

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 LNE in Oct. 2018 TC-L had 34 participants, 27 contact persons, 1 observer, and 5 guests (GB, PT, HU, 2xSA).

2. Projects

In the period under review there were a total of 17 active projects with status “in progress” and 1 with status “ongoing”, 5 projects being MRA comparisons. At the last TC-L meeting 3 new project proposals were discussed and are currently under preparation, however, 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
- EURAMET #1342 NANOSCALE conference series

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-K1.2011 | Gauge blocks | Final & Executive report, KCDB |
| EURAMET.L-K2 | Long Gauge blocks | Executive report, KCDB |
| EURAMET.L-K3.2009 | Angle comparison using an autocollimator | Final & Executive report, KCDB |
| EURAMET.L-K3.2009.2 | Bilateral comparison using AC | Final & Executive report, KCDB |
| EURAMET.L-K4.2015 | Diameter standards | In progress |
| EURAMET.L-K4.2005.1 | Diameter standards | Final & Executive report, KCDB |
| EURAMET.L-K5.2016 | Step gauge | In progress |
| EURAMET.L-K6 | 2D-CMM artefacts | Final & Executive report, KCDB |
| EURAMET.L-K7.2006 | Line scales | Final & Executive report, KCDB |
| EURAMET.L-K8 | Surface texture - Roughness | Final & Executive report, KCDB |

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-S25 | Comparison of pocket-type laser distance measurement instruments (EDMs) | Final & Executive report, KCDB |
| EURAMET.L-S26 | Measurement of groove depth | In progress |

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| | standards in the range 1 µm up to 1 mm | |
| EURAMET.L-S27 | Measurement of Steel Tapes of 10 m and 50 m | 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’.

4. CMCs

An overview of the past (after 2013) and present CMC submission is given in the table below. Red entries changed status during the period reported.

| Designation | Comment | Status |
|-------------------|------------------------|-----------------------|
| EURAMET.L.14.2013 | 14 CMCs / 3 countries | published, 2013-08-05 |
| EURAMET.L.15.2014 | 26 CMC / 8 countries | published, 2014-07-21 |
| EURAMET.L.16.2015 | 49 CMCs / 8 countries | published, 2015-10-15 |
| 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 | Inter-RMO review |

During the reporting period 4 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 EMRP/ 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 EMRP 2012, 2013 and of EMPIR 2014, 2015, 2016, 2017 and 2018 calls are listed below, changes to status of last year are indicated in red:

| Call | Project name | Status |
|-----------------------------------|---|-----------|
| EMRP 2012; Metrology for industry | Large volume metrology in industry | Completed |
| | Metrology for movement and positioning in six degrees of freedom | Completed |
| | Multi-sensor metrology for microparts in innovative industrial products | Completed |
| | Traceable in-process dimensional measurement | Completed |
| EMRP 2012; SI broader scope | Angle metrology | Completed |
| | Metrology for long distance surveying | Completed |

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|------------------------------|---|-------------|
| | Crystalline and self-assembled structures as length standards | Completed |
| EMRP 2013; Energy II | Traceable measurement of drive train components for renewable energy systems | Completed |
| EMPIR 2014; Industry | Metrology for highly-parallel manufacturing | Completed |
| | Metrology for length-scale engineering of materials | Completed |
| | Metrology for the photonics industry | Completed |
| EMPIR 2015; Health | Metrology for additively manufactured medical implants | In progress |
| EMPIR 2015; SI | Traceable three-dimensional nanometrology | In progress |
| | Reference algorithms and metrology on aspherical and freeform lenses | In progress |
| EMPIR 2017; Industry | Advanced Computed Tomography | In progress |
| | Large Volume Metrology Applications | In progress |
| | Multifunctional ultrafast microprobes for on-the-machine measurements | In progress |
| EMPIR 2017; Normative | 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; Health | Standardization of concentration measurements of extracellular vesicles for medical diagnosis | Start 2019 |
| EMPIR 2018; SI Broader Scope | Large scale dimensional measurement for geodesy | Start 2019 |
| EMPIR 2018; Normative | Measurements of the focal spot size on x-ray tubes with spot sizes down to 100 nm | Start 2019 |
| EMPIR 2018; Research Pot. | Traceability for contact probes and stylus instrument measurements | Start 2019 |

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, acts as TC-L contact person for capacity building issues since summer 2016. Tanfer regularly informed TC-L contacts about the RPOT and RMG calls and other capacity building instruments. He coordinated submissions of 2 JRP's from TC-L for the RPOT call in 2017 and in 2018, one of which was accepted as JRP (starting in 2019). Tanfer also prepared and coordinated the training events for long gauge blocks and tapes in 2018. The trainings were conducted in Montenegro (in MBM as host) with kind of contribution of lectures, Rudolf Thalmann, (METAS, CH), and Helge Karlsson, (Justervesenet, NO). 10 people from 6 different

EURAMET NMIs participated in theoretical and experimental trainings using the premises of MBM. Experimental training regarding to calibration of fixed storage tanks (OIML R71) which was demanded in the last years by EURAMET NMIs, is under discussion for 2019.

8. Meetings

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

- 2015 TC-L CP meeting, 26-28 October 2015, CEM, Tres Cantos, Spain

The annual meeting of 2015 was followed by a TC-L EMPIR workshop and a workshop on the results of JRP 'Angle metrology'

- 2016 TC-L CP meeting, 17-18 October 2016, VSL, Delft, Netherlands

The annual meeting of 2016 was followed by a TC-L EMPIR open workshop and meetings of the CCL WG-MRA and the CCL WG-Nano. In March the Nanoscale 2016 conference was organized in cooperation with the Technical University in Wroclaw, PL: => <http://www.nanoscale.ptb.de>

- 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

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.

10. Strategic Planning

TC-L contributed to the preparation of the CCL meeting in June 2018. The CCL strategy document was updated. The MeP for the unit of length, the metre, has been drafted with strong input from EURAMET NMIs and there are guiding documents prepared on the use of the crystalline Si lattice in nanometrology which will be published on World Metrology Day 2029 at the latest.

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

11. Outlook for 2019/2020

Next annual TC-L meeting 15.-16. Oct. 2019 at PTB, Braunschweig, DE. TC-L meeting in conjunction with Nanoscale 2019 conference (15./16.10.) and CCL WG-N (17.10.) and CCL-WG-MRA (17./18.10.) meetings. Preparation for EMPIR 2020 calls (PRT's) planned at a stakeholder workshop on Oct. 28/29, 2019 at PTB in Berlin. Next Macroscale conference in 2020 planned to be organized by NMISA in South Africa.

