

Speed of Sound Measurements of Binary Mixtures of 1,1,1,2-Tetrafluoroethane, 2,3,3,3-Tetrafluoropropene, and 1,3,3,3-Tetrafluoropropene Refrigerants

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Speed of sound data measured using a dual path pulse echo instrument are reported for binary mixtures of 1,1,1,2-Tetrafluoroethane (R134a), 2,3,3,3-Tetrafluoropropene (R1234yf), and 1,3,3,3-Tetrafluoropropene (R1234ze(E)). For each mixture data set the speed of sound is reported for two compositions with mol fractions of approximately 0.333 and 0.667. Speed of sound data are reported from 230 to 345 K from pressures tracing the bubble point curve up to a maximum pressure of 51.4 MPa. However, in order to avoid potential polymerization reactions data for mixtures containing R1234yf are limited to a maximum pressure of 12 MPa at temperatures below 298 K and 8 MPa at temperatures above 295 K. The mean uncertainty of the measured speed of sound is less than 0.1% with a maximum uncertainty of approximately 0.4% as the conditions approach the mixture critical region. The reported data are compared to available REFPROP mixture models, which presently are only correlated to pure component data, agree with the data with an absolute average deviation of 0.3% with maximum deviations as high as 1%. The comparisons to the REFPROP correlations show that further adjustments to the mixture models are needed to provide a representation of the data within its experimental uncertainty.