Case 12_4d

Design of an aerostatic thrust bearing with porous restrictor.

Problem: Aerostatic thrust bearing shown in Fig.12.14.

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

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

Diameter 2R1: $D_1 := 26 \cdot mm$ $R_1 := 0.5 \cdot D_1$

Diameter 2R2: $D_2 := 22 \cdot mm$ $R_2 := 0.5 \cdot D_2$

Ambient pressure: $p_a := 0.1 \cdot MPa$

Supply pressure: $p_s := 0.5 \cdot MPa$

Pressure factor: $\beta_0 := 0.6$

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

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

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

1) Dimensions of the porous surface:

2) Load capacity:

3) Axial bearing stiffness:

Load capacity: $F = 218.55\,N$

Dimensionless load capacity: $F_1 = 0.4348$ $Ae\_A = 0.725$

Axial bearing stiffness: $S = 49.2\,10^{6} \cdot \frac{N}{m}$

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

Flow rate : $M = 5.3 \times 10^{-6}\,kg\,s^{-1}$ $Q = 0.267\,\frac{liter}{min}$

Thickness porous surface: $s_p = 3.158\,mm$

4) Stiffness (ε=0.5):