



LINK'S BRAKE EMISSION SYSTEM 'M6330'

Measurement devices, sensors, and layout

Presented to PMP TF2

May 6th 2021

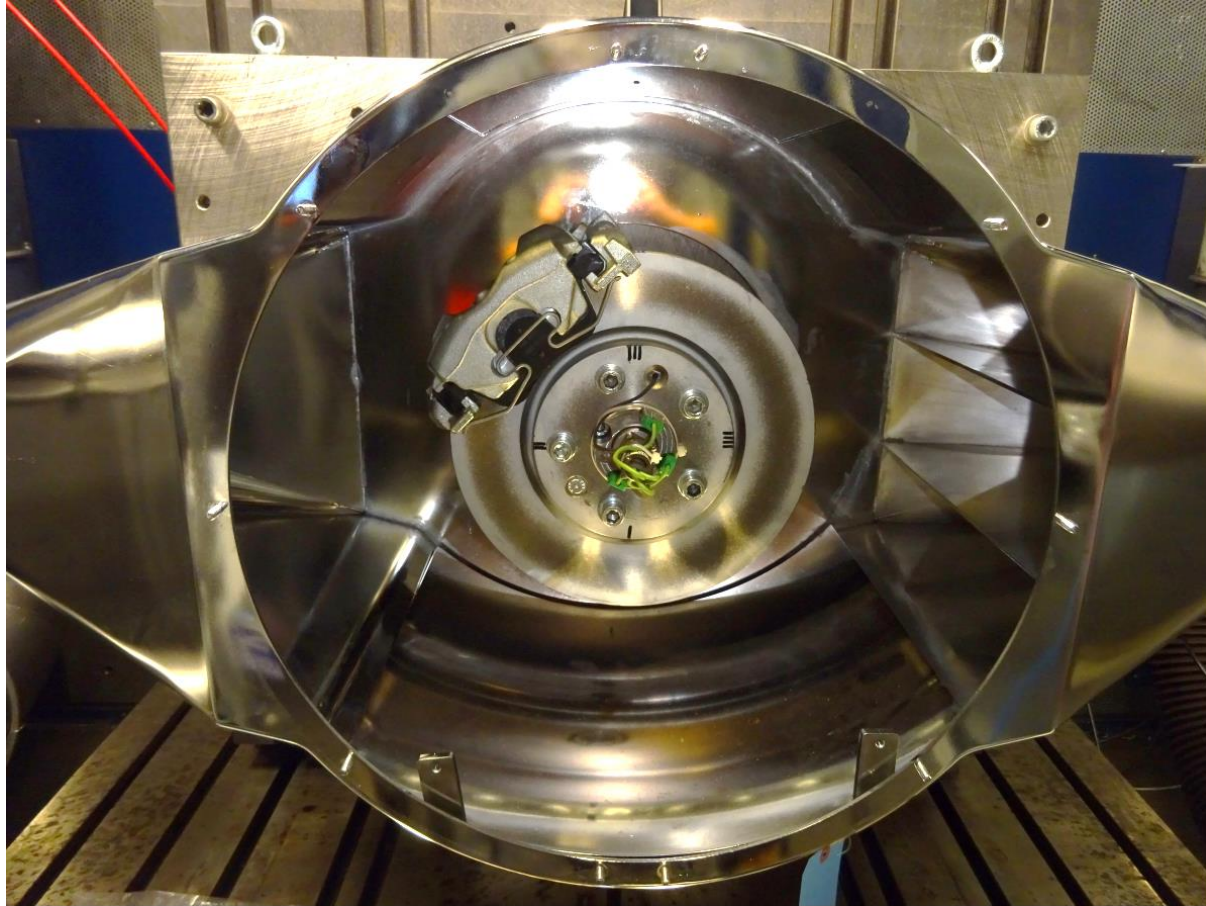


Link Engineering Company
Testing facility location (Germany)
Am Fleckenberg 10
Limburg an der Lahn, 65549

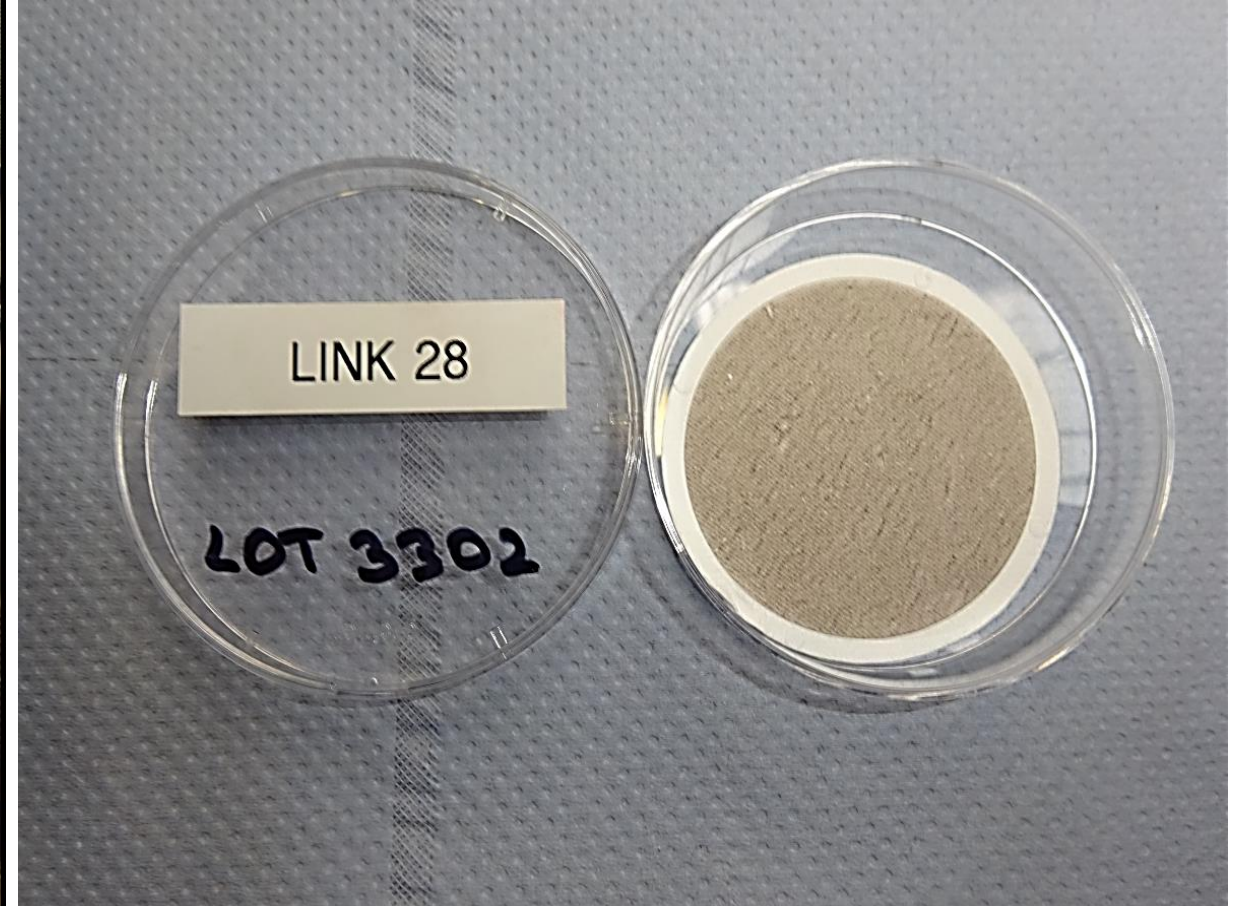
-
- Overall background and goal of this presentation
 - Enclosure
 - USA lab and EU lab comparison
 - Instrument background
 - PN
 - PM
 - Focus on Low volume samplers (LVS)
 - Filters / measurement standard – EN12341

Testing services aligned to ISO 17025:2017

Engineering and lab processes, weighing room, and fully-integrated test reports



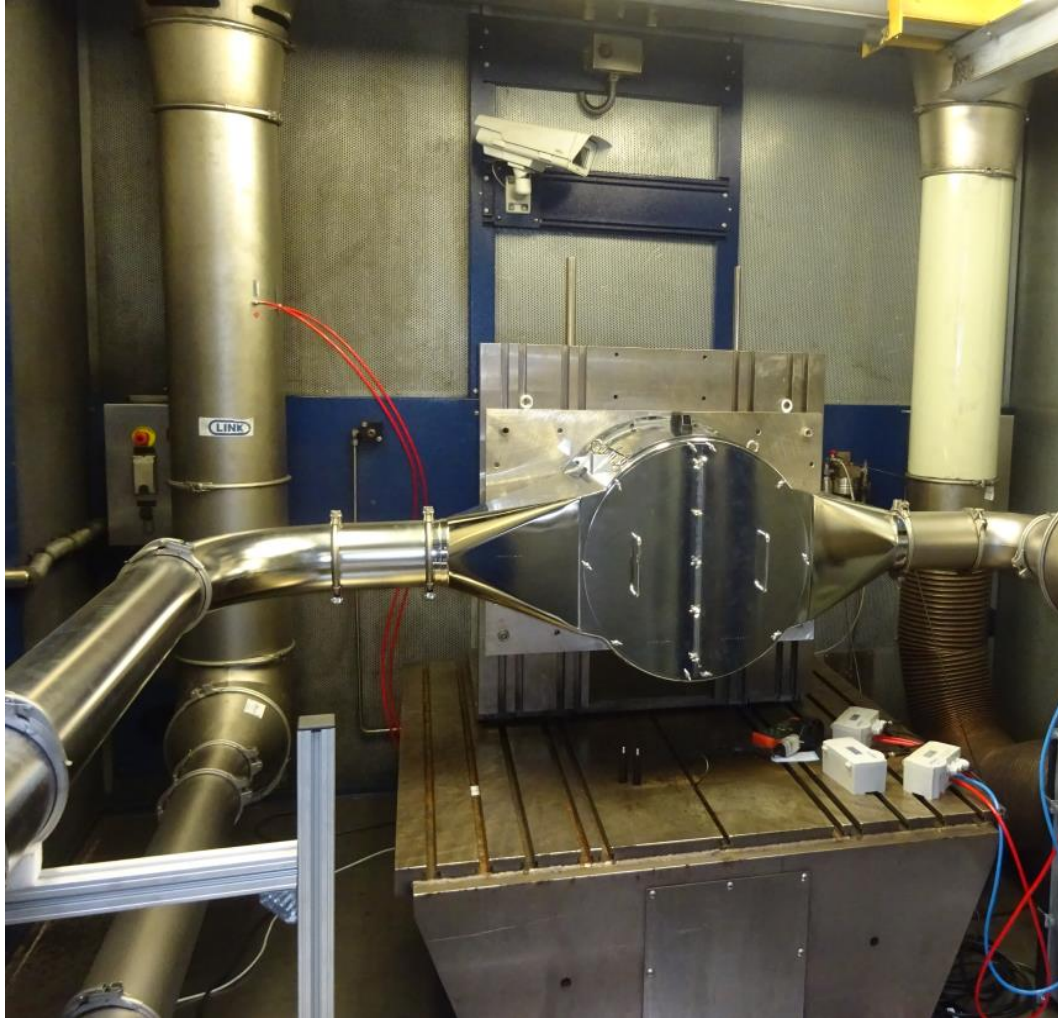
dedicated dynamometers



filter handling

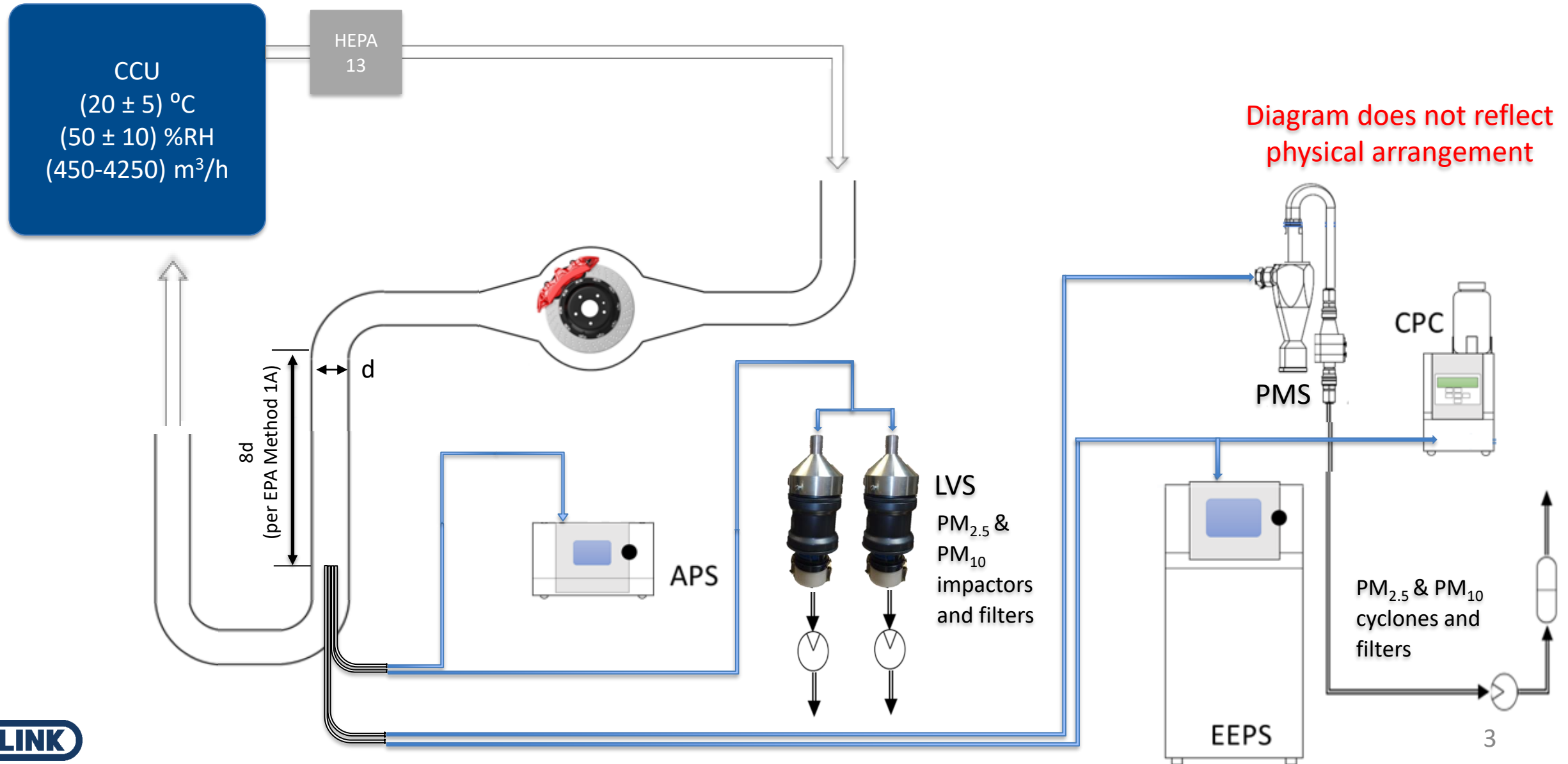
M6330 comprehensive configuration for PM, PN, and PSD

Conditioned air, aerodynamic enclosure, isokinetic, 6 nm-20 μm range



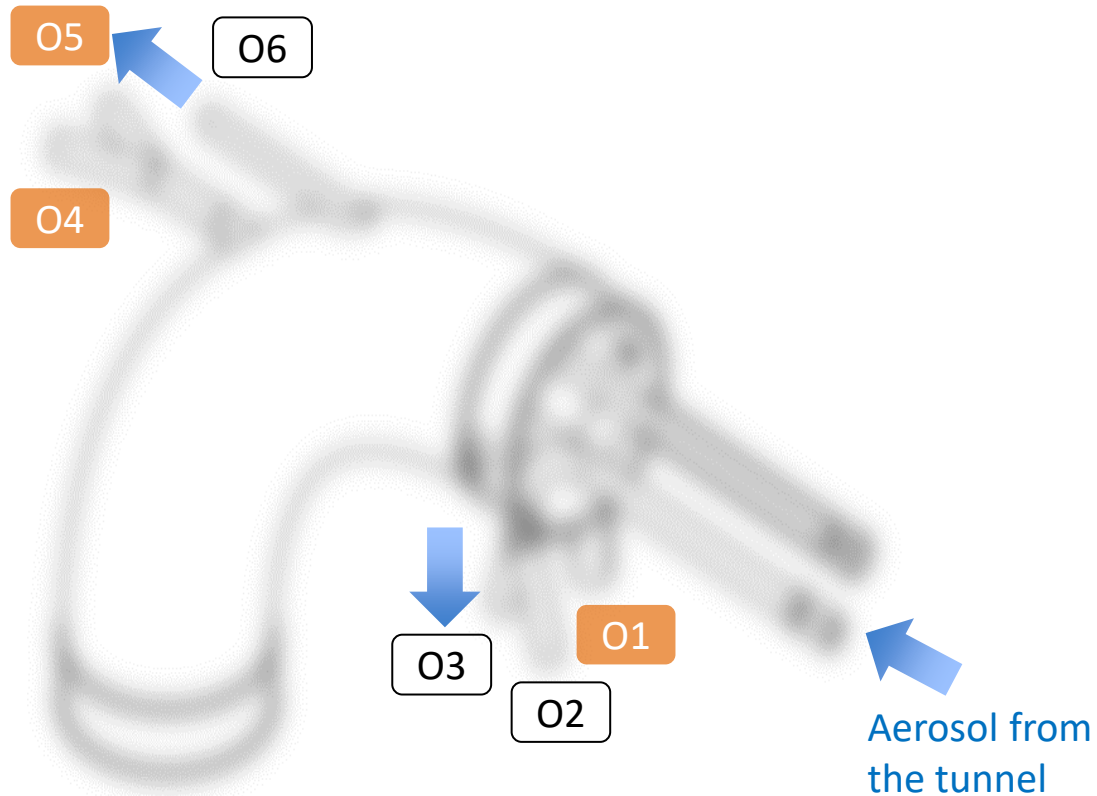
M6330 comprehensive configuration for PM, PN, and PSD

Conditioned air, aerodynamic enclosure, isokinetic, 6 nm-20 μm range



Particulate sampling elbow

Multiple inlets and outlets



Filled blocks represent outlets for PM sampling

Outlet	Instrument Model	Instrument Supplier	Flow (L/min)	Measurand
O1A*	LVS - PM _{2.5} impactor	Comde Derenda	38.3	PM
O1B*	LVS - PM ₁₀ impactor	Comde Derenda	38.3	PM
O2	APS 3321	TSI	5.0	PSD
O3	Empty – Optional for additional instruments	-	-	-
O4	PM filter holder 2000-30FVT PM ₁₀ cyclone 2000-30EI	URG	16.7	PM
O5	PM filter holder 2000-30FVT PM _{2.5} cyclone 2000-30EHS	URG	16.7	PM
O6A*	EEPS 3090	TSI	10.0	PSD
O6B*	CPC 3790A-10	TSI	1.0	PN

* connection to a flow splitter leading to multiple outlets

Particulate measurement range

PM, PN, and PSD

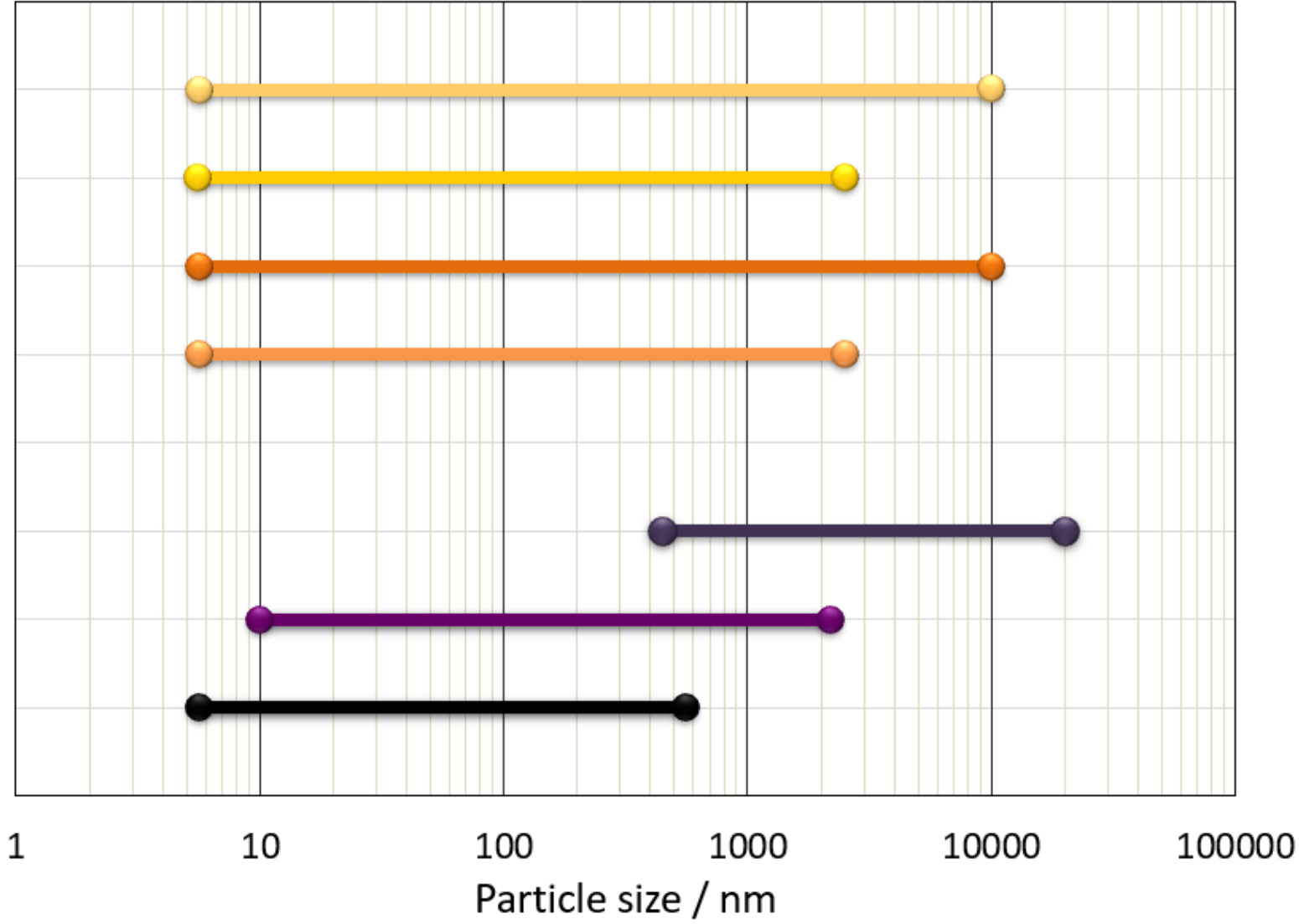
Bubbles along the lines are cutpoint diameters

Particle Mass

- PMS₁₀** – Cyclone + 47-mm filters
- PMS_{2.5}** – Cyclone + 47-mm filters
- LVS₁₀** – Impactor + 47 mm filter
- LVS_{2.5}** – Impactor + 47 mm filter

Particle Count

- APS** – Aerodynamic Particle Spec.
- CPC** – Condensation Particle Counter
- EEPS** – Engine Exhaust Particle Spec.



Particulate mass sampling

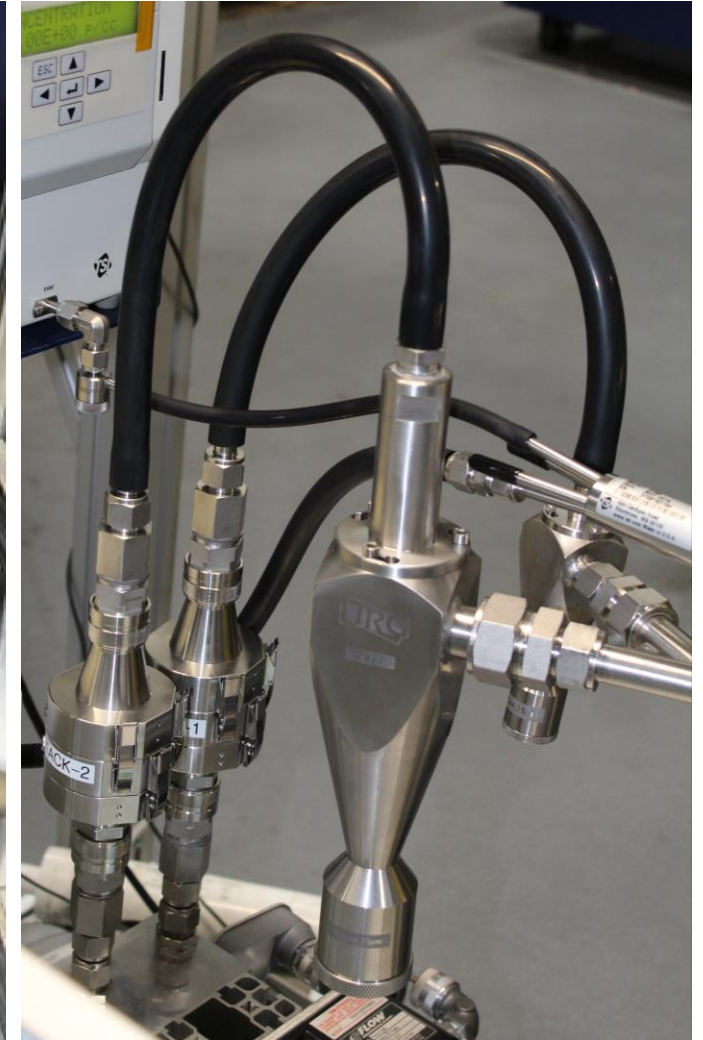
Using impactors or cyclones

Feature	LVS	PMS
Size control	Impactors	Cyclones
PM mass	Cut-off sizing PM2.5 PM10	Cut-off sizing PM2.5 PM10
Filter media	Quart-fiber or Glass fiber	PTFE (Teflon) Quart-fiber
Filter size	47 mm	47 mm
Chemical analysis feasibility	Feasible	Feasible
Inlet orientation	Vertical	Horizontal

LVS (Comde Derenda)



PMS (URG)

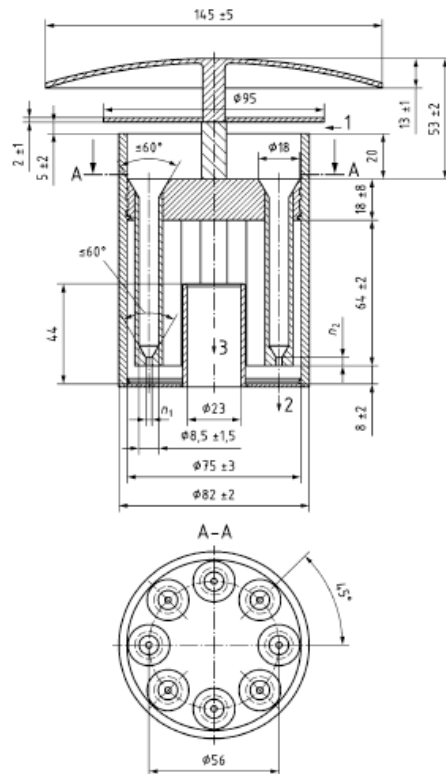


Particulate mass sampling

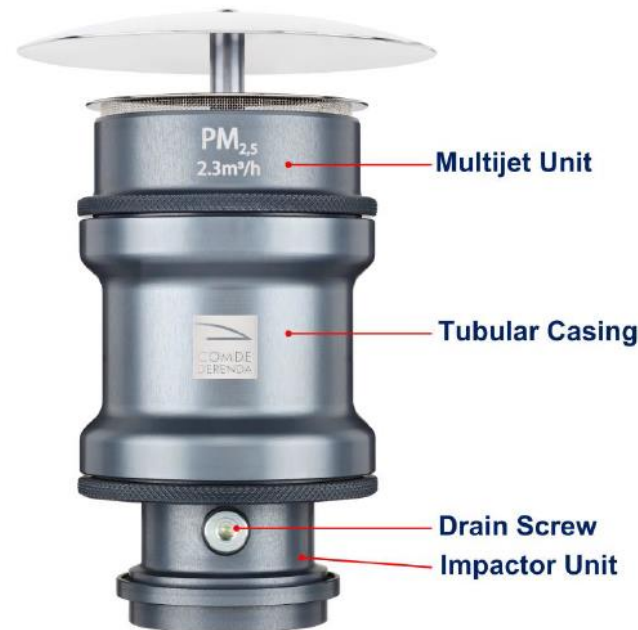
LVS impactors – per DIN EN 12341

Annex A (normative)

Design drawing of standard inlet for the sampling of PM_{10} and $PM_{2.5}$



Dimensions in millimetres



LVS

- Design to collect particulate matter (PM_{10} and $PM_{2.5}$) according to EN12341:2014
- The volumetric flow rate is electronically adjusted with an accuracy of $\leq 2\%$
- Volumetric flow rate set to $2.3 \text{ m}^3/\text{h}$ per EN

PM filter handling

Filter conditioning and storage per DIN EN12341

Equipment

- Weighing/equilibration chamber conditioned at the desired temperature and humidity
- Balance with a resolution of $\leq 10 \mu\text{g}$ (e.g. Sartorius ME 5-F)
- Electrostatic discharger
- Calibration weights (e.g. 100 mg, 1 g, 5 g)
- Temperature and humidity sensors + data logging

Filter preparation

- The filters must be equilibrated for ≥ 48 h before the first weighing
- Climatic conditions in the weighing/equilibration chamber :
19 - 20 °C as hourly mean value
45 - 50 % rH as hourly mean value
- Unloaded weighed filters may be stored for up to 2 months before sampling

PM filter handling

Filter conditioning and storage per DIN EN12341



← Temperature and humidity sensor

← Calibration weights

Sartorius ME 5-F balance with a resolution of 1 μg



PM filter handling

Filter conditioning and storage per DIN EN12341

Filter weighing procedure

- Balance performance check with 3 test weights
- Weighing of 4 unloaded and sampled reference filters of the same material as the test filters
- Reference filters always kept within the weighing/equilibration chamber; used as an indication of the system performance
- The filters are weighed 2 times (24 - 72 h between first and second weighing)

Filter size	Allowed difference between two weighing	
	Unloaded filters	Sampled filters
mm	mg	
47-50	0.04	0.06
150	0.5	0.8

- In case of higher differences a 3rd weighing is performed
- Difference between last 2 weighing > 0.04 mg for unloaded filters

↓
filter is discarded

- Difference between last 2 weighing > 0.06 mg for sampled filters

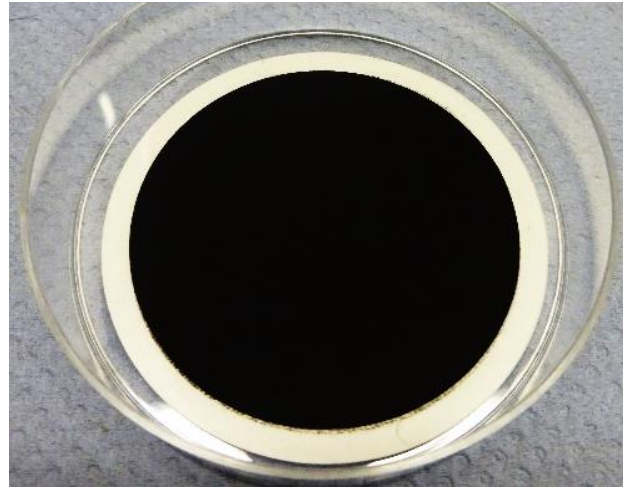
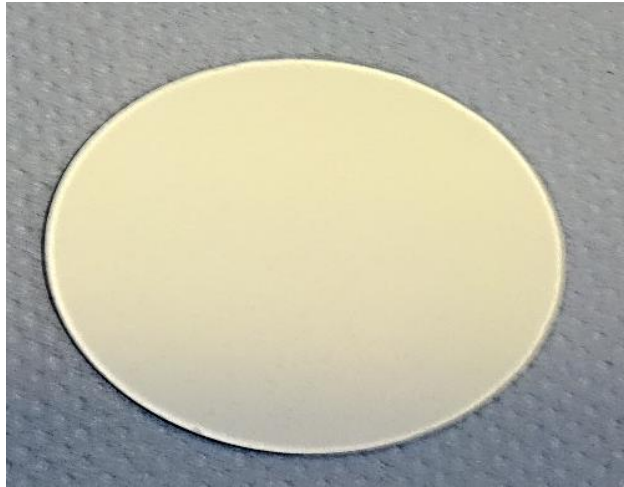
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results will be considered invalid

PM filter Loading

Filter loading per DIN EN 12341

- PM2.5 – application range between (1 to 120) $\mu\text{g}/\text{m}^3$ ~ 6.63 mg total
- PM10 – application range between (1 to 150) $\mu\text{g}/\text{m}^3$ ~ 8.28 mg total

- However, concentrations can go up to 200 $\mu\text{g}/\text{m}^3$ ~ 11.04 mg total





Thank you!

Link Europe GmbH
Alejandro Hortet