33.44 $50gpm$ **of** $250°F$ **water is pumped from a pressurized tank through** $3in$ **diameter schedule 40 steel suction piping. The inlet pressure at the pump is** $100psig$ **and the installation is at sea level. What is the net positive suction head?**

A. $170ft$

B. $200ft$

C. $230ft$

D. $260ft$

The elevation difference, h_z, between the top of the water and the pump is not given. The length of suction piping is not given so it is not possible to calculate the friction losses, h_f. Therefore, it is not possible to use the common equation for Net Positive Suction Head Available, which calls for h_z and h_f. However, the inlet pressure is known and the velocity can be determined, so it is possible to use the NPSHA for *existing conditions* equation.

$$NPSH_A = h_a + h_s + \frac{v^2}{2g} - h_{vpa}$$

The atmosheric head for a sea level installation is $14.7psia$. Convert to ft using the rule of thumb conversion factor for water.

$$h_a = 14.7psia\left(2.31\frac{ft}{psi}\right) \approx 34ft$$

The suction pressure, or inlet pressure, is given as $100psig$. There is no need to add atmopheric pressure because the previous term, h_a, accounts for the atmosphere. Convert to ft.

$$h_s = 100psig\left(2.31\frac{ft}{psi}\right) \approx 231ft$$

The velocity pressure is likely negligible, but it may be included for completeness. Use the Steel Pipe Friction Tables to look up the velocity of $50gpm$ flowing through a nominal $3in$ schedule 40 steel pipe.

$$\frac{v^2}{2g} = \frac{\left(2.17\frac{ft}{s}\right)^2}{2\left(32.2\frac{ft}{s^2}\right)} = 0.073ft$$

Use the Properties of Saturated Water and Steam table by temperature to look up the saturation pressure of water at $250°F$. Note the tank and suction line are pressurized, so it is feasible for water to be in a liquid state despite the elevated temperature. High vapor pressure is to be expected due to high temperature, which increases the risk of cavitation. Convert psi to ft.

$$h_{vpa} = 29.85psia\left(2.31\frac{ft}{psi}\right) \approx 69ft$$

Evaluate the NPSHA.

$$NPSH_A = 34ft + 231ft + 0.073ft - 69ft = 196ft$$

Answer B