Weights & Measures Quarterly

The Newsletter of the Weights and Measures Division
http://www.nist.gov/owm
Vol. 7 No. 3 August 2004

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

NIST Hosts W&M Administrators' Workshops

By Henry Oppermann

Fifty-one people, representing 39 state and local jurisdictions, attended two weights and measures administrators' workshops in June. The workshops, hosted by NIST Weights and Measures Division (WMD), provided enlightening presentations and stimulating discussions. NIST WMD plans to use the many important points raised in the discussions to develop an overview of weights and measures administrative issues for new W&M administrators. The participation of everyone in the discussions generated insightful and motivating ideas for dealing with the complex issues confronting W&M administrators. Our thanks to the following speakers, who put extensive effort in the development and delivery of impressive presentations:

The Secrets of a Successful Program: Steve Malone, NE; Mike Cleary, CA; and Tom Geiler, Barnstable, MA
Managing Inspections: Steve Malone, NE, and Alan Rogers, VA
The Future of W&M Oversight: Carol Hockert, MN; Craig Leisy, Seattle, WA; Bob Williams, TN; and Richard Cote, NH
Preparing a Legislative Package: Aves Thompson, AK, and Jerry Buendel, WA
Impact of Funding Sources: Mike Pinagel, MI, and Charles Gardner, Suffolk County, NY

During the first portion of each workshop, Bill White, Brent Rowe, and Alan O'Connor of RTI International presented information on the preliminary analysis of the data submitted in response to the NIST survey coupled with the results of the NCWM survey. Questions, comments, and discussions raised many valuable points that are being incorporated into the analysis. One of the difficulties revealed by the surveys is that there are variances in how W&M jurisdictions classify devices and the types of record-keeping systems used to track device and package inspections. A proposal made during the workshops suggested a "recommended" categorization of devices and a "recommended" record-keeping system structure be developed. If modification of a record-keeping system is needed, the jurisdiction should develop a system more consistent with the "recommended" system in order to generate inspection results comparable across other jurisdictions.

The preliminary analysis of the survey data clearly indicates that much more work is necessary to verify data and to gain an understanding of inspections and operations represented by the data. WMD expects that small groups of experts in the various areas of W&M inspection activities will have to examine the data that have been reported, examine how inspections are being done, and determine if there are "best practices" that should be emulated by others. It is hoped that these more extensive analyses will lead to the development of "model" weights and measures programs in several disciplines of W&M inspections.

We at NIST thank all those jurisdictions that took the time and effort to complete the NIST survey. Your assistance and cooperation were critical to collect the best information currently available on the operation of the weights and measures regulatory programs.

Forum Date Set for Use of Stored Vehicle Tare Weights

NIST WMD will hold a public forum on September 28, 2004, at the U.S. Department of Commerce Headquarters in Washington, DC, to address issues concerning the use of stored tare weights for the commercial weighing of trucks. There are numerous weighing applications (e.g., solid waste disposal and landfills, quarries, mining, agriculture, household moving and others) where net weights of commodities and/or service charges are determined using vehicle scales. Most commercial vehicle scales are required to be accurate to approximately ±0.2 percent (e.g., ±160 lb at 80,000 lb); however, stored vehicle tare weights have been found to have errors of several thousand pounds. This forum will discuss the issues and alternatives that should be considered in an effort to balance buyer and seller interests in the accuracy of these transactions.

The forum, which will begin at 10 a.m. and end at 4 p.m., will provide a review of state laws and regulations relating to commercial transactions and will examine those weights and measures laws which require commercial transactions to be computed on the basis of net weight.

Registration is free but advance registration is required due to security considerations. The deadline for registering is 5 p.m. EDT September 1. For additional information, please contact Tom Coleman by telephone at 301-975-4868 or by email at t.colean@nist.gov.

MAVs and USDA Products

By Kathy Dresser

Recently NIST received several questions about when to apply MAVs and when to apply USDA lower limits to meat and poultry products packaged at USDA plants. The answer is fairly straight-forward.

If the package bears a USDA seal, inspectors must apply the USDA lower limits (Table 2-9 in Handbook 133).
If the package does not bear a USDA seal, inspectors should apply the regular MAVs (Tables 2-5 and 2-6 in Handbook 133).

This applies not only to items found in the meat case, but also to products like soups

and broths that contain meat and poultry.

USDA seals may vary slightly from packer to packer. Below are a few examples of the types of seals that are commonly used:

Most of the confusion seems to stem from the fact that more and more often meat and poultry products are being prepackaged at central packing establishments, many of which are USDA plants. However, some of these meat and poultry products are not weighed at the point-of-pack and may not receive a USDA seal. Regardless of where the product is ultimately weighed and labeled, if it bears a USDA seal, the USDA lower limits apply; if there is no seal, the MAVs apply.

For further information contact Kathy Dresser at 301-975-3289 or by email at kathryn.dresser@nist.gov.

WMD Training Materials Available on Internet

NIST's Weights and Measures Division continues to update or develop new training materials and presentations in response to requests for training for weights and measures jurisdictions and industry. Since January 2004 WMD has provided technical training to 236 individuals in 14 different classes and additional classes are scheduled for later this year.

The training materials that NIST develop are free and are available at www.nist.gov/owm. Click on the bullet "NIST/W&M Training" in the center column of the home page to access WMD training material. Recently added to the site are presentations and other course material for both 2-day and 4- or 5-day classes on Vehicle & Axle-Load Scales (see Course 206).

Please contact WMD at (301) 975-4006 or by email at owm@nist.gov for additional information.

. . . in the field

Using Vapor Return Lines on Liquefied Petroleum Gas (LPG) Meters

By Dick Suiter

At the July 2004 NCWM Annual Meeting Item 332-1 UR.2.3. Vapor Return Line was withdrawn from the S&T Committee agenda. Handbook 44 Section 3.32. LPG and Anhydrous Ammonia Liquid-Measuring Devices, paragraph UR.2.3. currently has a provision for allowing the use of a vapor return line if it is not possible to make a normal delivery without its use or when filling a new tank for the first time if the ambient temperature is above 90 °F. The item proposed amending paragraph UR.2.3. to allow the use of a vapor return during custody transfer at wholesale terminals. During the S&T Committee discussion, the question was raised as to why it is acceptable to use a vapor return line during meter testing and calibration, but not during custody transfer. To appropriately answer that question a field official or service person must have a basic understanding of the properties of LPG and their effect on the measurement of the product.

The normal boiling point of a liquid is the point where the liquid changes to a vapor state. For instance, at 212 °F water changes to steam. Commercial LPG is a mixture of propane, butane, and other gases that can be liquefied through refrigeration or compression. Commercial LPG is maintained in a liquid state by keeping the liquid under pressure. The amount of pressure required to maintain the liquid state is related to the ambient temperature.

Typical commercial LPG has a normal boiling point of approximately -44 °F. In an *open* container LPG will remain in a liquid state at or below that temperature under normal atmospheric pressure. Above that temperature the liquid will begin to "boil" and change to a gaseous state or "LPG vapor." In a *closed* vessel as the liquid begins to "boil," the pressure within the vessel will rise. There is a direct relationship between the temperature of the liquid and the pressure created within the vessel. As the temperature increases, more liquid will change into gas and the pressure will increase. For instance, at a temperature of 40 °F the pressure is approximately 72 pounds per square inch gauge (PSIG). At 70 °F the pressure is approximately 132 PSIG, and at 100 °F the approximate pressure is 205 PSIG. If the temperature remains constant for a period of time, the liquid will cease to "boil" once the normal pressure for that temperature is achieved. This condition can be referred to as a "state of equilibrium."

From a state of equilibrium vapor in a closed vessel can return to a liquid state by either lowering the temperature of the vessel and its contents or by increasing the pressure within the vessel. The amount of LPG vapor created by one gallon or 231 cubic inches of LPG liquid with a specific gravity of 0.508 is approximately 36.39 cubic feet (cu ft). Conversely, converting 3639 cu ft (100 gallons) of LPG vapor to liquid will yield approximately 2.7 gallons of liquid.

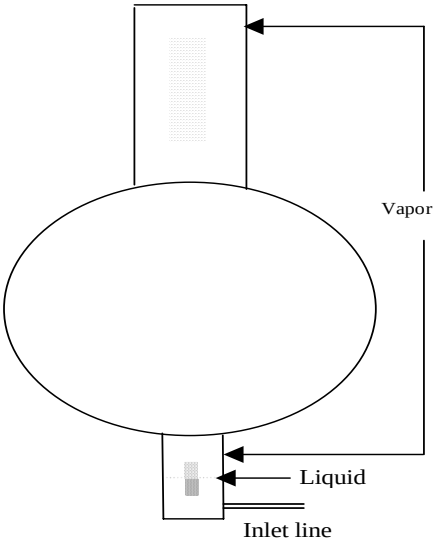
Without a vapor return line, when product delivery starts, the vapor in an LPG prover is compressed by the liquid pumped into the prover. Some of that vapor will return to a liquid state and some will occupy the remaining space above the level of the liquid in the prover when product delivery stops.

The example below illustrates what happens when a vapor return line is not used during a meter test or calibration. For the purposes of illustration, assume that the meter being tested in the example has no error and that product is dispensed until the meter indicates the nominal capacity of the prover.

The diagram in Figure 1 shows the condition of the prover at the start of the test; the

entire volume of the prover above the zero mark is filled with LPG vapor. As product is pumped into the prover, pressure increases as the vapor is compressed into a much smaller space. If the ambient temperature remains constant, the increased pressure will cause some of the vapor to return to a liquid state; as the product is liquefied, the pressure will drop and the contents of the vessel will again be at equilibrium.

The diagram in Figure 2 illustrates the prover at the end of the test. Because the liquid level is above the nominal capacity line of the prover, it would appear that there is error in the meter; however, that is not the case. The amount of liquid above the nominal capacity line represents vapor that has been liquefied.

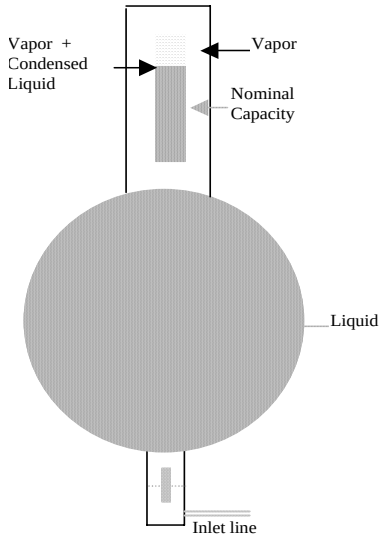


The entire volume of the prover above the zero mark is filled with LPG vapor.

Figure 1

Thus, without the use of a vapor return line during the testing or calibration of an LPG meter, irrespective of safety issues involved, the amount of vapor that would change to liquid might incorrectly be interpreted as meter error. On a 100-gallon delivery, the condensed vapor can represent as much as 2.7 gallons, depending on temperature and pressure conditions. For larger deliveries and tank sizes, the quantities are even greater.

During custody transfer at the retail level the same phenomenon occurs within the reciving vessel (the customer's tank) as



The volume of LPG vapor from the drawing on the left has been compressed. Some vapor became liquid. The remaining vapor occupies the space above the liquid level.

Figure 2

that above. The tank will always have a certain percentage of its total volume occupied by LPG vapor. That vapor will also be in a constant state of transition depending on ambient temperature and the accompanying vapor pressure. As the ambient temperature increases, more vapor is created and the tank pressure increases. As the temperature decreases, the pressure will decrease as some of the vapor returns to a liquid state. The percentage of total tank volume occupied by vapor will also change as the product is used and the remaining liquid boils to return the tank to a state of equilibrium.

When a vapor return line is used during normal meter proving or calibration, most of the vapor in the prover will be pushed through the vapor return line into the meter supply tank. This is desirable for meter proving or calibration to avoid the problems outlined in the examples above and to ensure accurate interpretation of the test results. However, it is not desirable for custody transfer at either the retail or wholesale level since the vapor that would be pushed from the customer's tank into the meter supply tank represents product that belongs to the customer.

If a vapor return line were to be used during the routine filling of a tank at either the retail or wholesale level, the actual amount transferred would be determined by such things as the ambient conditions at each tank at the beginning and end of the filling process, the amount of heat generated by the filling process, and the size and length of the vapor return line. When item 332-1 was being considered, information provided to the S&T Committee from various sources placed the amount of product transfer between 2.5 and 2.8 % of the delivered volume. The S&T Committee agreed that the potential amount is significant and agreed to withdraw the proposed change to permit a vapor return line at the wholesale level.

The Importance of Using Error Weights in Strain-Load Testing

By Rick Harshman

In the strain-load test of a scale, an unknown quantity of material or objects is applied to the load-receiving element of a scale to establish a reference load to which test weights are then added. The strain-load test is used to determine the accuracy of a portion of the total weighing range of a scale. Field personnel frequently utilize strain-load tests when testing large capacity scales so that accuracy can be verified in the weighing ranges where many of these scales are typically used. Strain-load tests are also frequently utilized when the amount of test weight available for testing is less than the minimum test loads required under Table 4 of the Scales Code in NIST Handbook 44.

To properly perform a strain-load test, error weights should be used to determine a reference point for the unknown load prior to adding the test weights to complete the test. Failure to determine a specific reference point using error weights can cause unacceptable errors in the performance results of this particular test. WMD frequently receives inquires regarding the use of error weights in testing scales. The paragraphs below describe procedures for conducting strain-load tests, including procedures for determining necessary reference points on scales having beam and digital indications.

Using Error Weights on a Beam Scale

During normal use of a beam scale, loads

are weighed by balancing the weighbeam to within the smallest graduation employed on any of the weighbars. However, balancing a beam to within the smallest graduation on a weighbar seldom causes a true balance condition. Instead, scale users are normally placed in the position of having to choose the poise settings that most correctly balance a beam. Oftentimes, one setting will cause the beam to rise beyond true balance while the next higher setting will cause the beam to remain below true balance. When strain-load testing a scale having a beam indication, the beam must be precisely balanced with the unknown load applied to the platform *before* the test weights are added to complete the test. Error weights are used in conjunction with poise settings to precisely balance the weighbeam with the unknown load applied. Proper balancing of the beam using error weights establishes the needed reference for completing this test. The procedure for conducting a strain-load test on a beam scale is as follows:

1. At zero load, balance in an amount of error weight equal to the maximum tolerance value applicable to the total of all test weights that will be used in the strain-load testing of the scale.
2. Apply the unknown load and slide the poises on the various weighbars to positions that cause the beam to become balanced to within the closest minimum graduation on the weighbar having the smallest size graduation.
3. Precisely balance the beam by adding or removing error weights from the platform in increments of 0.1d.
4. Total the amount of error weight on the platform and make note of it. The total amount of error weight and unknown load on the platform represents your reference point for the strain-load test.
5. Total the values of all poise settings and record the total on the inspection report, identifying the value as the weight of the unknown load.
6. Apply known test weights in predetermined increments or all at one time.
7. Add the reference weight of the unknown load to the value of the applied test weights and adjust the poises on the weighbars to equal the sum.
8. Properly balance the beam by adjusting the amount of error weight on the platform.
9. Determine the amount of error in the scale by totaling the amount of error weight on the platform and subtracting from it the amount used to balance the beam with the unknown load applied (reference amount from step 4).

After performance results have been determined and recorded for all of the test weights, remove the test weights and the unknown load from the platform. Verify that the scale returns to the initial zero-load balance by returning the amount of error weight initially added to the platform in step 1.

Using Error Weights on a Digital Scale

To perform the strain-load test on a scale having digital indications, error weights are used to establish, as a reference point, the center of the displayed division representing the unknown load. Once the center of the displayed division has been established, test weights can then be added and scale errors determined by direct reading of the indication. The procedure for conducting a strain-load test on a scale having digital indications is as follows:

1. Apply 10 error weights, each having a value of 0.1d, to the platform and zero the scale.
2. Apply the unknown load. Record the displayed value and identify it as the weight of the unknown load.
3. Remove error weights from the platform in 0.1d increments until the indication just begins flashing to the next lower division.
4. In a separate location on the platform begin a second group of error weights by adding back all of the error weights that were just removed in the previous step.
5. Continue adding additional error weights to this second group in 0.1d until the displayed indication just begins flashing to the next higher division.
6. Total the error weight in the second group and remove one-half of it from the platform. Doing so places the indication at the proper reference, i.e., in the center of the displayed division and properly establishes your reference point for the strain-load test.
7. Apply known test weights in predetermined increments or all at one time.
8. Add the weight of the unknown load (determined in step 2) to the value of the known test weights applied.
9. Scale error is determined by subtracting the summed value from step 8 from the displayed indication.

After performance results have been determined and recorded for all of the test weights, return weights equal to one division to the scale platform, remove the known test weights and the unknown load, and verify that the scale returns to zero.

It's important to note that for strain-load tests, tolerances are applied only to the known test weights or other known load portions (i.e., substitution loads) of the total test load.

For additional information regarding the use of error weights in testing scales, contact Rick Harshman (NIST) by e-mail at richard.harshman@nist.gov or by phone at (301) 975-8107.

Upcoming Changes for Sealing Requirements for Measuring Devices with Remote Configuration Capability

By Juana Williams

In 1998 the Liquid-Measuring Devices (LMD) Code and the Mass Flow Meters (MFM) Code of NIST Handbook 44 were modified to include a new requirement for the sealing of devices with remote configuration capability. This new, nonretroactive requirement takes effect as of January 1, 2005.

Currently the LMD and MFM Codes specify two different categories and methods of sealing for devices with remote configuration capability. For a Category 2 device the hardware to remotely change metrological parameters is controlled by physical hardware. For a Category 3 device access to remotely configure the device is unlimited or controlled through a software switch.

Under the new requirement LMDs and MFMs with remote configuration capability must meet the sealing requirements for Category 3 devices. Category 3 devices

must be sealed with an event logger type of audit trail which electronically records information about changes to metrological features. A Category 3 device must also make available a printed copy of the audit trail information through the device or another on-site device.

The new requirement is "nonretroactive" with an effective date of January 1, 2005. This means that it applies to:
- devices manufactured within a state after the effective date;
- both new and used devices brought into a State after the effective date; and
- devices used in noncommercial applications which are placed into commercial use after the effective date.

If you have any questions regarding the new requirements, please contact Juana Williams at (301) 975-3989.

Metrology News & UpDates

Legal Metrology and NCSLI

By Val Miller

Twelve State metrologists attending the 2004 NCSLI Conference in Salt Lake City, UT, met as a Legal Metrology Adhoc Committee on Sunday, July 11, and on Monday evening, July 12. The goal of the Sunday meeting was to develop a charter and operations plan for a committee that may serve as a connection between the general laboratory metrology community and the legal laboratory metrology community. The committee will be a resource for NCSLI attendees from around the world with an interest in legal metrology.

As part of this year's committee activities, the metrologists met with representatives of BIML and ASTM to discuss the current status of documentary standards important to laboratory metrologists and legal metrology and to learn how they can become involved in the revision process of these important reference documents as they support their routine calibrations for weights and measures officials and industry customers.

Dr. Jean Francois Magaña (BIML) announced that several pertinent OIML documents are soon to be published and that in the near future all OIML documents will be available for free download from the OIML website: www.oiml.org. Currently, there is a fee for obtaining these documents. Dr. George Rodriguez (Artel), chair of the ASTM E41 committee, gathered information to use in establishing working groups for the revision of five ASTM standards overseen by the ASTM E41 committee.

Metrologists visited the Utah State Standards Laboratory and took the opportunity to see and evaluate three of the new 3-inch neck stainless steel 5-gallon test measures recently introduced by Seraphin.

The annual NCSLI Conference is a unique opportunity for individuals from around the world (22 nations were represented at the 2004 Conference) working in the diverse world of metrology, to gather in one place and hear over 130 presentations on the many aspects of metrology, from measurement uncertainty to accreditation issues and laboratory management. This diverse group of presentations provides State metrologists with an opportunity to discuss measurement processes and results with some of the foremost experts in the field of metrology, with other metrologists performing similar measurements, and with some of the 130 equipment vendors who were also in attendance.

Each year State metrologist attendees remark that they gain a new perspective and appreciation for the complex field that they have chosen as their careers. It was also stated that hearing the perspective of attendees from outside the legal metrology community has given them a tremendous appreciation for the NIST WMD Laboratory Metrology Group (LMG) and the quality system that is in place. They find that many industry metrologists are just now developing a documented quality system while the State laboratories have had the requirement for a documented quality system for over 10 years, with 14 labs now accredited to ISO/IEC 17025 by NVLAP and several more laboratories in the accreditation process.

The 2005 NCSLI Conference will be held in Washington, D.C. It is expected that opportunity will be available as part of this conference to tour the newly opened NIST Advanced Measurements Laboratory, in addition to all of the normal events of the conference. State metrologists are encouraged to participate in the Legal Metrology Adhoc Committee meeting at the 2005 Conference. 2005 Conference information is available at www.ncsli.org. An item of note: Participating in the Conference by presenting a paper provides complimentary Conference registration. See the NCSLI website for details.

Annual Laboratory Submissions

Three critical factors will be analyzed during this year's annual review cycle--in addition to the usual appendices, checklists, summaries of scope, and uncertainty tables that are noted in the Table 1, Handbook 143. All requirements for annual submissions are based on the technical and general requirements in Handbook 143.

1. Quality Manuals.

Laboratory quality manuals must be updated by the submission period to be eligible for a Certificate of Measurement Traceability as of January 1, 2005. This deadline was extended from 2004 and has been announced in several mailings. This deadline will not be extended. Special emphasis must also be placed on ensuring that the criteria have actually been met and not on the fact that the quality manual has simply been updated. Compliance with your quality manual must be a part of the annual internal audit and management review.

Technical resources that may help in updating your quality manual which are compliant with NIST Handbook 143, Program Handbook and ISO/IEC 17025 are:

- NIST Handbook 143, State Weights and Measures Laboratories Program Handbook, 2003 (on the website: http://www.nist.gov/labmetrology, State Laboratory Program Resources).
- NISTIR 7028, Type Evaluation Laboratory Quality Manual Template, 2003 (on the website: http://www.nist.gov/owm).
- NCSLI Publication - Companion Volume

to Guide to Achieving Laboratory Accreditation, 2004 (free to NCSLI members).

2. Control Charts.
Based on evaluation of control/range charts and measurement assurance systems in the last submission cycle, LMG determined that additional effort needed to be spent on updating and analyzing data from measurements that are tracked in spreadsheets, control charts and range charts. NIST provided training to all State metrologists at the 2003 Regional Measurement Assurance Program (RMAP) training sessions. Additional training is available on the CD-ROM Basic Mass Metrology course in Module 1, Lesson 3. Both training resources considered how to create charts, how to analyze them, and how to use the data derived from them as indicators for taking action steps. A checklist was sent to all laboratories after the initial 2003-2004 assessments to help in the internal evaluation of measurement assurance systems. The checklist was designed to help laboratories and NIST review whether or not data are complete and meeting measurement assurance objectives. Objectives include: 1) monitoring the measurement process to obtain valid standards deviations of the measurement process that are used in uncertainty calculations; 2) monitoring the value of standards to determine stability and need for periodic calibrations; and, 3) a combination of items 1 and 2. Every measurement parameter and range must be covered by some type of measurement assurance system--usually control charts or range charts.

Technical resources that may help in reviewing, updating, and analyzing control charts:

- NISTIR 6969, Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations, 2003 (on the website: http://www.nist.gov/labmetrology); see specifically SOP 9, SOP 30.
- CD-ROM, Basic Mass Metrology, specifically Module 1, Lesson 3.
- Checklist for Control Chart Review, (on the website:http://www.nist.gov/labmetrology, Laboratory Metrology Training and Tools.)

3. Proficiency Test Follow-ups.
A checklist for use in performing follow-up assessments of round robins, interlaboratory comparisons, and proficiency tests was provided during RMAP training in 2000. It has been posted on the NIST website for use since that time. The "Laboratory Follow Up and Corrective Action Checklist" is a tool that should be used as a baseline for assessing each comparison in which a laboratory participates. Further, the assessment and evaluation of each comparison should be discussed during the laboratory's annual management review. The checklist provides a standardized approach to assessing the comparison results and for taking appropriate and suitable action. It is the responsibility of the laboratory to ensure that corrective action is documented and completed in a timely manner. Completion of the form for each comparison in which the laboratory has participated in 2003 and 2004 will be requested this year.

See resources on the website: http://www.nist.gov/labmetrology, Laboratory Metrology Training and Tools, Round Robin (Interlaboratory Comparison, ILC) Tools.

Training Needs Assessment & Feedback

Volume Calibrations.
The updated drafts of NIST Handbook 105-3 and 105-4 have been posted on the NIST website for review since March 2004. We are also reviewing the draft at regional metrology training sessions. Very little feedback has been received on these drafts. Nothing of significant concern has been identified that will cause NIST to create a working group to resolve technical issues. A special mailing will be conducted in the near future to key interested parties to solicit additional feedback. However, barring any significant technical issues, we expect this updated handbook to be published by the end of 2004.
Calibration Reports.
NIST has been evaluating calibration reports during the past year related to gravimetric volume calibrations and prover/test measure calibrations and has noted a number of concerns:
- Laboratories are not routinely reporting calibration values for test measure and prover calibrations (which may be needed by customers for assessing "as found" and "as left" data);
- Laboratories are not retaining data in the laboratory for those cases where simplified reports are provided to customers (which may be needed for resolving measurement discrepancies among jurisdictions);
- Laboratories are not including the appropriate reference temperatures, or the temperature of the calibration medium at the time of test with the data and/or on the calibration report; and
- Inappropriate compliance statements are being made to avoid reporting specific calibration data where the uncertainty exceeds the applicable tolerance of the test. For example, typical uncertainties for 5-gallon test measures are around 0.5 in^3. The tolerance in NIST Handbook 105-3 for 5 gallons is 0.2 in^3 to ensure that adjustment is made to zero error at the nominal volume. The median uncertainty for 100-gallon provers as reported in 2003 is 4.5 in^3 and the tolerance is 5 in^3. So, one half of the laboratories reporting uncertainties for 100-gallon calibrations are reporting uncertainties larger than the tolerance and the other half must ensure that they adjust to nominal values to claim compliance. When compliance statements are made, the tolerance needs to be stated. Compliance cannot be ensured unless the value ± the uncertainty is less than the tolerance. In volumetric measurements, often this is simply not the case.

NIST recommends that laboratories routinely include the following items on volumetric calibration reports:
- Calibrated volumetric values for provers and test measures (corrections/errors are not essential and are often misused);
- Appropriate measurement uncertainty for the calibration; and
- The temperature of the water used (and source/type when appropriate) at the time of calibration and the appropriate reference temperature. All provers and test measures used in petroleum measurements are referenced to 60 °F (15.56 °C) and glassware used for other applications is referenced to 20 °C.

In addition, all applicable measurement data must be retained for each calibration conducted by the laboratory whether reported to the client or not.

Handbook 143 states (with emphasis added):

"**5.10.1** General

The results of each test, calibration, or series of tests or calibrations carried out by the laboratory shall be reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test or calibration methods. The results shall be reported, usually in a test report or a calibration certificate (see note 1), and shall include all the information requested by the client and necessary for the interpretation of the test or calibration results and all information required by the method used. This information is normally that required by 5.10.2, and 5.10.3 or 5.10.4. In the case of tests or calibrations performed for internal clients, or in the case of a written agreement with the client, the results may be reported in a simplified way. Any information listed in 5.10.2 to 5.10.4 which is not reported to the client shall be readily available in the laboratory which carried out the tests and/or calibrations."

"**5.10.4.1** In addition to the requirements listed in 5.10.2, calibration certificates shall include the following, where necessary for the interpretation of calibration results: a) the conditions (e.g., environmental) under which the calibrations were made that have an influence on the measurement results; b) the uncertainty of measurement and/or a statement of compliance with an identified metrological specification or clauses thereof; and c) evidence that the measurements are traceable (see note 2 in 5.6.2.1.1)."

Dynamic Small Volume Provers (SVP).

NIST has received an increasing number of inquiries regarding the calibration and use of pipe/loop provers. API defines a "conventional pipe prover" as a prover for testing meters that generate at least 10,000 unaltered pulses during a prover pass and a "small volume prover" as one that does not permit a minimum accumulation of 10,000 direct (unaltered) pulses from the meter. Dynamic small volume provers (also called compact displacement provers) are a type of pipe prover that contains a moving piston that operates between indicators, has a smaller operating volume, and uses pulse interpolation methods. Therefore, the key differentiating factor between pipe provers and small volume provers (or compact provers) is one of size.

API references address the use of both conventional pipe provers and small volume provers. (See API Manual of Petroleum Measurement Standards, Chapter 4 - Proving Systems, Section 2 - Conventional Pipe Provers, and Section 3 - Small Volume Provers.) However, only the small volume provers have been evaluated for use in testing meters for commercial applications in the United States. NIST Handbook 105-7, which covers the specifications and tolerances for their use, was published in 1997 after numerous field comparisons with graduated neck type provers (of the type addressed in NIST Handbook 105-3) under field conditions.

Several critical problems must be addressed with the use of either the conventional pipe provers or the dynamic small volume provers for weights and measures applications. First, most jurisdictions do not have the capability to calibrate either type of prover. Secondly, there are no private service companies who are currently "recognized" or "accredited" by NIST NVLAP, A2LA or other NACLA-recognized accreditation bodies for providing calibrations that ensure traceable measurement results which are needed to meet State laws (i.e., through reciprocity). As a result, either 1) some jurisdictions allow the use of both types of provers if they have been calibrated by non-accredited sources, but they are likely to witness the calibration and use of such provers; or 2) a jurisdiction simply refuses to recognize either type of standard for use.

As noted earlier, Handbook 105-7 covers only the dynamic small volume prover as a recognized standard suitable for weights and measures applications. However, another problem noted by some jurisdictions with the use of small volume provers (aside from not having a suitable calibration source as already noted) is that the Examination Procedures Outlines do not specifically address the use of this type of standard for testing a meter. However, the EPOs are recommended testing guidelines and generally not legally enforceable procedures.

As a result of increased demand for a suitable calibration source for small volume provers, two state laboratories have developed the ability to provide calibrations. Indiana (for water-draw calibrations) and North Carolina (for water-draw and gravimetric calibrations). Indiana is accredited by NVLAP for this service and North Carolina is seeking an expansion of their NVLAP scope to cover this calibration. NIST is also working with two additional States (Michigan and Arizona) to ensure that regional calibration sources for small volume provers are available. A special gravimetric calibration project was undertaken by NIST to work with North Carolina, Michigan, and Arizona to develop gravimetric calibration methods in state laboratories to provide calibrations of dynamic small volume provers. A side benefit of this project will be the ability of these laboratories to also provide larger-volume gravimetric calibrations. Therefore, North Carolina, Michigan and Arizona will both have the ability to gravimetrically calibrate small volume provers and larger graduated neck type provers in the near future.

As a part of this project, staff from NIST, Michigan, and Arizona participated in and observed calibrations performed in the North Carolina laboratory in February 2004. Efforts were made at that time to refine the calibration procedures and to detail the uncertainty analysis. This was the second calibration performed in North Carolina on three Marathon Ashland Petroleum small volume provers. The provers had also been calibrated by Calibron (the manufacturer) and by the State of Indiana. So, repeatability data were available for the water-draw and gravimetric procedures for comparison purposes. Marathon Ashland Petroleum has also been performing tests at its terminals to compare the results of the graduated neck type provers and the dynamic small volume provers. Field testing data were presented at the 2003 NCWM annual meeting, the 2003 SWMA meeting and the 2003 MidMAP metrology meeting and

generally agree with earlier results that were obtained when developing NIST Handbook 105-7.

In addition to the development of laboratory procedures and capabilities, a 15-gallon national round robin is underway among these and other State laboratories that have the capability to gravimetrically calibrate 15-gallon (and some larger) provers for use in demonstrating proficiency in this new calibration area.

For those States needing to obtain a Recognized or Accredited calibration on small volume provers before allowing their use in legal metrology applications, Indiana, North Carolina, Michigan, and Arizona are all accredited by NVLAP and will be expanding their scope to cover this calibration if they have not already done so.

NCSL, International (formerly National Conference of Standards Laboratories)

NCSLI 2005 Dates/Location: August 6 - 11, 2005. Washington, DC

NCSLI 2005 Theme
2005 Theme: Advances In Science And Technology - Their Impact On Metrology
Advances in Science and Technology continue at an ever increasing rate, especially in the fields of Medicine, Nano-technology, Biology, and Space Sciences. These advances impact the metrology community in many ways from requiring the support of new standards and parameters, to providing state of the art quantum standards, to computerizing and automating measurement systems. The 2005 NCSLI Workshop & Symposium, to be held in Washington, DC, will provide a forum to discuss the impact of these advances on metrology, as well as other related issues. Please join us as we reflect on how far and fast metrology has progressed over the past quarter of a century and to discuss its future needs and directions.

Some basic examples illustrate the advances in Science and Technology that have shaped our current metrology practices: In DC Voltage, many metrologists started their careers using saturated cells capable of maintaining the volt at 1 ppm. They then switched to commercially available solid-state Zener standards which could maintain the volt at 0.3 ppm. Today calibration laboratories have access to portable Josephson Junction array technology with uncertainties better than 0.05 ppm. This represents a twenty-fold improvement in accuracy! In the area of mass measurements, the balances used twenty-five years ago were a double pan design with a sensitivity of 4.0 micrograms. Today, you can purchase electronic balances with 0.1 microgram resolution, an improvement of over forty times.

One challenge for the metrology community is to develop standards and calibration techniques to support these advances in science and technology. Calibration laboratories and National Metrology Institutes are finding it increasingly difficult to not only maintain their existing standards and capabilities, but they must expand their capabilities to include a larger dynamic range, provide lower uncertainties, and improve their efficiency. In addition, they must also develop, implement, and maintain brand new capabilities that did not exist only a few years ago.

In order to meet these challenges, the 2005 NCSLI Workshop & Symposium will again sponsor much needed training sessions for metrologists and managers, hold workshops covering current quality, management, and international issues, and have technical sessions discussing the latest advances in standards and calibration procedures. In addition, many NCSLI working committees will meet to discuss issues of mutual interest, including intrinsic standards, ISO standards, Small Business needs, intercomparisons, national measurement requirements, etc. You can participate in the activities by submitting an abstract and paper, viewing the latest advances in commercial instruments and standards, and discussing your ideas with peers from around the world.

The 2005 NCSLI Workshop and Symposium in Washington, DC, provides a forum to glimpse the future and share your thoughts with fellow metrologists. Please join us as we work to ensure that the metrology community meets the challenges presented by Advances in Science and Technology.

Call for Papers.

Abstracts are required for all proposed Workshops, Panels, and Papers.

Due Dates Proposed Abstracts: December 15, 2004
All Manuscripts: April 19, 2005

All abstracts and manuscripts should be electronic and submitted to the Website address below. Authors must ensure receipt of abstracts and manuscripts by NCSLI.

NCSL International
2995 Wilderness Place, Suite 107
Boulder, CO 80301-5404 USA
Phone: (303) 440-3339
FAX: (303) 440-3384
E-mail: CallForPapers@ncsli.org
Website: w.ncsli.org/Conference/abstract/
29 - 31

Calendar of Events

2004

AUGUST
6 - 20
Course 601, Checking the Net Contents of Packaged Goods
Phoenix, AZ
Contact: Tom Coleman, 301-975-4868

17 - 20
Retail Motor-Fuel Device Training
Topeka, Kansas
Contact: Diane Lee, 301-975-4405

18 - 20
Grain Moisture Meter and Near Infrared
NTETC Sector Meetings
Kansas City, Missouri
Contact: Diane Lee, 301-975-4405

29 - 31
NTETC Weighing Sector Meeting
Ottawa, Canada
Contact: Steve Patoray, 828-859-6178

30 - September 3
OH Regional Training Seminar
Course 206, Vehicle & Axle-Load Scales
Athens, OH
Contact: Ken Wheeler, 614-728-6290

SEPTEMBER
12 - 17
Western Weights & Measures Association (WWMA) Annual Meeting
Holiday Inn Capitol Plaza
Sacramento, CA
Contact: Roger Macey, 916-229-3043

19 - 21
Central Weights & Measures Association (CWMA) Interim Meeting
The Lodge
Bettendorf, IA
Contact: Judy Cardin, 608-224-4945

19 - 24
Vehicle and Axle-Load Scales Instructor Training
Kansas City Airport Marriott
Kansas City, MO
Contact: Rick Harshman, 301-975-8107

20 - 24
NEMAP Regional Metrology Training (Regional Members Only)
Charleston, WV
Contact: Georgia Harris, 301-975-4014

23 - 24
LPG Calibration & Meter Testing Training
Charleston, WV
Contact: Georgia Harris, 301-975-4014
(Attendance by application only; funding is tentative.)

27 - 29
Vehicle Stored Tare Forum
Washington, DC
Contact: Tom Coleman, 301-975-4868

27 - Oct. 1
SWAP Regional Metrology Training (Regional Members Only)
Kansas City, MO
Contact: Georgia Harris, 301-975-4014

27 - Oct. 1
OH Regional Training Seminar
Course 206, Vehicle & Axle-Load Scales
Findlay, OH
Contact: Ken Wheeler, 614-728-6290

OCTOBER
4 - 8
OH Regional Training Seminar
Course 206, Vehicle & Axle-Load Scales
Wilmington, OH
Contact: Ken Wheeler, 614-728-6290

6 - 7
Northeast Weights & Measures Association (NEWMA) Interim Meeting
Sheraton Springfield Monarch Place
Springfield, MA
Contact: Steve Agostinelli, 508-862-4669 or Bill Timmons, 781-589 7011

6-8
Asia-Pacific Legal Metrology Forum (APLMF)
Hacienda Hotel
San Diego, CA
Contact: Chuck Ehrlich, 301-975-4834

13
ANSI Annual Meeting
Marriott at Metro Center
Washington, DC
Contact: Pamela Suett, 212-642-4976

18 - 22
MidMAP Regional Metrology Training (Regional Members Only)
Hawthorne Suites, 317-322-0011
Indianapolis, IN
Contact: Georgia Harris, 301-975-4014

22 - 23
NTETC Measuring Sector
Biloxi, MS
Contact: Steve Patoray, 828-859-6178

24 - 27
Southern Weights & Measures Association (SWMA) Annual Meeting
Grand Casino Hotel
Gulfport, MS
Contact: Julie McLemore, 601-359-1111

24-29
12th International Legal Metrology Conference / 39th CIML Meeting
Berlin, Germany
Contact: Chuck Ehrlich, 301-975-4834

25 - 29
Basic Mass for Industry (FULL, but applications are being accepted for the waiting list)
NIST, Gaithersburg, MD
Contact: Georgia Harris, 301-975-4014
Applications at: http://www.nist.gov/labmetrology

25 - Nov. 5
Basic Metrology Seminar for States (FULL, but applications are being accepted for the waiting list)
NIST
Gaithersburg, MD
Contact: Georgia Harris, 301-975-4014
Applications at: http://www.nist.gov/labmetrology

NOVEMBER
10 - 14
Scale Manufacturers Association (SMA) Fall Meeting
Clearwater, FL
Contact: www.scalemanufacturers.org or 239-514-3441

15 - 19
Intermediate Metrology Seminar
NIST, Gaithersburg, MD
Contact: Georgia Harris, 301-975-4014
Applications at: http://www.nist.gov/labmetrology

OH Regional Training Seminar
Course 206, Vehicle & Axle-Load Scales
Canton, OH
Contact: Ken Wheeler, 614-728-6290

29 - December 3
OH Regional Training Seminar
Course 206, Vehicle & Axle-Load Scales
Columbus, OH
Contact: Ken Wheeler, 614-728-6290

DECEMBER
6 - 10
Basic Mass Metrology Seminar for Industry
NIST
Gaithersburg, MD
Contact: Georgia Harris, 301-975-4014
Applications at: http://www.nist.gov/lab-metrology

2005

JANUARY
23 - 27
NCWM Interim Meeting
Fairmont Miramar
Los Angeles, CA
Contact: NCWM, 240-632-9454

MAY
1 - 5
Central Weights & Measures Association (CWMA) Annual Meeting
Best Western Inn
Madison, WI
Contact: Judy Cardin, 608-224-4945

16 - 19
Northeast Weights & Measures Association (NEWMA) Annual Meeting
Best Western
Albany, NY
Contact: William Wilson, 518-565-4681

JULY
10-14
NCWM Annual Meeting
Hilton
Walt Disney World, FL
Contact: NCWM, 240-632-9454

For meetings and events for the American Petroleum Institute (API), please check the API website at www.api.org and click on the Meetings and Training Section under the "Energy Professional Site" bullet on the left-hand portion of the home page. Information for American Society for Testing and Materials (ASTM) meetings is available at www.astm.org on their Internet website. Click on the "Meetings" bullet on the left-hand portion of the home page. These meetings and seminars are updated on a continuous basis.

For information regarding American National Standards Institute (ANSI), click on the "Meetings and Events" bullet on their website at www.ansi.org.

If you want your meeting, conference or training session included in the Calendar of Events, please contact Lynn Sebring, 301-975-4006 (e-mail: lynn.sebring@nist.gov).