

سکوائرڈ اینڈ گراؤنڈ (Figure 10.2) →

Table 10-1 → $N_e = 2$
 $N_t = N_a + 2$
 $L_w = p N_a + 2d$
 $L_s = d N_t$
 $p = (L_w - 2d) / N_a$

$S_{ut} = \frac{A}{d^m}$

Table 10-4 → Hard-Drawn wire → $m = 0.190$, $A = 140 \text{ kpsi} \cdot \text{in}^m$
 (A227)

$S_{ut} = \frac{140}{(0.25)^{0.190}} = 182.2 \text{ kpsi}$

$S_{sy} = 0.56 S_{ut} = 0.56 \times 182.2 = 102.0 \text{ kpsi}$

$S_{su} = 0.67 S_{ut} = 0.67 \times 182.2 = 122.1 \text{ kpsi}$

Table 10-5 → $d > 0.125$ → $E = 28.5 \text{ Mpsi}$, $G = 11.4 \text{ Mpsi}$
 HD (A227)

$D = 2 - 0.25 = 1.75 \text{ inch}$

$c = \frac{D}{d} = \frac{1.75}{0.25} = 7 \rightarrow 4 \leq c \leq 12$ ✓ این شرط برقرار ہے۔

سختی: $k = \frac{F}{y}$

$k_1 = \frac{F_{min}}{y_{min}} = \frac{10}{1} = 10$, $k_2 = \frac{F_{max}}{y_{max}} = \frac{15}{2} = 7.5$ ✓

$k = \frac{d^4 G}{8 D^3 N_a} \Rightarrow N_a = \frac{d^4 G}{8 k D^3} = \frac{(0.25)^4 \times 11.4 \times 10^6}{8 \times 7.5 \times (1.75)^3} = 138.5 !$

3 ≤ N_a ≤ 15 X این شرط برقرار نہیں ہے!

$N_t = N_a + 2 = 140.5 !$

$L_s = d N_t = 0.25 \times 140.5 = 35.1 \text{ inch} > 2 \text{ inch}$ X قابل تبدیل ہے!

$L_w = L_s + y_{max} = 35.1 + 2 = 37.5 \text{ inch} > 4 \text{ inch}$ X قابل تبدیل ہے!

$$K_B = \frac{4C+2}{4C-3} = \frac{4(7)+2}{4(7)-3} = \frac{28+2}{28-3} = \frac{30}{25} = 1.2$$

$$\tau_s = K_B \frac{8F_{max}D}{\pi d^3} = 1.2 \times \frac{8 \times 15 \times 1.75}{\pi (0.25)^3} = 5,136.3 \text{ psi}$$

$$n_s = \frac{S_{sy}}{\tau_s} = \frac{102 \times 10^3}{5,136.3} = 19.9 !$$

انتقال
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$$F_a = \frac{F_{max} - F_{min}}{2} = \frac{15 - 10}{2} = 2.5 \text{ lb}$$

دینامیک (مستقر)

$$F_m = \frac{F_{max} + F_{min}}{2} = \frac{10 + 15}{2} = 12.5 \text{ lb}$$

$$\tau_a = K_B \frac{8F_a D}{\pi d^3} = 1.2 \times \frac{8 \times 2.5 \times 1.75}{\pi (0.25)^3} = 856.1 \text{ psi}$$

$$\tau_m = K_B \frac{8F_m D}{\pi d^3} = 1.2 \times \frac{8 \times 12.5 \times 1.75}{\pi (0.25)^3} = 4,280.3 \text{ psi}$$

Peen $\rightarrow S_{sa} = 57.5 \text{ kpsi}, S_{sm} = 77.5 \text{ kpsi}$

$$S_{se} = \frac{S_{sa}}{1 - \frac{S_{sm}}{S_{su}}} = \frac{57.5}{1 - \frac{77.5}{122.1}} = 157.4 \text{ kpsi}$$

$$n_f = \frac{S_{sa}}{\tau_a} = \frac{57.5 \times 10^3}{856.1} = 67.2 !$$

نویس: $L_0 < \frac{\pi D}{\alpha} \left[\frac{2(E-G)}{2G+E} \right]^{1/2}$

Table 10-2 $\rightarrow \alpha = 1 \Rightarrow (L_0)_{cr} = \frac{\pi \times 1.75}{1} \left[\frac{2(28.5 - 11.4)}{2 \times 11.4 + 28.5} \right]^{1/2} = 4.5 \text{ inch}$

$L_0 = 37.5 < (L_0)_{cr} = 4.5 \rightarrow$ کمانش رخداد!

Table A-5: $\delta = 0.282$

$$W = \frac{\pi^2 d^2 D N_a \delta}{4} = \frac{\pi^2 (0.25)^2 \times 1.75 \times 138.5 \times 0.282}{4} = 10.5 \text{ lb}$$

$$f_n = 0.5 \sqrt{\frac{386 k}{W}} = 0.5 \sqrt{\frac{386 \times 7.5}{10.5}} = 8.3 \text{ Hz}$$

تکانه بارگذاری: ۱۰ هرتز \leftarrow بسیار نزدیک است در دینامیک رخداد!

Time (s)	Speed (rpm)	$\omega, \text{ rad/s}$	μ	$F_r (N)$	$F_a (N)$	F_a / F_r
10	2000	200	0.07	2915.5	2750	0.94
10	2500	250	0.09	3334.1	2750	0.82
80	3000	2400	0.84	4272.0	2750	0.64
		2850	1.00			

* $F_r = \sqrt{F_x^2 + F_y^2}$

$F_e = X_i \cdot V F_r + Y_i \cdot F_a$

$V = 1$: rotation of inner ring

Table 11-2 : Bore : 30 mm $\xrightarrow{\text{Deep Groove}}$ $C_0 = 10 \text{ (kN)}$, $C_{10} = 19.5 \text{ (kN)}$
 Bore : 20 mm $\xrightarrow{\text{Angular Contact}}$ $C_0 = 6.55 \text{ (kN)}$, $C_{10} = 13.3 \text{ (kN)}$

$\left\{ \begin{array}{l} \frac{F_a}{C_0} = \frac{2750}{10 \times 10^3} = 0.28 \text{ Deep Groove} \\ \frac{F_a}{C_0} = \frac{2750}{6.55 \times 10^3} = 0.42 \text{ Angular Contact} \end{array} \right. \xrightarrow{\text{Table 11-1}} \left\{ \begin{array}{l} e = 0.38 \\ e = 0.42 \end{array} \right.$

بافتار به با استون آفر صبر اول با $\frac{F_a}{F_r}$ هست از مقدار e برآورد برود زیر است.

Table 11-1 \rightarrow $X_2 = 0.56$
 $Y_2 = 1.15$ Deep Groove (DG)
 $Y_2 = 1.04$ Angular Contact (AC)

ابن جدول

Table 11-5

$F_e (DG)$	$F_e (AC)$	a_f	$F_e (DG)$	$F_e (AC)$
4795.2	4492.7	1.2	5754.2	5391.2
5040.8	4738.3	1.2	5754.2 6049.0	5686.0
5554.8	5252.3	1.2	6665.8	6302.8

$a = 3$ ball-bearing

$F_e = \left[\sum f_i (a_{f,i} \cdot F_{e,i})^a \right]^{1/a}$

$F_e = 6558.0 \text{ (N)}$ Deep Groove $< C_{10} = 19.5 \text{ (kN)}$

$F_e = 6195.7 \text{ (N)}$ Angular Contact $< C_{10} = 13.3 \text{ (kN)}$

✓ خود بطریق در این مورد از نقطه نوبتید !!!

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Table 11-4 → 8 hrs Full service → Life = 20 (kh)

$$L_{10} = \frac{60 L_{10R}}{60 n_D} \left(\frac{C_{10}}{F_e} \right)^a = \frac{10^6}{60 \times 3000} \left(\frac{C_{10}}{F_e} \right)^3$$

$$L_{10} = 146.1 \text{ hr}$$

X - معادله از دست می آید و در دسترس نیست!

$$L_{10} = \frac{\text{XXXXXXXXXX}}{55.0} \text{ hr}$$

در این نقطه فقط عدد مناسب در دسترس است!!!