Brake emission measurement

Matteo Federici, Guido Perricone

Outline
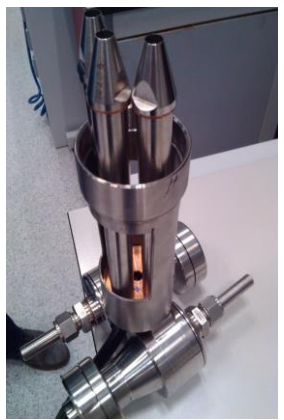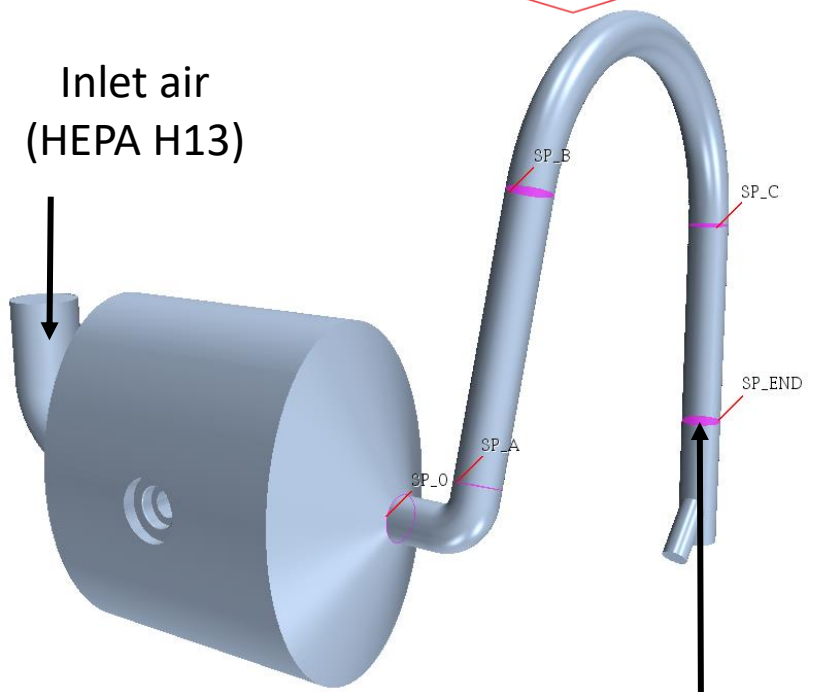
1. **Dyno bench setup;**

2. **Weighing system;**

3. **Clean room;**

4. **Statistical process stability: process control chart;**

5. **Points to be considered;**

1.Dyno bench setup

Dekati Elpi+

10 l min^{-1}

Inlet air
(HEPA H13)

SP_B

SP_C

SP_END

SP_O   SP_A

**Solid/Total
PN (CPC and Elpi+)**

TSI 3775

1.5 l min^{-1}

**Dekati
DEED**

TSI 3790A-10

1.0 l min^{-1}

Vertical,
coaxial and
isokinetic
sampling

PM (PM$_{10}$ impactor)

**PM$_{10}$ cyclons
flow rates
10 l min^{-1}**

**Chemical analysis
(filter holder)**

Instrument flow
rates: 10 l min^{-1}
PM$_{10}$ impactor air
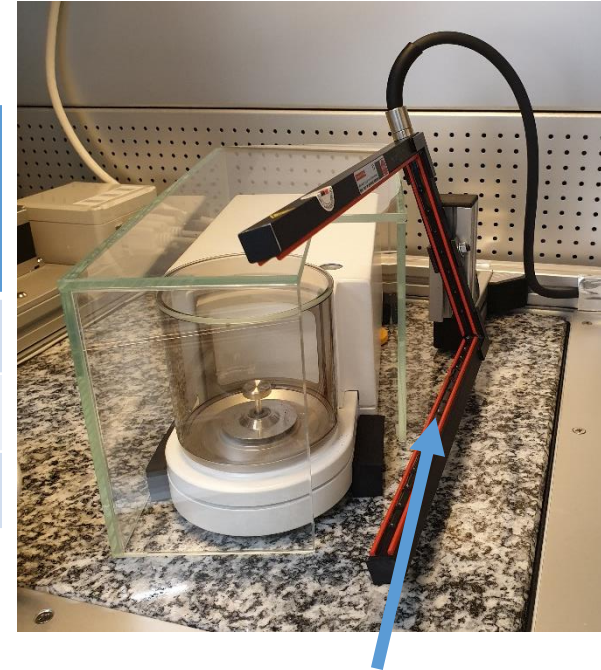flow controlled with
a digital mass-flow
controller

2.Weighing system

Analytical microbalance calibrated according to the DAkkS/DKD regulation

Manufacturer: Sartorius
Model: MSA2.7S-000-DM

DAkkS
Deutsche
Akkreditierungsstelle
D-K-19398-02-00

| Nominal Weight [mg]	Deviation [mg]	Measuring Uncertainty* [mg]	Relative Uncertainty [%]
10.0000	-0.0002	0.00421	0.0420
15.0000	-0.0001	0.00811	0.0540
100.0000	-0.0001	0.00992	0.0099

Measuring range: 0.0000 – 500.0000 mg
Readability: 0.0001 mg (0.1 µg)
Repeatability: 0.00005 mg at 200 mg

*the reported values are determined according to the EURAMET/cg-18/v.04 European guideline.

Charge neutralizer to stabilize the filter weight

2.Weighing system
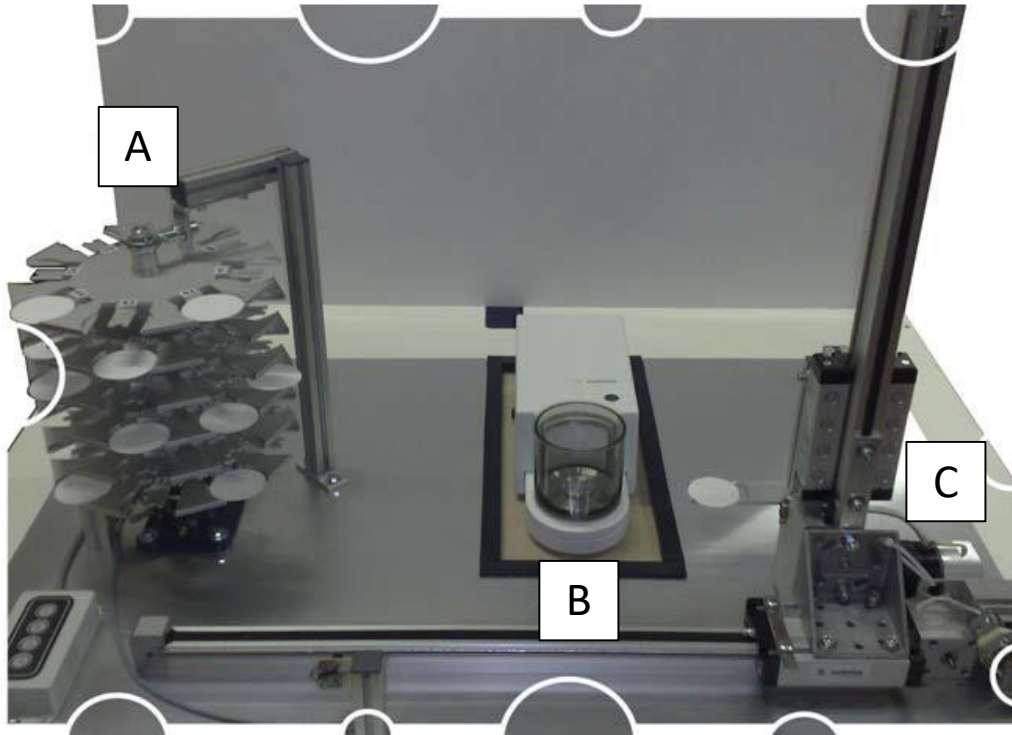
A: rotating tower to stock white and black filters
B: high precision balance
C: robotic arm that brings the filters to the balance

Conditioned + particle-free air glovebox

Environmental conditions:
22±1°C & Dew Point 9.5±1°C (45±3 % RH)

Fully automated procedure, filter conditioning before weighing at least 24 h *(Environmental conditions compliant with ECE Addendum 48: Regulation no. 49)*

3.Clean room

The glovebox where the filters are weighed is located into an ISO-6 certified clean room (according to ISO 14644-1)

The preparation of the filters, and the sampling devices (impactor and filter holder) is performed inside the clean room to prevent contaminations
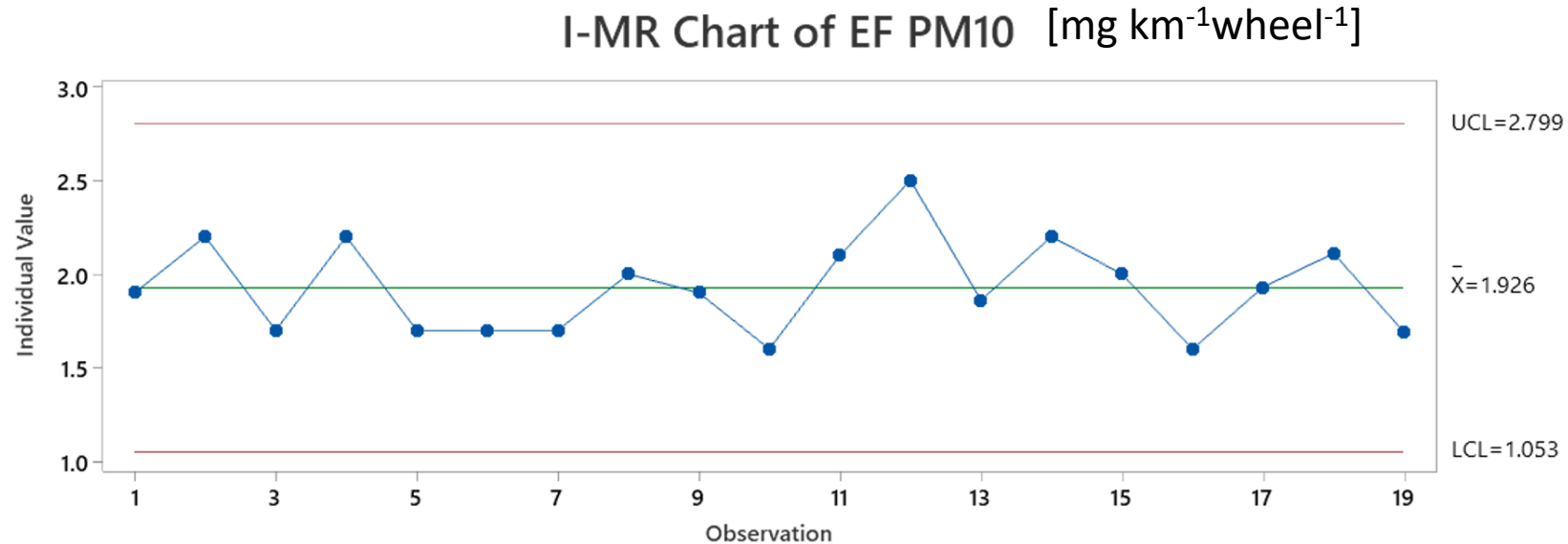
4.Statistical process stability: process control charts

19 data points have been collected to generate the process control chart (with the same brake system)

Average value: 1.92 ± 0.25* mg km^{-1}wheel^{-1}

*± 1σ

Methodology that we developed to check the stability of the measurement over the time

I-MR Chart of EF PM10 [mg km^{-1}wheel^{-1}]

5.Points to be considered within TF2

- Periodic check of the measurement stability, our proposal is to check the stability every six months.

- Consider that a certain variation in the measured values is expected. What is the allowed variability of the measurement?

THANK YOU