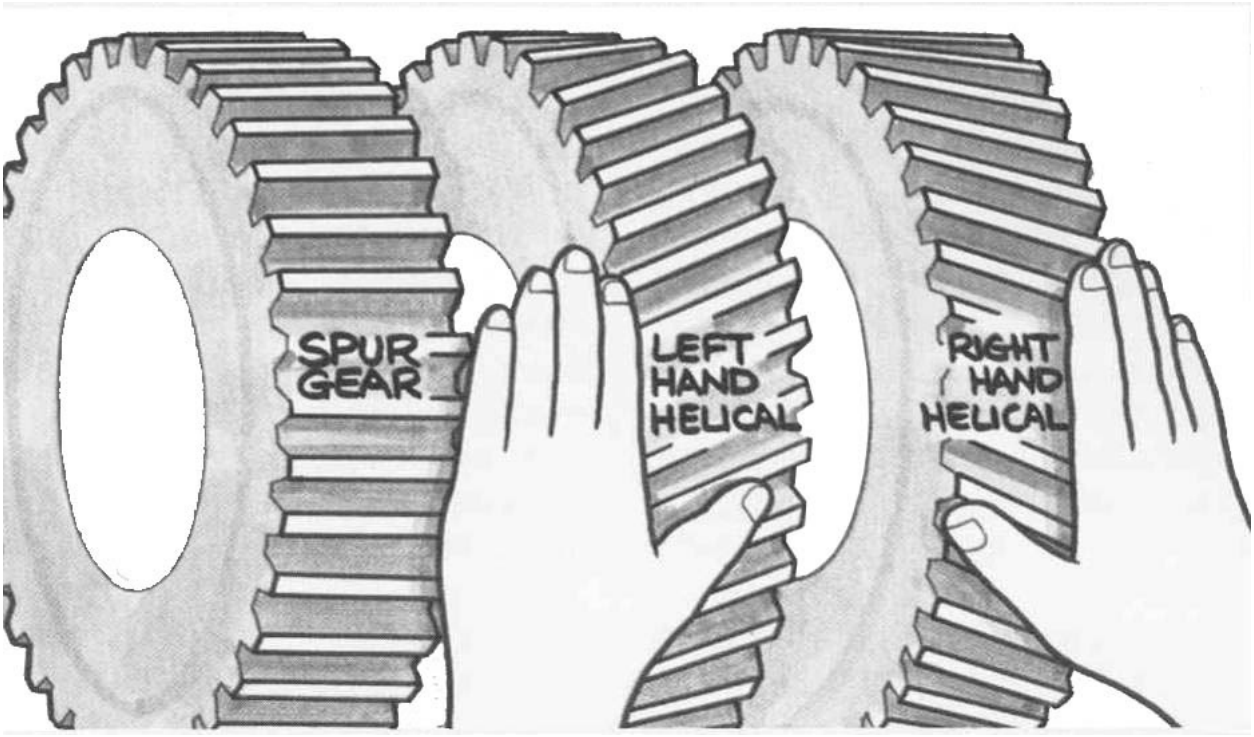
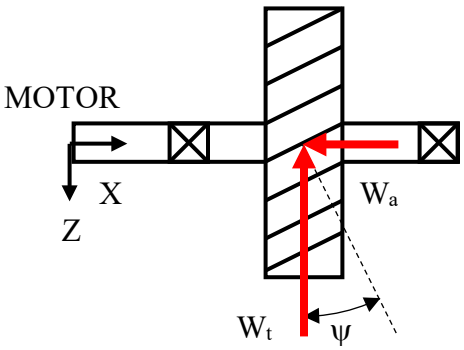
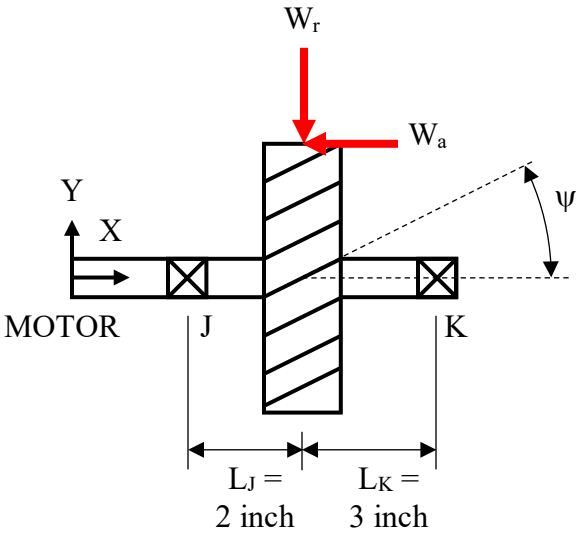
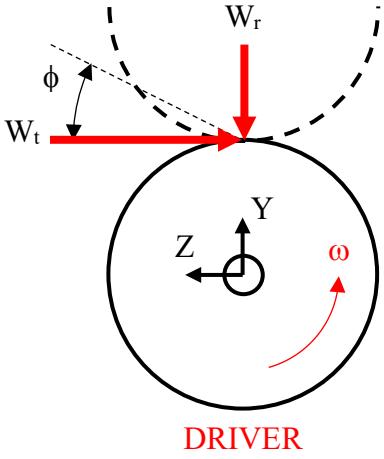

SPUR GEAR
LEFT HAND HELICAL
RIGHT HAND HELICAL



TOP VIEW



FRONT VIEW



SIDE VIEW

d = 4 inch r = 2 inch ϕ = 20° pressure angle ψ = 30° helix angle

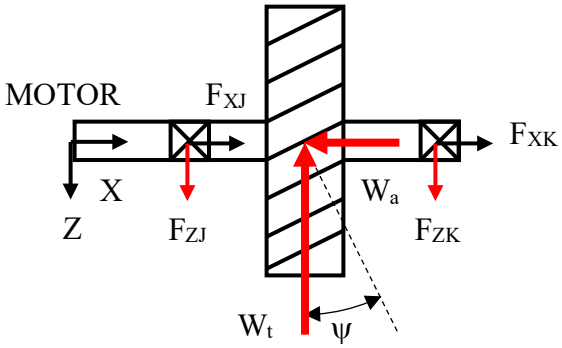
18 HP 250 rpm desire 10^8 rotations

$$250\ \text{rpm} = \left(\frac{250\ \text{rev}}{\text{min}}\right)\left(\frac{\text{min}}{60\ \text{sec}}\right)\left(\frac{2\pi\ \text{rad}}{\text{rev}}\right) = 26.18\ \text{rad/sec}$$

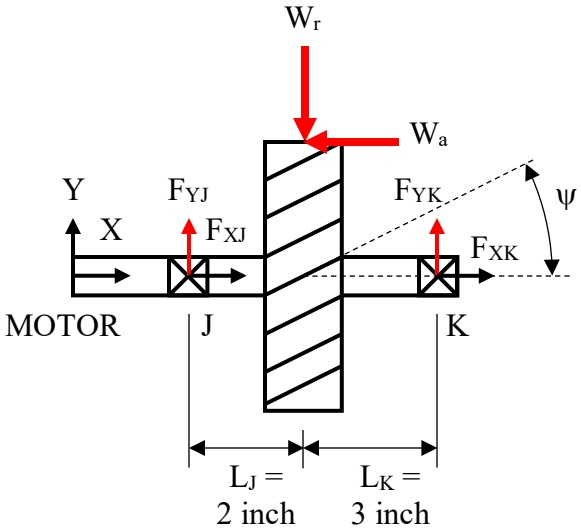
$$P = T\,\omega \qquad T = P / \omega = 18\ \text{HP}\left(\frac{\text{sec}}{26.18\ \text{rad}}\right)\left(\frac{550\ \text{ft.lbf}}{\text{HP.sec}}\right)\left(\frac{12\ \text{in}}{\text{ft}}\right) = 4538\ \text{in.lbf}$$

$T = W_t\, r$ $W_t = T / r = 2269$ lbf

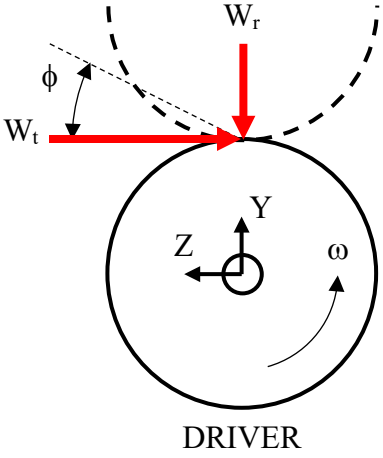
$W_r = W_t \tan\phi = 825.8$ lbf $W_a = W_t \tan\psi = 1310$ lbf



TOP VIEW



FRONT VIEW



SIDE VIEW

TOP VIEW $\sum M_Y$ about J CCW positive

$+W_t(L_J) - F_{ZK}(L_J + L_K) = 0$ $F_{ZK} = +907.6$ lbf

TOP VIEW $\sum M_Y$ about K CCW positive

$-W_t(L_K) + F_{ZJ}(L_J + L_K) = 0$ $F_{ZJ} = +1361.4$ lbf

FRONT VIEW $\sum M_Z$ about J CCW positive

$-W_r(L_J) + W_a(r) + F_{YK}(L_J + L_K) = 0$ $F_{YK} = -193.7$ lbf

FRONT VIEW $\sum M_Z$ about K CCW positive

$+W_r(L_K) + W_a(r) - F_{YJ}(L_J + L_K) = 0$ $F_{YJ} = +1019.5$ lbf

$F_{J\_RADIAL} = \sqrt{F_{YJ}^{\ 2} + F_{ZJ}^{\ 2}} = 1701$ lbf

$F_{K\_RADIAL} = \sqrt{F_{YK}^{\ 2} + F_{ZK}^{\ 2}} = 928$ lbf

assume worst case - W_a acts on bearing J

ball bearing selection

$F_r = 1701$ lbf $F_a = 1310$ lbf desire $L_{10} = 100$ for 100×10^6 rev inner race rotating

$P = X\ V\ F_r + Y\ F_a$ Eq. 11.22a

$V = 1$ Fig. 11-24

try $X = 1$ $Y = 0$ $P = F_r = 1701$ lbf

$L_{10} = (C / P)^3$ Eq. 11.20a

$C_{DESIRED} = P\ (L_{10})^{1/3} = 1701$ lbf $(100)^{1/3} = 7895$ lbf

try 6309 bearing $C = 9150$ lbf $C_0 = 6700$ lbf Fig. 11-23

$F_a / C_0 = 0.1955$ interpolate $e = 0.3493$ Fig. 11-24

$F_a / (V\ F_r) = 0.7701 > e$ $X = 0.56$ interpolate $Y = 1.273$ Fig. 11-24

$P = X\ V\ F_r + Y\ F_a = 2620$ lbf Eq. 11.22a

$C_{DESIRED} = P\ (L_{10})^{1/3} = 2620$ lbf $(100)^{1/3} = 12{,}161$ lbf

try 6311 bearing $C = 12{,}900$ lbf $C_0 = 10{,}000$ lbf Fig. 11-23

$F_a / C_0 = 0.131$ interpolate $e = 0.314$ Fig. 11-24

$F_a / (V\ F_r) = 0.7701 > e$ $X = 0.56$ interpolate $Y = 1.401$ Fig. 11-24

$P = X\ V\ F_r + Y\ F_a = 2788$ lbf Eq. 11.22a

$C_{DESIRED} = P\ (L_{10})^{1/3} = 2788$ lbf $(100)^{1/3} = 12{,}940$ lbf

probably OK 6311 bearing $C = 12{,}900$ lbf very close to $C_{DESIRED}$