

## In-Class Exercise Stress Strain Diagram for Nitinol SOLUTIONS

The figure below is a stress strain diagram for Nitinol

Using the figure below, calculate

- 1) The Young's modulus

This is the slope on the linear elastic region marked on the plot. *You need to convert %strain to strain before doing the calculation!*

$$E = \frac{\Delta\sigma}{\Delta\varepsilon} = \frac{60 - 0 \text{ksi}}{.01 - 0} = 6000 \text{ksi} = 6 \text{Msi}$$

- 2) 0.2% yield stress: This was a bad question. The 0.2% yield stress doesn't have meaning on superelastic materials because this point puts you in the superelastic plateau which is still elastic. A better question would be what is the strain where it begins to deform plastically (onset of plastic deformation). This is marked by the + in the plot below, about 8%.

- 3) Ductility (% elongation at fracture) is found by the red, dashed line to be about 12%.

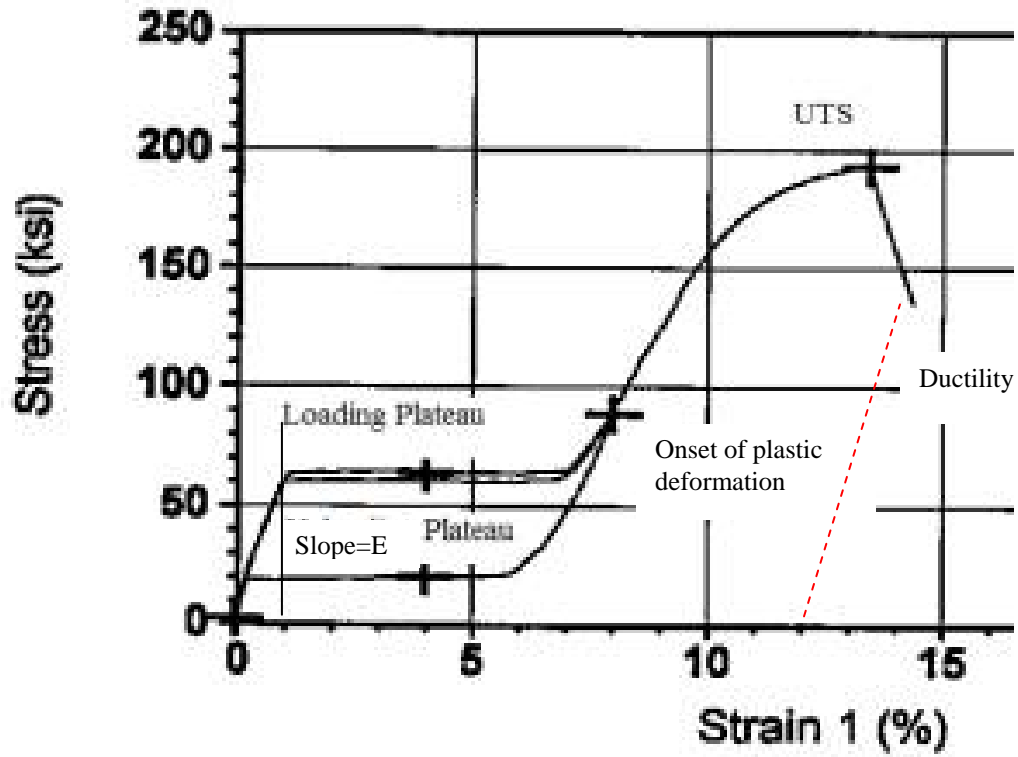
- 4) Force needed to create 1% strain if the sample is a 0.25 inch diameter wire.

From the plot, the stress needed to create 1% of strain is about 60ksi.

This needs to be converted to a force.

$$\sigma = \frac{F}{A_o}$$

$$F = \sigma \cdot A_o = 60 \times 10^3 \frac{\text{lbs}}{\text{in}^2} \cdot \pi \left( \frac{0.25 \text{in}}{2} \right)^2 = 2.95 \times 10^3 \text{ lbs}$$



NOTE: ksi is 1000 pounds per square inch

Figure from: <http://www.memry.com/nitinolfaq/nitinolfaq.html>