2-3. The force acting on a roumd bar is $F \sim N(80,10^2)$ lb. The bar has a diameter $d = 0.12$ in and a length $L = 10$ ft. The modulus of elasticity is $E = 10,600$ ksi. If the maximum permissible elongation is $\delta_a = 0.11$ in, determine the probability of failiure.

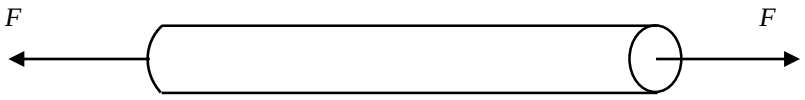

Fig. 2.3

Solution

The elongation of the wire under force *F* is

$$\delta = \frac{FL}{EA} = \frac{10(12)}{\left(10600 \times 10^3\right)\left(\frac{0.12^2 \pi}{4}\right)} F = 0.001F$$

Thus $\delta \sim N(\mu_\delta, \sigma_\delta)$, where

$\mu_\delta = 0.001\mu_F = 0.001 \times 80 = 0.08$

$\sigma_\delta = 0.001\sigma_F = 0.001 \times 10 = 0.01$.

Then

$$p_f = \Pr(\delta > \delta_a) = 1 - \Pr(\delta \le \delta_a) = 1 - \Pr\left(\frac{\delta - \mu_\delta}{\sigma_\delta} \le \frac{0.11 - 0.08}{0.01}\right) = 1 - \Phi(3) = 0.0013$$ **Ans.**