Laboratory Evaluation
2B Technologies
Personal Ozone Monitor (POM)
Background

Three 2B Technologies Personal Ozone Monitor (POM) (units IDs: 1043, 1105 and 1106) were field-tested at the South Coast AQMD Rubidoux fixed ambient monitoring station (07/29/2015 to 09/09/2015) under ambient weather conditions. Now, three new POMs (units ID: 1148, 1122, 1141) have been evaluated in the South Coast AQMD Chemistry Laboratory under controlled ozone concentration, temperature, and relative humidity.

2B Technologies POM (3 units tested):
- Ozone sensors (UV absorption, FEM)
- Each unit measures: Ozone (ppb)
  Unit cost: ~$4,500
- Time resolution: 10-sec to 1-hr
- Units IDs: 1148, 1122, 1141

FRM instrument:
- Ozone FRM (Serinus 10, American Ecotech, Providence, RI)
  Instrument cost: ~$7,000
- Time resolution: 1-min
Three POM units tracked well with the ozone conc. change as recorded by FRM.

POM units slightly underestimated the ozone conc. as recorded by FRM.

In ozone concentration range of 0-350 ppb, the three POM units showed very strong correlations with the corresponding FRM data ($R^2 > 0.99$) at 20 °C and 40% RH.
POM Accuracy

- Accuracy (20 °C and 40% RH)

<table>
<thead>
<tr>
<th>Steady State (#)</th>
<th>Sensor mean (ppb)</th>
<th>FRM (ppb)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37.1</td>
<td>41.0</td>
<td>90.5</td>
</tr>
<tr>
<td>2</td>
<td>73.8</td>
<td>82.1</td>
<td>89.9</td>
</tr>
<tr>
<td>3</td>
<td>107.1</td>
<td>120.8</td>
<td>88.6</td>
</tr>
<tr>
<td>4</td>
<td>212.7</td>
<td>235.0</td>
<td>90.5</td>
</tr>
<tr>
<td>5</td>
<td>296.8</td>
<td>330.9</td>
<td>89.7</td>
</tr>
</tbody>
</table>

- The three POM units showed high accuracy compared to the FRM at 20 °C and 40% RH. Accuracy ranges from 89.7 to 90.5%.

POM Data Recovery & Intra-model Variability

- Data recovery for ozone from 1148, 1122, and 1141 was 100%, 94.2%, and 100%, respectively.

- Low ozone measurement variations were observed among the three POM units at 20 °C and 40% RH.
• Precision (Effect of ozone conc., temperature and relative humidity)

The three POM units exhibited high precision during almost all tested conditions (ozone concentration, T and RH). POM 1122 experienced some instability at 5 °C, 40% RH and 20 °C, 65% RH.

FRM’s precision was also high across all conditions.
POM Climate Susceptibility

2B POM vs FRM (Ozone Conc. Ramping; 5 °C, 15% RH)

- FRM
- POM1148
- POM1122
- POM1141

2B POM vs FRM (Ozone Conc. Ramping; 35 °C, 15% RH)

- FRM
- POM1148
- POM1122
- POM1141

2B POM vs FRM (Ozone Conc. Ramping; 5 °C, 65% RH)

- FRM
- POM1148
- POM1122
- POM1141

2B POM vs FRM (Ozone Conc. Ramping; 35 °C, 65% RH)

- FRM
- POM1148
- POM1141

POM 1122 was not recording data during this experiment.

Low Temp - Low RH

High Temp - Low RH

Low Temp - High RH

High Temp - High RH
In the laboratory, the effect of NO$_2$ interferent is evaluated by exposing sensors to increasing concentrations of NO$_2$ at 20 °C and 40% RH. As shown in the figure, both the FRM and sensors maintained their baseline readings throughout the NO$_2$ concentration ramping from 0 to 300 ppb.
Accuracy: The three POM units showed high accuracy compared to the FRM at 20 °C and 40% RH. Accuracy ranges from 89.7 to 90.5%. (refer to slide 4)

Precision: The three POM units exhibited high precision during almost all tested conditions (ozone concentration, T and RH). POM 1122 experienced some instability at 5 °C, 40% RH and 20 °C, 65% RH. (refer to slide 5 and 6)

Intra-model Variability: Low ozone measurement variations were observed among the three POM units at 20 °C and 40% RH. (refer to slide 4)

Data Recovery: Data recovery for ozone from 1148, 1122, and 1141 was 100%, 94.2%, and 100%, respectively. (refer to slide 4)

Baseline: The three POM units reported baseline values close to 0 ppb.

Coefficient of Determination: POM units showed excellent correlation/linear response with the corresponding FRM ozone measurement data ($R^2 > 0.99$) between 0-400 ppb at 20 °C and 40% RH. (refer to slide 3)

Interferent: Sensors were inert to NO$_2$ at 20 °C and 40% RH. When NO$_2$ was increased from 0 to 300 ppb, the sensors maintained their baseline readings.

Drift: POM units had negligible drift over the course of laboratory testing.

Climate susceptibility: From the laboratory studies, temperature and relative humidity had little effect on the sensors’ performance. (refer to slide 6)