Given: Journal bearing, journal diameter = 3 in, $l = 1.5$ in, $W = 800$ lb$_f$, $n = 600$ rev/min, $C_r = 0.0025$ in, $T = 150°F$.

Find: Minimum oil-film thickness and the maximum film pressure for SAE10 and SAE40 lubricants.

Solution: From the temperature-viscosity chart,

$$\mu_{10} = 1.65\ \mu\text{reyn} \qquad \mu_{40} = 4.5\ \mu\text{reyn}.$$

The Sommerfeld number is given by

$$S = \left(\frac{r}{C_r}\right)^2 \frac{\mu N}{P}$$

$$S_{10} = \left(\frac{1.5\text{in}}{0.0025\text{in}}\right)^2 \frac{\left(1.65\times10^{-6}\ \frac{\text{lb}_f\text{-sec}}{\text{in}^2}\right)\left(\frac{600\text{rev}}{\text{min}}\right)\left(\frac{\text{min}}{60\text{sec}}\right)}{\left(\frac{800\text{lb}_f}{(3\text{in})(1.5\text{in})}\right)}$$

$$= 3.34\times10^{-2}$$

$$S_{40} = \left(\frac{4.5\ \mu\text{reyn}}{1.65\ \mu\text{reyn}}\right)\left(3.34\times10^{-2}\right) = 9.1\times10^{-2}$$

$$\frac{L}{D} = \frac{1.5\text{in}}{3\text{in}} = 0.5$$

From the chart in the notes,

$$\left(\frac{h_o}{C}\right)_{10} = 0.11 \qquad \left(\frac{h_o}{C}\right)_{40} = 0.2$$

$$\Rightarrow h_{o_{10}} = (0.11)(0.0025in)$$

$$\boxed{h_{o_{10}} = 0.000275in}$$

$$\Rightarrow h_{o_{40}} = (0.2)(0.0025in)$$

$$\boxed{h_{o_{40}} = 0.0005in}$$

Note that the higher viscosity oil has a higher oil film thickness.

Also, from the chart in the notes,

$$\left(\frac{P}{P_{max}}\right)_{10} = 0.23 \qquad \left(\frac{P}{P_{max}}\right)_{40} = 0.28$$

$$P = \frac{800lbf}{(3in)(1.5in)} = 178psi$$

$$\Rightarrow \boxed{P_{max_{10}} = \frac{178}{0.23} = 774psi}$$

$$\boxed{P_{max_{40}} = \frac{178}{0.28} = 635psi}$$

Note that the higher viscosity oil has a lower max pressure.