New Formulation for the Viscosity of *n*-Butane

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A new viscosity formulation for *n*-butane, based on the residual quantity concept, uses the reference equation of state by Bücker and Wagner [J. Phys. Chem. Ref. Data **35**, 929 (2006)] and is valid in the fluid region from the triple point to 650 K and to 100 MPa. The contributions for the zero-density viscosity and for the initial-density dependence were separately developed, whereas those for the critical enhancement and for the higher-density terms were pretreated. All contributions were given as a function of the reciprocal reduced temperature τ, while the last two contributions were correlated as a function of τ and of the reduced density δ. The different contributions were based on specific primary data sets, whose evaluation and choice were discussed in detail. The final formulation incorporates 13 coefficients derived employing a state-of-the-art linear optimization algorithm. The viscosity at low pressures $p \leq 0.2$ MPa is described with an expanded uncertainty of 0.5% (coverage factor $k = 2$) for temperatures $293 \leq T/\mathrm{K} \leq 626$. The expanded uncertainty in the vapor phase at subcritical temperatures $T \geq 298$ K as well as in the supercritical thermodynamic region $T \leq 448$ K at pressures $p \leq 30$ MPa is estimated to be 1.5%. It is raised to 4.0% in regions where only less reliable primary data sets are available and to 6.0% in ranges without any primary data, but in which the equation of state is valid. A weakness of the reference equation of state in the near-critical region prevents estimation of the expanded uncertainty in this region. Viscosity tables for the new formulation are presented in Appendix B for the single-phase region, for the vapor–liquid phase boundary, and for the near-critical region. *Published by AIP Publishing on behalf of the National Institute of Standards and Technology.* https://doi.org/10.1063/1.5020802

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