40.19 A make up pump that cycles on and off intermittently as required has a service factor of 1.25 and provides a water horsepower of $15hp$. The pump efficiency is 84%. The pump is driven by an electric motor with an efficiency of 93%. What is the smallest motor that could be used?

A. $10hp$

B. $15hp$

C. $20hp$

D. $25hp$

The service factor allows a pump to be run harder than its brake horsepower rating provided the pump is not used continuously, therefore the service factor is applicable for the intermittent use case. The water horsepower, whp, and pump efficiency can be used to determine the required of the motor, before accounting for the service factor:

$$bhp = \frac{whp}{\eta_p} = \frac{15hp}{.84} = 17.9hp$$

Divide by the service factor to specify the required motor bhp for intermittent use:

$$bhp_{SF} = \frac{17.9hp}{1.25} = 14.3hp$$

Note the motor efficiency is additional information and not required for the solution. Motors are sized based on *bhp only*, therefore it is not appropriate to consider electrical losses in the motor unless the question relates to required electrical power. A $15hp$ motor is sufficient.

Answer B

40.20 A boiler feed pump circulates $30gpm$ against $30ft$ of head. A booster pump in series is rated for $5ft$ of head at $30gpm$. What is the combined total discharge head for this arrangement?

A. $5ft$

B. $25ft$

C. $30ft$

D. $35ft$

Pumps in series must operate with the same volume flow rate. However, the pressure developed i.e. discharge head for series operation is additive. Substitute and solve:

$$\Delta h_{total} = \Delta h_{booster} + \Delta h_{boiler\,feed} = 5ft + 30ft = 35ft$$

Answer D