Heat Capacity of Saturated and Compressed Liquid Dimethyl Ether at Temperatures from (132 to 345) K and at Pressures to 35 MPa

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Dimethyl ether's chemical and thermophysical properties have made it an industrially important compound with many applications. Recently, dimethyl ether has been given increasing consideration as a clean burning synthetic fuel that can substitute for conventional diesel fuel and as an ozone-safe working fluid for refrigeration cycles. Accurate thermophysical properties will be essential to design and develop efficient processes that use this compound. Though a literature search reveals a recent surge in thermophysical properties research on dimethyl ether [1], it was clear that certain properties, notably heat capacity, were quite scarce and covered only limited ranges of temperature and pressure. Thus, molar heat capacities at constant volume (C_v) were measured with an adiabatic calorimeter. Temperatures ranged from the triple point of dimethyl ether near 132 K to the upper temperature limit of the calorimeter at 345 K, while pressures ranged from (0 to 35) MPa. The dimethyl ether sample had a purity of 0.999 mol fraction, which was verified by chemical analysis. Measurements were conducted on liquid in equilibrium with its vapor and on compressed liquid samples along isochores. Heat capacity results are reported for two-phase ($C_v^{(2)}$), saturated liquid (C_s), and single-phase (C_v) state conditions. Vapor pressure data are reported that are based on measurements of $C_v^{(2)}$ along a 2-phase isochore. The principal sources of uncertainty are the temperature rise measurement and the change-of-volume work adjustment. The expanded uncertainty (i.e., a coverage factor k=2 and thus a two-standard deviation estimate) for values of $C_v^{(2)}$ is estimated to be 0.5 %, for C_s it is 0.7 %, and for C_v it is 0.7 %. Deviations of both the present and published C_v, C_s, and vapor pressure results from those calculated with a fundamental equation of state [1] are discussed.

[1] E. C. Ihmels and E. W. Lemmon, *Fluid Phase Equilib.* **260**, 36 (2007).