Example problem-1

Calculate the uncertainty in head loss h_l expressed as

$$h_l = \frac{flV^2}{2gd}$$

Given uncertainties in l,v and d are 2%, 4% and 1%. Ignore the uncertainties in f and g

Example problem-2

Find uncertainties is the following calculated quantities

Flow rate in fully developed laminar region

$$Q = \frac{\pi \Delta p d^4}{128 \mu l}$$

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$$G_r = \frac{g \rho^2 \beta (T_s - T_\infty) l^3}{\mu^2}$$

Given uncertainties in Δp, d, μ, l, ρ, β and T are 4%, 2%, 3%, 2%, 4%, 5% and ±2 °C

Example problem-3

Q3. Airflow rate of 17m^3/h through a pipe of 60 mm ID at 20^{o}C is measured using a square edged orifice (β = 0.4). A pressure drop observed is 157.85 N/m^2 with $\pm$ 0.4%. If the area of orifice is maintained within 0.2 %, estimate the design stage uncertainty in the flow rate. Assume accuracies of C_d and ρ are $\pm$ 0.5%. Estimate the total error in the measurement for C_d = 0.63 and P = 0.97 bar abs and R= 287 J/kg K.

For an orifice, $Q = C_d A(2\Delta p/\rho)^{1/2}$