9.3.4.2 Rack and Pinion **Using Mott*

Nomenclature

P_D = diametral pitch (teeth/in)

N_P = number of teeth on the pinion

D_P = Circular Pitch Diameter of the pinion (in)

n_p = angular speed of the pinion (rpm)

v_t = pitch line velocity of the pinion

B = distance from back of the rack to pitch (in) (Table 8-10)

$B - C$ = distance from back of the rack to pinion centerline (in)

V_{rack} = speec of the rack (ft/min)

s_{rack} = distance the rack travels (ft)

t = time (s)

θ_p = number of revolution of the pinion (rev)

General Equations

pitch line speed: $v_t = \frac{D_p n_p}{2}$

speed of rack: $V_{rack} = \frac{\pi D_p n_p}{12}$

distance the rack travels: $S_{rack} = \frac{D_p \theta_p}{2}$

Design Steps

1. **Find the Pitch Diameter, D_p**

$$D_p = \frac{N}{P_D}$$

2. **Find distance from the pitch line to the back of the rack from the following table:**

TABLE 8–10 Example rack specifications

Diametral pitch	Pitch line to back (B)	Overall thickness	Face width	Nominal length [ft]
64	0.109	0.125	0.125	2
48	0.104	0.125	0.125	2
32	0.156	0.187	0.187	4
24	0.208	0.250	0.25	4
20	0.450	0.500	0.5	6
16	0.688	0.750	0.75	6
12	0.917	1.000	1	6
10	1.150	1.250	1.25	6
8	1.375	1.500	1.5	6
6	1.333	1.500	2	6
5	1.300	1.500	2.5	6
4	1.750	2.000	3.5	6

3. **Find the distance from the back of the rack to the pinion centerline (B-c)**

$$B - C = B + \frac{D_P}{2}$$

4. **Find velocity of the rack, V_{rack}**

$$V_{rack} = \left(\frac{\pi}{6}\right)\left(\frac{D_P n_P}{2}\right)$$

5. **Find the time it takes the rack to move some distance:**

$$t = 60\left(\frac{s_{rack}}{V_{rack}}\right)$$

6. **Find the number of revolutions required to move that rack that far:**

$$\theta_P = \left(\frac{6}{\pi}\right)\left(\frac{2s_{rack}}{D_P}\right)$$