Ref S11-12
B14-2

Estimate the remaining life (in revolutions) of an OZ series 30-mm angular contact ball bearing if the bearing has been subjected to 200,000 cycles at a radial load of 18 kN, and the new load is 30 kN.

$F_1 = 18$ kN $\quad \ell_1 = 2 \times 10^5$ cycles

$F_2 = 30$ kN $\quad \ell_2 = ?$

L_1, L_2 } unknown

* ① $\frac{L_1}{L_2} = \left(\frac{F_2}{F_1}\right)^a$ $\quad \frac{\ell_1}{L_1} + \frac{\ell_2}{L_2} = 1.00$ *

or $F_1^a L_1 = F_2^a L_2$

$= K$ (constant)

$K = C^a L_R$

From the table on page RB-9 of classnotes:

$C = 20.3$ kN

$L_R = 1 \times 10^6$ cycles

$K = (20.3)^3 (1 \times 10^6)$

$\boxed{K = 8.37 \times 10^9}$

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For the initial load conditions

$l_1 = 2\times10^5$ cyc ~ life used

$L_1 = ?$ ~ design life @ F_1

$l_2 = ?$ ~ life remaining

$L_2 = ?$ ~ design life @ F_2

$$L_1 = \frac{K}{F_1^a} \qquad L_2 = \frac{K}{F_2^a}$$

$$L_1 = \frac{8.37\times10^9}{(18)^3}$$ — note, load in kN

$$\boxed{L_1 = 1.43\times10^6 \text{ cycles}}$$

$$L_2 = \frac{8.37\times10^9}{(30)^3}$$

$$\boxed{L_2 = .31\times10^6 \text{ cycles}}$$

$$\sum_{i=1}^{n} \frac{l_i}{L_i} = 1$$

$$\frac{200{,}000}{1.43\times10^6} + \frac{l_2}{.31\times10^6} = 1$$

$$l_2 \approx 2.6\times10^5$$

$$\boxed{l_2 \approx 260{,}000 \text{ cycles}}$$