

Pipe Pressure Drop Calculation Sheet

$d := 30.0\text{-cm}, 35\text{-cm}.. 60\text{-cm}$ $l := 50\text{-m}$ $\text{cm_H2O} := 98.07\text{-Pa}$

$\text{cp} := 0.01\text{-poise}$

$Q := 100 \cdot \frac{\text{liter}}{\text{sec}}$

$\rho := 1.0 \cdot \frac{\text{kg}}{\text{liter}}$

$\mu := 1.0 \cdot \text{cp}$

$A(d) := \pi \cdot \frac{d^2}{4}$

$V(d) := \frac{Q}{A(d)}$

$\text{Re}(d) := \frac{\rho \cdot V(d) \cdot d}{\mu}$

| $\frac{d}{\text{cm}}$ | $\frac{A(d)}{\text{cm}^2}$ |
|-----------------------|----------------------------|
| 30.0 | 706.9 |
| 35.0 | 962.1 |
| 40.0 | $1.3 \cdot 10^3$ |
| 45.0 | $1.6 \cdot 10^3$ |
| 50.0 | $2.0 \cdot 10^3$ |
| 55.0 | $2.4 \cdot 10^3$ |
| 60.0 | $2.8 \cdot 10^3$ |

| $V(d)$ |
|---|
| $1.41 \cdot \text{m} \cdot \text{sec}^{-1}$ |
| $1.04 \cdot \text{m} \cdot \text{sec}^{-1}$ |
| $0.80 \cdot \text{m} \cdot \text{sec}^{-1}$ |
| $0.63 \cdot \text{m} \cdot \text{sec}^{-1}$ |
| $0.51 \cdot \text{m} \cdot \text{sec}^{-1}$ |
| $0.42 \cdot \text{m} \cdot \text{sec}^{-1}$ |
| $0.35 \cdot \text{m} \cdot \text{sec}^{-1}$ |

| $\text{Re}(d)$ |
|------------------|
| $4.2 \cdot 10^5$ |
| $3.6 \cdot 10^5$ |
| $3.2 \cdot 10^5$ |
| $2.8 \cdot 10^5$ |
| $2.5 \cdot 10^5$ |
| $2.3 \cdot 10^5$ |
| $2.1 \cdot 10^5$ |

$\epsilon := 0.002\text{-mm}$

Pipe roughness ϵ

$y(d) := -\log\left(\frac{\epsilon}{3.7 \cdot d} - \frac{4.52}{\text{Re}(d)} \cdot \log\left(\frac{7}{\text{Re}(d)} + \frac{\epsilon}{7 \cdot d}\right)\right)$

$f(d) := \begin{cases} \frac{16}{\text{Re}(d)} & \text{if } \text{Re}(d) < 2100 \\ \frac{1}{16 \cdot y(d)^2} & \text{otherwise} \end{cases}$ **Friction factor f**

| $f(d)$ |
|--------|
| 0.0034 |
| 0.0035 |
| 0.0036 |
| 0.0037 |
| 0.0037 |
| 0.0038 |
| 0.0039 |

$q(d) := \frac{1}{2} \cdot \rho \cdot V(d)^2$

Velocity head q

$$\Delta P_f(d) := 4 \cdot f(d) \cdot \frac{1}{d} \cdot q(d)$$

Pipe friction loss ΔP_f

$$K_f := 0.5 + .35 + .35$$

Entrance (0.5) and turn losses e.g. 2 turns of 45 deg (0.35) K_f

$$\Delta P(d) := \Delta P_f(d) + q(d) \cdot K_f$$

Total loss ΔP

| d | q(d) | $\Delta P_f(d)$ | $\Delta P(d)$ |
|------|--------|-----------------|---------------|
| cm | cm_H2O | cm_H2O | cm_H2O |
| 30.0 | 10.2 | 23.2 | 35.5 |
| 35.0 | 5.5 | 11.0 | 17.6 |
| 40.0 | 3.2 | 5.8 | 9.7 |
| 45.0 | 2.0 | 3.3 | 5.7 |
| 50.0 | 1.3 | 2.0 | 3.6 |
| 55.0 | 0.9 | 1.3 | 2.3 |
| 60.0 | 0.6 | 0.8 | 1.6 |