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## PAPR Canister Particulate Efficiency Benchmark Testing

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# CBRN Respirator Standards

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# Objective

- Assess particulate filter efficiency of NIOSH-certified PAPR combination canisters under different flow rate conditions
  - Initial penetration test
  - DOP aerosol loading vs. penetration test



# Initial Penetration Test

- **In-house Fabricated Test System**
  - Aerosol Generation
    - Nebulizer from TSI Model 8130 filter test apparatus
    - Poly-alpha Olefin (PAO) test aerosol (~0.2 CMD)
  - Challenge and Penetration Measurement
    - DustTrak™ (Model 8520, TSI, Inc.), photometer aerosol detector
    - Sensitivity ~0.001% penetration (99.999% efficiency)



# Initial Penetration Test

- **Test Matrix**

Canister	System Cyclic Flow Conditions Evaluated <sup>1</sup>		System Constant Flow Conditions Evaluated <sup>1</sup>
A	85 L/min [ 2.3 L, 37 BPM]	135 L/min [ 3.1 L, 44 BPM]	360 L/min
B			270 L/min
C			85 L/min

<sup>1</sup>Actual test airflow rate proportional to number of filters used in PAPR



# Initial Penetration Test Results

Canister <sup>1</sup>	Flow Condition	System Flow Rate (L/min)	Test Flow Rate (L/min)	Average Efficiency & Std Dev (%), n=3
A	Cyclic	85	42.5	99.996 ± 0.001
		135	67.5	99.995 ± 0.001
	Constant	360	180	99.992 ± 0.002
B	Cyclic	85	42.5	99.998 ± 0.001
		135	67.5	99.998 ± 0.001
	Constant	270	135	99.998 ± 0.001
C	Cyclic	85	42.5	99.997 ± 0.001
		135	67.5	99.996 ± 0.001
	Constant	85	42.5	99.999 ± 0.000

<sup>1</sup>Canisters from dual filter PAPR systems



# DOP Loading Test

- **Test Systems**

- Canister Loading Test System

- Automated filter tester (Model 8130, TSI, Inc)

- Dioctyl phthalate (DOP) test aerosol (~0.2 CMD)

- Sensitivity ~0.001% penetration (99.999% efficiency)

- Cyclic and Constant Penetration Test System

- In-house fabricated test system



# DOP Loading Test

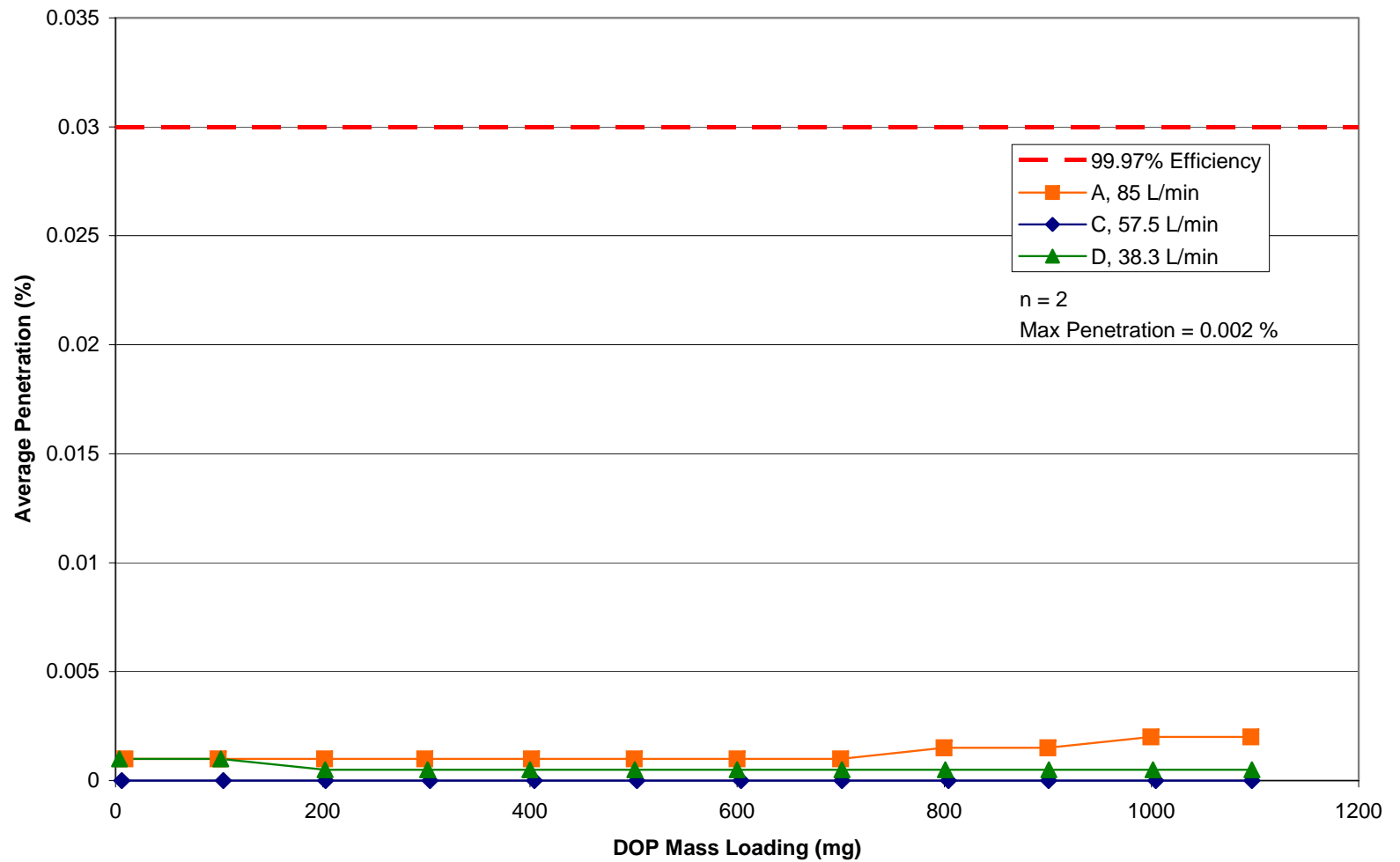
- **Test Method**

- Three canister models tested
  - A - 170 L/min PAPR, two filters
  - C - 115 L/min PAPR, two filters
  - D - 115 L/min PAPR, three filters
- Canister loading
  - Constant flow at minimum rated (“standard”) system flow rate
  - Loaded up to a total of 1100 mg
- Cyclic and constant flow penetration
  - 135 L/min cyclic flow
  - 270 L/min constant flow



# Loading Test Results

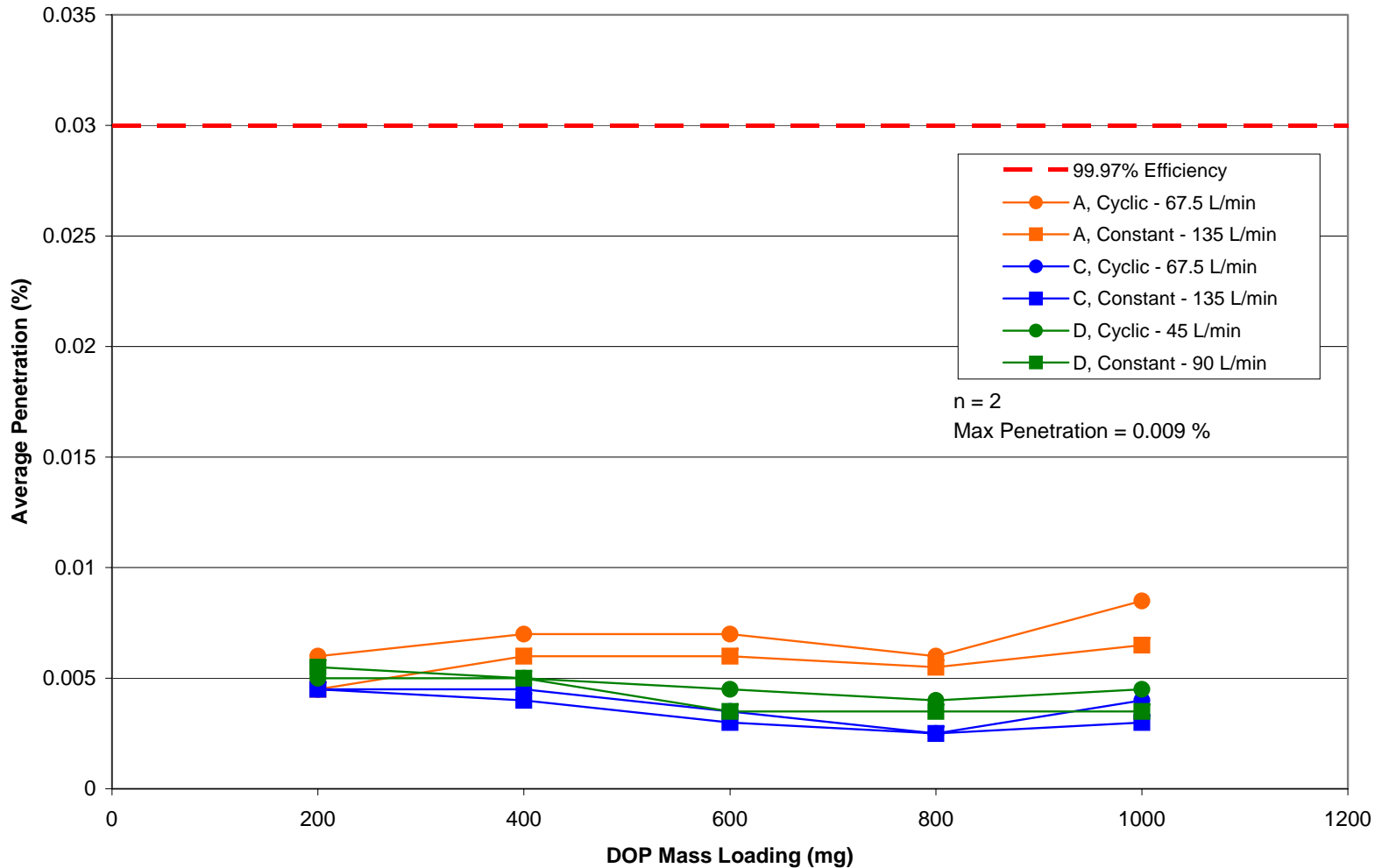
## Penetration vs. DOP Loading at Standard Constant Flow Rate



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# Loading Test Results

## Penetration vs. DOP Loading at High Cyclic and Constant Flow Rates



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# Summary

- All PAPR combination canisters tested exceeded 99.97% efficiency at flow rate conditions tested
  - Maximum initial penetration measured was 0.008% at 180 L/min constant test flow
- Particulate efficiency was not adversely affected by high DOP aerosol loading levels
  - Maximum penetration measured was 0.002% at standard constant flow condition
  - Maximum penetration measured was 0.009% at 67.5 L/min cyclic condition with ~ 1000 mg mass loading

