

Velocity of Sound in Perfluoropropane (C₃F₈), Perfluoroethane (C₂F₆) and their Mixtures

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The paper summarises speed of sound data measured in pure Perfluoropropane, pure Perfluoroethane, and their mixtures. Measurements were performed within the target range of temperatures between -20°C and 50°C, pressures up to 15 bar_a and for the mixtures up to 30% of Perfluoroethane in Perfluoropropane. The research was driven by demands of the several Large Hydron Collider CERN projects, to investigate the possibility of using mixtures of fluorocarbons in cooling circuits for particle physics applications. A new sonar analyzer, which is also described in detail, has been developed for the measurements. A custom-developed speed-of-sound instrument for continuous real-time measurement was adopted for speed-of-sound measurements in the gas phase with sonar electronics developed and aimed at expanding the use of the device, not only for sound velocity measurements in various gases and vapors, but also as a combined binary gas mixture analyzer or leak-checker. A theoretically-based PC SAFT equation of state or NIST package can be employed to predict expected values of the speed-of-sound, and those predictions are later used in the process of composition determination from the measured speed-of-sound in refrigerant mixtures. The instrument has many potential applications, including the analysis of mixtures of hydrocarbons, vapours for semi-conductor manufactures and anaesthesia.