Easy Guide
Pressure Loss Validation
Validation of pressure loss using a basic Flowmaster model and Hand Calculations.

P1 is the pressure into the system (= 437000 Pa)
Q is the volumetric flow rate (=65 l/min or 0.0010833 m3/s), set as -0.0010833 m3/s
D is the pipe diameter (= 0.015m2)
L is the pipe length (= 0.6m)
k is the Absolute Roughness (= 0.000025m), used to calculate friction loss

Flowmaster Model
A simple network in Flowmaster as shown below:

This gives a value of P2 = 418558 Pa (result at node 2 – Downstream Node)
The results for the pipe are shown below:

These results can be compared to those obtained from hand calculations. These hand calculations are shown below:

**Velocity**

\[ Q = Av \]

Where \( Q = 0.0010833 \text{ m}^3/\text{s} \)

\[ A = \pi D^2 \quad (D = 0.015 \text{ m}) \]

This gives \( v = 6.14 \text{ m/s} \)

Flowmaster gives \( v = 6.13 \text{ m/s} \)

This corresponds to a 0.13% difference.

**Reynolds Number**

\[ Re = \frac{\rho v D \mu}{\rho} \]

Where \( \rho = 1000 \text{ kg/m}^3 \)

\( v = 6.14 \text{ m/s} \)

\( \mu = 0.001002 \)

This gives \( Re = 91916.2 \)

Flowmaster gives \( Re = 91605.6 \)

This corresponds to a 0.3% difference.
Loss Coefficient

The loss coefficient can be worked out by first evaluating the friction factor. The relevant equations are shown below:

\[ P_2 - P_1 = \frac{fL}{d} \frac{\dot{m}_1 |\dot{m}_1|}{2\rho A^2} \]

Where \( k \) is the Absolute Roughness (= 0.000025m)
\( D \) is the diameter (=0.015m)
\( \text{Re} \) is the Reynolds number (=91605.6)
This gives a value of \( f = 0.0246 \)
This value of \( f \) can now be used to work out \( K \), the loss coefficient as shown over:

\[ K = \frac{fL}{d} \]

This gives \( K = 0.983 \) (0% discrepancy with Flowmaster value)

Pressure Drop

These values can now be substituted into the following equation to work out the pressure difference:

\[ f = f_i = \frac{0.25}{\log\left(\frac{k}{3.7D + 5.74} + 0.09\right)} \]

This can be simplified to:
\[ P_2 - P_1 = K \rho v^2 \]
This gives a pressure difference of 0.185 bar.
Flowmaster gives a value of 0.184 bar. This corresponds to a 0.5% difference.