

PMP Web Conference 27.04.2023

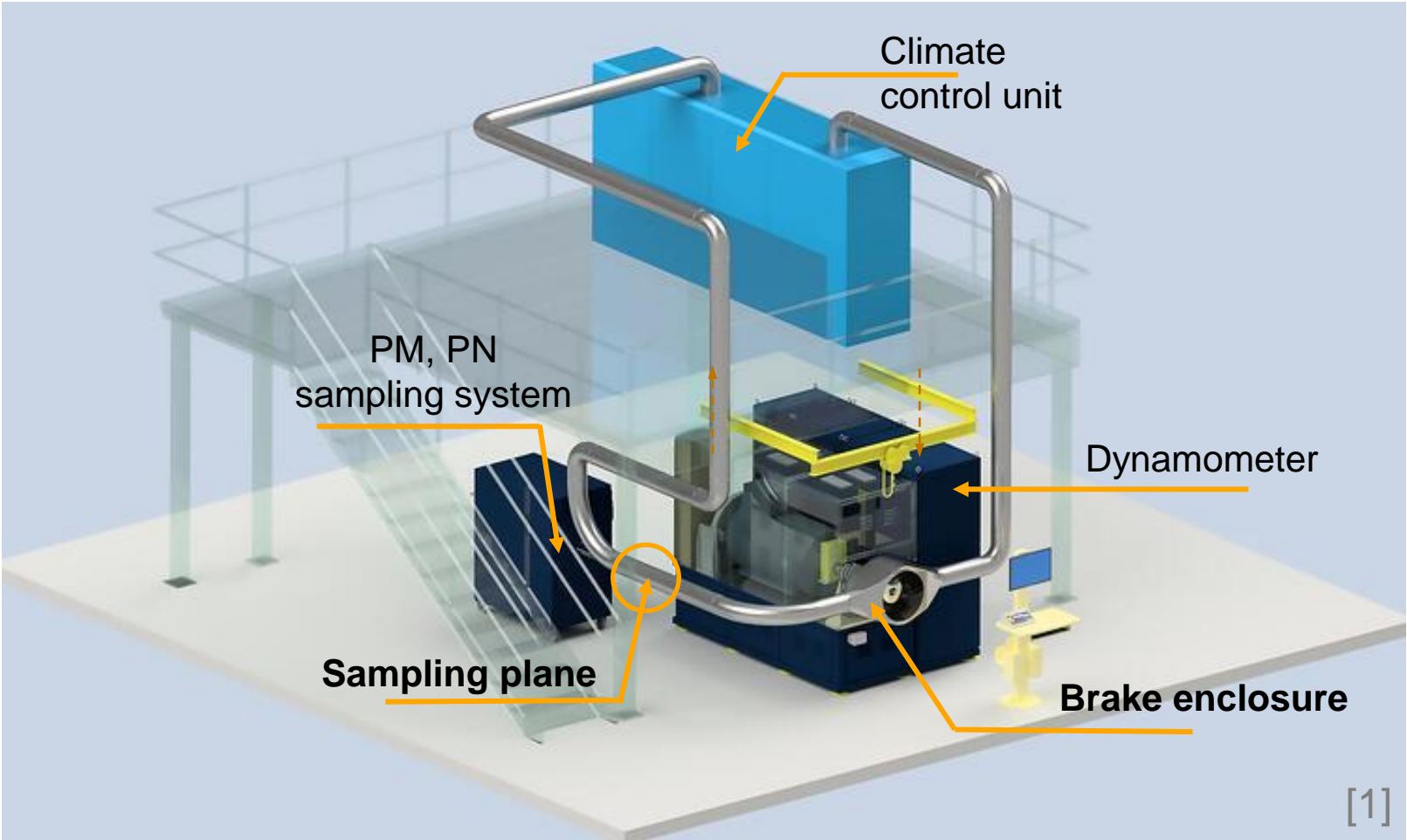
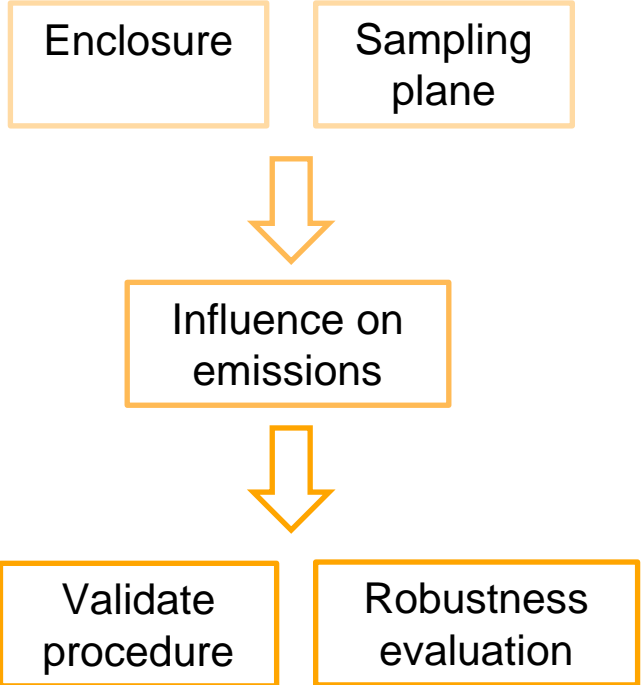
**Experimental Influence Analysis of the Sampling of Passenger Car
Brake Particle Emissions on a Dynamometer**

Cristina Loranca

Project Description

Master's Thesis – Cristina Loranca	
Timeframe	15.08.2022 – 15.10.2022
Location	Dyno Lab @ Continental Frankfurt
Brake System	ILS Disc brake
Supervisors	Dr. Hartmut Niemann (then TU Darmstadt) Achim Reich (Continental)

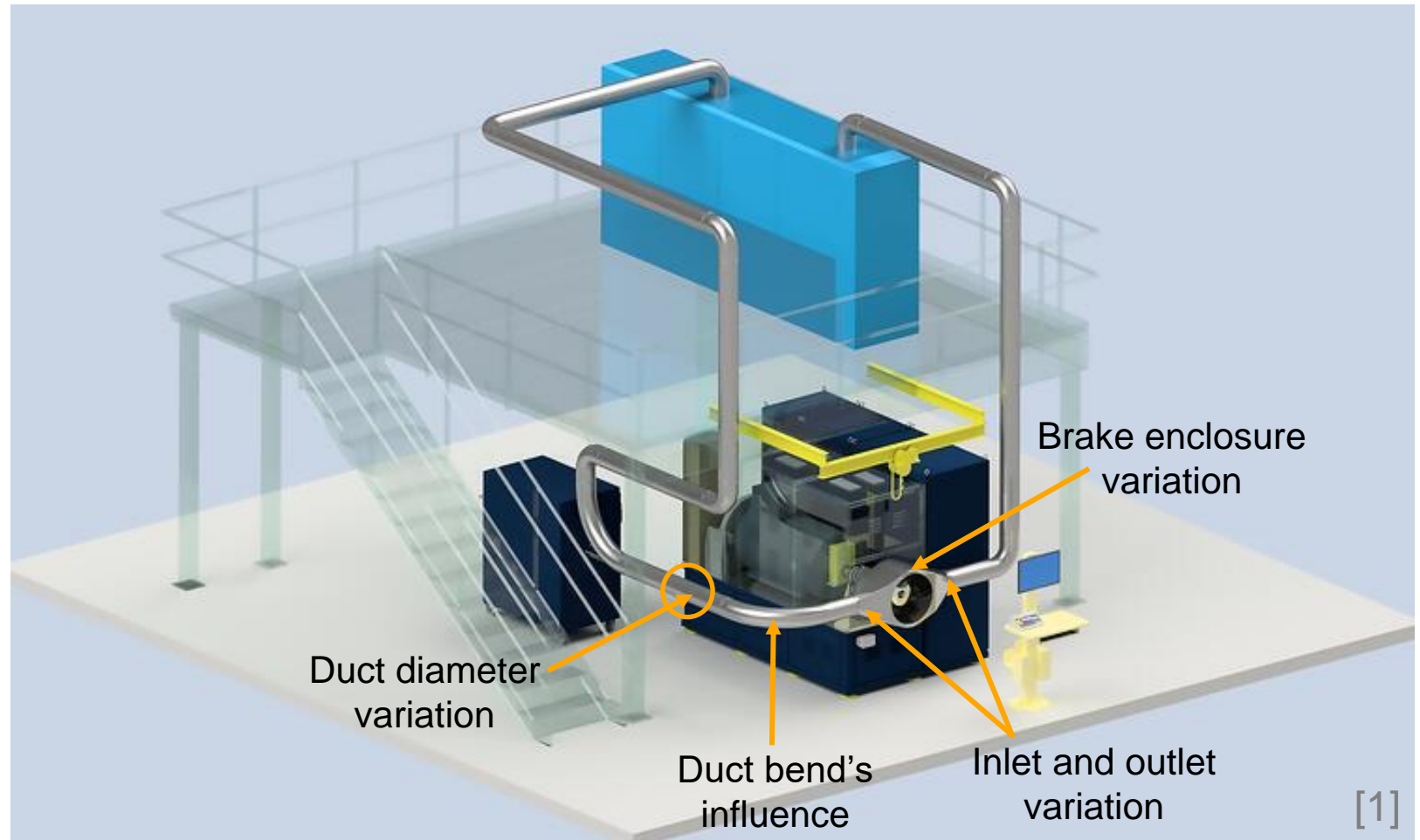
Motivation



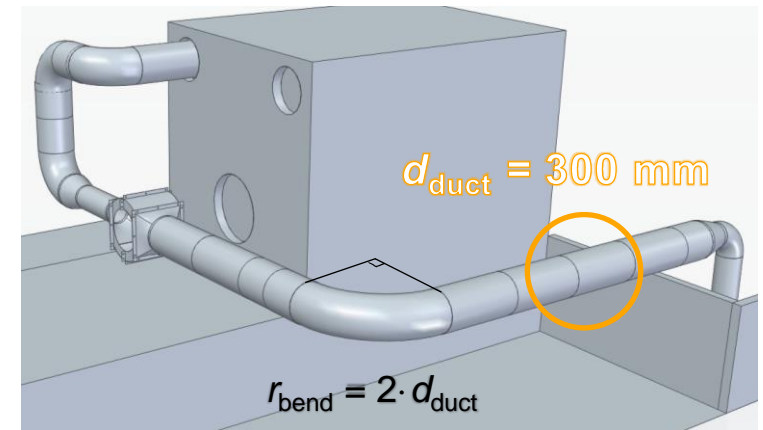
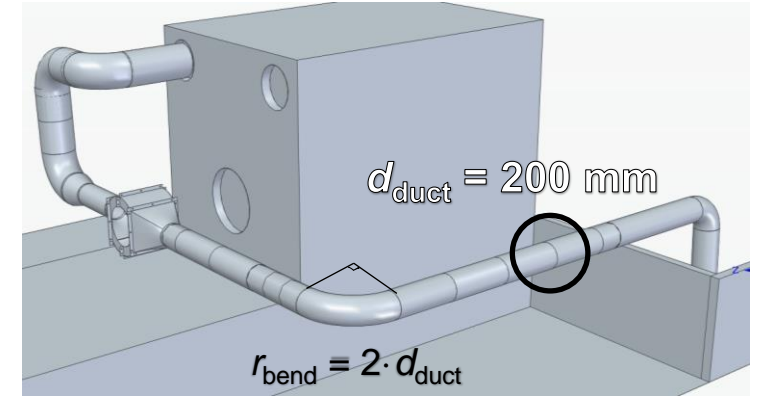
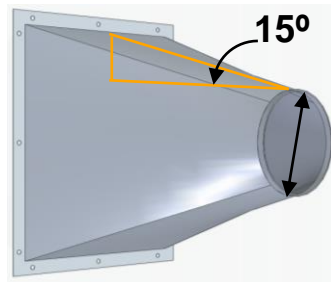
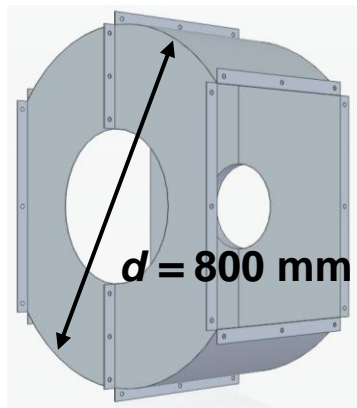
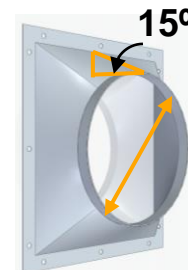
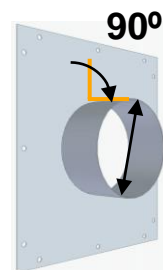
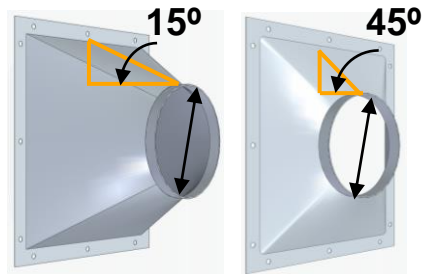
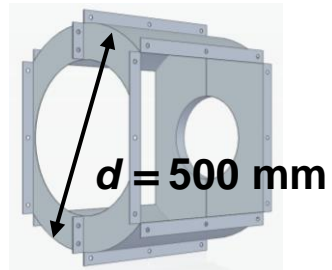
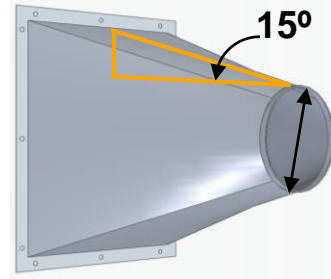
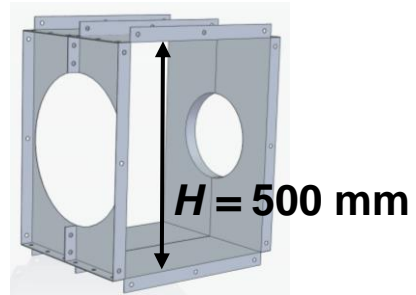
[1]

Approach

Systematic and sequential
variation of influences

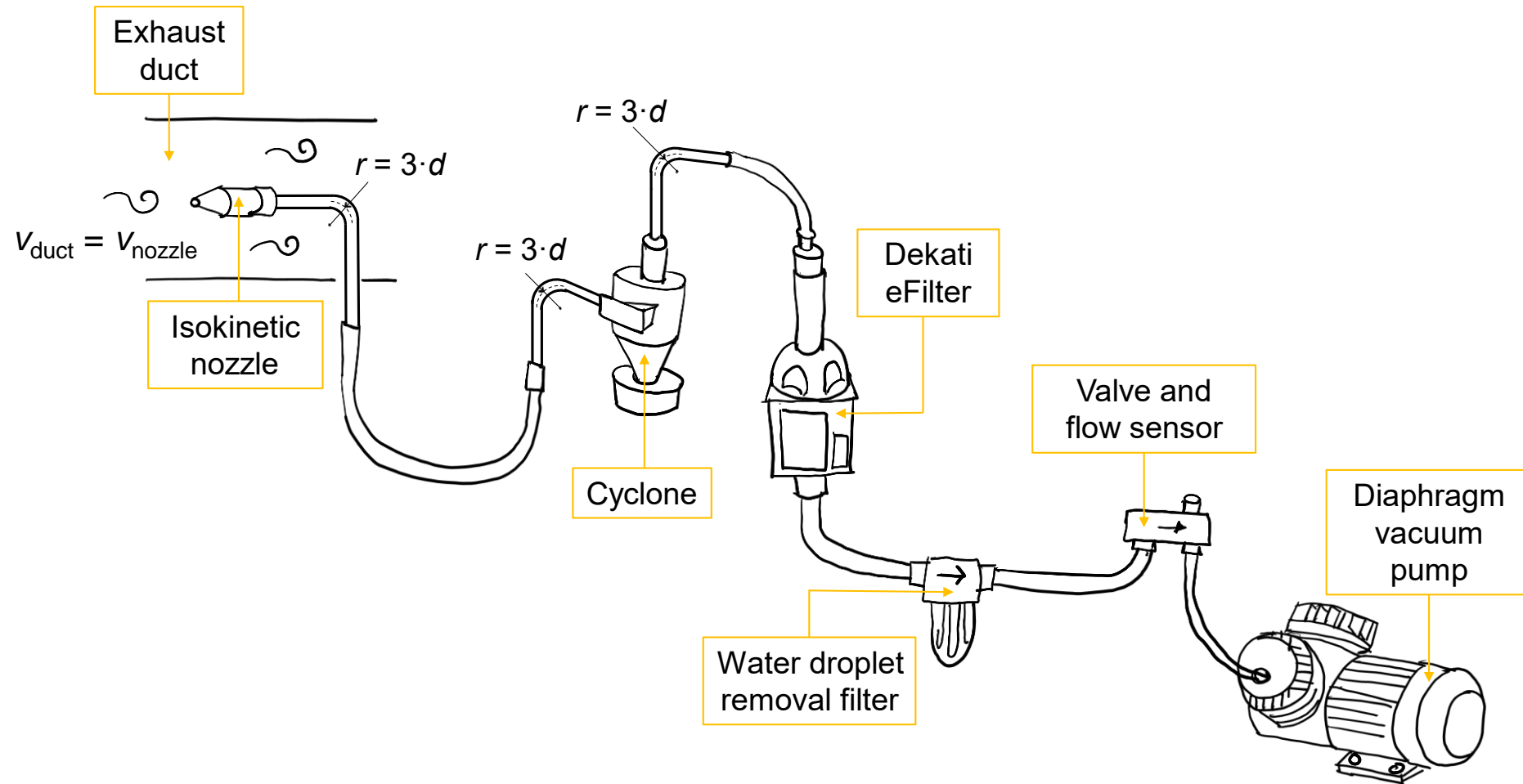


Approach Configurations



Approach

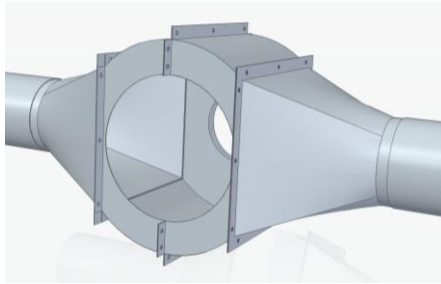
Measurement Equipment



Approach

Test Sequence

Reference Configuration



$$d_{\text{enclosure}} = 500 \text{ mm}$$

$$\alpha_{\text{inlet, outlet}} = 15^\circ$$

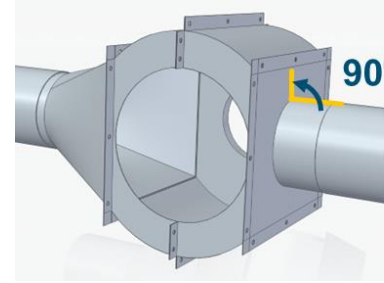
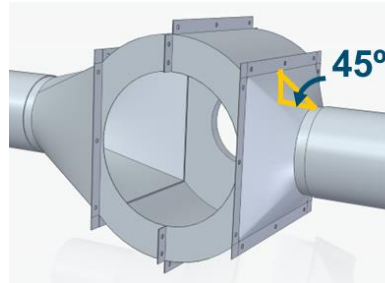
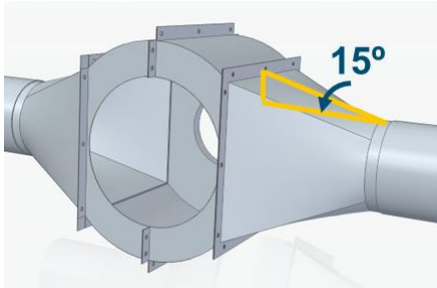
$$d_{\text{inlet}} = 200 \text{ mm}$$

$$d_{\text{outlet}} = 200 \text{ mm}$$

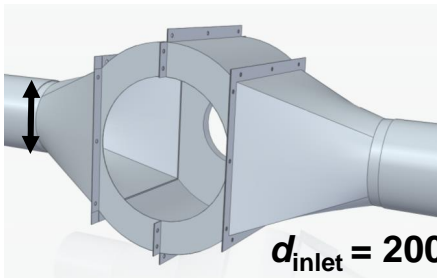
Test: WLTP Brake Trip 10

Outcome: PM_{10} (mg) \rightarrow EF (mg/km)

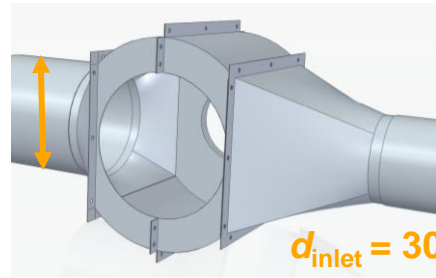
①



②



$$d_{\text{inlet}} = 200 \text{ mm}$$



$$d_{\text{inlet}} = 300 \text{ mm}$$

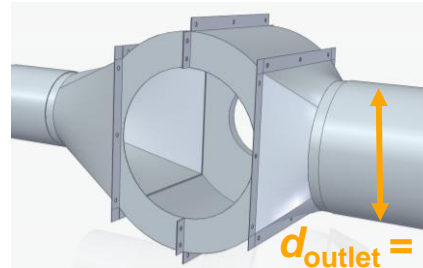
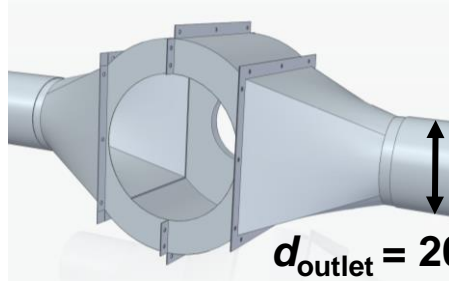
GTR's Requirements

- $\alpha_{\text{inlet, outlet}} = 15 - 30^\circ$
- $d_{\text{duct}} = 175 - 225 \text{ mm}$
- Enclosure's vertical symmetry

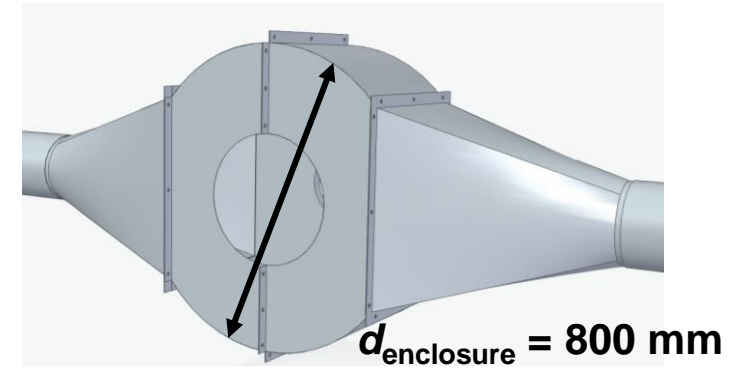
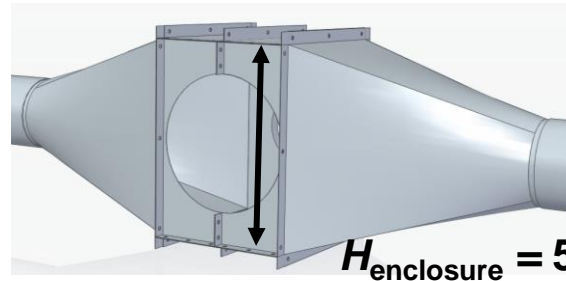
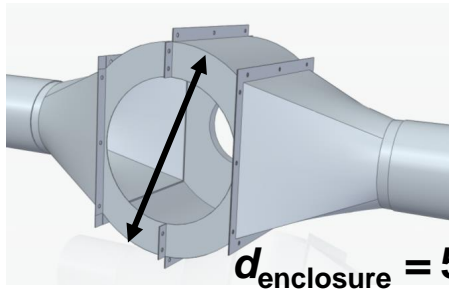
Approach

Test Sequence

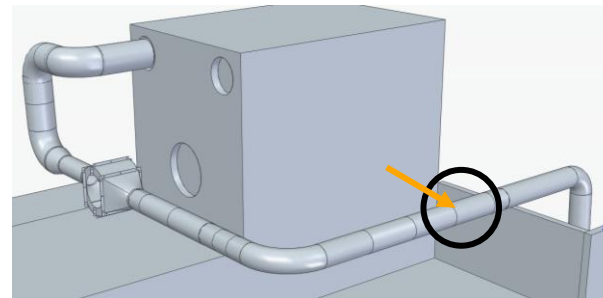
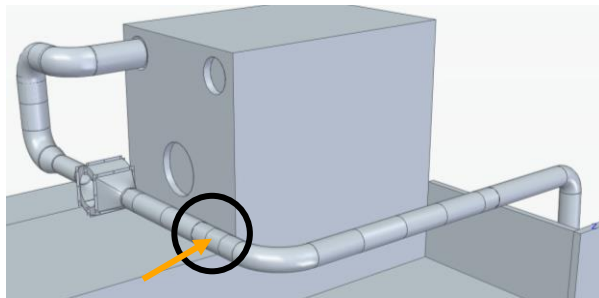
③



④



⑤

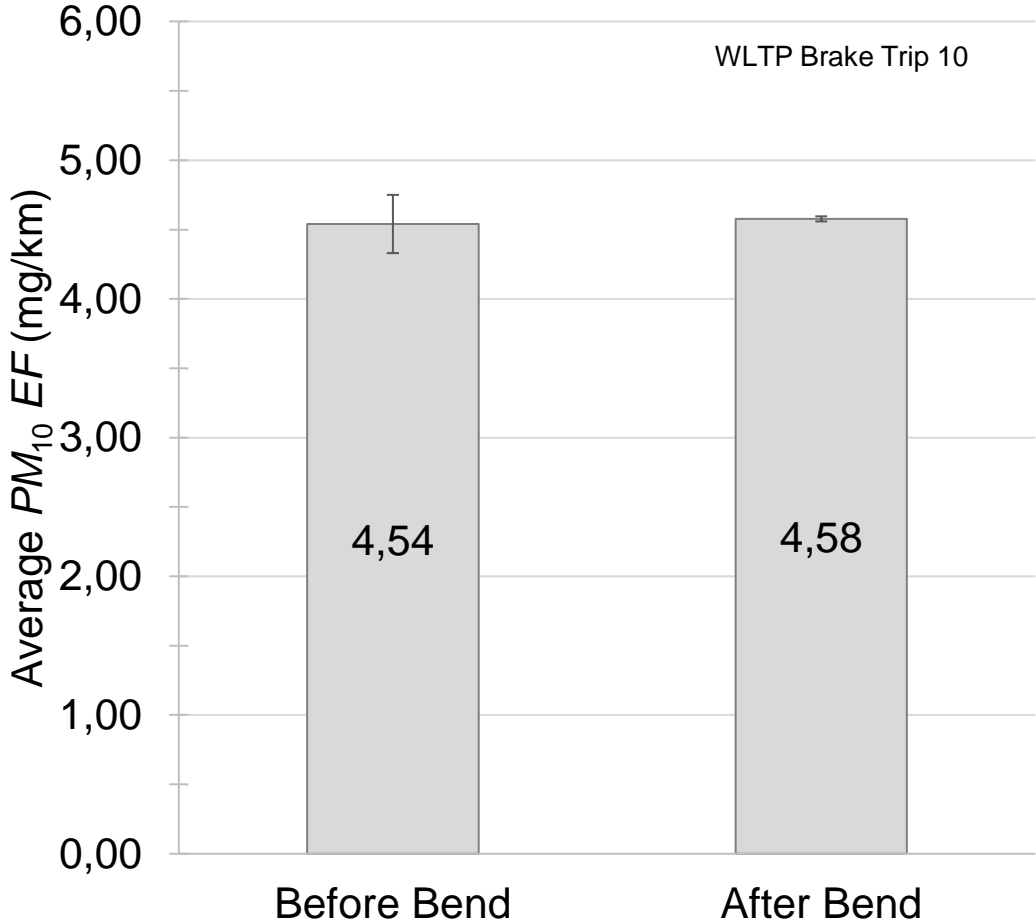
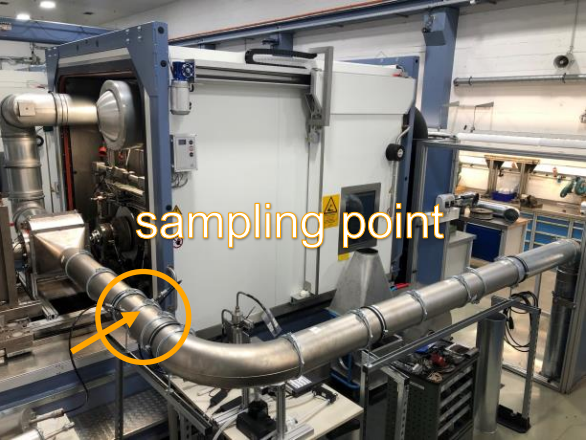


GTR's Requirements

- Circular enclosure
- $d_{\text{enclosure}} = 600 - 750 \text{ mm}$
- $d_{\text{duct}} = 175 - 225 \text{ mm}$

Results

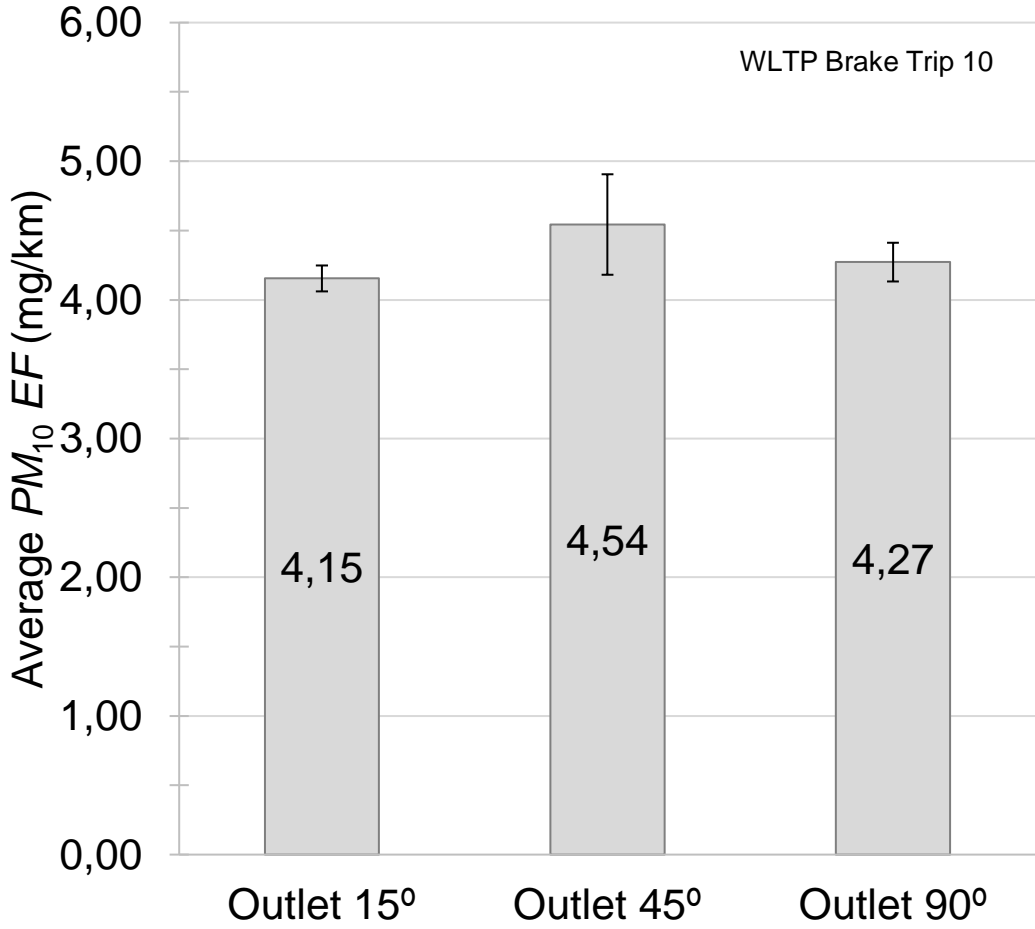
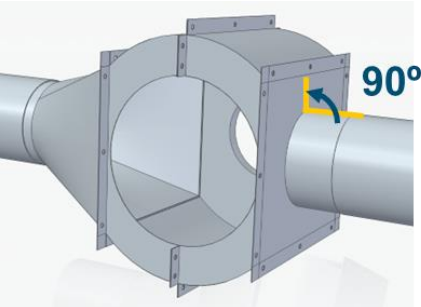
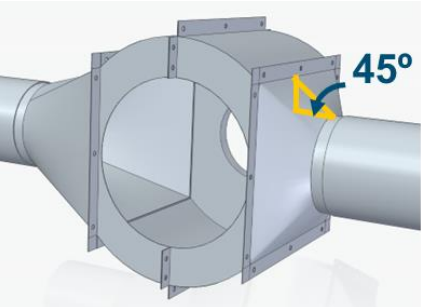
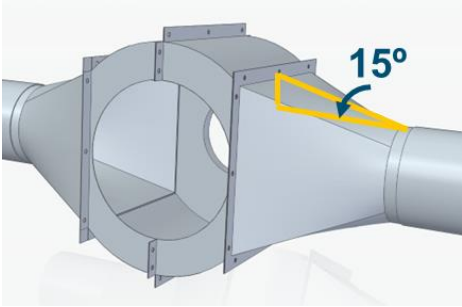
Sampling Point: Before or After Bend



- › Max. variant std. dev. < 5%
- › Variance EF < 1%

Results

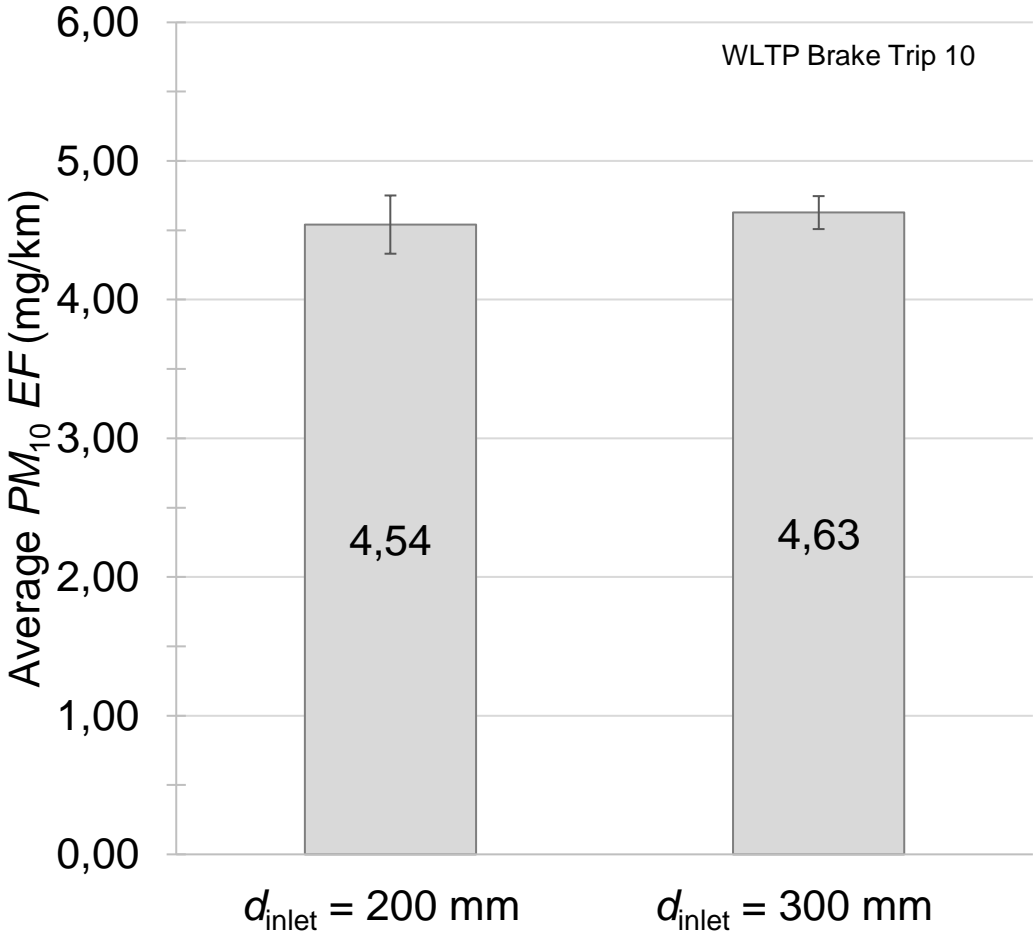
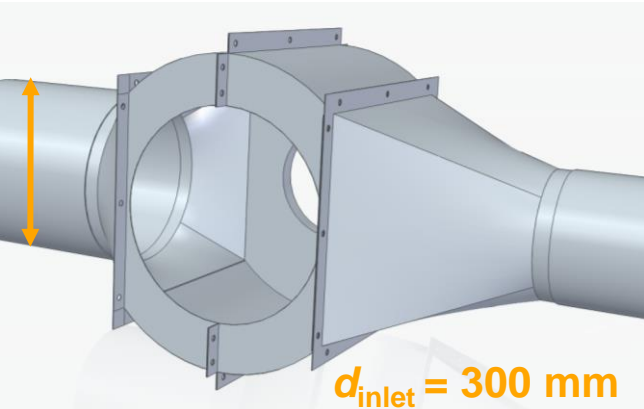
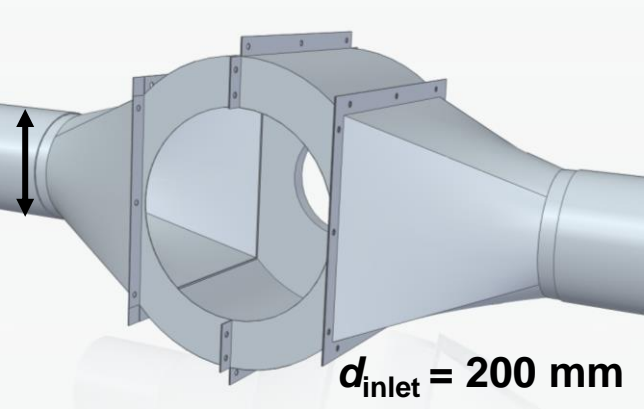
Outlet Angle Variation



- › Max. variant std. dev. < 8%
- › Variance *EF* < 9%

Results

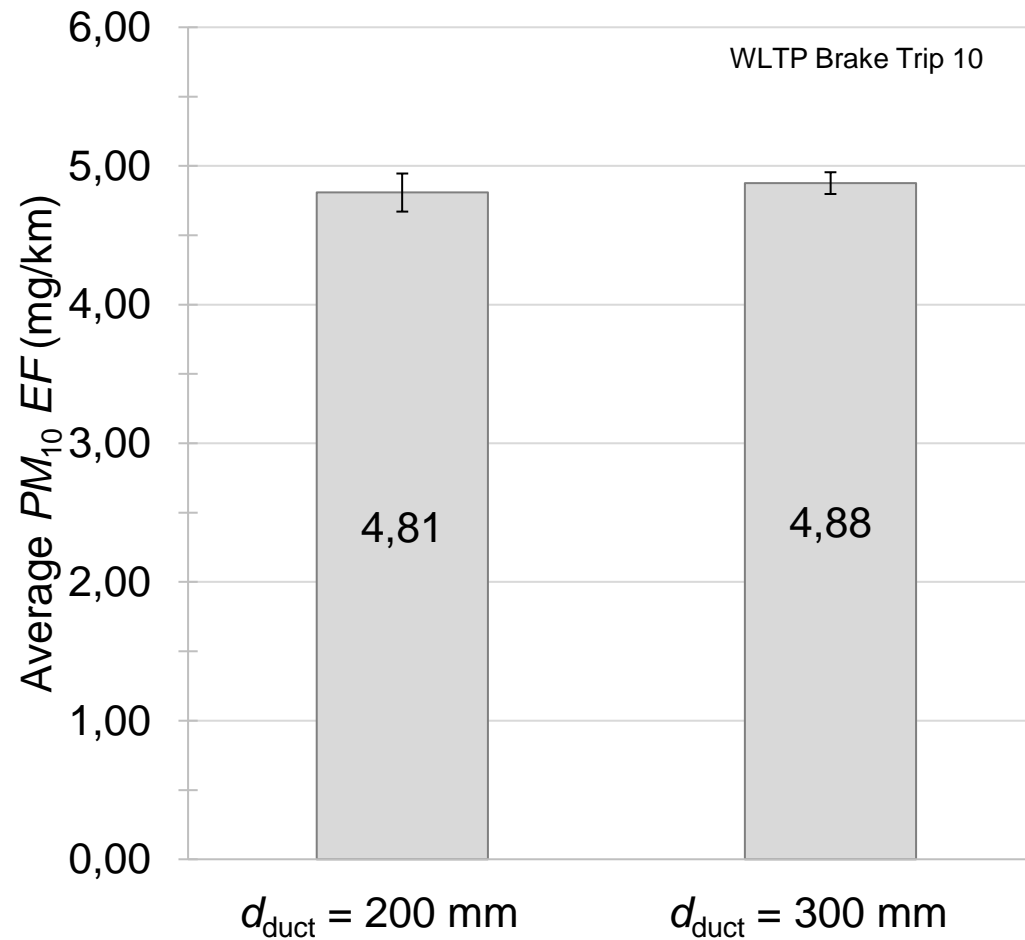
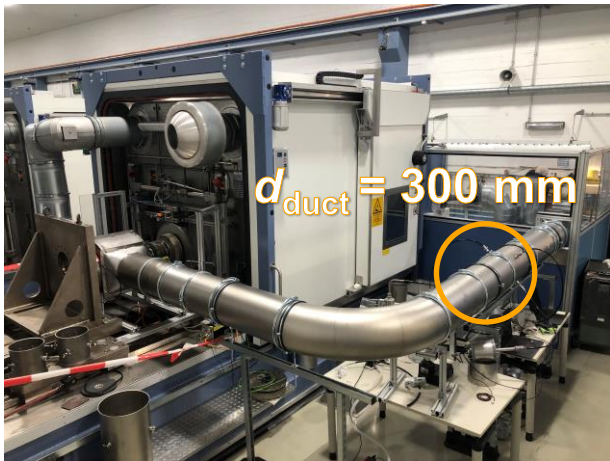
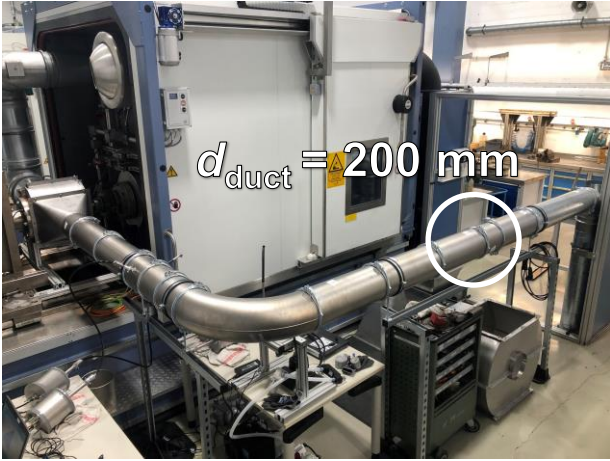
Inlet Duct Diameter Variation



- › Max. variant std. dev. < 5%
- › Variance $EF < 2\%$

Results

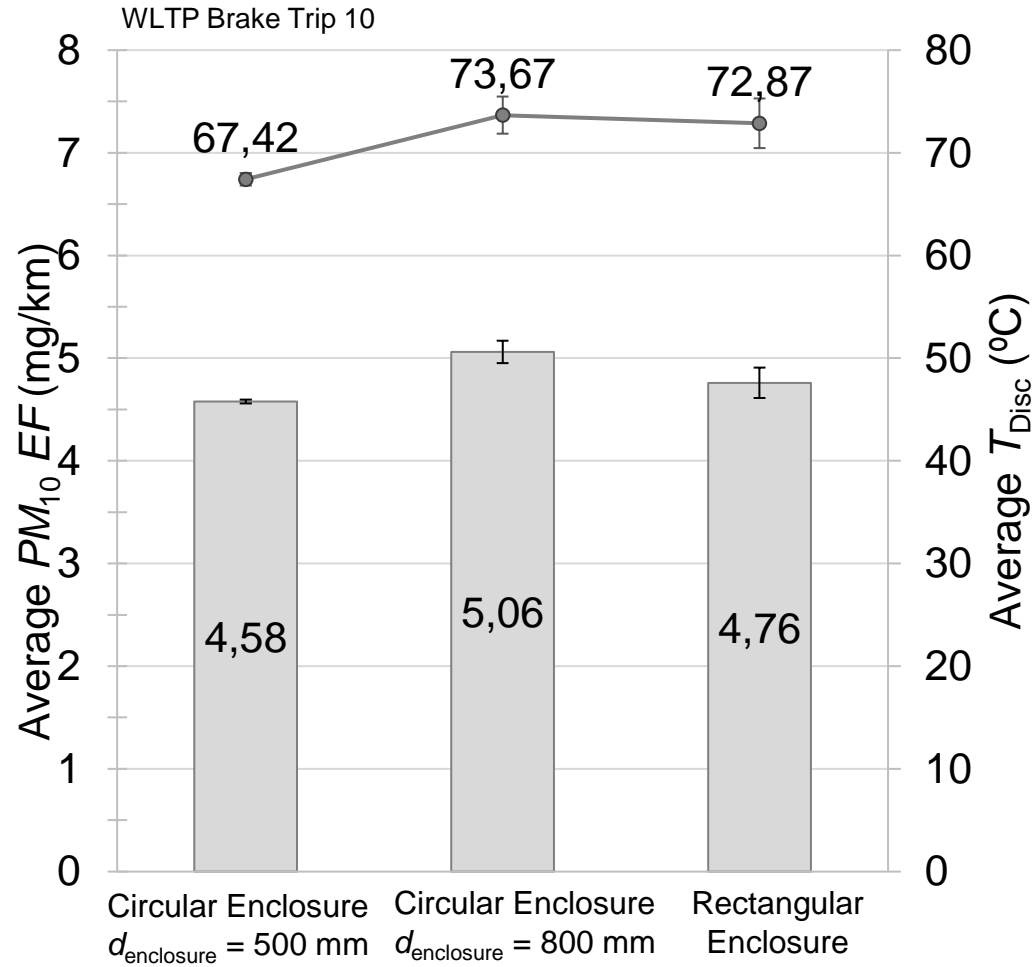
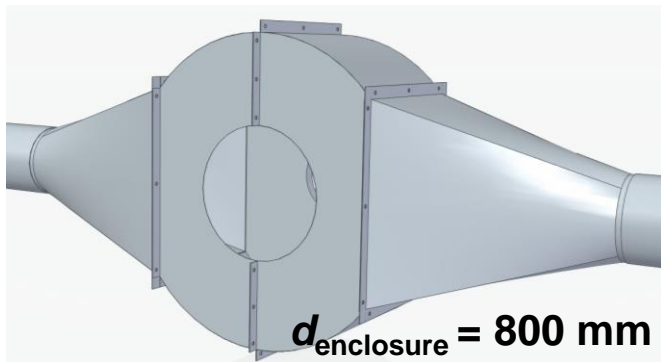
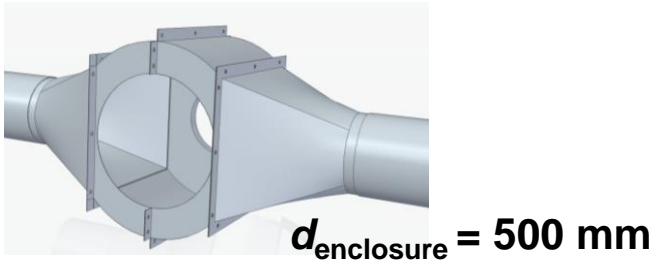
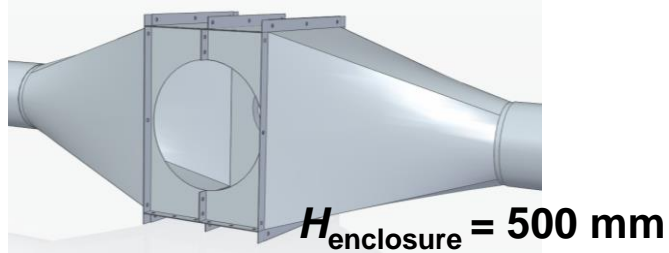
Duct Assembly Variation



- › Max. variant std. dev. < 3%
- › Variance $EF < 2\%$

Results

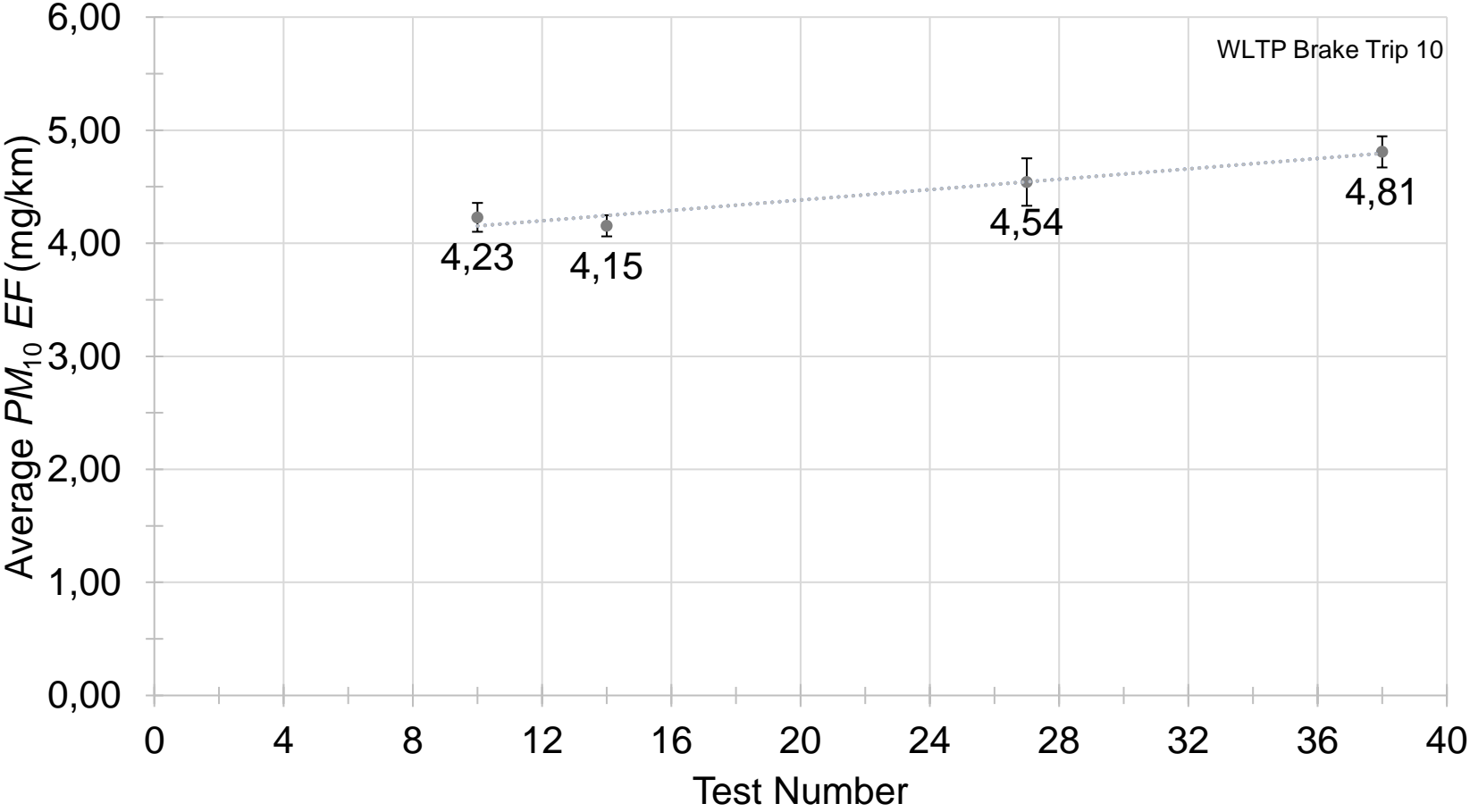
Enclosure Variation



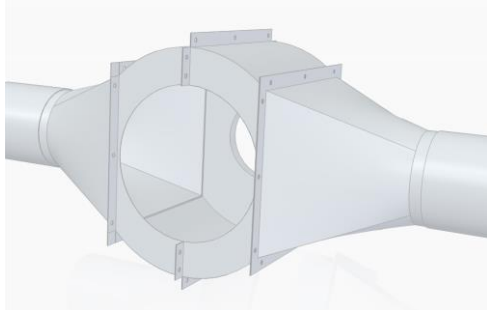
- > Max. variant std. dev. < 4%
- > ↑ EF 9%
- > ↑ T_{Disc} 9%

Results

Repeatability



↑ EF 12%

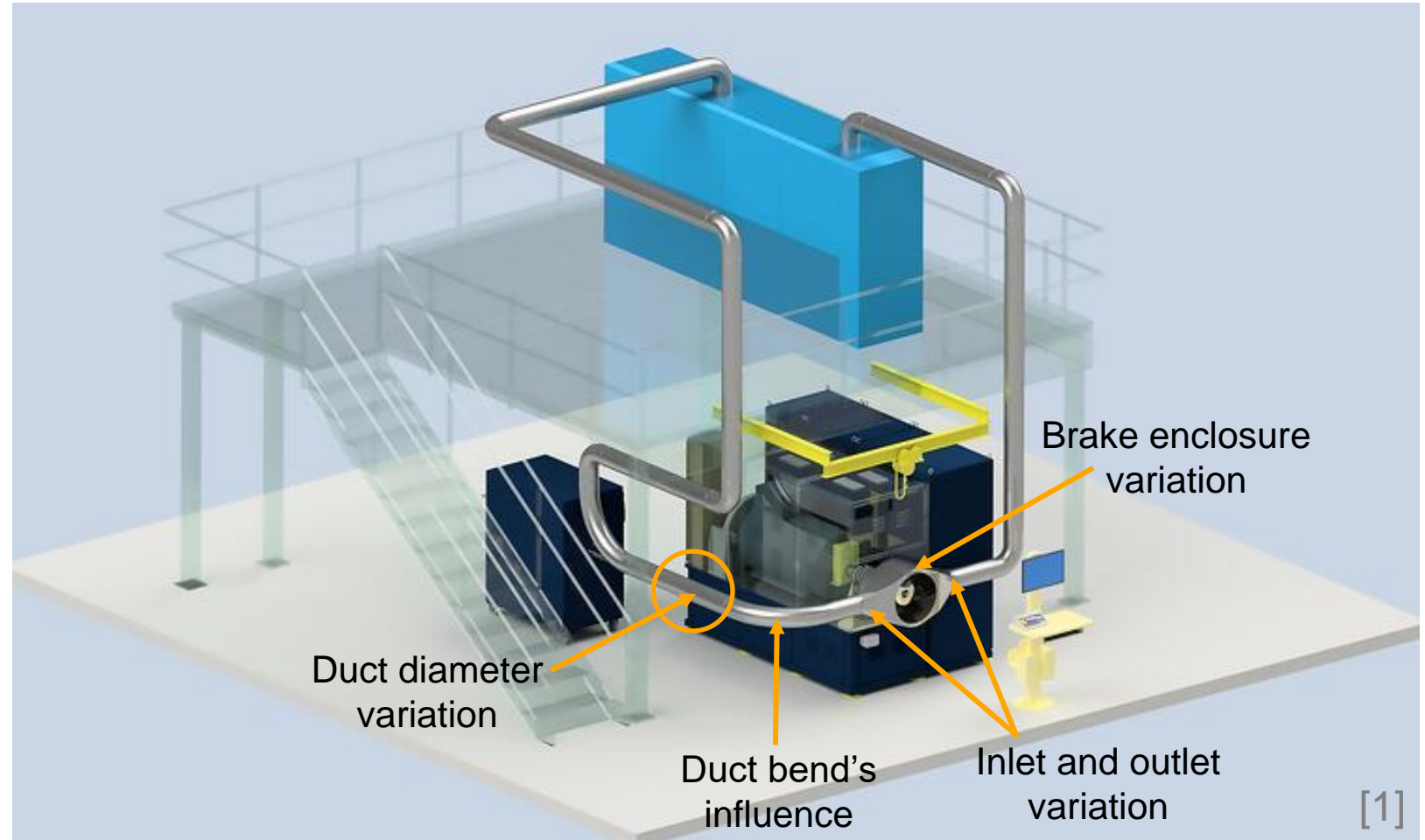


Conclusion

- › Highest std. dev. 8%
- › Max. PM_{10} EF variation 9%
- › PM_{10} not significantly influenced by tested geometric parameters

Proposal:

- › More permissive guidelines for studied geometric parameters
- › Repeat ILS



Thank you
for your attention

cristina.loranca@continental-corporation.com

Used Sources

[1]

https://info.linkeng.com/link-brake-emission-pro?utm_campaign=10%2F18%2F2022%20Emission%20Pro&utm_content=224851593&utm_medium=social&utm_source=linkedin&utm_channel=lcp-780933