Tutorial Sheet 6: Journal Bearings

1. A full journal bearing has a journal diameter of 25 mm, with a unilateral tolerance of -0.03mm. The bushing bore has a diameter of 25.03 mm and a unilateral tolerance of 0.04 mm. The l/d ratio is 1/2. The load is 1.2 kN and the journal runs at 1100 rev/min. If the average viscosity is 55 mPa·s, find the minimum film thickness, the power loss, and the side flow for the minimum clearance assembly.

   [0.0045 mm, 11.2 W, 177 mm^3/s]

2. A full journal bearing is 28 mm long. The shaft journal has a diameter of 56 mm with a unilateral tolerance of -0.012 mm. The bushing bore has a diameter of 56.05 mm with a unilateral tolerance of 0.012 mm. The load is 2.4 kN and the journal speed is 900 rev/min. For the minimum clearance assembly find the minimum oil-film thickness, the power loss, and the side flow if the operating temperate is 65°C and SAE 40 lubricating oil is used. [0.011 mm, 50 W, 995 mm^3/s]

3. A full journal bearing has a shaft diameter of 80 mm with a unilateral tolerance of -0.01 mm. The l/d ratio is unity. The bushing has a bore diameter of 80.08 mm with a unilateral tolerance of 0.03 mm. The SAE 40 oil supply is in an axial-groove sump with a steady-state temperature of 60°C. The radial load is 3 kN. Estimate the average film temperature, the minimum film thickness, the heat loss rate, and the lubricant side-flow rate for the minimum clearance assembly, if the journal speed is 8 rev/s.

4. A 64- × 64-mm sleeve bearing uses grade 20 lubricant. The axial-groove sump has a steady-state temperature of 43°C. The shaft journal has a diameter of 63.5 mm with a unilateral tolerance of -0.025 mm. The bushing bore has a diameter of 63.6 mm with a unilateral tolerance of 0.025 mm. The journal speed is 1120 rev/min and the radial load is 5.34 kN. Estimate

   (a) The magnitude and location of the minimum oil-film thickness

   (b) The eccentricity

   (c) The coefficient of friction

   (d) The power loss rate

   (e) Both the total and side oil-flow rates

   (f) The maximum oil-film pressure and its angular location

   (g) The terminating position of the oil film

   (h) The average temperature of the side flow

   (i) The oil temperature at the terminating position of the oil film

5. A natural-circulation pillow-block bearing has a journal diameter d of 62.5 mm with a unilateral tolerance of -0.025 mm. The bushing bore diameter B is 62.6 mm with a unilateral tolerance of 0.1 mm. The shaft runs at an angular speed of 1120 rev/min; the bearing uses SAE grade 20 oil and carries a steady load of 1350 N in shaft-stirred air at 21°C. The lateral area of the pillow-block housing is 38,700 mm^2. Perform a design assessment using minimum radial clearance for a load of 2700 N and 1350 N. Use Trumpler's criteria and assume that both l/d and α are unity.

[$\overline{T}_f \approx 93$°C; all of Trumpler's criteria are fulfilled]