

Case 12_4f

Design of an aerostatic shallow pocket thrust bearing.

Problem: Aerostatic bearing shown in Fig.12.10

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

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

Diameter pocket: $D_1 := 32 \cdot \text{mm}$ $R_1 := 0.5 \cdot D_1$ $R_1 = 16 \text{ mm}$

Gas inlet diameter: $D_2 := 1 \cdot \text{mm}$ $R_2 := 0.5 \cdot D_2$ $R_2 = 0.5 \text{ mm}$

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

Pocket depth: $h_2 := 5 \cdot 10^{-6} \cdot \text{m}$

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

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

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

1) Flow rate and intermediate pressure:



2) Pressure drop over inlet:



3) Load capacity:



4) Inherent stiffness:



Load capacity: $F = 241 \text{ N}$

Dimensionless load capacity: $F_1 = 190.33113 \text{ N}$ $Ae_A = 0.945$

Pressure after the restrictor: $\frac{p_r}{p_s} = 0.606$ $\beta = 0.507$

Axial bearing stiffness: $S = 48.1 \cdot 10^6 \cdot \frac{\text{N}}{\text{m}}$

Flow rate : $M = 7.905 \times 10^{-6} \frac{\text{kg}}{\text{s}}$ $Q = 0.399 \frac{\text{liter}}{\text{min}}$