

C12_5a

Design of a collar bearing with porous restrictor.

Problem: Aerostatic collar bearing shown in Fig.

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

Diameter 2R0: $D_0 := 40 \cdot \text{mm}$ $R_0 := 0.5 \cdot D_0$

Diameter 2R1: $D_1 := 32 \cdot \text{mm}$ $R_1 := 0.5 \cdot D_1$

Diameter 2R2: $D_2 := 25 \cdot \text{mm}$ $R_2 := 0.5 \cdot D_2$

Diameter 2R3: $D_3 := 20 \cdot \text{mm}$ $R_3 := 0.5 \cdot D_3$

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

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

Pressure factor: $\beta_0 := 0.6$

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

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

Permeability porous surface: $k_p := 2.5 \cdot 10^{-15} \cdot \text{m}^2$

1) Load capacity:



2) Flow rate:



4) Axial bearing stiffness:



Load capacity: $F = 162.08 \text{ N}$

Dimensionless load capacity: $F_1 = 0.32245$ $Ae_A = 0.537$

Axial bearing stiffness: $S = 36.6 \cdot 10^6 \cdot \frac{\text{N}}{\text{m}}$

Pressure after the restrictor: $\frac{p_r}{p_s} = 0.681$

Flow rate : $M = 2.046 \times 10^{-5} \frac{\text{kg}}{\text{s}}$ $Q = 1.032 \frac{\text{liter}}{\text{min}}$

Thickness porous surface: $s_p = 1.7 \text{ mm}$