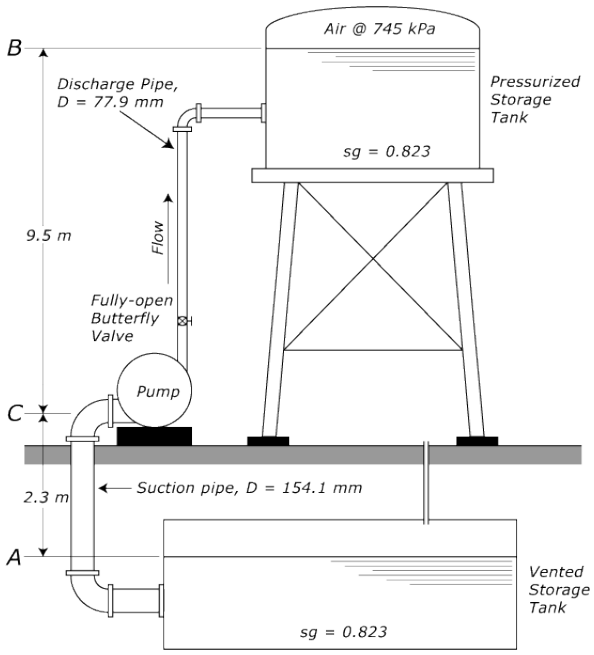
Module 7: Series A Pipeline (CIVL 318)



Example 1:
A pump delivers 13.5 L/s of kerosene at 25°C from an underground vented storage tank to an elevated storage tank pressurized to 745 kPa.
The suction pipe is 6-in Schedule 40 steel pipe and is 5.0 m long. It has a round-edged entrance with a radius of $r = 15$ mm.
The discharge pipe is 3-in Schedule 40 steel pipe, is 11.0 m long and includes a fully open butterfly valve with $L_e/D = 45$.
All elbows are "standard" with $L_e/D = 30$.

Solution:

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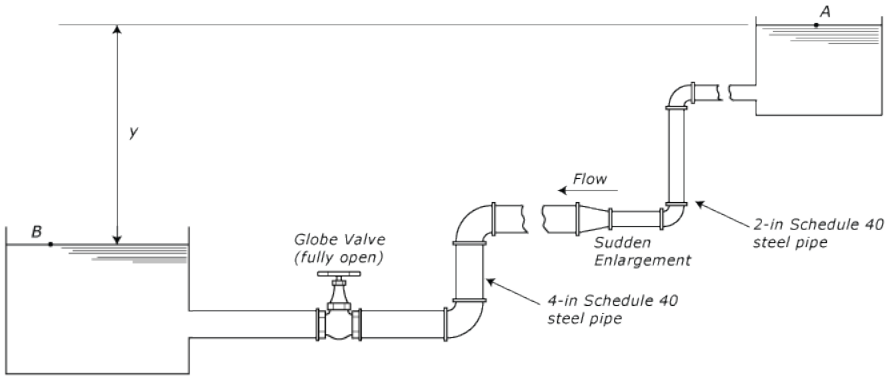
Example 2:

Gasoline at 25 °C flows under gravity from tank A to tank B; both tanks are open to the atmosphere.

The 2-in Schedule 40 steel pipe has a square entrance is 45.7 m long. The 4-in Schedule 40 steel pipe contains a fully-open globe valve and is 87.5 m long. There is a sudden enlargement between the two pipes, as shown. Both pipes are new commercial steel. All elbows are standard $90°$.

Determine the difference in surface elevation between tanks A and B required to maintain a flow of 425 L/min.



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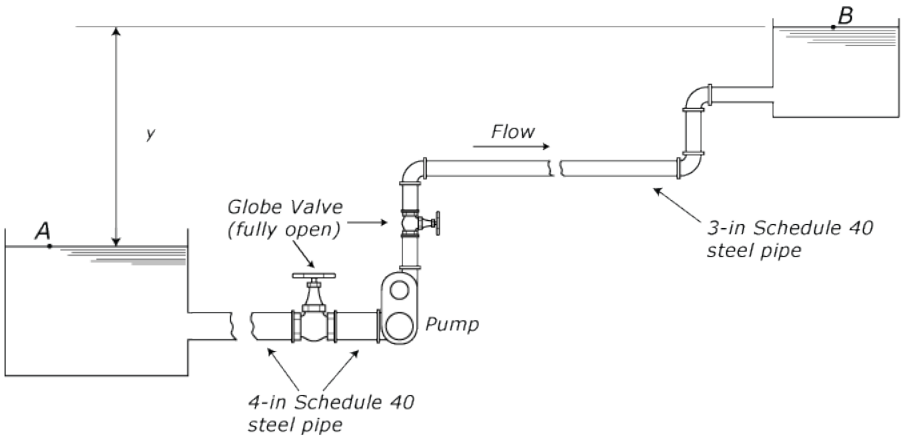
Example 3:

Water at 25 °C is pumped from tank A to tank B. Both tanks are open to the atmosphere.

The suction pipe is 4-in Schedule 40 steel pipe, has a well-rounded ($r/D > 0.15$) entrance, contains a fully open globe valve, and is 17.0 m long. The discharge pipe is 3-in Schedule 40 steel pipe, contains a fully open globe valve and three standard 90° elbows; it is 163.3 m long.

The elevation difference between A and B is 12.75 m and the volume flow rate is $Q = 900$ L/min.

If the pump is 78% efficient, determine the electrical power it uses.



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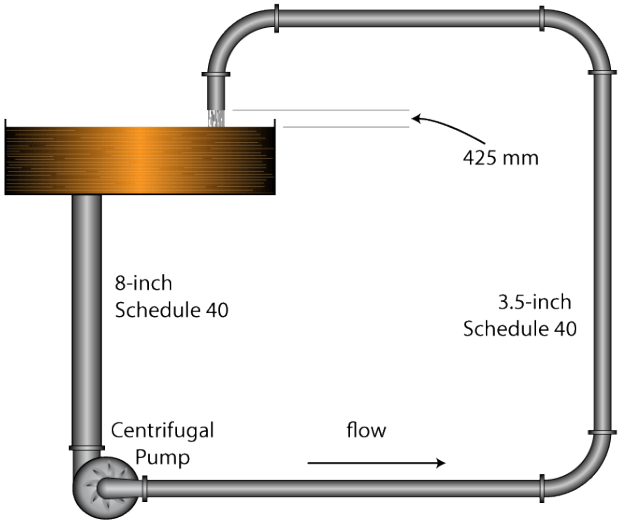
Example 4:

Heavy machine oil (sg=0.89 and $\eta = 3.80 \times 10^{-2}$ Pa $\cdot$ s) is circulated through a system repeatedly to test its stability.

The 8-inch Schedule steel pipe on the suction side of the pump has a square entrance and a length of 6.25 m and the 3.5-inch Schedule steel pipe on the discharge side of the pump has a length of 18.0 m. All elbows are long radius. The flow rate through the system is 13.5 L/s.

Determine the head added by the pump.



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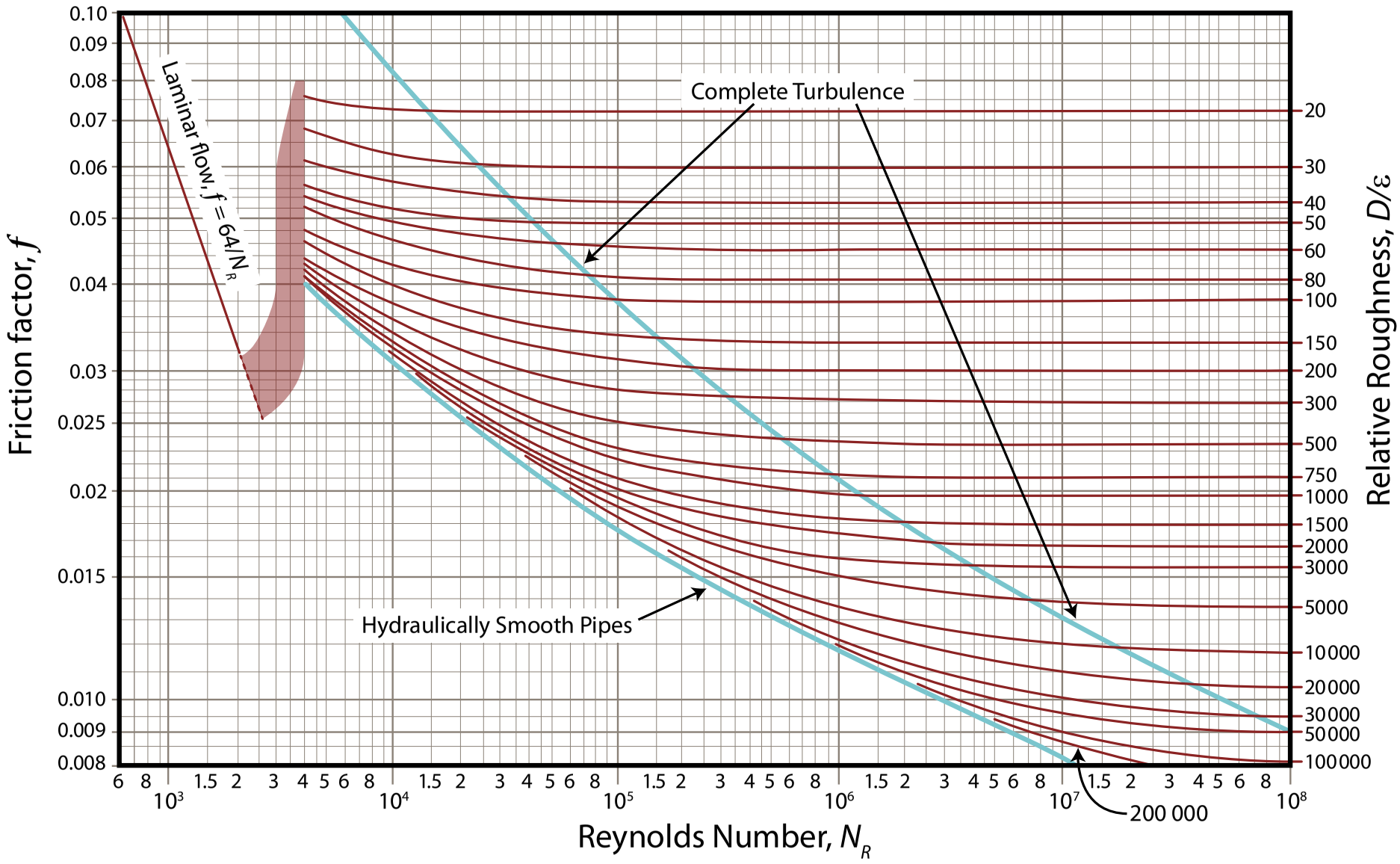
Friction factor, f
Reynolds Number, N_R
Relative Roughness, D/ε
Laminar flow, $f = 64/N_R$
Complete Turbulence
Hydraulically Smooth Pipes
200 000
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.025
0.02
0.015
0.010
0.009
0.008
6 8 10^3 1.5 2 3 4 5 6 8 10^4 1.5 2 3 4 5 6 8 10^5 1.5 2 3 4 5 6 8 10^6 1.5 2 3 4 5 6 8 10^7 1.5 2 3 4 5 6 8 10^8
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