33.25 $600gpm$ **of water flows horizontally through an** $8in$ **standard weight steel pipe. The pipe is fitted with an orifice meter with a contraction coefficient of** $C_c = 0.6$ **and a K-value of** 0.5**. The static pressure upstream of the orifice meter is** $15psig$**. What is the pressure downstream?**

A. $11psig$

B. $12psig$

C. $13psig$

D. $14psig$

Look up the formula for an Orifice Meter where a K value is given.

$$Q = KA_2\sqrt{\frac{2g_c\left(P_1 - P_2\right)}{\rho}}$$

The orifice area, A_2, depends on the contraction coefficient, C_c, which is given, and the internal area of the pipe prior to the contraction, which can be found from the Schedule 40 Steel Pipe table.

$$A_2 = C_cA_o$$

$$A_2 = (0.6)\left(\frac{50in^2}{144\frac{in^2}{ft^2}}\right) = 0.208ft^2$$

Solve for the change in pressure, $P_1 - P_2$, in units of $\frac{lb_f}{ft^2}(psf)$. Carefully show all units and align where necessary. Convert to psi at the end.

$$P_1 - P_2 = \left(\frac{Q}{KA_2}\right)^2\left(\frac{\rho}{2g_c}\right)$$

$$P_1 - P_2 = \left[\frac{\left(600\frac{gal}{min}\right)\left(\frac{1ft^3}{7.48gal}\right)\left(\frac{1min}{60s}\right)}{(0.5)\left(0.208ft^2\right)}\right]^2\left[\frac{\left(62.4\frac{lb_m}{ft^3}\right)}{2\left(32.2\frac{lb_m \cdot ft}{lb_f \cdot s^2}\right)}\right] = 160\frac{lb_f}{ft^2}$$

$$P_1 - P_2 = \left(160\frac{lb_f}{ft^2}\right)\left(\frac{1ft^2}{144in^2}\right) = 1.1\frac{lb_f}{in^2}$$

Solve for the downstream pressure, P_2.

$$P_2 = P_1 - 1.1psi = 15psig - 1.1psi = 13.9psig$$

Answer D