NORTON 10.9 & 10.13



BEARING DATA
30 mm DIA
130 mm LONG
0.0015 CLEARANCE RATIO ($C/r$)
1500 rpm
ISO VG 100 OIL
200°F → 93°C (ASSUME THIS IS AVG. TEMP)
7kN LOAD

SOMMERFELD NUMBER

$$S = \left(\frac{r}{c}\right)^2 \frac{\nu N}{P} = \left(\frac{1}{0.0015}\right)^2 \frac{9\times10^{-3}\,\frac{N}{m^2}\,sec\left(25\,\frac{rev}{sec}\right)}{1.79\times10^{6}\,\frac{N}{m^2}} = 0.056$$

$$\nu = 9\times10^{-3}\,\frac{N}{m^2}\,sec$$

$$N = 1500\,\frac{rev}{min}\times\frac{1\,min}{60\,sec} = 25\,\frac{rev}{sec}$$

$$P = \frac{7000N}{(.030m)(.130m)} = 1.79\times10^{6}\,\frac{N}{m^2}$$

NOTE: SOMMERFELD NUMBER FROM SOLUTIONS MANUAL IS CALCULATED FROM A DIFFERENT EQUATION AND IS $\pi$ TIMES LARGER, $\pi(0.056) = 0.1750$ AS PER INSTRUCTIONS IN LECTURE, WE DISREGARD THE METHOD IN THE TEXT.

$\frac{h_0}{C} \approx 0.3$ (USING $\frac{l}{d} = 4.33$, AND CHART PG. BEARINGS-19)

$$\frac{c}{r}r = C = 0.0015(.015\,m) = 0.0000225\,m$$

$$h_0 \approx 0.3(0.0000225m) = 0.00000675\,m = 6.75\times10^{-3}\,mm$$
$$= 0.00027\,in$$

FIND TORQUE AND POWER LOST IN BEARING

$S = 0.056$

FROM PG BEARINGS-21, $\frac{r}{c} f \approx 1.6 \quad \left(\frac{l}{D} = 4.33\right)$

$$f \approx 1.6(0.0015) = 0.0024$$

$$T = f W r = 0.0024\,(7{,}000\,N)\,0.015\,m = 0.252\,Nm$$

$$\text{POWER LOST} = f W \pi d N = 0.0024\,(7{,}000\,N)\,\pi\,(.030\,m)\,25\,\frac{rev}{sec} = 12.6\,W$$