



*Submicron Separation
and Containment
- Without the Filter!*

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Presented By:

Inventure Laboratories, Inc.

Knoxville, TN

Michael K. Carroll

Mitch Brooks

Thomas B. Shope, Ph.D.





Background

- Involved with cleanup operations within the DOE for more than 15 years
- Y-12 National Security Complex recognized the need to protect the workforce from exposure during cleanup operations



Background (continued)

- Anticipated waste types included:
 - Sanitary waste
 - Industrial waste
 - Hazardous waste
 - Low-Level waste (LLW)
 - Intermediate Level waste (ILW)
 - High-Level waste (HLW)
 - Mixed waste
 - Transuranic waste





How Big is This?...

- Within the Department of Energy alone, there are:
 - Approximately 700 buildings to be fully decommissioned
 - An additional 180,000 metric tons of scrap metal to be remediated



What was the problem?

- Large-scale clean up operations often produced unwanted dust and debris
- An efficient method for removing dust and debris that also provided maximum worker protection



Available Solutions?

- Traditional Drum Canister Style Systems
- Cyclonic Separators





Cyclone Challenges

- Cyclonic separators were not efficient at removing particles less than 10 microns
- Accumulation of particles on the motor and fan blades lead to eventual failure of the motor
- A filter could be used, but often resulted in restricted airflow



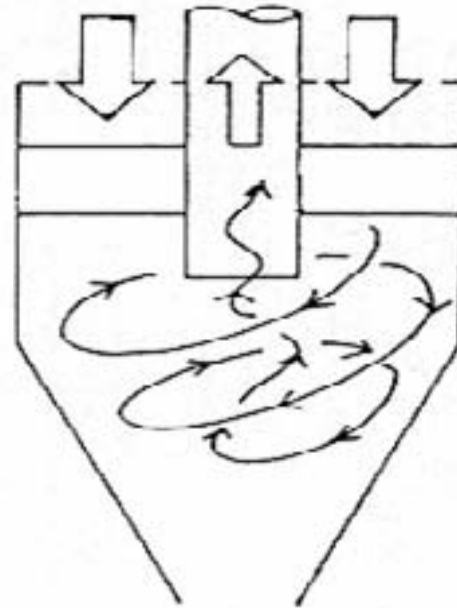
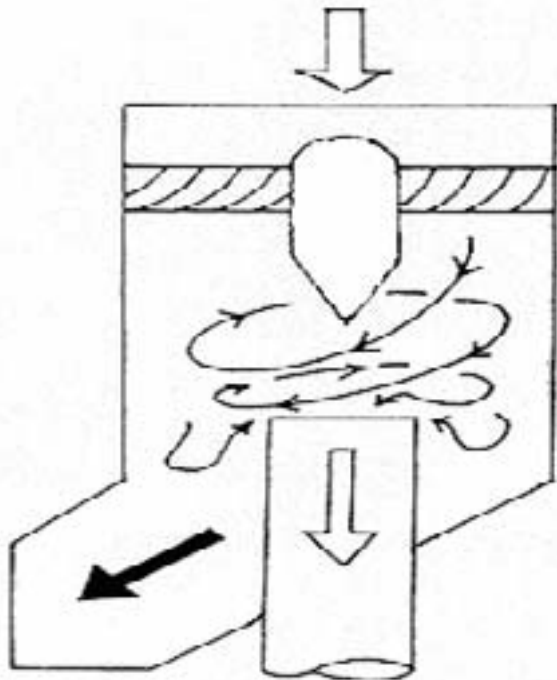


Cyclonic Separators

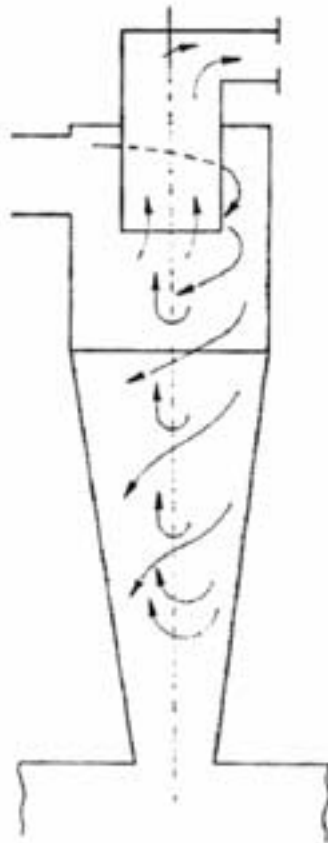
- Two primary orientations
 - Axial
 - Tangential
- Air stream enters a cylinder and is forced to spin in a vortex



Axial Orientation



Tangential Orientation





Cyclonic Separators (continued)

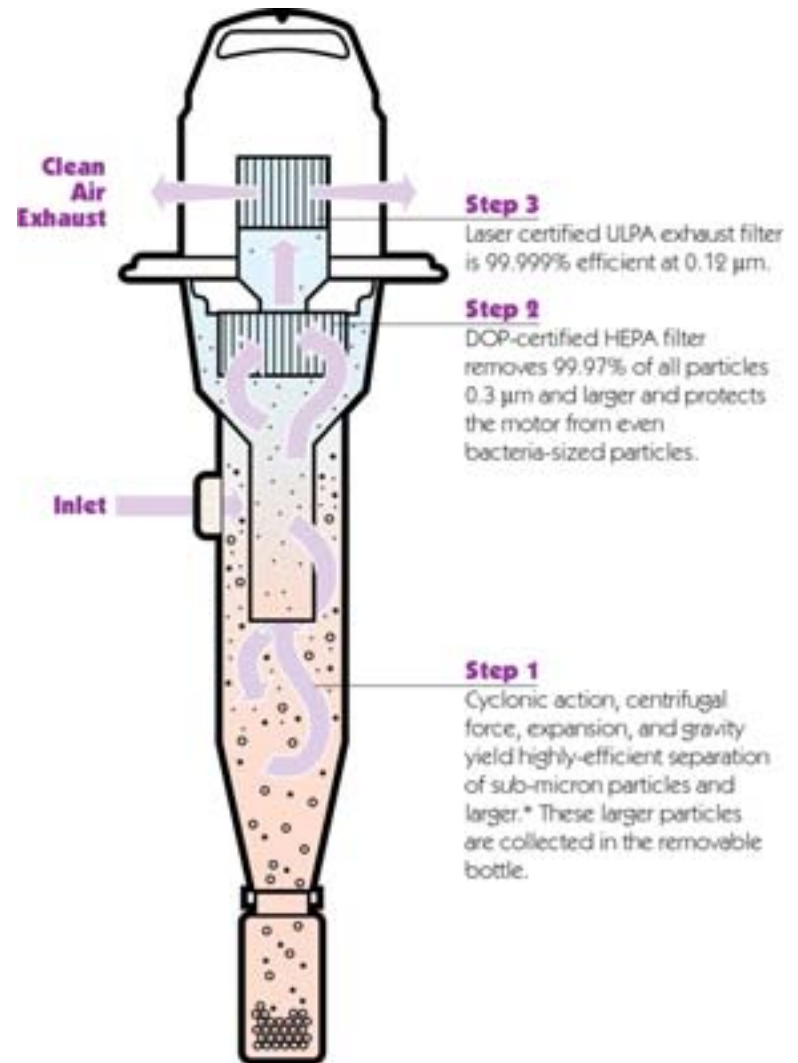
- $F = (mv^2) / r$ Equation 1
- Where
 - F = force required to keep an object moving along a circular path
 - m = mass
 - v = velocity
 - r = radius

SafeVac

SAFE NUCLEAR & HAZ MAT VACUUM SYSTEMS

M. Carroll, J. Kerns and J. McCracken, US Patent Accepted

- Minimal operator exposure
- Critically safe
- Dry / wet use
- Sealed, rigid waste container
- Reduced filter maintenance
- 3 stages of separation
 - Cyclone separator
 - HEPA Pre-Filter
 - ULPA Exhaust Filter



INVENTURE!
LABORATORIES, INC.



Materials & Chemistry Laboratory

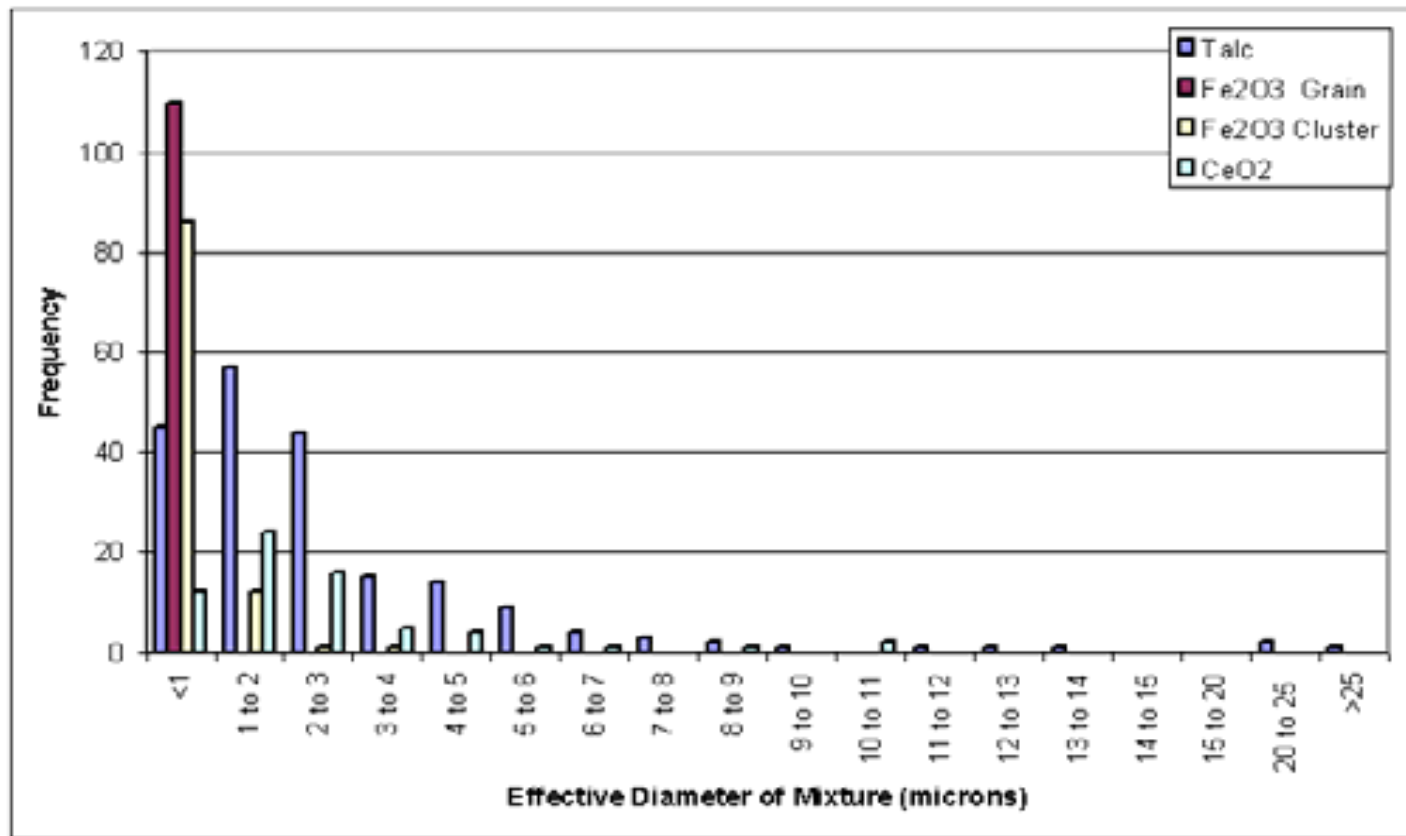
- Design a test that would simulate “real world” dust from cleanup operations
- Test must challenge the cyclones’ ability to remove particles
- Compare cyclonic separator to a traditional vacuum



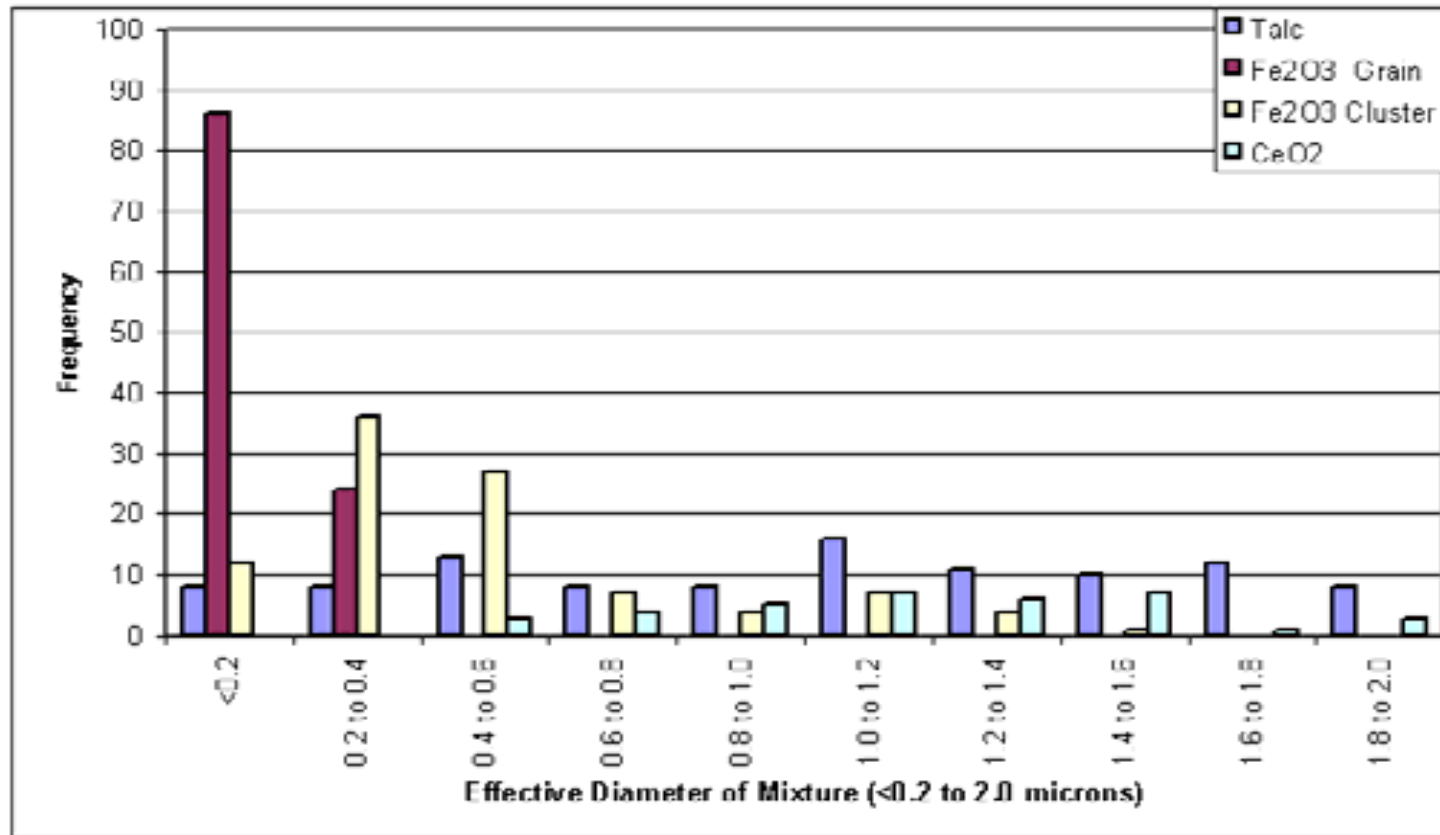
Sample Mixture

- 10 kg Fe₂O₃
- 10 kg Talc USP powder
- 1 kg CeO₂

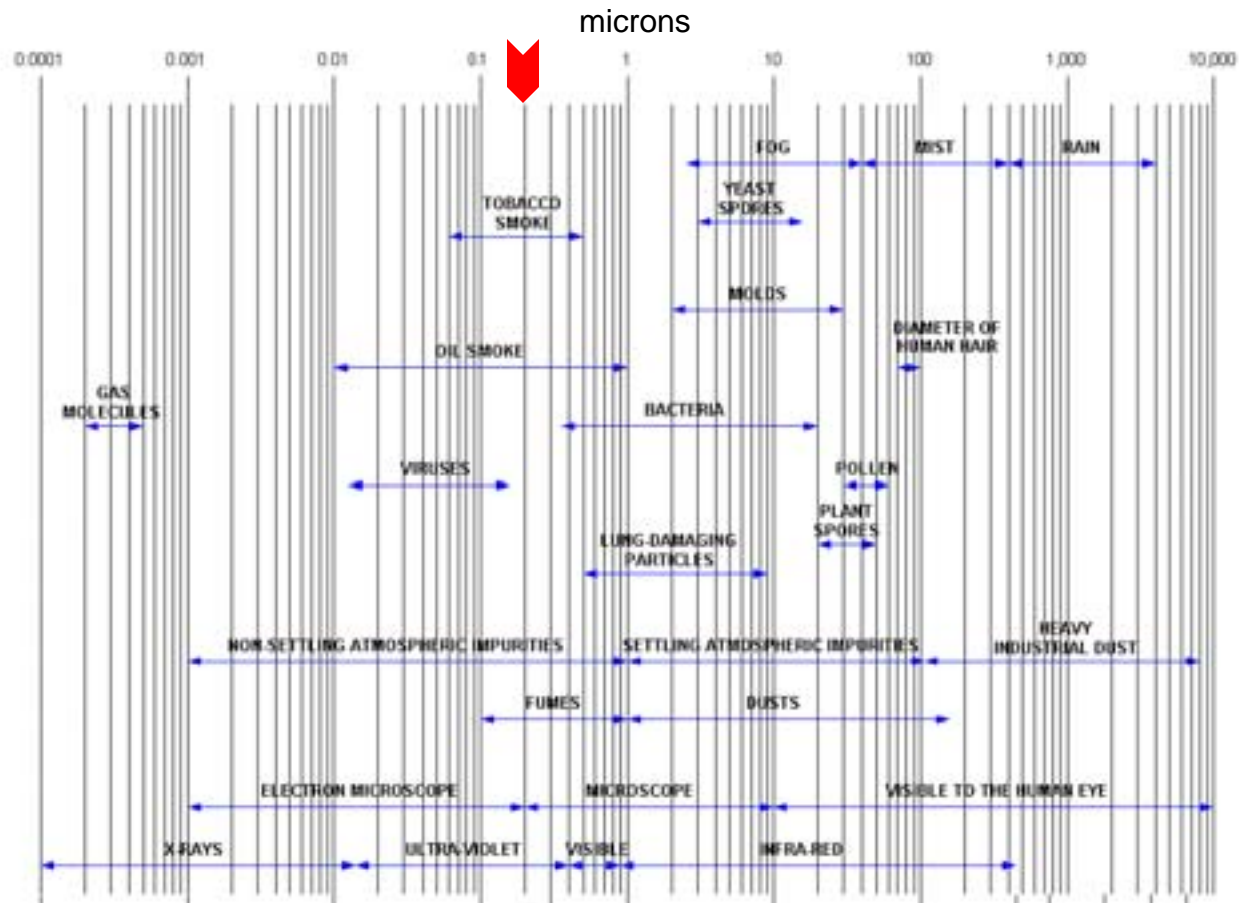
Particle Size



Particle Size (<2 microns)



Relative Size of Contaminants





Vacuum Comparison



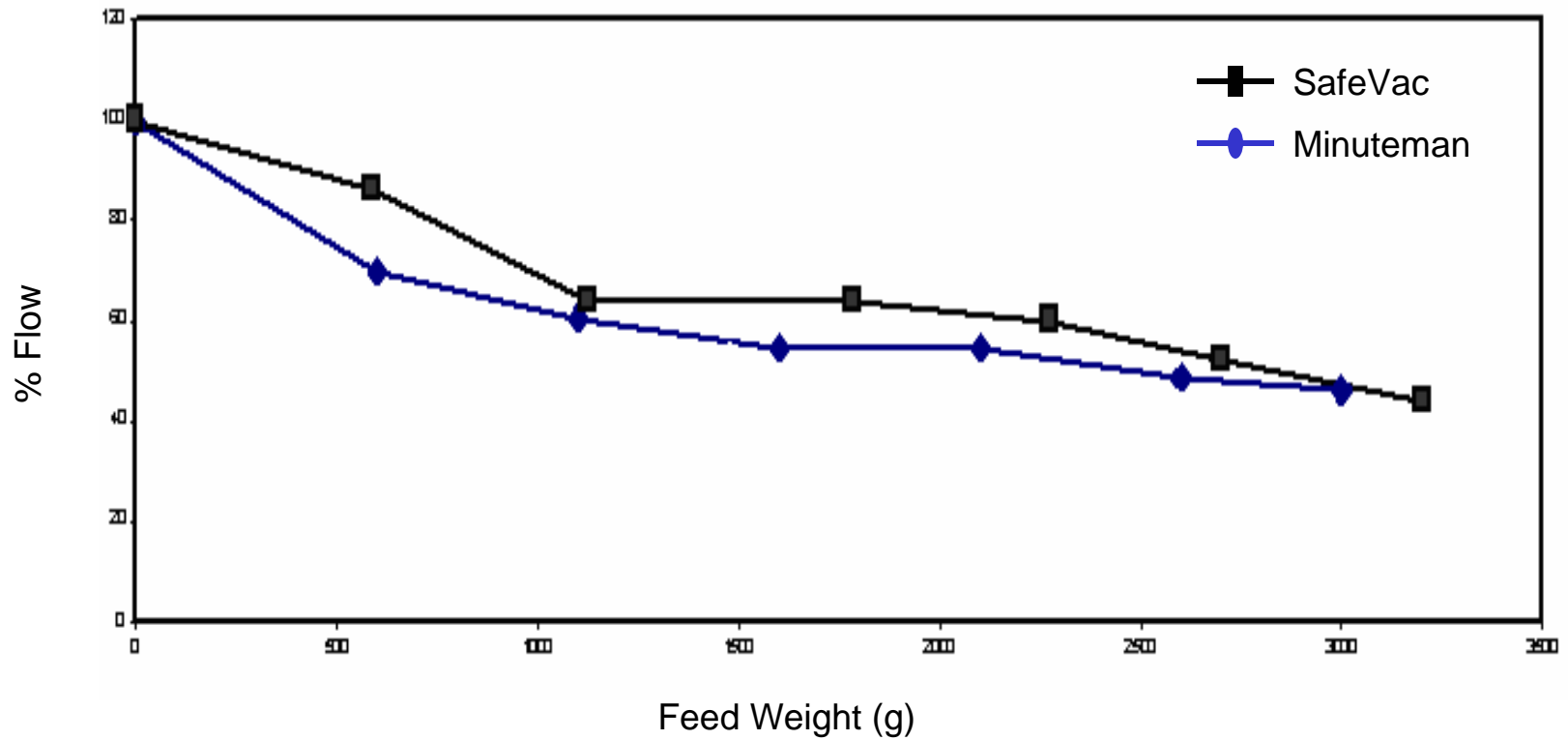
 **SafeVac**
SAFE NUCLEAR & HAZ MAT VACUUM SYSTEMS
Vacuum System



Minuteman[®]
Vacuum System No. 829123



Flow Rate





Recovery Efficiency



	<i>Test 1</i>	<i>Test 2</i>
Cyclone	94.0%	95.0%
HEPA Filter	3.1%	3.3%
ULPA Filter	0.3%	0.1%
Exhaust	Not Detectable	Not Detectable



Recovery Efficiency

<i>Minuteman</i> [®]	<i>Test 1</i>	<i>Test 2</i>
Canister	5.7%	2.9%
Collection Bag	87.0%	89.9%
Prefilter	5.7%	5.4%
Cloth Filter	0.03%	0.03%
HEPA Filter	0.01%	0.01%
Exhaust	Not Detectable	Not Detectable



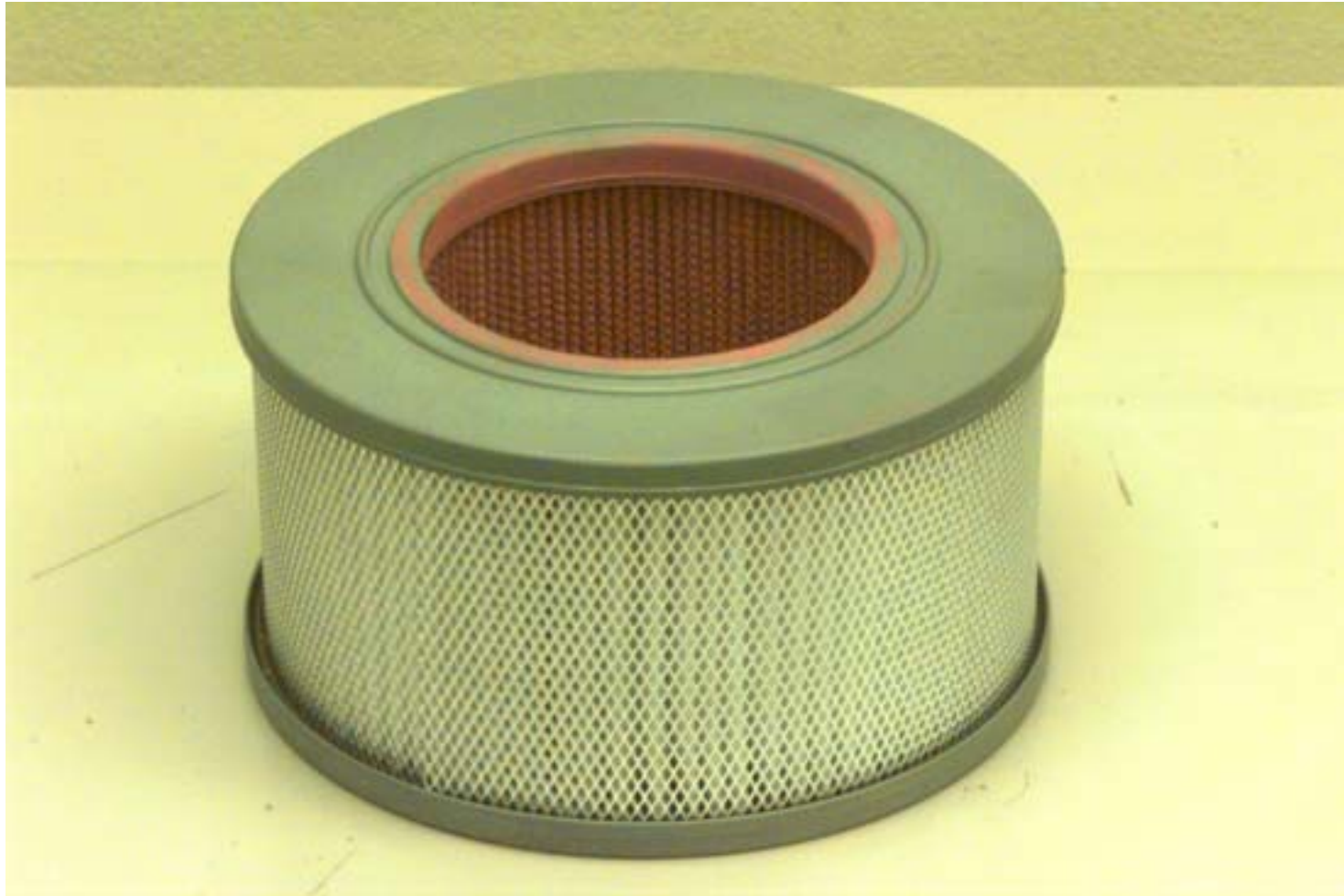
Minuteman cloth filter





Minuteman collection bag





SafeVac ULPA filter





Recovered material
containment

Minuteman SafeVac





SafeVac with glovebag containment system





Conclusions

- SafeVac and Minuteman recovery efficiencies are comparable
- SafeVac's cyclone alone removes >94% particles down to 0.2 micron—smaller than bacteria
- SafeVac's collection vessel provides better containment, thus greater user safety



Thank you!

Questions ?

