Effect of hood size on a qualitative fit test

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Respiratory Protection

- Provide adequate protection
- Fit the wearers face
- To ensure the mask fits carry out a fit test
Qualitative fit test (QLFT) kits

• Hood

• Two nebulisers to produce aerosols of the
  – Sensitivity solution
  – Test solution
Standard QLFT
Standard QLFT sensitivity test

- Bitrex sensitivity solution used
- Place the hood on the wearer
- Introduce sensitivity aerosol using nebuliser
- Count the number of squirts needed for the wearer to taste the solution

HSE Operational Circular 282/28
Standard qualitative fit test

• Don mask
• Place hood over wearers head
• Introduce initial number of squirts of test solution
• Perform each exercise for 1 minute
• Introduce half the number of initial squirts at 30 second intervals
• If the wearer can taste the Bitrex then the test has failed and the mask doesn’t fit
## Initial number of squirts

<table>
<thead>
<tr>
<th>Sensitivity result</th>
<th>Initial number of squirts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td>10</td>
</tr>
<tr>
<td>11-20</td>
<td>20</td>
</tr>
<tr>
<td>21-30</td>
<td>30</td>
</tr>
<tr>
<td>30+</td>
<td>-</td>
</tr>
</tbody>
</table>
Standard QLFT 7 exercises

- Normal breathing
- Deep breathing
- Head side to side
- Head up and down
- Talking out loud
- Bending at waist
- Normal breathing

HSE Operational Circular 282/28
Hood dimensions - standard hood

- 300mm (12”) in diameter
- 355mm (14”) in height
- Forms a cylindrical shape
- Internal hood space volume 20l

HSE Operational Circular 282/28
ANSI Z88.10:2010
QLFT Kits available

- Range of kits available on the UK market
- Range of hoods
- Differ in
  - Construction
  - Shape
  - Size
  - Volume
Identification of QLFT kits

- 10 commonly available QLFT kits purchased
- Three different designs of hood across the 10 manufacturers
Concerns over differing volumes

• How different are the volumes?
• Does this affect the concentration of aerosol in the hood space?
• Does this have a bearing on the quality and consistency of the fit test?
Standard Hood
Hood A
Hood A upright
Hood C flat
Hood C shaped
Hood volumes

- Total volume of hood, calculated from its external dimensions when placed on a mannequin torso
- Volume of standard Sheffield head calculated by water immersion technique
- Volume of empty space calculated
## Percentage increase of hood volumes

<table>
<thead>
<tr>
<th>Hood Type</th>
<th>Volume of hood space when worn (L)</th>
<th>% increase from standard hood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>A Upright</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>B</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>C Flat</td>
<td>48</td>
<td>140</td>
</tr>
<tr>
<td>C Shaped</td>
<td>44.5</td>
<td>122.5</td>
</tr>
<tr>
<td>+/- 5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI recommended hood space volume 20L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Experimental set up

• Standard Sheffield head attached to torso
• Connected to breathing machine
  – 1.5 l @ 20 strokes per minute
  – Regular breathing at low work rate (ISO, 2004)
• Tee shirt fitted to stop the hood slipping
• Alpha Solway 3030V disposable FFP3 mask fitted (used throughout testing)
Position of sampling location
Measurement

- **TSI PortaCount**
  - Measures ambient particles/cm$^3$

- **TSI AM150 Sidepack aerosol monitor (SPAM)**
  - Measures ambient particles mg/m$^3$ (mass)
  - Calibrated flow rate 0.7l/min
Tests

• PortaCounts and SPAMs allowed to equilibrate for 2 minutes
• 10 squirts of Bitrex test solution introduced before start of test
• 5 squirts introduced at 30 second intervals for 7 minutes – duration of fit test
• No attempt to simulate head movements or exercises during the test
Tests

• Each test was carried out on the 3 styles of hood in all configurations
• The aerosol concentration was measured
• Each hood configuration was tested 3 times and a mean concentration calculated
PortaCount results in hood volume order

<table>
<thead>
<tr>
<th>Hood Type</th>
<th>Particle/cm³</th>
<th>Volume(L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>65782</td>
<td>20</td>
</tr>
<tr>
<td>A</td>
<td>54523</td>
<td>20</td>
</tr>
<tr>
<td>B</td>
<td>39673</td>
<td>23</td>
</tr>
<tr>
<td>A Upright</td>
<td>53341</td>
<td>30</td>
</tr>
<tr>
<td>C Shaped</td>
<td>23876</td>
<td>46</td>
</tr>
<tr>
<td>C Flat</td>
<td>18582</td>
<td>47</td>
</tr>
</tbody>
</table>
PortaCount results in hood volume order
## SPAM results in hood volume order

<table>
<thead>
<tr>
<th>Hood Type</th>
<th>mg/m³</th>
<th>Volume(L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>3.76</td>
<td>20</td>
</tr>
<tr>
<td>A</td>
<td>4.52</td>
<td>20</td>
</tr>
<tr>
<td>B</td>
<td>2.43</td>
<td>23</td>
</tr>
<tr>
<td>A Upright</td>
<td>3.35</td>
<td>30</td>
</tr>
<tr>
<td>C Shaped</td>
<td>1.42</td>
<td>46</td>
</tr>
<tr>
<td>C Flat</td>
<td>0.99</td>
<td>47</td>
</tr>
</tbody>
</table>
SPAM results in hood volume order
Results

• There is a general trend in reduction of concentration of aerosol with increasing hood size

• A lower concentration of aerosol in the hood may lead to a fit test that is not as sensitive as required
Manufacturers

• Produce hoods which have a larger volume than that specified in 282/28 and recommended in the ANSI standard

• Instructions of correct assembly of the hood is sometimes unclear

• Instructions on the delivery of the aerosol is sometimes confusing
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