

Nonanalytical Fundamental Equation of State for Ammonia

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In this work, an equation of state (EOS) is developed in the form of the Helmholtz free energy, $F(\rho, T)$. The EOS is to represent experimental thermodynamic data of NH_3 in the regular and non regular, critical, region. The non regular addend, $F_n(\rho, T, D)$, is built in accordance scaling theory (ST). This EOS includes such parameters as critical characteristics, $D = (\alpha, \beta, \Delta \text{ et. al.})$, that are proposed by ST and connected with singularities of thermodynamic properties in the critical point. A methodical part of the investigation is devoted to the EOS form: it has to satisfy criterions that are typical for the critical region. Experimental (P, ρ, T) – data and C_v, ρ, T – results of NH_3 are combined in an input data set. It is placed in the T, P - intervals: 196 – 606 K and 0.01...100 MPa. A fitting routine is used to treat (P, ρ, T) – data together with C_v, ρ, T – results for the purpose of determining the EOS coefficients. A software program is produced for the calculation of thermodynamic properties with the help of the EOS. Calculated data are obtained with the routine and compared with experimental results as well as with known tabulated properties. A satisfactory agreement of the calculated results with literature data demonstrates that the EOS can successfully represent experimental data both in the regular and singular areas. The EOS can be used in the gas and liquid phases as well as along the coexistence curve. The EOS region is wider than the area of typical parametric equations of state. The EOS is used to build the standard reference data (Russia) on thermodynamic properties of ammonia in the above-mentioned wide region of pressures and temperatures including the critical region.