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JULY 2017

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Welcome Measurement Science Professionals. I hope you are all enjoying summer vacations, but also are making plans to attend the 2017 NCSLI Workshop & Symposium at the Gaylord National Convention Center, in National Harbor, Maryland. This year’s conference theme is “Precision & Performance with Measurement Science.” Join us as we explore the impact of precision measurements on industry.

I would like to extend an especially warm welcome to all first-time conference attendees. I encourage you to start off your conference experience by attending the “How to Navigate the NCSLI Conference,” presented by the NCSLI Early Career Professionals Committee, on Monday afternoon (the 14th). A new feature of this year’s conference is also on Monday afternoon. A session of presentations by many of the major national measurement institutes of the world followed by the Awards Reception. Come and hear about exciting measurement science projects at places like NIST, NRC-Canada, and CENAM. The conference offers you numerous networking opportunities, so get out there and engage.

The Keynote Presentations at the conference will feature a series of four talks focusing on the interactions between industry and the national measurement institutes. The relationship between the National Measurement Institutes and industry is well over 100 years old, and continues to be strong today. However, the rate at which the measurement challenges of industry are changing is forever increasing, as is measurement technology. How both sectors respond will greatly affect our futures.

Dr. Alan Steele, Chief Metrologist, NRC Canada will discuss “Metrology in a Research Technology Organization,” and Mr. Michael Garvey, President and CEO, M-7 Technologies will present on “Utilizing Precision Measurement Technologies to Transition from Traditional Manufacturing Segments to Advanced Manufacturing Activities” at the opening keynote on Tuesday morning. On Wednesday Morning, I will present the keynote address on “The Future of Metrology” along with Mr. G. Dan Hutcheson from VLSIresearch discussing “Semiconductor Metrology: What’s Important, Why It’s Important, and Where It’s Going.” On Thursday, Captain Craig Bomben from Boeing Test and Evaluation, will give the closing keynote.

One of the great benefits of holding the conference in Maryland is the close proximity of NIST. I am pleased to announce this year’s conference will feature special NIST tours on Friday allowing you the chance to explore some of the most advanced measurement labs in the world. Work in NIST laboratories translates into new high-accuracy measurement technologies, databases and standards related to the fundamental properties of advanced materials, and supporting tools and capabilities essential for cutting edge physics and metrology. The NCSLI Workshop & Symposium continues to be one of the best opportunities for measurement science professionals to meet and engage with the field’s leading metrology experts and innovators. I hope you take advantage of this one.

Finally, I would like to take this opportunity to thank the conference committee and all the volunteers involved in making our annual conference such a great success. I look forward to seeing everyone in Maryland!
The April 2017 meeting of the NCSLI Board of Directors was held April 24 - 25 in Salt Lake City, Utah. Fifteen board members and two guests were in attendance at the meeting. Key topics of discussion included revision of the bylaws, development of the policy on ends, 2017 proposed slate of candidates, review of liaison representatives, and strategic planning.

As the Board continues forward with implementation of the Carver model, drafts of the revised bylaws and the ends policy were reviewed. Both documents are expected to be presented for approval at a special WebEx Board meeting scheduled for June.

In its working sessions at this meeting, the board members developed strategies on division/section activities, membership benefits and training plans. Action plans were developed from each of the three strategies areas and implementation is under way.

The 2017 Slate of Candidates was approved by the Board. The following Vice Presidents were submitted for election to the Board for the 2018-2019 term: Tim Osborne, Executive Vice President, A2LA; Paul Packebush, Vice President, National Instruments; and Bob Sawyer, Vice President, Consumers Energy. The ballot will be forthcoming to the membership for voting in August.

The next meeting of the Board of Directors is scheduled for National Harbor, Maryland, August 13 - 14, 2017. We hope to see you there. Additional details, please contact the NCSLI Business Office.
Welcome New Members

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Contact: Alfredo Ramos
(858) 281-7134
aramos@dexcom.com

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basilio.b@midsouthinstruments.com

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Pressure Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>760-LLP</th>
<th>760-D</th>
<th>760-MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Pressure Range</td>
<td>±30 inH2O (75 mbar)</td>
<td>-12.5 to 35 psi (-0.86 to 2.5 bar)</td>
<td>-12.5 to 300 psig (-0.86 to 20 bar.g)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.05%FS(^1)</td>
<td>0.02%FS(^1)</td>
<td>0.02%FS(^3)</td>
</tr>
<tr>
<td>Stability</td>
<td>&lt;0.005%FS(^2)</td>
<td>&lt;0.005%FS(^2)</td>
<td>&lt;0.005%FS(^2)</td>
</tr>
<tr>
<td>Pressure Type</td>
<td>Differential, Gauge</td>
<td>Differential, Gauge</td>
<td>Gauge, Absolute</td>
</tr>
<tr>
<td>Resolution</td>
<td>6 digits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barometric Accuracy</td>
<td>N/A</td>
<td>N/A</td>
<td>60 Pa(^4)</td>
</tr>
<tr>
<td>Connection</td>
<td>Barb fitting</td>
<td>Hose, 5 ft (1.5 m), with built-in filter to 1/4BSPF, 1/4NPTF, and M20F adapters</td>
<td>Hose, 5 ft (1.5 m), with built-in filter to 1/4BSPF, 1/4NPTF, and M20F adapters</td>
</tr>
</tbody>
</table>

Electrical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>mA Measure</td>
<td>±30 mA</td>
<td>0.0001 mA</td>
<td>0.01%RD+0.005%FS</td>
<td>Impedance &lt;10Ω</td>
</tr>
<tr>
<td>V Measure</td>
<td>±30 V</td>
<td>0.0001 V</td>
<td>0.01%RD+0.005%FS</td>
<td>Impedance &gt;1MΩ</td>
</tr>
<tr>
<td>mA Source</td>
<td>24 mA</td>
<td>0.001 mA</td>
<td>0.01%RD+0.005%FS</td>
<td>20 mA @ 1K</td>
</tr>
<tr>
<td>Loop Power Source</td>
<td>24 V</td>
<td>N/A</td>
<td>±0.5 V</td>
<td>50 mA (Max Loading)</td>
</tr>
<tr>
<td>Pressure Switch</td>
<td>Open, close. Support for mechanical switches and NPN/PNP digital switches.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Compensation</td>
<td>41°F to 95°F (5°C to 35°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>&lt; ± (0.001%RD + 0.001%FS) / °C outside of 5°C to 35°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[1] FS specification applies to the span of the module range.
[2] Stability based on FS of the internal pressure module. Stability is 0.005%FS or 0.05 pa whichever is greater. Internal module is switchable.
[3] Specification based on gauge measurement. An additional 60 pa uncertainty will need to be included when measuring in absolute mode.
[4] 60 Pa uncertainty (k=2) includes calibration uncertainty, linearity, and long-term stability (<30 Pa per year). Barometer range of 90 to 110 kPa.

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The relationship between the National Measurement Institutes and industry is well over 100 years old, and continues to be strong today. However, the rate at which the measurement challenges of industry are changing is forever increasing. This series of four talks will focus on some of the current measurement challenges of industry and how NMIs are responding, and on the exciting future of measurement needs and how advances in metrology will meet those needs. Join us for these very insightful talks.

TUESDAY, AUGUST 15 | 8:30 AM – 10:00 AM
Maryland CD Ballroom

OPENING KEYNOTE ADDRESS
Metrology in a Research Technology Organization
Dr. Alan Steele, Chief Metrologist, NRC Canada

Utilizing Precision Measurement Technologies to Transition from Traditional Manufacturing Segments to Advanced Manufacturing Activities
Mr. Michael Garvey, President and CEO, M-7 Technologies

WEDNESDAY, AUGUST 16 | 9:00 AM – 10:00 AM
Maryland CD Ballroom

WEDNESDAY MORNING KEYNOTE ADDRESS
The Future of Metrology
Dr. James Olthoff, Director, Physical Measurement Laboratory, NIST

Semiconductor Metrology: What’s Important, Why It’s Important, and Where It’s Going
Mr. G. Dan Hutcheson, CEO and Chairman of VLSIresearch Inc.
Capt. Craig Bomben is the vice president of Flight Operations for Boeing Test & Evaluation and enterprise chief test pilot. Named to this position in 2015, Bomben provides operational leadership and business oversight for all flight operations, including developmental and production flight tests of Boeing commercial airplanes and military aircraft. Bomben also serves as the skill team captain for pilots across the enterprise.

Bomben assumed the additional responsibility as the VP BT&E Design Build in May 2016. The Design Build Team is responsible for the design, build and ultimate cost of both BT&E Lab Test and Flight Test Value Stream test articles.

Bomben also serves as the Boeing Executive Focal to Washington State University and serves as a board member on the Academic Advisory Board for the Voiland College of Engineering and Architecture.

Prior to his current role, Bomben was the BT&E chief test pilot for military aircraft for two years. In that role, Bomben led a team of pilots, aircrew and support personnel in the development, demonstration and production testing of all military products.

Bomben previously served as chief production pilot for commercial airplanes, assuring regulatory and safety compliance. He also oversaw day-to-day production test operations, including customer acceptance of airplanes.

Prior to assuming the role of chief production pilot for commercial airplanes in 2011, Bomben was responsible for conducting production and engineering flight tests on ZA004, the third 787 Dreamliner to enter flight test, and was a deputy chief pilot for the 737.

Before joining Boeing as a production flight test pilot in 2006, Bomben was a research test pilot for NASA’s Dryden Flight Research Center at Edwards Air Force Base, California for six years. His assignments included a variety of research and support activities while piloting the F/A-18, F-15B, T-38, DC-8, T-34C and King Air aircraft.

A 1987 graduate of the Naval Aviation Officer Training School, Bomben began his naval flying career in 1985 and his test pilot career in 1992 when he graduated from the Naval Test Pilot School. During his 16-year active Navy career, he conducted developmental flight testing of the F14D and FA-18 aircraft as well as the CT-133 and CF-188 aircraft. Bomben led numerous multi-national missions over Iraq in support of Operation Southern Watch and Operation Desert Storm. In 2001, Bomben transitioned to the Naval Reserves as the operations officer for Joint Forces Component Command, San Diego. As a reservist he was called on to serve in Operation Iraqi Freedom and Operation Southern Watch.

Bomben holds a bachelor’s degree in electrical engineering from Washington State University and an Executive MBA from the University of Washington. Foster School of Business. Bomben holds type ratings in all current Boeing production models, and has accumulated more than 8,000 hours of flying time in more than 75 different types of aircraft.
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Thunder Scientific Corporation
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Tovey Engineering, Inc.
Transcat, Inc.
Transmille Calibration
Trescal, Inc.
Troemner, LLC
Vibration Research
Western Environmental Corporation
WorkPlace Training
Learning Labs
WEDNESDAY, AUGUST 16
10:30 AM - 11:30 AM

Learning labs are designed to promote conceptual understanding and deeper engagement in problem solving for small groups. Each learning lab will consist of a 60-minute session, where attendees will engage through discussion and activities surrounding the topic. We will offer two Learning Labs this year (20 class limit) and both are open to all registered attendees.

LLI National Harbor 6
Instructor: Jeff Gust. Fluke Calibration

LL2 National Harbor 7
Risk Management
Instructor: Tim Osborne. American Association for Laboratory Accreditation (A2LA)

Lightning Talks
THURSDAY, AUGUST 17
10:30 AM - 11:30 AM
Maryland CD Ballroom

Theme: Technology and Scientific Trends
Lightning Talks are designed to be insightful, inspiring, enlightening, thought-provoking, useful, humorous and controversial. Lightning talks are short 10-minute sessions, fun for both the speaker and the audience. This year’s Lightning Talks revolve around the theme of technology and scientific trends that impact our lives. These talks will offer the audience the chance to hear multiple speakers in a single time slot, and learn many facts in a short time. This session is open to all registered attendees.

Mike Dobbert, Keysight Technologies
Paul Packebush, National Instruments Corporation
Arman Hovakemian, Naval Surface Warfare Center, Corona
Paul Reese, Baxter Healthcare Corporation
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The cancer statistics for the UK are somewhat sobering, one in two people born after 1960 will be diagnosed with some form of cancer during their lifetime\(^1\) and there are currently approximately 330,000 new diagnoses every year, a number which has been growing by around 2% per annum.\(^2\) All of us will be affected by this disease in some way at some point in our lives, and when it happens we need the reassurance that we will have access to the best care possible. Despite the significant improvements that have been made in the treatment of cancer over the last 40 years, the UK survival rate has continued to lag behind that in countries of similar wealth.\(^3\) This is manifested in the UK having amongst the lowest age-standardized incidence rates of rich countries, but amongst the highest mortality rates, meaning that fewer people in the UK survive a diagnosis of cancer than should.

The UK has a deserved reputation for creativity and excellence in the design and development of new interventions that have the potential to deliver significant improvements in outcomes. However, one potential cause for the UK’s high mortality rates is the fact that
other than in a few leading centers, internationally we are viewed as being slower to adopt new innovations, across all treatment modalities, than other countries, even where those innovations are clearly cost-effective and/or were developed within the UK health system. One of the critical enablers for rapid and widespread adoption of new innovations is ensuring their performance, safety and effectiveness can be measured and optimized in what is necessarily a conservative community.

“It is sobering to note that the value of good radiotherapy is substantially greater than the incremental gains that have been achieved with new drugs and/or biologicals. These results strongly reinforce the importance of doing well what we already know.” Peters et al Clin Oncol 2010.

**Ground-breaking metrology research supports UK healthcare provision**

In October last year NHS England, the public body which oversees delivery of the UK’s National Health Service (NHS) across England, initiated a consultation process: Modernizing Radiotherapy Services in England—developing proposals for future service models, which sets out a number of principles to guide the modernization of radiotherapy services and the development of future clinical commissioning products. The National Physical Laboratory (NPL) has played a key role in supporting the UK medical physics community from the beginning of the twentieth century, initially through the design, construction and calibration of specialized equipment...
alongside the development of world leading codes of practice in collaboration with the medical physicists professional institute to ensure rigorous and consistent dissemination of dose quantification into the clinic. A recent review of data collected by NPL over the last 20 years has shown how the combination of these factors have assisted in considerably reducing the variability of the dose delivered across the nation. In more recent times, ground-breaking metrology research has been undertaken to support innovative treatments where these complex systems require novel approaches to measurement to ensure continued consistency of the dose delivered to the patient. NPL continues to broaden this role to further enable the rapid, efficient and widespread adoption of advanced radiotherapy technologies thus supporting the NHS England principles to be delivered that will support improvements in patient outcomes.

A focus on the quality of radiotherapy treatment throughout the whole pathway

Towards Safer Radiotherapy states, “comparative audits can provide valuable opportunities to ensure safe delivery of radiotherapy and consistency of patient outcomes,” citing the NPL audit scheme as an example.5

In 2012 the UK government announced the £23 million Radiotherapy Innovation Fund (RIF) which was allocated by its Department of Health and Cancer Research UK (the largest cancer research and awareness charity in the country) with support from the Society of Radiographers and other professional bodies. The aim of the fund was to ensure that all radiotherapy centers could deliver a minimum of 24% of all radical treatments using inverse planned Intensity Modulated Radiotherapy (IMRT) by April 2013;6 thus vastly increasing the number of patients benefiting from access to this more advanced and targeted form of radiotherapy treatment. At the time it was recognized that in order for this target to be achieved, it would be necessary to deliver much of this using rotational IMRT (RIMRT), a faster and more complex delivery system. Simultaneously, a national audit for RIMRT was led by NPL and the Radiotherapy Trials Quality Assurance (RTTQA) team to independently verify the implementation of rotational therapy across the UK, to investigate the capabilities of the different planning and delivery systems, assess whether each combination of planning and delivery system had been optimized uniformly across each institution and provide credentialing for use in clinical trials. The audit concluded in 2013, visiting all...
UK radiotherapy centers who were in a position to participate (around two thirds of all UK radiotherapy centers), demonstrating variability between the centers ability to plan and deliver the same treatment even with the same equipment. The value of this national audit was to set the benchmark against which centers could be assessed and further to support and assist centers to achieve this standard so providing confidence in the ability of these institutions to deliver highly accurate patient treatments. Overall in the UK the variability of the delivery of this technique is shown to be less when compared to the rest of the world, with the UK achieving a 97% pass rate with tighter tolerances than were imposed in a comparative exercise conducted in the USA which achieved a 90% pass rate. Since the conclusion of this national audit, NPL has continued to offer this service to centers who have since commissioned this modality as well as to new centers both within the UK and abroad.

**Improved access to radiotherapy trials to include facilitation of radiotherapy trials**

“NPL support for independent external dose verification is acknowledged as playing a vital role in safety.” Elizabeth Miles, UK Radiotherapy Trials QA group coordinator.

The RIF marked a step change in the delivery of advanced radiotherapy in England; and following on from this initiative the Public Health England Strategy for Cancer 2014 annual report prioritizes the wide scale adoption of innovative radiotherapy technology for which there is currently insufficient provision. NHS England funding has enabled NPL, in partnership with the RTTQA, to play a key role in ensuring the safe and optimized uptake of new radiotherapy techniques and credentialing into clinical trials in support of the Commissioning through Evaluation program – this program enables a limited number of patients to access treatments that are not yet fully funded by the NHS, but nonetheless show significant promise for the future, while new clinical and patient experience data are collected within a formal evaluation program, but avoiding the need for costly clinical trials NPL end-to-end treatment verification services have provided centers with confidence in the delivery of new techniques such as Stereotactic Ablative Body Radiotherapy (SABR) for Non-Small-Cell Lung Cancer and Stereotactic Cranial Radiosurgery (SRS) – a specialist form of radiotherapy that can be used to treat patients with intracranial conditions, such as benign and malignant brain tumors. Both of these national audits have highlighted and resolved issues with inconsistencies in implementation that have resulted in significantly reduced variation in the dose delivered to the patient.

NPL takes a leading role internationally in the development of end-to-end treatment verification techniques, with many countries now basing their audit techniques and protocols on those developed by NPL and its collaborators. NPL is currently leading an international project to develop an audit of auditors, whereby we supply audit groups from across the world with a set of virtual audit measurements containing known errors, which are then analyzed and interpreted by the individual groups and their analysis reported back for assessment. This will allow centers from multiple countries to be included in international clinical trials, which is of particular importance for rarer cancers and/or new techniques such as proton beam therapy, to increase the number of patients that are able to participate in the trial.
The unique relationship between the UK’s National Measurement Institute, NPL, and the national clinical trials team (RTTQA) allows the further development of end-to-end audit for new advanced techniques such as proton beam therapy, MRI guided radiotherapy and molecular radiotherapy that will allow the establishment of new clinical trials for these modalities. With any audit or credentialing exercise one of the primary considerations, alongside accuracy, should be cost effectiveness. Pettersen, Aird and Olsen have examined this issue and stated that “The number of patients required in a Randomized Clinical Trial may be reduced by introducing appropriate dosimetry QA, as the risk of under-powering the study is minimized. Dosimetry QA in clinical studies is therefore cost-effective.”

PROFILES:
Rebecca Nutbrown, Head of Metrology for Medical Physics, National Physical Laboratory, UK:
Rebecca obtained her BSc (Hons) in Physics from Imperial College of Science Technology and Medicine in 1994. She went on to pursue a career in Radiation Dosimetry at NPL receiving her MSc (Distinction) in Radiation and Environmental Protection from the University of Surrey in 1999. Rebecca ran the Radiation Dosimetry group from 2007 to 2016. (Prior to this, since 2004, she was group leader for the X-ray and Chemical Dosimetry Group.) She has overseen the installation of the new NPL clinical linac and since led the development of related projects and collaborations. Since 2016 she has been responsible for setting up and leading the Metrology for Medical Physics Centre at NPL.

Dr. Catharine Clark, Head of Clinical Translation for Medical Physics and Principal Research Scientist, National Physical Laboratory, and Consultant Clinical Scientist, Royal Surrey County Hospital NHS Foundation Trust, UK:
Catharine completed her PhD in Radiation Physics in 1998 at University College London. She then moved to Paris, France, where she worked at the Institut Gustave Roussy and then to Stanford University, California, USA, before returning to the Royal Marsden, UK. Her research interests are focused on the practical implementation and dosimetric verification of advanced radiotherapy. She has led several audits for the national implementation of advanced radiotherapy techniques in the UK. Catharine has published 51 research papers, 4 book chapters and 2 national reports on these topics. She holds a joint post at the Royal Surrey County Hospital and NPL and is a member of the NCRI radiotherapy trials QA group.

REFERENCES:
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**Recommendation:**

- **IG:** The measurement was performed with a test current of 1 mA.
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The New Hampshire Department of Education (DOE) in conjunction with the Community College System of New Hampshire (CCSNH), local industry and high technology partners again assembled to reach out to New Hampshire girls in the 9th and 10th grades. This age group was selected as the target audiences because this is the age at which many young people begin focusing on interests that may ultimately become career paths. Paradoxically, it is also the age at which girls often seem to get “turned off” to math, science and technology.

New Hampshire Senator Maggie Hassan was the 2017 keynote speaker during the event hosted by the University of New Hampshire in Durham, NH. The Senator told the students that “even though women make up nearly half of the workforce in the United States, they’re really under-represented in the STEM fields.” There appears to be little change from a 2016 report that noted that women comprise 48% of the workforce but hold fewer than 27% of the workforce in STEM related fields. The Senator noted that, “research shows you make better decisions when men and women are both at the table.”

The Senator was an early advocate of STEM related education beginning with her executive order as the New Hampshire state Governor that created a STEM task force. One of the key focus points for this task force was the situation concerning the lack of women in STEM fields.1 In a statement dated January 13, 2015, then
Governor Hassan observed that “modernizing how we educate our students in the STEM fields of science, technology, engineering and math is critical to helping them develop the skills needed for good jobs in the innovation economy…” As the Senator discovered during her keynote address, the GTD event is so popular that student participation covered all grades from 9 through 12.

New Hampshire State Representative Ann McLane Kuster, in a letter to the New Hampshire Department of Education, Career Development Bureau, dated March 14, 2017 stated, “I commend our state’s education and business partnerships for today’s hands-on learning activities. Robust investments in STEM learning is critical for tomorrow’s workforce and the 21st century economy. I will continue my work in Congress to support and promote STEM education.”

The initial Girls Technology Day event was held March 14, 2013 on the NHTI (New Hampshire Technical Institute) campus with 120 girls and ten workshops. The 2017 schedule of events involved 35 High Schools, 807 students, 95 presenters spread over 162 workshops facilitated by a team of 73 volunteers. These statistics represent a change from the 2015 data for the number of participating schools (+ 125%), participating students (+ 162%), partner presenters (+ 250%) and available workshops (+ 150%).
OUR TEAM

Girls Technology Day, with experiments and discovery in metrology and the sciences, is an annual capstone event for NCSL International here in New Hampshire. Our team engaged a portion of the scheduled 807 students across 162 workshops as they moved from one workshop to another over the course of each event. 2017 was the third consecutive opportunity for NCSL International to engage this select group of students. Materials, professional skills and equipment were provided by a team consisting of NCSL International Learning and Development Committee members, NIST, ECM Global Solutions, NH State Metrologist and the State Department of Education.

All activities are STEM related with our team focus on measurement and metrology. The NCSLI team included William Hinton (NextEra Energy Retiree); Gary Confalone, Greyson Miller, Lucas Prato (ECM Global Solutions); Tim Osmer (NH State Metrologist); Abigail Confalone (NCSLI event production assistant volunteer) and Jim Prato (retired physics teacher).

The NCSLI team again recruited Abigail Confalone, the 16-year old daughter of workshop facilitator, Gary Confalone, to provide production assistance in photography and videography based on lessons learned at previous, large-scale events. She commented that as an observer “she gets to see everything behind the scenes and it was remarkable to observe and see how interested so many girls could be in the STEM field. All the girls at the...
event were very active in participating in each station and by the looks on their faces you could tell how fascinated and eager they were to learn more. With events like these, students can learn hands-on outside of the classroom and get to see how important STEM related jobs can be.”

Three sub-workshop experiments were again conducted in the area of metrology of length, temperature measurements and ultrasonic position measurements. Gary Confalone, Lucas Prato and Greyson Miller facilitated the Faro Edge Arm and presented Metrology – Length – Laser Measurement workshop. The operating theory, design and STEM applications for the Faro laser measurement arm along with an explanation of data acquisition were discussed and demonstrated. This workshop remained unchanged from previous GTD events due to how well it is received by the girls and chaperones alike. The girls operate the unit, collecting scans of many different objects including facial scans of several of the students. The girls were taught that scan data is captured as a point cloud in the attached laptop where the rendering could be further manipulated. The technology behind the Faro Edge Arm again made this equipment the star of the show.

“... it is inclusive and physically shows examples of how the careers work. I loved how it was interactive. It makes it easier to learn about what there is to do as a career.”
— Portsmouth High School Sophomore
Gary Confalone stated, "We can advise our children on promising career paths, but nothing compares to hands on participation. These girls now have an opportunity to experience what a career in the STEM field offers. Yes, science can be fun and getting together at this event reminds us how fortunate we are. We owe these girls the time to learn about all the various careers in STEM. It’s rewarding for me when I see the excitement in the students and equally in the enthusiasm in the presenters."

State Metrologist Tim Osmer again mentored the thermal measurement experiment Metrology – Temperature – Infrared Thermometry. This experiment uses infrared thermometry to assess the thermal resistance of a wall panel constructed by each girl or group of girls. The girls must apply any engineering skills they may possess in selecting insulating characteristics from an assortment of materials to be used to construct a wall panel. The design specifications limit the number of layers of material as well as assign the selection for the outer facing surface of the wall to match the emissivity factor for the Vernier Technology Infrared thermometer. Four panels are constructed by different girl(s) then inserted into the test frame with heat source (60 W bulb). The heat source is energized and infrared temperature data acquired and entered in an Excel spreadsheet. The individual wall temperature data was evaluated to determine acceptable to inferior performance relative to each other and how the material may have affected the insulating performance. One of the girls asked what will we do when 60 W incandescent bulbs are no longer available. Critical thinking and questions such as this were the norm at this event.

William Hinton mentored the falling object/local gravity experiment using a Vernier interface and acquisition equipment provided by Hinton Technical Services and a new position sensor donated by Vernier Technologies. The ultrasonic position sensor measures the distance over time as the object falls away from the sensor. Data was collected in a Chromebook running Vernier
“The hands-on workshops were full of energy and engaged the girls on real world applications of STEM. The presenters were passionate about their profession and it showed in their activities. For our students, the connections between what they learn in the classroom and where it is applied in the real world is very important.”
— Spaulding High School Teacher

The girls analyzed the velocity of the items (a paper coffee filter, multiple filters for mass effects and a tennis ball) and proposed why and how drag affected the two items.

The girls noted that air currents and people around the test location affected the data collection and multiple data runs were required to confirm and delete invalid data. The slopes of the line segments were analyzed and acceleration (dV/dt) due to gravity was determined to range from 7.6 m/s/s up to 12.5 m/s/s. One team determined that significantly more data would be required to lower the uncertainty of the measurements based on the data scatter.

Jim Prato, a 43-year career, retired physics teacher again partnered with our team to provide an ad hoc experiment explaining and demonstrating light wave communications. Simple components are configured in a series circuit (LED, battery, and a coil of wire). A cell phone headset’s output leads are connected in parallel with the wire coil. The LED is then pointed toward a solar cell connected to a low power audio amplifier and speaker. The girls can assemble the equipment and through experimentation determine the optimum emitter/receiver orientation as well as the audio (power) level.
The Girls Technology Day event is focused on 9th and 10th grade students. We took the opportunity to ask our participants what their future looks like. Their response ranged from entering the medical field to coding and robotics. Recent events with younger students is now part of my education outreach process. We are getting STEM and Metrology exposure to the younger students to instill an understanding of the art and science as well as suggesting a career in Metrology on the trade craft level.

Governor Chris Sununu addressed the attendees in a letter dated March 14, 2017 where he told them, “Science is more than just an important field for your careers. It is how to understand the world around us, and how we learn to make that a better world. No matter what you decide to do in life, and understanding of science and technology will better prepare you for work and life.

I started my professional career as an environmental engineer, cleaning up hazardous waste sites, and creating cleaner soil and groundwater. I cannot stress enough how important it is for today’s young students to become tomorrows scientists, engineers and leaders.

As you continue through high school, and look ahead to college and your career, remember that STEM opens up unlimited possibilities.”

William Hinton NextEra Energy Retiree and Owner of Hinton Technical Services, LLC in Rochester, NH. An NCSLI member since 1996, Hinton is a past NCSLI Board Member currently engaged in writing NCSLI documents and is a New Hampshire statewide Metrology Ambassador.

REFERENCES

NOTE:
SPECIAL THANKS
Vernier Software and Technology for the donation of sonic motion detector, model MD-BTD.
Magnets

The Star Attraction for McClelland First Graders
World Metrology day was again celebrated with future STEM (Science-Technology-Engineering-Math) practitioners from the first-grade class of Davita Fortier at the McClelland Elementary School here in Rochester, New Hampshire. This outreach project has become an annual event at this grade level as a tribute to World Metrology Day. Additionally, experience with students in the middle and high schools indicates that the need exists to introduce younger students to STEM and the world of metrology. Davita Fortier continues to introduce science into the education lives of these students even as the state support for STEM at this grade level dwindles.

A set of learning objectives, developed for previous Metrology Day magnet events, has proven to be valuable for Davita who uses them to teach the students in preparation for the event and for the Metrology Ambassador/Presenter to keep focused on the material for this age group.

They remain simple, concise and well suited to the audience:
1. Discuss the poles of a magnet and how they interact with each other,
2. Explain the earth as a magnet and why a compass works, and
3. Identify two uses for magnetism/magnets.

The learning objectives and the training material is contained in a PowerPoint presentation and is available from the author.

The students were primed for the event by Davita who leveraged the learning objectives to create and administer her own instruction on the principles of magnetism and explained what to expect during the morning’s event. Some of the magnets were removed from the collection used in previous years events due to their small size or high power and clamping force. Safety is paramount with young students and we follow the guidelines of the Consumer Product Safety Commission, 16 CFR Part 1240, Safety Standards for Magnet Sets.

The collection of magnets, while reduced in content, can be found around the house with small ceramic magnets taken from the tool box and off the refrigerator. Students were allowed to handle stronger neodymium magnets that are permanently attached to metals wands or mounted to steel pans that a mechanic would use to retrieve or contain steel parts close at hand, preventing their escape. The collection also included a large bar magnet often used on construction sites to collect metal objects dropped on the ground during construction or renovation.

A moderate-strength “rare-earth” neodymium magnet often used in the garage or home shop due to its substantial lifting power (45 lbs/20.4 kg) was attached to an iron machinist block and the students were challenged to remove the magnet from the block. Students attempted to remove this magnet during the three self-exploration periods.
Four work stations were created by grouping student desks into a square. Each station had a pair of plastic containers, one filled with many different items – plastic beads, a piece of steel chain, a golf ball, wooden biscuits, several coins, brass fittings, steel nuts and washer, paperclips, wooden knob and a large nail. The students took turns with a low-power ceramic magnet, removing magnetic items from the container and placing them into the other container. We circulated among the students, asking them why some items were magnetic and why others were not. They continued this until every student had completed the task.

A simple introduction to electricity was paired with the magnetism exploration through the fabrication of hand wound electromagnets each powered by two C-cell batteries. The challenge of the electromagnets was not so much the concept of electricity flowing through the coil to produce a magnetic field, but rather, training the students and their small hands in the operation of the alligator clips on the battery pack.

This group like all the previous groups was familiar with the salvage yard cranes that use an electromagnet to latch onto to an automobile and transport it to the crusher. The explanation of how this worked was kept very simple. They grasped the connection between completing the power circuit and the coils ability to attract paperclips from the end of the iron (steel) core.

The formal classroom instruction periods were very short, lasting less than 15-minutes followed by 20-minutes of self-discovery. The PowerPoint presentation contains large, full-color images that aid the students understanding of the material. After many years with students of all ages, it is very clear that students of any age learn better and remember more when they are involved and immersed in the discovery process associated with the science. The neodymium magnets were under strict control of the metrology ambassador, teacher Davita Fortier or the classroom teaching assistant, but beyond that, self-discovery was the rule. Some students turned the science of magnetism into art creating all manner of shapes and figures.

Magnetic lines of flux are a difficult concept to grasp and drawings don’t make it a physical representation for such young students. A high-pressure laminate panel inside a wooden frame, placed over a magnet then sprinkled with iron filings allows the students to see a representation of the lines of flux as the filings align with the flux field. They soon learned that they could move the magnet and see how the filings and the flux follow the magnet.
A laboratory magnetic stirrer was loaned by NCSLI members at the NextEra Energy – Seabrook Station Metrology Laboratory for the day’s event. This laboratory tool was used to demonstrate the coupling between magnets, one in the stirrer base and the other in the Teflon stirrer in the beaker. The vortex was referred to as a “tornado” for this age group. Surprise! One of the students corrected me saying that the weather creates a tornado. The spin-rate, as controlled by the students, creates a tornado/vortex right in the classroom and every student had an opportunity to control the stirrer and several times during the event, they chose to change the water color and start over.

The magnetic Lenz’s law effect has always been the star of the show, even ahead of the stirrer. A high strength neodymium magnet, when dropped into the opening of the 12-inch tube, drifts down the tube and drops from the bottom end in approximately four seconds while freefall from this height in open air is less than one-half second. High school students can understand the basic of Lenz’s law and eddy currents that control the rate of decent within the tube, but the first graders are simply mesmerized by the effect. The students would drop the magnets into the opening and watch it drift down the length of the tube doing it again and again. This demonstration included another challenge, teaching a six-year-old how to operate a stop watch. They are quick studies.

The students were unable to remove the neodymium magnet from the machinist’s block. We surreptitiously showed one of the students that sliding the magnet to the edge of the block, allowed the magnet to be removed. She told two friends who told two friends and by the end of the event, every student was successful in removing the magnet. The metrology ambassador came prepared with two dozen “Wooly Willy” magnet toys and every student and the teachers received one of the toys to remind them of their day being drawn to magnets and magnetism.

William Hinton
NextEra Energy Retiree and Owner of Hinton Technical Services, LLC in Rochester, NH. An NCSLI member since 1996, Hinton is a past NCSLI Board Member currently engaged in writing NCSLI documents and is a New Hampshire statewide Metrology Ambassador.

REFERENCES:
[1] Neodymium Magnets (aka Rare-Earth Magnets) en.wikipedia.org/wiki/Neodymium_magnet

Author note: While 16 CFR Part 1240 was rescinded in March 2017 due to a suit brought by a magnet manufacturer, the spirit and intent of the initial publication has value when working with students and magnets and will continue to be used to ensure safety during outreach events.
ASTM International and NCSL International Sign MOU to Collaborate in Metrology

ASTM International and NCSL International, two global organizations whose members share an interest in measurement science, signed a memorandum of understanding. Metrology, the former term for the science of measurement, is a field that cuts across many industries represented by ASTM International’s 145 Technical Committees.

The MOU was signed at ASTM International’s global headquarters during the meeting of its committee on quality and statistics. Simultaneously, ASTM International launched a subcommittee of that group devoted to measurement science, which involves many members of NCSL International.

“Collaboration throughout the measurement science community has been an NCSLI priority for years,” said Craig Gulka, Executive Director of NCSL International. “The missions of both organizations go hand-in-hand, and there is a need for sharing measurement science information across industries, so that we can be well aligned for this partnership.”

The MOU was signed by Gulka and Dan Smith, Vice President of Technical Committee Operations at ASTM International.

Collaboration between the organizations dates back to a jointly sponsored workshop in 2014 on the topic of temperature. The idea for an MOU moved forward as Dr. Ralph Paroli, ASTM International’s 2016 Board Chairman, gave the opening keynote address at the NCSLI Workshop & Symposium last year.

“Issues such as metrological traceability, which links measurement systems around the world, are becoming more and more important to governments, businesses, and society as a whole,” said Andrew Oldershaw, Sector Leader in Measurement Systems Engagement at the National Research Council of Canada, where Paroli works as director of R&D, measurement science and standards. “The new MOU and the new subcommittee could play an important role in helping National Metrology Institutes, laboratories, the accreditation community, and many others who depend on credible and independent methods and practices.”

Organizers say the collaboration could involve standards development and other activities related to:

- measurement methods for calibration, measurement-focused implementation, and interpretation guides for higher level requirements
- verification and validation of measurement methods
- quality management for measurement systems
- measurement risk management in measurement science
- Anyone interested in joining the new subcommittee can find more information here: www.astm.org/JOIN.

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Hello again, Colleagues. As mentioned in the previous Measurement Information Infrastructure (MII) article, a growing team of developers and advisors has worked hard over the last two years or so to start concepts, and plan the next steps.

Since then, NCSLI proposed to form a formal MII committee, while at the same time capturing and refocusing the existing 141 Automation Committee. The NCSLI Board approved the proposal in June, so rather than run the next regular MII article, we decided to announce the new MII and Automation Committee (MII&AC), operating within the 140 Laboratory Operations family under NCSLI Vice President Jim (Smitty) Smith.

Let’s refresh our MII memories and take a look at MII&AC’s proposed role in its development.
**MII Definition**
First, what exactly do we mean by an MII? Our working MII definition to date looks like this:

**Measurement Information Infrastructure — a set of normative standards that define data structures, taxonomies, service protocols and security for locating, communicating and sharing measurement information.**

**Vision**
Okay, so what does that mean? It means we no longer spend time manually writing, sending, interpreting and analyzing calibration and testing certificates, scopes of accreditation (SoA) and instrument spec sheets and no more time spent figuring how to use the data and where to enter it into our systems. It means all our computers talk to each other without ambiguity and exchange the data automatically much like what happens between airlines and flight reservation systems, or banks, credit card companies and merchants. It means a revolutionary change for measurement-related businesses.

How would it work? The MII will remove the ambiguity from our human-readable documents and define machine-readable versions: MII spec sheets, MII certificates, MII SoAs. Around those standardized definitions, software developers will create product features that allow you to leverage computing power into new value streams. All the technology already exists; we’ve only to harness it and standardize it.

**Charter & Objectives**
The Board of Directors approved the initial charter with the following elements:

1. Collect, develop, and disseminate information relative to the Metrologist magazine recurring series on MII & automation topics.
2. Develop & define industry libraries and taxonomies used to populate the common MII.
3. Periodically review and update the existing NCSLI information on the band of topics.
4. Provide a point of contact for member organizations requiring assistance with the MII standard.
5. Allow Members to openly participate, volunteer and create product relating to MII.

Along with the charter came these objectives:

1. Develop & define industry libraries and taxonomies to populate the common MII.
2. Provide regular articles to Metrologist for publication (4 times annually).

3. Create an annual participative face-to-face meeting covering topics of interest at NCSLI Conference plus web meetings as appropriate.
4. Provide an annual abstract submittal for Track, Presentation or Panel related to MII at the NCSLI Conference.

In essence, we plan to define the MII technical detail to most effectively facilitate MII software development around compatible, exchangeable measurement information. Harkening back to the early articles, we will “Standardize and Automate!”

The MII and automation share a common motivation. While typical measurement process automation handles the nuts & bolts of calibration or testing, the MII seeks to automate the bigger measurement industry picture, with more synergy between industry players. In the long run, an MII might wrap that synergy back around on itself and enable automated automation. You read that right. MII instrument spec sheets with embedded instrument models, certificates, and SoAs would enable a measurement professional to say “Let’s calibrate this instrument with those measurement standards to that specification” and an MII application would process that data to produce an automated nuts & bolts calibration or test routine, complete with an optimized test point selection, and uncertainty analysis guaranteed to comply with the laboratory’s SoA.

**Committee Meeting & MII Sessions**
We’ve scheduled the new committee meeting at the 2017 NCSLI Workshop & Symposium in National Harbor, Maryland, of course. The agenda will include discussion on any or all of the above elements and establishing operating guidelines, standing up an Automation Working Group to continue the 141 Committee’s past and future automation initiatives, outlining the MII Working Group Initiatives, and of course, standardizing the MII itself.

We welcome participation from all stakeholders and interested parties—calibration and testing laboratories, accreditation bodies, software developers, instrument manufacturers, vendors, and all other interested parties—so please join us. You should find us Tuesday, August 15, 5:30 PM to 7:00 PM, in the Magnolia 3 room.

In addition to the MII&AC meeting, the MII team will hold a panel discussion and demonstration at the conference (Session 4C, Wednesday, August 16). Please join us with your ideas, suggestions and comments or just to hear the latest status. And for technical detail, don’t forget to catch David Zajac present progress on SoA data representation in XML (Session 9C, Thursday, August 17). See you there!
NIST has recently made substantial improvements to its Johnson-noise thermometry system, which is playing a vital role in the worldwide effort to determine the value of a key physical constant in time for the impending redefinition of the International System of Units (SI) in 2018. The system is now capable of yielding statistical uncertainties 10 times smaller than its predecessor.

“It’s a new era of electronics and systems for noise thermometry,” says Weston Tew, who heads the Johnson Noise Thermometry (JNT) project at NIST’s Gaithersburg, MD, campus. “We’ve had other systems in the past, but this is now the third generation of technology.”

The upgrades will help Tew and colleagues in their pursuit of the most accurate values possible for the Boltzmann constant (k), which relates the total internal energy of a system to its temperature and will be used to redefine the kelvin, the SI unit of thermodynamic temperature. The measurement determines the ratio of k to another fundamental invariant of nature: the Planck constant (h), which relates energy to frequency.

The best authoritative measurements of the Boltzmann constant to date have been made with acoustic thermometers that relate the speed of sound in a gas to thermodynamic temperature. But it is highly desirable to compare values obtained to a similar uncertainty by different physics and different technology. That’s where JNT comes in the SI redefinition.

Johnson noise is the tiny fluctuation in voltage caused by random thermal motion of charge-carriers (chiefly electrons) in a resistor, which is directly proportional to temperature. The greater the amplitude of the voltage fluctuation, the higher the temperature.

JNT measurements are challenging. The thermal voltage noise signal is exceedingly faint compared to other sources of noise in the system—on the scale of nanovolts (10–9 V) per square root of the frequency for a 100 ohm resistor at room temperature. Yet NIST’s system can be utilized to measure k to a statistical uncertainty of only about 12 parts per million over one day of averaging.

The key enabling technology is an innovation developed at NIST’s Boulder, CO, laboratories: The Quantized Voltage Noise Source (QVNS). The QVNS generates a precisely controllable amount of voltage fluctuation which is basically equivalent to thermal voltage noise. But the QVNS signal is the opposite of random. It uses arrays of Josephson junctions, superconducting circuits that operate with quantum accuracy. It can be set to any desired value to match the thermal voltage noise of any resistor at any temperature, with output in perfectly quantized integer units of h/2e, where e is the charge of the electron. Thus, is serves as a calculable noise source reference.

NIST’s JNT instruments can operate in either of two modes. In the absolute measurement mode, the noise power of the QVNS is programmed to balance that of a thermally generated Johnson noise source, resulting in a thermodynamic temperature independent of any fixed-point reference. In the relative measurement mode, the process is repeated at another temperature and another synthesized noise power, resulting in a thermodynamic temperature ratio. Both methodologies represent a significant advance over conventional JNT methods, which have less flexibility and functionality.

“We’re generating noise, or rather, pseudo-noise,” Tew says. “You can program these Josephson junctions with a digital code generator that puts out very fast pulses. It looks like noise for all practical purposes, but is deterministic in the sense that it simply repeats a known pattern over and over again. But in the time domain it looks stochastic, noisy.”

That noise signal can be adjusted until it perfectly matches the amplitude of the thermal Johnson noise that exists in any conductor at a finite temperature.

NIST’s JNT research is conducted at three different locations on NIST’s Maryland and Colorado campuses.
The 1 cm² microchip used for NIST’s Johnson Noise Thermometry work, fabricated at the Boulder, Colo., campus.

It is the only experiment in the world that is measuring the ratio of \( k \) to \( h \). Doing so makes the measurement of \( k \) more accurate because of the much lower uncertainty in the value of \( h \).

In the experiment, the QVNS output is matched to Johnson noise from a resistor kept at the triple point of water. The thermal noise amplitude is proportional to the Boltzmann constant times the temperature, which is known exactly. The QVNS noise amplitude is determined by multiples of the Planck constant, which is known to an uncertainty of 12 parts per billion. Thus both \( k \) and \( h \) are incorporated as a ratio from these measurements.

The JNT process entails amplifying both those signals about 50,000-fold using identical apparatus and then matching the two. NIST’s improved electronics suite helps minimize errors in that process. “The beauty of it is that when you amplify the signal and you amplify the pseudo noise in exactly the same way, with the same instrumentation, a lot of systematic errors cancel out,” Tew says. “You can average away all the extraneous noise and what’s left is the noise you really want to measure.”

This capability can be used to measure absolute temperatures at fixed points on the international temperature scale. **

“We are excitedly anticipating the results of this study,” says Gerald Fraser, Chief of NIST’s Sensor Science Division. “If everything goes as planned, the NIST JNT measurements will provide a robust and independent test of the acoustic thermometry measurements that are presently the primary input for the value of the Boltzmann constant when it becomes fixed under the redefinition of the SI.”

* At present, the kelvin is defined in terms of the triple point of water, which is currently regarded as an exactly fixed value of 273.16 K. In the impending redefinition of the kelvin, the value of the Boltzmann constant will be exactly fixed, and the triple-point temperature will be determined experimentally.

** The International Temperature Scale of 1990 and companion documents specify numerous fixed reference points from less than a millikelvin to more than 1350 K. One important function of the JNT is to provide absolute primary thermometer measurements for several of the fixed points in the international temperature scale—notably those between about 500 K and 1000 K. This is higher than that range typically measured by acoustic thermometry, and overlaps with the range measured with radiometers.
Isotech Celebrating
35 Years and Queen’s Award

Founded in 1980 by John Tavener, Isotech grew to become a world leading supplier of temperature calibration equipment, today Isotech remains privately owned with John as President. In 2016 Isotech celebrated 35 years of trading and now in 2017 the company is celebrating winning the prestigious Queen’s Award for Enterprise.

John founded the company to make thermocouple referencing equipment for the power industry – as he set up a calibration laboratory it became apparent that there was no single company who could provide all the required equipment and expertise. Seeking to address this throughout the 1980s Isotech developed new and innovative dry blocks, liquid baths, thermometers and associated equipment. In 1989 the company purchased the metrology division of YSI Incorporated – which brought ITS-90 Fixed Points and Apparatus into the Isotech portfolio.

During the 1990s Isotech continued to develop internationally forming long lasting partnerships to support clients across the world with both pre and post-sales support. By the end of the 1990’s most of the world’s leading temperature laboratories were using Isotech equipment and many nations were trusting Isotech for their primary temperature standards. The company’s portable calibrators had developed and were the first in the world to have a separate input for a reference probe for high accuracy portable calibration of industrial sensors.

The laboratory at Isotech had grown in size and offered the lowest uncertainties of any privately owned company. In addition to providing calibration services many metrologists from around the world have visited the laboratory for training and to share knowledge.

Previously Isotech had not manufactured thermometry bridges; but concerned that existing technology was not keeping up John Tavener commenced a joint project leading to the development of the Isotech microK Thermometry Bridge which was launched in 2006. Today this is the instrument of choice for leading metrologists replacing older technology that relied on obsolete components. After celebrating 35 years of trading in 2016 the
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The company is now celebrating again – in April 2017 the company was awarded a Queen’s Award for Enterprise in the Innovation Category for the microK development.

John Tavener, commented, “We are delighted that Her Majesty the Queen has approved the Prime Minister’s recommendation that Isotech should receive a Queen’s Award for Enterprise in the Innovation category. We have worked hard over 35 years to develop new products providing unique solutions for temperature calibration and metrology; and we haven’t finished yet, we have more exciting products nearing the end of the R&D process”.

1980  Company Founded
1981  Shipped First Product
1983  Opened Calibration Laboratory
1985  Laboratory first Accredited “British Calibration Service”
1989  Purchases Metrology Product Line from YSI
1990  Isotech Journal of Thermometry
1995  First Home Page
2000  ISOCAL-6 Launched
2006  microK Launched
2016  Celebrating 35 Years of Trading
2017  Awarded Queen’s Award for Enterprise
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The Central Indiana Section 1133 spring meeting was held on April 27, 2017 at Purdue Polytechnic Columbus Indiana in the Advanced Manufacturing Center of Excellence (AMCE). A total of 37 participants attended.

The meeting started off with a welcome and introduction from our host Joseph Fuehne, PhD, PE, Director and Associate Professor at Purdue Polytechnic Columbus. Joe gave the history of the AMCE and the school’s name. Founded in 1983, Purdue Polytechnic Columbus is part of a statewide network that offers the same technology bachelor programs available at the West Lafayette campus. Purdue Polytechnic Columbus is currently headquartered in the Advanced Manufacturing Center of Excellence (AMCE) in Columbus.

The AMCE is a state-of-the-art education and workforce training center serving students and the industry alike in Southeastern Indiana. The building is home to AMCE’s certification and degree programs, as well as business development services for manufacturers. With integrated technology labs and classrooms designed for a science, technology, engineering, and math curriculum, the building enables distance learning.

The first presentation was an introduction to Zeiss’ Calypso software for coordinate measuring machines by Joseph Fuehne, PhD. Joe explained that the software has a simulation mode that allows the operator the opportunity to test measurement protocols in a virtual environment before running on a real CMM. This function prevents damage to expensive measurement tools that could occur if improperly programmed. By establishing a measurement plan and a point of origin, Joe demonstrated how the simulation program measured surfaces generated from a CAD model including flats and holes. Once the operator approves the plan, the software is downloaded into a jump drive and then loaded into the CMM for execution. This was demonstrated later in the measurement laboratory.

A discussion evolved about working with local manufacturers in developing training for employees to help them understand basic calibration requirements. Additional discussion included possible educational outreach to high school students in the AMCE/Purdue Polytechnic area of focus.

Purdue Polytechnic provided our morning break refreshments and Indianapolis Scale Company provided lunch. Participants greatly appreciated both, especially since the facility has limited nearby refreshment options.

Lloyd Baker, NCSLI Midwestern Region Coordinator, presented the recent updates from the Board. He then went on to explain the opportunities available at the upcoming NCSLI Workshop & Symposium scheduled for the National Harbor, Maryland in August. The NCSLI Conference will include committee meetings, tutorials, oral presentations, poster presentations NIST tours, exhibition hall, luncheons and receptions. In closing, Lloyd also spoke about the Technical Exchange scheduled for February 2018 in Orlando, Florida.
The third speaker was Ms. Bethany Hackett, Program Manager, ECT/Construction, from the National Voluntary Laboratory Accreditation Program (NVLAP). Her topic was “Updates to the International Standard ISO/IEC 17025 and ISO/IEC 17011.” Beth started with details of how the ISO CASCO Working Group 44 was composed and their progress/timelines for drafting, voting, revising and publishing updates to both standards. The feedback forms we received tell us that the audience greatly appreciated this update with all of the details. Thank you, Beth, for your insightful presentation.

The fourth speaker was Kirk Eggebrecht, Kirk Eggebrecht Consulting, working with Indianapolis Scale Company. His topic was “Weigh Scale and Balance Use through the Experience of an Indiana-Based Scale Company.” Kirk stated that nearly every building in the USA has at least one scale or balance. They are used everywhere including asphalt plants, gravel quarries, livestock facilities, pharmaceuticals, railroads, trucking, steel mills, etc. There are dozens of manufacturers, and service technicians must understand all the different makes and models.

Kirk discussed “Legal Metrology” telling the audience about NIST Handbook 44 and the various details as they apply to retail trade. HB 44 prescribes the test method, minimum test loads and scale classes and tolerances. Frequently non-legal-for-trade users will default to the tolerances listed out of convenience.

Kirk explained that application drives capacity, resolution and accuracy. He discussed high precision lab balances, lab and precision scales, high-resolution counting scales, bench and floor scales, tank and hopper scales, pallet and forklift scales, portable wheel weighers, truck scales, hanging scale and dynamometers, and rail scales.

### The scale Calibrator’s Unique Challenges:

1. Wide range of devices, applications and environments:
   a. From Micro-Balances to Truck & Rail Scales of all brands!
   b. From Legal for Trade to Unregulated
   c. From Clean Rooms to Pig Farms & Scrap Yards
2. 95+% of the work is at the customer:
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   b. Different safety & security rules, check-in procedures and other protocols
   c. “Where did the scale go?”
   d. “You’re not shutting my line down!”
   e. “What happened to the Fork Lift driver?”
   f. “Who is in charge, we have a problem?” – Do scales fall under Quality, Metrology, Maintenance, Purchasing or Production?
   g. To many customers, scales not viewed as measurement devices:
   h. Scale Calibrations require a Pass/Fail, but against what tolerance?
   i. Scales and Balances often thrown around, moved between plants, and/or re-applied for other uses – without regard to process needs!
   j. The cleaning of the scale often takes longer than the calibration or repair!
   k. The scale might weigh right if you do not blow a fan directly on it!
3. Technicians are not just Metrologists:
   a. Truck Driver, Trailer Hauler, Weightlifter, and Climber
   b. Repairmen (Detective, Electrician, Welder, Mechanic & Speed Reader)
   c. Installer (Assembler, Cement Layer, Electrician, and Fabricator)
   d. Customer Service Representative and Politician!
The meeting concluded at 3:00 PM with an optional tour of the Metrology/Three D printer lab.

The Central Indiana Section steering committee members are Amanda Garrett, John Bush and Elizabeth Robinette of Eli Lilly and Company, Kathy Kerner of Indianapolis Scale Company, Inc. and Section Coordinator is Charles Andrew, Eli Lilly and Company.
Cory Otto
cory.otto@bsci.com

The NCSL International Twin Cities Region held its most recent meeting on a beautiful spring day at the Maple Grove Community Center located in Maple Grove, Minnesota. The May 9, 2017 meeting was hosted by Carl Zeiss Industrial Metrology, LLC.

The day started with a transition of Section Coordinators from Corey Garbers (3M) to Cory Otto (Boston Scientific). Corey was recognized and thanked for his contributions to NCSL International and the Twin Cities Region.

Afterwards, attendees were welcomed with a round of Minnesota trivia. Minnesota’s state fish is the walleye (Sander vitreus) and with the May 13th “fishing opener” just around the corner, it seemed appropriate to pose the question, “What is the heaviest walleye caught in Minnesota history?” If you are interested, the answer appears at the end of this article.

Next up was a moment of appreciation and recognition of our veterans in honor of the upcoming Memorial Day holiday and a note on World Metrology Day.

In the spirit of continuous improvement, the steering committee chose to switch things up a little for their introductions. Historically, section steering committee introductions consist of a brief, “Hi, I am <insert name here> and I work for <insert company name here>.” This time, each steering committee member was asked to introduce themselves by answering the following questions:
1. How did you get into Metrology?
2. What past role(s) have you held?
3. If you could pass along one piece of information to someone new in our field, what would it be?
4. Where are you from?
5. What is something interesting about you?

This minor change set the tone for the day’s knowledge sharing activities, interactive discussions, and fun.

The host presentation for the meeting was delivered by Al Chaissen, Director of Aftermarket at Carl Zeiss Industrial Metrology, LLC. Al introduced attendees to Ziess’s history, capabilities, and foundation.

Satish Pragalsingh, Engineering Manager of the CRHF Physical and Dimensional Calibration Lab at Medtronic.
Following Al’s presentation, attendees heard from Satish Pragalsingh, Engineering Manager of the CRHF Physical and Dimensional Calibration Lab at Medtronic on the topic of, “How Do We Solve the Problem of Manufacturer’s Specifications?” Satish gave voice to the challenges many face balancing equipment capabilities, customer demands, and calibration requirements. Satish provided alternative methods to using manufacturer’s specifications (e.g. using published standards, memos from the manufacturer, deriving specifications mathematically, conducting measurement capabilities studies, etc.). In the end, it was clear that this is not a straightforward topic and it is one that requires partnering with equipment owners and clear communication.

After a break for refreshments and networking, Dr. Marcin B. Bauza, Director of New Technology and Innovation at Carl Zeiss Industrial Metrology, LLC presented on the topic of, “Metrology of Parts Made Using Additive Processes.” Dr. Bauza illustrated the differences between subtractive and additive manufacturing. Then, he discussed the challenges many face with measuring product made using additive processes by describing a case study that quantified the differences in measurements of a NIST artifact as built, after heat treat, and after wire EDM. Dr. Bauza finished his presentation by introducing computed tomography and its many benefits in this measurement application.

Before lunch, Paul Hanssen, President of WorkPlace Training educated attendees on the benefits of becoming a member of NCSL International and the upcoming annual conference at the Gaylord National Convention Center in National Harbor, Maryland from August 12 to 17, 2017.

Upon returning from lunch, Jane McDougall, Quality Manager at Precision Repair & Calibration moderated a panel discussion on the current trends in regulated industries. Attendees were able to fend off the inevitable post-lunch drowsiness with a flurry of back and forth questions and answers with panelists Shawn Mason (Sr. Hardware Calibration Specialist at Medtronic) speaking for ISO 17025, Walter Nowocin (Sr. Engineering Manager at Medtronic) speaking for ISO 13485, and Glenn Knight (Metrologist at Carl Zeiss Industrial Metrology, LLC) speaking for ISO 9000.

The final presentation for the day was unique in that a subject matter expert was not brought in to talk about the topic. Instead, a member of the region wanted to pose a question to the attendees and have an interactive dialogue. The topic, titled, “Here’s how we calibrate that... how do you? Conductivity and pH” was presented by Cory Otto, Metrology Manager at Boston Scientific. The presentation described conductivity and pH, their measurement applications, how Boston Scientific calibrates this equipment, the calibration challenges faced, and then asked attendees how they perform these calibrations. After much valuable discussion, a consensus was reached that this is not a straightforward measurement and that there is room for standardization in this area in the future.

The meeting wrapped up with a round of door prizes donated by the steering committee members.

The Twin Cities Region would like to offer a sincere thanks to Mark O’Connell, Site Manager for Metrology Services at Carl Zeiss Industrial Metrology, LLC for sponsoring the meeting, coordinating the refreshments and venue, arranging for speakers from Zeiss, and for ensuring the day went smoothly.

Did you keep reading to find out the answer to the trivia question earlier in this article? If so, the heaviest walleye caught in Minnesota history weighed 17 pounds, 8 ounces and was caught on May 13, 1979 on the Seagull River at Saganaga Lake.
Central Texas

The NCSLI Central Texas Section held its first meeting of the year in Austin, on March 17, 2017. The event was well attended with 32 participants.

Paul Packebush, National Instruments, and NCSLI Conference VP, kicked off the meeting with highlights from the recent NCSLI Board meeting and updates on the Workshop & Symposium scheduled for August 12-17, 2017 in National Harbor, Maryland.

Jack Somppi of Measurements International was first up with “Taking the Ohm from the SI to the Workbench to Benefit Industry,” covering the measurement of DC resistance with accuracies comparable to a National Metrology Institute (NMI).

Chris Grachanen, presented the long awaited official
recognition of the Calibration Occupation job title by the U.S. government. “US Government Officially Recognizes Calibration Occupations.” Chris and others spearheaded this effort for many years and it is with great pleasure that we are seeing the efforts rewarded to the benefit of the metrology community.

Ryan Saunders, Mitutoyo Corporation, presented a very informative presentation on “Proper Use and Care of Precision Hand Tools,” followed by a hands-on presentation, "How to make Correct Low Resistance Measurements" by Mike Sciulli from Tegam, Inc.

We are planning to hold two meetings a year, with the next meeting scheduled for the fall in one of the major industrial metro areas of our section.

The Central Texas section would like to thank the attendees, the presenters and NCSLI for their support. We would also like to thank National Instruments for hosting the meeting, providing refreshments and lunch, and for making this meeting a success; helping to grow the metrology community in our region.
Philadelphia

Donna Lodek
donna.lodek@transcat.com

The two-day Philadelphia Section meeting and training event was held on April 19-20, 2017 in Coatesville, Pennsylvania hosted by Cory Peters, Exelon PowerLabs.

Exelon PowerLabs is a leading calibration and testing lab with comprehensive capabilities for any industry. There are four individual labs strategically located from the upper midwest to the northeast, enabling their experienced staff of experts in engineering, metrology, and nuclear 11 power generation to support the urgent demands of our nation’s nuclear facilities, power grids, and critical supply chains.

Our meeting started with a review of the NCSLI Board highlights by Marcus McNeely, NCSLI Northeastern VP. Marcus explained the advantages of membership and how NCSLI is a leader in educational resources for metrology personnel, lab managers, technicians, and quality attendees. The presentation also included conference highlights and information on the upcoming Workshop & Symposium in National Harbor, Maryland on August 13-17, 2017 at the Gaylord National Convention Center.

We welcomed students, technicians, quality managers, lab managers, manufacturers and engineers. Our meeting was organized to showcase presentations with hands-on training, lots of networking and exhibitor demonstrations during the breaks and lunch. A tour of the Exelon facility was offered to attendees as well.

On the first day of our event we welcomed Edward Mulhern and Leon Chao from NIST, who defined the NIST-4 Watt Balance used to realize the kilogram by balancing electrical power with mechanical power. The discussion included the dissemination of mass in air and mass in volume with a 2018 target timeline to characterize the measurement environment; with the goal of calibration in a vacuum.

Jeff Grossman, from Fluke Instruments provided two presentations. The first presentation included the fundamentals of “Pressure Measurement” with discussions and hands-on training about the difference of gauge and absolute pressure measurements. Questions were forthcoming about the pressure calibrator used for the
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training; as well as understanding the different types of calibration reference standards and how to select the appropriate one for an application.

The second presentation provided by Jeff, included the concepts of “Gas Mass Flow Measurements” and history of specific equipment and flow based on temperature and time. Discussions included different ‘flow’ devices and types available for calibration reference standards. The questions and feedback from the attendees led to further conversations following the presentation; truly an interested subject from lab managers, technicians and students in attendance.

The second day of our region meeting we had training sessions concurrently scheduled to provide multi-discipline choice training options for our attendees. Pam Wright from the American Association for Laboratory Accreditation (A2LA) started us off with her presentation on the Draft International Standard ISO/IEC 17025: 2016 (E). Pam shared the revisions and updates made to ISO/IEC during the recent revision through the impact to the existing ISO/IEC compliant system, as well as the necessary steps to ensure compliance to the new standard. A brief quiz was held and reviewed to assure all questions were asked and answered following the presentation; our class did very well!

Steven Andersen from Ashcroft, Inc. provided a hands-on training and demonstration on “Pressure” using a hand-held pressure calibrator. The group was divided into three groups with each group learning the functions and operation of the devices. Participants learned how to use the devices such as the various functions and journal modes to interface with PC based data collection and how to verify the calibration.

Jun Bautista from Masy BioServices provided a hands-on training on “Conductivity Measurements and Calibration.” Jun used a characterized measurement cell (Primary standard) relevant for pure water conductivity. The class discussed conductivity and why is it being
measured, its importance regarding performance and regulatory requirements, the significance of temperature and its compensation, and finally, how to calibrate.

David Schurr from Exelon provided an exciting demonstration and training on "Electrifying Calibration in High Voltage." The learning objective was to understand the basic safety requirements associated with working with High Voltage; the techniques applied to a practical test and the effects of the electromagnetic field and other effects on measurements.

Scott Davidson from Exelon PowerLabs showed how to create a proper triple point of water using several methods; and then how to apply accuracy to an uncertainty budget. The class enjoyed the lab time to partake with a hands-on experience learning more about the temperature lab at Exelon.

“Common Errors in Torque Measurements” was presented by Zenailli Alireza from Morehouse Instrument Company. A walk-through training and a visit to the lab at Exelon included the importance of torque calibration and common errors in torque calibration. The agenda included torque definitions, potential measurement errors, using mass weights instead of force weights, uncertainty contributors, misalignment, and temperature effects on the torque cell cable.

The “Dimensional” class was taught by Cory Peters from Exelon PowerLabs. Demonstrations and discussions included: reading micrometers, how to take a step measurement with a set of calipers, and the best way to wring gage blocks together. All attendees participated!

Closing remarks included a reminder of the 2017 NSCLI Conference, “Precision & Performance with Measurement Science” on August 13-17, 2017 and ended with door prizes for many!

My deepest appreciation to Cory Peters and the staff at Exelon PowerLabs who hosted our 2017 Spring Philadelphia Section meeting and kindly provided breakfast and lunch for the two-day meeting with a photographer who did a fantastic job capturing the attendees and presenters during the meeting and training sessions.

We greatly appreciated our exhibitor’s participation. Thank you to Fluke, Beamex, and Measurement Instruments, for their support to ensure a successful event. And a special thank you to NCSL International for the support, education and resources to empower us all.
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