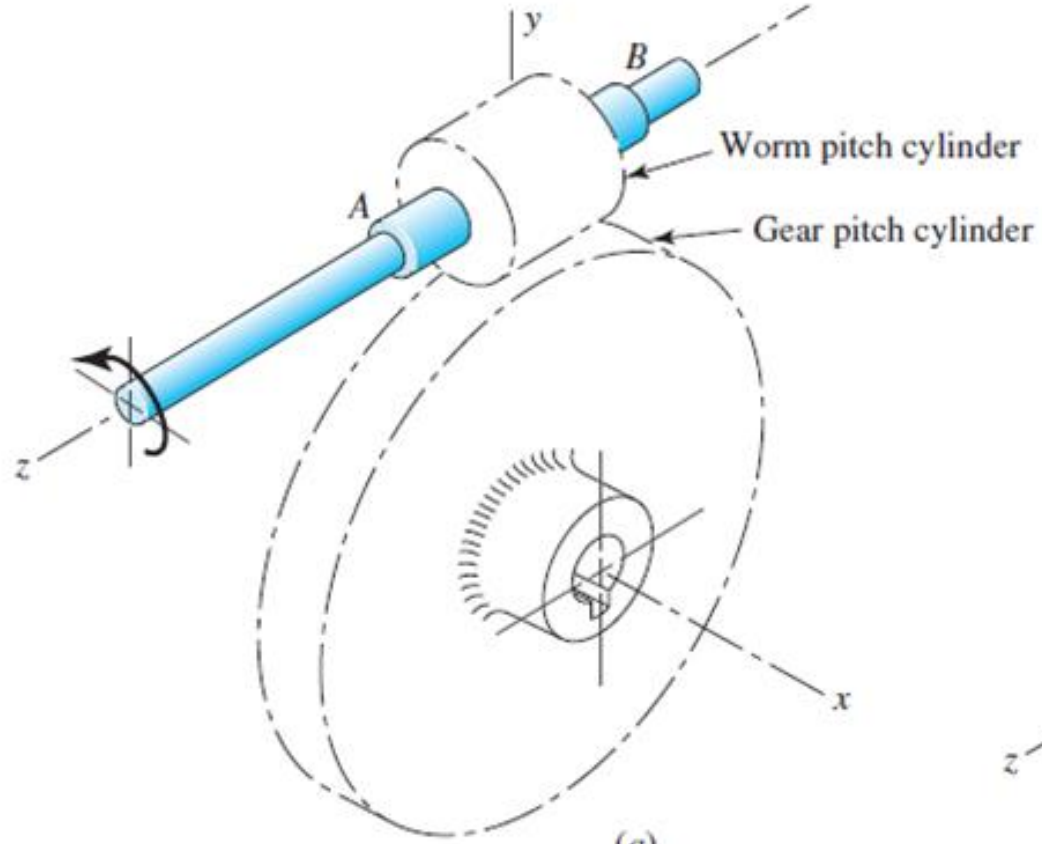
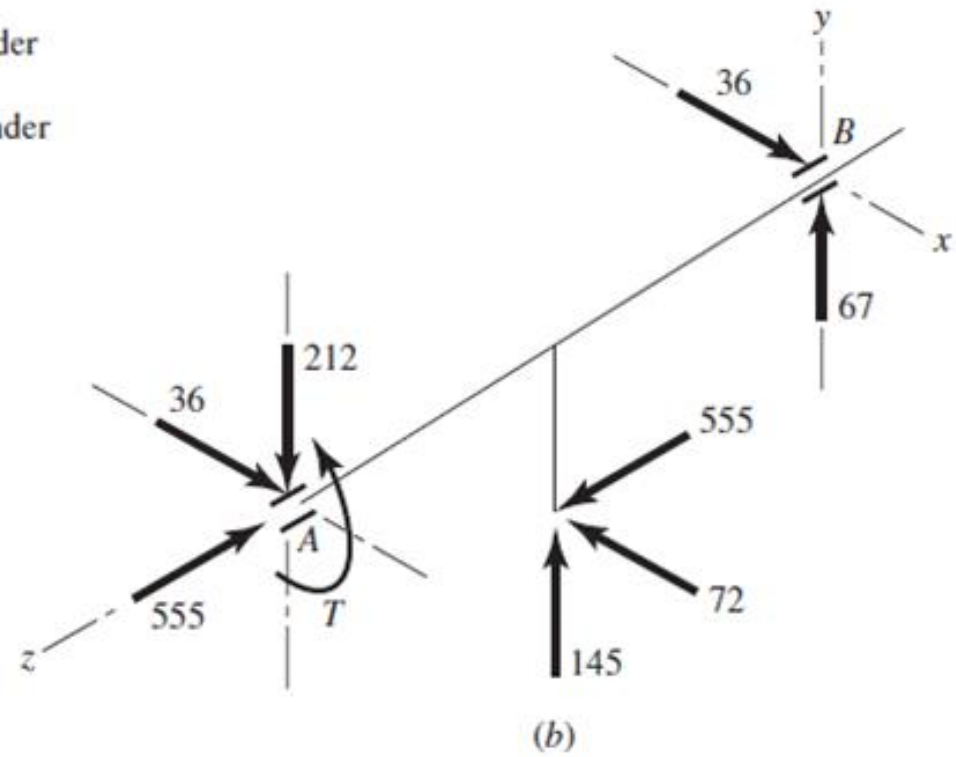
11-37 The worm shaft shown in part *a* of the figure transmits 1.2 hp at 500 rev/min. A static force analysis gave the results shown in part *b* of the figure. Bearing *A* is to be an angular-contact ball bearing selected from Table 11–2, mounted to take the 555-lbf thrust load. The bearing at *B* is to take only the radial load, so an 02-series cylindrical roller bearing from Table 11–3 will be employed. Use an application factor of 1.2, a desired life of 30 kh, and a combined reliability goal of 0.99, assuming distribution data from manufacturer 2 in Table 11–6. Specify each bearing.



(*a*)



(*b*)

Bearing at A (angular-contact ball)

$$F_r = \left(36^2 + 212^2\right)^{1/2} = 215 \text{ lbf} = 0.957 \text{ kN}$$

$$F_a = 555 \text{ lbf} = 2.47 \text{ kN}$$

First Trial:

Assume Fe=3.5 kN=F_D

$$C_{10} = a_f F_D \left(\frac{\mathcal{L}_D n_D 60}{\mathcal{L}_R n_R 60}\right)^{1/a} = 1.2(F_D)\left\{\frac{30000(500)(60)}{10^6}\right\}^{1/3} = 11.586\, F_D = 11.586(3.5) = 40.55 \text{ kN}$$

From Table 11-2: Select angular contact ball bearing with C_{10}=46.2 kN, C_o=28.5 kN.

F_a/C_o=2.47/28.5=0.0867, F_a/VF_r=2.47/(1)(0.957)=2.58 > e, X_2=0.56, Y_2=1.54

		$F_a/(VF_r) \le e$		$F_a/(VF_r) > e$	
F_a/C_0	e	X_1	Y_1	X_2	Y_2
0.084	0.28	1.00	0	0.56	1.55
0.110	0.30	1.00	0	0.56	1.45

$Fe=XVFr+YFa=0.56(1)(0.957)+1.54(2.47)=4.34$ kN

$C_{10}=11.586(4.34)=50.28$ kN > 46.2 kN

Second Trial:

Select angular contact ball bearing with $C_{10}=55.9$ kN $C_o=35.5$ kN.

$Fa/C_o=2.47/35.5=0.0696$, $Fa/VFr=2.47/(1)(0.957)=2.58 > e$, $X_2=0.56$, $Y_2=1.63$

		$F_a/(VF_r) \le e$		$F_a/(VF_r) > e$	
F_a/C_0	e	X_1	Y_1	X_2	Y_2
0.056	0.26	1.00	0	0.56	1.71
0.070	0.27	1.00	0	0.56	1.63
0.084	0.28	1.00	0	0.56	1.55

$Fe=XVFr+YFa=0.56(1)(0.957)+1.63(2.47)=4.56$ kN

$C_{10}=11.586(4.56)=52.86$ kN < 55.9 kN >>> OK

Bearing A: 02-60 mm bore angular contact ball bearing with $C_{10}=55.9$ kN $C_o=35.5$ kN.

Bearing B (straight roller bearing)

$$F_r = \left(36^2 + 67^2\right)^{1/2} = 76.1 \text{ lbf} = 0.339 \text{ kN}$$

$$C_{10} = a_f F_D \left(\frac{\mathcal{L}_D n_D 60}{\mathcal{L}_R n_R 60}\right)^{1/a} = 1.2(0.339)\left\{\frac{30\,000(500)(60)}{10^6}\right\}^{3/10} = 3.13 \text{ kN}$$

From Table 11-3: Select an 02-25 mm bore cylindrical roller bearing with C_{10}=16.8 kN C_o=8.8 kN.