

A Report on the Activities in Mass and Related Quantities at NMIA
Australia 2019-2021 related to CCM

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1. Research and Development Activities

Mass

- A 100 g automatic comparator with 0.1 μg resolution was installed and evaluated which will improve the uncertainties of E1 weights from 100 g to 10 g range.

Pressure and Vacuum

- The NMIA pressure project plans were significantly disrupted this year by the pandemic. In addition to restrictions on staff movements and participation in planned work, the project was tasked with establishing capability to test PPE in support of Government initiatives to increase local production. The diversion of pressure project resources has limited our activities, with the main focus on pressure scale maintenance with small incremental improvements. NMIA's research and development activities concentrate on the improving the accuracy of its primary realised pressure scale covering the range from 1 mPa absolute to 500 MPa. The Australian pascal is fundamentally realised by the application of dimensionally measured piston gauges, a static expansion system, and controlled clearance gauge.
- Completed a revision of its static expansion system implementation.
- Progressed the developed new analysis methods for the controlled clearance gauge.
- Completed the re measurement of a 490 mm² piston gauge, and commenced the regular reestablishment of the Australian hydraulic pressure scale.

Density

- A new hydrostatic weighing system is being assembled for solid density measurement. This system will be used to measure solid density standards with an estimated uncertainty better than 5 ppm using silicon sphere as reference standard. The dimension of the silicon sphere is being calibrated by NMIA length project.
- A new Anton Paar liquid density measuring system was installed to replace the previous version and to continue the measurement service for small liquid samples.

Force

- Dynamic force:
 - Small experiments conducted looking at frequency response of common load cells used in the lab;
 - Large-sledge Impulse 5.5kg Hammer with force sensor, 22.2kN capacity, recently purchased.

- Recalibration of 550kN deadweight machine underway using in-house developed in-situ machine weights weighing system. This task is expected to take 12 to 18 months to complete.

Fluid Flow

Gas Flow

- Commissioned a gas flow standard with a least uncertainty of $\pm 0.011\%$; a PVTt standard. A desktop variation to comply with ISO17025 has been submitted to NATA (The ILAC Australian body).
- Currently working on expanding our flow range for low pressure measurements from 7000 m³/h to 24000 m³/h.

Liquid Flow

- Measurement of LPG density using a pycnometer
- Development of a new low flow (0.05 to 20L/min) diesel meter flow rate calibration system for calibration in in-vehicle fuel usage flow meters

2. Status of Comparisons in Mass and Related Quantities

- APMP.M.P-K9 - The final report for this comparison concludes that participant's measurements are in good agreement with KCRV. NMIA acted as one of two linking laboratories for this comparison. Section 6.1 of the final report notes that the difference of the values of the participating linking laboratories, is greater than that reported in the relevant CC KC. This was attributed to the performance limitations of the transfer standard used for APMP.M.P-K9. Since NMIA's participation in the measurements of this comparison the Australian pressure traceability source has been updated, replacing the mercury interferometer manometer, with a dimensionally measured DHI model PG-9607 pressure balance. The measurement results obtained by NMIA for APMP.M.P-K9 were traceable to the now defunct mercury interferometer manometer. Validation activities for the PG-9607 pressure balance, show that the current NMIA traceability (established by the PG-9607 pressure balance) may align better with the KCRV values established by the APMP.M.P-K9 comparison.
- APMP.M.P-K15. Draft A - Draft A of the comparison report has been circulated by the pilot laboratory. NMIA has reviewed this draft and submitted review comments to the pilot laboratory for consideration.
- Performed measurements for APMP.M.FF-S3.2020 'APMP Supplementary Comparison for Water Flow Measurement' in Feb 2021.
- Participated and completed a CIPM Low Pressure Gas Flow Key Comparison (CCM.FF-K6.2017) with draft B is circulating now. NMI's PVTt standard was used in this comparison
- Final Report of APMP.M.M-K5 was pending publication since 2019.

- Planned participation in CCM.F-K1 for 5 kN and 10 kN force measurement - comparison scheduled 2021/22.
- Planned participation in CCM.D-K5 on liquid density scheduled in 2021.

3. Publication

NMIA presented “Alternative methodology for establishing a vacuum scale using a static expansion system” at the Metrology Society of Australasia conference and APMP TCM meeting during 2020.