

1. General Aspects

The Technical Committee for Flow (TC-F) is concerned with issues that are relevant to industry, regulation and trade involving the measurement of fluid quantity and fluid speed and related measurements derived from it (e.g. energy). The measurement of fluid quantities focuses on the measurements of water, hydrocarbon liquids, air and natural gas but also includes all other fluids and mixtures of fluids.

The first TC-F meeting was held in East Kilbride in 1988 with less than 10 participants. 55 members from 30 different countries attended the last TC-F meeting which was held in Bern in April 2019. There are 29 contact persons and about 90 flow experts involved.

The TC-F members are very active in the development of flow research facilities but also in facilities for type approval and support for legal metrology in their respective countries. Routine work for industrial and laboratory customers is also a big part of this community.

Furthermore TC-F is a type A liaison for the following organizations:

- ISO/TC 48 for the revision of the ISO 8655 (micropipettes)
- ISO/TC 28 for the revision of ISO 8222
- OIML TC8 – Measurement of quantity of fluids

2. Projects

Five projects have been proposed in 2018/2019. Two projects in terms of comparisons are ongoing and 14 are in progress. Four projects have been concluded in 2018/2019.

Two calibration guides were finished and approved, namely No. 24 Guidelines on the Calibration of Solid Anemometers Version 1.0, 02/2019 and No. 19 Guidelines on the Determination of Uncertainty in Gravimetric Volume Calibration Version 3.0, 09/2018.

A new guide on the Calibration, Operation and Handling of Micropipettes (E 1295) has been finished, but it is not handled as an calibration guide.

3. Comparisons

The EURAMET TC-F members are very active within the BIPM key comparison (KC) level field. The sub committee convenors will finish the new strategic tool for planning comparisons within the next months. The new merged service categories are waiting for the approval by the WGFF.

The draft B for EURAMET.M.FF-K4.1.2016 Volume comparison at 20 L is for approval with WGFF. The project 1450 Comparison of low air speed has been registered as supplementary comparison EURAMET.M.FF-S11, the same for EURAMET.M.FF- S10 project 1473 PTB-VTT MIKES DN100 comparison, and EURAMET.M.FF-S10 project 1325 Comparison for gas flow range 5 ml/min to 30 l/min.

4. CMCs

One set of CMCs were posted in the JCRB for RMO revision in 2018, EURAMET.M.57.2018.

The new CMC revision process 2018/2019 started in December 2018 EURAMET.M.65.2019 with the submission from 26 countries. The regional revision is finished but we have to wait until the new service categories have been approved by the BIPM.

Four CMC sets from other RMOs were reviewed in 2018 namely COOMET.M.33.2019, APMP.M.45.2018, APMP.M.46.2018, and SIM.M.41.2019.

5. Activities of the Subcommittees

The TC-F group is divided into four subcommittees (Gas flow, Liquid flow, Volume and Fluid speed) and 3 working groups (Strategy Working Group, CMC Review and comparisons Working Group, and EMPIR Task Force).

The subcommittee meetings are held separately during the TC-F meeting. Each subcommittee convenor decides on the agenda and the subjects to be debated based on participants' input. A poster session with the main calibration capabilities has been held during two subcommittee meeting.

- **Gas Flow subgroup** – Convenor – Bodo Mickan from PTB convenor elect is Tomas Valenta from CMI

Bodo Mickan presented the Part II of its workshop on uncertainty calculation for gas meters. This presentation focused on the estimation of correlation factors, data fitting assessment, and splitting the meter under test and the reference in repeatability/reproducibility analysis.

- **Liquid Flow subgroup** – Convenor – Marc de Huu from METAS

In the liquid flow subcommittee meeting, the development and improvement of national standards and measuring methods in the field of liquid flow were discussed. Also the guide on harmonization of the uncertainty budgets and calibration methods for liquid flow standards was discussed to be started again in 2018.

The subcommittee meeting also covered the following topics:

- Methods to measure liquid flow
- Strategy for national and international liquid flow measurement infrastructure
- New research topics
- Dissemination of expertise and knowledge on liquid flow

- **Volume** – Convenor – Miroslava Benkova from CMI convenor elect is Elsa Batista from IPQ

In the volume subcommittee meetings the coordination and exchange of knowledge on developments in the field of volume measurements have been discussed. Furthermore, the active participation of ISO standards convenors supports the mutual work.

The subcommittee meeting also covered the following topics:

- Traceability of liquid volume measurement to SI units
- Discussion on key and supplementary comparisons results
- Elaboration of technical guides and technical statements
- Training activities in the field of volume measurements

- **Fluid speed – Convenor** – Pier Giorgio Spazzini from INRIM; convenor elect but not yet confirmed Jan Gersl from CMI

The Fluid Speed Subcommittee meeting focussed on the methods for measurement of air speed; In particular, results from a recent Comparison for low air speeds were presented, showing good agreement between the participants and providing thus support for several CMCs; also, results from a research project aimed at determining the effect of blockage effects were presented. This analysis was conducted by calibrating anemometers of various sizes in wind tunnels of various dimensions; the results are very disperse, indicating the importance of the relative size of anemometer and tunnel; another important parameter is the positioning of the reference speed measurement.

Another important point was the final approval of a Guide for the calibration of Pitot tubes and the decision to prepare a second guide about calibration of thermal anemometers.

A new wind tunnel facility for calibration of LIDARs was presented by PTB.

The outcomes of the strategic planning on comparisons indicated that the low speed range is now covered, but for higher speeds the RMO Comparisons are quite outdated so that a new exercise would be useful, since several Laboratories would need linking to the recently completed BIPM.CCM.K3 Comparison. Tubitak-UME volunteered to pilot this exercise, which will be prepared in the next months.

- **CMC Working Group** –Coordinator – Elsa Batista from IPQ, new coordinator will be Petra Milota from BEV

The review and comparison group will be added by Esra Koc from UME, Urska Turnsek from MIRS, Erik Smits from VSL, and Florestan Ogheard from LNE-CETIAT.

The working group has to coordinate the review of CMCs. A list about the status of comparisons will be updated every six months by the coordinator. Final reports of comparisons will be approved by the coordinator before publication at the EURAMET site.

One of the major tasks is to finally develop the comparison strategy plan which should be reviewed at least every four years.

- **Strategy Working Group** – Coordinator – Emmelyn Graham from NEL

The working group is meant to foster collaborations and research to ensure that the EURAMET TC-F continually meets its objective in a timely manner. It should provide information about the European Metrology Research system under consideration of different national needs and the differences among NMIs/DIs (size, organization, orientation). The aim is to create a map of the current landscape of coordination among EURAMET members and to bring it into alignment with the roadmap of the TC Flow. The following topics from the current roadmap have been discussed and developments identified:

- energy sources on the energy line: metrology or new fluids following the energy transition
- normative section together with scrutiny group, for example for medical devices
- gap analysis for flow related standards
- review of EU directives impact on microfluidics/medical devices/health care
- EMN on medical devices

- **EMPIR Working Group** – Coordinator – Corinna Kroner from PTB

One of the main goals of the working group is to facilitate the interaction between NMIs/DIs active in the area of flow measurements but also with stakeholders to prepare PRTs. A particular focus to significantly increase TC-F's activities within EMPIR by submitting a greater number and more competitive PRTs will therefore be set.

Possible flow related PRTs for the EMPIR call 2020 have been identified, such as:

- SIP on the base of the multiphase flow project
- PRT on digitalisation
- PRT on hydrogen (IND or SIP, open for discussion),
- PRT on emission
- PRT on subsea metrology.
- Volume measurements of large volume tanks (IND or NRM).
- microfluidic standardisation
- characterisation of transfer standards flow meters (IND call).

- link between micropipettes standardisation and characterisation of transfer standards: investigate what the distance to real life between lab calibration and end-user uncertainty
- New gases – end users (IND).

6. Participation in EMRP/ EMPIR

To foster the participation of TC-F members in EMPIR projects, the EMPIR working Group /Task Force has been implemented. Within the call 2019 the following PRTs and PNTs were submitted:

JRPn03 Flow metering of non-conventional gases (biogas, biomethane, hydrogen, syngas and mixtures with natural gas)

Flow-related EMPIR-projects active or about to start:

Number	Title	Coordination	Duration
15SIP03	Standards and e-learning course to maximise the uptake of infusion and calibration best practices	VSL	2016-2019
16ENG01	Metrology for hydrogen vehicles	NPL	2017-2020
16ENG07	Multiphase flow reference metrology	NEL	2017-2020
16ENG09	Metrological support for LNG and LBG as transport fuel	VSL	2017-2020
16ENV08	Metrology for air pollutant emissions	NPL	2017-2020
17IND13	Metrology for real-world domestic water metering	PTB	2018-2021
18HLT08	Metrology for drug delivery	IPQ	2019-2022
	EMN on Energy Gases	VSL	2019-2023

7. Capacity Building: Activities of the last year and future needs

During the World Cafe in 2017 the need for further workshops was realized. Therefore, the following workshops were/will be realized:

2017:

- Training on Uncertainty in Volume Measurements (BEV 28/29 Nov 2017)
The training aimed at improving the knowledge of the laboratory staff in EURAMET NMIs/DIs on measurement uncertainty in static volume measurement.
LOCATION: BEV, Vienna, Austria, 2017-11-28 to 2017-11-29
Lecturers at the workshop: Elsa Batista (IPQ), Miroslava Benkova (CMI), Zoe Metaxiotou (EIM), Petra Milota (BEV), Wolfgang Schmid (EURAMET), Tanasko Tasić (EURAMET)

2018:

- Training on Calibration of Volume Equipment
The training aimed at improving the knowledge of the laboratory staff in EURAMET NMIs/DIs on calibration of various type of volume equipment, by the gravimetric and volumetric method.
LOCATION: IPQ, Caparica, Portugal, 2018-02-20 to 2018-02-23
Lecturers at the workshop: Elsa Batista (IPQ)
- Workshop on preparation of CMC Excel files (TCF Meeting)
The training aimed at improving the knowledge of NMIs/DIs regarding the rules and documents for submitting CMC files, new or revised entries.

- Workshop Uncertainty Calculation for Gas Meters (TCF Meeting)
The workshop was focused on the establishment of comprehensive working equations and realistic estimation of uncertainties for the input values. A typical technical situation of a volumetric gas flow calibration facility was used as background.
Lecturers at the workshop: Bodo Mikan (PTB)

2019:

- Training on Coordination of Comparisons
- Training on micro and nano flow calibrations
- Workshop Uncertainty Calculation for Gas Meters: Part II
 - Procedures to estimate covariances among correlated input values.
 - Best practice for curve fits to represent calibration results.
 - Procedure to separate the contributions to Type A uncertainties between MuT and reference standard.

2020:

- Uncertainty components in gravimetric calibrations
- Calibration on micro pipettes

8. Meetings

The next TC-F meeting will be in Ljubljana, Slovenia, 31st March - 02nd April 2020.

9. Strategic Planning

See strategy working group.

10. Outlook for 2019/2020

- Review of CMCs
- Foster the cooperation with standardization and regulation groups
- Finalising the strategic comparison plan
- Develop a new strategy plan

