Interchangeability of Gas Detection Tubes and Hand Pumps

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Gas Detection Tubes

Question: Can RAE tubes be used in Gastec or Draeger hand pumps and vice versa?

Answer: Gastec - Yes      Draeger - No
Milestones in better Tube Accuracy

- Sliding Scale vs precalibrated printed scale
- Early squeeze bulb pumps lacked accuracy
- Introduction of piston style pumps
- Flow limiting device moves from orifices to the tube itself
Modern Tube Types

Low-Vacuum Bellows
- ~7 mm tube o.d.
- Larger particles
- Examples:
  - Draeger Accuro
  - MSA Kwik-Draw

High-Vacuum Piston
- ~5 mm tube o.d.
- Smaller particles
- Examples:
  - RAE LP-1200
  - Gastec GV/100
  - Matheson-Kitagawa 8014-400A
Pump Designs
Pump Flow Characteristics

RAE LP-1200
Gastec GV/100
Kitagawa 8014-400A
Draeger Accuro
MSA Kwik-Draw

Piston Pumps
Bellows Pumps

Time (Seconds)
Internal Vacuum (cm Hg)
## System Flow Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Piston Pumps</th>
<th>Bellows Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Control</td>
<td>Tube</td>
<td>Pump</td>
</tr>
<tr>
<td>Pump Vacuum</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Tube Diameter</td>
<td>5 mm</td>
<td>7 mm</td>
</tr>
</tbody>
</table>
System Flow Characteristics

Flow rate can affect stain length because enough time is needed to:

- Allow color reaction to occur (High flow = stain too long)
- Allow pre-tube reactions to occur (High flow = stain too short)
# Summary of Interchangeability Tests

<table>
<thead>
<tr>
<th>Tube</th>
<th>Test Gas</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAE 100-10</td>
<td>10 ppm NH₃</td>
<td>RAE: 11, Gastec: 11, Kitagawa: 10 (0.5 min)</td>
</tr>
<tr>
<td>Gastec 3La</td>
<td>50 ppm NH₃</td>
<td>RAE: 51, Gastec: 52, Kitagawa: 50</td>
</tr>
<tr>
<td>RAE 100-20</td>
<td>300 ppm NH₃</td>
<td>RAE: 290, Gastec: 310, Kitagawa: 300</td>
</tr>
<tr>
<td>RAE 101-05</td>
<td>5 ppm Benz</td>
<td>RAE: 5.8, Gastec: 5.6, Kitagawa: 6.0 (10 min)</td>
</tr>
<tr>
<td>RAE 101-20</td>
<td>50 ppm Benz</td>
<td>RAE: 43, Gastec: 45, Kitagawa: 44</td>
</tr>
<tr>
<td>RAE 102-30</td>
<td>250 ppm CO</td>
<td>RAE: 230, Gastec: 230, Kitagawa: 240 (2 min)</td>
</tr>
<tr>
<td>RAE 103-40</td>
<td>0.5% H₂S</td>
<td>RAE: 0.42%, Gastec: 0.43%, Kitagawa: 0.43%</td>
</tr>
<tr>
<td>RAE 103-10*</td>
<td>25 ppm H₂S*</td>
<td>RAE: 29, Gastec: 29, Kitagawa: 29</td>
</tr>
<tr>
<td>Gastec 4LL*</td>
<td>25 ppm H₂S*</td>
<td>RAE: 26, Gastec: 27, Kitagawa: 26</td>
</tr>
<tr>
<td>Kitagawa 120SD*</td>
<td>25 ppm H₂S*</td>
<td>RAE: 29, Gastec: 29, Kitagawa: 29</td>
</tr>
</tbody>
</table>

*Tests Conducted at Stanford University*
Summary of Interchangeability Tests

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<th>Test Gas</th>
<th>RAE</th>
<th>Gastec</th>
<th>Kitagawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAE 103-10**</td>
<td>10 ppm H₂S**</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>20 ppm H₂S**</td>
<td>20</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>50 ppm H₂S**</td>
<td>46</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td>RAE 103-20</td>
<td>100 ppm H₂S</td>
<td>97</td>
<td>104</td>
<td>107</td>
</tr>
<tr>
<td>RAE 103-30</td>
<td>1000 ppm H₂S</td>
<td>1070</td>
<td>1070</td>
<td>1090</td>
</tr>
<tr>
<td>RAE 104-50*</td>
<td>10% CO₂*</td>
<td>9.2</td>
<td>9.8</td>
<td>9.6</td>
</tr>
<tr>
<td>Gastec 2H*</td>
<td>10% CO₂*</td>
<td>9.2</td>
<td>9.6</td>
<td>9.1</td>
</tr>
<tr>
<td>Kitagawa 126SH<em>10% CO₂</em></td>
<td>9.5</td>
<td>9.9</td>
<td>9.8</td>
<td></td>
</tr>
</tbody>
</table>

**Tests Conducted at San Francisco City College

*Tests Conducted at Stanford University
Piston Pump Interchangeability

- 58 Different mixed tube-pump combinations
- 11 Different chemicals
- Average deviation between pumps: 3.2%
- Max deviation between pumps: 14%
- Average deviation from standard: 6.7%
- Max deviation from standard: 24%
RAE Interchangeability Statement

Interchangeable Piston Pumps:
- RAE LP-1200
- Gastec GV/100
- Matheson-Kitagawa 8014-400A

Pumps Must Have Same:
- Volume Accuracy
- Flow Characteristics
- Tube Fit (5 mm = 5 mm)
RAE Interchangeability Statement
MSA Interchangeability Statement

Interchangeable Bellows Pumps:
- MSA Kwik-Draw
- Auer Gas-Tester II H
- Draeger Model 31
- Draeger Accuro

Pumps Must Have Same:
- Volume Accuracy
- Flow Characteristics
- Tube Fit (7mm = 7mm)
### Summary of Interchangeability Tests

<table>
<thead>
<tr>
<th>Tube</th>
<th>Test Gas</th>
<th>Dräger ppm</th>
<th>MSA ppm</th>
<th>Piston Avg ppm</th>
<th>Avg min</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAE 100-10</td>
<td>10 ppm NH₃</td>
<td>11</td>
<td>10</td>
<td>11</td>
<td>0.5</td>
</tr>
<tr>
<td>RAE 100-20</td>
<td>300 ppm NH₃</td>
<td>230</td>
<td>240</td>
<td>300</td>
<td>1</td>
</tr>
<tr>
<td>RAE 102-30</td>
<td>250 ppm CO</td>
<td>180</td>
<td>200</td>
<td>230</td>
<td>2</td>
</tr>
<tr>
<td>Gastec 4LL</td>
<td>25 ppm H₂S</td>
<td>25</td>
<td>25</td>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>Dräger H₂S 2/b</td>
<td>25 ppm H₂S</td>
<td>31</td>
<td>29</td>
<td>34</td>
<td>0.4</td>
</tr>
<tr>
<td>MSA H₂S-1</td>
<td>25 ppm H₂S</td>
<td>24</td>
<td>26</td>
<td>28</td>
<td>0.4</td>
</tr>
<tr>
<td>RAE 104-50</td>
<td>10% CO₂</td>
<td>9.2</td>
<td>9.3</td>
<td>9.5</td>
<td>1</td>
</tr>
<tr>
<td>Kitagawa 126SH</td>
<td>10% CO₂</td>
<td>9.1</td>
<td>9.2</td>
<td>9.7</td>
<td>1</td>
</tr>
<tr>
<td>RAE 107-20</td>
<td>50 ppm SO₂</td>
<td>49</td>
<td>50</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>RAE 109-20*</td>
<td>25 ppm NO</td>
<td>8.7</td>
<td>9.2</td>
<td>24</td>
<td>2</td>
</tr>
</tbody>
</table>

*Combination pre-tube & measurement tube.
MSA Interchangeability Statement
RAE Interchangeability Statement
Why do several government agencies have statements against interchangeability? All seem to be based on old 1974 study* using pumps of different design and flow characteristics and mostly are no longer used:

- Four orifice limited pumps
- one bellows pump
- one piston pump

Conclusions

- Tubes and pumps are interchangeable if design/performance criteria are the same and appropriate leak checks are performed.
- Interchangeability should be guided by pump specifications, not by brand name.
- Because the piston pumps tested are equivalent, any new tube designed to work on the Gastec pump will also work on the RAE or Kitagawa pumps, and vice versa.
Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.

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