

① $V_1 = 5 \text{ m s}^{-1}$ $V_2 = 2 \text{ m s}^{-1}$
 Pitot tube smaller end = 2.5 mm
 $h_f = \frac{0.35(V_1 - V_2)^2}{2g}$

$L = 2.0 \text{ m}$

At lower end

$\frac{P_1}{\rho} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho} + \frac{V_2^2}{2g} + z_2 + h_f$

$\frac{P_2}{\rho} = \frac{P_1}{\rho} + \frac{1}{2g}(V_1^2 - V_2^2) + (z_1 - z_2)h_f$

$2.5 + \frac{(5^2 - 2^2)}{2 \times 9.81} + 2 - \frac{(0.35(5-2)^2)}{2 \times 9.81}$

$= 2.5 + 1.07 + 2 - 0.1605$

$P_2 = 5.407 \text{ bar}$

Pressure at lower end = 5.407 bar

② Inlet diameter = ~~20 mm~~ 0.2 m

Outlet diameter = ~~10 mm~~ 0.1 m

$P_1 = 17.658 \text{ bar} = 17.658 \times 10^5 \text{ N/m}^2$

$g = 30 \text{ cm} = 0.3 \text{ m}$ (0.3 m of Mercury)

$C_d = 0.98$

$A_1 = \frac{\pi d^2}{4} = \frac{(\frac{20}{100})^2 \times 3.14}{4} = 0.0314 \text{ m}^2$

$A_2 = \frac{\pi d^2}{4} = \frac{(\frac{10}{100})^2 \times 3.14}{4} = 7.853 \times 10^{-5} \text{ m}^2$

$g = 0.3 \text{ m of mercury}$

$\frac{P_1}{\rho} = \frac{17.658 \times 10^5}{9.81} = 1.84 \times 10^4 \text{ m}^2 \text{ s}^{-2}$

$P_2 = 0.3 \times 13.6 = 4.08 \text{ of } H_2O$

ρ

$$h = \frac{P_1 - P_2}{\rho} = \frac{1.9 \times 10^{-4}}{1000} - (-4.08) = 4.08018 \text{ m}$$

$$Q = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh} = \frac{0.98 \times 0.0314 \times 7.153 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.953 \times 10^{-1})^2}}$$

$$\times \sqrt{2 \times 9.81 \times 4.088}$$

$$Q = 0.0709 \text{ m}^3/\text{s}$$

③ $D_1 = 15 \text{ cm}$ $D_2 = 30 \text{ cm}$ S and $h = 0.5 \text{ m}$

$Q = 0.064$

$$A_1 = \frac{\pi d^2}{4} = \frac{\pi (5/100)^2 \times 5.14}{4} = 0.0176 \text{ m}^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{\pi (30/100)^2 \times 5.14}{4} = 0.6706 \text{ m}^2$$

$$h = g \left[\frac{13.6}{0.9} - 1 \right]$$

$$h = 0.8 (14.1)$$

$$= 7.05 \text{ m} \approx 0.1$$

$$Q = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$$

$$Q = 0.64 \times 0.0176 \times 0.6706 \times \sqrt{2 \times 9.81 \times 7.05}$$

$$\sqrt{(0.6706)^2 - (0.0176)^2}$$

$$Q = \frac{9.35 \times 10^{-3}}{40112} = 2.33 \times 10^{-5} \text{ m}^3/\text{s}$$

④ $A_{10} = 15m$
 170mm of mercury (0.17m)
 500 of mercury (13.6)
 500 of sea water = 1.026
 $n = \gamma \left(\frac{Sh_1}{s} - 1 \right)$

$$h = 0.17 \left(\frac{13.6}{1.026} - 1 \right)$$

$$h = 2.083m$$

$$V = \sqrt{2gh}$$

$$V = 6.39ms^{-1}$$

5 $0.05 m^3/min$

15 bar

1700 ~~rpm~~ rev/min

15 Nm