Thermodynamic Properties of Sulfur Hexafluoride

D.R. Defibaugh and J.J. Hurly
Physical and Chemical Properties Division
Chemical Science and Technology Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899 USA

The thermodynamic properties of sulfur hexafluoride SF_6 have been measured using three apparatus: an acoustic resonator, a vibrating tube densimeter, and a Burnett $P\rho T$ apparatus.

The speed of sound, $u(T,P)$ in SF_6 was measured in a cylindrical resonator over the temperature and pressure ranges 240 K $\leq T \leq$ 460 K and 50 kPa $\leq P \leq$ 1500 kPa. The sound speed measurements were performed over isotherms and the ideal gas heat capacity, $C_p^o(T)$ determined from the zero pressure intercept at each temperature. The $C_p^o(T)$ results are fit to a polynomial function of temperature with an RMS deviation of less than 0.01%. The virial equation of state was then fit to the $u(P,T)$ surface to provide the density and acoustical virial coefficients. The virial coefficient's temperature dependence was expressed as the form derived from a model intermolecular potential. The proposed equation of state reproduces the measured sound speed surface with an RMS standard deviation of less than 0.005%. The experimental second and third virial coefficients are compared with previous experimental results and with values calculated from other proposed intermolecular potentials.

The equation of state of compressed liquid and supercritical SF_6 was measured with a vibrating tube densimeter over the temperature and pressure ranges 240 K $\leq T \leq$ 370 K and 2.6 MPa $\leq P \leq$ 6.5 MPa. In the dense vapor region, the equation of state was also measured on isochores whose densities were established by Burnett expansions. These data are in the range 280 K $\leq T \leq$ 400 K and at pressures below the lesser of either 20 MPa or the saturated vapor pressure. Some vapor pressure measurements were also made with the Burnett apparatus. An equation of state will be developed and presented.