Report of the CCM Working Group on Fluid Flow

Bodo Mickan

17th CCM meeting, 16 May 2019

Bureau International des Poids et Mesures

Proposed changes to membership

- In WGFF there is no request at the moment.
- 2018 Election of new chair / deputy chair:

  Bodo Mickan (PTB)

  Li Chunhui (NIM)

WG Meetings held since last CCM

- March 19 and 20, 2018 in Queretaro, Mexico (10th ISFFM 2018).

WG Meetings planned

- June 24 and 25, 2019 in Lisbon, Portugal (FLOMEKO 2019).

- 2020 ??
- 2021 (11th ISFFM)

Main actions taken and main achievements

- **AFRIMET**
- APMP
- COOMET
- EURAMET
- SIM

2017 AFRIMETS TC-M&RQ (Mass & Related Quantities)
Sub-Working Group: Flow
31 July - 1 August 2017, Pretoria, South Africa
Deona Jonker (NMISA)

Seven countries active in the field of flow

Interlaboratory comparisons:
AFRIMETS.M.FF-K4.2015 – Micro-pipettes 100 µL

South Africa (ISO/IEC 17025 accredited – SANAS)
volume of liquid: 5 µL to 20 L – CMC in BIPM KCDB

Main actions taken and main achievements

- AFRIMET
- **APMP**
- COOMET
- EURAMET
- SIM

Technical Committee for Fluid Flow **TCFF**

Chair: Takashi Shimada (NMIJ)

Annual meetings (last in 2018 in Singapore)

25 organizations from 24 economies

Venue	Daejeon	Beijing	DaNang	New Delhi
Year	2014	2015	2016	2017
Date	Sep.22-23	Nov.2-3	Nov.14-15	Nov.25-26
participants	16	16	12	16
Economies	11	11	10	14

Main actions taken and main achievements

- AFRIMET
- **APMP**
- COOMET
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- SIM

Technical Committee for Fluid Flow **TCFF**
Chair: Takashi Shimada (NMIJ)
Annual meetings (last in 2018 in Singapore)

2018: workshop to achieve sustainable TCFF activities:

- How to make CMC entries,
- How to carry out on site peer-review as a reviewer,
- How to make the uncertainty budgets,
- How to carry out the inter-comparisons, and etc.

Research on the flue gas S type Pitot tube and 3D Pitot tube calibration method and inter-comparison under different flow conditions

Main actions taken and main achievements

- AFRIMET
- APMP
- **COOMET**
- EURAMET
- SIM

Technical Committee 1.4 for Flow **TC-F**

Chair: Alexander Fafurin (VNIIR)

Annual meetings (last in 2018 in Kazan)

Improvement of the relationship to WGFF and EURAMET

Actual comparisons

- **E1396 “Tri-lateral comparison CMI-PTB-VNIIR to evaluate bell provers” (finished)**
- **COOMET 680/RU/16 "Comparisons of gas flow rates from 20 to 6500 m^3/h“**
- **Comparison VNIIR/CMI/BelGim/… in water 0.1 to 4.5 t/h**
- **Agreement on several bilateral activities VNIIR/NIM in flow**

Main actions taken and main achievements

- AFRIMET
- APMP
- COOMET
- **EURAMET**
- SIM

Chair: Isabel Caree (LNE-Cetiat)
Annual meetings (last in April 2019 in Bern)

Ongoing activities for comparisons in many fields

Facing more and more technology challenges

- **LNG**
- **Micro flow/volume (various liquids)**
- **Hydrogen (vehicles / power-to-gas)**
- **Multiphase flows**
- **Waste water and (very) large pipelines**
- **Flow meter diagnostics and sensor networks**

Main actions taken and main achievements

- AFRIMET
- APMP
- COOMET
- EURAMET
- **SIM**

Chair: Roberto Arias (CENAM)
last in March 2018 in Queretaro

NIST and CENAM most active, take part in almost all CCM.FF-KCs

Further activities concentrate on volume of liquids
Successful establishing of new CMCs for developing countries as Peru, Costa Rica, Urugay…

Main actions taken and main achievements

Development of CMCs

- Increasing numbers of CMCs in SIM, COOMET, APMP and EURAMET
- Mainly for volume of liquid by developing economies
- Ongoing process to reduce numbers of CMCs based on summarizing entries with redundancy (mass/volume; installations with similar capabilities; different fluids in use)
- **New service categories**: make it more consistent / logical and suitable for reduced number of CMC entries.

Main actions taken and main achievements

- **New service categories**: more simple, help to keep CMCs tight

9.10 Fluid Flow

9.10.1 Liquid flow

9.10.2 Gas flow

9.10.3 Quantity of fluid

9.10.4 Flow speed

9.10.5 Multiphase flow

9.10.6 Heat flow.

- Quantity of fluid includes all totalised quantities
- Liquid is all what is mixible
  => not mixible is multiphase
- Flow speed is gas and liquid
- CMC-entry for the physical realisation (volume/mass/molar, best uncertainty)
- Conversion via density or molar mass
  => additional uncertainty considered

Main actions taken and main achievements

- **New service categories**: more simple, help to keep CMCs tight

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WGFF asks CCM for formal approval of the new list of service categries.

Progressing the state of the art

Improvements in the comparison process

- Past experience should lead to kind of standard comparisons to avoid “the second invention of the wheel”
- E.g. CCM.FF-K6.2011 reflects already the experience of 6 comparisons being very similar in protocol and technology
- Transfer of experience to enhance the performance of proficiency testing in the area of accredited labs (ISO 17025)

Liaison & stakeholders

- Communication with EURAMET, APMP, and SIM TC-Flow chairs is routine.
- Relationship to COOMET is improved meanwhile.
- The WG chair travels to one RMO meeting annually.
  The most recent visit was to the SIM meeting in Queretaro, Mexico on March 18, 2018. (John Wright).
  The next will be to COOMET TC-F meeting September 5-6 2019 (Kazan / Russia)
- stakeholders: IMEKO TC9
  ISO TC 48 ([micro] pipettes)
  Legal Metrology (OIML / notified bodies)
  Accreditation Organizations

KCs completed and underway

Key Comparison	Measurand	Pilot Lab	Status
CCM.FF-K4.2011.2	Liquid volume, 100 μL	IPQ	Complete, 2013
CCM.FF-K6.2011	Low pressure gas flow	SMU / CMI	Complete, 2014
CCM.FF-K4.2011.1	Liquid volume, 20 L and 100 mL	CENAM	Complete, 2015
CCM.FF-K2.2015	Hydrocarbon liquid flow	NMIJ	Complete, 2016
CCM.FF-K3.2011	Air speed	LNE / PTB	Complete, 2017
CCM.FF-K3.2011.1	Air speed	LNE / PTB	Complete, 2018
CCM.FF-K1.2015	Water flow	PTB	In progress
CCM.FF-K2.2011.1	Hydrocarbon liquid flow	VSL	Draft A revised
CCM.FF-K6.2017	Low pressure gas flow	ITRI	In progress

KCs planed

Key Comparison	Measurand	Pilot Lab	Status
CCM.FF-K5.2016	High pressure gas flow	PTB	Delayed, technical reasons
CCM.FF-K1.2019	Microflow of water	NMIT / METAS	Planned

CCM.FF-K5.2016:

- High costs (> 70.000 €) shall be shared fair
  => administrative challenges / risks to handle the money.
- Pressure safety certificates for parts of the equipement run out
  => either additional money needed
  or all particpants agree to take (formal) risk.

Program of work for the next 5 years

- Continue effort to objectively apply KC results to CMC reviews.
- Plan next round of WGFF and RMO comparisons to start next 10 year cycle in 2020.
- Increase participation by developing economies, strengthen coordination and linkage with RMOs, encourage different labs to serve as Pilots of key comparisons.
- Solve KC transport and cost sharing problems.
- Share more validated uncertainty spreadsheet templates.
- Comparison calculation template, guidelines on linkage and how to handle multiple artifacts.

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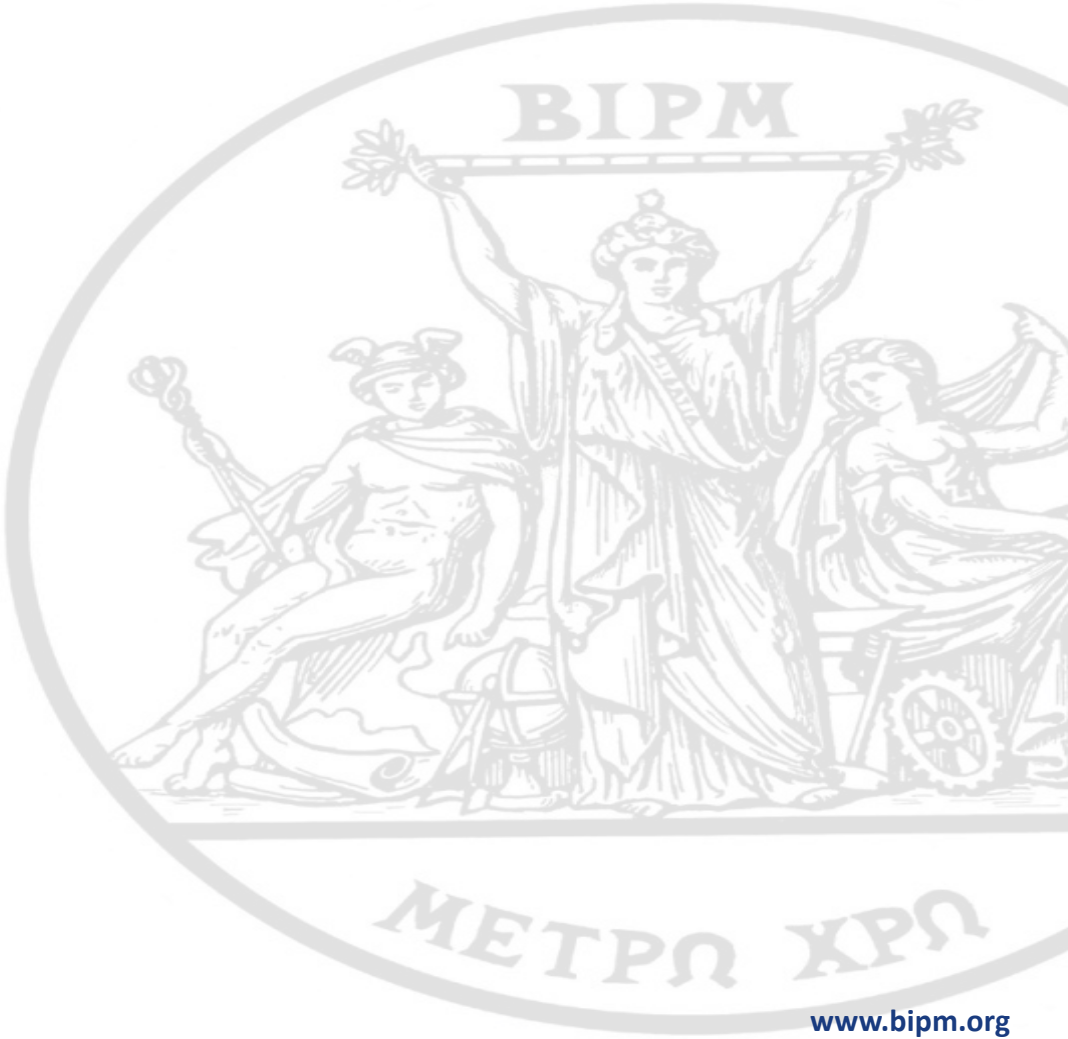

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