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## This Month in History

**June 6, 1872** - Susan B. Anthony, a pioneering feminist, was fined \$100 for voting in a presidential election at Rochester, NY. She worked for five decades to obtain the right for women to vote, which didn't happen until the 19<sup>th</sup> Amendment passed in 1920.

**June 6, 1755** - The famous American patriot, Nathan Hale (1755 - 1776) was born in Coventry, CT. He volunteered to be a spy during the American Revolution and was captured by the British. Hale admitted he was an American officer and spy. As he was taken to the gallows he said, "I only regret that I have but one life to lose for my country."

**June 10, 1652** - Silversmith John Hull opened the first mint in America in defiance of English colonial law. The first coin issued was the Pine Tree Shilling, which was designed by Hull.

# Petroleum Volume: Getting Calibrations in the Can

*Byline: John Wright, Physical Measurements Laboratory, Sensor Science Divisions*

The volume of oil and oil products moving through America's pipelines, waterways, roads, and rails borders on the unimaginable.

"Look at it this way," says John Wright, a Project Leader in PML's Fluid Metrology Group. "Per capita consumption of petroleum in the United States is 10 liters per day. And there are 300 million people. That's three billion liters moving around each day, and usually being metered several times along the way. The infrastructure requirements are mind-boggling." So is the value. Three billion liters is about 19 million barrels. And with crude oil priced around \$100 a barrel these days, approximately \$2 billion worth of petroleum travels from multiple sellers to multiple buyers every 24 hours. Clearly, even tiny errors in measurement can amount to a great deal of money.



*PML technician Sherry Sheckels uses a flashlight and magnification loupe to take exact water-level measurements on a stainless steel container.*

To ensure maximum accuracy, the U.S. petroleum industry relies on volume measurements traceable to NIST, and specifically to the Flow Metrology Group in PML's Sensor Science Division. Customers bring in their own "field test measures" – stainless steel containers ranging in capacity from four liters to 8,000 liters, made with graduated necks but informally called "cans" – to be calibrated.

The cans are used to calibrate various "prover" mechanisms that measure movement of volume per unit time, and the provers in turn are used to calibrate various kinds of flowmeters. Because the provers and meters differ widely in capacity, a variety of can sizes is typically necessary.

For example, Alberta-based calibrators Glenn Antoniuk and Barbara Germin recently spent two weeks at NIST calibrating 13 cans ranging from 1 to 500 gallons. That may seem like a long time, but the process is laborious and



Two customers prepare their “cans” for calibration in PML’s Fluid Metrology facility.

painstaking. Each can is cleaned and thoroughly dried, carefully leveled, and weighed empty. Then the can is filled with purified water and weighed again. This entire process is repeated five times for cans of 380 liters or less, and at least twice for larger cans.

“We often calibrate over 100 measures a year here, from all sorts of customers,” says Fluid Metrology technician Sherry Sheckels, “including some designed to be transported by barge out to offshore oil platforms for on-site calibrations.”

Not surprisingly, there are industry standards specified by the American Petroleum Institute that govern each stage of the calibration operation. For example, cans smaller than 20 liters are drained by pouring through the neck while tilted to 70 degrees from horizontal (not 90 degrees, which is completely vertical) and there are standardized drainage and drip times.

Because the mass, density and temperature of the water are extremely well known, container volume can be determined to high accuracy after correcting for factors such as thermal expansion of the metal. The petroleum industry expects uncertainties less than 0.05 % for custody transfer or billing applications. NIST’s can-volume calibrations are in the range of 0.01 percent for very large cans.

John Wright of the Fluid Metrology Group examines apparatus newly arrived from Mexico as part of an international volume-standard comparison. (Click image for a larger version.) The other variable of intense interest is how the measurements change or “drift” over time. “If our calibrations or our customers’ calibrations or the pipe-provers’ change too much,” Wright says, “then there’s a lot of retroactive money that changes hands. It can amount to very large sums because the volume is extraordinarily high.”

Glenn Antoniuk, whose company conducts calibrations from western Canada down to the Gulf Coast, agrees: “I’ve heard of settlements that have been in the millions.”

State laws governing the volumetric accuracy of products delivered to the consumer usually specify 0.5% uncertainty, and end-point distribution has to be monitored from time to time. “Five gallon cans are used at gas stations by state labs to make sure that pumps are calibrated properly,” Wright says.



John Wright of the Fluid Metrology Group examines apparatus newly arrived from Mexico as part of an international volume-standard comparison.

## Calendar 2012

Registration for training in the NIST Office of Weights and Measures is handled by Yvonne Branden at [yvonne.branden@nist.gov](mailto:yvonne.branden@nist.gov).

Course descriptions can be viewed on the Office of Weights and Measures website by clicking on the name of the course.  
<http://www.nist.gov/pml/wmd/calendar.cfm>

June 18  
Handbook 133 - Basic Training  
Class No. 5203  
Hartford, CT  
Contract: David Sefcik@  
[david.sefcik@nist.gov](mailto:david.sefcik@nist.gov)

June 18 (2 hours)  
Webinar - Basic Uncertainty Concepts  
Class No. 5170

June 18 (2 hours)  
Webinar - Documenting Traceability and Calibration Intervals  
Class No. 5180

June 19 (2 hours)  
Webinar - Calibration Report Evaluations  
Class No. 5171

June 19 (2 hours)  
Webinar - Conducting an Effective Management Review  
Class No. 5172

June 20 (2 hours)  
Webinar - NISTIR 6969 SOP 8 Part 1  
Class No. 5184

June 20 (2 hours)  
Webinar - NISTIR 7383 SOP 18 Part 1  
Class No. 5186

June 21 (2 hours)  
Webinar - NISTIR 6969 SOP 8 Part 2  
Class No. 5185

June 21 (2 hours)  
Webinar - NISTIR 7383 SOP Part 2  
Class No. 5187

June 22 (2 hours)  
Webinar - Basic Measurement Assurance  
Class No. 5188

June 22 (2 hours)  
Webinar - Control Charts Using PMAP Software  
Class No. 5212

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Because petroleum and other products sold by volume can cross many national borders, it is highly important that international standards agree as closely as possible. This necessitates round-robin comparisons, and Wright is now preparing to test a set of precision containers from Mexico.

“In general, the agreement among different national metrology institutes is extremely good,” Wright says. “But that doesn’t mean we can ever stop measuring.”

## Laboratory Metrology News

# Training Courses and Updated Publications Available

*Byline: Georgia Harris*

The Laboratory Metrology Program at the Office of Weights and Measures (OWM) has a collection of webinars for laboratory staff. These webinars are ideal for metrologists and intended to help bridge the gap between the previous Basic Metrology Seminar for States and the new Fundamentals of Metrology course. These courses are designed for weights and measures laboratory staff, but other participants are welcome, provided space is available.

The training calendar for Laboratory Metrology is located at: <http://www.nist.gov/pml/wmd/labmetrology/schedule.cfm>; or you can check out the OWM’s new combined activities (printable) calendar at: <http://www.nist.gov/pml/wmd/calendar.cfm>.

**Please register early and often for training courses in the OWM Contacts Management System!!!**

(Instructions on how to request training using the OWM Contacts Management System is located at: <http://www.nist.gov/pml/wmd/upload/how-to-request-training.pdf>)

## LABORATORY CALIBRATION PROCEDURES UPDATED

Several NISTIR Publications (5672, 6969, and 7383) have been updated this year to ensure compliance with the current definition of metrological traceability, to make improvements in consistency with standard international practices, and to support the new metrology training seminars. These pro-

June 28 (2 hours)  
Webinar - Traceability Assessments for Weights and Measures  
Class No. 5214

July 15 - 19  
National Conference on Weights and Measures (NCWM) Annual Meeting  
Portland, ME  
Contact: [info@ncwm.net](mailto:info@ncwm.net)

July 29 - August 2  
NCSLI Conference & Symposium  
Metrology and Testing - The Business End of Metrology  
Sacramento, CA  
Contact: NCSLI at <http://www.ncsli.org/>

August 9 (2 hours)  
Webinar - Calibration Report Evaluations  
Class No. 5175

August 16 (2 hours)  
Webinar - Contract Review  
Class No. 5176

August 20 - 24 (5 days)  
Fundamentals of Metrology  
Class No. 5179  
NIST  
Gaithersburg, MD

August 23 (2 hours)  
Webinar - Document Control and Recordkeeping  
Class No. 5177

August 30 (2 hours)  
Webinar - Proficiency Testing Follow Up Actions and Root Cause Analysis  
Class No. 5181

September 6 (2 hours)  
Webinar - Conducting an Effective Management Review  
Class No. 5178

September 10 - 13  
Central Weights and Measures Association (CWMA) Interim Meeting  
Bettendorf, IA  
Contact: Vicky Dempsey at [dempseyv@mcoho.org](mailto:dempseyv@mcoho.org)

September 10 - 13  
NEMAP\*  
Class No. 5154  
Portland, ME  
Contact: Danny Newcombe at [Danny.Newcombe@maine.gov](mailto:Danny.Newcombe@maine.gov)

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cedures and updates are also being reviewed in detail as a part of each of the 2012 Regional Measurement Assurance Program (RMAP) training events. Additional notes are being captured during each 2012 RMAP to identify changes that may be needed in future editions.

<http://www.nist.gov/pml/wmd/labmetrology/calibration.cfm>

Some Key Updates include:

GLP 4\* – notes that calibration intervals may not be stated as “as needed.” A fixed interval must be designated for all laboratory standards (see GLP 4 for possible wording to allow flexible intervals based on statistical data.)

GMP 13\* – Includes the latest definitions of metrological traceability.

GLP 10\* – The water density formula has been updated consistent with the latest International Conference on Weights and Measures (CIPM) formula that has been adopted and published in Metrologia.

All SOPs\* – references to traceability now refer to metrological traceability to SI units.

SOP\* 1 has been updated to ensure uniformity with Section 5.10 of Handbook 143 (and Handbook 150 and the ISO/IEC 17025 standard).

SOP\* 2 has been updated consistent with the latest International Conference on Weights and Measures (CIPM) air density formula that has been adopted and published in Metrologia.

SOP\* 8 for modified substitution has been updated consistent with the training provided during the past three years at RMAP sessions to incorporate additional uncertainty components for Echelon III calibrations that are more realistic.

SOPs\* 13 and 15 have not been updated. Instead, SOP 14 now includes procedures for standards previously addressed in those two SOPs.

SOPs\* 26 and SVP have not been updated, pending efforts by a national working group to address alternative test methods and standards.

SOP 33\*, for calibration of weight carts is now published.

A number of previous job aids have been added as appendices to related procedures.

## ENDNOTES

\*GLP – Good Laboratory Practices

GMP – Good Measurement Practices

SOP – Standard Operating Procedures

September 13 (2 hours)  
Webinar - Internal Auditing Best Practices  
Class No. 5182

September 16 - 20  
Western Weights and Measures Association  
(WWMA)  
Breckenridge, CO  
Contact: Mahesh Albuquerque at  
mahesh.albuquerque@state.co.us

September 24 - 27  
SWAP\*  
Class No. 5126  
Baton Rouge, LA  
Contact: Richert Williams at  
richer\_w@ldaf.state.la.us

October 1 - 5  
47<sup>th</sup> CIML Meeting, 14<sup>th</sup> OIML Conference  
Bucharest, Romania  
Contact: Charles Ehrlich at  
Charles.Ehrlich@nist.gov

October 7 - 10  
Southern Weights and Measures Association  
(SWMA)  
Louisville, KY  
Contact: Jason Glass at (502) 573-0282  
jason.glass@ky.gov

October 15 - 18  
MidMAP\*  
Class No. 5155  
Sioux Falls, SD  
Contact: Brad Stover at  
brad.stover@state.sd.us

October 15 - 26 (2 week)  
Mass Metrology Seminar  
Class No. 5192

October 16 - 17  
Northeastern Weights and Measures Association  
(NEWMA) Interim Meeting  
TBD  
Contact: James Cassidy at  
jcassidy@cambridgema.gov

October 18 (2 hours)  
Webinar - State Laboratory Annual Submission  
Process\*\*  
Class No. 5190

November 1 (2 hours)  
Webinar - State Laboratory Annual Submission  
Process \*\*  
Class No. 5191

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# Employee Highlights

## Elizabeth Gentry



## Receives the Prestigious Arthur S. Flemming Award for Outstanding Federal Employees

*Byline: Kenneth Butcher*

On June 4, 2012, at an Awards Ceremony held on the campus of George Washington University in Washington D.C., Elizabeth Gentry of the Office of Weights and Measures received the 2011 Arthur S. Flemming Award for her exceptional leadership as Metric Program Coordinator. The award was created in 1948, and twelve Flemming awards are given each year. Elizabeth leads the nation's efforts to implement the use of the International System of Units (SI) in trade and commerce through voluntary conversion. She advises federal agencies and businesses as they address SI related issues and works to ensure that the laws of other countries allow U.S. products into foreign markets. She also works with states to eliminate barriers to the use of SI units on packaged goods and in commercial transactions. Ms. Gentry has developed SI teaching tools and publications and has conducted educational outreach to school teachers and students across the country. One tool she created for teaching SI, that is exceptionally popular with teachers, is the "Metric Estimation Game" in which participants earn points by guessing the mass or dimensions of everyday objects.

Established by the Downtown Jaycees, the Flemming Awards honor outstanding federal employees. Arthur S. Flemming was a noted public servant and educator with over seven decades of public service including duty as the Secretary of the Department of Health, Education and Welfare under President Eisenhower and later as Chairman of the Civil Rights Commission

November 5 - 9 (1 week)  
Volume Seminar  
Class No. 5193

December 3 - 7 (1 week)  
Intermediate Metrology Seminar  
Class No. 5164

### 2013

January 27 - 30  
National Conference on Weights and Measures  
(NCWM) Interim Meeting  
Francis Marion Hotel  
Charleston, SC  
Contact: info@ncwm.net

January 28 - February 1 (5 days)  
Fundamentals of Metrology  
Class No. 5206

February 4 - 7 (4 days)  
Advanced Mass Seminar  
Class No. 5204

February 11 - 14 (4 days)  
Advanced Mass Hands-On Seminar  
Class No. 5205

March 4 - 15 (2 weeks)  
Mass Metrology Seminar  
Class No. 5207

April 8 - 11  
SEMAP\*  
Class No. 5209  
Tifton, GA

April 15 - 19 (5 days)  
Fundamentals of Metrology  
Course No. 5208

May 6 - 9  
WRAP\*  
Class No. 5216  
Helena, MT

May 13 - 24 (2 weeks)  
Mass Metrology Seminar  
Class No. 5217

\*Invitation Only

\*\*Limited to State Laboratory Program Participants



HAVE A HAPPY  
AND  
SAFE SUMMER

under Presidents Nixon, Ford, Carter and Reagan. Altogether Mr. Flemming served the government under eleven presidencies beginning with Franklin D. Roosevelt and ending with William J. Clinton. The award is sponsored by George Washington University and the Flemming Awards Commission. Recognized by the President of the United States, agency heads, and the private sector, the winners are selected from all areas of the federal service. More than 500 individuals have received the award to date. Nominees include any career federal employee with at least three, but no more than fifteen, years of government service. Past recipients include Neil Armstrong, Elizabeth Dole, the late Senator Daniel Patrick Moynihan, past NIST Directors Lewis Branscomb and Ernest Ambler, and Robert M. Gates who served as Secretary of the Department of Defense and Director of the CIA, and our own Georgia Harris.

## World Metrology Day

*Byline: Linda Crown, Editor*

May 20, 2012, marked the anniversary of the signing of the Treaty of the Meter. This treaty was signed on May 20, 1875. The United States and 16 other countries signed this treaty to recognize the importance of having uniformity in measurement and creating an atmosphere that would foster a global framework for the advancement of measurement science. World Metrology Day is celebrated each year to recognize this historic event. This day is celebrated in conjunction with the International Bureau of Weights and Measures (BIPM), the National Institute of Standards and Technology (NIST), the International Organization of Legal Metrology (OIML), and other National Metrology Institutes.

This year the theme was “Metrology for Safety.” NIST acknowledged this noteworthy date with a special program that touched on the many areas where measurement plays an important role in ensuring that products meet rigid standards. Weights and measures inspectors are well aware of the impact measurement standards and procedures have on checking the accuracy of meters, scales, and other equipment, and the important role it has in consumer protection.

NIST participates in areas of measurement well beyond the scope of the work performed in the Office of Weights and Measures. NIST creates standard reference materials, improves measurement tools, and develops performance metrics and advances metrology and safety for use in many fields. NIST’s work encompasses the health care fields in the calibration of medical machines (MRIs, PETs, CATs, and X-rays) to protect patients from harmful exposure. Ways are being developed to measure the impact of the environment on human health. Measuring the safety of building materials, roads and bridges, radio communications, radar, computer security, explosive and chemical detection, and body armor are just a few other areas that are being worked on. Being able to test and measure the impact of the success or failure of products provides you with the idea of the importance measurement plays in science and safety.

Take a few minutes to reflect on the impact measurement has on your daily life. How many gallons of fuel did you get at the pump? And, was that really a pound of cherries? Happy measuring . . . !

(Based on an article in the NIST *Tech Beat*, May 17, 2012, “Improving Safety Measures and Measures of Safety for World Metrology Day 2012,” URL: <http://www.nist.gov/pml/improving-safety-measures-and-measures-of-safety-for-world-metrology-day-2012.cfm>)

## 2012 NCWM ANNUAL MEETING

**JULY 14 - 19 2012  
PORTLAND, MAINE**

Registration Information is available at: URL: <http://www.ncwm.net/content/2012-ncwm-annual-meeting>