Pipe Flows – Introduction

(Image from: https://www.theprocesspiping.com/introduction-to-piping-system/)
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1. Entrance Region

The flow in the entrance region is complex and will not be investigated here. Experiments have shown that the dimensionless length of the entrance region depends on whether the entering flow is laminar or turbulent, with:

- laminar flow: \(L/D \approx 0.06 \, \text{Re}_D\)
- turbulent flow: \(L/D \approx 4.4 \, \text{Re}_D^{1/6}\)

For many engineering flows:
\[10^4 < \text{Re}_D < 10^5 \implies 20 < L/D < 30\]

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(1) [https://www.energy.gov/sites/prod/files/2014/05/f16/reduce_pumping_costs.pdf](https://www.energy.gov/sites/prod/files/2014/05/f16/reduce_pumping_costs.pdf)
(2) [http://pumps.org/EnergyEfficiency.aspx](http://pumps.org/EnergyEfficiency.aspx)