

## Establishing Metrology Standards - research projects outcomes

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**EMPIR**



The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

# IPQ – Portuguese Institute for Quality

IPQ is a public institute created in 1986 that, integrated in the indirect administration of the State, has as its mission the coordination of the **Portuguese Quality System**, the promotion and coordination of activities that aim to contribute to demonstrate the credibility of the action of economic agents, as well as the development of the activities necessary for its functions as a **National Metrology Institution** and a **National Standardization Body**.



# IPQ – Portuguese Institute for Quality

As a National  
Standardization  
Body:



- Coordinating the standardization subsystem,
- Promoting and supporting the development of national normative activity in a credible and sustainable way,
- Proceeding to the editing, dissemination and sale of standards and other normative documents at international, European and National level,
- Facilitating the dissemination and implementation of best practices and contributing to competitiveness, productivity and innovation of products and services.

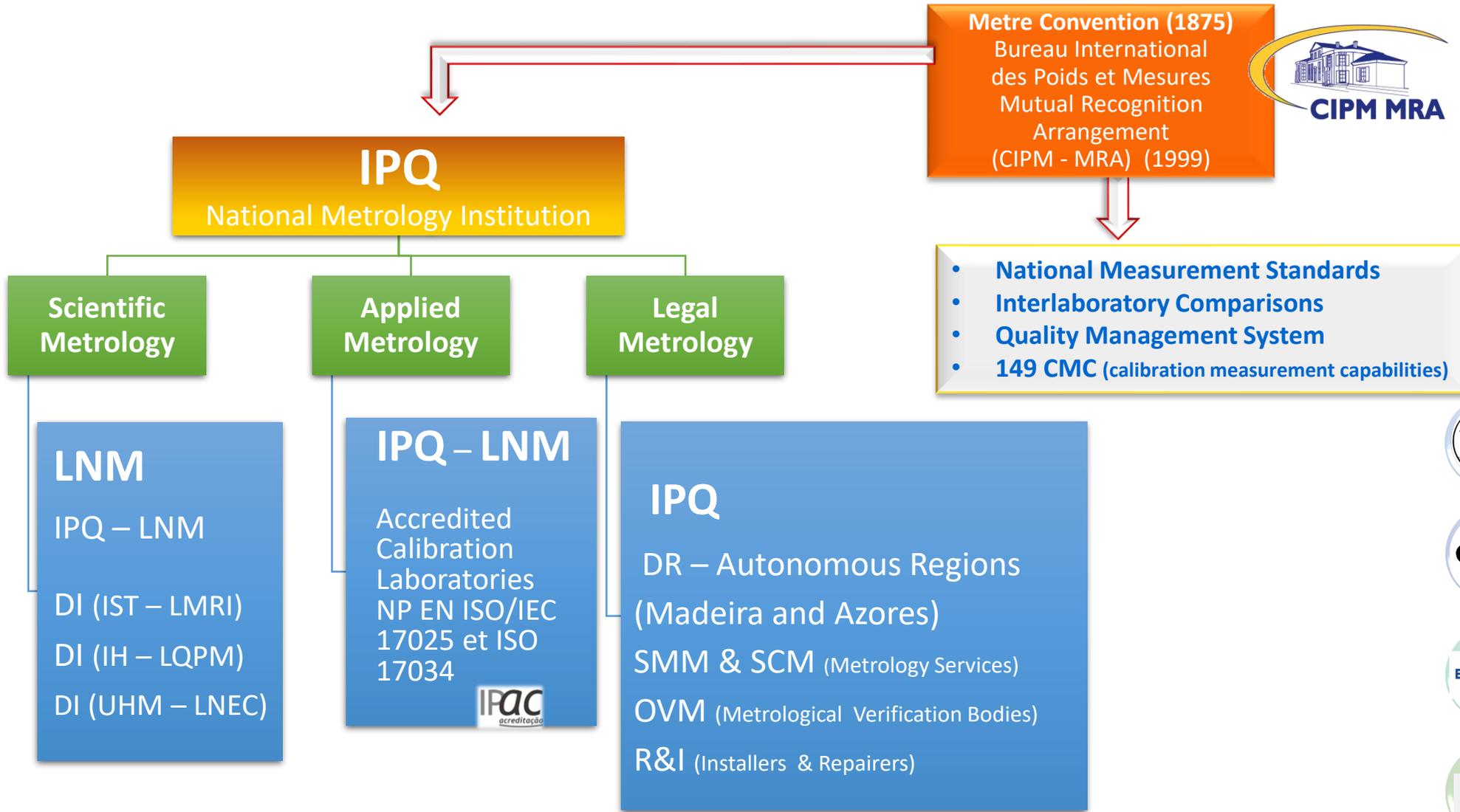
- Coordinating the subsystem of metrology,
- Ensuring the rigor and accuracy of the measurements performed,
- Ensuring its comparability and traceability, at national and international level,
- **Realization, maintenance and development of national standards of the units of measure,**
- Comprising the three domains: Scientific Metrology, Applied Metrology and Legal Metrology,
- Realizing the constitutional objective of sovereignty in the field of measurement standards and control of the necessary measuring instruments for industry and Portuguese society in general.

As a National  
Metrology  
Institution



# National Metrology Subsystem

## Metre Convention



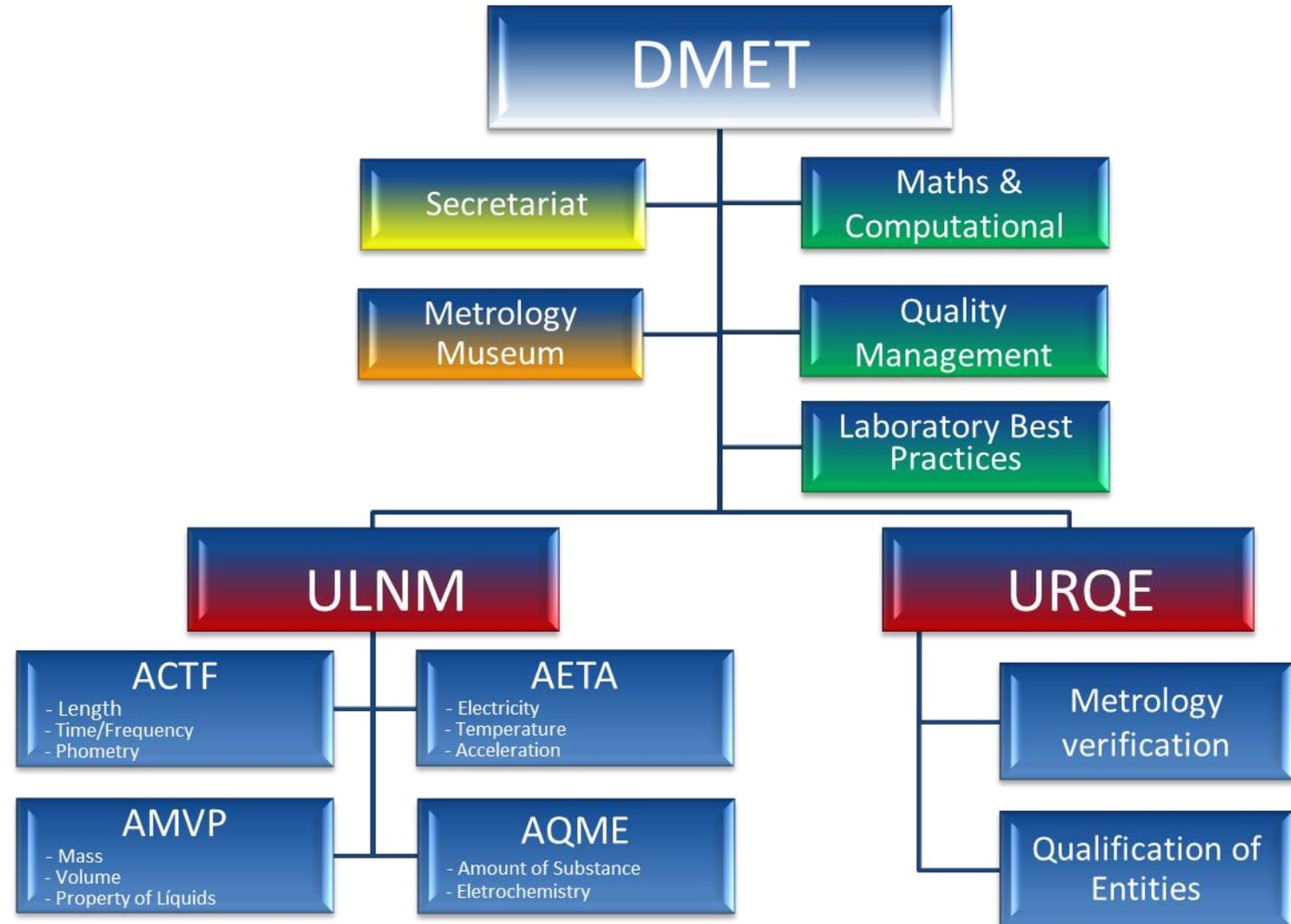
Portugal signed the **Metre Convention** on 20 May 1875

And belongs to the first group of 17 signatory countries

# Metrology Department

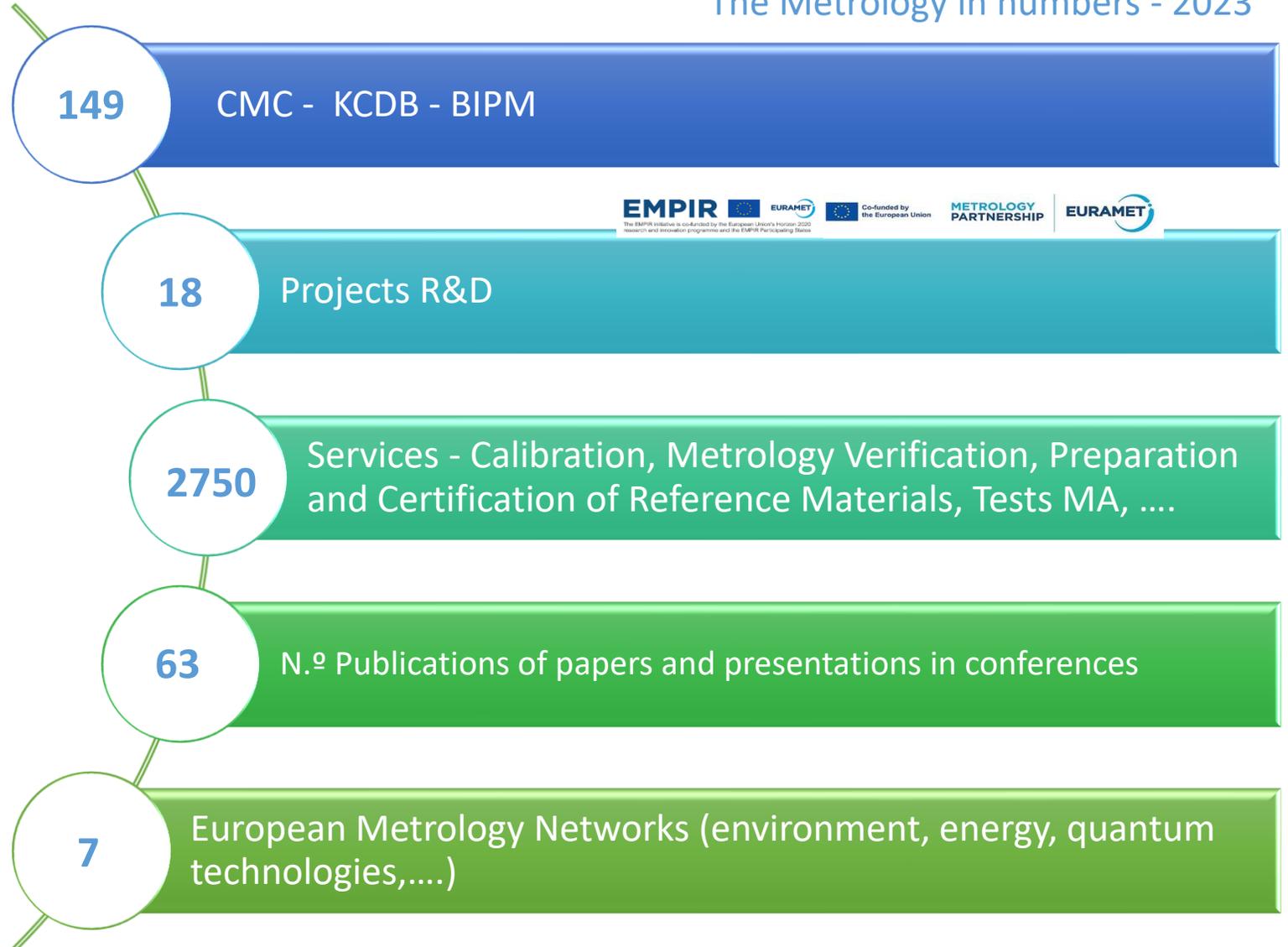


- Scientific Metrology
- Applied Metrology
- Legal Metrology



# National Metrology Laboratory

The Metrology in numbers - 2023



A laboratory with 52 technical metrological domains

Metrology Department with 41 persons

(80 % Academic Degree)

2 200 m<sup>2</sup> Laboratory area

10 000 m<sup>2</sup> Covered area

A self-sustained system

# National Metrology Laboratory



# IPQ-Volume and Flow Laboratory

The Volume and flow Laboratory of IPQ provides calibrations to the industry, mainly for water meters manufacturers, fuel companies, verification offices, chemical, analytical and pharmaceutical laboratories.

## Calibration of small volumes



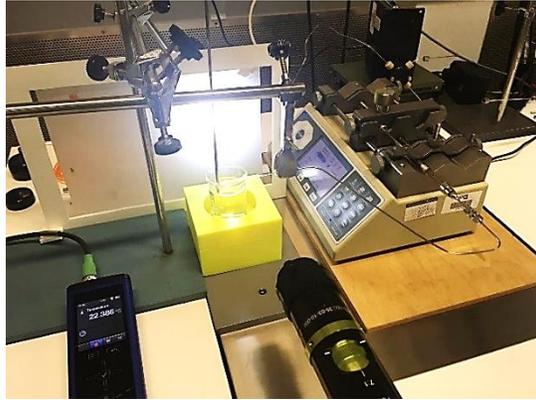
Range - From 0,1  $\mu$ L to 10 000 L

## Calibration of medium and large volumes



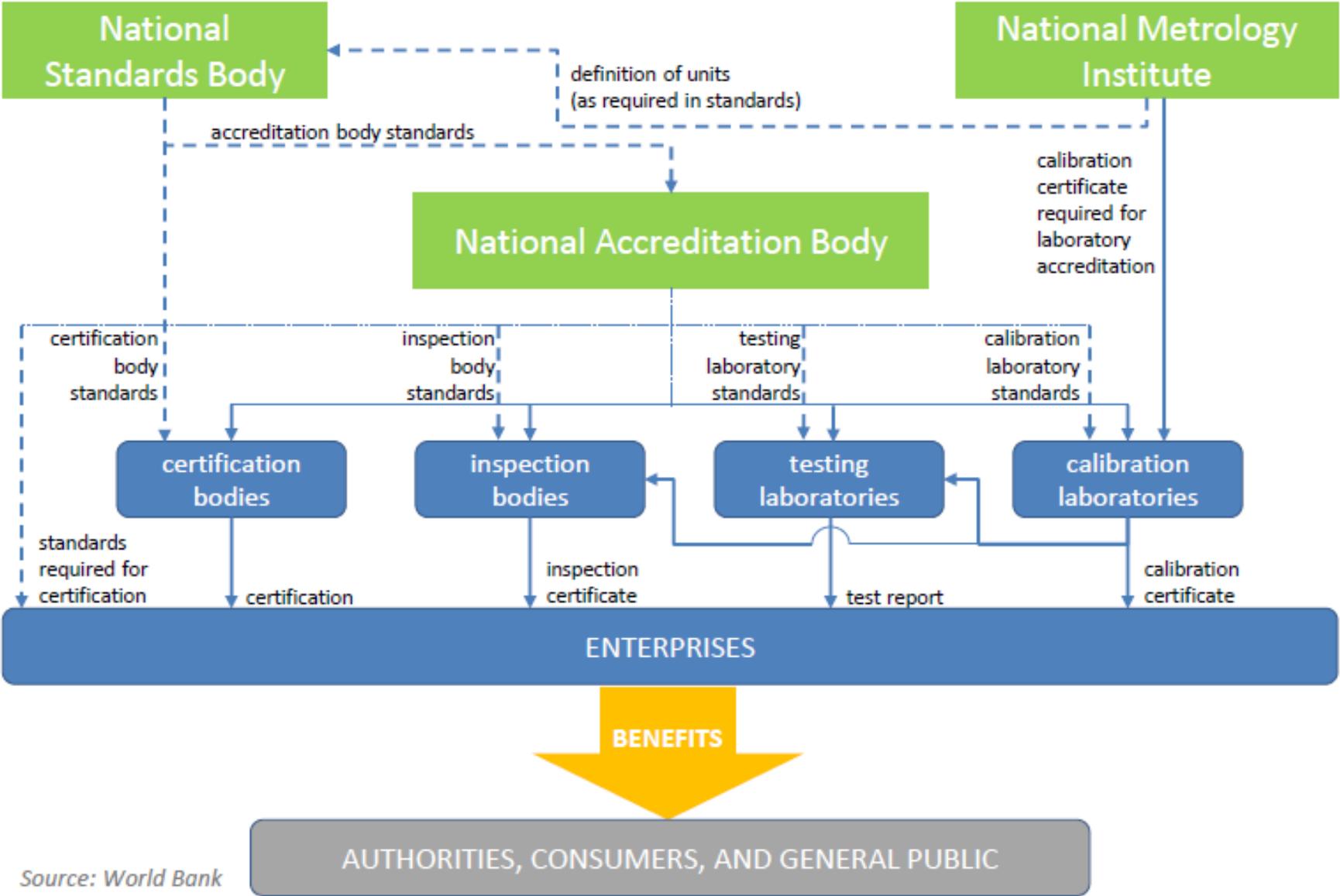
# IPQ-Volume and Flow Laboratory

## Calibration of dosing devices and flow meters



0,0003 mL/h up to 2000 mL/h with uncertainties of 2,5 % to 0,07 % (CMC published at BIPM)

# Quality Infrastructure



Source: World Bank

# Standardization

Is the process of implementing and developing technical standards based on the consensus of different parties that include firms, users, interest groups, standards organizations and governments.

Transparency

Openness

Representativeness

Impartiality and consensus

Coherence

Effectiveness and relevance



“Standards are the common language of world”

# Standardization

This activity has as its main objectives: the formulation, diffusion and application of norms in the fields of science, technique and economy obtaining benefits in the best adaptation of products, processes and services to the purposes to which they are intended the elimination of barriers to trade. Standardization can help maximize compatibility, interoperability, safety, repeatability, or quality.

# Standardization



# Standards

- Technical documents:
  - resulting from a consensus,
  - approved by a recognized standardization body (IPQ in Portugal),
  - establishing rules, guidelines or characteristics of products or services, processes and technologies
  - based on consolidated results of science, technology and experience,
  - and that aim to optimize the benefits for the community.
- Usually, non-binding and is available for voluntary use unless its application is required by legislation or contracts.



# Type of Standards

There are several types of standards, depending on the level of scope of the standardization body responsible for its publication:

International standards - ISO  
Internacional Standard Organization



European Standards- EN  
CEN – Comité Européen de Normalisation



National Standards- NP  
IPQ – Instituto Português da Qualidade



# ISO and CEN revision process

## Life cycle of a new or revised standard

- Proposal (NWIP – New Work Item Proposal, by P member)
- Preparation (WD – Working draft, by the working group of a TC)
- Committee (CD – Committee draft, send to the TC for [comments](#))
- Inquiry (ISO /DIS – Draft International standard, for vote and final comments)
- Approval (ISO FDIS – Final Draft International standard, for vote)
- Publication (ISO)

**Timeline – 36 or 48 months work for new standards**  
**All standards must be revised every 5 years**

# Standard revision process

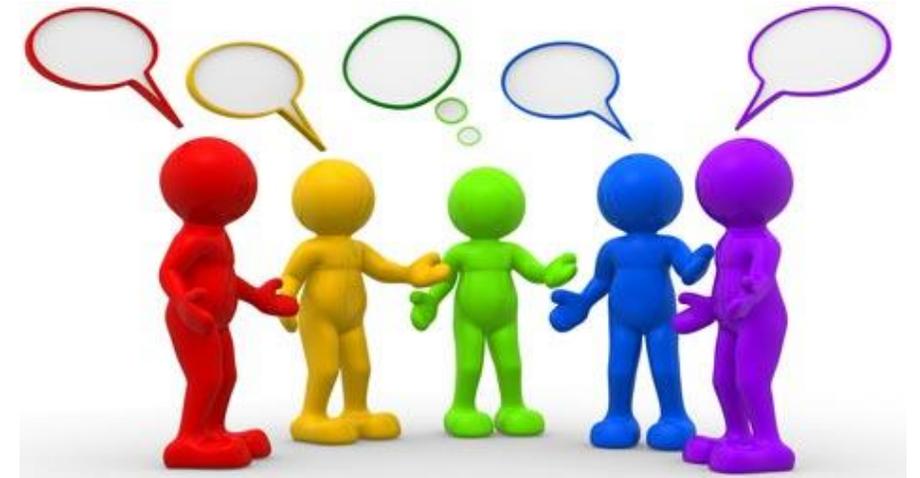


| STAGE             | SUBSTAGE  | 90  | DECISION   |
|-------------------|---|---|--|
| 00<br>PRELIMINARY | 00 REGISTRATION   | 20 START OF MAIN ACTION   | 60 COMPLETION OF MAIN ACTION                                       |
|                   | 00.00 Proposal for new project received                               | 00.20 Proposal for new project under review                         | 00.60 Close of review  |
| 10<br>PROPOSAL    | 10.00 Proposal for new project registered                             | 10.20 New project ballot initiated                                  | 10.60 Close of voting  |
|                   | 10.00.92 Proposal returned to submitter for further definition        | 10.98 New project rejected  | 10.99 New project approved   |
| 20<br>PREPARATORY | 20.00 New project registered in TC/SC work programme                  | 20.20 Working draft (WD) study initiated                            | 20.60 Close of comment period                                      |
|                   | 20.00.92 WD referred back to working group                            | 20.98 Project endorsed  | 20.99 WD approved for registration as CD                           |
| 30<br>COMMITTEE   | 30.00 Committee draft (CD) registered                                 | 30.20 CD ballot initiated   | 30.60 Close of voting/ comment period                              |
|                   | 30.00.92 Full report circulated, BS referred back to TC or SC         | 30.98 Project endorsed  | 30.99 CD approved for registration as DIS                          |
| 40<br>ENQUIRY     | 40.00 DIS registered  | 40.20 DIS ballot initiated, 12 weeks                                | 40.60 Close of voting  |
|                   | 40.00.92 Full report circulated, BS approved for registration as FDIS | 40.98 Project endorsed  | 40.99 Full report circulated, BS approved for registration as FDIS |
| 50<br>APPROVAL    | 50.00 Final text received or FDIS registered for formal approval      | 50.20 Final text to be registered or FDIS ballot initiated, 8 weeks | 50.60 Close of voting, Final returned by secretariat               |
|                   | 50.00.92 FDIS or draft referred back to TC or SC                      | 50.98 Project endorsed  | 50.99 FDIS or draft approved for publication                       |
| 60<br>PUBLICATION | 60.00 International Standard under publication                        | 60.60 International Standard published                              |  |
|                   | 90.00 International Standard under automatic review                   | 90.20 Close of review   | 90.60 International Standard to be revised                         |
| 90<br>REVIEW      | 90.00 International Standard under automatic review                   | 90.20 Close of review   | 90.60 International Standard confirmed                             |
|                   | 90.00.92 Decision made to withdraw                                    | 90.98 Decision made to withdraw                                     | 90.99 Withdrawal of International Standard proposed by TC or SC    |
| 95<br>WITHDRAWAL  | 95.00 International Standard under automatic review                   | 95.20 Withdrawal ballot initiated                                   | 95.60 Close of voting  |
|                   |   |   | 95.92 Decision made to withdraw                                    |



# How to engage with standardization bodies and TC

- **At ISO and CEN level:**
  - Find out which standardization technical committees (TC) and working group (WG) could benefit from your work
  - Identify if your country is Participant (P) or Observer member (O)
  - Register as expert in the TC/WG
  - Check which relevant standards will be under review with the next years
  - If a relevant standard is under discussion try to send comments and then try to attend the meeting to defend the comments



The European Association of National Metrology Institutes (EURAMET) is a Regional Metrology Organisation (RMO) of Europe. It coordinates the cooperation of National Metrology Institutes (NMI) of Europe in fields like research in metrology, traceability of measurements to the SI units, international recognition of national measurement standards and related Calibration and Measurement Capabilities (CMC) of its members.

**The science of measurement – metrology – is vital for scientific research, trade and industry, and our daily lives.**

EURAMET coordinates metrology research across Europe to provide the high accuracy, low uncertainty measurements needed both now and in the future. Three research programmes are currently bringing together world-class measurement expertise in a series of targeted projects: EMRP, EMPIR and EPM. More than 300 JRPs have been completed so far.



# CEN and CENELEC Co-operation with EURAMET



Within the context of metrology research, CEN and CENELEC co-operate with EURAMET, the European Association of National Metrology Institutes by identifying metrology research needs identified during standardization.

Through the cooperation agreement between CEN-CENELEC and EURAMET, CEN and CENELEC are invited to submit metrology research needs in support of their standardization activities to EURAMET.

This practice was piloted in the context of the EMRP programme (EMRP - the European Metrology Research Programme), intensified and formalized in the context of EMPIR, the "European Metrology Programme for Research and Innovation" in the frame of Horizon 2020, and is now to continue within the context of the **European Partnership on Metrology EPM** under Horizon Europe.



# EMPIR MFMET Overview

**Call:** 2020 Normative

**JRP name:** Establishing metrology standards in microfluidic devices

**JRP reference:** 20NRM02 MFMET

**Total budget:** ~ 1 M€

**Total labour:** ~120 MM

**Duration:** 36 months

**Start date:** June 2021

**Coordinating Organisation:** IPQ

**Partners** - 9 NMIs/DIs, 4 research institutions/university, 4 companies (17). 12 countries

**Collaborators/stakeholders:** 37

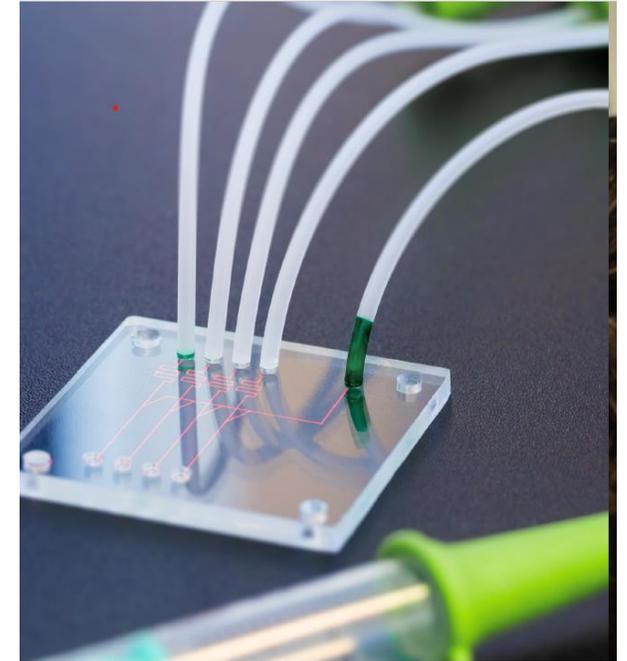
**Chief stakeholder:** The Microfluidic association

<https://mfmet.eu>,  
<https://zenodo.org/communities/mfmet>

# Objectives

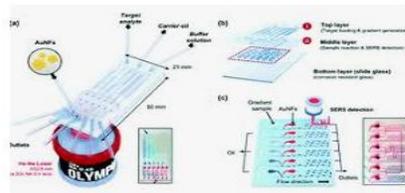
This project aims to contribute to the development of globally accepted standards for microfluidics and disseminate them to end users in industry (health and pharmaceutical sectors) and academia.

- ✓ by the development of **consensus-based measurement protocols & guidelines**
- ✓ By the **dissemination of metrology standards** towards normative committees (ISO TC48/WG3), industry and end users

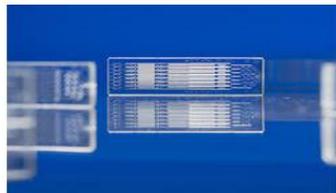


# Microfluidics

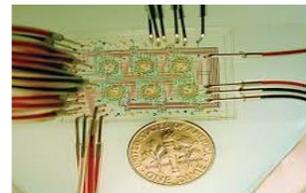
Microfluidics is both the science which studies the behavior of fluids through microchannels and the technology of manufacturing microminiaturized devices containing chambers and tunnels through which fluids flow or are confined



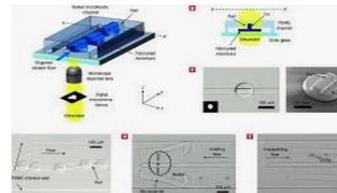
SERS-based droplet microfluidics for ...  
pubs.rsc.org



Dolomite Microfluidics offers new ...  
labbulletin.com



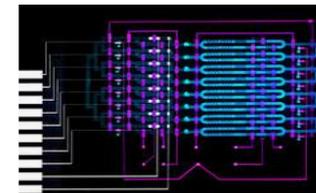
Microfluidics? What's That? A Beginn...  
microfluidicfuture.com



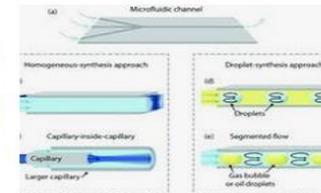
Concept of railed microfluidics and ...  
researchgate.net



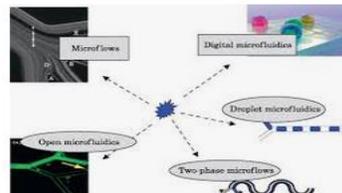
Future of Medical Diagnostics  
matmatch.com



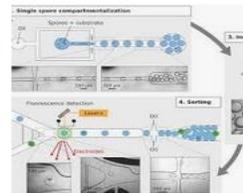
Microfluidics device helps diagnose ...  
eurekalert.org



Microfluidics and catalyst particles ...  
pubs.rsc.org



Digital Microfluidics - an overview ...  
sciencedirect.com



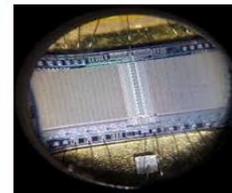
Droplet-based microfluidics ...  
researchgate.net



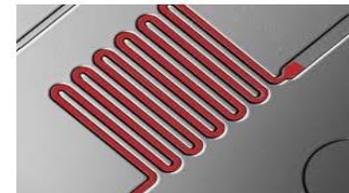
Yole, Yole Développement, Yole Development,  
yole.fr



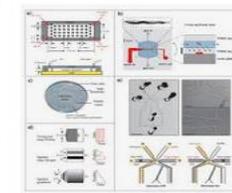
Future of Medical Diagnostics  
matmatch.com



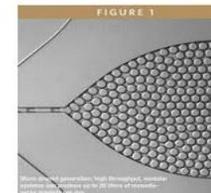
Microfluidics: A general ove...  
elvelflow.com



Using Microfluidics to Diagnose HIV - ASME  
asme.org



Microfluidics as a tool for C...  
wormbook.org



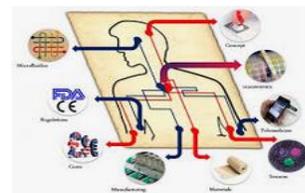
Microfluidics Approach to...  
drug-dev.com



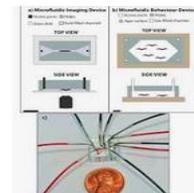
Laboratory Methods in ...  
elsevier.com · In stock



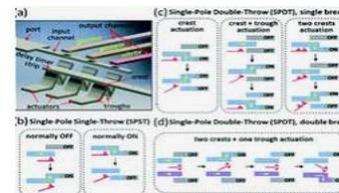
Microfluidics  
surfix.nl



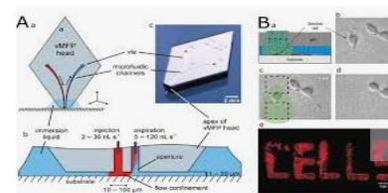
Microfluidics | Ali K. Yetisen  
scholar.harvard.edu



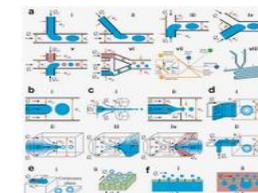
Microfluidics as a tool ...  
wormbook.org



Microfluidics News - Daily update on ...  
microfluidics-news.com



30 years of microfluidics - ScienceDirect  
sciencedirect.com



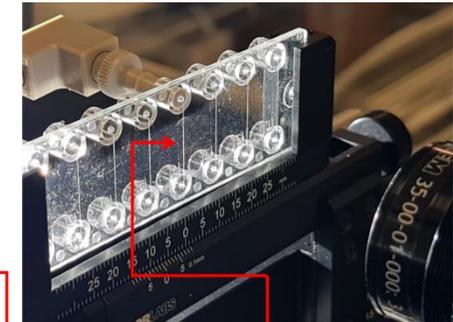
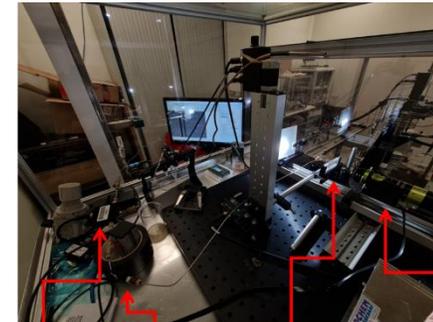
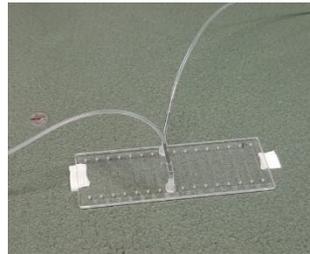
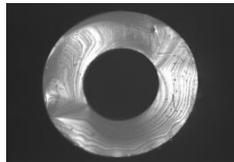
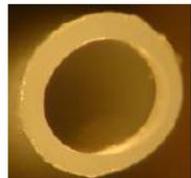
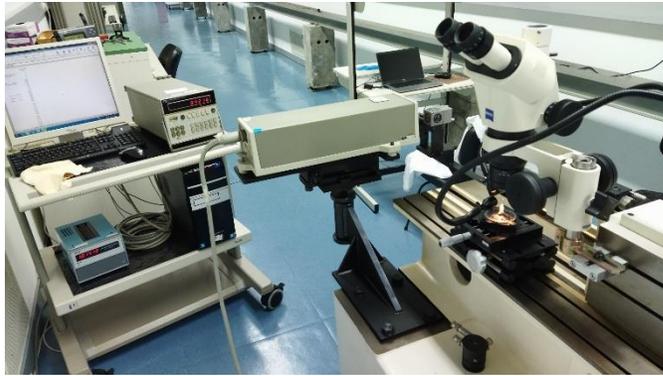
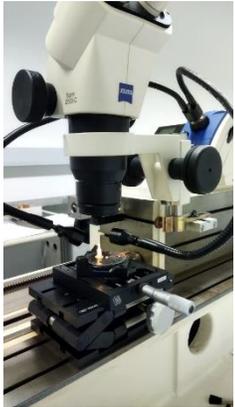
Droplet Microfluidics: T-Juncti...  
openwetware.org

## Related searches

- paper microfluidics
- mixing microfluidics
- single cell microfluidics

# Scientific outcomes MFMET project

Development of a test protocols for **liquid properties, dimensional and flow** measurements: length, density, contact angle, viscosity, flow, flow resistivity, volume, wettability, surface roughness, leakage, etc.



Thermal mass flow meter

Pressure sensor

Chip under test

Camera for inline reference flow rate measurement

100x100  $\mu\text{m}$  channel Outlet at atm. pressure

# MFMET and standardization activities

- **ISO/TC48/WG3** - Microfluidic devices
  - ISO 22916:2022 – Microfluidic devices – Interoperability requirements for dimensions, connections and initial device classification
  - ISO 10991:2023 Microfluidics – Vocabulary,
  - A new ISO/CD TS 6417 Microfluidic pumps — Symbols and performance communication is under development (committee draft has been circulated).
- **ISO/TC48/WG5**-Liquid handling devices- automatic
  - ISO 23783- 1, 2 and 3:2022 - Automated liquid handling systems
  - ISO/TR 6037 - Automated liquid handling systems – Uncertainty of the measurement procedures, under development.
- **ISO/TC84/WG11**-Syringes
  - ISO 7886-1 - Sterile hypodermic syringes for single use, Part 1: Syringes for manual use
- **CEN-CENELEC Focus Group Standards for Organ-on-Chip, specially in WG1 –terminology and WG3 – Engineering**, development of standardization roadmap.

# Route to impact for standardisation

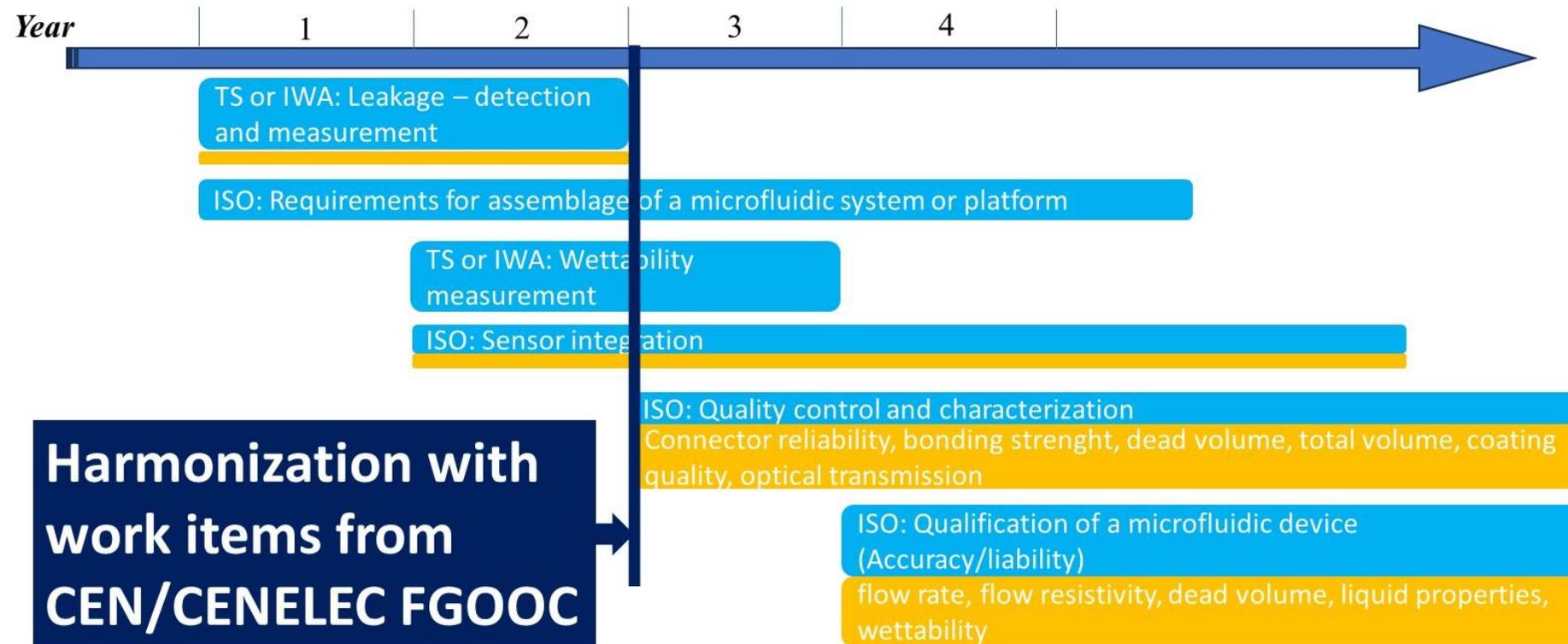
- Regular participation in 4 ISO TCs and CEN, **8 revised or new standards.**
- Proposal of new work Items at ISO/CEN level with project leadership
- Presentation of the project activities in the ISO/CEN TCs and explaining the needs for metrology in a common language
- Inclusion of key metrology documents in standards like GUM and VIM
- Providing technical reports directly to ISO/CEN TC secretariat
- The comments were sent by consortium P members or through EURAMET liaison officer.
- 90% of comments accepted in average



# ISO/TC48/WG3 – Microfluidic devices

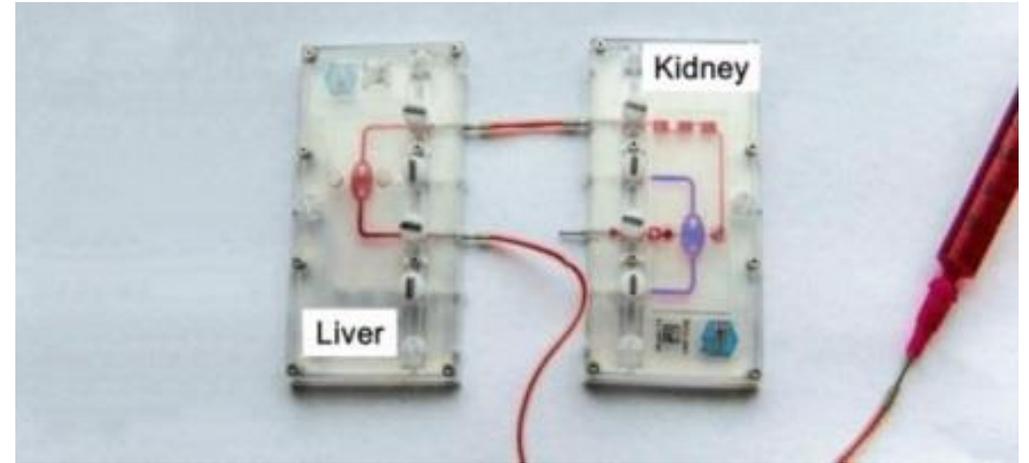
## ISOTC48/WG3 Timeline for working items

- From MFMET project
- From surveys



# EMPIR – MeDDII – 18HLT08

- **Call:** 2018 Health
- **JRP name:** Metrology for drug delivery
- **JRP reference:** 18HLT08 MeDDII
- **Total budget:** ~ 1,7 M€
- **Total labour:** ~200 MM
- **Duration:** 36 months (6 month extension)
- **Start date:** June 2019
- **Coordinating Organisation:** IPQ
- **Partners** - 9 NMIs/DIs, 5 universities, 2 manufacturers. 11 countries
- **Colaborators** – 40



# Overview

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- This project aims to characterize and improve dosing accuracy of existing drug delivery devices and multi infusion systems and enable traceable measurements of their volume, flow rate, pressure and inline sensing operation at very low infusion rates:
  - by the development of **new calibration methods**
  - by **expanding the existing metrological infrastructure**



# Needs and motivation



- **Infusion therapy** → Main form of therapy in health care.
- **Deviations** in medication dose into the patient bloodstream have **dramatic effects**.
- Wide range of applications (vasoactive drugs, multi-infusion therapy, pre-term babies therapy, organ-on-a-chip technology, etc.).

Validated metrological infrastructure for traceable measurement and calibration

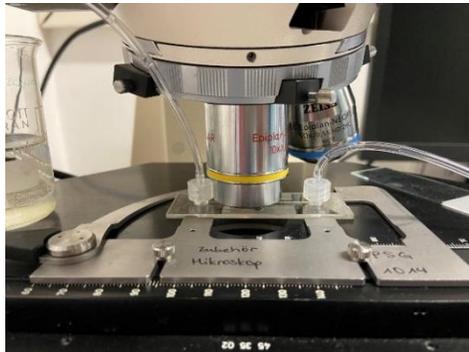
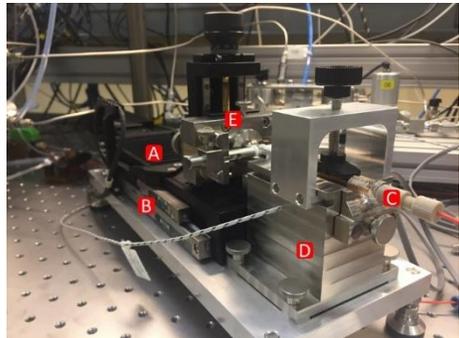
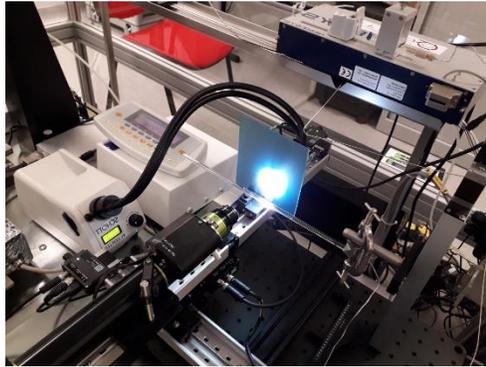
- volume
- ultra-low flow rates (< 100 nL.min<sup>-1</sup>)
- pressure
- fast changing flow rate
- physical properties of mixtures
- occlusion phenomena

**Crucial for patient safety and to advances in:**

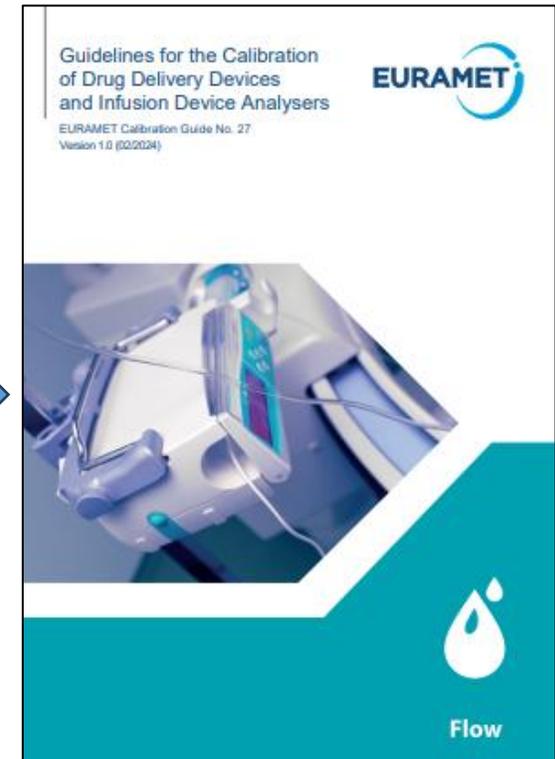
- ✓ microfluidics and organ-on-a-chip faithful reproduction of multi-organ functions
- ✓ reproducibility and accuracy of multi-infusion therapies
- ✓ reliability of drug delivery devices

# Scientific outcomes MEDDII project

## Development of metrology infrastructure and procedures for for ultra-low flow rates



New EURAMET  
Guide CG 27 -  
Guidelines for the  
Calibration of Drug  
Delivery Devices and  
Infusion Device  
Analysers



# Cooperation in standards development

| ISO TC          | Standard                         |
|-----------------|----------------------------------|
| ISO TC 84       | 7886-2:2020                      |
| ISO TC 210      | ISO TR 24971:2019                |
| TC62/SC62D/MT23 | ISO/IEC 60601-2-24:2012          |
| AAMI            | TIR 101:2021 (Technical report)  |
| AAMI            | Draft TIR 111 (Technical report) |
| ISO TC48/WG4    | ISO 8655-9:2022                  |
| ISO TC48/WG5    | ISO23783-1, 2 and 3:2022         |
| ISO TC48/WG5    | ISO/DTR 6037                     |
| ISO/TC 150/SC 6 | ISO 14708-4:2022                 |
| ISO/TC 212      | ISO DIS 15189                    |

# Route to impact for standardisation

- Participation in 6 different ISO TCs, 8 WG, **11 revised or new standards.**
- The majority of the comments sent by MeDDII consortium were of technical and metrological nature.
- Also, it was also suggested to include EURAMET cg guides, the VIM and the GUM in the bibliography.
- The comments were sent by consortium P members or thought EURAMET as liaison organisation.
- Several of the standards had project leaders that are also partners of the consortium. In average 70% of the comments were accepted.



# How can Metrology improve standards development

1. Improved measurement procedures
2. Use of more accurate instrumentation
3. More control of the test conditions
4. Adequate calculation formulas
5. Improvement of uncertainty estimation information



The use of standardized calibration procedures leads to comparable more accurate and reliable results that will benefit Industry and global economy.



<https://mfmet.eu>

<https://zenodo.org/communities/mfmet>



THANK YOU

**Elsa Batista**

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This project 20NRM02 MFMET has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.