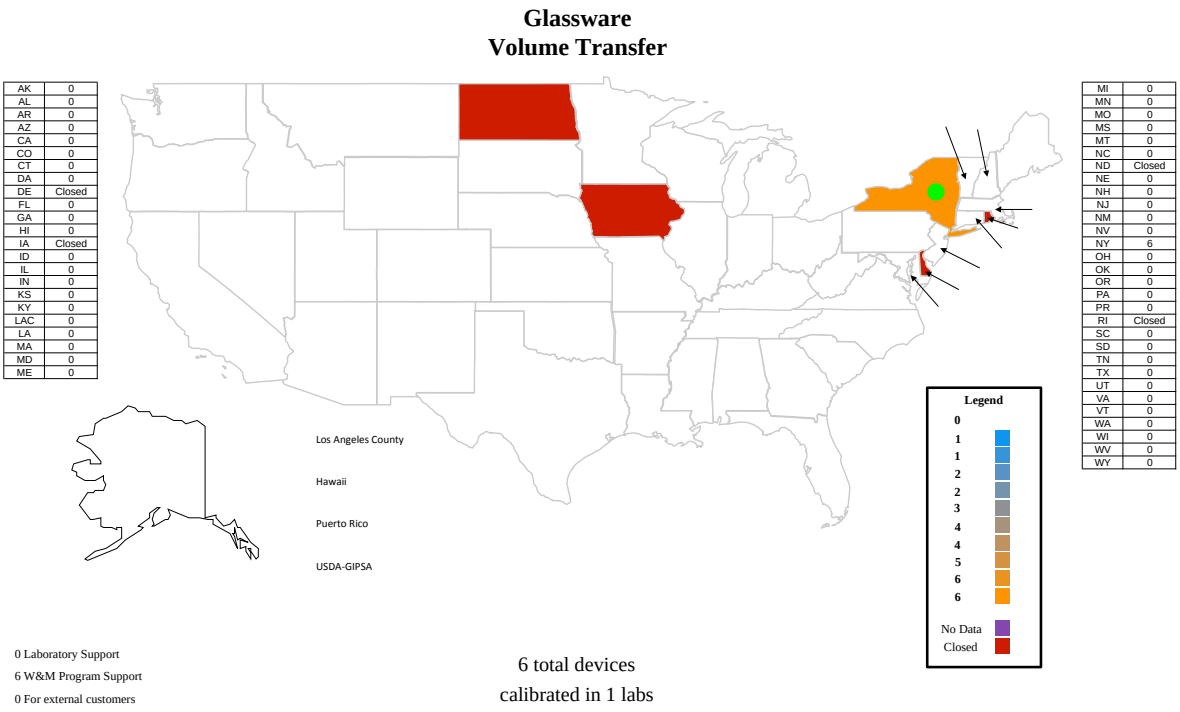
Comparison of previous surveys

Year	# Labs	Volume Transfer	Gravimetric	Total
1996	29			1,205
1998	24			844
1999	25			853
2000	27			668
2002	24			555
2004	17			332
2005	20	69	140	209
2006	18	82	172	254
2008	18	42	183	225
2010	16	43	288	331
2010	16	43	288	331
2012	8	170	78	248
2014	9	124	119	243
2016	10	6	75	81

Table 16: Glassware calibrations from previous surveys.

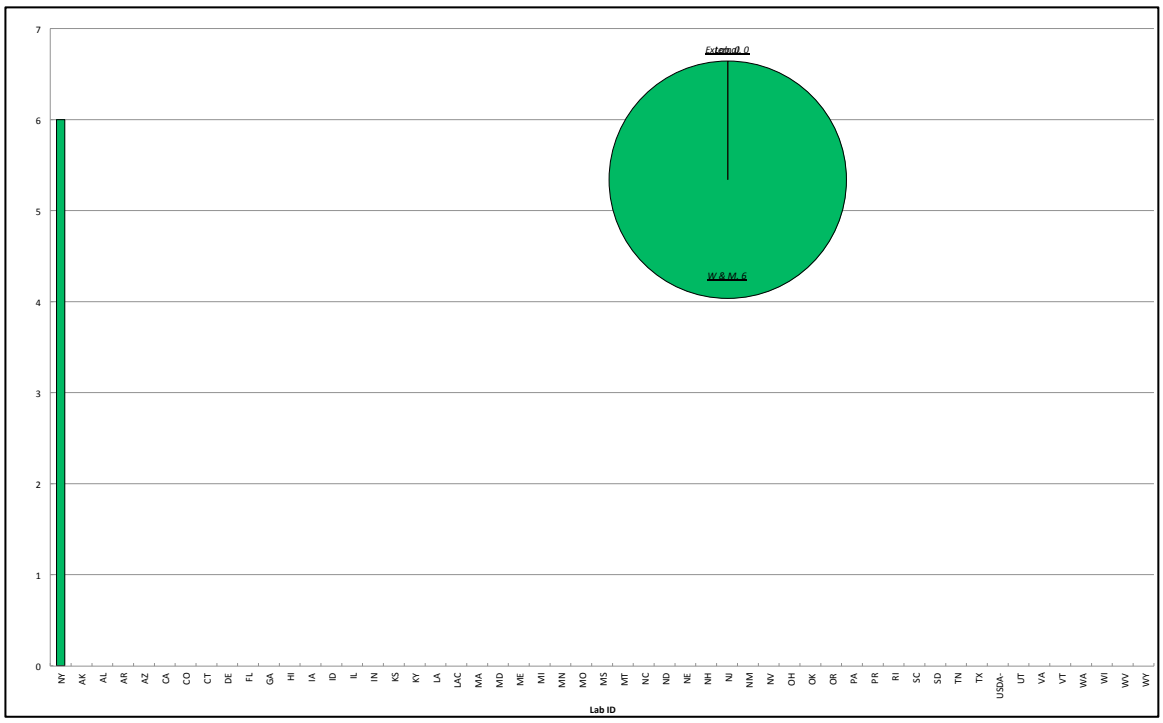
Notes and Comments

- 41 % of all glassware standards were tested for the laboratory
- 32 % of all glassware standards were tested for Weights and Measures enforcement programs.
- 27 % of all glassware standards were tested for external customers.



0 Laboratory Support
6 W&M Program Support
0 For external customers

6 total devices
calibrated in 1 labs

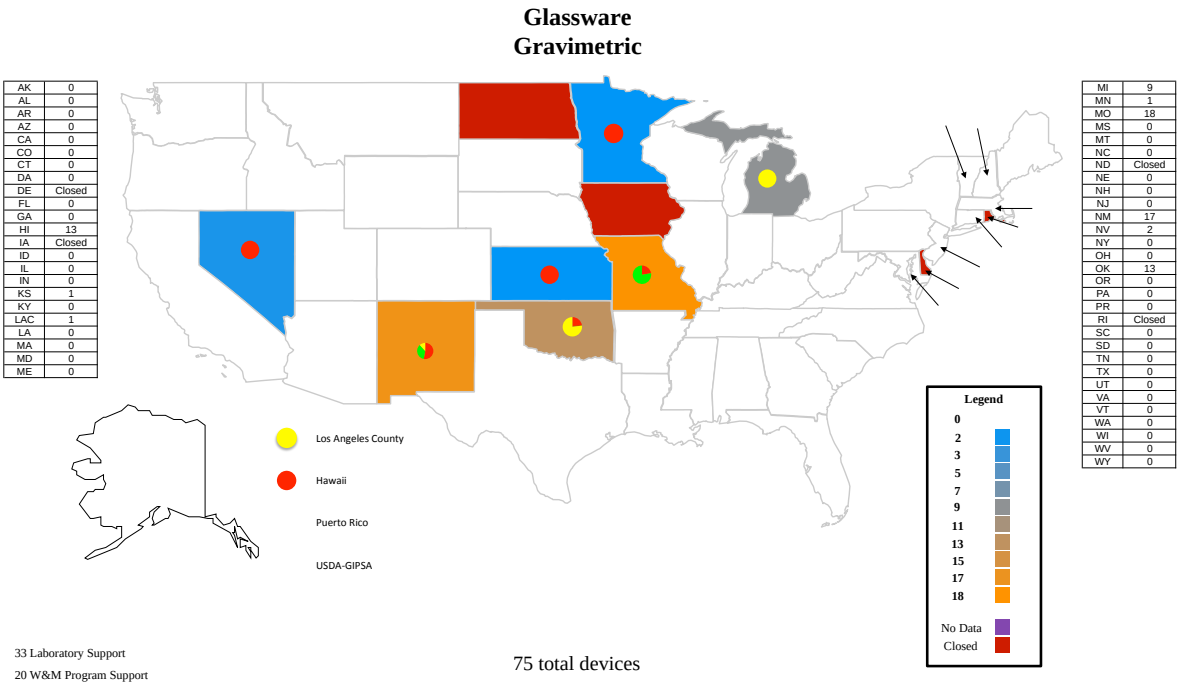


Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

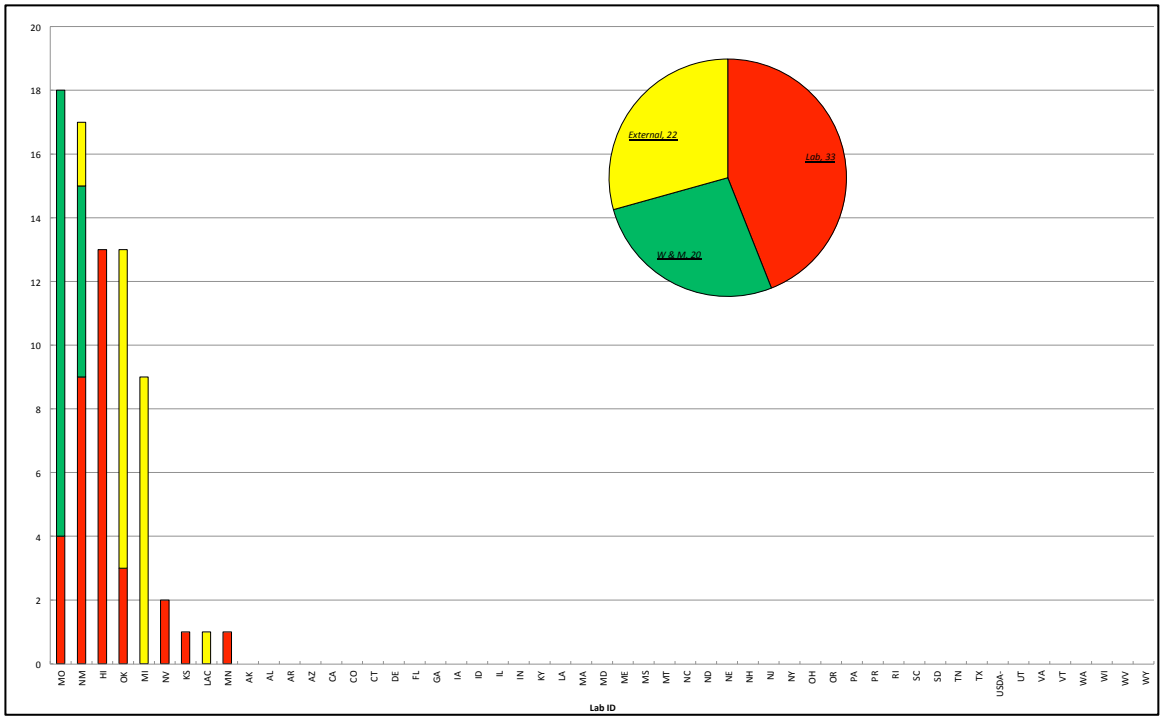
Figure 20: Glassware calibrations, volume transfer method

Gravimetric



33 Laboratory Support
20 W&M Program Support
22 For external customers

75 total devices
calibrated in 9 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 21: Glassware calibrations, gravimetric method.

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Test Measures (≤5 gallon)

Description

The graphs on the next two pages represent the total number of volume measurements performed on test measures by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 49 reporting laboratories, 46 labs performed a total of 7926 volume transfer tests.
- Of the 49 reporting laboratories, 18 labs performed a total of 84 gravimetric volume tests.

Comparison of previous surveys

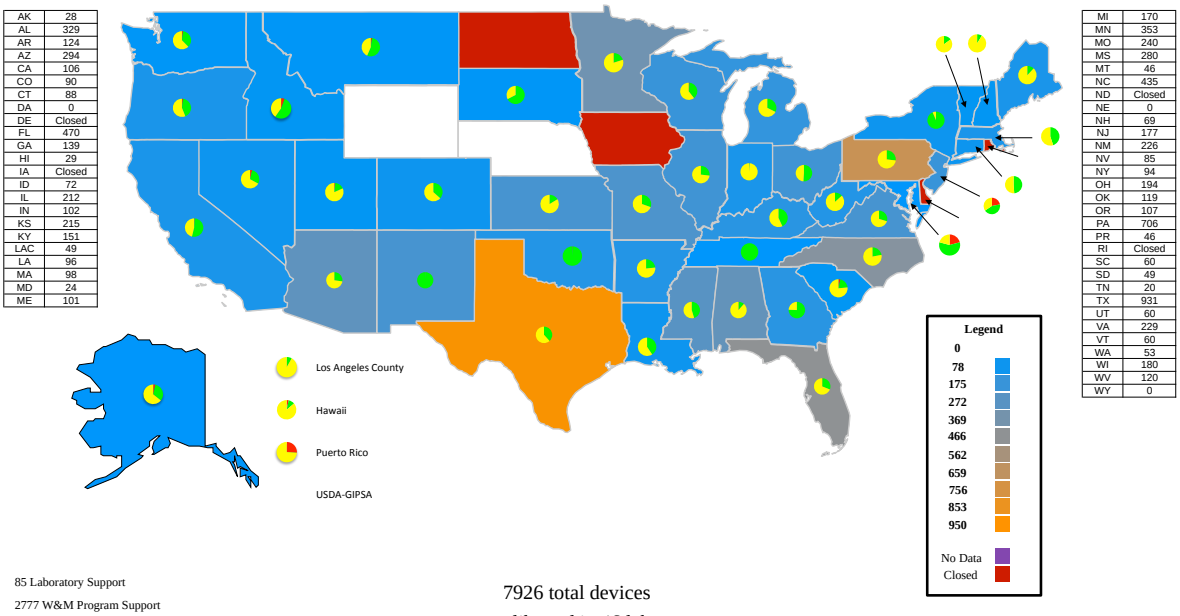
Year	# Labs	Volume Transfer	Gravimetric	Total
1996	48	8290		8290
1998	46	6861		6861
1999	45	6986		6986
2000	45	7368		7368
2002	48	6966		6966
2004	46	6400		6400
2005	42	6925	75	7000
2006	46	7532	77	7609
2008	49	7321	69	7390
2010	45	8216	73	8289
2012	46	7533	93	7626
2014	46	7863	128	7991
2016	46	7926	84	8010

Table 17: Test Measure (5 ≤ gal.) volume tests from previous surveys.

Notes and Comments

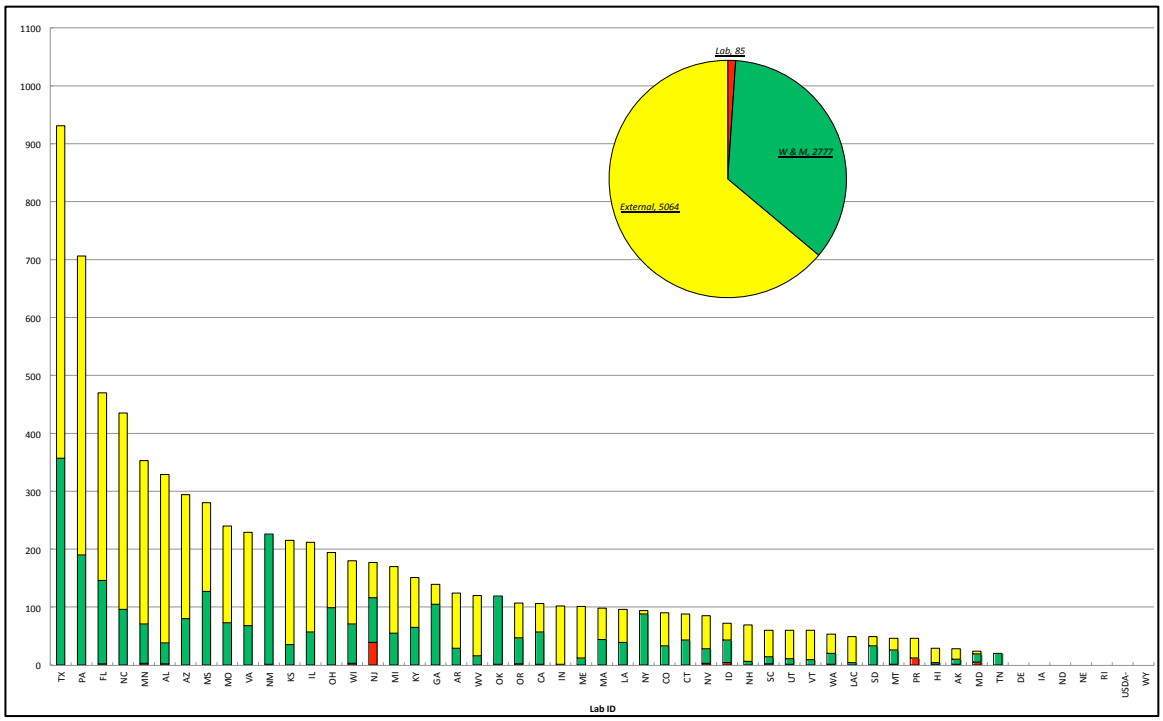
- 1 % of all test measures were tested for the laboratory
- 35 % of all test measures were tested for Weights and Measures enforcement programs.
- 64 % of all test measures were tested for external customers.

Open Neck Volumetric Test Measures (≤5 gallon)
Volume Transfer



85 Laboratory Support
2777 W&M Program Support
5064 For external customers

7926 total devices
calibrated in 46 labs

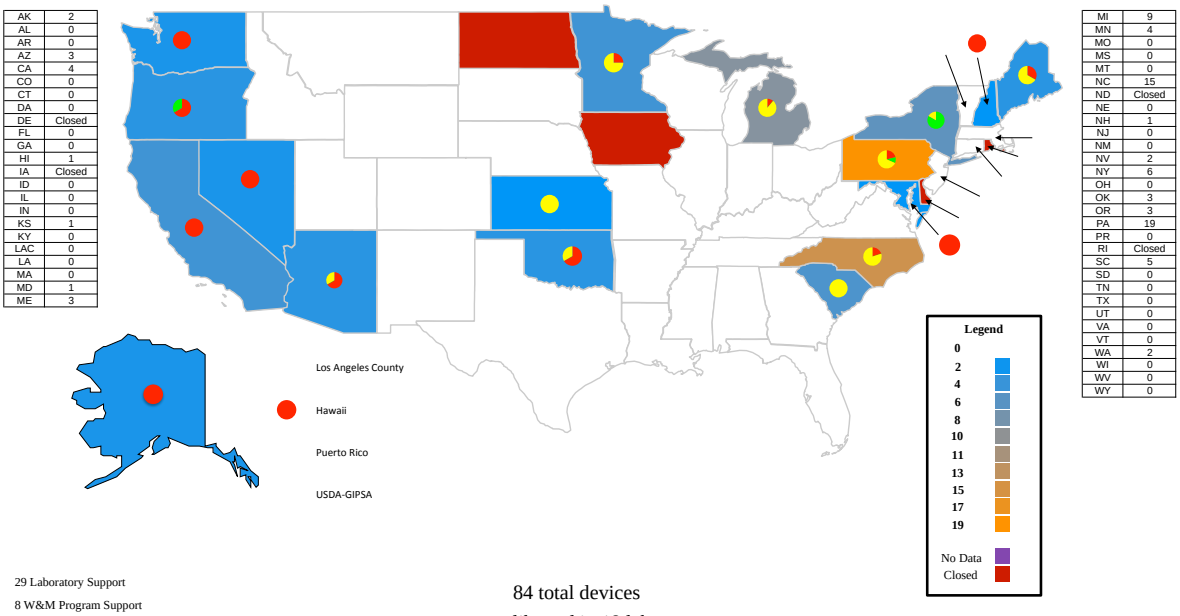


Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 22: Test Measure tests (≤5 gallon), volume transfer.

Open Neck Volumetric Test Measures (≤5 gallon)
Gravimetric



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FL	0
GA	0
HI	1
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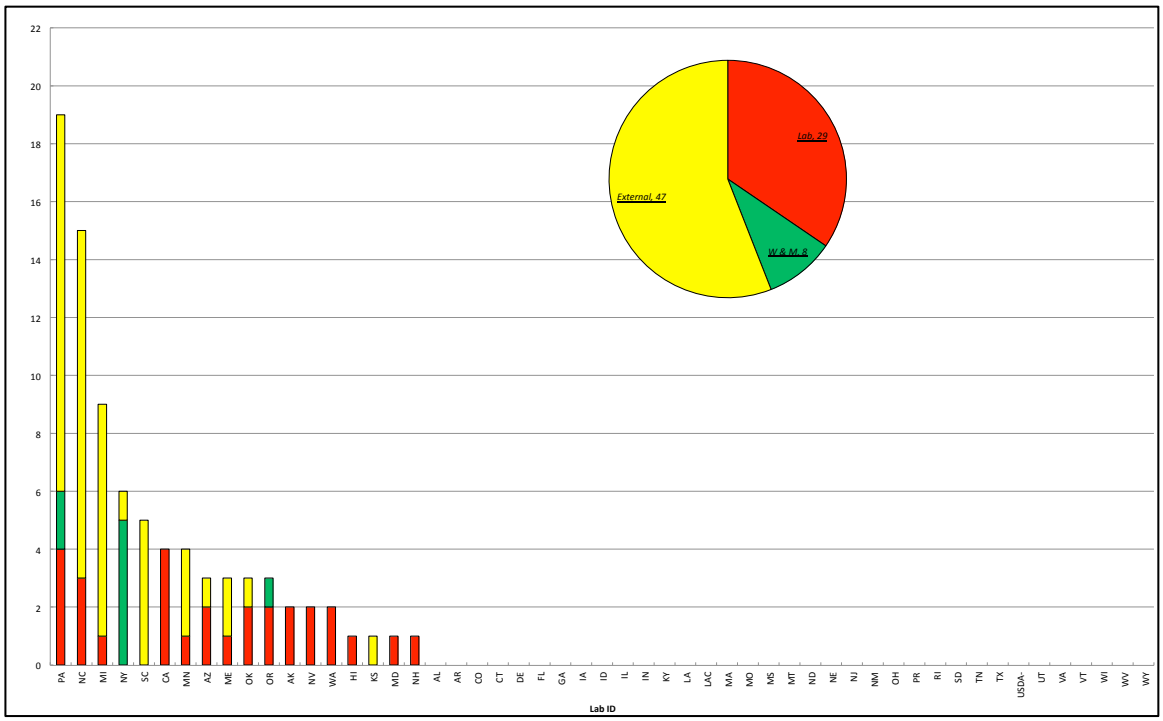
IL	0
IN	0
KS	1
KY	0
LAC	0
LA	0
MA	0
MD	1
ME	3

MI	9
MN	4
MO	0
MS	0
MT	0
NC	15
ND	Closed
NE	0
NH	1
NJ	0
NM	0
NV	2
NY	6
OH	0
OK	3
OR	3
PA	19
PR	0
RI	Closed
SC	5
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	2
WI	0
WV	0
WY	0

29 Laboratory Support
8 W&M Program Support
47 For external customers

84 total devices
calibrated in 18 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 23: Test Measure tests (≤5 gallon), gravimetric.

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Provers (> 5 gallon and ≤ 100 gallon)

Description

The graphs on the next two pages represent the total number of volume measurements performed on volumetric provers by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 49 reporting laboratories, 39 labs performed a total of 745 volume transfer tests.
- Of the 49 reporting laboratories, 11 labs performed a total of 58 gravimetric volume tests.

Comparison of previous surveys

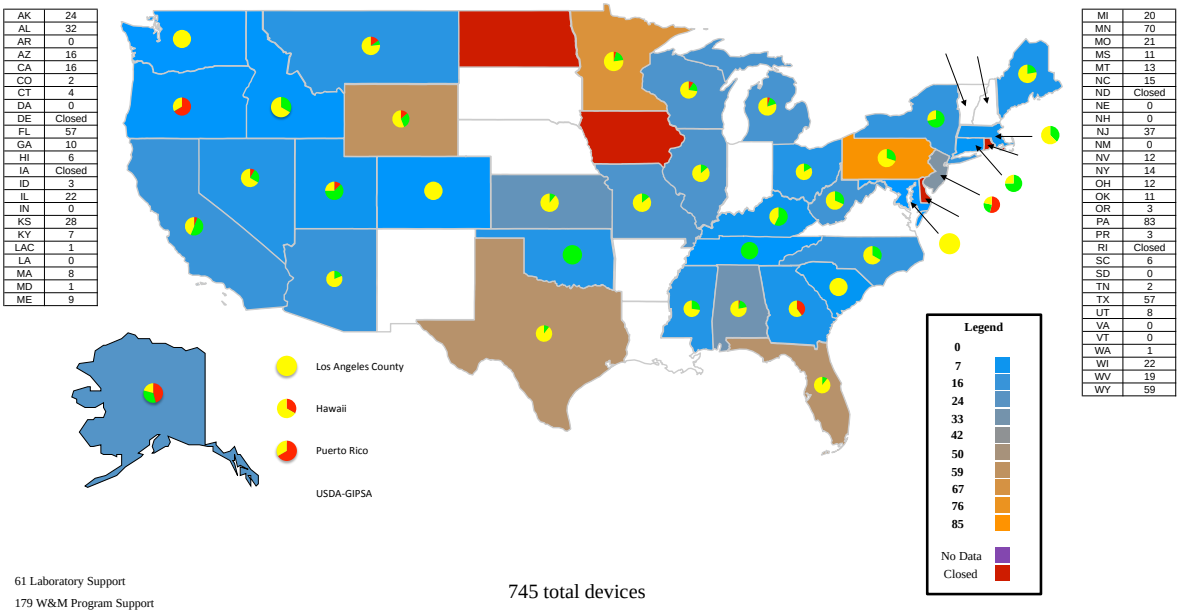
Year	# Labs	Volume Transfer	Gravimetric	Total
2005		726	47	773
2006		760	81	841
2008		737	46	783
2010	41	711	49	760
2012	39	713	31	744
2014	37	828	57	885
2016	39	745	58	803

Table 18: Provers (>5 gal. and ≤ 100 gal.) volume tests from previous surveys.

Notes and Comments

- 11 % of all provers (> 5 gal. and ≤ 100 gal.) were tested for the laboratory
- 23 % of all provers (> 5 gal. and ≤ 100 gal.) were tested for Weights and Measures enforcement programs.
- 66 % of all provers (> 5 gal. and ≤ 100 gal.) were tested for external customers.

Open Neck Volumetric Provers (>5 gallon and ≤100 gallon)
Volume Transfer

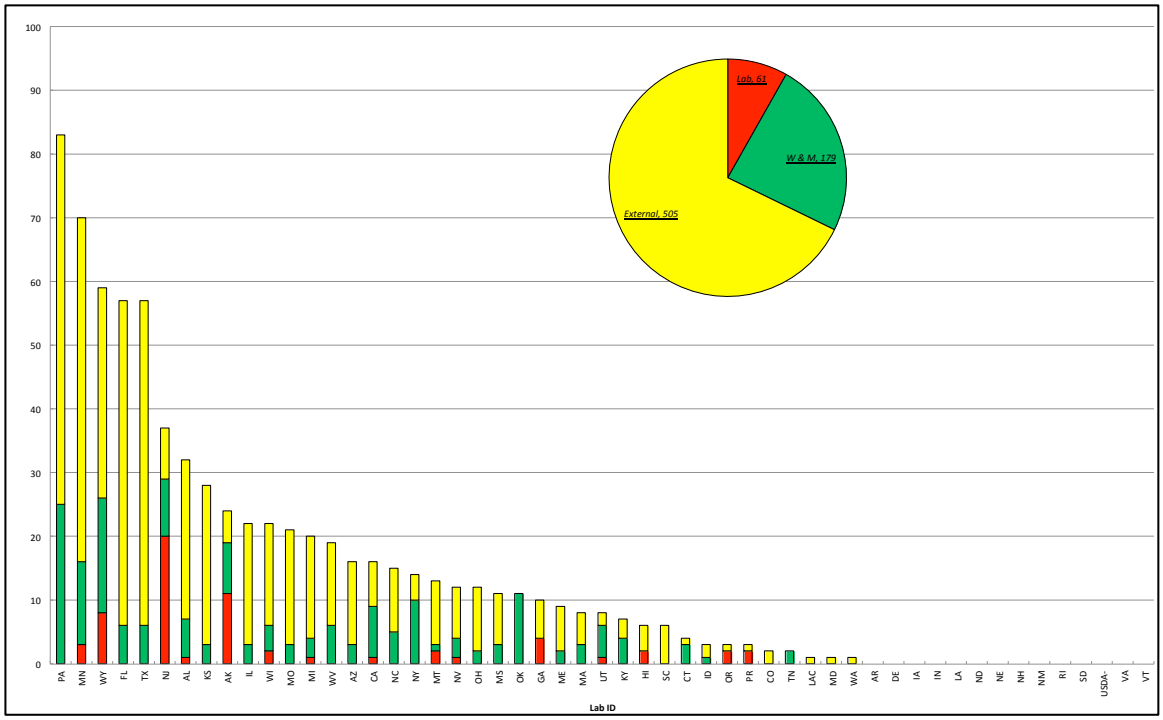


AK	24
AL	32
AR	0
AZ	16
CA	16
CO	2
CT	4
DA	0
DE	Closed
FL	57
GA	10
HI	6
IA	Closed
ID	3
IL	22
IN	0
KS	28
KY	7
LAC	1
LA	0
MA	8
MD	1
ME	9

MI	20
MN	70
MO	21
MS	11
MT	13
NC	15
ND	Closed
NE	0
NH	0
NJ	37
NM	0
NV	12
NY	14
OH	12
OK	11
OR	3
PA	83
PR	3
RI	Closed
SC	6
SD	0
TN	2
TX	57
UT	8
VA	0
VT	0
WA	1
WI	22
WV	19
WY	59

61 Laboratory Support
179 W&M Program Support
505 For external customers

745 total devices
calibrated in 39 labs



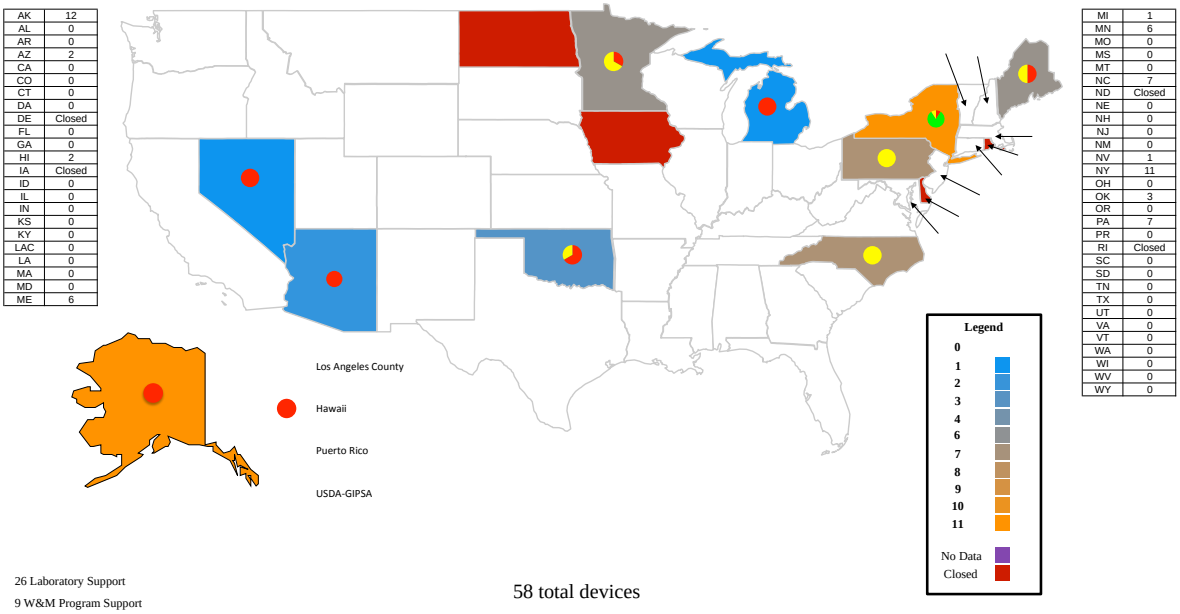
Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 24: Prover (≥5 gal. and < 100 gal.) tests, volume transfer.

Open Neck Volumetric Provers (>5 gallon and ≤100 gallon)
Gravimetric

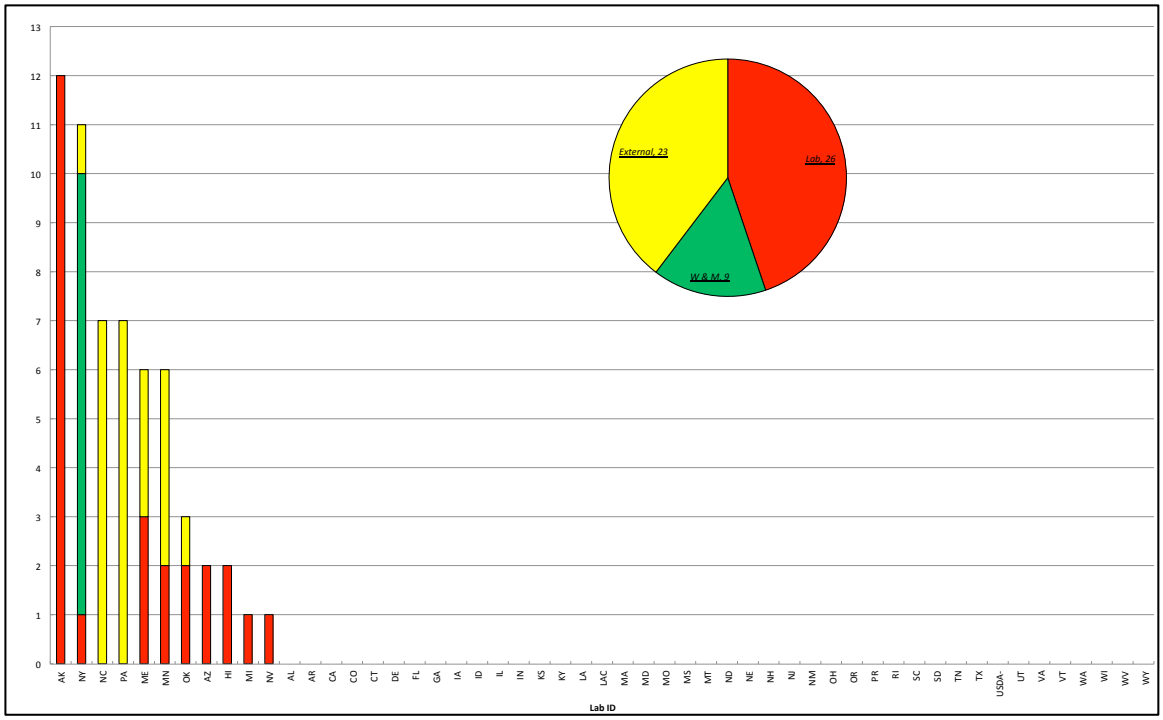
AK	12
AL	0
AR	0
AZ	2
CA	0
CO	0
CT	0
DA	0
DE	Closed
FL	0
GA	0
HI	2
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	6



MI	1
MN	6
MO	0
MS	0
MT	0
NC	7
ND	Closed
NE	0
NH	0
NJ	0
NM	0
NV	1
NY	11
OH	0
OK	3
OR	0
PA	7
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	0
WI	0
WV	0
WY	0

26 Laboratory Support
9 W&M Program Support
23 For external customers

58 total devices
calibrated in 11 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 25: Prover (≥5 gal. and < 100 gal.) tests, gravimetric.

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Provers (> 100 gallon)

Description

The graphs on the next two pages represent the total number of volume measurements performed on volumetric provers by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 49 reporting laboratories, 30 labs performed a total of 275 volume transfer tests.
- Of the 49 reporting laboratories, 1 lab performed 3 gravimetric volume tests.

Comparison of previous surveys

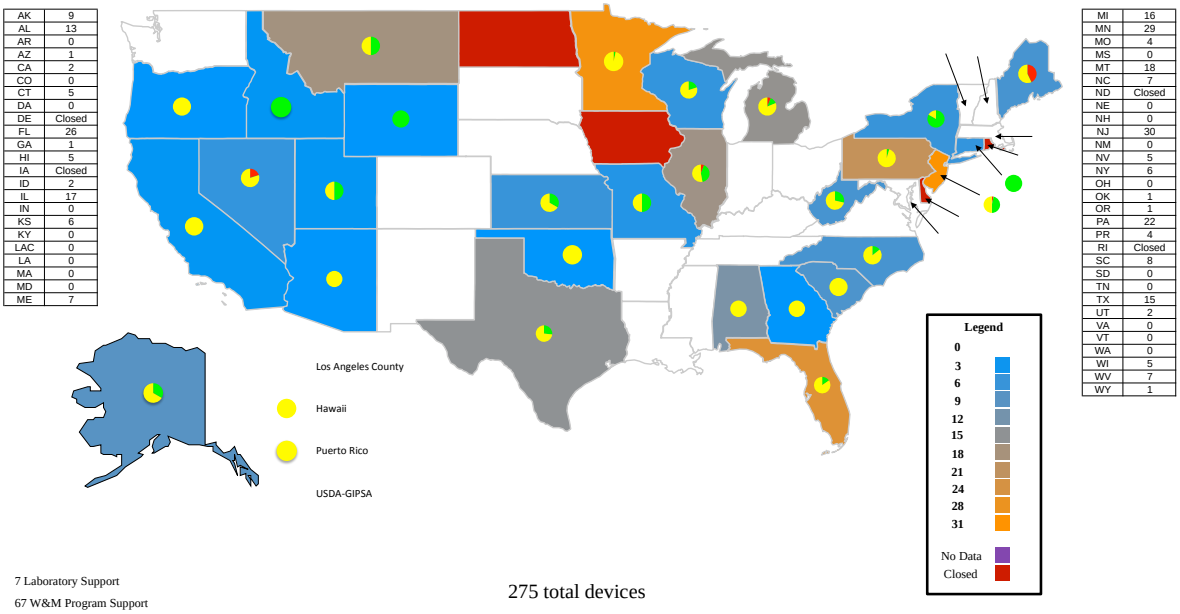
Year	# Labs	Volume Transfer	Gravimetric	Total
2005		201	1	202
2006		202	0	202
2008	34	284	0	284
2010	33	287	0	287
2012	30	237	1	238
2014	30	239	1	240
2016	30	275	3	278

Table 19: Provers (> 100 gal.) tests from previous surveys.

Notes and Comments

- 3 % of all provers (> 100 gal.) were tested for the laboratory.
- 24 % of all provers (> 100 gal.) were tested for Weights and Measures enforcement programs.
- 73 % of all provers (> 100 gal.) were tested for external customers.

Open Neck Volumetric Provers (>100 gallon)
Volume Transfer

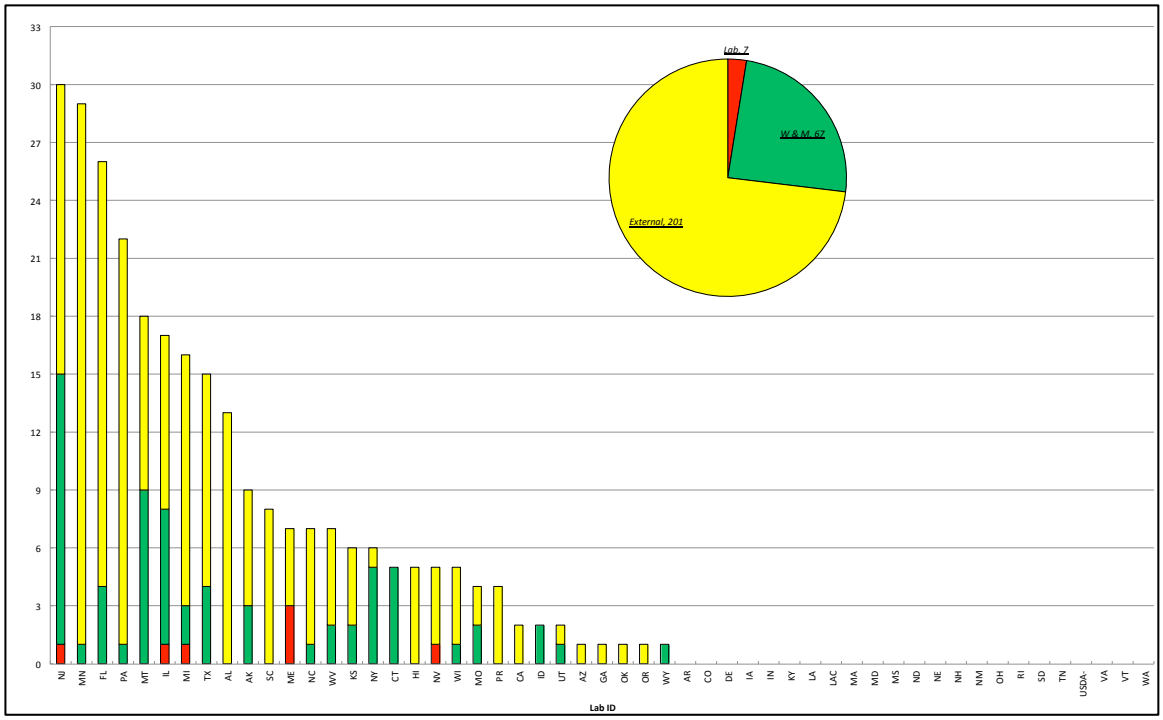


AK	9
AL	13
AR	0
AZ	1
CA	2
CO	0
CT	5
DA	0
DE	Closed
FL	26
GA	1
HI	5
IA	Closed
ID	2
IL	17
IN	0
KS	6
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	7

MI	16
MN	29
MO	4
MS	0
MT	18
NC	7
ND	Closed
NE	0
NH	0
NJ	30
NM	0
NV	5
NY	6
OH	0
OK	1
OR	1
PA	22
PR	4
RI	Closed
SC	8
SD	0
TN	0
TX	15
UT	2
VA	0
VT	0
WA	0
WI	5
WV	7
WY	1

7 Laboratory Support
67 W&M Program Support
201 For external customers

275 total devices
calibrated in 30 labs



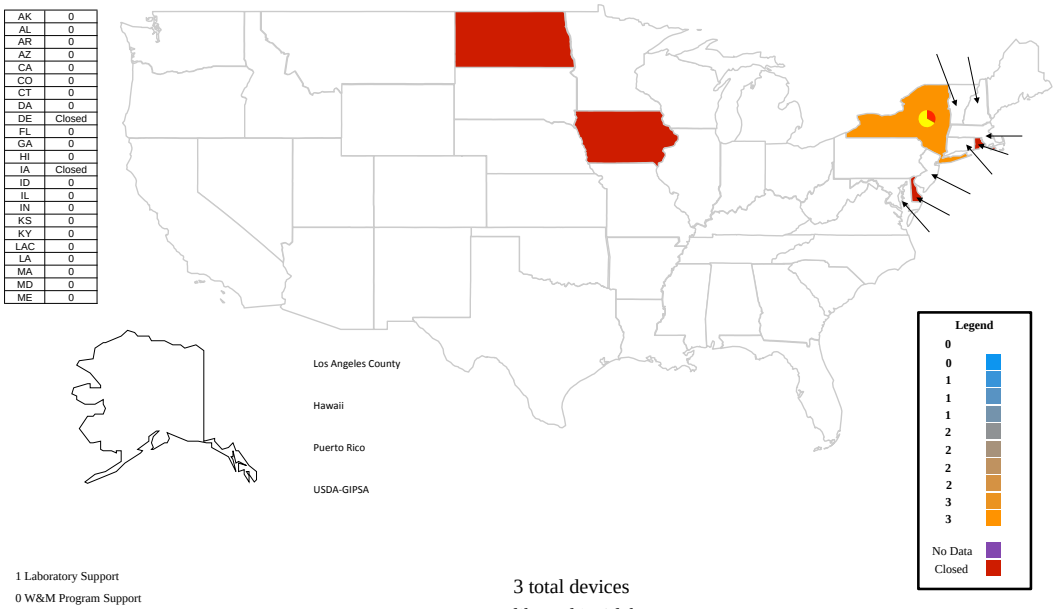
Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 26: Prover (>100 gal.) tests, volume transfer

Open Neck Volumetric Provers (>100 gallon)
Gravimetric

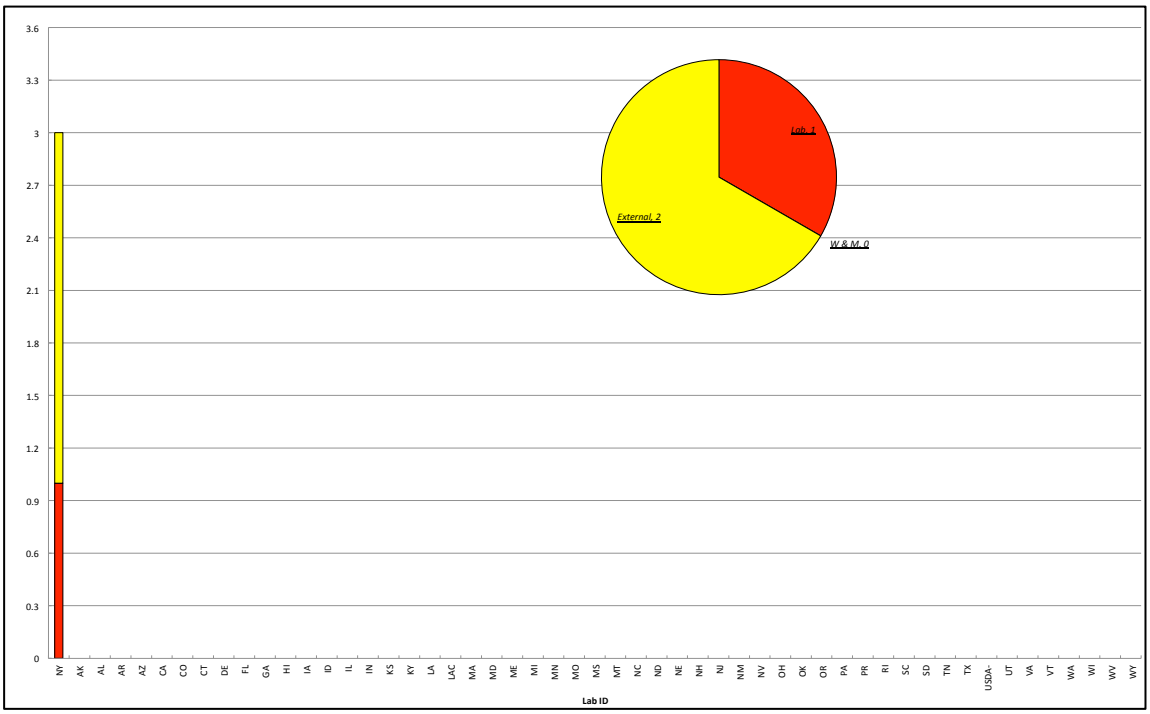
AK	0
AL	0
AR	0
AZ	0
CA	0
CO	0
CT	0
DA	0
DE	Closed
FL	0
GA	0
HI	0
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0



MI	0
MN	0
MO	0
MS	0
MT	0
NC	0
ND	Closed
NE	0
NH	0
NJ	0
NM	0
NV	0
NY	3
OH	0
OK	0
OR	0
PA	0
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	0
WI	0
WV	0
WY	0

1 Laboratory Support
0 W&M Program Support
2 For external customers

3 total devices
calibrated in 1 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 27: Prover (>100 gal.) tests, gravimetric

Liquefied Petroleum Gas (LPG) Provers

Description

The graphs on the next two pages represent the total number of measurements performed on LPG provers by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 49 reporting laboratories, 25 labs performed a total of 253 volume transfer tests.

Comparison of previous surveys

Year	# Labs	Volume Transfer
2005		226
2006		239
2008	27	249
2010	33	304
2012	24	228
2014	25	231
2016	25	253

Table 20: LPG Prover volume tests from previous surveys[5].

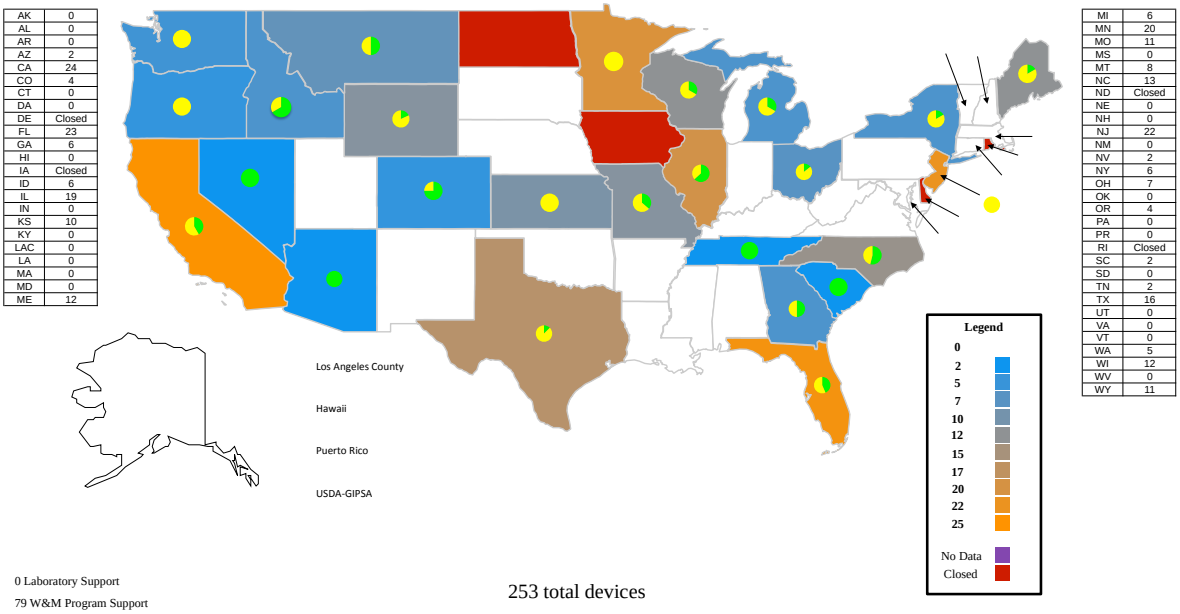
Notes and Comments

- 0 % of all LPG provers were tested for the laboratory.
- 31 % of all LPG provers were tested for Weights and Measures enforcement programs.
- 69 % of all LPG provers were tested for external customers.

[5] Prior editions of the survey included a survey of gravimetric testing of LPG style provers. This question was deleted in the 2016 edition. Laboratories have consistently reported performing no such measurements.

Liquid Propane Gas (LPG) Provers
Volume Transfer

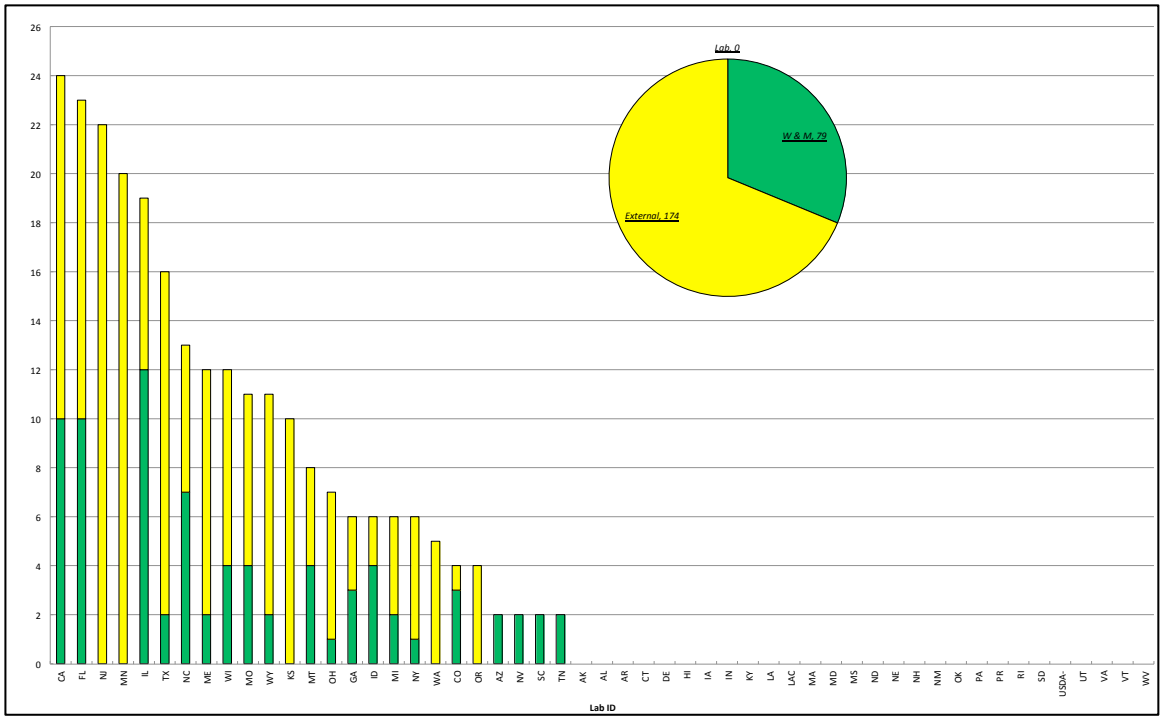
AK	0
AL	0
AR	0
AZ	2
CA	24
CO	4
CT	0
DA	0
DE	Closed
FL	23
GA	6
HI	0
IA	Closed
ID	6
IL	19
IN	0
KS	10
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	12



MI	6
MN	20
MO	11
MS	0
MT	8
NC	13
ND	Closed
NE	0
NH	0
NJ	22
NM	0
NV	2
NY	6
OH	7
OK	0
OR	4
PA	0
PR	0
RI	Closed
SC	2
SD	0
TN	2
TX	16
UT	0
VA	0
VT	0
WA	5
WI	12
WV	0
WY	11

0 Laboratory Support
79 W&M Program Support
174 For external customers

253 total devices
calibrated in 25 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 28: LPG Prover tests,volume transfer

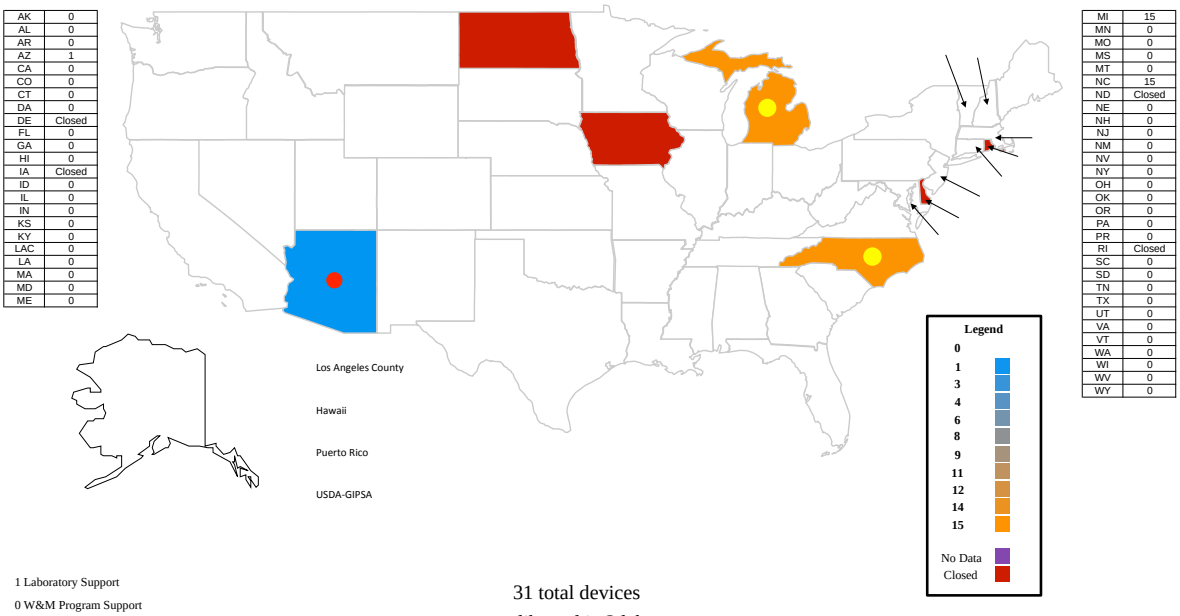
Findings

The graphs on the next pages represent the total number of volume measurements performed on dynamic small volume provers by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

Year	# Labs	Gravimetric	Volume Transfer	Total
2005		11	0	11
2006		20	0	20
2008	3	16	11	27 [MI,NC,VT]
2010	2	30	0	30 [MI,NC]
2012	3	57	0	57
2014	4	32	3	35
2016	3	31	0	31[AZ,MI,NC]

Table 21: SVP tests from previous surveys.

Small Volume Provers (SVP)
Gravimetric

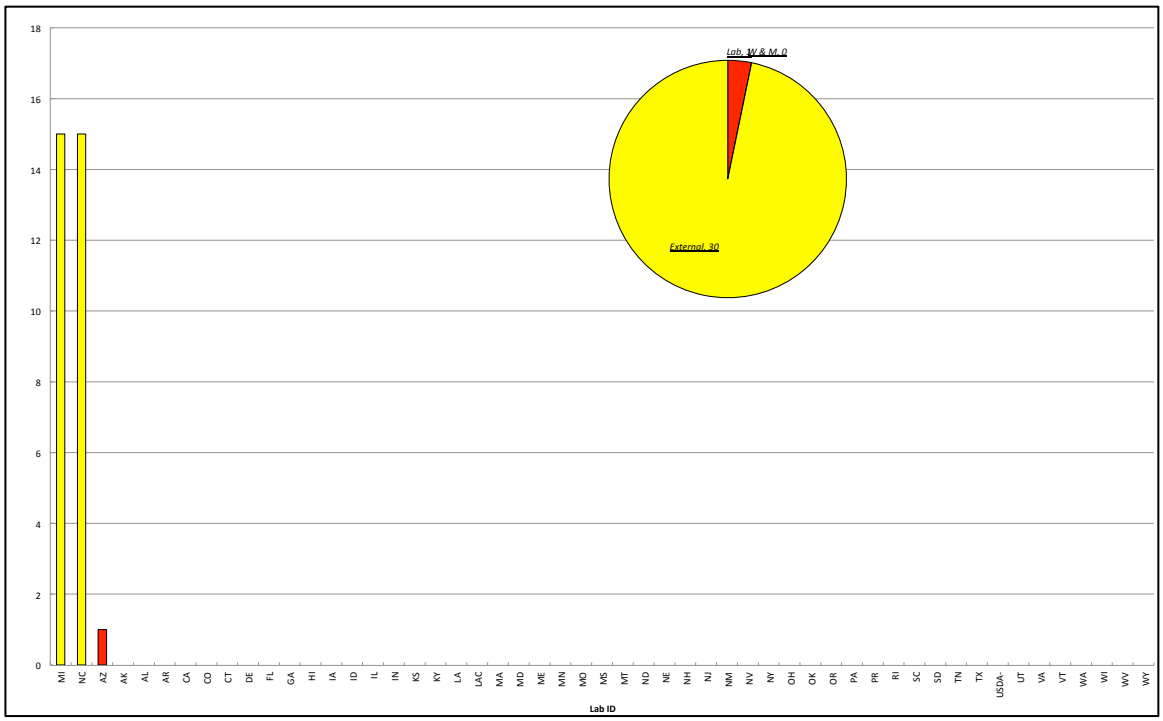


AK	0
AL	0
AR	0
AZ	1
CA	0
CO	0
CT	0
DA	0
DE	Closed
FL	0
GA	0
HI	0
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0

MI	15
MN	0
MO	0
MS	0
MT	0
NC	15
ND	Closed
NE	0
NH	0
NJ	0
NM	0
NV	0
NY	0
OH	0
OK	0
OR	0
PA	0
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	0
WI	0
WV	0
WY	0

1 Laboratory Support
0 W&M Program Support
30 For external customers

31 total devices
calibrated in 3 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 29: Small Volume Prover tests,gravimetric.

Temperature

Description

The graphs on the next page represent the total number of measurements performed on temperature sensing devices by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 6 labs tested a total of 242 temperature standards

Comparison of previous surveys

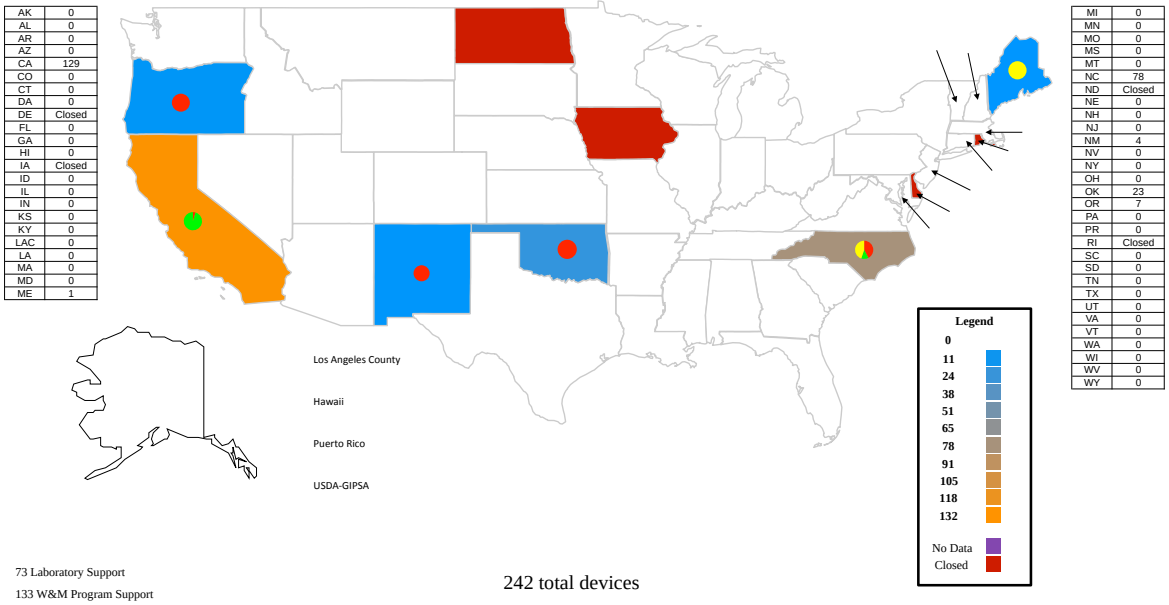
Year	# Labs	Total Devices
1996	20	447
1998	11	378
1999	12	514
2000	16	460
2002	13	456
2004	12	315
2005	15	418
2006	12	281
2008	13	498
2010	11	465
2012	7	191
2014	6	192
2016	6	242

Table 22: Temperature standard tests from previous surveys.

Notes and Comments

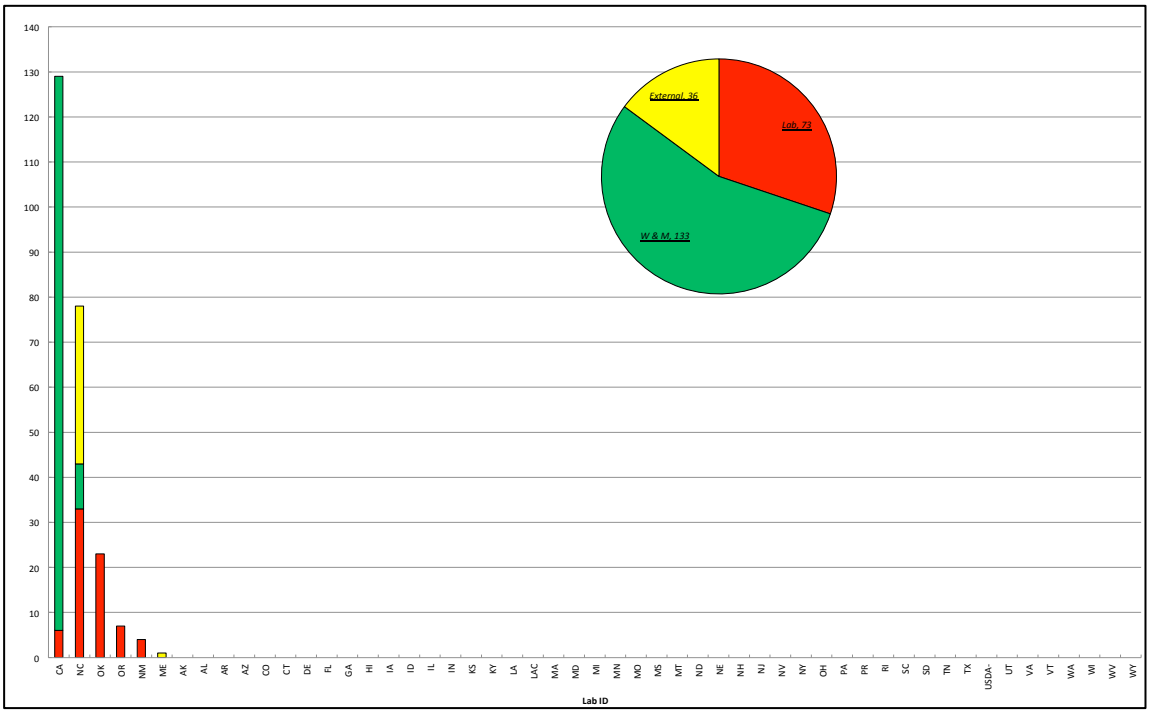
- 30 % of all temperature standards were tested for internal use by the laboratory.
- 55 % of all temperature standards were tested for the weight and measures program.
- 15 % of all temperature standards were tested for external customers.

Temperature



73 Laboratory Support
133 W&M Program Support
36 For external customers

242 total devices
calibrated in 6 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 30: Temperature standard tests.

Frequency

Description

The graphs on the next page represent the total number of measurements performed on frequency standards by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 4 labs tested a total of 14,501 frequency standards

Comparison of previous surveys

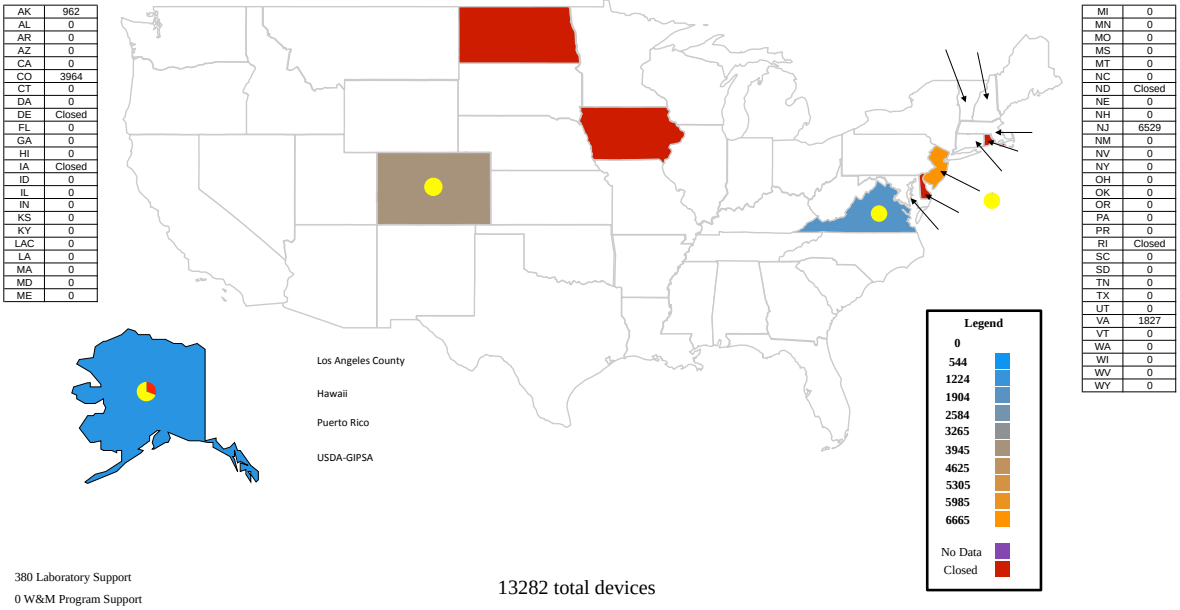
Year	# Labs	Total Devices
1996	6	12,518
1998	4	11,561
1999	5	13,518
2000	7	14,670
2002	6	13,785
2004	3	14,772
2005	4	15,162
2006	4	14,832
2008	4	15,058
2010	4	17,580
2012	4	14,177
2014	4	13,282
2016	4	14,501

Table 23 Frequency standard tests from previous surveys.

Notes and Comments

- 3 % of all frequency standards were tested for internal use by the laboratory.
- 0 % of all frequency standards were tested for the weight and measures program.
- 97 % of all frequency standards were tested for external customers.

Frequency

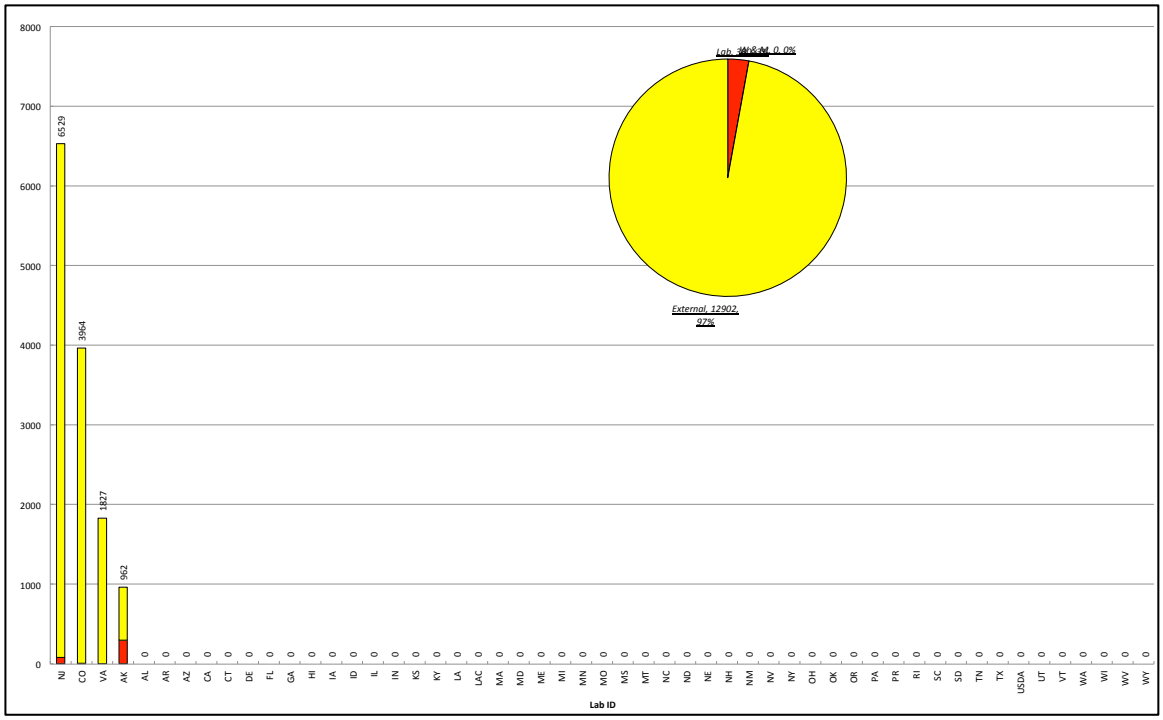


AK	962
AL	0
AR	0
AZ	0
CA	0
CO	3964
CT	0
DA	0
DE	Closed
FL	0
GA	0
HI	0
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0

MI	0
MN	0
MO	0
MS	0
MT	0
NC	0
ND	Closed
NE	0
NH	0
NJ	6529
NM	0
NV	0
NY	0
OH	0
OK	0
OR	0
PA	0
PR	0
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	1827
VT	0
WA	0
WI	0
WV	0
WY	0

380 Laboratory Support
0 W&M Program Support
12902 For external customers

13282 total devices
calibrated in 4 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 31 Frequency standard tests

Timing Devices

Description

The graphs on the next page represent the total number of measurements performed on timing devices by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 8 labs tested a total of 506 timing devices

Comparison of previous surveys

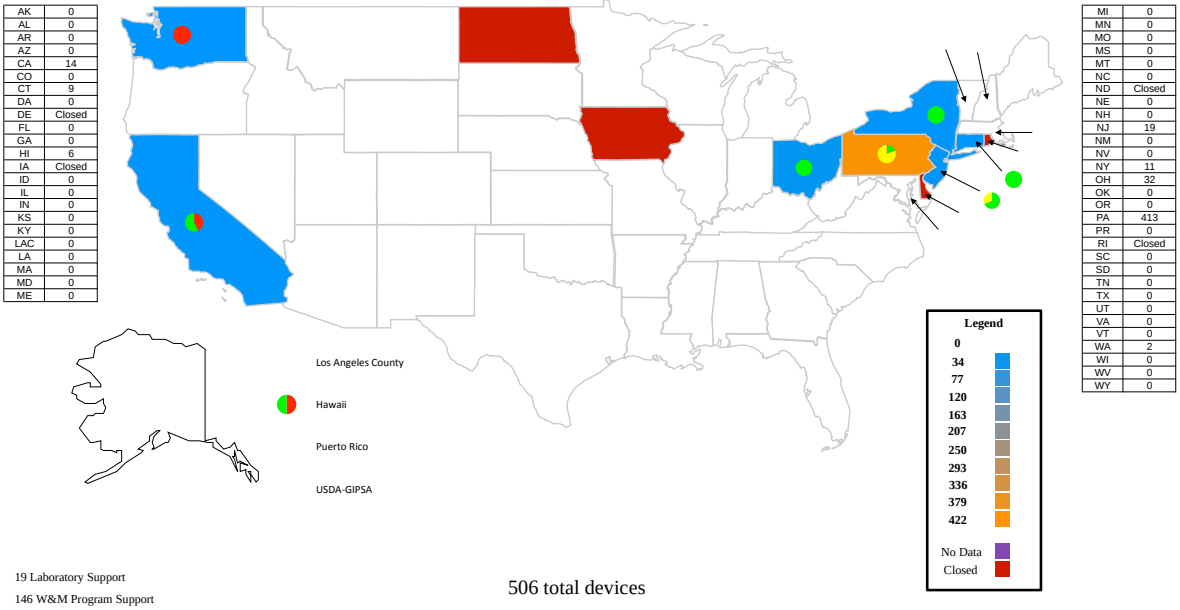
Year	# Labs	Total Devices
1996	13	161
1998	11	380
1999	14	451
2000	13	554
2002	11	479
2004	9	951
2005	8	387
2006	11	365
2008	11	401
2010	9	339
2012	10	577
2014	7	600
2016	8	506

Table 24: Timing devices tests from previous surveys

Notes and Comments

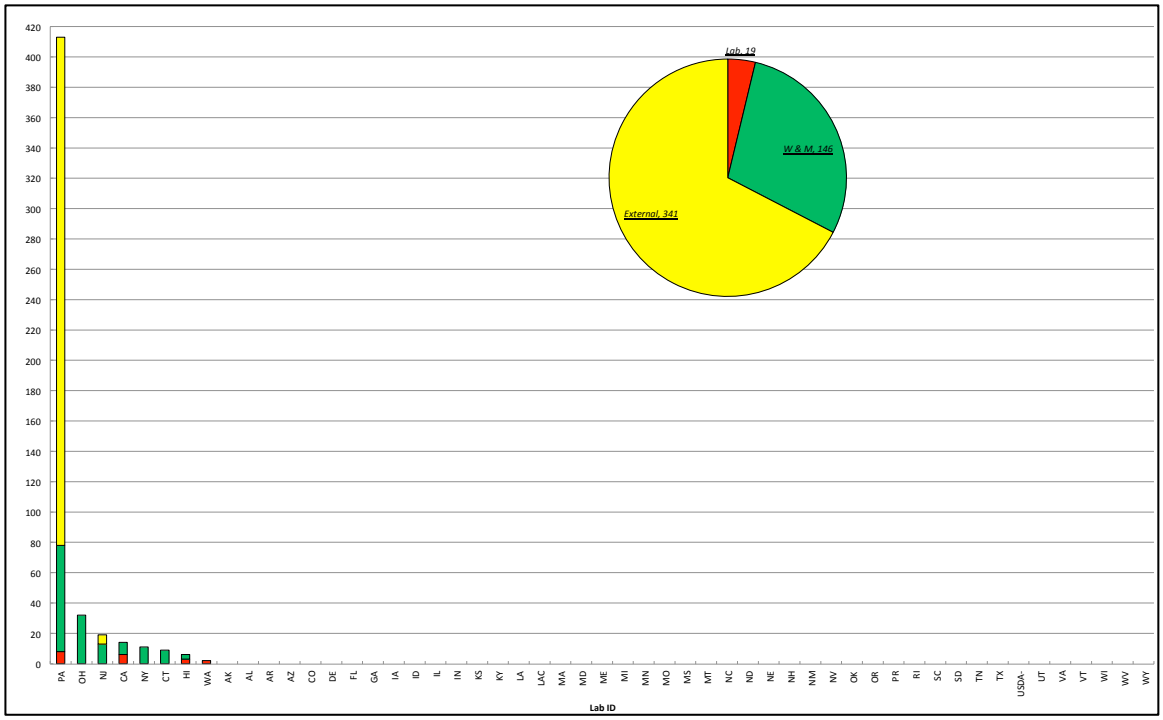
- 4 % of all timing devices were tested for internal use by the laboratory.
- 29 % of all timing devices were tested for the weight and measures program.
- 67 % of all timing devices were tested for external customers.

Timing Devices



19 Laboratory Support
146 W&M Program Support
341 For external customers

506 total devices
calibrated in 8 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 32 Timing device tests

Wheel Load Weighers

Description

The graphs on the next page represent the total number of measurements performed on wheel load weighers by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 14 labs tested a total of 6,541 wheel load weighers.

Comparison of previous surveys

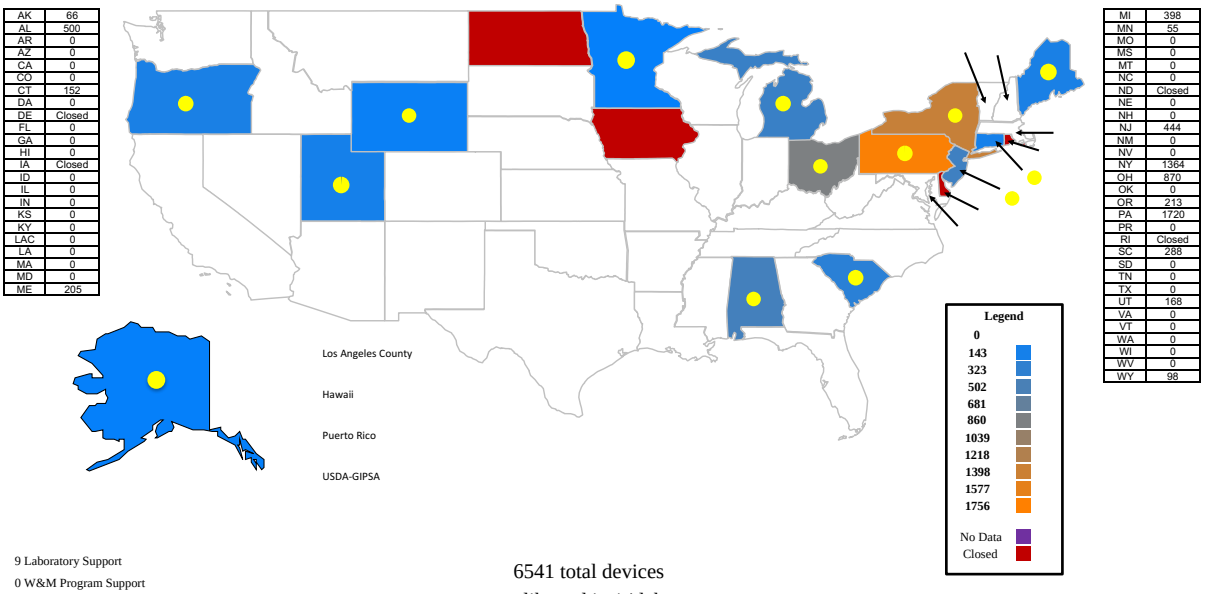
Year	# Labs	Total Devices
1998	19	12,178
1999	20	12,781
2000	22	13,699
2002	23	10,350
2004	21	10,884
2005	19	9,748
2006	20	10,567
2008	22	10,191
2010	20	10,815
2012	17	7,050
2014	16	6,515
2016	14	6,541

Table 25: Wheel load weigher tests from previous surveys

Notes and Comments

- < 1 % of all wheel load weighers were tested for internal use by the laboratory.
- 0 % of all wheel load weighers were tested for the weight and measures program.
- > 99 % of all wheel load weighers were tested for external customers.

Wheel Load Weighers

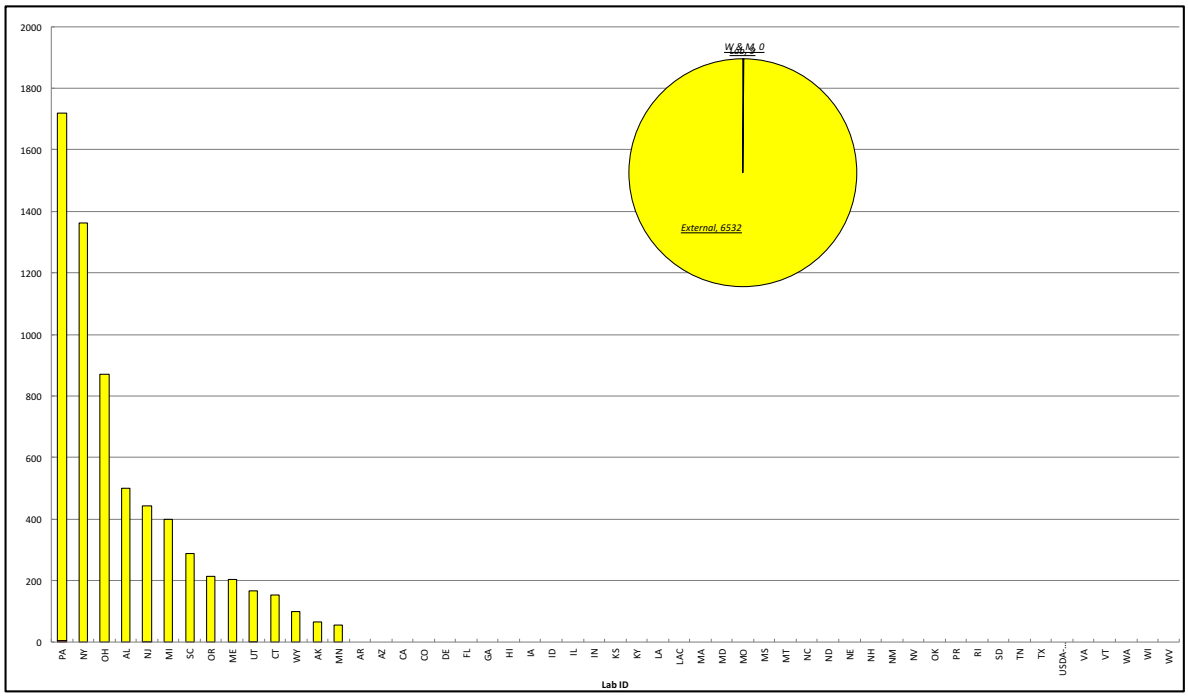


AK	66
AL	500
AR	0
AZ	0
CA	0
CO	0
CT	152
DA	0
DE	Closed
FL	0
GA	0
HI	0
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	205

MI	398
MN	55
MO	0
MS	0
MT	0
NC	0
ND	Closed
NE	0
NH	0
NJ	444
NM	0
NV	0
NY	1364
OH	870
OK	0
OR	213
PA	1720
PR	0
RI	Closed
SC	288
SD	0
TN	0
TX	0
UT	168
VA	0
VT	0
WA	0
WI	0
WV	0
WY	98

9 Laboratory Support
0 W&M Program Support
6532 For external customers

6541 total devices
calibrated in 14 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 33: Wheel load weigher tests

Lottery Balls

Description

The graphs on the next page represent the total number of measurements performed on lottery balls by the 49 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 49 reporting laboratories, 6 labs tested a total of 80,946 lottery balls

Comparison of previous surveys

Year	# Labs	Total Devices
1999	9	19,982
2000	13	24,702
2002	11	35,818
2004	11	40,939
2005	9	47,920
2006	9	41,068
2008	10	42,553
2010	8	46,515
2012	7	13,924[6]
2014	8	40,899
2016	6	80,946[7]

Table 26: Lottery balls tests from previous surveys

Notes and Comments

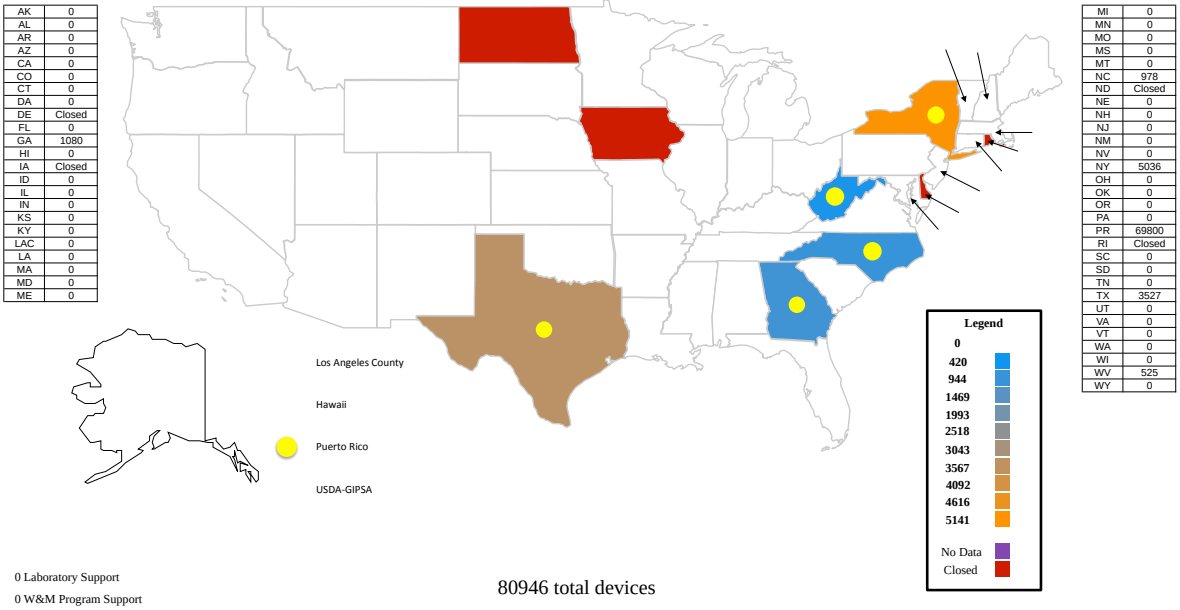
- 0 % of all lottery balls were tested for internal use by the laboratory.
- 0 % of all lottery balls were tested for the weight and measures program.
- 100 % of all lottery balls were tested for external customers.

The Puerto Rico metrology laboratory, which performs 65 % (approximately 30,000) of the total number of lottery balls tests, did not report in 2012.

[6] The metrology laboratory in Puerto Rico, which normally performs approximately 30,000 of the total number of lottery balls tests, did not submit survey responses in 2012.

[7] The metrology laboratory in Puerto Rico, which performs approximately 30,000 of the total number of lottery balls tests, reported 69,800 in 2016.

Lottery Balls

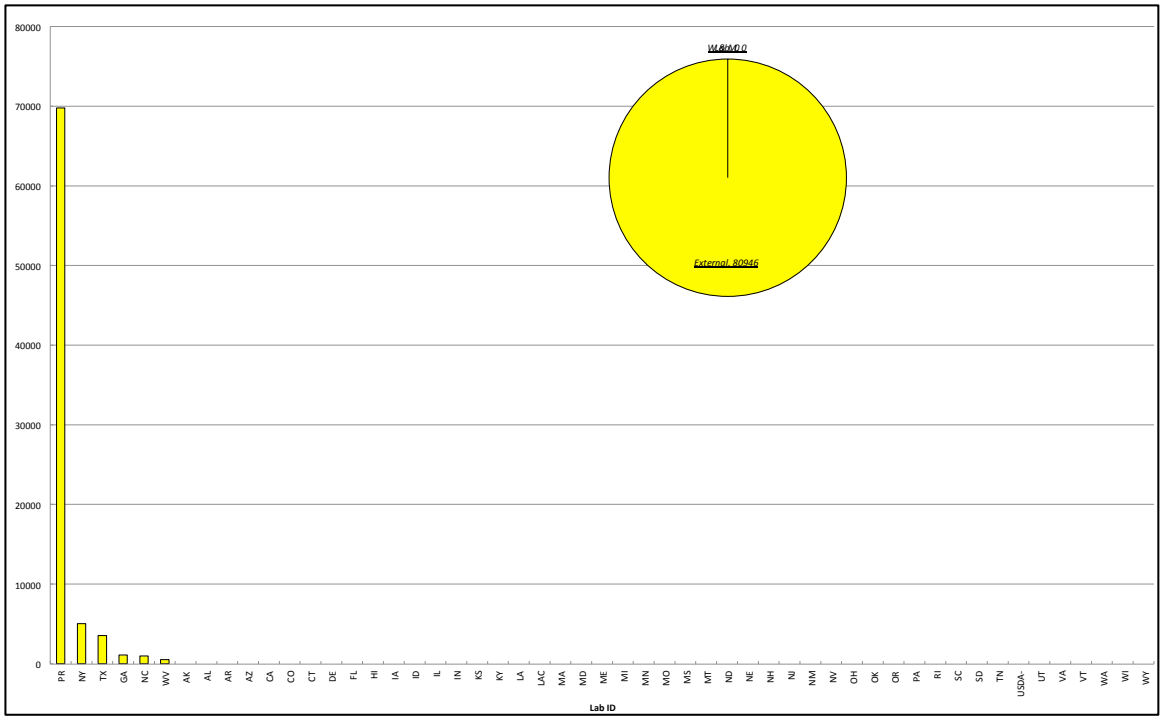


AK	0
AL	0
AR	0
AZ	0
CA	0
CO	0
CT	0
DA	0
DE	Closed
FL	0
GA	1080
HI	0
IA	Closed
ID	0
IL	0
IN	0
KS	0
KY	0
LAC	0
LA	0
MA	0
MD	0
ME	0

MI	0
MN	0
MO	0
MS	0
MT	0
NC	978
ND	Closed
NE	0
NH	0
NJ	0
NM	0
NV	0
NY	5036
OH	0
OK	0
OR	0
PA	0
PR	69800
RI	Closed
SC	0
SD	0
TN	0
TX	3527
UT	0
VA	0
VT	0
WA	0
WI	0
WV	525
WY	0

0 Laboratory Support
0 W&M Program Support
80946 For external customers

80946 total devices
calibrated in 6 labs



Bar and pie chart color codes

- Laboratory
- Weights and Measures
- External

Figure 34 Lottery Ball tests

Summary Other Tests

The category of "Other Tests" is included to give each of the SLP laboratories an opportunity to report calibration work done on devices that did not fit into any of the other categories in the survey. This should not be considered to be an exhaustive list as it was up to each laboratory to determine which tests were worth including in the workload survey and survey allowed for only 3 additional responses per laboratory surveyed.

Lab ID	Description	Lab	W&M	External	Total
AK	Watt Hour Meters (Witness)	0	0	2	2
AK	LIDARS for law enforcement speed detection	0	0	83	83
AZ	Master Meters	0	0	34	34
CA	AC Energy, watthour meter standards	0	13	0	13
CO	Grain Moisture	0	12	0	12
CT	Scales	0	4	19	23
CT	Water Tanks from Water Meter Test Bench	0	0	2	2
CT	Measuring Wheel	0	3	0	3
MA	Package Checking Scales	0	7	0	7
MA	Apothecary & Troy Weights	0	95	0	95
ME	Fish Linear	0	0	7	7
ME	Fish Volume	0	0	11	11
ME	Air Quality Filters	0	0	2,050	2,050
NC	Load Cells (for Highway Patrol Division)	0	0	8	8
NJ	Scales < 1000 lb	0	45	147	192
NJ	Laser Distance Devices	4	0	63	63
NJ	Watt Meter Bench Provers	2	0	72	74
NY	Cubic Foot Dry Measures (Mulch Box)	0	1	0	1
PA	Force Gauges <= 50 lbf	5	0	15	20
TX	Neck Calibrations for volume transfer artifacts	0	5	82	82
VT	Hydrometers (Tolerance tested for maple industry)	0	0	7,297	7,297

Table 27: Other tests reported by the participating laboratories

Laboratory Fees (2016)

Description

This information is provided as guidance for SLP member laboratories evaluating the fees they charge for measurement services as well as potential clients whom use their services.

The SLP laboratories charge fees for the calibration work they perform; when reviewing the fee estimates in this section consider;

- laboratories may provide an hourly rate and bill real time for all work done,
- laboratories may provide an hourly rate and bill based on the typical time to complete a calibration,
- laboratories may charge a fixed fee for routine calibration work,
- laboratories may charge additional fees for cleaning, repair, adjusting, packaging, etc. which are outside of that which is normally required for well cared for measurement standards.

The time it takes for any one laboratory to calibrate a particular item will vary significantly between laboratories because of differences in the staffing level, staff experience, the facility, the available weight handling equipment, and the available measurement equipment.

Laboratories were asked to quote the typical fee that they would charge for the various routine measurements instead of providing published hourly rates. This provides each lab with a similar set of assumptions when quoting fees for the survey enabling a more meaningful comparison of fee data between the individual SLP laboratories[8].

Additional Notes:

Only those labs responding to this section of the survey are represented. Labs responding with only a flat per hour service fee are not included, nor are any labs that did not respond to the survey, or are currently closed. No effort was made to extrapolate from previous surveys or to estimate calibration times for each requested service.

The fees quoted are based on in-state calibration work. Most of the member labs charge fees based solely on the measurement services provided, however, the following laboratories report charging higher rates for out-of- state customers;

- Georgia Metrology Laboratory
- NCDA&CS Standards Laboratory
- Oklahoma Bureau of Standards
- Vermont W&M Metrology Lab
- Wyoming Department of Agriculture

Details on labs charging higher rates for out-of-state customers may be found in the comments for sections 8-30 published in this report beginning on page 168.

[8] Actual fees may differ from those indicated for a variety of reasons including but not limited to the number of required adjustments and the general condition of the equipment as delivered to the laboratory.

Mass Echelon I

Description

Each laboratory was asked to estimate the fee charged for testing a precision weight kit in good condition containing 21 pieces from 100 g to 1 mg to ASTM Class 0 tolerances using echelon I procedures. Laboratories were not asked to allow for cleaning or adjustments.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2004	15	$617.87	--
2006	16	$758.75	+23 %
2008	14	$700.07	-8 %
2010	15	$780.83	+10 %
2012	14	$820.18	+5 %
2014	15	$870.90	<1 % Change
2016	13	$922.23	+6 %

Table 28: Average fee charged for echelon I mass testing from 2004 through 2016.

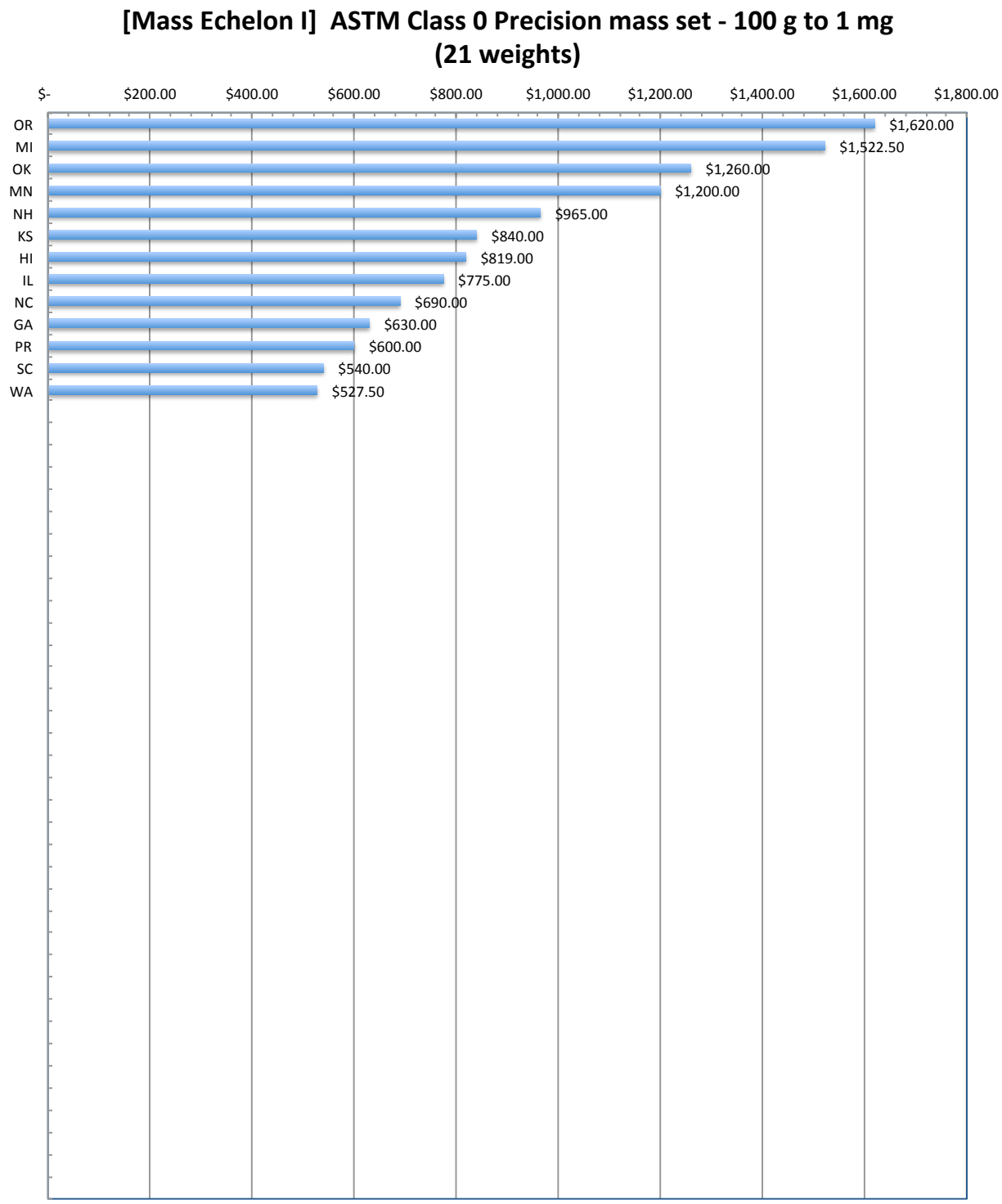


Figure 35: Fees charge for calibrating a precision weight kit containing 21 individual weights ranging from 100 g to 1 mg to ASTM Class 0 tolerances using echelon I testing techniques.

Mass Echelon II

Description

Each laboratory was asked to estimate the fee charged for testing a precision weight kit kit in good condition containing 21 pieces from 100g to 1mg to ASTM Class 2 tolerances using echelon II procedures. Laboratories were not asked to allow for cleaning or adjustments.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2000	33	$334.00	--
2002	39	$414.32	+24 %
2004	30	$431.43	+4 %
2006	31	$482.87	+12 %
2008	29	$496.18	+3 %
2010	29	$522.09	+5 %
2012	25	$636.25	+22 %
2014	27	$601.17	< 1 % Change
2016	26	$671.85	+12 %

Table 29: Average fee charged for echelon II mass testing from 2000 through 2016.

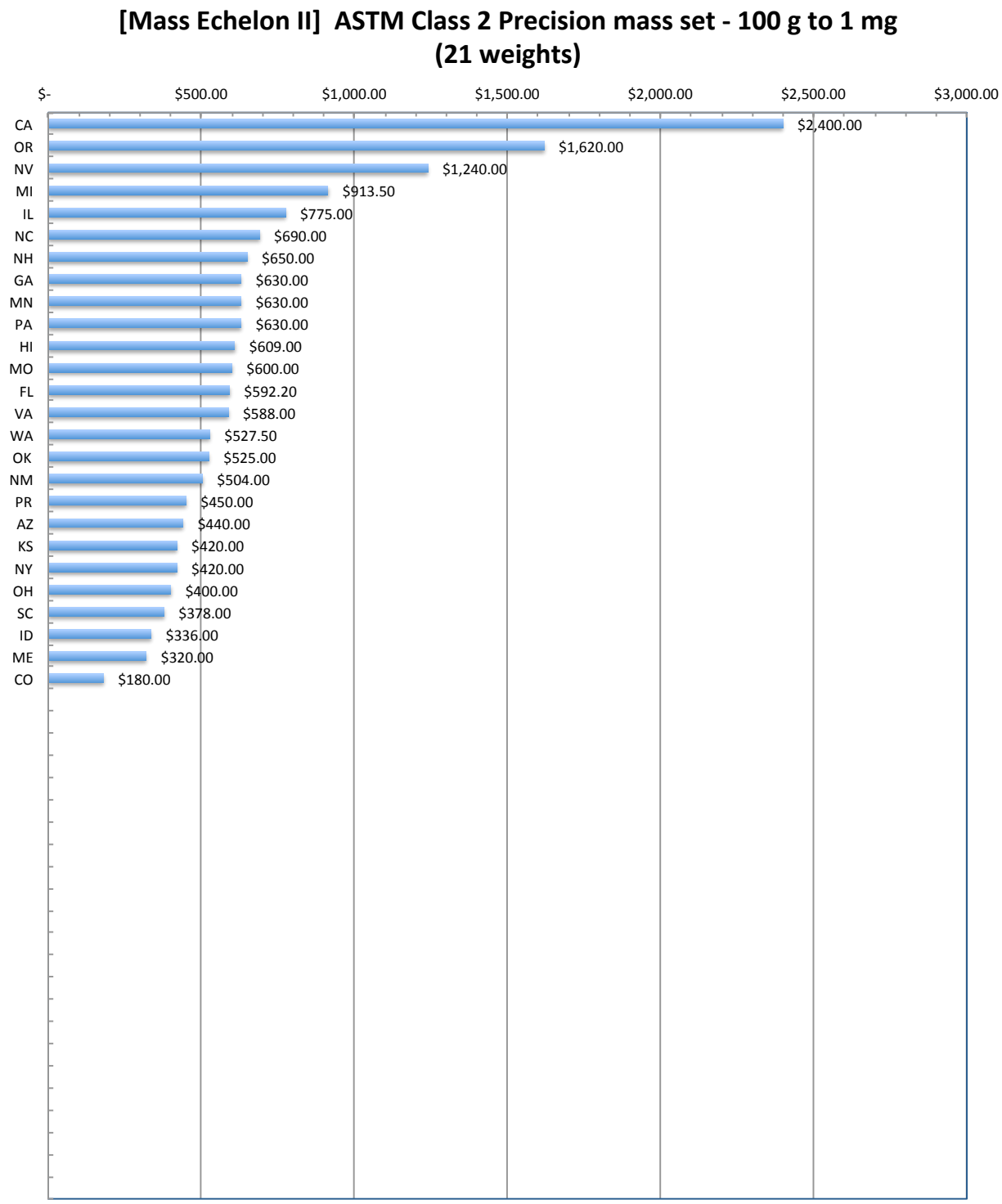


Figure 36: Fees charge for calibrating a precision weight kit containing 21 individual weights ranging from 100 g to 1 mg to ASTM Class 2 tolerances using echelon II testing techniques.

Mass Echelon III (31 lb kits)

Description

Each laboratory was asked to estimate the fee charged for testing a 31 lb weight kit containing 22 pieces to NIST Class F tolerances using echelon III procedures (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990). Laboratories were not asked to allow for cleaning or adjustments.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2000	36	$77.00	--
2002	41	$94.99	+23 %
2004	38	$121.13	+28 %
2006	42	$135.64	+12 %
2008	44	$156.93	+15 %
2010	41	$179.30	+14 %
2012	43	$186.93	+4 %
2014	46	$187.56	> 1 % change
2016	47	$203.97	> 1 % change

Table 30 Average fee charged for echelon III mass testing from 2000 through 2016.

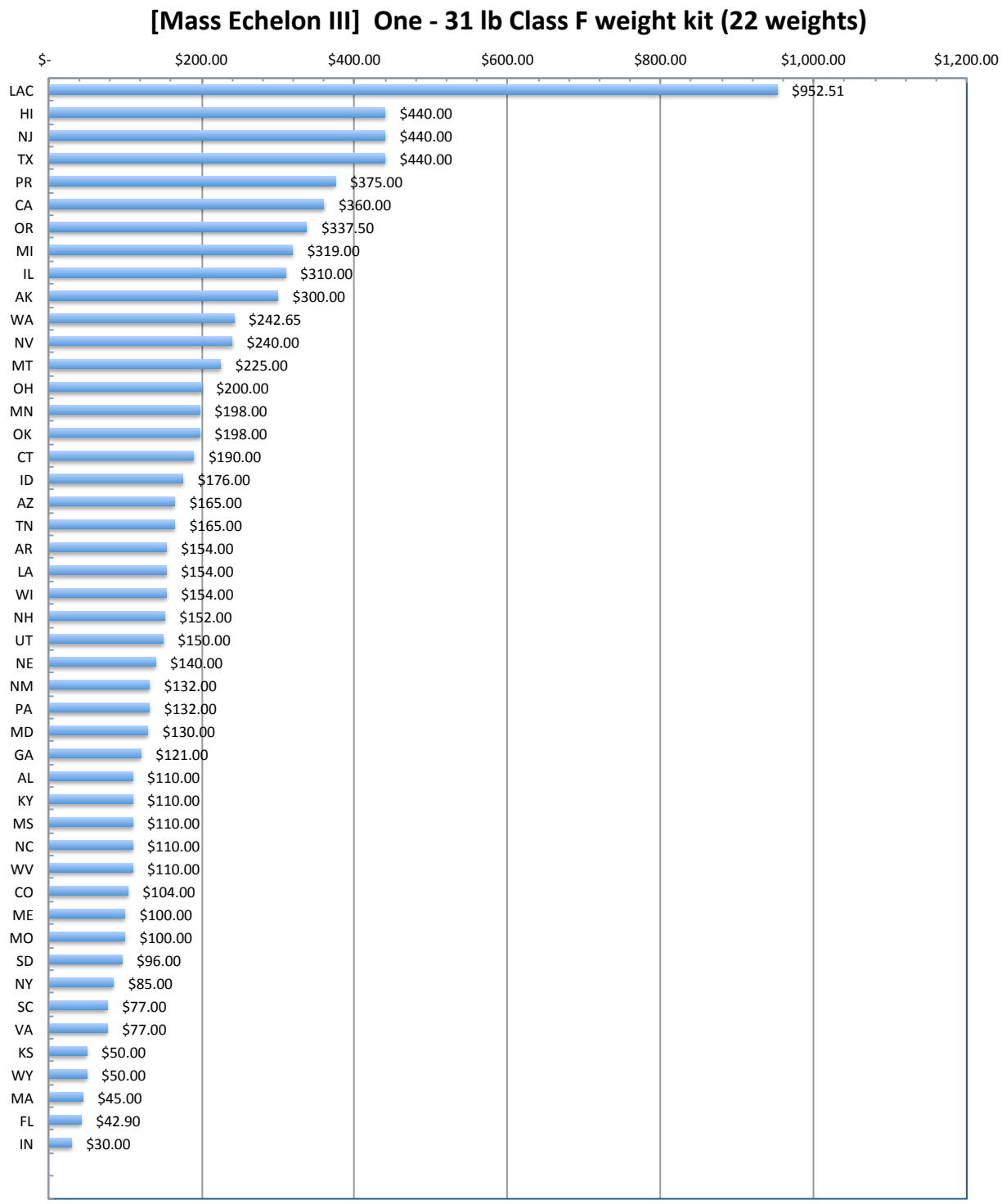


Figure 37: Fees charged for testing a 31 lb weight kit containing 22 pieces to NIST HB 105-1 Class F tolerances using mass echelon III procedures.

Mass Echelon III (50 lb Test Weights)

Description

Each laboratory was asked to estimate the fee charged for testing a set of 20 50 lb cast iron pipe-handle style test weights to NIST Class F tolerances using echelon III procedures (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990). Each lab was asked to provide an estimate assuming that 5 of the weights were adjusted.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2014	47	$294.67	--
2016	47	$351.98	+19 %

Table 31 Average fee charged for testing 20 50 lb cast iron pipe-handle test weights in 2016.

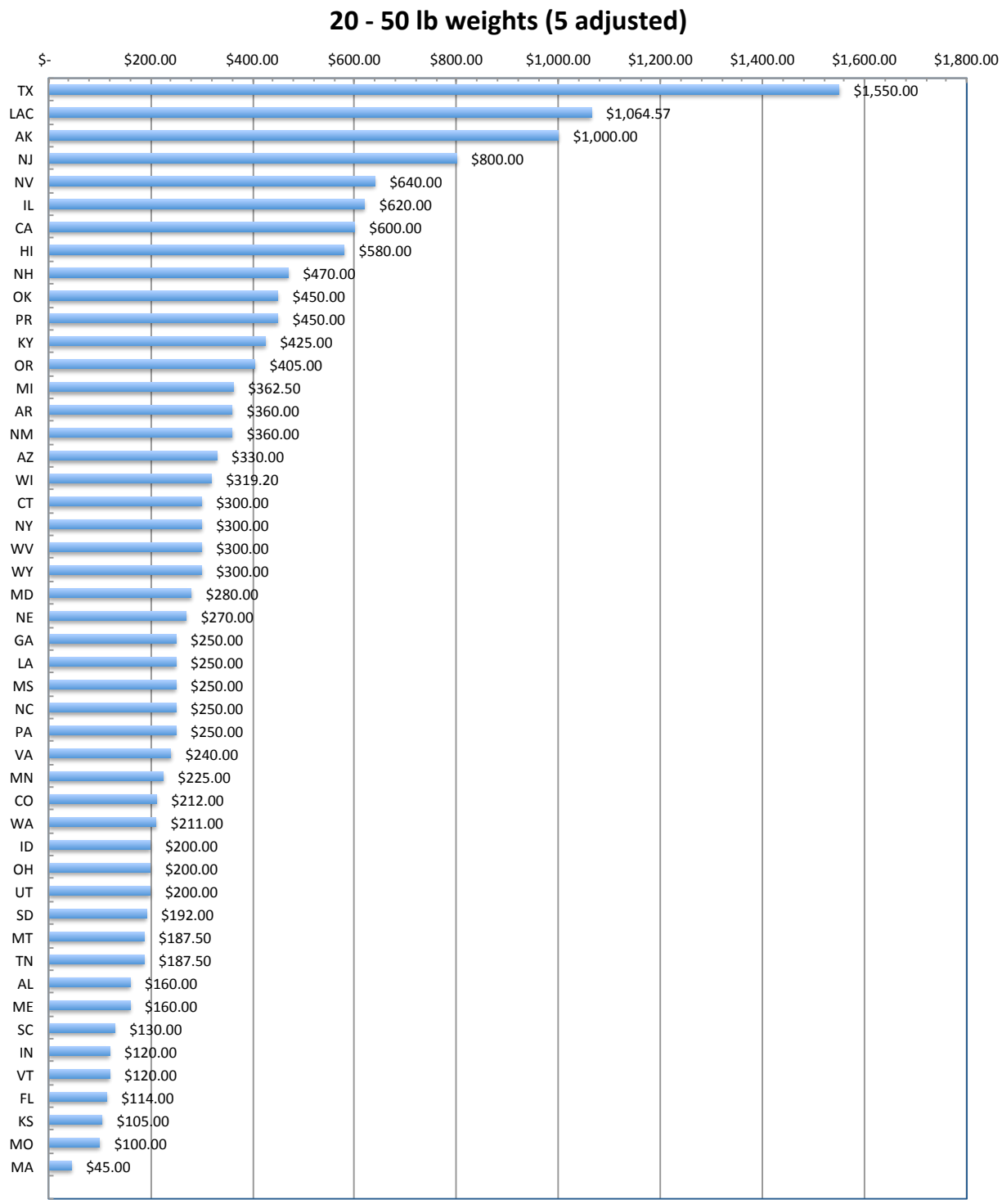


Figure 38: Fees charged for testing a set of 20 50 lb cast iron pipe-handle style test weights to NIST HB 105-1 Class F tolerances (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990) using mass echelon III procedures. 5 Adjustments were assumed.

Mass Echelon III (1000 lb Test Weights)

Description

Each laboratory was asked to estimate the fee charged for testing a set of 24 1,000 lb cast iron test weights according to NIST Class F tolerances using echelon III procedures (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990). Each lab was asked to provide an estimate assuming that 5 of the weights were adjusted.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2014	46	$1,058.00	--
2016	47	$820.06	-22 %

Table 32 Average fee charged for testing 24 1,000 lb cast iron test weights in 2016.

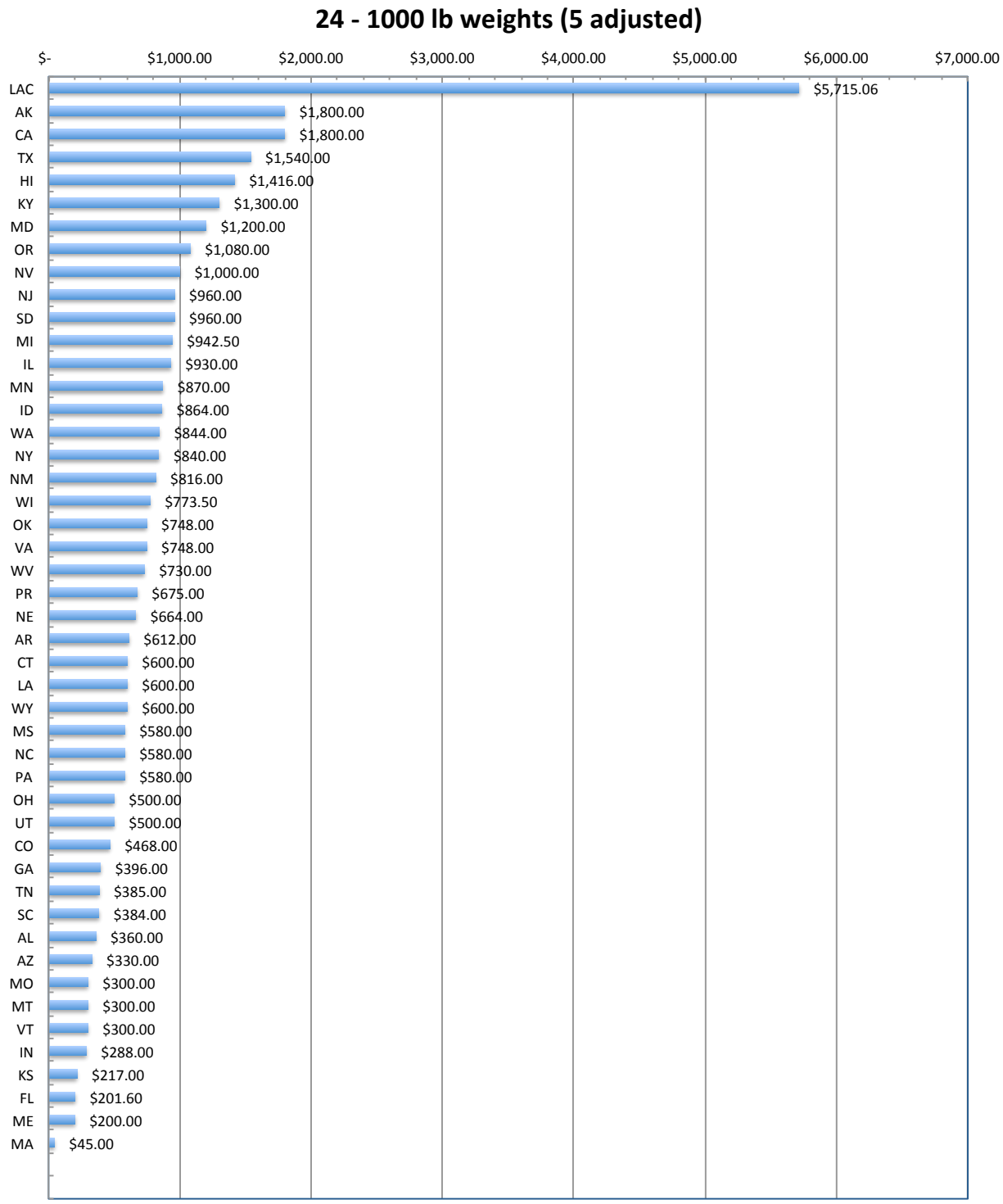


Figure 39: Fees charged for testing a set of 24 1,000 lb cast iron test weights to NIST HB 105-1 Class F tolerances using mass echelon III procedures. 5 Adjustments were assumed.

5,000 lb Weight Cart

Description

Each laboratory was asked to estimate the fee charged for testing a 5,000 lb weight cart according to NIST HB 105-8 tolerances using echelon III procedures (NIST Handbook 105-8 "Specifications and Tolerances for Field Standard Weight Carts", 2003). Laboratories were not asked to allow for cleaning or adjustments.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2004	28	$163.27	--
2006	31	$205.74	+23 %
2008	31	$185.80	+28 %
2010	34	$225.09	+21 %
2012	30	$201.65	-10 %
2014	31	$203.97	+1 %
2016	32	$205.01	< 1 % Change

Table 33: Average fee charged for a 5,000 lb weight cart testing from 2004 through 2016.

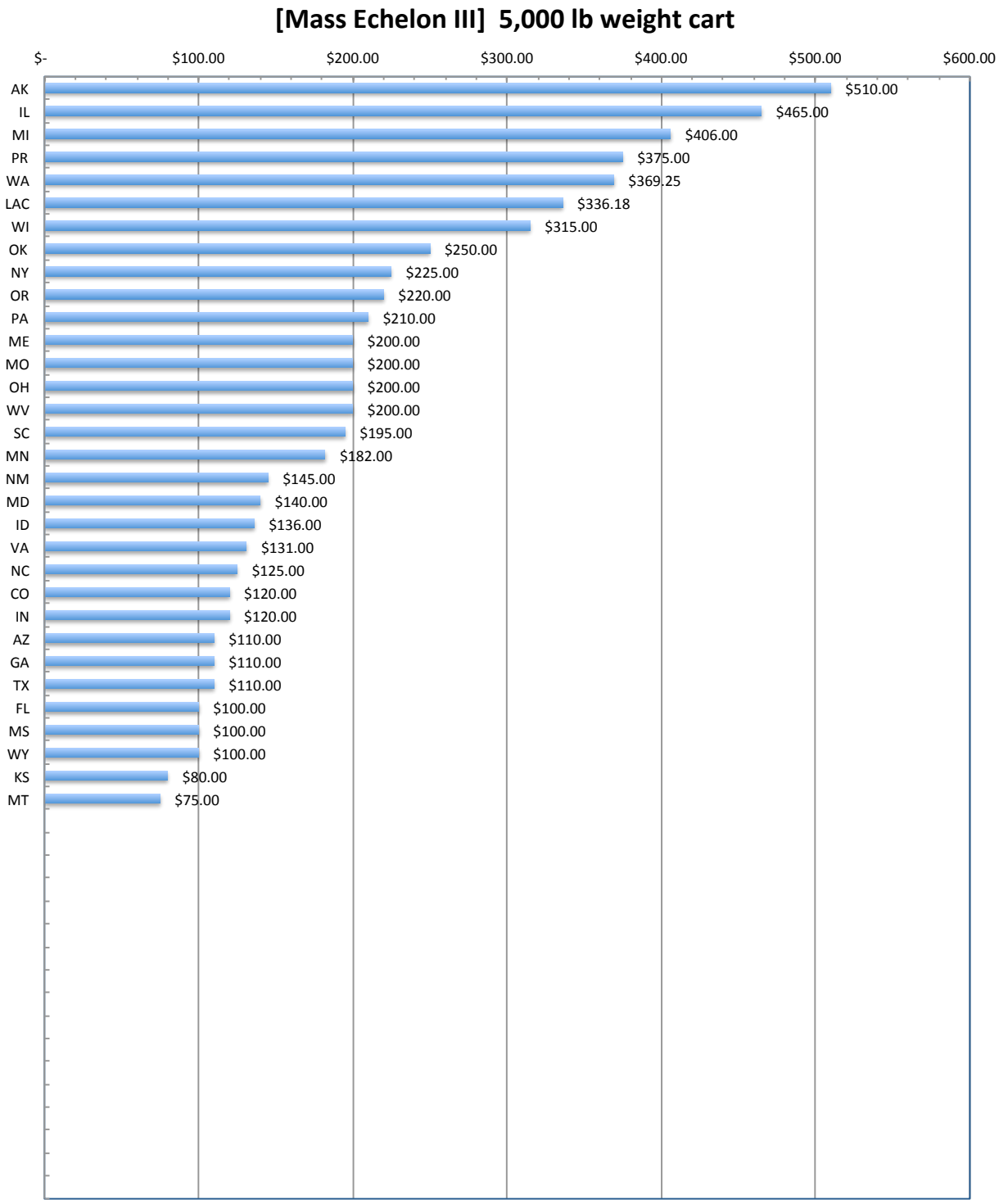


Figure 40: Fees charged for testing a 5,000lb weight cart according to NIST HB 105-8 tolerances using mass echelon III procedures.

Scale Truck Calibration Class F

Description

Each laboratory was asked to estimate the fee charged for testing the measurement equipment contained in a single scale truck. The truck was assumed to carry 24 1,000 lb class F cast cube weights requiring 5 adjustments, 20 50 lb class F pipe-handle weights requiring 5 adjustments, and 2 31 lb weight kits containing 22 pieces each. Echelon III mass calibration procedures were requested for all measurements.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2004	39	$1,050.56	--
2006	43	$1,060.77	+23 %
2008	42	$1,300.30	+28 %
2010	44	$1,455.69	+12 %
2012	42	$1,520.41	+4 %
2014	45	$1,472.13	-3 %
2016	47	$1,529.57	+4 %

Table 34: Average fee charged for typical scale truck testing from 2004 through 2016.

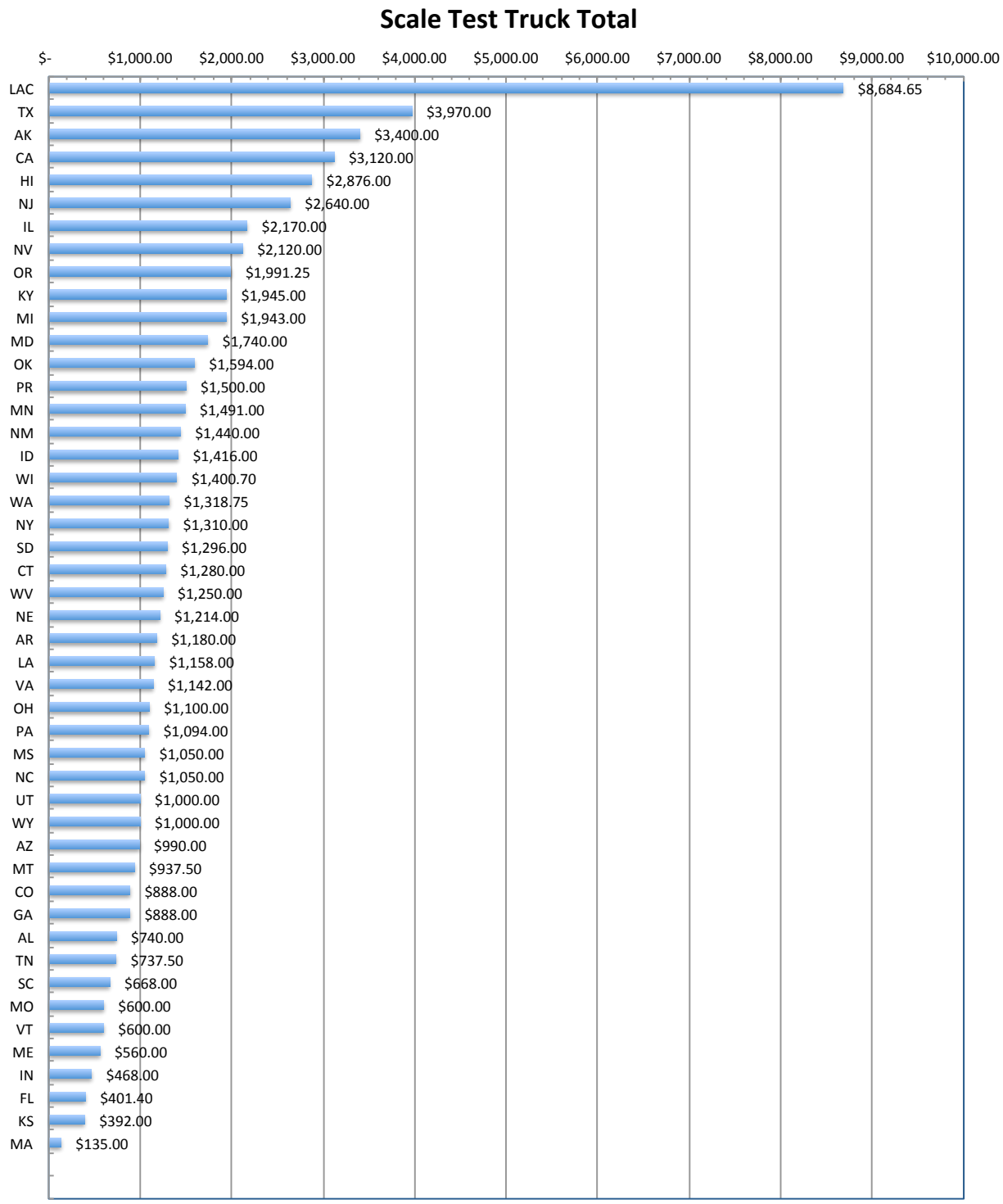


Figure 41: Fees charged for testing a typical scale truck according mass echelon III procedures.

Length 100 ft Steel Tape

Description

Each laboratory was asked to estimate the fee charged for 19 point testing of a 100 ft tape. Measurement points were requested at 1 ft intervals up to and including 10 ft then at 10 ft intervals up to and including 100 ft. It was left up to each lab to decide how best to test the steel tape, only the fee charged is reported here.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2000	33	$133.00	--
2002	36	$173.03	+30 %
2004	22	$250.89	+45 %
2006	22	$261.23	+4 %
2008	18	$244.86	-6 %
2010	16	$234.16	-4 %
2012	10	$246.00	+5 %
2014	9	$198.56	-19 %
2016	7	$200.71	+1 %

Table 35: Average fee charged for typical 19 point testing of a 100 ft steel tape from 2000 through 2016.

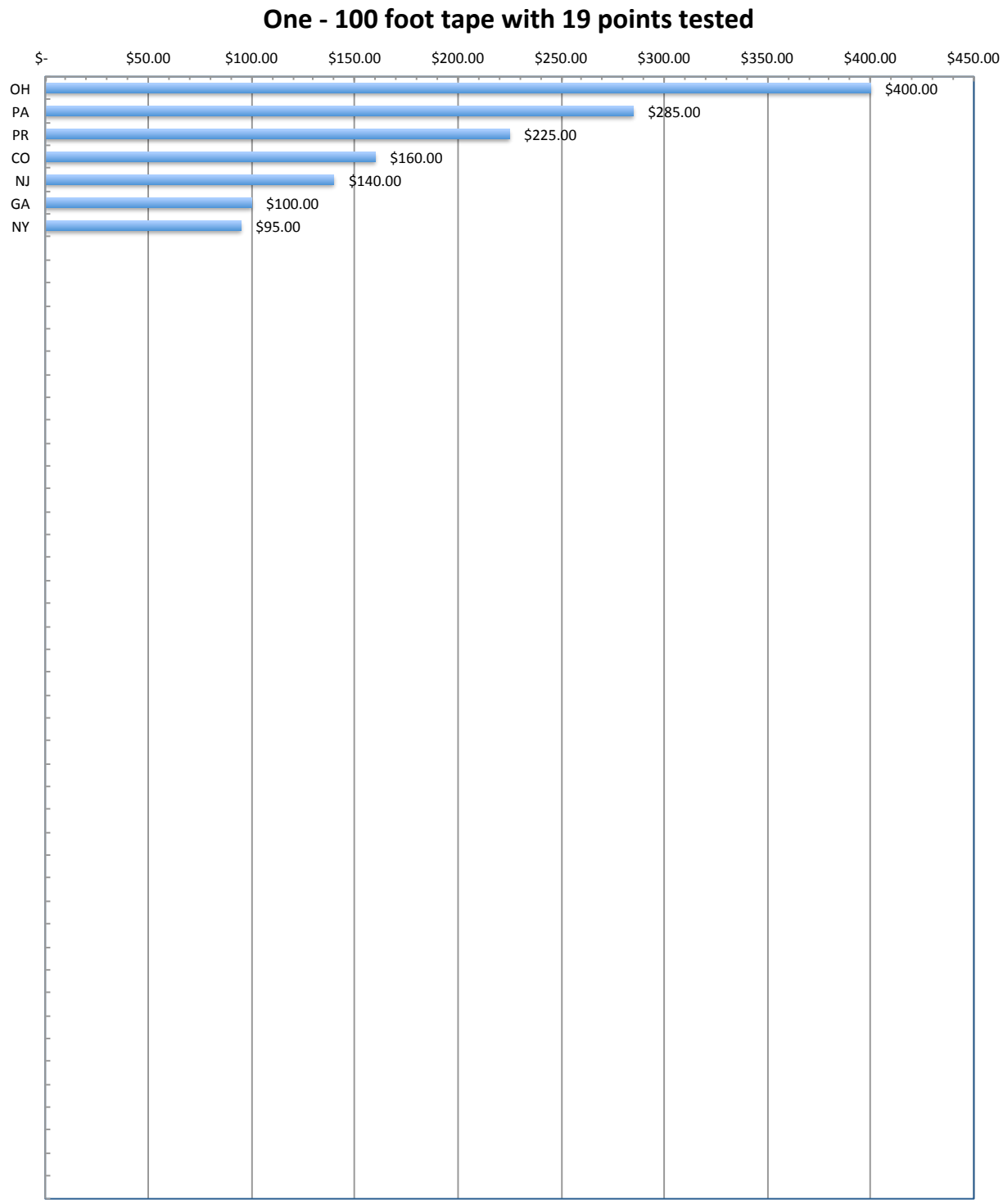


Figure 42: Fees charged for testing a steel 100 ft tape.

5 gallon test measures – Volume Transfer

Description

Each laboratory was asked to estimate the fee charged for testing a single 5 gallon field test measure according to NIST HB 105-3 (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) tolerances using a volume transfer calibration technique (for example SOP No. 18 in (Harris, NIST Internal Report 7383, "Selected Procedures for Volumetric Calibrations", 2017)).

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2000	35	$35.00	--
2002	41	$41.46	+18 %
2004	39	$42.06	+1 %
2006	43	$43.93	+4 %
2008	43	$56.89	+30 %
2010	44	$64.44	+13 %
2012	44	$63.61	-1 %
2014	46	$62.52	-2 %
2016	48	$67.07	+7 %

Table 36: Average fee charged for testing of a 5 gallon field test measure via volume transfer from 2000 through 2016.

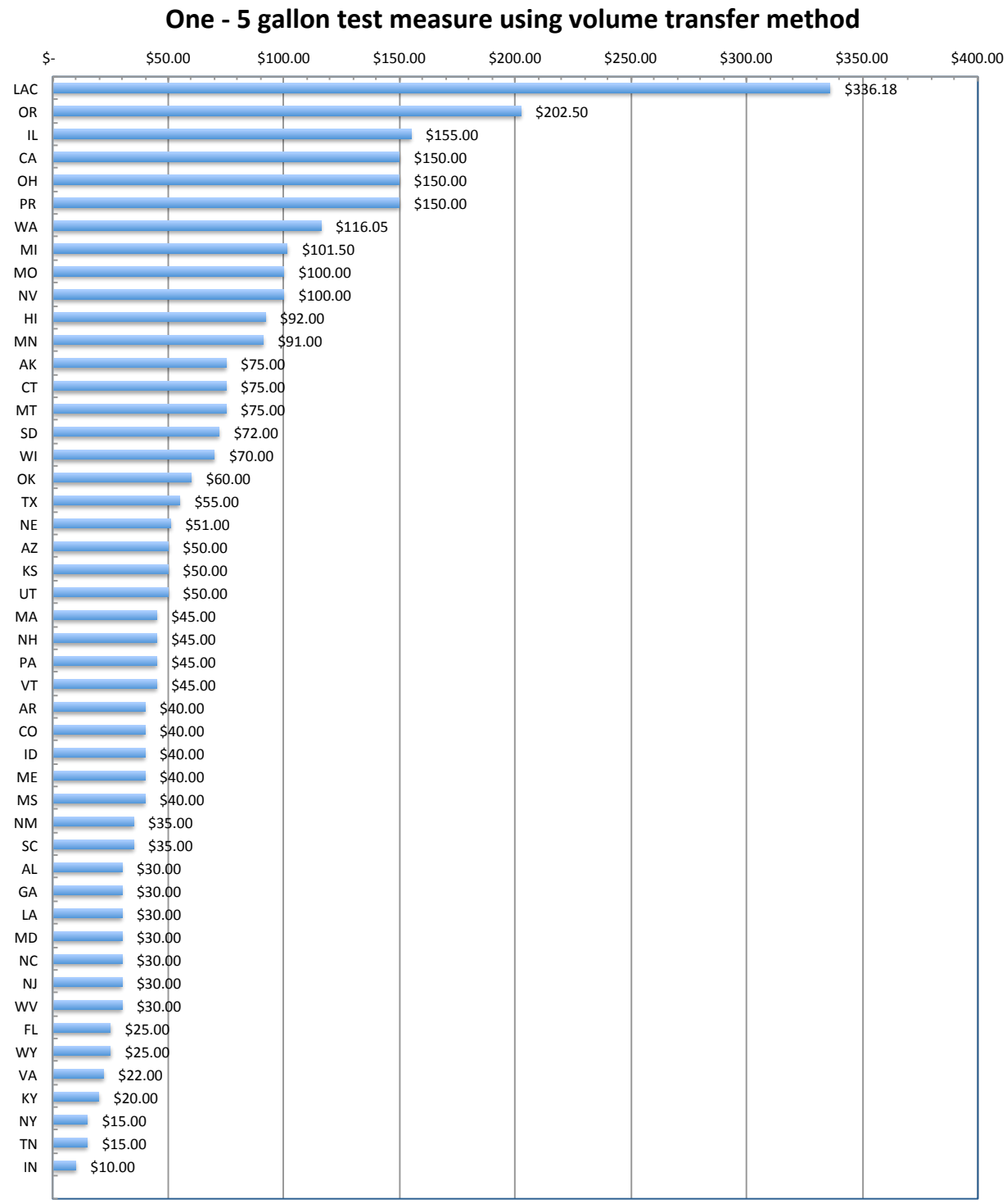


Figure 43: Fees charged for testing a 5 gallon field standard steel prover via volume transfer technique.

5 gallon test measure - Gravimetric

Description

Each laboratory was asked to estimate the fee charged for testing a single 5 gallon field standard test measure according to NIST HB 105-3 tolerances (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) using a gravimetric measurement technique.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	20	$177.95	--
2008	17	$173.65	+23 %
2010	21	$209.25	+21 %
2012	18	$215.24	+3 %
2014	22	$200.95	-7 %
2016	19	$241.26	+20 %

Table 37: Average fee charged for testing of a 5 gallon field test measure via gravimetric method from 2000 through 2016.

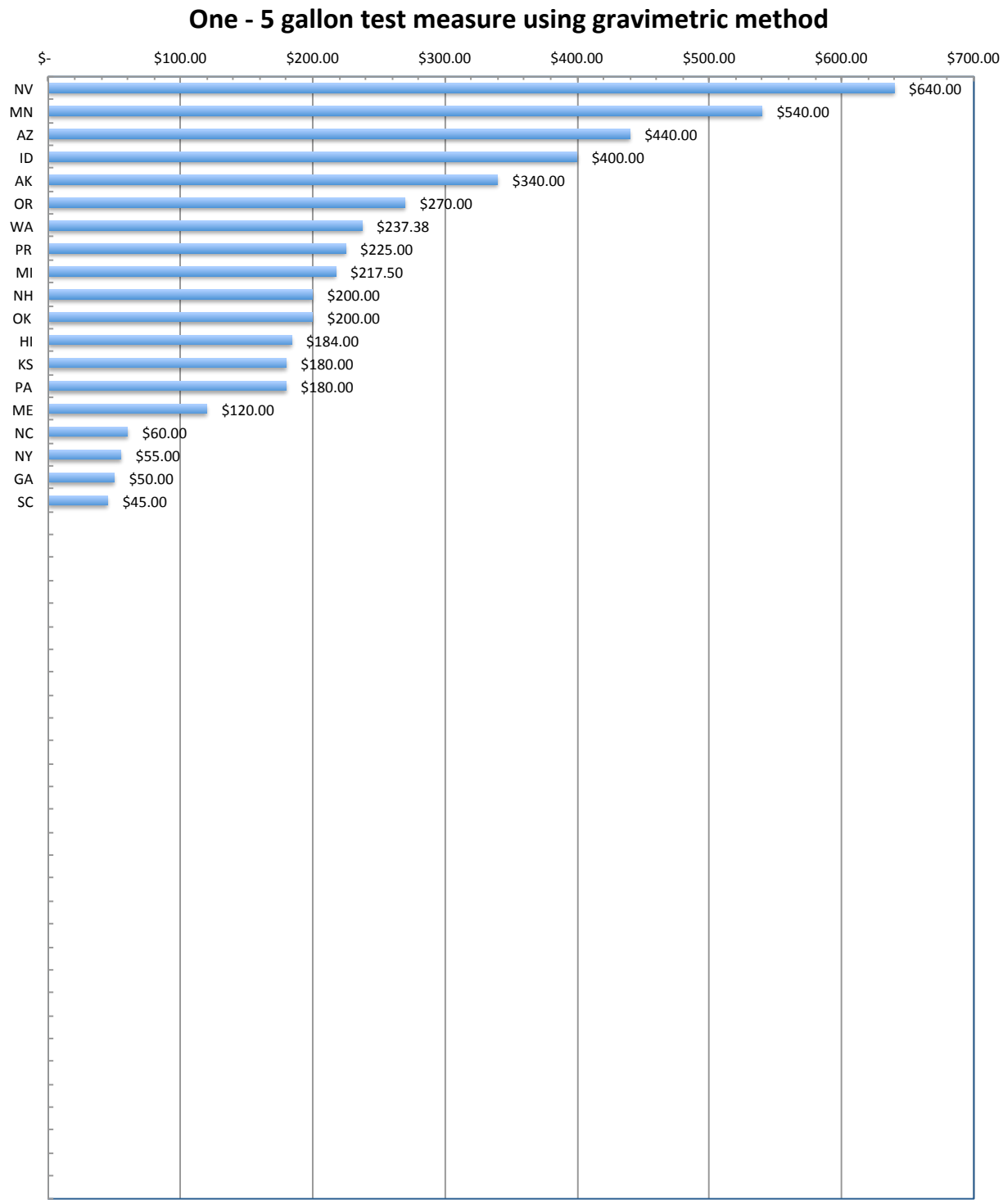


Figure 44 Fees charged for gravimetrically testing a 5 gallon field test measure.

100 gallon field standard prover – Volume Transfer

Description

Each laboratory was asked to estimate the fee charged for testing a 100 gallon field standard prover according to NIST HB 105-3 tolerances (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) using a volume transfer calibration technique.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2000	35	$108.00	--
2002	40	$125.19	+16 %
2004	35	$138.73	+11 %
2006	37	$145.32	+5 %
2008	36	$191.83	+32 %
2010	38	$219.76	+15 %
2012	38	$206.35	-6 %
2014	40	$217.01	+5 %
2016	42	$224.16	+3 %

Table 38: Average fee charged for testing of a 100 gallon field standard prover via volume transfer from 2000 through 2016.

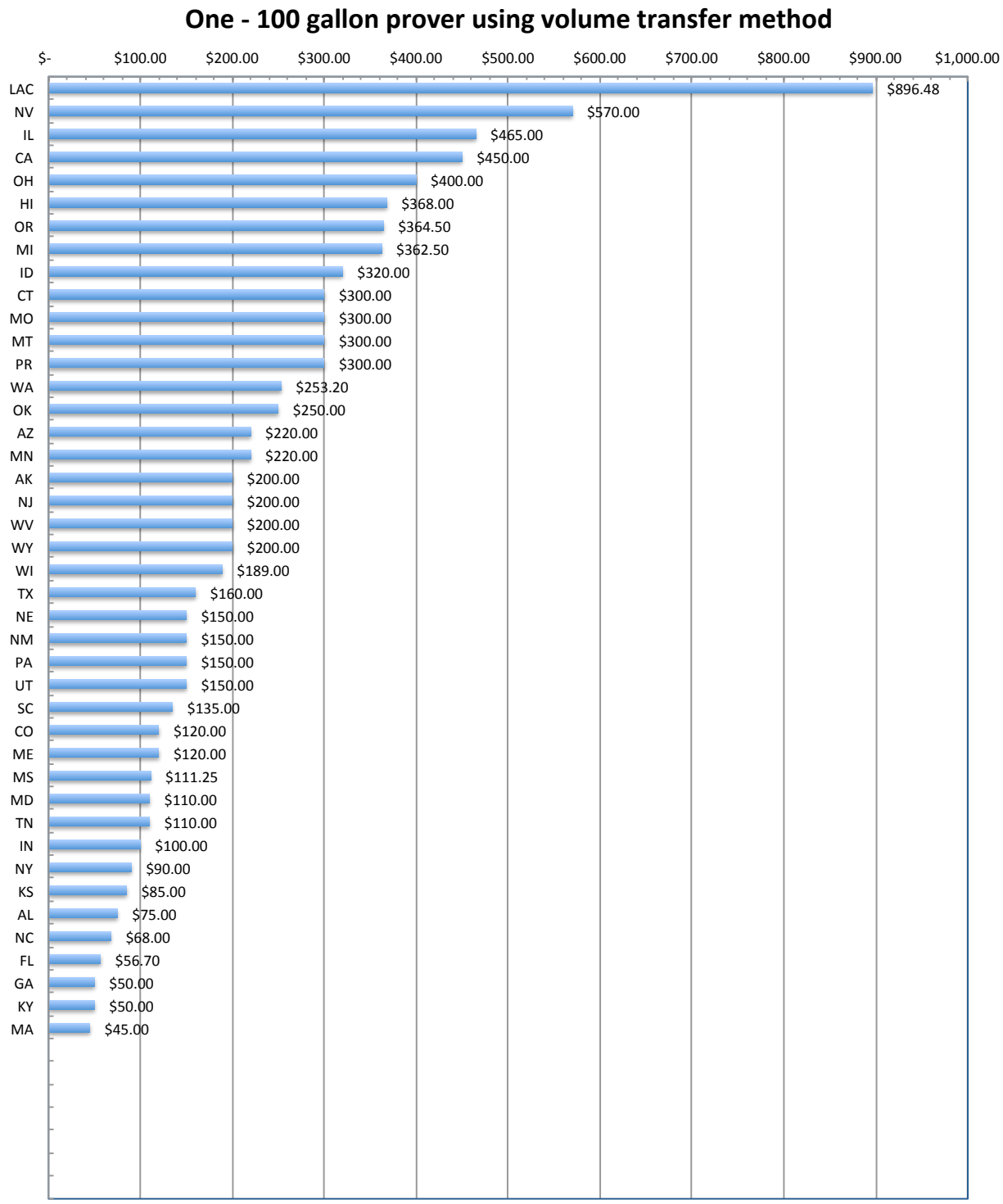


Figure 45: Fees charged for testing a 100 gallon field standard prover via volume transfer technique.

100 gallon field standard prover- Gravimetric

Description

Each laboratory was asked to estimate the fee charged for testing a 100 gallon field standard prover according to NIST HB 105-3 tolerances (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) using a gravimetric calibration technique.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	4	$265.00	+5 %
2008	7	$434.29	+64 %
2010	7	$597.14	+37 %
2012	7	$447.14	-25 %
2014	8	$670.63	+50 %
2016	7	$854.29	+27 %

Table 39: Average fee charged for testing of a 100 gallon field test standard prover via gravimetric method from 2006 through 2016.

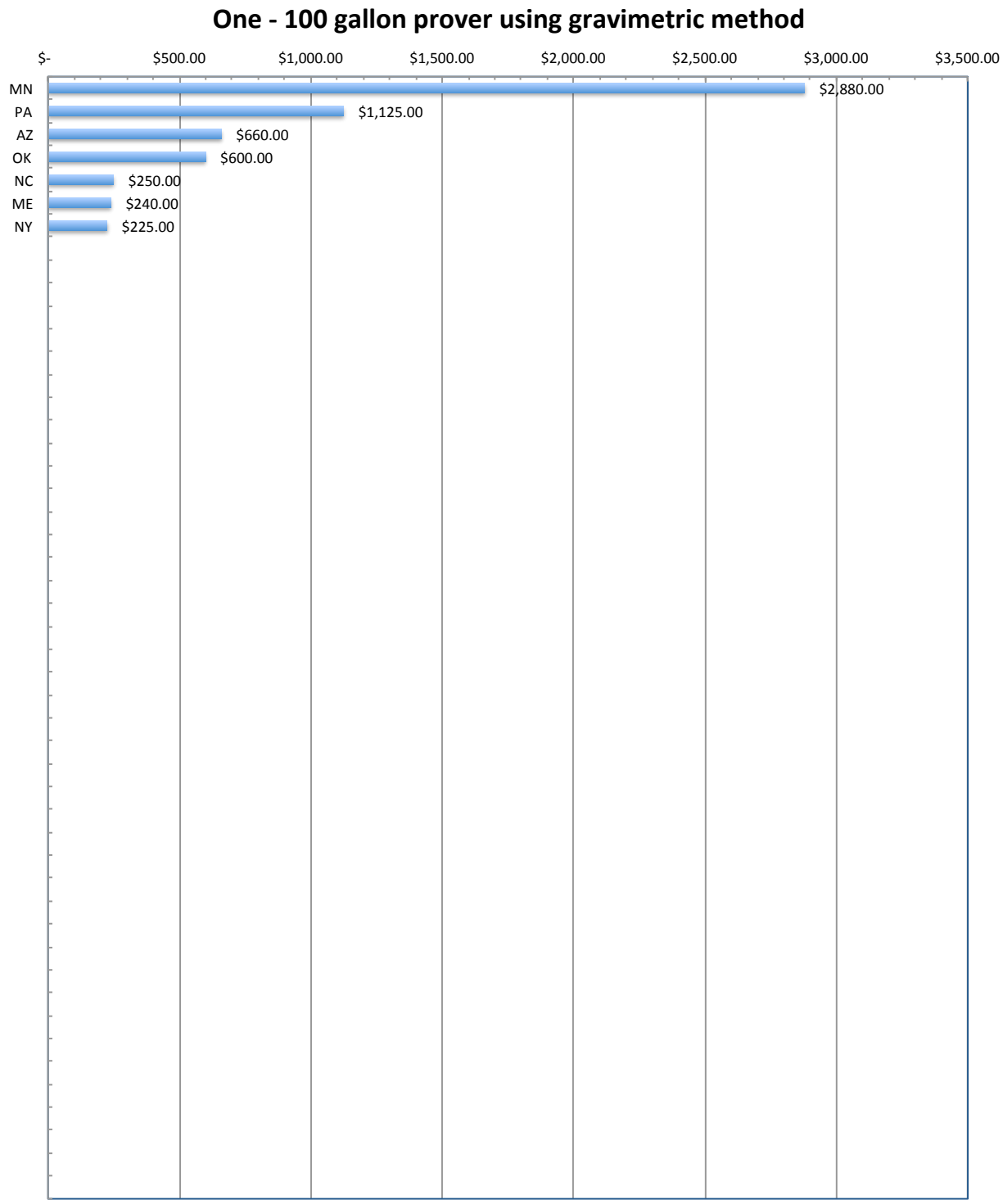


Figure 46: Fees charged for gravimetrically testing a 100 gallon field standard steel prover.

100 gallon field standard prover LPG – Volume Transfer

Description

Each laboratory was asked to estimate the fee charged for testing a 100 gallon liquefied petroleum gas (LPG) field standard prover according to NIST HB 105-4 tolerances (NIST Handbook 105-4, "Specifications and Tolerances for Liquified Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers", 2010) using a volume transfer calibration technique.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2006	32	$255.78	--
2008	31	$295.39	+23 %
2010	38	$219.75	-26 %
2012	29	$348.05	+58 %
2014	31	$347.05	< 1 % change
2016	30	$372.44	+7 %

Table 40: Average fees charged for the testing of a 100 gallon LPG prover from via volume transfer from 2006 through 2016.

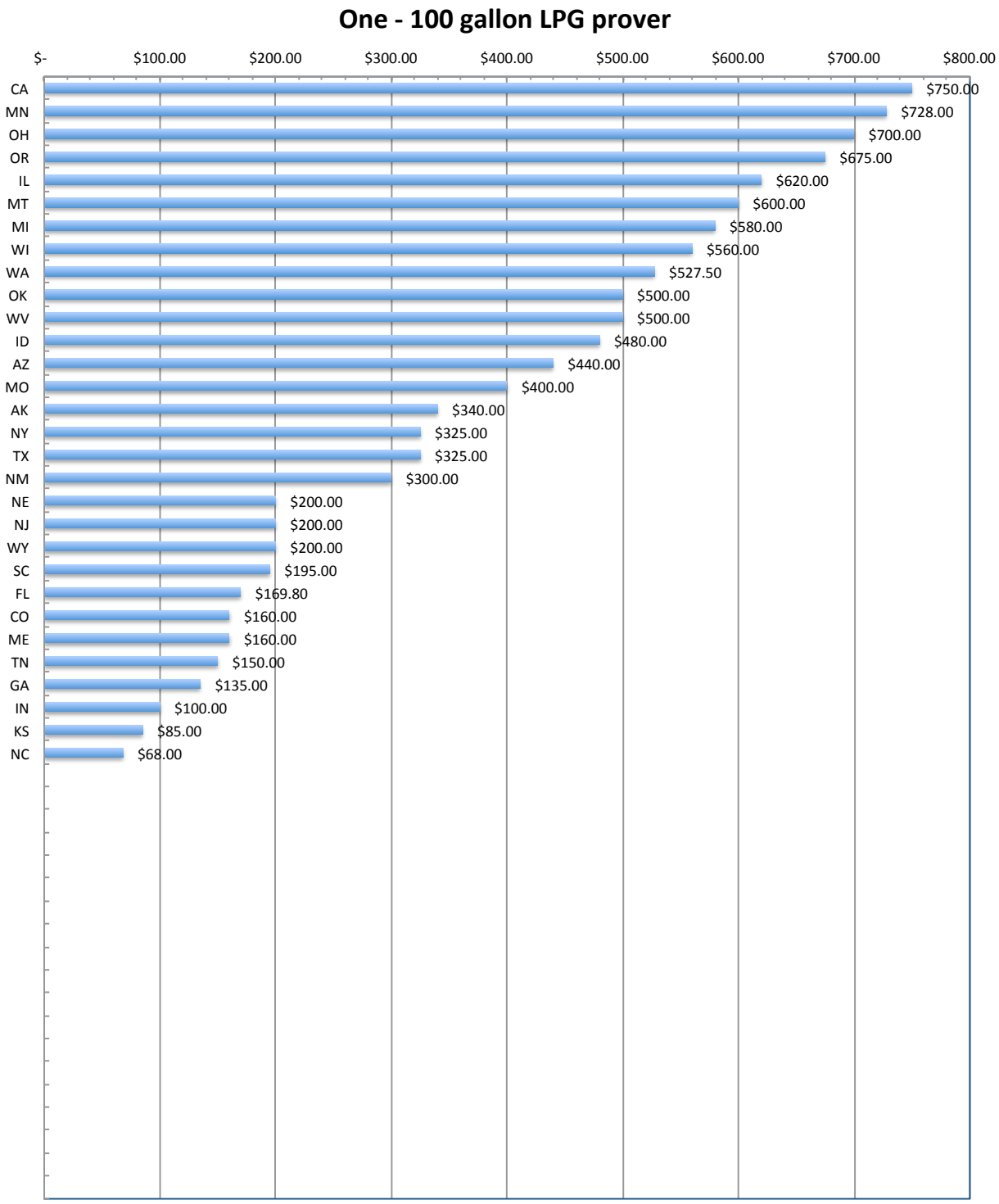


Figure 47: Fees charged for testing a 100 gallon LPG prover.

20 Gallon Dynamic Small Volume Prover (SVP) - Volume Transfer

NOTE: This question was inadvertently omitted from the 2016 survey. The 2014 survey information has been reprinted.

Description

Each lab was asked to estimate the fee for calibrating a 20 gallon SVP according to NIST HB 105- 7 tolerances (NIST Handbook 105-7, "Specifications and Tolerances for Dynamic Small Volume Provers", 1997) using a volume transfer calibration method. The sole reported fee is given in Table 41

Lab ID	Fee
MN	$540.00
CO	$120.00
NM	$120.00
ME	$100.00

Table 41: Fees charged for testing a SVP via volume transfer.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	3	$113.33	--
2008	2	$123.75	+9 %
2010	1	$100.00	-19 %
2012	2	$200.00	+100 %
2014	4	$220.00	+10 %

Table 42: Average fee charged for testing a SVP via volume transfer from 2006 through 2014.

20 Gallon Dynamic Small Volume Prover (SVP) – Volume Gravimetric

NOTE: This question was inadvertently omitted from the 2016 survey. The 2014 survey information has been reprinted.

Description

Each lab was asked to provide a fee for testing one 20 gallon SVP according to HB 105- 7 tolerances (NIST Handbook 105-7, "Specifications and Tolerances for Dynamic Small Volume Provers", 1997) using a gravimetric calibration method. The reported fees are given in Table 43. These measurements are not on all of the laboratory Scopes of Recognition/Accreditation and should be verified.

Lab ID	Fee
MN	$1,800.00
MI	$870.00
AZ	$770.00
ME	$200.00
NC	$140.00

Table 43: Fees charged for testing a SVP gravimetrically.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	3	$470.00	--
2008	3	$470.00	0 %
2010	3	$593.33	+26 %
2012	3	$593.33	0 %
2014	5	$756.00	+27 %

Table 44: Average fee charged for testing a SVP gravimetrically from 2006 through 2014.

Metrology Positions/Title and Salaries

Each laboratory was asked to provide position titles and salary ranges for personnel employed by the lab. They were asked to categorize each position according to the metrology function performed.

Lab ID	Job Title	Standardized Title	Min Annual	Max Annual
AK	State Metrologist II	Laboratory Supervisor	$57,336.00	$85,764.00
AK	State Metrologist I	Metrology/Calibration Technician	$49,776.00	$75,060.00
AL	Laboratory Supervisior	Laboratory Supervisor	$32,287.20	$48,924.00
AL	Comsumer W & M Protection Specialist: Lab	Metrology/Calibration Technician	$28,516.80	$47,757.60
AL	Labour	Support Staff	$9,000.00	$13,500.00
AR	Metrology Laboratory Manager	Supervisor	$43,200.00	$69,600.00
AR	Metrologist	Calibration Technician	$33,600.00	$55,200.00
AR	Agriculture Program Manager	Calibration Technician	$36,000.00	$60,000.00
AZ	State Metrologist	Laboratory Supervisor	$46,593.60	$79,424.40
AZ	Assistant State Metrologist	Metrology/Calibration Technician	$36,168.00	$67,982.40
CA	Principal State Metrologist	Laboratory Supervisor	$83,160.00	$94,452.00
CA	Measurement Standards Specialist III	Metrology/Calibration Technician	$53,064.00	$66,420.00
CA	Measurement Standards Specialist II	Metrology/Calibration Technician	$43,488.00	$53,808.00
CA	Measurement Standards Specialist I	Metrology/Calibration Technician	$38,016.00	$46,884.00
CO	Metrologist I	Metrology/Calibration Engineer	$46,620.00	$65,808.00
CO	Metrologist II	Metrology/Calibration Engineer	$50,112.00	$70,740.00
CO	Metrologist III	Metrology/Calibration Engineer	$53,868.00	$76,032.00
CO	Program Administrator/Laboratory Supervisor	Laboratory Supervisor	$75,144.00	$113,904.00
CT	Consumer Protection Metrologist	Metrology/Calibration Engineer	$54,763.92	$73,753.92
CT	Consumer Protection W&M Inspector	Metrology/Calibration Engineer	$61,530.00	$77,703.96
FL	Laboratory Manager	Laboratory Supervisor	$42,813.36	$88,847.16
FL	Senior Metrologist	Metrology/Calibration Technician	$31,847.52	$55,310.16
FL	Metrologist	Metrology/Calibration Technician	$27,087.12	$44,530.80
FL	Laboratory Technician IV	Support Staff	$24,498.96	$42,010.56
GA	State Metrologist	Laboratory Supervisor	$39,038.04	$71,523.00
GA	Metrologist	Metrology/Calibration Engineer	$30,000.00	$78,000.00
GIPSA	Program Manager		$94,608.00	$122,988.00
GIPSA	Industrial Specialist		$79,560.00	$103,428.00
HI	Metrologist I	Metrology/Calibration Technician	$43,428.00	$64,284.00
HI	Metrologist II	Metrology/Calibration Engineer	$46,932.00	$69,540.00
HI	Metrologist III	Laboratory Supervisor	$50,772.00	$75,192.00
ID	Section Manager/Metrologist	Laboratory Supervisor	$54,849.60	$97,947.60
ID	Ag Program Specialist	Metrology/Calibration Technician	$45,801.60	$81,802.80
IL	Public Service Administrator		$55,344.00	$83,880.00
IL	Products & Standards Inspector		$45,408.00	$65,376.00

Lab ID	Job Title	Standardized Title	Min Annual	Max Annual
IN	Technical Manager	Metrology/Calibration Technician	$24,999.60	$33,999.96
IN	Quality Manager	Metrology/Calibration Technician	$24,999.60	$33,999.96
IN	Inspector I	Weights & Measures Inspector	$25,011.96	$42,666.00
KS	Metrologist	Metrology/Calibration Engineer	$36,787.20	$36,787.20
KS	State Metrologist	Laboratory Supervisor	$42,547.20	$42,547.20
KY	Program Coordinator	Metrology/Calibration Engineer	$32,042.40	$53,270.40
KY	Agricultural Inspector I	Support Staff	$21,886.80	$36,102.48
KY	Metrology Lab Supervisor	Laboratory Supervisor	$38,770.08	$63,952.32
KY	Metrology Lab Technician I	Metrology/Calibration Technician	$24,072.96	$39,711.84
KY	Metrology Lab Technician II	Metrology/Calibration Technician	$29,129.28	$48,048.00
LA	Asst. Division Director	Laboratory Supervisor	$54,933.00	$109,325.04
LAC	Senior Metrologist	Laboratory Supervisor	$57,555.36	$75,487.68
LAC	Metrologist	Metrology/Calibration Technician	$54,515.04	$71,501.52
LAC	Agricultural/Weights and Measures Inspector III	Laboratory Supervisor	$58,272.00	$76,427.04
LAC	Agricultural/Weights and Measures Inspector II	Metrology/Calibration Technician	$52,275.36	$68,564.88
LAC	Agricultural/Weights and Measures Inspector I	Metrology/Calibration Technician	$49,520.88	$61,523.04
LAC	Associate Weights and Measures Inspector	Metrology/Calibration Technician	$43,554.00	$43,554.00
MA	Laboratory Manager, and	Laboratory Supervisor	$54,000.00	$78,000.00
MA	State Metrologist	Metrology/Calibration Engineer		
MD	Metrologist I	Metrology/Calibration Technician	$36,557.04	$57,807.96
MD	Administrator I	Laboratory Supervisor	$44,016.96	$70,265.04
ME	Metrologist	Laboratory Supervisor	$40,646.40	$55,180.80
MI	Metrologist Manager - 14	Laboratory Supervisor	$58,044.00	$85,440.00
MI	Metrology Specialist - 13	Metrology/Calibration Engineer	$53,892.00	$79,116.00
MI	Metrologist - 12	Metrology/Calibration Engineer	$49,668.00	$72,396.00
MI	Metrologist - P11	Metrology/Calibration Engineer	$47,292.00	$66,600.00
MI	Metrologist - 10	Metrology/Calibration Engineer	$40,848.00	$57,612.00
MI	Metrologist - 9	Metrology/Calibration Engineer	$39,516.00	$56,388.00
MN	State Program Administrator, Senior	Metrology/Calibration Technician	$45,894.00	$67,317.00
MN	State Program Administrator, Principal	Metrology/Calibration Engineer	$52,659.00	$77,589.96
MN	State Program Admin. Manager, Senior (Lab supervisor)	Laboratory Supervisor	$71,532.00	$87,240.00
MO	Metrologist	Laboratory Supervisor	$36,480.00	$59,340.00
MO	Metrology Specialist	Metrology/Calibration Technician	$31,500.00	$44,472.00
MS	Lab Director	Laboratory Supervisor	$45,154.92	$79,021.08
MS	Metrologist	Metrology/Calibration Technician	$28,962.24	$50,683.92
MT	Metrologist	Laboratory Supervisor	$42,474.00	$54,699.60
NC	Laboratory Manager	Laboratory Supervisor	$43,200.00	$70,800.00
NC	Quality Assurance Manager	Metrology/Calibration Engineer	$34,800.00	$56,400.00
NC	Metrologist I	Metrology/Calibration Technician	$32,400.00	$51,600.00
NC	Grain Moisture Program Supervisor	Metrology/Calibration Engineer	$34,800.00	$56,400.00

Lab ID	Job Title	Standardized Title	Min Annual	Max Annual
NC	Processing Assistant III	Support Staff	$30,000.00	$45,600.00
NE	We have only one Metrologist	Laboratory Supervisor	$42,000.00	$57,600.00
NH	Weights & Measures Metrologist	Metrology/Calibration Engineer	$36,328.56	$48,223.56
NH	Weights & Measures Metrologist - Part Time	Metrology/Calibration Technician		
NJ	Supervisor; Licensing, Metrology, and Registration	Laboratory Supervisor	$77,604.00	$112,548.00
NJ	Weights and Measures Inspector II	Metrology/Calibration Technician	$61,992.00	$91,248.00
NJ	Weights and Measures Inspector III	Metrology/Calibration Technician	$53,544.00	$78,840.00
NM	Regulatory Lab Manager	Laboratory Supervisor	$48,000.00	$72,000.00
NM	Metrologist, Intermediate	Metrology/Calibration Technician	$36,000.00	$54,000.00
NV	Metrologist III	Laboratory Supervisor	$47,606.40	$67,692.96
NV	Metrologist II	Metrology/Calibration Engineer	$43,639.20	$61,950.96
NV	Inspector/Lab Metrologist in training	Metrology/Calibration Technician	$40,110.48	$54,204.48
NY	Lab Manager	Laboratory Supervisor	$67,704.00	$85,632.00
NY	W&M Specialist I / Metrologist	Metrology/Calibration Engineer	$39,708.00	$66,492.00
NY	Office Assistant II	Support Staff	$33,972.00	$40,644.00
OH	Weights and Measures Supervisor	Laboratory Supervisor	$45,480.00	$57,432.00
OH	Weights and Measures Technologist	Metrology/Calibration Technician	$40,116.00	$52,164.00
OK	Metrologist I	Metrology/Calibration Technician	$26,502.12	$48,587.28
OK	Metrologist II	Metrology/Calibration Technician	$31,847.88	$58,387.68
OK	Metrologist III	Metrology/Calibration Engineer	$38,884.56	$71,288.40
OK	Metrologist IIII	Laboratory Supervisor	$43,162.68	$79,131.60
OR	Lead Metrologist	Metrology/Calibration Technician	$67,284.00	$98,472.00
OR	Metrologist	Metrology/Calibration Technician	$61,140.00	$89,544.00
PA	Laboratory Supervisor	Laboratory Supervisor	$53,613.96	$81,428.04
PA	Metrologist	Metrology/Calibration Technician	$50,151.96	$71,394.00
PA	Metrologist (PSL Basic Requirements)	Metrology/Calibration Engineer	$52,460.04	$71,394.00
PA	Metrologist (PSL Intermediate Requirements)	Metrology/Calibration Engineer	$54,747.96	$71,394.00
PA	Laboratory Administrative Assistant	Support Staff	$32,196.00	$48,039.00
PR	Laboratory Technician	Metrology/Calibration Technician		
SC	Program Manager I	Laboratory Supervisor	$32,838.00	$60,759.96
SC	Laboratory Technologist II	Metrology/Calibration Technician	$32,838.00	$60,759.96
SC	Laboratory Technologist II	Metrology/Calibration Technician	$32,838.00	$60,759.96
SC	Laboratory Technologist II	Metrology/Calibration Technician	$32,838.00	$60,759.96
SC	Administrative Assistant	Support Staff	$26,988.00	$49,932.00
SD	State Inspector	Metrology/Calibration Engineer	$33,528.00	$47,904.00
TN	State Metrologist		$36,636.00	$64,608.00
TX	Manager for Metrology Laboratory	Laboratory Supervisor	$51,612.00	$84,480.00
TX	Inspector V	Metrology/Calibration Engineer	$36,972.00	$58,392.00
TX	Program Specialist III	Metrology/Calibration Engineer	$42,240.00	$68,952.00
TX	Administrative Assistant IV	Support Staff	$32,976.00	$52,044.00

Lab ID	Job Title	Standardized Title	Min Annual	Max Annual
TX	Metrology Laboratory Technician	Support Staff	$24,912.00	$36,564.00
UT	State Metrologist	Metrology/Calibration Engineer	$43,800.00	$69,480.00
VA	Metrologist		$37,992.00	$49,992.00
VT	Weights & Measures Specialist/Metrologist		$55,992.00	$87,828.00
VT	Consumer Protection Specialist		$52,680.00	$82,608.00
WA	State Metrologist	Laboratory Supervisor	$44,652.00	$60,012.00
WI	Laboratory Director	Laboratory Supervisor	$46,917.36	$107,907.84
WI	Metrologist	Metrology/Calibration Technician	$46,845.36	$107,907.84
WI	Limited Term Employee (LTE)	Support Staff	$40,320.00	$40,320.00
WV	Program Specialist - Head Metrologist	Metrology/Calibration Technician	$32,496.00	$46,092.00
WV	Labor Inspector II - Assistant Metrologist	Metrology/Calibration Technician	$24,912.00	$43,896.00
WY	Inspection Supervisor	Laboratory Supervisor	$59,172.00	$88,764.00
WY	Inspection Specialist II	Metrology/Calibration Technician	$41,448.00	$62,184.00

Table 45: Metrologist position titles and salary ranges.

SLP Metrology Salaries - Standardized Title Comparison – Part 1

A comparison of salary ranging reported across the SLP is made here using the standardized titled reported for each job title;

- Laboratory Supervisor
- Metrology/Calibration Engineer
- Metrology/Calibration Technician

Salary comparisons were first compared using the data as reported by each laboratory without cost of living adjustments. Annual salaries for each position identified are plotted on a range from minimum to maximum and sorted on the highest possible compensation from high to low. Summary information for the entire program is provided showing minimum, maximum, and average values for the minimum salaries, maximum salaries, and salary ranges.

No adjustments have been made to these data to adjust for cost of living variations across the region.

Laboratory Supervisor

	Minimum	maximum	Average
Minimum Salary	$32,287.20	$83,160.00	$50,850.97
Maximum Salary	$48,924.00	$113,904.00	$77,948.48
Salary Range	$50,872.80	$64,980.00	$27,097.51

Metrologist/Calibration Engineer

	Minimum	maximum	Average
Minimum Salary	$30,000.00	$61,530.00	$44,294.29
Maximum Salary	$47,904.00	$79,116.00	$66,262.35
Salary Range	$31,530.00	$31,212.00	$21,968.06

Metrologist/Calibration Technician

	Minimum	maximum	Average
Minimum Salary	$24,072.96	$67,284.00	$39,378.61
Maximum Salary	$33,999.96	$107,907.84	$60,670.02
Salary Range	$43,211.04	$73,907.88	$21,291.42

Table 46: SLP metrologist compensation summary by standardized job titles.

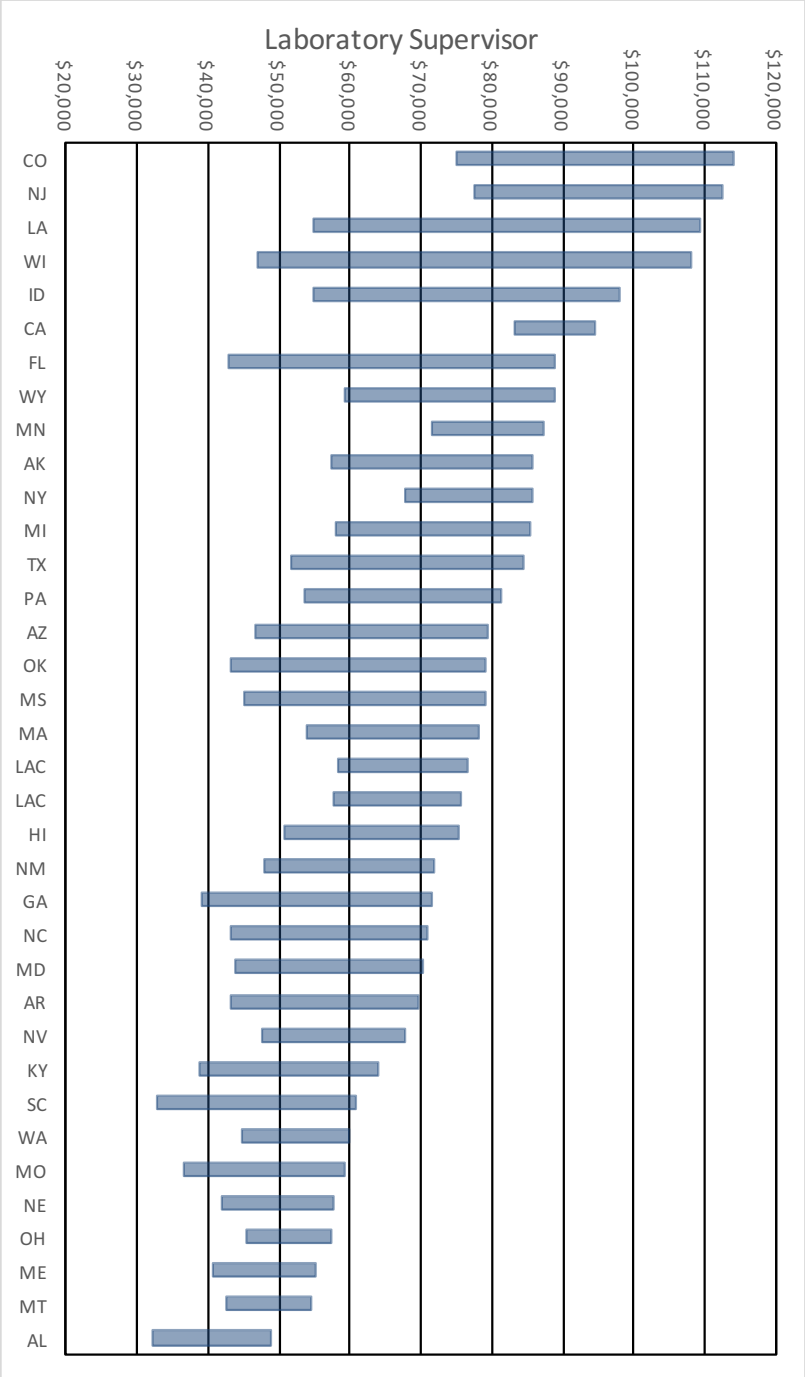


Figure 48: Salary ranges for Laboratory Supervisors

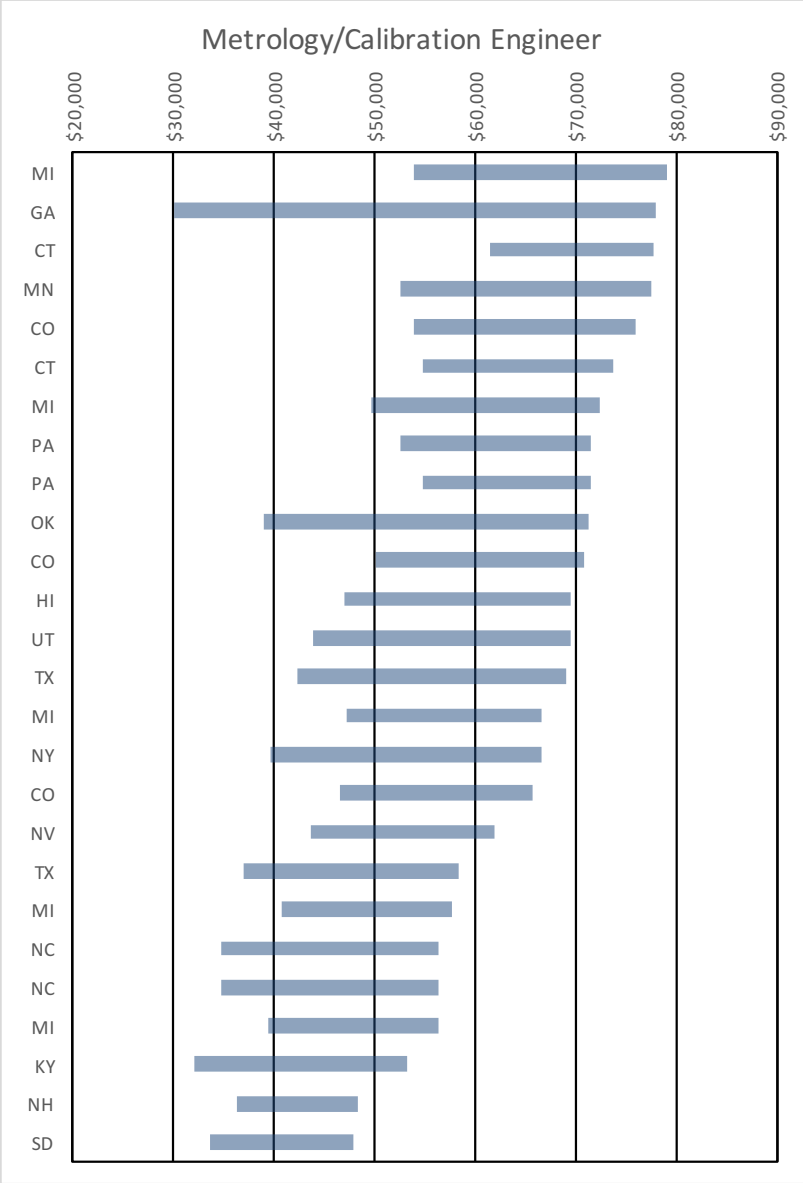


Figure 49: Salary ranges for Metrology/Calibration Engineers

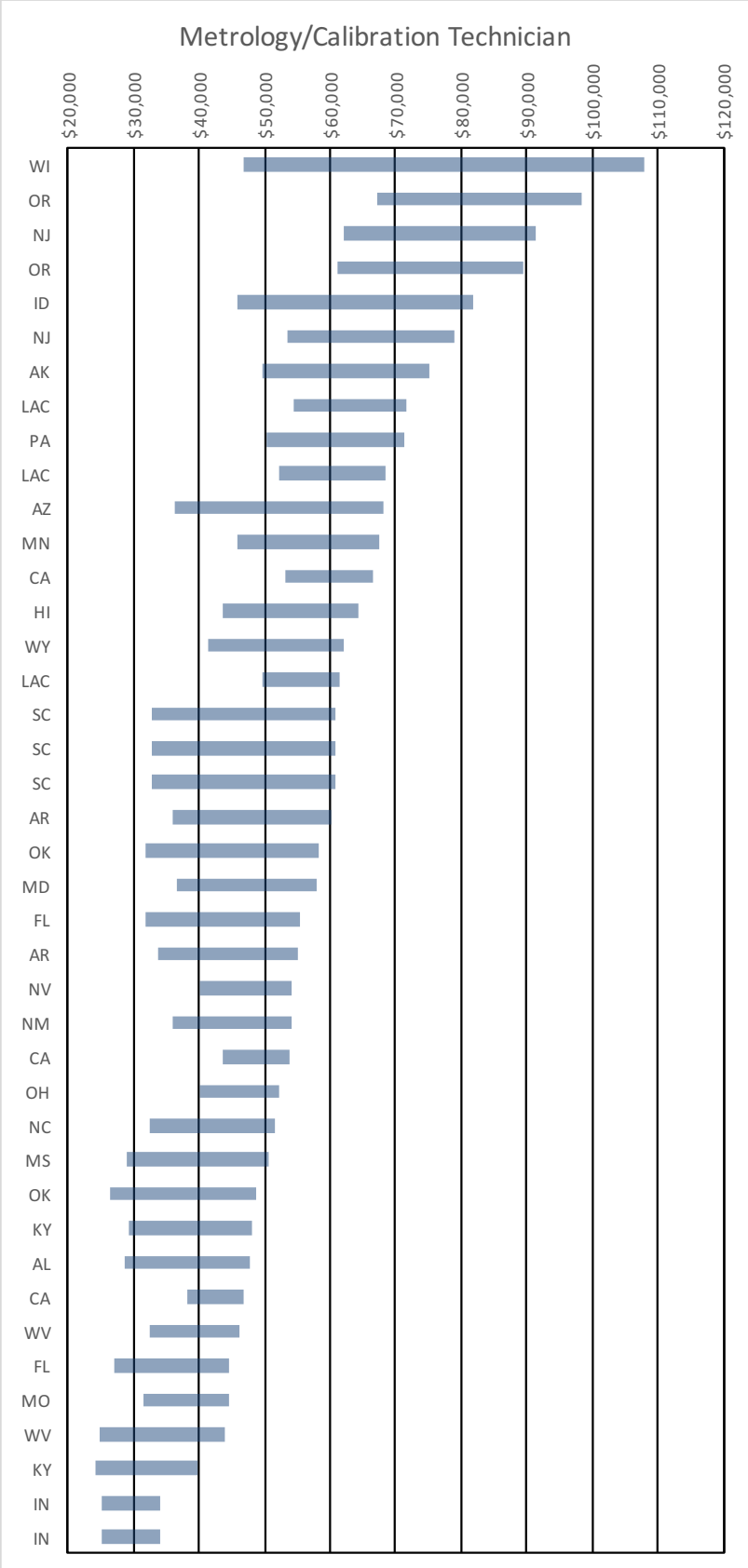


Figure 50: Salary ranges for Metrology/Calibration Technicians

SLP Metrology Salaries - Standardized Title Comparison – Part 2

A second comparison of salary ranging reported across the SLP is made here using the standardized titled reported for each job title;

- Laboratory Supervisor
- Metrology/Calibration Engineer
- Metrology/Calibration Technician

In this comparison the survey team utilized state and local government payroll data published by the United States Census.

https://www.census.gov/data/tables/2016/econ/apes/annual-apes.html

The United States Census surveys employment and payroll for the 50 state governments and all local governments including counties, municipalities, townships, special districts, and school districts. The average full-time employee annual salary is essentially assumed to represent the average compensation for all public employees in each region represented by the SLP.

The average annual public employee salary was calculated as the ratio of full-time payroll to full time employment obtained from the survey, “2016 United States Census State and Local Government Employee and Payroll Data Survey”. Metrologists’ salaries are reported in this section as the ratio of the salary in each region to the average public employee salary for that region. Federal government employment statistics are not included in the census survey cited.

It is acknowledged that this comparison is simplified as it neglects specific cost of living factors which can vary greatly from one municipality to another including cost of housing, cost of education, and cost health care. Public employee salaries are assumed to be indicative of the overall variations in the cost of living across the SLP regions as state and local governments must compete for qualified employees.

Laboratory Supervisor

	Minimum	maximum	Average
Minimum Salary	58%	110%	83%
Maximum Salary	89%	192%	128%
Salary Range	51%	103%	46%

Metrologist/Calibration Engineer

	Minimum	maximum	Average
Minimum Salary	53%	89%	69%
Maximum Salary	76%	153%	105%
Salary Range	36%	76%	35%

Metrologist/Calibration Technician

	Minimum	maximum	Average
Minimum Salary	45%	109%	65%
Maximum Salary	55%	169%	101%
Salary Range	64%	113%	36%

Table 47: SLP metrologist compensation summary by standardized job titles. Values are expressed as the ratio of reported salaries in all regions to the average public employee salary for all regions.

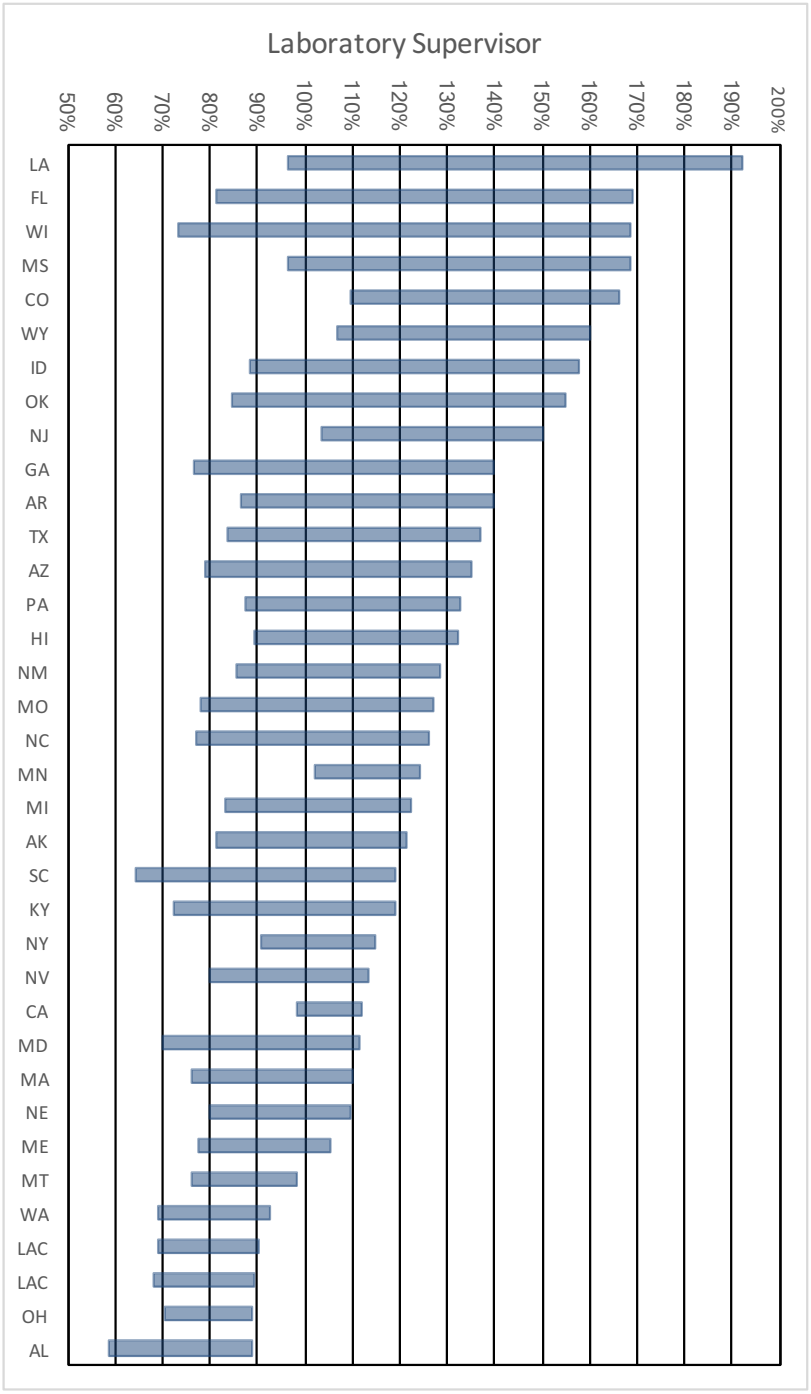


Figure 51: Salary ranges for Laboratory Supervisors expressed as the ratio of the salary in each region to the average public employee salary for that region

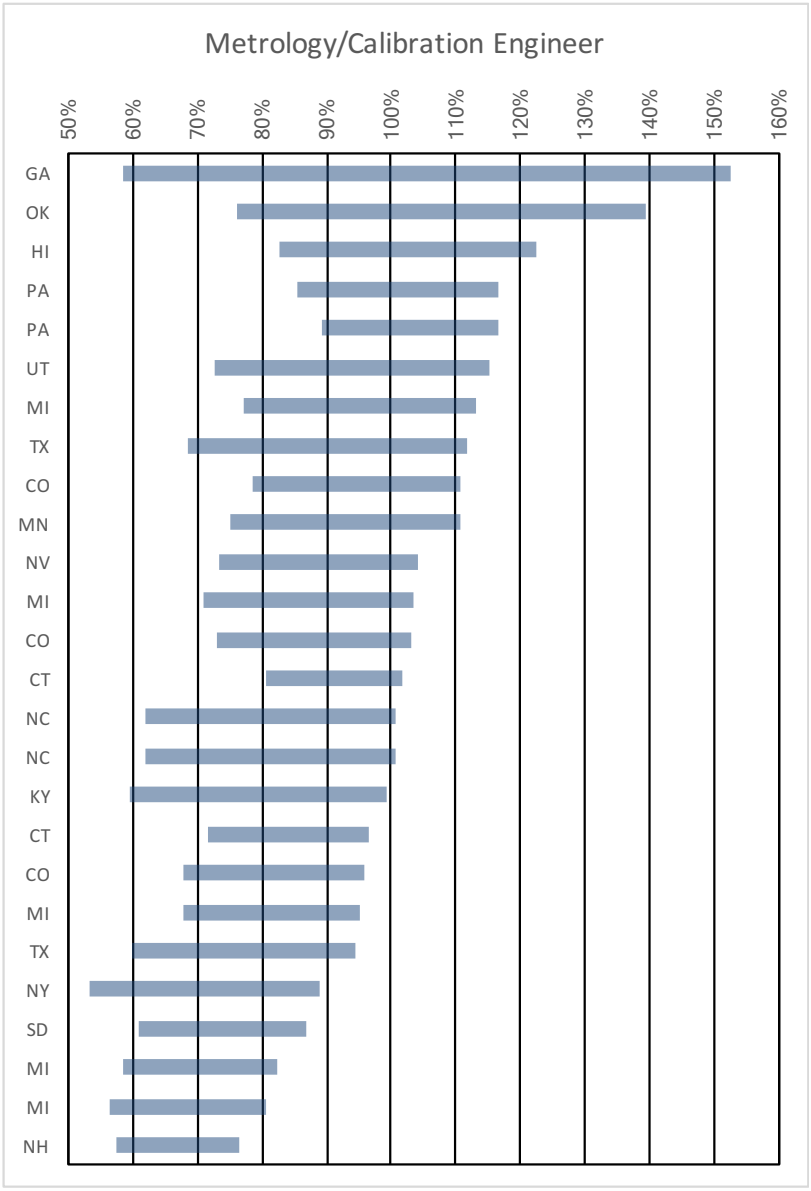


Figure 52: Salary ranges for Metrology/Calibration Engineers as the ratio of the salary in each region to the average public employee salary for that region.

Figure 53: Salary ranges for Metrology/Calibration Technicians expressed as the ratio of the salary in each region to the average public employee salary for that region.

2016 State Laboratory Program Metrologists

The survey requested specific data on each metrologists on staff in the SLP. These data include details on what measurements the metrologist is authorized to perform, his or her experience (in years) both in the SLP and outside of it, and the calendar year when he or she will be eligible for full retirement.

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time / Frequency	Temperature	Grain Moisture	Retirement	State Lab Exp.	Other Metrology Exp.	Total Metrology Exp
AK	Garret Brown	garret.brown@alaska.gov	N	P	F	F	F	N	F	N	N	2023	12	8	20
AK	Roger Holland	roger.holland@alaska.gov	N	P	F	F	P	N	F	N	N	2022	7	0	7
AL	Michael Bridges	michael.bridges@agi.alabama.gov			F	F						2027	7		7
AL	Deandre White	deandre.white@agi.alabama.gov			F	F						2038	3		3
AL	Anthony Gallagher	anthony.gallagher@agi.alabama.gov			F	F						2041	1		1
AR	Nikhil Soman	nikhil.soman@aspb.ar.gov			F	N					N	2032	5		5
AR	Charles Hawkins	charles.hawkins@aspb.ar.gov			F	F					N	2032	7		7
AR	Randy Burns	randy.burns@aspb.ar.gov			N	N					F	2008	42		42
AZ	Brian Sellers	bsellers@azda.gov		F	F	F	F					2024	12.5		12.5
AZ	Eric Gaedert	egaedert@azda.gov		F	F	F	F					2037	2.1		2.1
CA	Greg Boers	Greg.Boers@cdfa.ca.gov	N	F	F	F	F	F	F	F	N	2015	19	0	19
CA	Anthony Gruneisen	Anthony.Gruneisen@cdfa.ca.gov	N	F	F	F	F	F	F	F	N	2025	15	0	15
CA	Toni Bulai	Toni.Bulai@cdfa.ca.gov	N	P	P	P	P	P	P	P	N	2027	1	8	9
CO	Diane Wise	diane.wise@state.co.us	N	F	F	F	F	F	F	N	F	2012	23	0	23
CO	Kate Smetana	kate.smetana@state.co.us	N	F	F	F	F	N	F	N	F	2038	4.5	0	4.5
CT	Ana Maria Feliciano	ana.feliciano@ct.gov	N	N	F	F	N	N	F	N	N	2040	6		6
CT	Ion Daha	ion.daha@ct.gov	N	N	F	F	N	N	F	N	N	2033	8		8
FL	Amy Smith	Amy.Smith@freshfromflorida.com	N	F	F	F	P	N	N	N	N	2036	4		4
FL	Megan Money	Megan.Money@freshfromflorida.com	N	F	F	F	P	N	N	N	N	2042	4		4
FL	Michael Kruse	Michael.Kruse@freshfromflorida.com	N	F	F	F	P	N	N	N	N	2043	2.5		2.5
FL	Ryan DeSutter	Ryan.DeSutter@freshfromflorida.com	N	N	N	N	N	N	N	N	N	2045	1		1
GA	Kontz Bennett	kontz.bennett@agr.georgia.gov	N	F	F	F	P	P	N	N	N	2030	16		16
GA	Stan Diffie	stan.diffie@agr.georgia.gov	N	P	P	P	N	N	N	N	N	2027	0.17		0.17
GIPSA	Marcus Harwitz	Marcus.Harwitz@usda.gov			F								9	12	21
GIPSA	Al Rupert	Al.L.Ruert@usda.gov			F										
HI	Michael Tang	michael.tang@hawaii.gov	F	F	F	F	F	N	F	N	N	2019	16	0	16
ID	Kevin Merritt	kevin.merritt@agri.idaho.gov	N	F	F	F	F	N	N	N	N	2013	23		23
ID	Stacie Ybarra	stacie.ybarra@agri.idaho.gov	N	F	F	F	F	N	N	N	N	2034	5		5
IL	Karl Cunningham	karl.cunningham@illinois.gov	N	N	F	F						2025	12		12

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time / Frequency	Temperature	Grain Moisture	Retirement	State Lab Exp.	Other Metrology Exp.	Total Metrology Exp
IL	Berry Lauderdale	berry.lauderdale@illinois.gov	N	N	P	P						2035	0.5		0.5
IL	Mike Rockford	mike.rockford@illinois.gov	F	F	F	F							28		28
IN	Joshua Reagin	jreagin@isdh.in.gov			F	F						2060	3.5		3.5
IN	Howard Wickersham	hwickersham@isdh.in.gov			N	N						2025	1.5		1.5
KS	Kevin Uphoff	kevin.uphoff@ks.gov	F	F	F	F	F	N	N	N	N	2036	5		5
KS	Keith Arkenberg		F	F	F	N	N	N	N	N	N				
KY	Jason Glass	jason.glass@ky.gov	N	N	F	N	F	N	N	N	N	2029	13	0	13
KY	Chester Watson	chester.watson@ky.gov	N	N	F	N	F	N	N	N	N	2034	9	0	9
KY	Bill Baker	bill.baker@ky.gov	N	N	F	N	F	N	N	N	N	2035	9	0	9
LA	Richert Williams	richer_w@ldaf.state.la.us			F	F									
LAC	Kai-cheung (KC) Chow	Kchow@acwm.lacounty.gov	N	P	F	F	P	N	N	N	N	2011	15	0	15
LAC	Lina Ng	Lng@acwm.acwm.lacounty.gov	N	P	F	F	P	N	N	N	N	2038	9	0	9
MA	Raymond Costa	ray.costa@state.ma.us	N	N	F	F	N	N	N	N	N	2022	5	36	41
MD	Elizabeth Koncki	elizabeth.koncki@maryland.gov	N	N	P	P	N	N	N	N	F	2039	3		3
MD	Joseph Eccleston	joseph.eccleston@maryland.gov	N	N	P	P	N	N	N	N	N	2036	2		2
MD	Zach Tripoulas	zacharias.tripoulas@maryland.gov	N	N	F	F	N	N	N	N	N	2040	2		2
MD	Tong Hsu	tong.hsu@maryland.gov	N	N	P	P	N	N	N	N	N	2043	1		1
ME	Bradford Bachelder	bradford.bachelder@maine.gov	N	F	F	F	F	N	N	N	N	2053	5	0	5
MI	Craig Vanburen	vanburenc9@michigan.gov	P	P	P	P	P						17		17
MI	Neil Jones	jonesn@michigan.gov	F	F	F	F	F						17		17
MI	Nick Santini	santinin@michigan.gov		F	F	F	F						6		6
MI	Ryanne Hartman	hartmanr9@michigan.gov		F	F	F	F						6		6
MI	Scott Ferguson	fergusons9@michigan.gov		F	F	F	F						6		6
MN	Mark Nicollet	mark.nicollet@state.mn.us	P	F	F	F	F	N	N	N	N	2038	13	0	13
MN	Heidi Jones	heidi.jones@state.mn.us	N	P	F	P	N	N	N	N	N	2023	17	0	17
MN	Peter Whebbe	pete.whebbe@state.mn.us	N	F	F	F	F	N	N	N	N	2018	2	0	2
MN	Erik Alfvin	erik.alfvin@state.mn.us	N	F	F	F	F	N	N	N	N	2060	2	0	2
MN	Benj FitzPatrick	benjamin.fitzpatrick@state.mn.us	F	F	F	F	F	N	N	N	N	2047	3	0	3
MO	Kevin Hanson	Kevin.Hanson@mda.mo.gov	N	F	F	F	F	F	N	N	P	2021	17	4	21

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time / Frequency	Temperature	Grain Moisture	Retirement	State Lab Exp.	Other Metrology Exp.	Total Metrology Exp
MO	Tom Hughes	Tom.Hughes@mda.mo.gov	N	F	F	F	F	F	N	N	F	2022	18		18
MS	Mel Iasigi	Mel@mdac.ms.gov			F	F							16		16
MS	William Bell	WilliamBe@mdac.ms.gov			F	F							12		12
MT	David Fraser	dafraser@mt.gov	N	N	F	F	N	N	N	N	N	2030	3	0	3
NC	Sharon Woodard	sharon.woodard@ncagr.gov	F	F	F	F	F	F	N	F	P	2022	24.5	0	24.5
NC	Spurgeon Van Hyder	van.hyder@ncagr.gov	F	F	F	F	F	F	N	P	N	2024	22.5	0	22.5
NC	Ashley Lessard	ashley.lessard@ncagr.gov	P	P	F	F	F	F	N	N	N	2041	5.75	0	5.75
NC	Robert Rogers	robert.rogers@ncagr.gov	P	P	F	F	P	F	N	F	N	2041	5.17	8	13.1
NC	April Lee	april.lee@ncagr.gov	N	N	N	N	N	N	N	P	F	2042	4.5	0	4.5
NC	Sherry Teachey	sherry.teachey@ncagr.gov	P	P	F	F	F	F	N	P	N	2025	14	6.5	20.5
NC	Nicholas Cercone	nicholas.cercone@ncagr.gov	N	P	F	F	F	F	N	N	N	2045	1.67	0	1.67
NE	Joel P. Lavicky	joel.lavicky@nebraska.gov			p	p						2040	0.8		0.8
NH	Tim Osmer	timothy.osmer@agr.nh.gov	F	F	F	F	F	N	N	N	N	2041	10.5	0	10.5
NH	Richard Cote		F	F	F	F	F	N	N	N	N		19	0	19
NJ	Michael Cecere	CecereM@dca.lps.state.nj.us	N	N	F	F	N	F	F	N	N	2019	10	0	10
NJ	Kyle Pierson	PiersonK@dca.lps.state.nj.us	N	N	P	P	N	P	P	N	N	2040	1.5	0	1.5
NM	Clay Ivey	civey@nmda.nmsu.edu	N	F	F	F	F	N	N	P	N	2030	7		7
NM	Lorenzo Mireles	lmireles@nmda.nmsu.edu	N	N	P	N	P	N	N	N	N	2039	1		1
NV	Mary E. Gonzales	m.gonzales@agri.nv.gov		F	F	F	F					2020	2.5	10	12.5
NV	James Kellames	jkellames@agri.nv.gov		F	F	F	F					2035	3		3
NV	Jerome Plant	jplant@agri.gov.nv		N	N	P	N						0.75		0.75
NY	Eric Morabito	Eric.Morabito@agriculture.ny.gov	N	F	F	F	F	F	F	N	N	2019	5	0	5
NY	Jonathan Fox	Jonathan.Fox@agriculture.ny.gov	N	F	F	F	F	F	F	N	N	2030	1	0	1
NY	Michael Lejeune	Michael.Lejeune@agriculture.ny.gov	N	F	F	F	F	F	F	N	N	2035	1	0	1
OH	Tom Buck	tom.buck@agri.ohio.gov	N	F	F	F	F	N	F	N	N	2031	3	0	3
OH	Ken Johnson	ken.johnson@agri.ohio.gov	N	F	F	F	F	F	F	N	N	2020	27	6	33
OK	Jeremy Nading	Jeremy.Nading@ag.ok.gov	F	F	F	F	F	N	N	F	N	2037	10	0	10
OK	Richard Gonzales	Richard.Gonzales@ag.ok.gov	F	F	F	F	F	N	N	F	N	2012	30	0	30
OK	Erin Albers	Erin.Albers@ag.ok.gov	N	N	P	P	N	N	N	N	N	2038	2	0	2

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time / Frequency	Temperature	Grain Moisture	Retirement	State Lab Exp.	Other Metrology Exp.	Total Metrology Exp
OR	Aaron Aydelotte	aaydelotte@oda.state.or.us	F	F	F	F	F	N	N	F	N	2029	16	0	16
OR	Ray Nekuda	rnekuda@oda.state.or.us	F	F	F	F	F	N	N	N	N	2037	9	0	9
PA	James P. Gownley	jgownley@pa.gov	N	F	F	F	F	F	F	N	N	2030	15	0	15
PA	Christopher J. Drupp	cdrupp@pa.gov	N	F	F	F	F	F	F	N	N	2034	9	0	9
PA	Richard M. Radel, Jr.	riradel@pa.gov	N	F	F	F	F	F	F	N	N	2025	8.5	0	8.5
PA	David Welker	dawelker@pa.gov	N	F	F	F	F	F	F	N	N	2022	3.25	0	3.25
PA	Dustin Claycomb	duclaycomb@pa.gov	N	F	F	F	F	F	F	N	N	2031	2.5	5	7.5
PR	Abner Rodriguez	abrodriguez@daco.gobierno.pr	F	F	F	F	F	F	N	N	N	2040	14	0	14
SC	Robert McGee	rmcgee@scda.sc.gov	F	F	F	F	F				F	2023	22		22
SC	Timmothy Jones	tjones@scda.sc.gov	P	F	F	F	F				F	2044	3		3
SC	Terry Wessinger	twessing@scda.sc.gov	N	P	F	F	P				F	2019	4		4
SC	Antoine Montpeirous	amontpeirous@scda.sc.gov	N	P	F	P	P				P	2046	0	14	14
SD	Ron Peterson	ron.peterson@state.sd.us	N	N	F	F	N	N	N	N	N	2025	5		5
TN	K.H R Wilmoth	kenneth.wilmoth@tn.gov			F	F						2012	13		13
TX	Philip Lockwood	philip.lockwood@texasagriculture.gov	N	N	N	N	N	N	N	N	N	2005	1	0	1
TX	Preston Adachi	preston.adachi@texasagriculture.gov	N	F	F	F	F	N	N	N	N	2015	11	30	41
UT	Bill Rigby	brigby@utah.gov	N	P	F	F	P	N	N	N	N	2030	12		12
VA	William H. Loving	william.loving@vdacs.virginia.gov		X	X	X			X				17		17
VA	William I. Scott	william.scott@vdacs.virginia.gov											2		2
VT	Marc Paquette	marc.paquette@vermont.gov			F	F						2019	6		6
VT	Scott Dolan	scott.dolan@vermont.gov			P	P						2030	2		2
WA	Dan Wright	dwright@agr.wa.gov	F	F	F	F	F	F	F	N	N	2014	22	16	38
WI	Justin Lien	justin.lien@wisconsin.gov	N	N	F	F	N	N	N	N	N	2044	3		3
WI	Richard McCann	richard.mccann@wisconsin.gov	N	N	F	F	N	N	N	N	N	2026	17	5	22
WI	Paul Masterson	paul.masterson@wisconsin.gov	N	N	F	F	N	N	N	N	N	2045	2		2
WV	Anthony O'Brien	anthony.p.obrien@wv.gov	N	N	F	F	N	N	N	N	N	2025	19	0	19
WV	Tory Brewer	tory.d.brewer@wv.gov	N	N	F	F	N	N	N	N	N	2046	4	0	4
WY	Robert Weidler	robert.weidler@wyo.gov			F	F						2029	8	0	8
WY	Todd Stiles	todd.stiles@wyo.gov			N	N						2032	1	0	1

Table 48: Listing of SLP metrologists as of 2014. Each metrologist was asked to indicate which of the listed calibrations they are authorized to perform ("F" = Full authority, "N" = Not authorized, "P" = partial or limited authority), provide what year they are eligible for retirement, and to provide a measure of their metrology experience.

Figure 54: Retirement Eligibility Histogram. Of the 118 metrologists, 107 reported the year they would be eligible for full retirement. This may not reflect when any one person actually plans to leave the SLP.

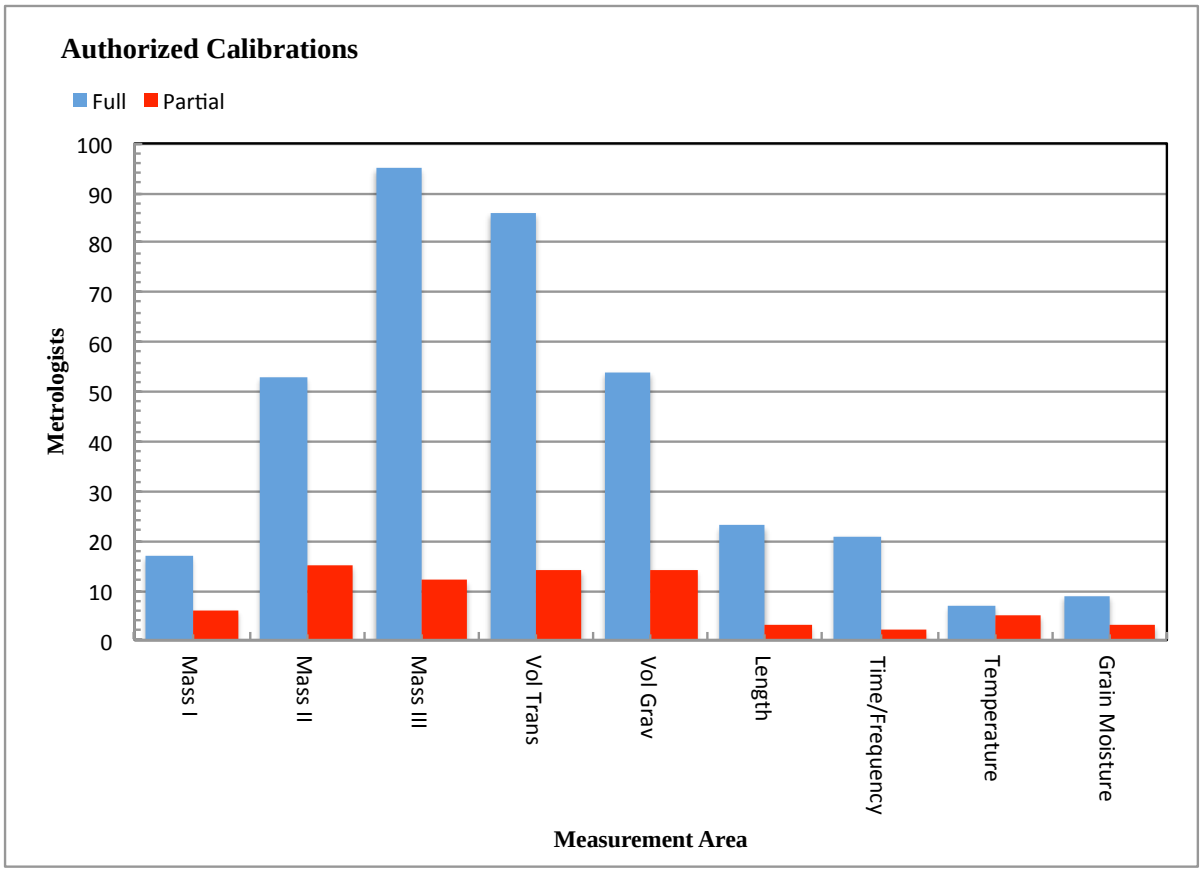


Figure 55: 118 Metrologists reporting. Metrologists were asked to indicate which type of calibrations they are authorized to perform on behalf of their laboratories.

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State Laboratory Program/Metrology Experience

Description

Total Metrology Experience:

Each metrologist was asked to disclose their metrology experience in years. The data was broken down into two categories, years experience in the SLP, and years metrology experience outside the SLP. Both Figure 56 and Figure 57 rank the SLP metrologists by total metrology experience.

Comparison of previous surveys

	Number of Metrologists	Average SLP Experience	Average Other Experience	Average Total Experience
2000	111	8.7	2.4	11.0
2002	113	9.1	2.1	11.2
2004	111	8.1	2.6	10.8
2006	112	8.3	3.1	11.4
2008	125	9.2	2.4	11.6
2010	121	9.5	1.9	11.4
2012	110	8.7	2.1	10.8
2014	118	9.2	1.7	10.9
2016	116	8.8	2.8	10.3

Table 49: Comparison matrix summarizing metrology experience reported by metrologists from 2000 to 2016.

Comments:

- Data was collected for 116 metrologist in the SLP from 49 laboratories.
- Each metrologist reports an average of 8.8 years the SLP experience each.
- Each metrologist reports an average of 2.8 years “other” experience each.
- Each of the 14 metrologist reporting “other” experience reports an average of 12 years other experience.
- Each metrologists report an average of 10.3 years total experience each.

NOTE: The survey team is aware of approximately half a dozen metrologists identified in this list who are either full time weights and measures employees working at best part time in the laboratory due to promotions or transfers or are working as post retirement contractors to help maintain laboratory accreditation. These individuals tend to be more senior and thus skew the overall measures of experience and retirement risk high.

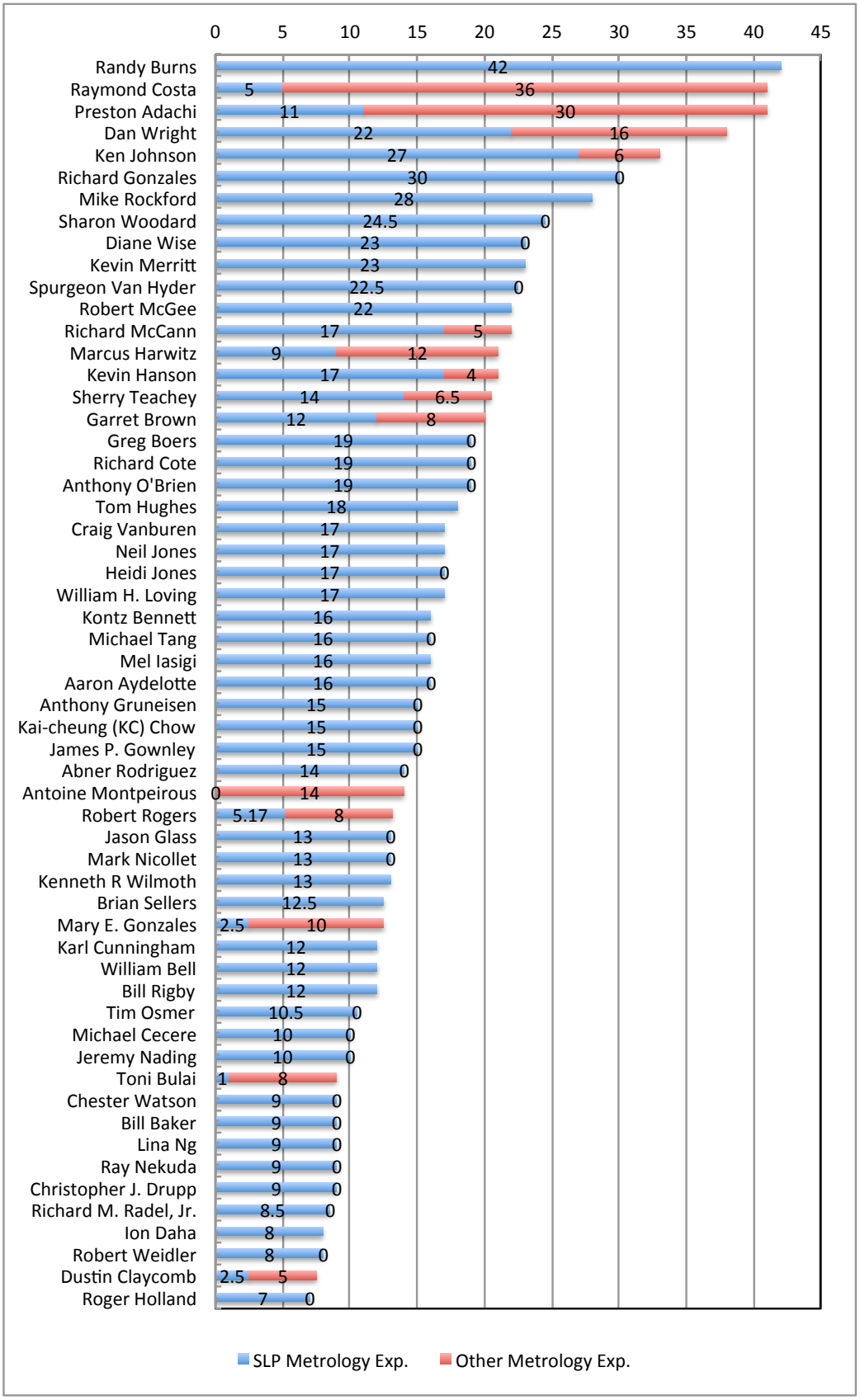

Figure 56: SLP metrologists ranked by years of experience. Blue indicates experience in the SLP, Red indicates other metrology experience.

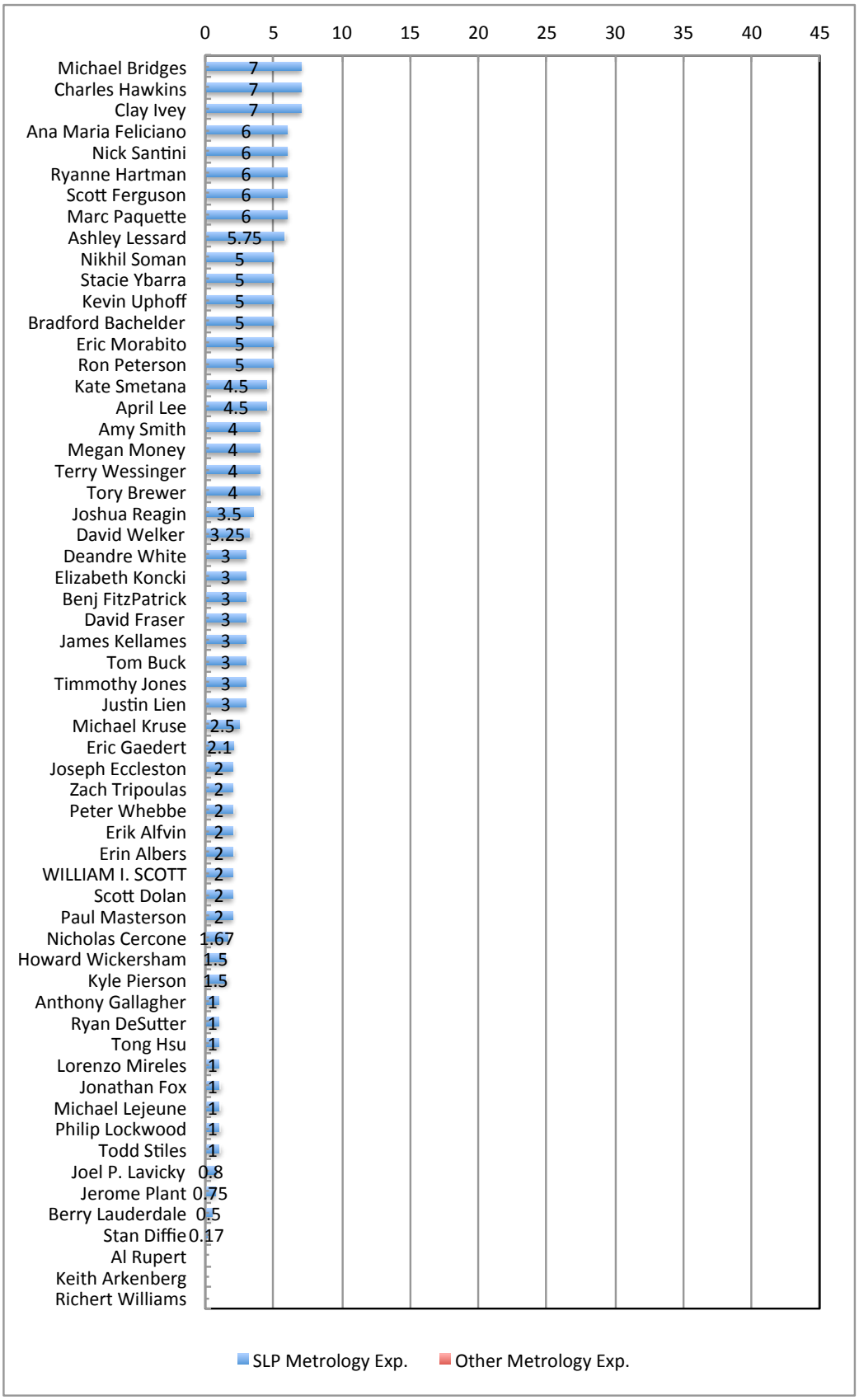

Figure 57: SLP metrologists ranked by years of experience. Blue indicates experience in the SLP, Red indicates other metrology experience.

Acknowledgment of Calibration Certificates Matrix

Each member laboratory was asked to identify what laboratories it will accept calibration certificates from. The choices were:

- From your laboratory ONLY[9].
- Any of the SLP member labs.
- Any SLP member lab having NIST/OWM Recognition.
- Any NVLAP Accredited Lab.
- Any Weight Manufacturer regardless of accreditation status.
- Any laboratory accredited by an accreditation body that is an ILAC signatory.

Lab ID	Your State Lab Only	Any State Lab Regardless of Status	Any NIST/OWM Recognized Lab	Any NVLAP Accredited Lab	Any Weight Manufacturer Regardless of Accreditation Status	Any Company or Lab that is Accredited by an Accreditation Body that is an ILAC Signatory
AK	No	No	Yes	Yes	No	Yes
AL	No	No	Yes	No	No	No
AR	No	No	No	No	No	No
AZ	No	No	Yes	Yes	No	Yes
CA	No	No	Yes	Yes	No	Yes
CO	Yes	No	Yes	Yes	No	Yes
CT	No	No	No	No	No	No
FL	No	No	Yes	Yes	No	Yes
GA	No	No	No	No	No	No
IL	No	No	No	No	No	No
HI	Yes	No	Yes	Yes	No	No
ID	No	No	Yes	No	No	Yes
IL	No	No	No	No	No	No
IN	No	No	Yes	Yes	No	No
KS	No	No	Yes	Yes	No	Yes
KY	No	No	Yes	Yes	No	Yes
LA	No	No	Yes	Yes	No	No
CA	No	No	Yes	Yes	No	Yes
MA	No	No	Yes	Yes	No	Yes
MD	No	No	Yes	No	No	No
ME	No	No	No	Yes	No	Yes

[9] This choice should have been exclusive of the other options. Some respondents may have answered this question assuming that this meant they would accept their own certificates in addition to others as identified.

Lab ID	Your State Lab Only	Any State Lab Regardless of Status	Any NIST/OWM Recognized Lab	Any NVLAP Accredited Lab	Any Weight Manufacturer Regardless of Accreditation Status	Any Company or Lab that is Accredited by an Accreditation Body that is an ILAC Signatory
MI	No	No	Yes	Yes	No	No
MN	No	No	Yes	No	No	No
MO	No	No	Yes	Yes	No	Yes
MS	No	No	Yes	No	No	No
MT	No	Yes	Yes	Yes	No	Yes
NC	No	No	Yes	Yes	No	Yes
NE	No	No	Yes	Yes	No	No
NH	No	No	Yes	Yes	No	Yes
NJ	Yes	No	Yes	No	No	No
NM	No	No	Yes	Yes	No	Yes
NV	No	No	Yes	Yes	No	Yes
NY	No	No	Yes	Yes	No	Yes
OH	No	No	Yes	Yes	No	No
OK	Yes	No	Yes	Yes	No	Yes
OR	No	No	Yes	Yes	No	Yes
PA	No	No	Yes	No	No	No
PR	Yes	No	No	No	No	No
SC	No	No	No	No	No	No
SD	Yes	No	Yes	Yes	No	No
TN	No	No	Yes	No	No	No
TX	No	No	Yes	Yes	No	Yes
UT	No	No	Yes	Yes	No	No
VA	No	No	No	No	No	No
VT	No	No	No	No	No	No
WA	No	No	Yes	Yes	No	Yes
WI	No	No	Yes	Yes	No	Yes
WV	No	No	No	No	No	No
WY	No	No	Yes	Yes	No	Yes

Table 50: Calibration Certificate acceptance matrix.

NOTE: The question of calibration acceptance seems to be a bit vague. One could take it to mean acceptance of a calibration certificate from a service provider for the calibration of measure and testing equipment used by the laboratory to carry out its work. Another interpretation involves the acceptance of those calibration certificates submitted by service agents registered or licensed by the state or county weights and measures program. A third interpretation would look at any calibration certificate submitted to the laboratory regardless of reason. The survey team cannot infer how each respondent interpreted the question.

Supplementary Questions

Some biannual surveys include a section covering subjects of potential interest by NIST OWM and the SLP member laboratories. These supplementary questions are designed to require only a minimum of research time in order to answer and the answers themselves are generally limited to one word, multiple choice responses.

Historical Supplementary Questions

- 2003 – Miscellaneous questions
- 2010 – Use of national and international standards (HB 105 series, OIML, ASTM)
- 2014 – Who do you use for calibration services; Time to calibrate measure and test equipment.
- 2016 – Weight cleaning policy, Masscode revision in service, largest weight cart, relative metric workload, and service request tracking.

There were 5 miscellaneous supplementary questions in the 2016 survey. Laboratory responses are tabulated in the following sections.

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Pre-Calibration Weight Cleaning Policy

Laboratories were asked if they routinely clean customer weights prior to calibration for echelon I, II, and III mass calibrations. A “Yes” response indicates that the laboratory will clean weights prior to calibration unless the customer requests that they not be cleaned.

NOTE: This question assumes that reasonable care of the weights prior to delivery to the laboratory for calibration. Weights which are visible soiled or are contaminated with foreign materials incompatible with the laboratory environment require special handling before measurements can be made. The laboratory may or may not contact the customer at this point depending on the policies and procedures in place.

Table 52 details responses supplied by each of the respondents. The survey team did not attempt to infer meaning in the absence of a response. Blank spaces indicate the absence of a response.

The following table provides an overview of weight cleaning policies as reported by the participant labs.

Summary	Echelon I	Echelon II	Echelon III
Yes	2	9	16
No	22	24	32
n/a	5	2	0
No response	20	14	1

Table 51: Laboratory pre-calibration weight cleaning policy summary matrix.

Lab ID	Echelon I	Echelon II	Echelon III
AK			Yes
AL			No
AR			No
AZ	No	No	No
CA		No	No
CO	n/a	yes	yes
CT	n/a	n/a	Yes
FL	No	Yes	Yes
GA	n/a	yes	no
GIPSA			No
HI	No	Yes	Yes
ID	NA	Yes	Yes
IL	No	No	No
IN			No
KS	No	No	No
KY	No	No	No
LA			No
LAC	No	No	Yes
MA			No
MD			No
ME	No	No	No
MI	No	No	No
MN	No	No	No
MO		No	Yes
MS			No

Lab ID	Echelon I	Echelon II	Echelon III
MT	No	No	No
NC	No	No	No
NE	No	No	no
NH	no	no	no
NJ	n/a	n/a	No
NM		Yes	Yes
NV		Yes	No
NY	No	No	No
OH	No	No	No
OK	No	No	Yes
OR	No	No	Yes
PA	n/a	No	No
PR	Yes	Yes	Yes
SC	Yes	Yes	Yes-SS Wts
SD			No
TN			Yes
TX	No	No	No
UT			Yes
VA		no	no
VT			No
WA	No	No	No
WI	No	No	Yes
WV			No
WY	No	No	Yes

Table 52: Laboratory pre-calibration weight cleaning policy responses.

Laboratories using Mass Code version 4.

Masscode was revised and released to SLP laboratories recognized for echelon I mass measurements in 2014. The software was updated primarily to

- make it compatible with more modern computer operating systems and
- to revise the method used by the software to estimate air buoyancy.

Each laboratory was asked to indicate whether or not they are using the latest revision of the masscode software. Labs responding "Yes" have adopted revision 4 into their calibration procedures. Labs responding "No" continue to use an older version of the software. Labs responding "N/A" are not using masscode in their laboratory.

The following table provides an overview of the use of Masscode revision 4 as reported by the participant labs.

Summary	Laboratories Using Masscode Version 4
Yes	9
No	1
N/A	39
No response	0

Table 53: Summary of laboratories currently using Mass Code version 4.

NOTE: Only 1 laboratory recognized for echelon I measurements is still using an old version. When asked the respondent stated that he is currently validating the software for use in the laboratory.

Lab ID	Using Mass Code Version 4?
AK	N/A
AL	N/A
AR	N/A
AZ	N/A
CA	N/A
CO	N/A
CT	N/A
FL	N/A
GA	N/A
GIPSA	N/A
HI	No
ID	N/A
IL	Yes
IN	N/A
KS	Yes
KY	N/A
LA	N/A
LAC	N/A
MA	N/A
MD	N/A
ME	N/A
MI	Yes
MN	Yes
MO	N/A
MS	N/A

Lab ID	Using Mass Code Version 4?
MT	N/A
NC	Yes
NE	N/A
NH	N/A
NJ	N/A
NM	N/A
NV	N/A
NY	N/A
OH	N/A
OK	Yes
OR	Yes
PA	N/A
PR	N/A
SC	Yes
SD	N/A
TN	N/A
TX	N/A
UT	N/A
VA	N/A
VT	N/A
WA	Yes
WI	N/A
WV	N/A
WY	N/A

Table 54: Laboratories currently using Masscode version 4.

Heaviest Weight Cart

Motorized weight carts are commonly used in the scale industry to test livestock and vehicle scales. Motorized weight carts come in a verity of shapes and sizes. Some are manufactured by a few suppliers in the US while others are custom made by individual service companies to accommodate specific storage and testing needs.

The SLP laboratories were asked to report the nominal mass of the heaviest cart they have seen in their laboratory. Figure 58 on page 154 is a histogram summarizing the responses received from all of the responding laboratories.

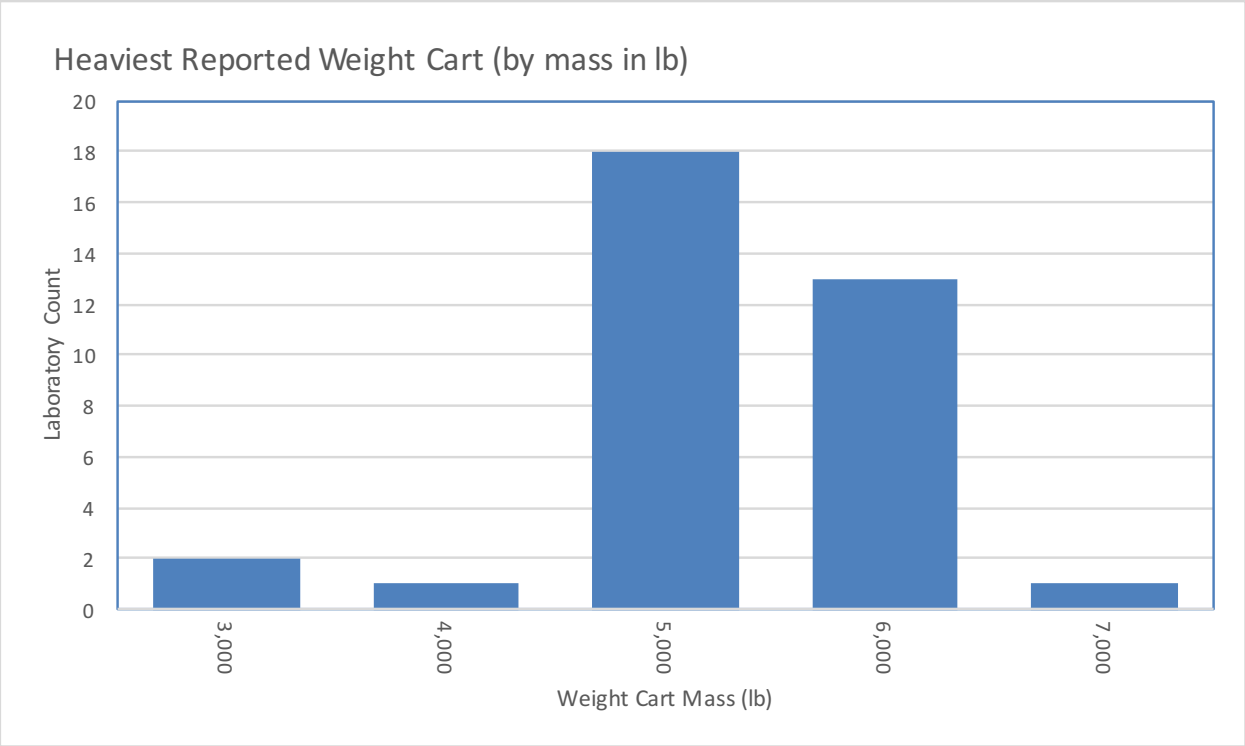

Figure 58: Heaviest weight carts reported by SLP laboratories.

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Relative Metric Workload

The SLP laboratories were asked to estimate the fraction of the metric mass standards in their overall mass measurement workload in order to get a rough estimate of the quantity of metric weights measured using echelon III measurement procedures. The question is broken down into three common categories of weights;

- Small scale testing weight kits. These are weight kits consisting of stainless steel weights having nominal mass values in metric units typically ranging up to 5 kg.
- Cast iron hand weights. These are typically cast iron pipe-handle style weights having nominal mass values in metric units in the neighborhood of 25 kg.
- Cast iron large weights. These are typically large cast iron weights having nominal mass values in metric units in excess of 50 kg.

Histograms of laboratory responses are presented in Figure 59, Figure 60, and Figure 61.

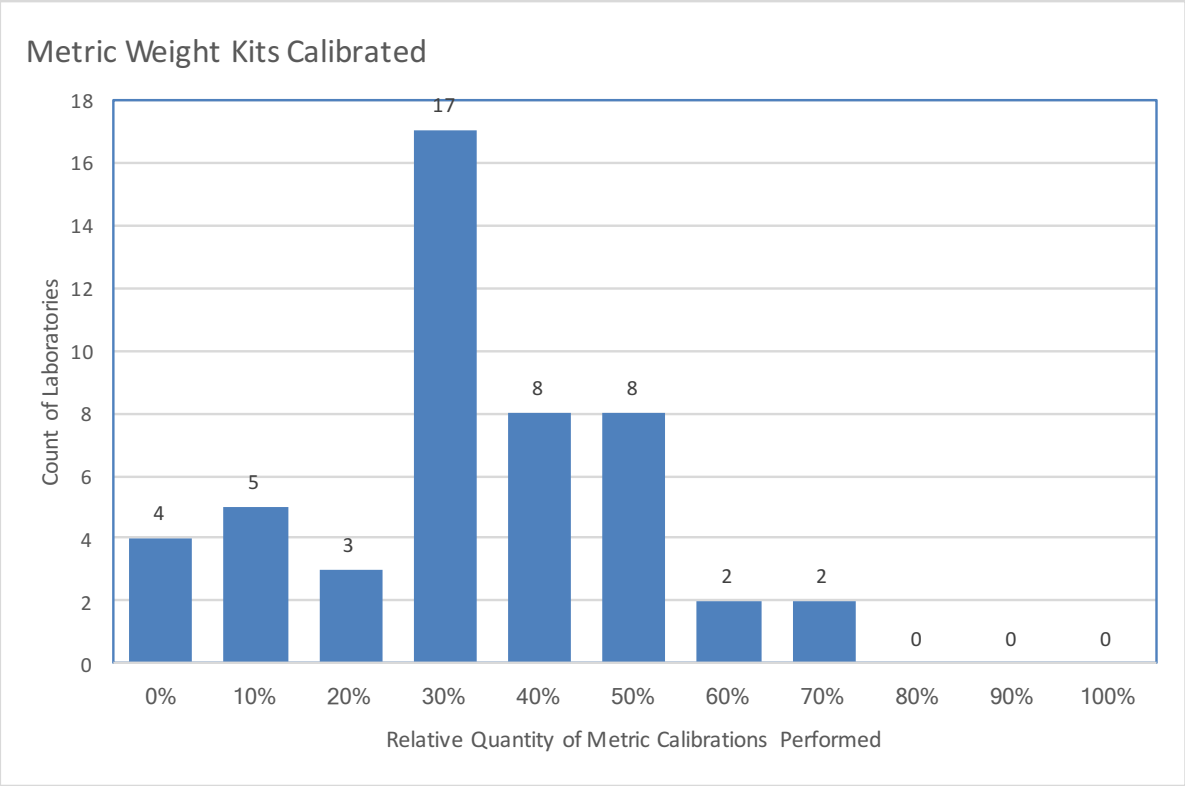

Figure 59: Relative portion of weight kits tested that are metric standards.

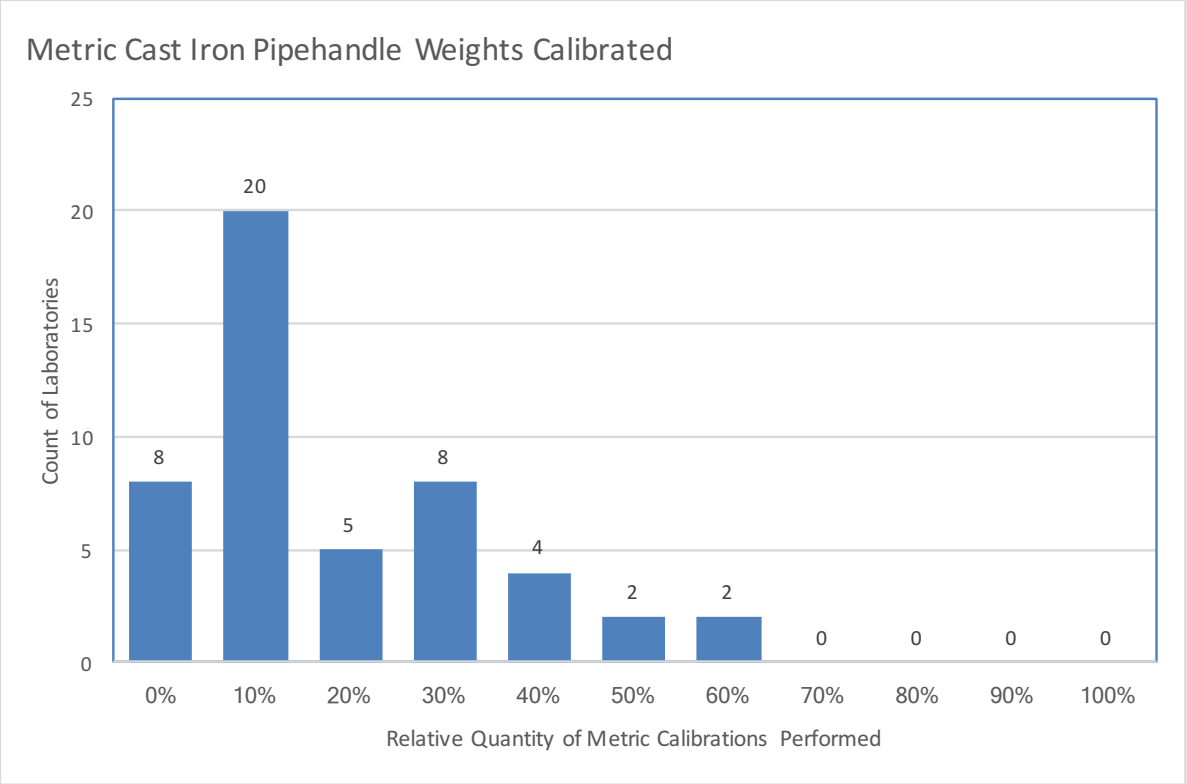

Figure 60: Relative quantity of metric cast iron pipe-handle metric weights tested.

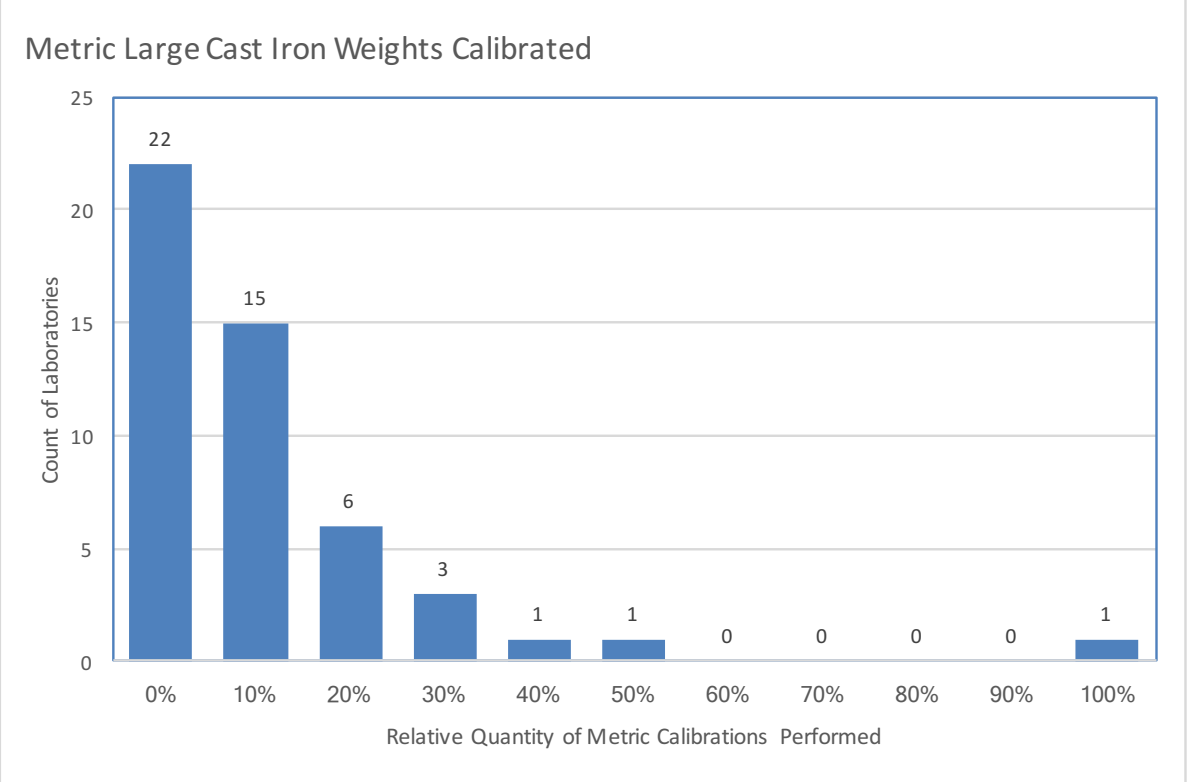

Figure 61: Relative portion of large cast iron metric weights tested.

Tracking Laboratory Service Requests

The SLP laboratories were asked;

1. if they actively track calibration services requested by their customers which they are unable to perform, and
2. to supply examples of services that their customers have requested

Responses are tabulated in Table 55 and summarized in Table 57. The survey team did not attempt to infer any meaning if a response was not provided. Blank spaces in the Table 55 indicate the absence of a response on the survey.

Table 57 lists the measurement services for which laboratories have received requests to perform as reported in the survey.

Tracking?	Count of Responses
Yes	15
No	24
No Response	10

Table 55: Summary of laboratories currently tracking customer service requests by survey response.

Lab ID	Tracking Service Requests?
AK	No
AL	No
AR	
AZ	No
CA	No
CO	Yes
CT	
FL	Yes
GA	Yes
GIPSA	
HI	Yes
ID	No
IL	No
IN	No
KS	Yes
KY	No
LA	No
LAC	Yes
MA	
MD	Yes
ME	Yes
MI	No
MN	Yes
MO	Yes
MS	No

Lab ID	Tracking Service Requests?
MT	No
NC	Yes
NE	No
NH	No
NJ	No
NM	
NV	Yes
NY	
OH	No
OK	Yes
OR	No
PA	No
PR	
SC	No
SD	Yes
TN	
TX	No
UT	No
VA	
VT	Yes
WA	No
WI	
WV	No
WY	No

Table 56: Laboratories currently tracking customer service requests.

Lab ID	Examples of Service Requests
AK	Precision weights (ASTM Class 2)
AK	Thermometry
AL	customers wanting a class higher than we can calibrated.
CA	Dimensional, calipers
CO	Echelon I calibrations
CO	Pressure gauges
CT	Mass Echelon I - Not in lab scope and Metrologist doesn't have training
CT	Mass Echelon II - Not in lab scope but Metrologist have training and participated in a PT - Intention to add to the scope in the near future
CT	Tapes - Not in lab scope and there is the need to recalibrate length bench in order to get the test in the scope of the lab
CT	Thermometry - No equipment in the lab to be able to perform tests (equipment is expensive) and lack of training
FL	2500 lb at the Echelon III level
FL	5 imperial gallons
FL	Echelon I
FL	Thermometry
GA	6000 lb. weight carts because the hoist does not meet the capacity.
GA	F-class weights that are over 2500 lb and up because the balance does not meet the capacity.
GIPSA	500 lb cast weights
GIPSA	Class F weight kits
GIPSA	weight carts less than 10,000 lb
HI	pressure
HI	temperature
HI	water meter
ID	Mass I
ID	Pressure Gauges
KS	flat granite surface table/plate
KS	thermometry
KY	Larger SI test weights
LAC	Echelon I and II mass calibrations- Lack of infrastructure and environmental stability to support measurements.
LAC	Large volume calibration- Lack of infrastructure and space for calibration.
MA	The occasional 1000 / 1500 gallon provers
MD	1,000 lb
MD	10,000 lb weight cart
MD	5,000 lb weight cart
MD	500 + gallon volume provers, volume transfer method
ME	Temperature calibrations. We have a lack of training, lack of time, and the work is not on our scope of accreditation

Lab ID	Examples of Service Requests
MN	Echelon I (prior to 12/2016)
MO	ASTM 1 calibrations, we are not a Mass I lab
MO	ASTM 2 calibrations, we temporarily lost Mass II due to environmental issues.
NC	Length - Gage Blocks
NC	Pressure Gages
NE	weight carts
NH	Lack of time or resources
NJ	2,000 lb Weight
NJ	Thermometry
NJ	Window Tint, Law Enforcement
NM	Gage block - 2 request
NM	Length - 1 request
NV	1 request for 2000 lb weight calibration (Mass Comparator limits)
NV	1 request for length calibration (not in scope send to other lab)
NV	2 requests for Echelon I calibration of metric weight kits (not in lab scope)
NV	2 requests for gage block calibration (not in scope or efficient)
NY	300 gallon LP prover
NY	300' tape
OH	Mass ASTM Class 1
PA	Echelon I Mass
PA	LPG Provers
PR	Lack of measurement standards
PR	Lack of time or other resources
SC	Load Cells
SD	<100 mg class F
SD	100 lb class F
SD	1500 lb class F
SD	Echelon II Mass
TN	METRIC WTS < 5KG
TX	Chitterling Sieve Tilt Block
TX	Metal Tapes
TX	Unclassified Weight for Safety Testing on Braking Systems
TX	Weight Baskets
UT	Large slab weights (2500 lb slab) = lack of equipment and facility
UT	Mass Echelon II and Echelon I = Lack of facility environment and not included on scope
UT	Weight Carts = lack of equipment and facility
VA	large vol
VA	LPG VOL

Lab ID	Examples of Service Requests
VA	temp
VT	Weight Carts.
WA	Troemner Ultra Class (I don't recognize as a valid class)
WI	Ech II requests
WI	newton weights
WI	troy weights
WY	5000 lb Class F weights (coal mine was thinking about purchasing some).
WY	Homemade weight trays.
WY	Precision weight calibration (EI or EII) for laboratory customer.

Table 57: Survey requests identified by responding laboratories.

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Comments – Survey Section 1 to 6

Sections 1 through 6 of the survey included questions covering

- the laboratory,
- job titles and salary ranges,
- laboratory customers, and
- acceptance of calibration certificates

Comments provided by individual SLP laboratories are listed in Table 58.

Lab ID	Comments
AK	Section 6: The laboratory's measurement scope and associated uncertainty is considered/evaluated.
AK	Section 6: The laboratory's measurement scope and associated uncertainty is considered/evaluated.
CO	We accept certificates from NON-state, ILAC signatory accredited labs only for work we are unable to perform at this laboratory (example: Echelon I calibrations).
CO	We accept certificates from NON-state, ILAC signatory accredited labs only for work we are unable to perform at this laboratory (example: Echelon I calibrations).
CT	The job description selected for Consumer Protection W&M Inspector has been chosen as Metrology/Calibration Engineer because the inspector that helps in the lab has training in Metrology (Basic Metrology Seminar), have been participating in PTs for the last 3 years and his background is Engineering.
CT	The job description selected for Consumer Protection W&M Inspector has been chosen as Metrology/Calibration Engineer because the inspector that helps in the lab has training in Metrology (Basic Metrology Seminar), have been participating in PTs for the last 3 years and his background is Engineering.
GA	State of Georgia accepts certificates from any NIST/OWM Recognized state lab. Private lab and manufacturer lab certificates are not accepted Georgia for licensing.
IN	Laboratory had conditional recognition for legal metrology work only during this time period
LA	not sure about all in A2LA thru Perry Johnson on list. Will have to review any lab accredited by these organizations.
ME	Not able to sort for section 5 to determine those that are not Weights and measures officials or service companies. Would estimate 20.
NC	I do not have an adequate way to determine which companies are NOT W&M officials or Service Companies. I provided a guesstimation.
NE	The Nebraska Standards Lab is retooling and is not currently open. The Nebraska Standards Lab is retooling and is not currently open. We hope to be able to complete a survey next year.
OK	A state laboratory or even a NVLAP accredited laboratory must be recognized by the Office of Weights and Measures before an acceptance of the calibrations can be made for legal for trade applications.
SC	New lab under construction. To be completed August 2017.
WY	Inspection Specialist is only part-time laboratory assistant, once training is completed they will hopefully play a more important role in laboratory functions.

Table 58: Comments provided by respondents regarding sections 1 through 6 of the survey.

Section 7 Comments

Section 7 of the survey includes questions regarding individual metrologists working in the SLP. Comments provided by individual SLP laboratories are listed in Table 59.

Lab ID	Comments
AK	Years of experience rounded to nearest year
AK	Years of experience rounded to nearest year
CT	The year eligible for retirement has been calculated when personnel reach the age of 67 which is the year for full (normal) retirement age for the personnel listed in Section 7. Years of Metrology experience of Ion Daha (W&M inspector) has been counting since he attended the Basic Metrology Seminar (in 2008) even he doesn't work full time in the lab (he has been helping the Metrologist in the lab and the last 3 years have been participating in PTs).
CT	The year eligible for retirement has been calculated when personnel reach the age of 67 which is the year for full (normal) retirement age for the personnel listed in Section 7. Years of Metrology experience of Ion Daha (W&M inspector) has been counting since he attended the Basic Metrology Seminar (in 2008) even he doesn't work full time in the lab (he has been helping the Metrologist in the lab and the last 3 years have been participating in PTs).
KS	During 2016 Keith Arkenberg also worked for the Kansas Metrology Laboratory but left 12/16/2016. Keith had the same authorized calibrations as Kevin except for the volume transfer and volume gravimetric.
MD	Grain is not on Scope. State regulator use only.
ME	There are two other people here that take measurements, one does air quality filters and one does wheel load weighers. Each technician is restricted to that item only. Air quality filters are not on our scope per say. The one doing wheel load weighers is a Maine State Trooper and the one doing filters is a weights and measures inspector.
MS	Year Eligible for Retirement: Mel Iasigi – 2020, William Bell – 2030. Cell in above section not accepting any year.
NE	The Nebraska Standards Lab is retooling and is not currently open. We hope to be able to complete a survey next year.
NH	Neither of the above still work in the lab.
NM	Actual Period of Time Covered: From 1/1/16 to 12/31/16
NV	Jerome is the metrologist in training at the Las Vegas Satellite lab. He plans on being there for 10 years
NY	Lejeune eligible to retire in 2035
TN	AN ADDITIONAL METROLOGIST HAS BEEN HIRED AND IS CURRENTLY BEING TRAINED BY NIST. THE HIRING PROCESS FOR A THIRD METROLOGIST IS IN PROGRESS.
TX	Cell M6 is not formatted correctly so line was skipped.
VT	Scott Dolan has attended Fundamentals of Metrology training and is working on his LAP problems. He is not yet a signatory, his work is reviewed by the metrologist Marc Paquette.
WY	Todd Stiles is currently in the training process and is not authorized to complete any calibrations on his own. He has attended Fundamentals and is scheduled for the mass seminar March 13, 2017.

Table 59: Comments provided by respondents regarding section 7 of the survey.

Comments – Survey Sections 8 to 30

Sections 8 through 30 of the survey cover the production of measurements by the SLP laboratories and the fees charged for measurement services. Comments provided by individual SLP laboratories are listed in Table 60.

Lab ID	Comments
AK	Price for a 3000 lb, or a 4000 lb weight cart, 6 hours @ $85/hr. Alaska does not have any 5K weight carts.
AK	Price for a 3000 lb, or a 4000 lb weight cart, 6 hours @ $85/hr. Alaska does not have any 5K weight carts.
CT	There is no charge for CT State Agencies, CT City Sealers. Fees are charged to industry's companies. For companies/individuals who uses equipment for W&M applications such as dealers and repairmen there is no charge if the following 3 conditions are met: the company is based in Connecticut or have a place of business in CT, they have a Repairmen / Dealer license from CT, and the technician that use the equipment leaves in CT. If one of the conditions is not met the lab will charge for the service.
CT	There is no charge for CT State Agencies, CT City Sealers. Fees are charged to industry's companies. For companies/individuals who uses equipment for W&M applications such as dealers and repairmen there is no charge if the following 3 conditions are met: the company is based in Connecticut or have a place of business in CT, they have a Repairmen / Dealer license from CT, and the technician that use the equipment leaves in CT. If one of the conditions is not met the lab will charge for the service.
GA	Out-of-state customers that are both located out-of-state and perform no work in Georgia are charged double the normal fees. Customers that are located out-of-state but perform work in Georgia are not considered to be out-of-state customers, and are therefore not charged double the normal fees. Also, out-of-state fees will not be charged to out-of-state customers that do not have an available NIST traceable laboratory in their state.
KS	Adjustment fees remain the same for out-of-state customers, however, out-of-state customers pay anywhere from $4.00 to $20.00 more per item depending on the item.
MA	The $45.00 fees shown in all of the above sections is per hour per person. We do not have flat fees based upon weight denominations, kit designs, number of pieces etc. (although I have attempted to change this but have met with resistance from on high). Only the Mass Echelon III calibration of large capacity 1000 lb and 500 lb weights and the Volume Transfer calibration of provers of 50 and 100 gallons always requires two men for safety purposes and therefore calculates to a fee of $90.00 per hour ($45.00 per hour per person). Fees are charged based upon this rate and duration of time required to perform the calibration and prepare the calibration certificate(s).
ME	The temperature calibration recorded in Sec. 22 is an off-sight calibration at a cannery.
NC	Fees are doubled for standards used primarily outside of NC. In Section 26, we test both mass & diameter.
NE	The Nebraska Standards Lab is retooling and is not currently open. We hope to be able to complete a survey next year. The fees we charge for all kits and large volume is 80.0$ per hour. 50 lb wts. are 8.50$ each and 50 to 1200 lb wts are 23.50 each. If we need to adjust artifacts, we charge 80.0$ per hour. Our rates have not changed for at least since 1998.
NH	We do not do weight carts, but provided the 50 lb cast iron weight cost above. "Lab (Internal)" = lab "W&M Program" = W&M field employees "External Customers" = licensed service technicians and business not associated with W&M
NV	These numbers are estimates since we charge by the hour not by the specific job
NY	Only mass is checked on lottery balls (drop down not working)
OK	Out of state customers are charged twice the fees for the same test items as in state customers. The reason this is enforced is because customers within the state of Oklahoma are charged taxes to fund the operations of this laboratory and the fee adjustment for out of state customers helps to offset this differential for them not supplementing the funding of the laboratory through taxes.
PR	The Laboratory fee is based on $75 per hour or fraction.
TX	Cells I 98,99,100 will not accept any answer that I try to enter. We only test the mass of the lottery balls.
VT	In State hourly Fee = $60.00/Hour Out of State Hourly Fee = $75.00/ Hour. In State 5-Gallon Measure = $45.00. Out of State 5 Gallon Measure = $60.00.
WI	Costs under Laboratory Fees: does not include our standard charges that get added onto each work order: Administrative Fee = $23.10; Certificate Fee = $ 35.00 (each)
WY	Out-of-state customers are charged double the in-state rate (rates listed are in-state).

Table 60: Comments provided by respondents regarding section 8 through 30 of the survey.

General Survey Comments

At the end of the workload survey the responding laboratory has an opportunity to provide any general comments about the entire survey. These comments are listed in Table 61.

Lab ID	Comments
NY	Due to loss of trained personnel, the NY Metrology Lab was issued a limited scope by NIST in June 2015 which allowed calibrations for Legal Metrology purposes only. Our full scope was reinstated by NIST on July 1, 2016. Additionally, the NVLAP accreditation ws suspended in July 2015 and remains so as of March 2017. A NVLAP audit was conducted in December 2016 and our full accreditation should be reinstated by the end of March 2017.
NM	I am surprised it wasn't a question but I just spent 157 minutes of my small life on this, sorry I did not get this to you sooner.
GIPSA	I was unable to enter the maximum monthly salary for the program manager position. The maximum monthly salary is $10,249.
NC	In Section 26 [Lottery Balls] - we test both mass and diameter.
MA	NOTE: The $45.00 per hour fee is "per man". This fee is charged only to customers in private industry and Weights and Measures officials from other states who come to MA because their state has no Metrology Laboratory (RI). Services performed for MA state agencies and city and town Sealers of Weights and Measures are never charged a fee. The predominance of this laboratory's services are provided to the 231 city and town sealers and a handful of service companies. Since the laboratory in a one-person occupied facility (me), all services are performed by this one person. I act as their metrologist, laboratory manager, quality manager, technical manager, certificate typist and all other duties associated with a metrology laboratory. The only time a field inspector is called in from the field to assist me is when performing calibration to 500 and 1000 lb cast iron weights used by truck scale servicing companies and oil provers of 100 gallon capacity. In these two cases, the $45.00 per hour fee is charged for both the metrologist (me) and the field inspector assisting me.
AK	Provided in sections as needed. Thank you, I use the surveys often when communicating with management.
AK	Provided in sections as needed. Thank you, I use the surveys often when communicating with management.
OH	Recent surveys have been completed in even numbered years only. This cycle is possibly missing trends in work due to two year calibration cycles that are required by most states for service companies' standards. Switching to odd numbered years for 2-3 cycles may reveal interesting trends with work loads based on recalibration intervals of external customers.
MD	Section 7 lists four personnel who perform metrology measurements/functions in the lab, but all are not full-time in the metrology lab. One is 50 % time to metrology, one is 25 % time to metrology, one is 5% time to metrology and the other was in training (15 % of time) for metrology in 2016.
PA	The Pennsylvania Standards Laboratory uses the results of this survey to evaluate fees, staffing and overall workload. The work that goes into getting this information compiled and published is greatly appreciated.

Table 61: General comments provided by respondents of the workload survey.

2016 Workload Information

NOTE: The following information should be based on a 12 month period, preferably Jan 1, 2016 through Dec 31, 2016 or the most recent fiscal year. Reported data should not be estimates. If unable to quote actual data, please attach your comments to the end of this survey.

Actual Period of Time Covered: From _____ To _____

8. Mass Echelon I (Match with Handbook 143 and Lab Scope)		
Number of mass standards calibrated using Advanced Weighing Designs and Mass Code Data Reduction. Regardless of Class and ASTM 1 or better, OIML E1, E2	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

9. Mass Echelon II (Match with Handbook 143 and Lab Scope)		
Number of mass standards. ASTM Class 2, 3 OIML Class F1, F2	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

10. Mass Echelon III (Match with Handbook 143 and Lab Scope)		
Number of mass standards (except weight carts). ASTM Class 4, 5, 6, 7 OIML Class M1, M2, M3 NIST Class F	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

11. Weight Carts		
Number of weight carts calibrated.	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

12. Railroad Test Cars (Master Scale)		
Number of cars calibrated.	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

13. Railroad Specific Weight Carts		
Number of weight carts calibrated.	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

14. Volume – Glassware			
Number of individual pieces of volumetric glassware calibrated. Note: Indicate number of Volume Transfer (V-T) (Volume II) and/or Gravimetric test methods (Volume I).		Vol-Transfer	Gravimetric
	Lab (Internal)		
	W&M Program		
	External Customers		
	Total		

15. Volume - SVP (Small Volume Provers) and CDP (Closed Loop Provers) (NOT test measures)			
Number of small volume provers calibrated.			Gravimetric
	Lab (Internal)		
	W&M Program		
	External Customers		
	Total		

16. Volume – LPG			
Number of individual LPG provers calibrated. Note: Indicate number of Volume Transfer (V-T) and/or Gravimetric test methods.		Vol-Transfer	Gravimetric
	Lab (Internal)		
	W&M Program		
	External Customers		
	Total		

17. Non-Pressurized Small Metal Standards (≤5 gallon)			
Number of metal volumetric standards (20 liter / 5 gallon and smaller). Note: Indicate number of Volume Transfer (V-T) and/or Gravimetric test methods.		Vol-Transfer	Gravimetric
	Lab (Internal)		
	W&M Program		
	External Customers		
	Total		

18. Volume – Non-Pressurized Medium Metal Standards (> 5 gallon and ≤ 100 gallon)			
Number of metal volumetric standards (larger than 20 liter / 5 gallon and less than or equal to 400 liter / 100 gallon). Note: Indicate number of Volume Transfer (V-T) and/or Gravimetric test methods.		Vol-Transfer	Gravimetric
	Lab (Internal)		
	W&M Program		
	External Customers		
	Total		

19. Volume – Non-pressurized Large Metal Standards (> 100 gallon)			
Number of metal volumetric standards (greater than 400 liter / 100 gallon). Note: Indicate number of Volume Transfer (V-T) and/or Gravimetric test methods.		Vol-Transfer	Gravimetric
	Lab (Internal)		
	W&M Program		
	External Customers		
	Total		

20. Length - Tapes		
Number of individual tapes (metal, fiberglass, woven fiberglass, cloth, etc.). Please enter number of devices tested, NOT number of points tested.	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

21. Length - Rigid Rules		
Number of rigid rules calibrated.	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

22. Thermometry		
Number of thermometers tested (mechanical, liquid-in-glass, thermocouples, thermistors, PRTs, SPRTs).	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

23. Frequency		
Number of frequency standards tested (includes tuning forks).	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

24. Timing Devices		
Number of timing devices tested (stopwatches).	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

25. Wheel Load Weighers		
Number of wheel load weighers tested:	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

26. Lottery Balls		
Number of lottery balls tested: Characteristic Tested: ❑ Mass ❑ Diameter ❑ Other *Describe Other*_____	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

27. *(A) Other Types of Measurements not covered in this survey*		
Describe type of measurement:	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

28. *(B) Other Types of Measurements not covered in this survey*		
Describe type of measurement:	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

29. *(C) Other Types of Measurements not covered in this survey*		
Describe type of measurement:	Lab (Internal)	
	W&M Program	
	External Customers	
	Total	

30. Laboratory Fees and Estimates		
In this section please estimate the typical fees charged for each of the described examples.		
Does your laboratory charge fees for external customers? YES ❑ NO ❑		
Do you have a minimum fee?		$
[Mass Echelon I] ASTM Class 0 Precision mass set 100 g to 1 mg (21 weights)		$
[Mass Echelon II] ASTM Class 2 Precision mass set 100 g to 1 mg (21 weights)		$
One – 31 lb Class F weight set (22 weights)		$
5,000 lb weight cart		$
Scale test truck:	24 – 1000 lb weights (5 adjusted)	$
	20 – 50 lb weights (5 adjusted)	$
	2 – 31 lb weight sets (22 weights each)	$
	TOTAL	$
One – 5 gallon test measure using volume transfer method:		$
One – 5 gallon test measure using gravimetric method:		$
One – 100 gallon prover using volume transfer method:		$
One – 100 gallon prover using gravimetric method:		$
One – 100 gallon LPG prover:		$
(deleted)		
One – 20 gallon SVP or CLP using gravimetric method:		$
One – 100 foot tape with 19 points tested:		$
Are out-of-state customers charged more than your in-state customers? YES ❑ NO ❑ If YES, please explain in the comment section.		

Supplementary Questions	
31. Do you clean the unknown weights prior to calibration?	Yes / No
32. Are you using the latest version of the Mass Code provided by NIST (Mass Code 4)?	Yes / No
33. What is the heaviest weight cart you have seen? (Do not include railroad track scale specific carts)	Weight (lb):
34. Estimate the ratio of proportion of metric weights your lab calibrates at Echelon III for; (provide your response as a percentage of your overall EIII workload)	Small Scale Testing Kits; Cast Iron Hand Weights; Cast Iron Large Weights;(
35. Identify some requests for calibration services that you have been unable to provide.	1) 2) 3) 4) 5)

1. Comments on Survey

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