14-27 Solution summary from Prob. 14-25: $n = 1145$ rev/min, $K_o = 1.25$, Grade 1 materials, $N_P = 22T$, $N_G = 60T$, $m_G = 2.727$, $Y_P = 0.331$, $Y_G = 0.422$, $J_P = 0.345$, $J_G = 0.410$, $P_d = 4T$ /in, $F = 3.25$ in, $Q_v = 6$, $(N_c)_P = 3(10^9)$, $R = 0.99$, $K_m = 1.240$, $K_T = 1$, $K_B = 1$, $d_P = 5.500$ in, $d_G = 15.000$ in, $V = 1649$ ft/min, $K_v = 1.534$, $(K_s)_P = (K_s)_G = 1$, $(Y_N)_P = 0.832$, $(Y_N)_G = 0.859$, $K_R = 1$

Pinion H_B: 250 core, 390 case
Gear H_B: 250 core, 390 case

Bending

$$(\sigma_{\text{all}})_P = 26\,728 \text{ psi} \qquad (S_t)_P = 32\,125 \text{ psi}$$
$$(\sigma_{\text{all}})_G = 27\,546 \text{ psi} \qquad (S_t)_G = 32\,125 \text{ psi}$$
$$W_1^t = 3151 \text{ lbf}, \qquad H_1 = 157.5 \text{ hp}$$
$$W_2^t = 3861 \text{ lbf}, \qquad H_2 = 192.9 \text{ hp}$$

Wear

$$\phi = 20^\circ, \quad I = 0.1176, \quad (Z_N)_P = 0.727$$
$$(Z_N)_G = 0.769, \quad C_P = 2300\sqrt{\text{psi}}$$
$$(S_c)_P = S_c = 322(390) + 29\,100 = 154\,680 \text{ psi}$$
$$(\sigma_{c,\text{all}})_P = \frac{154\,680(0.727)}{1(1)(1)} = 112\,450 \text{ psi}$$
$$(\sigma_{c,\text{all}})_G = \frac{154\,680(0.769)}{1(1)(1)} = 118\,950 \text{ psi}$$

$$W_3^t = \left(\frac{112\,450}{79\,679}\right)^2 (1061) = 2113 \text{ lbf}, \qquad H_3 = \frac{2113(1649)}{33\,000} = 105.6 \text{ hp}$$

$$W_4^t = \left(\frac{118\,950}{109\,600(0.769)}\right)^2 (1182) = 2354 \text{ lbf}, \quad H_4 = \frac{2354(1649)}{33\,000} = 117.6 \text{ hp}$$

Rated power

$$H_{\text{rated}} = \min(157.5, 192.9, 105.6, 117.6) = 105.6 \text{ hp} \quad \textit{Ans.}$$

Prob. 14-25:

$$H_{\text{rated}} = \min(157.5, 192.9, 53.0, 59.0) = 53 \text{ hp}$$

The rated power approximately doubled.