An Equation of State for the Thermodynamic Properties of Dimethyl Ether

Yong Zhou [S] and Jiangtao Wu [C]
State Key Laboratory of Multiphase Flow in Power Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi, China

A new thermodynamic property formulation for dimethyl ether has been developed based upon a selection of available experimental thermodynamic property data. The formulation includes a fundamental equation, a vapor pressure equation, a saturated liquid density equation and a saturated vapor density equation. The coefficients of the equation of state and ancillary equations were determined by a genetic optimization algorithm combined with a weighted least-squares fit of the selected experimental data. In determining the coefficients of the equation of state, multi-property fitting methods were used; including single-phase pressure-volume-temperature (pVT), heat capacity and sound of speed, as well as second viral coefficient, vapor pressure, and saturated liquid and saturated vapor density data. Deviations of experimental and calculated data are generally within the limits of the experimental accuracy. The equation of state has been developed to conform to the Maxwell criterion for two-phase liquid-vapor equilibrium states and is valid for temperatures from the triple point temperature to 550 K and pressure to 50 MPa and density to 800 kg/m^3. The deviation of the density ($100\times|\rho_{cal}-\rho_{exp}|/\rho_{exp}$) is generally less than 0.1 % and does not exceed 0.25 % in the liquid region. In the supercritical region, most of the density's deviation is less than 0.25 % except for very few data points. The uncertainty of the vapor pressure of the equation of state is generally less than 0.5 % but increases as the temperature decreases. Detailed comparisons between experimental and calculated data for the single-phase region, along the saturated curve and the critical region have been performed.