

$$D_g := 0.2 \text{ in}$$

$$K_c := 0.2$$

$$F_{preload} := 10 \text{ lbf}$$

$$\rho := 0.027 \frac{\text{lbm}}{\text{in}^3}$$

$$D_{pis} := 0.375 \text{ in}$$

$$P_b := 50 \text{ psi}$$

$$K_{spring} := 35 \frac{\text{lbf}}{\text{in}}$$

$$C_d := 0.7$$

$$A_{poppet} := \frac{\pi}{4} \cdot D_g^2$$

$$A_{comp} := \frac{\pi}{4} \cdot (D_{pis}^2 - D_g^2)$$

$$F_{back} := P_b \cdot \frac{\pi}{4} \cdot D_{pis}^2$$

$$A_{flow}(Stroke) := (0.35 \cdot Stroke) \cdot \text{in}$$

$$A_{dis}(Stroke) := (0.33 \cdot Stroke) + 0.029 \text{ in} \cdot \text{in}$$

$$Q := 1 \text{ gpm}$$

$$P_s := 100 \text{ psi}$$

$$P_{int} := P_b + 1 \text{ psi}$$

$$A_{in} := A_{flow}(Stroke)$$

$$A_{out} := A_{dis}(Stroke)$$

$$F_{inlet_pressure} := A_{poppet} \cdot (P_s)$$

$$F_{comp_pressure} := A_{comp} \cdot (P_{int})$$

$$F_{spring} := (F_{preload} + K_{spring} \cdot Stroke)$$

$$V_{inlet} := \frac{Q}{\frac{\pi}{4} \cdot D_g^2}$$

$$\Delta P_{in} := \frac{K_c \cdot V_{inlet}^2 \cdot \rho}{2}$$

Flow Equations

$$Q = C_d \cdot A_{in} \cdot \sqrt{2 \cdot \frac{P_s - P_{int}}{\rho}}$$

$$Q = C_d \cdot A_{out} \cdot \sqrt{2 \cdot \frac{P_{int} - P_b}{\rho}}$$

$$V_{inlet} = \frac{Q}{\frac{\pi}{4} \cdot D_g^2}$$

$$\Delta P_{in} = \frac{K_c \cdot V_{inlet}^2 \cdot \rho}{2}$$

Controls

$$Q \geq 0 \text{ gpm} \quad P_{int} \geq P_b$$

$$P_{int} \leq P_s \quad P_s > 0 \text{ psi}$$

Force Equations

$$F_{inlet_pressure} = A_{poppet} \cdot (P_s)$$

$$F_{comp_pressure} = A_{comp} \cdot (P_{int})$$

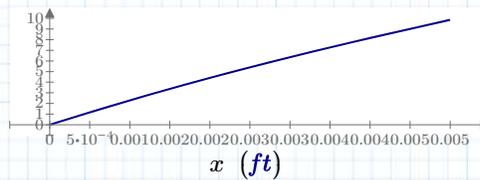
Force Balance

$$F_{back} + F_{spring} = F_{inlet_pressure} + F_{comp_pressure}$$

$$\text{ans}(Stroke) := \text{find}(Q, P_s, P_{int}, F_{inlet_pressure}, F_{comp_pressure})$$

$$\text{ans}(0.03 \text{ in}) = \begin{bmatrix} 5.402 \text{ gpm} \\ 350.411 \text{ psi} \\ 70.401 \text{ psi} \\ 11.008 \text{ lbf} \\ 5.564 \text{ lbf} \end{bmatrix}$$

$$x := 0 \text{ in}, 0.005 \text{ in} \dots 0.06 \text{ in}$$



$$\text{ans}(x)_0 \text{ (gpm)}$$

See next page for the problem

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$$\rho := 0.027 \frac{\text{lbm}}{\text{in}^3}$$

$$D_{pis} := 0.375 \text{ in}$$

$$P_b := 50 \text{ psi}$$

$$K_{spring} := 35 \frac{\text{lbf}}{\text{in}}$$

$$C_d := 0.7$$

$$A_{poppet} := \frac{\pi}{4} \cdot D_g^2$$

$$A_{comp} := \frac{\pi}{4} \cdot (D_{pis}^2 - D_g^2)$$

$$F_{back} := P_b \cdot \frac{\pi}{4} \cdot D_{pis}^2$$

$$A_{flow}(Stroke) := (0.35 \cdot Stroke) \cdot \text{in}$$

$$A_{dis}(Stroke) := (0.33(Stroke) + 0.029 \text{ in}) \cdot \text{in}$$

$$Q := 1 \text{ gpm}$$

$$P_s := 100 \text{ psi}$$

$$P_{int} := P_b + 1 \text{ psi}$$

$$V_{inlet} := \frac{Q}{\frac{\pi}{4} \cdot D_g^2}$$

$$A_{in} := A_{flow}(Stroke)$$

$$A_{out} := A_{dis}(Stroke)$$

$$F_{inlet_pressure} := A_{poppet} \cdot (P_s)$$

$$F_{comp_pressure} := A_{comp} \cdot (P_{int})$$

$$\Delta P_{in} := \frac{K_c \cdot V_{inlet}^2 \cdot \rho}{2}$$

$$F_{spring} := (F_{preload} + K_{spring} \cdot Stroke)$$

Flow Equations

Controls

$$Q = C_d \cdot A_{in} \cdot \sqrt{2 \cdot \frac{P_s - P_{int}}{\rho}}$$

$$V_{inlet} = \frac{Q}{\frac{\pi}{4} \cdot D_g^2}$$

$$Q \geq 0 \text{ gpm} \quad P_{int} \geq P_b$$

$$Q = C_d \cdot A_{out} \cdot \sqrt{2 \cdot \frac{P_{int} - P_b}{\rho}}$$

$$\Delta P_{in} = \frac{K_c \cdot V_{inlet}^2 \cdot \rho}{2}$$

$$P_{int} \leq P_s \quad P_s > 0 \text{ psi}$$

Force Equations

$$F_{inlet_pressure} = A_{poppet} \cdot (P_s)$$

$$F_{comp_pressure} = A_{comp} \cdot (P_{int})$$

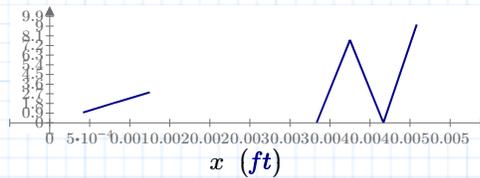
Force Balance

$$F_{back} + F_{spring} = F_{inlet_pressure} + F_{comp_pressure}$$

$$\text{ans}(Stroke) := \text{find}(Q, P_s, P_{int}, F_{inlet_pressure}, F_{comp_pressure}, V_{inlet}, \Delta P_{in})$$

$$\text{ans}(0.03 \text{ in}) = \begin{bmatrix} 5.402 \text{ gpm} \\ 350.411 \text{ psi} \\ 70.401 \text{ psi} \\ 11.008 \text{ lbf} \\ 5.564 \text{ lbf} \\ 55.172 \frac{\text{ft}}{\text{s}} \\ 3.065 \text{ psi} \end{bmatrix}$$

$$x := 0 \text{ in}, 0.005 \text{ in}..0.06 \text{ in}$$



$$\text{ans}(x)_0 \text{ (gpm)}$$