

Example 12: Multiple Phase Equilibria (isoplethic data)

TABLE 2

Experimental bubble point (liquid to liquid + vapor) $l \leftrightarrow l,g$, phase boundary (liquid + vapor to liquid + liquid + vapor) $l,g \leftrightarrow l_1,l_2,g$, and phase boundary (liquid + liquid + vapor to liquid + liquid) $l_1,l_2,g \leftrightarrow l_1,l_2$, data at pressure p and temperature T for $[w_1 \text{ CO}_2 + (1 - w_1)\{w_2 \cdot \text{HPG}(5700 \text{ g/mol}) + w_3 \cdot \text{CH}_3\text{OH}\}]$ at mass fractions w_1 of CO_2 , for $w_2 = 0.499$ and $w_3 = 0.501$.^a

| w_1 | T/K | p/MPa | phase change | w_1 | T/K | p/MPa | phase change | w_1 | T/K | p/MPa | phase change | w_1 | T/K | p/MPa | phase change |
|-------|--------------|----------------|-------------------------|-------|--------------|----------------|-------------------------|-------|--------------|----------------|-------------------------------------|-------|--------------|----------------|-------------------------------------|
| 0.020 | 332.70 | 0.941 | $l \leftrightarrow l,g$ | 0.050 | 332.66 | 2.218 | $l \leftrightarrow l,g$ | 0.100 | 332.99 | 4.330 | $l \leftrightarrow l,g$ | 0.150 | 333.00 | 5.281 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 342.47 | 1.081 | $l \leftrightarrow l,g$ | 0.050 | 342.41 | 2.523 | $l \leftrightarrow l,g$ | 0.100 | 343.00 | 4.691 | $l \leftrightarrow l,g$ | 0.150 | 343.01 | 5.917 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 352.20 | 1.246 | $l \leftrightarrow l,g$ | 0.050 | 352.12 | 2.867 | $l \leftrightarrow l,g$ | 0.100 | 353.03 | 5.611 | $l \leftrightarrow l,g$ | 0.150 | 353.04 | 6.517 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 361.89 | 1.407 | $l \leftrightarrow l,g$ | 0.050 | 352.17 | 2.848 | $l \leftrightarrow l,g$ | 0.100 | 363.03 | 6.282 | $l \leftrightarrow l,g$ | 0.150 | 363.05 | 7.058 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 371.57 | 1.594 | $l \leftrightarrow l,g$ | 0.050 | 361.82 | 3.202 | $l \leftrightarrow l,g$ | 0.100 | 373.04 | 6.952 | $l \leftrightarrow l,g$ | 0.150 | 373.07 | 7.518 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 381.29 | 1.812 | $l \leftrightarrow l,g$ | 0.050 | 361.89 | 3.183 | $l \leftrightarrow l,g$ | 0.100 | 383.03 | 7.633 | $l \leftrightarrow l,g$ | 0.150 | 383.05 | 7.899 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 390.99 | 2.042 | $l \leftrightarrow l,g$ | 0.050 | 371.57 | 3.552 | $l \leftrightarrow l,g$ | 0.100 | 393.04 | 8.053 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 393.18 | 8.179 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 400.73 | 2.317 | $l \leftrightarrow l,g$ | 0.050 | 371.57 | 3.539 | $l \leftrightarrow l,g$ | 0.100 | 403.07 | 8.198 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 403.13 | 8.340 | $l,g \leftrightarrow l_1,l_2,g$ |
| 0.020 | 410.48 | 2.622 | $l \leftrightarrow l,g$ | 0.050 | 381.29 | 3.914 | $l \leftrightarrow l,g$ | 0.100 | 408.02 | 8.198 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 333.00 | 6.271 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| 0.020 | 420.26 | 2.978 | $l \leftrightarrow l,g$ | 0.050 | 381.31 | 3.933 | $l \leftrightarrow l,g$ | 0.100 | 413.02 | 8.239 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 343.01 | 7.132 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| | | | | 0.050 | 390.88 | 4.398 | $l \leftrightarrow l,g$ | 0.100 | 423.02 | 8.179 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 353.04 | 8.012 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| | | | | 0.050 | 400.76 | 4.818 | $l \leftrightarrow l,g$ | 0.100 | 433.05 | 8.059 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 363.05 | 8.853 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| | | | | 0.050 | 410.51 | 5.268 | $l \leftrightarrow l,g$ | 0.100 | 442.99 | 8.039 | $l,g \leftrightarrow l_1,l_2,g$ | 0.150 | 373.07 | 9.684 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| | | | | 0.050 | 420.27 | 5.768 | $l \leftrightarrow l,g$ | 0.100 | 452.85 | 7.799 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | 0.150 | 393.18 | 11.239 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| | | | | 0.050 | 439.79 | 6.879 | $l \leftrightarrow l,g$ | 0.100 | 403.02 | 8.873 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | 0.150 | 403.13 | 11.855 | $l_1,l_2,g \leftrightarrow l_1,l_2$ |
| | | | | 0.050 | 449.55 | 7.494 | $l \leftrightarrow l,g$ | 0.100 | 408.02 | 9.134 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | | | | |
| | | | | | | | | 0.100 | 413.02 | 9.439 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | | | | |
| | | | | | | | | 0.100 | 423.02 | 9.974 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | | | | |
| | | | | | | | | 0.100 | 433.05 | 10.505 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | | | | |
| | | | | | | | | 0.100 | 443.00 | 11.050 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | | | | |
| | | | | | | | | 0.100 | 452.87 | 11.476 | $l_1,l_2,g \leftrightarrow l_1,l_2$ | | | | |
| | | | | | | | | 0.100 | 393.04 | 9.454 | $l \leftrightarrow l,g$ | | | | |
| | | | | | | | | 0.100 | 403.05 | 12.141 | $l \leftrightarrow l,g$ | | | | |
| | | | | | | | | 0.100 | 408.02 | 13.461 | $l \leftrightarrow l,g$ | | | | |

^a $u(w) = 0.001$, $u(T) = 0.02 \text{ K}$, and $u(p) = 0.005 \text{ MPa}$.