

R-438A (Freon™ MO99)

Zeotropic blend (8.5 % R-32 - 45 % R-125 - 44.2 % R-134a -
1.7 % R-600 - 0.6 % R-601a)

| | |
|---|--------|
| Molecular weight (g/mol) | 100.56 |
| Melting point (°C) | N/A |
| Boiling point (at 1.013 bar) | -42.31 |
| Temperature glide at 1.013 bar (K) | 6.25 |
| Critical temperature (°C) | 83.7 |
| Critical pressure (bar absolute) | 42.16 |
| Specific heat (liquid) at + 25°C (kJ/kg.K) | 1.454 |
| Specific heat (vapour) at 1.013 bar and + 25°C (kJ/kg.K) | 0.826 |
| Thermal capacity ratio (Cp/Cv) at + 25°C and 1.013 bar | 1.123 |
| Viscosity (liquid) at + 25°C in Centipoise (10 ⁻³ Pa.s) | 0.162 |
| Surface tension at + 25°C in dyne per centimetre (10 ⁻³ N/m) | 6.28 |
| Classification NF-EN 378 | A1 |
| GWP (IPCC 4) | 2265 |

◆ Main applications

R-438A (Freon™ MO99) is a "non azeotropic" HFC blend, which can replace R-22 (HCFC) in residential and commercial air conditioning applications, chillers and low & medium temperature direct expansion refrigeration systems.

Do not use in centrifugal chillers and check with us if they have a flooded evaporator.

◆ Commercial specifications

Composition: 45 % R-125 – 44.2 % R-134a – 8.5 % R-32 – 1.7 % R-600 – 0.6 % R-601a (±1.5 % / ±1.5 %-1.7 % / ±0.5 %-1.5 % / ±0.1 %-0.2 % / ±0.1 %-0.2 %).

Purity: ≥ 99.5 % weight.

Water content: ≤ 10 ppm weight.

Chloride ion test: negative

Acidity (HCl): ≤ 1 ppm weight.

Non-condensables (gas phase): ≤ 1.5 % volume.

High boiling residue: ≤ 0.01% volume.

◆ Oils

Use a mineral oil (MO), alkylbenzene (AB) or polyol ester (POE). Climalife recommend using a POE oil for all HFCs. Check with Climalife regarding the viscosity of the oil selected for your application, and the miscibility with the fluid under consideration.

◆ Regulation

The use and implementation of R-438A are governed by EU Regulation n° 517/2014.

The recovery of R-438A is mandatory under EU Regulation n° 517/2014.

(Refer to regulations enforced in each country).

Thermodynamic properties of R-438A - Saturated state

| Absolute pressure P (bar) | LIQUID | | | | | VAPOUR | | | | | Latent heat Lv (kJ/kg) |
|---------------------------------|----------------------------|---------------------------------------|--|---------------------------|----------------------------|-------------------------|--------------------------------------|---------------------------------------|---------------------------|----------------------------|------------------------------|
| | Bubble point t' (°C) | Volume v' (dm ³ /kg) | Density ρ' (kg/dm ³) | Enthalpy h' (kJ/kg) | Entropy s' (kJ/kg.K) | Dew point t" (°C) | Volume v" (m ³ /kg) | Density ρ" (kg/m ³) | Enthalpy h" (kJ/kg) | Entropy s" (kJ/kg.K) | |
| 0.021 | -100 | 0.621 | 1.611 | 75.183 | 0.435 | -92.79 | 7.010 | 0.143 | 325.122 | 1.849 | 249.939 |
| 0.033 | -95 | 0.627 | 1.595 | 81.316 | 0.469 | -87.86 | 4.571 | 0.219 | 328.033 | 1.828 | 246.718 |
| 0.051 | -90 | 0.633 | 1.580 | 87.410 | 0.503 | -82.93 | 3.065 | 0.326 | 330.968 | 1.808 | 243.559 |
| 0.076 | -85 | 0.639 | 1.564 | 93.479 | 0.536 | -78.0 | 2.109 | 0.474 | 333.922 | 1.791 | 240.442 |
| 0.110 | -80 | 0.646 | 1.549 | 99.537 | 0.568 | -73.08 | 1.485 | 0.673 | 336.889 | 1.775 | 237.352 |
| 0.157 | -75 | 0.652 | 1.534 | 105.591 | 0.599 | -68.16 | 1.068 | 0.936 | 339.867 | 1.761 | 234.275 |
| 0.219 | -70 | 0.659 | 1.518 | 111.651 | 0.629 | -63.25 | 0.783 | 1.277 | 342.848 | 1.749 | 231.197 |
| 0.299 | -65 | 0.665 | 1.503 | 117.723 | 0.658 | -58.33 | 0.584 | 1.712 | 345.829 | 1.737 | 228.107 |
| 0.401 | -60 | 0.672 | 1.488 | 123.812 | 0.687 | -53.42 | 0.443 | 2.258 | 348.805 | 1.727 | 224.993 |
| 0.531 | -55 | 0.679 | 1.472 | 129.925 | 0.715 | -48.51 | 0.341 | 2.935 | 351.769 | 1.718 | 221.844 |
| 0.692 | -50 | 0.687 | 1.456 | 136.066 | 0.743 | -43.6 | 0.266 | 3.764 | 354.717 | 1.709 | 218.651 |
| 0.889 | -45 | 0.694 | 1.440 | 142.239 | 0.771 | -38.69 | 0.210 | 4.768 | 357.643 | 1.702 | 215.404 |
| 1.013 | -42.31 | 0.698 | 1.432 | 145.578 | 0.785 | -36.05 | 0.186 | 5.390 | 359.208 | 1.698 | 213.629 |
| 1.129 | -40 | 0.702 | 1.424 | 148.449 | 0.797 | -33.79 | 0.167 | 5.973 | 360.542 | 1.695 | 212.092 |
| 1.418 | -35 | 0.710 | 1.408 | 154.701 | 0.824 | -28.89 | 0.135 | 7.405 | 363.408 | 1.689 | 208.707 |
| 1.761 | -30 | 0.719 | 1.391 | 160.998 | 0.850 | -23.99 | 0.110 | 9.094 | 366.236 | 1.684 | 205.238 |
| 2.165 | -25 | 0.728 | 1.374 | 167.346 | 0.876 | -19.1 | 0.090 | 11.072 | 369.020 | 1.679 | 201.675 |
| 2.637 | -20 | 0.737 | 1.357 | 173.747 | 0.901 | -14.21 | 0.075 | 13.374 | 371.754 | 1.674 | 198.007 |
| 3.185 | -15 | 0.746 | 1.340 | 180.208 | 0.926 | -9.32 | 0.062 | 16.040 | 374.432 | 1.670 | 194.224 |
| 3.816 | -10 | 0.757 | 1.322 | 186.733 | 0.951 | -4.44 | 0.052 | 19.111 | 377.046 | 1.667 | 190.313 |
| 4.537 | -5 | 0.767 | 1.303 | 193.329 | 0.976 | 0.44 | 0.044 | 22.635 | 379.589 | 1.663 | 186.260 |
| 5.358 | 0 | 0.779 | 1.284 | 200.000 | 1.000 | 5.32 | 0.038 | 26.665 | 382.052 | 1.660 | 182.052 |
| 6.285 | 5 | 0.790 | 1.265 | 206.754 | 1.024 | 10.19 | 0.032 | 31.263 | 384.424 | 1.657 | 177.670 |
| 7.329 | 10 | 0.803 | 1.245 | 213.599 | 1.048 | 15.05 | 0.027 | 36.496 | 386.694 | 1.654 | 173.095 |
| 8.496 | 15 | 0.817 | 1.224 | 220.543 | 1.072 | 19.91 | 0.024 | 42.447 | 388.846 | 1.651 | 168.303 |
| 9.797 | 20 | 0.831 | 1.203 | 227.597 | 1.096 | 24.76 | 0.020 | 49.211 | 390.865 | 1.649 | 163.268 |
| 11.241 | 25 | 0.847 | 1.180 | 234.772 | 1.120 | 29.61 | 0.018 | 56.901 | 392.730 | 1.646 | 157.958 |
| 12.837 | 30 | 0.865 | 1.157 | 242.083 | 1.144 | 34.44 | 0.015 | 65.656 | 394.420 | 1.643 | 152.337 |
| 14.594 | 35 | 0.883 | 1.132 | 249.546 | 1.168 | 39.26 | 0.013 | 75.647 | 395.906 | 1.640 | 146.359 |
| 16.524 | 40 | 0.904 | 1.106 | 257.183 | 1.192 | 44.08 | 0.011 | 87.092 | 397.154 | 1.636 | 139.971 |
| 18.637 | 45 | 0.928 | 1.078 | 265.020 | 1.216 | 48.87 | 0.010 | 100.274 | 398.121 | 1.632 | 133.102 |
| 20.944 | 50 | 0.954 | 1.048 | 273.093 | 1.241 | 53.65 | 0.009 | 115.576 | 398.749 | 1.627 | 125.656 |
| 23.456 | 55 | 0.985 | 1.015 | 281.454 | 1.266 | 58.41 | 0.007 | 133.537 | 398.956 | 1.622 | 117.502 |
| 26.186 | 60 | 1.021 | 0.979 | 290.179 | 1.291 | 63.14 | 0.006 | 154.961 | 398.621 | 1.615 | 108.443 |
| 29.148 | 65 | 1.066 | 0.938 | 299.389 | 1.318 | 67.84 | 0.006 | 181.138 | 397.551 | 1.607 | 98.162 |
| 32.355 | 70 | 1.123 | 0.890 | 309.307 | 1.346 | 72.49 | 0.005 | 214.383 | 395.404 | 1.596 | 86.097 |
| 35.820 | 75 | 1.205 | 0.830 | 320.416 | 1.377 | 77.04 | 0.004 | 259.682 | 391.454 | 1.580 | 71.038 |
| 39.535 | 80 | 1.351 | 0.740 | 334.261 | 1.415 | 81.41 | 0.003 | 332.854 | 383.473 | 1.554 | 49.212 |

Thermodynamic properties of R-438A - (superheated vapour) - Volume (dm³/kg)

| Sat. Temp. °C | Sat. Pressure bar | Superheat (°C) | | | | | | | | | | | | | | | | | | | | |
|---------------|-------------------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| -100 | 0.010 | 13858.562 | 14261.942 | 14664.882 | 15067.484 | 15469.819 | 15871.943 | 16273.895 | 16675.707 | 17077.403 | 17479.001 | 17880.518 | 18281.964 | 18683.351 | 19084.685 | 19485.974 | 19887.224 | 20288.439 | 20689.623 | 21090.780 | 21491.913 | 21893.024 |
| -95 | 0.017 | 8576.751 | 8820.141 | 9063.188 | 9305.966 | 9548.531 | 9790.924 | 10033.176 | 10275.312 | 10517.350 | 10759.306 | 11001.192 | 11243.018 | 11484.792 | 11726.520 | 11968.209 | 12209.863 | 12451.487 | 12693.083 | 12934.654 | 13176.204 | 13417.735 |
| -90 | 0.028 | 5485.439 | 5637.462 | 5789.211 | 5940.744 | 6092.104 | 6243.322 | 6394.423 | 6545.426 | 6696.346 | 6847.196 | 6997.986 | 7148.724 | 7299.417 | 7450.070 | 7600.688 | 7751.275 | 7901.835 | 8052.370 | 8202.884 | 8353.378 | 8503.855 |
| -85 | 0.043 | 3614.519 | 3712.525 | 3810.310 | 3907.917 | 4005.381 | 4102.727 | 4199.974 | 4297.138 | 4394.232 | 4491.265 | 4588.246 | 4685.182 | 4782.078 | 4878.939 | 4975.769 | 5072.571 | 5169.349 | 5266.106 | 5362.842 | 5459.561 | 5556.265 |
| -80 | 0.065 | 2447.088 | 2512.131 | 2576.992 | 2641.706 | 2706.299 | 2770.793 | 2835.205 | 2899.542 | 2963.820 | 3028.045 | 3092.225 | 3156.365 | 3220.470 | 3284.544 | 3348.590 | 3412.612 | 3476.612 | 3540.593 | 3604.555 | 3668.502 | 3732.435 |
| -75 | 0.096 | 1698.015 | 1742.351 | 1786.533 | 1830.592 | 1874.549 | 1918.421 | 1962.221 | 2005.960 | 2049.645 | 2093.285 | 2136.884 | 2180.449 | 2223.982 | 2267.487 | 2310.968 | 2354.427 | 2397.867 | 2441.288 | 2484.694 | 2528.085 | 2571.463 |
| -70 | 0.138 | 1204.943 | 1235.919 | 1266.764 | 1297.503 | 1328.155 | 1358.734 | 1389.250 | 1419.713 | 1450.129 | 1480.504 | 1510.844 | 1541.153 | 1571.434 | 1601.691 | 1631.925 | 1662.140 | 1692.336 | 1722.517 | 1752.683 | 1782.836 | 1812.977 |
| -65 | 0.195 | 872.692 | 894.833 | 916.861 | 938.797 | 960.658 | 982.455 | 1004.197 | 1025.892 | 1047.547 | 1069.165 | 1090.752 | 1112.310 | 1133.844 | 1155.356 | 1176.848 | 1198.321 | 1219.779 | 1241.222 | 1262.652 | 1284.070 | 1305.477 |
| -60 | 0.269 | 643.937 | 660.101 | 676.167 | 692.153 | 708.072 | 723.935 | 739.750 | 755.524 | 771.260 | 786.965 | 802.642 | 818.293 | 833.923 | 849.532 | 865.123 | 880.697 | 896.257 | 911.804 | 927.339 | 942.862 | 958.376 |
| -55 | 0.366 | 483.289 | 495.324 | 507.273 | 519.151 | 530.970 | 542.739 | 554.466 | 566.155 | 577.812 | 589.440 | 601.042 | 612.622 | 624.182 | 635.723 | 647.248 | 658.758 | 670.255 | 681.739 | 693.213 | 704.676 | 716.130 |
| -50 | 0.488 | 368.393 | 377.520 | 386.570 | 395.556 | 404.490 | 413.380 | 422.231 | 431.049 | 439.837 | 448.600 | 457.339 | 466.058 | 474.759 | 483.443 | 492.112 | 500.767 | 509.410 | 518.042 | 526.664 | 535.276 | 543.880 |
| -45 | 0.642 | 284.823 | 291.864 | 298.835 | 305.749 | 312.617 | 319.444 | 326.237 | 332.999 | 339.735 | 346.447 | 353.139 | 359.812 | 366.467 | 373.108 | 379.735 | 386.349 | 392.953 | 399.545 | 406.129 | 412.704 | 419.271 |
| -40 | 0.833 | 223.083 | 228.602 | 234.058 | 239.463 | 244.825 | 250.151 | 255.445 | 260.711 | 265.954 | 271.175 | 276.377 | 281.561 | 286.731 | 291.886 | 297.029 | 302.160 | 307.281 | 312.392 | 317.494 | 322.589 | 327.676 |
| -36.05 | 1.013 | 185.520 | 190.123 | 194.667 | 199.163 | 203.620 | 208.043 | 212.437 | 216.805 | 221.151 | 225.476 | 229.784 | 234.075 | 238.352 | 242.616 | 246.868 | 251.109 | 255.341 | 259.563 | 263.777 | 267.984 | 272.184 |
| -35 | 1.066 | 176.809 | 181.201 | 185.535 | 189.822 | 194.070 | 198.285 | 202.472 | 206.633 | 210.772 | 214.891 | 218.993 | 223.079 | 227.150 | 231.209 | 235.256 | 239.293 | 243.320 | 247.337 | 251.347 | 255.350 | 259.345 |
| -30 | 1.348 | 141.660 | 145.204 | 148.695 | 152.143 | 155.555 | 158.937 | 162.293 | 165.625 | 168.937 | 172.230 | 175.508 | 178.771 | 182.020 | 185.258 | 188.485 | 191.702 | 194.910 | 198.109 | 201.301 | 204.487 | 207.665 |
| -25 | 1.685 | 114.627 | 117.525 | 120.374 | 123.184 | 125.960 | 128.709 | 131.432 | 134.135 | 136.818 | 139.485 | 142.136 | 144.774 | 147.400 | 150.014 | 152.619 | 155.214 | 157.801 | 160.380 | 162.952 | 165.518 | 168.077 |
| -20 | 2.085 | 93.595 | 95.995 | 98.349 | 100.667 | 102.953 | 105.213 | 107.451 | 109.669 | 111.869 | 114.053 | 116.223 | 118.381 | 120.527 | 122.663 | 124.789 | 126.907 | 129.017 | 131.120 | 133.216 | 135.305 | 137.390 |
| -15 | 2.556 | 77.055 | 79.066 | 81.034 | 82.967 | 84.872 | 86.753 | 88.612 | 90.452 | 92.276 | 94.085 | 95.881 | 97.665 | 99.438 | 101.202 | 102.957 | 104.703 | 106.443 | 108.175 | 109.901 | 111.622 | 113.337 |
| -10 | 3.104 | 63.915 | 65.619 | 67.283 | 68.914 | 70.518 | 72.099 | 73.660 | 75.204 | 76.732 | 78.246 | 79.747 | 81.238 | 82.718 | 84.189 | 85.652 | 87.107 | 88.555 | 89.997 | 91.433 | 92.863 | 94.289 |
| -5 | 3.738 | 53.379 | 54.838 | 56.260 | 57.650 | 59.015 | 60.358 | 61.682 | 62.989 | 64.282 | 65.562 | 66.830 | 68.087 | 69.334 | 70.573 | 71.804 | 73.028 | 74.245 | 75.456 | 76.662 | 77.862 | 79.058 |
| 0 | 4.468 | 44.854 | 46.118 | 47.345 | 48.542 | 49.715 | 50.866 | 52.000 | 53.118 | 54.222 | 55.314 | 56.394 | 57.464 | 58.525 | 59.578 | 60.623 | 61.662 | 62.694 | 63.720 | 64.741 | 65.757 | 66.769 |
| 5 | 5.301 | 37.901 | 39.005 | 40.074 | 41.115 | 42.132 | 43.129 | 44.109 | 45.074 | 46.025 | 46.964 | 47.893 | 48.812 | 49.722 | 50.624 | 51.519 | 52.408 | 53.290 | 54.167 | 55.039 | 55.906 | 56.769 |
| 10 | 6.247 | 32.183 | 33.158 | 34.099 | 35.012 | 35.903 | 36.773 | 37.627 | 38.467 | 39.293 | 40.108 | 40.913 | 41.708 | 42.495 | 43.275 | 44.048 | 44.814 | 45.575 | 46.330 | 47.080 | 47.826 | 48.568 |
| 15 | 7.316 | 27.447 | 28.316 | 29.152 | 29.960 | 30.747 | 31.514 | 32.264 | 33.001 | 33.725 | 34.437 | 35.140 | 35.834 | 36.520 | 37.198 | 37.870 | 38.536 | 39.197 | 39.852 | 40.503 | 41.149 | 41.791 |
| 20 | 8.518 | 23.495 | 24.278 | 25.027 | 25.750 | 26.450 | 27.131 | 27.796 | 28.447 | 29.086 | 29.714 | 30.332 | 30.942 | 31.544 | 32.139 | 32.728 | 33.310 | 33.888 | 34.460 | 35.028 | 35.592 | 36.152 |
| 25 | 9.864 | 20.176 | 20.888 | 21.566 | 22.217 | 22.846 | 23.455 | 24.049 | 24.629 | 25.197 | 25.754 | 26.302 | 26.842 | 27.374 | 27.899 | 28.418 | 28.931 | 29.440 | 29.943 | 30.442 | 30.937 | 31.429 |
| 30 | 11.365 | 17.370 | 18.025 | 18.644 | 19.235 | 19.804 | 20.354 | 20.888 | 21.408 | 21.917 | 22.415 | 22.903 | 23.384 | 23.857 | 24.324 | 24.784 | 25.239 | 25.689 | 26.135 | 26.576 | 27.014 | 27.448 |
| 35 | 13.032 | 14.982 | 15.590 | 16.161 | 16.703 | 17.222 | 17.721 | 18.205 | 18.675 | 19.133 | 19.581 | 20.020 | 20.451 | 20.874 | 21.291 | 21.703 | 22.108 | 22.509 | 22.906 | 23.298 | 23.687 | 24.072 |
| 40 | 14.877 | 12.938 | 13.509 | 14.040 | 14.541 | 15.018 | 15.475 | 15.916 | 16.344 | 16.759 | 17.165 | 17.561 | 17.949 | 18.330 | 18.705 | 19.074 | 19.438 | 19.798 | 20.152 | 20.503 | 20.851 | 21.194 |
| 45 | 16.916 | 11.176 | 11.719 | 12.218 | 12.685 | 13.127 | 13.548 | 13.953 | 14.344 | 14.723 | 15.092 | 15.452 | 15.804 | 16.149 | 16.488 | 16.821 | 17.149 | 17.473 | 17.792 | 18.108 | 18.419 | 18.728 |
| 50 | 19.162 | 9.646 | 10.170 | 10.645 | 11.084 | 11.496 | 11.887 | 12.261 | 12.621 | 12.969 | 13.306 | 13.635 | 13.956 | 14.270 | 14.578 | 14.880 | 15.179 | 15.470 | 15.759 | 16.043 | 16.325 | 16.603 |
| 55 | 21.632 | 8.309 | 8.823 | 9.278 | 9.694 | 10.082 | 10.447 | 10.795 | 11.128 | 11.449 | 11.760 | 12.062 | 12.356 | 12.643 | 12.924 | 13.199 | 13.470 | 13.736 | 13.998 | 14.256 | 14.511 | 14.763 |
| 60 | 24.345 | 7.129 | 7.642 | 8.085 | 8.483 | 8.850 | 9.194 | 9.519 | 9.829 | 10.127 | 10.414 | 10.693 | 10.963 | 11.227 | 11.484 | 11.736 | 11.984 | 12.227 | 12.465 | 12.701 | 12.932 | 13.161 |
| 65 | 27.325 | 6.075 | 6.600 | 7.037 | 7.422 | 7.772 | 8.097 | 8.403 | 8.693 | 8.971 | 9.237 | 9.495 | 9.745 | 9.988 | 10.225 | 10.457 | 10.684 | 10.906 | 11.125 | 11.340 | 11.552 | 11.760 |
| 70 | 30.602 | 5.116 | 5.673 | 6.110 | 6.486 | 6.823 | 7.132 | 7.421 | 7.694 | 7.953 | 8.202 | 8.442 | 8.674 | 8.899 | 9.117 | 9.331 | 9.540 | 9.745 | 9.945 | 10.142 | 10.336 | 10.527 |
| 75 | 34.222 | 4.216 | 4.837 | 5.283 | 5.653 | 5.979 | 6.275 | 6.550 | 6.807 | 7.051 | 7.284 | 7.507 | 7.723 | 7.932 | 8.135 | 8.332 | 8.525 | 8.713 | 8.898 | 9.079 | 9.257 | 9.432 |
| 80 | 38.279 | 3.299 | 4.066 | 4.530 | 4.899 | 5.217 | 5.502 | 5.763 | 6.019 | 6.237 | 6.455 | 6.672 | 6.885 | 7.059 | 7.247 | 7.430 | 7.609 | 7.783 | 7.953 | 8.120 | 8.283 | 8.444 |

Thermodynamic properties of R-438A - (superheated vapour) - Enthalpy (kJ/kg)

| Sat. Temp. °C | Sat. Pressure bar | Superheat (°C) | | | | | | | | | | | | | | | | | | | | |
|---------------|-------------------|----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| -100 | 0.010 | 320.916 | 323.894 | 326.916 | 329.984 | 333.097 | 336.256 | 339.460 | 342.710 | 346.005 | 349.346 | 352.732 | 356.162 | 359.637 | 363.157 | 366.721 | 370.329 | 373.980 | 377.675 | 381.414 | 385.196 | 389.020 |
| -95 | 0.017 | 323.824 | 326.856 | 329.931 | 333.051 | 336.214 | 339.423 | 342.676 | 345.975 | 349.318 | 352.706 | 356.138 | 359.615 | 363.137 | 366.702 | 370.311 | 373.964 | 377.660 | 381.399 | 385.182 | 389.007 | 392.875 |
| -90 | 0.028 | 326.764 | 329.851 | 332.980 | 336.151 | 339.366 | 342.625 | 345.928 | 349.276 | 352.667 | 356.103 | 359.582 | 363.106 | 366.673 | 370.284 | 373.939 | 377.636 | 381.377 | 385.161 | 388.987 | 392.856 | 396.768 |
| -85 | 0.043 | 329.731 | 332.875 | 336.058 | 339.283 | 342.550 | 345.860 | 349.213 | 352.609 | 356.049 | 359.533 | 363.060 | 366.630 | 370.244 | 373.901 | 377.601 | 381.344 | 385.130 | 388.958 | 392.829 | 396.742 | 400.697 |
| -80 | 0.065 | 332.722 | 335.923 | 339.162 | 342.441 | 345.761 | 349.122 | 352.526 | 355.973 | 359.462 | 362.994 | 366.569 | 370.187 | 373.848 | 377.551 | 381.297 | 385.085 | 388.916 | 392.789 | 396.704 | 400.661 | 404.659 |
| -75 | 0.096 | 335.731 | 338.991 | 342.287 | 345.621 | 348.995 | 352.410 | 355.865 | 359.363 | 362.902 | 366.483 | 370.107 | 373.772 | 377.480 | 381.230 | 385.023 | 388.857 | 392.733 | 396.651 | 400.610 | 404.611 | 408.654 |
| -70 | 0.138 | 338.754 | 342.074 | 345.429 | 348.820 | 352.249 | 355.718 | 359.226 | 362.775 | 366.365 | 369.997 | 373.669 | 377.383 | 381.139 | 384.937 | 388.776 | 392.656 | 396.578 | 400.541 | 404.545 | 408.591 | 412.677 |
| -65 | 0.195 | 341.784 | 345.168 | 348.583 | 352.032 | 355.518 | 359.042 | 362.604 | 366.206 | 369.848 | 373.530 | 377.253 | 381.017 | 384.821 | 388.667 | 392.553 | 396.480 | 400.448 | 404.457 | 408.507 | 412.597 | 416.728 |
| -60 | 0.269 | 344.817 | 348.266 | 351.744 | 355.254 | 358.798 | 362.378 | 365.996 | 369.652 | 373.347 | 377.081 | 380.855 | 384.669 | 388.523 | 392.417 | 396.351 | 400.326 | 404.341 | 408.396 | 412.492 | 416.627 | 420.803 |
| -55 | 0.366 | 347.848 | 351.365 | 354.907 | 358.479 | 362.084 | 365.723 | 369.397 | 373.109 | 376.858 | 380.645 | 384.471 | 388.336 | 392.240 | 396.184 | 400.167 | 404.190 | 408.252 | 412.355 | 416.496 | 420.678 | 424.899 |
| -50 | 0.488 | 350.870 | 354.458 | 358.067 | 361.704 | 365.371 | 369.070 | 372.803 | 376.571 | 380.376 | 384.218 | 388.097 | 392.014 | 395.970 | 399.964 | 403.997 | 408.069 | 412.180 | 416.330 | 420.518 | 424.746 | 429.013 |
| -45 | 0.642 | 353.878 | 357.540 | 361.220 | 364.923 | 368.654 | 372.416 | 376.209 | 380.036 | 383.898 | 387.796 | 391.730 | 395.700 | 399.709 | 403.754 | 407.838 | 411.960 | 416.119 | 420.318 | 424.554 | 428.829 | 433.142 |
| -40 | 0.833 | 356.867 | 360.606 | 364.359 | 368.132 | 371.930 | 375.755 | 379.611 | 383.499 | 387.419 | 391.374 | 395.364 | 399.390 | 403.452 | 407.550 | 411.686 | 415.858 | 420.068 | 424.315 | 428.600 | 432.923 | 437.283 |
| -36.05 | 1.013 | 359.208 | 363.010 | 366.823 | 370.653 | 374.505 | 378.383 | 382.290 | 386.226 | 390.195 | 394.196 | 398.231 | 402.301 | 406.407 | 410.548 | 414.725 | 418.938 | 423.188 | 427.475 | 431.799 | 436.160 | 440.557 |
| -35 | 1.066 | 359.830 | 363.650 | 367.479 | 371.325 | 375.192 | 379.084 | 383.004 | 386.954 | 390.936 | 394.950 | 398.997 | 403.079 | 407.196 | 411.349 | 415.537 | 419.761 | 424.022 | 428.320 | 432.654 | 437.025 | 441.433 |
| -30 | 1.348 | 362.763 | 366.668 | 370.577 | 374.497 | 378.437 | 382.398 | 386.385 | 390.399 | 394.443 | 398.518 | 402.625 | 406.764 | 410.938 | 415.145 | 419.388 | 423.665 | 427.978 | 432.327 | 436.712 | 441.132 | 445.589 |
| -25 | 1.685 | 365.658 | 369.653 | 373.645 | 377.645 | 381.659 | 385.692 | 389.748 | 393.829 | 397.937 | 402.075 | 406.242 | 410.442 | 414.673 | 418.937 | 423.235 | 427.567 | 431.933 | 436.334 | 440.770 | 445.241 | 449.747 |
| -20 | 2.085 | 368.511 | 372.600 | 376.679 | 380.761 | 384.853 | 388.961 | 393.088 | 397.239 | 401.414 | 405.616 | 409.847 | 414.107 | 418.398 | 422.720 | 427.075 | 431.463 | 435.883 | 440.337 | 444.826 | 449.348 | 453.905 |
| -15 | 2.556 | 371.315 | 375.502 | 379.673 | 383.841 | 388.015 | 392.200 | 396.402 | 400.624 | 404.869 | 409.138 | 413.433 | 417.757 | 422.109 | 426.491 | 430.904 | 435.349 | 439.825 | 444.334 | 448.876 | 453.450 | 458.059 |
| -10 | 3.104 | 374.063 | 378.354 | 382.622 | 386.880 | 391.139 | 395.406 | 399.685 | 403.981 | 408.297 | 412.636 | 416.998 | 421.387 | 425.802 | 430.246 | 434.719 | 439.222 | 443.755 | 448.320 | 452.917 | 457.545 | 462.206 |
| -5 | 3.738 | 376.748 | 381.149 | 385.519 | 389.872 | 394.220 | 398.571 | 402.931 | 407.305 | 411.696 | 416.106 | 420.538 | 424.993 | 429.474 | 433.981 | 438.516 | 443.079 | 447.671 | 452.293 | 456.945 | 461.629 | 466.343 |
| 0 | 4.468 | 379.361 | 383.880 | 388.356 | 392.809 | 397.251 | 401.692 | 406.136 | 410.591 | 415.059 | 419.544 | 424.048 | 428.573 | 433.121 | 437.693 | 442.291 | 446.916 | 451.568 | 456.249 | 460.959 | 465.698 | 470.467 |
| 5 | 5.301 | 381.893 | 386.537 | 391.128 | 395.687 | 400.228 | 404.761 | 409.295 | 413.834 | 422.945 | 427.524 | 432.121 | 436.738 | 441.378 | 446.042 | 450.730 | 455.444 | 460.185 | 464.954 | 469.751 | 474.576 | 479.433 |
| 10 | 6.247 | 384.334 | 389.112 | 393.825 | 398.496 | 403.142 | 407.775 | 412.401 | 417.029 | 421.662 | 426.306 | 430.962 | 435.633 | 440.323 | 445.032 | 449.763 | 454.517 | 459.295 | 464.098 | 468.927 | 473.783 | 478.666 |
| 15 | 7.316 | 386.669 | 391.593 | 396.438 | 401.230 | 405.988 | 410.725 | 415.450 | 420.171 | 424.893 | 429.620 | 434.357 | 439.107 | 443.871 | 448.653 | 453.453 | 458.275 | 463.118 | 467.985 | 472.876 | 477.792 | 482.734 |
| 20 | 8.518 | 388.884 | 393.968 | 398.956 | 403.878 | 408.757 | 413.605 | 418.435 | 423.254 | 428.069 | 432.885 | 437.706 | 442.536 | 447.378 | 452.235 | 457.108 | 461.999 | 466.910 | 471.842 | 476.797 | 481.776 | 486.778 |
| 25 | 9.864 | 390.960 | 396.223 | 401.368 | 406.433 | 411.441 | 416.409 | 421.350 | 426.273 | 431.186 | 436.094 | 441.004 | 445.918 | 450.841 | 455.775 | 460.727 | 465.696 | 470.676 | 475.677 | 480.688 | 485.730 | 490.795 |
| 30 | 11.365 | 392.874 | 398.340 | 403.661 | 408.882 | 414.031 | 419.127 | 424.187 | 429.220 | 434.237 | 439.243 | 444.245 | 449.247 | 454.254 | 459.269 | 464.294 | 469.332 | 474.385 | 479.455 | 484.544 | 489.652 | 494.781 |
| 35 | 13.032 | 394.603 | 400.302 | 405.821 | 411.215 | 416.517 | 421.752 | 426.939 | 432.090 | 437.216 | 442.325 | 447.424 | 452.519 | 457.613 | 462.712 | 467.818 | 472.934 | 478.062 | 483.204 | 488.361 | 493.533 | 498.733 |
| 40 | 14.877 | 396.112 | 402.085 | 407.830 | 413.417 | 418.888 | 424.274 | 429.598 | 434.874 | 440.117 | 445.335 | 450.536 | 455.728 | 460.914 | 466.101 | 471.291 | 476.487 | 481.693 | 486.910 | 492.141 | 497.387 | 502.649 |
| 45 | 16.916 | 397.363 | 403.663 | 409.669 | 415.472 | 421.131 | 426.682 | 432.154 | 437.565 | 442.932 | 448.265 | 453.575 | 458.866 | 464.152 | 469.430 | 474.707 | 479.988 | 485.274 | 490.569 | 495.874 | 501.193 | 506.525 |
| 50 | 19.162 | 398.302 | 405.001 | 411.312 | 417.363 | 423.230 | 428.963 | 434.596 | 440.153 | 445.652 | 451.109 | 456.533 | 461.934 | 467.319 | 472.694 | 478.063 | 483.431 | 488.801 | 494.176 | 499.560 | 504.953 | 510.358 |
| 55 | 21.632 | 398.855 | 406.057 | 412.731 | 419.067 | 425.169 | 431.103 | 436.912 | 442.627 | 448.270 | 453.858 | 459.404 | 464.919 | 470.411 | 475.887 | 481.352 | 486.811 | 492.269 | 497.728 | 503.192 | 508.663 | 514.143 |
| 60 | 24.345 | 398.912 | 406.770 | 413.887 | 420.555 | 426.925 | 433.083 | 439.087 | 444.973 | 450.771 | 456.501 | 462.177 | 467.813 | 473.419 | 479.001 | 484.567 | 490.122 | 495.671 | 501.218 | 506.766 | 512.317 | 517.875 |
| 65 | 27.325 | 398.302 | 407.061 | 414.730 | 421.794 | 428.471 | 434.883 | 441.102 | 447.177 | 453.133 | 459.205 | 464.841 | 470.606 | 476.332 | 482.027 | 487.700 | 493.356 | 499.001 | 504.639 | 510.274 | 515.909 | 521.547 |
| 70 | 30.602 | 396.721 | 406.812 | 415.192 | 422.734 | 429.771 | 436.470 | 442.930 | 449.214 | 455.365 | 461.412 | 467.379 | 473.282 | 479.136 | 484.951 | 490.737 | 496.499 | 502.245 | 507.979 | 513.705 | 519.428 | 525.151 |
| 75 | 34.222 | 393.539 | 405.834 | 415.169 | 423.302 | 430.765 | 437.797 | 444.530 | 451.048 | 457.401 | 463.630 | 469.760 | 475.814 | 481.806 | 487.749 | 493.655 | 499.530 | 505.383 | 511.218 | 517.041 | 522.857 | 528.668 |
| 80 | 38.279 | 386.891 | 403.751 | 414.443 | 423.339 | 431.323 | 438.751 | 445.803 | 452.587 | 459.172 | 465.604 | 471.916 | 478.135 | 484.279 | 490.363 | 496.399 | 502.397 | 508.365 | 514.309 | 520.236 | 526.150 | 532.056 |

Thermodynamic properties of R-438A - (superheated vapour) - Entropy (kJ/kg.K)

| Sat. Temp. °C | Sat. Pressure bar | Superheat (°C) | | | | | | | | | | | | | | | | | | | | |
|---------------|-------------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| -100 | 0.010 | 1.885 | 1.902 | 1.918 | 1.935 | 1.951 | 1.967 | 1.983 | 1.999 | 2.015 | 2.030 | 2.046 | 2.061 | 2.076 | 2.091 | 2.106 | 2.120 | 2.135 | 2.149 | 2.164 | 2.178 | 2.192 |
| -95 | 0.017 | 1.859 | 1.876 | 1.893 | 1.909 | 1.925 | 1.941 | 1.957 | 1.973 | 1.988 | 2.004 | 2.019 | 2.034 | 2.049 | 2.064 | 2.078 | 2.093 | 2.107 | 2.122 | 2.136 | 2.150 | 2.164 |
| -90 | 0.028 | 1.837 | 1.853 | 1.870 | 1.886 | 1.902 | 1.918 | 1.933 | 1.949 | 1.964 | 1.980 | 1.995 | 2.010 | 2.024 | 2.039 | 2.054 | 2.068 | 2.083 | 2.097 | 2.111 | 2.125 | 2.139 |
| -85 | 0.043 | 1.816 | 1.833 | 1.849 | 1.865 | 1.881 | 1.897 | 1.912 | 1.928 | 1.943 | 1.958 | 1.973 | 1.988 | 2.002 | 2.017 | 2.031 | 2.046 | 2.060 | 2.074 | 2.088 | 2.102 | 2.116 |
| -80 | 0.065 | 1.798 | 1.814 | 1.830 | 1.846 | 1.862 | 1.878 | 1.893 | 1.908 | 1.923 | 1.938 | 1.953 | 1.968 | 1.983 | 1.997 | 2.011 | 2.026 | 2.040 | 2.054 | 2.068 | 2.082 | 2.095 |
| -75 | 0.096 | 1.781 | 1.797 | 1.813 | 1.829 | 1.845 | 1.860 | 1.876 | 1.891 | 1.906 | 1.921 | 1.936 | 1.950 | 1.965 | 1.979 | 1.993 | 2.007 | 2.022 | 2.036 | 2.049 | 2.063 | 2.077 |
| -70 | 0.138 | 1.766 | 1.782 | 1.798 | 1.814 | 1.830 | 1.845 | 1.860 | 1.875 | 1.890 | 1.905 | 1.920 | 1.934 | 1.949 | 1.963 | 1.977 | 1.991 | 2.005 | 2.019 | 2.033 | 2.046 | 2.060 |
| -65 | 0.195 | 1.753 | 1.769 | 1.785 | 1.800 | 1.816 | 1.831 | 1.846 | 1.861 | 1.876 | 1.891 | 1.905 | 1.920 | 1.934 | 1.948 | 1.962 | 1.976 | 1.990 | 2.004 | 2.018 | 2.031 | 2.045 |
| -60 | 0.269 | 1.741 | 1.757 | 1.773 | 1.788 | 1.804 | 1.819 | 1.834 | 1.849 | 1.863 | 1.878 | 1.893 | 1.907 | 1.921 | 1.935 | 1.949 | 1.963 | 1.977 | 1.991 | 2.004 | 2.018 | 2.031 |
| -55 | 0.366 | 1.730 | 1.746 | 1.762 | 1.777 | 1.793 | 1.808 | 1.823 | 1.837 | 1.852 | 1.867 | 1.881 | 1.895 | 1.909 | 1.924 | 1.937 | 1.951 | 1.965 | 1.979 | 1.992 | 2.006 | 2.019 |
| -50 | 0.488 | 1.720 | 1.736 | 1.752 | 1.767 | 1.783 | 1.798 | 1.813 | 1.827 | 1.842 | 1.856 | 1.871 | 1.885 | 1.899 | 1.913 | 1.927 | 1.941 | 1.954 | 1.968 | 1.981 | 1.995 | 2.008 |
| -45 | 0.642 | 1.712 | 1.728 | 1.743 | 1.759 | 1.774 | 1.789 | 1.804 | 1.818 | 1.833 | 1.847 | 1.862 | 1.876 | 1.890 | 1.904 | 1.917 | 1.931 | 1.945 | 1.958 | 1.972 | 1.985 | 1.998 |
| -40 | 0.833 | 1.704 | 1.720 | 1.735 | 1.751 | 1.766 | 1.781 | 1.796 | 1.810 | 1.825 | 1.839 | 1.853 | 1.867 | 1.881 | 1.895 | 1.909 | 1.923 | 1.936 | 1.950 | 1.963 | 1.976 | 1.989 |
| -36.05 | 1.013 | 1.698 | 1.714 | 1.730 | 1.745 | 1.760 | 1.775 | 1.790 | 1.805 | 1.819 | 1.833 | 1.847 | 1.862 | 1.875 | 1.889 | 1.903 | 1.917 | 1.930 | 1.944 | 1.957 | 1.970 | 1.983 |
| -35 | 1.066 | 1.697 | 1.713 | 1.728 | 1.744 | 1.759 | 1.774 | 1.788 | 1.803 | 1.818 | 1.832 | 1.846 | 1.860 | 1.874 | 1.888 | 1.901 | 1.915 | 1.929 | 1.942 | 1.955 | 1.969 | 1.982 |
| -30 | 1.348 | 1.691 | 1.706 | 1.722 | 1.737 | 1.752 | 1.767 | 1.782 | 1.797 | 1.811 | 1.825 | 1.839 | 1.853 | 1.867 | 1.881 | 1.895 | 1.908 | 1.922 | 1.935 | 1.948 | 1.962 | 1.975 |
| -25 | 1.685 | 1.685 | 1.701 | 1.716 | 1.732 | 1.747 | 1.762 | 1.776 | 1.791 | 1.805 | 1.820 | 1.834 | 1.848 | 1.862 | 1.875 | 1.889 | 1.902 | 1.916 | 1.929 | 1.942 | 1.955 | 1.969 |
| -20 | 2.085 | 1.680 | 1.696 | 1.711 | 1.727 | 1.742 | 1.757 | 1.771 | 1.786 | 1.800 | 1.815 | 1.829 | 1.843 | 1.856 | 1.870 | 1.884 | 1.897 | 1.911 | 1.924 | 1.937 | 1.950 | 1.963 |
| -15 | 2.556 | 1.675 | 1.691 | 1.707 | 1.722 | 1.737 | 1.752 | 1.767 | 1.782 | 1.796 | 1.810 | 1.824 | 1.838 | 1.852 | 1.866 | 1.879 | 1.893 | 1.906 | 1.919 | 1.932 | 1.945 | 1.958 |
| -10 | 3.104 | 1.671 | 1.687 | 1.703 | 1.718 | 1.733 | 1.748 | 1.763 | 1.778 | 1.792 | 1.806 | 1.820 | 1.834 | 1.848 | 1.862 | 1.875 | 1.889 | 1.902 | 1.915 | 1.928 | 1.941 | 1.954 |
| -5 | 3.738 | 1.667 | 1.683 | 1.699 | 1.715 | 1.730 | 1.745 | 1.760 | 1.774 | 1.789 | 1.803 | 1.817 | 1.831 | 1.844 | 1.858 | 1.872 | 1.885 | 1.898 | 1.911 | 1.925 | 1.938 | 1.950 |
| 0 | 4.468 | 1.664 | 1.680 | 1.696 | 1.712 | 1.727 | 1.742 | 1.757 | 1.771 | 1.786 | 1.800 | 1.814 | 1.828 | 1.841 | 1.855 | 1.869 | 1.882 | 1.895 | 1.908 | 1.921 | 1.934 | 1.947 |
| 5 | 5.301 | 1.660 | 1.677 | 1.693 | 1.709 | 1.724 | 1.739 | 1.754 | 1.768 | 1.783 | 1.797 | 1.811 | 1.825 | 1.839 | 1.852 | 1.866 | 1.879 | 1.893 | 1.906 | 1.919 | 1.932 | 1.945 |
| 10 | 6.247 | 1.657 | 1.674 | 1.690 | 1.706 | 1.721 | 1.737 | 1.751 | 1.766 | 1.781 | 1.795 | 1.809 | 1.823 | 1.837 | 1.850 | 1.864 | 1.877 | 1.890 | 1.903 | 1.917 | 1.929 | 1.942 |
| 15 | 7.316 | 1.654 | 1.671 | 1.688 | 1.704 | 1.719 | 1.734 | 1.749 | 1.764 | 1.779 | 1.793 | 1.807 | 1.821 | 1.835 | 1.848 | 1.862 | 1.875 | 1.888 | 1.902 | 1.915 | 1.928 | 1.940 |
| 20 | 8.518 | 1.651 | 1.669 | 1.685 | 1.701 | 1.717 | 1.732 | 1.747 | 1.762 | 1.777 | 1.791 | 1.805 | 1.819 | 1.833 | 1.847 | 1.860 | 1.874 | 1.887 | 1.900 | 1.913 | 1.926 | 1.939 |
| 25 | 9.864 | 1.649 | 1.666 | 1.683 | 1.699 | 1.715 | 1.731 | 1.746 | 1.761 | 1.775 | 1.790 | 1.804 | 1.818 | 1.832 | 1.845 | 1.859 | 1.872 | 1.886 | 1.899 | 1.912 | 1.925 | 1.937 |
| 30 | 11.365 | 1.646 | 1.663 | 1.681 | 1.697 | 1.713 | 1.729 | 1.744 | 1.759 | 1.774 | 1.788 | 1.803 | 1.817 | 1.831 | 1.844 | 1.858 | 1.871 | 1.885 | 1.898 | 1.911 | 1.924 | 1.936 |
| 35 | 13.032 | 1.642 | 1.661 | 1.678 | 1.695 | 1.711 | 1.727 | 1.743 | 1.758 | 1.773 | 1.787 | 1.802 | 1.816 | 1.830 | 1.843 | 1.857 | 1.870 | 1.884 | 1.897 | 1.910 | 1.923 | 1.936 |
| 40 | 14.877 | 1.639 | 1.658 | 1.676 | 1.693 | 1.710 | 1.726 | 1.741 | 1.757 | 1.771 | 1.786 | 1.801 | 1.815 | 1.829 | 1.843 | 1.856 | 1.870 | 1.883 | 1.896 | 1.909 | 1.922 | 1.935 |
| 45 | 16.916 | 1.635 | 1.655 | 1.673 | 1.691 | 1.708 | 1.724 | 1.740 | 1.755 | 1.770 | 1.785 | 1.800 | 1.814 | 1.828 | 1.842 | 1.856 | 1.869 | 1.882 | 1.896 | 1.909 | 1.922 | 1.935 |
| 50 | 19.162 | 1.631 | 1.651 | 1.671 | 1.689 | 1.706 | 1.722 | 1.738 | 1.754 | 1.769 | 1.784 | 1.799 | 1.813 | 1.827 | 1.841 | 1.855 | 1.869 | 1.882 | 1.895 | 1.908 | 1.921 | 1.934 |
| 55 | 21.632 | 1.626 | 1.648 | 1.667 | 1.686 | 1.704 | 1.721 | 1.737 | 1.753 | 1.768 | 1.783 | 1.798 | 1.813 | 1.827 | 1.841 | 1.855 | 1.868 | 1.882 | 1.895 | 1.908 | 1.921 | 1.934 |
| 60 | 24.345 | 1.620 | 1.643 | 1.664 | 1.683 | 1.701 | 1.719 | 1.735 | 1.751 | 1.767 | 1.782 | 1.797 | 1.812 | 1.826 | 1.840 | 1.854 | 1.868 | 1.881 | 1.895 | 1.908 | 1.921 | 1.934 |
| 65 | 27.325 | 1.612 | 1.638 | 1.660 | 1.680 | 1.699 | 1.717 | 1.734 | 1.750 | 1.766 | 1.781 | 1.796 | 1.811 | 1.826 | 1.840 | 1.854 | 1.868 | 1.881 | 1.895 | 1.908 | 1.921 | 1.934 |
| 70 | 30.602 | 1.602 | 1.631 | 1.655 | 1.676 | 1.696 | 1.714 | 1.732 | 1.748 | 1.764 | 1.780 | 1.795 | 1.810 | 1.825 | 1.839 | 1.853 | 1.867 | 1.881 | 1.894 | 1.908 | 1.921 | 1.934 |
| 75 | 34.222 | 1.588 | 1.623 | 1.649 | 1.672 | 1.692 | 1.711 | 1.729 | 1.746 | 1.763 | 1.779 | 1.794 | 1.809 | 1.824 | 1.838 | 1.853 | 1.867 | 1.880 | 1.894 | 1.907 | 1.921 | 1.934 |
| 80 | 38.279 | 1.565 | 1.612 | 1.642 | 1.666 | 1.688 | 1.707 | 1.726 | 1.743 | 1.760 | 1.777 | 1.792 | 1.808 | 1.823 | 1.837 | 1.852 | 1.866 | 1.880 | 1.893 | 1.907 | 1.920 | 1.933 |