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This Month in History

February 1, 2003 - Space Shuttle Columbia broke apart over Texas as it was preparing to land killing seven crew members.

February 3, 1870 - The 15th Amendment to the U.S. Constitution was ratified, which guaranteed citizens the right to vote regardless of their race, color, or previous condition of servitude.

February 3, 1913 - The 16th Amendment to the U.S. Constitution was ratified and gave Congress the authority to collect income taxes.

February 6, 1788 - Massachusetts became the 6th state to ratify the U.S. Constitution.

February 6, 1895 - Baseball great, George Herman "Babe" Ruth (1895-1948) was born in Baltimore, Maryland.

February 8, 1910 - William Boyce founded the Boy Scouts of America.

February 27, 1950 - The 22nd Amendment to the U.S. Constitution, limiting the president to two terms, was ratified.

A Glimpse into the Past - 100 Years Ago

By Linda Crown, Editor

What was discussed 100 years ago at the meeting of the Weights and Measures Community? In looking at the report from 1912, which was the seventh Annual Conference, the content of packaged goods were discussed. The weights and measures community were concerned that consumers be aware of what and how much they were buying. The following resolution was put forth by Mr. Joseph (Sealer of Weights and Measures, Richmond, Virginia) to the meeting attendees with the intent for it to be introduced into Congress.

Resolved, That this body recommend to Members of Congress that the Congress shall pass a uniform law providing that all foodstuffs, both fluid and packaged goods, be stamped with the standard weight and measure on the outside of such package containing such foodstuffs, and that all such goods be subject to inspection by the sealers of weights and measures in their respective jurisdictions, wherever such goods are manufactured or sold.

Resolved further, That a committee be appointed to present these resolutions to the Congress of the United States, and that sufficient copies be published for distribution to each member of this body among their respective Senators and Representatives in Congress.

Further discussion ensued and Mr. Joseph also stated that "if there is an open gateway for fraud it is through the package-goods system in the South." Mr. Joseph thought manufacturers should be required to "brand both gallons and fractional gallons on all bottles, and to brand the weight in ounces upon all their foodstuffs, so that when they are sold the consumer can regularly see what they are paying for. I therefore move that this resolution be referred to the committee, in order that the subject may be considered." This motion was seconded.

Additional comments were heard from Mr. Emery (State Superintendent of Weights and Measures, Wisconsin) with a question about which provisions of the Constitution the request for the resolution would come under – interstate commerce clause or the weights and measures clause. The Secretary (Mr. L. A. Fischer, Chief of Division of Weights and Measures, National Bureau of Standards, Washington, D.C.) spoke that he didn't see why the resolution should be limited to foodstuffs and suggested it should include all commodities. This was backed up by Dr. Reichmann (State Superintendent of Weights

and Measures, Albany, New York) and he suggested the resolution should be “very explicit and apply to all commodities. The resolution should not be in a net-weight proposition, but a net content of container proposition, or a net-quantity proposition; because by making it simply a net-weight proposition you give the opponents of such a proposition the very lever that they want.”

After additional discussion, it was agreed that a committee of three would work on the wording and the item would be put in the proper form for submission to Congress. Mr. Emery asked, “If this should become a law, what would be the relation to the State law?” Dr. Reichmann responded, “I think it would be very foolhardy for us to decide, or even to suggest to Congress, which side the proposition it would take. We must take the attitude that we leave it to their superior wisdom.”

It is interesting to see that we are still dealing with the same issues today, packaging and labeling. This was a major concern in 1912. The weights and measures representation felt that citizens should know what they were paying for. What I found interesting was the faith in Congress to decide this should become law and to use the power conferred on that body to fix the standards. Today, we continually work to uphold the standards that were set in motion with this meeting. While there are those out there who would believe that weights and measures is not very interesting, looking back in history gives you a new perspective and appreciation for the work that has been done over the years to maintain standards to protect the consumer. And, the interesting part is seeing the birth of it all through the meeting history of the Conference on Weights and Measures.

We hope you enjoyed this glimpse of the past.

A New Generation of Grain Moisture Meters

By G. Diane Lee

One of the technologies currently used in the commercial determination of grain moisture is dielectric technology, a technology that has been in use for over 60 years. Although dielectric technology has some inherent limitations, meter moisture determination has improved over the years with its use. Research in recent years by the Agriculture Research Service (ARS) and the United States Department of Agriculture (USDA) has provided new insight into the way moisture is sensed by dielectric type grain moisture meters. In addition to providing a brief history of dielectric technology, this article describes research that will give rise to a new generation of dielectric moisture meters, the impact of this new technology, and the selection of a new official meter.

Dielectric Moisture Meters – Pre-1998 Meters

Although some meters were automatic and displayed the results digitally without calculations, many of the first commercial dielectric grain moisture meters, including non-National Type Evaluation Program (NTEP) meters man-

Calendar 2012

Registration for training in the NIST Office of Weights and Measures is handled by Yvonne Branden at 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>

February 6 - 10 (1 week)
Fundamentals of Metrology
Class No. 5153

February 15 (2 hours)
Webinar - Traceability Assessments for Weights & Measures
Class No. 5160

February 27 - March 9 (2 weeks)
Mass Metrology Seminar
Class No. 5165

March 1 - 7
Weights and Measures Week
Contact: info@ncwm.net

March 14 (2 hours)
Webinar - Traceability Assessments for Weights & Measures
Class No. 5161

March 22 - 23 (2 days)
Measurement Science Conference/9th International Temperature Symposium
Anaheim, CA
Contact: <http://www.msc-conf.com/>

March 26 - 29
SEMAP*
Myrtle Beach, SC
Contact: Robert McGee at
rmcgee@scda.sc.gov

April 5 (2 hours)
Webinar - Traceability Assessments for Weights & Measures
Class No. 5162

April 19 (2 hours)
Webinar - Conducting an Effective Management Review
Class No. 5174

April 23 - 27 (1 Week)
Fundamentals of Metrology
Class No. 5163

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ufactured or placed into service before January 1, 1998, depended on user supplied measurements for the final moisture result. That is, the operator must make separate measurements of temperature, volume and/or weight and apply those measurements in making the final moisture determination. Some of these meters have interchangeable modules that have to be connected to and interchanged for different grain types. Some meters need look-up tables to determine the final moisture content of the grain sample. Along with the many user applied measurements and interactions that must be performed with these moisture meters, the meter calibrations for the various meter types are based on different prediction equations, and grain sample sets. All of these factors can affect uniformity among the various meters and the accuracy of the moisture determination.

A manual temperature correction is used for many of the meters that were placed into service before January 1, 1998. For these meters, the user manually determines the temperature of the grain. The grain moisture reading is obtained, then the temperature of the grain and moisture reading are compared to a look-up table that provides the final moisture results based on the grain temperature and the moisture reading. Some moisture levels exceed the look-up table so the user must calculate the temperature correction and final moisture result. Any user errors due to improper temperature measurements, improper use of the look-up table, incorrect look-up tables, and improper calculation of the temperature correction will contribute to errors in the final grain moisture result.

The weight of the grain is also a factor that will affect the moisture result. For many of the meters that were placed into service prior to January 1, 1998, the user must weigh the sample of grain prior to putting the sample in the grain moisture meter's hopper. Some of these meters have a scale within the hopper and the operator must read graduated lines to ensure that the sample weight is appropriate prior to making the measurement. Errors can occur due to improper weighing of the grain sample or inoperable or malfunctioning built-in scales.

Some of these grain moisture meters use "calibration modules", which are attachments for the meter that contain the calibrations for various grain types. These grain specific modules are connected to the meter and are interchanged by the user based on the various grain types for which the moisture determinations are made. Inappropriate use of the modules may cause errors in the test results.

Some of these meters do not directly indicate percent moisture. For these meters, a number based on the dielectric reading of the grain sample is obtained from the device by user-operated dials on the meter and the number obtained from the meter corresponds to a moisture value on a look-up table. User error due to inappropriate use of the meter and look-up tables could lead to errors in the test results of these meters.

Many of the variations and errors in the results obtained from this earlier generation of moisture meters could be attributed to operator error and calibration sample set variations.

May 3 (2 hours)
Webinar - Internal Auditing Best Practices
Class No. 5173

May 7 - 18 (2 weeks)
Mass Metrology Seminar
Class No. 5166

May 14 - 17
Northeastern Weights & Measures Association
(NEWMA) Annual Meeting
Seekonk, MA
Contact: James Cassidy at
jcassidy@cambridgema.gov

May 20
World Metrology Day
Contact: BIPM at
<http://www.bipm.org/en/convention/wmd/>

May 21 - 24 (4 days)
WRAP*
Cheyenne, WY
Contact: Rober Weidler at
rweidl@state.wy.us

May 20 - 24
Central Weights and Measures Association
(CWMA)
Cedar Rapids, IA
Contact: Ivan Hankins at
ivan.hankins@iowaagriculture.gov or
<http://www.cwma.net/>

June 4 - 8 (1 week)
Handbook 133 - Instructor Training
Frankfort, KY
Class No. 5183

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. 5186

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Dielectric Moisture Meters – Post-1998 Meters

In 1991 a National Type Evaluation Technical Committee (NTETC) Grain Sector was established to improve the uniformity and accuracy of commercial grain moisture meters and their associated measurements. As a result of the work of the Grain Sector, a National Type Evaluation Program (NTEP) for grain moisture meters was established; a new Code was developed in National Institute of Standards and Technology (NIST) Handbook (HB) 44 *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices* for field evaluation; and new criteria were developed in National Conference on Weights and Measures (NCWM), Inc. Publication 14 for NTEP evaluation of grain moisture meters for meters that were manufactured or placed into service after January 1, 1998.

Although there was no change to basic measurement technologies, improvements were made in commercial moisture determinations because meters manufactured or placed into service after January 1, 1998, were designed to meet the new criteria in NIST HB 44 and NCWM Publication 14. Changes to the design criteria for these meters were such that the operator was no longer required to determine grain volume, weight, and/or temperature of the grain sample; these measurements became a function of the meter and eliminated much of the user errors associated with these measurements. Operating range criteria for these meters is an automatic function to ensure that meter moisture determinations are only made within the specified meter and grain temperature and the grain moisture ranges of the meter. In addition, commercial meters under the new criteria are required to directly display and record the moisture content value as percent moisture content to eliminate errors associated with the use of look-up tables.

In addition to new design criteria, the development of the NTEP program for grain analyzers provides some assurance that grain moisture meters are designed in accordance with NIST HB 44 before that same pattern or type of device is used commercially. An added benefit of the NTEP program for grain moisture meters is the addition of a second phase of NTEP evaluation called the "Ongoing Calibration Program." The NTEP program for grain moisture meters is different than other device evaluations because of these two phases of evaluation: the NTEP phase I (device evaluation) and the NTEP Phase II program (ongoing calibration program). In phase I, the device is evaluated similar to other NTEP device evaluations to ensure that the device meets the criteria of NIST HB 44 and NTEP Criteria. The NTEP phase II program is a program whereby meter calibrations are tested annually. This annual meter calibration addresses the concerns with the calibrations of the older commercial meters, which were based on varying grain sample sets and different air oven reference laboratories. The NTEP calibration data is based on a national sample set which consists of samples of grain from across the United States and calibrations for NTEP meters that are aligned to a single air oven laboratory. This program reduces average differences between different meter models. The program does little to reduce sample-by-sample variability due to inherent design differences between meter models.

A New Generation of Grain Moisture Meters

Although there have been improvements in moisture determination with the implementation of new criteria and ongoing updates to the calibrations of all

June 20 (2 hours)
Webinar - NISTIR 7383 SOP 18 Part 1
Class No. 5183

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 - Control Charts Using PMAP Software
Class No. 5189

June 22 (2 hours)
Webinar - Uncertainties Using Kragten Spreadsheets
Class No. 5188

July 15 - 19
National Conference on Weights and Measures (NCWM) Annual Meeting
Portland, ME
Contact: 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 (1 week)
Fundamentals of Metrology
Class No. 5179

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

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meters manufactured or placed into service after January 1, 1998, described earlier, there are inherent limitations in dielectric technology. Dielectric moisture meters are influenced by the grain variety, size, weight, growing seasons, etc. and different sensing techniques and algorithms are in use by each meter. As such, separate calibrations for each grain type are needed. Since there are changes in crops from year to year, the relationship between the measured dielectric constant and the moisture are not stable from year to year and calibrations must be tested annually and adjusted appropriately. The cost of annual calibrations is exceeding the cost of the meter. The various sensing technologies have not changed for many years because each meter type has a specific sensing technology that is used in conjunction with a specific algorithm for predicting moisture. To further improve the grain moisture measurement system, research, which began in 1995, was conducted by the Agriculture Research Service (ARS) and the U.S. Department of Agriculture (USDA) in the dielectric response to grain moisture to improve the technology of dielectric grain moisture determination.

The radio frequency (RF) range for most commercial meters is 1 to 20 MHz. The research conducted by ARS and USDA was conducted at a much higher RF of 1 MHz to 501 MHz. The equipment used to conduct the research were a test cell, which was developed for the higher frequency, a funnel apparatus, which was used to adequately repeat fill the test cell, and a HP-4291A RF Impedance Analyzer, which was used to measure and record information at the high frequencies. USDA, Grain Inspection Packers and Stockyards Administration (GIPSA) collected data using this equipment on 3700 samples of grain that was collected from across the United States through the USDA annual moisture program. The goal was to get results that agreed closely with the official air oven moisture analysis.

One of the purposes of this research was to make a more effective grain moisture algorithm that could be used across meter types. This would further improve the uniformity among grain moisture meters. Several tests were conducted to include tests over wide frequency ranges, density tests at varying frequencies and dielectric loss at varying moisture levels. As a result of this research, it was determined that the 100 MHz to 200 MHz range was the optimal range for dielectric constant measurements and a unified moisture algorithm was developed based on a test frequency of 149 MHz.

With the unified moisture algorithm, meter designs operating at 149 MHz can be brought into better alignment with appropriate adjustments for grain density and cell dimensions. What this means for future grain moisture meters is greater uniformity in results on a sample-by-sample basis.

The results of this research and the unified moisture algorithm was provided to U.S. grain analyzer manufacturers and state and federal government representatives on August 22, 2001, in a technical presentation on "Theory and Engineering Aspects of a New Unified Grain Moisture Measurement Algorithm" presented by Dr. David Funk, USDA, GIPSA. At the current time, NTEP moisture certificates have been issued for three high frequency meter models.

This unified algorithm will likely impact the NTEP Phase II program for grain moisture meters, since calibrations for these meters will be unified through

September 10 - 13
NEMAP*
Portland, ME
Contact: Danny Newcombe at
Danny.Newcombe@maine.gov

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 17 - 20
MidMAP*
Sioux Falls, SD
Contact: Brad Stover at
brad.stover@state.sd.us

September 24 - 27
SWAP*
Baton Rouge, LA
Contact: Richert Williams at
richer_w@ldaf.state.la.us

October 15 - 26 (2 weeks)
Mass 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

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

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

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the new algorithm. The impact of new meter technology, to the extent that industry migrates to this technology, could mean an end to the need for NTEP Phase II evaluation for grain moisture meters as it currently exists. This could impact the NTEP program in 5 to 10 years and even to the extent that the current 5-year interagency agreement between NIST and GIPSA, which currently extends from 2010 to 2014, to fund the NTEP Phase II program, may no longer be necessary as it currently exists.

Selection of GIPSA's New Official Meter(s)

The Grain Inspection Advisory Committee (GIAC) is an advisory committee of the GIPSA, which is comprised of 15 members representing grain producers, processors, merchandisers, handlers, exporters, consumers, grain inspection agencies, and scientists. At its November 2009 meeting, the GIAC recommended that GIPSA evaluate the current moisture calibration for high moisture rough rice for accuracy when compared to the air oven reference method. After investigating the 2009 crop calibration, GIPSA reported that year to year differences and growing conditions in 2009 contributed to inaccuracies in the rough rice calibration. GIPSA concluded that improvements to the official meter's accuracy for grain samples with inaccuracies, such as the rough rice calibration, would degrade the overall accuracy and suggested that, for better official meter calibrations, a new meter technology is needed. The GIAC recommended that GIPSA move forward with expediency to determine the feasibility and selection of a new official moisture meter with a new measurement technology. GIPSA plans to implement the new technology for initial grains in May 2013 and implement the new technology for other grains in September 2013 and later. But, at its December 2011 meeting, the Grain Inspection Advisory Committee recommended the implementation of the 149 MHz technology for moisture measurements in August 2012 for fall harvest grains.

As the new meter technology is introduced into the market, more uniformity among meters will further improve the system of commercial grain moisture measurements. Impacts of this new technology will be discussed in future *Weights and Measures Connection* newsletter articles.

If you have any questions or comments, you may contact Diane Lee by e-mail at diane.lee@nist.gov.

Disclaimer:

Any mention of commercial products within this article is for information only; it does not imply recommendation or endorsement by NIST.

Did You Know?

An "acre" is a term that denotes area and appears both in the imperial and U.S. customary measuring systems. Originally the "acre" was the amount of ground that could be plowed by one man behind an ox in a day.

Before the use of the metric system, many of the European countries had their own "official" acres. The actual size of an acre could vary significantly from one country to another. Today, European countries use the hectare.

2013

January 27 - 30
National Conference on Weights and Measures Interim Meeting
Charleston, SC
Contact: info@ncwm.net

*Invitation Only

**Limited to State Laboratory Program Participants

CONTACTS FOR WEBINARS

- **Lab Metrology:** Val Miller at val.miller@nist.gov or view the Laboratory Metrology group webpage at: <http://www.nist.gov/pml/wmd/labmetrology/webinars.cfm>
- **Devices:** Tina Butcher at tina.butcher@nist.gov
- **Laws & Metric:** David Sefcik at david.sefcik@nist.gov or Lisa Warfield at lisa.warfield@nist.gov
Additional details on the above calendar items can be found at:
<http://ts.nist.gov/WeightsAndMeasures/calendar3.cfm>

VISIT THE NATIONAL FIRE PROTECTION ASSOCIATION FOR VALUABLE TIPS ON WINTER FIRES.

<http://www.nfpa.org/categoryList.asp?categoryID=2103&URL=Safety%20Information/For%20consumers/Holidays/Put%20a%20Freeze%20on%20Winter%20Fires&cookie%5Ftest=1>

Space heaters, whether portable or stationary, accounted for one-third (32 %) of home heating fires and four out of five (79 %) of home heating fire deaths.

The leading factor contributing to home heating fires (26 %) was failure to clean, principally creosote from solid-fueled heating equipment, primarily chimneys.

(Source: National Fire Protection Association)

The NIST Office of Weights and Measures

homepage:

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

Please change your browser's bookmark.