**47.9 The maximum pressure achieved in the cylinder of a car engine is $800psi$. How much force will be exerted on a $3.7in$ piston?**

A. $700lb_f$

B. $2,200lb_f$

C. $4,300lb_f$

D. $8,600lb_f$

A useful representation of pressure is the amount of force applied over an area. This can be expressed through the formula below and rearranged to solve for the force, $F$.

$$P = \frac{F}{A}$$

$$F = PA$$

Determine the area of the piston.

$$A = \frac{\pi}{4}D^2 = \frac{\pi}{4}(3.7in)^2 = 10.75in^2$$

Solve for the force.

$$F = PA = \left(800\frac{lb_f}{in^2}\right)(10.75in^2) = 8600lb_f$$

**Answer D**

**47.10 A spring with 10 coils has squared ends and a shear modulus of $10 \times 10^6 psi$. The diameter of the wire is $0.15in$ and the average coil diameter is $1in$. What is the spring constant?**

A. $52\frac{lb_f}{in}$

B. $63\frac{lb_f}{in}$

C. $79\frac{lb_f}{in}$

D. $105\frac{lb_f}{in}$

The Spring Constant for a Helical Compression Spring can be determined using the following formula, where $k$ is the spring constant, $d$ is the diameter of the wire, $G$ is the shear modulus, $D$ is the coil diameter, and $N$is the number of *active* coils.

$$k = \frac{d^4G}{8D^3N}$$

Using the table Type of Spring Ends, note that for squared ends the total number of coils $N_t$ is the number of active coils plus two. Solve for the number of active coils.

$$N_t = N + 2$$

$$N = N_t - 2 = 10 - 2 = 8$$

Solve for the spring constant.

$$k = \frac{d^4 G}{8 D^3 N} = \frac{(0.15in)^4 \left(10 \times 10^6 \frac{lb_f}{in^2}\right)}{8\,(1in)^3\,(8)} = 79 \frac{lb_f}{in}$$

**Answer C**

**47.11 An air handling unit uses 10% outside air at $88°F$ and $60\%$ RH and 90% recirculated air returned from the space, which is maintained at $76°F$ and $50\%$ RH. What is the dew point temperature of the air entering the coil?**

A. $56°F$

B. $58°F$

C. $63°F$

D. $65°F$

Define State 1 as the outside air, State 2 as the return air, and State 3 as the mixed air. The question does not concern the supply/discharge air after the coil.

Use the Psychrometric Chart to look up the humidity ratio for State 1 and State 2 which are fully defined.

$$T_1 = 88°F$$

$$RH_1 = 60\%$$

$$\omega_1 = .0172 \frac{lb_{H2O}}{lb_{da}}$$

$$T_2 = 76°F$$

$$RH_2 = 50\%$$

$$\omega_2 = .0096 \frac{lb_{H2O}}{lb_{da}}$$

Perform a mixing calculation to find the humidity ratio at State 3.