Given **The required cycle life is N = 1*E*6 cycles. Wire is 0.042-in (1.1-mm) dia.**

Assumptions **The torsional strengths and torsional shear stresses will be used on the Goodman diagram.**

Solution **See Figure 14-16.**

1 The material's ultimate tensile strength from Figure 14-3 or equation 14.3 (p. 792), converted to ultimate torsional strength with equation 14.4 (p. 793) using data from Table 14-4 (p. 792) allows one point on the Goodman line to be determined.

$$S_{ut} \cong 184\,649(0.042)^{-0.1625} = 309\,071 \text{ psi} \qquad (a)$$

$$S_{us} \cong 0.67 S_{ut}$$
$$= 0.67(309\,071) = 207\,078 \text{ psi} \qquad (b)$$

This value is plotted as point A on the diagram in Figure 14-16.

2 The S-N diagrams each provide one data point (S_{fw} or S_{ew}, depending on whether for finite or infinite life) on the modified-Goodman line for a material/size combination in pure torsional loading. The fatigue strength S_{fw} for that wire material and condition is taken from the S-N line of Figure 14-15 or calculated from the data in Table 14-9 (p. 803) as

$$@N = 1E6: \qquad S_{fw} \cong 0.33(309\,071) = 101\,993 \text{ psi} \qquad (c)$$

The x and y intercepts are $0.5S_{fw}$ = 50 996 psi. This is plotted as point B on the diagram in Figure 14-16. Note that for infinite life the value of S_{ew} from equation 14.13 would be plotted at B instead of this value of S_{fw} for a finite life.

3 Note in Figure 14-16 that the wire fatigue strength S_{fw} is plotted at point B ($\tau_a = \tau_m = 0.5\ S_{fw}$) corresponding to the test conditions of equal mean and alternating stress components (stress ratio $R = \tau_{min}/\tau_{max} = 0$). Point B is then connected with the ultimate shear strength S_{us} on the mean-stress axis at point A to draw the Goodman line, which is extended to point C.

4 We can now find the value of the fully reversed fatigue strength ($R = -1$), which is point C on the diagram. This value can be found from the equation for the Goodman line, defined in terms of its two known points, A and B:

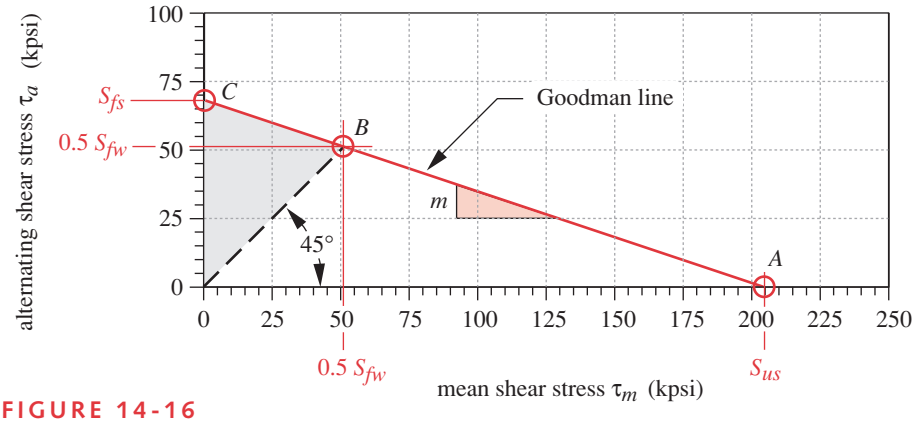

FIGURE 14-16

Torsional-Stress Modified-Goodman Diagram for 0.045-in Dia ASTM A228 Wire at N = 1*E*6 Cycles