## REFERENCE STATE

| | | | | |
|---|---|---|---|---|
| 0 | to | 302.920 | K | crystal |
| 302.92 | to | 2476.570 | K | liquid |
| above | | 2476.570 | K | ideal monatomic gas |

Refer to the individual tables for details.





Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p^\circ$ = 0.1 MPa

| $T$/K | $C_p^\circ$ | $S^\circ$ | $-[G^\circ-H^\circ(T_r)]/T$ | $H^\circ-H^\circ(T_r)$ | $\Delta_f H^\circ$ | $\Delta_f G^\circ$ | log $K_f$ |
|---|---|---|---|---|---|---|---|
| | J·K⁻¹·mol⁻¹ | | | kJ·mol⁻¹ | | | |
| 0 | 0. | 0. | INFINITE | −5.561 | 0. | 0. | 0. |
| 100 | 18.484 | 16.085 | 62.261 | −4.618 | 0. | 0. | 0. |
| 200 | 23.815 | 30.912 | 43.151 | −2.448 | 0. | 0. | 0. |
| 298.15 | 26.064 | 40.838 | 40.838 | 0. | 0. | 0. | 0. |
| 300 | 26.091 | 41.000 | 40.839 | 0.048 | 0. | 0. | 0. |
| 302.920 | 26.133 | 41.253 | 40.842 | 0.124 | CRYSTAL <--> LIQUID TRANSITION | | |
| 302.920 | 28.493 | 59.706 | 40.842 | 5.714 | | | |
| 400 | 27.154 | 67.426 | 46.408 | 8.407 | 0. | 0. | 0. |
| 500 | 26.819 | 73.445 | 51.237 | 11.104 | 0. | 0. | 0. |
| 600 | 26.694 | 78.324 | 55.358 | 13.780 | 0. | 0. | 0. |
| 700 | 26.568 | 82.428 | 58.939 | 16.442 | 0. | 0. | 0. |
| 800 | 26.568 | 85.976 | 62.102 | 19.099 | 0. | 0. | 0. |
| 900 | 26.568 | 89.105 | 64.932 | 21.756 | 0. | 0. | 0. |
| 1000 | 26.568 | 91.904 | 67.492 | 24.413 | 0. | 0. | 0. |
| 1100 | 26.568 | 94.436 | 69.828 | 27.069 | 0. | 0. | 0. |
| 1200 | 26.568 | 96.748 | 71.976 | 29.726 | 0. | 0. | 0. |
| 1300 | 26.568 | 98.875 | 73.965 | 32.383 | 0. | 0. | 0. |
| 1400 | 26.568 | 100.844 | 75.815 | 35.040 | 0. | 0. | 0. |
| 1500 | 26.568 | 102.677 | 77.546 | 37.697 | 0. | 0. | 0. |
| 1600 | 26.568 | 104.391 | 79.171 | 40.354 | 0. | 0. | 0. |
| 1700 | 26.568 | 106.002 | 80.702 | 43.010 | 0. | 0. | 0. |
| 1800 | 26.568 | 107.521 | 82.150 | 45.667 | 0. | 0. | 0. |
| 1900 | 26.568 | 108.957 | 83.524 | 48.324 | 0. | 0. | 0. |
| 2000 | 26.568 | 110.320 | 84.830 | 50.981 | 0. | 0. | 0. |
| 2100 | 26.568 | 111.616 | 86.075 | 53.638 | 0. | 0. | 0. |
| 2200 | 26.568 | 112.852 | 87.264 | 56.295 | 0. | 0. | 0. |
| 2300 | 26.568 | 114.033 | 88.402 | 58.951 | 0. | 0. | 0. |
| 2400 | 26.568 | 115.164 | 89.494 | 61.608 | 0. | 0. | 0. |
| 2476.570 | 26.568 | 115.998 | 90.301 | 63.643 | LIQUID <--> IDEAL GAS FUGACITY = 1 bar | | |
| 2476.570 | 21.260 | 220.462 | 90.301 | 322.353 | | | |
| 2500 | 21.251 | 220.662 | 91.522 | 322.851 | 0. | 0. | 0. |
| 2600 | 21.215 | 221.495 | 96.505 | 324.974 | 0. | 0. | 0. |
| 2700 | 21.184 | 222.295 | 101.149 | 327.094 | 0. | 0. | 0. |
| 2800 | 21.156 | 223.065 | 105.489 | 329.211 | 0. | 0. | 0. |
| 2900 | 21.131 | 223.807 | 109.556 | 331.325 | 0. | 0. | 0. |
| 3000 | 21.109 | 224.523 | 113.377 | 333.437 | 0. | 0. | 0. |
| 3100 | 21.090 | 225.214 | 116.973 | 335.547 | 0. | 0. | 0. |
| 3200 | 21.073 | 225.884 | 120.366 | 337.655 | 0. | 0. | 0. |
| 3300 | 21.059 | 226.532 | 123.574 | 339.762 | 0. | 0. | 0. |
| 3400 | 21.047 | 227.160 | 126.611 | 341.867 | 0. | 0. | 0. |
| 3500 | 21.036 | 227.770 | 129.493 | 343.971 | 0. | 0. | 0. |
| 3600 | 21.029 | 228.363 | 132.231 | 346.075 | 0. | 0. | 0. |
| 3700 | 21.023 | 228.939 | 134.837 | 348.177 | 0. | 0. | 0. |
| 3800 | 21.020 | 229.500 | 137.321 | 350.279 | 0. | 0. | 0. |
| 3900 | 21.018 | 230.045 | 139.691 | 352.381 | 0. | 0. | 0. |
| 4000 | 21.020 | 230.578 | 141.957 | 354.483 | 0. | 0. | 0. |
| 4100 | 21.024 | 231.097 | 144.125 | 356.585 | 0. | 0. | 0. |
| 4200 | 21.030 | 231.603 | 146.202 | 358.688 | 0. | 0. | 0. |
| 4300 | 21.040 | 232.098 | 148.193 | 360.791 | 0. | 0. | 0. |
| 4400 | 21.052 | 232.582 | 150.106 | 362.896 | 0. | 0. | 0. |
| 4500 | 21.068 | 233.055 | 151.944 | 365.002 | 0. | 0. | 0. |
| 4600 | 21.087 | 233.519 | 153.712 | 367.110 | 0. | 0. | 0. |
| 4700 | 21.109 | 233.972 | 155.415 | 369.219 | 0. | 0. | 0. |
| 4800 | 21.135 | 234.417 | 157.056 | 371.332 | 0. | 0. | 0. |
| 4900 | 21.165 | 234.853 | 158.640 | 373.446 | 0. | 0. | 0. |
| 5000 | 21.198 | 235.281 | 160.168 | 375.565 | 0. | 0. | 0. |
| 5100 | 21.236 | 235.701 | 161.645 | 377.686 | 0. | 0. | 0. |
| 5200 | 21.278 | 236.114 | 163.073 | 379.812 | 0. | 0. | 0. |
| 5300 | 21.324 | 236.520 | 164.455 | 381.942 | 0. | 0. | 0. |
| 5400 | 21.375 | 236.919 | 165.793 | 384.077 | 0. | 0. | 0. |
| 5500 | 21.431 | 237.312 | 167.090 | 386.217 | 0. | 0. | 0. |
| 5600 | 21.491 | 237.698 | 168.348 | 388.363 | 0. | 0. | 0. |
| 5700 | 21.556 | 238.079 | 169.568 | 390.515 | 0. | 0. | 0. |
| 5800 | 21.625 | 238.455 | 170.752 | 392.674 | 0. | 0. | 0. |
| 5900 | 21.700 | 238.825 | 171.903 | 394.841 | 0. | 0. | 0. |
| 6000 | 21.780 | 239.190 | 173.021 | 397.015 | 0. | 0. | 0. |

PREVIOUS: CURRENT: June 1983 (1 bar)

$S°(298.15\ K) = 40.838 \pm 0.20\ J \cdot K^{-1} \cdot mol^{-1}$
$T_{fus} = 302.92 \pm 0.02\ K$

$\Delta_f H°(0\ K) = 0\ kJ \cdot mol^{-1}$
$\Delta_f H°(298.15\ K) = 0\ kJ \cdot mol^{-1}$
$\Delta_{fus} H° = 5.59 \pm 0.04\ kJ \cdot mol^{-1}$

## Enthalpy of Formation

Zero by definition.

## Heat Capacity and Entropy

The adopted thermal functions are those recommended by Hultgren *et al.*[1] The heat capacity values were based on the studies of Phillips (0.1–4.2 K),[2] Seidel and Kiesom (0.35–4.38 K),[3] Eichenaur and Schulze (5–22 K),[4] Adams *et al.* (15–323 K),[5] and Clusius and Hartick (15–200 K).[6] Refer to Hultgren *et al.*[1] for details.

## Enthalpy of Fusion

Refer to the liquid table for details.

## Enthalpy of Sublimation

The enthalpy of sublimation is the enthalpy of formation of the gas, $\Delta_{sub} H°(298.15\ K) = \Delta_f H°(g, 298.15\ K)$.

## References


[1] R. Hultgren, P. D. Desai, *et al.*, "Selected Values of the Thermodynamics Properties of the Elements," American Society for Metals, Metals Parks, Ohio (1973).
[2] N. E. Phillips, Phys. Rev. **134**, A385 (1964).
[3] G. Seidel and P. H. Keesom, Phys. Rev. **112**, 1083 (1958).
[4] W. Eichenauer and M. Schulze, Z. Naturforsch. **14a**, 962 (1959).
[5] G. B. Adams, H. L. Johnston and E. C. Kerr, J. Am. Chem. Soc. **74**, 4784 (1952).
[6] K. Clusius and P. Hartick, Z. Physik. Chem. **134**, 243 9 (1928).




Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p°$ = 0.1 MPa

| $T$/K | $C_p°$ | $S°$ | $-[G°-H°(T_r)]/T$ | $H°-H°(T_r)$ | $\Delta_f H°$ | $\Delta_f G°$ | log $K_f$ |
|---|---|---|---|---|---|---|---|
| | J·K⁻¹mol⁻¹ | | | kJ·mol⁻¹ | | | |
| 0 | 0. | 0. | INFINITE | −5.561 | 0. | 0. | 0. |
| 100 | 18.484 | 16.085 | 62.261 | −4.618 | 0. | 0. | 0. |
| 200 | 23.815 | 30.912 | 43.151 | −2.448 | 0. | 0. | 0. |
| 250 | 24.907 | 36.338 | 41.262 | −1.231 | 0. | 0. | 0. |
| 298.15 | 26.064 | 40.838 | 40.838 | 0. | 0. | 0. | 0. |
| 300 | 26.091 | 41.000 | 40.839 | 0.048 | 0. | 0. | 0. |
| 302.920 | 26.133 | 41.253 | 40.842 | 0.124 | --- CRYSTAL <---> LIQUID --- | | |
| 350 | 27.004 | 45.091 | 41.160 | 1.376 | −5.661 | 0.875 | −0.131 |
| 400 | 27.460 | 48.726 | 41.883 | 2.737 | −5.670 | 1.810 | −0.236 |
| 450 | 27.916 | 51.987 | 42.827 | 4.122 | −5.638 | 2.743 | −0.318 |
| 500 | 28.372 | 54.952 | 43.894 | 5.529 | −5.575 | 3.672 | −0.384 |

PREVIOUS·  CURRENT: June 1983

$S°(298.15\ K) = [59.253]\ J·K^{-1}·mol^{-1}$
$T = 302.92 \pm 0.02\ K$

$\Delta_f H°(298.15\ K) = [5.578]\ kJ·mol^{-1}$
$\Delta_{fus} H° = 5.59 \pm 0.04\ kJ·mol^{-1}$

## Enthalpy of Formation

The enthalpy of formation, $\Delta_f H°(l, 298.15\ K)$, is calculated from that of the crystal by adding the enthalpy of fusion and the difference in enthalpy, $H°(302.92\ K) - H°(298.15\ K)$, between the crystal and liquid.

## Heat Capacity and Entropy

The heat capacity of the liquid is based on the recommendations of Hultgren *et al.*[1] These values are based on the enthalpy data of Kochethova and Rezukhina (315–712 K),[2] and the heat capacity data of Chen and Turnbull (245–611 K).[3]

## Enthalpy of Fusion

The adopted value for the enthalpy of fusion is derived from the direct calorimetric measurement of Roth *et al.*[4]

The temperature of fusion, $T_{fus} = 302.92 \pm 0.2$ K (corrected to IPTS–68), was derived from the study of Boedtker *et al.*[5]

## Enthalpy of Vaporization

The temperature at which $\Delta_r G° = 0$ (1 bar) for the process $Ga(l) \rightarrow Ga(g)$ is the adopted $T_{vap}$ (1bar). The difference in the enthalpies of formation of the ideal gas and liquid at $T_{vap}$ is $\Delta_{vap} H°$. Refer to the ideal gas table for additional information.

## References


[1] R Hultgren, P. D. Desai, *et al.*, "Selected Values of the Thermodynamics Properties of the Elements," American Society for Metals, Metals Parks, Ohio (1973).
[2] H. M Kochetkova and T. N. Rezukhina, Proc. 4th All-Union Conf. on Semiconductor Materials (Eng. transl ), 26 (1961).
[3] H. S. Chen and S. Turnbull, Acta Met. **16**, 369 (1968).
[4] W A. Roth, I. Meyer and H. Zeumar, Z. Anorg. Chem. **214**, 309 (1933); Z. Anorg Chem. **216**, 303 (1934).
[5] O. A. Boedtker, R. C. LaForce, *et al.*, Trans. Faraday Soc. **61**, 665 (1965).


Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p°$ = 0.1 MPa

| $T$/K | $C_p°$ | $S°$ | $-[G°-H°(T_r)]/T$ | $H°-H°(T_r)$ | $\Delta_f H°$ | $\Delta_f G°$ | log $K_f$ |
|---|---|---|---|---|---|---|---|
| | | J·K⁻¹mol⁻¹ | | kJ·mol⁻¹ | | | |
| 0 | | | | | | | |
| 100 | | | | | | | |
| 200 | | | | | | | |
| 250 | | | | | | | |
| 298.15 | 28.559 | 59.253 | 59.253 | 0. | 5.578 | 0.088 | −0.015 |
| 300 | 28.533 | 59.429 | 59.253 | 0.053 | 5.583 | 0.054 | −0 009 |
| 302.920 | 28.493 | 59.706 | 59.256 | 0.136 | --- CRYSTAL <---> LIQUID --- | | |
| 350 | 27.719 | 63.764 | 59.598 | 1.458 | 0. | 0. | 0. |
| 400 | 27.154 | 67.426 | 60.353 | 2.829 | 0. | 0. | 0. |
| 450 | 26.961 | 70.613 | 61.320 | 4.182 | 0. | 0. | 0. |
| 500 | 26.819 | 73.445 | 62.393 | 5.526 | 0. | 0. | 0. |
| 600 | 26.694 | 78.324 | 64.655 | 8.202 | 0. | 0. | 0. |
| 700 | 26.568 | 82.428 | 66.908 | 10.864 | 0. | 0. | 0. |
| 800 | 26.568 | 85.976 | 69.075 | 13.521 | 0. | 0. | 0. |
| 900 | 26.568 | 89.105 | 71.130 | 16.177 | 0. | 0. | 0. |
| 1000 | 26.568 | 91.904 | 73.070 | 18.834 | 0. | 0. | 0. |
| 1100 | 26.568 | 94.436 | 74.899 | 21.491 | 0. | 0. | 0. |
| 1200 | 26.568 | 96.748 | 76.625 | 24.148 | 0. | 0. | 0. |
| 1300 | 26.568 | 98.875 | 78.256 | 26.805 | 0 | 0. | 0. |
| 1400 | 26.568 | 100.844 | 79.800 | 29.462 | 0. | 0 | 0. |
| 1500 | 26.568 | 102.677 | 81.264 | 32.118 | 0. | 0. | 0. |
| 1600 | 26.568 | 104.391 | 82.657 | 34.775 | 0 | 0 | 0. |
| 1700 | 26.568 | 106.002 | 83.983 | 37.432 | 0. | 0 | 0. |
| 1800 | 26.568 | 107.521 | 85.249 | 40.089 | 0. | 0 | 0. |
| 1900 | 26.568 | 108.957 | 86.459 | 42.746 | 0. | 0. | 0. |
| 2000 | 26.568 | 110.320 | 87.619 | 45.403 | 0 | 0. | 0. |
| 2100 | 26.568 | 111.616 | 88.731 | 48.060 | 0. | 0 | 0. |
| 2200 | 26.568 | 112.852 | 89 799 | 50.716 | 0. | 0. | 0. |
| 2300 | 26.568 | 114.033 | 90.828 | 53.373 | 0. | 0. | 0. |
| 2400 | 26.568 | 115.164 | 91.818 | 56.030 | 0. | 0. | 0. |
| 2476.570 | 26.568 | 115.998 | 92.553 | 58.064 | ----- FUGACITY = 1 bar ----- | | |
| 2500 | 26.568 | 116.249 | 92.774 | 58.687 | −258.586 | 2.447 | −0.051 |
| 2600 | 26.568 | 117.291 | 93.697 | 61.344 | −258.052 | 12.878 | −0.259 |
| 2700 | 26.568 | 118.293 | 94.589 | 64.001 | −257.515 | 23.288 | −0.451 |
| 2800 | 26.568 | 119.260 | 95.453 | 66.657 | −256.975 | 33.679 | −0.628 |
| 2900 | 26.568 | 120.192 | 96.290 | 69.314 | −256.433 | 44.050 | −0.793 |
| 3000 | 26.568 | 121.093 | 97.102 | 71.971 | −255.888 | 54.402 | −0.947 |

PREVIOUS: CURRENT: June 1983

## CRYSTAL–LIQUID

| | | | |
|---|---|---|---|
| 0 | to | 302.92 K | crystal |
| above | | 302.92 K | liquid |

Refer to the individual tables for details.









Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p^\circ$ = 0.1 MPa

| | J·K⁻¹mol⁻¹ | | | kJ·mol⁻¹ | | | |
|---|---|---|---|---|---|---|---|
| $T$/K | $C_p^\circ$ | $S^\circ$ | $-[G^\circ-H^\circ(T_r)]/T$ | $H^\circ-H^\circ(T_r)$ | $\Delta_f H^\circ$ | $\Delta_f G^\circ$ | log $K_f$ |
| 0 | 0. | 0. | INFINITE | −5.561 | 0. | 0. | 0. |
| 100 | 18.484 | 16.085 | 62.261 | −4.618 | 0. | 0. | 0. |
| 200 | 23.815 | 30.912 | 43.151 | −2.448 | 0. | 0. | 0. |
| 250 | 24.907 | 36.338 | 41.262 | −1.231 | 0. | 0. | 0. |
| 298.15 | 26.064 | 40.838 | 40.838 | 0. | 0. | 0. | 0. |
| 300 | 26.091 | 41.000 | 40.839 | 0.048 | 0. | 0. | 0. |
| 302.920 | 26.133 | 41.253 | 40.842 | 0.124 | CRYSTAL <--> LIQUID TRANSITION | | |
| 302.920 | 28.493 | 59.706 | 40.842 | 5.714 | | | |
| 350 | 27.719 | 63.764 | 43.660 | 7.037 | 0. | 0. | 0. |
| 400 | 27.154 | 67.426 | 46.408 | 8.407 | 0. | 0. | 0. |
| 450 | 26.961 | 70.613 | 48.924 | 9.760 | 0. | 0. | 0. |
| 500 | 26.819 | 73.445 | 51.237 | 11.104 | 0. | 0. | 0. |
| 600 | 26.694 | 78.324 | 55.358 | 13.780 | 0. | 0. | 0. |
| 700 | 26.568 | 82.428 | 58.939 | 16.442 | 0. | 0. | 0. |
| 800 | 26.568 | 85.976 | 62.102 | 19.099 | 0. | 0. | 0. |
| 900 | 26.568 | 89.105 | 64.932 | 21.756 | 0. | 0. | 0. |
| 1000 | 26.568 | 91.904 | 67.492 | 24.413 | 0. | 0. | 0. |
| 1100 | 26.568 | 94.436 | 69.828 | 27.069 | 0. | 0. | 0. |
| 1200 | 26.568 | 96.748 | 71.976 | 29.726 | 0. | 0. | 0. |
| 1300 | 26.568 | 98.875 | 73.965 | 32.383 | 0. | 0. | 0. |
| 1400 | 26.568 | 100.844 | 75.815 | 35.040 | 0. | 0. | 0. |
| 1500 | 26.568 | 102.677 | 77.546 | 37.697 | 0. | 0. | 0. |
| 1600 | 26.568 | 104.391 | 79.171 | 40.354 | 0. | 0. | 0. |
| 1700 | 26.568 | 106.002 | 80.702 | 43.010 | 0. | 0. | 0. |
| 1800 | 26.568 | 107.521 | 82.150 | 45.667 | 0. | 0. | 0. |
| 1900 | 26.568 | 108.957 | 83.524 | 48.324 | 0. | 0. | 0. |
| 2000 | 26.568 | 110.320 | 84.830 | 50.981 | 0. | 0. | 0. |
| 2100 | 26.568 | 111.616 | 86.075 | 53.638 | 0. | 0. | 0. |
| 2200 | 26.568 | 112.852 | 87.264 | 56.295 | 0. | 0. | 0. |
| 2300 | 26.568 | 114.033 | 88.402 | 58.951 | 0. | 0. | 0. |
| 2400 | 26.568 | 115.164 | 89.494 | 61.608 | 0. | 0. | 0. |
| 2476.570 | 26.568 | 115.998 | 90.301 | 63.643 | FUGACITY = 1 bar | | |
| 2500 | 26.568 | 116.249 | 90.543 | 64.265 | −258.586 | 2.447 | −0.051 |
| 2600 | 26.568 | 117.291 | 91.551 | 66.922 | −258.052 | 12.878 | −0.259 |
| 2700 | 26.568 | 118.293 | 92.523 | 69.579 | −257.515 | 23.288 | −0.451 |
| 2800 | 26.568 | 119.260 | 93.461 | 72.236 | −256.975 | 33.679 | −0.628 |
| 2900 | 26.568 | 120.192 | 94.367 | 74.892 | −256.433 | 44.050 | −0.793 |
| 3000 | 26.568 | 121.093 | 95.243 | 77.549 | −255.888 | 54.402 | −0.947 |

PREVIOUS:  CURRENT: June 1983

IP(Ga, g) = 48380 ± 5 $cm^{-1}$
$S°(298.15\ K)$ = 169.042 ± 0.01 $J·K^{-1}·mol^{-1}$

$\Delta_f H°(0\ K)$ = 270.97 ± 2.1 $kJ·mol^{-1}$
$\Delta_f H°(298.15\ K)$ = 271.96 ± 2.1 $kJ·mol^{-1}$

| Electronic Levels and Quantum Weights | | |
|---|---|---|
| State | $\epsilon_i$, $cm^{-1}$ | $g_i$ |
| $^3P_{1/2}$ | 0 | 2 |
| $^3P_{3/2}$ | 826.24 | 4 |
| $^2S_{1/2}$ | 24788.58 | 2 |
| $^2P_{1/2}$ | 33044.06 | 2 |
| $^2P_{3/2}$ | 33155.03 | 4 |

## Enthalpy of Formation

The enthalpy of formation of Ga(g), as recommended by Hultgren *et al.*,[1] was derived from the third law analysis of seven vaporization studies and a spectroscopic calculation. The studies are: Matern *et al.* (1081–1213 K),[2] Macur *et al.* (1196–1473 K),[3] Alcock *et al.* (1173–1437 K),[4] Munir and Searcy (1174–1603 K),[5] Cochran and Foster (1179–1383 K),[6] Speiser and Johnston (1230–1518 K),[7] Hartick (1198–1391 K),[8] and the spectroscopic calculaion by Gurvich.[9]

## Heat Capacity and Entropy

The thermal functions were calculated using the atomic levels as given by Moore.[10] The resulting thermal functions are those recommended by Hultgren *et al.*[1]

## References


[1]R. Hultgren, P. D. Desai, *et al.*, "Selected Values of the Thermodynamic Properties of the Elements," American Society for Metals, Metals Park, Ohio, (1973).
[2]G. Matern, Yu. A. Sapozhnikov, *et al.*, Zzvest. Akad. Nauk SSSR, Metally, (3) 210 (1969).
[3]G. J. Macur, R. K. Edwards, and P. G. Wahlbick, J. Phys. Chem. **70**, 2956 (1966).
[4]C. B. Alcock, J. B. Cormish and P. Grievson, "Thermodynamics," Proc. Symp. Vienna, Vol. 1, 211–30, 367–8 (1965).
[5]Z. A. Munir and A. W. Searcy, J. Electrochem. Soc. **111**, 1170 (1964).
[6]C. N. Cochran and L. M. Foster, J. Electrochem. Soc. **109**, 144 (1962).
[7]R. Speiser and H. L. Johnston, J. Am. Chem. Soc. **75**, 1469 (1953).
[8]P. Hartick, Z. Physik. Chem. **134**, 1 (1960).
[9]L. V. Gurvich, Zh. Fiz. Khim. **34**, 1690 (1960).
[10]C. E. Moore, U. S. Nat. Bur. Stand., NSRDS–NBS–35, Vol. II, 1971 [Reprint of NBS Circ. 497, (1952).


Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p°$ = 0.1 MPa

| $T$/K | $C_p°$ | $S°$ | $-[G°-H°(T_r)]/T$ | $H°-H°(T_r)$ | $\Delta_f H°$ | $\Delta_f G°$ | log $K_f$ |
|---|---|---|---|---|---|---|---|
| | $J·K^{-1}mol^{-1}$ | | | $kJ·mol^{-1}$ | | | |
| 0 | 0. | 0. | INFINITE | −6.551 | 270.970 | 270.970 | INFINITE |
| 100 | 20.802 | 144.848 | 189.570 | −4.472 | 272.105 | 259.229 | −135.407 |
| 200 | 22.311 | 159.555 | 171.266 | −2.342 | 272.066 | 246.337 | −64.337 |
| 250 | 23.914 | 164.703 | 169.452 | −1.187 | 272.004 | 239.913 | −50.127 |
| 298.15 | 25.346 | 169.042 | 169.042 | 0. | 271.960 | 233.736 | −40.950 |
| 300 | 25.394 | 169.199 | 169.043 | 0.047 | 271.959 | 233.499 | −40.656 |
| 350 | 26.430 | 173.198 | 169.356 | 1.345 | 266.268 | 227.966 | −34.022 |
| 400 | 26.974 | 176.768 | 170.064 | 2.682 | 266.234 | 222.497 | −29.055 |
| 450 | 27.120 | 179.957 | 170.989 | 4.035 | 266.235 | 217.030 | −25.192 |
| 500 | 26.991 | 182.809 | 172.031 | 5.389 | 266.245 | 211.563 | −22.102 |
| 600 | 26.316 | 187.676 | 174.247 | 8.057 | 266.237 | 200.626 | −17.466 |
| 700 | 25.489 | 191.671 | 176.460 | 10.648 | 266.166 | 189.696 | −14.155 |
| 800 | 24.724 | 195.023 | 178.576 | 13.157 | 266.018 | 178.781 | −11.673 |
| 900 | 24.077 | 197.896 | 180.567 | 15.596 | 265.801 | 167.888 | −9.744 |
| 1000 | 23.550 | 200.405 | 182.428 | 17.977 | 265.524 | 157.023 | −8.202 |
| 1100 | 23.125 | 202.629 | 184.166 | 20.310 | 265.200 | 146.189 | −6.942 |
| 1200 | 22.781 | 204.626 | 185.789 | 22.604 | 264.838 | 135.385 | −5.893 |
| 1300 | 22.503 | 206.438 | 187.309 | 24.868 | 264.445 | 124.613 | −5.007 |
| 1400 | 22.275 | 208.097 | 188.735 | 27.107 | 264.027 | 113.872 | −4.249 |
| 1500 | 22.088 | 209.627 | 190.077 | 29.324 | 263.588 | 103.162 | −3.592 |
| 1600 | 21.933 | 211.048 | 191.344 | 31.525 | 263.132 | 92.482 | −3.019 |
| 1700 | 21.802 | 212.373 | 192.543 | 33.712 | 262.661 | 81.831 | −2.514 |
| 1800 | 21.692 | 213.616 | 193.679 | 35.886 | 262.179 | 71.208 | −2.066 |
| 1900 | 21.599 | 214.786 | 194.760 | 38.051 | 261.687 | 60.611 | −1.666 |
| 2000 | 21.519 | 215.892 | 195.789 | 40.207 | 261.186 | 50.041 | −1.307 |
| 2100 | 21.449 | 216.940 | 196.771 | 42.355 | 260.677 | 39.497 | −0.982 |
| 2200 | 21.389 | 217.937 | 197.711 | 44.497 | 260.162 | 28.976 | −0.688 |
| 2300 | 21.337 | 218.886 | 198.611 | 46.633 | 259.642 | 18.479 | −0.420 |
| 2400 | 21.291 | 219.794 | 199.475 | 48.764 | 259.116 | 8.005 | −0.174 |
| 2476.570 | 21.260 | 220.462 | 200.114 | 50.394 | ----- FUGACITY = 1 bar ----- | | |
| 2500 | 21.251 | 220.662 | 200.305 | 50.892 | 0. | 0. | 0. |
| 2600 | 21.215 | 221.495 | 201.104 | 53.015 | 0. | 0. | 0. |
| 2700 | 21.184 | 222.295 | 201.874 | 55.135 | 0. | 0. | 0. |
| 2800 | 21.156 | 223.065 | 202.618 | 57.252 | 0. | 0. | 0. |
| 2900 | 21.131 | 223.807 | 203.335 | 59.366 | 0. | 0. | 0. |
| 3000 | 21.109 | 224.523 | 204.030 | 61.478 | 0. | 0. | 0. |
| 3100 | 21.090 | 225.214 | 204.702 | 63.588 | 0. | 0. | 0. |
| 3200 | 21.073 | 225.884 | 205.354 | 65.696 | 0. | 0. | 0. |
| 3300 | 21.059 | 226.532 | 205.986 | 67.803 | 0. | 0. | 0. |
| 3400 | 21.047 | 227.160 | 206.599 | 69.908 | 0. | 0. | 0. |
| 3500 | 21.036 | 227.770 | 207.195 | 72.012 | 0. | 0. | 0. |
| 3600 | 21.029 | 228.363 | 207.775 | 74.115 | 0. | 0. | 0. |
| 3700 | 21.023 | 228.939 | 208.339 | 76.218 | 0. | 0. | 0. |
| 3800 | 21.020 | 229.500 | 208.889 | 78.320 | 0. | 0. | 0. |
| 3900 | 21.018 | 230.045 | 209.424 | 80.422 | 0. | 0. | 0. |
| 4000 | 21.020 | 230.578 | 209.947 | 82.524 | 0. | 0. | 0. |
| 4100 | 21.024 | 231.097 | 210.456 | 84.626 | 0. | 0. | 0. |
| 4200 | 21.030 | 231.603 | 210.954 | 86.729 | 0. | 0. | 0. |
| 4300 | 21.040 | 232.098 | 211.440 | 88.832 | 0. | 0. | 0. |
| 4400 | 21.052 | 232.582 | 211.915 | 90.937 | 0. | 0. | 0. |
| 4500 | 21.068 | 233.055 | 212.379 | 93.043 | 0. | 0. | 0. |
| 4600 | 21.087 | 233.519 | 212.834 | 95.150 | 0. | 0. | 0. |
| 4700 | 21.109 | 233.972 | 213.279 | 97.260 | 0. | 0. | 0. |
| 4800 | 21.135 | 234.417 | 213.715 | 99.372 | 0. | 0. | 0. |
| 4900 | 21.165 | 234.853 | 214.142 | 101.487 | 0. | 0. | 0. |
| 5000 | 21.198 | 235.281 | 214.560 | 103.605 | 0. | 0. | 0. |
| 5100 | 21.236 | 235.701 | 214.970 | 105.727 | 0. | 0. | 0. |
| 5200 | 21.278 | 236.114 | 215.373 | 107.853 | 0. | 0. | 0. |
| 5300 | 21.324 | 236.520 | 215.768 | 109.983 | 0. | 0. | 0. |
| 5400 | 21.375 | 236.919 | 216.156 | 112.118 | 0. | 0. | 0. |
| 5500 | 21.431 | 237.312 | 216.537 | 114.258 | 0. | 0. | 0. |
| 5600 | 21.491 | 237.698 | 216.912 | 116.404 | 0. | 0. | 0. |
| 5700 | 21.556 | 238.079 | 217.280 | 118.556 | 0. | 0. | 0. |
| 5800 | 21.625 | 238.455 | 217.642 | 120.715 | 0. | 0. | 0. |
| 5900 | 21.700 | 238.825 | 217.998 | 122.881 | 0. | 0. | 0. |
| 6000 | 21.780 | 239.190 | 218.348 | 125.055 | 0. | 0. | 0. |

PREVIOUS: CURRENT: June 1983 (1 bar)

IP($Ga^+$, g) = 165458 ± 5 $cm^{-1}$
$S°$(298.15 K) = 161.790 ± 0.04 $J·K^{-1}·mol^{-1}$

$\Delta_f H°$(0 K) = 849.8 ± 4.0 $kJ·mol^{-1}$
$\Delta_f H°$(298.15 K) = [856.648] $kJ·mol^{-1}$

| Electronic Levels and Quantum Weights | | |
|---|---|---|
| State | $\epsilon_i$, $cm^{-1}$ | $g_i$ |
| $^1S_0$ | 0 | 1 |
| $^3P_0$ | 47370 | 1 |
| $^3P_1$ | 47816 | 3 |
| $^3P_2$ | 48750 | 5 |

## Enthalpy of Formation

$\Delta_f H°(Ga^+, g, 0 K)$ is calculated from $\Delta_f H°(Ga, g, 0 K)$[1] using the spectroscopic value of IP(Ga) = 48387.63 ± 0.1 $cm^{-1}$(578.837 ± 0.001 $kJ·mol^{-1}$) from Moore.[2] The ionization limit is converted from $cm^{-1}$ to $kJ·mol^{-1}$ using the factor, 1 $cm^{-1}$ = 0.01196266 $kJ·mol^{-1}$, which is derived from the 1973 CODATA fundamental constants.[3] Rosenstock *et al.*[4] and Levin and Lias[5] have summarized additional ionization and appearance potential data.

$\Delta_f H°(Ga^+, g, 298.15 K)$ is calculated from $\Delta_f H°(Ga, g, 0 K)$ by using IP(Ga) with JANAF[1] enthalpies, $H°(0 K)-H°(298.15 K)$, for Ga(g), $Ga^+$(g), and $e^-$(ref). $\Delta_f H°(Ga \rightarrow Ga^+ + e^-, 298.15 K)$ differs from a room temperature threshold energy due to inclusion of these enthalpies and to threshold effects discussed by Rosenstock *et al.*[4] $\Delta_f H°(298.15 K)$ should be changed by −6.197 kJ $mol^{-1}$ if it is to be used in the ion convention that excludes the enthalpy of the electron.

## Heat Capacity and Entropy

The information on electronic energy levels and quantum weights, given by Moore,[2,6] is incomplete because many theoretically predicted levels have not been observed. Our calcualtions indicate that any reasonable method of filling in these missing levels and cutting off the summation in the partition function[7] has no effect on the thermodynamic functions to 6000 K This is a result of the high energy of all levels other than the ground state and the first three excited states; the next excited state is 70700 $cm^{-1}$ above the ground state Since inclusion of these excited states has no effect on the thermodynamic functions (to 6000 K), we list only the ground state and the first three excited states. The position of the $^3P_0$ levels are uncertain by 249 $cm^{-1}$. The reported uncertainty in $S°$(298.15 K) is due to uncertainties in the relative ionic mass and the fundamental constants. Extension of these calculations above 6000 K may require consideration of the excited states and use of different fill and cutoff procedures.[7]

## References


[1]JANAF Thermochemical Tables: Ga(g); $e^-$(ref), 3–31–82.
[2]C. E Moore, U. S. Nat. Bur. Stand., NSRDS–NBS–34, 8 pp. (1970).
[3]E. R. Cohen and B. N. Taylor, J. Phys. Chem. Ref. Data 2, 663 (1973).
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[6]C. E. Moore, U. S Nat. Bur. Stand., NSRDS–NBS–35, Volume II, (1970) [Reprint of NBS Circular 467, Volume II, 1952].
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Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p°$ = 0.1 MPa

| $T$/K | $C_p°$ | $S°$ | $-[G°-H°(T_r)]/T$ | $H°-H°(T_r)$ | $\Delta_f H°$ | $\Delta_f G°$ | log $K_f$ |
|---|---|---|---|---|---|---|---|
| | $J·K^{-1}mol^{-1}$ | | | $kJ·mol^{-1}$ | | | |
| 0 | 0. | 0. | INFINITE | −6.197 | 849.815 | | |
| 100 | 20.786 | 139.083 | 180.270 | −4.119 | | | |
| 200 | 20.786 | 153.491 | 163.691 | −2.040 | | | |
| 250 | 20.786 | 158.129 | 162.132 | −1.001 | | | |
| 298.15 | 20.786 | 161.790 | 161.790 | 0. | 856.648 | 814.332 | −142.668 |
| 300 | 20.786 | 161.919 | 161.790 | 0.038 | 856.677 | 814.069 | −141.742 |
| 350 | 20.786 | 165.123 | 162.044 | 1.078 | 851.767 | 807.783 | −120.555 |
| 400 | 20.786 | 167.898 | 162.606 | 2.117 | 852.475 | 801.451 | −104.659 |
| 450 | 20.786 | 170.347 | 163.333 | 3.156 | 853.201 | 795.030 | −92.285 |
| 500 | 20.786 | 172.537 | 164.145 | 4.196 | 853.935 | 788.527 | −82.377 |
| 600 | 20.786 | 176.326 | 165.869 | 6.274 | 855.417 | 775.307 | −67.496 |
| 700 | 20.786 | 179.531 | 167.598 | 8.353 | 856.912 | 761.837 | −56.849 |
| 800 | 20.786 | 182.306 | 169.267 | 10.431 | 858.413 | 748.152 | −48.849 |
| 900 | 20.786 | 184.754 | 170.854 | 12.510 | 859.913 | 734.280 | −42.616 |
| 1000 | 20.786 | 186.944 | 172.356 | 14.589 | 861.413 | 720.240 | −37.621 |
| 1100 | 20.786 | 188.926 | 173.774 | 16.667 | 862.914 | 706.050 | −33.528 |
| 1200 | 20.786 | 190.734 | 175.113 | 18.746 | 864.414 | 691.723 | −30.110 |
| 1300 | 20.786 | 192.398 | 176.379 | 20.824 | 865.914 | 677.272 | −27.213 |
| 1400 | 20.786 | 193.938 | 177.579 | 22.903 | 867.415 | 662.705 | −24.726 |
| 1500 | 20.786 | 195.372 | 178.718 | 24.982 | 868.915 | 648.030 | −22.566 |
| 1600 | 20.786 | 196.714 | 179.801 | 27.060 | 870.415 | 633.255 | −20.674 |
| 1700 | 20.786 | 197.974 | 180.834 | 29.139 | 871.916 | 618.387 | −19.001 |
| 1800 | 20.786 | 199.162 | 181.819 | 31.217 | 873.416 | 603.430 | −17.511 |
| 1900 | 20.786 | 200.286 | 182.762 | 33.296 | 874.917 | 588.390 | −16.176 |
| 2000 | 20.786 | 201.352 | 183.665 | 35.375 | 876.417 | 573.271 | −14.972 |
| 2100 | 20.786 | 202.366 | 184.532 | 37.453 | 877.917 | 558.077 | −13.881 |
| 2200 | 20.786 | 203.333 | 185.364 | 39.532 | 879.418 | 542.811 | −12.888 |
| 2300 | 20.786 | 204.257 | 186.166 | 41.610 | 880.918 | 527.477 | −11.979 |
| 2400 | 20.786 | 205.142 | 186.938 | 43.689 | 882.418 | 512.078 | −11.145 |
| 2500 | 20.786 | 205.991 | 187.683 | 45.768 | 625.333 | 499.064 | −10.427 |
| 2600 | 20.786 | 206.806 | 188.403 | 47.846 | 627.367 | 493.973 | −9.924 |
| 2700 | 20.786 | 207.590 | 189.100 | 49.925 | 629.404 | 488.804 | −9.456 |
| 2800 | 20.786 | 208.346 | 189.773 | 52.004 | 631.444 | 483.559 | −9.021 |
| 2900 | 20.786 | 209.076 | 190.427 | 54.082 | 633.487 | 478.241 | −8.614 |
| 3000 | 20.786 | 209.780 | 191.060 | 56.161 | 635.533 | 472.853 | −8.233 |
| 3100 | 20.786 | 210.462 | 191.675 | 58.239 | 637.580 | 467.397 | −7.876 |
| 3200 | 20.786 | 211.122 | 192.272 | 60.318 | 639.629 | 461.874 | −7.539 |
| 3300 | 20.786 | 211.761 | 192.853 | 62.397 | 641.679 | 456.288 | −7.222 |
| 3400 | 20.786 | 212.382 | 193.419 | 64.475 | 643.731 | 450.639 | −6.923 |
| 3500 | 20.786 | 212.984 | 193.969 | 66.554 | 645.785 | 444.930 | −6.640 |
| 3600 | 20.786 | 213.570 | 194.505 | 68.632 | 647.838 | 439.162 | −6.372 |
| 3700 | 20.786 | 214.140 | 195.028 | 70.711 | 649.893 | 433.337 | −6.118 |
| 3800 | 20.786 | 214.694 | 195.539 | 72.790 | 651.948 | 427.457 | −5.876 |
| 3900 | 20.786 | 215.234 | 196.037 | 74.868 | 654.004 | 421.522 | −5.646 |
| 4000 | 20.787 | 215.760 | 196.523 | 76.947 | 656.059 | 415.535 | −5.426 |
| 4100 | 20.787 | 216.273 | 196.999 | 79.026 | 658.114 | 409.497 | −5.217 |
| 4200 | 20.787 | 216.774 | 197.464 | 81.104 | 660.169 | 403.408 | −5.017 |
| 4300 | 20.788 | 217.263 | 197.919 | 83.183 | 662.223 | 397.270 | −4.826 |
| 4400 | 20.789 | 217.741 | 198.364 | 85.262 | 664.275 | 391.085 | −4.643 |
| 4500 | 20.790 | 218.209 | 198.799 | 87.341 | 666.327 | 384.853 | −4.467 |
| 4600 | 20.791 | 218.665 | 199.226 | 89.420 | 668.377 | 378.575 | −4.299 |
| 4700 | 20.792 | 219.113 | 199.645 | 91.499 | 670.425 | 372.253 | −4.137 |
| 4800 | 20.794 | 219.550 | 200.055 | 93.578 | 672.471 | 365.887 | −3.982 |
| 4900 | 20.797 | 219.979 | 200.457 | 95.658 | 674.514 | 359.479 | −3.832 |
| 5000 | 20.799 | 220.399 | 200.852 | 97.738 | 676.554 | 353.029 | −3.688 |
| 5100 | 20.803 | 220.811 | 201.239 | 99.818 | 678.591 | 346.538 | −3.549 |
| 5200 | 20.807 | 221.215 | 201.619 | 101.898 | 680.625 | 340.008 | −3.415 |
| 5300 | 20.812 | 221.612 | 201.993 | 103.979 | 682.654 | 333.438 | −3.286 |
| 5400 | 20.818 | 222.001 | 202.360 | 106.061 | 684.679 | 326.830 | −3.161 |
| 5500 | 20.825 | 222.383 | 202.720 | 108.143 | 686.700 | 320.184 | −3.041 |
| 5600 | 20.833 | 222.758 | 203.075 | 110.226 | 688.715 | 313.502 | −2.924 |
| 5700 | 20.843 | 223.127 | 203.423 | 112.310 | 690.726 | 306.784 | −2.811 |
| 5800 | 20.854 | 223.489 | 203.766 | 114.394 | 692.730 | 300.031 | −2.702 |
| 5900 | 20.866 | 223.846 | 204.104 | 116.480 | 694.728 | 293.243 | −2.596 |
| 6000 | 20.880 | 224.197 | 204.436 | 118.568 | 696.720 | 286.422 | −2.494 |

PREVIOUS: CURRENT: June 1983 (1 bar)

EA(Ga, g) = 0.30 ± 0.15 eV
$S°(298.15\ K)$ = [175.801 ± 0.1] $J·K^{-1}·mol^{-1}$

$\Delta_f H°(0\ K)$ = 242.025 ± 14.6 $kJ·mol^{-1}$
$\Delta_f H°(298\ 15\ K)$ = [238.531] $kJ·mol^{-1}$

| Electonic Levels and Quantum Weights | | |
|---|---|---|
| State | $\epsilon_i$, $cm^{-1}$ | $g_i$ |
| $^3P_0$ | 0 | 1 |
| $^3P_1$ | 220 | 3 |
| $^3P_2$ | 580 | 5 |

## Enthalpy of Formation

$\Delta_f H°(Ga^-, g, 0\ K)$ is calculated from $\Delta_f H°(Ga, g, 0\ K)$[1] using the adopted electron affinity of EA(Ga) = 0.30 ± 0.15 eV (28.945 ± 14.473 $kJ·mol^{-1}$). This value, recommended by Hotop and Lineberger,[2] is based on a photodetachment threshold (using conventional light sources) and semiempirical extrapolation.[3 4 5] Additional information on $Ga^-(g)$ may be obtained in the critical discussions of Hotop and Lineberger,[2,5] Rosenstock *et al.*[6] and Massey.[7]

$\Delta_f H°(Ga^-, g, 298.15\ K)$ is obtained from $\Delta_f H°(Ga, g, 0\ K)$ by using EA(Ga) with JANAF[1] enthalpies, $H°(0\ K)-H°(298.15\ K)$, for $Ga^-(g)$, Ga(g), and $e^-$(ref). $\Delta_f H°(Ga^- \rightarrow Ga + e^-, 298.15\ K)$ differs from a room-temperature threshold energy due to inclusion of these enthalpies and to threshold effects discussed by Rosenstock *et al.*[6] $\Delta_f H°(298.15\ K)$ should be changed by +6.197 $kJ·mol^{-1}$ if it is to be used in the ion convention that excludes the enthalpy of the electron.

## Heat Capacity and Entropy

The ground state electronic configuration for $Ga^-(g)$ is given by Hotop and Lineberger,[2, 5] Rosenstocsk *et al.*,[6] and Massey.[7] The fine-structure separation has been calculated via an isoelectronic extrapolation of ratios of fine structure separations and a quadratic isoelectronic extrapolation[4 5] and is that recommended by Hotop and Lineberger.[2]

A comparison of the isoelectronic sequences – $Ga^-(g)$, Ge(g), $As^+(g)$, $Se^{++}(g)$ – would suggest that a state, $^1D_2$, may exist at low wave numbers. However, this is most likely a metasable state lying at an energy greater than the electron affinity, as in the case of $Al^-(g)$. As discussed by Hotop and Lineberger,[2, 5] Rosenstock *et al.*,[6] and Massey,[7] no stable excited states have been observed. Thus, we assume no stable excited states exist.

## References


[1]JANAF Thermochemical Tables: Ga(g); $e^-$(ref), 3–31–82.
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Enthalpy Reference Temperature = $T_r$ = 298.15 K  Standard State Pressure = $p°$ = 0.1 MPa

| | $J·K^{-1}·mol^{-1}$ | | | $kJ·mol^{-1}$ | | | |
|---|---|---|---|---|---|---|---|
| $T$/K | $C_p°$ | $S°$ | $-[G°-H°(T_r)]/T$ | $H°-H°(T_r)$ | $\Delta_f H°$ | $\Delta_f G°$ | log $K_f$ |
| 0 | 0. | 0. | INFINITE | −8.265 | 242.025 | | |
| 100 | 29.645 | 143.110 | 201.948 | −5.884 | | | |
| 200 | 30.076 | 164.238 | 178.410 | −2.834 | | | |
| 250 | 28.867 | 170.824 | 176.263 | −1.360 | | | |
| 298.15 | 27.618 | 175.801 | 175.801 | 0. | 238.531 | 204.547 | −35.836 |
| 300 | 27.572 | 175.972 | 175.802 | 0.051 | 238.496 | 204.336 | −35.578 |
| 350 | 26.407 | 180.132 | 176.133 | 1.400 | 231 817 | 199.597 | −29.788 |
| 400 | 25.437 | 183.593 | 176.855 | 2.695 | 230.702 | 195.070 | −25.474 |
| 450 | 24.656 | 186.542 | 177.772 | 3.947 | 229.562 | 190.684 | −22.134 |
| 500 | 24.034 | 189.107 | 178 780 | 5 163 | 228.395 | 186.427 | −19.476 |
| 600 | 23.155 | 193.405 | 180.872 | 7.519 | 225.996 | 178.257 | −15.519 |
| 700 | 22.612 | 196.930 | 182.922 | 9.805 | 223.542 | 170 494 | −12.722 |
| 800 | 22.287 | 199.926 | 184.865 | 12.049 | 221.050 | 163 086 | −10.648 |
| 900 | 22.106 | 202.539 | 186.687 | 14.268 | 218.533 | 155.991 | −9.053 |
| 1000 | 22.021 | 204.863 | 188.390 | 16.473 | 216.003 | 149.177 | −7.792 |
| 1100 | 21.998 | 206.961 | 189.985 | 18.674 | 213.469 | 142.617 | −6.772 |
| 1200 | 22.012 | 208.875 | 191.480 | 20.874 | 210 933 | 136.288 | −5.932 |
| 1300 | 22.049 | 210.638 | 192.887 | 23.077 | 208.401 | 130.171 | −5.230 |
| 1400 | 22.097 | 212.274 | 194.214 | 25.284 | 205.873 | 124.248 | −4.636 |
| 1500 | 22.149 | 213.801 | 195.469 | 27.497 | 203.350 | 118.505 | −4.127 |
| 1600 | 22.199 | 215.232 | 196.660 | 29.714 | 200.832 | 112.931 | −3.687 |
| 1700 | 22.246 | 216.579 | 197.793 | 31.936 | 198.318 | 107.515 | −3.304 |
| 1800 | 22.287 | 217.852 | 198.872 | 34.163 | 195.810 | 102.246 | −2.967 |
| 1900 | 22.323 | 219.058 | 199.903 | 36.394 | 193.305 | 97.116 | −2.670 |
| 2000 | 22.353 | 220.203 | 200.890 | 38.627 | 190.803 | 92 118 | −2.406 |
| 2100 | 22.377 | 221.295 | 201.836 | 40.864 | 188.304 | 87.245 | −2.170 |
| 2200 | 22.395 | 222.336 | 202.744 | 43.103 | 185.807 | 82.491 | −1.959 |
| 2300 | 22.408 | 223.332 | 203.618 | 45.343 | 183.312 | 77.851 | −1.768 |
| 2400 | 22.417 | 224.286 | 204.459 | 47.584 | 180.818 | 73.319 | −1.596 |
| 2500 | 22.422 | 225.201 | 205.270 | 49.826 | −80.261 | 71.339 | −1 491 |
| 2600 | 22.423 | 226.080 | 206.054 | 52.068 | −82.221 | 77 442 | −1.556 |
| 2700 | 22.422 | 226.927 | 206.812 | 54.311 | −84.177 | 83 620 | −1.618 |
| 2800 | 22.417 | 227.742 | 207.545 | 56.553 | −86.131 | 89.870 | −1.677 |
| 2900 | 22.410 | 228.528 | 208.255 | 58 794 | −88.082 | 96.190 | −1.733 |
| 3000 | 22.402 | 229.288 | 208 943 | 61 035 | −90.032 | 102.578 | −1.786 |
| 3100 | 22.391 | 230.022 | 209.611 | 63.274 | −91.981 | 109.030 | −1.837 |
| 3200 | 22.379 | 230.733 | 210.260 | 65.513 | −93.929 | 115.545 | −1.886 |
| 3300 | 22.366 | 231.422 | 210.891 | 67 750 | −95.877 | 122.122 | −1.933 |
| 3400 | 22.351 | 232.089 | 211.505 | 69.986 | −97.825 | 128.757 | −1.978 |
| 3500 | 22.336 | 232.737 | 212.102 | 72.220 | −99.774 | 135 449 | −2.021 |
| 3600 | 22.320 | 233.366 | 212.684 | 74.453 | −101.723 | 142.198 | −2.063 |
| 3700 | 22.303 | 233.977 | 213.252 | 76.684 | −103.673 | 149.000 | −2.104 |
| 3800 | 22.286 | 234.572 | 213.805 | 78.914 | −105.624 | 155.855 | −2.142 |
| 3900 | 22.268 | 235.150 | 214.345 | 81.141 | −107.577 | 162.762 | −2.180 |
| 4000 | 22.250 | 235.714 | 214.872 | 83.367 | −109.531 | 169 718 | −2.216 |
| 4100 | 22.232 | 236.263 | 215.387 | 85.591 | −111.488 | 176.724 | −2.251 |
| 4200 | 22.214 | 236.799 | 215.891 | 87.814 | −113.447 | 183.777 | −2.286 |
| 4300 | 22.195 | 237.321 | 216.383 | 90.034 | −115.408 | 190.877 | −2.319 |
| 4400 | 22.176 | 237.831 | 216.865 | 92.253 | −117.373 | 198.022 | −2.351 |
| 4500 | 22.158 | 238.329 | 217.336 | 94.469 | −119.341 | 205.213 | −2.382 |
| 4600 | 22.139 | 238.816 | 217.798 | 96 684 | −121.312 | 212.447 | −2.412 |
| 4700 | 22.120 | 239.292 | 218.250 | 98.897 | −123.288 | 219.724 | −2.442 |
| 4800 | 22.102 | 239.757 | 218.693 | 101 108 | −125.267 | 227.043 | −2.471 |
| 4900 | 22.083 | 240.213 | 219.128 | 103.318 | −127.252 | 234.403 | −2.499 |
| 5000 | 22.065 | 240.659 | 219.554 | 105.525 | −129.241 | 241.804 | −2.526 |
| 5100 | 22.047 | 241.096 | 219.972 | 107.731 | −131.236 | 249.245 | −2.553 |
| 5200 | 22.029 | 241.524 | 220.382 | 109.934 | −133.236 | 256.724 | −2.579 |
| 5300 | 22.011 | 241.943 | 220.785 | 112.136 | −135.243 | 264.243 | −2.604 |
| 5400 | 21.993 | 242.354 | 221.181 | 114.336 | −137.256 | 271.799 | −2.629 |
| 5500 | 21.976 | 242 758 | 221.570 | 116.535 | −139.277 | 279.393 | −2.653 |
| 5600 | 21 958 | 243.154 | 221.951 | 118.732 | −141.305 | 287.023 | −2.677 |
| 5700 | 21 941 | 243.542 | 222.327 | 120.927 | −143.341 | 294.690 | −2.701 |
| 5800 | 21.924 | 243.924 | 222.696 | 123.120 | −145.385 | 302.393 | −2.723 |
| 5900 | 21.908 | 244.298 | 223.059 | 125.311 | −147.438 | 310.131 | −2.746 |
| 6000 | 21.891 | 244.666 | 223.416 | 127.501 | −149.501 | 317.903 | −2.768 |

PREVIOUS. CURRENT: June 1983 (1 bar)