

C12_4b

Design of a circular aerostatic thrust bearing with simple orifice restrictor.

Problem: Aerostatic thrust bearing shown in Fig.12.13a.

$$\text{MPa} := 10^6 \cdot \text{Pa}$$

Diameter bearing: $D_0 := 40 \cdot \text{mm}$ $R_0 := 0.5 \cdot D_0$ $R_0 = 20 \text{ mm}$

Dimiameter orifice: $D_1 := 1 \cdot \text{mm}$ $R_1 := 0.5 \cdot D_1$ $R_1 = 0.5 \text{ mm}$

Film thickness: $h_0 := 5 \cdot 10^{-6} \cdot \text{m}$

Supply pressure: $p_s := 0.5 \cdot \text{MPa}$

Ambient pressure: $p_a := 0.1 \cdot \text{MPa}$

Pressure factor: $\beta_0 := 0.6$

Coefficient of discharge: $C_D := 0.7$

Gas properties: $\eta := 18 \cdot 10^{-6} \cdot \text{Pa} \cdot \text{s}$ $R := 287 \cdot \frac{\text{m}^2}{\text{s}^2 \cdot \text{K}}$ $T := 293 \cdot \text{K}$

$$\rho_0 := 1.208 \cdot \frac{\text{kg}}{\text{m}^3} \quad \kappa := 1.4$$

1) Load capacity:



2) Flow rate:



3) Dimensions orifice restrictor:



4) Axial bearing stiffness



5) Dimensionless load capacity



Load capacity: $F = 63.53 \text{ N}$

Dimensionless load capacity: $F_1 = 0.1264$ $Ae_A = 0.211$

Axial bearing stiffness: $S = 2.441 \times 10^7 \frac{\text{N}}{\text{m}}$

Pressure after the restrictor: $\frac{p_r}{p_s} = 0.68$

Flow rate : $M = 6.189 \times 10^{-7} \frac{\text{kg}}{\text{s}}$ $Q = 0.031 \frac{\text{liter}}{\text{min}}$

Diameter simple orifice: $d_s = 0.07 \text{ mm}$