

52 gallon per minute in a 1" diameter type L copper tube

Series Pipes
CIVIL TOOLS PRO
English Units
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Data Entered

Flowrate = 52.00 gpm

Results

Diameter (in)	Length (ft)	Manning's N	Minor Losses	Friction Head Loss (ft)	Minor Head Loss (ft)	Velocity (fps)
1.03	50.00	0.010	0.000	152.25	0.000	20.02

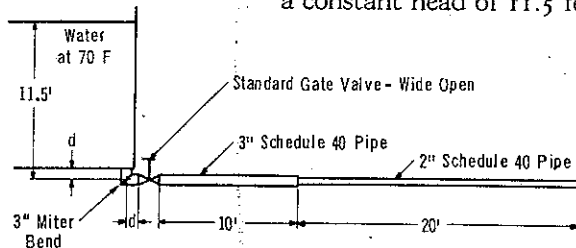
Total Losses

Friction Head Loss = 152.25 ft
Minor Head Loss = 0.00 ft
Total Head Loss = 152.25 ft

Discharge of Fluids from Piping Systems

Example 4-19...Water

Given: Water at 60 F is flowing from a reservoir through the piping system below. The reservoir has a constant head of 11.5 feet.



Find: The flow rate in gallons per minute.

Solution: 1. $Q = 19.65 d^2 \sqrt{\frac{h_L}{K}}$... page 3-4

$$R_e = \frac{50.6 Q \rho}{d \mu} \dots \text{page 3-2}$$

$$\beta = d_1/d_2 \dots \text{page A-26}$$

$$2. \quad K = 0.5 \dots \text{entrance; page A-29}$$

$$K = 60 f_T \dots \text{mitre bend; page A-29}$$

$$K_1 = 8 f_T \dots \text{gate valve; page A-27}$$

$$K = f \frac{L}{D} \dots \text{straight pipe; page 3-4}$$

$$K_2 = \frac{0.5 (1 - \beta^2) \sqrt{\sin \frac{\theta}{2}}}{\beta^4} \dots \text{sudden contraction; page A-26}$$

$$K = \frac{fL}{D\beta^4} \dots \begin{cases} \text{small pipe, in terms of} \\ \text{larger pipe; page 2-5} \end{cases}$$

$$K = \frac{1}{\beta^4} \dots \begin{cases} \text{exit from small pipe} \\ \text{in terms of larger pipe} \end{cases}$$

$$3. \quad d = 2.067 \dots \text{2" Sched. 40 pipe; page B-16}$$

$$d = 3.068 \dots \text{3" Sched. 40 pipe; page B-16}$$

$$\mu = 1.1 \dots \text{page A-3}$$

$$\rho = 62.371 \dots \text{page A-6}$$

$$f_T = 0.019 \dots \text{2" pipe; page A-26}$$

$$f_T = 0.018 \dots \text{3" pipe; page A-26}$$

$$4. \quad \beta = 2.067 / 3.068 = 0.67$$

$$K = 0.5 \dots \text{3" entrance}$$

$$K = 60 \times 0.018 = 1.08 \dots \text{3" mitre bend}$$

$$K_1 = 8 \times 0.018 = 0.14 \dots \text{3" gate valve}$$

$$K = \frac{0.018 \times 10 \times 12}{3.068} = 0.70 \dots \text{10 feet, 3" pipe}$$

For 20 feet of 2-inch pipe, in terms of 3-inch pipe,

$$K = \frac{0.019 \times 20 \times 12}{2.067 \times 0.67^4} = 10.9$$

For 2-inch exit, in terms of 3-inch pipe,

$$K = 1 / 0.67^4 = 5.0$$

For sudden contraction,

$$K_2 = \frac{0.5 (1 - 0.67^2) (1)}{0.67^4} = 1.37$$

$$\text{and, } K_{\text{TOTAL}} = 0.5 + 1.08 + 0.14 + 0.70 + 10.9 + 5.0 + 1.37 = 19.7$$

$$5. \quad Q = 19.65 \times 3.068^2 \sqrt{11.5 + 19.7} = 141$$

(this solution assumes flow in fully turbulent zone)

6. Calculate Reynolds numbers and check friction factors for flow in straight pipe of the 2-inch size:

$$R_e = \frac{50.6 \times 141 \times 62.371}{2.067 \times 1.1} = 1.96 \times 10^5$$

$$f = 0.021 \dots \text{page A-25}$$

and for flow in straight pipe of the 3-inch size:

$$R_e = \frac{50.6 \times 141 \times 62.371}{3.068 \times 1.1} = 1.32 \times 10^5$$

$$f = 0.020 \dots \text{page A-25}$$

7. Since assumed friction factors used for straight pipe in Step 4 are not in agreement with those based on the approximate flow rate, the K factors for these items and the total system should be corrected accordingly.

$$K = \frac{0.020 \times 10 \times 12}{3.068} = 0.78 \dots \text{10 feet, 3" pipe}$$

For 20 feet of 2-inch pipe, in terms of 3-inch pipe,

$$K = \frac{0.021 \times 20 \times 12}{2.067 \times 0.67^4} = 12.1$$

$$\text{and, } K_{\text{TOTAL}} = 0.5 + 1.08 + 0.14 + 0.78 + 12.1 + 5.0 + 1.37 = 21.0$$

$$8. \quad Q = 19.65 \times 3.068^2 \sqrt{11.5 + 21} = 137$$