Catalog Load Rating

radial load that causes 10% of bearings to foil
at rated lire

$FL^{1/a} = \text{constant}$

$a = 3$ ball bearings
$a = 10/3$ roller bearings

L revolutions
F load

$L = 60\,\mathcal{L}\,n$

n rpm
$\mathcal{L}$ hours

$$\underbrace{F_R(\mathcal{L}_R n_R 60)^{1/a} = F_R L_R^{1/a}}_{\text{rated}} = \underbrace{F_D L_D^{1/a} = F_D(\mathcal{L}_D n_D 60)^{1/a}}_{\text{design}}$$

Combined loading

F_e equivalent load

F_a axial load F_r radial load

C_0 static load rating

$V = 1.2$ when outer ring rotates

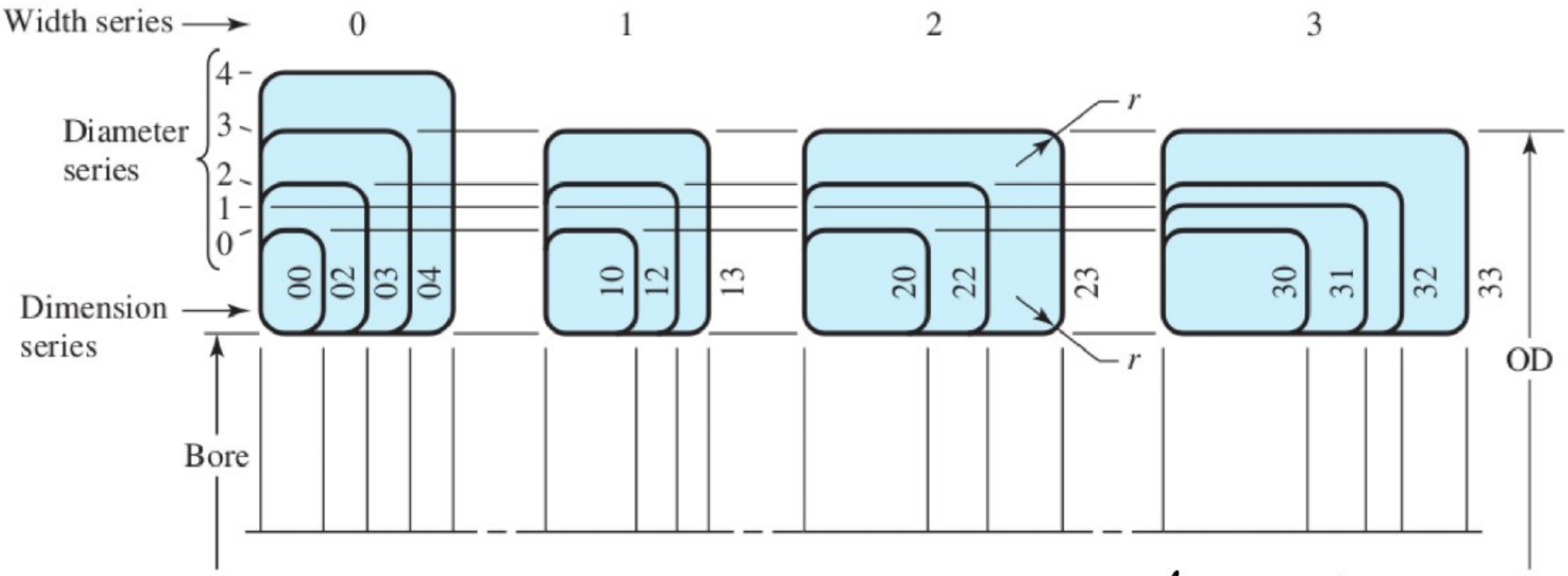
$V = 1$ when inner ring rotates

$$\frac{F_e}{VF_r} = 1 \qquad \frac{F_a}{VF_r} \le e$$

$$\frac{F_e}{VF_r} = X + Y\frac{F_a}{VF_r} \qquad \frac{F_a}{VF_r} > e$$

Table 11-1

F_a/C_0	e	$F_a/(VF_r) \le e$		$F_a/(VF_r) > e$	
		X_1	Y_1	X_2	Y_2
0.014*	0.19	1.00	0	0.56	2.30
0.021	0.21	1.00	0	0.56	2.15
0.028	0.22	1.00	0	0.56	1.99
0.042	0.24	1.00	0	0.56	1.85
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
0.110	0.30	1.00	0	0.56	1.45
0.17	0.34	1.00	0	0.56	1.31
0.28	0.38	1.00	0	0.56	1.15
0.42	0.42	1.00	0	0.56	1.04
0.56	0.44	1.00	0	0.56	1.00



dimensions in Table 11-2

An 02-series single-row deep-groove ball bearing is to be selected from Table 11–2 for the application conditions specified in the table. Assume Table 11–1 is applicable if needed. Specify the smallest bore size from Table 11–2 that can satisfy these conditions.

Problem Number	Radial Load	Axial Load	Design Life	Ring Rotating	Desired Reliability
11–24	8 kN	0 kN	10^9 rev	Inner	90%
11–25	8 kN	2 kN	10 kh, 400 rev/min	Inner	99%
→ **11–26**	8 kN	3 kN	10^8 rev	Outer	90%
11–27	10 kN	5 kN	12 kh, 300 rev/min	Inner	95%
11–28	9 kN	3 kN	10^8 rev	Outer	99%

$$\frac{F_a}{VF_r} = \frac{3\,kN}{1.2 \cdot 8\,kN} = 0.31 < e = 0.34$$

$C_0 = 16.6\ kN \quad ID = 40\ mm$

$$F_a / C_0 = \frac{3\,kN}{16.6\,kN} = 0.18$$

$$\frac{F_e}{VF_r} = 1 \quad \Rightarrow \quad F_e = VF_r = 1.2 \cdot 8\,kN = 9.6\ kN$$

$$F_R L_R^{1/a} = F_D L_D^{1/a}$$

$$30.7(1\times10^6)^{1/3} = 9.6\ L_D^{1/a} \quad \Rightarrow \quad \left(\frac{30.7(1\times10^6)^{1/3}}{9.6}\right)^3 = L_D = 3.3\times10^7 < 1\times10^8$$

$ID = 45\ mm$ $C_0 = 18.6\ kN$ $F_a / C_0 = \frac{3\ kN}{18.6\ kN} = 0.16$

$F_e = 9.6\ kN$

$F_R L_R^{1/3} = F_D L_D^{1/3}$

$33.2 (1 \times 10^6)^{1/3} = 9.6\ L_D^{1/3} \Rightarrow \left(\frac{33.2}{9.6} (1 \times 10^6)^{1/3} \right)^3 = L_D = 4.1 \times 10^7$

11-23 An 02-series single-row deep-groove ball bearing with a 30-mm bore (see Tables 11–1 and 11–2 for specifications) is loaded with a 2-kN axial load and a 5-kN radial load. The inner ring rotates at 400 rev/min.

(*a*) Determine the equivalent radial load that will be experienced by this particular bearing.

(*b*) Determine the predicted life (in revolutions) that this bearing could be expected to give in this application with a ~~99~~ 90 percent reliability.

$L_D = 1 \times 10^6$ rev

$F_a = 2\text{ kN} \quad F_r = 5\text{ kN} \quad C_0 = 10\text{ kN} \quad F_a/C_0 = 2/10 = 0.2$

$$\frac{F_a}{VF_r} = \frac{2\text{ kN}}{1.5\text{ kN}} = 0.4 > e = 0.34$$

$$\frac{F_e}{VF_r} = X + Y\frac{F_a}{VF_r} \Rightarrow \frac{F_e}{1.5\text{kN}} = 0.56 + 1.31\,\frac{2\text{kN}}{1.5\text{kN}} \Rightarrow F_e = 1.5\text{kN}\left(0.56 + 1.31\,\frac{2\text{kN}}{1.5\text{kN}}\right) = \boxed{5.42\text{kN}}$$

$$F_R L_R^{1/3} = F_D L_D^{1/3}$$

$$\left(\frac{F_R}{F_D} L_R^{1/3}\right)^3 = L_D$$

$$\left(\frac{19.5}{5.42}(1\times10^6)^{1/3}\right)^3 = \boxed{4.66\times10^7 \text{ rev}}$$