Important Design of Rolling Contact Bearing Formulas PDF

Formulas
Examples
with Units

List of 86
Important Design of Rolling Contact Bearing Formulas

1) Angular Contact Bearing Formulas

1.1) Axial Load for Back to Back Bearings when Fa by Fr is greater than 1.14 Formula

Evaluate Formula

Formula

$$F_a = \frac{P_b - (0.57 \cdot F_r)}{0.93}$$

Example with Units

$$2969.3548\,\text{N} = \frac{7350\,\text{N} - (0.57 \cdot 8050\,\text{N})}{0.93}$$

1.2) Axial Load for Back to Back Bearings when Fa by Fr is less than or equal to 1.14 Formula

Evaluate Formula

Formula

$$F_a = \frac{P_{eq} - F_r}{0.55}$$

Example with Units

$$2909.0909\,\text{N} = \frac{9650\,\text{N} - 8050\,\text{N}}{0.55}$$

1.3) Axial Load for Singly Mounted Bearings when Fa by Fr is greater than 1.14 Formula

Evaluate Formula

Formula

$$F_a = \frac{P_s - (0.35 \cdot F_r)}{0.57}$$

Example with Units

$$2951.7544\,\text{N} = \frac{4500\,\text{N} - (0.35 \cdot 8050\,\text{N})}{0.57}$$

1.4) Equivalent Dynamic Load for Back to Back Bearings when Fa by Fr is greater than 1.14 Formula

Evaluate Formula

Formula

$$P_b = (0.57 \cdot F_r) + (0.93 \cdot F_a)$$

Example with Units

$$7378.5\,\text{N} = (0.57 \cdot 8050\,\text{N}) + (0.93 \cdot 3000\,\text{N})$$

1.5) Equivalent Dynamic Load for Back to Back Bearings when Fa by Fr is less than or equal to 1.14 Formula

Evaluate Formula

Formula

$$P_b = F_r + (0.55 \cdot F_a)$$

Example with Units

$$9700\,\text{N} = 8050\,\text{N} + (0.55 \cdot 3000\,\text{N})$$

1.6) Equivalent Dynamic Load for Singly Mounted Bearings when Fa by Fr is greater than 1.14 Formula

Evaluate Formula

Formula

$$P_s = \left(0.35 \cdot F_r\right) + \left(0.57 \cdot F_a\right)$$

Example with Units

$$4527.5\,\text{N} = \left(0.35 \cdot 8050\,\text{N}\right) + \left(0.57 \cdot 3000\,\text{N}\right)$$

1.7) Radial Load for Back to Back Bearings when Fa by Fr greater than 1.14 Formula

Evaluate Formula

Formula

$$F_r = \frac{P_b - \left(0.93 \cdot F_a\right)}{0.57}$$

Example with Units

$$8000\,\text{N} = \frac{7350\,\text{N} - \left(0.93 \cdot 3000\,\text{N}\right)}{0.57}$$

1.8) Radial Load for Back to Back Bearings when Fa by Fr less than or equal to 1.14 Formula

Evaluate Formula

Formula

$$F_r = \left(P_{eq} - \left(0.55 \cdot F_a\right)\right)$$

Example with Units

$$8000\,\text{N} = \left(9650\,\text{N} - \left(0.55 \cdot 3000\,\text{N}\right)\right)$$

1.9) Radial Load for Singly Mounted Bearings when Fa by Fr is greater than 1.14 Formula

Evaluate Formula

Formula

$$F_r = \frac{P_s - \left(0.57 \cdot F_a\right)}{0.35}$$

Example with Units

$$7971.4286\,\text{N} = \frac{4500\,\text{N} - \left(0.57 \cdot 3000\,\text{N}\right)}{0.35}$$

2) Dynamic and Equivalent Load Formulas

2.1) Axial Thrust Load on Bearing given Equivalent Dynamic Load Formula

Evaluate Formula

Formula

$$F_a = \frac{P_b - \left(X \cdot V \cdot F_r\right)}{Y}$$

Example with Units

$$1293.6\,\text{N} = \frac{7350\,\text{N} - \left(0.56 \cdot 1.2 \cdot 8050\,\text{N}\right)}{1.5}$$

2.2) Dynamic Load Capacity for Ball Bearing Formula

Evaluate Formula

Formula

$$C = P_b \cdot \left(L_{10}^{\frac{1}{3}}\right)$$

Example with Units

$$38524.8985\,\text{N} = 7350\,\text{N} \cdot \left(144^{\frac{1}{3}}\right)$$

2.3) Dynamic Load Capacity for Bearing given Rated Bearing Life Formula

Evaluate Formula

Formula

$$C = P_b \cdot \left(L_{10}^{\frac{1}{p}}\right)$$

Example with Units

$$38524.8985\,\text{N} = 7350\,\text{N} \cdot \left(144^{\frac{1}{3}}\right)$$

2.4) Dynamic Load Capacity for Roller Bearing Formula

Evaluate Formula

Formula

$$C = P_b \cdot \left(L_{10}^{0.3} \right)$$

Example with Units

$$32643.4526\,\text{N} = 7350\,\text{N} \cdot \left(144^{0.3} \right)$$

2.5) Equivalent Dynamic Load for Bearing given Radial Factor Formula

Evaluate Formula

Formula

$$P_b = \left(X \cdot F_r \right) + \left(Y \cdot F_a \right)$$

Example with Units

$$9008\,\text{N} = \left(0.56 \cdot 8050\,\text{N} \right) + \left(1.5 \cdot 3000\,\text{N} \right)$$

2.6) Equivalent Dynamic Load for Back to Back Bearings Formula

Evaluate Formula

Formula

$$P_b = \left(X \cdot V \cdot F_r \right) + \left(Y \cdot F_a \right)$$

Example with Units

$$9909.6\,\text{N} = \left(0.56 \cdot 1.2 \cdot 8050\,\text{N} \right) + \left(1.5 \cdot 3000\,\text{N} \right)$$

2.7) Equivalent Dynamic Load for Back to Back Bearings when subjected to Pure Radial Load Formula

Evaluate Formula

Formula

$$P_b = 1 \cdot F_r$$

Example with Units

$$8050\,\text{N} = 1 \cdot 8050\,\text{N}$$

2.8) Equivalent Dynamic Load for Back to Back Bearings when subjected to Pure Thrust Load Formula

Evaluate Formula

Formula

$$P_b = 1 \cdot F_a$$

Example with Units

$$3000\,\text{N} = 1 \cdot 3000\,\text{N}$$

2.9) Equivalent Dynamic Load for Ball Bearing Formula

Evaluate Formula

Formula

$$P_b = \frac{C}{L_{10}^{\frac{1}{3}}}$$

Example with Units

$$7030.4533\,\text{N} = \frac{36850\,\text{N}}{144^{\frac{1}{3}}}$$

2.10) Equivalent Dynamic Load for Bearing given Rated Bearing Life Formula

Evaluate Formula

Formula

$$P_b = \frac{C}{L_{10}^{\frac{1}{p}}}$$

Example with Units

$$7030.4533\,\text{N} = \frac{36850\,\text{N}}{144^{\frac{1}{3}}}$$

2.11) Equivalent Dynamic Load for Roller Bearing Formula

Evaluate Formula

Formula

$$P_b = \frac{C}{L_{10}^{0.3}}$$

Example with Units

$$8297.1462\,\text{N} = \frac{36850\,\text{N}}{144^{0.3}}$$

2.12) Race Rotation Factor for Bearing given Radial Factor Formula

Evaluate Formula

Formula

$$V = \frac{P_{eq} - \left(Y \cdot F_a\right)}{X \cdot F_r}$$

Example with Units

$$1.1424 = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{0.56 \cdot 8050\,\text{N}}$$

2.13) Radial Factor of Bearing given Equivalent Dynamic Load Formula

Evaluate Formula

Formula

$$X = \frac{P_{eq} - \left(Y \cdot F_a\right)}{V \cdot F_r}$$

Example with Units

$$0.5331 = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{1.2 \cdot 8050\,\text{N}}$$

2.14) Radial Load of Bearing given Radial Factor Formula

Evaluate Formula

Formula

$$F_r = \frac{P_b - \left(Y \cdot F_a\right)}{X \cdot V}$$

Example with Units

$$4241.0714\,\text{N} = \frac{7350\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{0.56 \cdot 1.2}$$

2.15) Thrust Factor on Bearing given Equivalent Dynamic Load Formula

Evaluate Formula

Formula

$$Y = \frac{P_{eq} - \left(X \cdot V \cdot F_r\right)}{F_a}$$

Example with Units

$$1.4135 = \frac{9650\,\text{N} - \left(0.56 \cdot 1.2 \cdot 8050\,\text{N}\right)}{3000\,\text{N}}$$

3) Rated Bearing Life Formulas

3.1) Rated Bearing Life in Hours Formula

Evaluate Formula

Formula

$$L_{10h} = L_{10} \cdot \frac{10^6}{60 \cdot N}$$

Example

$$6857.1429 = 144 \cdot \frac{10^6}{60 \cdot 350}$$

3.2) Rated Bearing Life in Million Revolutions for Ball Bearings Formula

Evaluate Formula

Formula

$$L_{10} = \left(\frac{C}{P_b}\right)^3$$

Example with Units

$$126.0232 = \left(\frac{36850\,\text{N}}{7350\,\text{N}}\right)^3$$

3.3) Rated Bearing Life in Million Revolutions for Roller Bearings Formula

Evaluate Formula

Formula

$$L_{10} = \left(\frac{C}{P_b}\right)^{\frac{10}{3}}$$

Example with Units

$$215.6919 = \left(\frac{36850\,\text{N}}{7350\,\text{N}}\right)^{\frac{10}{3}}$$

3.4) Rated Bearing Life in Million Revolutions given Bearing Speed Formula

Evaluate Formula

Formula

$$L_{10} = 60 \cdot N \cdot \frac{L_{10h}}{10^6}$$

Example

$$168 = 60 \cdot 350 \cdot \frac{8000}{10^6}$$

3.5) Rated Bearing Life in Million Revolutions given Dynamic Load Capacity Formula

Evaluate Formula

Formula

$$L_{10} = \left(\frac{C}{P_b}\right)^p$$

Example with Units

$$126.0232 = \left(\frac{36850\,\text{N}}{7350\,\text{N}}\right)^3$$

3.6) Rated Bearing Life in Million Revolutions given Median Life Formula

Evaluate Formula

Formula

$$L_{10} = \frac{L_{50}}{5}$$

Example

$$144 = \frac{720}{5}$$

3.7) Rated Bearing Life in Million Revolutions given Nominal Life Formula

Evaluate Formula

Formula

$$L_{10} = \left(\frac{1000}{\pi \cdot D}\right) \cdot L_{10s}$$

Example with Units

$$144.6863 = \left(\frac{1000}{3.1416 \cdot 880\,\text{mm}}\right) \cdot 0.4$$

4) Rolling Contact Bearing Configuration Formulas

4.1) Axial Thrust Load on Bearing given Race Rotation Factor Formula

Evaluate Formula

Formula

$$F_a = \frac{P_{eq} - \left(X \cdot V \cdot F_r\right)}{Y}$$

Example with Units

$$2826.9333\,\text{N} = \frac{9650\,\text{N} - \left(0.56 \cdot 1.2 \cdot 8050\,\text{N}\right)}{1.5}$$

4.2) Axial Thrust Load on Bearing given Thrust Factor Formula

Evaluate Formula

Formula

$$F_a = \frac{P_{eq} - \left(X \cdot F_r\right)}{Y}$$

Example with Units

$$3428\,\text{N} = \frac{9650\,\text{N} - \left(0.56 \cdot 8050\,\text{N}\right)}{1.5}$$

4.3) Bore Diameter of Bearing Formula

Evaluate Formula

Formula

$$d = 2 \cdot \frac{M_t}{\mu \cdot W}$$

Example with Units

$$31.0078\,\text{mm} = 2 \cdot \frac{120\,\text{N*mm}}{0.0043 \cdot 1800\,\text{N}}$$

4.4) Coefficient of Friction of Roller Contact Bearing Formula

Evaluate Formula

Formula

$$\mu = 2 \cdot \frac{M_t}{d \cdot W}$$

Example with Units

$$0.0044 = 2 \cdot \frac{120\,\text{N*mm}}{30\,\text{mm} \cdot 1800\,\text{N}}$$

4.5) Friction Moment on Roller Contact Bearing Formula

Evaluate Formula

Formula

$$M_t = \mu \cdot W \cdot \left(\frac{d}{2}\right)$$

Example with Units

$$116.1\,\text{N*mm} = 0.0043 \cdot 1800\,\text{N} \cdot \left(\frac{30\,\text{mm}}{2}\right)$$

4.6) Load on Bearing given Moment on bearing Formula

Evaluate Formula

Formula

$$W = \frac{M_t}{\mu \cdot \left(\frac{d}{2}\right)}$$

Example with Units

$$1860.4651\,\text{N} = \frac{120\,\text{N*mm}}{0.0043 \cdot \left(\frac{30\,\text{mm}}{2}\right)}$$

4.7) Median Life of Roller Contact Bearing Formula

Evaluate Formula

Formula

$$L_{50} = 5 \cdot L_{10}$$

Example

$$720 = 5 \cdot 144$$

4.8) Nominal Life of Roller Contact Bearing Formula

Evaluate Formula

Formula

$$L_{10s} = \frac{L_{10}}{\frac{1000}{\pi \cdot D}}$$

Example with Units

$$0.3981 = \frac{144}{\frac{1000}{3.1416 \cdot 880\,\text{mm}}}$$

4.9) Number of Bearings required given Reliability Formula

Evaluate Formula

Formula

$$N_b = \frac{\log10\left(R_s\right)}{\log10\left(R\right)}$$

Example

$$3.3699 = \frac{\log10\left(0.65\right)}{\log10\left(0.88\right)}$$

4.10) Race Rotation Factor of Roller Contact Bearing Formula

Evaluate Formula

Formula

$$V = \frac{P_{eq} - \left(Y \cdot F_a\right)}{X \cdot F_r}$$

Example with Units

$$1.1424 = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{0.56 \cdot 8050\,\text{N}}$$

4.11) Radial Factor of Roller Contact Bearing Formula

Evaluate Formula

Formula

$$X = \frac{P_{eq} - \left(Y \cdot F_a\right)}{F_r}$$

Example with Units

$$0.6398 = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{8050\,\text{N}}$$

4.12) Radial Factor of Roller Contact Bearing given Race Rotation Factor Formula

Evaluate Formula

Formula

$$X = \frac{P_{eq} - \left(Y \cdot F_a\right)}{V \cdot F_r}$$

Example with Units

$$0.5331 = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{1.2 \cdot 8050\,\text{N}}$$

4.13) Radial Load on Bearing Formula

Evaluate Formula

Formula

$$F_r = \frac{P_{eq} - \left(Y \cdot F_a\right)}{X}$$

Example with Units

$$9196.4286\,\text{N} = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{0.56}$$

4.14) Radial Load on Bearing given Race Rotation Factor Formula

Evaluate Formula

Formula

$$F_r = \frac{P_{eq} - \left(Y \cdot F_a\right)}{X \cdot V}$$

Example with Units

$$7663.6905\,\text{N} = \frac{9650\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{0.56 \cdot 1.2}$$

4.15) Reliability of Bearing Formula

Evaluate Formula

Formula

$$R = e^{-\left(\frac{L}{a}\right)^{b}}$$

Example

$$0.5 = e^{-\left(\frac{5}{6.84}\right)^{1.17}}$$

4.16) Reliability of Bearing given Number of Bearings Formula

Evaluate Formula

Formula

$$R = R_s^{\frac{1}{N_b}}$$

Example

$$0.8979 = 0.65^{\frac{1}{4}}$$

4.17) Reliability of Complete Bearing System Formula

Evaluate Formula

Formula

$$R_s = R^{N_b}$$

Example

$$0.5997 = 0.88^{4}$$

4.18) Speed of Rotation of Bearing Formula

Evaluate Formula

Formula

$$N = L_{10} \cdot \frac{10^6}{60 \cdot L_{10h}}$$

Example

$$300 = 144 \cdot \frac{10^6}{60 \cdot 8000}$$

4.19) Thrust factor of Bearing Formula

Evaluate Formula

Formula

$$Y = \frac{P_{eq} - \left(X \cdot F_r\right)}{F_a}$$

Example with Units

$$1.714 = \frac{9650\,\text{N} - \left(0.56 \cdot 8050\,\text{N}\right)}{3000\,\text{N}}$$

4.20) Thrust factor of Bearing given Race Rotation Factor Formula

Evaluate Formula

Formula

$$Y = \frac{P_{eq} - \left(X \cdot V \cdot F_r\right)}{F_a}$$

Example with Units

$$1.4135 = \frac{9650\,\text{N} - \left(0.56 \cdot 1.2 \cdot 8050\,\text{N}\right)}{3000\,\text{N}}$$

4.21) Train Wheel Diameter considering Bearing Life Formula

Evaluate Formula

Formula

$$D = \left(\frac{1000}{\pi \cdot L_{10}}\right) \cdot L_{10s}$$

Example with Units

$$884.1941\,\text{mm} = \left(\frac{1000}{3.1416 \cdot 144}\right) \cdot 0.4$$

5) Self Aligning Ball Bearings Formulas

5.1) Axial Thrust Load on Self Aligning Ball Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$F_a = \frac{Peq_{sa} - \left(0.65 \cdot F_r\right)}{Y_2}$$

Example with Units

$$3341.6667\,\text{N} = \frac{12250\,\text{N} - \left(0.65 \cdot 8050\,\text{N}\right)}{2.1}$$

5.2) Axial Thrust Load on Self Aligning Ball Bearing when Fa by Fr is less than or equal to e Formula

Evaluate Formula

Formula

$$F_a = \frac{Peq_{sa} - F_r}{Y_1}$$

Example with Units

$$3000\,\text{N} = \frac{12250\,\text{N} - 8050\,\text{N}}{1.4}$$

5.3) Equivalent Dynamic Load on Self Aligning Ball Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$Peq_{sa} = \left(0.65 \cdot F_r\right) + \left(Y_2 \cdot F_a\right)$$

Example with Units

$$11532.5\,\text{N} = \left(0.65 \cdot 8050\,\text{N}\right) + \left(2.1 \cdot 3000\,\text{N}\right)$$

5.4) Equivalent Dynamic Load on Self Aligning Ball Bearing when Fa by Fr is less than or equal to e Formula

Evaluate Formula

Formula

$$Peq_{sa} = F_r + \left(Y_1 \cdot F_a \right)$$

Example with Units

$$12250\,\text{N} = 8050\,\text{N} + \left(1.4 \cdot 3000\,\text{N} \right)$$

5.5) Factor Y1 of Self Aligning Ball Bearing when Fa by Fr is less than or equal to e Formula

Evaluate Formula

Formula

$$Y_1 = \frac{Peq_{sa} - F_r}{F_a}$$

Example with Units

$$1.4 = \frac{12250\,\text{N} - 8050\,\text{N}}{3000\,\text{N}}$$

5.6) Factor Y2 of Self Aligning Ball Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$Y_2 = \frac{Peq_{sa} - \left(0.65 \cdot F_r \right)}{F_a}$$

Example with Units

$$2.3392 = \frac{12250\,\text{N} - \left(0.65 \cdot 8050\,\text{N} \right)}{3000\,\text{N}}$$

5.7) Radial Load on Self Aligning Ball Bearing when Fa by Fr greater than e Formula

Evaluate Formula

Formula

$$F_r = \frac{Peq_{sa} - \left(Y_2 \cdot F_a \right)}{0.65}$$

Example with Units

$$9153.8462\,\text{N} = \frac{12250\,\text{N} - \left(2.1 \cdot 3000\,\text{N} \right)}{0.65}$$

5.8) Radial Load on Self Aligning Ball Bearing when Fa by Fr is less than or equal to e Formula

Evaluate Formula

Formula

$$F_r = Peq_{sa} - \left(Y_1 \cdot F_a \right)$$

Example with Units

$$8050\,\text{N} = 12250\,\text{N} - \left(1.4 \cdot 3000\,\text{N} \right)$$

6) Spherical Roller Bearing Formulas

6.1) Axial Thrust Load on Spherical Roller Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$F_a = \frac{Peq_{sp} - \left(0.67 \cdot F_r \right)}{Y_2}$$

Example with Units

$$3074.5238\,\text{N} = \frac{11850\,\text{N} - \left(0.67 \cdot 8050\,\text{N} \right)}{2.1}$$

6.2) Axial Thrust Load on Spherical Roller Bearing when Fa by Fr is less than or equal to e Formula

Evaluate Formula

Formula

$$F_a = \frac{Peq_{sp} - F_r}{Y_1}$$

Example with Units

$$2714.2857\,\text{N} = \frac{11850\,\text{N} - 8050\,\text{N}}{1.4}$$

6.3) Equivalent Dynamic Load on Spherical Roller Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$Peq_{sp} = \left(0.67 \cdot F_r\right) + \left(Y_2 \cdot F_a\right)$$

Example with Units

$$11693.5\,\text{N} = \left(0.67 \cdot 8050\,\text{N}\right) + \left(2.1 \cdot 3000\,\text{N}\right)$$

6.4) Equivalent Dynamic Load on Spherical Roller Bearing when Fa by Fr is less than equal to e Formula

Evaluate Formula

Formula

$$Peq_{sp} = F_r + \left(Y_1 \cdot F_a\right)$$

Example with Units

$$12250\,\text{N} = 8050\,\text{N} + \left(1.4 \cdot 3000\,\text{N}\right)$$

6.5) Factor Y1 of Spherical Roller Bearing when Fa by Fr is less than or equal to e Formula

Evaluate Formula

Formula

$$Y_1 = \frac{Peq_{sp} - F_r}{F_a}$$

Example with Units

$$1.2667 = \frac{11850\,\text{N} - 8050\,\text{N}}{3000\,\text{N}}$$

6.6) Factor Y2 of Spherical Roller Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$Y_2 = \frac{Peq_{sp} - \left(0.67 \cdot F_r\right)}{F_a}$$

Example with Units

$$2.1522 = \frac{11850\,\text{N} - \left(0.67 \cdot 8050\,\text{N}\right)}{3000\,\text{N}}$$

6.7) Radial Load on Spherical Roller Bearing when Fa by Fr greater than e Formula

Evaluate Formula

Formula

$$F_r = \frac{Peq_{sp} - \left(Y_2 \cdot F_a\right)}{0.67}$$

Example with Units

$$8283.5821\,\text{N} = \frac{11850\,\text{N} - \left(2.1 \cdot 3000\,\text{N}\right)}{0.67}$$

6.8) Radial Load on Spherical Roller Bearing when Fa by Fr is less than equal to e Formula

Evaluate Formula

Formula

$$F_r = Peq_{sp} - \left(Y_1 \cdot F_a\right)$$

Example with Units

$$7650\,\text{N} = 11850\,\text{N} - \left(1.4 \cdot 3000\,\text{N}\right)$$

7) Stribeck's Equation Formulas

7.1) Angle between adjacent Balls of Ball Bearing Formula

Evaluate Formula

Formula

$$\beta = \frac{360}{z}$$

Example with Units

$$1375.0987° = \frac{360}{15}$$

7.2) Diameter of Ball of Bearing from Stribeck's Equation Formula

Evaluate Formula

Formula

$$d_b = \sqrt{\frac{5 \cdot C_o}{k \cdot z}}$$

Example with Units

$$4.2008\,\text{mm} = \sqrt{\frac{5 \cdot 45000\,\text{N}}{850\,\text{N/mm}^2 \cdot 15}}$$

7.3) Diameter of Ball of Bearing given Force required to produce Permanent Deformation in Ball Formula

Evaluate Formula

Formula

$$d_b = \sqrt{\frac{F}{k}}$$

Example with Units

$$4.2008\,\text{mm} = \sqrt{\frac{15000\,\text{N}}{850\,\text{N/mm}^2}}$$

7.4) Force required to produce Permanent Deformation of Balls of Ball Bearing Formula

Evaluate Formula

Formula

$$F = k \cdot d_b^{\,2}$$

Example with Units

$$14994\,\text{N} = 850\,\text{N/mm}^2 \cdot 4.2\,\text{mm}^{\,2}$$

7.5) Force required to produce Permanent Deformation of Balls of Ball Bearing given Static Load Formula

Evaluate Formula

Formula

$$F = 5 \cdot \frac{C_o}{z}$$

Example with Units

$$15000\,\text{N} = 5 \cdot \frac{45000\,\text{N}}{15}$$

7.6) K Factor for Ball Bearing from Stribeck's Equation Formula

Evaluate Formula

Formula

$$k = 5 \cdot \frac{C_o}{d_b^{\,2} \cdot z}$$

Example with Units

$$850.3401\,\text{N/mm}^2 = 5 \cdot \frac{45000\,\text{N}}{4.2\,\text{mm}^{\,2} \cdot 15}$$

7.7) K Factor for Ball Bearing given Force required to produce Permanent Deformation of Balls Formula

Evaluate Formula

Formula

$$k = \frac{F}{d_b^{\,2}}$$

Example with Units

$$850.3401\,\text{N/mm}^2 = \frac{15000\,\text{N}}{4.2\,\text{mm}^{\,2}}$$

7.8) Number of Balls of Ball Bearing from Stribeck's Equation Formula

Evaluate Formula

Formula

$$z = 5 \cdot \frac{C_o}{k \cdot d_b^{\,2}}$$

Example with Units

$$15.006 = 5 \cdot \frac{45000\,\text{N}}{850\,\text{N/mm}^2 \cdot 4.2\,\text{mm}^{\,2}}$$

7.9) Number of Balls of Ball Bearing given Angle between Balls Formula

Evaluate Formula

Formula

$$z = \frac{360}{\beta}$$

Example with Units

$$859.4367 = \frac{360}{24^\circ}$$

7.10) Number of Balls of Ball Bearing given Static Load Formula

Evaluate Formula

Formula

$$z = 5 \cdot \frac{C_o}{F}$$

Example with Units

$$15 = 5 \cdot \frac{45000\,\text{N}}{15000\,\text{N}}$$

7.11) Static Load on Ball of Ball Bearing from Stribeck's Equation Formula

Evaluate Formula

Formula

$$C_o = k \cdot d_b^{\,2} \cdot \frac{z}{5}$$

Example with Units

$$44982\,\text{N} = 850\,\text{N/mm}^2 \cdot 4.2\,\text{mm}^2 \cdot \frac{15}{5}$$

7.12) Static Load on Ball of Ball Bearing given Primary force Formula

Evaluate Formula

Formula

$$C_o = F \cdot \frac{z}{5}$$

Example with Units

$$45000\,\text{N} = 15000\,\text{N} \cdot \frac{15}{5}$$

8) Taper Roller Bearing Formulas

8.1) Axial Thrust Load on Taper Roller Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$F_a = \frac{Pb_t - \left(0.4 \cdot F_r\right)}{Y}$$

Example with Units

$$3000\,\text{N} = \frac{7720\,\text{N} - \left(0.4 \cdot 8050\,\text{N}\right)}{1.5}$$

8.2) Equivalent Dynamic Load on Taper Roller Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$Pb_t = \left(0.4 \cdot F_r\right) + \left(Y \cdot F_a\right)$$

Example with Units

$$7720\,\text{N} = \left(0.4 \cdot 8050\,\text{N}\right) + \left(1.5 \cdot 3000\,\text{N}\right)$$

8.3) Radial Load on Taper Roller Bearing when Fa by Fr is greater than e Formula

Evaluate Formula

Formula

$$F_r = \frac{Pb_t - \left(Y \cdot F_a\right)}{0.4}$$

Example with Units

$$8050\,\text{N} = \frac{7720\,\text{N} - \left(1.5 \cdot 3000\,\text{N}\right)}{0.4}$$

9) Thrust Ball Bearing Formulas

9.1) Minimum Axial Load on Thrust Ball Bearing Formula

Evaluate Formula

Formula

$$F_{min} = A \cdot \left(\left(\frac{N}{1000} \right)^2 \right)$$

Example with Units

$$0.2499\,\text{N} = 2.04 \cdot \left(\left(\frac{350}{1000} \right)^2 \right)$$

9.2) Minimum Load Factor for Thrust Ball Bearing Formula

Evaluate Formula

Formula

$$A = F_{min} \cdot \left(\left(\frac{1000}{N} \right)^2 \right)$$

Example with Units

$$2.0408 = 0.25\,\text{N} \cdot \left(\left(\frac{1000}{350} \right)^2 \right)$$

9.3) Rotational Speed of Bearing given Maximum Axial Load and Maximum Load Factor Formula

Evaluate Formula

Formula

$$N = 1000 \cdot \sqrt{\frac{F_{min}}{A}}$$

Example with Units

$$350.07 = 1000 \cdot \sqrt{\frac{0.25\,\text{N}}{2.04}}$$

Variables used in list of Design of Rolling Contact Bearing Formulas above

- **a** Constant a of Bearing
- **A** Minimum Load Factor
- **b** Constant b of Bearing
- **C** Dynamic Load Capacity of Bearing *(Newton)*
- C_o Static Load on Bearing *(Newton)*
- **d** Bore Diameter of Bearing *(Millimeter)*
- **D** Train Wheel Diameter *(Millimeter)*
- d_b Ball Diameter of a Bearing *(Millimeter)*
- **F** Force on Ball Bearing *(Newton)*
- F_a Axial or Thrust Load Acting on Bearing *(Newton)*
- F_{min} Minimum Axial Load Thrust Bearing *(Newton)*
- F_r Radial Load Acting on Bearing *(Newton)*
- **k** K Factor *(Newton per Square Millimeter)*
- **L** Corresponding Life of Bearing
- L_{10} Rated Bearing Life
- L_{10h} Rated Bearing Life in Hours
- L_{10s} Nominal Life in Millions of Kilometers
- L_{50} Median Life of Bearing
- M_t Friction Moment on Bearing *(Newton Millimeter)*
- **N** Speed of Bearing in RPM
- N_b Number of Bearings
- **p** Constant p of Bearing
- P_b Equivalent Dynamic Load on Back to Back Bearing *(Newton)*
- P_{eq} Equivalent Dynamic Load on Bearing *(Newton)*
- P_s Equivalent dynamic load on singly bearing *(Newton)*
- Pb_t Equivalent Dynamic Load on Taper Bearing *(Newton)*

Constants, Functions, Measurements used in list of Design of Rolling Contact Bearing Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **e**, 2.71828182845904523536028747135266249 *Napier's constant*
- Functions: **log10**, log10(Number) *The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Millimeter (mm) *Length Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Torque** in Newton Millimeter (N*mm) *Torque Unit Conversion*
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²) *Stress Unit Conversion*

- **Peq_{sa}** Equivalent Dynamic Load on Self Aligning Bearing *(Newton)*
- **Peq_{sp}** Equivalent Dynamic Load on Spherical Bearing *(Newton)*
- **R** Reliability of Bearing
- **R_s** Reliability of Bearing System
- **V** Race-Rotation Factor
- **W** Load Acting on Bearing *(Newton)*
- **X** Radial Factor
- **Y** Thrust Factor for Bearing
- **Y_1** Factor Y1 of Bearing
- **Y_2** Factor Y2 of Bearing
- **z** Number of Balls in Bearing
- **β** Angle between Balls of Bearing in Degrees *(Degree)*
- **μ** Coefficient of Friction for Bearing

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