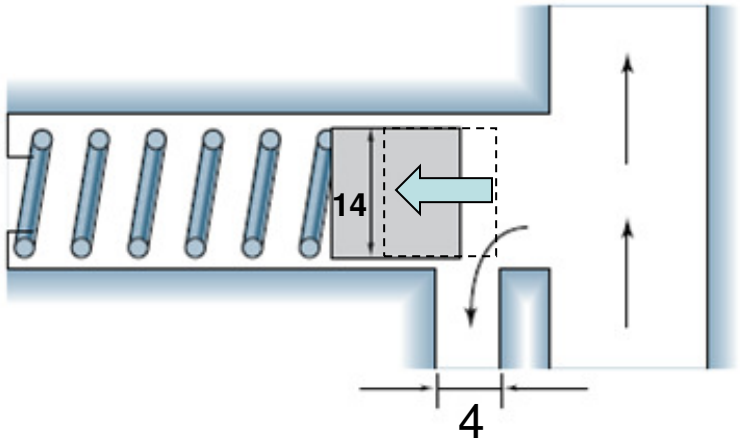
MEEG3311 Homework 10 – Chapter 17

10.1



A pressure relief valve, shown here, has a piston diameter of 14 mm and a slit length of 4 mm. The spring has mean coil diameter D = 12 mm and wire diameter d = 2.5 mm. The valve should open [at the dashed position] at 1.5 bar (0.15 MPa) pressure and be totally open [clearing the slit] at 4.5 bar (0.45 MPa) pressure, at which time the spring is fully compressed. The shear modulus for the spring material G = 80 GPa. The spring ends are squared and ground.

Calculate:
A. The number of active coils,
B. The free length,
C. The pitch of the spring,
D. The maximum shear stress for this geometry.

Hints: A change in force divided by the resulting change in deflection of a spring equals the spring rate. This dynamic spring application requires the use of Kwahl for stress.

10.2

A compression spring made of music wire is used for STATIC loading. Wire diameter d = 2.0 mm, coil outside diameter Do = 15 mm, and there are ten active coils. The spring ends are squared and ground. G = 79.3 GPa.

Find the following:

(a) Spring rate and solid length

(b) Greatest load that can be applied without yielding the wire

(c) Spring free length with load determined in part b that causes the spring to be solid

(d) Whether buckling is a problem.

10.3

A 20-mm mean diameter helical compression spring has 18 (active) coils, has 1.5-mm wire diameter, and is made of chromium vanadium, with G = 79.3 GPa. Assuming STATIC loading, determine the following:

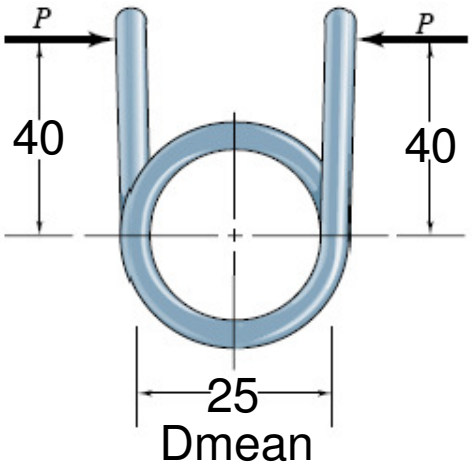
(a) The maximum load-carrying capacity for a safety factor of 1.5 guarding against yielding.

(b) The maximum deflection of the spring at that load.

(c) The free length for squared and ground ends, if the deflection from the max load bottoms out the spring.

10.4

A helical torsion spring, shown here, is made from hard-drawn steel with a wire diameter of 2.0 mm and 7.5 turns. Dimensions are in millimeters. E = 207 GPa.



(a) Using a safety factor of 2, find the maximum force and the corresponding angular displacement.

(b) What would the coil inside diameter be when the maximum load is applied?