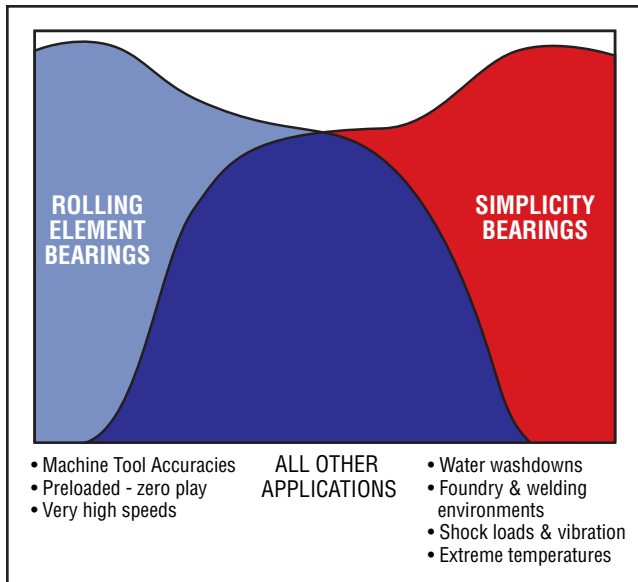


# WHAT MAKES SIMPLICITY® THE RIGHT CHOICE?



**Plane bearing applications represent 25% of total worldwide bearing usage.**

**Why?** Good engineering principles dictate the best bearing design for the application. Often ball bearings are asked to perform beyond their design capabilities. The rolling element industry has not helped users understand the limitations of their technology.

In 1983, linear ball bearing users came to Pacific Bearing® and asked for a linear bearing that simply would not fail. Dirt, vibration, shock loading, water washdowns, etc. were causing premature failure, often within days. After testing many material combinations, we chose the Simplicity design as the best solution.

In 1997, three years of rigorous development and testing resulted in the release of the next generation of plane bearing material – FrelonGOLD®. The original Simplicity bearings were improved with additional performance advantages. These are the advantages you will gain with Simplicity:

## LINER

- Self-lubricating – requires no external lubricant
- Embeddability of hard particulate eliminates galling and shaft damage
- Dampens vibration for quiet and smooth operation

## LOAD CAPACITY

- FrelonGOLD® supplies an average of 20x more load capacity than a standard linear ball bearing allowing the Design Engineer to use a more compact package
- Shock loads are absorbed without damage to components

## PERFORMANCE

- Simultaneous linear, oscillating, and rotary motions expand possibilities
- Reliable friction characteristics that do not increase over the life of the bearing
- Liner material similar to energized Teflon® seals
- Close fit & wiping action - cleans shafting - eliminating the need for seals

## LOW COST

- Average purchase price 15-30% less than rolling element linear bearings
- Operates maintenance free
- Reliable, predictable life
- WILL NOT CATASTROPHICALLY FAIL!!

### SIMPLICITY BEARING

Fines embed in Frelon® - eliminates shaft damage

Wiping action cleans shaft

Lubrication optional - smooth and quiet

### BALL BEARING

Excessive preload fatigues balls

Counterrotation creates stick-slip

Scored shafting destroys accuracy

Fines cause balls to slide

## WHAT GIVES SIMPLICITY® THESE ADVANTAGES?

### THE FRELON® BEARING LINER MATERIALS

FrelonGOLD®, FrelonJ®, FrelonF® are a compound of Teflon® and fillers developed for improved performance over other bearings. They provide low wear, low friction, self-lubrication, and high strength.

#### TEFLON FEATURES:

- Self-lubricating (runs without added lubricant)
- Embeddability of hard particulate
- Wide temperature range (-400°F/+500°F)  
(-240°C/+260°C)
- Chemically inert
- Vibration dampening (NO metal-to-metal contact)

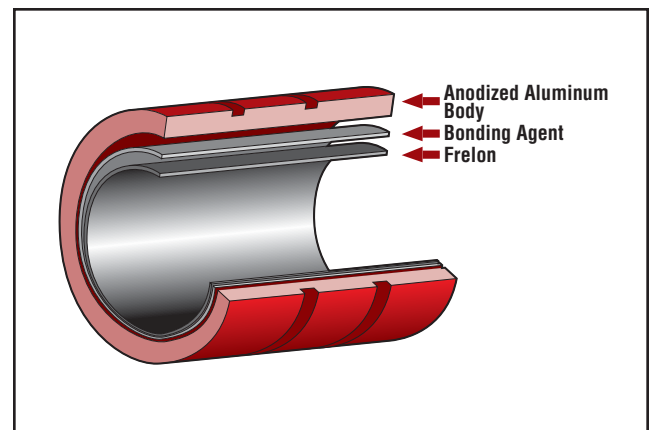
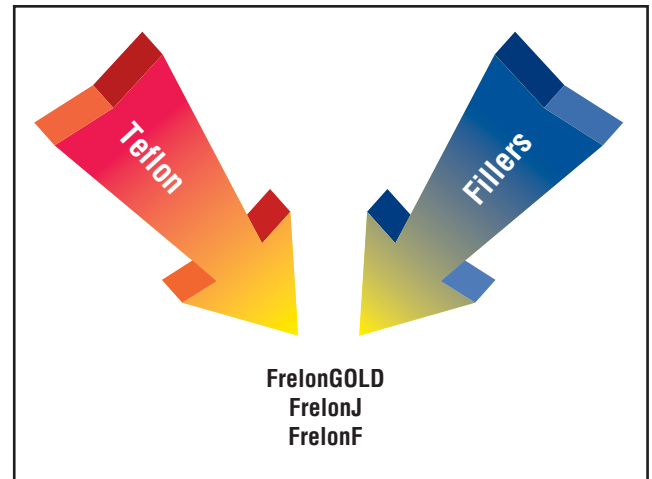
#### FILLER BENEFITS:

- High load capacity
- High strength
- Low wear rate vs. other materials

### PACIFIC BEARING HAS COMBINED FRELON® WITH PRECISION BEARING TECHNOLOGY TO CREATE SIMPLICITY®

- The Frelon liner is bonded to the bearing shell at the molecular level, which transfers the load and dissipates heat buildup throughout the bearing
- Will not rust or corrode due to anodized aluminum or stainless steel shell
- Patented self-aligning capabilities are standard (See pages 75-76 for information)
- Provides both linear, oscillating, rotary, or any combination of motions
- Maintenance free operation
- Will not damage shafting
- Smooth, quiet operation
- Highly accurate – all critical surfaces are ground on precision bearing grinders
- WILL NOT CATASTROPHICALLY FAIL!

Teflon® is a registered trademark of Dupont Corporation



FrelonGOLD®



FrelonJ®

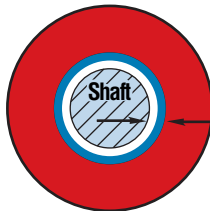


FrelonF®



Bearing Plug Shown - See Page 66

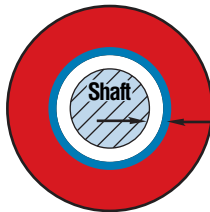
## RUNNING CLEARANCE



### Standard "FL"

Performs like a preloaded linear ball bearing

.0005" per side clearance average  
(.0127 mm)



### Compensated "FLC"

Performs like a standard linear ball bearing

.0015" + per side clearance average  
(.0381 + mm)

## BEARING LINER MATERIAL

Simplicity bearings are available with three liner materials.

**FrelonGOLD** is a brown base material with gold-colored fillers and is compatible with standard RC60 hardened steel shafting and RC70 ceramic coated Feather Shafting™.

**FrelonJ** is yellow and specially formulated to provide the optimum performance with 300 series stainless steel and bare aluminum shafting.

**FrelonF** is maroon and contains fillers that are compatible with RC60 hardened steel shafting and 440 stainless steel.

## RUNNING CLEARANCE

Simplicity bearings are available with two classes of running clearance.

### PRECISION—"FL":

- Performs like a preloaded ball bearing
- Tightest running clearance approximately .001" (.025mm)
- Use in applications that require high precision

**CAUTION:** Not recommended for all parallel shaft applications. Any misalignment can cause binding on the shaft. See recommended "FLC".

### COMPENSATED—"FLC":

- Performs like a standard ball bearing
- Additional clearance built into the I.D. (all other dimensions are the same as the precision bearings)
- Ideally suited for parallel shaft applications

**NOTE:** Many parallel shaft applications will run "FL" precision on one rail and "FLC" compensation on the opposite rail to accommodate slight misalignments.

## BEARING SHELL

Simplicity bearings are available in a variety of configurations to help meet specific application needs.

- Standard is 6061-T6 aluminum with anodized finish (standard)
- Special 316 stainless steel (no plating) (optional)

## STANDARD



Inch Series



ISO Metric Series



JIS Metric Series

## OPTIONAL



316 Stainless Steel

## BEARING SHELL (cont.)

### MATERIALS:

**6061-T6** – Is a heat treated and artificially aged aluminum with good strength and corrosion resistance.

**316 Stainless Steel** – Has an excellent corrosion resistance and is widely used by the paper, food, and other industries.

### FINISHES:

**Standard Anodized** – A sulfuric bath anodizing with a nickel acetate seal that will stand up to 14 days exposure in a 5% salt spray solution at 96°F. It is applied at a .0002" thickness.

**NOTE:** See page 96 for details on chemical resistance.

### TOLERANCES:

- All bearings are precision ground both I.D. and O.D. to provide the highest quality.
- Statistical Process Control (SPC) capabilities also increase final quality.

## SELF-ALIGNMENT FEATURE

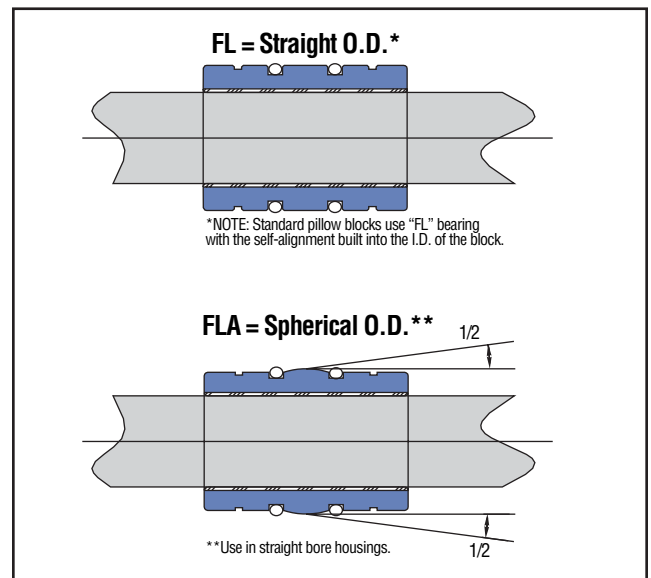
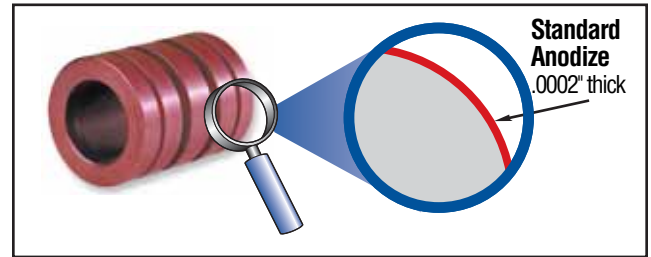
Simplicity bearings are available with a standard straight O.D. or a crowned self-aligning O.D.

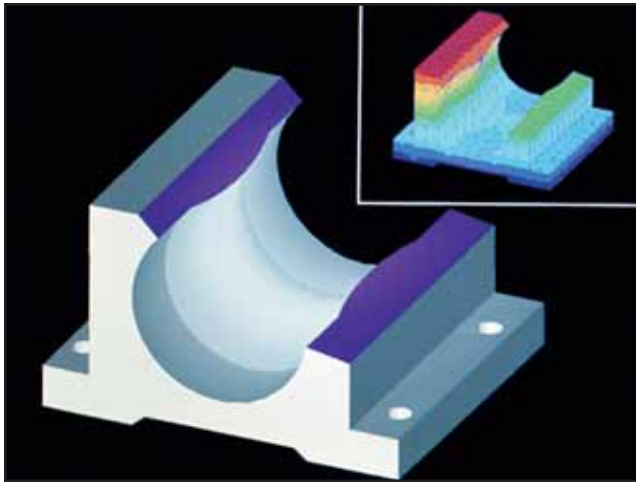
### “FL” – (Standard):

- Straight O.D.
- Pacific Bearing standard pillow blocks have the self-aligning capability designed into the block using standard “FL” bearings for the final assembly

### “FLA” – (Self-aligning O.D.):

- Has a crown on the O.D. allowing the bearing to re-align itself in binding situations
- Specifically designed to easily retrofit straight bore housings
- The bearing will allow 1/2° of misalignment capability from centerline (1° overall).
- O-rings are used on either side of the crown. This cushions and eliminates clatter in operation.





## PILLOW BLOCKS

- Made of 6063-T6 aluminum
- Pillow blocks are interchangeable with industry standard ball bearing pillow blocks
- Critical centerline dimensions hold accuracy within  $\pm.001"$  on inch sizes and  $\pm.015$  mm on metric sizes

### FINISHES:

- Clear anodized finish (Standard)

**Standard pillow blocks have built-in self-alignment in all directions.**

- Standard pillow blocks have  $1/2^\circ$  misalignment from centerline.
- This feature is built into the housing with a patented spherical radius at the midpoint of the block.
- This self-aligning capability will allow for some shaft deflection and misalignment.

**Rigid or straight bore housings are available.**

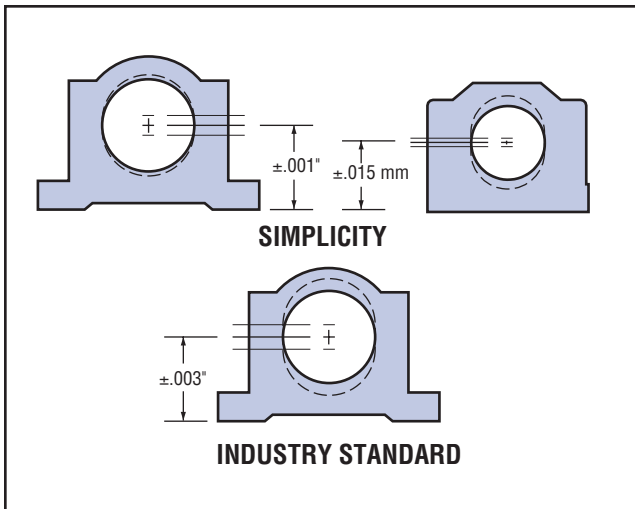
- This does not allow for any self-alignment and provides a very rigid assembly.
- They are typically used in single shaft applications.

## ADDITIONAL FEATURES

**O-Rings** – Used in standard pillow blocks and with self-aligning bearings.

**Nitrile Buna 70 (standard)** – A good general purpose rubber that is used in 98% of applications.  
-65°F to 275°F (-50°C to 135°C)

**Viton (special – designate with “V”)** – Used only in high temperature applications up to 400°F (up to 204°C).





## ADDITIONAL FEATURES (cont.)

**SEALS:** Use only in the most contaminated environments.

**Polymod® (standard)** – A high performance polymer modified material that reduces friction of a standard buna material by 50% and increases wear life

®Polymod is a registered trademark of Polymod Technologies, Inc.

**Temperature** – -40 – +482°F

**Urethane (special - designate with “U”)** – A moly-impregnated urethane scraper that is only for the severest applications - friction is greatly increased!

**Temperature** – -40 – +180°F

**Viton (special - designate with “V”)** – Used only in high temperature applications up to 400°F (up to 204°C).

**CAUTION:** 90% of applications do not require seals when using Simplicity bearings. The liner has a natural ability to wipe particles from the shafting. Any particulate (metal, sand, etc.) that does enter the bearing will embed itself into the soft liner not scoring the shafting or locking mechanical parts.

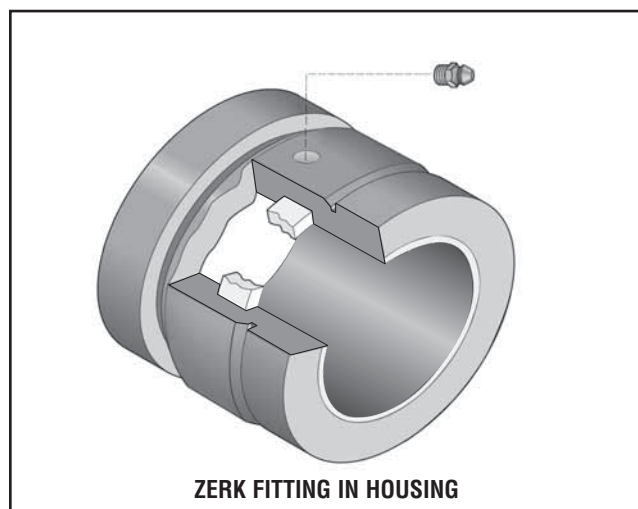
**LUBRICATION SYSTEM:** Order with “JKM” modifier

- Recommended for high speed, high load, and rotary or oscillating applications

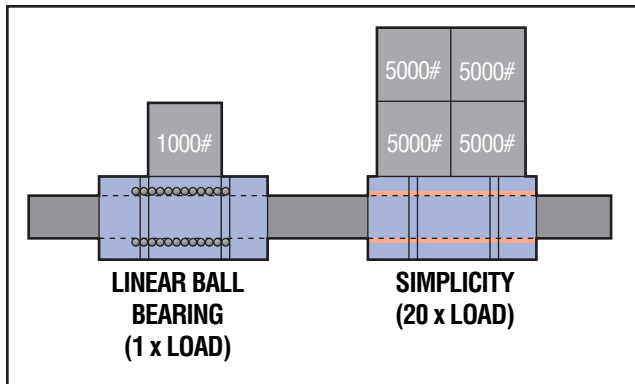
**Lubrication System consists of:**

**Felt wick** – Retains oil lubricants (remove when using grease lubrication)

**Zerk fitting** – Installed into pillow block, other housing, or directly into die sets PAC, PACM



ZERK FITTING IN HOUSING



## LOAD CAPACITY OF LINER

Simplicity bearings can carry from 4 to 20 times the load of a linear ball bearing.

BEARING MATERIAL	STATIC LOAD CAPACITY
FrelonGOLD®	3000 psi (210.9 kgf/cm <sup>2</sup> )
FrelonF® & FrelonJ®	1500 psi (105.45 kgf/cm <sup>2</sup> )

- Allows the engineer to maintain performance in a smaller designed package

Example: Simplicity 1/2" I.D. = 1" I.D. linear ball bearing

- Shock loads and vibration are absorbed
- Metal to metal contact is eliminated providing a smoother, quieter running assembly

## SPEED CHARACTERISTICS

Exceeding these speeds causes frictional heat and accelerates liner wear.

BEARING MATERIAL	NO LUBE CONTINUOUS MOTION	NO LUBE INTERMITTENT MOTION	WITH LUBRICATION*
FrelonGOLD	300 sfm	825 sfm	825 sfm
	60 in./sec.	165 in./sec.	165 in./sec.
	1.524 m/sec.	4.19m/sec.	4.19 m/sec.
FrelonF & FrelonJ	140 sfm	400 sfm	400 sfm
	28 in./sec.	80 in./sec.	80 in./sec.
	.711 m/sec.	2.03 m/sec.	2.03 m/sec.

\* Depending on the lubrication used, loads, and frequency of continuous or intermittent motion, speeds can be in excess of the numbers shown.

## PERFORMANCE RATINGS (for Linear Motion)

Plane bearings are rated by their limiting PV which is a combination of load over a given surface area and the velocity.

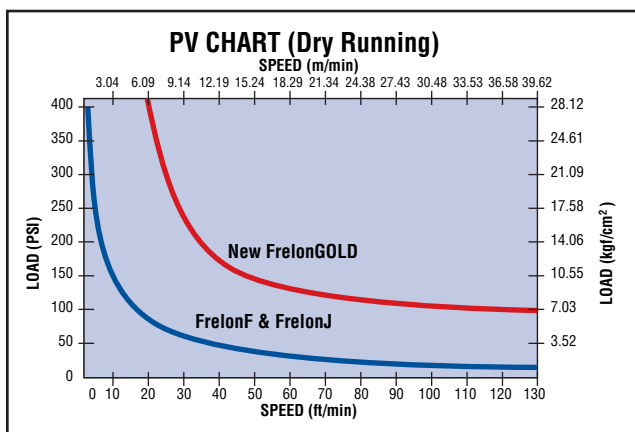
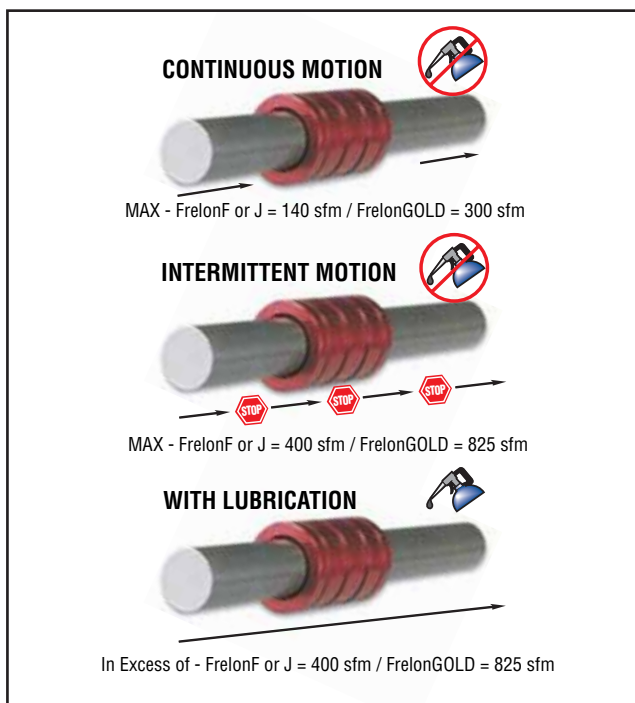
BEARING MATERIAL	MAX. "PV"	MAX. "P"	MAX. "V" (NO LUBRICATION)
FrelonGOLD	20,000 (psi x ft/min)	3000 psi	300sfm
	430 (kgf/cm <sup>2</sup> x m/min)	210.9 kgf/cm <sup>2</sup>	91.44 m/min.
FrelonF & FrelonJ	10,000 (psi x ft/min)	1500 psi	140 sfm
	215 (kgf/cm <sup>2</sup> x m/min)	105.45 kgf/cm <sup>2</sup>	42.66 m/min.

**PV** = The performance measurement of plane bearings

**PV** = P x V where P = pressure (load) in psi (kgf/cm<sup>2</sup>)

**V** = velocity (speed) in sfm (m/min.)

**NOTE:** All 3 parameters must be met by an application for the bearing to perform properly.



## WEAR RATE/LIFE EXPECTANCY

The life expectancy of a Simplicity bearing is dependent on application parameters.

Factors that will affect life...

- Shaft hardness, surface finish, and preparation
- Length of travel
- Temperature
- Contamination
- Running clearance
- Lubrication
- Speed
- And many, many other factors

The Radial Wear chart gives a guideline for a typical application at 10 psi (.703 kgf/cm<sup>2</sup>) traveling at 100 ft./min (30.48 m/min.).

## FACTORS AFFECTING WEAR RATE/LIFE

Shafting requirements for Frelon® bearing materials.

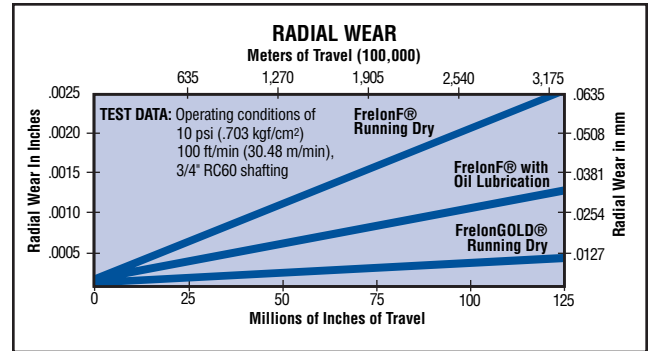
### BEST PERFORMANCE:

- Finish of 8 - 12 RMS
- Hardness of RC60

### ACCEPTABLE PERFORMANCE:

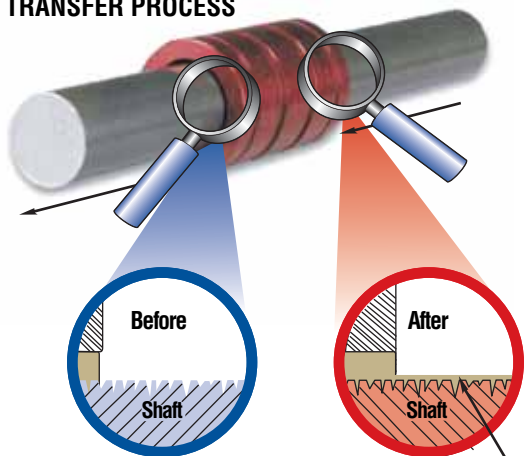
- Finish of 8 - 16 RMS
- Hardness of RC35
- Surface finish requirements apply to all three Frelon bearing materials.
- Rougher shafting can be used, but both bearing and shafting will wear at accelerated rates and binding may occur.

**NOTE:** Consult factory if using chrome plated shafting.





## FRELON® TRANSFER PROCESS



**NOTE:** At break-in, Frelon deposits a microscopic film on the shaft and fills the valleys in the surface finish creating a Frelon-on-Frelon running condition that is true self-lubrication.

## RECOMMENDED LUBRICATION

- Waylube Oil
- Light Weight Oils
- Petroleum Based Grease
- 3-in-1 oils



## NOT RECOMMENDED

- WD-40
- PTFE Sprays
- Fluorocarbons
- Silicon Oils, Grease or Spray



WD40® is a registered trademark of the WD40 company

## TRANSFER PROCESS OF LINER TO SHAFT

The interaction of the Frelon® material and the shafting creates a natural, microscopic transfer of the Frelon to the running surface. A thin film is deposited on the shaft, and the valleys in the surface finish are filled in with Frelon material during the initial break-in period. This transfer creates the self-lubricating condition of Frelon riding on Frelon.

This break-in period will vary depending on several criteria:

1. Preparation of the shafting prior to installation - it is best to clean the shafting with a 3-in-1 type oil before installing the bearings. This ensures that the surface will receive a full transfer of material.
2. Speed, load, and length of stroke specific to the application - typically the initial transfer process will take approximately 50-100 strokes of continuous operation. The running clearance on the bearing will increase an average of .0002" to .0005", depending on the length of the stroke and surface requiring the transfer.
3. How often the shafting is cleaned - if the shafting is cleaned regularly, increased wear will be seen in the bearings. This is due to the transfer process being performed over and over again.

**CAUTION:** Do not repeatedly clean the shafting with alcohol! This will remove the previously transferred material entirely and increase the wear to the bearing liner.

## LUBRICATION

Lubrication can...

- Reduce friction up to 50%.
- Minimize wear of liner.
- Reduce heat buildup allowing greater speeds. Actual speeds achieved are dependent on type of lubricant and frequency of application.
- Aid in cleaning the shafting for a proper transfer process. A minimum of initial lubrication of Simplicity bearings is strongly recommended.

## TEMPERATURE

Simplicity bearings can operate in a wide range of temperatures (-400°F/+500°F) (-240°C /+260°C). Temperature dependent on materials housed in pillow block and size of bearing.

- Maintains the same performance characteristics
- The thin liner allows heat to dissipate through the bearing shell

## THERMAL EXPANSION

The standard bearing ID options are designed for use in most industrial applications.

For temperatures below 0° F, the standard I.D. is recommended. (FL series)

For extreme high temperatures, the Compensated I.D. bearing is recommended (FLC) for the increased running clearance.

**CAUTION:** It is always best to inspect actual size at extreme temperatures to insure proper running clearance.

## ROTARY APPLICATIONS

Simplicity bearings will operate very well in rotary applications if applied properly.

Stationary rotary applications do not allow the heat to be spread over an extended area. It is retained in the I.D. of the bearing limiting speed and load.

- MAX Rotary Speed (No lube/continuous motion)
- 40 sfm (12.2 m/min.) for standard precision ID clearances
- 140 sfm (42.6 m/min.) for compensated ID clearances

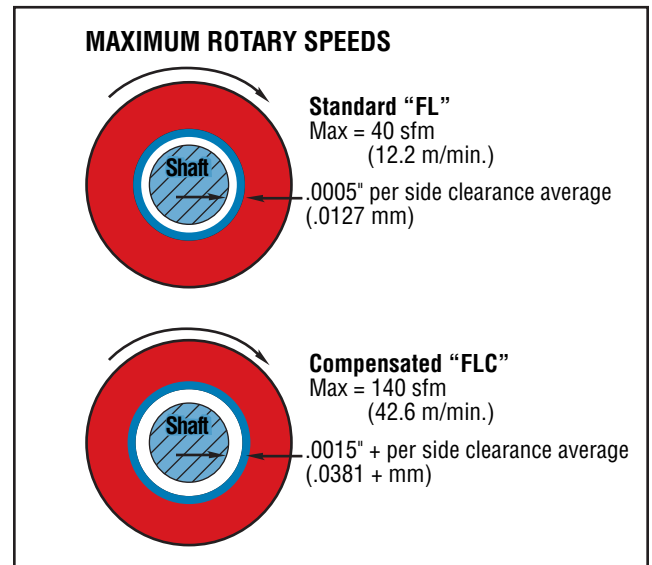
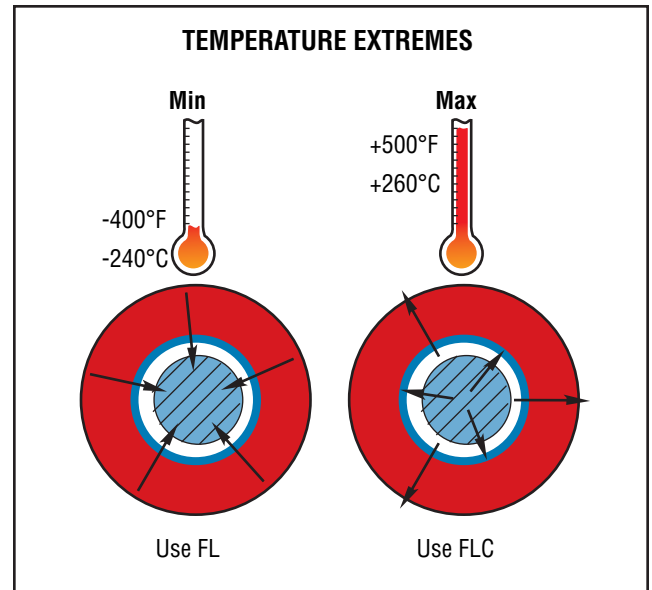
$$V(\text{sfm}) = .262 \times d \times \text{RPM}$$

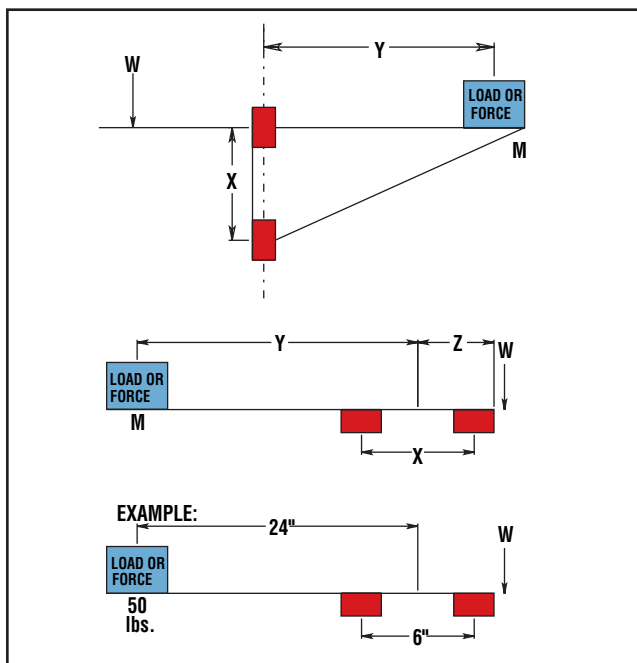
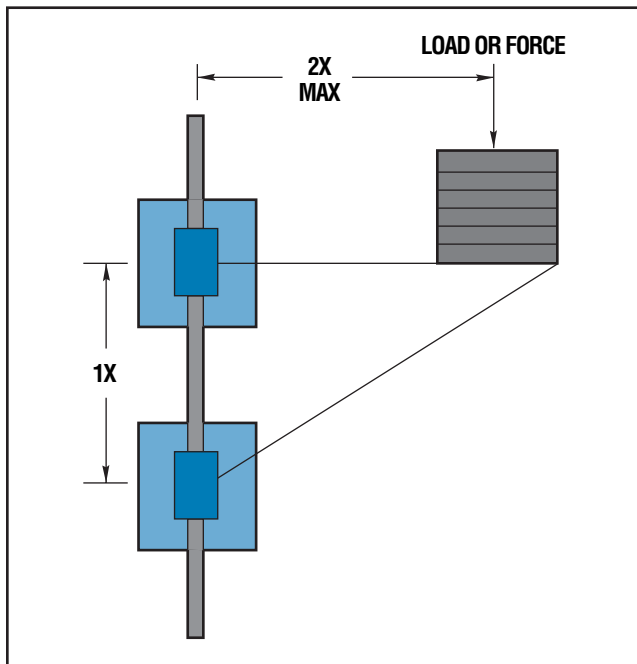
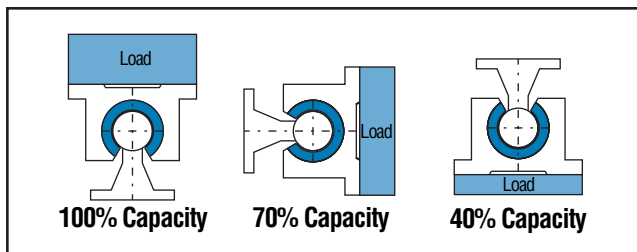
d = shaft diameter (inches)

RPM = revolutions per minute

- Properly maintained lubrication can increase these speeds dramatically.

**CAUTION:** It is always best to do specific testing for rotary applications above these limits where lubrication is to be used.





## OPEN BEARINGS ORIENTATION

Simplicity bearings can operate in any orientation.

Load capacities will vary on open bearings depending on the orientation in which they are being used.

## CANTILEVERED LOADS

- Maximum 2:1 ratio
- 1x = bearing separation on same shaft
- 2x = distance from shaft to load or force

**EXAMPLE:** If 2x equals 10" then 1x must be at least 5"

**CAUTION:** BINDING will occur if the 2:1 ratio is exceeded!

This principle is NOT load dependent! It is also NOT dependent on the driving force used! The bearings will bind whether hand or mechanically driven.

This principle is a product of friction.

What if more than 2:1 is required?

Often times holding the 2:1 ratio is not possible. One method of preventing binding problems in these cases is to use a counter balance.

For efficient counter balances, use this formula:

$$M * Y = W * Z$$

**NOTES:** To avoid problems when running without mass (M)  $Z = 1.5X$

W can be calculated; load on bearing will be:

$$\frac{M + W}{\# \text{ of bearings}}$$

**EXAMPLE:**  $50 * 24 = W * Z$  ( $Z = 1.5 * 6 = 9$ )

$$W = \frac{50 * 24}{9} = 133 \text{ lbs.}$$

$$\text{Load per bearing} = \frac{50 + 133}{4} = 45.75 \text{ lbs./bearing}$$

## SEVERE MISALIGNMENT SOLUTIONS

Linear ball bearings will continue to operate in a misaligned condition, but will cause damage to shafting and catastrophically fail.

Simplicity bearings DO NOT tolerate misalignment. They simply will stop moving without any damage to the shafting.

Self-aligning housings will aid in misalignment - up to  $1/2^\circ$  from centerline.

### POSSIBLE SOLUTIONS for use with Standard "FL":

Undersize the bearing O.D. (see chart) and install o-rings. See product pages for o-ring numbers.

Oversize the housing I.D. (see chart) and install the standard bearing with o-rings. See product pages for o-ring part numbers.

The additional clearance created by either method will allow the bearing to float in the housing and match the non-parallelism of the shafting.

**CAUTION:** This solution is only for SEVERE cases that the standard self-aligning will not accommodate.

**NOTE:** Maximum additional clearance and o-ring information for severe misalignment solutions on page 95. For complete installation instructions, see pages 93-95 in the Technical Section.

## MACHINING THE BEARINGS

Simplicity bearings can be machined and modified in the field.

If machining the I.D., be sure that more running clearance is actually needed! This is NOT a solution for binding!

To solve binding problems, first check:

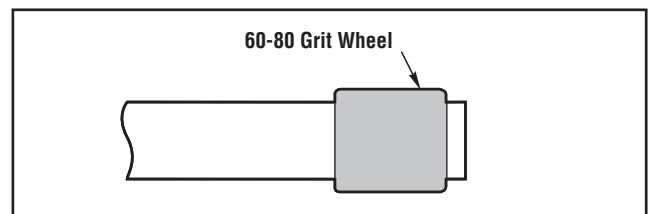
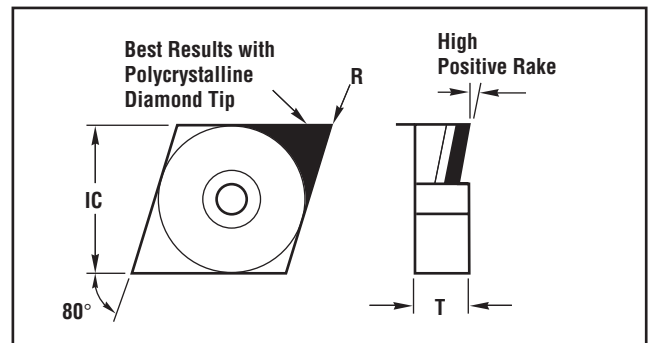
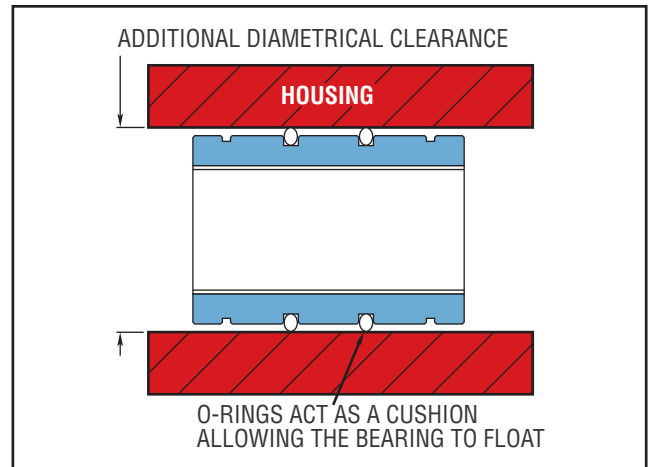
1. Shaft alignment
2. Cantilever limitations (page 82)
3. Shaft deflection (page 91)

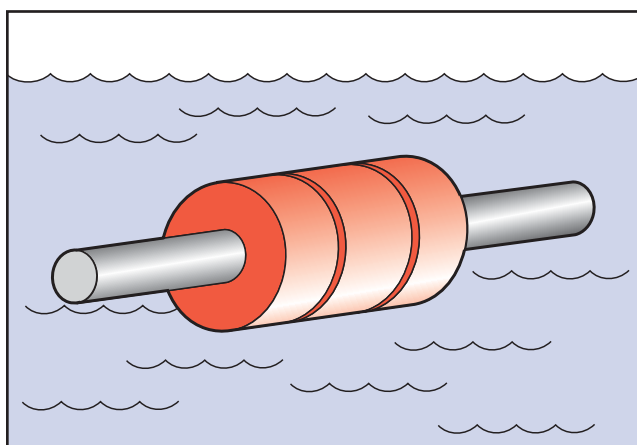
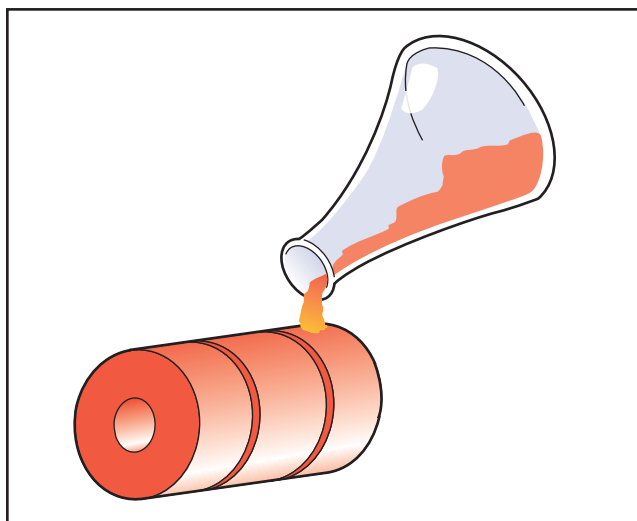
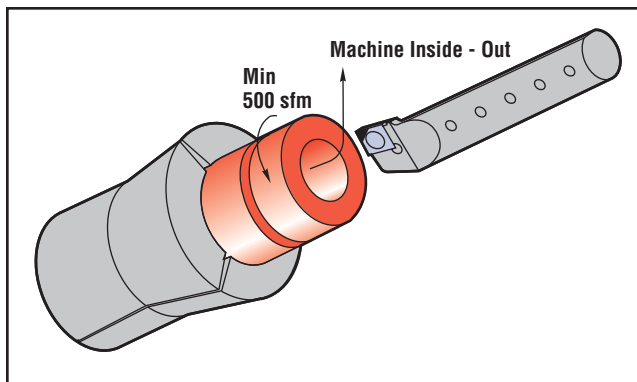
**NOTE:** The liner that is removed is also potential wear life that is removed!

When using insertable tools, polycrystalline diamond tip inserts with a high positive rake are best.

Carbide tools will only work with an extremely high positive rake. Tolerance and finish will be more difficult to hold. Recommended insert: ISCAR CNMS or DNMS 432-12

To hone or ID grind the liner, a 60-80 grit grinding wheel is recommended.





## MACHINING THE BEARINGS (cont.)

Machine the bearings at a minimum of 500 sfm (150 m/min.)

It is always best to cut from the inside out. When pushing in on the liner, it is possible to delaminate the material.

**CAUTION:** The bearing liner averages only .015" to .020" (.381 mm to .508 mm) thick on each side of the bearing wall. At the time of manufacture, tight tolerances on size, roundness, and concentricity are maintained. Any after sale modifications may compromise this quality. Pacific Bearing Company will not be held responsible for any damaged or destroyed product that is machined or altered.

## CHEMICAL RESISTANCE

Simplicity bearings stand up to harsh environments.

**FrelonF® and FrelonJ®** – almost universal chemical inertness. Only molten sodium and fluorine at elevated temperatures and pressures show any signs of attack.

**FrelonGOLD®** – the fillers in the material can be attacked by deionized water and other harsh chemicals.

**Anodized Aluminum Shell (Standard)** – good chemical resistance in most industrial applications.

**316 Stainless Steel Shell (Optional)** – excellent chemical and corrosion resistance in harsh environments. (See page 96 for complete chemical interaction listing.)

## SUBMERGED APPLICATIONS

Simplicity bearings will provide excellent performance in a submerged condition.

The bearings will employ the fluid as a lubricant showing increased velocities and wear life. Oils and non-salt water are especially effective.

Do not use FrelonGOLD in submerged applications.

## VACUUMS/OUTGASSING/CLEAN ROOMS

Due to self-lubrication, low outgassing, and a minimum of particulate (buildup), Simplicity bearings are excellent in clean rooms and vacuums.

Testing has been done on the Frelon® materials in accordance with ASTM E-595-90 with acceptable maximums of 1.00% TML and .10% CVCM.

MATERIAL	% TML	% CVCM
Frelon	0.00	0.00
FrelonJ	0.18	0.01

**TML** = Total Mass Loss

**CVCM** = Collected Volatile Condensable Materials

## CLASSES OF PLANE BEARINGS

Simplicity bearings are in a class of bearings known as plane bearings, which means that they have no rolling elements. There are three classes of plane bearings:

**Class I** - Require an outside source of lubrication (oil, grease, etc.).

**Class II** - Lubrication is impregnated within the walls of the bearing. (Bronze, powder metal, etc.) Typically these bearings require an added lubricant also.

**Class III** - Self-lubricating bearings, which do not require added lubricants.

Simplicity bearings are Class III plane bearings and are self-lubricating.

## RATING A PLANE BEARING

Plane bearing performance capacity is rated by PV.

**P** - pressure or load in pounds per square inch (psi) or kilograms per square centimeter (kg/cm<sup>2</sup>).

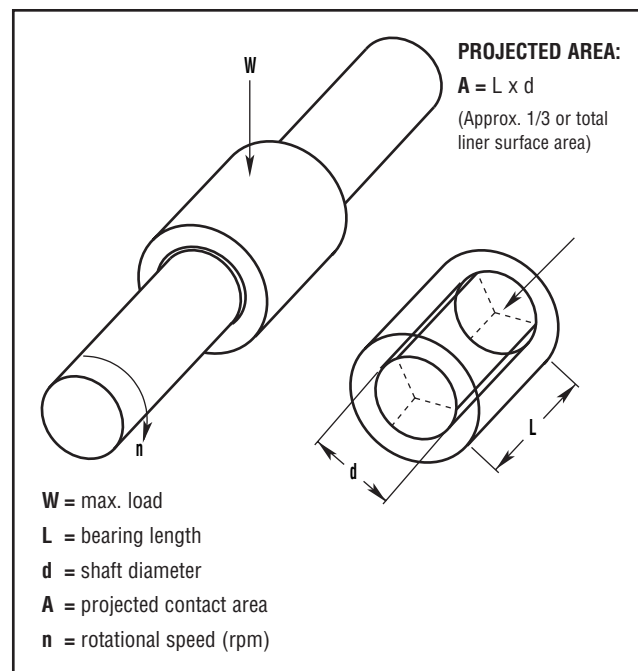
**V** - velocity or surface speed in feet per minute (fpm or sfm) or meters per minute (m/min).

**PV** - pressure velocity value.

## SIMPLICITY MAXIMUM PARAMETER

MAXIMUM PARAMETERS	P	V (RUNNING DRY)	PV
FRELONF® & FRELONJ®	1500 psi or 105.45 kgf/cm <sup>2</sup>	140 sfm or 42.67 m/min.	10,000 psi x ft/min. or 215 kgf/cm <sup>2</sup> x m/min.
FRELON GOLD®	3000 psi or 210.9 kgf/cm <sup>2</sup>	300 sfm or 91.44 m/min.	20,000 psi x ft/min. or 430 kgf/cm <sup>2</sup> x m/min.

**NOTE:** All three parameters must be met in order for the bearing to operate properly.



## FORMULAS FOR RATINGS

**PRESSURE IS OVER THE PROJECTED AREA OF LOAD:**

$$A = L \times d$$

$$P = \frac{W}{A} \text{ psi (or kg/cm}^2\text{)}$$

**VELOCITY:**

Linear = total distance traveled in one minute

**ROTATIONAL VELOCITY:**

$$V = \frac{\pi \times d \times n}{12} \text{ fpm (or m/min.)}$$

**PRESSURE VELOCITY VALUE (PV):**

$$PV = P \times V \text{ psi x fpm (or kg/cm}^2 \times \text{m/min)}$$

## PV EQUIVALENTS

	INCH	TECHNICAL METRIC	INT'L METRIC (SI)
LOAD	1 psi	.0703 kgf/cm <sup>2</sup>	.0069 N/mm <sup>2</sup>
VELOCITY	1 ft/min.	.3048 m/min.	.00508 m/sec.
PV	1 PV	.0214 PV	.000036 PV
FRELONF® & FRELONJ® MAX PV	10,000	215	.36
FRELON GOLD® MAX PV	20,000	430	.72



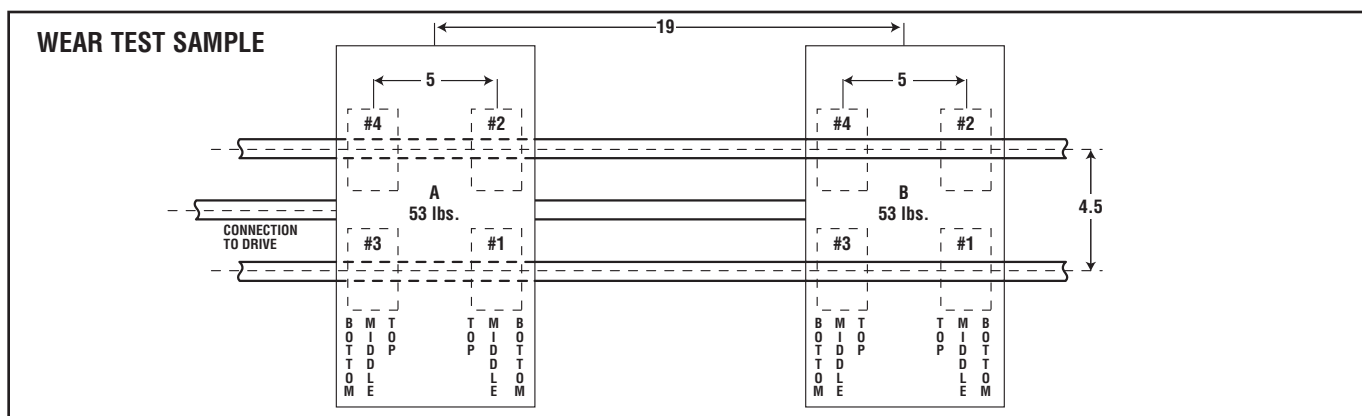
## WEAR RATE VS. LIFE EXPECTANCY

A rolling element linear bearing's life expectancy is usually expressed in total inches or meters. A rolling element rotary bearing's life expectancy is expressed in hours of operation. Both are also rated for average (L-50) and minimum (L-10) life. L-50 life is the average life that can be expected from 50% of rolling element bearings. In other words, 50% will not reach the average life expectancy. L-10 life is the minimum life (1/5 the average life) expected from 90% of rolling element bearings. In other words, 10% will not reach the minimum life expectancy. Theoretically they could fail upon installation.

Plane bearings are not rated by a life expectancy but by the wear rate of the bearing material. Wear is greatly dependent

upon the proper application of the bearing and material used. If it is not properly applied, it will fail. Failure, however, is subjective and dependent upon specific application requirements. 0.002" running clearance may not be acceptable in one application while another may be able to run a bearing until the liner is completely worn through. The user may then rotate it 30 degrees and continue to run it. This broad range of acceptability makes it difficult to determine life expectancy.

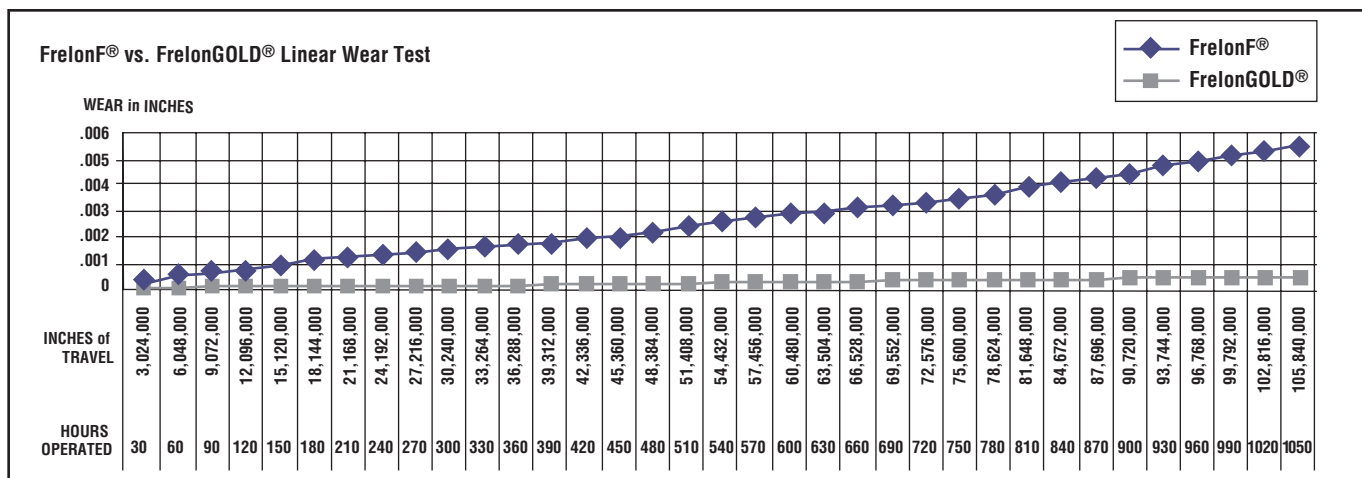
The first step is to determine what wear is acceptable for your application. Then utilizing the test data below, you can estimate the wear expected for your given application.



**CONDUCTED BY:** Pacific Bearing® Company  
**BEARING MATERIAL:** FrelonF® and FrelonGOLD®  
**SHAFT MATERIAL:** Standard RC60 steel shafting  
**SURFACE FINISH:** 8-12 RMS  
**SPEED:** 140 fpm (70 cycles/min; 1,680"/min; 100,800"/hour; 2,419,200"/day)  
**STROKE:** 12"

**LOAD:** 10.87 psi (53 lbs.)  
**BEARINGS USED:** FLN12 (3/4" open style bearings)  
**LUBRICATION:** None  
**TOTAL WEAR TO BEARING MATERIAL:**  
 FrelonF = .0055"  
 FrelonGOLD = .00042"

**NOTE:** Wear is an average of totals taken from 4 bearings per carriage.

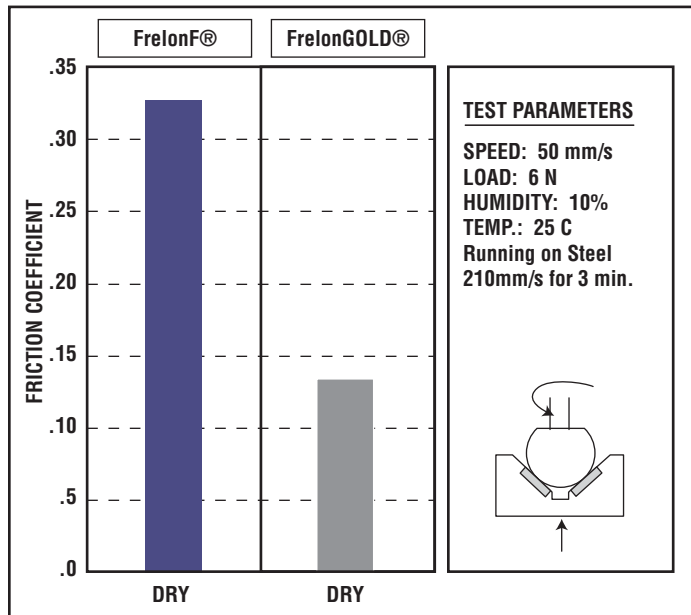


## COEFFICIENT OF FRICTION

A frequent misconception of plane bearings is that wear and friction are basically synonymous, in that, high friction equals high wear or that low friction equals low wear. While there can be a relation between the two, they should be addressed as separate issues in the design process.

For example, dry running virgin (unfilled) Teflon® on steel's coefficient of friction (c.o.f.) is approximately .1 while filled Teflon's c.o.f. can range from .125 to .4 depending on the fillers used. By comparison, however, the virgin Teflon will wear at a much greater rate.

### FRICTION TEST SAMPLE #1



**CONDUCTED BY:** Dr. Tillwich GmbH

**MANAGING DIRECTOR:** Mr. Werner Stehr (World leading tribologist with a seat on the ISOTC123 Committee establishing standards for tribological testing.)

**BEARING MATERIAL:** FrelonF® and FrelonGOLD®

**SHAFT MATERIAL:** Standard RC60 steel shafting

**SURFACE FINISH:** 8-12 RMS

**SPEED:** 50 mm/sec

**LOAD:** 6 N

**TEMP.:** 25° C

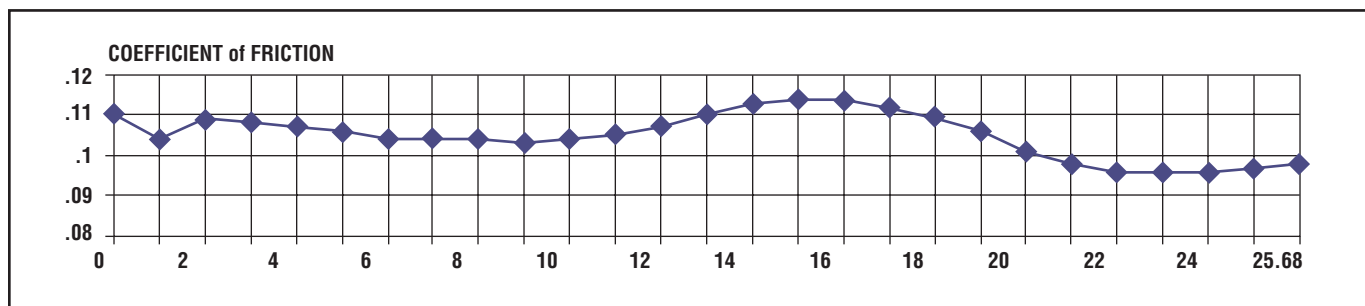
**LUBRICATION:** None

**AVG. COEFFICIENT OF FRICTION:**

FrelonF = .325

FrelonGOLD = .125

### FRICTION TEST SAMPLE #2



**CONDUCTED BY:** FrelonGOLD material processor

**BEARING MATERIAL:** FrelonGOLD

**SHAFT MATERIAL:** CRS 1018

**SPEED:** 100 fpm

**LOAD:** 100 psi

**DURATION:** 25.68 hours

**LUBRICATION:** None

**SURFACE FINISH:** 8 RMS

**AVERAGE COF:** 0.10

**MAX. COF:** 0.15

**MIN. COF:** 0.08

**AVG. RUNNING TEMP.:** 95.40° F

## LOAD CAPACITY (Pressure)

Depending upon the material used, a plane bearing's load capacity can greatly exceed a rolling element bearing. There are three basic reasons for this:

1. The area of surface contact with the shaft is far greater than rolling element bearings, which have point-to-point contact with a given number of balls.
2. A rolling element bearing must be oriented properly for the ball tracks to carry the load adequately, while a plane bearing can be mounted in any orientation.
3. Only one or two of the tracks in a rolling element bearing will actually carry any of the load applied.

Simplicity bearings have a thin liner that is bonded to a metal shell at the molecular level, allowing the load to be transferred throughout the bearing. This gives it an advantage over other plane bearings of solid plastic or polymer materials. These other materials will tend to "cold flow" under pressure. "Cold flow" means to deform or lose shape. The idea is similar to pressing your finger into a bar of soap - material will move or deform as pressure is applied.

## LINEAR SURFACE SPEEDS (Velocity)

In typical applications, speed is a known quantity and easily converted. Typically feet per minute or meters per minute are used. The most important factor that speed (along with friction) produces is heat buildup. This is not a critical factor in most linear applications because the heat is dissipated over the length of travel, and it does not affect the bearing. Short stroke or extremely high speed applications may see the effects of heat buildup in thermal expansion and the bearing ID locking on the shaft. A compensated ID bearing (FLC) is recommended in these applications.

## FACTORS THAT CONTRIBUTE TO WEAR LIFE

Proper mating of shaft and liner materials.

Surface finish 8-16 RMS (.20-.40mm) is required. Peaks in the surface that are polished to a radius provide the best running surface. Sharp peaks in the finish will be like a fine lapping compound wearing the I.D. of the bearing.

**NOTE:** Shafting damaged by use with ball bearings can be salvaged and used with Simplicity bearings. Spin in a lathe and polish with sand papers in this order: 120 grit, 180 grit, and 300 grit. This will also remove sharp peaks in the surface finish.

**Surface speed** - at high speeds, heat buildup will affect liner wear.

**Break-in transfer** - proper transfer process of the liner to the shaft. (pg. 80)

**Lubrication** - proper lubrication can greatly improve the wear rate of a bearing. At the same time, improper lubrication can increase wear and failure.

**Load & Wear Relationship** - Wear is proportional to  $(load)^3$ , so if load is reduced to 1/2, wear will be reduced to  $(1/2)^3$ .

**Contamination** - while migrating into the bearing and embedding into the liner, certain types of contamination may, over time, cause increased wear to the liner.

**NOTE:** This is not an all inclusive list. There are many, many more factors within an application that can affect wear to different degrees. These are the major issues and the first things to address in a design.

## TYPES AND EFFECTS OF LUBRICATION

Lubrication is any outside technique used for reducing the friction, wear, or both of a bearing. **Proper lubrication of Simplicity bearings is critical.** Evaluate lubrication needs on an application by application basis to determine whether or not it should be used at all, what type is needed, and how it is applied. Below are some criteria on which to base the lubricant decision:

DO NOT USE WD40™, PTFE sprays, or other oils, greases, or sprays that contain fluorocarbons or silicone. In testing, these lubricants have proven to cause long-term stick-slip problems with the Frelon lined bearings. They tend to become a gummy substance that ultimately increases friction.

### RECOMMENDED LUBRICANTS:

- Waylube oils
- Lightweight oils
- 3-in-1 type oils
- Lightweight petroleum based greases

WD40™ is a registered trademark of the WD40 Corporation.

## USING OILS WITH SIMPLICITY

DO NOT USE ANY TYPE OF MOTOR OIL OR OILS WITH ADDITIVES! These types of oils work well short term, but quickly become ineffective, and will cause stick-slip reactions in the bearing. As a rule of thumb, the less additives in the oil, the better the performance. Recommended oils are Mobil Vactra #2 (a way lube oil) and any standard 3-in-1 oil. The 3-in-1 oils are tremendous cleaning oils and are the best in preparing for a proper transfer of teflon to the shafting.

## GREASE PRODUCTS

DO NOT USE A MOLY FILLED OR OTHER TYPE FILLED GREASES! They become like a lapping compound on the ID of the bearing and increase wear dramatically.

## PROPER USE OF GREASES

Proper use of grease is critical for trouble-free operation.

Be sure the felt wick is removed from a “FL-xx-JKM” bearing because grease inserted through the zerk will cause the wick to act like a brake.

**Do not fill all of the running clearance with grease!** The temptation is to treat it like a rolling element bearing and fill it until it weeps from the end. This will cause greater friction and binding.

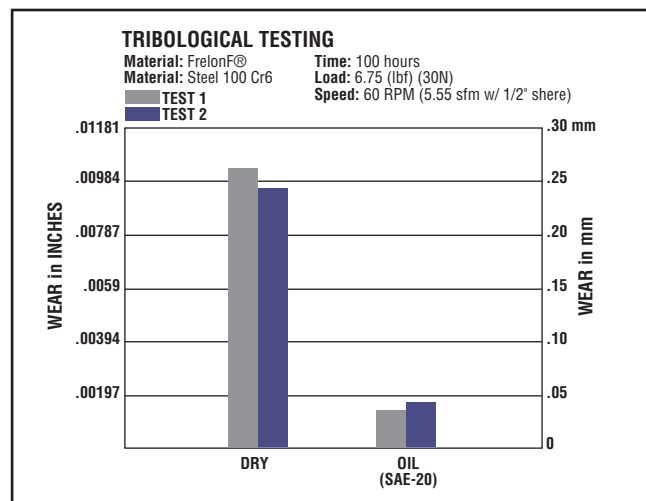
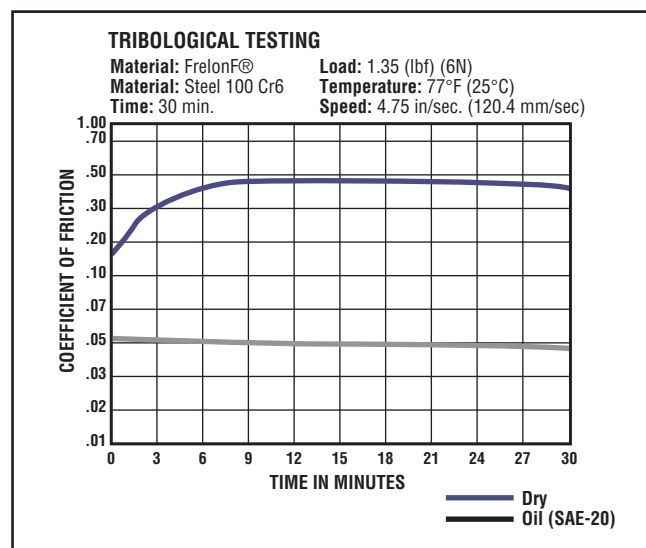
The rule of thumb for the bearing liner that “thin is better” applies to the use of grease also.

If grease is used and does not work in the application, it is possible to salvage the bearing with minimal work and to continue to operate. Follow the steps below:

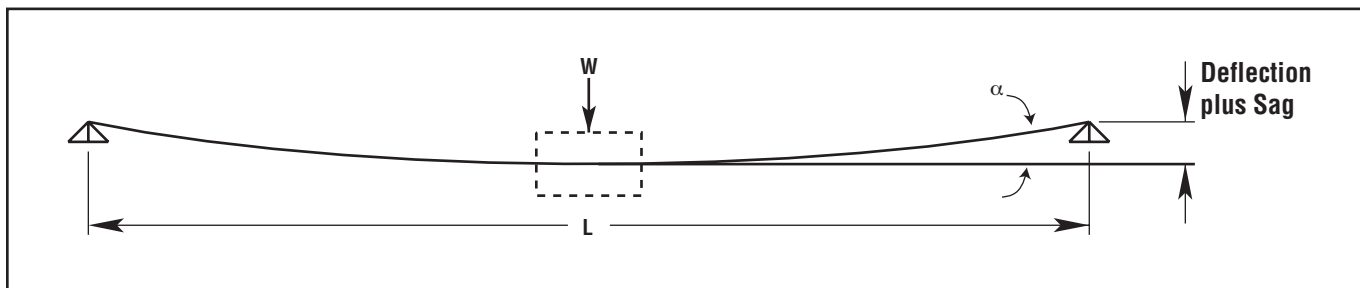
1. If possible, remove the bearing from the housing, wipe the grease from the liner, use a 3-in-1 type oil to clean the excess remaining grease, and reinstall.
2. If it is not possible to remove the bearing, wipe as much grease as possible away from the ends of the bearing, then start to fill with a 3-in-1 type oil for cleaning the liner. To speed the cleaning process, apply forced air to the bearing through the zerk hole and continue using oil lubrication.

## EFFECTS OF LUBRICATION

Lubrication can greatly increase the performance of a bearing when applied properly as noted earlier. Actual performance results for specific applications are difficult to predict due to the number of elements involved (temperature change with lube, useable life or aging of lubricant, etc.). Specific application testing is recommended to establish specific performance parameters. Below are charts with guidelines of performances.



## APPLICATION INFORMATION



### INCH

SHAFT DIAMETER	HARDENED STEEL		STAINLESS STEEL		FEATHER SHAFT	
	D	S	D	S	D	S
3/16"	$8.4 \times 10^4$	$1.7 \times 10^7$	$8.0 \times 10^4$	$1.6 \times 10^7$	$2.9 \times 10^4$	$1.65\text{E}+05$
1/4"	$2.67 \times 10^5$	$3.1 \times 10^7$	$2.54 \times 10^5$	$2.9 \times 10^7$	$9.2 \times 10^4$	$2.93\text{E}+05$
3/8"	$1.35 \times 10^6$	$6.9 \times 10^7$	$1.29 \times 10^6$	$6.5 \times 10^7$	$4.7 \times 10^5$	$6.58\text{E}+05$
1/2"	$4.27 \times 10^6$	$1.23 \times 10^8$	$4.06 \times 10^6$	$1.16 \times 10^8$	$1.5 \times 10^6$	$1.17\text{E}+06$
5/8"	$1.04 \times 10^7$	$1.92 \times 10^8$	$9.92 \times 10^6$	$1.81 \times 10^8$	$3.6 \times 10^6$	$1.83\text{E}+06$
3/4"	$2.16 \times 10^7$	$2.77 \times 10^8$	$2.06 \times 10^7$	$2.61 \times 10^8$	$7.5 \times 10^6$	$2.63\text{E}+06$
1"	$6.83 \times 10^7$	$4.92 \times 10^8$	$6.5 \times 10^7$	$4.63 \times 10^8$	$2.4 \times 10^7$	$4.68\text{E}+06$
1-1/4"	$1.67 \times 10^8$	$7.69 \times 10^8$	$1.59 \times 10^8$	$7.24 \times 10^8$	$5.8 \times 10^7$	$7.31\text{E}+06$
1-1/2"	$3.46 \times 10^8$	$1.11 \times 10^9$	$3.29 \times 10^8$	$1.04 \times 10^9$	$1.22 \times 10^8$	$1.05\text{E}+07$
2"	$1.09 \times 10^8$	$1.97 \times 10^9$	$1.04 \times 10^9$	$1.85 \times 10^9$	$3.8 \times 10^8$	$1.87\text{E}+07$
2-1/2"	$2.67 \times 10^8$	$3.07 \times 10^9$	$2.54 \times 10^9$	$2.9 \times 10^9$	N/A	N/A
3"	$5.53 \times 10^9$	$4.43 \times 10^9$	$5.27 \times 10^9$	$4.17 \times 10^9$	N/A	N/A
4"	$1.75 \times 10^{10}$	$7.87 \times 10^9$	$1.66 \times 10^{10}$	$7.41 \times 10^9$	N/A	N/A

### METRIC

SHAFT DIAMETER	HARDENED STEEL		STAINLESS STEEL	
	D	S	D	S
5 mm	$2.94 \times 10^8$	$3.12 \times 10^{11}$	$2.8 \times 10^8$	$2.94 \times 10^{11}$
6 mm	$6.11 \times 10^8$	$4.5 \times 10^{11}$	$5.81 \times 10^8$	$4.24 \times 10^{11}$
8 mm	$1.93 \times 10^9$	$8.0 \times 10^{11}$	$1.84 \times 10^9$	$7.53 \times 10^{11}$
10 mm	$4.71 \times 10^9$	$1.25 \times 10^{12}$	$4.48 \times 10^9$	$1.18 \times 10^{12}$
12 mm	$9.77 \times 10^9$	$1.8 \times 10^{12}$	$9.3 \times 10^9$	$1.69 \times 10^{12}$
13 mm	$1.35 \times 10^{10}$	$2.11 \times 10^{12}$	$1.28 \times 10^{10}$	$1.99 \times 10^{12}$
14 mm	$1.81 \times 10^{10}$	$2.45 \times 10^{12}$	$1.72 \times 10^{10}$	$2.31 \times 10^{12}$
16 mm	$3.09 \times 10^{10}$	$3.2 \times 10^{12}$	$2.94 \times 10^{10}$	$3.01 \times 10^{12}$
20 mm	$7.54 \times 10^{10}$	$5.0 \times 10^{12}$	$7.17 \times 10^{10}$	$4.71 \times 10^{12}$
25 mm	$1.84 \times 10^{11}$	$7.81 \times 10^{12}$	$1.75 \times 10^{11}$	$7.35 \times 10^{12}$
30 mm	$3.82 \times 10^{11}$	$1.12 \times 10^{13}$	$3.63 \times 10^{11}$	$1.06 \times 10^{13}$
35 mm	$7.07 \times 10^{11}$	$1.53 \times 10^{13}$	$6.73 \times 10^{11}$	$1.44 \times 10^{13}$
38 mm	$9.82 \times 10^{11}$	$1.8 \times 10^{13}$	$9.35 \times 10^{11}$	$1.7 \times 10^{13}$
40 mm	$1.21 \times 10^{12}$	$2.0 \times 10^{13}$	$1.15 \times 10^{12}$	$1.88 \times 10^{13}$
50 mm	$2.94 \times 10^{12}$	$3.12 \times 10^{13}$	$2.8 \times 10^{12}$	$2.94 \times 10^{13}$
60 mm	$6.11 \times 10^{12}$	$4.5 \times 10^{13}$	$5.81 \times 10^{12}$	$4.24 \times 10^{13}$
80 mm	$1.93 \times 10^{12}$	$8.0 \times 10^{13}$	$1.84 \times 10^{13}$	$7.53 \times 10^{13}$
100 mm	$4.71 \times 10^{13}$	$1.25 \times 10^{14}$	$4.48 \times 10^{13}$	$1.18 \times 10^{14}$
120 mm	$9.77 \times 10^{13}$	$1.8 \times 10^{14}$	$9.3 \times 10^{13}$	$1.69 \times 10^{14}$
150 mm	$2.39 \times 10^{14}$	$2.81 \times 10^{14}$	$2.27 \times 10^{14}$	$2.65 \times 10^{14}$

## SHAFT DEFLECTION

In applications where a support rail is not used, shaft deflection can become critical in the function of the bearing. If deflection is greater than the misalignment capabilities of a standard pillow block, binding can occur. Solutions would be to increase shaft and bearing size (to lessen the amount of deflection) or to use an open bearing configuration with a support rail. Follow the formulas below to check shaft deflection and sag.

### FORMULA FOR INCH AND METRIC SHAFTING DEFLECTION

Total shaft deflection in horizontal applications:

$$\text{Tot. Def} = \text{Def} + \text{Sag}$$

$$\text{Def} = w \times L^3 / D$$

$$\text{Sag} = L^4 / S$$

Def = Pure deflection due to load at center of shaft (inches or mm)

Sag = Deflection of shaft due to its own weight (inches or mm)

L = Shaft unsupported length (inches or mm)

w = load being applied at center of shaft (lbs. or N)

D = Deflection coefficient (D = 48 x E x I)

S = Sag coefficient (S = E x I x 384 / (5 x sw))

**NOTES:** I =  $\pi \times \text{diam}^4 / 64$

sw =  $\pi \times \text{diam}^2 / 4 \times \text{density}$

E = Modulus of Elasticity (Young's modulus)

## TOTAL DEFLECTION

ø1" Shaft

24" Length (L)

250# load (W)

$$\begin{aligned} \text{Deflection} &= \frac{W \times L^3}{D \text{ (from table)}} \\ &= \frac{250\# \times (24")^3}{6.83 \times 10^7} \\ &= \frac{3,456,000 \text{ in.}^3 \text{ lbs.}}{68,300,000 \text{ in.}^2 \text{ lbs.}} \end{aligned}$$

$$\text{Deflection} = 0.0506 \text{ in.}$$

$$\begin{aligned} \text{SAG} &= \frac{L^4}{S \text{ (from table)}} \\ &= \frac{(24)^4}{4.92 \times 10^8} \end{aligned}$$

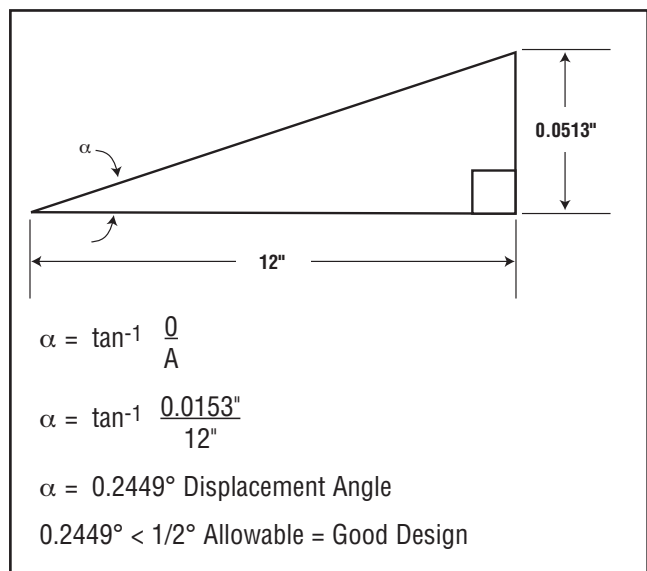
$$\text{SAG} = \frac{331,776 \text{ in.}^4}{492,000,000 \text{ in.}^3}$$

$$\text{SAG} = .000674 \text{ in.}$$

$$\begin{aligned} \text{Total Deflection} &= \text{Deflection} + \text{SAG} \\ &= 0.0506 \text{ in.} + .000674 \text{ in.} \end{aligned}$$

$$\text{Total Deflection} = 0.0513 \text{ in.}$$

## DISPLACEMENT ANGLE





## INSTALLING SIMPLICITY® BEARINGS

Applies to standard linear bearing series.

For sleeve and flange bearings, see product pages in the catalog.

PS - Page 38, PSM - Page 54, PSF - Page 39,  
PSFM - Page 55

### STRAIGHT BORE HOUSING - PRESS FIT BEARING

This type of configuration is **NOT** recommended for the vast majority of applications using Simplicity bearings.

It **does NOT** allow for any misalignment or shaft deflection.

Misalignment or shaft deflection will cause the bearing to bind on the shafting.

Extremely high precision applications may be able to employ this type of mounting. Typically the shafting has been aligned with a laser or some other highly precise equipment.

Due to bore closure in the pressing process, use a “C” series (compensated I.D.) bearing.

**EXAMPLE:** FLC24, FMC30, FJC30

The recommended installation procedure is to freeze the bearings at 0°F (-17.75°C) for 30-45 minutes. Using gloves, remove the bearings from the freezer and slip them into the housing. As they heat to room temperature, full contact between bearing and housing will be achieved. The greatest advantage to this technique over traditional pressing is greater accuracy in alignment.

This type of mounting will not allow for misalignment or shaft deflection. Both are very critical in the smooth operation of Simplicity bearings. A rolling element bearing may appear to initially operate in this condition, but it is operating in an extremely preloaded condition and will prematurely fail and in most cases destroy the shafting. Simplicity bearings will indicate the problem immediately upon installation by failing to move due to the binding condition. There are alternative mounting options that work extremely well.

PART NO.	MIN. HOUSING I.D. (INCHES)	MAX. HOUSING I.D. (INCHES)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)
FLC03	0.3729	0.3737	FMC05	11.995	11.972	FMTC06	11.954	11.972	FGC06	11.952	11.970	FJC06	11.961	11.979
FLC04	0.4978	0.4986	FMC08	15.954	15.972	FMTC08	14.954	14.972	FGC08	14.952	14.970	FJHC08	14.961	14.979
FLC06	0.6228	0.6236	FMC10	18.948	18.969	FMTC10	16.954	16.972	FGC10	16.952	16.970	FJC08	14.961	14.979
FLC08	0.8725	0.8734	FMC12	21.944	21.965	FMTC12	18.948	18.969	FGC12	21.945	21.966	FJC10	18.952	18.973
FLC10	1.1224	1.1234	FMC16	25.944	25.965	FMTC14	20.944	20.965	FGC15	24.945	24.966	FJC12	20.952	20.997
FLC12	1.2474	1.2484	FMC20	31.940	31.961	FMTC16	23.944	23.965	FGC16	25.945	25.966	FJC13	22.952	22.973
FLC16	1.5596	1.5607	FMC25	39.932	39.957	FMTC20	27.944	27.965	FGC18	27.945	27.966	FJC16	27.952	27.973
FLC20	1.9970	1.9981	FMC30	46.932	46.957	FMTC25	34.940	34.961	FGC20	31.945	31.966	FJC20	31.950	31.971
FLC24	2.3717	2.3729	FMC40	61.917	61.947	FMTC30	39.932	39.957	FGC25	39.937	39.962	FJC25	39.941	39.966
FLC32	2.9965	2.9977	FMC50	74.917	74.947	FMTC40	51.932	51.957	FGC30	44.937	44.962	FJC30	44.941	44.966
FLC40	3.7461	3.7473	FMC60	89.906	89.936	FMTC50	61.917	61.947	FGC35	51.937	51.962	FJC35	51.938	51.963
FLC48	4.4953	4.4966	FMC80	119.886	119.921				FGC40	59.927	59.957	FJC38	56.938	56.963
FLC64	5.9949	5.9963							FGC50	74.927	74.957	FJC40	59.928	59.958
												FJC50	79.922	79.952
												FJC60	89.919	89.949
												FJC80	119.899	119.934
												FJC100	149.896	149.931
												FJC120	179.875	179.915
												FJC150	209.849	209.895

**NOTE:** Use “C” (compensated I.D.) series bearings.

## INSTALLING SIMPLICITY® BEARINGS

### STRAIGHT BORE HOUSING - SLIP FIT BEARING

There are three basic configurations that work well, depending on the misalignment and shaft deflection in the application:

#### 1. Virtually NO misalignment

This method allows for NO or very little shaft deflection and misalignment.

Standard I.D. bearings will need tighter alignment than a "C" series (compensated I.D.) bearing.

Standard retention methods are acceptable.

**EXAMPLE:** snap rings, epoxy, etc.

**NOTE:** If using epoxy, do not touch the bearing liner with the bonding agent!

This type of mounting will allow for minimum misalignment or shaft deflection. Both are very critical in the smooth operation of Simplicity bearings. A rolling element bearing may appear to initially operate in this condition, but it is operating in an extremely preloaded condition and will prematurely fail and in most cases destroy the shafting. Simplicity bearings will indicate the problem immediately upon installation by failing to move due to the binding condition.

PART NO.	MIN. HOUSING I.D. (INCHES)	MAX. HOUSING I.D. (INCHES)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)
FL03	0.3755	0.3764	FM05	12.016	12.043	FMT06	12.016	12.043	FG06	12.016	12.043	FJ06	12.016	12.043
FL04	0.5006	0.5017	FM08	16.016	16.043	FMT08	15.016	15.043	FG08	15.016	15.043	FJH08	15.016	15.043
FL06	0.6256	0.6267	FM10	19.020	19.053	FMT10	17.016	17.043	FG10	17.016	17.043	FJ08	15.016	15.043
FL08	0.8758	0.8771	FM12	22.020	22.053	FMT12	19.020	19.053	FG12	22.020	22.053	FJ10	19.020	19.053
FL10	1.1258	1.1271	FM16	26.020	26.053	FMT14	21.020	21.053	FG15	25.020	25.053	FJ12	21.020	21.053
FL12	1.2510	1.2525	FM20	32.025	32.064	FMT16	24.020	24.053	FG16	26.020	26.053	FJ13	23.020	23.053
FL16	1.5635	1.5650	FM25	40.025	40.064	FMT20	28.020	28.053	FG18	28.020	28.053	FJ16	28.020	28.053
FL20	2.0012	2.0030	FM30	47.025	47.064	FMT25	35.025	35.064	FG20	32.025	32.064	FJ20	32.025	32.064
FL24	2.3762	2.3780	FM40	62.030	60.076	FMT30	40.025	40.064	FG25	40.025	40.064	FJ25	40.025	40.064
FL32	3.0012	3.0030	FM50	75.030	75.076	FMT40	52.030	52.076	FG30	45.025	45.064	FJ30	45.025	45.064
FL40	3.7514	3.7535	FM60	90.036	90.090	FMT50	62.030	62.076	FG35	52.030	52.076	FJ35	52.030	52.076
FL48	4.5014	4.5035	FM80	120.036	120.090				FG40	60.030	60.076	FJ38	57.030	57.076
FL64	6.0017	6.0042							FG50	75.030	75.076	FJ40	60.030	60.076
												FJ50	80.030	80.076
												FJ60	90.036	90.090
												FJ80	120.036	120.090
												FJ100	150.043	150.106
												FJ120	180.043	180.106
												FJ150	210.050	210.122

## INSTALLING SIMPLICITY® BEARINGS

### STRAIGHT BORE HOUSING - SLIP FIT BEARING (cont.)

#### 2. Standard applications with average misalignment

A self-aligning O.D. bearing is recommended.

**EXAMPLE:** FLA24, FMA30, FJA30

For details on the self-aligning O.D. feature, see page 75 of the product catalog.

The recommended method of retention for this mounting is a snap ring at each end.

**NOTE:** Do not use epoxy in this configuration. It will lock the bearing in place not allowing it to self-align.

Be sure to install the o-rings around the O.D. of the bearing to reduce noise while the bearing is in operation.

PART NO.	MIN. HOUSING I.D. (INCHES)	MAX. HOUSING I.D. (INCHES)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)	PART NO.	MIN. HOUSING I.D. (MM)	MAX. HOUSING I.D. (MM)
FLA03	0.3755	0.3764	FMA05	12.016	12.043	FMT06	N / A	N / A	FG06	N / A	N / A	FJA06	12.016	12.043
FLA04	0.5006	0.5017	FMA08	16.016	16.043	FMT08	N / A	N / A	FG08	N / A	N / A	FJHA08	15.016	15.043
FLA06	0.6256	0.6267	FMA10	19.020	19.053	FMT10	N / A	N / A	FG10	N / A	N / A	FJA08	15.016	15.043
FLA08	0.8758	0.8771	FMA12	22.020	22.053	FMT12	N / A	N / A	FG12	N / A	N / A	FJA10	19.020	19.053
FLA10	1.1258	1.1271	FMA16	26.020	26.053	FMT14	N / A	N / A	FG15	N / A	N / A	FJA12	21.020	21.053
FLA12	1.2510	1.2525	FMA20	32.025	32.064	FMT16	N / A	N / A	FG16	N / A	N / A	FJA13	23.020	23.053
FLA16	1.5635	1.5650	FMA25	40.025	40.064	FMT20	N / A	N / A	FG18	N / A	N / A	FJA16	28.020	28.053
FLA20	2.0012	2.0030	FMA30	47.025	47.064	FMT25	N / A	N / A	FG20	N / A	N / A	FJA20	32.025	32.064
FLA24	2.3762	2.3780	FMA40	62.030	60.076	FMT30	N / A	N / A	FG25	N / A	N / A	FJA25	40.025	40.064
FLA32	3.0012	3.0030	FMA50	75.030	75.076	FMT40	N / A	N / A	FG30	N / A	N / A	FJA30	45.025	45.064
FLA40	3.7514	3.7535	FMA60	90.036	90.090	FMT50	N / A	N / A	FG35	N / A	N / A	FJA35	52.030	52.076
FLA48	4.5014	4.5035	FMA80	120.036	120.090				FG40	N / A	N / A	FJA38	57.030	57.076
FLA64	6.0017	6.0042							FG50	N / A	N / A	FJA40	60.030	60.076
												FJA50	80.030	80.076
												FJA60	90.036	90.090
												FJA80	120.036	120.090
												FJA100	150.043	150.106
												FJA120	180.043	180.106
												FJA150	210.050	210.122

**NOTE:** FMT and FG series are NOT available with a self-aligning O.D

## INSTALLING SIMPLICITY® BEARINGS

### STRAIGHT BORE HOUSING - SLIP FIT BEARING (cont.)

#### 3. Severe misalignment

A standard O.D. bearing is recommended.

**EXAMPLE:** FL24, FM30, FJ30

Oversize the I.D. of the housing and install the bearing with o-rings. This will allow the bearing to “float” in the housing and match the misalignment or non-parallelism of the shafting.

The recommended method of retention for this mounting is a snap ring at each end.

**NOTE:** Do not use epoxy in this configuration. It will lock the bearing in place, not allowing it to self-align.

See page 84 of the product catalog for more details on this solution.

PART NO.	MAXIMUM ADDITIONAL CLEARANCE (INCHES)	PART NO.	MAXIMUM ADDITIONAL CLEARANCE (MM)	PART NO.	MAXIMUM ADDITIONAL CLEARANCE (MM)	PART NO.	MAXIMUM ADDITIONAL CLEARANCE (MM)	PART NO.	MAXIMUM ADDITIONAL CLEARANCE (MM)
FL03	0.0070	FM05	0.203	FMT06	0.203	FG06	0.203	FJ06	0.203
FL04	0.0080	FM08	0.203	FMT08	0.203	FG08	0.203	FJH08	0.203
FL06	0.0080	FM10	0.203	FMT10	0.203	FG10	0.203	FJ08	0.203
FL08	0.0080	FM12	0.203	FMT12	0.203	FG12	0.203	FJ10	0.203
FL10	0.0100	FM16	0.254	FMT14	0.203	FG15	0.254	FJ12	0.203
FL12	0.0100	FM20	0.254	FMT16	0.254	FG16	0.254	FJ13	0.203
FL16	0.0120	FM25	0.305	FMT20	0.254	FG18	0.254	FJ16	0.254
FL20	0.0120	FM30	0.305	FMT25	0.254	FG20	0.254	FJ20	0.254
FL24	0.0120	FM40	0.305	FMT30	0.305	FG25	0.305	FJ25	0.305
FL32	0.0120	FM50	0.305	FMT40	0.305	FG30	0.305	FJ30	0.305
FL40	0.0160	FM60	0.406	FMT50	0.305	FG35	0.305	FJ35	0.305
FL48	0.0160	FM80	0.508			FG40	0.305	FJ38	0.305
FL64	0.0200					FG50	0.305	FJ40	0.305
								FJ50	0.406
								FJ60	0.406
								FJ80	0.508
								FJ100	0.610
								FJ120	0.610
								FJ150	0.610

## CHEMICAL REACTION CHART

The original FrelonF® and FrelonJ® have almost universal chemical inertness. Only molten sodium and fluorine at elevated temperatures and pressures show any signs of attack. It is approved for use with liquid oxygen, N<sub>2</sub>O<sub>2</sub> hydrazine, UDMH, hydrocarbon fuels, high strength hydrogen peroxide, etc.

The FrelonGOLD® material is a composite of PTFE and a bearing filler. The PTFE is chemically inert. The chemical resistance shown in the chart below is defined by the compatibility of the filler with the various chemicals.

Other data in the chart below applies to the bearing shell and pillow block materials. The table is provided as a reference only. The data given will be affected by factors such as temperature, PV, degree of contact, strength of solution, etc. In each specific application, it is always advisable to conduct specific testing to determine suitability of use. This table only addresses general corrosion, NOT galvanic, SCC, or other types of corrosion. Corrosion rates are at room temperature unless otherwise noted.

Standard and hard coat data only apply when the coating is intact. If the coating is worn through or damaged, an area of galvanic and pitting corrosion will be created. Then use the bare aluminum data.

Standard Simplicity products use 6061-T6 aluminum alloy, which is known to have the best corrosion resistance of the high strength aluminum alloys. The sulfuric bath anodizing and nickel acetate sealing provide the best corrosion resistance available in anodized coatings. They can withstand a rigorous 14-day exposure in a 5% salt spray solution at 96°F per military specifications without significant damage. With the coating intact, it is considered to be inert in most fluids with a pH value between 5 and 8. Hard coat anodizing provides the same chemical resistance but is applied to a .002" thickness, providing a more durable surface that will stand up to greater abuse. However, if the coating is penetrated, the resistance is reduced.

Special stainless steel bearings use AISI 316 stainless, which has superior resistance over 303, 304, 420, 440, 17-4PH, and most other common stainless grades. 316 is generally considered to be the most corrosion resistant of conventional stainless steels.

**NOTE:** This information was compiled for Pacific Bearing® Company by Materials Engineering, Inc. of Virgil, IL. This specification information is believed to be accurate and reliable, however, no liability is assumed. INFORMATION IS FOR REFERENCE ONLY. USER MUST TEST SPECIFIC APPLICATIONS.

### E = < .002" per year

### G = < .020" per year

### S = < .050" per year

### U = > .050" per year

CHEMICAL	FRELONGOLD®	BARE ALUMINUM	STANDARD & HARD COAT ANODIZED ALUMINUM	316 STAINLESS STEEL	CHEMICAL	FRELONGOLD®	BARE ALUMINUM	STANDARD & HARD COAT ANODIZED ALUMINUM	316 STAINLESS STEEL
Acetic Acid, 20%	U	G	G	E	Hydrogen sulfide, dry	U	G	E	E
Acetone	G	E	E	E	JP-4	G	G	G	G
Ammonia, anhydrous	E	E	E	E	Kerosene	G	G	G	G
Ammonium hydroxide, 10%	U	U	U	E	Lactic acid, 10%	G	G	G	E
Ammonium chloride, 10%	U	U	U	G	Magnesium chloride, 50%	G	U	U	G
Ammyl acetate (122°F / 50°C)	G	E	E	E	Mercury	U	U	U	E
Barium hydroxide	U	U	U	G	Methyl alcohol	G	G	G	G
Beer	G	E	E	E	Methyl ethyl ketone	G	G	G	G
Boric acid solutions	G	E	E	G	Methylene chloride	G	E	E	G
Butane	G	G	G	G	Mineral oil	G	G	G	G
Calcium chloride, 20%	G	G	G	G	Naptha	G	G	G	G
Calcium hydroxide, 10%	G	G	G	G	Nitric acid, 70%	U	U	U	E
Carbon dioxide	G	E	E	G	Phosphoric acid, 10%	U	U	U	E
Carbon monoxide	E	E	E	E	Sodium chloride	G	U	U	E
Chlorine gas, dry	G	G	G	G	Sodium hydroxide, 20%	G	U	U	G
Chlorine gas, wet	U	U	U	U	Sodium hypochlorite, 20%	U	G	G	U
Chromic acid, 10%	U	G	E	E	Sodium peroxide, 10%	U	G	G	G
Citric acid, 5%	G	E	E	E	Steam (see water)	-	-	-	-
Ethyl acetate	G	E	E	G	Sulfur dioxide, wet	U	U	U	G
Ethyl alcohol	G	E	E	G	Sulfur dioxide, dry	G	G	G	G
Ethylene glycol	G	E	E	G	Sulfur trioxide	U	G	G	G
Ferric chloride, 50%	U	U	U	U	Sulfuric acid, 50%	U	U	U	U
Formic acid - Anhydrous	U	E	E	E	Sulfurous acid	U	G	G	E
Gasoline, Unleaded	G	G	G	G	Toluene (122°F / 50°C)	E	E	E	E
Hydrochloric acid, 20%	U	U	U	U	Turpentine	G	G	E	E
Hydrochloric acid, 35%	U	U	U	U	Water, demineralized	U	G	E	E
Hydrocyanic acid, 10%	U	G	G	G	Water, distilled	G	U	S	G
Hydrofluoric acid - dilute	U	U	U	U	Sea Water	G	G	E	G
Hydrofluoric acid, 48%	I	U	U	U	Water, sewage	G	U	S	G
Hydrogen	E	E	E	E	Xylene	G	G	G	G
Hydrogen peroxide - dilute	U	E	E	G	Zinc chloride solutions	U	U	U	G