

Accurate Values of the Transport Properties of Argon

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We determined the viscosity η and the thermal conductivity of argon at zero density with the uncertainty of only 0.038 % in the temperature range 200 K to 400 K. Our results will improve: (1) the argon-argon interatomic potential, (2) calculated boundary-layer corrections for primary acoustic thermometry, and (3) calibrations of laminar flow meters as well as instruments for measuring transport properties. At 298.15 K, we determined the ratio $\eta_{\text{argon}}/\eta_{\text{helium}} = 1.13800/-0.00018$ by measuring the flow rate of these gases through a quartz capillary of known dimensions and simultaneously measuring the pressures at the ends of the capillary. Between 200 K and 400 K, we used a two-capillary viscometer to determine $\eta_{\text{argon}}/\eta_{\text{helium}} = 1.21167 - 0.82034 \exp(T/123.78 \text{ K})$ with an uncertainty of 0.023 %. From $\eta_{\text{argon}}/\eta_{\text{helium}}$, we computed η_{argon} using the values of η_{helium} calculated *ab initio*. (For new *ab initio* calculations, see Hurly et al., this meeting.) Finally, we computed the thermal conductivity of argon with an uncertainty of 0.038 % from η_{argon} and values of the Prandtl number computed from various argon-argon interatomic potentials. Our values for $[\eta(T)/\eta(298 \text{ K})]_{\text{helium}}$ range from 0.77 to 1.21; they differ from those calculated *ab initio* by, at most, 0.0004. This small difference is consistent with the uncertain thermal expansion of the nickel capillaries of our two-capillary viscometer.