Measurements of Vapor Pressures and PVT Properties for n-Butane from 280 to 440 K at Pressures to 200 MPa

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A long-term objective of this study is to accumulate the precise measurement data for environmentally acceptable hydrocarbon refrigerants such as propane, n-butane, isobutane, and their mixtures in the wide ranges of temperatures and pressures. In our laboratory, the vapor pressure, saturated liquid density, and (P, V, T, x) property measurements for several substances had been carried out using the metal-bellows valuable volumometer developed by Kabata et al. [1] and modified by Miyamoto and Uematsu [2]. In this study, we will report our measurement results of (P, V, T) property for n-butane in the compressed liquid phase in temperatures from 280 K to 440 K at pressures up to 200 MPa. The volume-fraction purity of n-butane used was 0.9995. Before use, it was degassed three or four times by condensation in the liquid nitrogen. The expanded uncertainties (k=2) of temperature, pressure, and density measurements have been estimated to be less than 3 mK, 1.5 kPa - 0.2 % in the respective ranges of pressures, and 0.11 %, respectively. In the region of more than 100 MPa at 280 K and 440 K, the uncertainty in density measurements rises up to 0.15 % and 0.23 %, respectively.

Throughout the present study, the direct comparisons of the (P, V, T) measurements on the same temperatures and pressures with several data points from available literatures were made in order to assess the reliability of the present ones quantitatively. Moreover, we also observed the reproducibility of the available equation of state to the present measurements of n-butane in the ranges over the range of validity of the model, from which the necessity of the improvements for the available model can be confirmed.

[1] Y. Kabata, S. Yamaguchi, M. Takada and M. Uematsu, *J. Chem.Thermodyn.* **24,** 1019 (1992).
[2] H. Miyamoto and M. Uematsu, to appear in *J. Chem. Thermodyn.* (2006)