**Figure 1-1(b)** Engineering stress-strain curve and geometry of deformation typical of some polymers.
ELASTICITY: Elementary Treatment

- The normal of longitudinal stress $\sigma$ is defined as “resistance” per unit area. Applying the equilibrium-of-forces equation from mechanics of materials to the lower portion of the specimen we have: $\Sigma F = 0$

$$F = \sigma A = 0$$

$$\sigma = \frac{F}{A} \quad (1.1)$$

$A$ is the instantaneous area, therefore the stress is referred to as the true stress.

- Engineering stress, $s$ is defined as:

$$s = \frac{F}{A_o} \quad \text{Original Area}$$
• $\sigma$ is the internal resisting stress opposing the externally applied load, avoiding the breaking of the specimen.

• The stress convention used is as follows: Tensile stresses are positive, and Compressive stresses are negative.

Figure 1-2. Materials Testing System
Concept of Strain and the Types of Strains

• The engineering strain is defined as the ratio of the change in length to the original length of the same dimension.

\[ e = \frac{\delta}{l_o} = \frac{\Delta l}{l_o} = \frac{l_f - l_o}{l_o} \]  

(1.2)

Where \( e \) = average linear strain and \( \delta = \) deformation.
• The longitudinal strain or **true strain** is defined as:

\[
\begin{align*}
\frac{d \varepsilon_T}{d \ell} &= \frac{dl}{l} \quad (1.3a) \\
\varepsilon_T &= \int_{l_0}^{l_f} \frac{dl}{l} \quad (1.3b) \\
\varepsilon_T &= \ln\left(\frac{l_f}{l_0}\right) \quad (1.4)
\end{align*}
\]

where \(l_f\) and \(l_0\) are the final and initial lengths respectively.

• The sign convention is the same as that for stresses:
  - tensile strains are positive
  - compressive strains are negative.