

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 $293 \leq T/\text{K} \leq 626$. 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>

Key words: correlation; critical enhancement; fluid phase; normal butane; viscosity; viscosity tables.

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