A Comparison of Air Supply Diffusers and the Effects on Fume Hood Performance

by

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Fume Hood Performance

Containment is affected by:

• Fume Hood Design
• Flow (Face Velocity)
• Work Practices
• **Room Air Supply**
Effects of Supply Diffusers

Hood Opening

Air Supply Diffusers
Objectives

- Evaluate Affect of Different Diffusers on Hood Performance
  - Range of Flow Rates
  - Range of Supply Discharge Temperatures
  - Different Lab Configurations

- Assess Ability of Diffuser to Complement or Degrade Hood Performance
Test Methods

- **HP Fume Hood**
  - Vertical Sash Full Open
  - 60-fpm Average Face Velocity

- **3 Lab Configurations**
  - 10-ft Ceiling and 5-ft from Hood Opening

- **5 Supply Diffusers**

- **3 Air Supply Flows (250 cfm – 650 cfm)**

- **2 Supply Temperature Challenges**

- **3 Test Cycles – 5 minute duration each**
Lab Configuration 1

Hood

Diffuser
Lab Configuration 2

Hood

Diffuser
Lab Configuration 3

Hood

Diffuser
Supply Diffuser
Flow Measurement
Fume Hood Test Apparatus

- Supply Temp Probe
- Mannequin
- Temp Probe
- Detector
- Tracer Gas
- Ejector
- Flow Monitor
- Cross Draft Velocity Probes
- Computer, HoodPRO Software & DAQ
Duct Sox Diffuser

Lab Configuration 2
Radial Face Diffuser

Lab Configuration 2
Flat Face Radial Diffuser

Lab Configuration 2
4 Way Diffuser

Lab Configuration 3
## Lab Configuration 2 and 3
### Tracer Gas Test Results

<table>
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<th>DuctSox A</th>
<th>DuctSox C</th>
<th>Radial Face</th>
<th>Flat Face</th>
<th>4 Way Diffuser</th>
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**Lab Configuration 2**

**Lab Configuration 3**
Test Configuration 2 - Normal Challenge
DuctSOX A Diffuser
Face Velocity and Tracer Gas Data

Face Velocity - Temporal Variation = 10%
Containment - Control Level = <0.01 ppm
Face Velocity - Temporal Variation = 10%
Containment - Control Level = 0.10 ppm
Test Configuration 2 - Normal Challenge
DuctSOX A Diffuser
Cross Draft and Tracer Gas Data
Test Configuration 3 - Normal Challenge
Four Way Diffuser
Cross Draft and Tracer Gas Data

15 Minute Test
fpm

0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

ppm

Cross Draft (P) Tracer Gas Escape
Preferred Diffuser Location = Configuration 2
Minimize Drafts < 50% of AVG Face Velocity
Increase Distance and Decrease Volume
Findings and Conclusions

- Fabric 2x4 diffusers and Radial Perforated Diffusers Provide Equivalent Performance
- Diffusers should be located at least 5 feet from Hood
- Diffusers should be located to the side of the hood rather than in front of the hood
- Containment affected by high face velocity turbulence associated with high cross draft velocities
- High Velocity Directional Diffusers or Linear Slot Diffusers are Not Appropriate for Labs
- Diffuser Location and Discharge Temperature Can Affect Hood Performance and Should Be Investigated Further
Recommendations

- Additional investigation of more lab configurations
- Include less than ideal lab conditions with high air change rates and different dimensions
- Evaluate performance of different hoods under similar challenge conditions
- Diffusers specifications include discharge flow patterns at different flow rates and discharge temperatures
- Program and run CFD models to compare with empirical data
Final Thoughts

- Essential to characterize the phenomena associated with escape
  - Velocity
  - Pressure
  - Temperature
  - Aerodynamic Design

- Information Necessary to Update Standards and Guidelines
  - Lab Designs
  - Operating Specifications
  - Test Methods
End

Questions?