Tyler Rice
MET 330

Test # 3

1. 400 kpa thru 1.5 in pipe

400 kpa = 4 bar

1.5 in = 38.1 mm

6.5 m

$V = 3.05 \ m/sec$

$Q_1 = 401.754 \ L/min = 6.69 \times 10^{-3} \frac{m^3}{s}$

$$z_1 = \frac{V_2^2}{2g} + z_2 + h_{L_{1-2}}$$

$$h_{L_{1-2}} = h_{ent} + h_{Tee} + h_{reducer} + h_{L_1} + h_{L_2}$$

$$z_1 - z_2 = \frac{8}{g\pi^2 D_2^4} Q_2^2 + \frac{8 K_{ent}}{g\pi^2 D_1^4} Q_1^2 + \frac{8 K_{Tee}}{g\pi^2 D_1^4} Q_1^2 + \frac{8 K_{reducer}}{g\pi^2 D_1^4} Q_1^2 + \frac{8 f_1 L_1}{\pi^2 g D_1^5} Q_1^2 + \frac{8 f_2 L_2}{g\pi^2 D_2^5} Q_2^2$$

$$0.3m = \frac{8}{9.81(\pi)^2(0.0254)^4} Q_2^2 + \frac{8 \times 0.05}{9.81(\pi)^2(0.0381)^4}(6.69 \times 10^{-3})^2 + \frac{8 \times 1.62}{9.81(\pi)^2(0.0381)^4}(6.69 \times 10^{-3})^2 + \frac{8 \times 64}{9.81(\pi)^2(0.0381)^4}(6.69 \times 10^{-3})^2 + \frac{8 \times 6.5 (f_1)}{9.81(\pi)^2(0.0381)^5}(6.69 \times 10^{-3})^2 + \frac{8 \times 0.3 (F_2)}{9.81(\pi)^2(0.0254)^5}(Q_2)^2$$

$$0.3m = 198511.81 (Q_2)^2 + 0.067 + 2.84 + 112.31 + 11.40 + 2344627.7 (Q_2)^2$$

$$0.3 = 126.63 + 2543139.51 (Q_2)^2$$

$$126.33 = 2543139.51 (Q_2)^2$$

$$Q_2 = 0.00704 \frac{m^3}{s} = 7.04 \times 10^{-3} \frac{m^3}{s}$$

between point 1 and 3

$$z_1 = \frac{V_3^2}{2g} + h_{ent} + h_{Tee} + h_{reducer} + h_{elbow} + h_{L_2} + h_{L_3}$$

$$0.3 = \frac{8}{g\pi^2 D_3^4} Q_3^2 + \frac{8 \times K_{ent}}{g(\pi)^2 (D_2)^4} Q_2^2 + \frac{8 \times K_{Tee}}{g(\pi)^2 (D_2)^4} Q_2^2 + \frac{8 \times K_{reducer}}{g(\pi)^2 (D_2)^4} (Q_2)^2 + \frac{8 \times K_{elb}}{g(\pi)^2 (D_2)^4} Q_2^2 + \frac{8(L_2)}{g\pi^2 (D_2)^5} Q_2^2 + \frac{8(L_3)}{g\pi^2 (D_3)^5} Q_3^2$$

$$0.3 = \frac{8}{9.81(\pi)^2 (0.0254)^4} (Q_3)^2 + \frac{8(0.05)}{9.81(\pi)^2 (0.0254)^4} (7.04 \times 10^{-3})^2 + \frac{8(1.62)}{9.81(\pi)^2 (0.0254)^4} (7.04 \times 10^{-3})^2 + \frac{8(0.64)}{9.81(\pi)^2 (0.0254)^4} (7.04 \times 10^{-3})^2 + \frac{8(0.75)}{9.81(\pi)^2 (0.0254)^4} (7.04 \times 10^{-3})^2 + \frac{8(8.3)}{9.81(\pi)^2 (0.0254)^5} (7.04 \times 10^{-3})^2 + \frac{8(0.3)}{9.81(\pi)^2 (0.0254)^5} (Q_3)^2$$

$$0.3 = 198511.81 (Q_3)^2 + 0.49 + 15.93 + 6.29 + 7.37 + 3214.96 + 2344627.7 (Q_3)^2$$

$$0.3 = 2543139.58 (Q_3)^2 + 3245.04$$

$$2543139.58 (Q_3)^2 = 3245.34$$

$$(Q_3)^2 = 0.001276$$

$$Q_3 = 0.0357 \frac{m^3}{s} = 3.57 \times 10^{-2} \frac{m^3}{s}$$

So I found that $Q_1 = 6.69 \times 10^{-3} \frac{m^3}{s}$

$Q_2 = 7.04 \times 10^{-3} \frac{m^3}{s}$ (sprinkler 1)

$Q_3 = 3.57 \times 10^{-2} \frac{m^3}{s}$ (sprinkler 2)

The flows are not the same to each one. In order to make them both be equal you would have to put a valve just before each sprinkler so you could regulate the flow and make them be the same.

I found the velocity to be $3.05 \frac{m}{sec}$ so comparing that to the critical velocity of $3 \frac{m}{sec}$ I would say it is pretty close. If you wanted to get it closer you could change the pipe sizes.