Establishing Metrology Standards - research projects outcomes

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Head of volume and flow laboratory

MFMET and MeDDII project Coordinator

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**.

Instituto Português da Qualidade

IPQ – Portuguese Institute for Quality

Establishing Metrology Standards in Microfluidic Devices

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.

As a National Metrology Institution

- 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.

National Metrology Subsystem

Metre Convention

Metre Convention (1875)
Bureau International des Poids et Mesures
Mutual Recognition Arrangement
(CIPM - MRA) (1999)

CIPM MRA

- **National Measurement Standards**
- **Interlaboratory Comparisons**
- **Quality Management System**
- **149 CMC** (calibration measurement capabilities)

IPQ
National Metrology Institution

Scientific Metrology

LNM
IPQ – LNM

DI (IST – LMRI)
DI (IH – LQPM)
DI (UHM – LNEC)

Applied Metrology

IPQ – LNM

Accredited Calibration Laboratories
NP EN ISO/IEC 17025 et ISO 17034

IPAC acreditação

Legal Metrology

IPQ

DR – Autonomous Regions (Madeira and Azores)
SMM & SCM (Metrology Services)
OVM (Metrological Verification Bodies)
R&I (Installers & Repairers)

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

And belongs to the first group of 17 signatory countries

1875 – Metre Convention

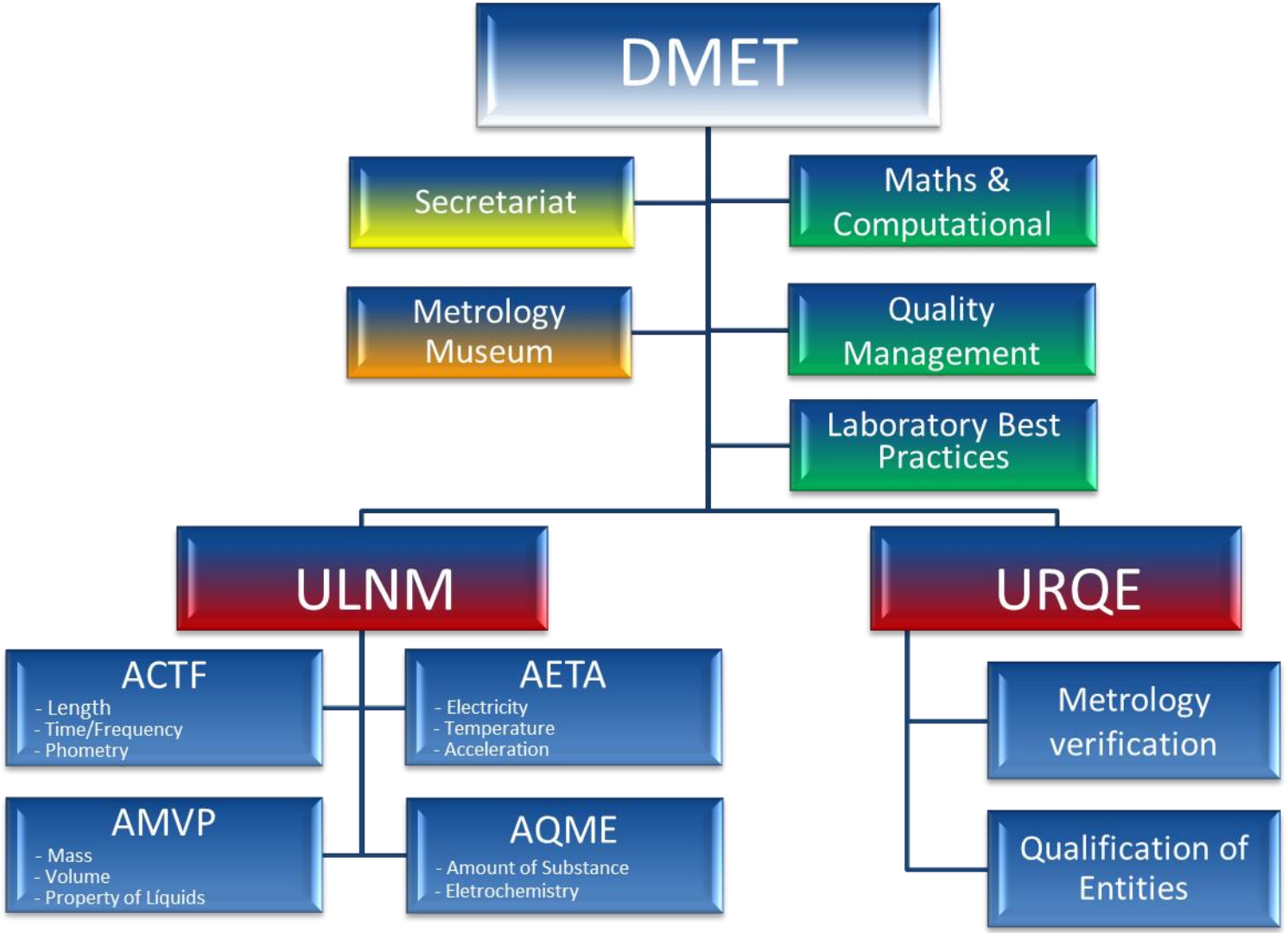
1984 - OIML

1987 – EURAMET

1990 – WELMEC

Metrology Department

- Scientific Metrology
- Applied Metrology
- Legal Metrology



National Metrology Laboratory

A laboratory with 52 technical metrological domains

Metrology Department with 41 persons

(80 % Academic Degree)

2 200 m^2 Laboratory area

10 000 m^2 Covered area

A self-sustained system

The Metrology in numbers - 2023

- **149** CMC - KCDB - BIPM
- **18** Projects R&D
- **2750** Services - Calibration, Metrology Verification, Preparation and Certification of Reference Materials, Tests MA, ….
- **63** N.º Publications of papers and presentations in conferences
- **7** European Metrology Networks (environment, energy, quantum technologies,….)

National Metrology Laboratory

IPQ-Volume and Flow Laboratory

MFMET
Establishing Metrology Standards in Microfluidic Devices

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

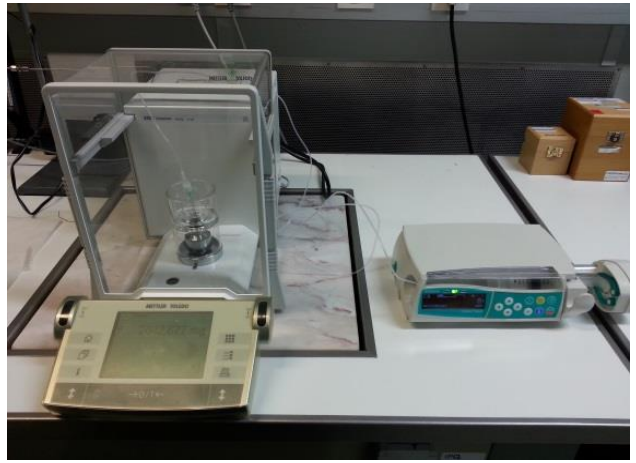
Calibration of medium and large volumes

Range - From 0,1 µL to 10 000 L

IPQ-Volume and Flow Laboratory

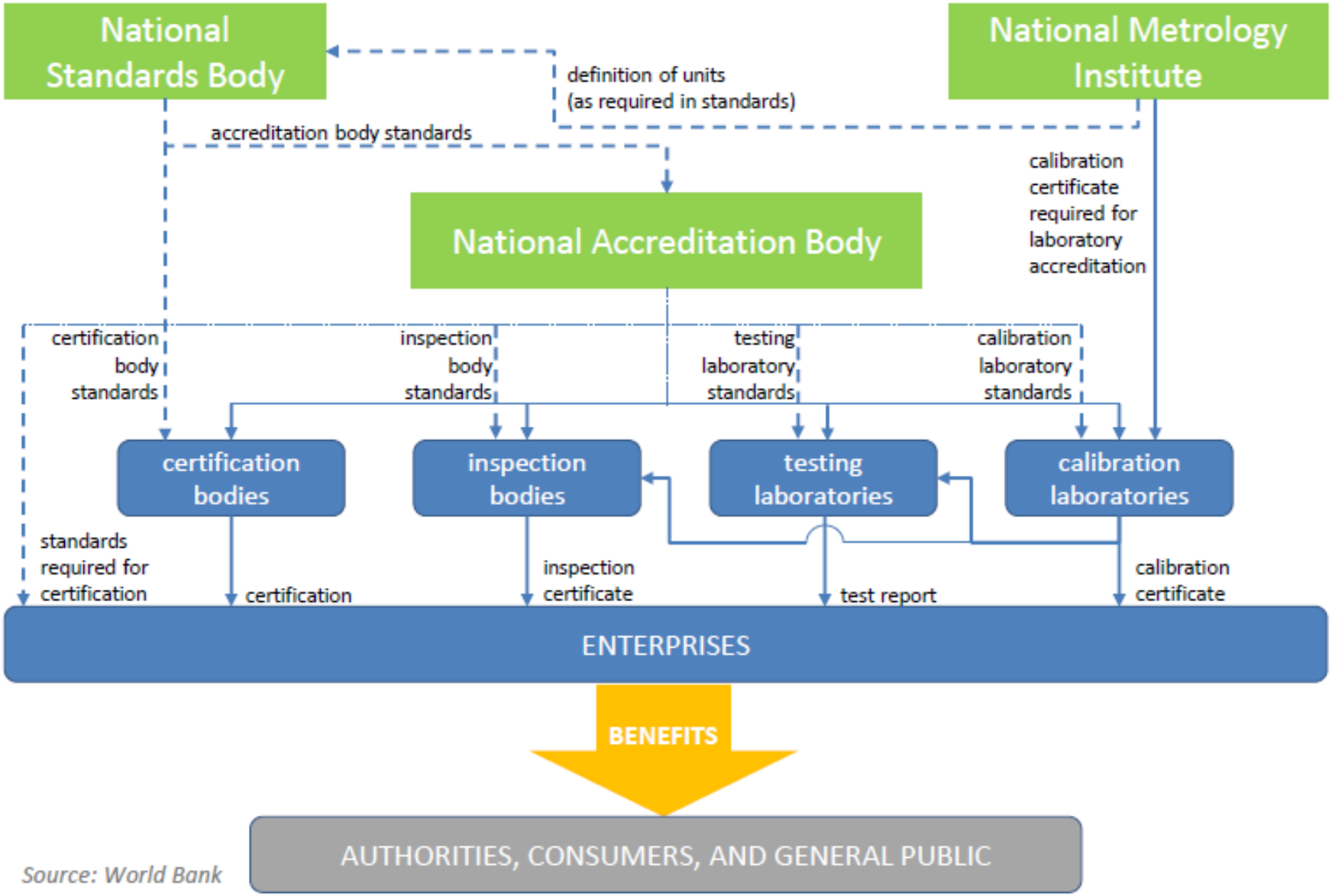
MFMET
Establishing Metrology Standards in Microfluidic Devices

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

Establishing Metrology Standards in Microfluidic Devices

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

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.

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

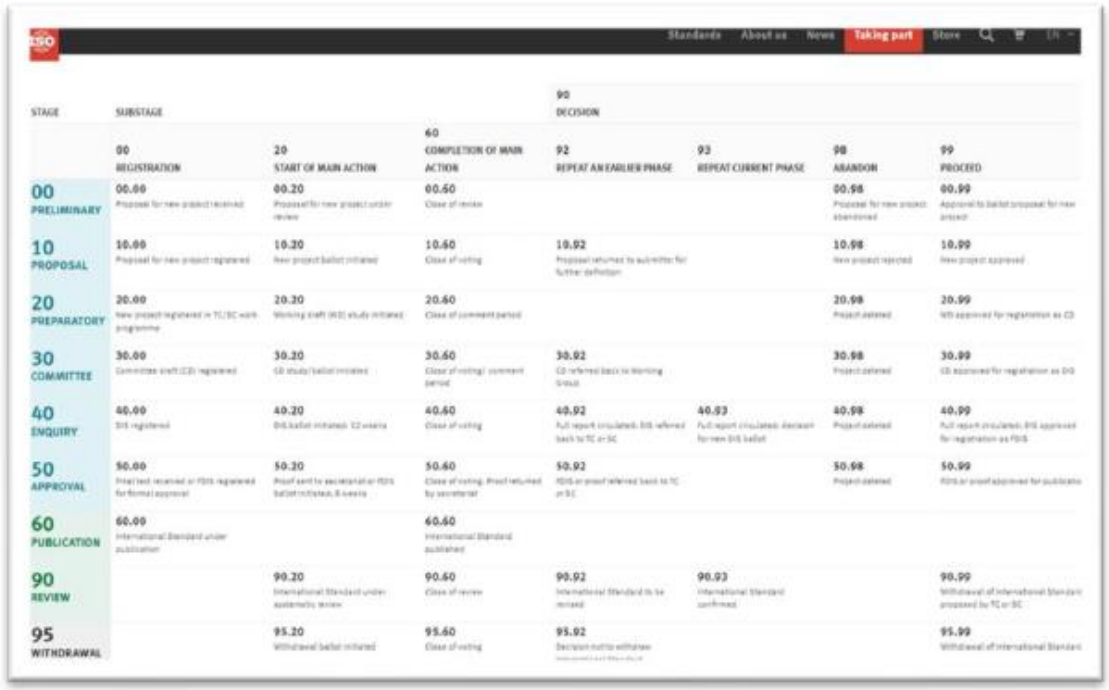
ISO and CEN revision process

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 our 48 months work for new standards
All standards must be revised every 5 years

Standard revision process



STAGE	SUBSTAGE			90 DECISION			
	00 REGISTRATION	20 START OF MAIN ACTION	60 COMPLETION OF MAIN ACTION	92 REPEAT AN EARLIER PHASE	93 REPEAT CURRENT PHASE	98 ABANDON	99 PROCEED
00 PRELIMINARY	00.00	00.20	00.60			00.98	00.99
10 PROPOSAL	10.00	10.20	10.60	10.92		10.98	10.99
20 PREPARATORY	20.00	20.20	20.60			20.98	20.99
30 COMMITTEE	30.00	30.20	30.60	30.92		30.98	30.99
40 ENQUIRY	40.00	40.20	40.60	40.92	40.93	40.98	40.99
50 APPROVAL	50.00	50.20	50.60	50.92		50.98	50.99
60 PUBLICATION	60.00		60.60				
90 REVIEW		90.20	90.60	90.92	90.93		90.99
95 WITHDRAWAL		95.20	95.60	95.92			95.99

https://www.iso.org/stage-codes.html

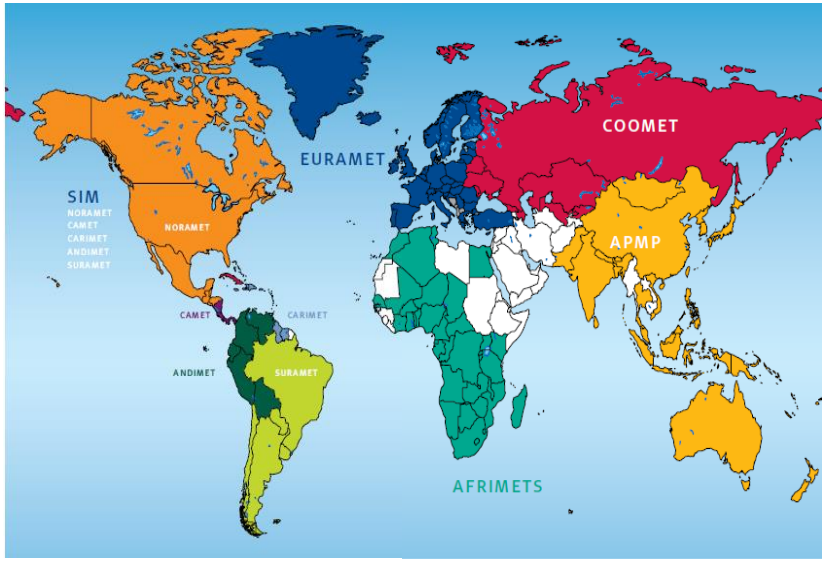
How to engage with standardization bodies and TC

- **At ISO and CEN level:**
  - Find out which standardization technical comities (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 in 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

Establishing Metrology Standards in Microfluidic Devices

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 refeence: 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

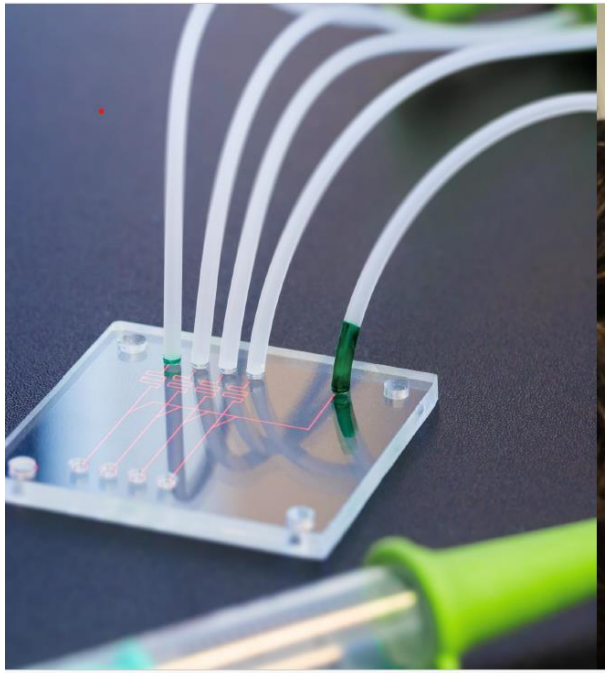
Chief stakeholder: The Microfluidic association

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

Objectives

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

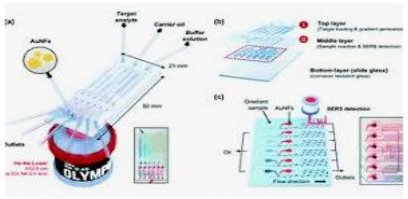
- ✓ by the development of **consensus-based measurement protocols & guidelines**
- ✓ By the **dissemination of metrology standards** towards normative committees (ISO TC48/WG3), industry and end users



Microfluidics

Establishing Metrology Standards in Microfluidic Devices

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 ...
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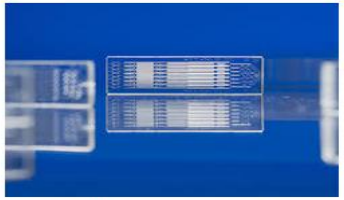
Dolomite Microfluidics offers new ...
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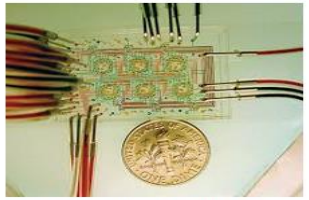
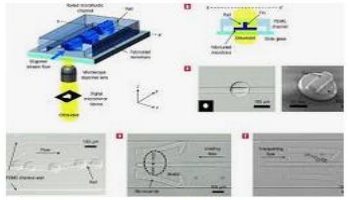

Microfluidics? What's That? A Beginn...
microfluidicfuture.com


Concept of railed microfluidics and ...
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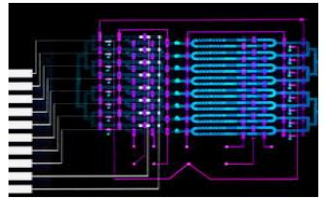
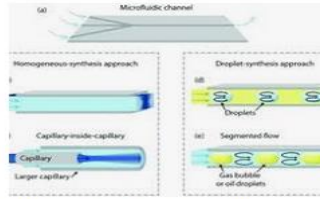
Future of Medical Diagnostics
matmatch.com


Microfluidics device helps diagnose ...
eurekalert.org



Microfluidics and catalyst particles ...
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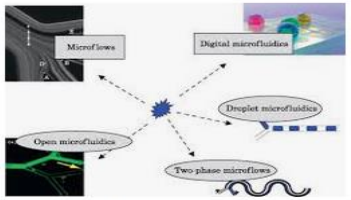
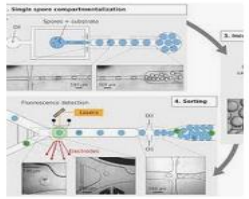


Digital Microfluidics - an overview ...
sciencedirect.com


Droplet-based microfluidics ...
researchgate.net

Yole, Yole Développement, Yole Development,
yole.fr


Future of Medical Diagnostics
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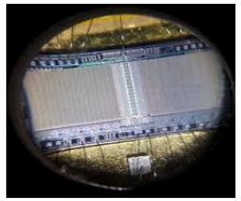
Microfluidics: A general ove...
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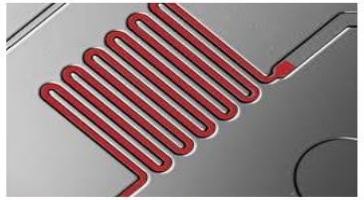
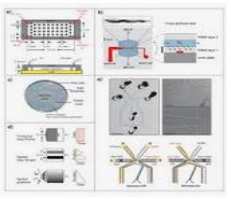

Using Microfluidics to Diagnose HIV - ASME
asme.org


Microfluidics as a tool for C...
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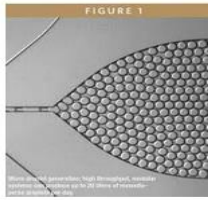
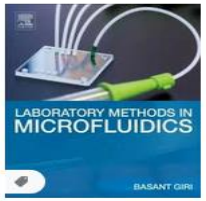
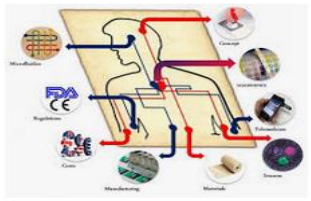


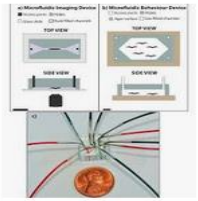
Microfluidics Approach to...
drug-dev.com



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


Microfluidics
surfix.nl


Microfluidics | Ali K. Yetisen
scholar.harvard.edu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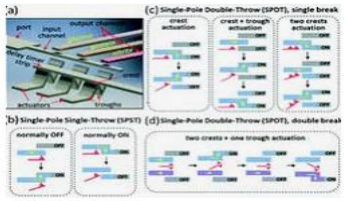
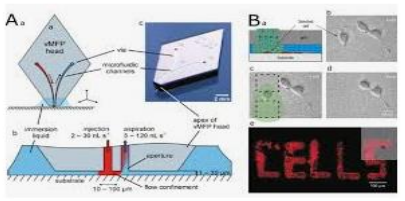
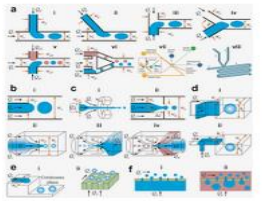

Microfluidics News - Daily update on ...
microfluidics-news.com



30 years of microfluidics - ScienceDirect
sciencedirect.com


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

Related searches


paper microfluidics

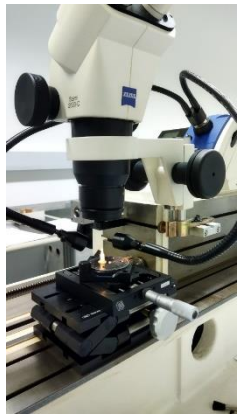

mixing microfluidics

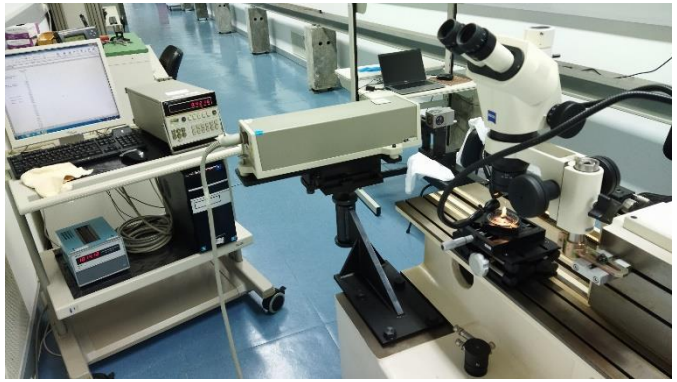

single cell microfluidics

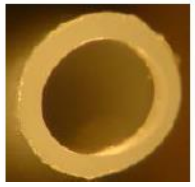
Scientific outcomes MFMET project

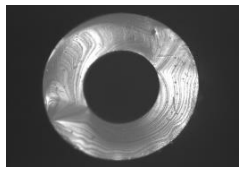
Establishing Metrology Standards in Microfluidic Devices

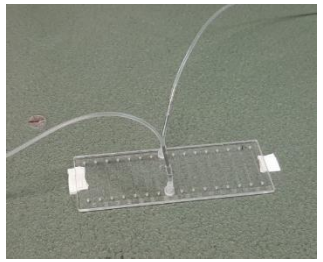
Development of a test protocols for **liquid proprieties, dimensional and flow** measurements: length, density, contact angle, viscosity, flow, flow resistivity, volume, wettability, surface roughness, leakage, etc.

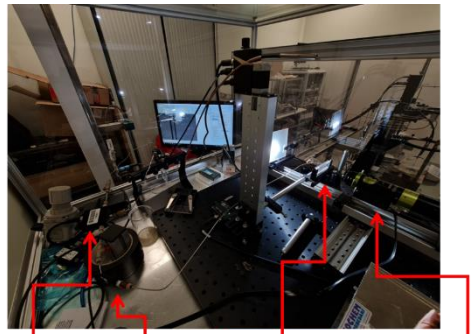


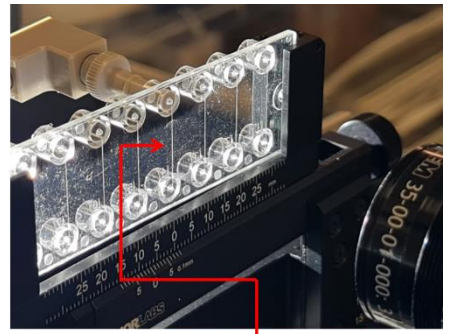












MFMET and standardization activities

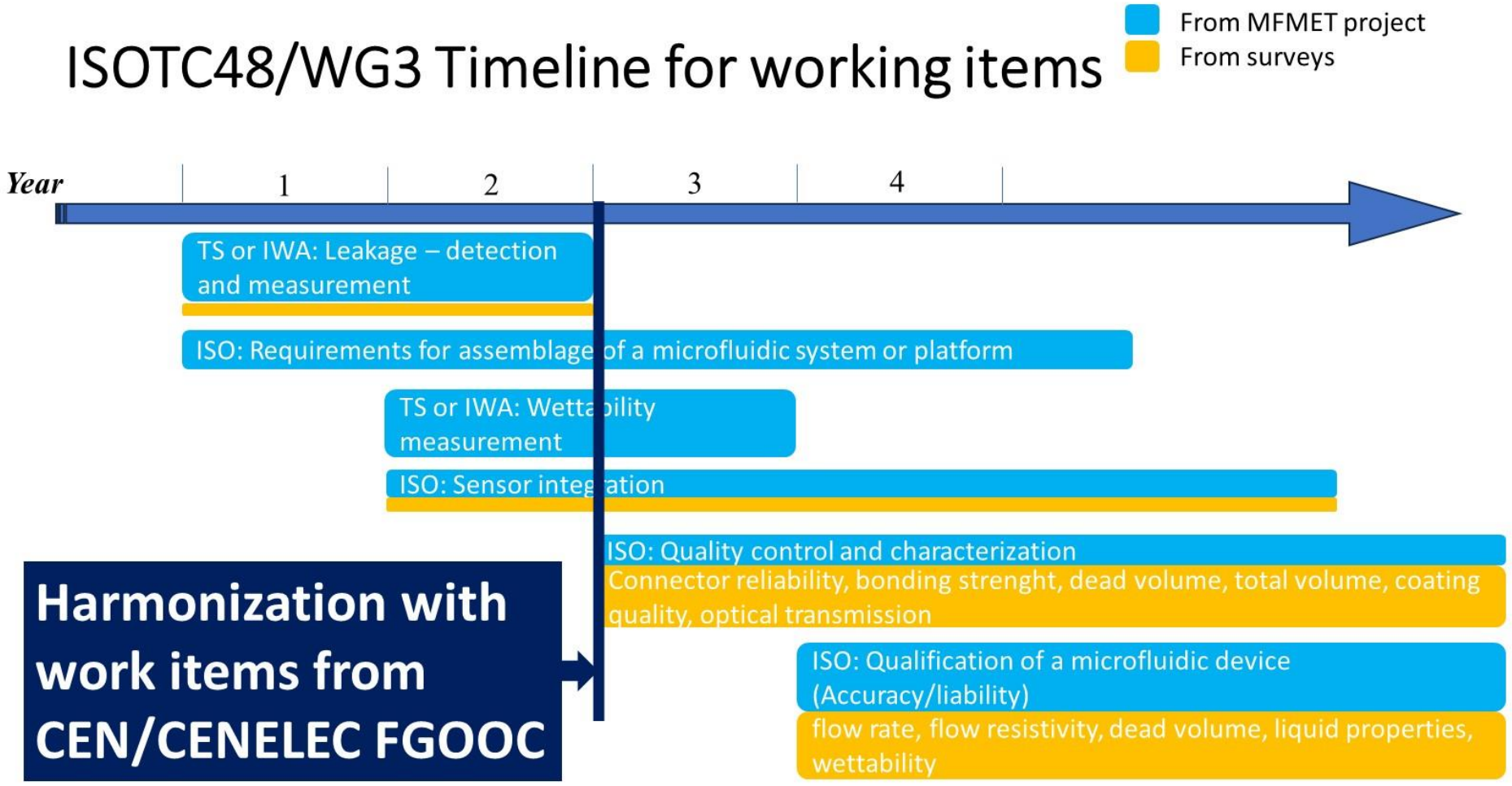
- **ISO/TC48/WG3** - Microfluidic devices
  - ISO 22916:2022 – Microfluidic devices – Interoperability requirements for dimensions, connections and initial device classification
  - ISO 10991:2023 Microfluidics – Vocabulary,
  - A new ISO/CD TS 6417 Microfluidic pumps — Symbols and performance communication 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

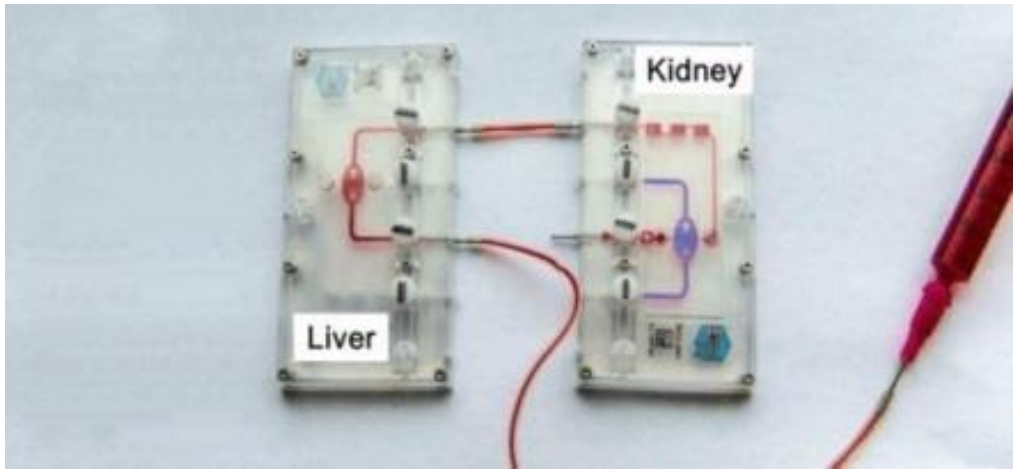
- Regular participation in 4 ISO TCs and CEN, **8 revised or new standards.**
- Proposal of new work Items at ISO/CEN level with project leadership
- Presentation of the project activities in the ISO/CEN TCs and explaining the needs for metrology in a common language
- Inclusion of key metrology documents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

ISO/TC48/WG3 – Microfluidic devices



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



MEDD II
Drugmetrology.com

Overview

- 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**

MEDD II

Drugmetrology.com

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

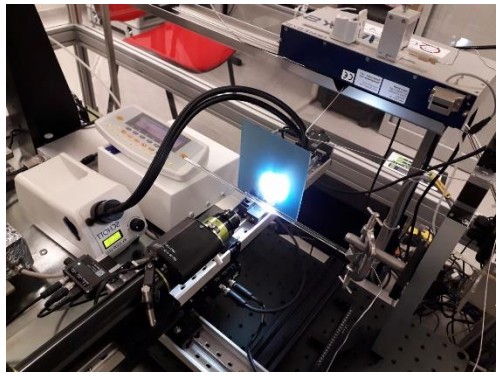
- volume
- ultra-low flow rates (< 100 $nL.min^{-1}$)
- pressure
- fast changing flow rate
- physical properties of mixtures
- occlusion phenomena

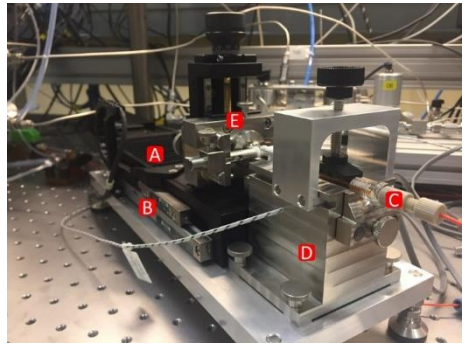
Crucial for patient safety and to advances in:

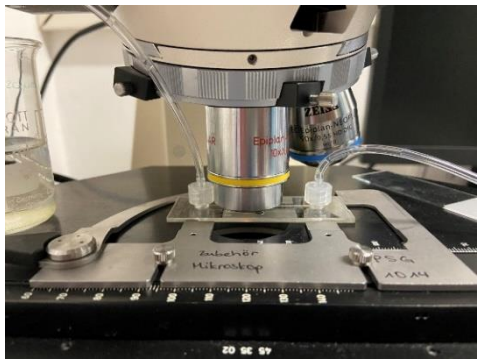
- ✓ microfluidics and organ-on-a-chip faithfull reproduction of multi-organ functions
- ✓ reproducibility and accuracy of multi-infusion therapies
- ✓ reliability of drug delivery devices

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

MFMET
Establishing Metrology Standards in Microfluidic Devices

THANK YOU

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