Viscosity of Ar, CO, CO_2, NH_3, SF_6, SiF_4 and C_4H_8 Gases Measured with a Greenspan Acoustic Viscometer

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A Greenspan viscometer (double cylindrical Helmholtz resonator) was used to determine the kinematic viscosity of the gases: argon, carbon monoxide, carbon dioxide, ammonia, sulfur hexafluoride, silicon tetrafluoride, octafluorocyclobutane. The data span the temperature range 220 K to 375 K, and pressures up to 3.4 MPa. We measured the complex (in-phase and quadrature) frequency-dependent response of the resonator in the vicinity of the Helmholtz mode. We calculated the response from a model that describes the acoustic field in terms of transmission line equations and an associated impedance network. This model includes corrections for end-effects terms, capillary inlet tube, and slits next to the seals between the body of the resonator and its ends. The viscosity and speed-of-sound are determined by comparing the measured response with the model. At 298 K, the present results for argon, methane, nitrogen, ethane and propane agree with the values reported by the literature within one per cent. The present results for the speed of sound agree within 0.01% with the results from other resonators that have higher quality factors optimized for speed-of-sound determinations.