

CRITICAL CONSTANTS OF INORGANIC COMPOUNDS

The parameters of the liquid-gas critical point are important constants in determining the behavior of fluids. This table lists the critical temperature, pressure, and molar volume, as well as the normal boiling point, for over 140 inorganic substances. The properties and their units are:

T_b : Normal boiling point in K at a pressure of 101.325 kPa (1 atmosphere); an "s" following the value indicates a sublimation point (temperature at which the solid is in equilibrium with the gas at a pressure of 101.325 kPa)

T_c : Critical temperature in K

P_c : Critical pressure in MPa

V_c : Critical molar volume in $\text{cm}^3 \text{mol}^{-1}$

The number of digits given for T_b , T_c , and P_c indicates the estimated accuracy of these quantities; however, values of T_c greater than 750 K may be in error by 10 K or more. Although most V_c values are given to three figures, they cannot be assumed accurate to better than a few percent. All values are experimentally determined except for a few values, indicated by an asterisk*, that are based on extrapolations. Methods of measurement are described and critiqued in Reference 1. Compounds are listed alphabetically by name.

References

1. Ambrose, D., and Young, C. L., *J. Chem. Eng. Data* 40, 345, 1995.
2. Morel, V., Bultel, A., and Chéron, B. G., *Int. J. Thermophys.* 30, 1853, 2009.
3. Ambrose, D., "Vapor-Liquid Constants of Fluids," in *Handbook of the Thermodynamics of Organic Compounds*, Stevenson, R. M., and Malanowski, S., Eds., Elsevier, New York, 1987.
4. Sato, M., Masui, G., and Uematsu, M., *J. Chem. Thermodyn.* 37, 931, 2005.
5. Velasco, S., Roman, F. L., White, J. A., and Mulero, A., *Fluid Phase Equilib.* 244, 11, 2006.
6. Nowak, P., Tielkes, T., Kleinrahm, R., and Wagner, W., *J. Chem. Thermodyn.* 29, 885, 1997.
7. Lemmon, E. W., and Span, R., *J. Chem. Eng. Data* 51, 785, 2006.
8. Goodwin, R. D., *J. Phys. Chem. Ref. Data* 14, 849, 1985.
9. Vargaftik, N. B., *Int. J. Thermophys.* 11, 467, 1990.
10. Nikitin, E. D., Pavlov, P. A., Popov, A. P., and Nikitina, H. E., *J. Chem. Thermodyn.* 27, 945, 1995.
11. Dillon, I. G., Nelson, P. A., and Swanson, B. S., *J. Chem. Phys.* 44, 4229, 1966.
12. Huber, M. L., Laesecke, A., and Friend, D. G., *The Vapor Pressure of Mercury*, NISTIR 6643, National Institute of Standards and Technology, Boulder, CO, March 2006; *Ind. Eng. Chem. Res.* 45, 7351, 2006.
13. Rau, H., Kutty, T. R. N., and Guedes de Carvalho, J. R. F., *J. Chem. Thermodyn.* 5, 291, 1973.
14. Funke, M., Kleinrahm, R., and Wagner, W., *J. Chem. Thermodyn.* 34, 717, 2002.
15. Sifner, O., and Klomfar, J., *J. Phys. Chem. Ref. Data* 23, 63, 1994.

| Name | Formula | T_b /K | T_c /K | P_c /MPa | V_c /cm ³ mol ⁻¹ | Ref. |
|------------------------|--------------------|----------|----------|------------|--|-------|
| Aluminum | Al | 2792 | 6700* | | | 2 |
| Aluminum bromide | AlBr ₃ | 528 | 763 | 2.89 | 310 | 3 |
| Aluminum chloride | AlCl ₃ | 453 s | 620 | 2.63 | 257 | 3 |
| Aluminum iodide | AlI ₃ | 655 | 983 | | 408 | 3 |
| Ammonia | NH ₃ | 239.82 | 405.56 | 11.357 | 69.8 | 3,4 |
| Ammonium chloride | NH ₄ Cl | 611 s | 1155 | 163.5 | | 3 |
| Antimony(III) bromide | SbBr ₃ | 561 | 904 | | 300 | 3 |
| Antimony(III) chloride | SbCl ₃ | 493.5 | 794 | | 272 | 3 |
| Antimony(III) iodide | SbI ₃ | 673 | 1102 | | | 3 |
| Argon | Ar | 87.302 | 150.687 | 4.863 | 75 | 3 |
| Arsenic | As | 889 s | 1673 | 22.3 | 35 | 3 |
| Arsenic(III) chloride | AsCl ₃ | 403 | 654 | | 252 | 3 |
| Arsine | AsH ₃ | 210.7 | 373.1 | | | 3 |
| Beryllium | Be | 2741 | 5205* | | | 5 |
| Bismuth | Bi | 1837 | 4620* | | | 5 |
| Bismuth tribromide | BiBr ₃ | 735 | 1220 | | 301 | 3 |
| Bismuth trichloride | BiCl ₃ | 714 | 1179 | 12.0 | 261 | 3 |
| Boron tribromide | BBr ₃ | 364.4 | 581 | | 272 | 3 |
| Boron trichloride | BCl ₃ | 285.80 | 455 | 3.87 | 239 | 3 |
| Boron trifluoride | BF ₃ | 173.3 | 260.8 | 4.98 | 115 | 3 |
| Boron triiodide | BI ₃ | 482.7 | 773 | | 356 | 3 |
| Bromine | Br ₂ | 332.0 | 588 | 10.34 | 127 | 3 |
| Carbon dioxide | CO ₂ | 194.6 s | 304.13 | 7.375 | 94 | 6 |
| Carbon disulfide | CS ₂ | 319 | 552 | 7.90 | 173 | 3 |
| Carbon monoxide | CO | 81.7 | 132.86 | 3.494 | 93 | 3,7,8 |
| Carbon oxy sulfide | COS | 223 | 375 | 5.88 | 137 | 3,7 |
| Cesium | Cs | 944 | 1938 | 9.4 | 341 | 9 |
| Chlorine | Cl ₂ | 239.11 | 417.0 | 7.991 | 123 | 3 |
| Chlorine pentafluoride | ClF ₅ | 260.1 | 416 | 5.27 | 233 | 3 |

| Name | Formula | T_b/K | T_c/K | P_c/MPa | $V_c/cm^3 mol^{-1}$ | Ref. |
|------------------------------------|----------------------------------|---------|---------|-----------|---------------------|------|
| Chlorotrifluorosilane | SiClF ₃ | 203.2 | 307.7 | 3.46 | | 3 |
| Diborane | B ₂ H ₆ | 180.8 | 289.8 | 4.05 | | 3 |
| Dichlorodifluorosilane | SiCl ₂ F ₂ | 241 | 369.0 | 3.5 | | 3 |
| Difluoramine | NHF ₂ | 250 | 403 | | | 3 |
| <i>cis</i> -Difluorodiazine | N ₂ F ₂ | 167.40 | 272 | 7.09 | | 3 |
| <i>trans</i> -Difluorodiazine | N ₂ F ₂ | 161.70 | 260 | 5.57 | | 3 |
| Fluorine | F ₂ | 85.04 | 144.41 | 5.1724 | 66 | 3 |
| Fluorine monoxide | F ₂ O | 128.8 | 215 | | | 3 |
| Gallium(III) bromide | GaBr ₃ | 552 | 806.7 | | 303 | 3 |
| Gallium(III) chloride | GaCl ₃ | 474 | 694 | | 263 | 3 |
| Gallium(III) iodide | GaI ₃ | 613 | 951 | | 395 | 3 |
| Germane | GeH ₄ | 185.1 | 312.2 | 4.95 | 147 | 3 |
| Germanium | Ge | 3106 | 9802* | | | 5 |
| Germanium(IV) bromide | GeBr ₄ | 459.50 | 718 | | 392 | 3 |
| Germanium(IV) chloride | GeCl ₄ | 359.70 | 553.2 | 3.861 | 330 | 3 |
| Germanium(IV) iodide | GeI ₄ | 621 | 973 | | 500 | 3 |
| Hafnium(IV) bromide | HfBr ₄ | 596 s | 746 | | 415 | 3 |
| Hafnium(IV) chloride | HfCl ₄ | 590 s | 725.7 | 5.42 | 314 | 3 |
| Hafnium(IV) iodide | HfI ₄ | 667 s | 916 | | 528 | 3 |
| Helium | He | 4.222 | 5.1953 | 0.22746 | 57 | 3 |
| Hydrazine | N ₂ H ₄ | 386.70 | 653 | 14.7 | | 3 |
| Hydrogen | H ₂ | 20.388 | 33.14 | 1.2964 | 65 | 3 |
| Hydrogen bromide | HBr | 206.77 | 363.2 | 8.55 | | 3 |
| Hydrogen chloride | HCl | 188 | 324.7 | 8.31 | 81 | 3 |
| Hydrogen fluoride | HF | 293 | 461 | 6.48 | 69 | 3 |
| Hydrogen iodide | HI | 237.60 | 424.0 | 8.31 | | 3 |
| Hydrogen peroxide | H ₂ O ₂ | 423.4 | 728* | 22* | | 10 |
| Hydrogen selenide | H ₂ Se | 231.90 | 411 | 8.92 | | 3 |
| Hydrogen sulfide | H ₂ S | 213.60 | 373.1 | 9.00 | 99 | 3,7 |
| Iodine | I ₂ | 457.6 | 819 | | 155 | 3 |
| Iodine bromide | IBr | 389 | 719 | | 139 | 3 |
| Iron | Fe | 3134 | 9340* | | | 5 |
| Krypton | Kr | 119.735 | 209.48 | 5.525 | 91 | 3,7 |
| Lithium | Li | 1615 | 3223* | 67* | 66* | 11 |
| Manganese | Mn | 2334 | 4325* | | | 5 |
| Mercury | Hg | 629.769 | 1764 | 167 | 43 | 3,12 |
| Mercury(II) bromide | HgBr ₂ | 591 | 1012 | | | 3 |
| Mercury(II) chloride | HgCl ₂ | 577 | 973 | | 174 | 3 |
| Mercury(II) iodide | HgI ₂ | 624 | 1072 | | | 3 |
| Molybdenum(V) chloride | MoCl ₅ | 541 | 850 | | 369 | 3 |
| Molybdenum(VI) fluoride | MoF ₆ | 307.2 | 473 | 4.75 | 226 | 3 |
| Neon | Ne | 27.097 | 44.49 | 2.6786 | 42 | 3 |
| Niobium(V) chloride | NbCl ₅ | 520.6 | 803.5 | 4.88 | 397 | 3 |
| Niobium(V) fluoride | NbF ₅ | 507 | 737 | 6.28 | 155 | 3 |
| Nitric oxide | NO | 121.41 | 180 | 6.48 | 58 | 3 |
| Nitrogen | N ₂ | 77.355 | 126.192 | 3.39 | 90 | 3 |
| Nitrogen chloride difluoride | NClF ₂ | 206 | 337.5 | 5.15 | | 3 |
| Nitrogen tetroxide | N ₂ O ₄ | 294.30 | 431 | 10.1 | 167 | 3 |
| Nitrogen trifluoride | NF ₃ | 144.40 | 234.0 | 4.46 | 126 | 3 |
| Nitrosyl chloride | NOCl | 267.7 | 440 | | | 3 |
| Nitrous oxide | N ₂ O | 184.67 | 309.52 | 7.245 | 97 | 3,7 |
| Nitryl fluoride | NO ₂ F | 200.8 | 349.5 | | | 3 |
| Osmium(VIII) oxide | OsO ₄ | 404.4 | 678 | | | 3 |
| Oxygen | O ₂ | 90.188 | 154.581 | 5.043 | 73 | 3 |
| Ozone | O ₃ | 161.80 | 261.1 | 5.57 | 89 | 3 |
| Perchloryl fluoride | ClO ₃ F | 226.40 | 368.4 | 5.37 | 161 | 3 |
| Phosphine | PH ₃ | 185.40 | 324.5 | 6.54 | | 3 |
| Phosphonium chloride | PH ₄ Cl | 246 s | 322.3 | 7.37 | | 3 |
| Phosphorothioc chloride difluoride | PSClF ₂ | 279.5 | 439.2 | 4.14 | | 3 |
| Phosphorothioc trifluoride | PSF ₃ | 220.90 | 346.0 | 3.82 | | 3 |

| Name | Formula | T_b/K | T_c/K | P_c/MPa | $V_c/cm^3 mol^{-1}$ | Ref. |
|-------------------------------------|--------------------------------|----------|---------|-----------|---------------------|------|
| Phosphorus | P | 553.7 | 994 | | | 3 |
| Phosphorus(III) bromide | PBr ₃ | 446.4 | 711 | | 300 | 3 |
| Phosphorus(III) chloride | PCl ₃ | 349.3 | 563 | | 264 | 3 |
| Phosphorus(V) chloride | PCl ₅ | 433 s | 646 | | | 3 |
| Phosphorus(III) chloride difluoride | PClF ₂ | 225.9 | 362.4 | 4.52 | | 3 |
| Phosphorus(III) dichloride fluoride | PCl ₂ F | 287.00 | 463.0 | 4.96 | | 3 |
| Phosphorus(III) fluoride | PF ₃ | 171.4 | 271.2 | 4.33 | | 3 |
| Potassium | K | 1032 | 2223* | 16* | 209* | 11 |
| Radon | Rn | 211.5 | 377 | 6.28 | | 3 |
| Rhenium(VII) oxide | Re ₂ O ₇ | 633 | 942 | | 334 | 3 |
| Rhenium(VI) oxytetrachloride | ReOCl ₄ | 496 | 781 | | 362 | 3 |
| Rubidium | Rb | 961 | 2093* | 16* | 247* | 11 |
| Selenium | Se | 958 | 1766 | 27.2 | | 3 |
| Selenium hexafluoride | SeF ₆ | 226.55 s | 345.5 | | | 3 |
| Selenium oxychloride | SeOCl ₂ | 450 | 730 | 7.09 | 235 | 3 |
| Silver | Ag | 2435 | 6410* | | | 5 |
| Sodium | Na | 1156 | 2573* | 35* | 116* | 11 |
| Sulfur | S | 717.76 | 1314 | 20.7 | 57.0 | 3,13 |
| Sulfur chloride pentafluoride | SF ₅ Cl | 254.10 | 390.9 | | | 3 |
| Sulfur dioxide | SO ₂ | 263.10 | 430.64 | 7.884 | 122 | 3,7 |
| Sulfur hexafluoride | SF ₆ | 209.35 s | 318.723 | 3.77 | 197 | 3,14 |
| Sulfur tetrafluoride | SF ₄ | 232.70 | 364 | | | 3 |
| Sulfur trioxide | SO ₃ | 317.7 | 491.0 | 8.2 | 127 | 3 |
| Tantalum(V) bromide | TaBr ₅ | 622 | 974 | | 461 | 3 |
| Tantalum(V) chloride | TaCl ₅ | 512 | 767 | | 402 | 3 |
| Tellurium | Te | 1261 | 2329* | | | 5 |
| Tellurium hexafluoride | TeF ₆ | 234.25 s | 356 | | | 3 |
| Tellurium tetrachloride | TeCl ₄ | 660 | 1002 | 8.56 | 310 | 3 |
| Tetrabromosilane | SiBr ₄ | 427 | 663 | | 382 | 3 |
| Tetrachlorosilane | SiCl ₄ | 330.80 | 508.1 | 3.593 | 326 | 3 |
| Tetrafluorohydrazine | N ₂ F ₄ | 199 | 309 | 3.75 | | 3 |
| Tetrafluorosilane | SiF ₄ | 187 | 259.0 | 3.72 | | 3 |
| Tetraiodosilane | SiI ₄ | 560.50 | 944 | | 558 | 3 |
| Tin(IV) bromide | SnBr ₄ | 478 | 744 | | 417 | 3 |
| Tin(IV) chloride | SnCl ₄ | 387.30 | 591.9 | 3.75 | 351 | 3 |
| Tin(IV) iodide | SnI ₄ | 637.50 | 968 | | 531 | 3 |
| Titanium(IV) bromide | TiBr ₄ | 506.7 | 795.7 | | 391 | 3 |
| Titanium(IV) chloride | TiCl ₄ | 409.60 | 638 | 4.66 | 339 | 3 |
| Titanium(IV) iodide | TiI ₄ | 650 | 1040 | | 505 | 3 |
| Tribromosilane | SiHBr ₃ | 382 | 610.0 | | 305 | 3 |
| Trichlorofluorosilane | SiCl ₃ F | 285.40 | 438.6 | 3.58 | | 3 |
| Trichlorosilane | SiHCl ₃ | 306 | 479 | | 268 | 3 |
| Trifluoramine oxide | NOF ₃ | 185.7 | 303 | 6.43 | 147 | 3 |
| Tungsten(VI) chloride | WCl ₆ | 610 | 923 | | 422 | 3 |
| Tungsten(VI) fluoride | WF ₆ | 290.3 | 444 | 4.34 | 233 | 3 |
| Tungsten(VI) oxytetrachloride | WOCl ₄ | 503 | 782 | | 338 | 3 |
| Uranium(VI) fluoride | UF ₆ | 329.65 s | 505.8 | 4.66 | 250 | 3 |
| Vanadyl chloride | VOCl | 400 | 636 | | 171 | 3 |
| Water | H ₂ O | 373.12 | 647.10 | 22.06 | 56 | 3 |
| Xenon | Xe | 165.051 | 289.733 | 5.842 | 118 | 7,15 |
| Xenon difluoride | XeF ₂ | 387.50 s | 631 | 9.32 | 148 | 3 |
| Xenon tetrafluoride | XeF ₄ | 388.90 s | 612 | 7.04 | 188 | 3 |
| Zirconium(IV) bromide | ZrBr ₄ | 633 s | 805 | | 424 | 3 |
| Zirconium(IV) chloride | ZrCl ₄ | 604 s | 778 | 5.77 | 319 | 3 |
| Zirconium(IV) iodide | ZrI ₄ | 704 s | 960 | | 530 | 3 |