



Quiz - 3

Name: key  
Student #:

A pillow-block journal bearing has shaft diameter of 50 mm and a bore diameter of 50.1 mm. The bearing has a 50 mm length and it supports a 2500 N load. The journal runs at rotational speed of 2400 rpm. Knowing that the bearing uses SAE-40 lubricant and the steady-state average film temperature is  $\bar{T}_f = 65^\circ\text{C}$ ,

- a) Find the Sommerfeld number.

Fig 12-13 ~  $\mu = 30 \text{ mPa}\cdot\text{s}$

$r = 25 \text{ mm}$ ,  $N = 2400/60 = 40 \text{ rev/s}$ ,  $C = 0.1/2 = 0.05 \text{ mm}$

$P = \frac{W}{DL} = \frac{2500}{50 \times 50} = 1 \text{ MPa}$

$\Rightarrow S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P} = \left(\frac{25}{0.05}\right)^2 \frac{(30 \times 10^{-3}) \times 40}{1 \times 10^6} = 0.3$

$S = 0.3$

- b) Find the minimum film thickness,  $h_o$ .  $L/d = 1$

Fig 12-16 ~  $\frac{h_o}{c} \approx 0.625$

$\Rightarrow h_o = 0.625 \times 0.05 = 0.0313$

$h_o = 0.0313 \text{ mm}$

- c) Find the maximum temperature,  $T_{max}$ .

Fig 12-24 ~  $\frac{0.12 \Delta T_c}{\rho} = 2.15$ ,  $\Delta T_c = 17.92^\circ\text{C}$

$\Rightarrow T_{max} = 65 + 17.92/2 = 73.96^\circ\text{C}$

$T_{max} = 73.96^\circ\text{C}$

- d) Find the coefficient of friction,  $f$ .

Fig 12-18 ~  $\frac{r}{c} f \approx 6.2$

$\Rightarrow f = 6.2 \left(\frac{0.05}{25}\right) = 0.0124$

$f = 0.0124$

- e) Find the rate of heat generation due to friction,  $H_{gen}$ .

$H_{gen} = 2\pi W N c \left(\frac{r}{c} f\right) = 2\pi \times 2500 \times 40 \times (0.05 \times 10^{-3}) \times 6.2$

$\Rightarrow H_{gen} = 194.78 \text{ W}$

$H_{gen} = 194.78 \text{ Watt}$

- f) Find the coefficient of friction using Petroff's equation and the percentage error.

$f = 2\pi^2 \frac{\mu N}{P} \frac{r}{c} = 2\pi^2 \frac{(30 \times 10^{-3}) \times 40}{1 \times 10^6} \frac{25}{0.05} = 0.0118$

$\text{Error} = \frac{0.0124 - 0.0118}{0.0124} \times 100\% = 4.5\%$

$f = 0.0118$

$\text{Error} = 4.5\%$