

JULY 8-12, 2023 | ORLANDO, FLORIDA  
ROSEN SHINGLE CREEK® HOTEL & CONFERENCE CENTER



**NCSL INTERNATIONAL**  
Serving the World of Measurement

# 2023 NCSL International Workshop & Symposium

Understanding  
**Climate  
Change**  
through  
**Metrology**

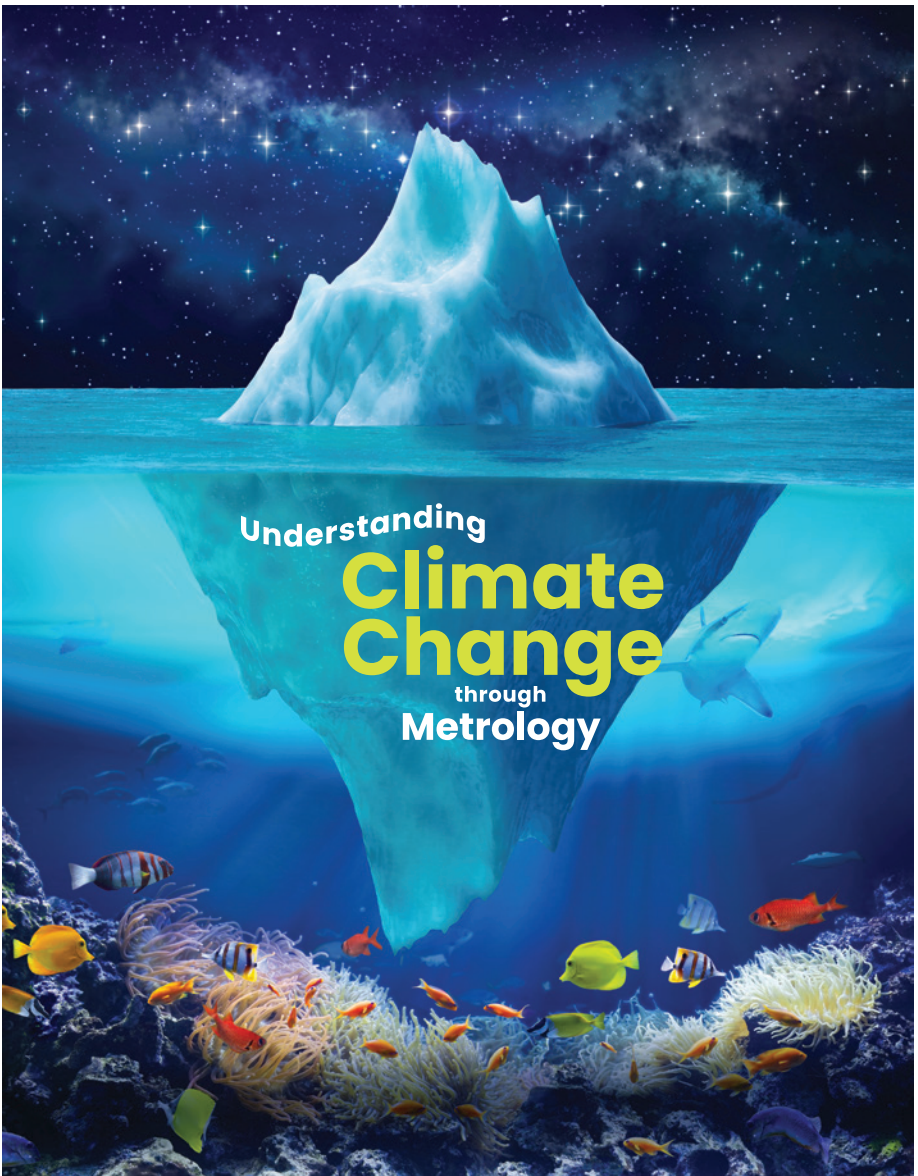
TUTORIAL PROGRAM  
JULY 8-9

EXHIBITION HALL  
JULY 10-12

TECHNICAL PROGRAM  
JULY 11-12

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Understanding  
**Climate  
Change**  
through  
Metrology



## 2023 NCSL International Workshop & Symposium

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# Welcome

The NCSL International Workshop & Symposium is your gateway to the decision-makers for the B2B measurement science industry. We invite you to connect with the owners, executives, and managers from companies and associations that support the calibration, testing and service industry, including many of the largest in North America. Our exhibitors are here to showcase new products, meet new customers, and network with the leading experts in the measurement science industry.

Whether you are a student or a long-time professional, you will have the opportunity to learn, network, and grow during this year's conference.

We're glad you are here!

THANK YOU TO OUR

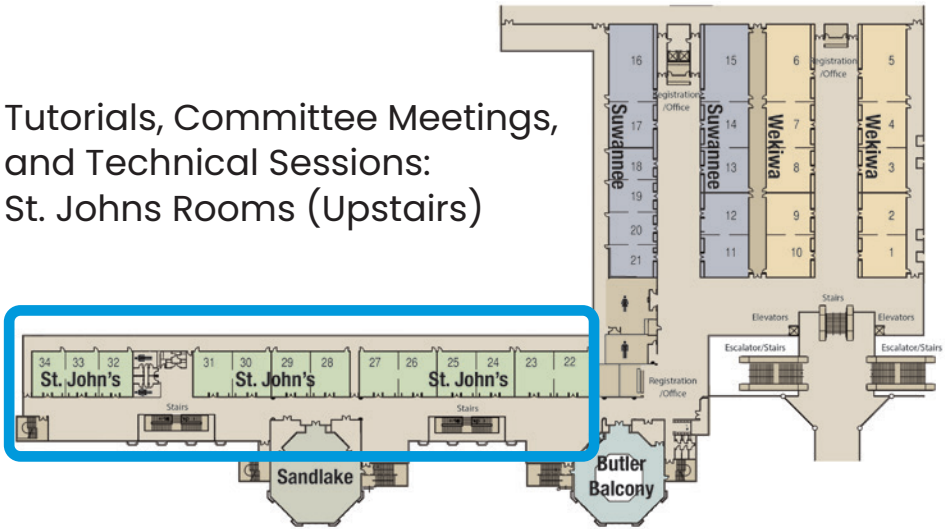
## Sponsors



# Venue Maps



Tutorials, Committee Meetings,  
and Technical Sessions:  
St. Johns Rooms (Upstairs)

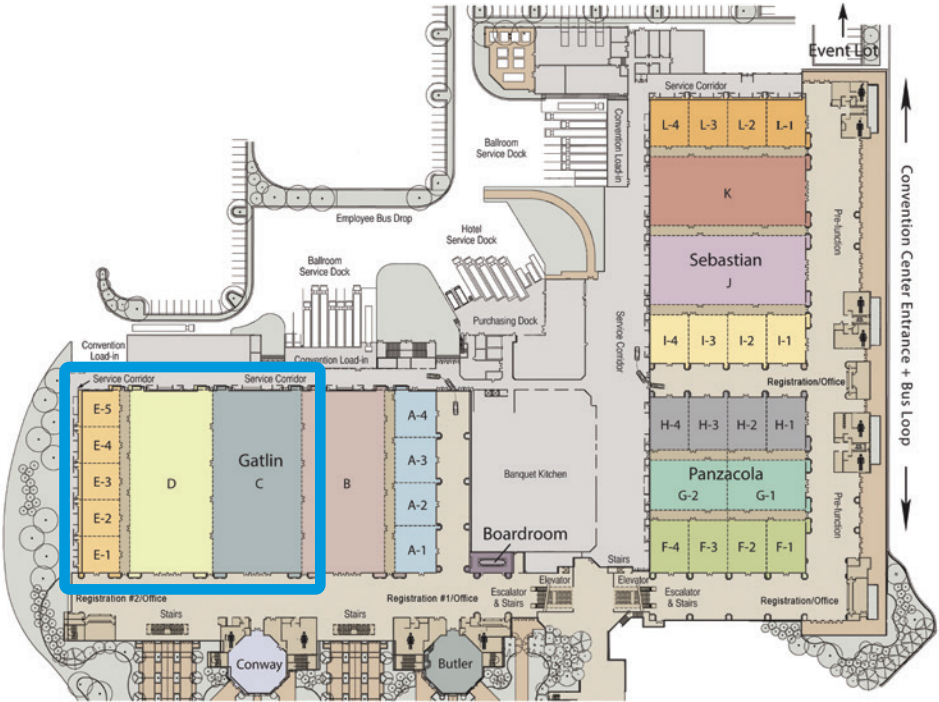




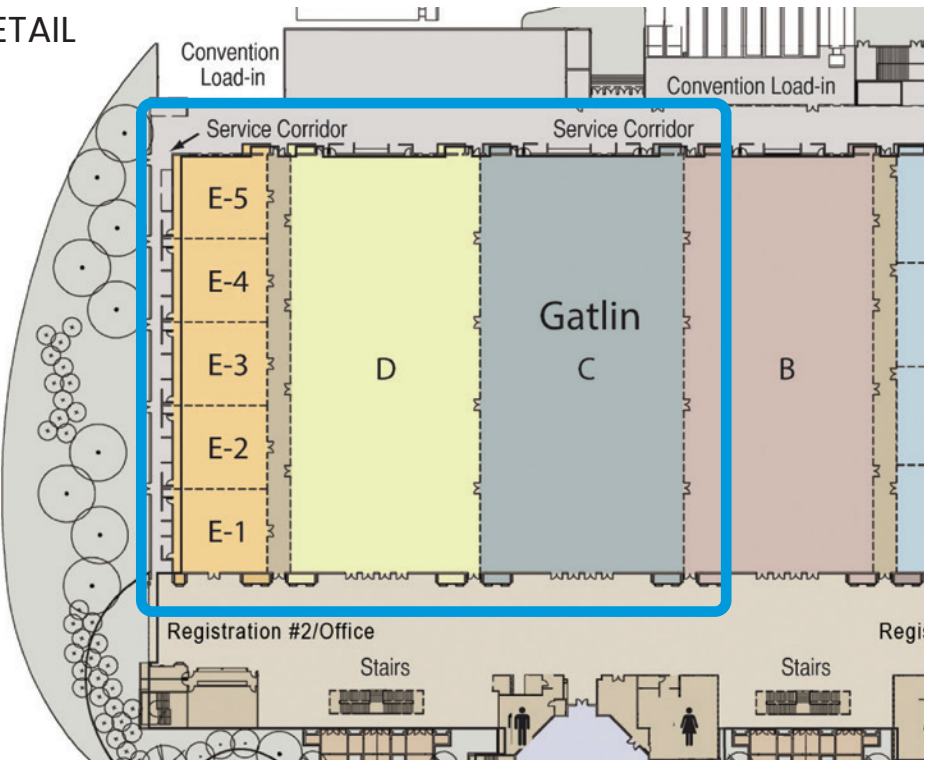
# Venue Maps

Exhibit Hall: Gatlin C/D

General Session: Gatlin E



## DETAIL



NCSLI WORKSHOP & SYMPOSIUM 2023

# Keynote Address

Monday, July 10 | 4:00 PM – 5:30 PM | Room: Gatlin E

## Conference Opening Session

### Georgette Macdonald

Director General, NRC Metrology

NCSLI Board of Directors, President (2023–2024)

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NCSLI WORKSHOP & SYMPOSIUM 2023

# Keynote Address

Tuesday, July 11 | 8:30 AM – 10:00 AM | Room: Gatlin E

## Addressing Climate Change and Fostering Sustainability Standards and Measurement-related Opportunities

### Mary Saunders

Vice President for Government Relations and Public Policy, ANSI

The green transition agenda – a shift toward clean energy and sustainable growth – is a top priority for many countries worldwide. In the United States, the Council on Environmental Quality has released updated guidance that calls for federal agencies to take a much broader look at the climate change impacts from major new infrastructure projects, government policies and federal decisions. In January, the Biden administration outlined a blueprint for using billions in public dollars to expand the use of electric vehicles and low-carbon fuels to help put the U.S. on a course to eliminate carbon emissions from the transportation sector by 2050. And the European Commission has adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

In the standards space, the International Organization for Standardization (ISO) has embraced the United Nation's Sustainable Development Goals (UN SDGs), which include taking urgent action to

combat climate change and its impacts. ISO has published guidance to provide standards developers with a systematic approach to addressing sustainability issues in a coherent and consistent manner, with regard to both new and revised standards, and in a manner related to the objective and scope of the standard being developed. Many other standards developing organizations have mapped their standardization projects to one or more of the UN SDGs.

On a practical level, standards intended to address climate change effects and foster sustainability must be comprehensive, technically robust and cover the entire range of emission sources, manufacturers, and applications. New mechanisms to ensure compliance and a framework to assess life-cycle emissions may also be required. This keynote presentation will explore ongoing domestic and international discussions aimed at addressing and reducing carbon and other greenhouse gas emissions, highlighting the important role of standards, measurement and testing advancements to support stated policy goals.



## BIO

Mary Saunders joined the American National Standards Institute (ANSI) as Vice President for Government Relations and Public Policy in March 2017. She leads ANSI's efforts to advocate greater use of voluntary consensus standards and conformance programs by government agencies and broader participation by agency personnel in standards development. She also works with ANSI members to create standardization-related outreach programs to legislators and to increase understanding of the private-sector standards community among executive branch agencies and White House offices. Mary is a key player at ANSI in fostering understanding among opinion leaders of the major role standards and conformance play in the international and domestic marketplace. Ms. Saunders has served on a number of boards in the standards and technology space, including the ASTM International Board, ANSI, and IEEE Standards Association Board of Governors. She is currently a nonresident Fellow of the Atlantic Council's Geotech Center. In 2020 Ms. Saunders served as a volunteer on President-elect Biden's 20-person agency review team for the Department of Commerce, helping the administration understand agency operations so it would be prepared to hit the ground running on day one.

# Keynote Address

Wednesday, July 12 | 8:30 AM – 10:00 AM | Room: Gatlin E

## The Climate: Greenhouse Gas Measurements, Data, and Information Usage and Needs

**Dr. James R. Whetstone**

Special Programs Office, National Institute of Standards and Technology (NIST)

Our climate is largely the result of processes that warm Earth's atmosphere which provides the environments upon which life as we know it exists. Atmospheric greenhouse gases are the agents that drive that warming. The physical processes causing atmospheric warming depend upon the amounts of greenhouse gases in the atmosphere. Current levels of these have become causes of concern as our atmosphere warms beyond the recent historical levels that have controlled our climate over the last few thousand years and support degree human activities. The current degree of atmospheric warming is of concern and is driving greenhouse gas mitigation actions and policies as a means of reducing atmospheric warming. As greenhouse gas mitigation actions proceed, quantitative data and information are becoming more important as the selection and implementation of these are based on GHG amounts. The fundamentals of atmospheric warming and greenhouse gas quantification methods and approaches will be presented.

Keynote addresses  
drive the shared  
daily dialogue that  
connects attendees from  
around the globe.





## BIO

James R. Whetstone, Ph.D., is Special Assistant to the Director for Greenhouse Gas Measurements Program at the National Institute of Standards and Technology (NIST) and is responsible for the NIST-wide research program in greenhouse gas measurements. This program seeks to advance the measurement science, standards, and measurement methodologies supporting greenhouse gas measurements. He has established multinational collaborations and investigations in partnership with other federal agencies, industry and academic institutions, and is active within the greenhouse gas measurements communities both in the United States and abroad. He is a frequent speaker at conferences and enables dialog among a wide range of communities with research interests in measurements.

Prior to this appointment, he was Chief of NIST's Process Measurements Division, where he was responsible for research ranging from advances in contact and remote sensing technologies to development of new approaches to the realization of measurement standards for temperature, pressure, relative humidity, and flow rate. During his career at NIST, he has received numerous awards for his technical achievements, leadership, and innovation.

Dr. Whetstone received his Bachelor of Science Degree in Physics and Mathematics from Texas Western College, now the University of Texas at El Paso, and his Ph. D. in Physics from Vanderbilt University in high energy particle interactions. He then joined the National Bureau of Standards, now NIST. His early developments in frequency-stabilized laser technology and measurement standards for mass and fluid density, fluid flow rate, and moisture in gases lead to many publications and new research opportunities relevant to greenhouse gases.

# Keynote Address

Wednesday, July 12 | 4:30 PM - 6:30 PM | Room: Gatlin E

## Closing Keynote & Cocktail Party!

### Isotopic Measurements of Carbon Dioxide: The Role of Measurement Standards

**Juris Meija**

NRC Metrology

Isotopic measurements provide valuable information about the origin of greenhouse gases. As carbon dioxide levels increase, there is a corresponding shift toward lighter isotopic composition similar to that of fossil fuels. Detecting such isotopic shifts requires extremely precise measurements, which must also be globally reproducible in order to make reliable policy decisions. This presentation will outline the collective search for the ideal measurement standard for carbon isotope measurements, which has taken us from fictional oceans to toilet seat marbles, and complex mathematical conventions that separate data from reliable results.





## BIO

Juris Meija is a senior research scientist at the National Research Council of Canada. His research aims to improve the reliability of chemical and isotope ratio measurements through the development of certified reference materials and a better understanding of the measurements themselves. He has served as the Chair of the IUPAC Commission on Isotopic Abundances and Atomic Weights and has contributed extensively to the establishment of international documentary standards in metrology. Among his notable contributions is the redefinition of the mole.

We're proud to showcase  
some of the world's  
most inspired thinkers  
as they tackle the  
most timely topics  
of today and tomorrow.



# Getting the Most from Your Conference Investment

Whether you are a first-timer at an NCSLI Workshop & Symposium, or a seasoned attendee of many conferences, the investment of your time and your organization's resources can be enhanced by following these helpful suggestions.

1. Review the program and the NCSLI Conference website for this year's theme, keynote speakers, and other useful information.
2. Start with an end in mind. Based upon a review of the Conference content, outline the objectives that you will accomplish as a result of attending the Conference. Get support from your management and determine if they have any specific objectives as well.
3. Prepare a list of the most important questions that you would like answered by the presenters, exhibitors, and other contacts to be made at the Conference.
4. Consider which tutorials will help you meet your personal, corporate, and professional development objectives.
5. If you are a member of an NCSLI committee, be sure to complete your homework prior to attending the meeting (review draft documents in advance, ask for a copy of the agenda if you haven't received one, be prepared to actively participate). If you are not currently serving on a committee, identify the committees that you would like to contribute to. All NCSLI committee meetings are "open" and welcome guest participation and new members. You are not required to be an NCSLI member to participate.
6. If more than one person from your organization plans to attend the Conference, meet and develop a plan on who will attend which sessions, who will contact which key exhibitors, and how to best organize the Conference experience. This way you can share information and resources with each other and with others in your organization to optimize your time.
7. Keep your business cards handy for sharing and networking.
8. After the Conference, review what you've learned. Share your experience with your manager and coworkers. Connect with the people and organizations you met throughout the Conference.
9. Start planning for next year! Call for Papers opens soon!

# Conference Overview

## SATURDAY, JULY 8

7:00 AM – 6:00 PM	Tutorial Registration	St. John's Foyer (upstairs)
7:00 AM – 8:00 AM	Tutorial Continental Breakfast	St. John's Foyer (upstairs)
8:00 AM – 5:00 PM	Tutorials (Additional Paid Workshops)	St. John's Rooms 27-33 (upstairs)
10:00 AM – 10:30 AM	Morning Break	St. John's Foyer (upstairs)
12:00 PM – 1:00 PM	Lunch (on your own)	Hotel restaurants available
3:00 PM – 3:30 PM	Afternoon Break	St. John's Foyer (upstairs)

## SUNDAY, JULY 9

7:00 AM – 6:00 PM	Registration	St. John's Foyer (upstairs)
7:00 AM – 8:00 AM	Tutorial Continental Breakfast	St. John's Foyer (upstairs)
8:00 AM – 5:00 PM	Tutorials (Additional Paid Workshops)	St. John's Rooms 27-33 (upstairs)
10:00 AM – 10:30 AM	Morning Break	St. John's Foyer (upstairs)
12:00 PM – 1:00 PM	Lunch (on your own)	Hotel restaurants available
3:00 PM – 3:30 PM	Afternoon Break	St. John's Foyer (upstairs)

## MONDAY, JULY 10

7:00 AM – 8:00 PM	Registration	Gatlin Foyer Reg 2
7:30 AM – 4:00 PM	Committee Meetings	St. John's Rooms 27-33 (upstairs)
8:00 AM – 4:30 PM	Exhibitor Move-In	Gatlin C/D Exhibit Hall
4:00 PM – 5:30 PM	Conference Opening Session	Gatlin E
6:00 PM – 8:00 PM	Conference Welcome Reception	Gatlin C/D Exhibit Hall

**TUESDAY, JULY 11**

7:00 AM – 6:00 PM	Registration	Gatlin Foyer Reg 2
7:30 AM – 6:30 PM	Trade Show	Gatlin C/D Exhibit Hall
7:30 AM – 8:30 AM	Attendee Continental Breakfast	Gatlin C/D Exhibit Hall
8:30 AM – 10:00 AM	Keynote Presentation & Awards	Gatlin E
10:00 AM – 10:30 AM	Session Break	Gatlin C/D Exhibit Hall
10:30 AM – 4:30 PM	Technical Program	St. John's Rooms 27-33 (upstairs) + Gatlin E1
11:30 AM – 1:00 PM	Plated Luncheon	Gatlin C/D Exhibit Hall
2:00 PM – 2:30 PM	Session Break	Gatlin C/D Exhibit Hall
5:00 PM – 6:30 PM	Evening Social Mixer	Gatlin C/D Exhibit Hall

**WEDNESDAY, JULY 12**

7:00 AM – 1:30 PM	Registration	Gatlin Foyer Reg 2
7:30 AM – 1:00 PM	Trade Show	Gatlin C/D Exhibit Hall
7:30 AM – 8:30 AM	Attendee Continental Breakfast	Gatlin C/D Exhibit Hall
8:30 AM – 10:00 AM	Keynote Presentation & Awards	Gatlin E
10:00 AM – 10:30 AM	Session Break	Gatlin C/D Exhibit Hall
10:30 AM – 4:30 PM	Technical Program	St. John's Rooms 27-33 (upstairs) + Gatlin E1
11:30 AM – 1:00 PM	Plated Luncheon	Gatlin C/D Exhibit Hall
1:30 PM	Trade Show Close	Gatlin C/D Exhibit Hall
1:30 PM – 6:00 PM	Trade Show Teardown	Gatlin C/D Exhibit Hall
2:00 PM – 2:30 PM	Session Break	St. John's Foyer (upstairs)
4:30 PM – 6:30 PM	Closing Keynote & Cocktail Party!	Gatlin E



# SIM Early Career Metrologist Award 2023

With the foresight to the future of measurement science, a dynamic cooperation between NCSLI International and SIM, Sistema Interamericano de Metrología (Inter-American Metrology System), established the Early Career Metrologist Competition. This opportunity was created to promote growth among National Metrology Institutes (NMIs) and Designated Institutes (DIs) while fostering scientific thinking and measurement research within the region. The winners are chosen from a group of competitive scientific papers submitted by metrologists with less than five working years of experience in the NMIs or DIs of that region. from across the Americas. Upon conception, it was decided one winner and one runner-up would be chosen from each of the following SIM regions: ANDIMET (Northern South American Metrology Cooperation), CAMET (Central American Metrology Cooperation), CARIMET (Caribbean Island Metrology Cooperation), NORAMET (North American Metrology Cooperation), and SURAMET. (Southern South American Metrology Cooperation).

For each winning paper chosen, the author received the opportunity to attend the annual NCSLI Workshop & Symposium to present their winning paper in the technical program!

Please take time to attend a session and support these early career metrologists!



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TUESDAY, JULY 11 | 1:00 PM – 2:00 PM

TECHNICAL PROGRAM SESSION 2D | ROOM: GATLIN E1

**Effect of the number of fringes on the measurement of Gauge Blocks using an interference pattern.**

**Jorge Luis Galvis Arroyave, National Metrology Institute of Colombia (ANDIMET)**

Abstract: The National Metrology Institute of Colombia and the metrology laboratories in charge of providing traceability to the industry have been challenged by the exponential growth of new technologies and the improvement of the measurement systems of industry in Colombia. As a result, the National Institute of Metrology of Colombia (INM) has adapted and modified its technologies to ensure the traceability chain for the latest and most innovative measurement systems. In a joint effort with the Universidad de los Andes, we present preliminary results for a 2 mm grade 0 gauge block length measurement using a Twyman-Green interferometer and the use of phase stepping as a technique to verify the laser beam wavefront. We also present the suitability of the interferometer for gauge block length measurements and the effect of the number of fringes on the length measurement results and uncertainty. This apparatus is intended to be the first prototype of an interferometer for gauge block measurement and calibration in Colombia.

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TUESDAY, JULY 11 | 1:00 PM – 2:00 PM

TECHNICAL PROGRAM SESSION 2D | ROOM: GATLIN E1

**A Technical Transfer Workshop for Strengthening SARS-CoV-2 Detection Laboratories by PCR**

**Sergio Luis Dávila González, National Metrology Institute of Colombia (ANDIMET)**

Abstract: Based on results of a SARS-CoV-2 Proficiency Test by PCR, performed in 2020 in Colombia with 120 laboratories, 14% showed difficulties at detecting viral RNA at low concentrations - 14 copies/uL, reporting in some cases a negative result or a false negative. In order to strengthen the national network of SARS-CoV-2 detection laboratories by PCR, a technical workshop was organized; for this, two RNA control materials in two concentration levels were prepared and sent to 38 laboratories, they had to prepare a calibration curve from 105 to 101 copies/uL by diluting the materials and measure them by the implemented qPCR protocols. Based on the results, they could evaluate the precision at each concentration level, the amplification efficiency, and the detection at low concentration, near the limit of detection. The development and execution of these activities made it possible to identify possible metrological weaknesses of the laboratories in the detection of SARS-CoV-2 sequences by RT-PCR and will improve the quality of the measurements from the perspective of public health surveillance.

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WEDNESDAY, JULY 12 | 1:00 PM – 2:00 PM

TECHNICAL PROGRAM SESSION 6C | ROOM: ST. JOHN'S  
32/33

**Cryogenic thermometry: performance evaluation of hand-made prototypes for metal sheath SPRT calibration at the Triple Point of Argon**

**Brenda Tenaglia Giunta, Instituto Nacional de Tecnología Industrial, Argentina (INTI) (SURAMET)**

Abstract: In the following paper a measurements data comparison between the early vs latest version of the Triple Point for Argon (TP-Ar) system is presented. The updates made on the equipment improved the stability of the freezing-melting plateau, extending its duration above 240 minutes. The repeatability and Self-Heating (SH) parameters were maintained, having a difference in the order of  $0.1 \cdot 10^{-3} \text{ m}\Omega$  and  $0.1 \text{ mK}$  respectively. The slope parameter showed a difference of  $1 \text{ mK}$  between both versions and this improvement allow to generate more stables plateaus. Moreover, this article describes the performance evaluation of hand-made aluminum bushings in metal sheath SPRT's calibrations. In general, it has been possible to observe a decrease of a few  $\text{m}\Omega$  in the SH effect when the bushings were used. The comparison between  $25.5 \Omega$  and  $100 \Omega$  SPRT showed that the SH effect is ten times lower in the SPRT with nominal resistance of  $25.5 \Omega$ . Finally, heat flow measurements at different immersion depths are discussed.

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WEDNESDAY, JULY 12 | 2:30 PM – 3:30 PM

TECHNICAL PROGRAM SESSION 7A | ROOM: ST. JOHN'S  
28/29

**Modified Winkler Method (MWM): Primary Method for Calibration of Dissolved Oxygen (DO) Sensors**

**Eric Ortiz Apuy, Departamento de Metrología Química - Laboratorio Costarricense de Metrología (LACOMET) (CAMET)**

Abstract: A primary method has been developed by the Chemistry Department (DMQ) of the Costa Rican Metrology Laboratory (LACOMET) for the calibration of dissolved oxygen (DO) sensors using a Modified Winkler Method (MWM). This calibration service was developed in order to satisfy the metrological needs of the region related to traceability in DO measurements in bodies of water and environmental samples. The experimental procedure is based on two subsystems (1) Oxygen Saturation System and (2) Amperometric Titration System. The first subsystem focuses on water-saturated sample preparation under controlled laboratory conditions for subsample recollection and instrument calibration; for the second subsystem, the fixed DO content present in each subsample is quantified by the semi-automated MWM. The MWM was exhaustively validated in the performance characteristics of precision, trueness, and measurement uncertainty. In addition, the LACOMET participated in a regional comparison in order to demonstrate the comparability of results between National Metrology Institutes (NMI). Finally, the results presented in this work demonstrate that the DMQ-LACOMET has a traceable method to perform the calibration of DO sensors with a measurement uncertainty as low as  $0.10 \text{ mg/L}$  ( $k=2$ ). This new service pretends to support the metrological needs in the Costa Rican industry and testing laboratories, as well as the regional comparability in the calibration of DO measurement sensors.





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# Committee Meetings

## MONDAY, JULY 10

### ROOM: ST. JOHN'S 27

8:00 AM Accreditation Resources Committee

10:00 AM ASC Z540 Committee Meeting

1:00 PM Calibration Systems Resources Committee

### ROOM: ST. JOHN'S 28

8:00 AM Accelerated Career-Development Committee (AC-DC)

10:00 AM Testing Lab Committee

1:00 PM Calibration Procedures Committee

### ROOM: ST. JOHN'S 29

8:00 AM Energy & Renewables Metrology

10:00 AM Airline & Aerospace Metrology Committee

1:00 PM Healthcare Metrology Committee

### ROOM: ST. JOHN'S 30

8:00 AM Calibration Intervals and Metrology Practice

10:00 AM Measurement Information Infrastructure (MII) & Automation Committee

1:00 PM Dimensional Metrology Committee

### ROOM: ST. JOHN'S 31

8:00 AM Educators Corner Committee

10:00 AM Measurement Comparison Programs Committee

1:00 PM Intrinsic and Derived Standards Committee

### ROOM: ST. JOHN'S 32

8:00 AM Legal Metrology Committee

10:00 AM Automotive Committee



NCSLI WORKSHOP & SYMPOSIUM 2023

# Special Events

MONDAY | 4:00 PM – 5:30 PM | GATLIN E

## Conference Opening Session

Speaker: Georgette Macdonald

MONDAY | 6:00 PM – 8:00 PM | EXHIBIT HALL GATLIN C/D

## Conference Welcome Reception

TUESDAY | 8:30 AM – 10:00 AM | GATLIN E

## Keynote & Awards

Speaker: Mary Saunders

Addressing Climate Change and Fostering Sustainability Standards and Measurement-related Opportunities





TUESDAY | 5:00 PM – 6:30 PM | EXHIBIT HALL GATLIN C/D  
**Evening Social Mixer**

WEDNESDAY | 8:30 AM – 10:00 AM | GATLIN E

## **Keynote & Awards**

Speaker: Dr. James R. Whetstone

The Climate: Greenhouse Gas Measurements, Data, and Information Usage and Needs

WEDNESDAY | 4:30 PM – 6:30 PM | GATLIN E

## **Closing Keynote & Cocktail Party!**

Speaker: Juris Meija

Isotopic Measurements of Carbon Dioxide:  
The Role of Measurement Standards







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Pressure



Temperature

Electrical



# Tutorial Schedule

## SATURDAY JULY 8 | 8:00 AM – 5:00 PM | FULL DAY

Introduction to Measurement Uncertainty	St. John's 27
Risk-based thinking in Metrology and Testing	St. John's 28
How to Select, Implement, and Maintain Calibration Management Software Systems in a Regulated Environment	St. John's 29

## SATURDAY JULY 8 | 8:00 AM – 12:00 PM | HALF DAY AM

Dynamic Sensors and Calibration	St. John's 30
Introduction to Deadweight Pressure Testers	St. John's 31
The 3 Rs; Reading, Writing, and Reviewing: Accreditation Scopes, Service Requests, & Cal Certs	St. John's 32

## SATURDAY JULY 8 | 1:00 PM – 5:00 PM | HALF DAY PM

Topics in Dimensional Metrology	St. John's 32
Introduction to Dry Block Temperature Calibrators	St. John's 31
Understanding Instrument Specifications	St. John's 30

## SUNDAY, JULY 9 | 8:00 AM – 5:00 PM | FULL DAY

Practical Risk Management and Company Objectives—Asset Management	St. John's 27
Auditing, Traceability, and Auditing of Traceability	St. John's 28
Introduction to Pressure Metrology	St. John's 29

## SUNDAY JULY 9 | 8:00 AM – 12:00 PM | HALF DAY AM

MAY THE FORCE BE WITH YOU	St. John's 30
Temperature Calibration Uncertainty Budget Creation and Management	St. John's 31
Introduction to Photonics	St. John's 32
Calibration of 6.5 Digits, Meters and Electrometers	St. John's 33

## SUNDAY JULY 9 | 1:00 PM – 5:00 PM | HALF DAY PM

Who Needs Another Session on Risk or Decision Rules?	St. John's 30
Climate Chambers Characterization	St. John's 32

# Tutorial Program

Saturday, July 8 | 8:00 AM – 5:00 PM (Full Day)

Saturday, July 8 | 8:00 AM to 5:00 PM (Full Day)

Room: St. John's 27

## Introduction to Measurement Uncertainty

**Instructors: Collin Delker PhD and Nevin Martin, Sandia National Laboratories**

**Abstract:** Get back to basics with this introductory course on evaluation of measurement uncertainty based on the Guide to Expression of Uncertainty in Measurement (GUM). The course aims to provide a practical and hands-on training for both calibration lab personnel and test engineers and technicians, assuming no prerequisite knowledge of uncertainty. It starts by covering the basic terminology of metrology, including accuracy, precision, degrees of freedom, standard uncertainty, and expanded uncertainty, followed by statistical tools necessary for uncertainty evaluation. Identification of uncertainty contributors and assessing their significance in a measurement is discussed, along with a detailed mathematical evaluation of uncertainty components by Type A and Type B methods. Next, the course covers how the individual uncertainty components are combined and expressed as an expanded uncertainty with a high level of confidence for both direct and indirect measurements. The GUM approach to combining uncertainty components is presented, followed by the Monte Carlo approach defined in Supplement 1 to the GUM. Finally, an easy approach to computing the mathematical evaluation is presented by using the free and open-source SUNCAL software for uncertainty evaluation. Incorporating examples involving football, bananas, beer, and lava, this course has become popular and in demand at Sandia and other U.S. National Labs and government calibration labs. Please bring laptops to the class.

### Learning Objectives:

1. Identify sources of uncertainty in a measurement
2. Define a measurement model equation and distinguish direct and indirect models.
3. Perform basic statistical calculations necessary for uncertainty evaluation.
4. Evaluate Type A and Type B uncertainty contributors.
5. Calculate combined uncertainty of a measurement model using the GUM and Monte Carlo approaches.

Saturday, July 8 | 8:00 AM to 5:00 PM (Full Day)

Room: St. John's 28

## Risk-based thinking in Metrology and Testing

**Instructors: Rob Knake, NIST NVLAP**

**and Andy Oldershaw, National Research Council of Canada**

**Abstract:** This full-day tutorial will cover the fundamentals of risk management in the laboratory context. Risk-based thinking has, over the years, become

intrinsic to the process approach to quality management. For a long time, it has been observable in multiple areas of society from the economy, defense, healthcare, and transportation the list is endless. Even in our everyday lives, our decision risks are weighed; most often subconsciously, habitually, and informally. For example, whether you choose to carry a rain jacket or the route you choose to get home from work.

Management system standards are a one size fits all solution, tailorable through statements such as to the extent necessary, as appropriate, sufficient to ISO/IEC 17025:2017 requires laboratories to consider risks and opportunities. This tutorial will help those involved in planning, managing, implementing, and reviewing any aspect of laboratory management systems to apply risk-based thinking to determine what these statements mean to their situation.

Tools and techniques to identify, analyze, respond to, monitor, and review risks will be introduced.

The tutorial will include instruction, group exercises, and group discussions.

#### **Intended audience.**

Anyone with responsibilities for decision-making, quality, measurement assurance, auditing, or an interest in managing risks in the laboratory..

#### **Learning Objectives:**

1. Understand common sources of measurement-related risks.
2. Be able to apply qualitative and quantitative risk analysis techniques for measurement related risks,
3. Understand how to apply risk-based decision-making in a measurement environment and
4. Understand how to evaluate actions and maintain current knowledge of risks in a measurement system.

**Saturday, July 8 | 8:00 AM to 5:00 PM (Full Day)**

Room: St. John's 29

### **How to Select, Implement, and Maintain Calibration Management Software Systems in a Regulated Environment**

**Instructor: Walter Nowocin, IndySoft**

Abstract: Selecting and Implementing a Calibration Management Software System is a critical process for a calibration laboratory, especially in a bio-medical regulated environment. However, there are few examples or documents that explain this process from a user's perspective. The objective of this paper is to explain the selection process, provide examples of the documentation used, and pass along lessons that were learned. The following topics will be discussed: Selection Process Overview, Develop Business Requirements, Convert Requirements to a Scoring Matrix, Evaluate Vendors, Implementation Process Overview, System Development and Validation Life Cycle, Data Conversion, Test Scripts, and Implementation, and Maintenance Process Overview.

#### **Learning Objectives:**

1. Comprehension: Identify the main aspects of the Selection process.
2. Identify the main aspects of the Implementation process.
3. Identify the main aspects of the Maintenance process.



## Saturday, July 8 | 8:00 AM – 12:00 PM (Half Day AM)

Saturday, July 8 | 8:00 AM to 12:00 PM (Half Day AM)

Room: St. John's 30

### **Dynamic Sensors and Calibration**

**Instructor: Mike Mains, The Modal Shop**

Abstract: The vibration calibration class will dive into calibration theory, standards, and methodology for dynamic sensors as well as detailed construction of different sensor types and the operational theories behind them. The target audience is a beginner to intermediate level.

#### **Learning Objectives:**

1. Attendees will gain a greater understanding of calibration theory, standards, and methodology.
2. Attendees will gain a greater understanding of different sensor types.
3. Attendees will gain a greater understanding of the importance of calibration and gain hands-on experience while participating in relevant labs.

Saturday, July 8 | 8:00 AM to 12:00 PM (Half Day AM)

Room: St. John's 31

### **Introduction to Deadweight Pressure Testers**

**Instructor: Scott Crone, AMETEK STC**

Abstract: This course is an introduction to the design, construction, theory of operation, practical use, and common errors associated with deadweight pressure testers. The course will start by explaining the theory of operation of deadweight pressure testers. It will include details on piston gauges and ball type testers. The material will include deadweight tester use, best practices, setup, care, misuses, and common issues experienced while using deadweight testers including a section on site corrections with examples. The course will finish with hands-on activities with a deadweight pressure tester.

#### **Learning Objectives:**

1. Understand the theory behind a deadweight tester.
2. Gain an awareness of the design and basic operation of a deadweight pressure tester and appreciate best practices.
3. Recognize issues with deadweight tester performance.
4. Understand site corrections and learn how to calculate and apply them to deadweight pressure tester output.
5. Understand the proper calibration of a deadweight pressure tester.

Saturday, July 8 | 8:00 AM to 12:00 PM (Half Day AM)

Room: St. John's 32

### **The 3 Rs; Reading, Writing, and Reviewing: Accreditation Scopes, Service Requests, & Cal Certs**

**Instructor: Heather A. Wade, Heather Wade Group**

Abstract: Some frequent challenges and ISO/IEC 17025 assessment deficiencies have to do with finding and requesting external services and ensuring the equipment being returned to service is fit for purpose and meets requirements.

These challenges and deficiencies can be addressed and prevented by having knowledge and understanding of the learning objectives.

### **Learning Objectives:**

This session is appropriate for consumers and suppliers of calibration services. This tutorial will include hands-on exercises for attendees to practice searching for and interpreting calibration scopes of accreditation, comparing and interpreting scopes of accreditation, and reviewing and interpreting calibration certificates to meet ISO/IEC 17025 requirements. At the end of this half-day tutorial, participants will know how to:

1. Search and interpret calibration scopes of accreditation.
2. Consistently communicate service requests between calibration vendors and customers.
3. Read and interpret calibration certificates.

## Saturday, July 8 | 1:00 PM – 5:00 PM (Half Day PM)

Saturday, July 8 | 1:00 PM to 5:00 PM (Half Day PM)

Room: St. John's 32

### **Topics in Dimensional Metrology**

**Instructors: Jim Salsbury PhD and Jeff Meyerholz, Mitutoyo America Corporation**

**Abstract:** This intermediate-level course is designed to further the knowledge of those working in dimensional calibration labs. This course goes beyond basic technician-level skills and addresses a number of slightly more advanced topics for those wanting to move their careers forward in dimensional calibration. This course is ideal for those looking to develop or refine technical management knowledge in dimensional calibration. The course will start by covering a number of common mistakes in calibration methods and then move into more complex issues like temperature, deformation, reversals, specifications, proficiency testing, interim testing, certificates, measurement uncertainty, and decision rules. Finally, this course will discuss the latest developments in national (ASME) and international (ISO) dimensional metrology standards and the impact of those standards in the calibration lab.

Saturday, July 8 | 1:00 PM to 5:00 PM (Half Day PM)

Room: St. John's 31

### **Introduction to Dry Block Temperature Calibrators**

**Instructor: Scott Crone, AMETEK STC**

**Abstract:** This course is an introduction to the design, construction, evolution, practical use, and common errors associated with dry block temperature calibrators. The course will start by examining known temperature calibration devices including their benefits and limitations. It will progress to discuss dry block calibrator design, evolution, and progression to the current level of temperature standard. The material will include dry block selection, use, best practices, setup, care, misuses, and common issues experienced while using dry block calibrators. The course will finish with hands-on activities with various levels of dry block calibrators.

**Learning Objectives:**

1. Understand the purpose of using a dry-block calibrator and where it may be advantageous of over other technologies, but also understand where it may be limited or inappropriate.
2. Gain an awareness of the design and basic operation of a dry block calibrator as well as understanding the evolution of the models from the inception of the technology to the models available today.
3. Practical applications, proper use, care, and common mistakes made when using dry block calibrators
4. Understand how to perform basic operations using a dry block calibrator

**Saturday, July 8 | 1:00 PM to 5:00 PM (Half Day PM)**

Room: St. John's 30

**Understanding Instrument Specifications**

**Instructor: Mike Johnston, Fluke Calibration**

Abstract: Instrument specifications play a crucial role in measurement and testing, but their lack of standardized definitions can often lead to confusion and uncertainty. In this tutorial, we will delve into the world of instrument specifications and explore the different ways in which manufacturers and other organizations define these statements. By understanding and interpreting these specifications, participants will gain the knowledge and skills necessary to make meaningful metrological decisions. Using examples from a wide range of measurement disciplines, we will highlight the quirks and tricks of interpreting instrument specifications. Topics covered will include common terminologies, units, tolerances, accuracy, precision, resolution, and calibration. Practical strategies for evaluating specifications, comparing instruments, and selecting appropriate instruments for specific measurement tasks will also be discussed.

**Sunday, July 9 | 8:00 AM – 5:00 PM (Full Day)**

**Sunday, July 9 | 8:00 AM to 5:00 PM (Full Day)**

Room: St. John's 27

**Practical Risk Management and Company Objectives – Asset Management**

**Instructor: Tim Osborne, A2LA Workplace Training (AWPT)**

Abstract: Every business has SMART objectives, that is, specific, measurable, achievable, relevant, and timely. There are two key objectives that every business focuses on: 1) revenue (profit and loss), and 2) asset utilization (turnaround time). Asset utilization or velocity, the ability to maximize an asset's usefulness or "uptime" is pivotal in generating revenue and ensuring customer confidence in an organization's ability to deliver the product or service in the time committed. ISO 9001, and its derivative standards, as well as ISO/IEC 17025:2017 understood this from a business perspective which is the reason for elevating risk-based thinking and risk management to a higher plane. While 17025 focuses on risk management from a reactive position (see 7.10.1b)

for nonconformances), proactive risk management is something on which management drives and can prepare.

This 8-hour workshop is designed to approach risk management proactively from either a qualitative or quantitative perspective, students' choice, on the topic of asset management. Using ISO 31000 and 31010 techniques and tools as the basis for our approach, the class will analyze the expenses in the context of balancing a calibration interval program, intermediate checks, intra and inter-laboratory comparisons, proficiency testing, customer satisfaction, internal audits, and management reviews to evaluate the risk to the organization and derive an action plan. The goal is to be able to take the risk analysis techniques used in this workshop and immediately apply it to the organization. Ideal attendees should have some laboratory supervisory or management experience and a basic familiarity with Microsoft Excel. Attendees are required to bring a laptop with Excel installed (97 and up acceptable).

### Learning Objectives:

1. Establish and define risk levels for its organization.
2. Describe and document the context of a process.
3. Identify and Analyze risks and risk levels using a risk register (simplified PFMEA).
4. Establish monitoring points to manage risk and costs.
5. Develop an action plan for implementation to measure plan success.

**Sunday, July 9 | 8:00 AM to 5:00 PM (Full Day)**

Room: St. John's 28

### **Auditing, Traceability, and Auditing of Traceability**

**Instructors: Rob Knake, NIST NVLAP and Andy Oldershaw, National Research Council of Canada**

**Abstract:** This full-day tutorial will cover the fundamentals of internal auditing based on the ISO 19011:2018 Guidelines for auditing management systems standard. The course will also include the applicable requirements of ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories, so you can ensure that you have a solid audit program in place that complies with your accreditation body and/or customer requirements. The course will start with general auditing principles and will cover critical auditing elements such as audit planning, preparation, conduct, key auditor attributes, audit techniques, documentation of audit findings, and audit closing activities.

A critical element in the operation of every laboratory is metrological traceability. This course will delve deeper into the specifics of how to appropriately audit metrological traceability and the associated requirements of the ISO standards, customer requirements, and/or the requirements of your accreditation body. The tutorial will define what metrological traceability is, what requirements need to be considered, and how you specifically audit your laboratory to ensure you have appropriate metrological traceability. Without metrological traceability, you can't have confidence in your measurement results. You can't just rely on a statement that results are traceability to the international system of units (SI) as your means of auditing metrological traceability. This course will help you to confirm that you have appropriately established metrological traceability to support the results that are provided to your customers. The tutorial will include instruction, group exercises, and group discussions.



**Learning Objectives:**

1. List at least two reasons for performing an internal audit.
2. Describe at least five attributes of an effective auditor.
3. Describe the internal audit planning and process.
4. Identify objective evidence.
5. Explain the concepts of metrological traceability.
6. Compare calibration certificates against requirements of ISO/IEC 17025
7. Use auditing tools to demonstrate the chain of traceability.

**Sunday, July 9 | 8:00 AM to 5:00 PM (Full Day)**

Room: St. John's 29

**Introduction to Pressure Metrology**

**Instructor: Josh Biggar, Fluke Calibration**

**Abstract:** This class is an introduction to pressure calibration that will examine physical principles of pressure, pressure modes and pressure measuring devices. Learn how to assess pressure calibration needs and common sources of uncertainty. Interact with hands-on pressure calibration exercises and analyze results.

**Learning Objectives:**

1. Understand the physical principles of pressure
2. Fundamental concepts of pressure calibration
3. Identify types and sources of uncertainties

**Sunday, July 9 | 8:00 AM – 12:00 PM (Half Day AM)**

**Sunday, July 9 | 8:00 AM to 12:00 PM (Half Day AM)**

Room: St. John's 30

**MAY THE FORCE BE WITH YOU**

**Instructor: Henry Zumbrun, Morehouse Instruments**

**Abstract:** This course will cover the importance of calibrating force measurement devices on how they are being used to reduce measurement errors and lower uncertainty.

**Learning Objectives:**

1. Identify various force calibration equipment types and perform basic load cell troubleshooting techniques.
2. Identify potential force measurement errors.
3. Implement proper force calibration techniques as discussed and demonstrated in class.
4. Know the risk level associated with conformity assessment when measurement errors are not accounted for properly in the Measurement Uncertainty

Each participant will leave with a better understanding of best practice techniques for making better force measurements. The reason this matters is that better measurements improve safety, and increase profitability in that measurements performed correctly result in fewer recalls, improve efficiencies, and build trust. Everyone in attendance will receive a free copy of "Force Calibration for Technicians and Quality Managers: Top Conditions, Methods, and Systems that Impact Force Calibration Results," a 200-plus page e-book devoted to best force practices including information on adapters, measurement uncertainty, error sources, equipment selection, troubleshooting tips, sources of error in force measurement, and much more.

**Sunday, July 9 | 8:00 AM to 12:00 PM (Half Day AM)**

Room: St. John's 31

## **Temperature Calibration Uncertainty Budget Creation and Management**

**Instructor: Mingjian Zhao, Additel**

**Abstract:** Temperature calibration uncertainty budgets are a crucial component of a reliable and dependable laboratory and/or onsite calibrations. In this tutorial, we will explore the creation and management of temperature uncertainty budgets for SPRT calibration by a fixed point, PRT calibration by fluidized baths and drywells, and TC calibration using a temperature calibration furnace. We will explore calibration uncertainty budgets for each in detail. Each participant will be provided with an Excel spreadsheet that can be used to formulate their specific ISO 17025 uncertainty budgets. Upon completion, participants will have the know-how and tools needed to implement robust temperature uncertainty budgets in their own calibration processes.

### **Learning Objectives:**

1. Gain a broad but detailed understanding of temperature uncertainty budgets.
2. Explore calculations used to calculate budgets for SPRT, PRT and TC temperature calibrations.
3. Learn how to use the provided Excel spreadsheet to create and calculate uncertainty budgets.

**Sunday, July 9 | 8:00 AM to 12:00 PM (Half Day AM)**

Room: St. John's 32

## **Introduction to Photonics**

**Instructor: Kevin Douglass, National Institute of Standards and Technology**

**Abstract:** A brief introduction to photonics emphasizing applications in sensing will be presented. Photonic device technology encompasses fiber optics, Fiber-Bragg gratings, silicon nanophotonics, optomechanics, and more. Beginning with an understanding of optical resonators, photonic resonators such as ring resonators, photonic crystal cavity resonators, and other novel devices will be discussed. The role of photonics is to replace traditional metrology tools that rely on electrons with technology that uses photons. The outlook and the opportunities for photonics in metrology will be discussed.

### **Learning Objectives:**

1. Understand the background knowledge of photonic technologies.
2. Understand the application of photonic technologies.

**Sunday, July 9 | 8:00 AM to 12:00 PM (Half Day AM)**

Room: St. John's 33

**Calibration of 6.5 Digits, Meters and Electrometers****Instructor: Jonathan Bailey, Transmille Calibration**

Abstract: This course has been designed to further the knowledge of those working in electrical calibration laboratories. This course will involve both a presentation & practical measurements sessions to assist in the understanding of the measurements being shown throughout the sessions. The course has two elements, the first is understanding how to use & apply previous knowledge to higher specification devices to help better understand associated errors and differences when calibrating 6.5-digit specification devices.

The second element is advancing the knowledge on high-value resistance measurements / low current using an electrometer to better understand how to measure these parameters and reduce errors when measuring 10M Ohms and above.

**Learning Objectives:**

1. Supporting knowledge of electrical calibrations when testing 6.5 digit meters
2. Understanding the principles of resistance measurements with meters & electrometers
3. Understanding high resistance measurements

**Sunday, July 9 | 1:00 PM – 5:00 PM (Half Day PM)****Sunday, July 9 | 1:00 PM to 5:00 PM (Half Day PM)**

Room: St. John's 30

**Who Needs Another Session on Risk or Decision Rules?****Instructor: Henry Zumbrun, Morehouse Instruments**

Abstract: Almost everyone, the concept of evaluating measurement risk and making statements of conformance, has gotten so much debate since the ISO/IEC 17025:2017 standard came out that we see decision rules as a prevailing topic, and yet many are still confused. This 4-hour session will help the participant eliminate much of the noise on decision rules. It will provide guidance anyone can take away and implement in their laboratory. This session aims to give guidance beyond simply requesting a 4:1 TUR or accepting a shared-risk scenario as with simple acceptance.

When a calibration report is provided by a calibration supplier, a typical concern for the customer is to know if the item calibrated is within the tolerance specified so they can continue using the device. While this traditional approach has been used by many for the last several decades, measurement science has evolved where it is not a simple binary issue of a "pass" or "fail" status to the manufacturer's specification without considering measurement uncertainty.

Laboratory accreditation to ISO/IEC 17025:2017 has advanced the good practices related to calibration to include more information about the process of calibrating an item and just calling it within conformance ("pass" or "fail").

This presentation educates both the consumer and supplier of calibration services on what is required of them to ensure that an "appropriate" pass or fail call is made to meet the customer's requirements when a calibration activity occurs. The presentation offers the appropriate foundational tools for the participant to evaluate what they need from their vendors and ensure their customers receive metrologically traceable calibration with an agreed-upon level of risk.

### **Learning Objectives:**

1. Are my measurements traceable? Understanding metrological traceability.
2. Understanding the decision rules for conformance
3. Specifying the conformance requirements by the customer.
4. How measurement uncertainty impacts a decision rule.
5. How a statement of conformity should be reported.

**Sunday, July 9 | 1:00 PM to 5:00 PM (Half Day PM)**

Room: St. John's 32

## **Climate Chambers Characterization**

**Instructor: Roberto Benitez, Etalons**

**Abstract:** The pharmaceutical industry requires strict temperature control throughout the Cold Chain. Parts of the Cold Chain are the medicine refrigerators, the warehouses, and some climatic chambers. This requirement makes it necessary to evaluate the inside temperature accuracy and temperature uniformity of those devices. The aeronautics and the automotive industry have developed some standards to qualify the furnaces, autoclaves, or climatic chambers, they called this area, Pyrometry Testing. According to the Metrology concepts, those pyrometry standards differ a little bit in the definition of calibration, primary standard, and secondary standard. Some other industries require accurate temperature measurements in their manufacturing process, to apply heat to change the characteristics of their products or to provide heat treatment to the final production parts. This Tutorial presents a new approach to demonstrate full compliance for Thermal Processing Equipment Calibration, System Accuracy Tests, and Temperature Uniformity Surveys, using Measurement Science.

### **Learning Objectives:**

1. Learn the healthcare areas where metrology could be applied.
2. Know some standards or RP's used to qualify Climatic Chambers.
3. Motivate healthcare specialists to apply metrology science in their field.
4. Think about the importance of Metrology in the healthcare industry.



# Technical Program

## SESSION 1

TUESDAY, JULY 11 | 10:30 AM – 11:30 AM

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### 1A | ROOM: ST. JOHN'S 28/29

#### **Guardbanding One-sided Maximum and Minimum Tolerances**

Collin Delker PhD, Sandia National Laboratories

#### **Let's Talk About Bias: Measurement Bias**

Henry Zumbun, Morehouse Instruments

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### 1B | ROOM: ST. JOHN'S 30/31

#### **Meeting the Demand for Isotopic Carbon Dioxide and Methane Gas Reference Materials for Underpinning Global Observations**

Ruth Hill-Pearce, National Physical Laboratory (NPL)

#### **Developing Measurement Methods for Short-Lived Climate Pollutants: Methane and Black Carbon**

Jalal Norooz Oliaee, National Research Council Canada (NRC)

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### 1C | ROOM: ST. JOHN'S 32/33

#### **Discovering the Importance of VNA Power Levels and IF BW Settings When Measuring Passive Components**

Robert Feldman, National Instruments Corporation

#### **Propagation Of Uncertainty in Cascaded & De-embedded VNA Acquisitions**

Amos Martin, Tektronix, Inc.

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### 1D | ROOM: GATLIN E1

#### **The Revised ISO 3611 on Micrometers: Standard Tolerances and Decision Rules**

James Salsbury PhD, Mitutoyo America Corporation

#### **The Revised ASME B89.1.9 Gage Blocks: Standardized Decision Rules**

James Salsbury PhD, Mitutoyo America Corporation

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### 1E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Supplier Calibration Certificate Review**

Danae Powell, Pacific Northwest National Laboratory Battelle

## POSTER PRESENTATIONS

Tuesday, July 11 | 11:30 AM – 12:00 PM  
Exhibit Hall

### **Counting Neutrons: A Case Study from the Nuclear Weapons Enterprise**

Stephen Crowder and Elmer Collins, Sandia National Laboratories

### **Calibration Capabilities of RF & Microwave Laboratory**

Ahmed Aljawan, SASO, Saudi Arabia

### **From Standards to Seminars: Legal Metrology Resources from NIST's Office of Weights and Measures**

Elizabeth Benham, NIST Office of Weights and Measures

## POSTER PRESENTATIONS

Wednesday, July 12 | 11:30 AM – 12:00 PM  
Exhibit Hall

### **Control Chart Design and Evaluation in the Measurement Systems: Practical Examples for Pressure Calibration**

Hsiu-Lin Lin, Industrial Technology Research Institute (ITRI), Taiwan

### **Calibration of Video Cameras Frame Rate Utilizing Interleaved-Frame Analysis Technique**

Alvis C.F. Au Yeung, Innovation and Technology Commission (ITC), Hong Kong

### **Calibration of Harmonics and Inter-Harmonics based on Digital Sampling at the Standards and Calibration Laboratory (SCL)**

Stephen C.L. Chow, Innovation and Technology Commission (ITC), Hong Kong

## SESSION 2

TUESDAY, JULY 11 | 1:00 PM – 2:00 PM

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### 2A | ROOM: ST. JOHN'S 28/29

#### **Digital Calibration Certificates, DCC seen from a customer point of view**

Heidi Foldal, Novo Nordisk A/S

#### **How to Successfully exchange metrological outputs when embarking on digital transformation of metrology**

Ryan White, National Research Council Canada (NRC)

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### 2B | ROOM: ST. JOHN'S 30/31

#### **Primary Reference Solar Cell Calibrations at NIST**

Behrang Hamadani, National Institute of Standards and Technology (NIST)

#### **How useful is a field-operable I-V curve tracer?**

Alex Cimaroli, Fluke Calibration

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### 2C | ROOM: ST. JOHN'S 32/33

#### **Voltage Divider Calibration with a Programmable Josephson Voltage Standard**

Dr. Alain Rüfenacht, National Institute of Standards and Technology (NIST)

#### **Improving Uncertainties of Laboratory DC Voltage Scaling**

Kai Wendler, Measurements International

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### 2D | ROOM: GATLIN E1

#### **Effect of the number of fringes on the measurement of Gauge Blocks using an interference pattern – SIM**

Jorge Luis Galvis Arroyave, National Metrology Institute of Colombia

#### **A technical transfer workshop for strengthening SARS-CoV-2 detection laboratories by PCR – SIM**

Sergio Luis Dávila González, National Metrology Institute of Colombia

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### 2E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Planning for Successful Proficiency Testing**

Carol Hockert, National Association for Proficiency Testing (NAPT),  
Rob Knake, NIST NVLAP

## SESSION 3

TUESDAY, JULY 11 | 2:30 PM – 3:30 PM

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### 3A | ROOM: ST. JOHN'S 28/29

#### **Top 10 Deficiencies for ISO/IEC 17025 Calibration Lab Assessments**

Harry Spinks, TechTrolley LLC

#### **The Hidden Value of FDA 21 CFR Part 11, Electronic Records; Electronic Signatures**

Walter Nowocin, IndySoft Corporation

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### 3B | ROOM: ST. JOHN'S 30/31

#### **Metrological Challenges of Electric Vehicle Charging Standards**

Amr Said, National Research Council Canada (NRC)

#### **Alternative Fuels in the Marketplace: Electric Vehicles and the Evolving Regulatory Landscape**

Katrice Lippa, National Institute of Standards and Technology (NIST)

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### 3C | ROOM: ST. JOHN'S 32/33

#### **Optimization of Multi-junction Thermal Converter AC-DC Difference Performance Using a Circuit Model**

Tam Duong, National Institute of Standards and Technology (NIST)

#### **Monte Carlo Methods for Unraveling Mass Uncertainty Calculations**

Benjamin FitzPatrick, Minnesota Department of Commerce

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### 3D | ROOM: GATLIN E1

#### **Planck extension for high-precision vacuum mass comparators**

Markus Pabst, Technische Universität Ilmenau

#### **Updates on Two Tabletop Kibble-based Instruments Geared Toward Commercialization at NIST**

Leon Chao, National Institute of Standards and Technology (NIST)

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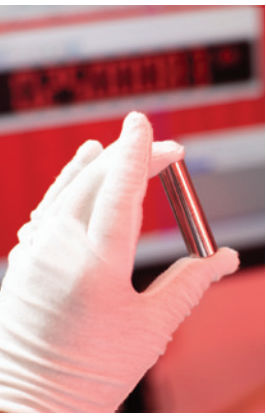
### 3E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Understanding ISO 10012: Managing Measurement Processes and Future Updates**

Jonathan Harben, Keysight Technologies

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## SESSION 4

TUESDAY, JULY 11 | 3:30 PM – 4:30 PM

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### 4A | ROOM: ST. JOHN'S 28/29

#### **A Web-Based Environment for Processing Digital Calibration Certificates by Employing GEMIMEG-Tool**

Dr. Khaled M. Ahmed, National Measurement and Calibration Center (NMCC)

#### **What makes a Good Measurement?**

James Smith, Boeing Test & Evaluation Asset Management

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### 4B | ROOM: ST. JOHN'S 30/31

#### **Establishing Electric Vehicle Supply Equipment (EVSE) Accuracy through Metrological Traceability**

Maritoni Litorja, National Institute of Standards and Technology (NIST)

#### **The Core Values of Leadership**

Patrick Jester, G.T. Michelli Co.

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### 4C | ROOM: ST. JOHN'S 32/33

#### **Sandia's JAWS system for AC-DC Difference Measurements**

Raegan Johnson, Sandia National Laboratories / National Institute of Standards and Technology

#### **Sandia's Pulsed High Current Calibration System**

Edward O'Brien, Sandia National Laboratories

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### 4D | ROOM: GATLIN E1

#### **The Treaty of the Metre – Nearly 150 years old and still going strong**

Dr. James Olthoff, NIST

#### **Standards, Metrology and Conformity Assessment, Tools to Facilitate Trade and Market Access**

Ed Nemeroff, NCSLI Past President, and Wildhack Recipient

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### 4E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Measure Twice, Learn Once: Explore Metrology Concepts through Hands-On Outreach Activities**

Elizabeth Benham, National Institute of Standards and Technology (NIST) and Andrew Oldershaw, National Research Council (NRC)

## SESSION 5

WEDNESDAY, JULY 12 | 10:30 AM – 11:30 AM

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### 5A | ROOM: ST. JOHN'S 28/29

#### **Method for Verifying Measurement Uncertainties for Every Test Point Against Your Lab's 17025 Scope of Accreditation**

Michael Schwartz, Cal Lab Solutions, Inc.

#### **Uncertainty 310: Using Pooled Uncertainties to Improve Measurement Uncertainty**

Jeff Gust, Fluke Calibration

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### 5B | ROOM: ST. JOHN'S 30/31

#### **Temperature Measurements to Support Climate Change Decision Making**

Andrew Todd, National Research Council Canada (NRC)

#### **Remote Sensing of the Earth from Space: A Half-Century of Measuring a Changing Planet**

David Allen, National Institute of Standards and Technology (NIST)

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### 5C | ROOM: ST. JOHN'S 32/33

#### **Implementation of a Site Distributed 10MHz GPS Disciplined Frequency Standard**

Amos Martin, Tektronix, Inc.

#### **Spatially-Resolved Spectral Transmittance Measurement System for Coated Linear Variable Filters with Ultra-Low Transmittance Beyond Cut-Off Wavelength**

Dr. Khaled M. Ahmed, National Measurement and Calibration Center (NMCC)

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### 5D | ROOM: GATLIN E1

#### **Rethinking Air Force Measurement Decision Risk**

Barry Mancz; Evan Elliott; Salvatore Capra, Air Force Metrology & Calibration (AFMETCAL)

#### **Realization of Pressure (or Temperature) Using a Vacuum Mass Balance**

Richard Green, National Research Council (NRC)

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### 5E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Hands-on vs On-line: Can the two coexist?**

Jeff Meyerholz, Mitutoyo America Corporation

## SESSION 6

WEDNESDAY, JULY 12 | 1:00 PM – 2:00 PM

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### 6A | ROOM: ST. JOHN'S 28/29

#### **Laboratories & Calibration Providers: Communication Breakdowns**

Stephanie Morin, American Association for Laboratory Accreditation (A2LA)

#### **Accreditation Hurdles from Common Deficiencies: Top 10 Overall Deficiencies for A2LA accredited ISO/IEC 17025 Laboratories and for Calibration Laboratories in Particular**

Vincent Pugh, American Association for Laboratory Accreditation (A2LA)

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### 6B | ROOM: ST. JOHN'S 30/31

#### **The Need to Build a Metrology Foundation Prior to Implementing Solar Radiation Management**

Gerald Fraser, NIST PML Time and Frequency

#### **Metrology Needs for Carbon Dioxide Removal and Carbon Capture Use and Storage**

Dr. Pamela M. Chu, National Institute of Standards and Technology (NIST)

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### 6C | ROOM: ST. JOHN'S 32/33

#### **Study of Resistance Ratio Long-Term Stability of SPRTs, PRTs, and IPRTs**

Frank Liebmann, Fluke Calibration

#### **Cryogenic Thermometry: Performance Evaluation of Hand-made Prototypes for Metal Sheath SPRT Calibration at the Triple Point of Argon – SIM**

Brenda Tenaglia Giunta, Instituto Nacional de Tecnología Industrial (INTI)

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### 6D PANEL DISCUSSION | ROOM: GATLIN E1

MODERATOR: MARK KUSTER

#### **Metrology's Digital Transformation**

Panelists: James Fedchek, NIST; Heidi Foldal, Novo Nordisk;

Mike Schwartz, Cal Lab Solutions, Ryan White, NRC

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### 6E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Professional Career Development: Career, Training & Mentoring Planning Overview; Steps, Strides & Leaps**

James Smith, Boeing Test & Evaluation Asset Management

## SESSION 7

WEDNESDAY, JULY 12 | 2:30 PM – 3:30 PM

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### 7A | ROOM: ST. JOHN'S 28/29

#### **Some Perspective on Risk and Decision Rules in Calibration**

James Salsbury PhD, Mitutoyo America Corporation

#### **Circumventing Uncertain Reality – or Not?**

Mark Kuster, Independent Researcher, Consultant

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### 7B | ROOM: ST. JOHN'S 30/31

#### **Introduction to Metrological Traceability and Common Paths for Microwave/RF Measurements**

Jeff Guerrieri, NVLAP

#### **Explaining a New Method for Task-Specific Uncertainty Evaluations for CMM Measurements**

Craig Shakarji, NIST

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### 7C | ROOM: ST. JOHN'S 32/33

#### **Body Temperature Measurements**

Roberto Benitez

#### **Modified Winkler Method (MWM): Primary Method for Calibration of Dissolved Oxygen (DO) Sensors – SIM**

Eric Ortiz Apuy, Laboratorio Costarricense de Metrología (LACOMET)

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### 7D PANEL PRESENTATION | ROOM: GATLIN E1

MODERATOR: CHRISTOPHER HEIRD

#### **RP-6 5th Edition Update**

Walter Nowocin, IndySoft; Stan Flores, Alcon; Howard Zion, Transcat;

Guanghong Zeng, Novo Nordisk

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### 7E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Use of FMEA for Reducing Calibration Process Risk**

Frank Liebmann, Fluke Calibration



## SESSION 8

WEDNESDAY, JULY 12 | 3:30 PM – 4:30 PM

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### 8A | ROOM: ST. JOHN'S 28/29

#### **Latest development of the NIST Programmable Josephson Voltage Standard**

Dr. Alain Rüfenacht, NIST

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### 8B | ROOM: ST. JOHN'S 30/31

#### **Mass Comparators: Measurement Uncertainty Estimation and Service Requirements**

Ian Ciesniewski, Mettler Toledo

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### 8E LEARNING LAB | ROOM: ST. JOHN'S 27

#### **Introduction to Networking with Suppliers, Manufacturers, Customers and Industry Professionals**

James Smith, Boeing Test & Evaluation Asset Management

Thank you speakers  
for all the outstanding  
submissions!

# Learning Labs Program

Tuesday, July 11

Tuesday, July 11, 2023 | 10:30 AM – 11:30 AM

1E Learning Lab | Room: St. John's 27

## Supplier Calibration Certificate Review

**Danae Powell, Pacific Northwest National Laboratory Battelle**

This hands-on tutorial addresses the growing concern and often confusion amongst practitioners surrounding the review, analysis and acceptance of supplier provided calibration certificates. Presentation Materials, topics and open discussion are based on the LM (Lab Management) guide in development by the NCSLI Laboratory Operations groups. Focus of the tutorial includes process elements, methods for standardizing tasks and actions, hands on review of sample certificates and in-depth discussion of steps to be taken for common and recurring issues. The tutorial is specifically designed for Quality, Staff, and technical personnel who are tasked with oversight or review of supplier certificates.

This tutorial is one building block in developing internal people & processes along with establishing standardized methods for efficient review of supplier services. Discussion is centered on ISO/IEC 17025:2017 criteria (section 7.8.2) but is designed to be flexible for inclusion of other Standards paying particular attention to the need for "customized" services or those based on Professional Society guides/methods e.g., ASTM, IEEE, ASME, ANSI, ISA etc.

The calibration life cycle process from development of a Request for Service (RFS) through the Documentation of an Accepted/Unacceptable service event will be presented and detailed with attendees. Opportunities to discuss prime concerns from personal applications will be provided to better customize the discussion. Understanding the calibration life cycle service model will create higher quality products and services for all industries.

Tuesday, July 11, 2023 | 1:00 PM – 2:00 PM

2E Learning Lab | Room: St. John's 27

## Planning for Successful Proficiency Testing

**Carol Hockert, National Association for Proficiency Testing (NAPT) and Rob Knake, NIST NVLAP**

The learning lab will identify critical elements to consider during the development of a PT plan to ensure the selected PTs appropriately evaluate your lab's measurement capabilities. Laboratories often don't properly evaluate their proficiency testing activities to ensure that they are appropriate for their intended outcomes. This session will walk participants through a process for evaluating proficiency testing activities to ensure your intended outcomes are achieved. Participants will also participate in a hands-on measurement demonstration and evaluation of the measurement data generated. There are many elements that influence the results of a PT, including your measurement capability, the uncertainty and measurement characteristics of the PT artefact, the evaluation (pass/fail) criteria, the measurement method(s) set out in the scheme, etc. If you are not considering these elements prior to participating in proficiency testing, you may have failed before you even participate.

Tuesday, July 11, 2023 | 2:30 PM – 3:30 PM

3E Learning Lab | Room: St. John's 27

## **Understanding ISO 10012: Managing Measurement Processes and Future Updates**

**Jonathan Harben, Keysight Technologies**

ISO 10012 is an international standard that provides guidance on the management of measurement processes and measurement systems. The standard aims to ensure that organizations are able to produce reliable measurement data, improve their quality management systems, and meet the requirements of their customers.

Under the current plan, a draft committee draft (CD) version of the revised ISO 10012 will be available after May 2023. The new ISO 10012 will be closely aligned with ISO9000 series of documents. It will be more comprehensive than previous version. ISO 10012 is currently a Type B standard and is now planned as a Type A standard (like ISO 17025). Intention is it will be 'certifiable'.

This learning lab covers the future updates to the ISO 10012 standard. Participants will learn about the proposed changes to the standard, including the incorporation of the latest updates and the alignment with other ISO management system standards.

By the end of this learning lab, participants will have a basic understanding of ISO 10012 and its importance in quality management. They will also be equipped with the knowledge of the proposed updates to the standard, ensuring they are up-to-date with the latest developments in measurement management.

Tuesday, July 11, 2023 | 3:30 PM – 4:30 PM

4E Learning Lab | Room: St. John's 27

## **Measure Twice, Learn Once: Explore Metrology Concepts through Hands-On Outreach Activities**

**Elizabeth Benham, NIST and Andrew Oldershaw, National Research Council (NRC)**

Are you a measurement science enthusiast? You're invited to explore a wide variety of fun hands-on education outreach activities during this learning lab session. Discover ways to communicate basic measurement concepts that encourage Science, Technology, Engineering, and Mathematics (STEM) career pursuits through engaging and relatable activities. Presenters will demonstrate and model measurement science concepts and share lesson outlines. Ideas for multiple student grade levels will be shared. Session participants will leave with a handout collection that will help them replicate activities within their community.

## Wednesday, July 12

Wednesday, July 12, 2023 | 10:30 AM – 11:30 AM

5E Learning Lab | Room: St. John's 27

### **Hands-on vs Online: Can the two coexist?**

**Jeff Meyerholz, Mitutoyo America Corporation**

Traditional metrology training has taken the form of job shadowing and on-the-job training. The “learn as you go” method had been employed for generations. COVID forced a rethink. A trend in training transitions all professional development and onboarding to an online learning management system. This can standardize the learning process across locations and experiences. Each method of delivery, in-person and online, have benefits and advances. How can a company leverage both to streamline and strengthen learning?

The session will allow participants to work in small groups to brainstorm learning strategies that will merge in-person, virtual, and online learning to optimize the training of staff that use small dimensional hand tools. Openly discuss what training methods might work for their unique needs and how to possibly sidestep obstacles or pitfalls. Participants will be able to connect with others interested in staff development and be exposed to strategies that work in various industries. Participants are encouraged to attend the session willing to engage in the process of learning development.

Wednesday, July 12, 2023 | 1:00 PM – 2:00 PM

6E Learning Lab | Room: St. John's 27

### **Professional Career Development: Career, Training & Mentoring Planning Overview; Steps, Strides & Leaps**

**James Smith, Boeing Test & Evaluation Asset Management**

Is your career going how you planned? Job stagnant, monotonous and less than fulfilling? If that is good for you, then congratulations, cruise, enjoy and hope for the best! BUT, if you are looking for professional growth and skill development, perhaps build a network in the Measurement Science Community or become a SME (Subject Matter Expert) well maybe you are interested in some Plan Development insights.

Do your supervisors support your professional development ideas but have no active plan to move you forward? If you have thought about developing a mentoring or career strategy but are unsure about where to start, what next steps to take, what resources are available or want to find an ongoing support group then this could be the team to engage with?

This year's Career Development Learning Lab will focus on the creation of custom plans for each of the program core elements: Career, Training & Mentorship. The three core supports for developing successful professionals. Each plan template is meant to be flexible and action orientated, detailing your



direction and customized for accelerating your career path.

Wednesday, July 12, 2023 | 2:30 PM – 3:30 PM

7E Learning Lab | Room: St. John's 27

## **Use of FMEA for Reducing Calibration Process Risk**

**Frank Liebmann, Fluke Calibration**

Failure mode effect analysis (FMEA) is a risk identifying exercise that has been used in industry for product designs for decades. There are a number of forms of FMEA to include systems FMEA, design FMEA, process FMEA, and service FMEA, and software FMEA. The design FMEA and process FMEA are the most familiar to design engineers. The design FMEA focuses on what may go wrong due to design issues with the product, while the process FMEA assumes a perfect design and focuses in on what may go wrong during the manufacturing process.

FMEA also may be used in a similar fashion to analyze calibration processes. The same sorts of flows are considered as those in a manufacturing process using a process FMEA. A similar result may be accomplished by using a simple risk analysis tool. However, FMEA is a more robust tool, and should be considered for complex calibration processes. This helps a laboratory comply with ISO/IEC 17025:2017 Section 8.5.

Wednesday, July 12, 2023 | 3:30 PM – 4:30 PM

8E Learning Lab | Room: St. John's 27

## **Introduction to Networking with Suppliers, Manufacturers, Customers and Industry Professionals**

**James Smith, Boeing Test & Evaluation Asset Management**

Few Technical Events provide direct insight into the skill development of Networking and customer/supplier engagement. Conferences and symposiums market the premise, embrace the concepts, and sell the idea of face-to-face communication at these events but often methods and the logic behind professional engagement are left for people to gather without much direction.

Working with customers, suppliers, OEM representatives, distributors, SMEs (Subject Matter Experts), etc. provides numerous opportunities to enhance or hinder your career. Long-term damage to a working relationship can have a severe impact on your ability to effectively mature a project or gain an objective.

As a part of career deployment, communication in its various elements will always be a core skill needing constant development and practice. Poor communicators rarely attain their full potential and are often overlooked for advancements when compared to those who show these skills openly.

This Learning lab will cover several aspects, examples, and opportunities for the attendees to use in developing their personal strategies and tactics to accelerate their people skill goals. We will go over some basic elements and examples, establishing a baseline for actions. We then include opportunities and examples which place the willing professionals into situations where their skills are developed and honed.

# Exhibit Hall Schedule

## Trade Show: Gatlin Hall C/D

### Monday, July 10, 2023

- |                   |                              |
|-------------------|------------------------------|
| 8:00 AM – 4:30 PM | Exhibitor Move-in            |
| 6:00 PM – 8:00 PM | Conference Welcome Reception |

### Tuesday, July 11, 2023

- |                     |                                |
|---------------------|--------------------------------|
| 7:30 AM – 6:30 PM   | Trade Show Hours               |
| 7:30 AM – 8:30 AM   | Attendee Continental Breakfast |
| 10:00 AM – 10:30 AM | Session Break AM               |
| 11:30 AM – 12:00 PM | Poster Presentations           |
| 11:30 AM – 1:00 PM  | Luncheon                       |
| 2:00 PM – 2:30 PM   | Session Break PM               |

### Wednesday, July 12, 2023

- |                     |  |
|---------------------|--|
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| 7:30 AM – 8:30 AM   | Attendee Continental Breakfast             |
| 10:00 AM – 10:30 AM | Session Break AM                           |
| 11:30 AM – 12:00 PM | Poster Presentations                       |
| 11:30 AM – 1:00 PM  | Luncheon                                   |
| 1:00 PM             | Trade Show Close                           |
| 1:00 PM – 6:00 PM   | Trade show Teardown                        |
| 2:00 PM – 2:30 PM   | Session Break PM (in the St. John's Foyer) |



# Exhibitors

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A.K.O Inc.	302
A2LA Workplace Training (AWPT)	313
Additel Corporation	307
Advanced Energy	610
American Association for Laboratory Accreditation (A2LA)	213
American Technical Services Inc. (MOX)	301
Ametek Sensors, Test & Calibration	513
Andeen-Hagerling, Inc.	210
ANSI National Accreditation Board (ANAB)	612
Applied Technical Services, Inc.	101
Cal Lab Solutions, Inc.	118
Constellation PowerLabs	303
Druck	602
Essco Calibration Laboratory	406
Flow Systems, Inc.	606
Fluke Calibration	207
Graftel	103
Guildline Instruments Limited	219
Hidow	400

# Exhibitors

EXHIBITOR	BOOTH
IndySoft, Inc.	408
International Accreditation Service (IAS)	308
Isotech North America	418
Masy BioServices	403
Measurements International, Inc.	201
Measurement Science Conference (MSC)	120
Meatest s.r.o.	119
Mensor	200
Mettler-Toledo, LLC	306
Michelli Weighing & Measurement	419
Mitutoyo America Corporation	100
Morehouse Instrument Company, Inc.	212
National Association for Proficiency Testing (NAPT)	300
National Metrology Institute of Japan (NMIJ/AIST)	507
National Physical Laboratory (NPL)	506
National Research Council Canada (NRC)	512
National Voluntary Laboratory Accreditation Program (NVLAP)	503
NCSL International	501



# Exhibitors

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NIST Calibration Services	509
Northrop Grumman Corporation	310
Ohm-Labs, Inc.	206
Pond Engineering Laboratories, Inc.	518
Precision Environments, Inc.	208
Process Sensing Technologies	401
Ralston Instruments, LLC	508
RH Systems, LLC	519
Sartorius Corporation	412
Scantek, Inc.	102
Sika USA	500
Technical Maintenance, Inc. (TMI)	502
The Modal Shop	413
Thunder Scientific Corporation	407
Tovey Engineering, Inc.	619
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**Questions? Contact NCSL International**

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