

1. General Aspects

EURAMET TC-L currently has contact persons from 34 EURAMET members and 4 named observers: 1 from a DI, 2 from liaison NMIs (EG, ZA) and 1 from liaison organization (BIPM). In the last meeting held at PTB in Oct. 2019, TC-L had 42 participants, 26 contact persons, 3 observers (EG, UA, ZA) and 11 guests (2xSA, 1 UAE, 1 AU, 1 SE, 1 GB, 1 HU, 1 CH, 1 AT, 1 MX, 1 Research Council and 2 EURAMET Officers).

2. Projects

In the period under review there were a total of 16 active projects with status “in progress” and 1 with status “ongoing”, 10 projects being MRA comparisons. 7 of these were discussed as proposals at the last TC-L meeting being later registered and started with the exception of one of them which is under preparation and not yet registered.

Two of the long-term TC-L projects are related to conference series, organized by TC-L at different locations with colleagues from PTB serving as main contact:

- EURAMET #1343 MacroScale conference series

Last Macroscale was organized in 2017 at VTT. Macroscale 2020 was scheduled for Nov. 2020 in South Africa, organised by NMISA. However, this was postponed to 2022 due to Covid-19 (2021 will be the CCL and CCL WG meetings at BIPM).

- EURAMET #1342 NANOSCALE conference series

Nanoscale 2019 was organised at PTB in Braunschweig in October with more than 100 participants from 25 countries and 5 continents. Next Nanoscale will be organized in 2023 in Europe, one year later than usual, to allow Macroscale to happen in 2022.

These triannual conferences collect length metrology researchers globally from NMIs, academia and industry.

3. Comparisons

3.1 Key Comparisons

The current status of EURAMET length key comparisons, in line with the CCL-KC, is as follows. Changes since the last GA meeting are marked in **red** in the status column.

Designation	Title	Status
EURAMET.L-K1	Gauge blocks	Final report, KCDB
EURAMET.L-K1.1	Gauge blocks	Final report, KCDB
EURAMET.L-K1.2		Final report, KCDB
EURAMET.L-K1.2011	Gauge blocks	Final & Executive report, KCDB
EURAMET.L-K1.2019	Gauge blocks	In progress
EURAMET.L-K2	Long Gauge blocks	Final & Executive report, KCDB
EURAMET.L-K3.1	Optical polygons	Final report, KCDB
EURAMET.L-K3.2009	Angle comparison using an autocollimator	Final & Executive report, KCDB
EURAMET.L-K3.2009.1	Angle blocks	Final report, KCDB
EURAMET.L-K3.2009.2	Bilateral comparison using AC	Final & Executive report, KCDB
EURAMET.L-K4.2005	Diameter standards	Final & Executive report, KCDB
EURAMET.L-K4.2005.1	Diameter standards	Final & Executive report, KCDB
EURAMET.L-K4.2015	Diameter standards	In progress
EURAMET.L-K5.2004	Step gauge	Final & Executive report, KCDB
EURAMET.L-K5.2016	Step gauge	Final Report, KCDB

		Executive Report in preparation
EUROMET.L-K6	2D-CMM artefacts	Final & Executive report, KCDB
EUROMET.L-K7.2006	Line scales	Final & Executive report, KCDB
EURAMET.L-K7.2014	Line scales	Final report, KCDB
EURAMET.L-K8	Surface texture - Roughness	Final & Executive report, KCDB
EURAMET.L-K8.2013	Surface texture - Roughness	Final & Executive report, KCDB
EURAMET.L-K8.2020	Surface texture - Roughness	In progress

3.2 Supplementary comparisons

Recently active supplementary comparisons:

Designation	Title	Status
EURAMET.L-S23	High precision roundness by error separation technique	Final & Executive report, KCDB
EURAMET.L-S24	Involute gear standards	Final & Executive report, KCDB
EURAMET.L-S25	Comparison of pocket-type laser distance measurement instruments (EDMs)	Final & Executive report, KCDB
EURAMET.L-S26	Measurement of groove depth standards in the range 1 μm up to 1 mm	Final report, KCDB
EURAMET.L-S27	Measurement of Steel Tapes of 10 m and 50 m	In progress
EURAMET.L-S28	Measurement of flatness of 300 mm diameter optical flat	In progress
EURAMET.L-S29	Measurement of a Stage Micro-metre 10 μm to 1000 μm	In progress
EURAMET.L-S30	Measurement of sphere diameters 20 mm to 25 mm	In progress

3.3 Corrective actions due to insufficient performance in KC/SC

CCL guidance is that so-called executive reports are made after each KC/SC by pilot and accepted by participants and RMO/CCL. In these reports those laboratories with problems to demonstrate their CMC capability are listed and the nature of the problem is explained. If corrective actions have been performed they are also listed. In the annual TC-L meetings any pending issues are discussed. A table is maintained and updated by TC-L where all corrective actions are listed. The DECISION CCL 2 (2015) – ‘*Procedure for discrepant result corrective actions*’ describes the responsibilities: ‘the NMI proposes corrective actions which are agreed by the RMO (e.g. TC-L) within 90 days, informs the pilot of these (for inclusion in the Executive Report) and then implements them’. Since 2006 until now 13 corrective actions took place. The last two were closed in October 2018. Since then no new action have been opened.

4. CMCs

An overview of the past (after 2016) and present CMC submission is given in the table below. Red entries changed status during the period reported.

Designation	Comment	Status
EURAMET.L.17.2016	50 CMCs / 11 countries	published, 2016-10-05
EURAMET.L.18.2017	42 CMCs / 7 countries	published, 2017-10-30

EURAMET.L.19.2018	16 CMCs / 5 countries	published, 2018-09-12
EURAMET.L.20.2019	16 CMCs / 6 countries	published, 2020-03-31
EURAMET.L.21.2020	So far: 15 CMCs / 2 countries	Postponed, after transformation to quantity equations is finished (*)

(*) EURAMET TC-L has been the first RMO in finishing the transformation from numerical to quantity equations in early July 2020. All revised files of 31 EURAMET NMIs with at least one CMC entry in length were transferred to the BIPM (KCDB manager). Such revised CMC files were integrated into the KCDB at the beginning of August.

During the reporting period 5 CMC sets from other RMOs were treated by TC-L.

5. Activities of the Subcommittees

There are no sub-committees in TC-L.

6. Participation in EMPIR

In the 2018 EMPIR calls (Health, SI Broader Scope, Normative, ...) there were a few funded JRPs with direct connection to TC-L.

Length related accepted JRPs of EMPIR 2014, 2015, 2016, 2017, 2018 and 2019 calls are listed below, changes to status of last year are indicated in red. EMPIR 2020 SRTs in process of preparing the corresponding consortia and JRPs at the moment of producing this report are also indicated.

Call	Project name	Status
EMPIR 2014 <i>Industry</i>	Metrology for highly-parallel manufacturing	Completed
	Metrology for length-scale engineering of materials	Completed
	Metrology for the photonics industry	Completed
EMPIR 2015 <i>Health</i>	Metrology for additively manufactured medical implants	Completed
EMPIR 2015 <i>SI</i>	Traceable three-dimensional nanometrology	Completed
	Reference algorithms and metrology on aspherical and freeform lenses	Completed
EMPIR 2017 <i>Industry</i>	Advanced Computed Tomography	In progress
	Large Volume Metrology Applications	In progress
	Multifunctional ultrafast microprobes for on-the-machine measurements	In progress
EMPIR 2017 <i>Normative</i>	Improved traceability chain of nanoparticle size measurements	In progress
	Standards for the evaluation of the uncertainty of coordinate measurements in industry	In progress
EMPIR 2018 <i>Health</i>	Standardization of concentration measurements of extracellular vesicles for medical diagnosis	In progress
EMPIR 2018 <i>SI Broader Scope</i>	Large scale dimensional measurement for geodesy	In progress
EMPIR 2018 <i>Normative</i>	Measurements of the focal spot size on x-ray tubes with spot sizes down to 100 nm	In progress
EMPIR 2018 <i>Research potential</i>	Traceability for contact probes and stylus instrument measurements	In progress
EMPIR 2019 <i>Supp. for Networks</i>	Support for a European Metrology Network on advanced manufacturing	In progress

EMPIR 2019 <i>Energy</i>	Metrology for enhanced reliability and efficiency of wind energy systems	In progress
	High throughput metrology for nanowire energy harvesting devices	In progress
EMPIR 2020	SRT-i04	Bid writing
	SRT-i08	No bid
	SRT-i09	Bid writing
	SRT-i12	No bid
	SRT-i15	Bid writing
	SRT-i24	Possibly no bid
	SRT-f10	Bid writing

There are also other approved projects with some length related research:

Call	Project name	Status
EMRP 2012; Metrology for industry	Novel electronic devices based on control of strain at the nanoscale	Completed
	Metrology to enable high temperature erosion testing	Completed
EMPIR 2014; Industry	Metrology for manufacturing 3D stacked integrated circuits	Completed
	Metrology for innovative nanoparticles	Completed
EMPIR 2015; SI	Nano-scale traceable magnetic field measurements	In progress
EMPIR 2017; Ind	Metrology for the Factory of the Future	In progress

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

Tanfer Yandayan from TUBITAK UME, TR, is the TC-L contact person in charge of capacity building issues since summer 2016. Tanfer regularly informs TC-L contacts about the RPOT and RMG calls and other capacity building instruments.

In 2019 there was no activity for capacity building in EURAMET TC-L but new activities will be further taken into account in the new network project, 19NET01 AdvManuNet: "Support for a European Metrology Network on Advanced Manufacturing", which started just in June 2020.

8. Meetings

The following list shows the TC-L meetings and related activities over the last 3 years:

- 2017 TC-L CP meeting, 16-17 October 2017, VTT-MIKES, Espoo, Finland

The annual TC-L meeting of 2017 was followed by the Macroscale conference and a meeting of the CCL WG-MRA in the same week at VTT-MIKES: => <http://www.macroscale.org>

- 2018 TC-L CP meeting, 15-16 October 2018, LNE, Paris, France

The annual TC-L meeting of 2018 was followed by 2 half day workshops: a) News from NMIs; b) TC-L workshop in preparation for the EMPIR calls in 2019 and 2020.

- 2019 TC-L CP meeting, 14-15 October 2019, PTB, Braunschweig, Germany

The annual TC-L meeting of 2019 was followed by the Nanoscale conference and a meeting of the CCL WG-MRA and WG-N in the same week at PTB: => <http://www.nanoscale.ptb.de>.

9. Issues

One NMI from EURAMET TC-L was involved in 2018 in a so-called APMP hybrid comparison as the provider of a calibration certificate. The issue of hybrid comparison was further discussed at the

EURAMET BoD/TCC meeting in February 2019. TC-L is in principle open for the hybrid comparison approach.

A quality assessment for SWEDAC based on using this approach has been suggested by JV. The suggested procedure does not match exactly the APMP approach. So, it will be analyzed soon, probably in our TC-L meeting 2020.

10. Strategic Planning

TC-L contributed to the preparation of the CCL meeting in June 2018 where the CCL strategy document was updated. The MeP for the unit of length, the metre, was drafted with strong input from EURAMET NMIs and also guiding documents were prepared on the use of the crystalline Si lattice in nanometrology which were published on World Metrology Day 2020.

=> <http://www.bipm.org/wg/AllowedDocuments.jsp?wg=CCL-WG>

A call for *Metrologia* "Focus Issue on Length Metrology" was promoted within CCL and TC-L colleagues are preparing some papers to be published.

Also there is an open Special Issue of MST on "Metrology for Manufacturing":

https://iopscience.iop.org/journal/0957-0233/page/Special_Issue_Metrology_Manufacturing

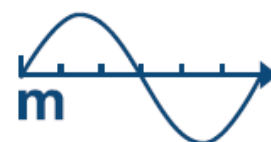
A paper is currently under review at MST, "The lattice parameter of silicon; a secondary realisation of the metre", authored by the current chair of the CCL WG-Nano and its two predecessors (co-chairs): Andrew Yacoot, Harald Bosse, Ron Dixon.

We also have to mention here the new networking project JNP "Support for a European metrology network on advanced manufacturing". It is expected that a proposal for an EMN on Metrology for advanced manufacturing will be presented for the next EURAMET GA in May 2021. Martti Heinonen from VTT is the mentor from the BoD working group on EMNs for this network:

<https://www.euramet.org/research-innovation/search-research-projects/details/project/support-for-a-european-metrology-network-on-advanced-manufacturing>

11. Outlook for 2020/2021

Next annual TC-L meeting 12.-13. Oct. 2020 at DFM, Denmark will be for the first time Virtual, as a consequence of Covid-19. On it, apart from reviewing the status of the different projects, basically comparisons, the new EMPIR 2020 PRTs, with participation of many EURAMET NMIs, will be presented and a small training session on submitting new CMC entries in the KCDB will be provided to our TC-L colleagues, just after having completed the reviewing of all new CMCs expressed in quantity equations.



Length