National Research Council of Canada

Main Research and Development Activities

Mass:

The main research activities at NRC in the area of mass since the meeting of the CCM in 2019 has entailed studies designed to improve traceability to and dissemination from the NRC Kibble balance. We've manufactured new tungsten masses with high polish that are compatible with the high magnetic fields of the kibble balance, these are both at the 100 g and 1 kilogram level. Improvements have been made to the evaluation of the Abbe error in the Kibble balance, resulting in an associated uncertainty of 3 ppb. We participated in CCM.M-K8.2019 and some of the improvements are included in the resulting measurement uncertainties, including those associated with new transport enclosures designed to promote transport stability. The vessels were used to transport the traveling standards for CCM.M-K8 2019 between NRC and the BIPM and the resulting transport stability was low, below the uncertainty of the stability measurements themselves.

NRC and NIST began a comparison of realizations at the 100 g level. The comparison was interrupted by the pandemic, but measurements at NRC showed realization at that level would result in a relative uncertainty of between 20 ppb – 25 ppb, with the type A of the measurement around 14 ppb.

NRC also continued participation in the SIM kilogram Dissemination Project (SKDP), in which masses have been distributed to 29 NMIs across the region and their stability monitored. NRC has explored the impact of the standard cleaning of the SKDP artefacts and their mass uptake over time, both gravimetrically and through atomic force microscopy and XPS. The masses from across the region are planned to be recalibrated at NIST and NRC in the summer of 2021.

Density:

We replaced our primary liquid density reference system ensuring continuity in the scale by performing density comparison of the new/old systems. We have also replaced and upgraded our oscillating densitometer, including new automation features. In support of Canada's COVID response we have tested many syringes imported to Canada to ensure they will meet the low dead-space requirements needed to provide the target number of doses from each COVID-19 vaccine vial. We have also generated a predictive dosing model used to estimate the probability of achieving a target number of doses from a vaccine vial, depending on the syringe properties used for vaccination and other operational parameters. This work was performed in collaboration with the Public Health Agency of Canada and provincial and regional health authorities.

Pressure:

We have acquired and calibrated new instruments to increase overlap across our pressure scale (1 kPa-200 MPa) particularly at the medium to high pressure piston ranges. We have also installed new automated mass handlers for our lower pressure range including for a 50 mm piston which we will use as we transition from our primary mercury manometer. We continue maintenance/improvements of our primary interferometric manometer and have acquired mercury from our NIST colleagues to exchange that in the NRC manometer and compare with historical results.

COVID response:

National Research Council MRQ team was heavily engaged in the NRC COVID response and in April 2020 to April 2021 was largely redirected to leading the development of capability perform and provide the testing for particle filtration efficiency of respirators (PFE). To this end three facilities were developed to test PFE of respirators, surgical masks, and filtration materials, as well as measurement of pressure differential <2500 Pa. With MRQ leading a larger group across the Metrology research centre, NRC tested over 5000 samples for lot qualification and for product development from over 50 manufacturers. This supported the decision making on over 120 Million imported respirators and the development of many new products manufactured domestically and approved for sale by Canadian health regulators. We have also disseminated the associated knowledge/technology developed to other Canadian test labs who have been building capability to test PFE, and we supported their accreditation by providing inter-laboratory comparisons. As part of our exit strategy, which should see our involvement mostly phased out by March 2022, we are developing the Canadian quality infrastructure to support the industry and test labs, such as comparison protocols, reference materials, and supporting standards development.

Comparison Participation: SIM.M.M-K6 (50 kg), CCM.M-K8.2019, CCM DK5

Publications 2019-2021 :

C. A. Sanchez and B. M. Wood, "Abbe Offset Measurement in the NRC Kibble Balance," *2020 Conference on Precision Electromagnetic Measurements (CPEM)*, 2020, pp. 1-2, doi: 10.1109/CPEM49742.2020.9191778.

Stock, Michael et al. (2020). Report on the CCM key comparison of kilogram realizations CCM.M-K8.2019. Metrologia. 57. 07030. 10.1088/0026-1394/57/1A/07030.