

**330:148 (g) Machine Design
Assignment 5 (Spring Design)**

Due date October 8, 2007

1. A spring has an overall length of 3 inches when it is not loaded and a length of 1.85 inches when carrying a load of 12 pounds. Compute the spring rate. (Ans: 10.43 lb/in)
2. The following data are known for a spring: Total number of coils = 20; Squared and ground ends; Outside diameter = 0.75 inch; Wire diameter = 0.059 inch (25-gage music wire); Free length = 3 inches. For this spring compute the spring index, the pitch, the pitch angle, and the solid length. (Ans: 11.71; 0.16 in; 4.218°; 1.18 in)
3. A compression spring with squared and ground ends is made from gage 22 music wire and has an OD of 0.875 inch. The pitch is 0.225 inch and the free length is 5 inches. Determine
 - a. Number of active coils (Ans: 21.787 coils)
 - b. Mean diameter (Ans: 0.826 in)
 - c. Spring constant (k) (Ans: 0.695 lb/in)
 - d. Solid height (Ans: 1.166 in)
 - e. Pitch angle (λ) (Ans: 4.96°)
 - f. The deflection to make the spring solid (Ans: 3.834 in)
 - g. The force to make the spring solid (Ans: 2.66 lb)
 - h. The Wahl factor (Ans: 1.084)
 - i. The stress at the solid height (Ans: 51,552 lb/in²)
4. A prototype machine needs a spring to fit inside a tube with an inside diameter of $\frac{3}{4}$ inch and needs a force of ≈ 16 pounds at a 3-inch length and ≈ 32 pounds at a 2-inch working length.
 - a. Find the spring rate of this spring. (Ans: 16 lb/in)
 - b. What would be the free length? (Ans: 4 in)
 - c. Select a spring from Appendix 12. (Ans: C0720-081-4000)
5. Design a helical compression spring for the following conditions: $1\frac{5}{8}$ inch maximum outside diameter, 4-inch free length, and 75-pound load at a $1\frac{1}{2}$ -inch deflection. Assume average service, S&G ends, and oil tempered ASTM A229 wire. For your first iteration, assume the Wahl factor (K) = 1.3. (Ans: $D_m = 1.375$ in; Use US steel gage 7 wire; 12.57 coils)