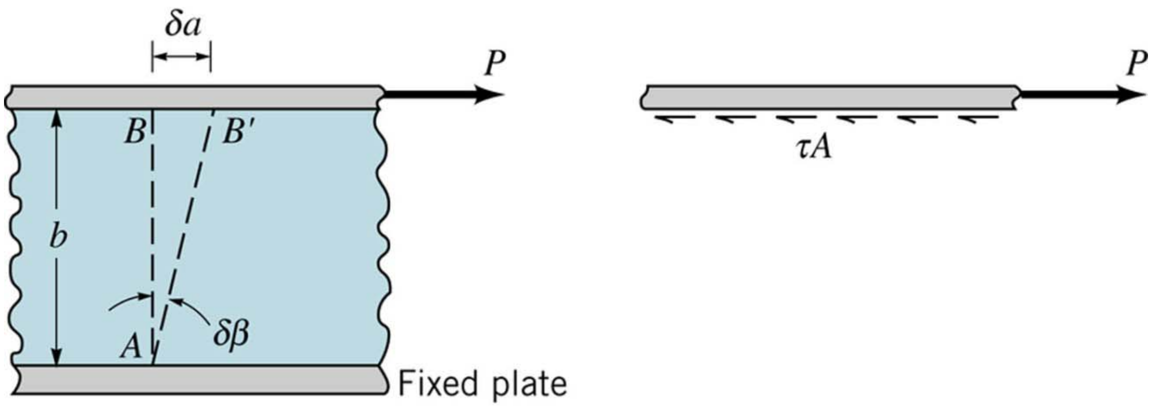
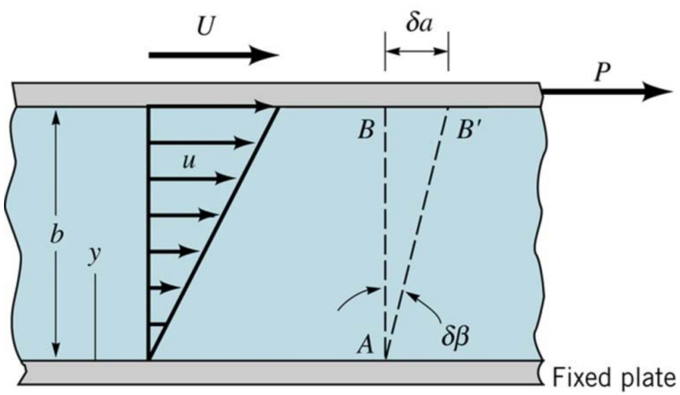
# Moving fluid: Viscosity




(a) (b)




*no-slip condition*

$P$ is a force tangent to the surface (the shearing stress):

$$\tau = \frac{P}{A}$$

$$\tau = \mu \frac{du}{dy}$$ Eq (1.9)

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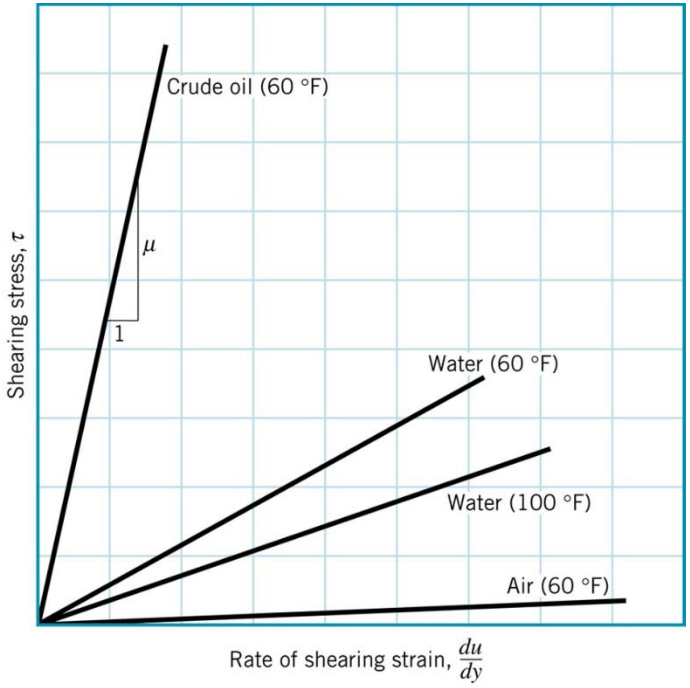


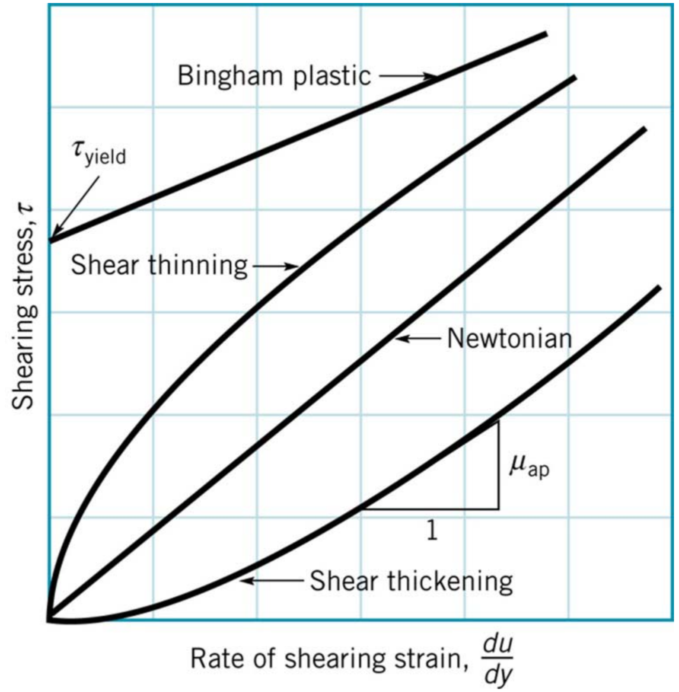


Newtonian fluids: $$\tau = \mu \frac{du}{dy}$$ Eq (1.9)

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Dynamic viscosity:

$$\mu = \frac{\tau}{du/dy} \qquad \left[\frac{\mathrm{N/m^2}}{1/\mathrm{s}}\right] = [\mathrm{Pa \cdot s}]$$

$FL^{-2}T$

Kinematic viscosity:

$$\nu = \frac{\mu}{\rho} \qquad \left[\frac{\mathrm{N/m^2}}{(1/\mathrm{s})(\mathrm{kg/m^3})}\right] = [\mathrm{m^2/s}]$$

$L^{2}T^{-1}$

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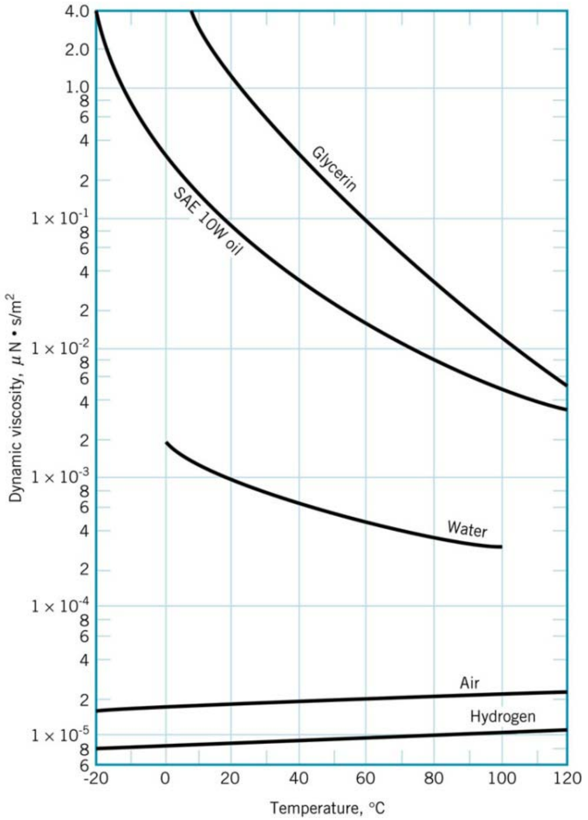
Viscosity is very sensitive to temperature:




Liquids:

$$\mu = D\exp(B/T)$$ Eq (1.11)

(Andrade's equation)

Gases:

$$\mu = \frac{CT^{3/2}}{T+S}$$ Eq (1.10)

(Sutherland equation)