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Experimental Measurement of Speeds of Sound in Liquid Carbon Monoxide and Development of High-Pressure, High-Temperature Equations of State[1] JOSEPH ZAUG, Lawrence Livermore National Laboratory, JEFFREY CARTER, Picarro.com, SORIN BASTEA, MICHAEL ARMSTRONG, FRIED LAURENCE, Lawrence Livermore National Laboratory — We report the adiabatic sound speeds for supercritical fluid carbon monoxide along two isotherms, from 0.17 to 2.13 GPa at 297 K and from 0.31 to 3.2 GPa at 600 K. The carbon monoxide was confined in a resistively heated diamond-anvil cell and the sound speed measurements were conducted in situ using a recently reported variant of the photoacoustic light scattering effect. The measured sound speeds were then used to parameterize a single site dipolar exponential-6 intermolecular potential for carbon monoxide. PT thermodynamic states, sound speeds, and shock Hugoniots were calculated using the newly parameterized intermolecular potential and compared to previously reported experimental results. Additionally, we generated an analytical equation of state for carbon monoxide by fitting to a grid of calculated PT states over a range of 0.1-10 GPa and 150-2000 K. A 2 percent mean variation was found between computed high-pressure solid-phase densities and measured data -a surprising result for a spherical interaction potential. We further computed a rotationally dependent fluid to beta-solid phase boundary; results signal the relative magnitude of short-range rotational disorder under conditions that span existing phase boundary measurements.

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