**Designation: ~~D4651 – 08~~ D4651 – 14**

# Standard Specification for Isobutane Thermophysical Property Tables[1]

This standard is issued under the fixed designation D4651; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 The thermophysical property tables for isobutane are for use in the calculation of the pressure-volume-temperature (PVT), thermodynamic, and transport properties of isobutane for process design and operations. ~~Tables are provided for gaseous and liquid isobutane at temperatures between 120 and 570 K at pressures to 20 MPa. One table provides properties at the conditions of liquid-vapor equilibrium (saturation properties). The other~~ Two tables provide properties at the conditions of liquid-vapor equilibrium (saturation properties), one for liquid and one for vapor, at temperatures between 120 K and the critical point, 407.81 K. A third table provides properties at selected *T*,*p* points for the equilibrium phase at ~~those conditions.~~ temperatures between 120 K and 570 K at pressures to 20 MPa. The tables were developed ~~by~~using the National Institute of Standards and Technology ~~from a~~ Standard Reference Database product REFPROP, version ~~8.0.~~9.1.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

## 2. Applicability

2.1 These tables apply directly only to pure ~~gaseous isobutane. However, it is expected that they may find substantial use~~isobutane. They may also be used in mathematical models and tables for the thermophysical properties of mixtures containing isobutane.

## 3. Tables

3.1 These tables were produced by equations from a computer package, "NIST Standard Reference Database 23; Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1."[2] A wide selection of units (SI units, engineering units, chemical units) and additional properties are available with this program.

3.2 These thermophysical property tables are:

3.2.1 *Thermophysical Properties of ~~Coexisting Gaseous and Liquid Isobutane,~~ Isobutane Liquid at Vapor-Liquid Equilibrium,* in SI units. See Table 1.

3.2.2 *Thermophysical Properties of Isobutane ~~Along Isobars,~~ Vapor at Vapor-Liquid Equilibrium,* in SI units. See Table 2.

3.2.3 *Thermophysical Properties of Isobutane Along Isobars,* in SI units. See Table 3.

3.3 The ~~tabulated thermophysical properties~~ symbols are:

*T*, temperature (K)
ρ, molar density (~~mol·l~~(mol·L$^{-1}$)
*H*, molar enthalpy (J·mol$^{-1}$)
*S*, molar entropy (J·K$^{-1}$·mol$^{-1}$)
$C_v$, constant volume molar heat capacity (J·K$^{-1}$·mol$^{-1}$)
$C_p$, constant pressure molar heat capacity (J·K$^{-1}$·mol$^{-1}$)
*c*, speed of sound (m·s$^{-1}$)
η, viscosity (μPa·s)
λ, thermal conductivity (mW·m$^{-1}$·K$^{-1}$)

3.4 The tabulated thermophysical properties are:

ρ, molar density (mol·L$^{-1}$)
*H*, molar enthalpy (J·mol$^{-1}$)

[1] This specification is under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.08 on Thermophysical Properties.

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[2] Available from Standard Reference Data, National Institute of Standards and Technology (NIST), 100 Bureau Drive, Stop 3460, Gaithersburg, MD 20899.

**TABLE 1 Thermophysical Properties of Isobutane Liquid at Vapor-Liquid Equilibrium**

| $T$ K | $P$ MPa | $\rho$ mol·l$^{-1}$ | $H$ J·mol$^{-1}$ | $S$ J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | $c$ m·s$^{-1}$ | $\eta$ μPa·s | $\lambda$ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 120 | 1.0633E-07 | 12.636 | -5912.6 | -34.216 | 69.001 | 99.308 | 1945.4 | 6055.8 | 156.73 |
| 122 | 1.6734E-07 | 12.603 | -5713.6 | -32.571 | 69.251 | 99.681 | 1928.5 | 5441.0 | 156.30 |
| 124 | 2.5915E-07 | 12.571 | -5513.9 | -30.948 | 69.501 | 100.06 | 1911.9 | 4910.8 | 155.85 |
| 126 | 3.9524E-07 | 12.538 | -5313.4 | -29.344 | 69.752 | 100.43 | 1895.5 | 4450.9 | 155.38 |
| 128 | 5.9407E-07 | 12.506 | -5112.1 | -27.759 | 70.004 | 100.81 | 1879.3 | 4049.9 | 154.89 |
| 130 | 8.8064E-07 | 12.473 | -4910.1 | -26.193 | 70.255 | 101.18 | 1863.4 | 3698.4 | 154.39 |
| 132 | 1.2883E-06 | 12.441 | -4707.4 | -24.646 | 70.505 | 101.56 | 1847.7 | 3389.0 | 153.86 |
| 134 | 1.8611E-06 | 12.408 | -4503.9 | -23.116 | 70.754 | 101.93 | 1832.2 | 3115.4 | 153.32 |
| 136 | 2.6564E-06 | 12.376 | -4299.7 | -21.603 | 71.003 | 102.30 | 1816.9 | 2872.5 | 152.76 |
| 138 | 3.7483E-06 | 12.343 | -4094.7 | -20.107 | 71.250 | 102.68 | 1801.7 | 2656.0 | 152.19 |
| 140 | 5.2314E-06 | 12.311 | -3889.0 | -18.627 | 71.497 | 103.05 | 1786.8 | 2462.5 | 151.60 |
| 142 | 7.2252E-06 | 12.278 | -3682.5 | -17.162 | 71.743 | 103.42 | 1772.0 | 2288.8 | 150.99 |
| 144 | 9.8793E-06 | 12.245 | -3475.3 | -15.713 | 71.988 | 103.79 | 1757.4 | 2132.5 | 150.37 |
| 146 | 1.3379E-05 | 12.213 | -3267.4 | -14.279 | 72.233 | 104.16 | 1742.9 | 1991.3 | 149.74 |
| 148 | 1.7953E-05 | 12.180 | -3058.7 | -12.859 | 72.477 | 104.53 | 1728.6 | 1863.6 | 149.09 |
| 150 | 2.3880E-05 | 12.147 | -2849.3 | -11.454 | 72.720 | 104.89 | 1714.4 | 1747.6 | 148.43 |
| 152 | 3.1496E-05 | 12.115 | -2639.1 | -10.062 | 72.964 | 105.26 | 1700.3 | 1642.0 | 147.75 |
| 154 | 4.1206E-05 | 12.082 | -2428.2 | -8.6838 | 73.207 | 105.63 | 1686.4 | 1545.6 | 147.07 |
| 156 | 5.3493E-05 | 12.049 | -2216.6 | -7.3185 | 73.451 | 106.00 | 1672.6 | 1457.5 | 146.37 |
| 158 | 6.8925E-05 | 12.016 | -2004.2 | -5.9659 | 73.695 | 106.36 | 1658.9 | 1376.7 | 145.67 |
| 160 | 8.8176E-05 | 11.984 | -1791.1 | -4.6257 | 73.940 | 106.73 | 1645.3 | 1302.4 | 144.95 |
| 162 | 0.00011203 | 11.951 | -1577.3 | -3.2975 | 74.186 | 107.10 | 1631.8 | 1234.1 | 144.22 |
| 164 | 0.00014139 | 11.918 | -1362.8 | -1.9812 | 74.432 | 107.47 | 1618.3 | 1171.0 | 143.48 |
| 166 | 0.00017732 | 11.885 | -1147.5 | -0.67634 | 74.679 | 107.83 | 1605.0 | 1112.6 | 142.74 |
| 168 | 0.00022101 | 11.852 | -931.41 | 0.61730 | 74.928 | 108.20 | 1591.8 | 1058.6 | 141.98 |
| 170 | 0.00027386 | 11.819 | -714.63 | 1.9000 | 75.178 | 108.57 | 1578.6 | 1008.4 | 141.22 |
| 172 | 0.00033740 | 11.786 | -497.11 | 3.1721 | 75.430 | 108.95 | 1565.6 | 961.80 | 140.45 |
| 174 | 0.00041343 | 11.752 | -278.84 | 4.4337 | 75.684 | 109.32 | 1552.6 | 918.37 | 139.67 |
| 176 | 0.00050391 | 11.719 | -59.816 | 5.6852 | 75.939 | 109.69 | 1539.6 | 877.85 | 138.88 |
| 178 | 0.00061107 | 11.686 | 159.96 | 6.9268 | 76.197 | 110.07 | 1526.8 | 839.98 | 138.09 |
| 180 | 0.00073738 | 11.653 | 380.48 | 8.1588 | 76.456 | 110.45 | 1514.0 | 804.54 | 137.30 |
| 182 | 0.00088560 | 11.619 | 601.77 | 9.3813 | 76.718 | 110.83 | 1501.3 | 771.33 | 136.49 |
| 184 | 0.0010588 | 11.586 | 823.82 | 10.595 | 76.983 | 111.21 | 1488.6 | 740.15 | 135.68 |
| 186 | 0.0012602 | 11.552 | 1046.6 | 11.799 | 77.250 | 111.60 | 1476.0 | 710.84 | 134.87 |
| 188 | 0.0014935 | 11.519 | 1270.2 | 12.995 | 77.519 | 111.98 | 1463.4 | 683.26 | 134.05 |
| 190 | 0.0017628 | 11.485 | 1494.6 | 14.182 | 77.792 | 112.37 | 1450.9 | 657.25 | 133.23 |
| 192 | 0.0020724 | 11.451 | 1719.8 | 15.360 | 78.067 | 112.77 | 1438.5 | 632.72 | 132.40 |
| 194 | 0.0024270 | 11.418 | 1945.7 | 16.531 | 78.345 | 113.16 | 1426.1 | 609.54 | 131.57 |
| 196 | 0.0028316 | 11.384 | 2172.5 | 17.694 | 78.627 | 113.56 | 1413.7 | 587.61 | 130.73 |
| 198 | 0.0032918 | 11.350 | 2400.0 | 18.849 | 78.911 | 113.96 | 1401.4 | 566.84 | 129.90 |
| 200 | 0.0038135 | 11.316 | 2628.4 | 19.996 | 79.199 | 114.37 | 1389.1 | 547.15 | 129.06 |
| 202 | 0.0044031 | 11.282 | 2857.6 | 21.136 | 79.490 | 114.78 | 1376.9 | 528.46 | 128.21 |
| 204 | 0.0050671 | 11.248 | 3087.6 | 22.269 | 79.785 | 115.19 | 1364.7 | 510.71 | 127.37 |
| 206 | 0.0058130 | 11.213 | 3318.5 | 23.394 | 80.082 | 115.61 | 1352.6 | 493.83 | 126.52 |
| 208 | 0.0066482 | 11.179 | 3550.1 | 24.513 | 80.384 | 116.03 | 1340.5 | 477.76 | 125.67 |
| 210 | 0.0075808 | 11.145 | 3782.7 | 25.626 | 80.689 | 116.46 | 1328.4 | 462.45 | 124.82 |
| 212 | 0.0086196 | 11.110 | 4016.1 | 26.731 | 80.998 | 116.88 | 1316.3 | 447.85 | 123.97 |
| 214 | 0.0097734 | 11.075 | 4250.4 | 27.831 | 81.310 | 117.32 | 1304.4 | 433.92 | 123.12 |
| 216 | 0.011052 | 11.041 | 4485.5 | 28.924 | 81.626 | 117.76 | 1292.4 | 420.62 | 122.27 |
| 218 | 0.012465 | 11.006 | 4721.5 | 30.011 | 81.946 | 118.20 | 1280.5 | 407.90 | 121.41 |
| 220 | 0.014023 | 10.971 | 4958.5 | 31.092 | 82.269 | 118.65 | 1268.6 | 395.73 | 120.56 |
| 222 | 0.015736 | 10.936 | 5196.3 | 32.168 | 82.596 | 119.10 | 1256.7 | 384.08 | 119.71 |
| 224 | 0.017618 | 10.901 | 5435.1 | 33.238 | 82.927 | 119.55 | 1244.9 | 372.92 | 118.86 |
| 226 | 0.019678 | 10.865 | 5674.8 | 34.302 | 83.262 | 120.02 | 1233.0 | 362.23 | 118.02 |
| 228 | 0.021930 | 10.830 | 5915.4 | 35.361 | 83.601 | 120.48 | 1221.3 | 351.97 | 117.17 |
| 230 | 0.024387 | 10.794 | 6157.0 | 36.415 | 83.944 | 120.96 | 1209.5 | 342.12 | 116.32 |
| 232 | 0.027061 | 10.759 | 6399.5 | 37.464 | 84.290 | 121.43 | 1197.8 | 332.66 | 115.47 |
| 234 | 0.029967 | 10.723 | 6643.0 | 38.508 | 84.640 | 121.92 | 1186.1 | 323.57 | 114.63 |
| 236 | 0.033118 | 10.687 | 6887.5 | 39.547 | 84.995 | 122.41 | 1174.4 | 314.83 | 113.79 |
| 238 | 0.036530 | 10.651 | 7133.0 | 40.582 | 85.353 | 122.90 | 1162.8 | 306.42 | 112.94 |
| 240 | 0.040218 | 10.615 | 7379.5 | 41.612 | 85.714 | 123.40 | 1151.2 | 298.32 | 112.10 |
| 242 | 0.044196 | 10.578 | 7627.1 | 42.637 | 86.080 | 123.91 | 1139.6 | 290.53 | 111.27 |
| 244 | 0.048482 | 10.542 | 7875.6 | 43.658 | 86.450 | 124.42 | 1128.0 | 283.01 | 110.43 |
| 246 | 0.053092 | 10.505 | 8125.2 | 44.675 | 86.823 | 124.94 | 1116.4 | 275.77 | 109.60 |
| 248 | 0.058042 | 10.468 | 8375.9 | 45.688 | 87.200 | 125.46 | 1104.9 | 268.78 | 108.77 |
| 250 | 0.063350 | 10.431 | 8627.7 | 46.697 | 87.581 | 126.00 | 1093.4 | 262.04 | 107.94 |
| 252 | 0.069033 | 10.394 | 8880.5 | 47.703 | 87.966 | 126.54 | 1081.9 | 255.54 | 107.12 |
| 254 | 0.075109 | 10.357 | 9134.4 | 48.704 | 88.354 | 127.08 | 1070.4 | 249.25 | 106.30 |
| 256 | 0.081597 | 10.319 | 9389.5 | 49.702 | 88.746 | 127.63 | 1059.0 | 243.18 | 105.48 |
| 258 | 0.088516 | 10.281 | 9645.6 | 50.696 | 89.142 | 128.19 | 1047.5 | 237.31 | 104.67 |
| 260 | 0.095885 | 10.243 | 9903.0 | 51.687 | 89.541 | 128.76 | 1036.1 | 231.63 | 103.86 |
| 262 | 0.10372 | 10.205 | 10161 | 52.674 | 89.944 | 129.33 | 1024.7 | 226.14 | 103.05 |
| 264 | 0.11205 | 10.167 | 10421 | 53.658 | 90.351 | 129.91 | 1013.3 | 220.83 | 102.25 |
| 266 | 0.12089 | 10.128 | 10682 | 54.639 | 90.761 | 130.50 | 1002.0 | 215.68 | 101.45 |

**TABLE 1** *Continued*

| $T$ K | $P$ MPa | ρ mol·l$^{-1}$ | $H$ J·mol$^{-1}$ | $S$ J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | $c$ m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 268 | 0.13025 | 10.090 | 10944 | 55.617 | 91.175 | 131.10 | 990.63 | 210.70 | 100.66 |
| 270 | 0.14017 | 10.051 | 11207 | 56.592 | 91.592 | 131.70 | 979.29 | 205.87 | 99.867 |
| 272 | 0.15066 | 10.012 | 11472 | 57.564 | 92.012 | 132.32 | 967.96 | 201.19 | 99.082 |
| 274 | 0.16174 | 9.9721 | 11738 | 58.534 | 92.436 | 132.94 | 956.65 | 196.65 | 98.301 |
| 276 | 0.17344 | 9.9324 | 12005 | 59.501 | 92.864 | 133.57 | 945.35 | 192.25 | 97.524 |
| 278 | 0.18577 | 9.8925 | 12273 | 60.465 | 93.294 | 134.21 | 934.06 | 187.98 | 96.753 |
| 280 | 0.19876 | 9.8523 | 12543 | 61.427 | 93.728 | 134.86 | 922.77 | 183.83 | 95.986 |
| 282 | 0.21243 | 9.8118 | 12813 | 62.386 | 94.165 | 135.52 | 911.50 | 179.81 | 95.224 |
| 284 | 0.22681 | 9.7710 | 13086 | 63.343 | 94.606 | 136.19 | 900.23 | 175.89 | 94.467 |
| 286 | 0.24192 | 9.7300 | 13359 | 64.298 | 95.050 | 136.87 | 888.97 | 172.09 | 93.715 |
| 288 | 0.25777 | 9.6887 | 13635 | 65.250 | 95.496 | 137.56 | 877.72 | 168.40 | 92.969 |
| 290 | 0.27440 | 9.6470 | 13911 | 66.201 | 95.946 | 138.26 | 866.47 | 164.80 | 92.227 |
| 292 | 0.29183 | 9.6051 | 14189 | 67.150 | 96.400 | 138.97 | 855.22 | 161.31 | 91.491 |
| 294 | 0.31008 | 9.5628 | 14468 | 68.096 | 96.856 | 139.70 | 843.98 | 157.91 | 90.761 |
| 296 | 0.32917 | 9.5202 | 14749 | 69.042 | 97.315 | 140.43 | 832.74 | 154.59 | 90.036 |
| 298 | 0.34914 | 9.4773 | 15031 | 69.985 | 97.778 | 141.18 | 821.50 | 151.37 | 89.316 |
| 300 | 0.37000 | 9.4339 | 15315 | 70.927 | 98.243 | 141.94 | 810.25 | 148.22 | 88.602 |
| 302 | 0.39177 | 9.3902 | 15600 | 71.867 | 98.711 | 142.72 | 799.01 | 145.16 | 87.894 |
| 304 | 0.41450 | 9.3462 | 15887 | 72.806 | 99.183 | 143.51 | 787.76 | 142.17 | 87.191 |
| 306 | 0.43819 | 9.3017 | 16176 | 73.743 | 99.657 | 144.32 | 776.50 | 139.26 | 86.494 |
| 308 | 0.46288 | 9.2568 | 16466 | 74.680 | 100.13 | 145.14 | 765.24 | 136.41 | 85.803 |
| 310 | 0.48858 | 9.2114 | 16758 | 75.615 | 100.62 | 145.98 | 753.97 | 133.64 | 85.118 |
| 312 | 0.51534 | 9.1657 | 17051 | 76.549 | 101.10 | 146.84 | 742.69 | 130.92 | 84.439 |
| 314 | 0.54317 | 9.1194 | 17346 | 77.482 | 101.59 | 147.71 | 731.40 | 128.27 | 83.765 |
| 316 | 0.57209 | 9.0727 | 17643 | 78.414 | 102.07 | 148.61 | 720.10 | 125.68 | 83.098 |
| 318 | 0.60215 | 9.0255 | 17942 | 79.346 | 102.57 | 149.52 | 708.78 | 123.15 | 82.437 |
| 320 | 0.63335 | 8.9777 | 18242 | 80.276 | 103.06 | 150.46 | 697.45 | 120.67 | 81.781 |
| 322 | 0.66573 | 8.9295 | 18544 | 81.207 | 103.56 | 151.42 | 686.10 | 118.24 | 81.132 |
| 324 | 0.69932 | 8.8806 | 18848 | 82.137 | 104.06 | 152.40 | 674.72 | 115.86 | 80.489 |
| 326 | 0.73415 | 8.8312 | 19154 | 83.066 | 104.57 | 153.41 | 663.33 | 113.53 | 79.851 |
| 328 | 0.77023 | 8.7811 | 19462 | 83.995 | 105.08 | 154.45 | 651.91 | 111.25 | 79.220 |
| 330 | 0.80761 | 8.7304 | 19772 | 84.925 | 105.59 | 155.52 | 640.46 | 109.01 | 78.595 |
| 332 | 0.84630 | 8.6790 | 20084 | 85.854 | 106.11 | 156.62 | 628.99 | 106.81 | 77.976 |
| 334 | 0.88635 | 8.6270 | 20398 | 86.783 | 106.63 | 157.75 | 617.48 | 104.65 | 77.363 |
| 336 | 0.92776 | 8.5741 | 20715 | 87.713 | 107.15 | 158.92 | 605.94 | 102.53 | 76.757 |
| 338 | 0.97059 | 8.5206 | 21033 | 88.643 | 107.68 | 160.13 | 594.36 | 100.45 | 76.156 |
| 340 | 1.0148 | 8.4662 | 21354 | 89.574 | 108.21 | 161.39 | 582.74 | 98.394 | 75.561 |
| 342 | 1.0606 | 8.4109 | 21677 | 90.505 | 108.74 | 162.69 | 571.08 | 96.375 | 74.973 |
| 344 | 1.1078 | 8.3548 | 22002 | 91.438 | 109.28 | 164.04 | 559.37 | 94.387 | 74.390 |
| 346 | 1.1565 | 8.2977 | 22330 | 92.371 | 109.83 | 165.44 | 547.62 | 92.427 | 73.814 |
| 348 | 1.2068 | 8.2396 | 22661 | 93.306 | 110.38 | 166.91 | 535.81 | 90.495 | 73.243 |
| 350 | 1.2587 | 8.1805 | 22994 | 94.242 | 110.93 | 168.44 | 523.94 | 88.587 | 72.679 |
| 352 | 1.3123 | 8.1202 | 23330 | 95.180 | 111.49 | 170.04 | 512.02 | 86.704 | 72.120 |
| 354 | 1.3674 | 8.0588 | 23668 | 96.120 | 112.06 | 171.73 | 500.02 | 84.842 | 71.567 |
| 356 | 1.4243 | 7.9961 | 24010 | 97.062 | 112.63 | 173.50 | 487.96 | 83.000 | 71.020 |
| 358 | 1.4829 | 7.9321 | 24354 | 98.007 | 113.21 | 175.38 | 475.82 | 81.177 | 70.479 |
| 360 | 1.5433 | 7.8666 | 24702 | 98.954 | 113.80 | 177.37 | 463.60 | 79.371 | 69.944 |
| 362 | 1.6054 | 7.7996 | 25053 | 99.904 | 114.39 | 179.48 | 451.29 | 77.580 | 69.415 |
| 364 | 1.6694 | 7.7310 | 25408 | 100.86 | 114.99 | 181.74 | 438.89 | 75.802 | 68.891 |
| 366 | 1.7352 | 7.6606 | 25766 | 101.82 | 115.60 | 184.15 | 426.38 | 74.034 | 68.374 |
| 368 | 1.8030 | 7.5883 | 26128 | 102.78 | 116.22 | 186.76 | 413.76 | 72.277 | 67.862 |
| 370 | 1.8727 | 7.5139 | 26494 | 103.75 | 116.86 | 189.58 | 401.01 | 70.526 | 67.356 |
| 372 | 1.9444 | 7.4372 | 26864 | 104.72 | 117.50 | 192.66 | 388.14 | 68.779 | 66.856 |
| 374 | 2.0181 | 7.3580 | 27239 | 105.7 | 118.17 | 196.03 | 375.12 | 67.036 | 66.363 |
| 376 | 2.0939 | 7.2762 | 27619 | 106.68 | 118.84 | 199.74 | 361.94 | 65.292 | 65.877 |
| 378 | 2.1718 | 7.1913 | 28005 | 107.68 | 119.54 | 203.88 | 348.59 | 63.544 | 65.398 |
| 380 | 2.2519 | 7.1031 | 28396 | 108.68 | 120.26 | 208.53 | 335.05 | 61.791 | 64.926 |
| 382 | 2.3343 | 7.0111 | 28794 | 109.69 | 121.01 | 213.80 | 321.32 | 60.027 | 64.465 |
| 384 | 2.4189 | 6.9149 | 29198 | 110.72 | 121.79 | 219.85 | 307.36 | 58.248 | 64.014 |
| 386 | 2.5058 | 6.8138 | 29611 | 111.76 | 122.62 | 226.90 | 293.15 | 56.450 | 63.577 |
| 388 | 2.5951 | 6.7072 | 30032 | 112.81 | 123.49 | 235.25 | 278.69 | 54.626 | 63.158 |
| 390 | 2.6869 | 6.5941 | 30464 | 113.88 | 124.42 | 245.34 | 263.93 | 52.770 | 62.764 |
| 392 | 2.7812 | 6.4732 | 30907 | 114.98 | 125.42 | 257.82 | 248.86 | 50.870 | 62.403 |
| 394 | 2.8782 | 6.3430 | 31365 | 116.11 | 126.52 | 273.75 | 233.42 | 48.915 | 62.093 |
| 396 | 2.9778 | 6.2012 | 31840 | 117.27 | 127.74 | 294.88 | 217.58 | 46.887 | 61.861 |
| 398 | 3.0802 | 6.0444 | 32336 | 118.48 | 129.14 | 324.44 | 201.26 | 44.761 | 61.762 |
| 400 | 3.1856 | 5.8674 | 32862 | 119.75 | 130.78 | 369.01 | 184.38 | 42.498 | 61.898 |
| 402 | 3.2940 | 5.6611 | 33429 | 121.12 | 132.80 | 444.47 | 166.79 | 40.030 | 62.501 |
| 404 | 3.4057 | 5.4067 | 34065 | 122.65 | 135.47 | 601.19 | 148.23 | 37.215 | 64.151 |
| 406 | 3.5210 | 5.0501 | 34847 | 124.52 | 139.62 | 1125.7 | 128.12 | 33.651 | 68.999 |
| 407.81 | 3.6284 | 4.0403 | 36583 | 128.73 | 152.07 | 329210 | 106.84 | 25.500 | 348.88 |

*S*, molar entropy (J·K$^{-1}$·mol$^{-1}$)

**TABLE 1 Thermophysical Properties of Coexisting Gaseous and Liquid Isobutane**

| *T* K | *P* MPa | ρ mol·l$^{-1}$ | *H* J·mol$^{-1}$ | *S* J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | *c* m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 114 | 2.455E-08 | 12.733 | -23331 | 110.20 | 68.27 | 98.21 | 1997.4 | 8618 | 157.88 |
| 114 | 2.455E-08 | 2.59E-08 | 4595.2 | 355.17 | 42.89 | 51.20 | 139.53 | 2.855 | 2.287 |
| 118 | 6.643E-08 | 12.668 | -22937 | 113.60 | 68.75 | 98.94 | 1962.5 | 6774 | 157.1 |
| 118 | 6.643E-08 | 6.771E-08 | 4802.2 | 348.68 | 43.96 | 52.28 | 141.68 | 2.960 | 2.512 |
| 122 | 1.673E-07 | 12.603 | -22540 | 116.91 | 69.25 | 99.68 | 1928.5 | 5441 | 156.3 |
| 122 | 1.673E-07 | 1.65E-07 | 5013.4 | 342.75 | 45.02 | 53.34 | 143.79 | 3.066 | 2.741 |
| 126 | 3.952E-07 | 12.538 | -22140 | 120.14 | 69.75 | 100.43 | 1895.5 | 4451 | 155.4 |
| 126 | 3.952E-07 | 3.773E-07 | 5228.8 | 337.35 | 46.06 | 54.38 | 145.87 | 3.171 | 2.974 |
| 130 | 8.806E-07 | 12.473 | -21736 | 123.29 | 70.26 | 101.18 | 1863.4 | 3698 | 154.4 |
| 130 | 8.806E-07 | 8.147E-07 | 5448.4 | 332.40 | 47.09 | 55.40 | 147.92 | 3.276 | 3.211 |
| 134 | 1.861E-06 | 12.408 | -21330 | 126.36 | 70.75 | 101.93 | 1832.2 | 3115 | 153.3 |
| 134 | 1.861E-06 | 1.67E-06 | 5672.0 | 327.87 | 48.09 | 56.41 | 149.94 | 3.381 | 3.453 |
| 138 | 3.748E-06 | 12.343 | -20921 | 129.37 | 71.25 | 102.68 | 1801.7 | 2656 | 152.9 |
| 138 | 3.748E-06 | 3.267E-06 | 5899.6 | 323.72 | 49.09 | 57.40 | 151.94 | 3.486 | 3.699 |
| 142 | 7.225E-06 | 12.278 | -20509 | 132.32 | 71.74 | 103.42 | 1772.0 | 2289 | 151.0 |
| 142 | 7.225E-06 | 6.12E-06 | 6131.1 | 319.92 | 50.06 | 58.38 | 153.90 | 3.591 | 3.948 |
| 146 | 1.338E-05 | 12.213 | -20094 | 135.20 | 72.23 | 104.16 | 1742.9 | 1991 | 149.7 |
| 146 | 1.338E-05 | 1.102E-05 | 6366.5 | 316.43 | 51.03 | 59.34 | 155.84 | 3.695 | 4.202 |
| 150 | 2.388E-05 | 12.147 | -19675 | 138.03 | 72.72 | 104.89 | 1714.4 | 1748 | 148.4 |
| 150 | 2.388E-05 | 1.915E-05 | 6605.6 | 313.23 | 51.98 | 60.30 | 157.76 | 3.799 | 4.461 |
| 154 | 4.121E-05 | 12.082 | -19254 | 140.80 | 73.21 | 105.63 | 1686.4 | 1546 | 147.1 |
| 154 | 4.121E-05 | 3.219E-05 | 6848.5 | 310.30 | 52.93 | 61.25 | 159.65 | 3.903 | 4.723 |
| 158 | 6.893E-05 | 12.016 | -18830 | 143.51 | 73.70 | 106.36 | 1658.9 | 1377 | 145.7 |
| 158 | 6.893E-05 | 5.248E-05 | 7095.1 | 307.60 | 53.87 | 62.19 | 161.51 | 4.007 | 4.989 |
| 162 | 0.000112 | 11.951 | -18403 | 146.18 | 74.19 | 107.10 | 1631.8 | 1234 | 144.2 |
| 162 | 0.000112 | 8.319E-05 | 7345.3 | 305.12 | 54.80 | 63.12 | 163.35 | 4.110 | 5.260 |
| 166 | 0.0001773 | 11.885 | -17974 | 148.80 | 74.68 | 107.83 | 1605.0 | 1113 | 142.7 |
| 166 | 0.0001773 | 0.0001285 | 7599.0 | 302.85 | 55.73 | 64.05 | 165.16 | 4.214 | 5.534 |
| 170 | 0.0002739 | 11.819 | -17541 | 151.38 | 75.18 | 108.57 | 1578.6 | 1008 | 141.2 |
| 170 | 0.0002739 | 0.0001938 | 7856.2 | 300.77 | 56.65 | 64.99 | 166.95 | 4.317 | 5.813 |
| 174 | 0.0004134 | 11.752 | -17105 | 153.91 | 75.68 | 109.32 | 1552.6 | 918.4 | 139.7 |
| 174 | 0.0004134 | 0.000286 | 8116.8 | 298.87 | 57.58 | 65.92 | 168.70 | 4.420 | 6.095 |
| 178 | 0.0006111 | 11.686 | -16666 | 156.41 | 76.20 | 110.07 | 1526.8 | 840.0 | 138.1 |
| 178 | 0.0006111 | 0.0004133 | 8380.8 | 297.12 | 58.50 | 66.85 | 170.43 | 4.522 | 6.382 |
| 182 | 0.0008856 | 11.619 | -16224 | 158.86 | 76.72 | 110.83 | 1501.3 | 771.3 | 136.5 |
| 182 | 0.0008856 | 0.0005859 | 8648.1 | 295.52 | 59.43 | 67.79 | 172.13 | 4.624 | 6.672 |
| 186 | 0.0012602 | 11.552 | -15780 | 161.28 | 77.25 | 111.60 | 1476.0 | 710.8 | 134.9 |
| 186 | 0.0012602 | 0.0008161 | 8918.6 | 294.06 | 60.36 | 68.74 | 173.80 | 4.726 | 6.967 |
| 190 | 0.0017628 | 11.485 | -15332 | 163.66 | 77.79 | 112.37 | 1450.9 | 657.2 | 133.2 |
| 190 | 0.0017628 | 0.0011181 | 9192.1 | 292.73 | 61.29 | 69.69 | 175.44 | 4.828 | 7.265 |
| 194 | 0.002427 | 11.418 | -14880 | 166.01 | 78.35 | 113.16 | 1426.1 | 609.5 | 131.6 |
| 194 | 0.002427 | 0.0015085 | 9468.7 | 291.52 | 62.23 | 70.65 | 177.05 | 4.929 | 7.567 |
| 198 | 0.0032918 | 11.350 | -14426 | 168.33 | 78.91 | 113.96 | 1401.4 | 566.8 | 129.9 |
| 198 | 0.0032918 | 0.0020061 | 9748.2 | 290.42 | 63.18 | 71.63 | 178.61 | 5.029 | 7.873 |
| 202 | 0.0044031 | 11.282 | -13969 | 170.62 | 79.49 | 114.78 | 1376.9 | 528.5 | 128.2 |
| 202 | 0.0044031 | 0.0026324 | 10031 | 289.42 | 64.14 | 72.62 | 180.14 | 5.130 | 8.183 |
| 206 | 0.005813 | 11.213 | -13508 | 172.87 | 80.08 | 115.61 | 1352.6 | 493.8 | 126.5 |
| 206 | 0.005813 | 0.0034111 | 10316 | 288.52 | 65.10 | 73.62 | 181.63 | 5.230 | 8.496 |
| 210 | 0.0075808 | 11.145 | -13043 | 175.11 | 80.69 | 116.46 | 1328.4 | 462.4 | 124.8 |

**TABLE 2** *Continued*

| *T* K | *P* MPa | ρ mol·l$^{-1}$ | *H* J·mol$^{-1}$ | *S* J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | *c* m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 210 | 0.0075808 | 0.0043687 | 10603 | 287.71 | 66.08 | 74.64 | 183.08 | 5.329 | 8.813 |
| 214 | 0.0097734 | 11.075 | -12576 | 177.31 | 81.31 | 117.32 | 1304.4 | 433.9 | 123.1 |
| 214 | 0.0097734 | 0.0055342 | 10893 | 286.98 | 67.06 | 75.68 | 184.48 | 5.428 | 9.133 |
| 218 | 0.012465 | 11.006 | -12105 | 179.49 | 81.95 | 118.20 | 1280.5 | 407.9 | 121.4 |
| 218 | 0.012465 | 0.006939 | 11186 | 286.33 | 68.06 | 76.74 | 185.83 | 5.527 | 9.457 |
| 222 | 0.015736 | 10.936 | -11630 | 181.65 | 82.60 | 119.10 | 1256.7 | 384.1 | 119.7 |
| 222 | 0.015736 | 0.0086174 | 11481 | 285.75 | 69.07 | 77.82 | 187.12 | 5.625 | 9.784 |
| 226 | 0.019678 | 10.865 | -11151 | 183.78 | 83.26 | 120.02 | 1233.0 | 362.2 | 118.0 |
| 226 | 0.019678 | 0.010606 | 11778 | 285.24 | 70.10 | 78.93 | 188.37 | 5.723 | 10.12 |
| 230 | 0.024387 | 10.794 | -10669 | 185.89 | 83.94 | 120.96 | 1209.5 | 342.1 | 116.3 |
| 230 | 0.024387 | 0.012943 | 12077 | 284.79 | 71.14 | 80.06 | 189.56 | 5.821 | 10.45 |
| 234 | 0.029967 | 10.723 | -10183 | 187.99 | 84.64 | 121.92 | 1186.1 | 323.6 | 114.6 |
| 234 | 0.029967 | 0.015671 | 12377 | 284.40 | 72.19 | 81.21 | 190.68 | 5.918 | 10.79 |
| 238 | 0.03653 | 10.651 | -9693.1 | 190.06 | 85.35 | 122.90 | 1162.8 | 306.4 | 112.9 |
| 238 | 0.03653 | 0.018834 | 12680 | 284.07 | 73.26 | 82.39 | 191.75 | 6.015 | 11.13 |
| 242 | 0.044196 | 10.578 | -9199.1 | 192.12 | 86.08 | 123.91 | 1139.6 | 290.5 | 111.3 |
| 242 | 0.044196 | 0.022477 | 12984 | 283.78 | 74.34 | 83.60 | 192.74 | 6.112 | 11.47 |
| 246 | 0.053092 | 10.505 | -8700.9 | 194.15 | 86.82 | 124.94 | 1116.4 | 275.8 | 109.6 |
| 246 | 0.053092 | 0.026651 | 13290 | 283.55 | 75.44 | 84.83 | 193.67 | 6.208 | 11.82 |
| 250 | 0.06335 | 10.431 | -8198.5 | 196.18 | 87.58 | 126.00 | 1093.4 | 262.0 | 107.9 |
| 250 | 0.06335 | 0.031405 | 13597 | 283.36 | 76.55 | 86.10 | 194.52 | 6.304 | 12.17 |
| 254 | 0.075109 | 10.357 | -7691.7 | 198.18 | 88.35 | 127.08 | 1070.4 | 249.2 | 106.3 |
| 254 | 0.075109 | 0.036794 | 13905 | 283.21 | 77.68 | 87.40 | 195.30 | 6.401 | 12.53 |
| 258 | 0.088516 | 10.281 | -7180.5 | 200.18 | 89.14 | 128.19 | 1047.5 | 237.3 | 104.7 |
| 258 | 0.088516 | 0.042874 | 14214 | 283.10 | 78.82 | 88.73 | 196.00 | 6.497 | 12.89 |
| 262 | 0.10372 | 10.205 | -6664.7 | 202.15 | 89.94 | 129.33 | 1024.7 | 226.1 | 103.0 |
| 262 | 0.10372 | 0.049705 | 14525 | 283.03 | 79.98 | 90.10 | 196.62 | 6.594 | 13.26 |
| 266 | 0.12089 | 10.128 | -6144.2 | 204.12 | 90.76 | 130.50 | 1002.0 | 215.7 | 101.4 |
| 266 | 0.12089 | 0.057348 | 14836 | 282.99 | 81.15 | 91.50 | 197.15 | 6.690 | 13.62 |
| 270 | 0.14017 | 10.051 | -5618.9 | 206.07 | 91.59 | 131.70 | 979.29 | 205.9 | 99.87 |
| 270 | 0.14017 | 0.065869 | 15147 | 282.98 | 82.34 | 92.94 | 197.59 | 6.787 | 14.00 |
| 274 | 0.16174 | 9.9721 | -5088.6 | 208.01 | 92.44 | 132.94 | 956.65 | 196.6 | 98.30 |
| 274 | 0.16174 | 0.075336 | 15459 | 283.01 | 83.54 | 94.42 | 197.94 | 6.885 | 14.38 |
| 278 | 0.18577 | 9.8925 | -4553.3 | 209.94 | 93.29 | 134.21 | 934.06 | 188.0 | 96.75 |
| 278 | 0.18577 | 0.085821 | 15772 | 283.06 | 84.76 | 95.94 | 198.20 | 6.983 | 14.77 |
| 282 | 0.21243 | 9.8118 | -4012.7 | 211.87 | 94.17 | 135.52 | 911.50 | 179.8 | 95.22 |
| 282 | 0.21243 | 0.0974 | 16084 | 283.13 | 85.99 | 97.51 | 198.35 | 7.082 | 15.16 |
| 286 | 0.24192 | 9.7300 | -3466.7 | 213.78 | 95.05 | 136.87 | 888.97 | 172.1 | 93.72 |
| 286 | 0.24192 | 0.11015 | 16397 | 283.23 | 87.24 | 99.13 | 198.41 | 7.183 | 15.56 |
| 290 | 0.2744 | 9.6470 | -2915.2 | 215.68 | 95.95 | 138.26 | 866.47 | 164.8 | 92.23 |
| 290 | 0.2744 | 0.12417 | 16709 | 283.35 | 88.50 | 100.79 | 198.35 | 7.284 | 15.97 |
| 294 | 0.31008 | 9.5628 | -2358 | 217.58 | 96.86 | 139.70 | 843.98 | 157.9 | 90.76 |
| 294 | 0.31008 | 0.13954 | 17021 | 283.49 | 89.78 | 102.51 | 198.19 | 7.388 | 16.38 |
| 298 | 0.34914 | 9.4773 | -1794.9 | 219.46 | 97.78 | 141.18 | 821.50 | 151.4 | 89.32 |
| 298 | 0.34914 | 0.15635 | 17332 | 283.65 | 91.07 | 104.29 | 197.92 | 7.492 | 16.81 |
| 302 | 0.39177 | 9.3902 | -1225.8 | 221.35 | 98.71 | 142.72 | 799.01 | 145.2 | 87.89 |
| 302 | 0.39177 | 0.17472 | 17643 | 283.82 | 92.38 | 106.13 | 197.52 | 7.600 | 17.24 |
| 306 | 0.43819 | 9.3017 | -650.4 | 223.22 | 99.66 | 144.32 | 776.50 | 139.3 | 86.49 |
| 306 | 0.43819 | 0.19476 | 17952 | 284.01 | 93.70 | 108.04 | 197.01 | 7.709 | 17.69 |

**TABLE 2** *Continued*

| $T$ K | $P$ MPa | ρ mol·l$^{-1}$ | $H$ J·mol$^{-1}$ | $S$ J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | $c$ m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 310 | 0.48858 | 9.2114 | -68.6 | 225.09 | 100.62 | 145.98 | 753.97 | 133.6 | 85.12 |
| 310 | 0.48858 | 0.21659 | 18259 | 284.22 | 95.03 | 110.03 | 196.37 | 7.822 | 18.15 |
| 314 | 0.54317 | 9.1194 | 519.9 | 226.96 | 101.59 | 147.71 | 731.40 | 128.3 | 83.76 |
| 314 | 0.54317 | 0.24034 | 18565 | 284.43 | 96.38 | 112.10 | 195.59 | 7.938 | 18.63 |
| 318 | 0.60215 | 9.0255 | 1115.4 | 228.83 | 102.57 | 149.52 | 708.78 | 123.2 | 82.44 |
| 318 | 0.60215 | 0.26617 | 18870 | 284.66 | 97.75 | 114.27 | 194.68 | 8.057 | 19.12 |
| 322 | 0.66573 | 8.9295 | 1718 | 230.69 | 103.56 | 151.42 | 686.10 | 118.2 | 81.13 |
| 322 | 0.66573 | 0.29422 | 19171 | 284.89 | 99.13 | 116.54 | 193.62 | 8.181 | 19.63 |
| 326 | 0.73415 | 8.8312 | 2328.2 | 232.55 | 104.57 | 153.41 | 663.33 | 113.5 | 79.85 |
| 326 | 0.73415 | 0.3247 | 19470 | 285.13 | 100.51 | 118.93 | 192.41 | 8.310 | 20.16 |
| 330 | 0.80761 | 8.7304 | 2946.1 | 234.40 | 105.59 | 155.52 | 640.46 | 109.0 | 78.60 |
| 330 | 0.80761 | 0.35779 | 19766 | 285.37 | 101.91 | 121.44 | 191.05 | 8.445 | 20.71 |
| 334 | 0.88635 | 8.6270 | 3572.3 | 236.26 | 106.63 | 157.75 | 617.48 | 104.6 | 77.36 |
| 334 | 0.88635 | 0.39372 | 20058 | 285.62 | 103.31 | 124.10 | 189.52 | 8.586 | 21.29 |
| 338 | 0.97059 | 8.5206 | 4207.0 | 238.12 | 107.68 | 160.13 | 594.36 | 100.4 | 76.16 |
| 338 | 0.97059 | 0.43277 | 20345 | 285.87 | 104.71 | 126.93 | 187.82 | 8.735 | 21.89 |
| 342 | 1.0606 | 8.4109 | 4850.8 | 239.98 | 108.74 | 162.69 | 571.08 | 96.38 | 74.97 |
| 342 | 1.0606 | 0.47521 | 20627 | 286.11 | 106.11 | 129.97 | 185.94 | 8.893 | 22.53 |
| 346 | 1.1565 | 8.2977 | 5504.1 | 241.85 | 109.83 | 165.44 | 547.62 | 92.43 | 73.81 |
| 346 | 1.1565 | 0.5214 | 20903 | 286.36 | 107.52 | 133.26 | 183.86 | 9.061 | 23.21 |
| 350 | 1.2587 | 8.1805 | 6167.6 | 243.72 | 110.93 | 168.44 | 523.94 | 88.59 | 72.68 |
| 350 | 1.2587 | 0.57173 | 21172 | 286.59 | 108.95 | 136.89 | 181.59 | 9.241 | 23.93 |
| 354 | 1.3674 | 8.0588 | 6842.0 | 245.60 | 112.06 | 171.73 | 500.02 | 84.84 | 71.57 |
| 354 | 1.3674 | 0.62668 | 21433 | 286.82 | 110.41 | 140.94 | 179.11 | 9.44 | 24.70 |
| 358 | 1.4829 | 7.9321 | 7528.1 | 247.49 | 113.21 | 175.38 | 475.82 | 81.18 | 70.48 |
| 358 | 1.4829 | 0.68681 | 21684 | 287.03 | 111.93 | 145.55 | 176.40 | 9.645 | 25.53 |
| 362 | 1.6054 | 7.7996 | 8226.8 | 249.38 | 114.39 | 179.48 | 451.29 | 77.58 | 69.42 |
| 362 | 1.6054 | 0.7528 | 21924 | 287.22 | 113.53 | 150.87 | 173.45 | 9.875 | 26.43 |
| 366 | 1.7352 | 7.6606 | 8939.5 | 251.30 | 115.60 | 184.15 | 426.38 | 74.03 | 68.37 |
| 366 | 1.7352 | 0.82548 | 22152 | 287.39 | 115.23 | 157.11 | 170.25 | 10.13 | 27.41 |
| 370 | 1.8727 | 7.5139 | 9667.7 | 253.22 | 116.86 | 189.58 | 401.01 | 70.53 | 67.36 |
| 370 | 1.8727 | 0.90588 | 22364 | 287.54 | 117.03 | 164.55 | 166.77 | 10.41 | 28.50 |
| 374 | 2.0181 | 7.358 | 10413 | 255.18 | 118.17 | 196.03 | 375.12 | 67.04 | 66.36 |
| 374 | 2.0181 | 0.99533 | 22559 | 287.65 | 118.96 | 173.60 | 163.00 | 10.72 | 29.71 |
| 378 | 2.1718 | 7.1913 | 11179 | 257.16 | 119.54 | 203.88 | 348.59 | 63.54 | 65.40 |
| 378 | 2.1718 | 1.0956 | 22732 | 287.72 | 121.02 | 184.89 | 158.90 | 11.08 | 31.09 |
| 382 | 2.3343 | 7.0111 | 11968 | 259.17 | 121.01 | 213.80 | 321.32 | 60.03 | 64.46 |
| 382 | 2.3343 | 1.2090 | 22878 | 287.73 | 123.23 | 199.43 | 154.46 | 11.49 | 32.68 |
| 386 | 2.5058 | 6.8138 | 12785 | 261.24 | 122.62 | 226.90 | 293.15 | 56.45 | 63.58 |
| 386 | 2.5058 | 1.3389 | 22991 | 287.68 | 125.63 | 218.98 | 149.63 | 11.97 | 34.55 |
| 390 | 2.6869 | 6.5941 | 13638 | 263.36 | 124.42 | 245.34 | 263.93 | 52.77 | 62.76 |
| 390 | 2.6869 | 1.4904 | 23060 | 287.52 | 128.27 | 246.92 | 144.37 | 12.55 | 36.83 |
| 394 | 2.8782 | 6.3430 | 14539 | 265.59 | 126.52 | 273.75 | 233.42 | 48.92 | 62.09 |
| 394 | 2.8782 | 1.6716 | 23068 | 287.23 | 131.24 | 290.57 | 138.63 | 13.26 | 39.74 |
| 398 | 3.0802 | 6.0444 | 15510 | 267.96 | 129.14 | 324.44 | 201.26 | 44.76 | 61.76 |
| 398 | 3.0802 | 1.8978 | 22982 | 286.73 | 134.75 | 369.40 | 132.32 | 14.18 | 43.73 |
| 402 | 3.294 | 5.6611 | 16603 | 270.60 | 132.80 | 444.47 | 166.79 | 40.03 | 62.50 |
| 402 | 3.294 | 2.2035 | 22733 | 285.85 | 139.26 | 557.25 | 125.27 | 15.48 | 50.08 |

**TABLE 2** *Continued*

| T<br>K | P<br>MPa | ρ<br>mol·l$^{-1}$ | H<br>J·mol$^{-1}$ | S<br>J·mol$^{-1}$·K$^{-1}$ | $C_v$<br>J·mol$^{-1}$·K$^{-1}$ | $C_p$<br>J·mol$^{-1}$·K$^{-1}$ | c<br>m·s$^{-1}$ | η<br>μPa·s | λ<br>mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 406 | 3.521 | 5.0501 | 18021 | 274.00 | 139.62 | 1125.70 | 128.12 | 33.65 | 69.00 |
| 406 | 3.521 | 2.7246 | 22042 | 283.91 | 146.50 | 1601.40 | 116.78 | 17.90 | 66.35 |
| 407 | 3.580 | 4.7629 | 18568 | 275.32 | 143.30 | 2459.70 | 116.97 | 31.07 | 77.26 |
| 407 | 3.580 | 2.9844 | 21611 | 282.79 | 149.68 | 3556.20 | 113.83 | 19.21 | 81.05 |

**TABLE 2 Thermophysical Properties of Isobutane Vapor at Vapor-Liquid Equilibrium**

| T<br>K | P<br>MPa | ρ<br>mol·l$^{-1}$ | H<br>J·mol$^{-1}$ | S<br>J·mol$^{-1}$·K$^{-1}$ | $C_v$<br>J·mol$^{-1}$·K$^{-1}$ | $C_p$<br>J·mol$^{-1}$·K$^{-1}$ | c<br>m·s$^{-1}$ | η<br>μPa·s | λ<br>mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 120 | 1.0633E-07 | 1.0657E-07 | 21733 | 196.17 | 44.496 | 52.811 | 142.74 | 3.0131 | 2.6257 |
| 122 | 1.6734E-07 | 1.6497E-07 | 21840 | 193.27 | 45.023 | 53.338 | 143.79 | 3.0658 | 2.7408 |
| 124 | 2.5915E-07 | 2.5136E-07 | 21947 | 190.51 | 45.546 | 53.861 | 144.83 | 3.1185 | 2.8569 |
| 126 | 3.9524E-07 | 3.7727E-07 | 22055 | 187.87 | 46.064 | 54.379 | 145.87 | 3.1711 | 2.9740 |
| 128 | 5.9407E-07 | 5.5821E-07 | 22164 | 185.34 | 46.578 | 54.892 | 146.90 | 3.2237 | 3.0922 |
| 130 | 8.8064E-07 | 8.1474E-07 | 22275 | 182.92 | 47.087 | 55.402 | 147.92 | 3.2763 | 3.2114 |
| 132 | 1.2883E-06 | 1.1738E-06 | 22386 | 180.61 | 47.592 | 55.907 | 148.93 | 3.3288 | 3.3317 |
| 134 | 1.8611E-06 | 1.6704E-06 | 22498 | 178.39 | 48.094 | 56.409 | 149.94 | 3.3813 | 3.4530 |
| 136 | 2.6564E-06 | 2.3492E-06 | 22611 | 176.27 | 48.591 | 56.906 | 150.94 | 3.4337 | 3.5753 |
| 138 | 3.7483E-06 | 3.2669E-06 | 22726 | 174.24 | 49.085 | 57.400 | 151.94 | 3.4860 | 3.6987 |
| 140 | 5.2314E-06 | 4.4943E-06 | 22841 | 172.30 | 49.575 | 57.891 | 152.92 | 3.5384 | 3.8231 |
| 142 | 7.2252E-06 | 6.1198E-06 | 22957 | 170.44 | 50.062 | 58.378 | 153.90 | 3.5906 | 3.9485 |
| 144 | 9.8793E-06 | 8.2517E-06 | 23074 | 168.66 | 50.546 | 58.862 | 154.88 | 3.6429 | 4.0750 |
| 146 | 1.3379E-05 | 1.1022E-05 | 23193 | 166.95 | 51.028 | 59.344 | 155.84 | 3.6950 | 4.2025 |
| 148 | 1.7953E-05 | 1.4591E-05 | 23312 | 165.32 | 51.506 | 59.823 | 156.80 | 3.7472 | 4.3310 |
| 150 | 2.3880E-05 | 1.9149E-05 | 23432 | 163.75 | 51.982 | 60.300 | 157.76 | 3.7992 | 4.4606 |
| 152 | 3.1496E-05 | 2.4924E-05 | 23553 | 162.25 | 52.456 | 60.774 | 158.71 | 3.8513 | 4.5912 |
| 154 | 4.1206E-05 | 3.2185E-05 | 23675 | 160.82 | 52.928 | 61.247 | 159.65 | 3.9032 | 4.7228 |
| 156 | 5.3493E-05 | 4.1247E-05 | 23798 | 159.44 | 53.397 | 61.717 | 160.58 | 3.9551 | 4.8555 |
| 158 | 6.8925E-05 | 5.2475E-05 | 23921 | 158.12 | 53.866 | 62.187 | 161.51 | 4.0070 | 4.9892 |
| 160 | 8.8176E-05 | 6.6294E-05 | 24046 | 156.86 | 54.332 | 62.655 | 162.43 | 4.0588 | 5.1239 |
| 162 | 0.00011203 | 8.3191E-05 | 24171 | 155.65 | 54.798 | 63.122 | 163.35 | 4.1105 | 5.2596 |
| 164 | 0.00014139 | 0.00010372 | 24298 | 154.49 | 55.262 | 63.589 | 164.26 | 4.1622 | 5.3964 |
| 166 | 0.00017732 | 0.00012852 | 24425 | 153.38 | 55.726 | 64.054 | 165.16 | 4.2138 | 5.5342 |
| 168 | 0.00022101 | 0.00015829 | 24553 | 152.31 | 56.188 | 64.520 | 166.06 | 4.2654 | 5.6729 |
| 170 | 0.00027386 | 0.00019384 | 24682 | 151.29 | 56.651 | 64.985 | 166.95 | 4.3168 | 5.8127 |
| 172 | 0.00033740 | 0.00023606 | 24812 | 150.32 | 57.113 | 65.451 | 167.83 | 4.3682 | 5.9535 |
| 174 | 0.00041343 | 0.00028595 | 24943 | 149.39 | 57.575 | 65.917 | 168.70 | 4.4196 | 6.0953 |
| 176 | 0.00050391 | 0.00034461 | 25075 | 148.49 | 58.037 | 66.384 | 169.57 | 4.4708 | 6.2381 |
| 178 | 0.00061107 | 0.00041325 | 25207 | 147.64 | 58.500 | 66.852 | 170.43 | 4.5220 | 6.3819 |
| 180 | 0.00073738 | 0.00049321 | 25340 | 146.82 | 58.963 | 67.320 | 171.29 | 4.5732 | 6.5267 |
| 182 | 0.00088560 | 0.00058593 | 25474 | 146.04 | 59.426 | 67.791 | 172.13 | 4.6242 | 6.6725 |
| 184 | 0.0010588 | 0.00069300 | 25609 | 145.30 | 59.891 | 68.262 | 172.97 | 4.6751 | 6.8192 |
| 186 | 0.0012602 | 0.00081613 | 25745 | 144.58 | 60.356 | 68.736 | 173.80 | 4.7260 | 6.9669 |
| 188 | 0.0014935 | 0.00095718 | 25881 | 143.90 | 60.823 | 69.212 | 174.63 | 4.7768 | 7.1156 |
| 190 | 0.0017628 | 0.0011181 | 26018 | 143.25 | 61.291 | 69.690 | 175.44 | 4.8275 | 7.2652 |
| 192 | 0.0020724 | 0.0013012 | 26156 | 142.63 | 61.760 | 70.170 | 176.25 | 4.8781 | 7.4158 |
| 194 | 0.0024270 | 0.0015085 | 26295 | 142.04 | 62.231 | 70.653 | 177.05 | 4.9286 | 7.5673 |
| 196 | 0.0028316 | 0.0017426 | 26434 | 141.48 | 62.704 | 71.140 | 177.83 | 4.9790 | 7.7198 |
| 198 | 0.0032918 | 0.0020061 | 26574 | 140.94 | 63.179 | 71.629 | 178.61 | 5.0294 | 7.8732 |
| 200 | 0.0038135 | 0.0023017 | 26715 | 140.43 | 63.656 | 72.122 | 179.38 | 5.0796 | 8.0275 |
| 202 | 0.0044031 | 0.0026324 | 26857 | 139.94 | 64.135 | 72.618 | 180.14 | 5.1297 | 8.1827 |
| 204 | 0.0050671 | 0.0030011 | 26999 | 139.48 | 64.617 | 73.118 | 180.89 | 5.1797 | 8.3389 |
| 206 | 0.0058130 | 0.0034111 | 27142 | 139.04 | 65.101 | 73.623 | 181.63 | 5.2297 | 8.4959 |
| 208 | 0.0066482 | 0.0038658 | 27285 | 138.62 | 65.587 | 74.131 | 182.36 | 5.2795 | 8.6539 |
| 210 | 0.0075808 | 0.0043687 | 27429 | 138.23 | 66.077 | 74.644 | 183.08 | 5.3292 | 8.8127 |
| 212 | 0.0086196 | 0.0049235 | 27574 | 137.85 | 66.569 | 75.161 | 183.78 | 5.3789 | 8.9724 |
| 214 | 0.0097734 | 0.0055342 | 27720 | 137.50 | 67.064 | 75.684 | 184.48 | 5.4284 | 9.1330 |
| 216 | 0.011052 | 0.0062046 | 27866 | 137.16 | 67.561 | 76.211 | 185.16 | 5.4778 | 9.2945 |
| 218 | 0.012465 | 0.0069390 | 28012 | 136.85 | 68.062 | 76.743 | 185.83 | 5.5271 | 9.4569 |
| 220 | 0.014023 | 0.0077418 | 28159 | 136.55 | 68.567 | 77.281 | 186.48 | 5.5763 | 9.6201 |
| 222 | 0.015736 | 0.0086174 | 28307 | 136.27 | 69.074 | 77.824 | 187.12 | 5.6254 | 9.7842 |
| 224 | 0.017618 | 0.0095704 | 28455 | 136.01 | 69.585 | 78.373 | 187.75 | 5.6744 | 9.9492 |
| 226 | 0.019678 | 0.010606 | 28604 | 135.76 | 70.099 | 78.928 | 188.37 | 5.7234 | 10.115 |
| 228 | 0.021930 | 0.011728 | 28753 | 135.53 | 70.616 | 79.488 | 188.97 | 5.7722 | 10.282 |
| 230 | 0.024387 | 0.012943 | 28903 | 135.31 | 71.137 | 80.055 | 189.56 | 5.8209 | 10.449 |
| 232 | 0.027061 | 0.014256 | 29053 | 135.11 | 71.662 | 80.629 | 190.13 | 5.8696 | 10.618 |
| 234 | 0.029967 | 0.015671 | 29204 | 134.92 | 72.190 | 81.208 | 190.68 | 5.9182 | 10.787 |
| 236 | 0.033118 | 0.017195 | 29355 | 134.75 | 72.722 | 81.795 | 191.22 | 5.9666 | 10.957 |
| 238 | 0.036530 | 0.018834 | 29506 | 134.59 | 73.257 | 82.388 | 191.75 | 6.0151 | 11.128 |
| 240 | 0.040218 | 0.020593 | 29658 | 134.44 | 73.796 | 82.988 | 192.25 | 6.0634 | 11.300 |
| 242 | 0.044196 | 0.022477 | 29810 | 134.30 | 74.339 | 83.595 | 192.74 | 6.1117 | 11.473 |
| 244 | 0.048482 | 0.024495 | 29963 | 134.18 | 74.886 | 84.210 | 193.22 | 6.1600 | 11.647 |
| 246 | 0.053092 | 0.026651 | 30116 | 134.07 | 75.436 | 84.832 | 193.67 | 6.2082 | 11.822 |
| 248 | 0.058042 | 0.028952 | 30269 | 133.97 | 75.990 | 85.462 | 194.11 | 6.2564 | 11.997 |

**TABLE 2** *Continued*

| *T* K | *P* MPa | ρ mol·l$^{-1}$ | *H* J·mol$^{-1}$ | *S* J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | *c* m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 250 | 0.063350 | 0.031405 | 30423 | 133.88 | 76.548 | 86.099 | 194.52 | 6.3045 | 12.174 |
| 252 | 0.069033 | 0.034017 | 30577 | 133.80 | 77.110 | 86.744 | 194.92 | 6.3527 | 12.352 |
| 254 | 0.075109 | 0.036794 | 30731 | 133.73 | 77.676 | 87.398 | 195.30 | 6.4008 | 12.530 |
| 256 | 0.081597 | 0.039744 | 30886 | 133.67 | 78.245 | 88.060 | 195.66 | 6.4489 | 12.710 |
| 258 | 0.088516 | 0.042874 | 31041 | 133.62 | 78.819 | 88.730 | 196.00 | 6.4971 | 12.891 |
| 260 | 0.095885 | 0.046192 | 31196 | 133.58 | 79.396 | 89.409 | 196.32 | 6.5453 | 13.073 |
| 262 | 0.10372 | 0.049705 | 31351 | 133.55 | 79.977 | 90.097 | 196.62 | 6.5935 | 13.256 |
| 264 | 0.11205 | 0.053421 | 31506 | 133.53 | 80.561 | 90.793 | 196.89 | 6.6419 | 13.440 |
| 266 | 0.12089 | 0.057348 | 31662 | 133.51 | 81.150 | 91.499 | 197.15 | 6.6903 | 13.625 |
| 268 | 0.13025 | 0.061495 | 31818 | 133.50 | 81.742 | 92.215 | 197.38 | 6.7387 | 13.812 |
| 270 | 0.14017 | 0.065869 | 31974 | 133.50 | 82.338 | 92.940 | 197.59 | 6.7873 | 14.000 |
| 272 | 0.15066 | 0.070480 | 32130 | 133.51 | 82.938 | 93.675 | 197.78 | 6.8361 | 14.189 |
| 274 | 0.16174 | 0.075336 | 32286 | 133.53 | 83.542 | 94.421 | 197.94 | 6.8850 | 14.380 |
| 276 | 0.17344 | 0.080446 | 32442 | 133.55 | 84.149 | 95.177 | 198.08 | 6.9340 | 14.572 |
| 278 | 0.18577 | 0.085821 | 32598 | 133.58 | 84.760 | 95.944 | 198.20 | 6.9833 | 14.766 |
| 280 | 0.19876 | 0.091469 | 32754 | 133.61 | 85.375 | 96.722 | 198.29 | 7.0328 | 14.961 |
| 282 | 0.21243 | 0.097400 | 32911 | 133.65 | 85.993 | 97.511 | 198.35 | 7.0825 | 15.159 |
| 284 | 0.22681 | 0.10362 | 33067 | 133.70 | 86.615 | 98.312 | 198.39 | 7.1325 | 15.357 |
| 286 | 0.24192 | 0.11015 | 33223 | 133.75 | 87.241 | 99.126 | 198.41 | 7.1828 | 15.558 |
| 288 | 0.25777 | 0.11700 | 33379 | 133.81 | 87.870 | 99.952 | 198.39 | 7.2334 | 15.761 |
| 290 | 0.27440 | 0.12417 | 33535 | 133.87 | 88.503 | 100.79 | 198.35 | 7.2844 | 15.966 |
| 292 | 0.29183 | 0.13168 | 33691 | 133.94 | 89.140 | 101.64 | 198.29 | 7.3357 | 16.173 |
| 294 | 0.31008 | 0.13954 | 33847 | 134.01 | 89.780 | 102.51 | 198.19 | 7.3875 | 16.382 |
| 296 | 0.32917 | 0.14776 | 34003 | 134.09 | 90.423 | 103.39 | 198.07 | 7.4397 | 16.593 |
| 298 | 0.34914 | 0.15635 | 34158 | 134.17 | 91.070 | 104.29 | 197.92 | 7.4925 | 16.807 |
| 300 | 0.37000 | 0.16534 | 34314 | 134.26 | 91.721 | 105.20 | 197.74 | 7.5457 | 17.024 |
| 302 | 0.39177 | 0.17472 | 34469 | 134.34 | 92.375 | 106.13 | 197.52 | 7.5996 | 17.243 |
| 304 | 0.41450 | 0.18452 | 34623 | 134.44 | 93.033 | 107.08 | 197.28 | 7.6541 | 17.465 |
| 306 | 0.43819 | 0.19476 | 34778 | 134.53 | 93.695 | 108.04 | 197.01 | 7.7092 | 17.691 |
| 308 | 0.46288 | 0.20544 | 34932 | 134.63 | 94.361 | 109.02 | 196.70 | 7.7650 | 17.919 |
| 310 | 0.48858 | 0.21659 | 35086 | 134.74 | 95.030 | 110.03 | 196.37 | 7.8217 | 18.151 |
| 312 | 0.51534 | 0.22822 | 35239 | 134.84 | 95.703 | 111.05 | 196.00 | 7.8791 | 18.387 |
| 314 | 0.54317 | 0.24034 | 35392 | 134.95 | 96.380 | 112.10 | 195.59 | 7.9375 | 18.627 |
| 316 | 0.57209 | 0.25298 | 35544 | 135.06 | 97.061 | 113.17 | 195.15 | 7.9967 | 18.870 |
| 318 | 0.60215 | 0.26617 | 35696 | 135.18 | 97.746 | 114.27 | 194.68 | 8.0570 | 19.118 |
| 320 | 0.63335 | 0.27991 | 35847 | 135.29 | 98.434 | 115.39 | 194.17 | 8.1184 | 19.370 |
| 322 | 0.66573 | 0.29422 | 35997 | 135.41 | 99.125 | 116.54 | 193.62 | 8.1810 | 19.627 |
| 324 | 0.69932 | 0.30915 | 36147 | 135.53 | 99.819 | 117.72 | 193.04 | 8.2448 | 19.889 |
| 326 | 0.73415 | 0.32470 | 36296 | 135.65 | 100.51 | 118.93 | 192.41 | 8.3100 | 20.156 |
| 328 | 0.77023 | 0.34090 | 36444 | 135.77 | 101.21 | 120.17 | 191.75 | 8.3766 | 20.429 |
| 330 | 0.80761 | 0.35779 | 36592 | 135.89 | 101.91 | 121.44 | 191.05 | 8.4448 | 20.708 |
| 332 | 0.84630 | 0.37539 | 36738 | 136.02 | 102.61 | 122.75 | 190.31 | 8.5146 | 20.994 |
| 334 | 0.88635 | 0.39372 | 36884 | 136.14 | 103.31 | 124.10 | 189.52 | 8.5861 | 21.286 |
| 336 | 0.92776 | 0.41284 | 37028 | 136.26 | 104.01 | 125.49 | 188.69 | 8.6596 | 21.585 |
| 338 | 0.97059 | 0.43277 | 37171 | 136.39 | 104.71 | 126.93 | 187.82 | 8.7352 | 21.892 |
| 340 | 1.0148 | 0.45354 | 37313 | 136.51 | 105.41 | 128.42 | 186.90 | 8.8129 | 22.207 |
| 342 | 1.0606 | 0.47521 | 37453 | 136.64 | 106.11 | 129.97 | 185.94 | 8.8930 | 22.531 |
| 344 | 1.1078 | 0.49781 | 37592 | 136.76 | 106.81 | 131.58 | 184.92 | 8.9757 | 22.865 |
| 346 | 1.1565 | 0.52140 | 37729 | 136.88 | 107.52 | 133.26 | 183.86 | 9.0611 | 23.208 |
| 348 | 1.2068 | 0.54602 | 37865 | 137.00 | 108.23 | 135.03 | 182.75 | 9.1495 | 23.562 |
| 350 | 1.2587 | 0.57173 | 37998 | 137.11 | 108.95 | 136.89 | 181.59 | 9.2411 | 23.928 |
| 352 | 1.3123 | 0.59860 | 38130 | 137.23 | 109.67 | 138.86 | 180.38 | 9.3362 | 24.306 |
| 354 | 1.3674 | 0.62668 | 38259 | 137.34 | 110.41 | 140.94 | 179.11 | 9.4350 | 24.698 |
| 356 | 1.4243 | 0.65606 | 38386 | 137.45 | 111.16 | 143.17 | 177.78 | 9.5379 | 25.105 |
| 358 | 1.4829 | 0.68681 | 38510 | 137.55 | 111.93 | 145.55 | 176.40 | 9.6453 | 25.528 |
| 360 | 1.5433 | 0.71903 | 38632 | 137.65 | 112.72 | 148.11 | 174.96 | 9.7575 | 25.968 |
| 362 | 1.6054 | 0.75280 | 38751 | 137.74 | 113.53 | 150.87 | 173.45 | 9.8750 | 26.427 |
| 364 | 1.6694 | 0.78824 | 38866 | 137.83 | 114.37 | 153.86 | 171.89 | 9.9982 | 26.908 |
| 366 | 1.7352 | 0.82548 | 38978 | 137.92 | 115.23 | 157.11 | 170.25 | 10.128 | 27.411 |
| 368 | 1.8030 | 0.86464 | 39086 | 137.99 | 116.11 | 160.66 | 168.55 | 10.264 | 27.941 |
| 370 | 1.8727 | 0.90588 | 39190 | 138.06 | 117.03 | 164.55 | 166.77 | 10.409 | 28.498 |
| 372 | 1.9444 | 0.94937 | 39290 | 138.12 | 117.98 | 168.84 | 164.92 | 10.561 | 29.088 |
| 374 | 2.0181 | 0.99533 | 39385 | 138.17 | 118.96 | 173.60 | 163.00 | 10.723 | 29.713 |
| 376 | 2.0939 | 1.0440 | 39474 | 138.21 | 119.97 | 178.92 | 160.99 | 10.896 | 30.378 |
| 378 | 2.1718 | 1.0956 | 39558 | 138.24 | 121.02 | 184.89 | 158.90 | 11.081 | 31.089 |
| 380 | 2.2519 | 1.1505 | 39635 | 138.25 | 122.11 | 191.67 | 156.73 | 11.278 | 31.853 |
| 382 | 2.3343 | 1.2090 | 39704 | 138.25 | 123.23 | 199.43 | 154.46 | 11.491 | 32.677 |
| 384 | 2.4189 | 1.2716 | 39765 | 138.24 | 124.41 | 208.42 | 152.10 | 11.721 | 33.572 |
| 386 | 2.5058 | 1.3389 | 39817 | 138.20 | 125.63 | 218.98 | 149.63 | 11.972 | 34.551 |
| 388 | 2.5951 | 1.4115 | 39858 | 138.13 | 126.92 | 231.58 | 147.06 | 12.245 | 35.630 |
| 390 | 2.6869 | 1.4904 | 39886 | 138.04 | 128.27 | 246.92 | 144.37 | 12.546 | 36.832 |
| 392 | 2.7812 | 1.5766 | 39899 | 137.92 | 129.70 | 266.03 | 141.57 | 12.881 | 38.187 |
| 394 | 2.8782 | 1.6716 | 39894 | 137.75 | 131.24 | 290.57 | 138.63 | 13.256 | 39.738 |
| 396 | 2.9778 | 1.7777 | 39866 | 137.54 | 132.91 | 323.33 | 135.56 | 13.682 | 41.551 |

**TABLE 2** *Continued*

| *T* K | *P* MPa | ρ mol·l$^{-1}$ | *H* J·mol$^{-1}$ | *S* J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | *c* m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|
| 398 | 3.0802 | 1.8978 | 39809 | 137.25 | 134.75 | 369.40 | 132.32 | 14.175 | 43.728 |
| 400 | 3.1856 | 2.0369 | 39712 | 136.88 | 136.83 | 439.11 | 128.90 | 14.761 | 46.452 |
| 402 | 3.2940 | 2.2035 | 39559 | 136.37 | 139.26 | 557.25 | 125.27 | 15.484 | 50.083 |
| 404 | 3.4057 | 2.4155 | 39312 | 135.63 | 142.29 | 801.43 | 121.33 | 16.437 | 55.527 |
| 406 | 3.5210 | 2.7246 | 38868 | 134.43 | 146.50 | 1601.4 | 116.78 | 17.902 | 66.347 |
| 407.81 | 3.6284 | 3.7092 | 37136 | 130.09 | 153.85 | 409210 | 107.93 | 23.329 | 402.21 |

$C_v$, constant volume molar heat capacity (J·K$^{-1}$·mol$^{-1}$)

$C_p$, constant pressure molar heat capacity (J·K$^{-1}$·mol$^{-1}$)

~~*These*~~*c*, ~~tables were produced by equations from a computer package, "NIST Standard Reference Database 23; Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version =8.0" A wide selection of units (SI~~ speed of sound (m·s$^{-1}$~~units, engineering units, chemical units) is available with this program.~~)

η, viscosity (μPa·s)

λ, thermal conductivity (mW·m$^{-1}$·K$^{-1}$)

## 4. Additional Information

4.1 Reference state properties are required to calculate ~~certain of~~ the thermodynamic properties ~~(enthalpy, entropy, etc.)~~enthalpy and entropy from an equation of state formulation. The reference state properties used ~~to generate the tables in this specification are:~~are those specified by the International Institute of Refrigeration (IIR): enthalpy, ~~*H,*~~*H* = 200 J/g, and entropy, ~~*S, at 298.15 K and 0.101325 MPa (H = 17932.6 J/mol and S =* 295.390 J/(mol K). The molar mass of isobutane is 58.122 g/mol.~~ = 1 J/(g·K), for the saturated liquid at 273.15K (0°C).

4.2 The molar mass of isobutane is 58.122 g/mol.

## 5. Keywords

5.1 isobutane; isobutane gas tables; natural gas; thermodynamic properties of isobutane; transport properties of ~~isobutane~~isobutane; 2-methylpropane

**TABLE 2 Thermophysical Properties of Isobutane Along Isobars**

| $T$ K | ρ mol·l$^{-1}$ | $H$ J·mol$^{-1}$ | $S$ J·mol$^{-1}$·K$^{-1}$ | $C_v$ J·mol$^{-1}$·K$^{-1}$ | $C_p$ J·mol$^{-1}$·K$^{-1}$ | $c$ m·s$^{-1}$ | η μPa·s | λ mW·m$^{-1}$·K$^{-1}$ |
|---|---|---|---|---|---|---|---|---|
| | | | | Pressure = 0.1 MPa | | | | |
| 120 | 12.636 | -22732 | 115.25 | 69.01 | 99.31 | 1945.6 | 6063 | 156.7 |
| 130 | 12.474 | -21730 | 123.28 | 70.26 | 101.18 | 1863.7 | 3702 | 154.4 |
| 140 | 12.311 | -20709 | 130.84 | 71.51 | 103.04 | 1787.1 | 2465 | 151.6 |
| 150 | 12.148 | -19669 | 138.01 | 72.73 | 104.89 | 1714.8 | 1749 | 148.5 |
| 160 | 11.985 | -18611 | 144.84 | 73.95 | 106.72 | 1645.7 | 1304 | 145.0 |
| 170 | 11.820 | -17534 | 151.37 | 75.19 | 108.57 | 1579.1 | 1009 | 141.2 |
| 180 | 11.654 | -16439 | 157.63 | 76.46 | 110.44 | 1514.5 | 805.3 | 137.3 |
| 190 | 11.486 | -15325 | 163.65 | 77.80 | 112.37 | 1451.5 | 657.9 | 133.3 |
| 200 | 11.317 | -14192 | 169.46 | 79.21 | 114.36 | 1389.7 | 547.7 | 129.1 |
| 210 | 11.146 | -13038 | 175.09 | 80.70 | 116.44 | 1329.0 | 462.9 | 124.9 |
| 220 | 10.972 | -11863 | 180.56 | 82.28 | 118.63 | 1269.2 | 396.1 | 120.6 |
| 230 | 10.796 | -10665 | 185.88 | 83.95 | 120.94 | 1210.1 | 342.4 | 116.4 |
| 240 | 10.616 | -9443.3 | 191.08 | 85.72 | 123.39 | 1151.6 | 298.5 | 112.1 |
| 250 | 10.432 | -8196.6 | 196.17 | 87.58 | 125.99 | 1093.7 | 262.2 | 108.0 |
| 260 | 10.244 | -6923.0 | 201.16 | 89.54 | 128.76 | 1036.2 | 231.6 | 103.9 |
| 261.07 | 10.223 | -6785.7 | 201.69 | 89.76 | 129.06 | 1030.1 | 228.7 | 103.4 |
| 261.07 | 0.048038 | 14452 | 283.04 | 79.71 | 89.77 | 196.48 | 6.571 | 13.17 |
| 270 | 0.046232 | 15263 | 286.10 | 81.85 | 91.69 | 200.26 | 6.797 | 14.03 |
| 280 | 0.044385 | 16191 | 289.47 | 84.33 | 93.96 | 204.32 | 7.048 | 15.02 |
| 290 | 0.042696 | 17142 | 292.81 | 86.87 | 96.34 | 208.25 | 7.297 | 16.04 |
| 300 | 0.041143 | 18118 | 296.12 | 89.47 | 98.80 | 212.04 | 7.544 | 17.08 |
| 320 | 0.038379 | 20144 | 302.65 | 94.79 | 103.90 | 219.32 | 8.032 | 19.24 |
| 340 | 0.035985 | 22275 | 309.11 | 100.19 | 109.15 | 226.26 | 8.515 | 21.50 |
| 360 | 0.033886 | 24511 | 315.50 | 105.61 | 114.45 | 232.90 | 8.992 | 23.86 |
| 380 | 0.032029 | 26853 | 321.83 | 111.00 | 119.76 | 239.30 | 9.463 | 26.32 |
| 400 | 0.030372 | 29301 | 328.11 | 116.31 | 125.01 | 245.50 | 9.929 | 28.88 |
| 420 | 0.028882 | 31853 | 334.33 | 121.52 | 130.16 | 251.51 | 10.39 | 31.54 |
| 440 | 0.027536 | 34506 | 340.50 | 126.61 | 135.21 | 257.36 | 10.85 | 34.31 |
| 460 | 0.026312 | 37260 | 346.62 | 131.56 | 140.12 | 263.07 | 11.30 | 37.18 |
| 480 | 0.025194 | 40110 | 352.69 | 136.36 | 144.89 | 268.64 | 11.75 | 40.16 |
| 500 | 0.024169 | 43055 | 358.70 | 141.01 | 149.52 | 274.09 | 12.20 | 43.23 |
| 520 | 0.023225 | 46090 | 364.65 | 145.51 | 154.00 | 279.42 | 12.64 | 46.41 |
| 540 | 0.022353 | 49214 | 370.54 | 149.87 | 158.34 | 284.65 | 13.07 | 49.69 |
| 560 | 0.021545 | 52423 | 376.38 | 154.08 | 162.54 | 289.78 | 13.51 | 53.08 |
| 570 | 0.021163 | 54059 | 379.27 | 156.13 | 164.58 | 292.31 | 13.72 | 54.81 |
| | | | | Pressure = 1 MPa | | | | |
| 120 | 12.642 | -22672 | 115.16 | 69.09 | 99.28 | 1947.80 | 6125 | 156.9 |
| 130 | 12.480 | -21670 | 123.18 | 70.34 | 101.14 | 1866.30 | 3738 | 154.6 |
| 140 | 12.318 | -20649 | 130.75 | 71.58 | 103.00 | 1790.10 | 2488 | 151.8 |
| 150 | 12.156 | -19610 | 137.91 | 72.80 | 104.84 | 1718.10 | 1765 | 148.7 |
| 160 | 11.993 | -18552 | 144.74 | 74.02 | 106.67 | 1649.40 | 1315 | 145.2 |
| 170 | 11.829 | -17476 | 151.26 | 75.25 | 108.50 | 1583.20 | 1018 | 141.6 |
| 180 | 11.663 | -16382 | 157.52 | 76.53 | 110.37 | 1519.00 | 812.5 | 137.6 |
| 190 | 11.497 | -15269 | 163.53 | 77.86 | 112.28 | 1456.30 | 663.8 | 133.6 |
| 200 | 11.329 | -14136 | 169.34 | 79.27 | 114.26 | 1395.00 | 552.6 | 129.5 |
| 210 | 11.158 | -12983 | 174.97 | 80.76 | 116.33 | 1334.70 | 467.2 | 125.3 |
| 220 | 10.986 | -11809 | 180.43 | 82.34 | 118.50 | 1275.40 | 399.9 | 121.0 |
| 230 | 10.811 | -10613 | 185.75 | 84.01 | 120.78 | 1216.80 | 345.8 | 116.8 |
| 240 | 10.632 | -9393.2 | 190.94 | 85.78 | 123.20 | 1158.90 | 301.6 | 112.6 |
| 250 | 10.450 | -8148.6 | 196.02 | 87.64 | 125.76 | 1101.60 | 265.0 | 108.5 |
| 260 | 10.264 | -6877.5 | 201.00 | 89.60 | 128.48 | 1044.70 | 234.4 | 104.4 |
| 270 | 10.073 | -5578.3 | 205.91 | 91.64 | 131.39 | 988.22 | 208.3 | 100.4 |
| 280 | 9.8753 | -4249.0 | 210.74 | 93.77 | 134.50 | 931.89 | 186.0 | 96.54 |
| 290 | 9.6707 | -2887.5 | 215.52 | 95.98 | 137.85 | 875.56 | 166.7 | 92.76 |
| 300 | 9.4575 | -1491.0 | 220.25 | 98.27 | 141.50 | 819.00 | 149.9 | 89.09 |
| 320 | 8.9965 | 1420.8 | 229.64 | 103.07 | 150.01 | 703.88 | 121.6 | 82.11 |
| 339.34 | 8.4843 | 4421.1 | 238.74 | 108.03 | 160.97 | 586.60 | 99.07 | 75.76 |
| 339.34 | 0.44655 | 20440 | 285.95 | 105.18 | 127.92 | 187.21 | 8.787 | 22.10 |
| 340 | 0.44469 | 20525 | 286.20 | 105.28 | 127.80 | 187.76 | 8.800 | 22.17 |
| 360 | 0.39823 | 23064 | 293.46 | 109.15 | 126.93 | 202.25 | 9.225 | 24.47 |
| 380 | 0.36400 | 25620 | 300.37 | 113.65 | 128.89 | 214.08 | 9.673 | 26.95 |
| 400 | 0.33698 | 28227 | 307.05 | 118.33 | 132.00 | 224.30 | 10.13 | 29.56 |
| 420 | 0.31474 | 30904 | 313.58 | 123.10 | 135.73 | 233.45 | 10.59 | 32.28 |
| 440 | 0.29591 | 33658 | 319.99 | 127.87 | 139.75 | 241.82 | 11.04 | 35.12 |
| 460 | 0.27964 | 36495 | 326.29 | 132.59 | 143.92 | 249.58 | 11.50 | 38.05 |
| 480 | 0.26537 | 39415 | 332.51 | 137.22 | 148.11 | 256.88 | 11.94 | 41.09 |
| 500 | 0.25270 | 42420 | 338.64 | 141.74 | 152.29 | 263.78 | 12.39 | 44.23 |
| 520 | 0.24135 | 45507 | 344.69 | 146.13 | 156.41 | 270.37 | 12.83 | 47.47 |
| 540 | 0.23109 | 48676 | 350.67 | 150.40 | 160.46 | 276.68 | 13.27 | 50.81 |
| 560 | 0.22176 | 51924 | 356.58 | 154.54 | 164.41 | 282.75 | 13.70 | 54.25 |
| 570 | 0.21740 | 53578 | 359.50 | 156.56 | 166.35 | 285.70 | 13.92 | 56.01 |
| | | | | Pressure = 2 MPa | | | | |