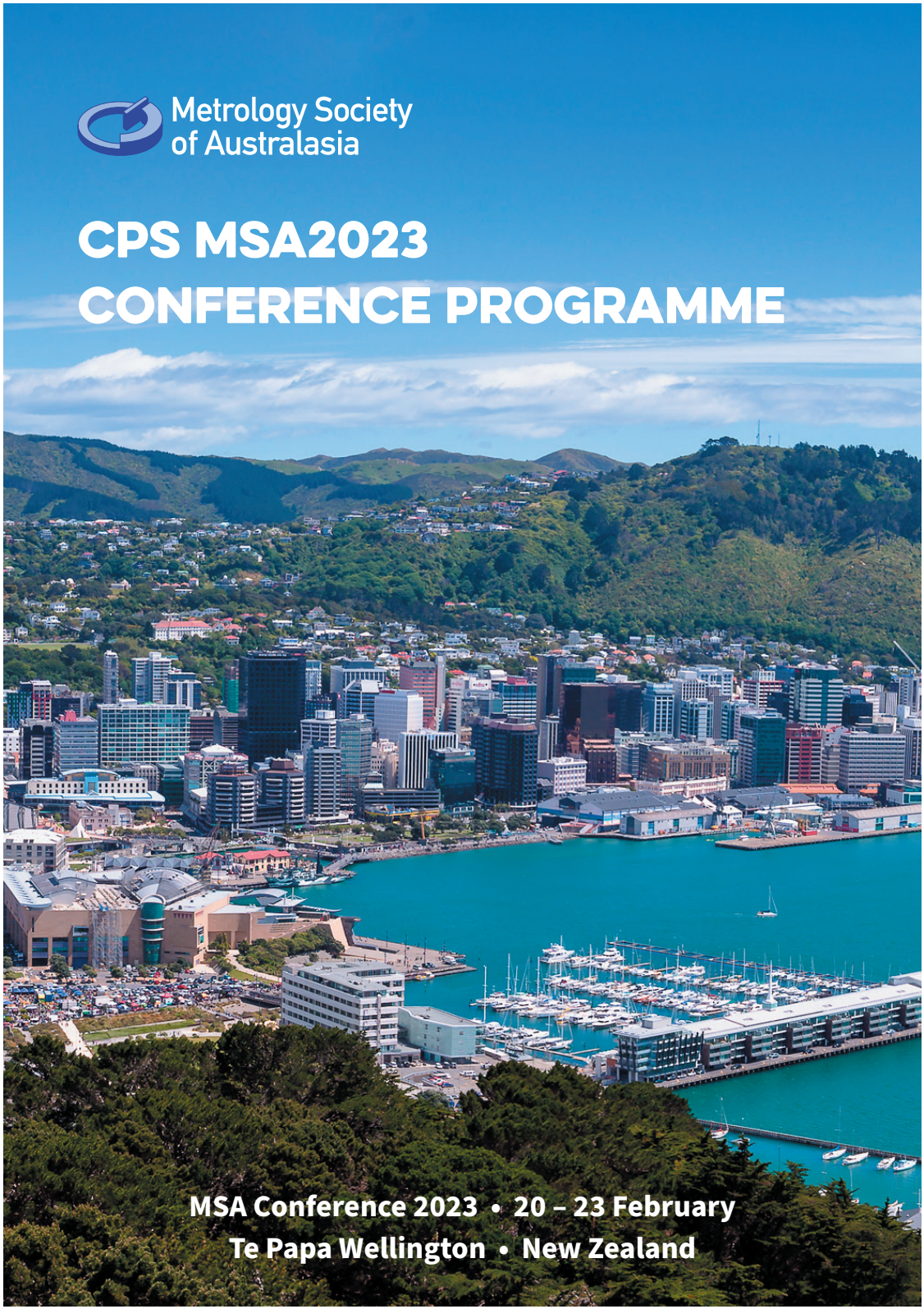
Metrology Society of Australasia

CPS MSA2023 CONFERENCE PROGRAMME



MSA Conference 2023 • 20 – 23 February
Te Papa Wellington • New Zealand

MSA2023 CONFERENCE PROGRAMME –
MONDAY 20TH TO THURSDAY 23RD FEBRUARY

Monday		Tuesday		Wednesday		Thursday
	7:30 am	**Exhibition / Tea & Coffee**		**Exhibition / Tea & Coffee**		MSA AGM Breakfast and meeting – *register to attend*
	8:30 am			Plenary – Blair Hall		
	9:00 am	Conference Opening		9:10 am **Session 4 – Main Stage**	CPS Workshop - Day 2 Breakout space open all day from 9:10 am	Plenary – Timothy Naish
	9:20 am	Plenary – Michael McGlynn				**Session 7 – Main Stage**
	10:00 am	**Exhibition / Tea & Coffee**		**9:50 am Exhibition / Tea & Coffee**		**10:00 am Exhibition / Tea & Coffee**
	10:30 am	**Session 1 – Main Stage**	CPS workshop – Day 1 Breakout space open all day except for plenary talks and NZ metrologist award	10:20 am **Session 5 – Main Stage** Metrology Education		**Session 8 – Main Stage**
	12 noon	**Exhibition / Lunch**		**Exhibition / Lunch**		**Exhibition / Lunch**
1:00 pm MSL Tour Meet at Te Papa Coach stop 12:45 pm	**1:00 pm**	Plenary - Brian Young		**Session 6 – Main Stage**	CPS workshop – Day 2 continues	Plenary – Jens Nicolaysen
	1:40 pm	**Session 2 – Main Stage**				**Session 9 – Main Stage**
				2:30 pm Depart Te Papa for WETA Digital Tour		
	3:00 pm	**Exhibition / Tea & Coffee**				**Exhibition / Tea & Coffee**
	3:30 pm	NZ Metrologist Award announcement				Closing Comments Conference ends
	3:45 pm	**Session 3 Main Stage**				
5:00 pm Welcome Function	**5:00 pm**	Day 1 ends				
	6:30 pm – 10:30 pm	**Conference Dinner – Sponsored by WIKA** Pre-dinner drinks and canapés – Signs of a Nation – Level 4, followed by dinner in Te Marae				

WELCOME

Dr KHALED CHAHINE
PRESIDENT, METROLOGY SOCIETY OF AUSTRALASIA

On behalf of the Metrology Society of Australasia, I welcome all the delegates and exhibitors to what promises to be a very enjoyable conference.

It's been 29 years since our first Annual General Meeting held in 1994, and it's only the second MSA conference to be held in New Zealand. As Daniel Burke, my predecessor, once said, "The role of the metrologist in society is fundamental, yet, like solid foundations for buildings, it is opaque to the broader community."

In recent times, the MSA has strived to reduce this 'opaqueness' by utilising platforms such as the MSA website and LinkedIn in order to build awareness of what metrology is and what we metrologists do!

I look forward to the dedicated Education portion of the conference programme – MSA has been very active in this space and we continue to engage with educators in Oceania and beyond.

While the pandemic disrupted the timing of this event – twice – it did not halt metrology research. Indeed, the pandemic has accelerated research in some areas.

I invite you to enjoy the diverse scientific programme on offer in Wellington this week.

I congratulate the New Zealand organising committee for their excellent preparation leading up to this conference and I encourage you to participate to the fullest in the conference sessions so you will, in turn, receive the fullest benefit from this unique gathering.

MEMBERSHIP

The MSA is an association of professional metrologists, engineers, scientists, technicians, and measurement experts throughout Australia and New Zealand, and around the world, who measure, evaluate, calibrate, maintain, educate, train, design, sell, invent, and develop measurement technologies and the science and art of metrology. Join us now and receive not only the many benefits of the Society but also share in and contribute to the exciting and significant role that the Metrology Society of Australasia is playing in modern measurement and technology.
http://www.metrology.asn.au/msaconnected/about-msa/join-the-msa

HEALTH AND SAFETY

Everyone at Te Papa is responsible for their own health and safety, and for contributing towards the maintenance of a safe working environment. Te Papa and MSA are committed to ensuring the health, safety, security, and wellbeing of all visitors to our conference, and to the safety and security of exhibits and equipment on display.

We all share this responsibility: the venue coordinators, MSA organisers, delegates, exhibitors, contractors, and volunteers. We ask that you ensure that everyone attending the event maintain the highest standards of safety at all times. All attendees are expected to comply in all respects to the requirements of the Health & Safety Act, including but not limited to:

- You must follow all safety instructions from Te Papa staff members at all times.
- All electrical equipment must be PAT tested and tagged, and all electrical cords must be taped down.
- Fire egress routes must be kept clear at all times. It is illegal to block emergency exits and the access route to an emergency exit.
- You must not obscure or cover emergency exit signs or store equipment in the fire staircase.
- All fire call points and fire hose cabinets must be kept clear.

EMERGENCIES

First Aid

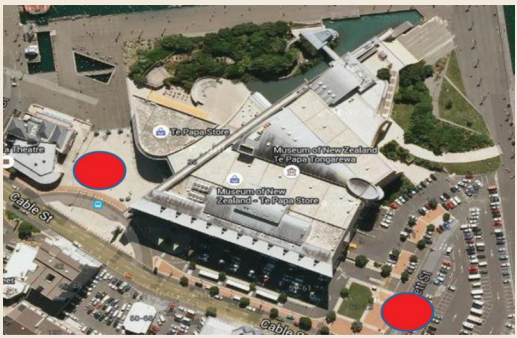
The first aid room is located on Level 3 in the back of house area. Automated External Defibrillators are available at the Information desk on Level 2, at Espresso on Level 4, and the back of house area on Level 1 in the Security Control Room.

First aid kits are also available on all floors. Please advise your Floor Supervisor for first aid assistance.

Fire Evacuation

The first aid room is located on Level 3 in the back of house area. Automated External Evacuation is essential even if you cannot see or locate the fire. The continuous sound of fire alarms will be activated to notify all occupants to vacate the building immediately.

Egress is available from all floors and areas in the building via the marked emergency exits or by the main staircase. The building is also fitted with an automatic sprinkler system, manual fire alarms, fire hose reels, and extinguishers on each floor.



Te Papa Visitor Services team will take full charge of the evacuation and make sure the building has been fully evacuated. Our team will follow procedures to assist disabled visitors in the case of an evacuation. Evacuation assembly points are:

- By Te Papa Museum forecourt near Circa Theatre; or
- At Barnett Street–Cable Street corner, next to Waitangi Park.

Earthquake

Te Papa sits on 150 base isolators to protect the building from earthquakes. The building will sway up to half a metre, which is normal, as it is designed to withstand an 8.5 magnitude earthquake and is a designated civil defence centre.

Te Papa would be among the safer places in Wellington in a major earthquake. All visitors must stay away from windows, find cover, and remain under shelter or in the venue. Our Visitor Services team will provide instructions should there be an evacuation.

Tsunami Alert

In the event of a tsunami alert, our Visitor Services team will ensure all guests are advised and guided to the higher levels of the building. This will be on Level 4 and above of the museum.

SECURITY

Building security services are included in our MSA venue hire charge. This is to look after the operations of the museum building and assist with wayfinding while the conference is happening.

General site and access security for our hired venue space is the responsibility of 'CPS MSA2023'.

Security of individual trade exhibition sites within the confines of the stand itself are the responsibility of the exhibitor.

The hired space will be locked down at the end of the day. We advise all event attendees to not leave any valuables unattended or unsecured at any time.

Te Papa and MSA accept no responsibility for any loss or damage suffered by anyone.

SMOKING

Te Papa is a non-smoking environment. Smoking is only permitted outside the confines of the building and away from the museum main entrance doors.

All types of electronic smoking devices are also not permitted inside the museum building.

TOILETS & ACCESSIBILITY

There is only one entrance to the museum for all visitors. Should there be a need to access a different entry or exit point, you will be advised by your Conference Coordinator.

For events in Oceania – toilets are back out of the room (into the public area) and turn left before the stairs. Another set of toilets is available just after the bridge to Te Huinga Centre.

ACCESS AND ACCESS TIMES

General access must be through Te Papa Museum main entrance. Pack-in and Pack-out access via the loading dock is under the control of the Conference Coordinator.

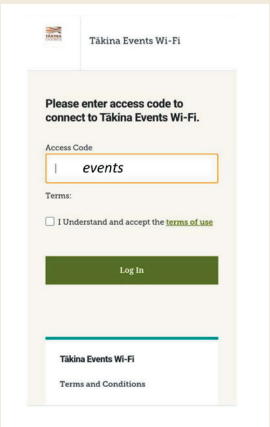
INTERNET ACCESS

Te Papa offers complimentary Wi-Fi and is shared by all function attendees. It is suitable for basic internet browsing, such as checking emails and social media accounts.

There is an allowed maximum of 2 GB per 24 hours per user.

To access the correct Wi-Fi, connect to **Tākina Events** on your device.

A Tākina Events internet page will pop up when you open your browser; type in the access code – **events** – and accept the T&Cs.



MSA PLATINUM SPONSORS

CPS NZ LTD

Instrumentation & Calibration Experts

CPS Labs is New Zealand's premier IANZ accredited calibration facility, covering three companies across five labs in two countries, calibrating more than 15 000 devices per year.

We undertake calibration in pressure, temperature, infrared, electrical, torque, and mass, as well as relief valve testing.

Life for CPS started way back in 1987, soon after the share market crash, doing pressure calibration on test gauges for cylinder testing stations – one piece of reference test gear operating in one market. Over the years, CPS grew from these small beginnings as a 'one-man band' to now, on a good day, having up to 18 staff members working across the group.

CPS's success is attributed to a fierce focus on customer satisfaction and the unyielding and continual hard graft that Kirsty Russell puts in to CPS. Kirsty's work ethic from those early formative years, through to the present day, is and always has been, second to none.

CPS's focus for the first 15 years was around pressure gauge calibration, expanding with another dead-weight tester and testing boiler gauges for steam boilers. It wasn't until later in the 1990s that suppliers required traceable calibrations.

In the late 1990s, the CPS Comparator was invented by Chris Woudenberg to speed up pressure gauge calibration, especially onsite. This has grown into a very successful product that is exported to dozens of countries worldwide.

In the early 2000s, CPS became the New Zealand distributor for Crystal Engineering, which manufactured the highly successful XP2i digital pressure gauge. This paved the way for the ensuing CPS expansion.

On a visit to Crystal Engineering, Chris noticed how they were calibrating XP2i's in their labs using DHI pressure controllers instead of dead weight testers. They used to have 24/7 shifts of staff calibrating the gauges manually – but not anymore, once automation had started!

The next day Chris flew out to DHI in Phoenix Arizona and was offered the DHI agency for New Zealand, and promptly ordered a pressure controller and piston gauge for the automated calibration of XP2i's and to embark on the track of having the lowest pressure uncertainties in New Zealand and Australia. This paved the way for CPS's pressure calibration expansion, which hasn't really stopped to this day. CPS now have seven pressure controllers and two piston gauges, which enable CPS to perform thousands of XP2i calibrations each year – not to mention many other brands as well.

A couple of years after Chris's initial visit, DHI was sold to Fluke. CPS was offered the Fluke agency for NZ, but what was offered was not Fluke multimeters (which is what Chris and Kirsty thought) but 'Fluke Calibration', which at that time covered electrical and temperature calibration equipment, as Fluke had recently brought Hart Scientific.

This was the start of another CPS expansion phase. They expanded their scope and opened an office in New Plymouth. Driven by Paul Martin, the local temperature expert, CPS became accredited in temperature, tying in nicely with their Fluke Calibration (Hart Scientific) agency.

Very soon after, Paul mentioned CPS should get into electrical calibration. This was driven by Fonterra wanting their Beamex multi-function calibrators like the MC5, calibrated. CPS were doing the pressure calibrations but outsourcing the Beamex electrical calibrations. No one else (MSL apart) could do all the functions in-house, so we expanded our capabilities to calibrate their electrical functions. This started with the purchase of an 8.5-digit reference multimeter, thus initiating the CPS expansion of 'calibrating the calibrators' and doing all the Beamex's pressure, temperature and electrical functions in-house.

Around this time, CPS were selling a lot of the Fluke 55XX series calibrators but they weren't being calibrated properly here in New Zealand as no NZ lab had low enough uncertainties or the processes to do their calibrations. CPS undertook a huge electrical expansion so it could calibrate these, this process involved a massive 3 Day IANZ audit.

Also around this time, CPS expanded into the calibration of DHI (now Fluke) pressure controllers using a Fluke automated dead weight tester or piston gauge – the only one of its kind in the Southern Hemisphere at that time. This capability meant that CPS's pressure uncertainties were lower than those of New Zealand's national metrology institute, MSL.

We were also one of the World's first ISO 17025 accredited companies for the calibration of thermal imaging cameras – a task we couldn't have done without help from the team at the Measurement Standards Laboratory (MSL).

Being a very customer-focused company, we wanted to offer the total package and complete the 'sales loop'.

We used to, and still do, sell calibration equipment with our calibration certificate in one of our very own custom-made carry cases, complete with a CNC-cut foam insert – something none of our competitors offers!

We are stoked when we see equipment arrive in the lab, still in its original case, many years after the initial sale. It always gives us immense pride to know that our customers trust us with their kit and understand that we supply them with first-rate gear as well as an outstanding calibration service.

Contact CPS at http://www.cps.co.nz/ Phone: +64 9 636 4999 E-mail: info@cps.nz

DINNER AND LANYARD SPONSOR

WIKA

YOUR GLOBAL MARKET LEADER IN PRESSURE, TEMPERATURE AND LEVEL MEASUREMENT.

Founded in 1946, WIKA is a family-run business acting globally, with over 10 000 highly qualified employees. WIKA competently and reliably supports its customers worldwide, with a presence in over 43 countries.

Over the past 75 years, WIKA has built a reputation as a renowned partner and competent specialist for any task in the field of measurement technology. WIKA offers a broad product spectrum of calibration instruments for the physical measured values of pressure and temperature, and for electrical measured values. A multitude of specific patents ensure unmatched performance characteristics with many of our calibration instruments.

In recent years, WIKA has successfully integrated three renowned manufacturers of calibration equipment into the Group:

- **Mensor** is known in the market for its outstanding portfolio of pressure controllers, and consolidates WIKA's position as the market leader in the worldwide calibration market.
- **DH-Budenberg**'s product range includes high-end pressure primary standards and transfer standards of the Desgranges & Huot brand, as well as laboratory and industrial standards of the Budenberg brand.
- **ASL** resistance bridges, with highly stable thermometers, are used specifically in temperature laboratories.

The range of services offered includes the calibration of pressure and temperature measuring instruments in the WIKA-owned accredited laboratories and a mobile service to calibrate your instruments on site.

New Zealand: WIKA Instruments Ltd
Auckland 1025, New Zealand
Tel.: +64 9 847 9020
sales.nz@wika.com
www.wika.co.nz

IANZ

Australia: WIKA Australia Pty Ltd
Sydney Head Office, Australia
Tel.: +61 2 8845 5222
sales.au@wika.com
www.wika.com.au

NATA

GOLD SPONSOR

FLUKE 5560A, FLUKE 5550A, AND FLUKE 5540A MULTI-PRODUCT CALIBRATORS

Fluke has delivered precision calibration for more than 50 years. The company's instruments are found in laboratories everywhere, including national metrology institutes where metrologists calibrate to the highest levels of performance and reliability. The calibration industry is facing many challenges that demand innovative solutions to ensure the advancement of industries reliant on precision and accuracy.

Calibration Today

Calibration services today are driven primarily by demands in the electrical sector, where there are increasingly stringent measures on quality assurance and requirements on more regularly scheduled calibrations. The dramatic increase in workloads is landing on an industry deficient of skilled technicians and equipment that allows them to meet the soaring demand. A survey of calibration professionals – the majority of whom conduct more than 750 calibrations annually – revealed that 54 % are getting by with fewer resources while their workloads have increased. The majority say they are trying to meet the demand for more – and more complex – calibrations with fewer skilled technicians. In addition, 49 % say they will either be retiring in the next five years or changing professions. The majority of respondents (52 %) said better performance was one of the most challenging aspects of calibration work today, followed by the need to calibrate faster (48 %) and using outdated equipment (47 %).

Addressing Today's Issues in Calibration

Fluke introduced the next generation of calibrators to meet the increased and changing demands of the industry and address the reduction in skilled workers:

- Fluke 5560A High-Performance Multi-Product Calibrator.
- Fluke 5550A Performance Multi-Product Calibrator.
- Fluke 5540A Multi-Product Calibrator.

These new calibrators help directly solve some of the issues the industry experiences today:

- Improve accuracy: The Fluke Multi-Product Calibrators do better than 4:1 accuracy, exceeding demand.
- Ensure consistency: Fully automated with Fluke Calibration MET/CAL software enables each calibration to be performed the same way every time, no matter who does the job.
- Enable the workforce: The Fluke Multi-Product Calibrators cover a wide and varied workload and are intuitive to use. Technicians perform work with a single instrument to increase efficiency.
- Simplify training: The new interface makes these calibrators very easy for technicians to learn. Wide workload coverage enables calibration managers to simplify training because the lab can do more with a single instrument.
- Transportability: An optional portability kit enables mobile calibration technicians to easily transport the instruments.

Technological Advancements

The Fluke 5560A features a 17.8 cm graphical user interface with intuitive menus that are easy to navigate and read. The new interface provides access to common functions with the touch of a finger and color-coded fields that make it easy to see where to enter data.

Other new or improved features include: 30 A Class D transconductance amplifier, Visual Connection Management™ connection terminals, new output block design, 1000 V direct amplifier, improved thermocouple input/output mechanical /thermal design.

To learn more about Fluke Calibration's electrical calibration solutions, visit: https://fluke.co/5560a-msa

SILVER SPONSORS

RAPID-TECH EQUIPMENT

Measurement Standards Laboratory of New Zealand

IANZ

The NZ mark of competence
Tohu Matatau Aotearoa

NATA

DELIVERING CONFIDENCE FOR 75 YEARS

BRONZE SPONSORS

APL Australian Pressure Laboratory
Pressure • Vacuum • Electrical

IOT Scientific
INTERNET OF THINGS SCIENTIFIC

de Calibration & Compliance
ISO/IEC 17025 IANZ Metrology & Calibration Lab
de Survey NZ
ISO/IEC 17020 IANZ Inspection Body
de Consulting Engineers & Inspection
ISO 9001 Quality Management Systems
de Group

TEX AT SITE
Solutions | Service | Excellence

Teltherm
Fast, reliable sales & service from the experts in industrial instrumentation and calibration.
Talk to us today about your business needs.
09 633 0040 | sales@teltherm.co.nz
teltherm.co.nz

MCC

KEYSIGHT TECHNOLOGIES

VAISALA

ISOTECH

ETL LTD ELECTROTEST

Photometric Solutions International®

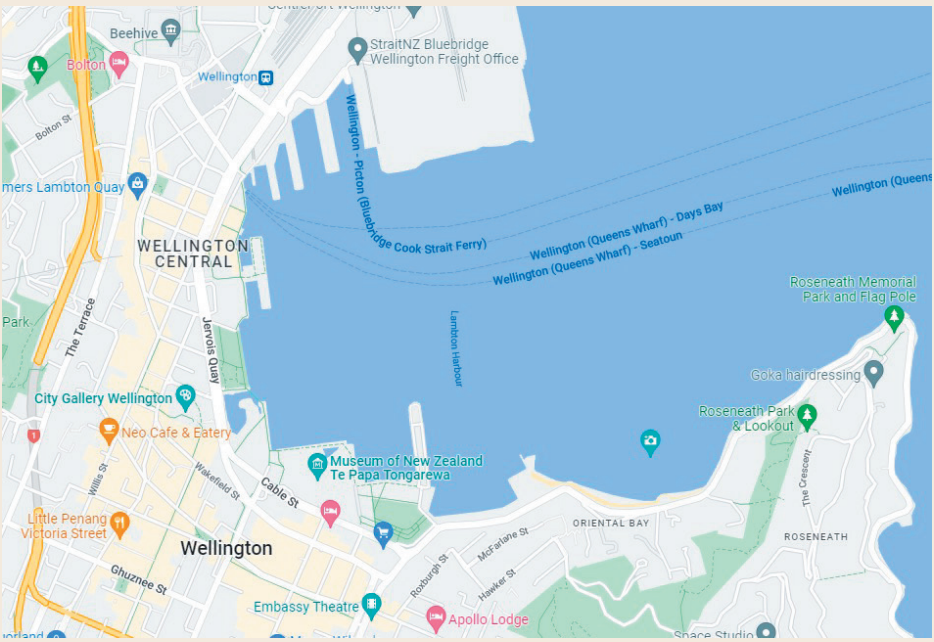
Australian Photometry and Radiometry Laboratory

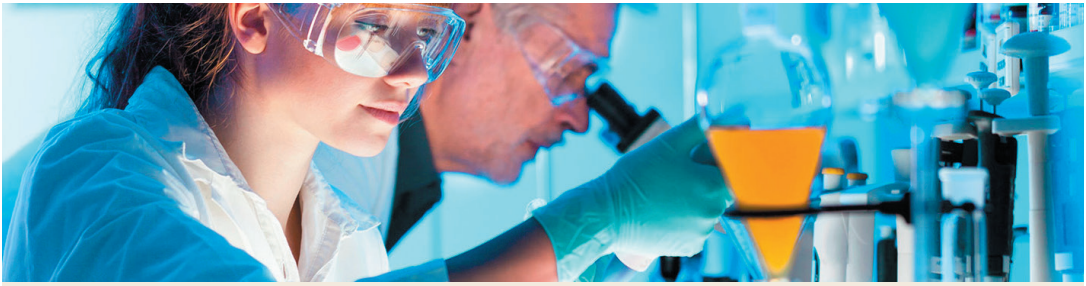
CONFERENCE VENUE

Museum of New Zealand | Te Papa

55 Cable Street
Wellington Waterfront

Welcome Function and Conference – Oceania Room – Level 3
Conference Dinner – Te Marae – Level 4





MSA USEFUL CONTACTS

Conference Committee

Cynthia Lendrum – Committee Chair, Venue and Comms
Cynthia.Lendrum@callaghaninnovation.govt.nz

Anne Evans – Sponsorship and Programme
anne@teltherm.co.nz

Brigitte Sargent – Sponsorship
BSargent@geotechnics.co.nz

Gavin Tasker – Technical Committee and Programme
GTasker@ianz.govt.nz

Daryl Pettit – Speakers, Metrologist Award
Daryl.Pettit@wika.com

Chris Milligan – Logistics
Chris.Milligan@airways.co.nz

Dr Peter Saunders – Programme and abstracts
peter.saunders@measurement.govt.nz

USEFUL WELLINGTON CONTACTS

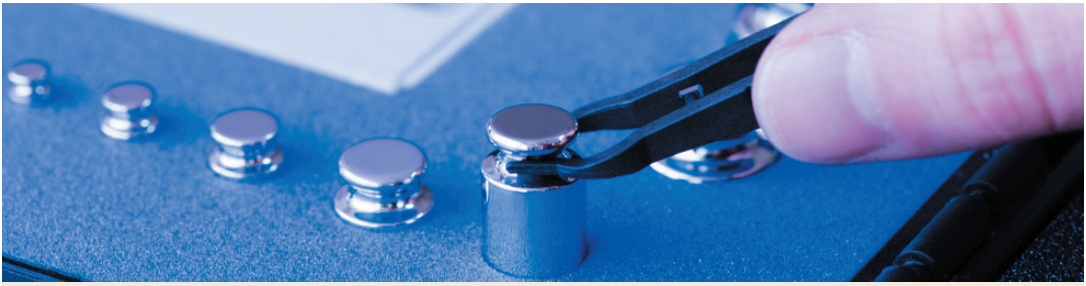
New Zealand Emergency Services: Ambulance, Fire and Police. Dial 111 from any public or private telephone or mobile phone in New Zealand

Wellington Police: 41 Victoria Street, Wellington Central, Wellington 6011
Phone: 04 381 2000

Wellington Hospital: 49 Riddiford Street, Newtown, Wellington 6021, Phone: 04 385 5999

Wellington i-Site: 111 Wakefield Street, Te Aro, Wellington 6011, Phone: 04 802 4860

Wellington Taxis: Corporate Cabs: 0800 789 789



SOCIAL PROGRAMME

Monday 20th February – 1:00 pm

MSL Lab Tour – Travel to Lower Hutt to visit the Measurement Standards Laboratory, with tours of several lab spaces, enjoy afternoon tea and the chance to meet MSL scientists. Registration required.

Coach departs Te Papa bus park – 1:00 pm / Returning by 5:00 pm

---

Monday 20th February – 5:00 pm

Welcome Function and Registration – Join us for the first viewing of the trade stands, register, connect with other delegates, enjoy refreshments and a warm welcome to Wellington. Partners must register.

Oceania Room – Te Papa – 5:00 pm to 7:00 pm

Tuesday 21st February – 6:30 pm

MSA2023 Conference Dinner – sponsored by WIKA

We welcome you to the very special and significant space of *Te Marae* for our conference dinner. First, we gather together in the exhibition hall "Signs of a Nation" from 6:30 pm for canapés and pre-dinner drinks before proceeding into *Te Marae*. Partners must register.

Connect with any Te Papa host during the conference to learn more about this remarkable space and the stories behind the carvings within *Te Marae*.

Wednesday 22nd February – 3:00 pm

WETA Digital Site Tour and Experience – Departing Te Papa 2:30 pm

From The Lord of the Rings and The Hobbit to District 9 – learn about the making of props, costumes, and creatures created for your favourite films. Interact with cool stuff from their creative departments and, if you're lucky, catch an artist at work on our tour stage. We are being treated to a special glimpse into the special effects that has made WETA Digital a household name in Hollywood. Enjoy canapés and drinks before returning to Te Papa by 6:00 pm.

Coaches depart from the Te Papa bus stop at 2:30 pm. Partners must register.

Thursday 23rd February – 7:30 am

MSA Exec Breakfast and AGM – Oceania Room

Join this breakfast meeting to accept the minutes from the last AGM, hear the annual financial and president's reports and elect a new Exec committee. Non-members are welcome but only members can vote. Please register with the MSA Secretary at the registration desk. Copies of the minutes and the necessary forms will be available from the registration desk until midday Wednesday.

PLENARY SPEAKERS

Michael McGlynn – Tonkin + Taylor Group

Michael has more than 20 years' experience in sales and marketing, including four years as Head of Marketing and Communications at Tonkin + Taylor.

The focus of Michael's team at T+T is disrupting the environmental and engineering consultancy industry by building digital products to create new opportunities and revenue streams for the Group.

Recently his focus has been on digital transformation, innovating quickly and responsively to improve the Group's digital product development process and creating digital brands with purpose.

Michael's approach is strategic and holistic. His expertise will enlighten delegates as to the processes involved in the 'productising' of digital initiatives and the direct impact this has on business growth.

Title: "***A framework for productising digital initiatives***"

Dr Brian Young, BSc(Hon), PhD, CMInstD – IANZ

Brian is an experienced science leader, diplomat, and neuroscientist. He began his career in science with a BSc(Hon) degree in psychology at the University of Canterbury, followed by PhD study in behavioural neuroscience at Dartmouth College (USA). His neuroscience research work extended across UNC-Chapel Hill, and SUNY-Stony Brook in the United States, followed by the University of Otago and HortResearch in New Zealand.

Brian's subsequent career in science diplomacy took him back to the United States where he was the inaugural Science & Technology Counsellor in the New Zealand Embassy (Washington DC). Following his diplomatic post, Brian was the Director, Research at the University of Otago, and for the nine years prior to his appointment at IANZ, he was the Director of the Defence Technology Agency.

In addition to his science leadership credentials, Brian has had nine years of governance experience representing New Zealand in several international defence science & technology boards. More locally he is a board member of the Museum of Transport and Technology and is a chartered member of the Institute of Directors.

Title: "***Metrology from the perspective of a non-metrological scientist***"

Dr Blair Hall – MSL

Blair Hall leads a project in data metrology at the Measurement Standards Laboratory of New Zealand. He chairs the APMP Focus Group on Digital Transformation in Metrology (DXFG), he is a member of the IMEKO Technical Committee 6 (Digitalisation), and a member of the NCSLI Technical Committee 141 (Measurement Information Infrastructure). He is also a member of a group advising the International Committee for Weights and Measures Task Group on the Digital SI (CIPM-TG-DSI).

Blair holds a doctorate in physics from the Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, and has worked at the Swiss national metrology institute (METAS) and at Massey University, New Zealand, where he lectured in physics and electronics.

Title: "***Pathways towards digital transformation in metrology***"

Prof Timothy Naish – Victoria University of Wellington

Tim Naish is a Professor in Earth Sciences at the Antarctic Research Centre, Victoria University of Wellington, where he was Director from 2008–2017. His research focuses on past, present, and future climate change with specific emphasis on how the Antarctic ice sheets respond to climate change and influence global sea-level.

Tim has made 15 expeditions to Antarctica, including leading the international ANDRILL scientific drilling programme in 2006–2007. He was a lead author on the Intergovernmental Panel on Climate Change, 5th Assessment Report. Tim is currently co-leader of the New Zealand Sea Rise Programme, that has produced location specific predictions of future sea-level rise for managing hazard and risk to Aotearoa's coastal communities.

Tim and his "Melting Ice & Rising Seas Team" were awarded the 2019 NZ Prime Minister's Science Prize. He was awarded the Tinker Muse Prize for Antarctic Science and Policy, the New Zealand Antarctic Medal, and is a Fellow of the Royal Society of New Zealand.

Title: "***Climate change and what does it mean for us?***"

Jens Nicolaysen – JNC

Jens has been a full time ISO 9001 auditor for over 30 years. He has worked extensively in Europe and throughout the world. He currently does contract audits for DQS Germany and is based in Hamburg, Germany. One of his biggest clients is currently the WIKA group of companies. The WIKA contract requires Jens to travel worldwide, to all the continents and countries where WIKA has offices. Jens currently visits around 130 different countries every 3 to 4 years.

In the past, Jens has also audited companies such as Airbus, Rolls Royce, and various car manufacturing companies. During his auditing career, Jens has come across some amusing and funny scenarios as well as some absolutely bazaar, myth defying and sometimes scary procedures that people and companies have put in place to satisfy their ISO requirements.

Title: "***Global auditing***"

DETAILED PROGRAMME – TUESDAY 21 FEBRUARY

9:00 am	**Opening Ceremony – Main Stage** Welcome message and housekeeping from Liam Shanahan, MSA Vice President	
9:20 am – Plenary 1 – Main Stage "A framework for productising digital initiatives" Michael McGlynn, Tonkin + Taylor		
10:00 am	**Morning Tea and Exhibitions**	
10:30 am to 12:00 pm	**Session 1 – Main Stage**	CPS workshop runs over 2 days in the breakout space –"Advancement in calibration" a hands-on learning experience
Ellie Molloy Measurement Standards Laboratory	How well can we see through our windscreens, and can we measure that?	
Peter Apian-Bennewitz Pab Advanced Technologies Ltd	High-power LED as light-source in scanning gonio-photometer for BSDF/Scatter measurements	
Tony Bergen Australian Photometry and Radiometry Laboratory	The challenges of calibrating bilirubin radiometers	
Yin Hsien Fung Measurement Standards Laboratory	Optics and metrology	
10:30 am to 5:00 pm	**Workshop Breakout Session – Breakout Room (Parallel)** CPS workshop continues except during plenary talks and NZ Metrologist Award	
12:00 pm	**Lunch and Exhibitions**	
1:00 pm – Plenary 2 – Main Stage "Metrology from the perspective of a non-metrological scientist" Brian Young, International Accreditation New Zealand		
1:30 pm to 3:00 pm	**Session 2 – Main Stage**	
Liam Shanahan Australian Pressure Lab	Approaches for handling hysteresis in digital pressure references	
Peter McDowall Measurement Standards Laboratory	International trends in realisation of the pascal	
Owen Brace NMIA	Development of an active arm bridge for high value resistors at NMIA	
David Turner SIMTARS	Good metrology in mine safety	
3:00 pm	**Afternoon Tea and Exhibitions**	
3:30 pm	**NZ Metrologist Award – Main Stage**	
3:50 pm – 5:00 pm	**Session 3 – Main Stage**	
Giorgio Buonanno University of Cassino and Southern Lazio	Ventilation matters in reducing SARS-COV-2 airborne transmission in schools	
Nigel Gibson IOT Scientific	Covid manufacturing disruption to start-up businesses	
Peter Saunders Measurement Standards Laboratory	**Workshop** – Understanding the field of view and target size for infrared thermometers	
6:30 pm to 10:30 pm **Conference Dinner – Signs of a Nation and Te Marae, Level 4, Te Papa**		

DETAILED PROGRAMME – WEDNESDAY 22 FEBRUARY

8:30 am – Plenary 3 – Main Stage "Pathways towards digital transformation in metrology" Blair Hall, Measurement Standards Laboratory		
9:10 am to 9:50 am	**Session 4 – Main Stage**	"Advancement in calibration". Day 2 of the CPS workshop continues all day in the breakout space.
Cory Brooks RBR Ltd	Development and evaluation of a 900L temperature calibration bath	
Paul Demchick Real World Education	Laboratory education programmes as a model for metrology education	
9:50 am	**Morning Tea and Exhibitions**	
10:20 am to 12:00 pm	**Session 5 – Main Stage**	
Ian Kennedy National Science Roadshow Trust	Science education in schools	
Rod White Independent Researcher	The MSA lectures on measurement	
Melanie Ooi University of Waikato	Metrology education initiative at University of Waikato	
	Education discussion panel	
12:00 pm	**Lunch and Exhibitions**	
12:45 pm to 2.15 pm	**Workshop Breakout Session – Breakout Room (Parallel)** Day 2 of the CPS hands-on workshop continues "Advancement in calibration"	
1:00 pm to 2:15 pm	**Session 6 – Main Stage**	
Michael Tecofsky RF Test Solutions	Ensuring your uncertainties update when your CMCs change	
Christian Laurio Department of Science and Technology, Philippines	Evaluating the preparedness of a developing economy in the implementation of digital calibration certificates	
Michael Schwartz Cal Lab Solutions	Standardising metrology for the digital age – how the metrology taxonomy works	
2:30 pm to 6:00 pm	**WETA Digital tour** Coaches depart Te Papa – assemble at Te Papa bus stop Returning to Te Papa by 6:30 pm	

DETAILED PROGRAMME – THURSDAY 23 FEBRUARY

7:30 am to 8:45 am	**MSA AGM Breakfast and meeting – Oceania and Main Stage** *You must register to attend by Tuesday*
9:00 am – Plenary 4 – Main Stage "Climate change and what does it mean for us?" Timothy Naish, Victoria University of Wellington	
9:40 am to 10:00 am	**Session 7 – Main Stage**
Marcus Wilson University of Waikato	Measuring electrical properties of batteries at ultra-long timescales
10:00 am	**Morning Tea and Exhibitions**
10:30 am to 12:00 pm	**Session 8 – Main Stage**
Paul McMullen NATA	The benefits of accuracy-based proficiency testing schemes
Lenice Evergreen Measurement Standards Laboratory	Step by step: our journey through a key comparison
Peter Saunders Measurement Standards Laboratory	Triple point of water comparison
Annette Koo Measurement Standards Laboratory	Post-SI redefinition
12:00 pm	**Lunch and Exhibitions**
1:00 pm – Plenary 5 – Main Stage "Global auditing" Jens Nicolaysen	
1:40 pm to 3:00 pm	**Session 9 – Main Stage**
Tony Bergen Australian Photometry and Radiometry Laboratory	The importance of standards providing standardisation
Daryl Pettit WIKA NZ	The cost of quality
Rod White Independent Researcher	Standard v expanded uncertainty
	Ask an expert panel – your questions
3:00 pm	**Closing comments** **Afternoon Tea and Exhibitions**

HOW WELL CAN WE SEE THROUGH OUR WINDSCREENS, AND CAN WE MEASURE THAT?

Ellie Molloy, Annette Koo

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail (corresponding author): ellie.molloy@callaghaninnovation.govt.nz

Everyone who has driven a car will be familiar with the fact that as dust and other dirt particles build up on your windscreen, it gets more difficult to see clearly, especially when you are driving towards the sun. This is because the particles cause light to scatter as it passes through the glass, making the windscreen become hazy. Figure 1 shows the difference between two samples with different haze values. We can see that the hazier the sample, the less clear the image behind.

The degree to which light scatters as it passes through materials is of interest in the development of various optical thin films, such as those used in solar cells and those in optoelectronic devices, including our laptops and cellphones. One way of quantifying this is to measure the 'transmittance haze' of a material. Transmittance haze is defined as the fraction of transmitted light that deviates from the incident beam by more than 2.5°.

Rather than measuring the entire scattering distribution of the material – i.e., the amount of light scattered to every angle through a sample – we can use integrating spheres, which capture light from a range of scattering angles, to approximate the haze. In fact, several different documentary standards have been developed specifying the use of integrating spheres in the measurement of haze, but integrating spheres can only approximate the haze, as the definition requires an infinitesimal beam to be incident on the sample, which is not achievable in reality.

Figure 1. Photograph of two haze standards with different haze values – the left standard has a haze value of 40%, the standard on the right has a haze value of 90%.

In order to understand the limitations of the sphere-based approach to measuring transmittance haze, we have measured the full scattering distributions for a range of samples and compared the results with the approximation from an integrating sphere. We have found that for some samples, the sphere approximates the definition well, whereas for other samples the relative difference is more than 50%.

HIGH-POWER LED AS A LIGHT-SOURCE IN SCANNING A GONIO-PHOTOMETER FOR BSDF/ SCATTER MEASUREMENTS

Peter Apian-Bennewitz
pab-opto, Freiburg, Germany
bsdf@pab.nz

Scanning gonio-photometers for bidirectional scattering distribution function (BSDF) measurements consist of an adjustable mount for the sample, a light source generating the incident beam, and a mechanically movable detector to capture the outgoing light (ASTM E2387-05). To resolve details of the BSDF with high angular resolution, the incident radiance generated by the light source must be high and narrowly localised. Together with the detector size, this defines the best overall achievable angular resolution of an instrument – its signature.

Traditional light-sources for BSDF measurements in the visible and near-infrared use halogen and xenon short-arc bulbs as spectrally-broadband emitters. While both sources have optical advantages, newer high-power, single-chip LEDs have become an interesting alternative.

We describe current results from tests using LEDs in comparison to existing halogen, xenon, and laser-diode sources in the PG2 scanning gonio-photometer. Near-monochromatic LEDs, without fluorescent layers, are considered primarily. Aspects include achievable beam power versus angular resolution, electrical aspects (e.g., noise), and spectral suitability. Conclusions in respect to different measurement applications are given.

THE CHALLENGES OF CALIBRATING BILIRUBIN RADIOMETERS

Tony Bergen

Australian Photometry and Radiometry Laboratory, Melbourne, Australia

E-mail (corresponding author): tony@aprlab.com.au

Jaundice is a condition in which the skin turns a yellowish colour due to the presence in the blood of high levels of bilirubin, an orange-coloured pigment contained in red blood cells that is released into the bloodstream when the cells break down. It is relatively common in prematurely delivered newborn babies because the baby's liver hasn't developed sufficiently to remove the bilirubin from the bloodstream. Treatment is usually by phototherapy – exposing the skin of the baby to blue-coloured light near the peak of the bilirubin action spectrum shown in Figure 1.

Bilirubin radiometers measure the broadband irradiance of the phototherapy lamps used in the treatment, to ensure that adequate levels of irradiation are used. There are two main problems with the calibration and use of bilirubin radiometers:

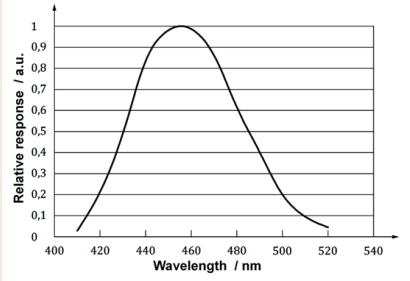


Figure 1. Action spectrum for the photoisomerisation of bilirubin (DIN 5031-10:2018-03).

1. There is no standardised optical radiation source for the treatment, and no standardised spectral responsivity function for the instruments. This can lead to significant spectral mismatch errors when using an instrument to measure a source that has a different spectral distribution to the source used in the calibration.
2. The instruments themselves often display measurements in the units of spectral irradiance rather than broadband irradiance, and it requires the calibration lab to make a judgement on the bandwidth of the instrument.

In 2021–22, the Australian Photometry and Radiation Laboratory (formerly Steve Jenkins and Associates) undertook an intercomparison with the Research Institutes of Sweden for the calibration of a bilirubin radiometer. When the sources used in the intercomparison were not controlled, the difference in calibration results exceeded 15% (E_n = –2.7), whereas when the sources were similar the difference in calibration results was reduced to 1.5% (E_n = –0.24).

The results of the intercomparison emphasise the need to effectively communicate the nature of the source that the instrument will be used to measure, so that the calibration can be made fit for purpose. Unfortunately, not all applicants know this.

OPTICS AND METROLOGY

Yin Hsien Fung

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail: yinhsien.fung@measurement.govt.nz

Since the advent of laser technology in the 1960s, optical measurement techniques have been utilised in metrology, especially in length, time, and light standards. Optical methods have enabled measurements to be made with increased resolution and range, while having flexible scalability and adaptability. For the past few decades, laser and optics technologies have been improving remarkably, and this has led to their growing importance in metrology. Furthermore, the recent revision of some of the SI base units, including the redefinition of the kilogram based on Planck's constant, has opened up the possibilities of using optical methods in other areas of metrology, such as mass and force, where measurements can be extended to even lower scales while being traceable to the redefined SI. In this talk, I will attempt to explain the rationale behind the emerging trend of optics-based measurement methods and give a review on how optics are being used in different areas of metrology. To illustrate this, we will look at a few examples from recent international developments, including: radiation pressure small force measurements; quantum pressure and vacuum standards; optical frequency combs, and photonic thermometers. Finally, we will discuss the emergence of these developments in the New Zealand context.

THE RETURN JOURNEY: APPROACHES FOR HANDLING HYSTERESIS IN DIGITAL PRESSURE REFERENECS

Liam Shanahan, Randall Anderson

Australian Pressure Laboratory, Melbourne, Australia

E-mail: liam.shanahan@auspressurelab.com.au

In recent decades, electro-mechanical and digital pressure sensing technology has improved in both quality and value. As a result, many calibration laboratories now utilise and/or rely on digital pressure sensors as their references and primary traceability to the Pascal, including in medium- and low-uncertainty applications.

External calibration of pressure sensors is typically performed over their full operating range, where the sensing element reaches a maximum level of strain, resulting in a corresponding maximum hysteresis effect evident in the falling pressure assessment. In practice, the sensors may often be used over a smaller range and, therefore, the true magnitude of the hysteresis may be significantly less than observed and reported during the external calibration.

If the degree of hysteresis is a function of the maximum pressure reached during measurement, how can we account for it when operating over ranges that are less than the full calibrated range? This presentation discusses some approaches that may be suitable for handling and better characterising hysteresis in digital pressure references.

INTERNATIONAL TRENDS IN REALISATION OF THE PASCAL

Peter D McDowall

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail (corresponding author): peter.mcdowall@measurement.govt.nz

Realisation of the pascal has remained largely unchanged for the past 140 years. Since early experiments in the late 1800s, the dead-weight tester has become the preferred primary realisation of the pascal in many laboratories around the world, alongside mercury-based U-tube manometers. While changes have been made to improve their reliability and accuracy, the basic operating principle is still based on the original concept of force per unit area.

Present international research offers the possibility of a radically different approach to pressure realisation based on the ideal gas law. By exploiting the interaction between atoms and light, properties such as pressure can be determined from a sample of gas via the ideal gas law. Although this is not a new concept, it has become a more attractive method for pressure realisation since the value of Boltzmann's constant was fixed in 2019. Still largely confined to research laboratories, these new techniques have shown accuracies comparable to traditional methods in the low-pressure range.

In this talk, we will discuss how optical methods can be used to observe changes in the pressure of a volume of gas. Furthermore, we will look at some examples of international developments on optical pressure standards, and how these might influence future realisations of the pascal.

DEVELOPMENT OF AN ACTIVE ARM BRIDGE FOR HIGH VALUE RESISTORS AT NMIA

Owen J Brace

National Measurement Institute, Sydney, Australia

E-mail: Owen.Brace@measurement.gov.au

An active arm bridge is under development at NMIA to automate the calibration of resistors in the 10^9 Ω to 10^{14} Ω range. This system will replace the guarded Wheatstone bridge currently used for DC calibration services. A well-built active arm bridge will result in a significant reduction in measurement uncertainty while still enabling the calibration of high-value resistors with test voltages up to 1000 V.

The four-arm bridge consists of two programmable calibrators (used as precision voltage sources), a reference resistor, a test resistor, and an electrometer as a null detector. One terminal of each resistor is connected to the Hi output of a different calibrator, while each resistor shares a common Lo, which feeds into the electrometer. When no current flows to the electrometer, the bridge is balanced and the ratio of voltages is equal to the ratio of resistances. If the value of the reference resistor is known, the value of the test resistor can then be calculated. Traceability of high-value reference resistors can be achieved through a chain of 10:1 ratio measurements from a 100 MΩ standard.

A custom software has been developed that balances the bridge to a true null. The null is achieved by supplying a constant voltage to the test resistor and adjusting the voltage to the reference resistor until the balance condition is obtained. A zero measurement and reversing the polarity of the calibrators is undertaken with each measurement to ensure the effect of burden and thermal voltages are adequately mitigated.

Initial measurements up to the 10 GΩ level show promising results. Quantitative results of high-value resistors, comparison to our existing systems, and an uncertainty budget will be presented at the conference.

METROLOGY IN MINE SAFETY

David Turner
Technical Director, Simtars
Chair of Board NATA, Australia
E-mail: David.turner@simtars.com.au

The Safety in Mines Testing and Research Station (Simtars) was established in 1983 by the Queensland Government following the tragedies of the Box Flat Colliery and Kianga No. 1 Colliery underground mine explosions. Simtars has since grown to become a world-leading centre for mining safety and health technical services, delivering complementary scientific, engineering, and training services, both nationally and internationally. Simtars operates within Resources Safety & Health Queensland (RSHQ), and one of its key purposes is to provide research, incident response, and scientific investigation support to the Queensland resources regulator and industry.

The NATA accredited services that support mine safety include gas concentration measurement and analysis, testing for respirable dust exposure determination, testing and certification of equipment used in explosive atmospheres, and the calibration of equipment used in these applications. These services were developed specifically to support the underground coal mining industry, but the capabilities are provided more generally to support related industries and the community. Simtars has carried out various research projects over the last 30 years, many of which have led to significant developments and improvements in the Queensland mining industry's ability to measure and gather information. These include mine gas monitoring and analysis and the use of digital 3D laser scanning for investigation support.

This presentation provides insights into good metrology in mine safety, and how third-party recognition and peer review provided by accreditation gives industry peace-of-mind.

VENTILATION MATTERS IN REDUCING SARS-COV-2 AIRBORNE TRANSMISSION IN SCHOOLS

Giorgio Buonanno[1,2,*], Lidia Morawska[2], Luca Ricolfi[3,4], Luca Stabile[1]

[1] Department of Civil and Mechanical Engineering, University of Cassino and Southern Lazio, Cassino, Italy
[2] International Laboratory for Air Quality and Health, Queensland University of Technology, Brisbane, Australia
[3] Department of Psychology, University of Turin, Italy
[4] David Hume Foundation, Turin, Italy

**Corresponding author:*
Prof. Giorgio Buonanno
Dep. of Civil and Mechanical Engineering – University of Cassino and Southern Lazio
Via Di Biasio 43, 03043 Cassino (FR) – Italy
Email: buonanno@unicas.it

While increasing the ventilation rate is an important measure to remove inhalable virus-laden respiratory particles and lower the risk of infection, direct validation in schools with population-based studies is lacking. Schools represent a critical indoor environment due to the high crowding indexes (number of people relative to the size of the confined space), the long exposure times, and the possible inadequate clean (pathogen-free) air supply. We investigated the strength of association between ventilation and SARS-CoV-2 transmission reported among the students of Italy's Marche region in more than 10,000 classrooms, of which 316 were equipped with mechanical ventilation. We used ordinary and logistic regression models to explore the relative risk associated with the exposure of students in classrooms. For classrooms equipped with mechanical ventilation systems, the relative risk of infection decreased with the increase in ventilation: ventilation ranging from 10 L s^{-1} $student^{-1}$ to 14 L s^{-1} $student^{-1}$ reduced the likelihood of infection for students by 80% compared with a classroom with only natural ventilation. From the regression analysis, as confirmed by the predictive theoretical approach, we obtained a relative risk reduction in the range 12% to 15% for each additional unit of ventilation rate per person. We need high ventilation rates (> 10 L s^{-1} $student^{-1}$) to protect students in classrooms from airborne transmission; this is higher than the rate needed to remove pollutants from anthropogenic indoor air pollution sources. The excellent agreement between the results from the retrospective cohort study and the outcomes of the predictive theoretical approach makes it possible to assess the risk of airborne transmission for any indoor environment.

COVID MANUFACTURING DISRUPTION TO START-UP BUSINESSES

Nigel Gibson

IOT Scientific, Brisbane, Queensland, Australia
E-mail: iotscientific@gmail.com

This talk describes the different challenges for a new device manufacturer during the COVID lockdown period in Australia and New Zealand. The constructive feedback from members and attendees of MSA 2020 gave me ideas to improve my specialised Wireless Temperature Mapping Device and software. Beyond COVID the trade wars that dove-tailed into the same time period had its own challenges.

Many start-ups and other businesses had to ask, "is this delay COVID or trade-war related?" with components coming out of China.

With a new temperature device, the next question is how do we calibrate the device to achieve accurate and reproducible results, what sort of reference thermometer should we purchase, where to calibrate it, and how to determine the uncertainty?

I posted a job for an Electrical/Mechanical Engineer on an online job platform. The result was finding a Mechanical Engineer who had run out of money and a friendship that meant we could help each other solve problems. Martin is an engineer from Sweden who was caught in a lockdown on the other side of the world in Kerikeri, New Zealand. He would end up being caught like so many others in unusual circumstances and learn to adapt to the new normal. When I advised him of the purpose of the design work I was working on and how it related to laboratories, he was chuffed to help. From his designs and remote back and forth, I ordered components from Singapore and had a local sheet metal manufacturer, who again was thankful of work during lock down in Brisbane. I also had some CNC work done in India because my local CNC contact, Bruce, never reopened his CNC workshop in Brisbane.

A colleague told me of an Internet of Things group that met up at a share space in the Valley area of Brisbane once a month. We got to one meeting and from there no more meetings took place. Brisbane was locked down and subsequently the start-up and share space was closed, never to open again – so many business models were broken by the COVID lockdowns. For my electronic design, I had to make major changes to boards that used chips that now had a two-year wait time, so a decision was made to redesign the board and make new microcontroller assemblies. There were so many posts on Reddit about people sharing their experiences about start-ups being thwarted by the chip shortage and shutdowns around the world – everyone had to learn about supply chains and bottlenecks and the downside to "just-in-time" manufacturing.

Despite all these problems, I was able to manufacture a custom oil temperature bath to suit my temperature probe array, compliant with ISO 17025.

UNDERSTANDING THE FIELD OF VIEW AND TARGET SIZE FOR INFRARED THERMOMETERS

Peter Saunders

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail: peter.saunders@measurement.govt.nz

Infrared (IR) thermometers are manufactured with a wide range of fields of view, nominally specified, for example, as 12:1 or 60:1 or others, with different fields of view suitable for different applications. These distance-to-spot-size ratios (which can be interpreted as angular fields of view) imply that the size of the measurement spot on the target increases in proportion to measurement distance. However, further inspection of manufacturers' specifications indicates that the field of view is generally more complicated than that given by a simple angle, and it can often be quite baffling as to how the field view is defined.

It is important to understand the field of view because the measurement spot must always be smaller than the target size to obtain a sensible temperature reading. If the target underfills the field of view, then the reading will be some unpredictable average of the target temperature and the temperatures of all the objects surrounding or behind the target that are also within the field of view.

Choosing an appropriate target size is also complicated by the phenomenon known as the size-of-source effect (SSE), where imperfections in the optical system of the IR thermometer blur the boundaries of the field of view, so that targets somewhat larger than the nominal field of view are required for reliable measurements.

In this workshop, we will explore how to interpret manufacturers' specifications for field of view and examine what this means in the context of calibration of an IR thermometer using either a blackbody cavity or a flat-plate calibrator. Workshop attendees will be provided with a software tool to help visualise how the field of view varies with measurement distance, and which can be used to calculate the effective emissivity of a blackbody cavity for a given IR thermometer. Advice will also be given on how to deal with the complication of the SSE, and how to provide information on a calibration certificate that maximises its usefulness to the end user.

DEVELOPMENT AND EVALUATION OF A 900 L TEMPERATURE CALIBRATION BATH

Greg Johnson, Quinn Ingram, Jun Wang

RBR Ltd, Ottawa, Canada

E-mail (Greg Johnson): greg.johnson@rbr-global.com

RBR is developing a 900 L calibration bath to complete temperature calibrations for over 5000 instruments per year. The bath is designed to increase calibration throughput capacity and accommodate instruments of varying dimensions. The purpose of this study is to characterise the performance and accuracy of the temperature bath. An external temperature control system with a heating capacity of 27 kW and a cooling capacity of 25 kW enables quick and efficient temperature setpoint changes. Heat exchange with the outside environment is significantly minimised using an insulating decoupler in the stirring system and 30 cm of thermal insulation covering all external surfaces of the bath. To evaluate the temperature distribution within the bath, 12 thermistor thermometers are calibrated to ≤ 1 mK, with traceability to the International Temperature Scale of 1990 (ITS-90). Results indicate an elapsed time of 2 hours for a temperature change from 4 °C to 32 °C, with a temperature stability of ≤ 1 mK and a temperature uniformity of ≤ 0.5 mK, demonstrating that this new temperature bath can be used as a calibration system.

LABORATORY EDUCATION PROGRAMMES AS A MODEL FOR METROLOGY EDUCATION

Sashi Jeffries, Rebecca Demchick, Carla Tudreu, Paul H Demchick

Real World Education (New Zealand Laboratory Education Programmes), Palmerston North, New Zealand

E-mail (corresponding author): staff@real.ac.nz

Real World Education is New Zealand's government-funded specialist provider of laboratory education. Its New Zealand Laboratory Education (NZLE) programmes range from Level 4 (low-end undergraduate) to Level 8 (postgraduate) on the New Zealand Qualifications Framework. The vast majority of NZLE delivery is workplace-based or remote delivery. This is required because New Zealand's population it too dispersed to make face-to-face delivery available to most New Zealanders. Over the past decade, we have developed increasingly fit-for-purpose ways of teaching and assessing remotely, including practical skills.

Real World Education was approached by a New Zealand-based member of the Metrology Society of Australasia about possible cooperation. Several interesting conversations followed. There seems to be scope for cooperation. It would seem like there is a particularly acute need for early training, either before employment or early in employment.

In this presentation we will present aspects of how our current programmes work as a model for the sort of things Real World Education could do in bespoke programmes for metrology. Although Real World Education's current thinking about possible bespoke programmes will be presented, it is hoped that those attending the session will provide feedback, since if Real World Education is involved, the intention would be to build the programmes to be of maximum use to the metrology field. Funding options and whether the programmes would be offered only in New Zealand will be discussed.

REACHING OUT AND INSPIRING THE NEXT GENERATION OF SCIENCE-SAVVY CITIZENS, INNOVATORS, AND SCIENTISTS ACROSS AOTEAROA NEW ZEALAND

Ian Kennedy

National Science Technology Roadshow Trust

E-mail: ian@roadshow.org

Science education in primary and intermediate schools in New Zealand has been of particular concern for the last few decades:

- Little over a quarter of primary and intermediate schools have effective science programmes[1].
- By year 8, few students see themselves in STEM-based careers[2].
- Students have few opportunities for hands-on science activities[3].
- Overall, primary teachers have relatively low levels of confidence to teach science[4].

Addressing these factors at a grass-roots level and getting more hands-on science learning experiences into schools to engage students is key to the pursuit of STEM careers and to producing science-savvy citizens who will take our economy forward and create a sustainable future. This is where the National Science Technology Roadshow Trust has been playing its role, working in partnerships, to provide:

- Science-based hands-on learning experiences, with complementary resources, to primary and intermediate schools across cities and provincial New Zealand through the Science Roadshow. Prior to COVID, we were annually being visited by over 47,000 students from more than 500 schools in more than 100 communities. And today, the reach and visitation numbers are trending back toward those figures.
- Intensive four-day in-service science workshops for primary and intermediate teachers through the Sir Paul Callaghan Science Academy. These have upskilled more than 650 primary teachers, helping them to provide better science learning experiences for their students.
- High-quality resources based on key socio-scientific issues; for example, Future Food Roadshow, which explored food from its cultural significance and impact on our health to its effect on NZ's unique position as a primary producer, exporter, and innovator.

To ensure New Zealand's future prosperity, it is time to think laterally and combine efforts to promote positive science learning experiences for all students across the motu and keep their innate curiosity alive.

[1] Science in The New Zealand Curriculum: Years 5 to 8 (May 2012).

[2] NEMP (2007) New Zealand's National Education Monitoring Project (University of Otago).

[3] National Monitoring Study of Student Achievement-Science 2012.

[4] TIMMS (2018) Trends in International Mathematics and Science Study.

THE MSA LECTURES ON MEASUREMENT

Rod White

Independent Researcher, Lower Hutt, New Zealand

Email: rodwhitenz@gmail.com

Despite the importance of metrology to almost every aspect of a modern functioning technological society, metrology lacks a formal system for its teaching. Instead, metrology is most often taught on the job in a master–apprentice relationship. Because mentors, work experiences, and measurement disciplines differ, every metrologist's knowledge is highly individual, full of gaps, and occasionally eccentric, and usually lacks a global perspective and overview of metrological principles.

This talk describes the motivation for and content of a set of twelve lectures developed for the Metrology Society of Australasia (MSA) as a resource for the teaching of metrology as a part of any applied science course at any tertiary level. The lectures cover the nature of measurement, measurement uncertainty, and measurement quality – topics relevant to every measurement and measurement discipline. The primary aims of the lectures are to help tertiary students develop a sufficient understanding of metrology to enable them to make and recognise high-quality measurements, to interact appropriately with other professional users of measurements, and to recognise and interact with the key elements of their national quality infrastructure.

The lectures are not intended to replace the discipline-specific training courses already offered by national metrology institutes (NMI in Australia and MSL in New Zealand). Rather, they are intended to complement these courses by providing an overview of metrology that is normally beyond the scope of their courses. It is also intended that these lectures be a beginning and that other metrologists will add and extend the material, so they grow into a more complete and coherent resource. The lectures were presented for the first time in 2022 at the University of Waikato as half of a fourth-year electrical engineering measurement and instrumentation course.

WORK-READY ENGINEERING GRADUATES IN INSTRUMENTATION AND MEASUREMENT

Melanie Ooi, Harish Devaraj, Ye Chow Kuang

School of Engineering, University of Waikato, Hamilton, New Zealand

E-mail (corresponding author): melanie.ooi@waikato.ac.nz

One of the biggest challenges of delivering an effective engineering curriculum is ensuring its relevancy at a national and international level. In 2019, at the IEEE International Instrumentation and Measurement Conference, the idea of a joint education initiative between academic institutions and the Metrology Society of Australasia (MSA) was conceptualised. Following this discussion, the MSA Education Initiative was further developed, and the University of Waikato (UoW) joined the partnership with the intention of incorporating the measurement syllabus into a paper taught within its Mechatronics and Electrical and Electronics Engineering (EEE) programmes.

This talk will specifically discuss the MSA–UoW education partnership, which consists of three components: (1) Measurement Lecture Series, a set of 12 lectures developed by the MSA; (2) Sensors Lecture Series, a set of 12 practical lectures on sensors developed by UoW; and (3) an Instrumentation Workshop on the design of sensing devices for specific measurement objectives, including uncertainty reporting.

The intention is to produce graduates to serve the “Smart Electronics and Robotics” market. While there are electronics, robotics, and computer science papers in the EEE and Mechatronics programmes, there are gaps between these different disciplines. Topics taught in this Sensors, Instrumentation, and Measurement paper developed by the MSA–UoW education partnership will link these disciplines seamlessly, thus producing better graduates.

Understanding the relevance of measurement to engineering, including the associated decisions, costs, risks, variations, and error, is a critical capability ensuring students select and deploy the appropriate types of measurement with appropriate sensing technology. Students can then integrate the selected sensing technologies to develop bespoke measurement systems for a given application, as well as characterise and develop calibration procedures that comply with international accreditation and/or certification standards for instruments.

ENSURING YOUR UNCERTAINTIES UPDATE WHEN YOUR CMCs CHANGE

Michael Tecofsky, Dave Kelly

RF Test Solutions Ltd, Lower Hutt, New Zealand

E-mail (Michael Tecofsky): mike.tecofsky@rftest.co.nz

When I began at RF Test Solutions 13 years ago, there was no automated system to ensure that if the uncertainties on a standard changed, then all corresponding future reports would be updated. I saw this as a major quality issue and set about making changes to eliminate it.

I started by simply changing the format that our CMCs are recorded in, so that every uncertainty spreadsheet could use the VLookUp function to get the latest information. Unfortunately, this did not allow for easy expansion of the ranges. Luckily, Dave Kelly began at RF Test Solutions and added a new function called Named Ranges, which gave us greater flexibility.

These simple changes mean that changes to any of our standards' uncertainties only require one spreadsheet to be updated, so that all future reports we issue will use the appropriate uncertainty.

EVALUATING THE PREPAREDNESS OF A DEVELOPING ECONOMY IN THE IMPLEMENTATION OF DIGITAL CALIBRATION CERTIFICATES

Christian D Laurio, Michael Jason A Solis

Industrial Technology Development Institute – Department of Science and Technology, Bicutan, Taguig City, Philippines
E-mail (corresponding author): cdlaurio@itdi.dost.gov.ph

A calibration certificate is an important artefact for industry to assure its stakeholders of the reliability of the performance of measuring instruments and the quality of products and services they produce. Regrettably, the current paper-based calibration certificate or digitised copy falls short of the demand of modern industrial technology, such as smart devices, the Internet of Things, robotics, etc. Industry 4.0, the so-called industrial revolution of the modern age, paved the way for the international metrology community to address its need for measurement and calibration through the inception of digital transformation in metrology. One of these initiatives is the concept of a digital calibration certificate (DCC). However, the ever-growing technological innovations pose a challenge to a developing economy like the Philippines to keep up with these advances, given their current technological and economic standing.

In this paper, the researchers identified and assessed the minimum requirements to implement the digitalisation of calibration certificates in the Philippines. The motivation for this research is the lack of activities or studies regarding the viability of implementing DCCs in the Philippines. The researchers reviewed published journals and related studies from national metrology institutes (NMIs) with ongoing initiatives in DCCs, and investigated the Philippines' current economic and technological situations. The requirements for implementing DCCs were categorised in terms of: (1) technical knowledge; (2) technological infrastructures; and (3) annual budget. These factors became the basis for assessing the readiness of the Philippines to implement DCCs. Results suggested that with the current situation regarding technical skills, infrastructures, and budget allocations, a developing economy like the Philippines still has a long way to go before it can fully implement DCCs. Nonetheless, the results gave insights into the gaps and opportunities the Philippines need to improve on in implementing DCCs in the future.

WEDNESDAY, 1:40 PM – 2:00 PM

STANDARDISING METROLOGY FOR THE DIGITAL AGE – HOW THE METROLOGY TAXONOMY WORKS

Michael L Schwartz

Cal Lab Solutions, Aurora, CO

MSchwartz@CalLabSolutions.com

As the world moves into the digital age, metrology will have to keep pace. There's more to this digital revolution than digital calibration reports in PDF format. Everything needs to be converted to a machine-readable format: equipment specifications, calibration requirements, measurement uncertainties, scopes of accreditation, training records, … and the list keeps growing.

Over the past 30 years as a metrology software developer, I have seen the need for a way to simplify and unify metrology data for the digital world. Now there is a new idea called "Metrology Taxonomy", developed in conjunction with the NCSLI (National Conference of Standards Laboratories International) 141 Committee, that will help calibration labs and accreditation bodies digitise their measurement data.

There is a lot of work ahead to digitise everything metrology, and this presentation will show the work we are doing and the tools freely available as we progress into the digital age.

MEASURING ELECTRICAL PROPERTIES OF BATTERIES AT ULTRA-LONG TIMESCALES

M T Wilson[1], C Dunn[2], V Farrow[2], M Mucalo[1], J B Scott[2]

[1]Te Aka Mātuatua – School of Science, University of Waikato, New Zealand
[2]School of Engineering, University of Waikato, New Zealand
E-mail (corresponding author): marcus.wilson@waikato.ac.nz

Quantifying battery behaviour is critical to the development of new battery technologies and energy storage systems. While it is straightforward to measure properties such as impedance at short timescales (i.e., frequencies higher than ~1 Hz), the relevance of this is questionable since rechargeable batteries in normal usage are often cycled on timescales of hours or days. Making measurements at these timescales, for example impedance measurements below ~1 mHz, is more challenging. In this paper we discuss approaches to quantifying battery behaviour at timescales from hours to weeks (frequency scales of ~0.1 mHz down to ~1 µHz). We present frequency domain measurements and time domain measurements, achieved through four-point measurements with a Keysight 66332A at around 100 mA rms. At low frequencies, significant charge is shifted in a measurement cycle, complicating the interpretation. The digitisation of a sinewave can introduce errors such as constant current offsets that build in significance with time. The operating point (DC voltage level) of the battery must be controlled since it influences impedance at the lowest frequencies as a result of the voltage-dependent nature of different electrochemical processes. We relate the voltage-dependent effects to time-domain measurements such as cyclic voltammetry and incremental capacity analysis.

THE BENEFITS OF ACCURACY-BASED PROFIENCY TESTING SCHEMES

Paul McMullen

NATA, Melbourne, Australia

E-mail paul.mcmullen@nata.com.au

Proficiency testing is widely recognised as an essential tool for demonstrating the competence of conformity assessment bodies, which includes testing and calibration laboratories. Proficiency testing can provide evidence of competence and it can be an indicator of an underlying or emerging problem. This presentation is an introduction to proficiency testing as a form of interlaboratory comparisons and focuses on the benefits of accuracy-based proficiency testing.

STEP BY STEP: OUR JOURNEY THROUGH A KEY COMPARISON

Lenice A Evergreen

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail: lenice.evergreen@measurement.govt.nz

Key comparisons underpin the global metrology system and allow national metrology institutes (NMIs) to compare their measurement capabilities. They give NMIs the opportunity to realise a certain quantity to their very best level, and the results of key comparisons demonstrate the global equivalence of NMI measurements.

MSL's Length Section recently installed a new high-accuracy coordinate measurement machine, and we were eager to take part in a comparison within the Asia Pacific Metrology Programme (APMP) to show off our new capabilities. The APMP Calibration of Step Gauge key comparison gave us the opportunity to test our technique, confirm our technical competence, and hopefully improve our calibration and measurement capability (CMC).

In this talk, we will discuss our journey through this key comparison – from logistics during a global pandemic, through designing the method, ensuring a stable environment, taking measurements, unexpected issues, analysing results, and calculating measurement uncertainties. Finally, we may reveal how well we compare to other NMIs in the Asia–Pacific region.

INTERNATIONAL COMPARISON OF TRIPLE-POINT-OF-WATER CELLS

Peter Saunders

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail: peter.saunders@measurement.govt.nz

The triple point of water (TPW), at a temperature of 0.01 °C, is the most accurate reference used in the realisation of the International Temperature Scale of 1990 (ITS-90), and until the recent SI redefinition, was used to define thermodynamic temperature. So, it is important to ensure that everyone's TPW cells around the world realise the same value. The Consultative Committee for Thermometry organised an international comparison of TPW cells beginning in April 2021 and finishing at the end of 2022. MSL, along with 14 other national metrology institutes around the world, participated in this comparison.

This talk will discuss the measurements made by MSL and describe the many corrections for effects such as isotopic composition of the water, impurities, and hydrostatic pressure required to achieve uncertainties below a few tens of microkelvin.

THE INTERNATIONAL SYSTEM OF UNITS – THE POST REDEFINITION COMEDOWN?

Annette Koo

Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand

E-mail: annette.koo@measurement.govt.nz

Four years ago, the International System of Units (SI) underwent a landmark redefinition. Four defining constants were fixed, allowing us to leave behind the artefact kilogram. Realisations of units and uncertainty of measurement are now reaching new limits. Or are they?

After the euphoric emotion that the culmination of decades of scientific work brought, how are things working out, what is still to be solved, and what is still in the pipeline for the SI?

In this presentation I will take four units – the kelvin, the second, the candela, and the kilogram – and I will present how the community has responded to the redefinition and ask, “what next?”

THE IMPORTANCE OF STANDARDS PROVIDING STANDARDISATION

Tony Bergen

Australian Photometry and Radiometry Laboratory, Melbourne, Australia

E-mail (corresponding author): tony@aprlab.com.au

A test standard should provide a clear and unambiguous means of testing a product. Ideally, if a product is given to two laboratories with the same instructions to test the product according to a particular standard, then the results for each laboratory should be equivalent to within the measurement uncertainties.

What are the consequences if the standard test method is not clear and unambiguous, or if it is open to interpretation? First, it is clear that the results between two laboratories may not be equivalent to within the measurement uncertainties. Secondly, in the case of a standard which contains performance requirements, one laboratory may find that the product complies and the other one may not.

What should a laboratory do if it is aware of an ambiguity in a test standard? Should they:

- Seek advice from the standardisation organisation who wrote the standard?
- Interpret the standard according to either consumer risk or producer risk?
- Interpret the standard according to the way which makes the most sense – trying to guess the intention of the writers of the standard?
- Provide multiple results in the test report?
- Provide one result in the test report as an average of the results for the different ways of interpreting the standard, with consequently widened measurement uncertainties?
- Write in the test report a description of the way that the standard is ambiguous and their reasons for the way that they have interpreted the standard?

The presenter will provide some examples of different standards in his field of optics and radiometry for which standard test methods are open to interpretation, and explore the open questions listed above.

THE COST OF QUALITY

Daryl Pettit
Wika New Zealand, Auckland, New Zealand
E-mail: daryl.pettit@wika.com

Having worked in the field of metrology and calibration for over 30 years, I have noticed that there are three constants:

- There is usually a quality requirement, either regulatory or voluntarily, in most industries.
- No one really knows the true cost of quality.
- The accountants and senior management prefer to spend as little as possible on quality, perhaps because they perceive it as an expense that does not add value.

This presentation will focus primarily on the second point, the true cost of quality. There is literature readily available concerning quality assurance and its requirements, but little information is available in relation to the evaluation of the annual spend on quality.

This presentation will deconstruct the quality beast, strip it out into its component parts, and reveal the true cost of quality.

You might be surprised – you may even ask yourself, “is it really worth it?”

THE NATURE AND PURPOSES OF MEASUREMENT UNCERTAINTY

Rod White[1], **Blair Hall**[2]

[1]*Independent Researcher, Lower Hutt, New Zealand*

[2]*Measurement Standards Laboratory of New Zealand, Lower Hutt, New Zealand*

Email: rodwhitenz@gmail.com

The importance of measurement uncertainty is found in metrological traceability. Traceability is achieved when a series of measurements and calibrations provides an uninterrupted and auditable chain linking the final measurement to primary realisations of SI units. The quality and utility of traceable measurement is ensured because each link in this chain is objectively characterised in terms of measurement uncertainty. So, a clear understanding of the nature and purpose of uncertainty and how it should be calculated is essential to delivering metrological traceability. Despite the publication of the Guide to the Expression of Uncertainty in Measurement (GUM) in 1993, nearly three decades of the application of the GUM to metrological research, and the recent publication of several supplements to the GUM, there is no clear explanation for the need for having both standard and expanded uncertainties. Here, we show that standard and expanded uncertainties are different in nature and serve quite different purposes. Standard uncertainty is used as a parameter in measurement models to describe the dispersion of measurement results with respect to the measurand. It is descriptive and has an objective meaning in terms of the measurement processes. Uncertainty in this sense must be propagated along traceability chains to deliver meaningful results. Expanded uncertainty is used to make decisions at the end of a chain. Rather than describe unpredictable behaviour in a measurement process, it allows an inference about the measurand to be made given a particular measurement result.

SESSIONS NOT TO BE MISSED

Tuesday 21st February – From 10:30 am

CPS – presents Advancement in Calibration – Part 1.
This is a concurrent session in the CPS breakout space.

Tuesday 21st February – 3:30 pm – 3:50 pm

The winner of the NZ Metrologist Award will be announced.

Wednesday 22nd February – 11:20 am – 12:00 pm

Education discussion session– this is an open forum for all to take part.

Wednesday 22nd February – From 9:10 am

CPS – presents Advancement in Calibration – Part 2.
This is a concurrent session in the CPS breakout space.

Thursday 23rd February – 2:40 pm

The ask an epert forum.
Experts will answer questions posed by industry, academia, regulatory bodies, and the audience.

Metrology Society of Australasia

Join us at MSA 2023

The Oceania Room
Te Papa
55 Cable Street, Te Aro, Wellington 6011