

### 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 VTT-MIKES in Oct. 2017 TC-L had 31 participants, 23 contact persons, 1 Convenor of WG on Capacity Building, 3 liaison contacts (NMISA, SASO, NMCC), and 4 guests including and 1 guest from the hosting NMI and 1 guest from SIM.

### 2. Projects

In the period under review there were a total of 14 active projects with status “in progress” and 5 with status “ongoing”, 6 projects being MRA comparisons. At the last TC-L meeting 1 new project proposal were discussed.

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
EUROMET.L-K2	Long Gauge blocks	Executive report, KCDB
EURAMET.L-K3.2009	Angle comparison using an autocollimator	Final report, KCDB
EURAMET.L-K3.2009.2	Bilateral comparison using AC	Draft B
EURAMET.L-K4.2015	Diameter standards	In progress
EUROMET.L-K4.2005.1	Diameter standards	Draft B1
EURAMET.L-K5.2016	Step gauge	In progress
EUROMET.L-K6	2D-CMM artefacts	Final & Executive report, KCDB
EUROMET.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-S22	Calibration of gauge blocks by mechanical comparison	Final & Executive report, KCDB
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 standards in the range 1 µm up to 1 mm	In progress
EURAMET.L-S27	Measurement of Steel Tapes of 10 m and 50 m	Started

### 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 2012) and present CMC submission is given in the table below. Red entries changed status during the period reported.

Designation	Comment	Status
EURAMET.L.12.2012	7 CMCs / 1 country	published, 2012-12-08
EURAMET.L.13.2012	11 CMCs / 3 countries	published, 2013-02-26
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	Inter-RMO review

During the reporting period 2 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 2017 EMPIR calls (Industry, Fundamental, Normative, ...) there were several funded JRPs with direct connection to TC-L.

Length related accepted JRPs of EMRP 2011, 2012, 2013 and of EMPIR 2014, 2015, 2016 and 2017 calls are listed below, changes to status of last year are indicated in red:

Call	Project name	Status
EMRP 2011; SI broader scope	Traceability of sub-nm length measurements	Completed

EMRP 2011; New Technologies	Traceable measurement of mechanical properties of nano-objects	Completed
	Traceability for computationally-intensive metrology	Completed
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
	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	In progress
	Metrology for length-scale engineering of materials	In progress
	Metrology for the photonics industry	In progress
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	Start: 6/18
	Large Volume Metrology Applications	Start: 6/18
	Multifunctional ultrafast microprobes for on-the-machine measurements	Start: 6/18
EMPIR 2017; Normative	Improved traceability chain of nanoparticle size measurements	Start: 5/18
	Standards for the evaluation of the uncertainty of coordinate measurements in industry	Start: 6/18

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

Call	Project name	Status
EMRP 2011; New Technologies	Traceable characterisation of nanostructured devices	Completed
	Metrology with/for NEMS	Completed
	Metrology of electro-thermal coupling for new functional materials technology	Completed
EMRP 2011; Health	Metrological characterisation of microvesicles from body fluids as non-invasive diagnostic biomarkers	Completed
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	In progress
	Metrology for innovative nanoparticles	In progress
EMPIR 2015; SI	Nano-scale traceable magnetic field measurements	In progress
EMPIR 2017; Ind	Metrology for the Factory of the Future	Start: 6/18

## 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 also coordinated submissions of 2 JRP's from TC-L for the RPOT call in 2017 and the preparation of training events for long gauge blocks and tapes in 2018.

The EURAMET project 1237 'Calibration of Short Gauge Blocks by Mechanical Comparison' started on 1 August 2012 under collaboration type of 'consultancy' and was completed under capacity building activities. The aim of this project was to prepare the West Balkan Countries for inter-comparison measurements and identify the problems that may occur when such countries participate in MRA comparisons. It was an exercise with 2 days preparatory workshop at the initialization stage and was piloted by TUBITAK UME. The exercise comparison started following to the workshop as planned but there were several delays due to lack of the equipment of the participants, movement of the laboratories, change of the staff etc. Such problems were overcome by helping these new NMIs through exchange of several mails and even performing a second short workshop for their new staff in TUBITAK UME. Despite these difficulties, the project was completed by following the guides for MRA comparisons and the final report is ready.

Various solutions were applied to solve the problems and NMIs were practically trained for further comparisons (e.g. participation in comparisons using equipment of other organizations in the country). Interim information was provided about the results of some countries to encourage them to participate in a MRA comparison. This worked very well and one country participated in MRA comparison (EURAMET.L-S22). This NMI now has registered CMC on Gauge Blocks. Two other NMIs have participated in another MRA comparison (GULFMET.L-S1) successfully fulfilling the main aim of the project. The remaining other 2 NMIs now have the knowledge for successful participation in inter-comparisons and will do so as soon as they have the equipment.

## 8. Meetings

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

- 2014 TC-L CP meeting, 27-28 October 2014, BEV, Wien, Austria
- Macroscale 2014 Conference, 28-30 October 2014, BEV, Wien, Austria

This conference was arranged by BEV and PTB in co-operation with CCL and EURAMET TC-L. During or around this conference many JRPs had their project meetings

- 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>

## 9. Issues

The topic of 'generic 1D' CMCs was further discussed within TC-L and within CCL-WG-MRA as well in the reporting period. This topic addresses to provide guidelines for the specification (and review) of CMC entries for 1D measurands like e.g. distances or diameters on different type of measuring objects (cylinders, spheres or workpiece-like standards) using multi-purpose measuring instruments like coordinate measuring machines (CMM).

## 10. Strategic Planning

During 2017 and 2018 TC-L contributed to the preparation of the CCL meeting in June 2018. The CCL strategic document is currently updated, the MeP for the unit of length, the metre, has been drafted and there are guiding documents on the use of the crystalline Si lattice in nanometrology under discussion. All of these activities have been strongly influenced by TC-L.

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

## 11. Outlook for 2018/2019

Next annual TC-L meeting 15.-16. Oct. 2018 at LNE. Preparation for EMPIR 2019 (JRP's) and 2020 calls (PRT's). TC-L meeting 14.-15. Oct. 2019 at PTB. DE in conjunction with Nanoscale 2019 conference (15./16.10.) and CCL WG-N (17.10.) and CCL-WG-MRA (17./18.10.) meetings.

