TA Instruments

Thermal Analysis & Rheology

# THERMAL APPLICATIONS NOTE

## Sapphire Specific Heat Capacity Literature Values

Specific heat capacity measurements by DSC require the use of a well-characterized reference material (usually sapphire) to obtain results. The table below summarizes specific heat capacity data (literature values) for sapphire as a function of temperature. These values can be used in the required calculations.

| Temperature °C | K | Specific Heat J/g°C | Temperature °C | K | Specific Heat J/g°C |
|---|---|---|---|---|---|
| -183.15 | 90 | 0.0949 | 126.85 | 400 | 0.9423 |
| -173.15 | 100 | 0.1261 | 136.85 | 410 | 0.9545 |
| -163.15 | 110 | 0.1603 | 146.85 | 420 | 0.9660 |
| -153.15 | 120 | 0.1968 | 156.85 | 430 | 0.9770 |
| -143.15 | 130 | 0.2349 | 166.85 | 440 | 0.9875 |
| -133.15 | 140 | 0.2739 | 176.85 | 450 | 0.9975 |
| -123.15 | 150 | 0.3134 | 186.85 | 460 | 1.0070 |
| -113.15 | 170 | 0.3526 | 196.85 | 470 | 1.0161 |
| -103.15 | 170 | 0.3913 | 206.85 | 480 | 1.0247 |
| -93.15 | 180 | 0.4291 | 216.85 | 490 | 1.0330 |
| -83.15 | 190 | 0.4659 | 226.85 | 500 | 1.0409 |
| -73.15 | 200 | 0.5014 | 236.85 | 510 | 1.0484 |
| -63.15 | 210 | 0.5356 | 246.85 | 520 | 1.0557 |
| -53.15 | 220 | 0.5684 | 256.85 | 530 | 1.0627 |
| -43.15 | 230 | 0.5996 | 266.85 | 540 | 1.0692 |
| -33.15 | 240 | 0.6294 | 276.85 | 550 | 1.0756 |
| -23.15 | 250 | 0.6579 | 286.85 | 560 | 1.0817 |
| -13.15 | 260 | 0.6848 | 296.85 | 570 | 1.0876 |
| -3.15 | 270 | 0.7103 | 306.85 | 580 | 1.0932 |
| 0.00 | 273.15 | 0.7180 | 316.85 | 590 | 1.0987 |
| 6.85 | 280 | 0.7343 | 326.85 | 600 | 1.1038 |
| 16.85 | 290 | 0.7572 | 336.85 | 610 | 1.1089 |
| 26.85 | 300 | 0.7788 | 346.85 | 620 | 1.1137 |
| 36.85 | 310 | 0.7994 | 356.85 | 630 | 1.1183 |
| 46.85 | 320 | 0.8188 | 366.85 | 640 | 1.1228 |
| 56.85 | 330 | 0.8373 | 376.85 | 650 | 1.1271 |
| 66.85 | 340 | 0.8548 | 386.85 | 660 | 1.1313 |
| 76.85 | 350 | 0.8713 | 396.85 | 670 | 1.1353 |
| 86.85 | 360 | 0.8871 | 406.85 | 680 | 1.1393 |
| 96.85 | 370 | 0.9020 | 416.85 | 690 | 1.1431 |
| 106.85 | 380 | 0.9161 | 426.85 | 700 | 1.1467 |
| 116.85 | 390 | 0.9296 | 446.85 | 720 | 1.1538 |

| Temperature °C | K | Specific Heat J/g°C | Temperature °C | K | Specific Heat J/g°C |
|---|---|---|---|---|---|
| 466.85 | 740 | 1.1604 | 806.85 | 1080 | 1.2383 |
| 486.85 | 760 | 1.1667 | 826.85 | 1100 | 1.2417 |
| 506.85 | 780 | 1.1726 | 846.85 | 1120 | 1.2451 |
| 526.85 | 800 | 1.1783 | 866.85 | 1140 | 1.2484 |
| 546.85 | 820 | 1.1837 | 886.85 | 1160 | 1.2516 |
| 566.85 | 840 | 1.1888 | 906.85 | 1180 | 1.2548 |
| 586.85 | 860 | 1.1937 | 926.85 | 1200 | 1.2578 |
| 606.85 | 880 | 1.1985 | 976.85 | 1250 | 1.2653 |
| 626.85 | 900 | 1.2030 | 1026.85 | 1300 | 1.2724 |
| 646.85 | 920 | 1.2074 | 1076.85 | 1350 | 1.2792 |
| 666.85 | 940 | 1.2117 | 1126.85 | 1400 | 1.2856 |
| 686.85 | 960 | 1.2159 | 1176.85 | 1450 | 1.2917 |
| 706.85 | 980 | 1.2198 | 1226.85 | 1500 | 1.2975 |
| 726.85 | 1000 | 1.2237 | 1276.85 | 1550 | 1.3028 |
| 746.85 | 1020 | 1.2275 | 1326.85 | 1600 | 1.3079 |
| 766.85 | 1040 | 1.2312 | 1376.85 | 1650 | 1.3128 |
| 786.85 | 1060 | 1.2348 | | | |

Table taken from D. A. Ditmars, et. al., *J. Res. Nat. Bur. Stand.*, *87,* (2), 159-163 (1982).

The values in the table were determined by Ginnings and Furukawa of the National Bureau of Standards on aluminum oxide in the form of synthetic sapphire (corundum). The sapphire pieces passed a #10 sieve but were retained by a #40 sieve, and had 99.98 to 99.99 % purity by weight. Heat capacity values below the experimental range were obtained by extrapolation of the Debye equation fitted to the experimental value at the lowest temperature. The units J/g-mole are absolute joules per degree per gram mole (molecular weight - 101.9613) at a constant pressure of 1 atmosphere (100 Pa).


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