Measuring the Viscosity of Gases with a Greenspan Viscometer

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The Greenspan viscometer is an acoustic resonator composed of two gas-filled chambers coupled by a duct of radius r_d. In the lowest order, the viscosity of the gas is $\eta = \pi f \rho (r_d/Q)^2$, where f and Q are the resonance frequency and quality factor of the isolated Greenspan mode, and ρ is the gas density. We installed a Greenspan viscometer in an automated facility capable of spanning the temperature range 200 K to 400 K and pressures up to 3.3 MPa. We measured the frequency and Q of the Greenspan mode when the resonator was filled with seven gases: Ar, He, CH_4, C_3H_8, N_2, SF_6, CF_4, and C_2F_6. The data were interpreted using a complete, parameter-free model [1]. In the limit of low density, the resulting values of the viscosities of Ar, He, N_2, C_3H_8 and SF_6 agreed within ±0.3 % with the values obtained by Vogel *et al.* [3-4] using oscillating disk techniques. The present results and Vogel's results are consistent with the viscosity ratios determined by Berg using capillary flow [5].

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