

Elastic Potential Energy stored in a stretched or compressed spring:

Let a spring of spring constant k is being stretched. When its extension is x , the spring force generated in the spring is given by

$$F_s = - kx$$

In this case the un-stretched position [$x = 0$] is taken as reference position.

So, potential energy stored in the spring when it is moved from unstretched [$x = 0$] condition to the final stretched condition [$x = x$] is

$$U = - \int_{x=0}^{x=x} F_s \cdot dx$$

$$U = \int_0^x - kx \cdot dx$$

$$U = k \left[\frac{x^2}{2} \right]_0^x$$

$$U = \frac{1}{2} kx^2$$

So, elastic Potential Energy stored in a stretched or compressed spring is

$$U = \frac{1}{2} kx^2 \quad \dots\dots\dots(15)$$