Type approval and verification of particle-measuring devices for PTI

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Agenda

1. Swiss requirements for particle measuring devices for PTI
2. Verifications of particle measuring devices for PTI
3. PTI type approval at METAS
4. Calibration capabilities at METAS
5. Consulting services provided by METAS

Swiss requirements for PTI counters - Overview

- **Reference conditions**
  Particle number concentration related to the ambient conditions prevailing during the individual measurement.

- **Error limits for counting efficiency**

GMD (nm)	Error limit for CE
23	CE < 50 %
41	CE > 40 %
80	70 % < CE < 130 %
200	< 300 %

- **Measuring range**
  min (50'000…5'000'000) cm^{-3}

- **Efficiency VPR**
  > 95 %, checked with tetracontane aerosol
  GMD_{mob} 30 nm @ > 1e5 cm^{-3}

- **Response time**
  > 70 % of final value in 10 seconds

- **Sequence for the official measurement**
  15 s waiting time
  5 s measurement 1
  5 s pause
  5 s measurement 2
  5 s pause
  5 s measurement 3

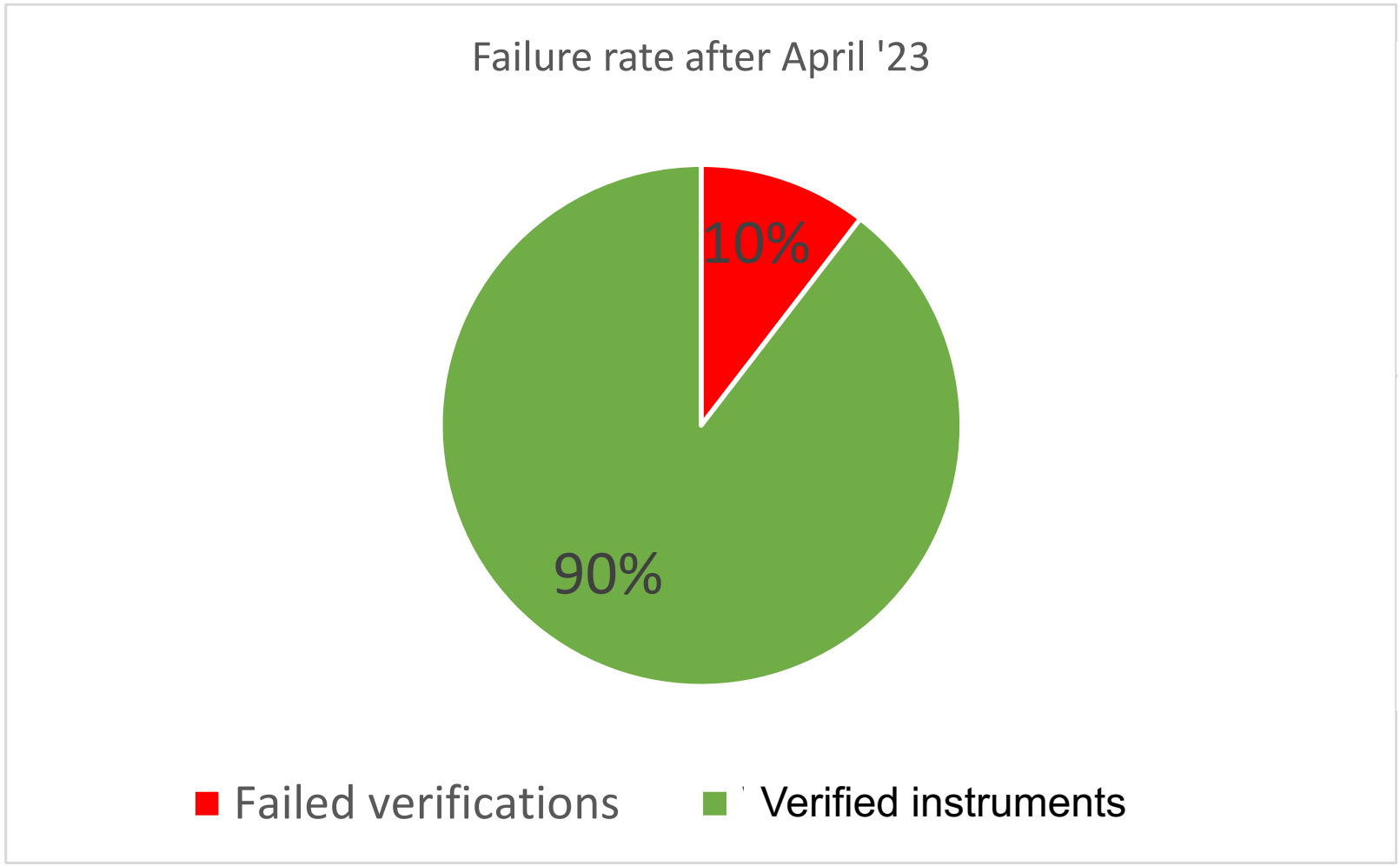
  → Average = final result

Verifications in CH

- Every measuring device used for official measurements must be **verified by METAS** at least once a year.
- One of the requirements for the verification is **prior maintenance** (at least once per year) by the manufacturer or distributor.
- During verification, an **official measurement is simulated**. A soot aerosol (GMD_{mob} 80 nm) is generated and the measured value by the device under test (DUT) is compared with the reference value.
- All verifications performed with **combustion particles as test aerosols**.[1][2]
- The verification **error limit is ± 30 %.**
- METAS has performed almost 2’000 PTI verifications in the last 2 years

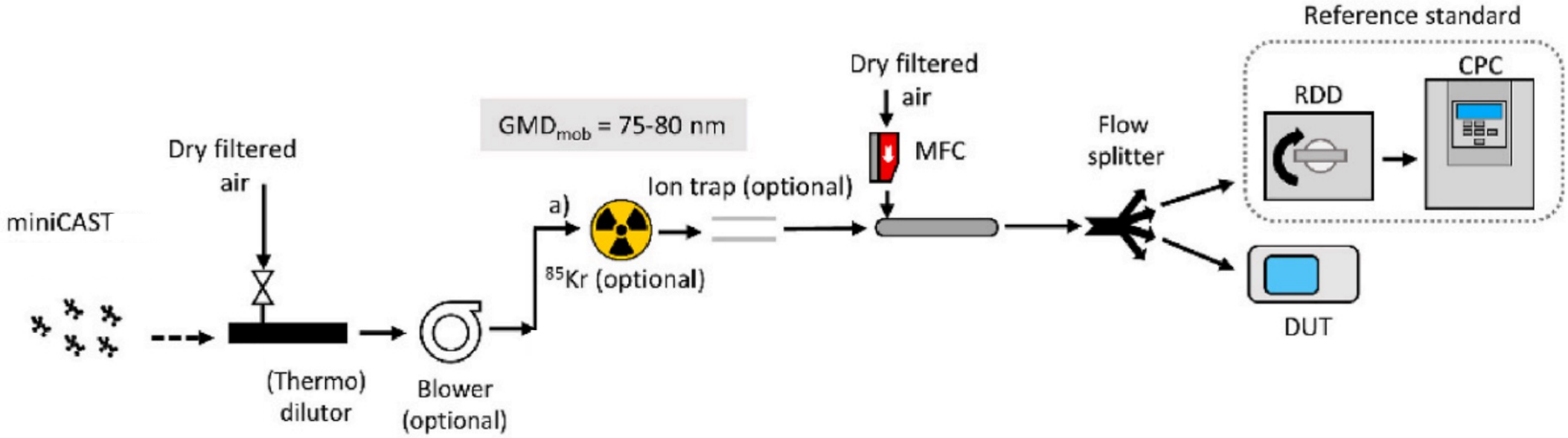
[1] Vasilatou et al, https://doi.org/10.1016/j.jaerosci.2023.106182
[2] Hammer et al, https://doi.org/10.5194/ar-2023-16

Verifications in CH



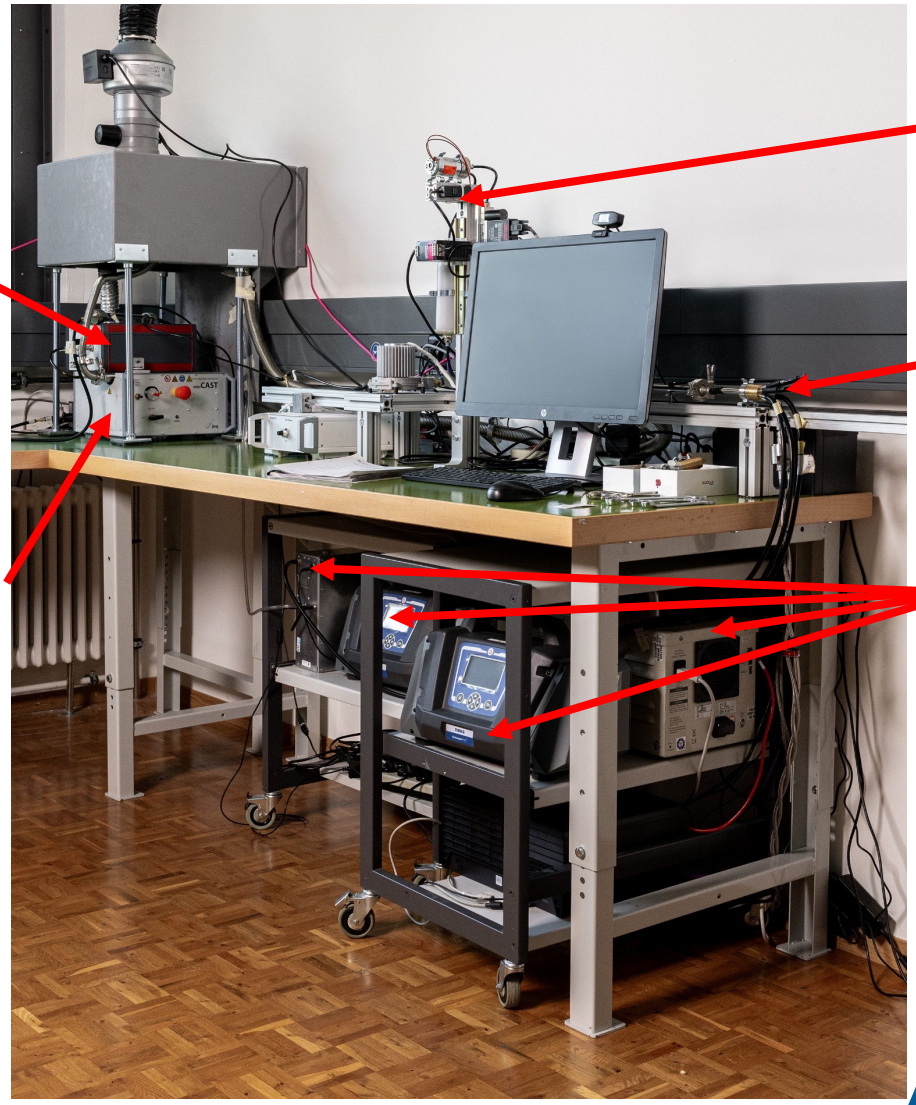
- Most rejections are due to **poor adjustment**
  => CE beyond range of (70…130) %.
- **Adjustments with soot aerosols** seem to lead to a **lower rejection rate**.
- **Improvement** in the adjustment procedure is possible and leads to less rejections (see figure).
- **Calibration of reference devices** including generator and set-up (e.g. NaCl nebuliser etc.) is essential.

Set-up for PTI verification at METAS



or NPET
(TSI Inc.)

Verification set-up at METAS



Catalytic Stripper and dilutor

Soot generator (miniCAST Type BC)

Active Dilution Bridge

8-Port Flow Splitter

Reference instruments for counting and size

PTI type approval at METAS

- Manufacturers of PTI counters need to fulfil the requirements of national legislation, e.g. in BE/NL/DE.

- METAS is able to perform full type approvals for all these countries.

- METAS performs tests such as

- climate tests according to OIML D11: ambient temperatures, humidity, damp heat cyclic
- ambient pressure to simulate different altitudes
- mechanical impact and vibration according to OIML D11
- EMC according to OIML D11 and DIN EN 61000-4
- Counting efficiency
- VPR efficiency

Calibration competences

Instrument category	Expanded uncertainty
Condensation particle counter (CPC) with size-selected monodisperse aerosols according to ISO 27891	(2…3) %
Reference devices for calibration/verification of PTI counters	(4…6) %

Our CPC calibration certificates are internationally recognised!

Please find more calibration services at https://www.metas.ch/metas/en/home/fabe/partikel-und-aerosole.html

Consulting

- METAS was the first National Metrology Institute (NMI) type approve devices PTI counters and has decades of experience in measuring combustion aerosols.
- METAS is happy to provide consulting services and help other institutes build the necessary expertise and Know-How.
- METAS possesses climate and pressure chambers to simulate different environmental conditions and altitudes.

Thank you for your attention!

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For more information please visit our website
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METAS
Ihre Referenz.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Institut für Metrologie METAS

Approved measuring devices (status as per 26.02.2024)

- TSI NPET 3795
- Naneos HEPaC
- TEN AEM
- Capelec CP3070-1+S
- AVL DiTEST Counter
- Mahle PMU 400
- Texa NP 01
- Bartec nEC
- Continental DX280
- VLT E9700

List of approved instruments (metas.ch)
Geräteart: Choose «Partikelmessgeräte»