

Static vs Dynamic Load

The static load rating of a bearing block for a given diameter ballscrew is a measure of the capability of the bearing block to support the load under nonoperating conditions. The dynamic load rating is a measure of the applied operating load the bearing blocks can withstand.

In a horizontal application, the load is usually supported by ways, rails, or guides. The screw is primarily used to move the load. For this reason, the dynamic load rating of the bearing blocks is more critical than the static load rating.

In a vertical application, the screw not only moves the load but also supports the load when it is not moving. Therefore, the bearing block static and dynamic load ratings must be taken into consideration.

Stiffness

Stiffness is a measure of the ballscrew resistance to deflect with respect to the applied thrust load and the unsupported length of the screw. A screw held fixed at both ends in spaced angular contact bearings is four times stiffer than a screw fixed at one end and free at the other.

End Play/Backlash

Supporting the screw with duplex or spaced angular contact bearings provides the end support needed to control axial movement of the screw. Although both bearing arrangements for a given ballscrew diameter have the same thrust load capacity, the spaced bearing arrangement increases the stiffness of the overall ballscrew assembly.

Nominal Load Ratings for Standard Comptrol Bearing Blocks

Screw Diameter (in.)	TYPE A		TYPE B & C			
	Radial Load Capacity (lbs.)		Thrust Load Capacity (lbs.)		Radial Load Capacity (lbs.)	
	Static	Dynamic*	Static	Dynamic*	Static	Dynamic*
0.625	697	1,550	3,262	3,035	1,690	2,810
0.750	1,210	2,560	5,288	4,925	2,740	4,560
1.000	1,470	2,860	7,199	5,875	3,730	5,440
1.130	1,750	3,150	9,032	6,556	4,680	6,070
1.500	2,520	4,380	11,059	8,381	5,730	7,760
2.000	4,270	6,900	19,493	12,744	10,100	11,800
2.250	7,080	11,900	34,740	23,652	18,000	21,900
2.500	6,520	9,800	32,617	19,224	16,900	17,800
3.000	11,700	18,400	55,970	35,964	29,000	33,300

* Dynamic Load Ratings based on one million revolutions or 500 hours at 33¹/₃ r.p.m. For assistance calculating life expectancy, contact Comptrol. See Design Notes 3 & 4 below.

Compression/Column Loading

The compression load rating of a ballscrew is a measure of the maximum applied axial load the screw can support without buckling. The formulas below show that increasing the rigidity of the bearing block arrangement increases the end fixity factor (C_c) used to calculate the compression load capacity of the screw.

$$P_{CR} = C_c \times 14.05 \times 10^6 \times \frac{D^4}{L^2}$$

$$P_s = P_{CR} \times F_s$$

where:

- P_{CR} = Critical Compression Load (lbs.)
- P_s = Safe Compression Load (lbs.)
- D = Screw Minor Root Diameter (in.)
- L = Unsupported Length (in.)
- F_s = Safety Factor (.80 maximum)
- C_c = End Fixity Factor (Column Load)
 - 0.25 Rigid-Free
 - 1.00 Simple-Simple
 - 2.00 Rigid-Simple
 - 4.00 Rigid-Rigid

Critical Speed

The critical speed rating of a ballscrew determines the safe operating speed* for a given ballscrew diameter and length. The formulas below show that increasing the rigidity of the end mounting arrangement increases the end fixity factor (C_s). This results in a higher critical speed rating and safe operating speed.

$$N = C_s \times 4.76 \times 10^6 \times \frac{D}{L^2}$$

$$N_s = N \times F_s$$

where:

- N = Critical Speed Rating (r.p.m.)
- N_s = Safe Operating Speed (r.p.m.)
- D = Screw Minor Root Diameter (in.)
- L = Length between bearing blocks (in.)
- F_s = Safety Factor (.80 maximum)
- C_s = Critical Speed End Fixity Factor
 - 0.36 Rigid-Free
 - 1.00 Simple-Simple
 - 1.47 Rigid-Simple
 - 2.23 Rigid-Rigid

Design Notes

- Whenever possible a screw should be held fixed at both ends with no residual stress on the screw. If the screw must be held under stress, tension is always more desirable than compression.
- If the drive motor is not in-line with the centerline of the screw, radial loads must be taken into consideration. Typical examples are belt, gear, or chain drive applications.
- If the same type bearing block is used on both ends, the load is shared unless a one end has a Type CD journal.
- For Simple-Simple or Rigid-Simple end support, the Dynamic Load rating will be determined by the Type B or C bearing block selected.
- The end journals for Comptrol bearing blocks must be machined per the dimensions specified on Page 13.