40.4 $30gpm$ of $120°F$ water flows through a nominal $1^1/2in$ 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 $1\frac{1}{2}inch$ 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 $1\frac{1}{2}inch$ 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:

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

Apple 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

40.5 A pump designed to operate at $100gpm$ and $50ft$ of head is determined to be oversized. The pump's impeller diameter is decreased by 20%. What is the resulting pressure developed by the pump after this change?

A. $26ft$

B. $32ft$

C. $40ft$

D. $50ft$

Lookup Pump Affinity Laws in the reference handbook and choose the formula where head pressure changes as a function of Impeller Diameter Change:

$$\frac{h_2}{h_1} = \left(\frac{D_2}{D_1}\right)^2 \rightarrow h_2 = h_1 \left(\frac{D_2}{D_1}\right)^2$$

where h_1, the head pressure provided by the pump before the impeller diameter change, is known, and h_2 is to be determined. The actual diameter is unknown, but the 20% reduction implies the ratio of the diameters as such:

$$D_2 = (1 - .2)\, D_1 \rightarrow \frac{D_2}{D_1} = .8$$

The volume flow rate, Q, will also change; however, that is extra information and does not impact the pressure.

Substitute and solve for h_2:

$$h_2 = h_1 \left(\frac{D_2}{D_1}\right)^2 = (50ft)\,(.8)^2 = 32ft$$

Answer B