



# TC for Metrology in Length: Report to CCL

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**Length**

# OUTLINE



- EURAMET TC-L: Areas of impact & roadmaps
- EMRP & EMPIR:
  - European Metrology Programme for Innovation and Research
  - EMN: European Metrology Networks
- EURAMET TC-L
- Nanoscale and Macroscale conference series

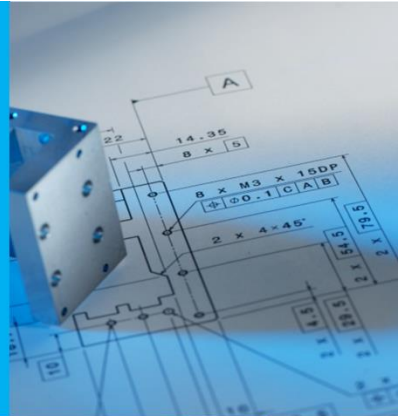


Length

# Length metrology - Areas of Impact



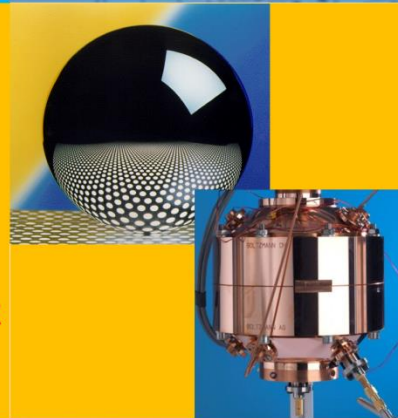
Traceability in dimensional measurements underpins all manufacturing, engineering and assembly industry worldwide, ensuring compatibility & interchangeability of parts.



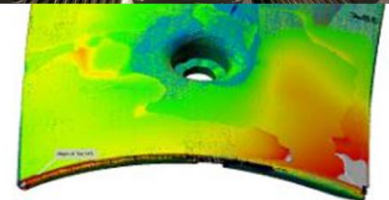
Topics are dealt with in **four TC-L Roadmaps:**

- Advanced Manufacturing
- Micro- and nanometrology
- Large volume and long range metrology
- Enabling fundamental research

Precision engineering and dimensional metrology are key to **3 SI re-definitions** based on fundamental constants: form & dimension of **Avogadro** spheres and **Boltzmann** resonators, **Planck** balance interferometry



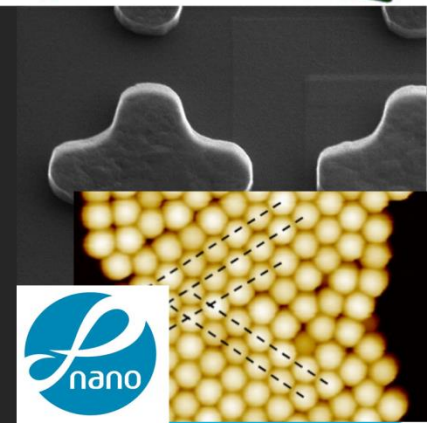
For new **science** (particle accelerators), **energy generation** (wind, civil nuclear), better accuracy & *in situ* calibration are speeding up manufacturing and enabling better efficiency, longer lifetimes. Solving gearbox problems is key to wind energy.



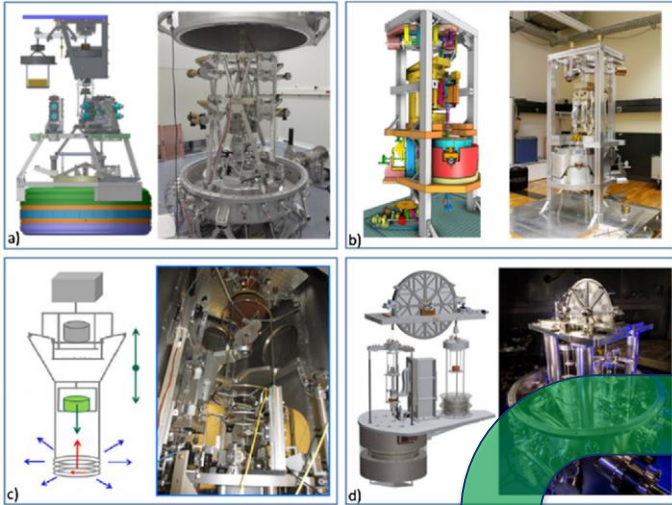
In aerospace, improving accuracy in aircraft assembly is reducing weight, reducing fuel burn (lower **environmental impact**, better **energy efficiency**). Key needs are accuracy and traceability for parts up to 40 m size.



Surface form and texture are critical to many nano-scale devices, particularly for *in-vivo* applications for **health**. Traceability infrastructure for 3D surface texture and simple dimensions on nano particles

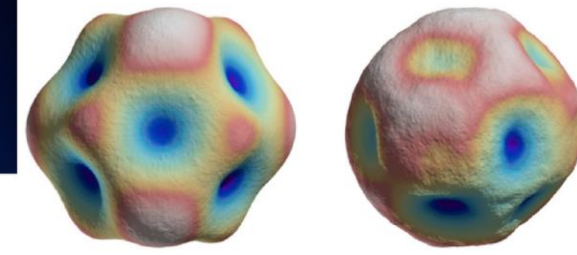
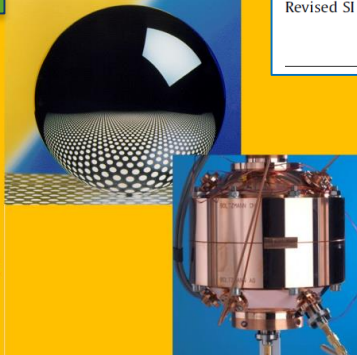


# Length metrology and precision manufact.: – Support of Revised SI



Traceability in dimensional measurements underpins all manufacturing, engineering and assembly industry worldwide, ensuring compatibility & interchangeability of parts.

Precision engineering and dimensional metrology are key to 3 SI re-definitions based on fundamental constants: form & dimension of Avogadro spheres and Boltzmann resonators, Planck balance interferometry



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**ELSEVIER**

**Contributions of precision engineering to the revision of the SI**

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**ABSTRACT**

All measurements performed in science and industry are based on the International System of Units, the SI. It has been proposed to revise the SI following an approach which was implemented for the redefinition of the unit of length, the metre, namely to define the SI units by fixing the numerical values of so-called defining constants, including  $c$ ,  $h$ ,  $e$ ,  $k$  and  $N_A$ . We will discuss the reasoning behind the revision, which will likely be put into force in 2018. Precision engineering was crucial to achieve the required small measurement uncertainties and agreement of measurement results for the defining constants.

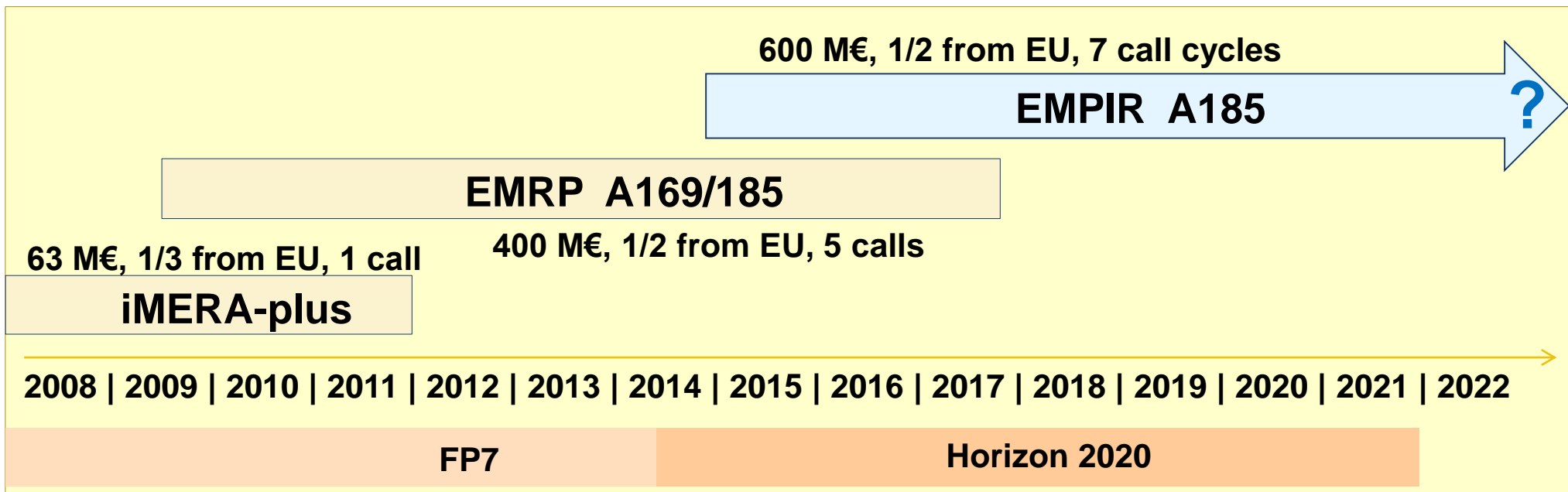
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# EMRP & EMPIR



- coordination of national metrology research programmes
  - 23 participating states in EMRP
  - 28 participating states in EMPIR
- jointly agreed strategic research agenda
- implemented by EURAMET e.V.
- highly integrated



# EMPIR Calls

## Schedule

*(preliminary;  
indicative budgets  
actual budgets also  
depend on # of  
published SRTs)*

## Thematic calls:

- Metrology for**
- **Industry**
- **SI**
- **Health**
- **Environment**
- **Energy**
- **Fundamental**

Year	M€	TPs	M€
2014	50	IND	43,5
		Rpot	3
		SIP	1
2015	80	HEA	40
		SI	30
		PRE-NO	5
		Rpot	3
		SIP	1
2016	95	ENV	40
		ENG	40
2017	95	IND	50
		FUN	30
2018	95	HEA	40
		SI	40
2019	95	ENV	40
		ENG	40
2020	90	IND	30
		FUN	30
		?	?



## Additional calls:

- likely every year
- **Pre-Normative**  
(link to CEN-STAIR)
- **Research Potential**  
(capacity building)
- **Support for Impact**  
(increase impact of finished JRPs)



Length

# EMPIR: Projects related to TC-L

## Call 2014:

- Metrology for innovative nanoparticles (NPL)
- Metrology for highly-parallel manufacturing (NPL)
- Metrology for length-scale engineering of materials (NPL)
- Metrology for manufacturing 3D stacked integrated circuits (LNE)
- Metrology for the photonics industry (MIKES)

## Call 2015:

- Metrology for additively manufactured medical implants (LNE)
- Traceable three-dimensional nanometrology (VTT)
- Reference algorithms and metrology on aspherical and freeform lenses (LNE)

## Call 2017:

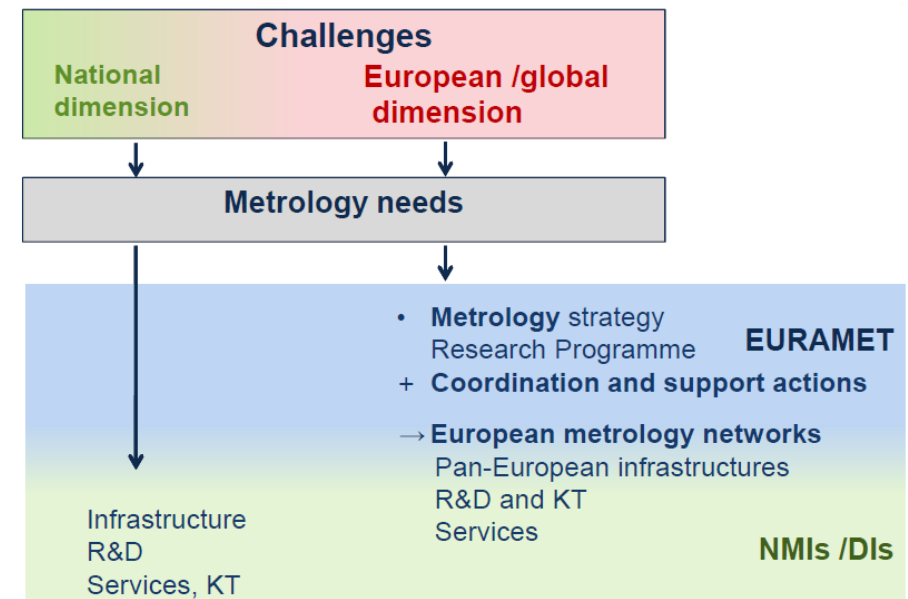
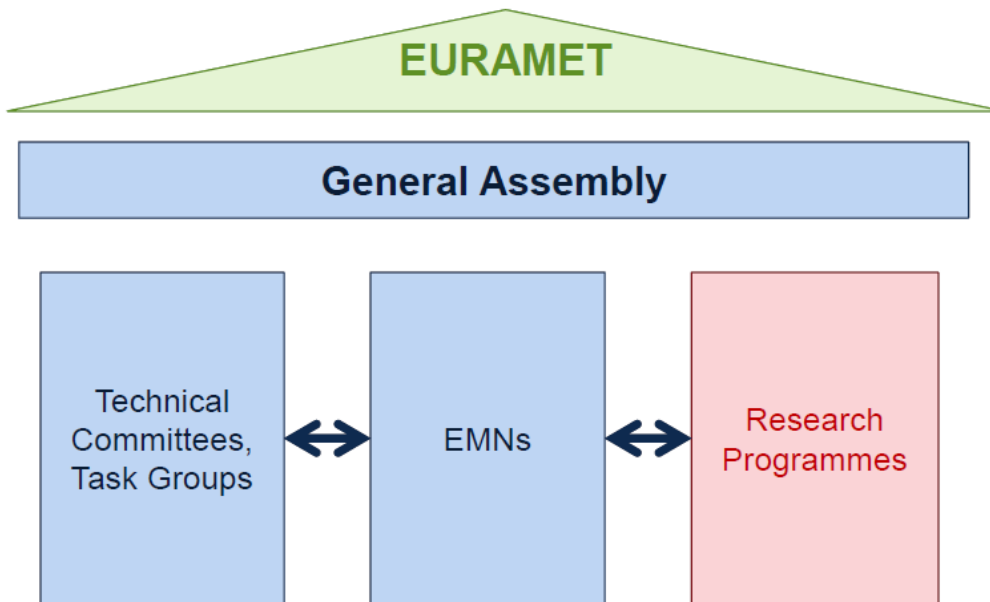
- Advanced Computed Tomography (PTB)
- Large Volume Metrology Applications (NPL)
- Multifunctional ultrafast microprobes for on-the-machine measurements (PTB)
- Improved traceability chain of nanoparticle size measurements (BAM)
- Standards for the evaluation of the uncertainty of coordinate measurements in industry (INRIM)

# EMN: European Metrology Network



EMN needs to cover a field which:

- is of **strategic importance at the European level** and has a high potential impact, which is too wide for individual players;
- Needs capabilities and/or tools beyond the ones which are already established at NMIs and DIs.





# EMN: European Metrology Network

EMN topics approved by the EURAMET GA, 2018:

- Climate and Ocean Observation
- Mathematics and Statistics
- Quantum Technologies
- Smart Electricity Grids
- Traceability in Laboratory Medicine
- Energy gases
- Resources for these EMN vary between 70 FTE - 130 FTE over 10 - 17 countries

TC-L related EMN topics TC-L drafted but to be further refined for next GA:

- Advanced Manufacturing
- Nanoparticles / Nanomaterials characterisation
- Metrology for geodesy and surveying

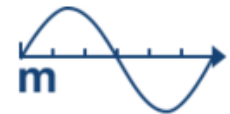
## TECHNICAL COMMITTEE FOR LENGTH

The Technical Committee of Length supports industry and researchers by coordinating and further developing the measurement related to the unit of length, the metre. Technical areas include:

- Wavelength (frequency) standards
- Dimensional measurement (length, area, volume)
- Angle measurement
- Co-ordinate measurement
- Measurements for micro- and nano-technology
- Form measurement (shape, flatness, roundness, cylindricity, straightness)
- Surface texture
- Roughness measurement
- Measurement of complex geometry
- Calibration of measuring instruments
- Distance measurement

## TC-L MENU

- [TC-L Contacts](#)
- [TC-L Projects](#)
- [Events](#)
- [Annual Reports & Documents](#)



**Length**

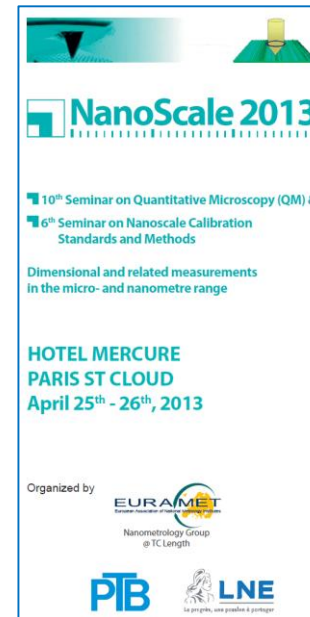
## Technical Committee for Length

- TC-L currently has contact persons from 34 NMI's
  - 4 official observers; COOMET TC-L chair invited to attend
- At 2017 meeting at VTT-MIKES we had observers/guests from:
  - South-Africa, Saudi-Arabia, Mexico
- Occasionally TC-L has also has other guests
- TC-L has no sub-committees, but 3 convenors for:
  - EMPIR: preparation of TC-L for EMPIR Calls; coordination & information
  - Capacity building: training workshops, RPOT activities
  - CMC review: former TC-L chairperson
- TC-L holds workshops in conjunction with its annual meetings:
  - Sharing of experience, e.g. in gauge block calibration
  - Preparation of TC-L for coming EMPIR calls
  - Open workshop with stakeholders in preparation of EMPIR proposals

# Nanoscale and Macroscale conferences



- Presentation and discussion of latest research results in dimensional metrology at the nano- and macroscale
- Period of usually 3 years
- Co-location with TC-L and/or CCL-WG meetings aimed at
- Registered as EURAMET  
TC-L projects: #1342 & #1343



**MACROScale** *Recent Developments in Traceable Dimensional Measurements*

28th - 30th October 2014, BEV, Vienna, Austria

**MACROScale** *Recent Developments in Traceable Dimensional Measurements*

17th - 19th October 2017, VTT MIKES, Espoo, Finland

# Macroscale 2017 Conference



- Organised by VTT-MIKES, and PTB in co-operation with EURAMET TC-L
- October 17<sup>th</sup> to 19<sup>th</sup>, 2017
- VTT-MIKES, Espoo, Finland
- > 80 participants



**Thank you  
for your attention!**

**=> TC-L Meeting 2018:  
15-16 Oct. 2018, LNE, FR**

**=> TC-L Meeting 2019:  
14-15 Oct. 2019, PTB, DE**

**=> In conjunction with Nanoscale 2019 conference (15-16 Oct)  
and CCL WG-MRA and WG-N meetings (17-18 Oct)**



**TC-L Oct. 2017, VTT-MIKES, FI**