

Progress Report to CCM from 2021 to 2023 for the Meeting of the Consultative Committee for Mass and Related Quantities (CCM) NMC - A*STAR, Singapore

1. Introduction

The National Metrology Centre (NMC) is Singapore's national measurement institute, under the Agency for Science, Technology and Research (A*STAR).

Mission : Advance measurement science & technology to strengthen and disseminate traceability to the International System of Units (SI)

Vision : A world-class National Metrology Institute in Measurement Science & Technology

2. Relocation of NMC Laboratories

NMC moved into the new location in CleanTech 3 in April 2022. The whole relocation exercise took about 1.5 years to complete as we had to vacate the old location in Science Park 1 in Oct 2020 as the building was slated to be demolished. Construction for the new building however was delayed due to the COVID-19 pandemic and was ready in early 2022.

During the interim period, most of the NMC operations were stopped and the equipment were placed in storage. Only a small amount of measurement services was available in alternate locations. All NMC's mass & related quantities measurement services were not available except for liquid flow and limited range of pressure measurements.

Pressure, gas flow, liquid flow measurement services are now resumed in stages after technical commissioning, quality system & safety checks from end 2022 onwards. Full measurement services resumption for all mass & related quantities areas including mass & force, air velocity will be available from end Oct 2023 onwards.

3. Mass & Related Quantities Capabilities in NMC

NMC has 25 Mass & Related Quantities CMCs in the KCDB with measurement and calibration technical capabilities in :

- Mass : 1 mg to 50 kg
- Force : upto 5 kN (deadweight)
- Pressure
 - Absolute pressure, gas medium, upto 5.2E+05 Pa
 - Gauge pressure, gas medium, upto 8.0E+06 Pa
 - Gauge pressure, liquid medium, upto 4.0E+08 Pa

- Differential pressure, gas medium, upto 1.3E+04 Pa
- Vacuum : 10 mbar to 0.5 E-6 mbar
- Fluid Flow : Mass gas flow rate, 2.00E-05 g/s to 23.0 g/s
 - Volume gas flow rate, 1.70E-02 cm³/s to 1.90E+01 dm³/s
 - Liquid flow rate, 0.6 metric ton/h to 80 metric ton/h

4. Comparisons

Due to the relocation of the laboratories, most of the equipment were in storage. As such, no comparison in the mass & related quantities areas was carried out during the period 2021 to May 2023.

5. Invitation as Technical Peer Reviewer

Two NMC staff Mr Wu Jian (pressure, vacuum etc.) and Mr Lee Shih Mean (mass, force, torque, volumetric etc.) were invited to be the peer reviewers for the Standards and Calibration Laboratory (SCL-HK, China). The peer review was successfully conducted remotely online in April 2021.

6. Future Plans

- i. Redefinition of the kg
NMC holds the Pt-Ir national prototype kilogram mass standard (No. 83). With the redefinition of the SI kg in 20 May 2019, NMC is currently looking into developing capabilities to realise the redefined kilogram.
- ii. Peer Review of Mass & Related Quantities Area in NMC
As a signatory to the CIPM MRA, NMC will be organising the peer review of the NMC's mass and related quantities areas in 2024 to 2025.

7. Publications

- i. Y Fang, Y Zeng, BC Khoo, "A new real-gas model to characterize and predict gas leakage for high-pressure gas pipeline", Journal of Loss Prevention in the Process Industries. Volume 74. January 2022, 104650.
- ii. Shavrina, E.; Y Zeng; Khoo, B.C.; Nguyen, V.-T. The Investigation of Gas Distribution Asymmetry Effect on Coriolis Flowmeter Accuracy at Multiphase Metering. Sensors 2022, 22, 7739. <https://doi.org/10.3390/s22207739>
- iii. S. H. Lee, Y Zeng, K.-C. Tsai, K.-H. Cheong, T. Chinarak, "Inter-comparison of micro-liquid flow standarad system in APMP", FLOMEKO 2022. November 1-4 2022. Chongqing. China