3.8 **Hourly Averaged Tracer Data**

Tracer concentrations averaged over one hour have been plotted in the 12-hour and 3-hour bar graphs shown in the following figures. The station numbers shown in each bar graph correspond to those given in Figure 1 and Table 2.
Figure 135.

1. CONC. PPT
   0 11 TIME 23
   120

2. CONC. PPT
   0 11 TIME 23
   120

3. CONC. PPT
   0 11 TIME 23
   120

4. CONC. PPT
   0 11 TIME 23
   120

5. CONC. PPT
   0 11 TIME 23
   120

6. CONC. PPT
   0 11 TIME 23
   120

7. CONC. PPT
   0 11 TIME 23
   120

8. CONC. PPT
   0 11 TIME 23
   120

9. CONC. PPT
   0 11 TIME 23
   120

10. CONC. PPT
    0 11 TIME 23
    120

11. CONC. PPT
    0 11 TIME 23
    120

12. CONC. PPT
    0 11 TIME 23
    120

13. CONC. PPT
    0 11 TIME 23
    120

TEST 1
Figure 136.

1

2

3

4

5

6

7

8

9

10

11

12

14

TEST 1
Figure 137.
Figure 138.
Figure 139.

[Images of graphs labeled 2 to 14, with vertical axis labeled 'CONC. PPT' and horizontal axis labeled 'TIME']

TEST 3
Figure 140.

1000

CONC. PPT

0

10 TIME 22

TEST 3
Figure 141.

1. CONC. PPT
2. 0
3. 16 TIME 4
4. 600
5. 4
6. 600
7. 16 TIME 4
8. 0
9. 16 TIME 4
10. 600
11. 16 TIME 4
12. 0
13. 16 TIME 4
14. 600

TEST 4
Figure 141a.

3

4

5

6

8

9

10

11

12

14

TEST 4
Figure 142.
Figure 143.

TEST 6
Figure 144.
Figure 145.
Figure 146.
Figure 147.

Legend:
- **Conc. PpT**
- **Start Time**

<p>| | | | |</p>
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TEST 2
Figure 148.

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<td>2800</td>
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<td>1323</td>
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<td>1326</td>
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<td>1331</td>
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</table>
3.9 Hourly Averaged Crosswind Tracer Concentrations

The maximum hourly and 3-hourly averaged tracer concentrations obtained with the sequential samplers have been plotted as functions of crosswind distance in the following figures. Distances for the 3-hour sequential samplers were measured north from the intersection of Highway 4 and Route 160. Distances for the 12-hour sequential samplers located along Highway 99 were measured south from Station 3 (Sacramento) along a north-south line. The 3-hour averaged data were calculated from the maximum 3 hours of data which occurred during the test.
Figure 150.

TEST CAL1 DATE: 08/31/76 TIME: 1400-2200

TEST CAL2 DATE: 09/02/76 TIME: 1400-2000

TEST CAL3 DATE: 09/05/76 TIME: 0300-1000

1-HOUR AVERAGE
3-HOUR AVERAGE

CONC. (PPT)

DISTANCE SOUTH OF SACRAMENTO (KM.)
Figure 151.

TEST CAL4 DATE: 09/06/76 TIME: 2000-0500

- ▲ 1-HOUR AVERAGE
- □ 3-HOUR AVERAGE

DISTANCE SOUTH OF SACRAMENTO (KM.)

TEST CAL6 DATE: 09/10/76 TIME: 0700-1600

- ▲ 1-HOUR AVERAGE
- □ 3-HOUR AVERAGE

TEST CAL7 DATE: 09/13/76 TIME: 1800-0500

- ▲ 1-HOUR AVERAGE
- □ 3-HOUR AVERAGE

DISTANCE SOUTH OF SACRAMENTO (KM.)
3.10 Mass Balance of Tracer Data

The integration of the automobile and airborne traverse data over the crosswind traverse distance can be used to determine the average flux of tracer gas passing through the traverse vertical plane. This flux can then be compared to the amount of tracer released at the source to provide a mass balance on the experimental data:

\[
\% \text{ tracer observed} = \frac{\int_{-\infty}^{\infty} \int_{0}^{L} u(z) C(y, z) \, dz \, dy}{Q} \times 100
\]

where \( Q \) is the release rate, \( L \) is the height of the mixing layer, \( u(z) \) is the wind velocity, and \( C(y, z) \) is the tracer concentration. This expression may be simplified by assuming a constant wind velocity, \( u(z) = \bar{u} \), and a uniform vertical tracer distribution, \( C(z, y) = \bar{C}(y) \), over a height \( \ell \):

\[
\% \text{ tracer observed} = \bar{u} \sum_{i=1}^{n} \ell_i \left( \int_{-\infty}^{\infty} C(y) \, dy \right)_i
\]

where \( \sum \ell_i \) equals the height of the mixing layer. In the following calculations, \( u \) was obtained by vector averaging the available wind data from points downwind of the source, and \( L \) was also averaged from available data. For cases where only surface tracer data were available, \( n=1 \) and \( \ell=L \); the tracer was assumed to be vertically well-mixed from the surface to the height of the mixing layer. Where traverse data were available at more than one height, \( n \) was taken to be equal to the number of traverses and \( \ell_i \) was taken to be a height arbitrarily assigned to each crosswind traverse. In this case, the tracer was assumed to be vertically well-mixed over a discrete portion of the mixing layer. The average wind speed, mixing
height and percent tracer observed in traverses where the assumptions were considered reasonable are given in Table 8.

If one assumes 100% of the tracer was observed and the average wind speed is correct, it is possible to calculate a new height based upon the tracer data. Similarly, if the mixing height is assumed correct, an average wind speed can be predicted from the tracer data:

\[
L_{\text{pred}} = L \cdot \frac{\% \text{ observed}}{100}\%
\]

\[
u_{\text{pred}} = u \cdot \frac{\% \text{ observed}}{100}\%
\]

The results of these calculations are also given in Table 8.
TABLE 8

TRACER MASS BALANCE RESULTS

<table>
<thead>
<tr>
<th>Trav Time</th>
<th>X (km)</th>
<th>L (m)</th>
<th>u (m/sec)</th>
<th>% tracer observed</th>
<th>Lpred (m)</th>
<th>u pred (m/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7* 1701-1753</td>
<td>51.9</td>
<td>1600</td>
<td>295/3.5</td>
<td>204</td>
<td>784</td>
<td>1.7</td>
</tr>
<tr>
<td>4* 1400-1415</td>
<td>35.2</td>
<td>780</td>
<td>290/6.2</td>
<td>36</td>
<td>2167</td>
<td>17.2</td>
</tr>
<tr>
<td>4 1400-1415</td>
<td>10.7</td>
<td>780</td>
<td>290/6.2</td>
<td>74(CBrF₃)</td>
<td>1053</td>
<td>8.4</td>
</tr>
<tr>
<td>5* 1445-1503</td>
<td>34.1</td>
<td>980</td>
<td>290/6.2</td>
<td>20</td>
<td>4900</td>
<td>31.0</td>
</tr>
<tr>
<td>5 1400-1415</td>
<td>10.0</td>
<td>980</td>
<td>290/6.2</td>
<td>134(CBrF₃)</td>
<td>731</td>
<td>4.6</td>
</tr>
<tr>
<td>6* 1515-1530</td>
<td>32.8</td>
<td>980</td>
<td>290/6.2</td>
<td>14</td>
<td>7000</td>
<td>49</td>
</tr>
<tr>
<td>7 1545-1635</td>
<td>25.3</td>
<td>1180</td>
<td>290/5.4</td>
<td>239</td>
<td>494</td>
<td>2.3</td>
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<tr>
<td>9* 1630-1715</td>
<td>70.9</td>
<td>1500</td>
<td>290/4.6</td>
<td>110</td>
<td>1364</td>
<td>4.2</td>
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<tr>
<td>10* 1630-1737</td>
<td>67.4</td>
<td>1500</td>
<td>300/4.2</td>
<td>121</td>
<td>1240</td>
<td>3.5</td>
</tr>
<tr>
<td>10 1630-1737</td>
<td>57.0</td>
<td>1500</td>
<td>300/4.2</td>
<td>331(CBrF₃)</td>
<td>416</td>
<td>1.2</td>
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<tr>
<td>11* 1731-1815</td>
<td>73.5</td>
<td>1500</td>
<td>290/4.8</td>
<td>250</td>
<td>600</td>
<td>1.9</td>
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</tbody>
</table>

Test 3 (9/5/76)

| 3 0213-0259 | 51.7 | 700 | 280/6.2 | 774 | 90 | 0.8 |
| 8 0414-0545 | 47.4 | 690 | 280/4.7 | 649 | 106 | 0.7 |
| 10 0432-0517 | 39.5 | 700 | 270/5.2 | 558 | 125 | 0.9 |
| 14* 0637-0647 | 37.2 | 740 | 306/3.3 | 118 | 627 | 2.8 |

AVE. 136

* Traverse data indicate that only a portion of the plume was traversed.
TABLE 8 (cont.)

TRACER MASS BALANCE RESULTS

<table>
<thead>
<tr>
<th>Trav Time</th>
<th>Time (km)</th>
<th>X (m)</th>
<th>L (m)</th>
<th>u (m/sec)</th>
<th>% tracer observed</th>
<th>L pred (m)</th>
<th>U pred (m/sec)</th>
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<td>2232-2320</td>
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<td>570</td>
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<td>400</td>
<td>143</td>
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<td>545</td>
<td>300/3.8</td>
<td>307</td>
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<td>3000</td>
<td>31/1.8</td>
<td>198</td>
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<td>0.9</td>
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<td>1314-1330</td>
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<td>3000</td>
<td>31/1.8</td>
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<td>3000</td>
<td>6/1.1</td>
<td>66</td>
<td>4545</td>
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<td>3000</td>
<td>338/0.8</td>
<td>47</td>
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### TABLE 8 (cont.)

**TRACER MASS BALANCE RESULTS**

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<th>Trav</th>
<th>Time</th>
<th>( X ) (km)</th>
<th>( L ) (m)</th>
<th>( u ) (m/sec)</th>
<th>% tracer observed</th>
<th>( L_{\text{pred}} ) (m)</th>
<th>( u_{\text{pred}} ) (m/sec)</th>
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<td>3333</td>
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<td>960</td>
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<td>14000</td>
<td>51</td>
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<td>1537-1611</td>
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<td>1500</td>
<td>280/3.5</td>
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<td>545</td>
<td>260/4.5</td>
<td>24</td>
<td>2271</td>
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<td>1835-1901</td>
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<td>500</td>
<td>260/4.8</td>
<td>30</td>
<td>1667</td>
<td>16.0</td>
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</table>

Airborne

| 6    | 0945-0958  | 17.1          | 300         | 310/0.9        | 8                 | 3807            | 11.4             |

\[
\begin{align*}
\text{8} & \quad 1327-1343 & \quad 61.6 & \quad 244=\ell_1 & \quad 280/1.7 & \quad 4 & \quad \{113 \text{ total} \} \\
\text{9} & \quad 1348-1404 & \quad 61.4 & \quad 122=\ell_2 & \quad 280/1.7 & \quad 3 \\
\text{11} & \quad 1428-1456 & \quad 61.7 & \quad \frac{2134=\ell_3}{L=2500} & \quad 290/1.3 & \quad 106 & \quad 2212 & \quad 1.5 \\
\text{12} & \quad 1759-1812 & \quad 72.7 & \quad 2500 & \quad 280/4.2 & \quad 120 & \quad 2079 & \quad 3.5 \\
\end{align*}
\]

\[
\text{AVE.} \quad 80
\]
TABLE 8 (cont.)

TRACER MASS BALANCE RESULTS

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<thead>
<tr>
<th>Travr</th>
<th>Time</th>
<th>X</th>
<th>L</th>
<th>u</th>
<th>% tracer</th>
<th>Lpred</th>
<th>Upred</th>
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<tbody>
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<td>(km)</td>
<td></td>
<td>(m)</td>
<td>(m/sec)</td>
<td>observed</td>
<td>(m)</td>
<td>(m/sec)</td>
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<td>Test 8 (9/14/76)</td>
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<td>0906-0931</td>
<td>14.4</td>
<td>350</td>
<td>270/2.2</td>
<td>110</td>
<td>318</td>
<td>2.0</td>
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<tr>
<td>2</td>
<td>0941-1007</td>
<td>15.7</td>
<td>480</td>
<td>270/2.2</td>
<td>61</td>
<td>787</td>
<td>3.6</td>
</tr>
<tr>
<td>3</td>
<td>1047-1151</td>
<td>48.9</td>
<td>800</td>
<td>240/4.2</td>
<td>168</td>
<td>476</td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>1154-1218</td>
<td>18.4</td>
<td>300</td>
<td>270/3.1</td>
<td>13</td>
<td>2308</td>
<td>23.8</td>
</tr>
</tbody>
</table>

**Ave. 88**

Airborne

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>X</th>
<th>L</th>
<th>u</th>
<th>% tracer</th>
<th>Lpred</th>
<th>Upred</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0858-0911</td>
<td>17.4</td>
<td>350</td>
<td>270/3.6</td>
<td>18</td>
<td>1951</td>
<td>20.1</td>
</tr>
<tr>
<td>4</td>
<td>0942-0955</td>
<td>17.4</td>
<td>114= L₁</td>
<td>220/3.6</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0959-1012</td>
<td>17.2</td>
<td>122= L₂</td>
<td>190/6.3</td>
<td>20</td>
<td>102 total</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1016-1028</td>
<td>17.2</td>
<td>244= L₃</td>
<td>190/6.3</td>
<td>80</td>
<td>471</td>
<td>6.2</td>
</tr>
</tbody>
</table>

L=480 AVE. 60

**Overall Average: 154% of tracer observed in 51 crosswind traverses**

With Tests 3 and 4 omitted,

**Overall Average: 95% of tracer observed in 43 crosswind traverses**
3.11 Crosswind Horizontal and Vertical Standard Deviations as Functions of Downwind Distance

The horizontal dispersion parameter $\sigma_y$ is usually related to downwind distance, $X$, in terms of dispersion coefficients, $a$ and $b$:

$$\sigma_y = a X^b.$$  

The values of $a$ and $b$ can be determined from the Gaussian best-fit results for the automobile traverse tracer data. If $\sigma_y$ versus $X$ is plotted, a linear least-squares best-fit of the data yields the coefficients $a$ and $b$. The data and corresponding best-fit lines are shown in the following figures for each release site, each test, and for each of four meteorological periods; the values of $a$, $b$ and the standard deviation of the least-squares fit for the curves are given in Table 9. The meteorological periods are based on the typical wind patterns and mixing layer heights which prevail in the region during the summer months. The four periods and the times of occurrence are Pre-Sea Breeze (0600-1100), Sea Breeze (1300-1800), Sea Breeze Tail (1900-0000), and Nighttime (0000-0500). The vertical dispersion parameter $\sigma_z$ can be written

$$\sigma_z = c X^d.$$  

The results of the linear best-fit of $\sigma_z$ versus $X$ data are shown in the following figures; values of $c$ and $d$ are given in Table 10.
Figure 152.

SIGMA-Y, METERS

X, METERS

CAL. DELTA TEST 1

Dow Auto Traverse
Figure 153.

CAL. DELTA TEST 2

Martinez Auto Traverse
Figure 154.

Cal. Delta Test 2

Dow Auto Traverse
Figure 155.

CAL. DELTA TEST 3
Dow Auto Traverse
Figure 156.

SIGMA-Y, METERS

X, METERS

CAL. DELTA TEST 4

Dow Auto Traverse
Figure 157.

CAL. DELTA TEST 5

Dow Auto Traverse
Figure 158.

SIGMA-Y, METERS

X, METERS

CAL. DELTA TEST 6
Dow Auto Traverse
Figure 159.

CAL. DELTA TEST 7
Pinole Auto Traverse
Figure 160.

CAL. DELTA TEST 8
Pinole Auto Traverse
Figure 161.

SIGMA-Y, METERS

X, METERS

PRE-SEA BREEZE

Dow Auto Traverse
Figure 162.

PRE-SEA BREEZE
Pinole Auto Traverse
Figure 163.

Sea Breeze

Dow Auto Traverse
Figure 164.
Figure 165.

SEA BREEZE

Pinole-Martinez Auto Traverse
Figure 166.

Sea Breeze Tail
Dow Auto Traverse
Figure 167.

SIGMA-Y, METERS

X, METERS

NIGHTTIME
Dow Auto Traverse
TABLE 9
HORIZONTAL CROSSWIND DISPERSION COEFFICIENTS
\[ \sigma_y = a x^b \]

<table>
<thead>
<tr>
<th>Test, Release Point</th>
<th>( a \cdot 10^{-b} )</th>
<th>( b )</th>
<th>( \sigma ) (std. dev. about best-fit line)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1, Dow</td>
<td>5.31 \cdot 10^{-2}</td>
<td>1.11</td>
<td>284</td>
</tr>
<tr>
<td>Test 2, Dow</td>
<td>1.12 \cdot 10^{-5}</td>
<td>1.84</td>
<td>230</td>
</tr>
<tr>
<td>Test 2, Martinez</td>
<td>1.31 \cdot 10^{-8}</td>
<td>2.50</td>
<td>3710</td>
</tr>
<tr>
<td>Test 3, Dow</td>
<td>3.71 \cdot 10^{-5}</td>
<td>1.71</td>
<td>1030</td>
</tr>
<tr>
<td>Test 4, Dow</td>
<td>8.17 \cdot 10^{-4}</td>
<td>1.37</td>
<td>428</td>
</tr>
<tr>
<td>Test 5, Dow</td>
<td>7.09 \cdot 10^{-1}</td>
<td>0.784</td>
<td>362</td>
</tr>
<tr>
<td>Test 6, Dow</td>
<td>6.52 \cdot 10^{-6}</td>
<td>1.87</td>
<td>331</td>
</tr>
<tr>
<td>Test 7, Dow</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Test 7, Pinole</td>
<td>2.40 \cdot 10^{-1}</td>
<td>0.958</td>
<td>3850</td>
</tr>
<tr>
<td>Test 8, Pinole</td>
<td>5.33 \cdot 10^{-4}</td>
<td>1.48</td>
<td>75</td>
</tr>
</tbody>
</table>

\* \( \sigma = \left( \sum_{i=1}^{n} (\sigma_y - \sigma_y)^2 / (n-1) \right)^{1/2} \)
where \( \sigma_y \) are the data points and \( \sigma_y = ax^b \)

<table>
<thead>
<tr>
<th>Meteorological Period, Release Point</th>
<th>( a \cdot 10^{-b} )</th>
<th>( b )</th>
<th>( \sigma ) (m) (std. dev. about best-fit line)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Sea Breeze, Dow</td>
<td>8.34 \cdot 10^{-5}</td>
<td>1.62</td>
<td>344</td>
</tr>
<tr>
<td>Pre-Sea Breeze, Pinole</td>
<td>4.54 \cdot 10^{-2}</td>
<td>1.08</td>
<td>1960</td>
</tr>
<tr>
<td>Sea Breeze, Dow</td>
<td>4.74 \cdot 10^{-2}</td>
<td>1.07</td>
<td>1230</td>
</tr>
<tr>
<td>Sea Breeze, Martinez</td>
<td>1.31 \cdot 10^{-8}</td>
<td>2.50</td>
<td>3710</td>
</tr>
<tr>
<td>Sea Breeze, Pinole</td>
<td>4.06 \cdot 10^{-2}</td>
<td>1.12</td>
<td>4330</td>
</tr>
<tr>
<td>Sea Breeze, Pinole &amp; Martinez</td>
<td>3.57 \cdot 10^{-3}</td>
<td>1.34</td>
<td>5050</td>
</tr>
<tr>
<td>Sea Breeze Tail, Dow</td>
<td>8.17 \cdot 10^{-4}</td>
<td>1.37</td>
<td>428</td>
</tr>
<tr>
<td>Nighttime, Dow</td>
<td>3.71 \cdot 10^{-5}</td>
<td>1.71</td>
<td>1030</td>
</tr>
<tr>
<td>Pasquill Stability Class</td>
<td>a</td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>A (very unstable)</td>
<td>0.40</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>B (unstable)</td>
<td>0.40</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>C (slightly unstable)</td>
<td>0.23</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>D (neutral)</td>
<td>0.14</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>E (slightly stable)</td>
<td>0.11</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>F (stable)</td>
<td>0.072</td>
<td>0.89</td>
<td></td>
</tr>
</tbody>
</table>

Figure 168.

CAL. DELTA TEST 1
Dow Auto Traverse
Figure 169.

CAL. DELTA TEST 2

Dow Auto Traverse
Figure 170.

CAL. DELTA TEST 2
Martinez Auto Traverse
Figure 171.

CAL. DELTA TEST 3

Dow Auto Traverse
Figure 173.

SIGMA-Z, METERS

X, METERS

CAL. DELTA TEST 6
Dow Auto Traverse
Figure 174.

CAL. DELTA TEST 7
Pinole Auto Traverse
Figure 175.

CAL. DELTA TEST 8
Pinole Auto Traverse
Figure 176.

SEA BREEZE
DOWN AUTO TRAV.
Figure 177.

Sea Breeze
Martinez Auto Trav.
Figure 178.

SEA BREEZE

PINOLE AUTO TRAV.
Figure 179.

SEA BREEZE
PINOLE-MART AUTO TRAV.
Figure 180.

SEA BREEZE TAIL
DON AUTO TRAV.
Figure 181. Nighttime Dow Auto Trav.
TABLE 10

VERTICAL CROSSWIND DISPERSION COEFFICIENTS

\[ \sigma_z = c x^d \]

<table>
<thead>
<tr>
<th>Test, Release Point</th>
<th>( c )</th>
<th>( d )</th>
<th>( \sigma ) (std. dev. about best-fit line)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1, Dow</td>
<td>3.37 ( \times 10^{-1} )</td>
<td>0.681</td>
<td>45</td>
</tr>
<tr>
<td>Test 2, Dow</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Test 2, Martinez</td>
<td>6.61 ( \times 10^{-2} )</td>
<td>0.847</td>
<td>246</td>
</tr>
<tr>
<td>Test 3, Dow</td>
<td>6.83 ( \times 10^{1} )</td>
<td>0.0582</td>
<td>146</td>
</tr>
<tr>
<td>Test 4, Dow</td>
<td>1.46</td>
<td>0.400</td>
<td>14</td>
</tr>
<tr>
<td>Test 5, Dow</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Test 6, Dow</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Test 7, Dow</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Test 7, Pinole</td>
<td>1.90 ( \times 10^{2} )</td>
<td>0.257</td>
<td>5228</td>
</tr>
<tr>
<td>Test 8, Pinole</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\[ \sigma = \left( \frac{1}{n-1} \sum_{i=1}^{n} (\sigma_{z_i} - \sigma_z)^2 \right)^{\frac{1}{2}} \]

where \( \sigma_{z_i} \) are the data points and \( \sigma_z = c x^d \)

<table>
<thead>
<tr>
<th>Meteorological Period, Release Point</th>
<th>( c )</th>
<th>( d )</th>
<th>( \sigma ) (m) (std. dev. about best-fit line)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Sea Breeze, Dow</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pre-Sea Breeze, Pinole</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sea Breeze, Dow</td>
<td>4.93</td>
<td>0.424</td>
<td>194</td>
</tr>
<tr>
<td>Sea Breeze, Martinez</td>
<td>6.61 ( \times 10^{-2} )</td>
<td>0.847</td>
<td>246</td>
</tr>
<tr>
<td>Sea Breeze, Pinole</td>
<td>4.96 ( \times 10^{1} )</td>
<td>0.414</td>
<td>8529</td>
</tr>
<tr>
<td>Sea Breeze, Pinole &amp; Martinez</td>
<td>2.52 ( \times 10^{-2} )</td>
<td>1.04</td>
<td>6570</td>
</tr>
<tr>
<td>Sea Breeze Tail, Dow</td>
<td>1.46</td>
<td>0.400</td>
<td>14</td>
</tr>
<tr>
<td>Nighttime, Dow</td>
<td>6.83 ( \times 10^{1} )</td>
<td>0.0582</td>
<td>146</td>
</tr>
</tbody>
</table>
\[ \sigma_z = \exp \{ a_0 + a_1 \ln X + a_2 (\ln X)^2 + a_3 (\ln X)^3 \} \]

<table>
<thead>
<tr>
<th>Turner-Pasquill Stability Class</th>
<th>(a_0)</th>
<th>(a_1)</th>
<th>(a_2)</th>
<th>(a_3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (very unstable)</td>
<td>6.10</td>
<td>2.11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B (unstable)</td>
<td>4.70</td>
<td>1.09</td>
<td>9.12(\times)10(^{-3})</td>
<td>-2.14(\times)10(^{-3})</td>
</tr>
<tr>
<td>C (slightly unstable)</td>
<td>4.10</td>
<td>0.940</td>
<td>-7.56(\times)10(^{-3})</td>
<td>2.86(\times)10(^{-4})</td>
</tr>
<tr>
<td>D (neutral)</td>
<td>3.46</td>
<td>0.662</td>
<td>-1.28(\times)10(^{-2})</td>
<td>-1.12(\times)10(^{-3})</td>
</tr>
<tr>
<td>E (slightly stable)</td>
<td>3.12</td>
<td>0.592</td>
<td>-9.61(\times)10(^{-3})</td>
<td>-4.24(\times)10(^{-3})</td>
</tr>
<tr>
<td>F (stable)</td>
<td>2.63</td>
<td>0.651</td>
<td>-6.08(\times)10(^{-2})</td>
<td>2.03(\times)10(^{-3})</td>
</tr>
</tbody>
</table>

3.12 Comparison of Experimental Dispersion Results with Pasquill Dispersion Parameters

The best-fit lines for $\sigma_y$ versus $X$ and $\sigma_z$ versus $X$ from the preceding section are plotted with the corresponding Pasquill $\sigma_y$ and $\sigma_z$ lines in the following figures. The values of the Pasquill $\sigma_y$ dispersion coefficients for each stability class are given in Table 9. The coefficients of a best-fit curve corresponding to each Pasquill vertical dispersion curve are given in Table 10.
Figure 182.

CAL. DELTA TEST 1
DOW AUTO TRAV.
Figure 183.

Cal. Delta Test 2
Martinez Auto Tray.
Figure 184.

SIGMA-Y, METERS

X, METERS

CAL. DELTA TEST 2
DOW AUTO TRAV.
Figure 185.

SIGMA-Y, METERS

X, METERS

CAL. DELTA TEST 3
DOW AUTO TRAV.
Figure 186.

X, METERS

SIGMA-Y, METERS

10^5
10^4
10^3
10^2
10^1

10^5
10^4
10^3
10^2
10^1

CAL. DELTA TEST 4
DOW AUTO TRAV.
Figure 187.

CAL. DELTA TEST 5
DOW AUTO TRAV.
Figure 188.

CAL. DELTA TEST 6
DOW AUTO TRAV.
Figure 190.

X, METERS

SIGMA-Y, METERS

10^5
10^4
10^3
10^2
10^1

10^2 10^3 10^4 10^5

CAL. DELTA TEST 8
PINELE AUTO TRAV.
Figure 191.

SIGMA-Y, METERS

X, METERS

PRE-SEA BREEZE
DOW AUTO TRAV.
Figure 192.

SIGMA-Y, METERS

PRE-SEA BREEZE
PINOLE AUTO TRAV.
Figure 193.
Figure 194.

SEA BREEZE
MARTINEZ AUTO TRAV.
Figure 195.

SEA BREEZE
PINOLE AUTO TRAV.
Figure 196.

SEA BREEZE
PINOLE-MART AUTO TRAV.
Figure 197.

X, METERS

SIGMA-Y, METERS

SEA BREEZE TAIL
DOW AUTO TRAV.
Figure 198.

X, METERS

SIGMA-Y, METERS

10^1

10^2

10^3

10^4

10^5

10,000

100,000

1,000,000

NIGHTTIME

DOW AUTO TRAV.
Figure 199.

CAL. DELTA TEST 1
DON AUTO TRAV.
Figure 200.

Sigma-z, Meters

X, Meters

Cal. Delta Test 2
Martinez Auto Trav.
Figure 202.

CAL. DELTA TEST 4
DON AUTO TRAV.
Figure 203.

SIGMA-Z, METERS

X, METERS

CAL. DELTA TEST 7
PINOLE AUTO TRAY.
Figure 204.

SIGMA-Z, METERS

X, METERS

SEA BREEZE
DOW AUTO TRAV.
Figure 206.

\[ \text{SEA BREEZE} \]
\[ \text{PINOLE AUTO TRAV.} \]
Figure 208.

Sea Breeze Tail
Don Auto Trav.
Figure 209.

![Graph showing relationships between sigma-z and x in meters for nighttime down auto trav.](image-url)

- SIGMA-Z, METERS
- X, METERS

Legend:
- A
- B
- C
- D
- E
- F

NIGHTTIME
DOWN AUTO TRAV.
4. Relationship of Dispersion Data to Wind Data

4.1 Fluctuations in the Horizontal Winds

Wind data from the Dow site at two heights, from Brentwood, and from a tower at the Rancho Seco Nuclear Power Plant provide a means of determining the hourly standard deviation of the horizontal wind, \( \sigma_0 \), for the four locations. At Dow and Brentwood, \( \sigma_0 \) was calculated for an hour from 5-minute averaged observations; no information is available concerning the calculation procedure for the Rancho Seco data.

In the following figures \( \sigma_0 \) is plotted versus time of day for the eight test days at each location. Also shown are the values of \( \sigma_0 \) corresponding to the Pasquill stability classes. The measured values of \( \sigma_0 \) are tabulated in Section 6.1.
Figure 210.
DOW SURFACE

DOW TOWER

BRENTWOOD
Figure 211.

RANCHO SECO TOWER

TIME (PDT)

SIGMA THETA

0 4 8 12 16 20 24

TEST 1
TEST 2
TEST 3
TEST 4
TEST 5
TEST 6
TEST 7
TEST 8
4.2 Horizontal Dispersion as a Function of Wind Fluctuations

The relationship between horizontal dispersion in terms of $\sigma_y$ and wind fluctuations in terms of $\sigma_\theta$ can be determined from the tracer data. An idealized crosswind dispersion distance, $A$, may be defined as

$$A = X \cdot \tan \sigma_\theta = X \sigma_\theta$$

where $X$ is the downwind distance and $\sigma_\theta$ is measured in radians. The value of $A$ is one-half of the crosswind distance at $X$ through which the plume centerline fluctuated over one hour. In the following figure, $\sigma_y$ for each traverse is plotted as a function of $A(\sigma_\theta)$ for the value of $\sigma_\theta$ measured at the surface on the Dow site for the hour in which the traverse was taken.
Figure 212. Horizontal Crosswind Standard Deviation ($\sigma_y$) as a function of the horizontal standard deviation of the wind ($\sigma_\theta$) measured at the Dow site in the Montezuma Hills.

\[ \sigma_y = 6.00E-01 \times \sigma_\theta - 2.37E 02 \]

- TEST 1
- TEST 2
- TEST 3
- TEST 4
- TEST 5
- TEST 6
- TEST 7

SIG-Y BASED ON 5-MINUTE AVERAGING TIME
4.3 *Atmospheric Stability Classification*

Turner's (1961) method of determining stability class based upon wind speed and insolation was used to classify the stability for each test period. The average insolation or cloud cover, the average wind speed, the average mixing layer depth, and the resulting stability class are given in the following table. The average wind vector at the tracer release point during the release period is also given.
### TABLE 11

**AVERAGE METEOROLOGICAL CONDITIONS DURING FIELD TESTS**

<table>
<thead>
<tr>
<th>Test</th>
<th>Time PDT</th>
<th>L* m</th>
<th>u** deg/m/sec</th>
<th>u* * u** (release point)</th>
<th>Cloud cover</th>
<th>Stability class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1200-1800</td>
<td>960</td>
<td>300/3.4</td>
<td>270/5.3</td>
<td>clear</td>
<td>B-C</td>
</tr>
<tr>
<td>2</td>
<td>1100-1700</td>
<td>830</td>
<td>290/4.3</td>
<td>270/4.0 (Mart.)</td>
<td>clear</td>
<td>B-C</td>
</tr>
<tr>
<td></td>
<td>1300-1500</td>
<td></td>
<td></td>
<td>270/9.2 (Dow)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0000-0600</td>
<td>860</td>
<td>290/3.3</td>
<td>280/9.3</td>
<td>scattered</td>
<td>D-F</td>
</tr>
<tr>
<td>4</td>
<td>1800-0000</td>
<td>510</td>
<td>290/3.3</td>
<td>280/7.1</td>
<td>broken</td>
<td>D-F</td>
</tr>
<tr>
<td>5</td>
<td>1100-1500</td>
<td>1910</td>
<td>340/2.6</td>
<td>17/1.8</td>
<td>scattered</td>
<td>B-C</td>
</tr>
<tr>
<td>6</td>
<td>0600-1400</td>
<td>1250</td>
<td>270/1.2</td>
<td>280/6.3</td>
<td>overcast</td>
<td>D</td>
</tr>
<tr>
<td>7</td>
<td>0600-1900</td>
<td>830</td>
<td>280/2.3</td>
<td>240/2.6 (Pinole)</td>
<td>scattered</td>
<td>B-C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>270/4.6 (Dow)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0700-1300</td>
<td>1200</td>
<td>250/3.6</td>
<td>220/3.7</td>
<td>scattered</td>
<td>B-C</td>
</tr>
</tbody>
</table>

* The average height of the mixing depth, L, was calculated from available hourly mixing depths for all stations over the indicated time period.

** The average wind direction and speed was obtained by vector averaging data from all downwind stations over the time indicated.

*** u_r is the average wind direction and speed at the tracer release point during the time of the release. Surface data from Rodeo (4 Km northeast of Pinole) were used for determining u_r at Pinole.
