

CEN Workshop 103

*Validation of proposed cabin air quality assessment
method – results of repeatability and reproducibility
testing*

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VIAQ 23rd sessions, virtual meeting

9 November 2021

Overview of progress

- Continued testing to validate method proposed based on SAE paper
- Four sets of equipment auditioned, to cover particle mass, number and distribution
- Improvement to draft CEN Workshop Agreement document at earlier round
- Good calibration process established
- Repeatability tested with internal round robin at Emissions Analytics
- Reproducibility tested with external round robin with Volvo, VW, Mahle

WP1 – Equipment – Thank you for the support of...



Catalytic Instruments
hot technologies • clean solutions

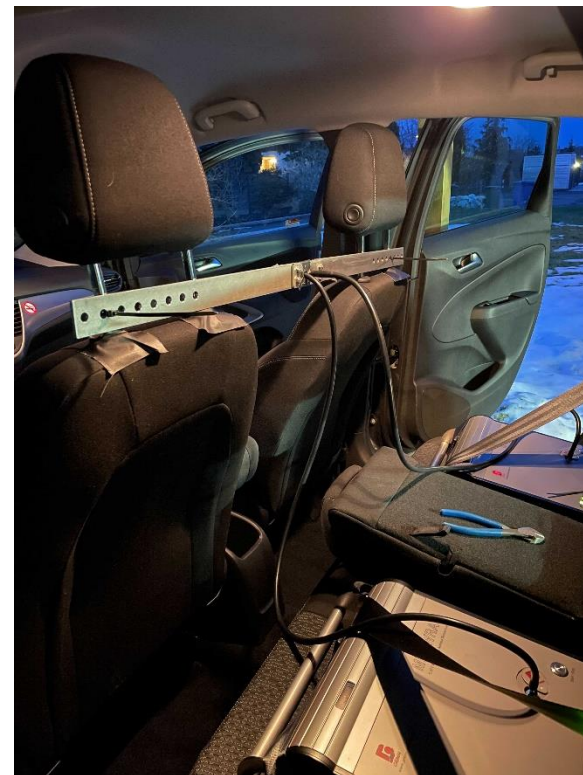


GRIMM  **AEROSOL
TECHNIK**

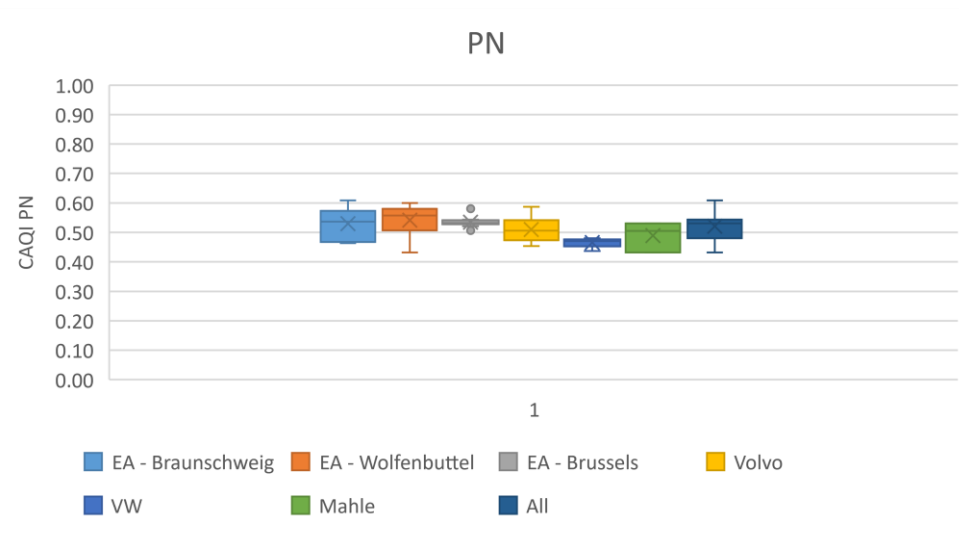
Grimm CPC5410; Grimm miniWRAS 1379; Catalytic Instruments Catalytic Stripper CS015

WP1 – Sampling method

- Stainless steel
 - Smooth curves
 - Conductive tubing
- 1" diameter satisfies isokinetic sampling up to $2\mu\text{m}$ at 80km/h

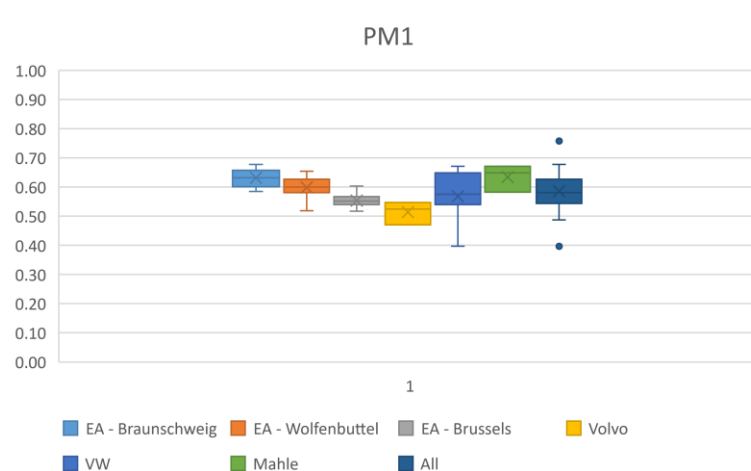
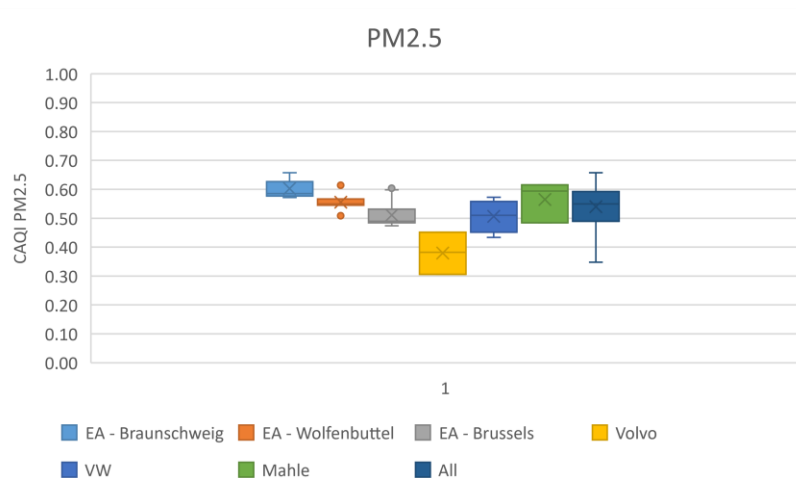


WP2 – PN results across different participants



	FRESH				
	Repeats	Test duration	Max PN outside	Avg PN outside	PN CAQI
EA - Braunschweig	9	1800 +/- 0	106000	3774 +/- 1665	0.53 +/- 0.05
EA - Wolfenbittel	8	1800 +/- 0	225600	2409 +/- 1088	0.54 +/- 0.05
EA - Brussels	13	1776 +/- 58	95110	5162 +/- 1029	0.53 +/- 0.02
Volvo	7	1800 +/- 0	46770	2247 +/- 962	0.51 +/- 0.04
VW	5	1476 +/- 329	77240	6149 +/- 4620	0.47 +/- 0.02
Mahle	3	1800 +/- 0	93160	8603 +/- 3830	0.49 +/- 0.05

WP2 – PM results across different participants



	FRESH							
	Repeats	Test duration	Max PM 2.5 outside	Avg PM 2.5 outside	PM 2.5 CAQI	Max PM 1 outside	Avg PM 1 outside	PM 1 CAQI
EA - Braunschweig	8	30 +/- 1	27.84631	7.2 +/- 4.8	0.60 +/- 0.03	25.48002	6.0 +/- 4.6	0.63 +/- 0.03
EA - Wolfenbittel	9	30 +/- 0	18.51349	8.2 +/- 2.7	0.56 +/- 0.03	13.93779	6.9 +/- 2.5	0.60 +/- 0.04
EA - Brussels	13	30 +/- 1	38.59832	8.1 +/- 1.9	0.51 +/- 0.04	17.90033	6.4 +/- 1.6	0.55 +/- 0.02
Volvo	4	30 +/- 0	26.22082	5.9 +/- 1.4	0.41 +/- 0.14	10.10509	2.8 +/- 1.6	0.56 +/- 0.14
VW	4	30 +/- 6	30.56749	8.2 +/- 2.3	0.51 +/- 0.06	21.21617	6.7 +/- 1.5	0.52 +/- 0.08
Mahle	3	38 +/- 6	51.06297	16.3 +/- 6.5	0.56 +/- 0.07	41.00139	14.1 +/- 6.8	0.63 +/- 0.05

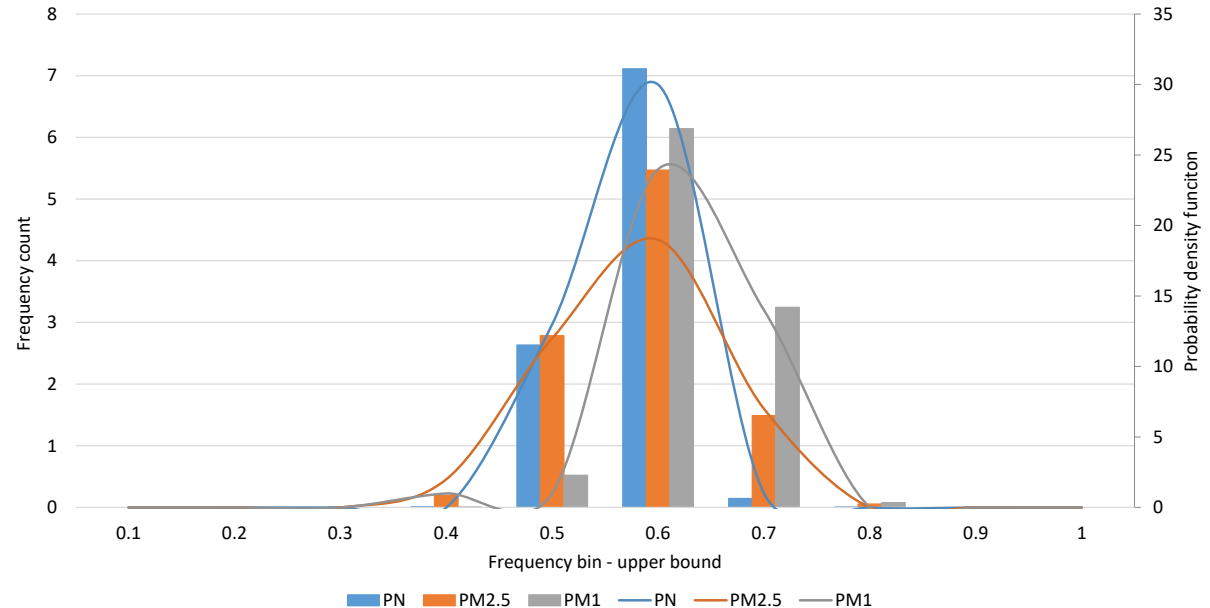
WP2 – Variability

	RECIRC			FRESH		
	PN	PM2.5	PM1	PN	PM2.5	PM1
External round robin						
Mean	0.10	0.12	0.10	0.52	0.53	0.58
Standard deviation	0.03	0.03	0.02	0.05	0.07	0.06
Internal round robin						
Standard deviation	0.02	0.02	0.01	0.08	0.04	0.05
Change in standard deviation	0.01	0.01	0.01	-0.03	0.03	0.01

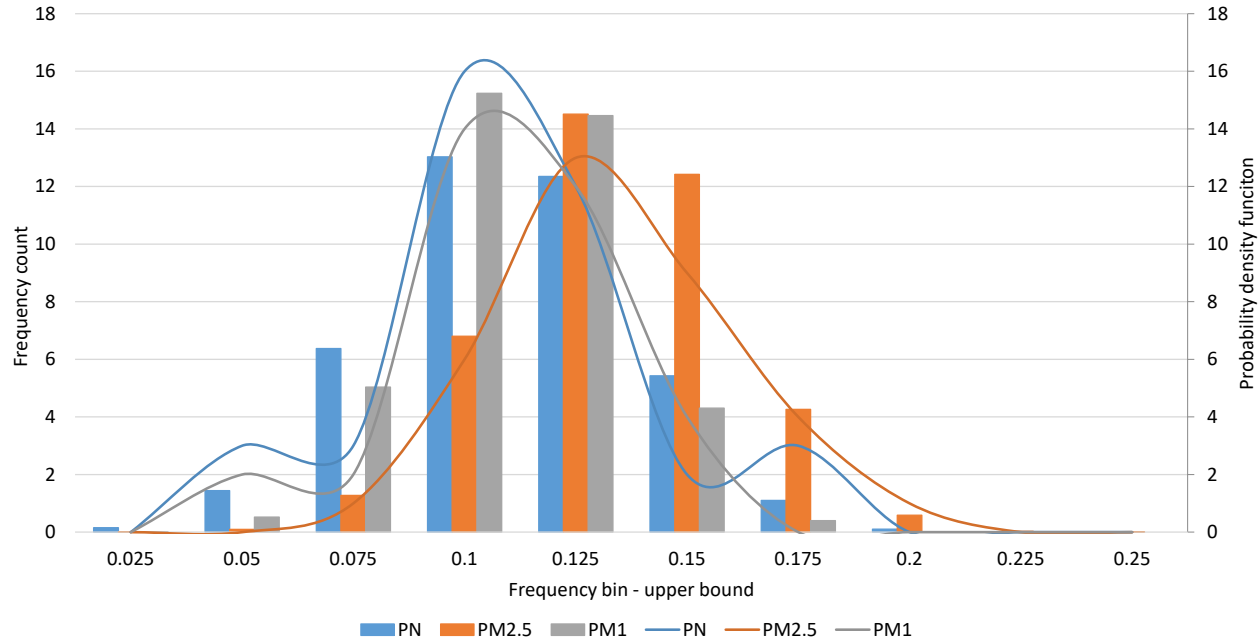
- Change in PN equipment helped reduce variability

WP2 – Summary results – fresh air

- Each measure fits Gaussian distribution
- Error is random
- Confidence increases with number of repeats

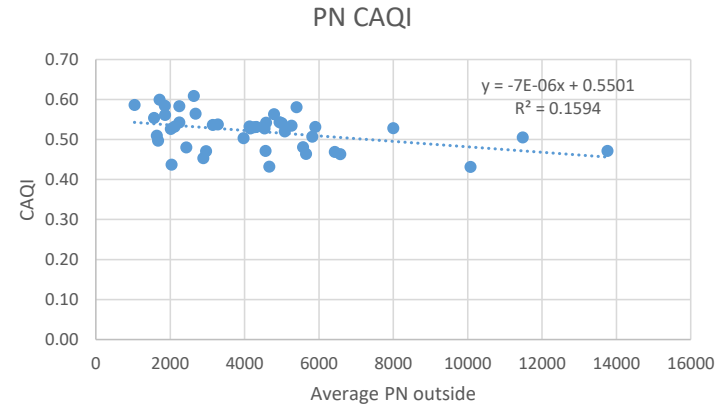
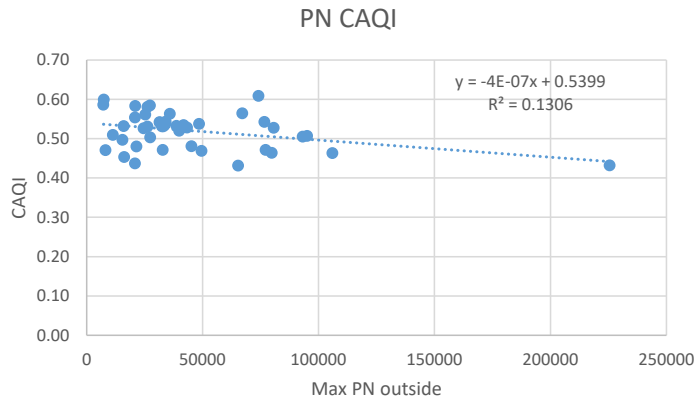


WP2 – Summary results – recirculation

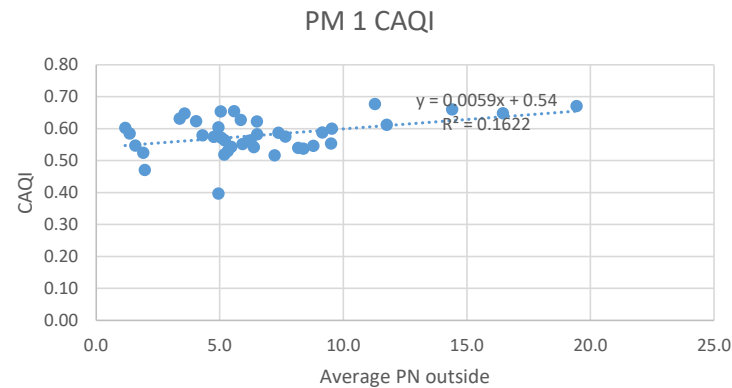
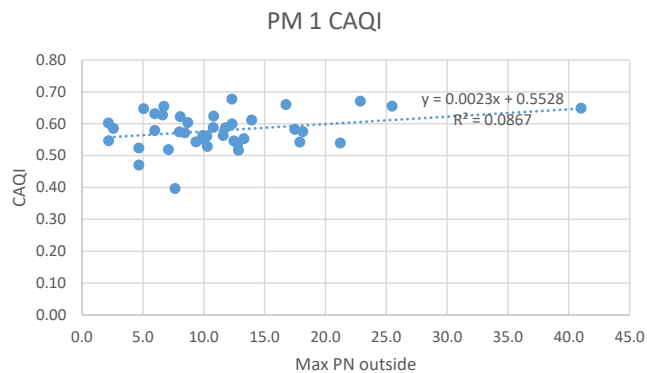
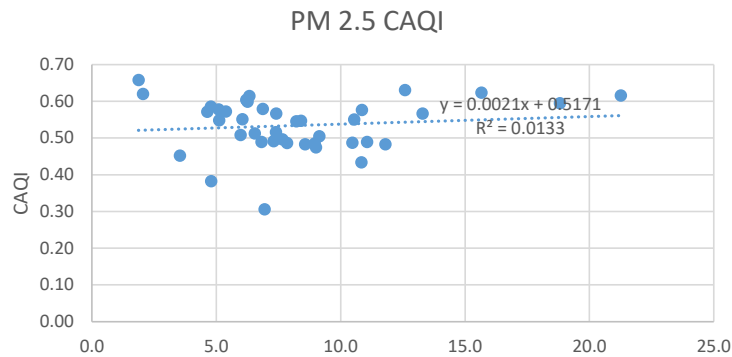
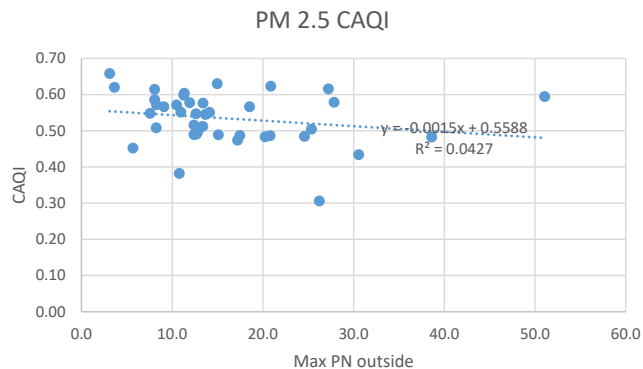


WP3 – Boundary conditions (1)

- Weak or zero dependency between CAQI and on-road ambient particle concentrations
- Consistent with previous findings
- Propose that no additional boundaries are needed

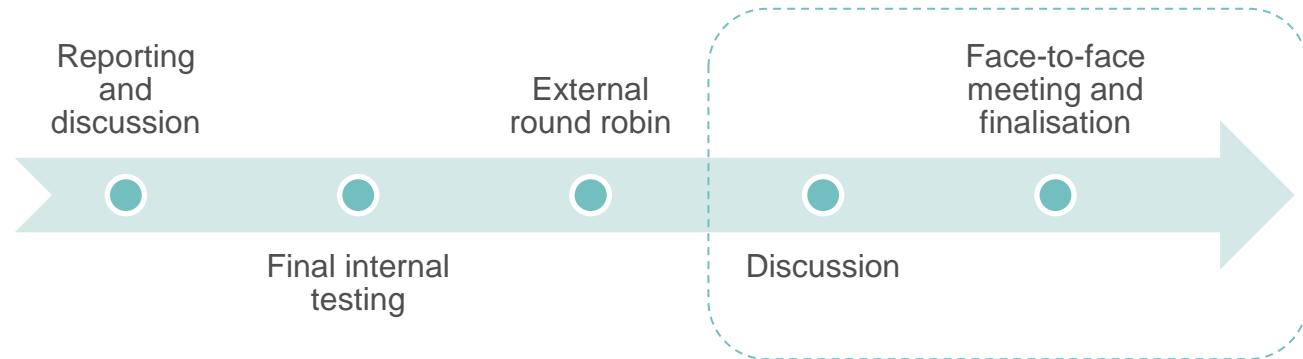


WP3 – Boundary conditions (2)



Next steps

- Update, review and finalise draft CWA
- Agree document Q4 2021





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