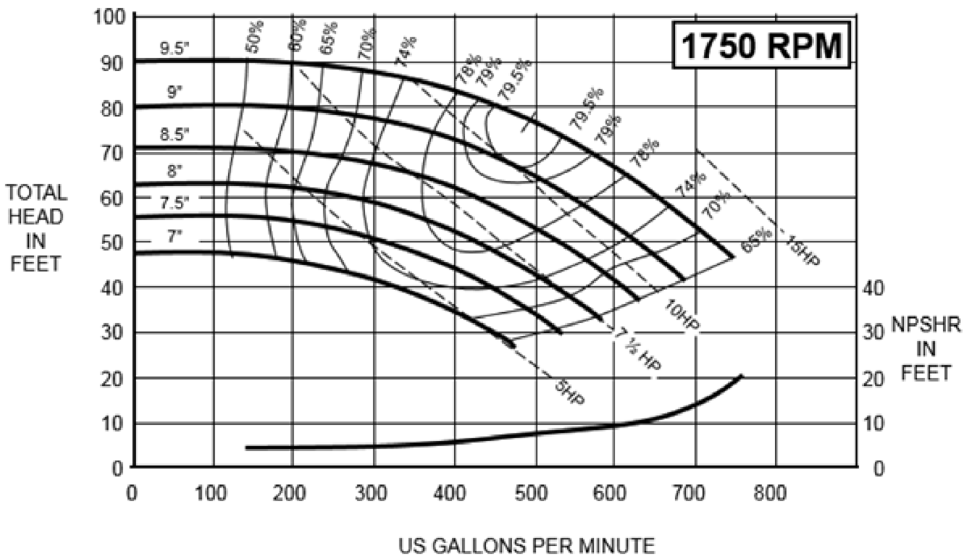
46.50 The flow rate at the operating point of a $7\frac{1}{2}HP$ pump described by the pump curve below is $300gpm$. What is the amount of pump head needed at the pump shaft?



A. $59ft$

B. $69ft$

C. $74ft$

D. $79ft$

Reading the Pump Performance Curve, follow the $7\frac{1}{2}HP$ curve until it intersects with $300gpm$. This is the operating point. Use the vertical axis to obtain the total head in ft at the operating point. This represents the head added to the fluid by the pump.

$$h_{added} \approx 59ft$$

The head needed *at the shaft* is greater than the head added to the fluid because the pump is not 100% efficient. Read the efficiency at the operating point.

$$\eta_{pump} \approx 75\%$$

Find the amount of head needed at the pump shaft.

$$h_{shaft} = \frac{h_{added}}{\eta_{pump}} = \frac{59ft}{0.75} = 78.7ft$$

Answer D

46.51 A pump is driven by a 4-pole synchronous motor. What is the nominal rotational speed? Ignore slip.

A. $1200rpm$

B. $1800rpm$

C. $2400rpm$

D. $3600rpm$

The number of poles of a Synchronous Speed Motor determines the speed in rpm. Read directly from the table for 4 poles.

$$N = 1800rpm$$

Answer B

46.52 The pressure drop through a chilled water coil at the design flow rate of $25gpm$ is $8psi$. During normal operation, the actual flow rate is $4gpm$. What is the pressure drop in normal operation?

A. $0.2psi$

B. $1.3psi$

C. $4.1psi$

D. $8.0psi$

The pressure drop is a function of the physical design of the coil and the velocity pressure from the water. Static pressure in a hydronic system tends to be relatively stable and gravitational effects are likely to be minimal in the vicinity of the coil. The primary driver is the operation of the control valve which allows more or less flow into the coil. Recall $Q = vA$. Since the coil cross-sectional area is constant, the velocity is proportional to the volume flow rate. Since velocity pressure depends on the *square* of the velocity, relate the ratio of the pressure drops to the ratio of the velocities *squared*. Then substitute flow rate for velocity since flow rates are given. Substitute and solve for ΔP_{actual}.

$$\frac{\Delta P_{actual}}{\Delta P_{design}} = \left(\frac{v_2}{v_1}\right)^2 = \left(\frac{Q_2}{Q_1}\right)^2 = \left(\frac{4gpm}{25gpm}\right)^2 = 0.0256$$

$$\Delta P_{actual} = 0.0256\left(\Delta P_{design}\right) = 0.0256\left(8psi\right) = 0.2psi$$

Answer A