

Description of Behavior of Pure Fluids in Wide Area of States Including the Critical Point

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The knowledge of the behavior of liquids over a wide area of states is necessary for applications both for the design of thermal machinery, and in chemical process technologies. There are many equations of state which describe the behavior of liquids far from the critical area with acceptable accuracy. But these equations, despite the quite good description of thermodynamic properties, do not describe the singular behavior in critical area. Recently, attempts were undertaken to connect scaled equations of state with Landau-expansion or with Van-der-Vaals - like equation. However these attempts were based on the parametrical Scofield equation. It led to a complex form of expressions for thermodynamic functions that produced many difficulties in their practical application. We offer a new equation of state describing P - V - T data He^4 and SF_6 in an interval of reduced densities from -1 to $+1$ and reduced temperatures from -0.3 to $+0.3$, including the critical point. It includes the regular equation of state approximating P - V - T data outside of critical area, and the nonparametric scale equation of state, adequately describing P - V - T data near to the critical points that incorporate with a crossover function, describing a damping of fluctuations at removal from a critical point. Two different equations of state are taken as a regular part of the joined equation: the new cubic equation of state proposed by us and the Kaplun equation of state for the description of data including liquid states. The nonparametric scale equation of state with three system-dependent constants, offered by us earlier, is taken as the scaled part of the joined equation of state. Conditions $(\partial P/\partial v)_T = 0$ and $(\partial^2 P/\partial v^2)_T = 0$ are satisfied in a critical point for the joined equation. Approximation of the most exact data on He^4 and SF_6 by use of the new equation of state shows that it correctly describes P - V - T data with a pressure error within $\pm 0.5\%$.