

**46.59** A fan rated for  $15bhp$  is controlled by a variable frequency drive and runs at  $900rpm$  which is 50% of its maximum speed, supplying  $20,000cfm$  of air against a system pressure of  $1.5in\ wg$ . The existing filters are replaced with new high efficiency filters increasing the pressure drop by  $0.75in\ wg$ . What is the required fan speed following this upgrade?

- A.  $1100rpm$
- B.  $1350rpm$
- C.  $2030rpm$
- D.  $3040rpm$

Consider the original operating conditions as State 1 and the final operating conditions as State 2. Use the **Fan Affinity Laws** to find the new speed,  $N_2$ . Pressure changes with the *square* of the change in speed. Therefore, speed changes with the *square root* of the change in pressure. Select equation '1b' and cross out the diameter and density ratios which are not changing and may be assumed to equal 1.

$$P_1 = P_2 \left( \frac{N_1}{N_2} \right)^2$$

$$N_2 = N_1 \sqrt{\frac{P_2}{P_1}} = (900rpm) \sqrt{\frac{2.25in\ wg}{1.5in\ wg}} = 1102rpm$$

**Answer A**

**46.60** An atypical hydronic system permits the velocity of water to reach a maximum of  $12\frac{ft}{s}$  when required. What is the smallest nominal schedule 40 steel pipe size that should be selected for a flow rate of  $50gpm$ ?

- A.  $1in$
- B.  $1.25in$
- C.  $1.5in$
- D.  $2in$

Use the relation  $Q = vA$  to specify the required area. Express area as  $A = \frac{\pi}{4}D^2$  and solve for the minimum diameter.

$$A = \frac{Q}{v}$$

$$A = \frac{\pi}{4}D^2$$