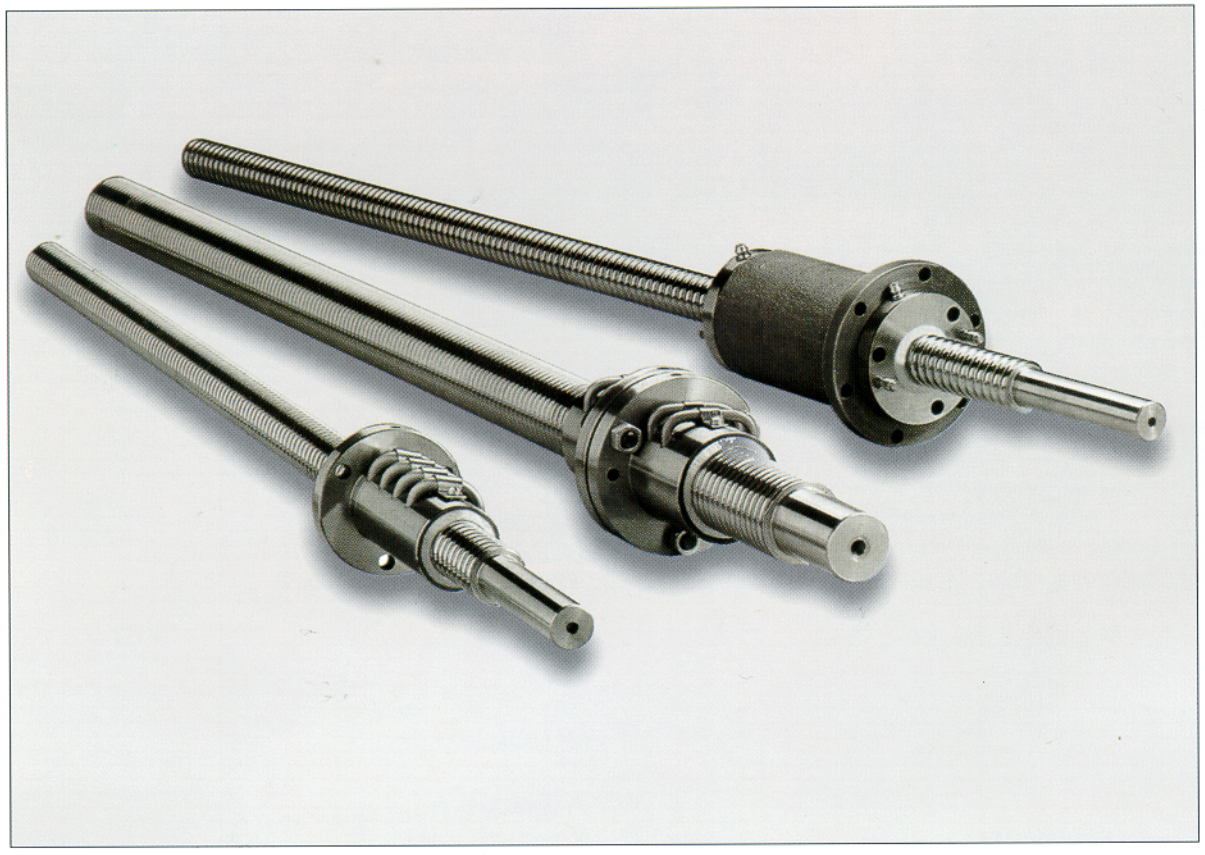
Sales, Service, and Repair

Precision Ground and Rolled Ball Screws

Inch and metric sizes for a wide variety of precision machine control applications.



RBC® BEARINGS

Linear Precision Products

www.rbcbearings.com
800.627.3639

ROLLER BEARING COMPANY OF AMERICA

Innovation, commitment and quality have been traditions at RBC since 1919. RBC's product focus demands continuous research, testing and development of the best product for specific applications.

What We Manufacture

RBC and its divisions are manufacturers of bearings and precision products for applications in construction, mining and material handling equipment; mobile hydraulics systems; farm machinery; transportation equipment; automation and robotics; machine tool and semi-conductor industries; and a wide range of other industrial machinery. RBC is also a major manufacturer of bearings and precision products for critical and demanding aircraft and aerospace applications. RBC's high quality bearings include:

- **Spherical Plain Bearings** - Radial, angular contact, high misalignment, extended inner ring, QUADLUBE™ long life bearings, ArmaBearings™ , self-lubricating bearings, inch and metric.
- **Cam Followers and Yoke Rollers** - Standard stud, heavy stud, yoke type, caged roller followers, RBC Roller™ long life cam followers, Hexlube™ universal cam followers, airframe track rollers.
- **Heavy Duty Needle Roller Bearings** - Pitchlign® caged heavy duty needle roller bearings, inner rings, type TJ Tandem Roller bearings for long life.
- **Rod Ends** - Commercial and industrial, precision, Mil-Spec series, aircraft, self-lubricating, inch and metric.
- **Self-Lubricating Bearings** - Radial, thrust, rod ends, spherical plain bearings, high temperature, high loads, inch and metric.
- **Thin Section Ball Bearings** - Standard cross sections to one inch. Sizes to 40 inches. Stainless steel and other materials available. Seals are available on all sizes and standard cross sections.
- **Airframe Control Bearings** - Ball bearing types, self-lubricating types, needle roller track rollers.
- **Mast Guide and Sheave Bearings** - Mast guide rollers and carriage rollers, chain sheaves (for leaf chain), toothless sprockets (for roller chain), heavy duty roller bearing construction.
- **Ground; Semiground and Unground Ball Bearings** - Full complement, utilizes design with burnished races for higher loads, long life and smooth operation.
- **Custom Designed Bearings** - RBC produces a wide range of custom bearings for specific customer applications.
- **Pins and Shafts** - RBC manufactures all types of pins, needles, shafts and rollers.
- **Tapered Roller Bearings** - Case hardened in a variety of sizes, used in Class A heavy truck and trailer wheel bearings, final drive transmissions and gear boxes.

RBC Precision Ball Screws

RBC Precision Ball Screws offer high reliability and durability under many different operating conditions. High accuracy and smooth operation is the result of precision processing, assembly, and inspection in a controlled environment. High stiffness with little axial play is achieved in preloaded RBC Precision Ball Screws.

RBC Precision Ball Screws are available in a wide range of materials with numerous options to maximize their performance in your application. Choose from either precision or ground ball screws, in either inch or metric sizes. Depending on the application, RBC will supply a ball screw with either internal or external ball returns. Special materials, flanges and wipers are all available. RBC keeps many standard series in stock for quick delivery. RBC Precision Ball Screws are produced with short lead times to minimize downtime.

Repair Service

RBC uses it's expertise and manufacturing capabilities to evaluate and repair precision ball screws from almost all manufacturers. Call RBC for details regarding the QuickTurn® program.

How We Can Serve You

To allow our customers to meet the ever increasing challenges from industry, RBC uses a total quality control system that employs statistical quality control at all facilities. This enables RBC to provide traceability, serialization, and certification.

RBC is sufficiently compact enough to provide innovative custom designs, yet large enough to manufacture in high volume to a just-in-time program.

RBC has district sales representatives throughout the USA and authorized agents worldwide. RBC products are stocked and sold by over 300 authorized distributors in the USA. For assistance with your bearing application, contact RBC at:

Roller Bearing Company of America
400 Sullivan Way • West Trenton, New Jersey 08628
Phone: (609) 882-5050 • Fax: (609) 882-5533

For Linear Products, contact:

RBC Linear Precision
1298 Thunderbolt Drive • Walterboro, South Carolina 29488
Phone: (843) 538-5040 • Fax: (843) 538-6020

An RBC engineer and/or sales representative will be available for consultation. RBC's commitment, innovation, and quality will provide the most cost effective solutions to your bearing requirements.

Warranty

RBC products are warranted for material and workmanship for a period not to exceed 90 days from shipment and for a value not to exceed purchase price. No other warranty is in effect.

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1. RBC Ball Screws

1.1 Classification of Ball Screws

1.2 Standard Precision Ball Screw Availability Tables

Inch Series

OD (in)	LEAD (in)												
	0.050	0.100	0.125	0.200	0.250	0.333	0.375	0.400	0.500	0.660	0.750	1.000	2.000
0.250	X	X											
0.375		X											
0.500	X	X		X					X				
0.625				X					X				
0.750		X		X	X				X			X	
0.875													
1.000				X	X							X	X
1.250				X	X								
1.500				X	X				X			X	X
1.750													
2.000				X	X				X			X	X
2.250									X			X	
2.500					X				X				
3.000									X	X		X	
3.500													
4.000													

Metric

OD (mm)	LEAD (mm)											
	0.5	1	1.5	2	2.5	3	4	5	6	8	10	12
16								X				
20								X				
25								X				
28												
32								X				
36												
40								X			X	
45												
50								X			X	
55												
63											X	
80											X	

1.3 Standard Rolled Ball Screw Availability Tables

Inch Series

OD (in)	LEAD (in)										
	0.050	0.0625	0.100	0.125	0.200	0.250	0.500	0.660	0.473	1.000	2.000
0.187	X	X									
0.312	X		X								
0.375				X							
0.500					X		X				
0.625					X						
0.750					X		X				
1.000					X	X	X			X	
1.500						X	X		X	X	X
2.000							X			X	
2.250							X				
2.500							X				
3.000								X			

Metric Series

OD (mm)	LEAD (mm)		
	5	10	25
16	X		
25	X	X	X
40	X	X	
50		X	
63		X	

RBC custom ground precision ball screws are available in many of the OD/Lead combinations not included in the standard series shown. Please contact RBC for additional assistance.

2. Features of RBC Ball Screws

2.1 Reliability

RBC's commitment to total Quality Management is reflected in the exacting requirements at each manufacturing process of the ball screw. RBC's quality system is built on the principles of traceability, continuous improvement in quality, and employee involvement in quality improvement. This helps assure trouble free operation for the life of the ball screw.

2.2 High Accuracy

All RBC ball screw components undergo precision processing, assembly and inspection in a controlled environment, ensuring high precision and quality. Use of the latest CNC equipment is an important part of maintaining high accuracy.

2.3 Smooth Operation

The high mechanical efficiency of RBC ball screws results from the rolling contact of precision ball bearings and precisely ground ball threads. As compared to the relatively inefficient sliding friction of the conventional acme screw, ball screw power requirements are minimized. Thus, smaller and lighter power transmission components may be utilized. RBC's Dynamic Torque Test & Measurement System is critical to assuring the smoothness of torque necessary for demanding applications.

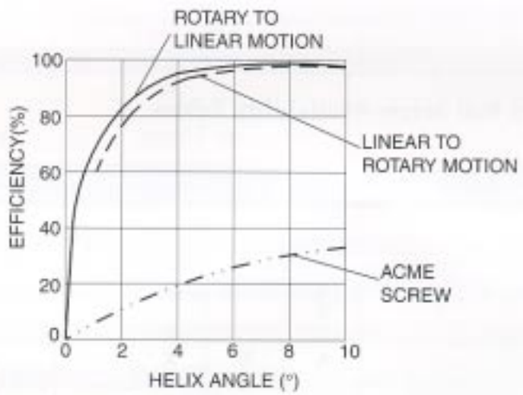
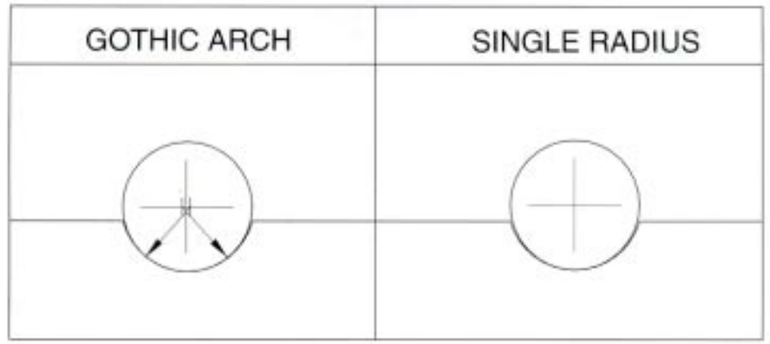


Fig. 2.1 Mechanical Efficiency of RBC Precision Ball Screw

2.4 High Stiffness

When axial play is minimized on conventional acme lead screws, the drive torque becomes excessive and the operation is not smooth. The axial play in RBC precision ball screws may be reduced to zero by preloading and a smooth operation is still possible. Therefore, both low torque and high stiffness can be obtained simultaneously. RBC currently manufactures both the single radius and the gothic arch thread profiles.



2.5 High Durability

The use of controlled steel sources and low stress heat treatment procedures result in superior durability of RBC Ball Screws.

2.6 Lead Time

RBC has readily available the standard stock series items in this catalog. Standard stock items can be modified to meet our customers' end journal configurations and length requirements within days. Custom ball screws require our industry leading 6 week lead time.

3. RBC Ball Screw Selection Procedure

Correct selection of the ball screw for the application is critical to ensure proper operation and life of the ball screw. The process of selection is shown in the flow chart.

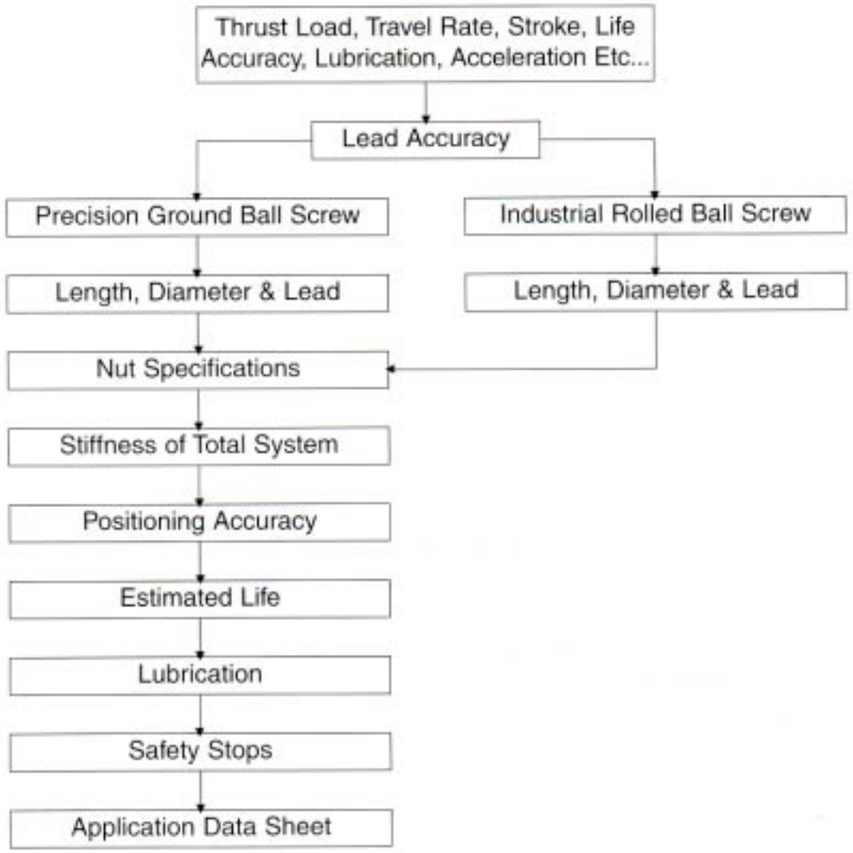


Fig. 3.1 Procedure for Selecting Ball Screws (Flow Chart)

4. Accuracy of RBC Ball Screws

4.1 Lead Accuracy

Lead accuracy of RBC ball screws is specified in three basic terms (C, v_{300}, and $v_{2\pi}$). These are defined in Table 4.1. The Tolerance for the Specified Travel (e_p) and Travel Variations (v_{300} and $v_{2\pi}$) are shown in Tables 4.2 and 4.3. The Travel Compensation (C) is to be specified by the customer for the specific application. RBC manufactures to ISO Standards, however, RBC can manufacture to a JIS Standard equivalency.

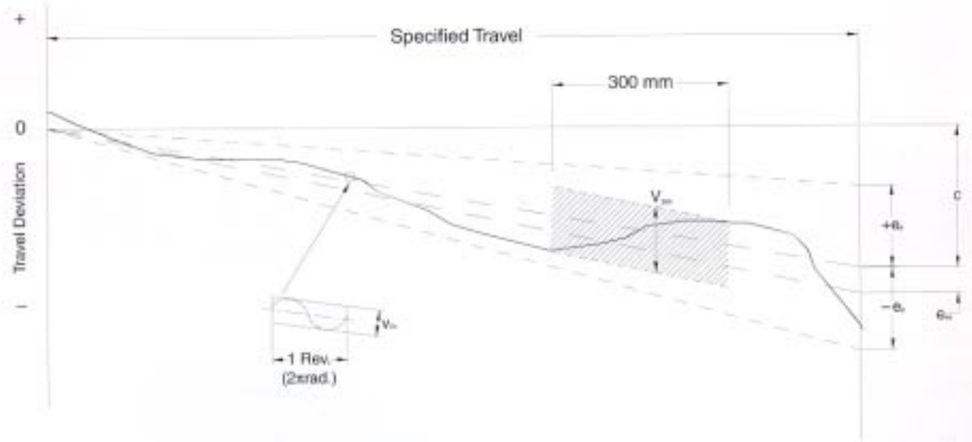


Fig. 4.1 Diagram of Lead Accuracy

Table 4.1 Definition of Terms for Lead Accuracy

Term	Symbol	Definition
Travel Compensation	C	The difference between the specified travel & the nominal travel within the useful travel
Actual Mean Travel Deviation	e_{sa}	The difference between the actual mean travel and the specified travel within the useful travel
Tolerance on Specified Travel	e_p	Half the difference between the maximum and minimum values of the permissible actual mean travel
Travel Variations	v_{300}	Band Width parallel to the actual mean travel over any 300mm of travel
Wobble Error	$v_{2\pi}$	Band Width parallel to the actual mean travel over any 2π rad of travel (1 revolution)

Table 4.2 Tolerance on Specified Travel (e_p)

Tolerance on Specified Travel (e_p)						Units: µm (unless specified)
Travel Length (mm)		Class 1	Class 3	Class 5	Class 7	Class 10
Above	Up to & Including					
–	315	6	12	23	–	–
315	400	7	13	25	–	–
400	500	8	15	27	–	–
500	630	9	16	32	–	–
630	800	10	18	36	–	–
800	1000	11	21	40	–	–
1000	1250	13	24	47	–	–
1250	1600	15	29	55	–	–
1600	2000	18	35	65	–	–
2000	2500	22	41	78	–	–
2500	3150	26	50	96	–	–
3150	4000	32	62	115	–	–
4000	5000	–	76	140	–	–
5000	6300	–	–	170	–	–

Table 4.3 Variation per 300mm (v_{300}) and Wobble Error ($v_{2\pi}$)

Variation Per 300mm and Wobble Error					Units: µm (unless specified)
Accuracy Grade	Class 1	Class 3	Class 5	Class 7	Class 10
v_{300}	6	12	23	52	210
$v_{2\pi}$	4	6	8	–	–

Table 4.4 JIS Standards for Actual Mean Travel Deviation (e_{sa})

Actual Mean Travel Deviation (e_{sa})					Units: µm (unless specified)
Accuracy Grade		C0	C1	C3	C5
Travel length (mm)					
Above	Up to & Including				
–	315	4	6	12	23
315	400	5	7	13	25
400	500	6	8	15	27
500	630	6	9	16	30
630	800	7	10	18	35
800	1000	8	11	21	40
1000	1250	9	13	24	46
1250	1600	11	15	29	54
1600	2000	–	18	35	65
2000	2500	–	22	41	77
2500	3150	–	26	50	93
3150	4000	–	32	62	115
4000	5000	–	–	76	140
5000	6300	–	–	–	170
6300	8000	–	–	–	213
8000	10000	–	–	–	265

Table 4.5 JIS Standards for Variation per 300mm (v_{300}) and Wobble Error ($v_{2\pi}$)

Variation Per 300mm and Wobble Error				Units: µm (unless specified)
Accuracy Grade	C0	C1	C3	C5
v_{300}	3.5	5	8	18
$v_{2\pi}$	3	4	6	8

4.2 Mounting Accuracy & Tolerances

To use a ball screw correctly and achieve long life with trouble free operation, correct specification of geometrical tolerances is very important. RBC's measurement processes conform to both ISO & JIS standards for ball screw measurement. RBC will help you determine the tolerance levels as they vary with accuracy level.

(1) Bearing Runout with respect to the ball groove.
(2) Journal Runout with respect to the ball groove.
(3) Shoulder Perpendicularity with respect to the bearing diameter.
(4) Nut Flange Perpendicularity with respect to the ball groove.
(5) Nut Body Concentricity with respect to the ball groove.
(6) Nut Flat Parallelism with respect to the ball groove.
(7) Total Indicated Runout of the threaded portion of the shaft with respect to the shaft center line.

All RBC ball screws are manufactured, inspected and guaranteed to be within specifications.

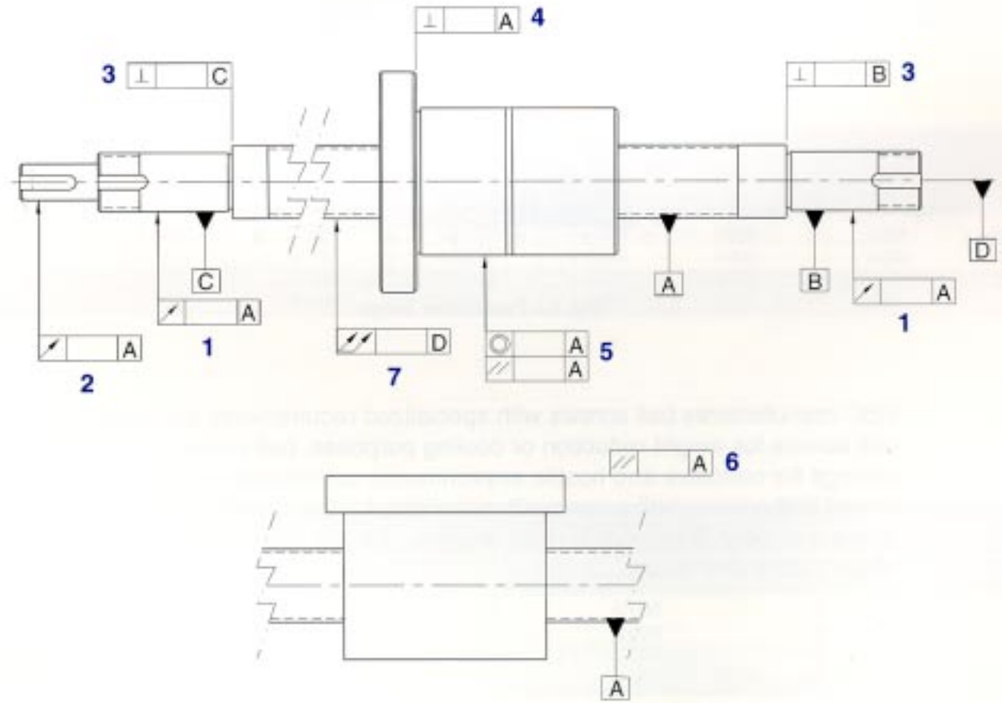


Fig. 4.2 Mounting Accuracy and Tolerances

5. Screw Shaft Design

5.1 Ball Screw Manufacturing Capability

RBC's production capabilities are shown below. RBC has manufactured ball screws up to 6" in diameter and up to 36 ft in length. Contact RBC if your required screw shaft dimensions exceed this scope.

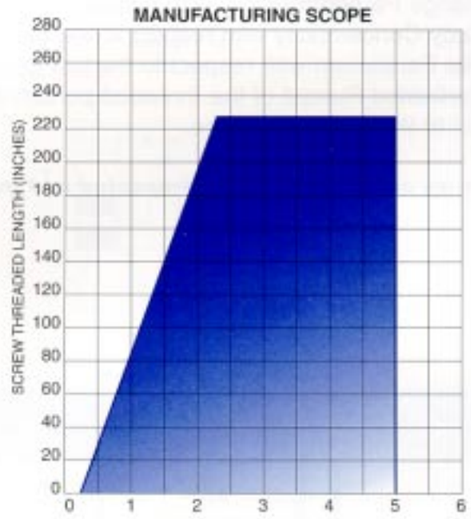


Fig. 5.1 Production Scope

RBC manufactures ball screws with specialized requirements including hollow ball screws for weight reduction or cooling purposes, ball screws with specialty platings for corrosive and hostile environments, combined right and left hand thread ball screws, ball screws with specialized drive methods such as splined journals or gear driven rotating nut designs. RBC is committed to satisfying all of our customers' needs.

5.2 Mounting Methods

The critical speed and column-buckling load depend on the method of mounting and the unsupported length of the shaft. Typical mounting methods for ball screws are shown in the figure below. Use the figures below to determine the correct mounting distance for calculating critical speed and buckling load.

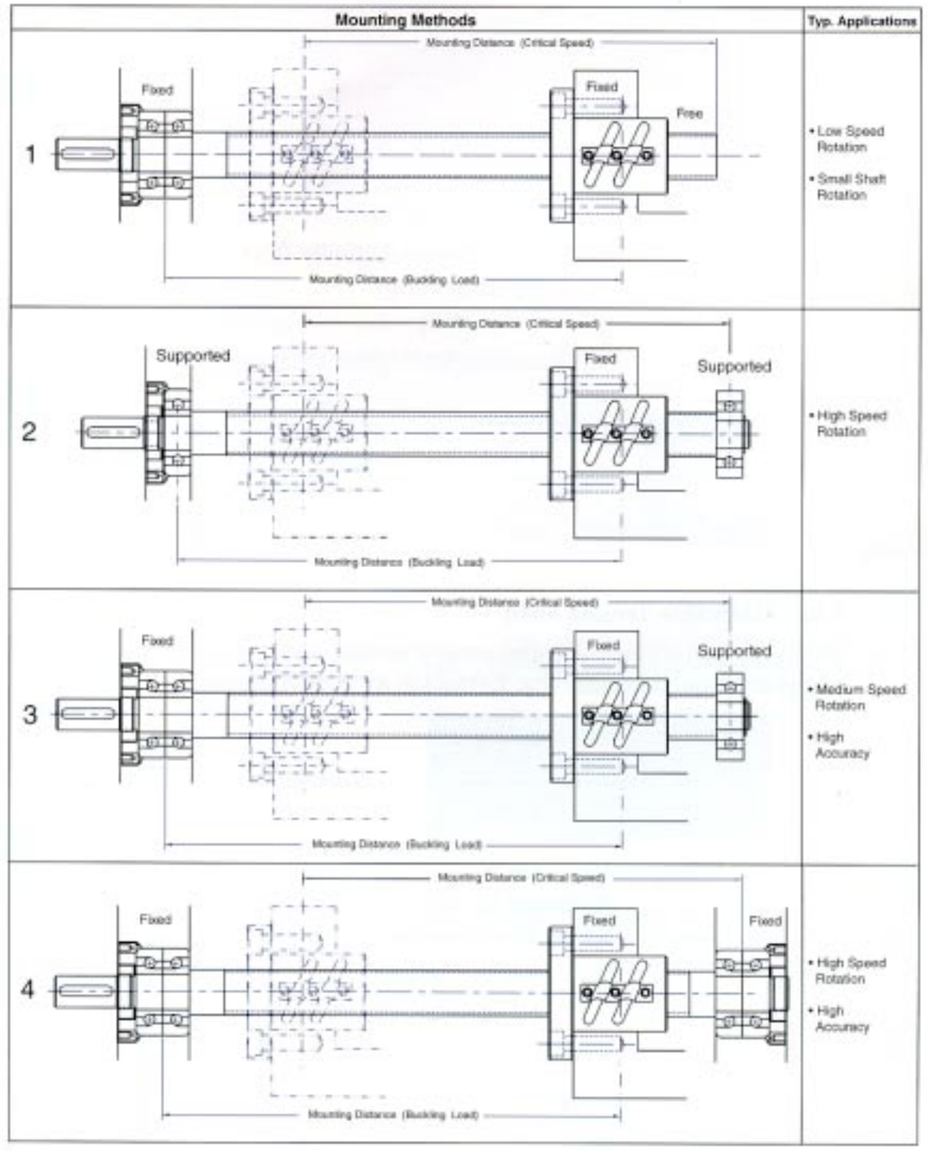


Fig. 5.1 Common End Journal Mounting for Ball Screws

5.3 Allowable Axial Load

5.3.1 Compressive Load

The safety of the screw shaft against buckling needs to be checked when the screw shaft will experience a compressive load. Fig. 5.4 shows a diagram, which summarizes the allowable compressive load for buckling for each nominal outside diameter of screw shaft. The formula for calculating the buckling load is as follows:

$$P_{CR} = \frac{F_s \times C_f \times 14.05 \times 10^5 \times D_r^4}{L_m^2}$$

Where;

P_{CR} = critical column load (lbs)
D_r = screw shaft groove diameter (in)
L_m = mounting length (in)
F_s = safety factor (0.5)
C_f = end mounting factor (see table below)

C_f	End Mounting
0.25	one end **Fixed**, one end **Free**
1.00	both ends **Supported**
2.00	one end **Fixed**, one end **Supported**
4.00	both ends **Fixed**

5.3.2 Allowable Tensile Load

When the ball screw will experience a tensile load, the maximum load of the ball screw must be checked. The formula is as shown below.

$$P = q \times \frac{(\pi \times d_r^2)}{4}$$

Where;

P = Allowable Tensile Load (lbs)
q = Allowable Tensile Stress (55,000 lb/in²)
d_r = Screw Shaft Groove Diameter (in)

How to use the graph:

a) Determine the maximum compression load
b) Determine the unsupported length
c) Determine your end support bearing arrangement
d) At the intersection point, move to the right until you touch a diagonal line, this line is your ball screw outside diameter.

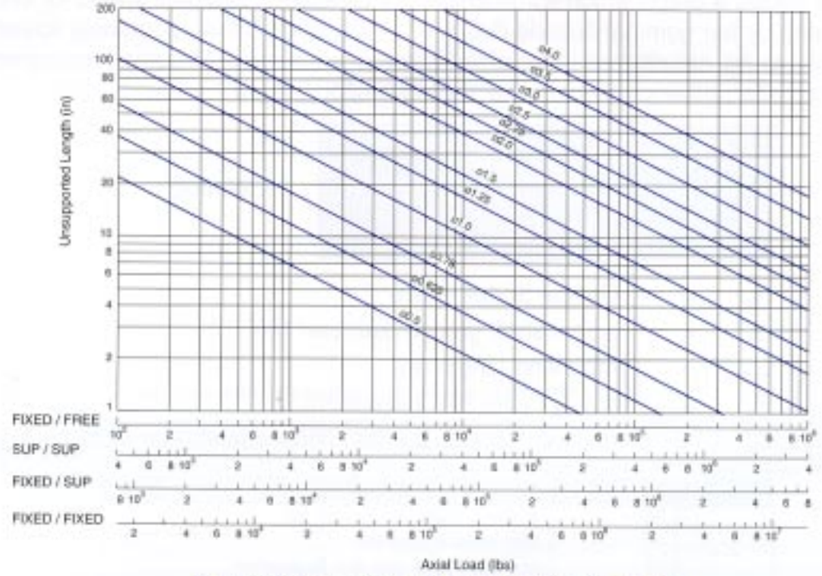


Fig. 5.4 Compression vs. Unsupported Length (in)

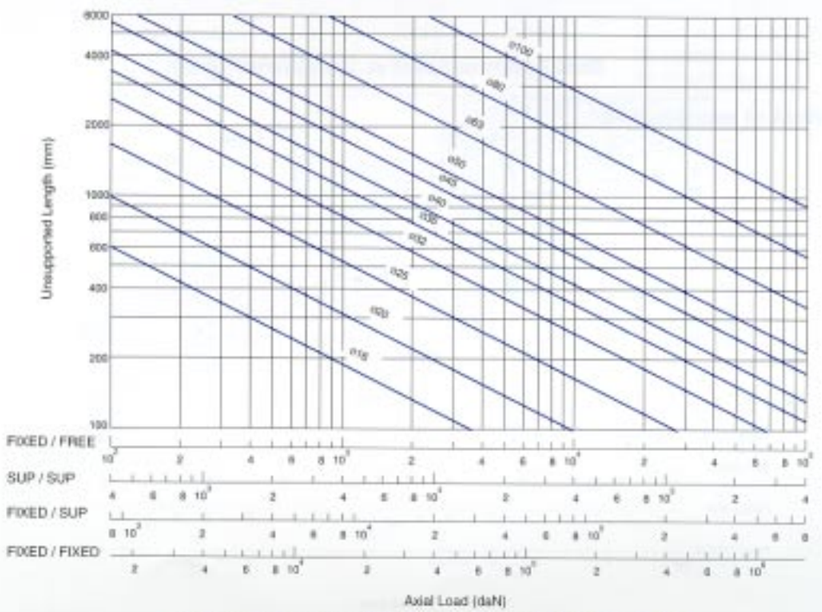


Fig. 5.4 Compression vs. Unsupported Length (mm)

5.4 Allowable Rotational Speed

5.4.1 Critical Speed

It is extremely important to ensure that the ball screw rotational speed is not resonant with the natural frequency of the screw shaft. RBC uses a safety factor of 80% or less of this critical speed as an allowable rotational speed. Fig. 5.5 shows a graph which summarizes the allowable rotational speed for critical speed by the nominal outside diameter of the shaft. If the operational speed is close to the natural frequency of the screw, then different mounting arrangements or an alternative screw diameter should be considered.

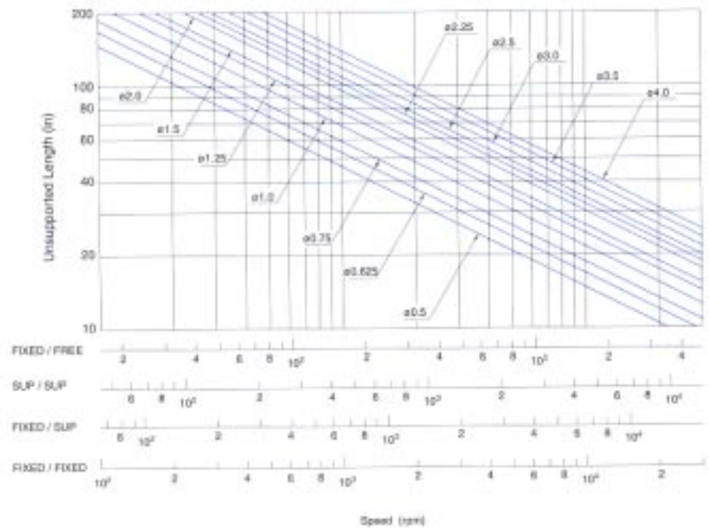
$$N_c = \frac{F_s \times C_s \times 4.76 \times 10^6 \times D_r}{L_m^2}$$

Where;

N_c = Critical Speed (rpm)
D_r = screw shaft groove diameter (in)
L_m = mounting length (in)
F_s = safety factor (0.8 maximum)
C_s = end mounting factor for critical speed (see table below)

C_s	End Mounting
0.36	one end **Fixed**, one end **Free**
1.00	both ends **Supported**
1.47	one end **Fixed**, one end **Supported**
2.23	both ends **Fixed**

Shaft Rotational Speed vs. Unsupported Length



Shaft Rotational Speed vs. Unsupported Length

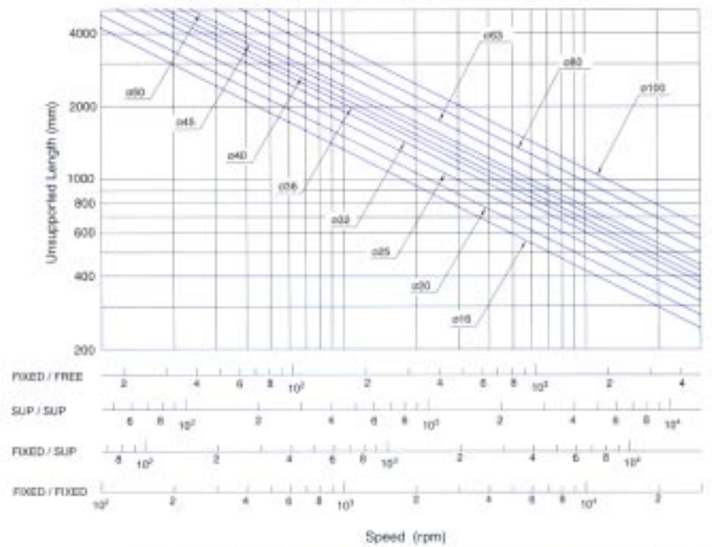


Fig. 5.5 Critical Speed Limit for Selected Shaft Root Dia.

5.4.2 $d_m \bullet n$ Value

The allowable rotation speed is also restricted by the ability of the ball re-circulation system to withstand higher speeds. The term for this measure is the $d_m \bullet n$ value (d_m: ball circle diameter, n: rotation speed, min^{-1}). Many ball screw manufacturers sell product with a non-heat treated ball re-circulation system which limits the $d_m \bullet n$ value to about 2,756 in/min (70,000 mm/min). RBC's standard ball re-circulation systems are heat treated and are rated per the table below.

Return System Type	Max $d_m \bullet n$ (in / min)	Max $d_m \bullet n$ (mm / min)
Heat Treated Tube	3,937	100,000
Deflector	4,724	120,000
Yoke Deflector/ Tube Combination	4,724	120,000

For speeds beyond these values, consult RBC

5.5 Precautions for Screw Design

5.5.1 Thread Runoff & Adjacent Diameter

The following considerations should be given to ensure an economical design for your ball screw application. The ball thread runoff must extend off one end of the screw shaft for the following ball nut models. This is to facilitate the loading of the ball nut package.

a) Internal deflector type
b) Yoke deflector type
c) Flange/Base mount housing type

5.5.2 Hardness/Transition Zone

RBC's ball screw shaft is induction hardened. Thus, an incompletely hardened zone may be present at each end of the screw thread area, depending on the design. Please consider this when designing the effective stroke. Consult RBC for details.

6. Nut Design

6.1 Nut Selection

6.1.1 Series

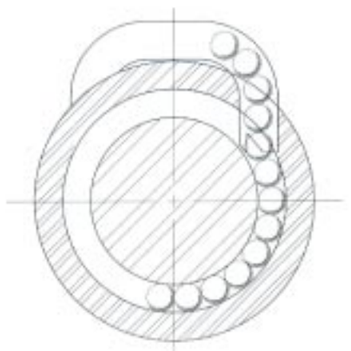
The required accuracy, delivery, size and ball nut style must be considered when selecting the proper series for your application.

6.1.2 Ball Re-Circulation Type

Select the ball re-circulation type according to the ball nut mounting, and application.

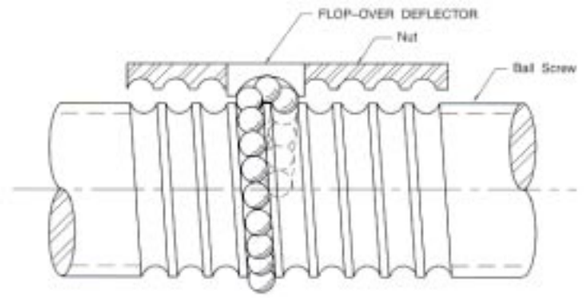
Standard external return tube type

- Suitable for large lead / screw shaft diameter ratio



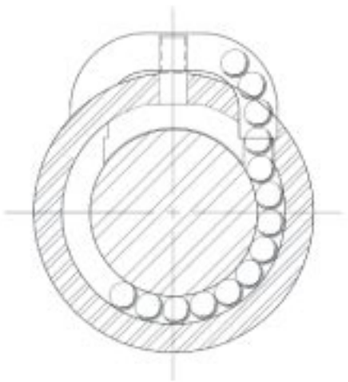
Ball deflector type

- Compact ball nut outside diameter
- Suitable for small lead/shaft outside diameter ratio



External yoke style deflector

- Standard offering for GN3066 model
- Suitable for high travel rates and large dynamic capacities.



6.1.3 Design of Nuts

Tight clearance between the ball nut and mounting housing should be avoided. Impact to the ball nut can cause breakage or denting of the ball return system. Decide the ball nut type, ball return method and flange mounting from the allowable space for mounting, number of circuits, stiffness and required life.

a) Use of Wiper
   Please indicate whether or not wipers are required. Wipers are supplied standard on most models. Wipers can affect the nut length.
b) Number of Circuits
   This is based on required load/life performance, mounting envelope and economic efficiency.
c) Lubrication Hole
   Standard nuts are provided with lubrication holes and/or lube fittings. Some exceptions are found within the GV series.
d) Removal of the nut package
   Removal of the ball nut for assembly purposes should be avoided.

6.2 Precautions for Nut Design

6.2.1 Moment & Radial Loads

Optimal performance of the ball screw is realized when the load distribution on steel balls rolling between the screw shaft and nut is as even as possible. Moment load on the nut will cause concentrated loading on a small portion of the steel balls, thereby affecting operational properties and shortening the service life. It is essential to avoid a radial load as much as possible. Consult RBC for design options to enhance life on moment or radial loaded applications.

6.2.2 Rotating Nut Designs

Proper consideration of the bearing support for rotating nut designs is important. Consult RBC for this configuration.

7. Specification of Accuracy Requirements

7.1 System Stiffness

Poor system stiffness of ball screws results in loss of positioning accuracy. Proper consideration of system stiffness is essential to achieve the desired positioning accuracy.

7.1.1 Axial Stiffness of the Ball Screw System

Axial elastic displacement and stiffness of the ball screw system is calculated as follows:

$$q = \frac{F_a}{K_t}$$

$$\frac{1}{K_t} = \frac{1}{K_s} + \frac{1}{K_n} + \frac{1}{K_b}$$

q	=	Axial displacement of ball screw system (in)
F_a	=	Axial load on feed system (lbs)
K_t	=	Axial stiffness of ball screw system (lb/in)
K_s	=	Axial stiffness of screw shaft (lb/in)
K_n	=	Axial stiffness of ball nut (lb/in)
K_b	=	Axial stiffness of support bearing (lb/in)

7.1.2 Axial Stiffness of Screw Shaft; K_s

a) Fixed – Free

$$K_s = \frac{A \times E}{a}$$

Where;

K_s	=	Axial stiffness of the screw shaft (lb/in)
A	=	Cross-Sectional area of the screw shaft (in^2)
E	=	Modulus of elasticity (29×10^6 lb/in^2)
a	=	Distance between the support & center of the nut (in)

b) Fixed – Fixed

$$K_s = \frac{A \times E \times L}{a \times b}$$

Where;

K_s	=	Axial stiffness of the screw shaft (lb/in)
A	=	Cross-Sectional area of the screw shaft (in^2)
E	=	Modulus of elasticity (29×10^6 lb/in^2)
L	=	Unsupported Length (in)
a	=	Distance between the left support & center of the nut (in)
b	=	Distance between the right support & center of the nut (in)

7.1.3 Stiffness of Nut; K_n

$$K_n = \frac{A_n \times E}{L_n}$$

Where;

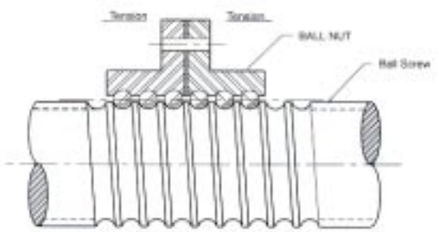
K_n	=	Axial stiffness of the nut (lb/in)
A_n	=	Cross-Sectional area of the nut (in^2)
E	=	Modulus of elasticity (29×10^6 lb/in^2)
L_n	=	Length of the nut (in)

7.1.4 Preloading of Ball Screws

Preload eliminates axial backlash and reduces displacement due to axial loads, thus improving the rigidity of the ball screw. RBC offers the following preload techniques:

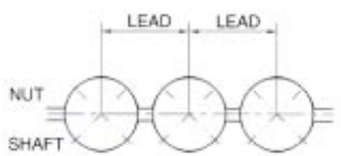
a) Double Nut Preloading
Preloading is achieved by inserting a spacer (shim) between two nuts. This is generally referred to as "tension preload." Compression preloading is possible with doublenuts.

DOUBLE NUT PRELOAD

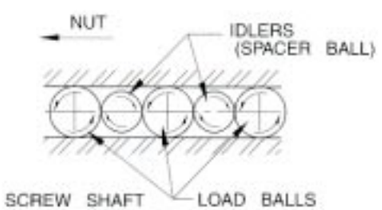


With the Double nut preload system, the nuts are loaded against each other to provide a tension preload. This is achieved by placing a spacer (shim) between the nuts.

b) Single Nut Preloading (Oversized Balls)
A single nut can be preloaded in two ways. One method is to insert steel balls slightly larger than the ball groove space (oversized balls) which is referred to as "four point contact." This is suitable for light preloading. The use of spacer balls (1:1 ratio) is standard to improve operability.



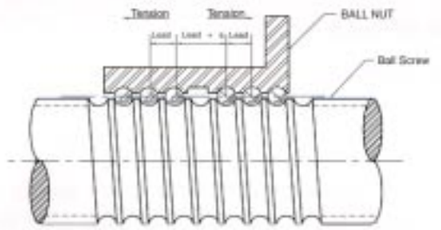
FOUR–POINT CONTACT



EFFECT OF SPACER BALLS

c) Single Nut Preloading (Integral Offset)
Another method of preloading a single nut is to grind a shift into the nut, which has the same effect of inserting a spacer on a double nut. This method is suitable for medium to heavy preloading.

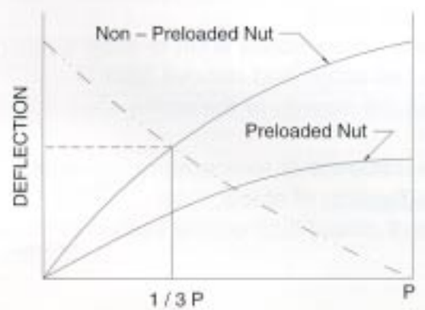
INTEGRAL PRELOAD



With the integral preload system, one circuit of balls is loaded against the other circuit of balls to provide a tension preload. This is achieved by placing a slight shift in the lead between the two circuits.

7.1.5 Effects of Preload

Applying a load to the ball screw causes a deflection of both the ball nut and screw shaft grooves and of the ball bearing at the contact areas. The initial deflection as the load is applied is the greatest. After this initial deflection, change in deflection for increased load is much less, and tripling the load only doubles the deflection. The recommended preload is 1/3 of the mean applied load. Without having good data on the application, a maximum preload of 10% of the dynamic rating @ 10^6 revolutions should be used. This would be considered "heavy preload" and 5% would be considered a "light preload." It is good to keep in mind that over preloading causes a shortening of the life as well as excess heat generation. Note that the least stiff member in the system is the dictator of the overall system spring rate, and preloading the nut to a greater stiffness than the bearings in order to improve the overall system spring rate cannot compensate for an un-stiff bearing arrangement.



7.2 Positioning Accuracy

7.2.1 Factors for Influencing Positioning Accuracy

Positioning accuracy error factors include lead accuracy and system stiffness. Thermal displacement due to heat generation and positional error of the guide system also play an important role.

7.2.2 Specification of Lead Accuracy

a) Accuracy grade
Select the accuracy grade based on the required positioning accuracy.

b) Pre-Tensioning of the Ball Screw Lead
The basic lead of a ball screw is the same as the nominal lead. The basic lead may be set to either the minus or plus side in order to compensate for elongation due to temperature increases or elongation of the screw shaft under an external load.

7.2.3 Countermeasure Against Thermal Displacement

Thermal displacement of the screw shaft results in deterioration of positioning accuracy. The magnitude of the thermal displacement is calculated as follows:

$$\Delta D = \varepsilon \times \theta \times L$$

Where;

ΔD = Thermal displacement (in)
ε = Coefficient of thermal expansion (6.33×10^{-6} / °F)
θ = Temperature rise (°F) of screw shaft
L = Screw shaft length (in)

Thermal displacement can be controlled as follows:

a) Reduce heat generation
- Optimization of preload of ball screw and support bearing
- Correct selection and supply of lubricant
- Increase the ball screw lead, thus reducing rotational speed

b) Cool the ball screw
- Use a hollow screw shaft to allow cooling fluid to flow through the ball screw and remove heat.
- Cool the outside of the screw shaft with cooling oil or air

c) Avoid the influence of temperature increase
- Pre-Tension of screw shaft
- Use of closed loop control system to compensate for thermal errors

8. Service Life

The service life of ball screws, should be considered in terms of both wear life and fatigue life. Accuracy deterioration due to wear is largely influenced by operating conditions, lubrication effectiveness, etc.

8.1 Wear Life

Normal maintenance, lubrication, and the use of contamination prevention devices such as bellows or telescopic covers will keep wear to a minimum. The amount of wear is proportional to the number of cycles under load that the system experiences. Severe operating conditions such as high speed oscillation (less than one turn) or hostile dirty environments will shorten the wear life.

8.2 Fatigue Life

The fatigue life of the ball screw may be estimated from the basic dynamic rated load as is the case of rolling bearings.

8.2.1 Basic Dynamic Rated Load; C_a

The basic dynamic rated load is an axial load which allows 90% of a group of identical ball screws (rotated under the same conditions) to rotate without flaking for 1 million revolutions. This basic dynamic rated load is shown in the table of dimensions for each series.

8.2.2 Fatigue Life

a) Calculation of fatigue life
The fatigue life is generally expressed by the total number of revolutions. The total rotation hours or total travel distance may also be used to express life. The fatigue life is calculated as follows:

$$L = [C_a / (F_a \times f_w)]^3 \times 10^6$$

Where;

L = Rated Fatigue Life (revolutions)
C_a = Basic Dynamic Rating (lbs)
F_a = Axial Load (lbs)
f_w = Load Factor [Use 1.0–1.2 for smooth impact free rotation, 1.2–1.5 for average conditions, & 1.5 for rotation with impact]

Selection of an excessively long fatigue life for the application is not economical and results in a large size ball screw. Typical targets for fatigue life are:

Machine tool	20,000 hours
Industrial machinery	10,000 hours
Automatic control systems	15,000 hours
Measurement system	15,000 hours

b) Mean load
Where the axial load varies, use a mean load calculation.

1) Varying Loads (non-linear)

$$F_m = \frac{[\,(\%_1(P_1)^3) + (\%_2(P_2)^3) + \ldots\ldots + (\%_n(P_n)^3)\,]^{1/3}}{100\%}$$

Where;

F_m = Equivalent Mean Load (lbs)
$P_{1,2,\ldots,n}$ = Varying Axial Thrust Load (lbs)
$\%_{1,2,\ldots,n}$ = Percentage of Stroke or Cycle at the load $P_{1,2,\ldots,n}$ Respectively

2) Varying Loads (approximately linear)

$$F_m = 1/3 \times [F_{min} + (2 \times F_{max})]$$

Where;

F_m = Equivalent Mean Load (lbs)
F_{min} = Minimum Load of Cycle (lbs)
F_{max} = Maximum Load of Cycle (lbs)

8.2.3 Influence of Mounting Error

Moment loads or radial load on the ball screw reduces both operability and fatigue life. Careful installation of the ball screw is critical.

8.3 Allowable Load on Grooves

When the ball screw is to be used infrequently or at a low rotational speed, then the maximum axial load must be less than the basic static load capacity.

8.3.1 Basic Static Rated Load: Coa

The basic static rated load is an axial static load which will produce a permanent combined deformation at contact points of the balls to ball grooves equal to 0.01% of the ball diameter.

8.3.2 Calculation of Allowable Load

The allowable load is calculated as follows:

$$F_{max} = C_{oa} / f_s$$

Where;

F_{max} = Maximum Allowable Load (lbs)
C_{oa} = Basic Static Capacity (lbs)
f_s = Allowable load factor (1 ~ 2 normal operation, 2 ~ 3 impact loads)

8.3.3 Standard Material & Hardness

	Rockwell Hardness
Screw shaft (4150 VDS)	58 – 62
Ball nut (4150 VDS)	58 – 62
Ball bearing (52100)	62 – 64

*Special ball screws (440C SS,17-4 PH SS) for special environments are available. Also, consult RBC for surface treatments if necessary.

RBC's screwshaft is heat treated using a single bar quench process to ensure low residual stresses in the bar.

8.3.4 Hardness Coefficient

When materials other than RBC standard materials are used, and the surface hardness is less than HRC58, the basic dynamic rated load (C_a) and basic static rated load (C_{oa}) need to be corrected. Consult RBC for the correction factors.

9. Driving Torque

9.1 Ball Screw Torque

9.1.1 Normal Operation

The torque when converting rotary motion into linear motion is calculated as follows:

$$T_a = \frac{F_a \times L}{2 \times \pi \times e_1}$$

Where;

T_a = Normal Operating Torque (in*lbs)
F_a = Axial Load (lbs)
L = Lead (in)
e_1 = Normal Efficiency (0.90 ~ 0.95)

9.1.2 Reverse Operation

The torque from converting linear motion into rotary motion is calculated as follows:

$$T_b = 0.143 \times F_a \times L$$

Where;

T_b = Reverse/Backdriving Torque (in*lbs)
F_a = Axial Load (lbs)
L = Lead (in)

9.1.3 When a Preload is Applied

Dynamic torque produced by a preload can be calculated as follows:

$$T_d = \frac{P_{PL} \times L \times k}{2 \times \pi}$$ Where;

T_d = Preload Frictional Torque (in*lbs)
P_{PL} = Preload (lbs)
L = Lead (in)
k = Preload Torque Coefficient (normally 0.2)

9.2 Motor Driving Torque

The torque required to drive a mechanical system against an external load is calculated as follows:

9.2.1 Driving Torque at a Constant Speed

$$T_1 = (T_d + \frac{[F + (\mu \times W)] \times L}{2 \times \pi \times e_1} + T_s)$$ Where;

T_1 = Drive Torque at Constant Speed (in*lbs)
T_d = Preload Frictional Torque (in*lbs)
F = Axial Cutting Force (lbs)
μ = Coefficient of Friction of the Slide Surface
W = Moving Weight (lbs) (Table + Workpiece)
L = Lead (in)
e_1 = Normal Efficiency (0.90 ~ 0.95)
T_s = Support Bearing Dynamic Torque (in*lbs)

9.2.2 Driving Torque During Acceleration

$$T_2 = T_1 + (J \times \omega)$$ Where;

$$J = J_m + J_s + \frac{W \times L^2}{4 \times G \times \pi^2}$$ Where;

T_2 = Maximum Driving Torque During Acceleration (in*lbs)
ω = Angular Acceleration of the Motor (rad/s²)
T_1 = Drive Torque at Constant Speed (in*lbs)

9.2.2 Driving Torque During Acceleration (Continued)

J = Total Moment of Inertia on Motor (lb*in*s²)
J_m = Moment of Inertia of the Motor (lb*in*s²)
J_s = Moment of Inertia of the Screw Shaft (lb*in*s²)
W = Moving Weight (lbs) (Table + Workpiece)
L = Lead (in)
G = Gravitational Acceleration (386.4 in/s²)

10. Lubrication and Safety Design

10.1 Lubrication

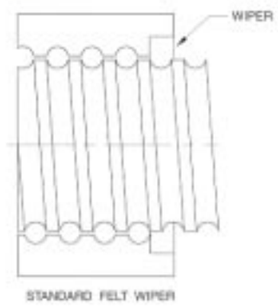
RBC's standard grease is suitable for highly loaded gears and actuator screw mechanisms. With a viscosity of 3.1 cSt @ 210˚F and an operating temperature range of -100˚F (-73˚C) to 300˚F (149˚C), RBC's standard grease (qualified under the MIL-PRF-23827C specification) can be used in most ball screw applications. RBC's standard oil is an ISO VG220 Way Oil & has an operating range of -65˚F to 250˚F. For lubrication under special service conditions, consult RBC.

10.2 Contaminant Prevention

Any foreign matter or water, if allowed to enter the ball screw, may increase friction and cause damage. For example, the entry of chips or cutting oil may be expected with machine tools depending on the work environment. Where entry of foreign matter is anticipated, use of bellows or a telescopic cover is recommended.

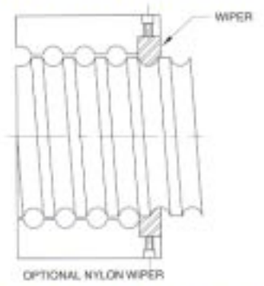
Provision of wipers at both ends of the nut package will also prove to be effective. Most models are supplied with a wiper.

10.2.1 Standard Felt Wiper (Precision Series)

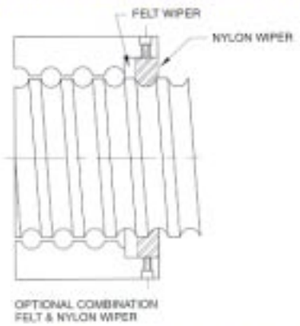


STANDARD FELT WIPER

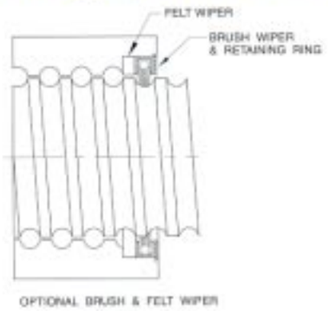
10.2.2 Optional Nylon Wiper (Precision Series)



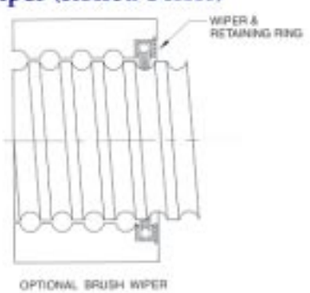
10.2.3 Optional Combination Felt & Nylon Wipers (Precision Series)



10.2.4 Optional Brush & Felt Wiper (Precision Series)



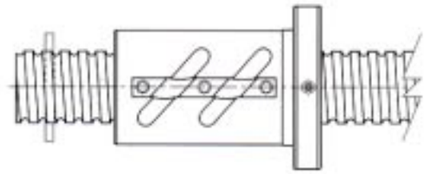
10.2.5 Optional Brush Wiper (Rolled Series)



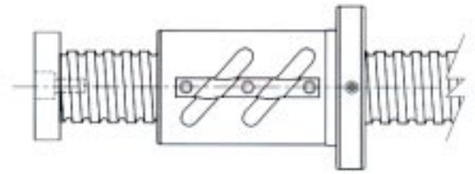
10.3 Safety Mechanism

Stops are used at the ends of the screw shaft to prevent the ball nut from running off the end of the shaft. Stops should be located so the ball nut does not come into contact with them at the end of the required stroke. RBC offers several styles of stops as shown below.

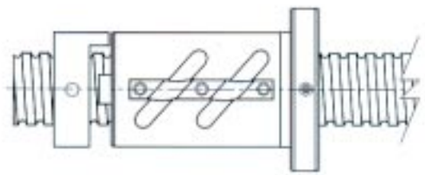
10.3.1 Spiral Pin Method



10.3.2 End Cap Method



10.3.3 Dog Stop Method



11. RBC Part Number

The part numbering system used by RBC distinguishes the product and is composed of basic specifications. This system is used for drawings, orders and identification of product.

11.1 Standard Precision Series Example:

GN1005	R	3	0350	A	C	O
1	2	3	4	5	6	7

POSITION: 1 **Indicates series type**

POSITION: 2 **Indicates thread direction(RH or LH)**

POSITION: 3 **Indicates ISO lead accuracy**

- class 1 = 0.0002"/ft
- class 3 = 0.0005"/ft
- class 5 = 0.001"/ft
- class 7 = 0.002"/ft
- class 9 = 0.006"/ft

POSITION: 4 **Indicates shaft length (inches)**

POSITION: 5 **Indicates ball nut style**

- A = std. singlenut 2-circuit non-preload w/flange
- B = std. singlenut 2-circuit preload w/flange
- C = std. singlenut 2-circuit non-preload w/v-thd
- D = std. singlenut 2-circuit preload w/v-thd
- E = std. singlenut 4-circuit preload w/flange
- F = std. singlenut 4-circuit preload w/v-thd
- G = std. doublenut 4-circuit preload, flange to flange
- H = std. doublenut preload flange mount housing
- I = std. doublenut preload base mount housing
- J = std. doublenut preload miniature housing
- K = std. singlenut non-preload miniature
- L = std. singlenut 4-circuit non-preload

POSITION: 6 **Indicates journal style adjacent to v-thd / flange**

- A = standard single bearing journal
- B = standard duplexed bearing journal
- C = standard multiple bearing journal
- D = standard pillow block journal
- N = annealed or blank end
- O = no journal

POSITION: 7 **Indicates journal style away from to v-thd / flange**

- A = standard single bearing journal
- B = standard duplexed bearing journal
- C = standard multiple bearing journal
- D = standard pillow block journal
- N = annealed or blank end
- O = no journal

11.2 Non-Standard Precision Series Example:

GN1005	-	XXXXX
1		2

POSITION: 1 **Indicates series type**

POSITION: 2 **Indicates shop sequence number**

11.3 Standard Rolled Series Example:

RS0308	12	F	A	3	5	X
1	2	3	4	5	6	7

POSITION: 1 **Indicates series type**

POSITION: 2 **Indicates threaded length of shaft**

POSITION: 3 **Indicated with of without flange**

- F = with flange
- O = without flange

POSITION: 4 **Indicates end annealing**

- A = annealed end
- O = no annealing

POSITION: 5 **Indicates annealed length in inches on (left end journal) or standard journal type**

- E, E1, F, F1,H, H1 = See Sketches
- # = Length in inches of annealed end

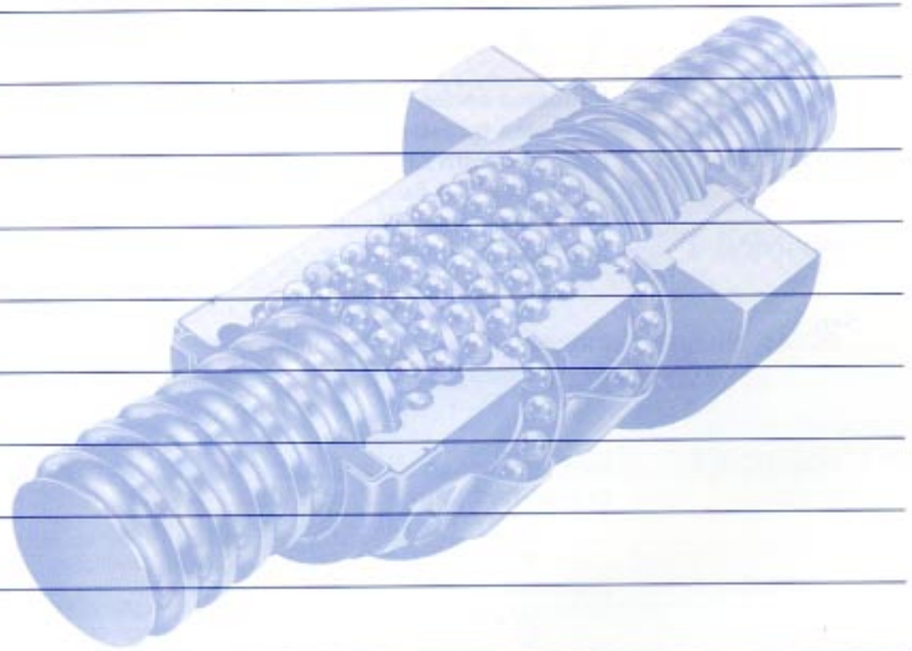
POSITION: 6 **Indicates annealed length in inches on (right end journal) or standard journal type**

- E, E1, F, F1,H, H1 = See Sketches
- # = Length in inches of annealed end

POSITION: 7 **Indicates wiper kit**

- W = with wiper kit
- X = without wiper kit

Notes



12. RBC Precision Ground Ball Screws – Dimensional Tables

RBC's Standard Series for Precision Ground Ball Screws covers a wide range of ball screw applications.

Precision Ground Series

MM Series is a metric lead series with an external ball return and an integral flange. Series includes Single Nut Preload and Non Preload Units and a double nut offering.

IM Series is a metric lead series with an internal return (deflector) and an integral flange. Series includes Single Nut Preload, Non Preload and double nut offerings. Based on screw major diameter two standard flange mounting hole patterns are provided.

GN Series is an inch lead series with an external ball return and integral flange. Series includes Single Nut Preload and Non Preload units and double nut preload offerings. Series also includes Flange Mount Housing and Base Mount Housing units as standard.

GV Series is an inch lead series with an external ball return and optional flange. This provides the customer with alternative mounting arrangements based on application. Flanges can be provided with standard patterns shown.

RB Series is an inch lead series designed for high speed applications. 2 and 4 start are provided as standard or preloaded and non preloaded models. Optional Flanges are provided with the patterns shown.

P Series is a miniature stainless steel series with an internal return for use in medical, instrumentation and special environment applications such as food processing. This is an inch lead series. This series is available preloaded and non preloaded.

Precision Rolled Series

RBC's standard rolled series is provided with a 0.006"/ft lead accuracy. Lead accuracies down to 0.001"/ft may be specified. For higher accuracy, less than 0.001"/ft, please consult RBC.

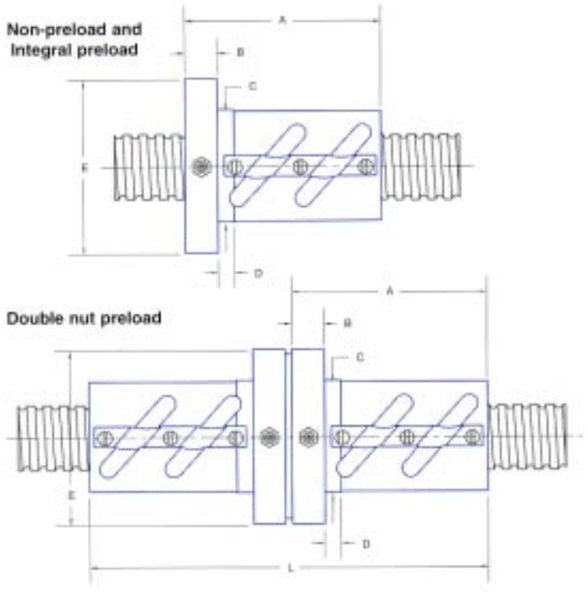
M Series is a miniature stainless steel fine inch lead series with an internal ball return. This is available preloaded and non preloaded with a lead accuracy of 0.006"/ft as standard. Higher lead accuracys are available upon request.

RMS Series is a metric lead series with an external ball return and an optional flange. 3 Standard Flange Patterns for this series are provided in the tables.

RS Series is an inch lead series with an external return and an optional flange. 3 Standard Flange Patterns for this series are provided in the tables.

All of the above series can be machined with the standard journal configurations provided or customized to meet your needs.

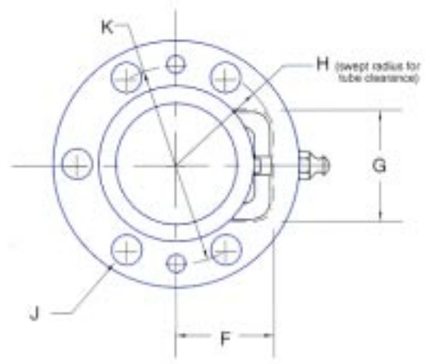
12.1 MM Series (Metric, External Ball Return, Integral Flange)



Model No.	Major Screw Dia.	Ball Dia.	Lead (mm)	A	B	C (max)	D	E	F	G	H	J		K	L
												No. of Holes	Hole Dia.		
MM2005	0.75	0.1250	5	2.28	0.40	1.187	0.31	2.25	0.93	1.03	0.90	3	0.281	1.750	4.68
MM2505	1.00	0.1250	5	2.71	0.40	1.500	0.31	2.62	1.09	1.31	1.11	3	0.281	2.125	5.56
MM3205	1.25	0.1250	5	2.12	0.40	1.687	0.31	2.87	1.14	1.48	1.17	3	0.344	2.312	4.37
MM4005	1.50	0.1250	5	2.31	0.40	2.000	0.31	3.25	1.37	1.71	1.38	3	0.344	2.625	4.75
MM4010	1.50	0.1562	10	2.68	0.43	2.062	0.31	3.25	1.34	1.68	1.41	3	0.344	2.625	5.50
MM5005	2.00	0.1250	5	2.31	0.40	2.500	0.31	4.00	1.57	2.15	1.69	5	0.406	3.250	4.75
MM5010	2.00	0.2500	10	4.50	0.77	3.250	0.37	5.12	1.93	2.43	2.30	5	0.531	4.250	9.12
MM6310	2.50	0.2500	10	4.50	0.77	3.750	0.37	5.62	2.19	3.06	2.60	5	0.531	4.625	9.12

Dimensions in inches unless specified

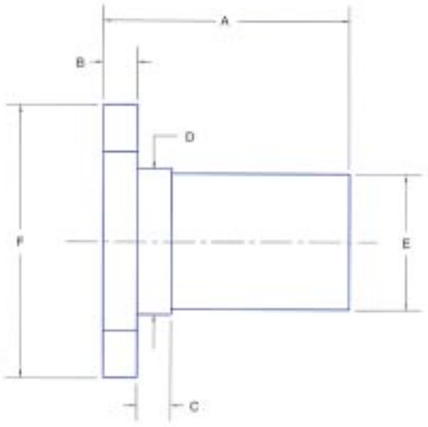
12.1 MM Series (Metric, External Ball Return, Integral Flange) - Continued



Singlenut Preload load ratings (lbs)		Doublenut Preload load ratings (lbs)		Singlenut non-Preload load ratings (lbs)		
Dynamic Load 10^6 Inches(lbs)	Max. Static Capacity (lbs)	Dynamic Load 10^6 Inches(lbs)	Max. Static Capacity (lbs)	Dynamic Load 10^6 Inches(lbs)	Max. Static Capacity (lbs)	Axial Play (backlash)
1,227	8,475	2,230	15,409	2,230	15,409	0.007
1,378	11,322	2,506	20,586	2,506	20,586	0.007
1,533	14,623	2,787	26,587	2,787	26,587	0.007
1,634	17,470	2,970	31,762	2,970	31,762	0.007
1,881	14,558	3,420	26,469	3,420	26,469	0.009
1,829	23,622	3,325	42,949	3,325	42,949	0.007
6,211	47,160	11,292	85,745	11,292	85,745	0.012
6,728	58,565	12,231	106,485	12,231	106,485	0.012

Dimensions in inches unless specified

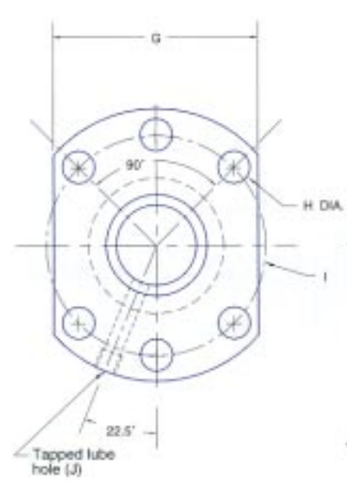
12.2 IM Series (Metric, Internal Ball Return, Integral Flange)



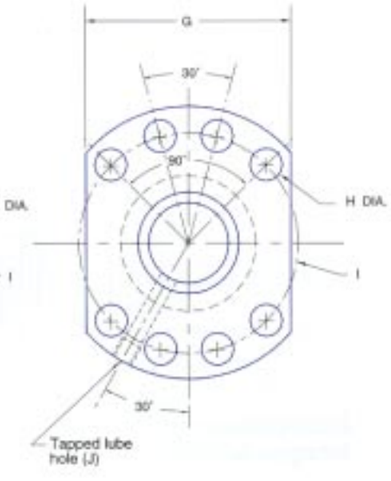
Model No.	Major Screw Dia. mm (in)	Ball Dia.	Lead (mm)	A	B	C	D (max)	E	F	G	H
IM1605	16 (0.614)	0.1378	5	2.165	0.393	0.393	1.1021	1.097	1.890	1.575	0.217
IM2005	20 (0.772)	0.1378	5	2.205	0.393	0.393	1.3776	1.373	2.165	1.732	0.217
IM2505	25 (0.969)	0.1378	5	2.850	0.393	0.393	1.5744	1.569	2.440	1.890	0.260
IM3205	32 (1.244)	0.1378	5	3.250	0.472	0.393	1.9681	1.963	3.150	2.441	0.354
IM4005	40 (1.559)	0.1378	5	3.540	0.472	0.393	2.4800	2.475	3.660	2.756	0.354
IM4010	40 (1.559)	0.2812	10	6.260	0.550	0.630	2.4800	2.475	3.660	2.756	0.354
IM5005	50 (1.949)	0.1378	5	4.985	0.630	0.630	2.9524	2.947	4.330	3.346	0.433
IM5010	50 (1.949)	0.2812	10	6.365	0.630	0.630	2.9524	2.947	4.330	3.346	0.433
IM6310	63 (2.461)	0.2812	10	6.615	0.710	0.630	3.5428	3.538	4.920	3.740	0.433
IM8010	80 (3.130)	0.2812	10	8.270	0.790	0.630	4.1334	4.128	5.710	4.331	0.531

Dimensions in inches unless specified

12.2 IM Series (Metric, Internal Ball Return, Integral Flange) - Continued



Major Screw Dia < 40

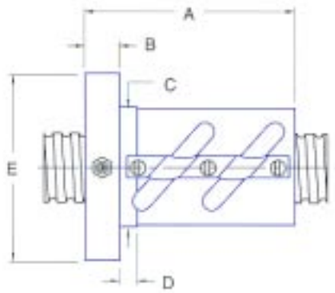


Major Screw Dia > 40

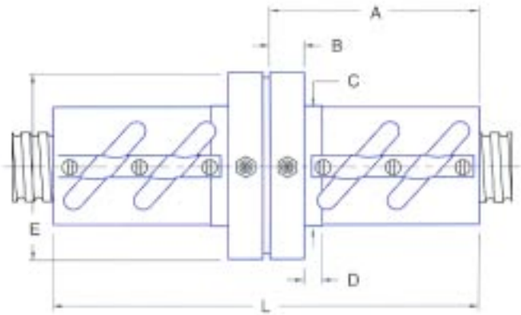
I	J	Singlenut Preload load ratings (lbs)		Doublenut Preload load ratings (lbs)	
		Dynamic Load 10⁶ Inches (lbs)	Max. Static Capacity (lbs)	Dynamic Load 10⁶ Inches (lbs)	Max. Static Capacity (lbs)
1.496	M6 X 1.0	1,461	3,676	-----	-----
1.772	M6 X 1.0	2,383	6,812	-----	-----
2.008	M6 X 1.0	3,804	12,261	-----	-----
2.559	M6 X 1.0	4,332	16,348	-----	-----
3.071	M8 X 1.0	5,736	24,786	-----	-----
3.071	M8 X 1.0	-----	-----	12,514	41,206
3.661	M8 X 1.0	-----	-----	7,344	36,473
3.661	M8 X 1.0	-----	-----	13,764	51,027
4.252	M8 X 1.0	-----	-----	15,381	65,650
4.921	M8 X 1.0	-----	-----	20,403	100,301

Dimensions in inches unless specified

12.3 GN Series (Inch, External Ball Return, Integral Flange)



Non–preload and Integral preload

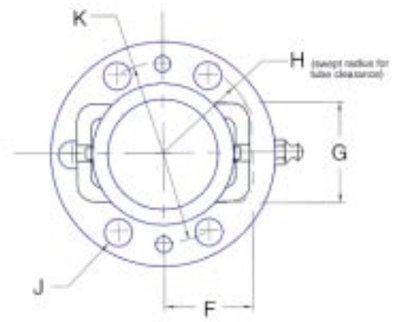


Double nut preload

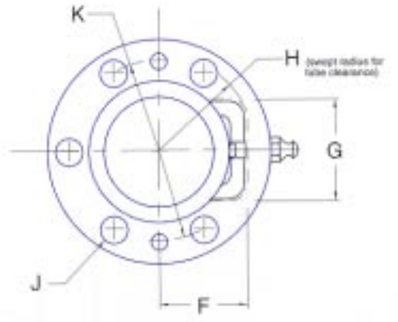
GN Series Model No.	Screw Major Dia	Type A/B	Ball Dia	Lead	A	B	C (max)	D	E	F	G	H	J		K	L
													# of Holes	Hole Dia.		
GN-0505	0.500	B	0.1250	0.20	2.28	0.37	1.025	-	2.00	0.72	0.81	0.75	3	0.281	1.562	4.68
GN-0502	0.500	A	0.1250	0.50	2.38	0.37	1.062	-	2.00	0.80	0.75	0.86	5	0.266	1.562	4.87
GN-0605	0.625	B	0.1250	0.20	2.28	0.37	1.025	-	2.00	0.81	0.87	0.83	3	0.218	1.562	4.68
GN-0602	0.625	A	0.1250	0.50	2.38	0.37	1.187	-	2.30	0.87	0.87	0.93	5	0.281	1.875	4.87
GN-0705	0.750	B	0.1250	0.20	2.28	0.40	1.187	0.31	2.25	0.93	1.03	0.90	3	0.281	1.750	4.68
GN-0704	0.750	B	0.1250	0.25	2.68	0.40	1.135	0.31	2.25	0.93	1.03	0.91	3	0.281	1.750	3.62
GN-1005	1.000	B	0.1250	0.20	2.28	0.40	1.406	0.31	2.62	1.02	1.20	1.03	3	0.281	2.125	4.68
GN-1004	1.000	B	0.1562	0.25	2.71	0.40	1.500	0.31	2.62	1.09	1.31	1.11	3	0.281	2.125	5.56
GN-1205	1.250	B	0.1250	0.20	2.12	0.40	1.687	0.31	2.87	1.14	1.48	1.17	3	0.344	2.312	4.37
GN-1204	1.250	B	0.1562	0.25	2.68	0.40	1.750	0.31	2.94	1.25	1.59	1.23	3	0.344	2.437	5.50
GN-1505	1.500	B	0.1250	0.20	2.31	0.40	2.000	0.31	3.25	1.37	1.71	1.38	3	0.344	2.625	4.75
GN-1504	1.500	B	0.1562	0.25	2.68	0.43	2.062	0.31	3.25	1.34	1.68	1.41	3	0.344	2.625	5.50
GN-1502	1.500	B	0.2500	0.50	4.50	0.62	2.250	0.31	3.87	1.55	1.85	1.61	5	0.406	3.125	9.12
GN-2005	2.000	B	0.1250	0.20	2.31	0.40	2.500	0.31	4.00	1.57	2.15	1.69	5	0.406	3.250	4.75
GN-2004	2.000	B	0.1562	0.25	2.68	0.44	2.562	0.31	4.00	1.64	2.25	1.72	5	0.406	3.250	5.50
GN-2002	2.000	B	0.3750	0.50	5.12	0.77	3.250	0.37	5.12	2.25	2.65	2.27	5	0.531	4.250	10.37
GN-2202	2.250	B	0.3750	0.50	5.12	0.77	3.500	0.37	5.50	2.37	2.81	2.39	5	0.531	4.625	10.37
GN-2504	2.500	B	0.1562	0.25	2.68	0.44	3.125	0.31	4.50	1.90	2.60	2.18	5	0.406	3.875	5.50
GN-2502	2.500	B	0.3750	0.50	5.12	0.77	3.750	0.37	5.62	2.50	3.06	2.53	5	0.531	4.625	10.37
GN-3002	3.000	B	0.3750	0.50	5.12	0.75	4.250	0.37	6.25	2.87	2.84	2.89	5	0.531	5.250	10.37
GN-3066	3.000	B	0.5000	0.66	6.75	1.00	4.562	0.50	7.00	3.06	3.53	3.13	5	0.656	5.875	13.62
GN-3001	3.000	B	0.5000	1.00	9.12	1.00	4.562	0.50	7.00	3.06	3.53	3.13	5	0.656	5.875	18.37

Dimensions in inches unless specified

12.3 GN Series (Inch, External Ball Return, Integral Flange) - Continued



Type A

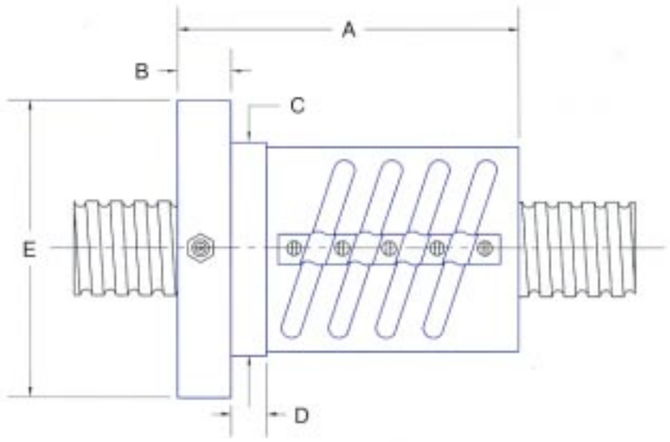


Type B

Single Nut Preload		Double Nut Preload		Single Nut Non-Preload		
Dynamic Load 10^6 Inches (lbs)	Max. Static Capacity (lbs)	Dynamic Load 10^6 Inches (lbs)	Max. Static Capacity (lbs)	Dynamic Load 10^6 Inches (lbs)	Max. Static Capacity (lbs)	Axial Play (backlash)
1,018	5,622	1,851	10,222	1,851	10,222	0.007
1,382	5,622	2,513	10,222	2,513	10,222	0.007
1,137	7,050	2,067	12,817	2,067	12,817	0.007
1,495	7,050	2,719	12,817	2,719	12,817	0.007
1,223	8,475	2,241	15,409	2,241	15,409	0.007
1,338	8,475	2,414	15,409	2,414	15,409	0.007
1,385	11,322	2,519	20,586	2,519	20,586	0.007
2,025	13,993	3,682	25,441	3,682	25,441	0.009
1,540	14,623	2,800	26,587	2,800	26,587	0.007
2,230	17,690	4,054	32,167	4,054	32,167	0.009
1,642	17,470	2,986	31,762	2,986	31,762	0.012
2,454	22,102	4,462	40,185	4,462	40,185	0.007
5,822	33,905	10,586	61,646	10,586	61,646	0.009
1,838	23,622	3,342	42,949	3,342	42,949	0.007
2,730	29,507	4,963	53,649	4,963	53,649	0.009
11,470	67,747	20,855	123,177	20,855	123,177	0.017
12,077	76,293	21,958	138,715	21,958	138,715	0.017
2,960	39,910	5,380	67,109	5,380	67,109	0.009
12,620	84,835	22,948	154,245	22,948	154,245	0.017
14,623	111,212	26,587	202,204	26,587	202,204	0.017
23,415	142,340	42,570	258,800	42,570	258,800	0.023
26,797	142,340	48,722	258,800	48,722	258,800	0.023

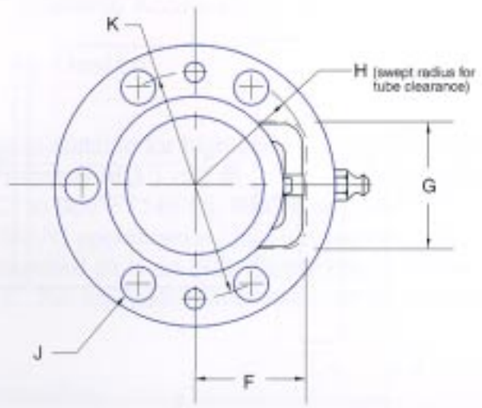
Dimensions in inches unless specified

Right hand models shown.
Left hand models available upon request.



Model No.	Major Shaft Dia.	Ball Dia.	Lead	A	B	C (max)	D	E	F
GN1205	1.250	0.1250	0.20	3.31	0.40	1.687	0.31	2.87	1.14
GN1204	1.250	0.1562	0.25	4.18	0.40	1.750	0.31	2.94	1.25
GN1505	1.500	0.1250	0.20	3.53	0.40	2.000	0.31	3.25	1.37
GN1504	1.500	0.1562	0.25	4.18	0.43	2.062	0.31	3.25	1.34
GN2005	2.000	0.1250	0.20	3.53	0.40	2.500	0.31	4.00	1.57
GN2004	2.000	0.1562	0.25	4.18	0.44	2.562	0.31	4.00	1.64
GN2002	2.000	0.3750	0.50	8.12	0.77	3.250	0.37	5.12	2.25
GN2202	2.250	0.3750	0.50	8.12	0.77	3.500	0.37	5.50	2.37
GN2504	2.500	0.1562	0.25	4.18	0.44	3.125	0.31	4.50	1.93
GN2502	2.500	0.3750	0.50	8.12	0.77	3.750	0.37	5.62	2.50
GN3002	3.000	0.3750	0.50	8.20	0.75	4.250	0.37	6.25	2.87

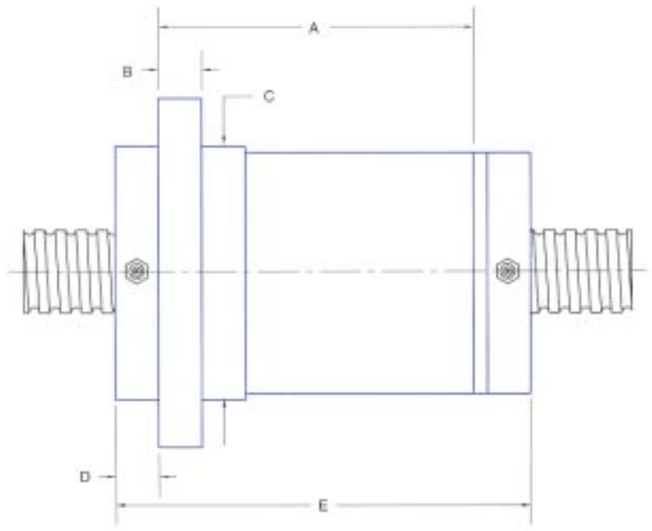
Dimensions in inches unless specified



G	H	Qty. Holes	Hole Dia. J	K	Dynamic Load 10^6 Inches (lbs)	Max. Static Load (lbs)
1.48	1.17	3	0.344	2.312	2,800	26,587
1.59	1.23	3	0.344	2.437	4,054	32,167
1.71	1.38	3	0.344	2.625	2,986	31,762
1.68	1.41	3	0.344	2.625	4,462	40,185
2.15	1.69	5	0.406	3.250	3,342	42,949
2.25	1.72	5	0.406	3.250	4,963	53,649
2.62	2.27	5	0.531	4.250	20,855	123,177
2.81	2.39	5	0.531	4.625	21,958	138,715
2.71	2.08	5	0.406	3.875	5,380	67,109
3.06	2.53	5	0.531	4.625	22,948	154,245
2.84	2.89	5	0.531	5.250	26,587	202,204

Dimensions in inches unless specified

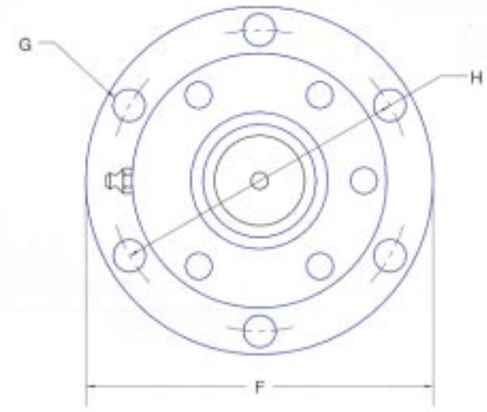
12.3 GN Series (Inch, External Ball Return, Integral Flange, Flange Mount Housing) - Continued



Model No.	Major Shaft Dia.	Ball Dia.	Lead	A	B	C (max)
GN0705	0.75	0.1250	0.20	3.75	0.37	2.312
GN1004	1.00	0.1562	0.25	4.72	0.37	2.750
GN1205	1.25	0.1250	0.20	3.75	0.50	3.000
GN1505	1.50	0.1250	0.20	3.81	0.50	3.375
GN1504	1.50	0.1562	0.25	4.65	0.50	3.375
GN2005	2.00	0.1250	0.20	3.81	0.62	4.125
GN2004	2.00	0.1562	0.25	4.62	0.62	4.125
GN2002	2.00	0.3750	0.50	8.75	0.75	5.250
GN2202	2.25	0.3750	0.50	8.75	0.75	5.625
GN2504	2.50	0.1562	0.25	4.62	0.62	4.625
GN2502	2.50	0.3750	0.50	8.75	0.75	5.750
GN3002	3.00	0.3750	0.50	9.25	0.75	6.375

Dimensions in inches unless specified

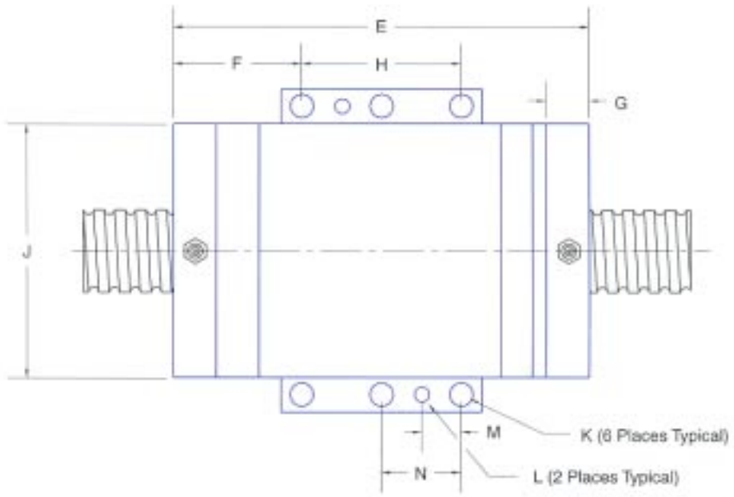
12.3 GN Series (Inch, External Ball Return, Integral Flange, Flange Mount Housing) - Continued



D	E	F	G	H	Dynamic Load 10^{6} Inches (lbs)	Max. Static Capacity (lbs)
0.40	4.680	3.18	0.281	2.750	2,241	15,409
0.40	5.640	3.62	0.281	3.187	3,682	25,441
0.40	4.680	4.12	0.344	3.562	2,800	26,587
0.40	4.740	4.50	0.344	3.937	2,986	31,762
0.43	5.640	4.50	0.344	3.937	4,462	40,185
0.40	4.740	5.50	0.406	4.812	3,342	42,949
0.44	5.640	5.50	0.406	4.812	4,963	53,649
0.77	10.420	7.12	0.531	6.187	20,855	123,177
0.77	10.420	7.50	0.531	6.562	21,958	138,715
0.44	5.630	6.00	0.406	5.312	5,380	67,109
0.77	10.420	7.50	0.531	6.625	22,948	154,245
0.75	10.875	8.25	0.531	7.312	26,587	202,204

Dimensions in inches unless specified

12.3 GN Series (Inch, External Ball Return, Integral Flange, Base Mount Housing) - Continued

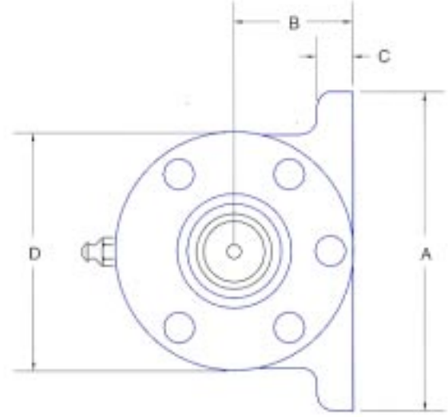


Model No.	Major Shaft Dia.	Ball Dia.	Lead	A	B	C	D	E	F
GN0705	0.75	0.1250	0.20	3.62	1.187	0.50	2.31	4.68	1.03
GN1004	1.00	0.1562	0.25	4.18	1.375	0.62	2.68	5.64	1.07
GN1205	1.25	0.1250	0.20	4.43	1.500	0.62	2.93	4.68	1.03
GN1505	1.50	0.1250	0.20	5.00	1.687	0.75	3.31	4.74	1.19
GN1504	1.50	0.1562	0.25	5.00	1.687	0.75	3.31	5.64	1.20
GN2005	2.00	0.1250	0.20	5.87	2.062	0.87	4.06	4.74	1.19
GN2004	2.00	0.1562	0.25	5.87	2.062	0.87	4.06	5.64	1.20
GN2002	2.00	0.3750	0.50	7.93	2.625	1.25	5.25	10.42	2.15
GN2202	2.25	0.3750	0.50	8.81	2.812	1.50	5.62	10.42	2.27
GN2504	2.50	0.1562	0.25	6.81	2.312	1.00	4.62	5.63	1.25
GN2502	2.50	0.3750	0.50	8.81	2.937	1.50	5.75	10.42	2.27
GN3002	3.00	0.3750	0.50	10.06	3.250	1.75	6.43	10.87	2.56

Dimensions in inches unless specified

RBC BEARINGS

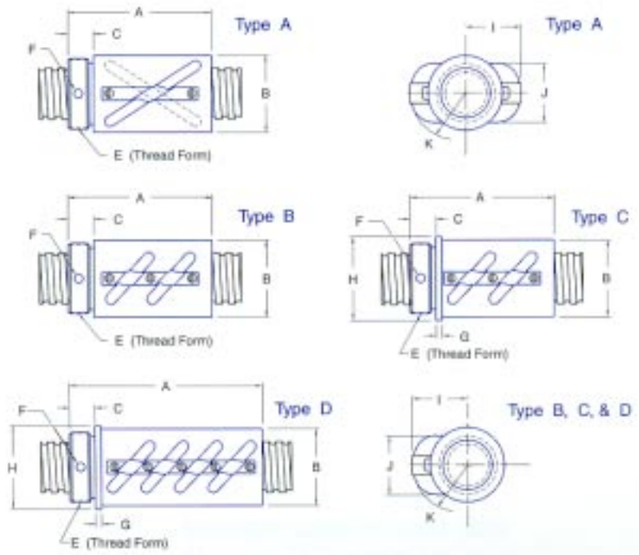
12.3 GN Series (Inch, External Ball Return, Integral Flange, Base Mount Housing) - Continued



G	H	J	K	L	M	N	Dynamic Load 10^6 Inches (lbs)	Max. Static Capacity (lbs)
0.40	2.500	3.000	0.281	0.218	0.625	1.250	2,241	15,409
0.40	3.375	3.500	0.344	0.281	0.843	1.687	3,682	25,441
0.40	2.500	3.750	0.344	0.281	0.625	1.250	2,800	26,587
0.40	2.250	4.187	0.406	0.344	0.562	1.125	2,986	31,762
0.43	3.125	4.187	0.406	0.344	0.781	1.562	4,462	40,185
0.40	2.250	5.000	0.468	0.406	0.562	1.125	3,342	42,949
0.44	3.125	5.000	0.468	0.406	0.718	1.562	4,963	53,649
0.77	6.000	6.625	0.656	0.593	1.500	3.000	20,855	123,177
0.77	5.750	7.250	0.781	0.781	1.437	2.875	21,958	138,715
0.44	3.000	5.750	0.531	0.468	0.750	1.500	5,380	67,109
0.77	5.750	7.250	0.781	0.718	1.437	2.875	22,948	154,245
0.75	5.625	8.250	0.906	0.843	1.406	2.812	26,587	202,204

Dimensions in inches unless specified

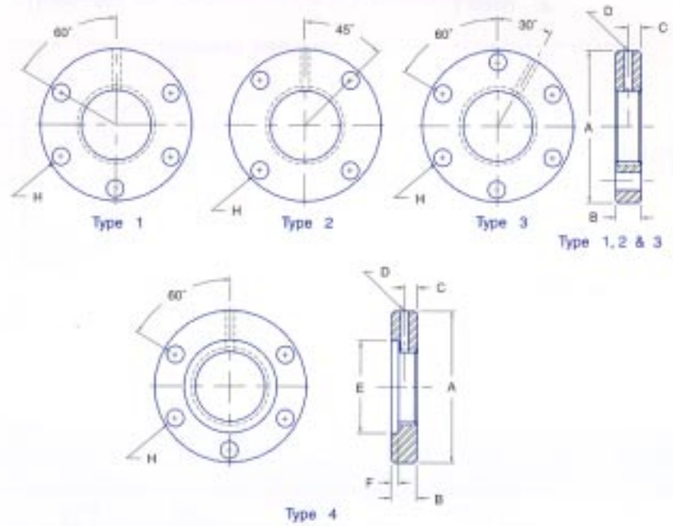
12.4 GV Series (Inch, External Ball Return, Optional Flange)



Model No.	Major Screw Dia.	Ball Dia.	Lead	Nut Type	A	B (max)	C	D	"V" Thread Form E	Lube Hole Dia. F	G	Max H	Max I	Max J	Tube Clearance K
GV0502	0.500	0.1250	0.500	A	2.200	1.062	0.40	-----	.937-16 UN-2A	-----	-----	-----	0.800	0.700	0.820 R
GV0605	0.625	0.1250	0.200	B	2.200	1.062	0.50	-----	.937-16 UN-2A	-----	-----	-----	0.760	0.781	0.800 R
GV0602	0.625	0.1250	0.500	A	2.200	1.130	0.40	-----	.937-16 UN-2A	-----	-----	-----	0.850	0.825	0.875 R
GV0705	0.750	0.1250	0.200	B	2.810	1.312	0.50	0.156	1.173-18 UN-2A	0.125	-----	-----	0.850	0.937	0.875 R
GV1005	1.000	0.1250	0.200	B	2.905	1.620	0.50	0.170	1.563-18 UNEF-2A	0.156	-----	-----	0.965	1.160	1.000 R
GV1004	1.000	0.1562	0.250	B	3.370	1.685	0.50	0.170	1.563-18 UNEF-2A	0.156	-----	-----	1.050	1.220	1.082 R
GV1205	1.250	0.1250	0.200	C	3.120	1.650	0.49	0.170	1.625-20 UN-2A	0.156	0.1	1.800	1.080	1.375	1.109 R
GV1505	1.500	0.1250	0.200	D	3.620	2.020	0.50	0.170	1.937-16 UN-2A	0.156	0.1	2.125	1.240	1.620	1.288 R
GV1504	1.500	0.1562	0.250	D	4.260	2.020	0.50	0.170	1.937-16 UN-2A	0.156	0.1	2.125	1.325	1.640	1.380 R
GV1502	1.500	0.2500	0.500	B	4.620	2.250	0.75	0.250	2.125-20 UN-2A	0.187	-----	-----	1.550	1.850	1.575 R
GV1501	1.500	0.3437	1.000	A	5.180	2.625	1.00	0.280	2.250-20 UN-2A	0.187	-----	-----	1.890	2.000	1.960 R
GV2202	2.250	0.3750	0.500	B	6.810	3.375	1.57	0.780	3.137-12 UN-2A	0.187	-----	-----	2.230	2.750	2.259 R
GV2201	2.250	0.3750	1.000	A	6.810	3.375	1.57	0.780	3.137-12 UN-2A	0.187	-----	-----	2.250	2.750	2.300 R

Dimensions in inches unless specified

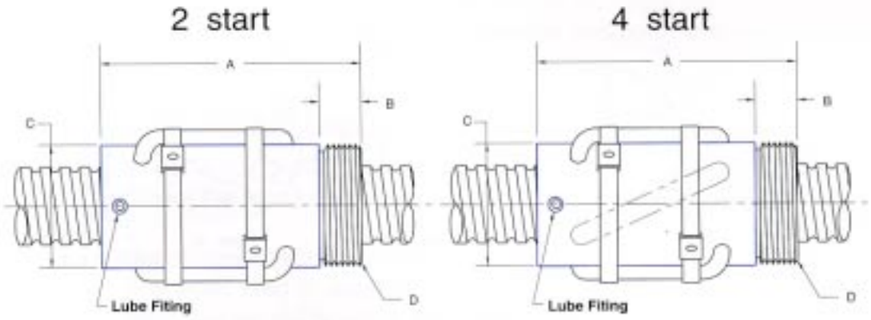
12.4 GV Series (Inch, External Ball Return, Optional Flange) - Continued



Flange Type	A	B	C	D	E	F	Hole Dia. H1	Bolt Circle	Singlenut Preload load ratings (lbs)		Singlenut non-preload load ratings (lbs)		
									Dynamic Load 10^6 Inches	Maximum Static Load	Dynamic Load 10^6 Inches	Maximum Static Load	Max Axial Play
1	2.000	0.531	-----	-----	-----	-----	0.266	1.562	1,336	4,942	2,429	9,883	0.007
1	2.000	0.531	-----	-----	-----	-----	0.266	1.562	1,100	3,880	1,998	7,762	0.007
1	2.000	0.531	-----	-----	-----	-----	0.266	1.562	1,430	4,191	2,597	7,372	0.007
1	2.300	0.531	0.265	0.250	-----	-----	0.281	1.875	1,592	9,950	2,894	19,897	0.007
1	2.750	0.535	0.268	0.250	-----	-----	0.281	2.250	1,267	9,422	1,933	15,812	0.007
1	2.875	0.545	0.272	0.250	-----	-----	0.344	2.250	1,647	11,638	2,513	19,531	0.009
4	2.770	0.660	0.330	0.250	1.800	0.100	0.344	2.312	1,990	17,170	3,617	34,332	0.007
4	3.500	0.660	0.330	0.250	2.125	0.100	0.344	2.750	2,880	27,870	5,239	55,738	0.007
4	3.500	0.660	0.330	0.250	2.125	0.100	0.344	2.750	3,796	13,130	6,904	23,098	0.009
1	3.875	0.780	0.390	0.250	-----	-----	0.406	3.125	5,630	29,800	10,235	59,602	0.012
2	4.940	1.020	0.510	0.250	-----	-----	0.531	4.125	10,835	40,640	19,700	81,275	0.019
3	5.380	1.582	0.791	0.250	-----	-----	0.656	4.375	15,590	90,000	28,354	179,119	0.017
3	5.380	1.582	0.791	0.250	-----	-----	0.656	4.375	19,650	90,000	35,724	179,119	0.017

Dimensions in inches unless specified

12.5 RB Series (Inch, External Ball Return, Optional Flange, High Helix – Large Lead)



Non-Preload

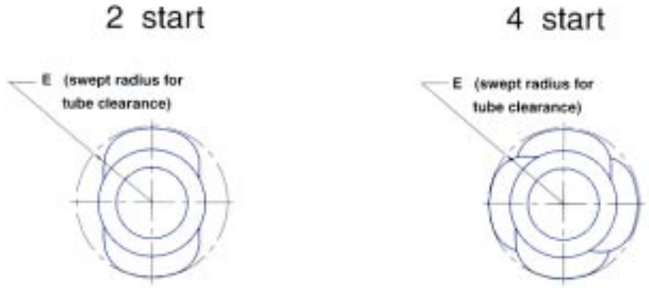
Model No.	Major Shaft Dia.	Ball Dia.	Lead	A	B	C	D
RB0701A	0.750	0.1250	1.000	2.88	0.50	1.312	1.250-16
RB0702A	0.750	0.1562	0.500	2.68	0.50	1.312	1.250-16
RB1001A	1.000	0.1562	1.000	3.00	0.62	1.625	1.500-16
RB1020A	1.000	0.1562	2.000	3.00	0.62	1.625	1.500-16
RB1520E	1.500	0.1875	2.000	5.00	0.75	2.250	2.125-16
RB1520F	1.500	0.1875	2.000	5.00	0.75	2.250	2.125-16
RB2001A	2.000	0.1562	1.000	3.62	1.00	2.875	2.625-16
RB2001B	2.000	0.1562	1.000	3.62	1.00	2.875	2.625-16
RB2020E	2.000	0.1875	2.000	5.31	1.00	2.875	2.625-16
RB2020F	2.000	0.1875	2.000	5.31	1.00	2.875	2.625-16

Preload

Model No.	Major Shaft Dia.	Ball Dia.	Lead	A	B	C	D
RB0701B	0.750	0.1250	1.000	2.88	0.50	1.312	1.250-16
RB0702B	0.750	0.1562	0.500	2.68	0.50	1.312	1.250-16
RB1001B	1.000	0.1562	1.000	3.00	0.62	1.625	1.500-16
RB1020C	1.000	0.1562	2.000	3.00	0.62	1.625	1.500-16
RB1520G	1.500	0.1875	2.000	5.00	0.75	2.250	2.125-16
RB1520H	1.500	0.1875	2.000	5.00	0.75	2.250	2.125-16
RB2001C	2.000	0.1562	1.000	3.62	1.00	2.875	2.625-16
RB2001D	2.000	0.1562	1.000	3.62	1.00	2.875	2.625-16
RB2020G	2.000	0.1875	2.000	5.31	1.00	2.875	2.625-16
RB2020H	2.000	0.1875	2.000	5.31	1.00	2.875	2.625-16

Dimensions in inches unless specified

12.5 RB Series (Inch, External Ball Return, Optional Flange, High Helix – Large Lead) - Continued



Non-Preload

E	No. Turns Circuit	No. Starts	Max. Axial Play	Max. Static Load (lbs)	Dynamic Load 10⁶ Travel (lbs)
0.94	1.50	2	0.005	5,282	1,862
1.00	2.50	2	0.009	9,957	3,018
1.12	1.50	2	0.006	8,722	2,846
1.12	0.67	4	0.006	7,882	3,241
1.53	1.67	4	0.008	31,555	10,978
1.53	1.67	2	0.008	17,415	6,058
1.87	1.67	4	0.006	36,548	7,785
1.87	1.67	2	0.006	20,170	4,296
1.94	1.67	4	0.008	43,500	12,595
1.94	1.67	2	0.008	23,953	6,950

Preload

E	No. Turns Circuit	No. Starts	Max. Static Load (lbs)	Dynamic Load 10⁶ Travel (lbs)
0.94	1.50	2	3,201	1,024
1.00	2.50	2	6,034	1,660
1.12	1.50	2	5,285	1,565
1.12	0.67	4	4,362	1,793
1.53	1.67	4	17,415	6,058
1.53	1.67	2	9,580	3,333
1.87	1.67	4	20,170	4,296
1.87	1.67	2	11,113	2,367
1.94	1.67	4	23,953	6,950
1.94	1.67	2	13,177	3,823

Dimensions in inches unless specified

12.5 RB Series (Inch, External Ball Return, Optional Flange, High Helix – Large Lead) - Continued

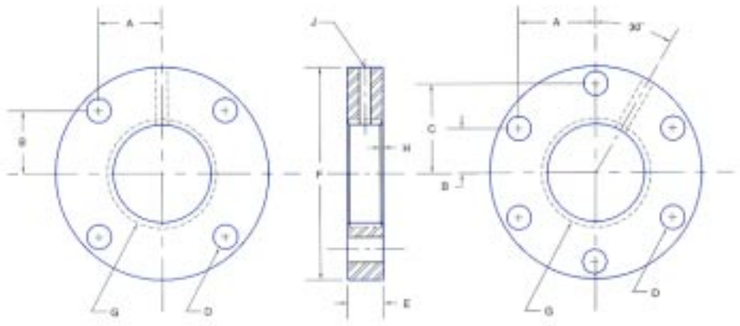


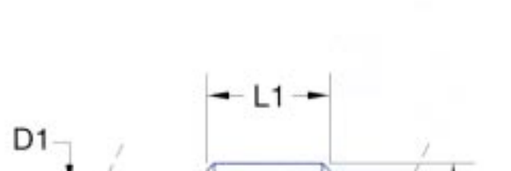
Fig. 1

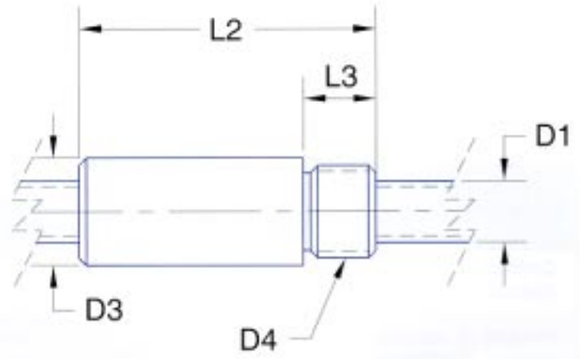
Fig. 2

Model No.	Fig. No.	A	B	C	D	E	F	G	H	J
RB0701A-B	2	0.907	0.523	1.047	0.281	0.530	2.60	1.250-16	0.04	.192/.185
RB0702A-B	2	0.907	0.523	1.047	0.281	0.530	2.60	1.250-16	0.04	.192/.185
RB1001A-B	1	0.972	0.972	-----	0.281	0.660	3.25	1.500-16	0.04	.256/.247
RB1020A-C	1	0.972	0.972	-----	0.281	0.660	3.25	1.500-16	0.04	.256/.247
RB1520E-F-G-H	1	1.370	1.370	-----	0.531	0.780	4.62	2.125-16	0.04	.319/.308
RB2001A-B-C-D	2	2.057	1.187	2.375	0.531	1.031	5.62	2.625-16	0.06	.383/.370
RB2020E-F-G-H	2	2.257	1.187	2.375	0.531	1.031	5.62	2.625-16	0.06	.383/.370

Dimensions in inches unless specified

12.6 P Series (Inch, Internal Ball Return, Miniature – Fine Lead)





Series P- Precision Grade (.0005"/ft)

Model No.	Screw Major Dia. (D1)	Minor Dia. (ref)	Lead (RH)	Nom. Ball Dia.	D2	L1	D3
P-0405	0.250	0.217	0.05	0.0394	.5625	0.687	0.750
P-0410	0.250	0.217	0.10	0.0394	.5625	0.875	0.750
P-0610	0.375	0.326	0.10	0.0625	.7500	0.937	1.000
P-0805	0.500	0.467	0.05	0.0393	.8437	0.737	1.093
P-0810	0.500	0.451	0.10	0.0625	.9062	0.937	1.187
P-1210	0.750	0.701	0.10	0.0625	1.2500	0.937	1.500

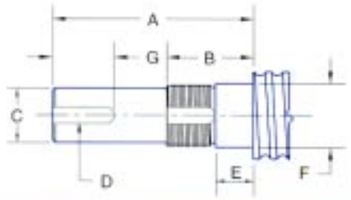
Series P- Precision Grade (.0005"/ft)

Model No.	L2	L3	D4	Nom. Axial Play (backlash) (singlenut)	Max. Static Capacity (lbs) Single Nut Double Nut	Dynamic Load 10^6 Travel (lbs) Single Nut Double Nut
P-0405	2.093	0.31	11/16-24	0.002	170	15
P-0410	2.468	0.31	11/16-24	0.002	170	18
P-0610	2.687	0.37	13/16-20	0.002	370	39
P-0805	2.281	0.37	15/16-20	0.002	370	22
P-0810	2.718	0.37	1-20	0.002	530	46
P-1210	2.750	0.37	1-5/16-18	0.002	800	59

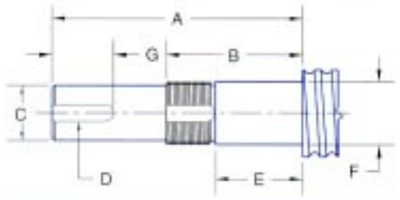
Dimensions in inches unless specified

12.7 Standard End Journals

Type A–Single bearing



Type B–Duplexed bearings

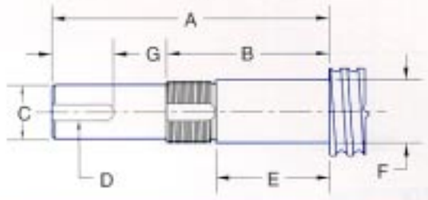


GN Series	GV Series	MM Series IM Series	RB Series	Type A Single Bearing			Type B Duplexed Bearing			Type C Multiple Bearing		
				A	B	E	A	B	E	A	B	E
GN0505 GN0502	GV0502			1.62	0.75	0.328	2.00	1.12	0.687	2.69	1.81	1.390
GN0605 GN0602	GV0605 GV0602	IM1605		1.75	0.81	0.375	2.12	1.19	0.750	2.94	2.00	1.546
GN0705 GN0704	GV0705	MM2005 IM2005	RB0701 RB0702	1.87	0.87	0.406	2.31	1.31	0.835	3.18	2.18	1.680
GN1004	GV1005 GV1004	MM2505 IM2505	RB1001 RB1020	2.37	1.06	0.520	2.91	1.59	1.071	4.03	2.71	2.154
GN1005				2.37	1.06	0.520	2.91	1.59	1.071	4.03	2.71	2.154
GN1205 GN1204	GV1205	MM3205 IM3205		2.68	1.12	0.562	3.28	1.71	1.150	4.44	2.88	2.311
GN1505	GV1505 GV1504 GV1502 GV1501	MM4005 IM4005		2.97	1.16	0.600	3.59	1.78	1.229	4.87	3.06	2.469
GN1504 GN1502		MM4010 IM4010	RB1520	2.97	1.16	0.600	3.59	1.78	1.229	4.87	3.06	2.469
GN2005 GN2004		MM5005 IM5005	RB2001 RB2020	3.53	1.34	0.717	4.28	2.09	1.465	5.78	3.59	2.941
GN2002		MM5010 IM5010		4.19	2.00	0.875	5.09	2.91	1.780	6.91	4.71	3.565
GN2504				4.93	2.06	0.796	5.75	2.87	1.623	7.41	4.53	3.256
GN2202	GV2202 GV2201			5.16	2.28	1.031	6.22	3.34	2.095	8.34	5.47	4.201
GN2502		MM6310 IM6310		5.16	2.28	1.031	6.22	3.34	2.095	8.34	5.47	4.201
GN3002 GN3066 GN3001		IM8010		6.18	2.50	1.190	7.41	3.72	2.410	9.87	6.18	4.831

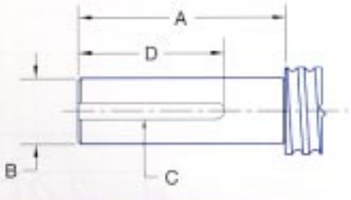
Dimensions in inches unless specified

12.7 Standard End Journals - Continued

Type C–Multiple duplexed bearings



Type D–Pillow block

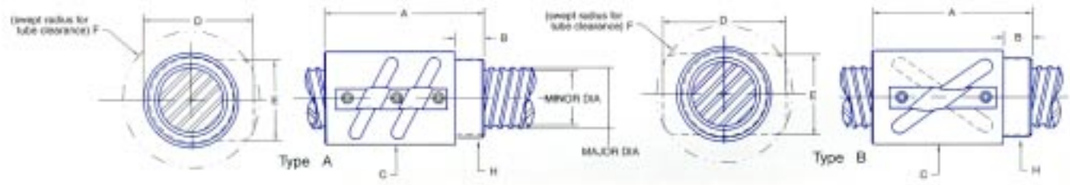


Common Dimensions for Type A, B, and C							Type D Pillow Block				Basic Pillow Block No.
C	D	F	G	Nut	Washer	Bearing	A	B	C	D	
.312/.311	1/8X1/16	.3939/.3936	0.56	N-00	W-00	200	2.25	.3750/.3745	1/8X1/16	1.25	006
.375/.374	1/8X1/16	.4726/.4723	0.62	N-01	W-01	201	2.44	.5000/.4995	1/8X1/16	1.38	008
.500/.499	1/8X1/16	.5908/.5905	0.68	N-02	W-02	202	2.62	.6250/.6245	3/16X3/32	1.50	010
.625/.624	3/16X3/32	.7877/.7873	0.71	N-04	W-04	204	3.15	.7500/.7495	3/16X3/32	1.50	012
.625/.624	3/16X3/32	.7877/.7873	0.71	N-04	W-04	204	3.15	.8750/.8745	3/16X3/32	1.50	014
.750/.749	3/16X3/32	.9846/.9842	0.87	N-05	W-05	205	3.15	1.000/.9995	1/4X1/8	1.50	100
1.000/.999	1/4X1/8	1.1814/1.1810	1.00	N-06	W-06	206	4.00	1.2500/1.2495	5/16X5/32	1.75	106
1.000/.999	1/4X1/8	1.1814/1.1810	1.00	N-06	W-06	206	4.00	1.3750/1.3745	5/16X5/32	1.75	108
1.375/1.374	5/16X5/32	1.7721/1.7716	1.49	N-09	W-09	209	4.81	1.6250/1.6245	3/8X3/16	3.00	110
1.375/1.374	5/16X5/32	1.5752/1.5745	1.49	N-08	W-08	308	4.81	1.6250/1.6245	3/8X3/16	3.00	110
1.750/1.749	3/8X3/16	2.1659/2.1653	1.75	N-11	W-11	211	5.87	2.000/1.999	1/2X1/4	3.00	200
1.750/1.749	3/8X3/16	1.9689/1.9684	1.75	N-10	W-10	310	4.81	1.7500/1.7495	3/8X3/16	3.00	112
1.750/1.749	3/8X3/16	1.9689/1.9684	1.75	N-10	W-10	310	5.87	2.000/1.999	1/2X1/4	3.00	200
2.250/2.249	1/2X1/4	2.3627/2.3621	2.00	N-12	W-12	312	7.43	2.500/2.499	5/8X5/16	4.68	208

Dimensions in inches unless specified

13. RBC Precision Rolled Ball Screws – Dimensional Tables

13.1 RMS Series (Metric, External Ball Return, Optional Flange)

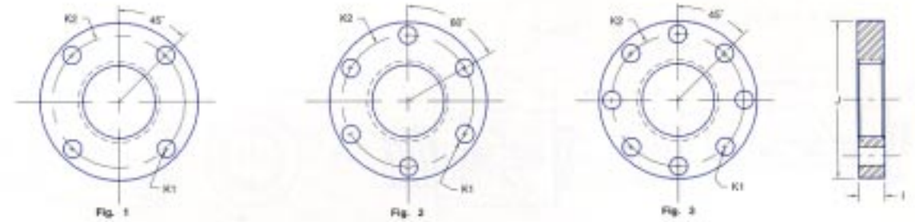


Items are sold as an assembly with customer journal requirements

Model No.	Major Screw Dia. (mm)	Minor Dia. (ref)	Lead (mm)	Ball Dia.	A Max.	B Max.	C Max.	D Max.	E Max.
RMS1605A	15.672	12.903	5	0.1378	2.70	0.650	1.260	1.531	0.970
RMS2505A	24.714	21.920	5	0.1378	2.93	0.690	1.654	1.933	1.060
RMS2510A	24.740	21.630	10	0.1378	2.93	0.709	1.673	2.077	1.358
RMS2510	24.740	21.971	10	0.1378	3.29	0.640	1.688	2.130	1.011
RMS2525	24.409	21.260	25	0.1562	3.29	0.640	1.688	2.194	1.044
RMS4005A	39.751	36.906	5	0.1378	3.01	0.770	2.283	2.563	1.780
RMS4010A	39.751	34.290	10	0.2810	5.00	1.060	2.559	3.012	1.970
RMS5010A	49.632	44.169	10	0.2810	5.08	1.140	3.071	3.524	2.330
RMS6310A	62.687	57.175	10	0.2810	5.08	1.140	3.622	4.075	2.760

Dimensions in inches unless specified

13.1 RMS Series (Metric, External Ball Return, Optional Flange) - Continued

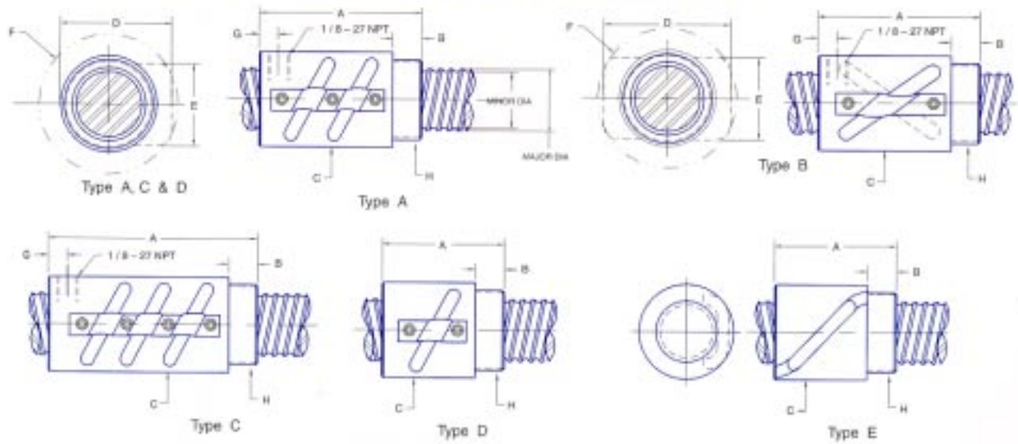


Items are sold as an assembly with customer journal requirements

F Max.	Flange Fig.	H "V" Threads	I Max.	J Max.	K1 Hole Dia.	K2 No. of Flange Holes & Bolt Circle Dia.
0.782	2	M30 X 1,5	0.674	2.210	0.260	(6) equally spaced on a 1.732 dia bolt circle
1.125	2	M40 X 1.5	0.714	2.840	0.354	(6) equally spaced on a 2.244 dia bolt circle
1.386	2	M40 X 1.5	0.709	2.846	0.354	(6) equally spaced on a 2.244 dia bolt circle
1.083	1,2	M40 X 1.5	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.175	1,2	M40 X 1.5	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.303	3	M56 X 1.5	0.792	3.706	0.433	(8) equally spaced on a 2.992 dia bolt circle
1.538	3	M60 X 2.0	1.107	4.611	0.709	(8) equally spaced on a 3.583 dia bolt circle
1.809	3	M72 X 2.0	1.186	5.123	0.709	(8) equally spaced on a 4.095 dia bolt circle
2.061	3	M85 X 2.0	1.186	5.674	0.709	(8) equally spaced on a 4.646 dia bolt circle

Dimensions in inches unless specified

13.2 RS Series (Inch, External Ball Return, Optional Flange)

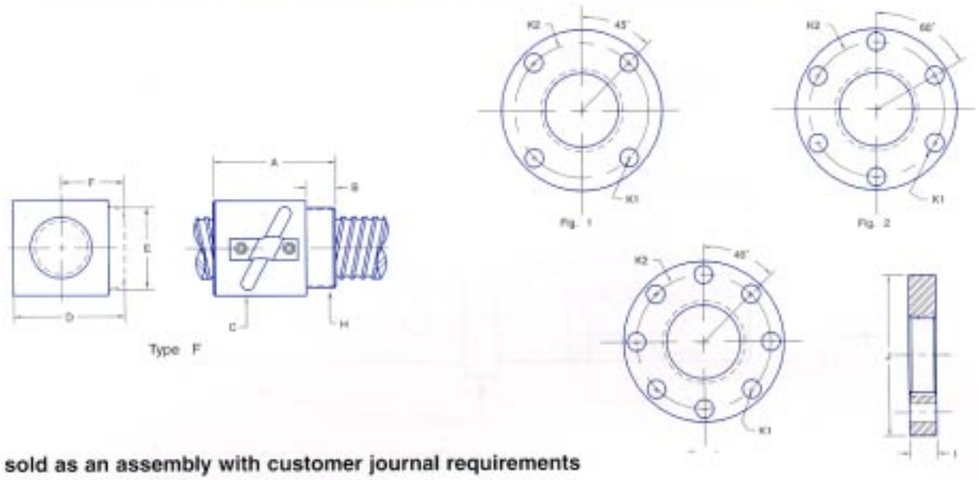


Items are sold as an assembly with customer journal requirements

Model No.	Max Screw Dia.	Minor Dia. (ref)	Ball Dia.	Lead	Max Std Length	RH/LH	No. of Circuits	No. of Starts	Turns Per Circuit	Nut Type	A Max.	B Max.	C Max.	D Max.
RS-0308	0.380	0.313	0.078	0.125	48	RH	2	1	2.5	A	1.89	0.317	0.786	0.915
RCS0308	0.380	0.313	0.078	0.125	48	RH	1	1	2.5	E	1.01	0.330	0.830	0.830
RS-0505	0.510	0.405	0.125	0.200	72	RH	2	1	2.5	A	2.76	0.390	1.067	1.339
RS-0502	0.510	0.405	0.125	0.500	72	RH	2	2	3.5	B	2.76	0.390	1.070	1.630
RSS0502	0.510	0.405	0.125	0.500	72	RH	2	2	3.5	B	2.76	0.390	1.070	1.630
RCS0605	0.610	0.503	0.125	0.200	72	RH	1	1	3.5	D	1.72	0.505	1.130	1.360
RKS0605	0.610	0.503	0.125	0.200	72	LH	1	1	3.5	D	1.72	0.505	1.130	1.357
RQS0605	0.610	0.503	0.125	0.200	72	RH	1	1	3.5	F	1.72	0.505	1.005	1.300
RS-0705	0.765	0.655	0.125	0.200	72	RH	2	1	3.5	A	2.89	0.505	1.317	1.521
RCS0705	0.765	0.655	0.125	0.200	72	RH	1	1	3.5	D	1.89	0.505	1.317	1.550
RS-0702	0.765	0.629	0.156	0.500	72	RH	2	2	3.5	B	2.94	0.505	1.317	1.984
RSS0702	0.765	0.629	0.156	0.500	72	RH	2	2	3.5	B	2.94	0.505	1.317	1.984
RS-1004	0.985	0.836	0.156	0.250	144	RH	2	1	3.5	A	3.14	0.630	1.692	1.882
RLS1004	0.985	0.836	0.156	0.250	144	LH	2	1	3.5	A	3.14	0.630	1.690	1.880
RCS1004	0.985	0.836	0.156	0.250	144	RH	1	1	3.5	D	2.36	0.630	1.692	1.913
RKS1004	0.985	0.836	0.156	0.250	144	LH	1	1	3.5	D	2.36	0.630	1.692	1.913
RS-1002	1.015	0.879	0.156	0.500	144	RH	2	2	3.5	B	3.13	0.630	1.692	1.882
RS-1001	0.985	0.836	0.156	1.000	144	RH	2	4	1.5	B	3.10	0.605	1.692	2.172
RSS1001	0.985	0.836	0.156	1.000	144	RH	2	4	1.5	B	3.10	0.605	1.692	2.172
RS-1105	1.130	1.020	0.125	0.200	144	RH	2	1	3.5	A	2.51	0.485	1.692	1.963
RS-1520	1.435	1.210	0.281	2.000	144	RH	2	4	1.5	B	5.26	1.005	2.621	3.400
RHS1520	1.435	1.210	0.281	2.000	144	RH	2	4	1.5	B	5.26	1.005	2.621	3.400
RS-1547	1.415	1.150	0.344	0.473	144	RH	2	1	2.5	B	4.32	0.875	2.621	2.909
RS-1504	1.515	1.379	0.156	0.250	144	RH	2	1	3.5	A	3.26	0.760	2.098	2.427
RS1502	1.535	1.265	0.312	0.500	144	RH	2	1	3.5	A	5.59	0.755	2.630	3.177
RLS1502	1.535	1.265	0.312	0.500	144	LH	2	1	3.5	A	5.59	0.755	2.630	3.154
RS-1501	1.480	1.143	0.344	1.000	144	RH	2	2	1.5	B	3.65	1.010	2.630	3.696
RHS1501	1.480	1.143	0.344	1.000	144	RH	2	2	1.5	B	3.65	1.010	2.630	3.696
RS-2002	2.045	1.723	0.375	0.500	144	RH	2	1	3.5	A	6.41	1.505	3.255	3.861
RLS2002	2.045	1.723	0.375	0.500	144	LH	2	1	3.5	A	6.41	1.505	3.255	3.861
RS-2001	2.045	1.723	0.375	1.000	144	RH	2	2	3.5	B	6.41	1.505	3.255	4.460
RS-2202	2.180	1.868	0.375	0.500	144	RH	2	1	3.5	A	6.71	1.570	3.380	3.995
RS-2502	2.545	2.222	0.375	0.500	144	RH	2	1	3.5	A	6.78	1.755	4.005	4.640
RS-2501	2.545	2.222	0.375	1.000	144	RH	2	2	3.5	B	6.78	1.755	4.005	5.274
RS-3066	2.950	2.483	0.500	0.660	144	RH	3	1	2.5	C	9.35	2.010	4.775	5.486

Dimensions in inches unless specified

13.2 RS Series (Inch, External Ball Return, Optional Flange) - Continued

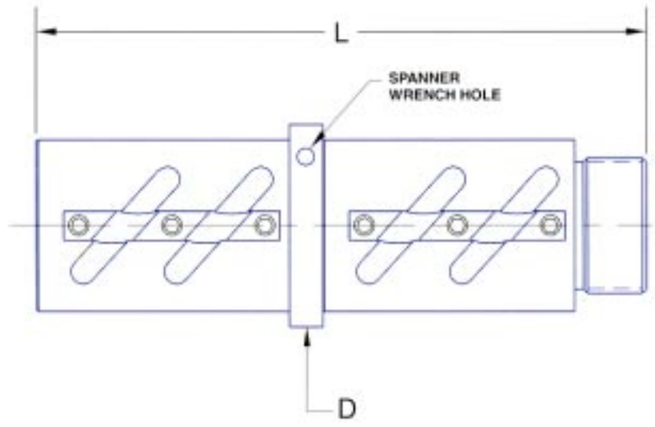


Items are sold as an assembly with customer journal requirements

E Max.	F Max.	G Max.	H "V" Threads	Flange Fig.	I Max.	J Max.	K1 Hole Dia.	K2 No. of Flange Holes & Bolt Circle Dia.
0.468	0.55R	--	11/16-24 UNEF-2A	1	0.350	1.650	0.177	(4) equally spaced on a 1.240 dia bolt circle
----	-----	--	11/16-24 UNEF-2A	1	0.350	1.650	0.177	(4) equally spaced on a 1.240 dia bolt circle
0.665	0.85R	--	15/16-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.667	0.86R	--	15/16-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.667	0.83R	--	15/16-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.787	0.80R	--	15/16-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.787	0.80R	--	15/16-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.797	0.80R	--	15/16-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.917	0.94R	--	1.173-18 UNS-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.959	0.90R	--	1.173-18 UNS-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.983	1.06R	--	1 1/4-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
0.983	1.06R	--	1 1/4-16 UN-2A	1	0.540	2.630	0.281	(4) equally spaced on a 2.090 dia bolt circle
1.191	1.12R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.190	1.05R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.185	1.09R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.185	1.08R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.191	1.12R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.200	1.17R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.199	1.10R	--	1 9/16-18 UNEF-2A	1	0.640	3.280	0.281	(4) equally spaced on a 2.750 dia bolt circle
1.281	1.22R	--	1 5/8-20 UN-2A	1	0.495	3.230	0.281	(4) equally spaced on a 2.702 dia bolt circle
1.576	1.68R	0.50	2 1/4-20 UN-2A	1	1.030	4.970	0.531	(4) equally spaced on a 4.125 dia bolt circle
1.576	1.68R	0.50	2 1/4-20 UN-2A	1	1.030	4.970	0.531	(4) equally spaced on a 4.125 dia bolt circle
1.916	1.61R	--	2.548-18 NS-2A	1	0.895	4.937	0.531	(4) equally spaced on a 4.062 dia bolt circle
1.733	1.53R	--	1.967-18 UNS-2A	1	0.815	4.410	0.397	(4) equally spaced on a 3.500 dia bolt circle
1.564	1.93R	0.46	2.360-18 UNS-2A	1	0.785	4.650	0.531	(4) equally spaced on a 3.875 dia bolt circle
1.566	1.88R	0.46	2.360-18 UNS-2A	1	0.785	4.650	0.531	(4) equally spaced on a 3.875 dia bolt circle
1.737	1.96R	--	2 1/4-20 UN-2A	1	1.030	4.970	0.531	(4) equally spaced on a 4.125 dia bolt circle
1.737	1.96R	--	2 1/4-20 UN-2A	1	1.030	4.970	0.656	(4) equally spaced on a 4.125 dia bolt circle
2.010	2.27R	0.50	3-12 UN-2A	3	1.536	5.410	0.656	(8) equally spaced on a 4.250 dia bolt circle
2.010	2.27R	0.50	3-12 UN-2A	3	1.536	5.410	0.656	(8) equally spaced on a 4.250 dia bolt circle
2.330	2.29R	0.50	3-12 UN-2A	3	1.536	5.410	0.656	(8) equally spaced on a 4.250 dia bolt circle
2.545	2.48R	0.50	3.137-12 UNS-2A	2	1.587	5.410	0.656	(6) equally spaced on a 4.375 dia bolt circle
2.371	2.77R	0.50	3 5/8-12 UN-2A	3	1.785	6.030	0.656	(8) equally spaced on a 5.000 dia bolt circle
2.381	2.66R	0.50	3 5/8-12 UNS-2A	3	1.785	6.030	0.656	(8) equally spaced on a 5.000 dia bolt circle
3.356	3.34R	0.50	4.325-12 UNS-2A	3	2.025	7.410	0.781	(8) equally spaced on a 6.250 dia bolt circle

Dimensions in inches unless specified

13.2 RS Series (Inch, External Ball Return, Optional Flange) - Continued



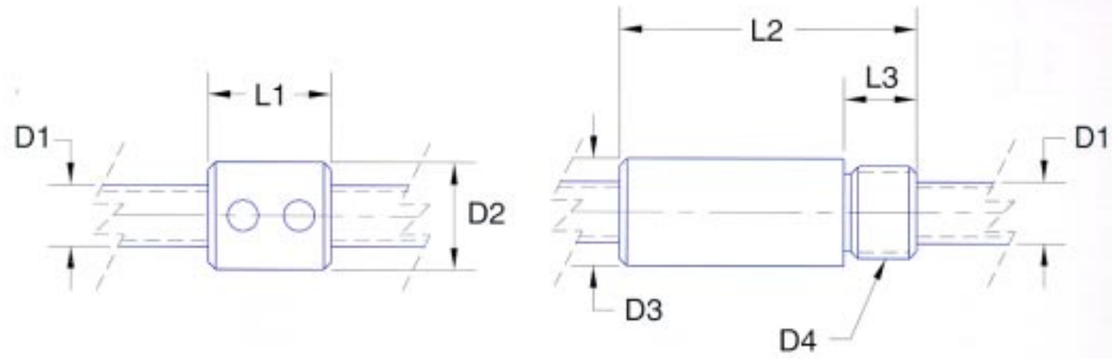
Items are sold as an assembly with customer journal requirements

Model No.	Dimensions			Spanner Wrench Hole Dia. (nom)	Adjusting Dia. (max) D	Preloaded Ball Nut Part No.	Recommended Preload		Maximum Preload	
	Max. Major Screw Dia.	Lead	L				Dynamic Load* (lbs)	Static Load (lbs)	Dynamic Load* (lbs)	Static Load (lbs)
RPS0308	0.375	0.125	4.13	0.203	0.375	8103-448-004	450	4200	350	4100
RPS0505	0.500	0.200	5.95	0.203	0.500	8105-448-008	1080	9280	840	9040
RPS0502	0.500	0.500	6.00	0.203	0.500	8105-448-009	1980	13130	1540	12690
RDS0605	0.625	0.200	3.55	0.203	0.625	8106-448-015	720	6070	560	5910
RES0605	0.625	0.200	3.55	0.203	0.625	8106-448-019	720	6070	560	5910
RPS0705	0.750	0.200	6.08	0.266	0.750	8107-448-012	1710	18610	1330	18230
RPS0702	0.750	0.500	6.18	0.266	0.750	8107-448-011	3150	23855	2415	23165
RPS1004	1.000	0.250	6.64	0.266	1.000	8110-448-017	3015	30415	2345	29745
RTS1004	1.000	0.250	6.64	0.266	1.000	8110-448-018	3015	30415	2345	29745
RPS1002	1.000	0.500	6.64	0.266	1.000	8110-448-016	3555	31905	2765	31115
RPS1001	1.000	1.000	6.52	0.266	1.000	8110-448-015	2025	13525	1575	13075
RPS1105	1.125	0.200	5.50	0.266	1.125	8111-448-004	2160	27310	1680	26830
RPS1520	1.435	2.000	11.25	0.437	1.435	8115-448-059	6840	28240	5320	26720
RJS1520	1.435	2.000	11.25	0.437	1.435	8115-448-060	6840	28240	5320	26720
RPS1504	1.500	0.250	7.00	0.437	1.500	8115-448-012	3645	47045	2835	46235
RPS1502	1.500	0.500	12.10	0.437	1.500	8115-448-006	11610	101010	9030	98430
RTS1502	1.500	0.500	12.10	0.437	1.500	8115-448-007	11610	101010	9030	98430
RPS1501	1.500	1.000	8.16	0.437	1.500	8115-448-011	7425	46975	5775	45325
RPS2002	2.000	0.500	13.92	0.500	2.000	8120-448-006	17235	154635	13405	150805
RTS2002	2.000	0.500	13.92	0.500	2.000	8120-448-007	17235	154635	13405	150805
RPS2001	2.000	1.000	13.90	0.500	2.000	8120-448-023	19755	152605	15365	148215
RPS2202	2.250	0.500	14.22	0.437	2.250	8122-448-003	17370	159220	13510	155360
RPS2502	2.500	0.500	14.79	0.437	2.500	8125-448-006	19080	183880	14840	179640
RPS2501	2.500	1.000	14.79	0.437	2.500	8125-448-004	24210	199910	18830	194530
RPS3066	3.000	0.666	19.92	0.500	3.000	8130-448-004	34200	320150	26600	312550

*Load rating is reduced by the preload force amount when compared to standard RS Series.

Dimensions in inches unless specified

13.3 M Series (Inch, Internal Ball Return, Miniature-Fine Lead)



Series M- Industrial Grade (.006"/ft)

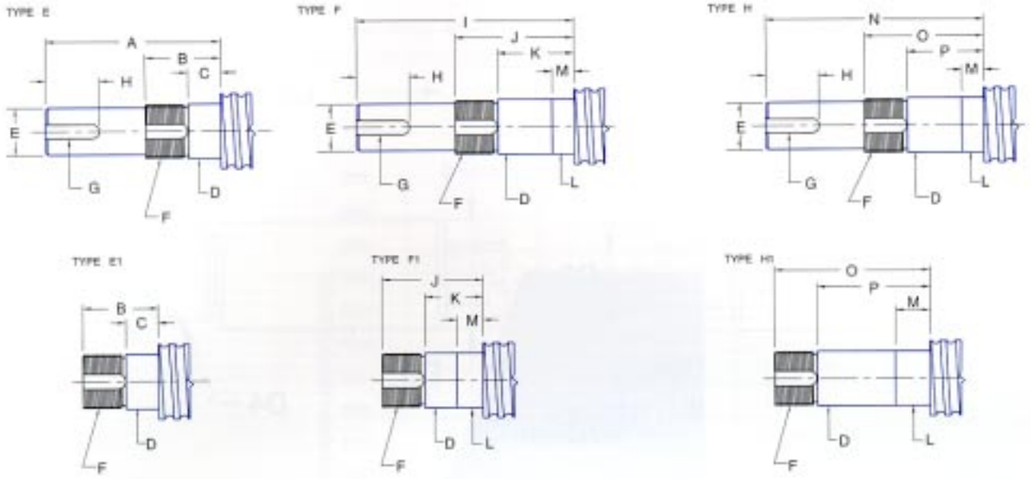
Model No.	Screw Major Dia. (D1)	Minor Dia. (ref)	Lead (RH)	Nom. Ball Dia.	D2	L1	D3
M-0305	0.187	0.154	0.0500	0.0394	.5000	0.62	0.689
M-0306	0.187	0.154	0.0625	0.0394	.5000	0.62	0.689
M-0505	0.312	0.278	0.0500	0.0394	.5935	0.75	0.752
M-0510	0.298	0.248	0.1000	0.0625	.7000	0.85	0.877

Series M- Industrial Grade (.006"/ft)

Model No.	L2	L3	D4	Nom. Axial Play (backlash) (singlenut)	Max. Static Capacity (lbs) Single Nut Double Nut	Dynamic Load 10" Travel (lbs) Single Nut Double Nut
M-0305	1.853	0.270	9/16-24	0.002	94	28
M-0306	1.853	0.270	9/16-24	0.002	94	28
M-0505	2.135	0.270	11/16-24	0.002	162	37
M-0510	2.447	0.332	13/16-20	0.002	236	64

Dimensions in inches unless specified

13.4 Standard End Journals

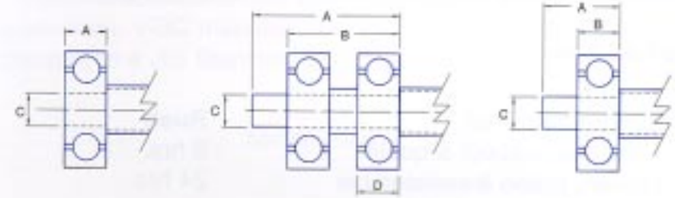


Model No.	SCREW DIA.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
RS0605 RLS0605 RMS1605A	0.625	2.10	0.812	0.331	.4726/.4723	.406/.405	.469-32	0.125	0.625	3.00	1.70	1.225	.4756/.4753	0.500	3.79	2.49	2.014
RS0705C1 RS0705 RS0702 RSS0702	0.750	2.48	0.940	0.449	.5908/.5905	.500/.499	.586-32	0.125	0.625	3.54	2.08	1.586	.6153/.6150	0.625	4.60	3.22	2.729
RS1004C1 RLS1004C1 RS1004A RLS1004A RS1002 RS1001 RMS2505A RMS2510A RMS2525A	1.000	2.63	1.040	0.489	.7877/.7873	.625/.624	.781-32	0.187	0.625	3.88	2.23	1.665	.8122/.8119	0.625	5.13	3.51	2.964
RS1105	1.125	2.96	1.125	0.528	.9846/.9842	.750/.749	.969-32	0.187	1.250	4.33	2.46	1.869	1.0006/1.0003	0.750	5.71	3.64	3.050
RS1501 RS1504 RS1502 RLS1502 RMS4005A RMS4010A	1.500	2.96	1.150	0.567	1.1814/1.1810	1.000/.999	1.173-18	0.250	1.500	4.33	2.53	1.947	1.2059/1.2056	0.750	6.71	4.33	3.758
RS2002 RLS2002 RS2001 RMS5010A	2.000	3.94	1.300	0.646	1.5752/1.5747	1.375/1.374	1.563-18	0.312	2.000	5.50	2.88	2.230	1.5997/1.5994	0.875	8.38	5.31	4.671

Dimensions in inches unless specified

13.5 Standard End Journals - Miniature- Fine Lead Series

Type AA **Type BB** **Type CC**

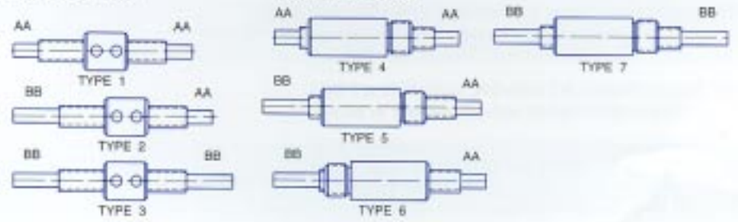


P– Series	Type AA		Type BB				Type CC		
Model No.	A	C	A	B	C	D	A	B	C
P-0405	0.156	.1876/.1873	1.125	0.625	.1876/.1873	0.156	0.50	0.156	.1876/.1873
P-0410	0.156	.1876/.1873	1.125	0.625	.1876/.1873	0.156	0.50	0.156	.1876/.1873
P-0610	0.218	.2501/.2498	1.750	0.937	.2501/.2498	0.218	0.75	0.218	.2501/.2498
P-0805	0.218	.3751/.3748	1.875	1.000	.3751/.3748	0.218	0.75	0.218	.3751/.3748
P-0810	0.218	.3751/.3748	1.875	1.000	.3751/.3748	0.218	0.75	0.218	.3751/.3748
P-1210	0.250	.5002/.4999	2.375	1.250	.5002/.4999	0.250	1.00	0.250	.5002/.4999

M– Series	A	C	A	B	C	D	A	B	C
M-0305	0.156	.1250/.1246	1.000	0.562	.1250/.1246	0.156	-----	-----	-----
M-0306	0.156	.1250/.1246	1.000	0.562	.1250/.1246	0.156	-----	-----	-----
M-0505	0.156	.1875/.1871	1.125	0.625	.1875/.1871	0.156	-----	-----	-----
M-0510	0.156	.1875/.1871	1.125	0.625	.1875/.1871	0.156	-----	-----	-----

Dimensions in inches unless specified

SINGLE NUT **DOUBLE NUT**



14. Service and Repair

RBC has repaired ball screws on the equipment of virtually every machine tool manufacturer. We are conveniently located in Walterboro, SC which provides easy access from much of the US and especially the Southeast. We specialize in responding to your repair needs quickly to keep your critical equipment operating. Our complete ball screw repair service is designed to meet your demanding lead time requirements.

Repair lead times

Service required	Rush	Normal
• Receive, inspect & quote	8 hrs.	24 hrs.
• Clean, polish & reassemble with stock components	24 hrs.	48 hrs.
• Clean, polish, regrind shaft or ball nut and reassemble	3 days	1 week
• Restore end journal diameters	1 week	2 weeks
• Clean, polish, mfg. new ball nut or screw shaft and reassemble	4 weeks	6 weeks
• Polish, mfg. new ball nut or screw shaft, regrind other screw or nut and reassemble	4 weeks	6 weeks

Warranty

All ball screws are repaired by highly skilled personnel using materials that meet or exceed the original equipment manufacturers specifications. We guarantee all workmanship on repaired ball screws for one year of service.

15. Glossary

Axial play (backlash) – The free motion between the ball nut and screw shaft without rotation between the components.

Axial rigidity – The resistance of the ball screw assembly to axial deflection under load.

Backdriving – The ability of the ball nut or screw shaft to rotate when an axial thrust load is applied to the opposite member of the assembly.

Ball bearing – The integral part of the ball screw assembly, interspaced in the helical annulus between the nut and screw shaft which transmits axial motion under load and conforms to the accuracy of the ball path created by the assembly of the nut, screws shaft and ball.

Spacer ball (idler) – A ball that acts as an idler tending to prevent skidding or friction resulting from the interplay between load balls. The diameter of which is smaller than the adjacent load balls and carries no axial thrust load.

Ball circuit – The helical groove between the nut and screw shaft in which a specified number of recirculating balls travel, transmitting the load reaction between the nut and screw shaft.

Ball groove (ball track) – The helical groove of a ball nut and ball screw shaft which transmits the load reaction between the ball nut, ball screw and ball bearings.

Ball return system – The method of recirculating the ball bearings within a ball circuit.

Ball return (internal) – A means of recirculating the balls within a circuit by means of a crossover deflector, which is within the outside diameter of the ball nut body.

Ball return (external) – The utilization of a return tube external to the nut body to accomplish recirculation of the balls within a circuit.

Ball screw shaft – The male helical threaded member of a ball screw assembly.

Circuit – The closed path of recirculating balls in a ball nut.

Circuit (single) – A ball nut with only one closed path for recirculating balls.

Circuit (multiple) – A ball nut with two or more closed paths, each containing recirculating balls.

Column load – The axial compressive load applied to either the ball nut or screw shaft.

Column load (maximum) – The maximum compressive load that can be applied without permanent structural deformation.

Compensation – The ability of an electro-mechanical system to "remember" the actual characteristics of a ball screw assembly; lead accuracy, backlash, repeatability and then adjust by programming these parameters.

Concentricity – The relative tolerance of one diameter to another about a common axis.

Conformity – Ratio of ball track radius to the ball bearing diameter.

Contact angle – An angle formed by a line perpendicular to the screw shaft axis and a line drawn through the all contact points in the screw shaft ball track and the ball nut track.

Critical speed – Rotational speed of a ball nut or ball screw shaft that produces a resonant vibration of the ball screw shaft.

Deflection (elastic deformation) – The deformation of the ball screw assembly given an applied load.

Deviation – An actual quantitative measurement that is other than specified.

Dimension – Specified quantitative measure and tolerance.

Drag torque – The actual force measured at a radius of a ball screw assembly with or without wipers.

Drive torque – The actual force (including drag torque) to actuate the ball screw assembly.

Drunkenness – The characteristic of a ball screw assembly under load and rotation. The plane at the interface deviates in both concentricity and perpendicularity.

Dynamic axial load rating – The constant centric axial load that the ball screw can theoretically withstand for a basic rating life of one million revolutions.

Efficiency – 90 – 95% for ball screws measured by the following criteria; load, stroke, surface finish, RPM & lubrication.

End journal – The portion of the ball screw upon which is mounted the support bearings; and is specified to conform to particular standards of concentricity, parallelism, perpendicularity and classified by grades.

Equivalent load- The mean load derived from the combination of varying loads that results in a life measured in terms of inches or cycles.

Fatigue life – Life of the ball screw assembly under the condition of a varying/reversing load measured in inches or cycles.

Friction – The resistance to relative motion, rolling or sliding, between the ball nut, ball bearings and screw shaft. Normally in the range of .0025 to .0035 for ball screws.

Full radius – A ball track cross section of the ball nut or ball screw shaft whose opposing flanks are of similar radius and are measured from a common center.

Gothic Arch (ogival) – A ball track cross section of either the ball nut or ball screw shaft whose opposing flanks are of similar radius, but offset from the center.

Hardness – The property of substances determined by their ability to abrade or indent one another. Typically, Rockwell "C" or Brinell measurement is used for obtaining a numerical value based on a metals resistance to permanent indentation.

Heat treatment – The combination of heating and cooling operations applied to a metal or alloy in the solid state to obtain desired conditions or properties; induction, nitriding, carburizing, etc.

Inertia of Screw – Half the product of the mass times the square of the screw radius.

Land – Area between two adjacent ball tracks on the screw shaft or ball nut.

Lead – The axial distance between a point on a thread to the corresponding point on the next thread.

Lead (actual) – The measured lead of the ball screw thread from a specified starting point to a corresponding point within a specified length.

Lead error (accumulated) – The summation of lead error over a specified length of travel, measured by the actual travel of the ball nut or accumulation of lead error of the threaded screw.

Lead error – The error in lead length per turn, per inch, per foot or overall compared to the basic lead specified.

Life – The usable life of a ball screw assembly given in terms of inches of travel.

Lubrication – Oil, grease or dry film medium used to reduce friction, enhance life and dissipate heat.

Multiple thread – A screw shaft with two or more independent threads.

Nominal diameter – Specified diameter without tolerance.

Parallelism – The relationship of the axial length of diameters to a reference axial length.

Pitch – The distance from a point on a ball track to a corresponding point on the next track, parallel to the ball screw or ball nut axis.

Pitch diameter (Ball circle) – The nominal diameter of a theoretical cylinder passing through the centers of the balls when they are in contact with the ball screw and ball nut tracks.

Precision – Term used to describe the degree of manufacturing accuracy.

Preload – The use of one group of ball grooves in opposition to another to eliminate axial backlash and increase stiffness of a ball nut assembly.

Radial load – Load acting at a radius perpendicular to axis of rotation.

Radial play (sideplay) – Total free radial motion between the ball nut and screw shaft without rotation between the two components

Reversibility – The ability of a ball screw assembly to reverse direction.

Runout – Diametral measure 360 degrees of a given diameter to a reference axis of rotation.

Single start – A ball screw having the lead equal to the pitch.

Spring rate – A measure of stiffness. Ball screw spring rate is equal to the load divided by the linear deflection. Total system spring rate is the reciprocal of the sum of the reciprocal spring rate of the individual members.

Stiffness – Resistance to deflection.

Static load rating – The static centric axial load that corresponds to a total permanent deformation of the ball bearing and ball track at the most heavily stressed contact of 0.0001" of the ball bearing diameter.

Stops – Interference elements, effective at the end of the ball nut travel, which prevents accidental disassembly.

Stroke – The axial distance in either direction that the screw and nut travels in moving the load.

Temperature range – Allowable operating environment range; -60 to 250 degrees F.

Thermal expansion – The growth diameter and length as a result of elevated temperatures caused by the absorption of heat.

Tolerance limits – The bandwidth of allowable manufacturing dimensions from a nominal design specified value.

Torque – Force applied at a radius commonly measured in "in-lbs or Newton-meters."

Travel – The axial distance traversed by the screw or nut in one direction.

Turns – The number of revolutions that the ball nut track makes about the screw axis one Circuit.

Vee-thread – Threaded portion of ball nut or screw shaft.

Variation – Rate of change in relation to a specified condition.

Velocity – Refers to ball velocity within the ball track.

Wipers – Protecting elements included in the ball nut to exclude foreign material and improve the retention of lubricate.

Wobble error – The total variation peak-to-peak, in lead error for one revolution of the ball nut.

16. Conversion Factors

a) Length

1 m	=	39.37 in
1 m	=	1,000 mm
1 in	=	25.4 mm

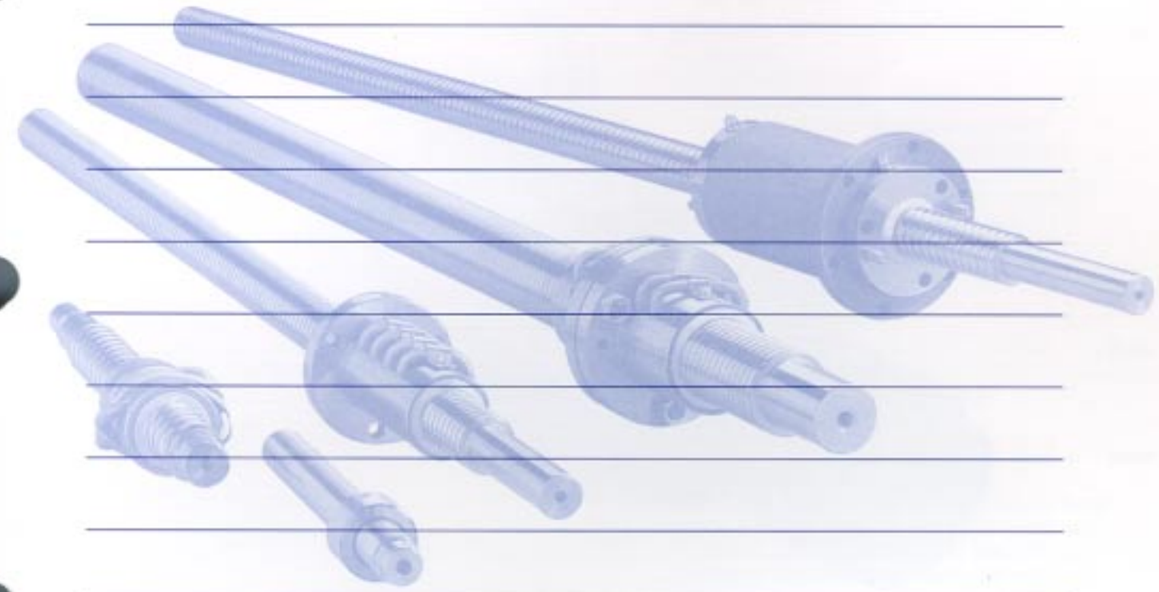
b) Force

1 N	=	.22481 lb
1 N	=	3.5969 oz
1 kgf	=	2.2046 lb
1 kgf	=	35.274 oz
1 lb	=	16 oz
1 lb	=	4.4485 N

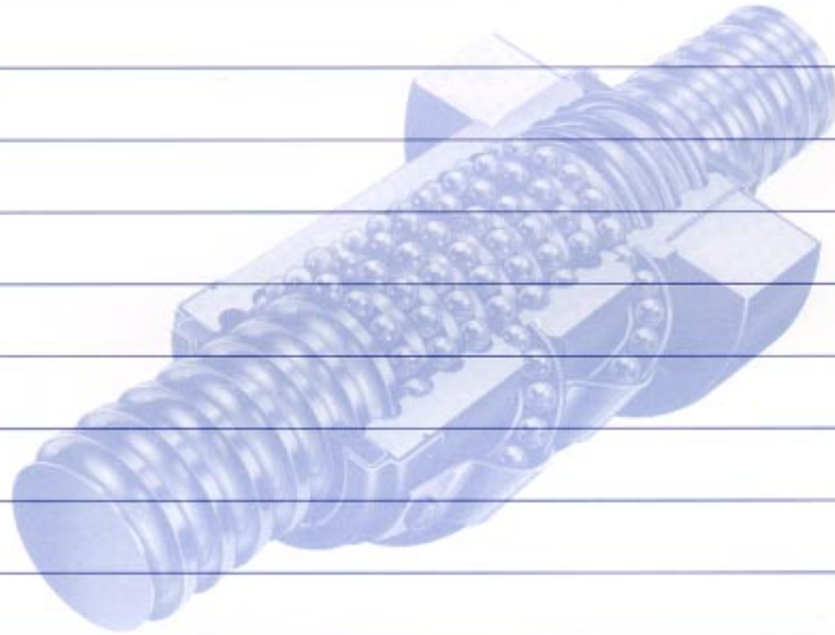
c) Torque

1 N-m	=	8.85075 in-lb
1 N-m	=	141.612 in-oz
1 kgf-cm	=	.8681 in-lbs

Notes



Notes



17. Application Data Form

BALL SCREW APPLICATION DATA FORM

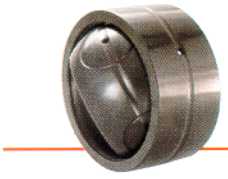
Customer: _____ Customer Part No. _____
Phone No. _____ RBC Part No. _____
Contact: _____ Date: _____ Eng. _____

1. Mounting:
   - A. Horizontal _____
     - 1. Reversible load? _____
   - B. Vertical _____
     - 1. Counter balanced? _____ Amount: _____ (lbs. or N)
   - C. Universal _____
2. Rotating member: _____ Ball screw _____ Ball nut
3. Major diameter required: _____
4. Lead required: _____ (RH or LH)
5. Lead accuracy required: _____ "/ft (cumulative)
6. Preloaded: _____ Yes _____ No Amount: _____ (lbs. or N)
7. Nominal operating load: _____ (lbs. or N)
8. Maximum dynamic load: _____ (lbs. or N)
9. Maximum static load: _____ (lbs. or N)
10. Maximum travel rate: _____ (in/min or RPM)
11. Life expectancy: _____ (inches of travel)
12. Required stroke: _____
13. Strokes/hr: _____
14. Hrs/day: _____
15. Days/yr: _____
16. End journal configuration: Rigid/Rigid Rigid/Simple Rigid/Free Simple/Simple
17. Unsupported length: _____
18. Required ball return system: _____ Internal _____ External _____ Optional
19. Lubrication (oil, grease): _____
20. Operating temperature range: _____

RBC BEARINGS

Innovation. Commitment. Quality.

RBC has been producing bearings in the USA since 1919. In addition to unique custom bearings, RBC offers a full line of standard industrial and aerospace bearings, including:

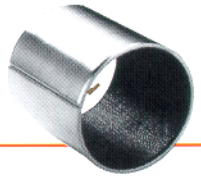


Spherical Plain Bearings

Radial, angular contact, extended inner ring, high misalignment. **QuadLube®**, **ImpactTuff®**, **SpreadLock® Seal**, **CrossLube®** bearings, and self-lubricating bearings. Available in inch and metric sizes.

Thin Section Ball Bearings

Standard cross sections to one inch. Sizes to 40 inches. Stainless steel and other materials are available. Seals are available on all sizes and standard cross sections.



Self-Lubricating Bearings

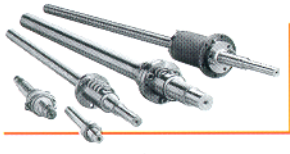
Radial, thrust, rod ends, spherical bearings, high temperature, high loads. Available in inch and metric sizes.

Airframe Control Bearings

Ball bearing types, self-lubricating types, needle roller track rollers.

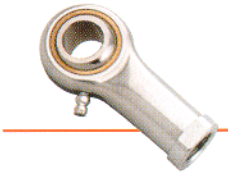
Pins and shafts

RBC manufactures all types of pins, needle rollers, shafts, and rollers.



Ball Screws

Precision ground, rolled, ball splines. Long life, low wear, high accuracy. **QuickTurn™ Ball Screw Repair Service.**

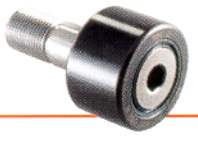


Rod Ends

Commercial and industrial, precision, Mil-Spec series, self-lubricating, and aircraft. Available in inch and metric sizes.

Ball Bearings

Precision ground, semiground, unground. High loads, long life, smooth operation. Offered in caged and full complement configurations.



Cam Followers

Standard stud, heavy stud, yoke type, caged roller followers. Patented **RBC Roller®** cylindrical roller cam followers, **HexLube®** universal cam followers, airframe track rollers.

Needle Roller Bearings

Pitchlign® caged heavy duty needle roller bearings, inner rings, **TJ TandemRoller®** bearings for long life.

Tapered Roller Bearings

Case-hardened in a variety of sizes. Used in Class 8 heavy truck and trailer wheel bearings, gearboxes, and final drive transmissions.

Specials

RBC manufactures many specialty bearings for the aerospace, oil and energy, semiconductor equipment, packaging, heavy truck, and other industries.

RBC BEARINGS

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