

## Curiosity Number 24. Comparison of Viscosity Laws

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This curiosity comes about because I used Keye's viscosity law when I coded up **FRICION**. I used Keyes Law at the recommendation of Hopkins, NASA TN D-6945, "Charts for Predicting Turbulent Skin Friction From the Van Driest Method (II)," October 1972. However, it's typical to hear about Sutherland's viscosity law. What's the difference? Lets see. In a quick internet search I found some notes from the Wind code manual. There it says: Use Sutherland's law when the temperature is greater than 180° R. Use Keye's law for  $T$  less than 160° R. Use a linear combination of these laws for  $160^\circ \text{ R} < T < 180^\circ \text{ R}$ . Wow.

Hopkins, in TN D-6945 says that Keye's Law is more accurate for low temperatures, and agrees within 3% of Sutherland's Law for higher temperature.

The Sutherland law is given everywhere. Keyes viscosity law is.

$$\mu = \frac{2.32 \times 10^{-8} T^{1/2}}{1 + (220 / T) \times 10^{-9/T}}$$

where  $T$  is in °R. The plot with the two different viscosity laws is shown below. All things considered, I think either one is OK. I normalized by the viscosity at sea level to simplify the numbers and I think you get a better feel for the size of the effect of temperature on viscosity.

Comparison of Sutherland's and Keye's Viscosity Laws

