



# Opteon™ XL41

## Refrigerant

### Transport Properties of Opteon™ XL41 (R-454B) Engineering (I/P) Units

#### Physical Properties

|                                  |                            |
|----------------------------------|----------------------------|
| Molecular Weight                 | 62.6 lb/lb-mole            |
| Boiling Point at                 |                            |
| One Atmosphere                   | -58.9 °F                   |
| Critical Temperature             | 172.6 °F                   |
| Critical Pressure                | 763.9 psia                 |
| Critical Density                 | 27.66 lb/ft <sup>3</sup>   |
| Critical Volume                  | 0.0362 ft <sup>3</sup> /lb |
| Ozone Depletion Potential        | 0                          |
| Global Warming Potential (AR4)   | 466                        |
| ASHRAE Standard 34 Safety Rating | A2L                        |

#### Units and Factors

- t = temperature in °F
- P = pressure in lb/in<sup>2</sup> absolute (psia)
- C<sub>p</sub> = Heat capacity at constant pressure in Btu/(lb<sub>m</sub>·°R)
- C<sub>v</sub> = Heat capacity at constant volume in Btu/(lb<sub>m</sub>·°R)
- C<sub>p</sub>/C<sub>v</sub> = Heat capacity ratio (dimensionless)
- μ = Viscosity in centipoise
- v = Kinematic viscosity in centistokes
- k = Thermal conductivity in Btu/(hr-ft-Btu/(lb<sub>m</sub>·°F))
- c = Velocity of sound in ft/sec
- γ = Surface Tension in lb<sub>f</sub>/ft
- h<sub>f</sub> = enthalpy of saturated liquid in Btu/lb
- s<sub>f</sub> = entropy of saturated liquid in Btu/(lb) (°R)

One atmosphere = 14.696 psia

Reference point for enthalpy and entropy:

h<sub>f</sub> = 0.0 Btu/lb at -40°F

s<sub>f</sub> = 0.0 Btu/lb·°R at -40°F

This information is based on NIST Standard Database 23, Version 10 (Lemmon, E.W.; Huber, M.L.; McLinden, M.O.; REFPROP Reference Fluid Thermodynamic and Transport Properties - National Institute of Standards and Technology, 2013) using Chemours interaction parameters with R-1234yf.

**Opteon™ XL41 (R-454B)**  
**Saturation Properties - Transport Properties Table**

| Temp<br>°F | Heat Capacity, $c_p$<br>[Btu/lb <sub>m</sub> ·°R] |        | $c_p/c_v$<br>Vapor | Viscosity<br>[centipoise] |         | Kinematic Viscosity<br>[centistokes] |       | Thermal Conductivity<br>[Btu/hr-ft·°F] |         | Vel. of Sound<br>[ft/sec] |        | Surface<br>Tension<br>[lb <sub>f</sub> /ft] |
|------------|---|--------|--------------------|---------------------------|---------|--------------------------------------|-------|--|---------|---------------------------|--------|---|
|            | Liquid  | Vapor  |                    | Liquid                    | Vapor   | Liquid                               | Vapor | Liquid                                 | Vapor   | Liquid                    | Vapor  |   |
| -40        | 0.3558  | 0.2128 | 1.2778             | 0.2440                    | 0.00964 | 0.2019                               | 1.767 | 0.08600                                | 0.00523 | 2724.3                    | 613.42 | 0.001180                                    |
| -39        | 0.3561  | 0.2135 | 1.2785             | 0.2423                    | 0.00967 | 0.2008                               | 1.730 | 0.08577                                | 0.00524 | 2715.6                    | 613.67 | 0.001173                                    |
| -38        | 0.3563  | 0.2142 | 1.2792             | 0.2407                    | 0.00970 | 0.1997                               | 1.695 | 0.08555                                | 0.00526 | 2706.9                    | 613.92 | 0.001166                                    |
| -37        | 0.3566  | 0.2149 | 1.2800             | 0.2391                    | 0.00972 | 0.1986                               | 1.660 | 0.08533                                | 0.00528 | 2698.2                    | 614.16 | 0.001159                                    |
| -36        | 0.3569  | 0.2156 | 1.2807             | 0.2375                    | 0.00975 | 0.1975                               | 1.626 | 0.08510                                | 0.00530 | 2689.4                    | 614.40 | 0.001152                                    |
| -35        | 0.3572  | 0.2163 | 1.2815             | 0.2359                    | 0.00978 | 0.1965                               | 1.593 | 0.08488                                | 0.00532 | 2680.7                    | 614.63 | 0.001145                                    |
| -34        | 0.3575  | 0.2170 | 1.2823             | 0.2343                    | 0.00980 | 0.1954                               | 1.561 | 0.08466                                | 0.00534 | 2672.0                    | 614.85 | 0.001138                                    |
| -33        | 0.3578  | 0.2177 | 1.2831             | 0.2328                    | 0.00983 | 0.1944                               | 1.529 | 0.08443                                | 0.00536 | 2663.2                    | 615.07 | 0.001131                                    |
| -32        | 0.3581  | 0.2184 | 1.2839             | 0.2312                    | 0.00986 | 0.1934                               | 1.499 | 0.08421                                | 0.00537 | 2654.4                    | 615.28 | 0.001124                                    |
| -31        | 0.3584  | 0.2191 | 1.2848             | 0.2297                    | 0.00988 | 0.1923                               | 1.469 | 0.08399                                | 0.00539 | 2645.7                    | 615.48 | 0.001116                                    |
| -30        | 0.3587  | 0.2198 | 1.2856             | 0.2281                    | 0.00991 | 0.1913                               | 1.440 | 0.08377                                | 0.00541 | 2636.9                    | 615.68 | 0.001109                                    |
| -29        | 0.3591  | 0.2205 | 1.2865             | 0.2266                    | 0.00994 | 0.1903                               | 1.411 | 0.08354                                | 0.00543 | 2628.1                    | 615.87 | 0.001102                                    |
| -28        | 0.3594  | 0.2213 | 1.2874             | 0.2251                    | 0.00997 | 0.1893                               | 1.384 | 0.08332                                | 0.00545 | 2619.3                    | 616.05 | 0.001095                                    |
| -27        | 0.3597  | 0.2220 | 1.2883             | 0.2236                    | 0.00999 | 0.1883                               | 1.356 | 0.08310                                | 0.00547 | 2610.4                    | 616.23 | 0.001088                                    |
| -26        | 0.3600  | 0.2227 | 1.2892             | 0.2221                    | 0.01002 | 0.1873                               | 1.330 | 0.08288                                | 0.00549 | 2601.6                    | 616.40 | 0.001081                                    |
| -25        | 0.3604  | 0.2235 | 1.2901             | 0.2207                    | 0.01005 | 0.1864                               | 1.304 | 0.08265                                | 0.00551 | 2592.7                    | 616.56 | 0.001074                                    |
| -24        | 0.3607  | 0.2242 | 1.2911             | 0.2192                    | 0.01007 | 0.1854                               | 1.279 | 0.08243                                | 0.00553 | 2583.9                    | 616.72 | 0.001067                                    |
| -23        | 0.3611  | 0.2249 | 1.2920             | 0.2178                    | 0.01010 | 0.1844                               | 1.255 | 0.08221                                | 0.00555 | 2575.0                    | 616.87 | 0.001060                                    |
| -22        | 0.3614  | 0.2257 | 1.2930             | 0.2164                    | 0.01013 | 0.1835                               | 1.231 | 0.08199                                | 0.00557 | 2566.2                    | 617.01 | 0.001053                                    |
| -21        | 0.3618  | 0.2264 | 1.2940             | 0.2149                    | 0.01015 | 0.1825                               | 1.207 | 0.08176                                | 0.00559 | 2557.3                    | 617.14 | 0.001046                                    |
| -20        | 0.3621  | 0.2272 | 1.2950             | 0.2135                    | 0.01018 | 0.1816                               | 1.185 | 0.08154                                | 0.00561 | 2548.4                    | 617.27 | 0.001039                                    |
| -19        | 0.3625  | 0.2280 | 1.2960             | 0.2121                    | 0.01020 | 0.1807                               | 1.162 | 0.08132                                | 0.00563 | 2539.5                    | 617.39 | 0.001033                                    |
| -18        | 0.3628  | 0.2287 | 1.2971             | 0.2107                    | 0.01023 | 0.1798                               | 1.140 | 0.08110                                | 0.00565 | 2530.5                    | 617.51 | 0.001026                                    |
| -17        | 0.3632  | 0.2295 | 1.2981             | 0.2094                    | 0.01026 | 0.1788                               | 1.119 | 0.08088                                | 0.00567 | 2521.6                    | 617.62 | 0.001019                                    |
| -16        | 0.3636  | 0.2303 | 1.2992             | 0.2080                    | 0.01028 | 0.1779                               | 1.098 | 0.08066                                | 0.00569 | 2512.7                    | 617.72 | 0.001012                                    |
| -15        | 0.3640  | 0.2311 | 1.3003             | 0.2066                    | 0.01031 | 0.1770                               | 1.078 | 0.08044                                | 0.00571 | 2503.7                    | 617.81 | 0.001005                                    |
| -14        | 0.3643  | 0.2318 | 1.3014             | 0.2053                    | 0.01034 | 0.1761                               | 1.058 | 0.08021                                | 0.00573 | 2494.8                    | 617.90 | 0.000998                                    |
| -13        | 0.3647  | 0.2326 | 1.3026             | 0.2040                    | 0.01036 | 0.1753                               | 1.039 | 0.07999                                | 0.00576 | 2485.8                    | 617.98 | 0.000991                                    |
| -12        | 0.3651  | 0.2334 | 1.3037             | 0.2026                    | 0.01039 | 0.1744                               | 1.020 | 0.07977                                | 0.00578 | 2476.8                    | 618.05 | 0.000984                                    |
| -11        | 0.3655  | 0.2342 | 1.3049             | 0.2013                    | 0.01042 | 0.1735                               | 1.001 | 0.07955                                | 0.00580 | 2467.8                    | 618.11 | 0.000977                                    |
| -10        | 0.3659  | 0.2350 | 1.3061             | 0.2000                    | 0.01044 | 0.1726                               | 0.983 | 0.07933                                | 0.00582 | 2458.8                    | 618.17 | 0.000970                                    |
| -9         | 0.3663  | 0.2358 | 1.3073             | 0.1987                    | 0.01047 | 0.1718                               | 0.966 | 0.07911                                | 0.00584 | 2449.8                    | 618.22 | 0.000964                                    |
| -8         | 0.3667  | 0.2367 | 1.3085             | 0.1975                    | 0.01050 | 0.1709                               | 0.948 | 0.07889                                | 0.00586 | 2440.8                    | 618.26 | 0.000957                                    |
| -7         | 0.3672  | 0.2375 | 1.3098             | 0.1962                    | 0.01052 | 0.1701                               | 0.931 | 0.07867                                | 0.00589 | 2431.8                    | 618.30 | 0.000950                                    |
| -6         | 0.3676  | 0.2383 | 1.3111             | 0.1949                    | 0.01055 | 0.1692                               | 0.915 | 0.07845                                | 0.00591 | 2422.8                    | 618.33 | 0.000943                                    |
| -5         | 0.3680  | 0.2391 | 1.3124             | 0.1937                    | 0.01057 | 0.1684                               | 0.899 | 0.07823                                | 0.00593 | 2413.7                    | 618.35 | 0.000936                                    |
| -4         | 0.3684  | 0.2400 | 1.3137             | 0.1924                    | 0.01060 | 0.1676                               | 0.883 | 0.07801                                | 0.00595 | 2404.7                    | 618.36 | 0.000929                                    |
| -3         | 0.3689  | 0.2408 | 1.3150             | 0.1912                    | 0.01063 | 0.1668                               | 0.867 | 0.07779                                | 0.00597 | 2395.6                    | 618.37 | 0.000923                                    |
| -2         | 0.3693  | 0.2417 | 1.3164             | 0.1900                    | 0.01065 | 0.1659                               | 0.852 | 0.07757                                | 0.00600 | 2386.5                    | 618.37 | 0.000916                                    |
| -1         | 0.3698  | 0.2425 | 1.3178             | 0.1887                    | 0.01068 | 0.1651                               | 0.837 | 0.07735                                | 0.00602 | 2377.4                    | 618.36 | 0.000909                                    |
| 0          | 0.3702  | 0.2434 | 1.3192             | 0.1875                    | 0.01070 | 0.1643                               | 0.823 | 0.07714                                | 0.00604 | 2368.3                    | 618.34 | 0.000902                                    |
| 1          | 0.3707  | 0.2442 | 1.3206             | 0.1863                    | 0.01073 | 0.1635                               | 0.809 | 0.07692                                | 0.00607 | 2359.2                    | 618.31 | 0.000896                                    |
| 2          | 0.3711  | 0.2451 | 1.3220             | 0.1851                    | 0.01076 | 0.1628                               | 0.795 | 0.07670                                | 0.00609 | 2350.1                    | 618.28 | 0.000889                                    |
| 3          | 0.3716  | 0.2460 | 1.3235             | 0.1840                    | 0.01078 | 0.1620                               | 0.781 | 0.07648                                | 0.00611 | 2341.0                    | 618.24 | 0.000882                                    |
| 4          | 0.3721  | 0.2469 | 1.3250             | 0.1828                    | 0.01081 | 0.1612                               | 0.768 | 0.07626                                | 0.00614 | 2331.9                    | 618.19 | 0.000875                                    |
| 5          | 0.3726  | 0.2478 | 1.3265             | 0.1816                    | 0.01084 | 0.1604                               | 0.755 | 0.07605                                | 0.00616 | 2322.7                    | 618.14 | 0.000869                                    |
| 6          | 0.3730  | 0.2486 | 1.3281             | 0.1805                    | 0.01086 | 0.1596                               | 0.742 | 0.07583                                | 0.00619 | 2313.6                    | 618.08 | 0.000862                                    |
| 7          | 0.3735  | 0.2496 | 1.3297             | 0.1793                    | 0.01089 | 0.1589                               | 0.729 | 0.07561                                | 0.00621 | 2304.4                    | 618.00 | 0.000855                                    |
| 8          | 0.3740  | 0.2505 | 1.3313             | 0.1782                    | 0.01091 | 0.1581                               | 0.717 | 0.07539                                | 0.00624 | 2295.2                    | 617.93 | 0.000849                                    |
| 9          | 0.3745  | 0.2514 | 1.3329             | 0.1770                    | 0.01094 | 0.1574                               | 0.705 | 0.07518                                | 0.00626 | 2286.0                    | 617.84 | 0.000842                                    |
| 10         | 0.3750  | 0.2523 | 1.3345             | 0.1759                    | 0.01096 | 0.1566                               | 0.693 | 0.07496                                | 0.00628 | 2276.8                    | 617.74 | 0.000835                                    |
| 11         | 0.3755  | 0.2532 | 1.3362             | 0.1748                    | 0.01099 | 0.1559                               | 0.682 | 0.07474                                | 0.00631 | 2267.6                    | 617.64 | 0.000829                                    |
| 12         | 0.3761  | 0.2542 | 1.3379             | 0.1737                    | 0.01102 | 0.1552                               | 0.671 | 0.07453                                | 0.00634 | 2258.4                    | 617.53 | 0.000822                                    |
| 13         | 0.3766  | 0.2551 | 1.3397             | 0.1726                    | 0.01104 | 0.1544                               | 0.659 | 0.07431                                | 0.00636 | 2249.2                    | 617.41 | 0.000815                                    |

**Opteon™ XL41 (R-454B)**  
**Saturation Properties - Transport Properties Table**

| Temp<br>°F | Heat Capacity, $c_p$<br>[Btu/lb <sub>m</sub> ·°R] |        | $c_p/c_v$<br>Vapor | Viscosity<br>[centipoise] |         | Kinematic Viscosity<br>[centistokes] |       | Thermal Conductivity<br>[Btu/hr-ft·°F] |         | Vel. of Sound<br>[ft/sec] |        | Surface<br>Tension<br>[lb <sub>f</sub> /ft] |
|------------|---|--------|--------------------|---------------------------|---------|--------------------------------------|-------|--|---------|---------------------------|--------|---|
|            | Liquid  | Vapor  |                    | Liquid                    | Vapor   | Liquid                               | Vapor | Liquid                                 | Vapor   | Liquid                    | Vapor  |   |
| 14         | 0.3771  | 0.2561 | 1.3414             | 0.1715                    | 0.01107 | 0.1537                               | 0.649 | 0.07409                                | 0.00639 | 2240.0                    | 617.28 | 0.000809                                    |
| 15         | 0.3777  | 0.2570 | 1.3432             | 0.1704                    | 0.01109 | 0.1530                               | 0.638 | 0.07388                                | 0.00641 | 2230.7                    | 617.15 | 0.000802                                    |
| 16         | 0.3782  | 0.2580 | 1.3450             | 0.1693                    | 0.01112 | 0.1523                               | 0.628 | 0.07366                                | 0.00644 | 2221.5                    | 617.01 | 0.000796                                    |
| 17         | 0.3788  | 0.2590 | 1.3469             | 0.1683                    | 0.01115 | 0.1516                               | 0.617 | 0.07345                                | 0.00647 | 2212.2                    | 616.85 | 0.000789                                    |
| 18         | 0.3793  | 0.2599 | 1.3488             | 0.1672                    | 0.01117 | 0.1509                               | 0.607 | 0.07323                                | 0.00649 | 2202.9                    | 616.69 | 0.000783                                    |
| 19         | 0.3799  | 0.2609 | 1.3507             | 0.1661                    | 0.01120 | 0.1502                               | 0.598 | 0.07302                                | 0.00652 | 2193.6                    | 616.53 | 0.000776                                    |
| 20         | 0.3805  | 0.2619 | 1.3527             | 0.1651                    | 0.01122 | 0.1495                               | 0.588 | 0.07280                                | 0.00655 | 2184.3                    | 616.35 | 0.000769                                    |
| 21         | 0.3810  | 0.2629 | 1.3546             | 0.1640                    | 0.01125 | 0.1488                               | 0.578 | 0.07259                                | 0.00657 | 2175.0                    | 616.16 | 0.000763                                    |
| 22         | 0.3816  | 0.2639 | 1.3566             | 0.1630                    | 0.01127 | 0.1481                               | 0.569 | 0.07238                                | 0.00660 | 2165.7                    | 615.97 | 0.000756                                    |
| 23         | 0.3822  | 0.2650 | 1.3587             | 0.1620                    | 0.01130 | 0.1474                               | 0.560 | 0.07216                                | 0.00663 | 2156.4                    | 615.77 | 0.000750                                    |
| 24         | 0.3828  | 0.2660 | 1.3608             | 0.1610                    | 0.01133 | 0.1467                               | 0.551 | 0.07195                                | 0.00666 | 2147.0                    | 615.56 | 0.000743                                    |
| 25         | 0.3834  | 0.2671 | 1.3629             | 0.1599                    | 0.01135 | 0.1461                               | 0.543 | 0.07173                                | 0.00668 | 2137.7                    | 615.34 | 0.000737                                    |
| 26         | 0.3840  | 0.2681 | 1.3651             | 0.1589                    | 0.01138 | 0.1454                               | 0.534 | 0.07152                                | 0.00671 | 2128.3                    | 615.11 | 0.000730                                    |
| 27         | 0.3846  | 0.2692 | 1.3673             | 0.1579                    | 0.01140 | 0.1447                               | 0.526 | 0.07131                                | 0.00674 | 2118.9                    | 614.88 | 0.000724                                    |
| 28         | 0.3853  | 0.2702 | 1.3695             | 0.1569                    | 0.01143 | 0.1441                               | 0.517 | 0.07110                                | 0.00677 | 2109.5                    | 614.63 | 0.000718                                    |
| 29         | 0.3859  | 0.2713 | 1.3718             | 0.1559                    | 0.01145 | 0.1434                               | 0.509 | 0.07088                                | 0.00680 | 2100.1                    | 614.38 | 0.000711                                    |
| 30         | 0.3866  | 0.2724 | 1.3741             | 0.1550                    | 0.01148 | 0.1428                               | 0.501 | 0.07067                                | 0.00683 | 2090.7                    | 614.12 | 0.000705                                    |
| 31         | 0.3872  | 0.2735 | 1.3764             | 0.1540                    | 0.01150 | 0.1421                               | 0.494 | 0.07046                                | 0.00686 | 2081.3                    | 613.85 | 0.000698                                    |
| 32         | 0.3879  | 0.2746 | 1.3788             | 0.1530                    | 0.01153 | 0.1415                               | 0.486 | 0.07025                                | 0.00689 | 2071.8                    | 613.57 | 0.000692                                    |
| 33         | 0.3885  | 0.2758 | 1.3812             | 0.1520                    | 0.01156 | 0.1409                               | 0.478 | 0.07004                                | 0.00692 | 2062.4                    | 613.28 | 0.000686                                    |
| 34         | 0.3892  | 0.2769 | 1.3837             | 0.1511                    | 0.01158 | 0.1402                               | 0.471 | 0.06982                                | 0.00695 | 2052.9                    | 612.98 | 0.000679                                    |
| 35         | 0.3899  | 0.2781 | 1.3862             | 0.1501                    | 0.01161 | 0.1396                               | 0.464 | 0.06961                                | 0.00698 | 2043.5                    | 612.68 | 0.000673                                    |
| 36         | 0.3906  | 0.2792 | 1.3888             | 0.1492                    | 0.01163 | 0.1390                               | 0.457 | 0.06940                                | 0.00702 | 2034.0                    | 612.36 | 0.000666                                    |
| 37         | 0.3913  | 0.2804 | 1.3914             | 0.1482                    | 0.01166 | 0.1383                               | 0.450 | 0.06919                                | 0.00705 | 2024.5                    | 612.04 | 0.000660                                    |
| 38         | 0.3920  | 0.2816 | 1.3941             | 0.1473                    | 0.01168 | 0.1377                               | 0.443 | 0.06898                                | 0.00708 | 2014.9                    | 611.71 | 0.000654                                    |
| 39         | 0.3928  | 0.2828 | 1.3968             | 0.1464                    | 0.01171 | 0.1371                               | 0.436 | 0.06877                                | 0.00711 | 2005.4                    | 611.37 | 0.000648                                    |
| 40         | 0.3935  | 0.2840 | 1.3995             | 0.1455                    | 0.01173 | 0.1365                               | 0.429 | 0.06856                                | 0.00715 | 1995.9                    | 611.01 | 0.000641                                    |
| 41         | 0.3942  | 0.2852 | 1.4023             | 0.1445                    | 0.01176 | 0.1359                               | 0.423 | 0.06835                                | 0.00718 | 1986.3                    | 610.65 | 0.000635                                    |
| 42         | 0.3950  | 0.2865 | 1.4051             | 0.1436                    | 0.01178 | 0.1353                               | 0.417 | 0.06814                                | 0.00721 | 1976.8                    | 610.28 | 0.000629                                    |
| 43         | 0.3957  | 0.2877 | 1.4080             | 0.1427                    | 0.01181 | 0.1347                               | 0.410 | 0.06794                                | 0.00725 | 1967.2                    | 609.91 | 0.000622                                    |
| 44         | 0.3965  | 0.2890 | 1.4110             | 0.1418                    | 0.01183 | 0.1341                               | 0.404 | 0.06773                                | 0.00728 | 1957.6                    | 609.52 | 0.000616                                    |
| 45         | 0.3973  | 0.2903 | 1.4140             | 0.1409                    | 0.01186 | 0.1335                               | 0.398 | 0.06752                                | 0.00732 | 1948.0                    | 609.12 | 0.000610                                    |
| 46         | 0.3981  | 0.2916 | 1.4171             | 0.1400                    | 0.01189 | 0.1329                               | 0.392 | 0.06731                                | 0.00735 | 1938.4                    | 608.71 | 0.000604                                    |
| 47         | 0.3989  | 0.2929 | 1.4202             | 0.1391                    | 0.01191 | 0.1324                               | 0.386 | 0.06710                                | 0.00739 | 1928.7                    | 608.30 | 0.000598                                    |
| 48         | 0.3997  | 0.2943 | 1.4234             | 0.1383                    | 0.01194 | 0.1318                               | 0.381 | 0.06689                                | 0.00742 | 1919.1                    | 607.87 | 0.000591                                    |
| 49         | 0.4006  | 0.2956 | 1.4266             | 0.1374                    | 0.01197 | 0.1312                               | 0.375 | 0.06669                                | 0.00746 | 1909.4                    | 607.44 | 0.000585                                    |
| 50         | 0.4014  | 0.2970 | 1.4299             | 0.1365                    | 0.01200 | 0.1306                               | 0.370 | 0.06648                                | 0.00750 | 1899.7                    | 606.99 | 0.000579                                    |
| 51         | 0.4023  | 0.2984 | 1.4333             | 0.1356                    | 0.01202 | 0.1301                               | 0.364 | 0.06627                                | 0.00754 | 1890.0                    | 606.54 | 0.000573                                    |
| 52         | 0.4031  | 0.2998 | 1.4367             | 0.1348                    | 0.01205 | 0.1295                               | 0.359 | 0.06607                                | 0.00757 | 1880.3                    | 606.07 | 0.000567                                    |
| 53         | 0.4040  | 0.3012 | 1.4402             | 0.1339                    | 0.01208 | 0.1290                               | 0.354 | 0.06586                                | 0.00761 | 1870.6                    | 605.60 | 0.000561                                    |
| 54         | 0.4049  | 0.3026 | 1.4437             | 0.1331                    | 0.01211 | 0.1284                               | 0.349 | 0.06565                                | 0.00765 | 1860.8                    | 605.11 | 0.000555                                    |
| 55         | 0.4058  | 0.3041 | 1.4473             | 0.1322                    | 0.01213 | 0.1278                               | 0.344 | 0.06545                                | 0.00769 | 1851.1                    | 604.62 | 0.000548                                    |
| 56         | 0.4067  | 0.3056 | 1.4510             | 0.1314                    | 0.01216 | 0.1273                               | 0.339 | 0.06524                                | 0.00773 | 1841.3                    | 604.11 | 0.000542                                    |
| 57         | 0.4077  | 0.3071 | 1.4548             | 0.1305                    | 0.01219 | 0.1267                               | 0.334 | 0.06504                                | 0.00777 | 1831.5                    | 603.60 | 0.000536                                    |
| 58         | 0.4086  | 0.3086 | 1.4586             | 0.1297                    | 0.01222 | 0.1262                               | 0.329 | 0.06483                                | 0.00781 | 1821.7                    | 603.07 | 0.000530                                    |
| 59         | 0.4096  | 0.3102 | 1.4625             | 0.1289                    | 0.01225 | 0.1257                               | 0.324 | 0.06463                                | 0.00785 | 1811.9                    | 602.54 | 0.000524                                    |
| 60         | 0.4106  | 0.3117 | 1.4665             | 0.1281                    | 0.01227 | 0.1251                               | 0.320 | 0.06442                                | 0.00790 | 1802.0                    | 602.00 | 0.000518                                    |
| 61         | 0.4116  | 0.3133 | 1.4706             | 0.1272                    | 0.01230 | 0.1246                               | 0.315 | 0.06422                                | 0.00794 | 1792.2                    | 601.44 | 0.000512                                    |
| 62         | 0.4126  | 0.3149 | 1.4747             | 0.1264                    | 0.01233 | 0.1241                               | 0.311 | 0.06401                                | 0.00798 | 1782.3                    | 600.87 | 0.000506                                    |
| 63         | 0.4136  | 0.3166 | 1.4790             | 0.1256                    | 0.01236 | 0.1235                               | 0.306 | 0.06381                                | 0.00803 | 1772.4                    | 600.30 | 0.000500                                    |
| 64         | 0.4146  | 0.3183 | 1.4833             | 0.1248                    | 0.01239 | 0.1230                               | 0.302 | 0.06360                                | 0.00807 | 1762.5                    | 599.71 | 0.000494                                    |
| 65         | 0.4157  | 0.3199 | 1.4877             | 0.1240                    | 0.01241 | 0.1225                               | 0.298 | 0.06340                                | 0.00812 | 1752.6                    | 599.12 | 0.000488                                    |
| 66         | 0.4168  | 0.3217 | 1.4922             | 0.1232                    | 0.01244 | 0.1220                               | 0.294 | 0.06320                                | 0.00816 | 1742.6                    | 598.51 | 0.000483                                    |
| 67         | 0.4179  | 0.3234 | 1.4968             | 0.1224                    | 0.01247 | 0.1214                               | 0.289 | 0.06299                                | 0.00821 | 1732.7                    | 597.89 | 0.000477                                    |

**Opteon™ XL41 (R-454B)**  
**Saturation Properties - Transport Properties Table**

| Temp<br>°F | Heat Capacity, $c_p$<br>[Btu/lb <sub>m</sub> ·°R] |        | $c_p/c_v$<br>Vapor | Viscosity<br>[centipoise] |         | Kinematic Viscosity<br>[centistokes] |       | Thermal Conductivity<br>[Btu/hr-ft·°F] |         | Vel. of Sound<br>[ft/sec] |        | Surface<br>Tension<br>[lb <sub>f</sub> /ft] |
|------------|---|--------|--------------------|---------------------------|---------|--------------------------------------|-------|--|---------|---------------------------|--------|---|
|            | Liquid  | Vapor  |                    | Liquid                    | Vapor   | Liquid                               | Vapor | Liquid                                 | Vapor   | Liquid                    | Vapor  |   |
| 68         | 0.4190  | 0.3252 | 1.5015             | 0.1216                    | 0.01250 | 0.1209                               | 0.285 | 0.06279                                | 0.00826 | 1722.7                    | 597.26 | 0.000471                                    |
| 69         | 0.4201  | 0.3270 | 1.5062             | 0.1208                    | 0.01253 | 0.1204                               | 0.281 | 0.06259                                | 0.00830 | 1712.7                    | 596.62 | 0.000465                                    |
| 70         | 0.4213  | 0.3288 | 1.5111             | 0.1200                    | 0.01256 | 0.1199                               | 0.277 | 0.06239                                | 0.00835 | 1702.7                    | 595.97 | 0.000459                                    |
| 71         | 0.4225  | 0.3307 | 1.5161             | 0.1192                    | 0.01259 | 0.1194                               | 0.274 | 0.06218                                | 0.00840 | 1692.6                    | 595.31 | 0.000453                                    |
| 72         | 0.4237  | 0.3326 | 1.5212             | 0.1185                    | 0.01262 | 0.1189                               | 0.270 | 0.06198                                | 0.00845 | 1682.6                    | 594.64 | 0.000447                                    |
| 73         | 0.4249  | 0.3345 | 1.5264             | 0.1177                    | 0.01266 | 0.1184                               | 0.266 | 0.06178                                | 0.00850 | 1672.5                    | 593.95 | 0.000442                                    |
| 74         | 0.4261  | 0.3365 | 1.5317             | 0.1169                    | 0.01269 | 0.1179                               | 0.263 | 0.06158                                | 0.00856 | 1662.4                    | 593.26 | 0.000436                                    |
| 75         | 0.4274  | 0.3385 | 1.5371             | 0.1162                    | 0.01273 | 0.1174                               | 0.259 | 0.06138                                | 0.00861 | 1652.3                    | 592.55 | 0.000430                                    |
| 76         | 0.4287  | 0.3405 | 1.5427             | 0.1154                    | 0.01277 | 0.1169                               | 0.256 | 0.06118                                | 0.00866 | 1642.2                    | 591.83 | 0.000424                                    |
| 77         | 0.4300  | 0.3426 | 1.5484             | 0.1146                    | 0.01280 | 0.1164                               | 0.252 | 0.06097                                | 0.00872 | 1632.0                    | 591.10 | 0.000419                                    |
| 78         | 0.4313  | 0.3447 | 1.5542             | 0.1139                    | 0.01284 | 0.1159                               | 0.249 | 0.06077                                | 0.00877 | 1621.8                    | 590.36 | 0.000413                                    |
| 79         | 0.4327  | 0.3468 | 1.5601             | 0.1131                    | 0.01287 | 0.1154                               | 0.246 | 0.06057                                | 0.00883 | 1611.6                    | 589.61 | 0.000407                                    |
| 80         | 0.4341  | 0.3490 | 1.5662             | 0.1124                    | 0.01291 | 0.1150                               | 0.242 | 0.06037                                | 0.00889 | 1601.4                    | 588.85 | 0.000401                                    |
| 81         | 0.4355  | 0.3512 | 1.5724             | 0.1116                    | 0.01295 | 0.1145                               | 0.239 | 0.06017                                | 0.00894 | 1591.1                    | 588.07 | 0.000396                                    |
| 82         | 0.4369  | 0.3535 | 1.5787             | 0.1109                    | 0.01298 | 0.1140                               | 0.236 | 0.05997                                | 0.00900 | 1580.9                    | 587.29 | 0.000390                                    |
| 83         | 0.4384  | 0.3558 | 1.5852             | 0.1101                    | 0.01302 | 0.1135                               | 0.233 | 0.05977                                | 0.00906 | 1570.6                    | 586.49 | 0.000385                                    |
| 84         | 0.4399  | 0.3582 | 1.5919             | 0.1094                    | 0.01306 | 0.1130                               | 0.230 | 0.05957                                | 0.00913 | 1560.3                    | 585.67 | 0.000379                                    |
| 85         | 0.4415  | 0.3606 | 1.5987             | 0.1086                    | 0.01310 | 0.1126                               | 0.227 | 0.05937                                | 0.00919 | 1549.9                    | 584.85 | 0.000373                                    |
| 86         | 0.4430  | 0.3630 | 1.6057             | 0.1079                    | 0.01313 | 0.1121                               | 0.224 | 0.05917                                | 0.00925 | 1539.6                    | 584.02 | 0.000368                                    |
| 87         | 0.4446  | 0.3655 | 1.6128             | 0.1072                    | 0.01317 | 0.1116                               | 0.221 | 0.05897                                | 0.00932 | 1529.2                    | 583.17 | 0.000362                                    |
| 88         | 0.4463  | 0.3681 | 1.6201             | 0.1065                    | 0.01321 | 0.1112                               | 0.218 | 0.05878                                | 0.00938 | 1518.8                    | 582.31 | 0.000357                                    |
| 89         | 0.4479  | 0.3707 | 1.6276             | 0.1057                    | 0.01325 | 0.1107                               | 0.215 | 0.05858                                | 0.00945 | 1508.4                    | 581.43 | 0.000351                                    |
| 90         | 0.4497  | 0.3734 | 1.6353             | 0.1050                    | 0.01329 | 0.1103                               | 0.212 | 0.05838                                | 0.00952 | 1497.9                    | 580.55 | 0.000346                                    |
| 91         | 0.4514  | 0.3761 | 1.6432             | 0.1043                    | 0.01333 | 0.1098                               | 0.210 | 0.05818                                | 0.00959 | 1487.4                    | 579.65 | 0.000340                                    |
| 92         | 0.4532  | 0.3789 | 1.6513             | 0.1036                    | 0.01337 | 0.1093                               | 0.207 | 0.05798                                | 0.00966 | 1476.9                    | 578.74 | 0.000335                                    |
| 93         | 0.4550  | 0.3817 | 1.6596             | 0.1028                    | 0.01341 | 0.1089                               | 0.204 | 0.05778                                | 0.00974 | 1466.3                    | 577.81 | 0.000329                                    |
| 94         | 0.4569  | 0.3847 | 1.6681             | 0.1021                    | 0.01345 | 0.1084                               | 0.202 | 0.05759                                | 0.00981 | 1455.8                    | 576.88 | 0.000324                                    |
| 95         | 0.4589  | 0.3876 | 1.6769             | 0.1014                    | 0.01349 | 0.1080                               | 0.199 | 0.05739                                | 0.00989 | 1445.2                    | 575.93 | 0.000318                                    |
| 96         | 0.4608  | 0.3907 | 1.6858             | 0.1007                    | 0.01353 | 0.1075                               | 0.196 | 0.05719                                | 0.00997 | 1434.5                    | 574.96 | 0.000313                                    |
| 97         | 0.4629  | 0.3938 | 1.6951             | 0.1000                    | 0.01357 | 0.1071                               | 0.194 | 0.05699                                | 0.01005 | 1423.9                    | 573.99 | 0.000308                                    |
| 98         | 0.4649  | 0.3970 | 1.7045             | 0.0993                    | 0.01362 | 0.1066                               | 0.191 | 0.05679                                | 0.01013 | 1413.2                    | 573.00 | 0.000302                                    |
| 99         | 0.4671  | 0.4003 | 1.7143             | 0.0986                    | 0.01366 | 0.1062                               | 0.189 | 0.05660                                | 0.01021 | 1402.4                    | 571.99 | 0.000297                                    |
| 100        | 0.4692  | 0.4036 | 1.7243             | 0.0979                    | 0.01370 | 0.1058                               | 0.186 | 0.05640                                | 0.01029 | 1391.7                    | 570.97 | 0.000292                                    |
| 101        | 0.4715  | 0.4071 | 1.7346             | 0.0972                    | 0.01375 | 0.1053                               | 0.184 | 0.05620                                | 0.01038 | 1380.9                    | 569.94 | 0.000286                                    |
| 102        | 0.4738  | 0.4106 | 1.7451             | 0.0965                    | 0.01379 | 0.1049                               | 0.182 | 0.05601                                | 0.01047 | 1370.1                    | 568.90 | 0.000281                                    |
| 103        | 0.4761  | 0.4142 | 1.7560             | 0.0958                    | 0.01383 | 0.1044                               | 0.179 | 0.05581                                | 0.01056 | 1359.2                    | 567.83 | 0.000276                                    |
| 104        | 0.4786  | 0.4180 | 1.7673             | 0.0951                    | 0.01388 | 0.1040                               | 0.177 | 0.05561                                | 0.01065 | 1348.3                    | 566.76 | 0.000271                                    |
| 105        | 0.4811  | 0.4218 | 1.7788             | 0.0944                    | 0.01393 | 0.1036                               | 0.175 | 0.05542                                | 0.01075 | 1337.4                    | 565.67 | 0.000266                                    |
| 106        | 0.4836  | 0.4257 | 1.7907             | 0.0937                    | 0.01397 | 0.1031                               | 0.173 | 0.05522                                | 0.01085 | 1326.4                    | 564.57 | 0.000260                                    |
| 107        | 0.4863  | 0.4298 | 1.8030             | 0.0930                    | 0.01402 | 0.1027                               | 0.170 | 0.05502                                | 0.01094 | 1315.4                    | 563.45 | 0.000255                                    |
| 108        | 0.4890  | 0.4339 | 1.8156             | 0.0924                    | 0.01407 | 0.1023                               | 0.168 | 0.05482                                | 0.01105 | 1304.3                    | 562.31 | 0.000250                                    |
| 109        | 0.4918  | 0.4382 | 1.8287             | 0.0917                    | 0.01412 | 0.1019                               | 0.166 | 0.05463                                | 0.01115 | 1293.2                    | 561.17 | 0.000245                                    |
| 110        | 0.4947  | 0.4426 | 1.8421             | 0.0910                    | 0.01416 | 0.1014                               | 0.164 | 0.05443                                | 0.01126 | 1282.0                    | 560.00 | 0.000240                                    |
| 111        | 0.4977  | 0.4471 | 1.8560             | 0.0903                    | 0.01421 | 0.1010                               | 0.162 | 0.05424                                | 0.01137 | 1270.9                    | 558.82 | 0.000235                                    |
| 112        | 0.5008  | 0.4518 | 1.8704             | 0.0896                    | 0.01426 | 0.1006                               | 0.160 | 0.05404                                | 0.01148 | 1259.6                    | 557.63 | 0.000230                                    |
| 113        | 0.5039  | 0.4566 | 1.8853             | 0.0889                    | 0.01432 | 0.1002                               | 0.158 | 0.05384                                | 0.01159 | 1248.3                    | 556.42 | 0.000224                                    |
| 114        | 0.5072  | 0.4615 | 1.9006             | 0.0882                    | 0.01437 | 0.0997                               | 0.156 | 0.05365                                | 0.01171 | 1237.0                    | 555.19 | 0.000219                                    |
| 115        | 0.5106  | 0.4667 | 1.9165             | 0.0876                    | 0.01442 | 0.0993                               | 0.154 | 0.05345                                | 0.01183 | 1225.6                    | 553.95 | 0.000214                                    |
| 116        | 0.5141  | 0.4720 | 1.9329             | 0.0869                    | 0.01447 | 0.0989                               | 0.152 | 0.05325                                | 0.01196 | 1214.2                    | 552.69 | 0.000209                                    |
| 117        | 0.5177  | 0.4774 | 1.9500             | 0.0862                    | 0.01453 | 0.0985                               | 0.150 | 0.05306                                | 0.01208 | 1202.7                    | 551.41 | 0.000204                                    |
| 118        | 0.5215  | 0.4831 | 1.9676             | 0.0855                    | 0.01458 | 0.0981                               | 0.148 | 0.05286                                | 0.01221 | 1191.2                    | 550.11 | 0.000199                                    |
| 119        | 0.5254  | 0.4889 | 1.9859             | 0.0848                    | 0.01464 | 0.0977                               | 0.146 | 0.05266                                | 0.01235 | 1179.6                    | 548.80 | 0.000194                                    |
| 120        | 0.5294  | 0.4950 | 2.0049             | 0.0842                    | 0.01470 | 0.0973                               | 0.144 | 0.05247                                | 0.01249 | 1167.9                    | 547.48 | 0.000189                                    |
| 121        | 0.5336  | 0.5013 | 2.0246             | 0.0835                    | 0.01476 | 0.0968                               | 0.142 | 0.05227                                | 0.01263 | 1156.3                    | 546.13 | 0.000185                                    |

**Opteon™ XL41 (R-454B)**  
**Saturation Properties - Transport Properties Table**

| Temp<br>°F | Heat Capacity, $c_p$<br>[Btu/lb <sub>m</sub> ·°R] |        | $c_p/c_v$<br>Vapor | Viscosity<br>[centipoise] |         | Kinematic Viscosity<br>[centistokes] |       | Thermal Conductivity<br>[Btu/hr-ft·°F] |         | Vel. of Sound<br>[ft/sec] |        | Surface<br>Tension<br>[lb <sub>f</sub> /ft] |
|------------|---|--------|--------------------|---------------------------|---------|--------------------------------------|-------|--|---------|---------------------------|--------|---|
|            | Liquid  | Vapor  |                    | Liquid                    | Vapor   | Liquid                               | Vapor | Liquid                                 | Vapor   | Liquid                    | Vapor  |   |
| 122        | 0.5379  | 0.5078 | 2.0451             | 0.0828                    | 0.01482 | 0.0964                               | 0.141 | 0.05207                                | 0.01277 | 1144.5                    | 544.77 | 0.000180                                    |
| 123        | 0.5424  | 0.5146 | 2.0664             | 0.0821                    | 0.01488 | 0.0960                               | 0.139 | 0.05188                                | 0.01292 | 1132.7                    | 543.38 | 0.000175                                    |
| 124        | 0.5471  | 0.5216 | 2.0886             | 0.0814                    | 0.01494 | 0.0956                               | 0.137 | 0.05168                                | 0.01308 | 1120.8                    | 541.98 | 0.000170                                    |
| 125        | 0.5520  | 0.5289 | 2.1117             | 0.0808                    | 0.01500 | 0.0952                               | 0.135 | 0.05149                                | 0.01324 | 1108.9                    | 540.56 | 0.000165                                    |
| 126        | 0.5571  | 0.5365 | 2.1357             | 0.0801                    | 0.01507 | 0.0948                               | 0.134 | 0.05129                                | 0.01340 | 1096.9                    | 539.13 | 0.000160                                    |
| 127        | 0.5624  | 0.5444 | 2.1608             | 0.0794                    | 0.01513 | 0.0944                               | 0.132 | 0.05109                                | 0.01357 | 1084.8                    | 537.67 | 0.000156                                    |
| 128        | 0.5679  | 0.5526 | 2.1870             | 0.0787                    | 0.01520 | 0.0940                               | 0.130 | 0.05090                                | 0.01374 | 1072.7                    | 536.19 | 0.000151                                    |
| 129        | 0.5737  | 0.5612 | 2.2144             | 0.0780                    | 0.01527 | 0.0936                               | 0.129 | 0.05070                                | 0.01392 | 1060.5                    | 534.69 | 0.000146                                    |
| 130        | 0.5797  | 0.5702 | 2.2430             | 0.0774                    | 0.01534 | 0.0932                               | 0.127 | 0.05050                                | 0.01411 | 1048.3                    | 533.18 | 0.000142                                    |
| 131        | 0.5860  | 0.5796 | 2.2730             | 0.0767                    | 0.01541 | 0.0928                               | 0.125 | 0.05031                                | 0.01430 | 1035.9                    | 531.64 | 0.000137                                    |
| 132        | 0.5926  | 0.5894 | 2.3044             | 0.0760                    | 0.01548 | 0.0924                               | 0.124 | 0.05011                                | 0.01450 | 1023.6                    | 530.08 | 0.000133                                    |
| 133        | 0.5996  | 0.5997 | 2.3374             | 0.0753                    | 0.01556 | 0.0920                               | 0.122 | 0.04991                                | 0.01470 | 1011.1                    | 528.49 | 0.000128                                    |
| 134        | 0.6069  | 0.6105 | 2.3720             | 0.0746                    | 0.01564 | 0.0916                               | 0.121 | 0.04972                                | 0.01491 | 998.6                     | 526.89 | 0.000124                                    |
| 135        | 0.6146  | 0.6218 | 2.4085             | 0.0739                    | 0.01572 | 0.0912                               | 0.119 | 0.04952                                | 0.01513 | 986.0                     | 525.26 | 0.000119                                    |
| 136        | 0.6227  | 0.6338 | 2.4468             | 0.0732                    | 0.01580 | 0.0908                               | 0.118 | 0.04933                                | 0.01535 | 973.3                     | 523.61 | 0.000115                                    |
| 137        | 0.6312  | 0.6464 | 2.4873             | 0.0725                    | 0.01588 | 0.0904                               | 0.116 | 0.04913                                | 0.01559 | 960.6                     | 521.94 | 0.000111                                    |
| 138        | 0.6402  | 0.6596 | 2.5300             | 0.0718                    | 0.01597 | 0.0900                               | 0.115 | 0.04894                                | 0.01583 | 947.8                     | 520.24 | 0.000106                                    |
| 139        | 0.6497  | 0.6737 | 2.5752             | 0.0711                    | 0.01605 | 0.0896                               | 0.113 | 0.04874                                | 0.01608 | 934.9                     | 518.52 | 0.000102                                    |
| 140        | 0.6598  | 0.6885 | 2.6230             | 0.0704                    | 0.01614 | 0.0892                               | 0.112 | 0.04855                                | 0.01635 | 921.9                     | 516.77 | 0.000098                                    |
| 141        | 0.6706  | 0.7042 | 2.6738             | 0.0697                    | 0.01624 | 0.0888                               | 0.110 | 0.04835                                | 0.01662 | 908.9                     | 515.00 | 0.000094                                    |
| 142        | 0.6820  | 0.7210 | 2.7278             | 0.0690                    | 0.01633 | 0.0884                               | 0.109 | 0.04816                                | 0.01690 | 895.8                     | 513.20 | 0.000090                                    |
| 143        | 0.6942  | 0.7388 | 2.7853             | 0.0683                    | 0.01643 | 0.0879                               | 0.107 | 0.04797                                | 0.01720 | 882.6                     | 511.37 | 0.000086                                    |
| 144        | 0.7072  | 0.7578 | 2.8467             | 0.0676                    | 0.01654 | 0.0875                               | 0.106 | 0.04777                                | 0.01750 | 869.3                     | 509.51 | 0.000082                                    |
| 145        | 0.7211  | 0.7781 | 2.9124             | 0.0668                    | 0.01664 | 0.0871                               | 0.105 | 0.04758                                | 0.01783 | 855.9                     | 507.62 | 0.000078                                    |
| 146        | 0.7361  | 0.7998 | 2.9828             | 0.0661                    | 0.01675 | 0.0867                               | 0.103 | 0.04740                                | 0.01816 | 842.5                     | 505.71 | 0.000074                                    |
| 147        | 0.7522  | 0.8232 | 3.0585             | 0.0654                    | 0.01686 | 0.0863                               | 0.102 | 0.04721                                | 0.01851 | 829.0                     | 503.76 | 0.000070                                    |
| 148        | 0.7697  | 0.8484 | 3.1401             | 0.0646                    | 0.01698 | 0.0859                               | 0.101 | 0.04702                                | 0.01888 | 815.3                     | 501.78 | 0.000066                                    |
| 149        | 0.7885  | 0.8757 | 3.2284             | 0.0639                    | 0.01710 | 0.0855                               | 0.099 | 0.04684                                | 0.01927 | 801.6                     | 499.76 | 0.000062                                    |
| 150        | 0.8091  | 0.9053 | 3.3240             | 0.0631                    | 0.01723 | 0.0851                               | 0.098 | 0.04666                                | 0.01967 | 787.8                     | 497.71 | 0.000059                                    |
| 151        | 0.8315  | 0.9375 | 3.4282             | 0.0623                    | 0.01736 | 0.0847                               | 0.097 | 0.04648                                | 0.02010 | 773.9                     | 495.62 | 0.000055                                    |
| 152        | 0.8560  | 0.9726 | 3.5420             | 0.0616                    | 0.01750 | 0.0843                               | 0.095 | 0.04631                                | 0.02055 | 759.9                     | 493.49 | 0.000051                                    |
| 153        | 0.8831  | 1.0112 | 3.6668             | 0.0608                    | 0.01765 | 0.0839                               | 0.094 | 0.04614                                | 0.02102 | 745.8                     | 491.33 | 0.000048                                    |
| 154        | 0.9130  | 1.0538 | 3.8045             | 0.0600                    | 0.01780 | 0.0835                               | 0.093 | 0.04598                                | 0.02152 | 731.5                     | 489.12 | 0.000045                                    |
| 155        | 0.9463  | 1.1010 | 3.9569             | 0.0592                    | 0.01796 | 0.0831                               | 0.091 | 0.04582                                | 0.02206 | 717.1                     | 486.86 | 0.000041                                    |
| 156        | 0.9837  | 1.1537 | 4.1268             | 0.0584                    | 0.01813 | 0.0826                               | 0.090 | 0.04568                                | 0.02263 | 702.6                     | 484.55 | 0.000038                                    |
| 157        | 1.0258  | 1.2127 | 4.3173             | 0.0575                    | 0.01831 | 0.0822                               | 0.089 | 0.04554                                | 0.02323 | 688.0                     | 482.19 | 0.000035                                    |
| 158        | 1.0736  | 1.2795 | 4.5324             | 0.0567                    | 0.01849 | 0.0818                               | 0.088 | 0.04542                                | 0.02388 | 673.2                     | 479.78 | 0.000031                                    |
| 159        | 1.1286  | 1.3556 | 4.7773             | 0.0558                    | 0.01869 | 0.0814                               | 0.086 | 0.04531                                | 0.02458 | 658.2                     | 477.30 | 0.000028                                    |
| 160        | 1.1923  | 1.4432 | 5.0588             | 0.0549                    | 0.01891 | 0.0809                               | 0.085 | 0.04522                                | 0.02534 | 643.1                     | 474.76 | 0.000025                                    |
| 161        | 1.2672  | 1.5451 | 5.3856             | 0.0540                    | 0.01914 | 0.0805                               | 0.084 | 0.04516                                | 0.02617 | 627.8                     | 472.14 | 0.000023                                    |
| 162        | 1.3564  | 1.6651 | 5.7701             | 0.0530                    | 0.01938 | 0.0801                               | 0.083 | 0.04513                                | 0.02707 | 612.2                     | 469.44 | 0.000020                                    |
| 163        | 1.4646  | 1.8086 | 6.2290             | 0.0520                    | 0.01965 | 0.0796                               | 0.081 | 0.04513                                | 0.02807 | 596.4                     | 466.64 | 0.000017                                    |
| 164        | 1.5986  | 1.9834 | 6.7865             | 0.0510                    | 0.01995 | 0.0792                               | 0.080 | 0.04519                                | 0.02918 | 580.3                     | 463.74 | 0.000015                                    |
| 165        | 1.7688  | 2.2009 | 7.4788             | 0.0500                    | 0.02027 | 0.0787                               | 0.079 | 0.04531                                | 0.03044 | 563.9                     | 460.71 | 0.000012                                    |
| 166        | 1.9923  | 2.4792 | 8.3621             | 0.0488                    | 0.02064 | 0.0782                               | 0.078 | 0.04552                                | 0.03188 | 547.1                     | 457.52 | 0.000010                                    |
| 167        | 2.2986  | 2.8481 | 9.5296             | 0.0476                    | 0.02105 | 0.0777                               | 0.076 | 0.04584                                | 0.03358 | 529.9                     | 454.13 | 0.000008                                    |
| 168        | 2.7429  | 3.3606 | 11.1459            | 0.0463                    | 0.02153 | 0.0772                               | 0.075 | 0.04636                                | 0.03561 | 512.3                     | 450.50 | 0.000006                                    |
| 169        | 3.4426  | 4.1211 | 13.5349            | 0.0449                    | 0.02211 | 0.0767                               | 0.074 | 0.04716                                | 0.03817 | 494.0                     | 446.52 | 0.000004                                    |

**Opteon™ XL41 (R-454B)**  
**Superheated Vapor - Viscosity Table**

Viscosity in centipoise

Saturation Properties in Light Blue

| Temp<br>°F | ABSOLUTE PRESSURE, psia |         |         |         |         |         |         |         |         |         |         |         |         |
|------------|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|            | 14.696                  | 25      | 50      | 75      | 100     | 150     | 200     | 250     | 300     | 350     | 400     | 450     | 500     |
|            | -57.1                   | -36.8   | -6.6    | 13.4    | 28.9    | 52.5    | 70.7    | 85.8    | 98.7    | 110.0   | 120.2   | 129.4   | 137.8   |
|            | 0.00918                 | 0.00973 | 0.01053 | 0.01105 | 0.01145 | 0.01206 | 0.01258 | 0.01313 | 0.01364 | 0.01417 | 0.01471 | 0.01530 | 0.01595 |
| -55        | 0.00923                 |         |         |         |         |         |         |         |         |         |         |         |         |
| -50        | 0.00937                 |         |         |         |         |         |         |         |         |         |         |         |         |
| -45        | 0.00951                 |         |         |         |         |         |         |         |         |         |         |         |         |
| -40        | 0.00964                 |         |         |         |         |         |         |         |         |         |         |         |         |
| -35        | 0.00978                 | 0.00978 |         |         |         |         |         |         |         |         |         |         |         |
| -30        | 0.00991                 | 0.00991 |         |         |         |         |         |         |         |         |         |         |         |
| -25        | 0.01005                 | 0.01005 |         |         |         |         |         |         |         |         |         |         |         |
| -20        | 0.01018                 | 0.01018 |         |         |         |         |         |         |         |         |         |         |         |
| -15        | 0.01031                 | 0.01031 |         |         |         |         |         |         |         |         |         |         |         |
| -10        | 0.01044                 | 0.01044 |         |         |         |         |         |         |         |         |         |         |         |
| -5         | 0.01057                 | 0.01057 | 0.01057 |         |         |         |         |         |         |         |         |         |         |
| 0          | 0.01070                 | 0.01070 | 0.01070 |         |         |         |         |         |         |         |         |         |         |
| 5          | 0.01084                 | 0.01084 | 0.01084 |         |         |         |         |         |         |         |         |         |         |
| 10         | 0.01096                 | 0.01096 | 0.01096 |         |         |         |         |         |         |         |         |         |         |
| 15         | 0.01109                 | 0.01109 | 0.01109 | 0.01109 |         |         |         |         |         |         |         |         |         |
| 20         | 0.01122                 | 0.01122 | 0.01122 | 0.01122 |         |         |         |         |         |         |         |         |         |
| 25         | 0.01135                 | 0.01135 | 0.01135 | 0.01135 |         |         |         |         |         |         |         |         |         |
| 30         | 0.01148                 | 0.01148 | 0.01148 | 0.01148 | 0.01148 |         |         |         |         |         |         |         |         |
| 35         | 0.01161                 | 0.01161 | 0.01161 | 0.01161 | 0.01161 |         |         |         |         |         |         |         |         |
| 40         | 0.01173                 | 0.01173 | 0.01173 | 0.01173 | 0.01173 |         |         |         |         |         |         |         |         |
| 45         | 0.01186                 | 0.01186 | 0.01186 | 0.01186 | 0.01186 |         |         |         |         |         |         |         |         |
| 50         | 0.01199                 | 0.01199 | 0.01199 | 0.01199 | 0.01199 |         |         |         |         |         |         |         |         |
| 55         | 0.01211                 | 0.01211 | 0.01211 | 0.01211 | 0.01211 | 0.01213 |         |         |         |         |         |         |         |
| 60         | 0.01224                 | 0.01224 | 0.01224 | 0.01224 | 0.01224 | 0.01226 |         |         |         |         |         |         |         |
| 65         | 0.01236                 | 0.01236 | 0.01236 | 0.01236 | 0.01236 | 0.01238 |         |         |         |         |         |         |         |
| 70         | 0.01249                 | 0.01249 | 0.01249 | 0.01249 | 0.01249 | 0.01251 |         |         |         |         |         |         |         |
| 75         | 0.01261                 | 0.01261 | 0.01261 | 0.01261 | 0.01261 | 0.01264 | 0.01269 |         |         |         |         |         |         |
| 80         | 0.01273                 | 0.01273 | 0.01273 | 0.01273 | 0.01274 | 0.01276 | 0.01283 |         |         |         |         |         |         |
| 85         | 0.01286                 | 0.01286 | 0.01286 | 0.01286 | 0.01286 | 0.01289 | 0.01296 |         |         |         |         |         |         |
| 90         | 0.01298                 | 0.01298 | 0.01298 | 0.01298 | 0.01299 | 0.01301 | 0.01310 | 0.01323 |         |         |         |         |         |
| 95         | 0.01310                 | 0.01310 | 0.01310 | 0.01311 | 0.01311 | 0.01314 | 0.01323 | 0.01336 |         |         |         |         |         |
| 100        | 0.01322                 | 0.01322 | 0.01323 | 0.01323 | 0.01324 | 0.01328 | 0.01336 | 0.01348 | 0.01367 |         |         |         |         |
| 105        | 0.01335                 | 0.01335 | 0.01335 | 0.01335 | 0.01336 | 0.01341 | 0.01348 | 0.01360 | 0.01379 |         |         |         |         |
| 110        | 0.01347                 | 0.01347 | 0.01347 | 0.01348 | 0.01348 | 0.01353 | 0.01361 | 0.01373 | 0.01390 |         |         |         |         |
| 115        | 0.01359                 | 0.01359 | 0.01359 | 0.01360 | 0.01361 | 0.01366 | 0.01374 | 0.01385 | 0.01401 | 0.01426 |         |         |         |
| 120        | 0.01371                 | 0.01371 | 0.01371 | 0.01372 | 0.01374 | 0.01379 | 0.01386 | 0.01397 | 0.01413 | 0.01436 |         |         |         |
| 125        | 0.01383                 | 0.01383 | 0.01384 | 0.01384 | 0.01386 | 0.01391 | 0.01399 | 0.01410 | 0.01425 | 0.01446 | 0.01477 |         |         |
| 130        | 0.01395                 | 0.01395 | 0.01396 | 0.01397 | 0.01399 | 0.01404 | 0.01411 | 0.01422 | 0.01436 | 0.01456 | 0.01485 | 0.01530 |         |
| 135        | 0.01407                 | 0.01407 | 0.01408 | 0.01409 | 0.01411 | 0.01416 | 0.01424 | 0.01434 | 0.01448 | 0.01467 | 0.01494 | 0.01533 |         |
| 140        | 0.01419                 | 0.01419 | 0.01420 | 0.01421 | 0.01423 | 0.01429 | 0.01436 | 0.01446 | 0.01460 | 0.01478 | 0.01503 | 0.01538 | 0.01593 |
| 145        | 0.01431                 | 0.01431 | 0.01432 | 0.01434 | 0.01436 | 0.01441 | 0.01448 | 0.01458 | 0.01472 | 0.01489 | 0.01512 | 0.01544 | 0.01592 |
| 150        | 0.01443                 | 0.01443 | 0.01444 | 0.01446 | 0.01448 | 0.01453 | 0.01461 | 0.01470 | 0.01483 | 0.01500 | 0.01522 | 0.01552 | 0.01594 |
| 155        | 0.01454                 | 0.01455 | 0.01456 | 0.01458 | 0.01460 | 0.01465 | 0.01473 | 0.01483 | 0.01495 | 0.01511 | 0.01532 | 0.01560 | 0.01598 |
| 160        | 0.01466                 | 0.01467 | 0.01468 | 0.01470 | 0.01472 | 0.01478 | 0.01485 | 0.01495 | 0.01507 | 0.01522 | 0.01542 | 0.01568 | 0.01603 |
| 165        | 0.01478                 | 0.01478 | 0.01480 | 0.01482 | 0.01484 | 0.01490 | 0.01497 | 0.01507 | 0.01519 | 0.01534 | 0.01553 | 0.01577 | 0.01609 |
| 170        | 0.01490                 | 0.01490 | 0.01492 | 0.01494 | 0.01496 | 0.01502 | 0.01509 | 0.01518 | 0.01530 | 0.01545 | 0.01563 | 0.01587 | 0.01616 |
| 175        | 0.01501                 | 0.01502 | 0.01504 | 0.01506 | 0.01508 | 0.01514 | 0.01521 | 0.01530 | 0.01542 | 0.01556 | 0.01574 | 0.01596 | 0.01624 |
| 180        | 0.01513                 | 0.01514 | 0.01515 | 0.01517 | 0.01520 | 0.01526 | 0.01533 | 0.01542 | 0.01554 | 0.01568 | 0.01585 | 0.01606 | 0.01632 |
| 185        | 0.01525                 | 0.01525 | 0.01527 | 0.01529 | 0.01532 | 0.01537 | 0.01545 | 0.01554 | 0.01565 | 0.01579 | 0.01596 | 0.01616 | 0.01641 |
| 190        | 0.01536                 | 0.01537 | 0.01539 | 0.01541 | 0.01543 | 0.01549 | 0.01557 | 0.01566 | 0.01577 | 0.01590 | 0.01607 | 0.01626 | 0.01650 |
| 195        | 0.01548                 | 0.01549 | 0.01550 | 0.01553 | 0.01555 | 0.01561 | 0.01569 | 0.01578 | 0.01589 | 0.01602 | 0.01617 | 0.01636 | 0.01659 |
| 200        | 0.01559                 | 0.01560 | 0.01562 | 0.01564 | 0.01567 | 0.01573 | 0.01580 | 0.01589 | 0.01600 | 0.01613 | 0.01628 | 0.01647 | 0.01669 |
| 205        | 0.01571                 | 0.01572 | 0.01574 | 0.01576 | 0.01579 | 0.01585 | 0.01592 | 0.01601 | 0.01612 | 0.01624 | 0.01639 | 0.01657 | 0.01678 |
| 210        | 0.01582                 | 0.01583 | 0.01585 | 0.01588 | 0.01590 | 0.01596 | 0.01604 | 0.01613 | 0.01623 | 0.01636 | 0.01650 | 0.01668 | 0.01688 |
| 215        | 0.01594                 | 0.01595 | 0.01597 | 0.01599 | 0.01602 | 0.01608 | 0.01615 | 0.01624 | 0.01635 | 0.01647 | 0.01661 | 0.01678 | 0.01698 |
| 220        | 0.01605                 | 0.01606 | 0.01608 | 0.01611 | 0.01613 | 0.01619 | 0.01627 | 0.01636 | 0.01646 | 0.01658 | 0.01672 | 0.01689 | 0.01708 |
| 225        | 0.01617                 | 0.01618 | 0.01620 | 0.01622 | 0.01625 | 0.01631 | 0.01639 | 0.01647 | 0.01658 | 0.01670 | 0.01683 | 0.01699 | 0.01718 |
| 230        | 0.01628                 | 0.01629 | 0.01631 | 0.01634 | 0.01636 | 0.01643 | 0.01650 | 0.01659 | 0.01669 | 0.01681 | 0.01694 | 0.01710 | 0.01728 |
| 235        | 0.01639                 | 0.01640 | 0.01643 | 0.01645 | 0.01648 | 0.01654 | 0.01662 | 0.01670 | 0.01680 | 0.01692 | 0.01705 | 0.01721 | 0.01738 |
| 240        | 0.01651                 | 0.01652 | 0.01654 | 0.01656 | 0.01659 | 0.01666 | 0.01673 | 0.01682 | 0.01692 | 0.01703 | 0.01716 | 0.01731 | 0.01749 |
| 245        | 0.01662                 | 0.01663 | 0.01665 | 0.01668 | 0.01671 | 0.01677 | 0.01684 | 0.01693 | 0.01703 | 0.01714 | 0.01727 | 0.01742 | 0.01759 |
| 250        | 0.01673                 | 0.01674 | 0.01676 | 0.01679 | 0.01682 | 0.01688 | 0.01696 | 0.01704 | 0.01714 | 0.01726 | 0.01738 | 0.01753 | 0.01769 |
| 255        | 0.01684                 | 0.01685 | 0.01688 | 0.01690 | 0.01693 | 0.01700 | 0.01707 | 0.01716 | 0.01726 | 0.01737 | 0.01749 | 0.01763 | 0.01780 |
| 260        | 0.01696                 | 0.01697 | 0.01699 | 0.01702 | 0.01704 | 0.01711 | 0.01718 | 0.01727 | 0.01737 | 0.01748 | 0.01760 | 0.01774 | 0.01790 |

## Opteon™ XL41 (R-454B)

### Superheated Vapor - Heat Capacity Table

Heat Capacity,  $C_p$ , in Btu/lb<sub>m</sub>·°R

Saturation Properties in Light Blue

| Temp<br>°F | ABSOLUTE PRESSURE, psia |        |        |        |        |        |        |        |        |        |        |        |        |
|------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|            | 14.696                  | 25     | 50     | 75     | 100    | 150    | 200    | 250    | 300    | 350    | 400    | 450    | 500    |
|            | -57.1                   | -36.8  | -6.6   | 13.4   | 28.9   | 52.5   | 70.7   | 85.8   | 98.7   | 110.0  | 120.2  | 129.4  | 137.8  |
|            | 0.2017                  | 0.2150 | 0.2378 | 0.2555 | 0.2712 | 0.3005 | 0.3301 | 0.3624 | 0.3992 | 0.4427 | 0.4962 | 0.5648 | 0.6574 |
| -55        | 0.2008                  |        |        |        |        |        |        |        |        |        |        |        |        |
| -50        | 0.1991                  |        |        |        |        |        |        |        |        |        |        |        |        |
| -45        | 0.1979                  |        |        |        |        |        |        |        |        |        |        |        |        |
| -40        | 0.1971                  |        |        |        |        |        |        |        |        |        |        |        |        |
| -35        | 0.1965                  | 0.2139 |        |        |        |        |        |        |        |        |        |        |        |
| -30        | 0.1961                  | 0.2114 |        |        |        |        |        |        |        |        |        |        |        |
| -25        | 0.1959                  | 0.2095 |        |        |        |        |        |        |        |        |        |        |        |
| -20        | 0.1959                  | 0.2080 |        |        |        |        |        |        |        |        |        |        |        |
| -15        | 0.1959                  | 0.2070 |        |        |        |        |        |        |        |        |        |        |        |
| -10        | 0.1961                  | 0.2062 |        |        |        |        |        |        |        |        |        |        |        |
| -5         | 0.1963                  | 0.2056 | 0.2364 |        |        |        |        |        |        |        |        |        |        |
| 0          | 0.1966                  | 0.2052 | 0.2325 |        |        |        |        |        |        |        |        |        |        |
| 5          | 0.1970                  | 0.2049 | 0.2294 |        |        |        |        |        |        |        |        |        |        |
| 10         | 0.1974                  | 0.2048 | 0.2270 |        |        |        |        |        |        |        |        |        |        |
| 15         | 0.1979                  | 0.2048 | 0.2251 | 0.2537 |        |        |        |        |        |        |        |        |        |
| 20         | 0.1984                  | 0.2049 | 0.2235 | 0.2488 |        |        |        |        |        |        |        |        |        |
| 25         | 0.1990                  | 0.2051 | 0.2223 | 0.2448 |        |        |        |        |        |        |        |        |        |
| 30         | 0.1996                  | 0.2053 | 0.2213 | 0.2416 | 0.2696 |        |        |        |        |        |        |        |        |
| 35         | 0.2003                  | 0.2057 | 0.2205 | 0.2390 | 0.2635 |        |        |        |        |        |        |        |        |
| 40         | 0.2009                  | 0.2060 | 0.2199 | 0.2368 | 0.2586 |        |        |        |        |        |        |        |        |
| 45         | 0.2016                  | 0.2065 | 0.2194 | 0.2350 | 0.2546 |        |        |        |        |        |        |        |        |
| 50         | 0.2024                  | 0.2069 | 0.2191 | 0.2336 | 0.2513 |        |        |        |        |        |        |        |        |
| 55         | 0.2031                  | 0.2075 | 0.2189 | 0.2324 | 0.2486 | 0.2959 |        |        |        |        |        |        |        |
| 60         | 0.2039                  | 0.2080 | 0.2189 | 0.2314 | 0.2463 | 0.2881 |        |        |        |        |        |        |        |
| 65         | 0.2047                  | 0.2086 | 0.2189 | 0.2306 | 0.2443 | 0.2817 |        |        |        |        |        |        |        |
| 70         | 0.2056                  | 0.2092 | 0.2189 | 0.2299 | 0.2427 | 0.2764 |        |        |        |        |        |        |        |
| 75         | 0.2064                  | 0.2099 | 0.2191 | 0.2294 | 0.2413 | 0.2720 | 0.3201 |        |        |        |        |        |        |
| 80         | 0.2073                  | 0.2106 | 0.2193 | 0.2291 | 0.2401 | 0.2683 | 0.3104 |        |        |        |        |        |        |
| 85         | 0.2081                  | 0.2113 | 0.2196 | 0.2288 | 0.2392 | 0.2651 | 0.3025 |        |        |        |        |        |        |
| 90         | 0.2090                  | 0.2121 | 0.2199 | 0.2286 | 0.2384 | 0.2623 | 0.2959 | 0.3490 |        |        |        |        |        |
| 95         | 0.2099                  | 0.2128 | 0.2203 | 0.2286 | 0.2378 | 0.2600 | 0.2903 | 0.3361 |        |        |        |        |        |
| 100        | 0.2109                  | 0.2136 | 0.2208 | 0.2286 | 0.2373 | 0.2580 | 0.2856 | 0.3257 | 0.3930 |        |        |        |        |
| 105        | 0.2118                  | 0.2144 | 0.2212 | 0.2287 | 0.2369 | 0.2562 | 0.2815 | 0.3171 | 0.3732 |        |        |        |        |
| 110        | 0.2127                  | 0.2153 | 0.2218 | 0.2288 | 0.2366 | 0.2548 | 0.2780 | 0.3099 | 0.3577 |        |        |        |        |
| 115        | 0.2137                  | 0.2161 | 0.2223 | 0.2290 | 0.2364 | 0.2535 | 0.2750 | 0.3037 | 0.3452 | 0.4135 |        |        |        |
| 120        | 0.2146                  | 0.2170 | 0.2229 | 0.2293 | 0.2363 | 0.2524 | 0.2724 | 0.2985 | 0.3349 | 0.3913 |        |        |        |
| 125        | 0.2156                  | 0.2178 | 0.2235 | 0.2296 | 0.2363 | 0.2515 | 0.2701 | 0.2940 | 0.3263 | 0.3741 | 0.4559 |        |        |
| 130        | 0.2166                  | 0.2187 | 0.2242 | 0.2300 | 0.2363 | 0.2507 | 0.2682 | 0.2901 | 0.3191 | 0.3602 | 0.4257 | 0.5560 |        |
| 135        | 0.2176                  | 0.2196 | 0.2248 | 0.2304 | 0.2365 | 0.2501 | 0.2664 | 0.2867 | 0.3129 | 0.3489 | 0.4029 | 0.4983 |        |
| 140        | 0.2185                  | 0.2205 | 0.2255 | 0.2309 | 0.2366 | 0.2496 | 0.2649 | 0.2837 | 0.3076 | 0.3394 | 0.3851 | 0.4591 | 0.6109 |
| 145        | 0.2195                  | 0.2214 | 0.2262 | 0.2314 | 0.2369 | 0.2492 | 0.2636 | 0.2811 | 0.3030 | 0.3314 | 0.3707 | 0.4304 | 0.5372 |
| 150        | 0.2205                  | 0.2224 | 0.2270 | 0.2319 | 0.2372 | 0.2488 | 0.2625 | 0.2789 | 0.2990 | 0.3246 | 0.3589 | 0.4085 | 0.4892 |
| 155        | 0.2215                  | 0.2233 | 0.2277 | 0.2325 | 0.2375 | 0.2486 | 0.2616 | 0.2769 | 0.2954 | 0.3187 | 0.3491 | 0.3912 | 0.4550 |
| 160        | 0.2225                  | 0.2242 | 0.2285 | 0.2331 | 0.2379 | 0.2485 | 0.2607 | 0.2751 | 0.2924 | 0.3136 | 0.3407 | 0.3771 | 0.4294 |
| 165        | 0.2236                  | 0.2252 | 0.2293 | 0.2337 | 0.2383 | 0.2484 | 0.2601 | 0.2736 | 0.2897 | 0.3092 | 0.3336 | 0.3654 | 0.4093 |
| 170        | 0.2246                  | 0.2262 | 0.2301 | 0.2343 | 0.2387 | 0.2484 | 0.2595 | 0.2723 | 0.2873 | 0.3053 | 0.3274 | 0.3556 | 0.3932 |
| 175        | 0.2256                  | 0.2271 | 0.2309 | 0.2350 | 0.2392 | 0.2485 | 0.2590 | 0.2711 | 0.2852 | 0.3018 | 0.3221 | 0.3473 | 0.3800 |
| 180        | 0.2266                  | 0.2281 | 0.2318 | 0.2357 | 0.2398 | 0.2486 | 0.2587 | 0.2701 | 0.2833 | 0.2988 | 0.3174 | 0.3401 | 0.3689 |
| 185        | 0.2276                  | 0.2291 | 0.2326 | 0.2364 | 0.2403 | 0.2488 | 0.2584 | 0.2692 | 0.2817 | 0.2961 | 0.3132 | 0.3339 | 0.3595 |
| 190        | 0.2287                  | 0.2300 | 0.2335 | 0.2371 | 0.2409 | 0.2491 | 0.2582 | 0.2685 | 0.2802 | 0.2938 | 0.3096 | 0.3285 | 0.3515 |
| 195        | 0.2297                  | 0.2310 | 0.2343 | 0.2378 | 0.2415 | 0.2493 | 0.2581 | 0.2679 | 0.2790 | 0.2917 | 0.3064 | 0.3237 | 0.3445 |
| 200        | 0.2307                  | 0.2320 | 0.2352 | 0.2386 | 0.2421 | 0.2497 | 0.2580 | 0.2674 | 0.2779 | 0.2898 | 0.3035 | 0.3195 | 0.3385 |
| 205        | 0.2317                  | 0.2330 | 0.2361 | 0.2393 | 0.2427 | 0.2500 | 0.2580 | 0.2669 | 0.2769 | 0.2882 | 0.3010 | 0.3158 | 0.3332 |
| 210        | 0.2328                  | 0.2340 | 0.2370 | 0.2401 | 0.2434 | 0.2504 | 0.2581 | 0.2666 | 0.2761 | 0.2867 | 0.2988 | 0.3126 | 0.3285 |
| 215        | 0.2338                  | 0.2350 | 0.2379 | 0.2409 | 0.2441 | 0.2508 | 0.2582 | 0.2664 | 0.2754 | 0.2855 | 0.2968 | 0.3096 | 0.3244 |
| 220        | 0.2348                  | 0.2360 | 0.2388 | 0.2417 | 0.2448 | 0.2513 | 0.2584 | 0.2662 | 0.2748 | 0.2843 | 0.2950 | 0.3070 | 0.3207 |
| 225        | 0.2359                  | 0.2370 | 0.2397 | 0.2425 | 0.2455 | 0.2518 | 0.2586 | 0.2661 | 0.2743 | 0.2834 | 0.2934 | 0.3047 | 0.3175 |
| 230        | 0.2369                  | 0.2380 | 0.2406 | 0.2434 | 0.2462 | 0.2523 | 0.2589 | 0.2660 | 0.2739 | 0.2825 | 0.2920 | 0.3027 | 0.3146 |
| 235        | 0.2379                  | 0.2390 | 0.2415 | 0.2442 | 0.2470 | 0.2528 | 0.2592 | 0.2661 | 0.2736 | 0.2818 | 0.2908 | 0.3008 | 0.3120 |
| 240        | 0.2389                  | 0.2400 | 0.2425 | 0.2450 | 0.2477 | 0.2534 | 0.2595 | 0.2661 | 0.2733 | 0.2811 | 0.2897 | 0.2992 | 0.3097 |
| 245        | 0.2400                  | 0.2410 | 0.2434 | 0.2459 | 0.2485 | 0.2540 | 0.2599 | 0.2662 | 0.2731 | 0.2806 | 0.2888 | 0.2977 | 0.3076 |
| 250        | 0.2410                  | 0.2419 | 0.2443 | 0.2468 | 0.2493 | 0.2546 | 0.2603 | 0.2664 | 0.2730 | 0.2802 | 0.2880 | 0.2964 | 0.3058 |
| 255        | 0.2420                  | 0.2429 | 0.2452 | 0.2476 | 0.2501 | 0.2552 | 0.2607 | 0.2666 | 0.2730 | 0.2798 | 0.2872 | 0.2953 | 0.3041 |
| 260        | 0.2430                  | 0.2439 | 0.2462 | 0.2485 | 0.2509 | 0.2558 | 0.2612 | 0.2668 | 0.2730 | 0.2795 | 0.2866 | 0.2943 | 0.3026 |









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