

40.3 900gpm of water flows through an 8in pipe with a relative roughness of 0.0004 and a Reynolds number of 400,000. What is the pressure loss per hundred feet of pipe?

- A. 0.1ft
- B. 0.2ft
- C. 1.2ft
- D. 1.4ft

Pressure loss can be calculated using the **Darcy** equation:

$$h_f = \frac{fLv^2}{2Dg}$$

where f is the friction factor, L is the length of pipe, v is the velocity, D is the inside diameter, and g is acceleration due to gravity.

Start by looking up the diameter for a nominal 8 inch pipe in the reference handbook using the **steel pipe friction tables**. For convenience, convert from inches to feet:

$$D = \frac{7.981in}{12\frac{in}{ft}} = .6651ft$$

The velocity may also be looked up from the same table for a given GPM and pipe size. If the flow or size are non-standard, it may be necessary to calculate the velocity using $v = \frac{Q}{A}$, but that is not required in this case.

$$v = 5.77\frac{ft}{s}$$

Use the **Moody Diagram** to look up the friction factor which is a function of the Reynolds number, Re , and the relative roughness, $\frac{\epsilon}{D}$. Both the Reynolds number and relative roughness were given.

$$f = f\left(Re, \frac{\epsilon}{D}\right) \approx .0175$$

Substitute into the Darcy Equation and solve for the friction loss:

$$h_f = \frac{fLv^2}{2Dg} = \frac{(.0175)(100ft)\left(5.77\frac{ft}{s}\right)^2}{2(.6651ft)\left(32.2\frac{ft}{s^2}\right)} = 1.36ft$$

Answer D

40.4 30gpm of 120°F water flows through a nominal 1½in schedule 40 steel pipe. What is the Reynolds number?

- A. 52,000
- B. 97,000
- C. 104,000
- D. 1,250,000

Look up **Reynolds Number** in the reference handbook and use the equation:

$$Re = \frac{vD}{\nu}$$

where v is velocity, D is diameter, and ν is kinematic viscosity.

Look up **steel pipe friction tables** and find the diameter of nominal 1½inch pipe. Convert to feet:

$$D = \frac{1.61in}{12\frac{in}{ft}} = .1342ft$$

In the same table, look up the velocity of 30gpm through a 1½inch pipe:

$$v = 4.73\frac{ft}{s}$$

Lookup **Properties of Water** and find a table that provides kinematic viscosity as a function of temperature. Read the value for 120°F:

$$\nu = .609 \times 10^{-5} \frac{ft^2}{s}$$

Apply the Reynolds Number formula. Note the Reynolds Number is unitless.

$$Re = \frac{vD}{\nu} = \frac{\left(4.73\frac{ft}{s}\right) (.1342ft)}{\left(.609 \times 10^{-5} \frac{ft^2}{s}\right)} \approx 104,000$$

Answer C