Self Lubricating Bearings

RBC Bearings is the leader in self-lubricating technology with our patented Fiberglide® liners. We produce a broad line of standard inch and metric self-lubricating bearings in journal and thrust configurations. This unique bearing product offers the user design freedom as well as cost benefits from its “maintenance free” characteristics.

The self-lubricating thrust and journal bearings are suited for applications where normal lubrication is difficult or costly. Fiberglide® lined thrust and journal bearings are designed to be used under oscillating motion, interrupted start-stop, or axial motion. They are recommended where high loads are combined with low surface speeds. Fiberglide® products can also be used where non-lubricating fluids might be present.

Self Lubricating Bearings Selection Guide

Type	Description	Dimensions	Applications
	CJS Journal bearings, coiled steel backing, zinc plated.	Nom. shaft diameter- .375 to 10.000 Bearing length- . 250 to 6.50 Wall thickness- .045 to .093	The CJS bearing works excellent in any pivot or linkage application. For construction and farm equipment, this product is typically used in kingpins, rock shafts, differentials, hinges, pedals and many other pivot points.
	CJT Journal bearings,thin walled, coiled steel backing, zinc plated	Nom. shaft diameter- .500 to 10.000 Bearing length- .375 to 6.50 Wall thickness - .060	This bearing is designed as a direct replacement with conventional 1/16" wall bushings. These bearings are used in self-lubricated chain, variable speed sheaves, boom pivot points on fork lifts and many similar applications.
	CJH Journal bearings, heavy walled, coiled steel backing, zinc plated	Nom. shaft diameter- .750 to 10.000 Bearing length - .375 to 11.00 Wall thickness - .125	This bearing is designed as a direct replacement with the conventional 1/8" wall bronze bushings. Typical applications include suspension points on large trucks and railroad cars. These products are also used in the boom foot pivot of large cranes.
	CJM Metric Journal bearings, coiled steel backing, zinc plated	Nom. shaft diameter- 8MM to 120MM Bearing length- 8MM to 165MM Wall thickness- 1.0 to 2.5MM	This product is the metric equivalent to the CJS product and used in similar applications.
	LJS Journal bearings, liner type, non-metallic	Nom. shaft diameter- 1.000 to 12.000 Bearing length- .375 to 6.50 Wall thickness- .022 to .062	These bearings are used in many harsh applications and in food handling machinery. Typical applications include butterfly valves and trunnion support pivots. This product is also used in sheaves and hoists for marine applications.
	FTS Thrust bearings, metal-backed, single sided	Nom. shaft diameter- .250 to 3.250 I.D. - .280 to 3.312 O.D. - .500 to 4.875 Thickness- .030 to .060	These bearings accommodate thrust in clutches, hospital beds, screw jacks, valve actuators, vehicle suspensions, and many other applications.

	LTD Thrust bearings, laminated phenolic-backed, double-sided	Nom. shaft diameter- .250 to 3.250 I.D. - .280 to 3.312 O.D. - .500 to 4.875 Thickness- .030 to .094	These bearings are used in cam actuator arms, turntable support bearings, exercise equipment, truck differentials and many other applications.
	FTP Thrust packs, Two piece assembly	I.D. - 1.000 to 3.000 O.D. -1.750 to 4.625 Thickness- .130	These bearings are used in articulated frame joints, pivot arm supports, kingpins and many other applications.
	SJR Sealed Journal Brgs. solid cold rolled steel sleeve with two polyurethane seals.	Nom. shaft diameter- 1.000 to 5.000 Bearing length- 1.000 - 4.000 Wall thickness- .250 - .375	These bearings are used in crane boom foot positions, wheels and pallet jacks, frame supports for large trucks and other construction equipment and many other applications.

Self Lubricating Bearings

Engineering Data

Many factors affect the overall performance of FIBERGLIDE® bearings. Those of primary concern include applied load, surface velocity, operating mode, surface temperature, mating surface finish and running clearance.

All performance values referred to in this section are based on dry operation. When running in a fluid atmosphere, FIBERGLIDE® bearings may have limitations. Where application requirements exceed those shown, consult Transport Dynamics engineering department for specific recommendations.

FIBERGLIDE® lined bearings are designed to be used under oscillating motion, interrupted start-stop, or axial motion. They are recommended where high loads are combined with low surface speeds.

Design Calculations

(journals-oscillating motion) CPM=cycles per minute

Proj. Area (sq.in.) =

Shaft Dia. Max (or Nom. I.D.) x length

P Pressure (psi) =

Load (Lbf) ÷ by Proj. Area

V. Velocity (FPM) =

Shaft Dia. Max x π /12 X 4 x osc. Angle° x CPM/360

Bearing Wear

Bearing wear is affected by many factors. For the most part, tests conducted by Transport Dynamics subject journal bearings to 20,000 psi loads with the bearing fixed and the shaft oscillating. The values shown in the charts on page 6 are representative of the normal wear rate range that can be expected when amplitude is ±45°, frequency is 10 CPM, and shaft finish is 16 RMS under room temperature conditions.

It will be noted that a wear-in period takes place during the first few thousand cycles. During this period some PTFE is transferred to the mating surface. In addition, the fibers are generally reoriented, the high points of the weave are flattened and adjacent fibers tend to blend together. After the break-in period, the bearing surface will become smooth and shiny.

Because of the many variables which influence wear, it is extremely difficult to project bearing life for all types of applications. For this reason, the Transport Dynamics Engineering Department should be consulted when questions of this nature arise. Wear life calculations are based on rubbing distance of travel.

Bearing Load Limits

Static Pressure Limit (Constant pressure*)
10,000 psi with phenolic backing
30,000 psi with steel backing

Dynamic pressure limits while oscillating
20,000 psi suggested maximum.

Velocity Limit

Under dry running conditions, the maximum allowable surface velocity will depend on the applied load and other operating parameters. In general, surface speed should be kept below 35 FPM (Feet Per Minute) at 10,000 psi load or 600 FPM at 100 psi load.

PV Factor

For plain, dry-running bearings, it is often helpful to reference a pressure-velocity (PV) factor as a guide in determining bearing capability. It should be understood that this factor is actually a variable which reflects the point where surface temperatures are at a maximum, but are still stable. The maximum PV established for FIBERGLIDE is:

PV continuous-60,000
PV intermittent-150,000

Temperature Limit

Normal operating temperatures should be kept below 300°F for standard FIBERGLIDE® bearings. An increase in wear rates may be experienced at temperatures above 350°F. Note that at elevated operating temperatures, the PV limit will be decreased in order to prevent the surface temperature from exceeding 300°F, (environmental temperature plus friction heat generated). When temperatures exceed 300°F or fall below -200°F, consult Transport Dynamics Engineering Department for specific recommendations.

Coefficient of Thermal Expansion

When bonded to a metal backing, FIBERGLIDE's coefficient of expansion can normally be regarded as identical to that of the backing, with steel backing 8.4 x 106 in/in/°F.

Mating Surfaces

FIBERGLIDE, being non-metallic, will operate against most metals, but better performance is obtained with the hardest available mating surfaces. Hardened steel, hard anodized aluminum, hard chrome or nickel plate are recommended. A surface hardness of 45-50 R_c is desirable, but satisfactory performance can also be obtained with softer materials. Generally, a surface finish on the mating components of 16-32µ inch should be provided. Shaft materials or surface treatments should be selected that will effectively resist corrosion. Transport Dynamics recommends a max surface finish of 32 Rms and minimum hardness of 40Rc.

To determine the approximate reduction in life for different values of shaft finish and hardness, see below.

Surface Finish µ in.	Life Factor	Hardness Rockwell Reading	Life Factor
8-16	1.00	R_c50	1.00
32	0.55	R_c40	0.60
63	0.20	R_c30	0.40

Coefficient of Friction

Coefficient of friction depends upon type of movement, finish of mating surface, ambient temperature, bearing pressure, velocity and other variables. Figs. 1,2, and 3 were obtained from flat specimens and may be used as a guide. Note in Fig. 1 that the coefficient drops off as bearing load increases. This offers the advantage of using the smallest bearing sizes to obtain the least amount of friction. Fig. 3 shows the coefficient of friction increasing as surface velocity increases from 2-20 FPM. This feature is particularly valuable for vehicle steering systems.

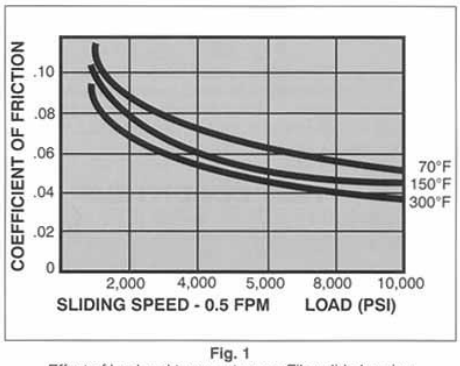


Fig. 1
Effect of load and temperature on Fiberglide bearing

Contamination

FIBERGLIDE® can tolerate small amounts of dirt, but reduced bearing life will result. Optimum life is achieved if dirt or abrasive particles are excluded. If a dirty environment is likely, we recommend installation of a simple seal.

Running Clearance

As a general rule, close running fits, and often slight interference fits (.0005 in.) are selected for oscillating motion when minimum starting torque is less important than the elimination of free play. For constant rotation, a free-running fit is normally recommended, the exact amount depending on bearing bore size. A rule of thumb would be 0.0015 inches per inch of bore (bearing installed).

Bearing Housing and Shaft Sizing

Standard FIBERGLIDE® journal bearings (CJS/CJT/CJM/CJH/SJR Type) are installed into the housing bore using a press fit. Recommended housing bores should be held to the tolerance shown to insure the proper fit and size.

The LJS Type bearing is hand slip fit into its recommended housing bore to provide optimum fit-up. CJS/CJT/CJM/CJH types can also be provided for slip fits on special order.

RBC Transport Dynamics offers a special service to properly size housing and shaft for each new application. Contact RBC Transport Dynamics Engineering Department for details.

Fluid Compatibility

FIBERGLIDE® can tolerate most fluids or contaminants found in bearing applications, although some reduction of dry bearing life will result. Fluids tend to flush PTFE solid particle lubricants out of the bearing. Grease tends to act as a magnet to attract and retain dirt. Following are some of the environments in which these bearings have operated successfully:

- Hydraulic Oils
- Mild acids
- Greases
- Gasoline
- Lubricating oils
- Detergent solutions
- Ammonium hydroxide
- Liquid Nitrogen
- Seawater
- Toluene
- Kerosene

Metric Technical Data Conversions

Common Values Used in Fiberglide Catalog Converted to Metric Units from Imperial Units

Fiberglide Bearing Load Limits:	
Static Pressure Limits (Constant)	
Phenolic Backed:	10,000 psi = 69 N/mm²
Steel Backed:	30,000 psi = 207 N/mm²
Dynamic Pressure Limits (Oscillating)	
Phenolic Backed:	10,000 psi = 69 N/mm²
Steel Backed:	20,000 psi = 138 N/mm²
Velocity Limit:	
Surface Speed Should be Kept Below 35 ft/min at 10,000 psi = 0.175 m/s at 69 N/mm²	
or 600 ft/min at 100 psi = 3 m/s at 0.69 N/mm²	
PV Factor:	
Max Continuous PV	60,000 psi-ft/min = 2.07 N/mm²-m/s
Max Intermittent PV	150,000 psi-ft/min = 5.175 N/mm²-m/s
Temperature Limit:	
Normal Operating Temperature Should Be Kept Below 300°F = 149°C	
Increased Wear Rates May Be Experienced Above 350°F = 177°C	
Consult TD Engineering Dept. When Temperature is Below -200°F = -129°C	
Mating Surfaces:	
Surface Finishes	8 µ in = 0.2 µ m
	16 µ in = 0.4 µ m
	32 µ in = 0.8 µ m
	63 µ in =1.6 µ m
Running Clearance:	
Slight Interferrence Fit Recommended for Oscillating Motion	.0005 in = .0127 mm

Free-Running Fit Recommended for Constant Rotation	.0015 in/in of bearing ID	.0015 mm/mm of bearing ID
Test Conditions:		
Bearing ID	1.00 in = 25.4 mm	
Bearing Length	0.50 in = 12.7 mm	
Bearing Loads	2,500 lb = 562.5 N	
	5,000 lb = 1125 N	
Bearing Pressures	5,000 psi = 34.5 N/mm²	
	10,000 psi = 69 N/mm²	

Fiberglide-Fabroid:

A Comparison of FIBERGLIDE and FABROID Bearings with Other Self-Lubricating Types

	Metal-Backed Fiberglide	Metal-Backed Fabroid	Filled PTFE	PTFE Impreg-nated Bronze	Oil Impreg-nated Bronze
Typ. Dynamic Load (psi)	2,000 to 10,000	5,000 to 20,000	0 to 500	500 to 3,000	100 to 2,000
Typ. Dynamic Load (N/mm²)	13.8 to 69	34.5 to 138	0 to 3.45	3.45 to 20.7	0.69 to 13.8
Max. Static Load (psi)	30,000	60,000 [1)]	2,500	20,000	11,000
Max. Static Load (N/mm²)	207	414	17.25	138	75.9
Maximum PV Value (psi-ft/min)	50,000	60,000	10,000	50,000	50,000
Maximum PV Value (N/mm²-m/s)	1.725	2.07	0.345	1.725	1.725
Temperature Range (°F)	-320 to +300	-320 to +400	-400 to +500	-320 to +500	-65 to +250
Temperature Range (°C)	-196 to +149	-196 to +204	-240 to +260	-196 to +260	-54 to +121

[1)] For Low Speed Oscillating Conditions-static loads over 30,000 psi (N/mm²) or dynamic loads over 20,000 psi (N/mm²) require metal backing of high strength stainless steel or equivalent materials.

Bearings-Installation:	
Journal Bearings	
Min. Housing Lead-in Chamfer	.050 in = 1.27 mm

Min. Shaft Lead-in Chamfer	.125 in = 3.175 mm
or	
Min. Shaft Corner Radius	.060 in = 1.524 mm
Thrust Bearings	
	Allowable Corner Radius of Stepped Shafts Through ID of
FTS	.015 in = .381 mm
LTD	.030 in = .762 mm

General Formulas for Metric Conversion of All Imperial Units in Fiberglide Catalog

Measurement	Imperial Unit	Conversion Factor	Metric Unit
Distance	in	25.4	mm
Load (Force)	lb	0.225	N
Pressure	psi	0.0069	N/mm^2 = MPa
Temperature	°F	-32 x $^5/_9$	°C
Projected Area	in^2	645.16	mm^2
Surface Velocity	ft/min	0.005	m/s
PV	psi-ft/min	3.45E-05	N/mm^2-m/s
Surface Finish	µ in	0.025	µ m

Example: 5,000 psi x 0.0069 = 34.5 N/mm^2

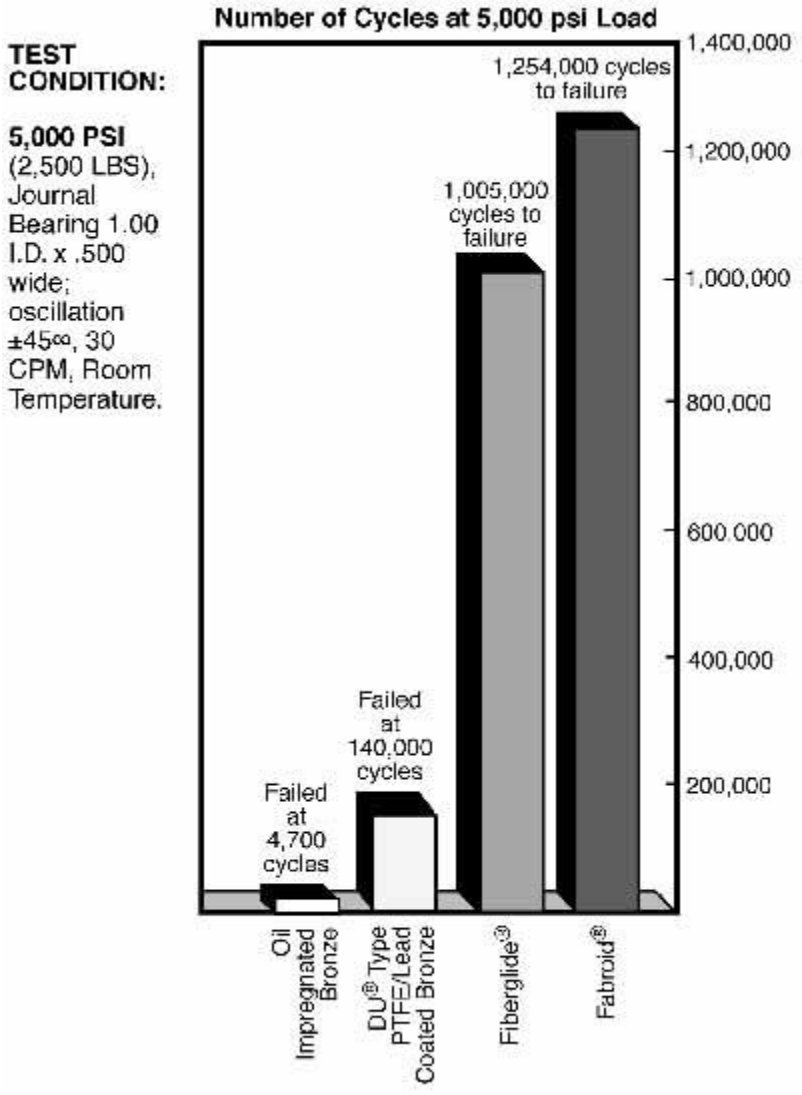
Tests

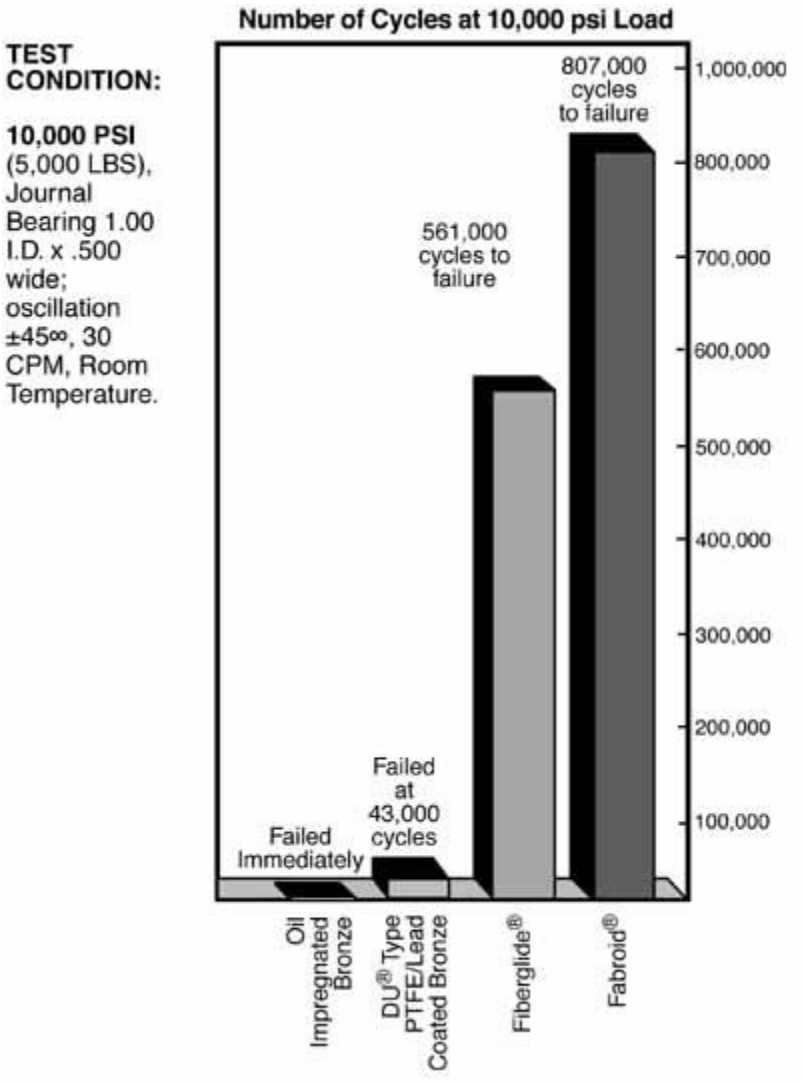
- 5,000 psi load
- 10,000 psi load

Tests were conducted to compare the load carrying capability and wear life of four standard self-lubricating bearing products. Transport Dynamics performed all testing on the same test machine and fixturing. Standard FIBERGLIDE® and FABROID® products are presented herein. Transport Dynamics offers other self-lubricating bearing products capable of dynamic loading to 40,000 psi and ultimate static loading to 120,000 psi.

Test Conditions

The bearings were placed under a fixed load with an oscillating shaft. The test bearing size was 1.00 inch I.D. by .500 inches long. The test conditions were 10,000 psi (5,000 lbs.) and 5,000 psi (2,500 lbs.) loads with an oscillation of +/- 45 degrees and 30 cycles peer minute at room temperature. Approximately every 10,000 cycles, the bearings were removed and inspected for wear.





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Fiberglide® - Fabroid®

- Comparisons with Other Self-Lubricating Bearings
- Wear Curves

The graphs below are typical wear curves for two types of self-lubricating liner materials; Standard FIBERGLIDE® A, and FABROID® G. The standard FIBERGLIDE® A material is suitable for most applications and significantly outperforms other bearing types. But, should your application include extraordinarily high static and/or dynamic loads, extremes of temperature, or chemical resistance requirements, Transport Dynamics manufactures a variety of liner materials and backing for critical service applications. There are two types of FIBERGLIDE® liners depending on the product configuration and three types of FABROID®.

Transport Dynamics is the originator, innovator and leader in self-lubricating bearing technology with over thirty years of material development and application experience. The original Fabroid® Liner System was patented in 1958. Evolution in the development of materials has created three generations of self-lubrication liner technology.

Today's materials represent a significant advance in technology and their increased capabilities offer solutions in applications previously judged to be borderline or beyond material capability. Contact Transport Dynamics Engineering Department for a detail publication of all our liner systems. Request Engineering Bulletin #106, Bearing Design Guide.

A Comparison of FIBERGLIDE and FABROID Bearings with Other Self-Lubricating Types

	METAL-BACKED FIBERGLIDE	METAL-BACKED FABROID®	FILLED PTFE
TYP. DYNAMIC LOAD (psi)	2,000 TO 10,000	5,000 TO 20,000	0 TO 500
MAX. STATIC LOAD (psi)	30,000	60,000 ❶	2,500
MAXIMUM PV VALUE	50,000	60,000	10,000
TEMPERATURE RANGE (°F)	-320 +300	-320 +400	-400 +500
CHEMICAL RESISTANCE	GOOD	EXCELLENT	EXCELLENT
MINIMUM COEFFICIENT OF FRICTION	.03	.03	.02

	PTFE IMPREG-NATED BRONZE	OIL IMPREG-NATED BRONZE
TYP. DYNAMIC LOAD (psi)	500 TO 3,000	100 TO 2,000
MAX. STATIC LOAD (psi)	20,000	11,000
MAXIMUM PV VALUE	50,000	50,000
TEMPERATURE RANGE (°F)	-320 +500	-65 +250
CHEMICAL RESISTANCE	FAIR	POOR
MINIMUM COEFFICIENT OF FRICTION	.03	.05

FOR LOW SPEED OSCILLATING CONDITIONS - static loads over 30,000 psi or dynamic loads over 20,000 psi require metal backing of high strength stainless steel or equivalent materials.