33.53 A hydraulic press has an $18in$ stroke and a $4in$ bore. The stroke time is $3seconds$ and the hydraulic fluid has a specific gravity of 0.87. The press is controlled by a two-way control valve with a flow coefficient of 3.5. What is the pressure drop across the valve?

A. $2psi$

B. $27psi$

C. $166psi$

D. $245psi$

Determine the volume flow rate through the hydraulic press. Volume is the product of stroke length and area, where area is a function of the bore (diameter). Divide by time to obtain the volume flow rate. Convert to gpm.

$$Q = \frac{V}{t}$$

$$Q = \frac{(1.5ft)\left[\frac{\pi}{4}\left(\frac{4in}{12\frac{in}{ft}}ft\right)^2\right]}{3s} = 0.0436\frac{ft^3}{s}$$

$$Q = 0.0436\frac{ft^3}{s}\left(\frac{7.48gal}{ft^3}\right)\left(\frac{60s}{1min}\right) = 19.58gpm$$

Use the equation for the Valve Flow Coefficient which includes the specific gravity for fluids other than water. Solve for the pressure drop, ΔP. The volume flow rate must be specified in gpm, and the units for pressure drop will be psi.

$$C_v = Q\sqrt{\frac{SG}{\Delta P}}$$

$$\Delta P = SG\left(\frac{Q}{C_v}\right)^2$$

$$\Delta P = 0.87\left(\frac{19.58}{3.5}\right)^2 = 27.2psi$$

Answer B