43.11 **An air handling fan delivers $9000cfm$ against a total pressure of $3in\,wg$ at standard conditions. A new unit is designed to provide the same volume flow using a fan with a 25% larger diameter which runs at half the speed. What is the air horsepower produced by the new air handler?**

A. $1hp$

B. $2hp$

C. $4hp$

D. $5hp$

Make a table to organize the original and new conditions, and use subscripts 1 and 2, respectively. Take into account the given information regarding the new diameter increasing by 25% and the new speed reducing by half.

	Original (1)	New (2)
Q	$9000cfm$	$9000cfm$
P	$3in\,wg$	P_2
D	D_1	$D_2 = 1.25D_1$
N	N_1	$N_2 = \frac{N_1}{2}$
W	W_1	W_2

Look up Fan Power in the reference handbook and use the formula to determine the air horsepower for the original state, W_1. This book will typically use AHP; however, the handbook uses P_s or P_e, and the Fan Laws table uses W for power. In this problem we will freely interchange between all of these parameters with the understanding that all refer to *air horsepower*.

$$AHP_1 = W_1 = \frac{Q_1 \Delta P_1}{6356} = \frac{(9000)\,(3)}{6356} = 4.25hp$$

Note there is no reference to efficiency so assume $\eta = 1$ and may be ignored.

Select from the Fan Affinity Laws equation #1c:

$$W_1 = W_2 \times \left(\frac{D_1}{D_2}\right)^5 \left(\frac{N_1}{N_2}\right)^3 \left(\frac{\rho_1}{\rho_2}\right)$$

The density of the air under the new conditions may be assumed to be unchanged. Therefore assume $\rho_1 = \rho_2$. Swap the subscripts for convenience. Simplify and solve for the new power, W_2. Note the diameters and speeds need not be known. Instead the ratio of new to old may be used.

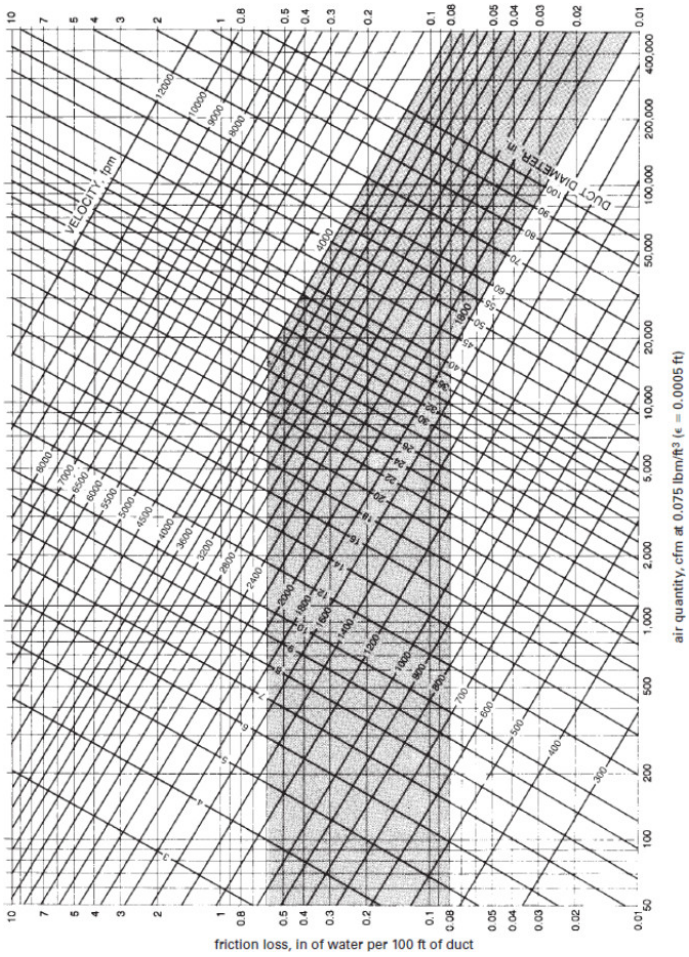
$$W_2 = W_1 \times \left(\frac{D_2}{D_1}\right)^5 \left(\frac{N_2}{N_1}\right)^3$$

$$W_2 = (4.25hp)\,(1.25)^5\,(.5)^3 = 1.62hp$$

There are alternative solutions to this problem using a different fan affinity law. The laws are internally consistent so if time permits, you may want to check your answer by taking a different avenue.

Answer B

43.12 **A $600ft$ long round duct with a diameter of $12in$ delivers $1000cfm$. There are (12) 90-degree elbows with a bend radius of double the duct diameter, contributing an equivalent length of 10 times the duct diameter for each fitting. What is the friction loss?**



A. $0.8in\,wg$

B. $1.4in\,wg$

C. $2.0in\,wg$

D. $2.8in\,wg$

Use the friction loss chart provided to determine the ΔP based on the volume flow rate and duct diameter given:

$$Q = 1000cfm$$