

Given and Required:

Determine the energy necessary to stretch a spring (with a spring constant of 200 lbf/in) 4 inches.
Express your answer in Btu.

$$1 \text{ Btu} = 778.169 \cdot \text{ft} \cdot \text{lbf}$$

Solution:

The spring constant is defined as

$$k := 200 \frac{\text{lbf}}{\text{in}}$$

The length for the spring to be stretch is defined as

$$L := 4 \text{ in}$$

The energy necessary to stretch the spring will be determined by the work required to stretch the spring.
The work necessary to stretch a spring is given by

$$W = \int F \, dx$$

where F is the force applied to the spring and dx is the distance that the force is applied. The force necessary to stretch the spring is given by Hooke's Law or simple

$$W = \int k \cdot x \, dx$$

The limits of the integral will be from 0 to L (or 4 in). This is shown below.

$$W := \int_0^L k \cdot x \, dx = 1600 \cdot \text{in} \cdot \text{lbf}$$

Knowing the conversion between Btu and in lbf, the energy required in Btu may be found by a simple unit conversion. However, since this solution is beeing done in Mathcad, Mathcad can do it for us.

$$W = 0.171 \cdot \text{Btu}$$