

# Design and Evaluation of a High-Flowrate (10 Lpm) Nanoparticle Respiratory Deposition (NRD) Sampler

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## Background

Current industrial hygiene practice relies on size-selective personal samplers (e.g., respirable), which obscure the quantification of nanoparticles.

The 2.5-Lpm Nanoparticle Respiratory Deposition (NRD) sampler collects nanoparticles smaller than 300 nm in a way that mimics human respiratory deposition. This criterion is known as the nanoparticulate matter (NPM) curve.



## Objective

Develop an NRD sampler that operates at 10 Lpm to facilitate lower limits of quantification

## Methods

### Design of new sampler

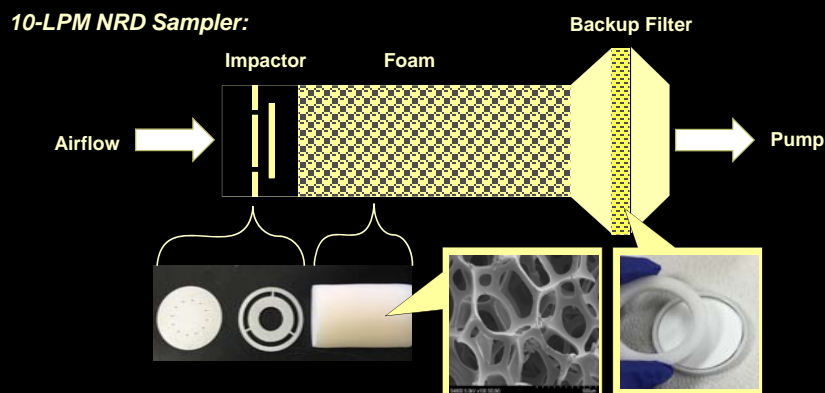
- Designed 12-jet and 30-jet impactor to have 50% cut-off diameter of 300 nm
- Scaled up 90 pore per inch polyurethane foam used as diffusion substrate in 2.5-Lpm NRD sampler for 10 Lpm
- Included backup filter: mixed cellulose ester (MCE), diameter of 47-mm, pore size of 8-µm

### Evaluation

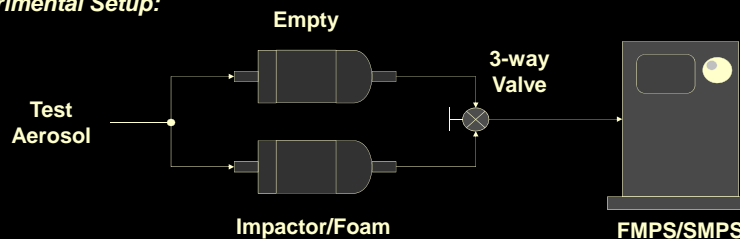
- Measured pressure drop through components with a differential pressure gauge
- Measured collection efficiency by size of the two impactor sections (with fast mobility particle sizer, FMPS) and the foam (with a scanning mobility particle sizer, SMPS)

$$\eta = 1 - \frac{C_{Impactor/Foam}}{C_{Empty Housing}}$$

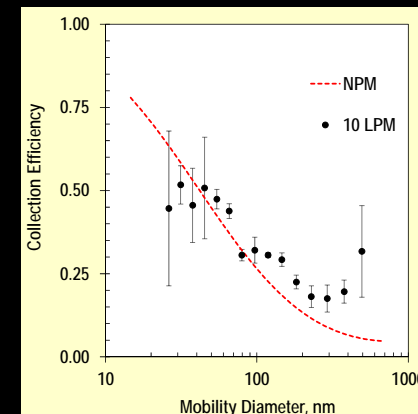
- Compared overall collection efficiency by size to the NPM sampling criterion, which follows deposition in the human lung (defined by ICRP) for particles smaller than 300 nm



### Experimental Setup:



### 90 PPI Foam and Impactor Collection Efficiency:



Shape of collection efficiency curve similar to NPM criterion

50% diameter was 44 nm (target = 40 nm)

### Pressure Drop:

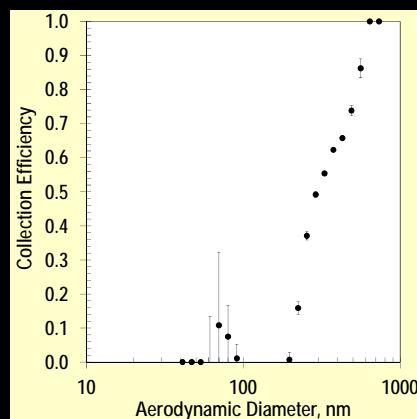
	2.5 NRD, inches H <sub>2</sub> O	10-Lpm NRD, inches H <sub>2</sub> O
Foam	14	14
Full set (Inlet, impactor, foam, & MCE)	35 *	24 **

\*0.8-µm MCE; \*\*8.0-µm MCE

Pressure drop was comparable to the 2.5-Lpm sampler

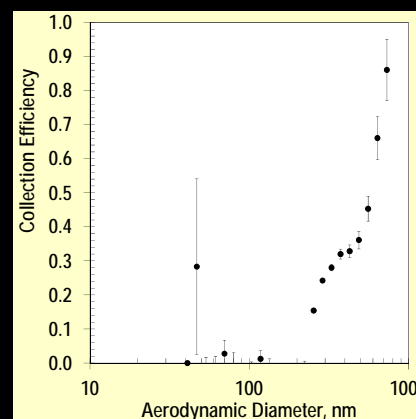
## Results

### 12-Jet Impactor Collection Efficiency



50% diameter: 280 nm

### 30-Jet Impactor Collection Efficiency



50% diameter: 600 nm

## Conclusions and Future Work

- Early stages of design and evaluation of a high-flow NRD sampler promising
- Further evaluate design options with less pressure drop at the backup filter
- Develop and test new respirable inlet

## Acknowledgements

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