An improved nose-only flow-past chamber for chronic inhalation exposure of rats

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Motivation

• For a chronic aerosol inhalation study of room-aged cigarette sidestream smoke (RASS) and diesel engine exhaust (DEE), nose-only exposure chambers that enable the simultaneous exposure of 5 groups of approx. 200 rats each were required.1

  – The nose-only exposure mode was preferred, because it prevents deposition of aerosol particles on skin and fur, thereby minimizing the uptake of aerosol particles by grooming.2,3

  – Re-breathing of exhaled test aerosol was to be kept to a minimum.

  – Limited laboratory floor space was available, so, none of the commercially available nose-only flow-past chambers were suitable.4,5

Cannon et al.\textsuperscript{1} improves the standard nose-only exposure chamber

- 40 ports available (5 reserved for sampling; 35 used for rat exposure).
- Decreased effect of non-uniform distribution of aerosol concentration.

\textsuperscript{1} Cannon WC, Blanton EF, McDonald KE. 1983. \textit{Am. Ind. Hyg. Assoc. J.} \textbf{44}(12): 923-928.
Pauluhn et al.¹ further improves the nose-only exposure chamber

- Uniform spatial exposure of aerosol.

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The PMI nose-only flow past chamber

- Uniform spatial exposure of aerosol.
- Increased number of ports: 200.
- Minimal re-breathing of exhaled air.
- Minimal irritation.
Aerosol loss and uniform distribution within the PMI nose-only flow past chamber

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>RASS</th>
<th>DEE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low dose</td>
<td>High dose</td>
<td>Low dose</td>
</tr>
<tr>
<td>TPM concentration</td>
<td>mg/m³</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Aerosol distribution</td>
<td>RSD (%)</td>
<td>5.0</td>
<td>2.4</td>
</tr>
<tr>
<td>TPM loss</td>
<td>%</td>
<td>2.9</td>
<td>1.2</td>
</tr>
</tbody>
</table>

TPM = total particulate matter
Particle size distribution of test aerosol within the PMI nose-only flow past chamber

**RASS**

**DEE**
The PMI nose-only flow-past chamber

- Uniform and consistent spatial aerosol distribution within the exposure chamber
  - aerosols undergo no significant changes in particle size distribution on their way through the exposure chamber

- Flow direction of the aerosol in the breathing zone passes the nose of the rat at 90° to the flow direction of the exhaled air
  - minimizes re-breathing of exhaled air

- Aerosol velocity in the breathing zone of the rat at a flow rate of 1 l/min through each holding tube is only 0.1 m/s
  - protects the rats from irritative effects

- Increased number of exposure ports: 200
  - more efficient use of laboratory floor space
Acknowledgement

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