

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. The 31th annual meeting was held online in November 2020. 68 members from 30 different countries attended this last TC-F meeting. Initially planned at the end of March 2020 in Ljubljana (Slovenia), the 31st TC-F annual meeting has been postponed in November because of the lockdown caused by the COVID-19 pandemic.

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

The table below shows the status of the different projects listed for TC-F in the EURAMET Project database.

The numbers in brackets corresponds to latest information, since the last report.

	Comparison	Research	Consultation	Total
Agreed	0 (0)	0 (0)	0 (0)	0 (0)
In progress	15 (8)	1 (0)	0 (0)	16 (8)
Ongoing	0 (0)	2 (0)	0 (0)	2 (0)
Completed	69 (0)	10 (0)	6 (0)	85 (0)
Concluded	5 (0)	1 (0)	0 (0)	6 (0)
Total	89 (8)	14 (0)	6 (0)	109 (8)

3. Comparisons

The EURAMET TC-F members are very active within the BIPM key comparison (KC) level field.

The status of the different comparisons in which the TC-F is involved is given in the table below (changes since the last annual report are marked in **red** in the status column). Only comparisons agreed, in progress or approved and completed within the year are listed.

EURAMET n°	Title	Coordinating Institute	Status	KCDB
-	Water flow: 30 m ³ /h to 200 m ³ /h	PTB	Report in progress, Draft B	CCM.FF-K1.2015
-	Hydrocarbon liquid flow and water flow from 10 kg/min to 60 kg/min	VSL	Report in progress, Draft B	CCM.FF-K2.2011
-	High pressure gas flow from 65 m ³ /h to 1450 m ³ /h (0,1 to 8,8 MPa)	PTB	Planned	CCM.FF-K5.2016
-	Low pressure gas flow from 2 cm ³ /min to 10000 cm ³ /min	CMS/ITRI	Report in progress, Draft B	CCM.FF-K6.2017
1224	Comparison VSL - PTB Volume flow for Natural Gas under High Pressure	PTB	in progress	
1325	Comparison for gas flow range 5 ml/min to 30 l/min	MIKES	Approved	EURAMET.M.FF-S10
1397	Comparison of high-pressure gas-flow facilities between NEL, PTB and FORCE	NEL	in progress	
1450	Comparison of low air speed	CMI	in progress	EURAMET.M.FF-S11

EURAMET n°	Title	Coordinating Institute	Status	KCDB
1452	Comparison with 20, 50 and 250 L test measures	VSL	in progress	
1473	PTB-VTT MIKES DN100 comparison	MIKES	in progress	EURAMET.M.FF-S13
1476	Air flow low pressure Qmax 400 m ³ /h	VSL	in progress	EURAMET.M.FF-S12
1479	Inter-comparison of 1000 L proving tank	MIRS	in progress	EURAMET.M.FF-S14
1504	Bilateral inter-comparison in the gas flow range from 0.002 m ³ /h to 2.5 m ³ /h with sonic nozzles	CMI	in progress	
1506	Validation of standards for liquid flow rate under dynamic flows	LNE-CETIAT	in progress	
1507	Comparisons of standards for liquid flow rates under static load changes	CMI	in progress	
1508	Pilot study intercomparison of ultra-low liquid flow rates in range below 100 nL/min	NEL	in progress	
1511	Bilateral inter-comparison in the gas flow range from 0.5 m ³ /h to 75 m ³ /h with sonic nozzles	CMI	in progress	

EURAMET n°	Title	Coordinating Institute	Status	KCDB
1515	Comparison of air speed in the range of 1-40 m/s	UME	in progress	
1517	Pilot study on high-pressure natural gas primary calibration facilities	VSL	in progress	
1518	Inter-comparison of gas provers in the gas flow range 0,25 m3/h to 25 m3/h	BEV	in progress	

4. CMCs

The following CMCs have been submitted for JCRB review in 2020 via the KCDB 2.0 web platform. The date of approval is also given in the Table.

NMI	Country	Field	Number of CMCs	Date of Approval
IMBiH	Bosnia and Herzegovina	Volume	2	2020-08-21
GUM	Poland	Gas flow	1	
VTT MIKES	Finland	Gas flow	2	2021-02-15
DPM	Albania	Volume	2	2021-02-09
BIM	Bulgaria	Volume	1	2020-08-21
FORCE	Denmark	Gas flow	2	2021-02-21
LNE-LADG	France	Gas flow	3	2020-10-09

The following CMCs from other RMOs were reviewed in 2020:

NMI	Country	Field	Number of CMCs	Date of Approval
GEOSTM	Georgia	Volume	2	2020-10-02
GEOSTM	Georgia	Volume	1	2021-03-10
NIM	China	Gas flow	2	202-06-16
NIMT	Thailand	Gas flow	2	2020-04-14
NMC, A*STAR	Singapore	Gas flow	2	2020-04-14
NMC, A*STAR	Singapore	Fluid speed	2	2020-04-14
VNIIM	Russia	Liquid flow	1	2020-12-03

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 annual meeting. Each subcommittee convenor decides on the agenda and the subjects to be debated based on participants' input. However, due to the coronavirus pandemic, the 2020 TC-F meeting has been rescheduled in November.

The following topics were discussed during the subcommittee meetings:

- Gas Flow subgroup: Toma Valenta (CMI)
 - Status of the on-going projects
 - Presentation of the new capabilities of revised piston provers at METAS (Switzerland)
 - Survey of the CMCs. Expressed interest in a new comparison involving bell provers
- Liquid Flow subgroup: Marc De Huu (METAS)
 - Status of the on-going projects
 - Presentation of recent developments at LNE-CETIAT (France) (dynamic gravimetric method, optical nanoflow standard)
 - Proposal of a new comparison in the field of nanoflow by NEL
- Volume subgroup : Elsa Batista (IPQ)
 - Status of the on-going projects
 - Active participation of ISO standards' convenors with presentations
 - Organisation of a separate virtual meeting in January 2021 in order to plan the next volume comparisons
- Flow speed subgroup : Jan Gersl (CMI)
 - Status of the on-going projects

- Detailed presentation by CMI of experimental results (Project 1431) concerning the impact of the anemometers' insertion depth in a wind tunnel. Discussions. Participants agreed that a new project should start to go further in the investigation

The Working Group coordinators and activities are:

- CMC working group: Petra Milota (BEV)
 - The review team (12 members with an expertise in the different fields) is in charge of the CMCs review (see §4)
- Strategy working group: Chris Mills on behalf of Emmelyn Graham (NEL)
 - 7 members
 - After the 2019 TC-F meeting, Emmelyn Graham informed us she will no longer be involved in the TC-F activities with immediate effect. Until an official vote during the next face-to-face TC-F meeting, her colleague, Chris Mills, agreed to do the role. However, the update of the roadmap is delayed
- EMPIR working group: Corina Kroner (PTB)
 - 9 members
 - Organisation of an on-line meeting in preparation of the first call within the European Partnersip on Metrology in December 2020.

6. Participation in EMRP/ EMPIR

Information of the participation of on-going projects:

Number	Short name	Full name	Coordination	Duration
17IND13	Metrowamet	Metrology for real-world domestic water metering	PTB	2018-2021
18HLT08	MeDDII	Metrology for drug delivery	IPQ	2019-2022
18NRM06	NEWGASMET	Flow metering of renewable gases	LNE	2019-2022
18NET01	Energy Gases	Support for a European Metrology Network for energy gases	VSL	2019-2023
19ENG04	MetroHyVe 2	Metrology for hydrogen vehicles 2	NPL	2020-2023

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

Different activities of training and workshops in the field of fluid flow realized in the last years are listed above, as well as future needs already identified:

- 2017
 - Training on Calibration of Volume Equipment
 - Objective: Improvement of 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
 - Lecturer(s): Elsa Batista (IPQ), Miroslava Benkova (CMI), Zoe Metaxiotou (EIM), Petra Milota (BEV), Wolfgang Schmid (EURAMET), Tanasko Tasić (EURAMET)
- 2018
 - Training on Uncertainty in Volume Measurements
 - Objective: Improvement of 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
 - Lecturer(s): Elsa Batista (IPQ)
 - Workshop on preparation of CMC Excel files
 - Objective: Improvement of the knowledge of NMIs/DIs regarding the rules and documents for submitting CMC files, new or revised entries
 - Location: 2018TC-F meeting
 - Lecturer(s): Elsa Batista (IPQ)
 - Workshop Uncertainty Calculation for Gas Meters
 - Objective: 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 use as background
 - Location: 2018 TC-F meeting
 - Lecturer(s): Bodo Mickan (PTB)
- 2019
 - Training on Coordination of Comparisons
 - Objective: Improvement of the knowledge of the TC-F members about the coordination of comparisons
 - Location: 2019 TC-F meeting
 - Lecturer(s): Elsa Batista (IPQ)
 - Training on micro and nano flow calibrations
 - Objective: Improvement of the knowledge about micro and nano liquid flow
 - Location: 2019 TC-F meeting
 - Lecturer(s): Hugo Bissig (METAS)
 - Workshop Uncertainty Calculation for Gas Meters: Part II
 - Objective: 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
 - Location: 2019 TC-F meeting
 - Lecturer(s): Bodo Mickan (PTB)

- 2021¹
 - Uncertainty components in gravimetric calibrations in liquid flow
 - Objective: Improvement of the knowledge of the TC-F members
 - Location: 2021 TC-F meeting
 - Lecturer(s): Florestan Ogheard (LNE-CETIAT)
 - Workshop Calibration on Micropipettes and standardization
 - Objective: Improvement of the knowledge of the TC-F members
 - Location: 2021 TC-F meeting
 - Lecturer(s): Zoe Metaxiotou (EIM)
 - EURAMET-COOMET training course on small volume comparisons
 - Objective: Improvement of the knowledge of the laboratory staff in EURAMET and COOMET NMI/DIs on measurement uncertainty evaluation of interlaboratory comparisons in small static volume measurement
 - Location: Initially planned in March 2020 GEOSTM, Tbilisi, Georgia. POSTPONED
 - Lecturer(s): Elsa Batista (IPQ), Zoe Metaxiotou (EIM)
 - In house verification of piston pipettes
 - Objective: To provide hospital laboratories with a brief, handy “Rescue Manual ” for performing a quick in house verification of the measuring status of pipettes in order to identify the ones which do not perform safely within specifications in the context of Covid-19 crisis
 - Location: Euramet website, tbd
 - Lecturer(s): Elsa Batista (IPQ), Zoe Metaxiotou (EIM)

8. Meetings

Due to the Coronavirus pandemic, the next TC-F meeting, initially planned in Ljubljana, Slovenia, 31st March - 02nd April 2020, has been rescheduled 3rd – 5th November 2020 and finally held on line.

10. Strategic Planning

See strategy working group.

11. Outlook for 2020/2021

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

¹ 2020 activities have been postponed in 2021 due to the pandemic situation