High Performance Fluoropolymer Composite Bearings

RULON® CJ

Long-wearing, maintenance-free bearing material for high-load applications

- High-load capacity
- Self-lubricating design
- Low coefficient of friction
- Temperature resistant
- Dimensionally stable in fluids
- Chemical resistant
- Flexible material design
- Low-weight/high-strength ratio
- Tolerates shaft misalignment
- Excellent against shock loading
- Thick walls for drop in replacements of bronze or metal bearings

SAINT-GOBAIN
PERFORMANCE PLASTICS

Saint-Gobain

Saint-Gobain is a worldwide group whose history spans more than three centuries. Created in 1665 in France, Saint-Gobain launched its first industrial Department with the production of mirrors, which adorn the famous Hall of Mirrors at Versailles.

Expansion beyond French borders began in the middle of the 19th century. An international pioneer, Saint-Gobain established a glass factory in Germany in 1857, another in Italy in 1889 and one in Belgium in 1904. The group moved toward the New World in 1937 with the opening of a plant in Brazil.

Early Diversification
Strongly established in flat glass production, Saint-Gobain began looking toward other activities at the beginning of the 20th century. The company entered the papermaking business in 1925, and the insulation business in 1936. The 1970 addition of the company Pont-á-Mousson, the world leader in cast iron pipes, reinforced Saint-Gobain's position in the construction market.

Throughout the 1970's and 80's the Saint-Gobain Group continued to pursue both internal and external growth, which culminated with the 1990 acquisition of Norton Company, one of the world's leading abrasives and ceramics manufacturers.

Norton Performance Plastics in turn acquired Furon Company and created the new Saint-Gobain Performance Plastics, combining decades of experience and leadership in metal-backed and polymer bearings and components.

The Rulon® trademark had been acquired by Furon in the purchase of Dixon Industries Corporation, founded in 1876 by Ezra Dixon, specializing in self-lubricating bearings for the then emerging textile industry in the northeastern United States.

Rulon® Composite Bearings

An Overview

RULON CJ Composites Out Perform Metals

RULON CJ composites are ideal for non-lubricated, high-load applications in a variety of climates and operating environments, exhibit a high load capacity similar to bronze, powdered metal and steel, and provide longer wear and extended operating life without the costs associated with lubrication. RULON CJ composites are available with thick walls for drop in replacement of metal, steel and bronze bearings. RULON CJ composites also don't rust like metal components, so you can use them in environments where traditional metals corrode and fail. You'll find Saint-Gobain Performance Plastics bearing materials in heavy-duty agricultural, automotive, construction, industrial, marine, railway, and material handling equipment.

RULON CJ composites possess a modulus of elasticity that falls between rigid metals and soft plastics. RULON CJ components are rigid enough to support heavy loads, yet compliant enough to tolerate moderate amounts of shaft misalignment without highly stressing the ends. The composite wall acts like a spring and the thicker the wall section of the bearing the greater the deflection for a given load. Thick wall bearings tolerate greater shaft misalignment and provide better shock absorbency.

FEATURESkk	BENEFITS
High-load capacity/ high-shock load capability	Accommodates tremendous compression loads that literally crush competing composite materials.
Self-lubricating design	Provides maintenance-free operation and eliminates the need for costly and messy greasing systems.
Low coefficient of friction	Reduces wear and extends operating life. Coefficients as low as 0.05 in dry applications and <0.009 in lubricated environments.
Temperature resistant	Operates flawlessly in temperatures ranging from cryogenic levels to a high of 300°F (149°C). Call for higher temperture availability.
Dimensionally stable in fluids (water, corrosive liquids, and chemical solutions)	Absorption rates are negligible, providing near zero swell.
Chemical resistant	Compatible with a wide range of lubricants and media.
Flexible material design	Suitable for press fit, freeze fit, epoxy bonding, as well as conventional mechanical retention.
Low weight/high strength	Accommodates high-load with a compact strength ratio light weight construction.
Thick-wall availability	Drop in replacement for metal or bronze bearings

Rulon® CJ and FCJ Composites

Light-weight, high-strength, fatigue-resistant RULON CJ composites are the ideal bearing choice for non-lubricated high-load/low-speed applications. RULON CJ bearings provide excellent resistance to impact and shock loads and are capable of withstanding a high degree of shaft misalignment.

RULON FCJ bearings are the ideal choice for combination motion-oscillatory, linear, and/or rotary applications. Their ability to run successfully against mild steel shafting makes for a cost-competitive system. Their versatility makes them excellent general purpose self-lubricating bearings.

The self-lubricating wear surface of RULON CJ and FCJ composites are capable of reducing both equipment costs and the need for maintenance. Use RULON CJ bearings in applications where:

- Conventional lubricants will not function.
- Shock loads are present.
- Stick-slip operation is undesirable.
- Low cost is an issue, particularly when taking into consideration the bearing, lubrication system, or maintenance.

Use RULON CJ when your application requires:

- High-load capacity.
- Resistance to chemical, galvanic, or fretting corrosion.
- Minimal galling and scoring.
- Reduced weight.
- Electrical insulation.

Use RULON FCJ in applications where you would normally use low-speed porous and cast bronze. It is corrosion resistant, practically chemically inert, and electrically insulating. RULON FCJ bearings are more tolerant of small contaminants than standard RULON CJ bearings. They are also easily machined using standard techniques. Standard RULON FCJ sizes interchange with standard bronze bearings. That means RULON FCJ is not only an ideal alternative to metal, it's also a perfect fit.

Typical Specifications

Recommended Operating Limits and Engineering Information

Properties		RULON CJ	RULON FCJ	BRONZE
Maximum Pressure (P) (static)	psi MPa	35,000 (1) 241	20,000 138	10.600 73
Maximum Velocity (V) (no load)	ft/min m/sec	150 .76	500 2.54	80 .40
Maximum PV (continuous)	psi x ft/min MPa x m/sec	30,000 (2) 1.05	35,000 1.22	50,000 1.73
Temperature — Typical Range	°F °C	-320/+350 -195/+176	-320/+350 -195/+176	— —
Shaft Hardness — Minimum, Rockwell Scale		Rc 50	RB 25	—
Shaft Finish Recommended Ra (Microinches)		8-16	8-16	—
Shaft Material		Steel	Steel	—
Coefficient of Friction (Static/Dynamic Range)		.02 - .25	.01 - .20	—
Water Absorption ASTM D570		<.5%	<.5%	—
Thermal Conductivity	BTU in/hr/ft²/°F W/m/°C	3.0 .43	3.0 .43	— —
Linear Coefficient of Thermal Expansion (ASTM D696) 78°F to 300°F 26°C to 149°C	in/in/°F cm/cm/°C	7 x 10^{-6} 13 x 10^{-6}	7 x 10^{-6} 13 x 10^{-6}	— —

(1) 15,000 psi maximum dynamic
(2) 50,000 PV maximum intermittent

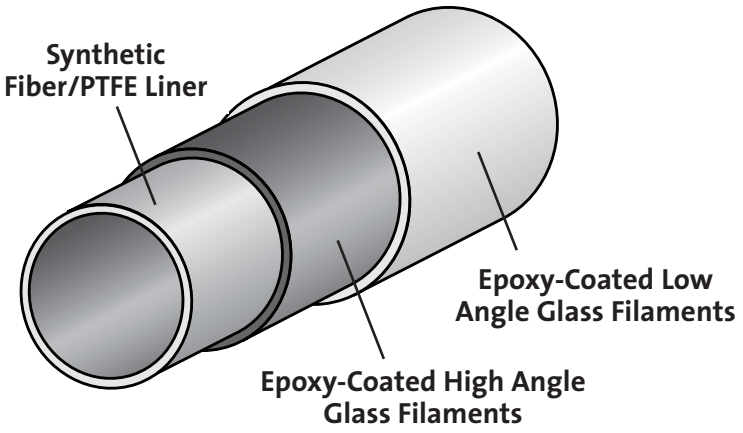
General Description

The RULON CJ composite bearing is a multi-layer structure. The inner-most layer consists of a synthetic fiber/PTFE layer. The second layer consists of epoxy-coated high-angle glass filaments . The outer-most layer consists of epoxy-coated low-angle glass filiments.

The synthetic and PTFE fibers used in the liner have a long history of successful use as a bearing wear surface for rod end and aircraft spherical bearings. The high-load capacity and reliability of these bearings has made them the preferred design for many applications.

Fiberglass/epoxy filament wound composites were originally developed for use as pressure vessels and rocket motor cases. Their lightweight, high strength, and fatigue resistance make them ideal materials for structural applications. When used to make a bearing, this material allows the selection of fiber angles to provide optimum strength and rigidity. The resulting structure has a modulus of elasticity of approximately 2 x 10^6 psi (13.79 GPa) placing it in an intermediate area between rigid metals and soft plastic. It is rigid enough to support heavy loads, and at the same time compliant enough to tolerate moderate amounts of shaft misalignment without highly stressing the bearing corners. The composite wall acts like a spring and the thicker the wall section of the bearing the greater the deflection for a given load *(See Figure C,* page 5*)*. This allows thick wall bearings to tolerate greater shaft misalignment. The wear surface will support the shaft primarily as a function of the load rather than the shaft clearance. As load is applied, the wear surface will conform to the shaft assuring a large contact area. In contrast, the contact area of metal bearings decreases sharply as shaft clearances increase, and increase only slightly with load.

RULON CJ BEARING CONSTRUCTION



Bearing Wear

Figure A (page 5) depicts the typical wear pattern of a RULON CJ or FCJ bearing. There is an initial break-in period during which a transfer film is established on the mating surface. In some situations, up to .001" (.03mm) of wear may occur at break-in and in other situations the wear may be negligible. After the break-in period, the wear rate stabilizes and remains relatively constant for the life of the bearing. There is a transfer film of PTFE, epoxy, and some synthetic fiber that clings tenaciously to the metal surface, and acts as a lubricant between the shaft and the bearing.

The equilibrium wear rate depends on a number of factors including loads, speeds, shaft hardness, and shaft surface finish. Under laboratory conditions, radial wear is approximately proportional to both sliding distance and load. The wear rate is often reported as a factor K. This relationship can be expressed as follows:

W = KPVT

W =	*Radial wear in inches*
K =	*Wear factor*
P =	*Load in psi*
V =	*Sliding velocity (ft/min)*
T =	*Time in hours*

The following table shows the actual measured wear factor for a number of conditions of oscillation and rotation. These values were obtained using Rc 50 shafts with a surface finish of 16 Ra (.4 µm). The wear factor would increase if the shaft material was softer or the surface finish rougher. The performance using the softer shafts was significantly lower, especially at the higher load condition. While performance is lower, it is adequate for many less demanding applications.

Measured Wear Factors for Rulon CJ Composite Bearings

Type of Operation	*P lbs/in²*	*V ft/min*	*K in³xmin/lbxftxhr*
Oscillation ±25°	229	43.6	9.6×10^{-10}
	4,900	2.0	1.9×10^{-10}
	15,000	.73	2.0×10^{-9}
Rotation	64	78.5	39.8×10^{-10}
	64	157.0	24.9×10^{-10}
	256	39.3	14.9×10^{-10}
	512	39.3	12.4×10^{-10}

Measured Wear Factors for RULON FCJ Composite Bearings

Type of Operation	*P lbs/in²*	*V ft/min*	*K in³xmin/lbxft x hr*
Oscillation ±25°	229	43.6	7.4×10^{-10}
	4,900	2.0	1.6×10^{-10}
	14,000	.73	5.52×10^{-10}
Rotation	64	78.5	33.1×10^{-10}
	64	157.00	19.9×10^{-10}
	256	39.3	14.6×10^{-10}
	512	39.3	12.41×10^{-10}

Using wear factors, the radial wear of a RULON CJ bearing can be estimated by calculating W and adding .001" (.025 mm) for break-in wear. The liner can sustain .015-.020" (.38 mm-.51 mm) wear and still operate normally. Bearings having an inside diameter of over 2-1/2" have a thicker liner capable of sustaining .025" to

FIGURE A: TYPICAL WEAR BEHAVIOR FOR COMPOSITE BEARINGS

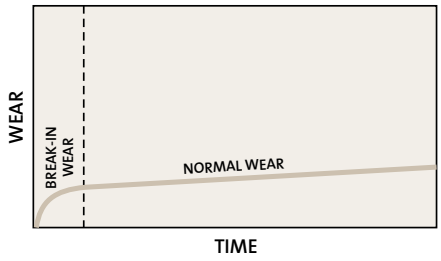


FIGURE B: WEAR VS. SURFACE FINISH

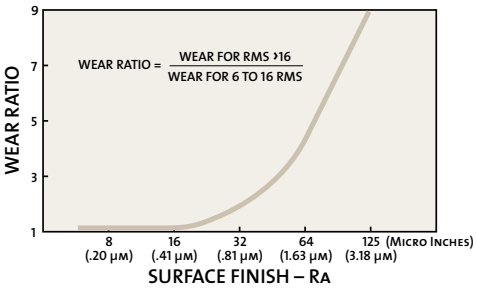
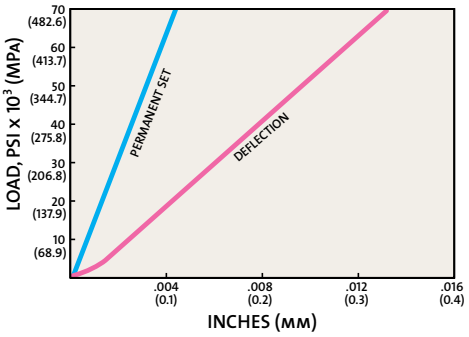


FIGURE C: DEFLECTION

Chart shows the deflection and the permanent set of a typical RULON CJ Composite Bearing at load.



.030" (.64mm - .76mm) wear. Surface finish affects wear rate as shown in *Figure B*. Field experience has shown that hard chrome plating gives excellent wear performance and protects the shaft from corrosion. Softer coatings such as cadmium and zinc will not stand up in service and quickly wear off.

Load Capacity

Normal application of load will cause a simple elastic deflection of the RULON CJ bearing along with some permanent set. The set is primarily due to compaction of the synthetic fiber/PTFE liner. We do not typically recommend subjecting the bearings to over 35,000 psi (241 MPa) load. In common with other materials, fiberglass/epoxy composites can undergo fatigue after repeated application of stress. Fatigue has not been a limiting factor in the use of the RULON CJ bearing. In fact, laboratory tests have shown that in many cases the bearing is more fatigue-resistant than the shaft. Laboratory tests show that the bearings fail by a gradual crushing action rather than a rapid catastrophic failure. This is consistent with typical composite behavior in which stress is supported by many fibers. If one fiber breaks, the load is redistributed among the others. Breakage of the entire structure will not occur until a large number of the individual fibers are broken. RULON CJ composite bearings can easily withstand 35,000 psi (241 MPa) static load or 15,000 psi (103 MPa) dynamic load with a great deal of reliability. In many cases, higher loading can be tolerated if the design and conditions of service are discussed fully with a Saint-Gobain Performance Plastics bearing specialist.

Length to diameter ratio is also an important design consideration. Test results from the laboratory and the field have shown that the optimum performance can be attained by specifying a length to inside diameter ratio (L/D) ranging from .5 to 2. When the L/D ratio of less than .5 is used, it is possible to create highly stressed areas at the corner of the bearing and cracking will occur at this location prematurely. If the L/D ratio is over 2, with any amount of shaft misalignment, cross corner jamming will occur and unit stresses can exceed the 15,000 psi (103 MPa) safe dynamic limit or the 35,000 psi (241 MPa) static limit of the bearings. Bearings built with the proper L/D ratio will accept misalignment and shock load without premature failure *(Figure C)*.

Coefficient of Friction

The coefficient of friction of a synthetic fiber/PTFE lined composite journal bearing running against a hardened Rc 50 steel shaft with a 16 Ra (.4 µm) surface, or less, varies from .02 to .25 depending on the load, the relative sliding velocity, and the bearing surface temperature. Generally, the coefficient of friction decreases with increasing load (*See Figure D*).

This information indicates that if the lowest coefficient of friction is desired, the smallest bearing capable of sustaining the load should be used, and that the bearings are capable of performing best under peak operating conditions when temperatures and loads may be higher.

Lubrication

The synthetic fiber/PTFE fabric wear surface of the RULON CJ bearing is a self-contained boundary lubrication system, however, the addition of conventional lubricants often improves the overall performance of the RULON CJ bearing. "Lubricant" is a very general term, and it is often said that any liquid will act as a lubricant. To some extent, this is true if hydrodynamic conditions are established, and the surfaces have minimal contact. The composite bearing, in earth moving equipment, operates generally in a state of boundary lubrication. Hydrocarbon oils are advantageous and can produce tenfold reductions in wear rates. Liquid lubricants can carry away heat and reduce the coefficient of friction. Greases can be used

FIGURE D: COEFFICIENT OF FRICTION VS. LOAD

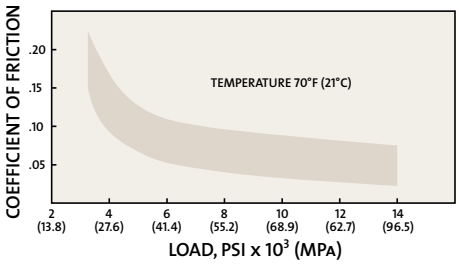


FIGURE E: DEFLECTION

Chart shows the deflection and the permanent set of a typical RULON FCJ Composite Bearing at load.

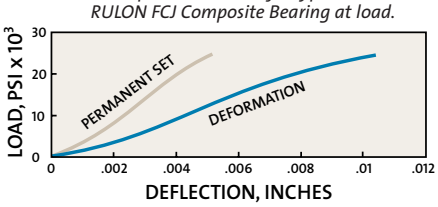
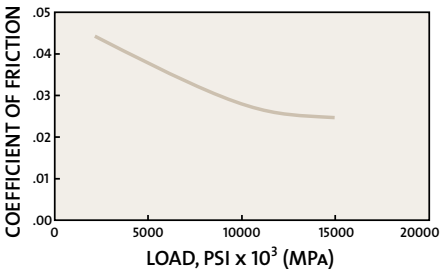


FIGURE F: COEFFICIENT OF FRICTION VS. LOAD



for lubrication, to prevent corrosion, and keep contamination out of the journal. In oscillating motion, the synthetic fiber/PTFE liner acts as a true boundary lubricant when the direction of motion changes and the lubrication film collapses. In rotation, with oil lubrication, the wear rate of the RULON CJ composite has been found equal to sintered or cast bronze bearings. Fluorocarbon oils and greases should be avoided because they have been found to soften the synthetic fibers and greatly increase the rate of wear.

It is possible to add lubrication holes to the RULON CJ bearing, but grooves are impractical. The abrasion resistance of the synthetic fibers makes groove fabrication difficult and costly.

Thermal Properties

The operating temperature range for RULON CJ bearings is -320°F to +300°F (-195°C to +149°C). The bearing has been heat stabilized at a temperature above

300°F (149°C) and very little dimensional change will occur in the bearing during operation. In the free state, the coefficient of expansion of the RULON CJ bearing in the radial direction is approximately 7×10^{-6} in/in/°F. When press fit into a housing, the RULON CJ bearing assumes the coefficient of expansion of the housing material, as long as the press fit is maintained, and thus the elastic modulus of the bearing is maintained, because the elastic modulus of the bearing is lower than the elastic modulus of most metals.

The RULON CJ composite is a thermal insulator and when heat is generated from running friction, the bearing wear surface may be hotter than the adjacent housing due to the thermal lag. (Higher temperature available upon request.)

Since the installed bearing cannot expand outward, it grows inward, reducing the shaft clearance. For this reason, the shaft clearance should be increased for dry running applications that have high running velocities. Naturally, fluid cooling and lubricants will reduce the operating temperatures. Heat transfer through the bearing wall is proportional to the wall thickness, and the thinner the composite wall, the greater the transfer of heat.

Measuring Operating PV

PV is a means of measuring the performance capabilities of bearings. P is expressed as pressure or pounds per square inch on the projected bearing area. V is the velocity in feet per minute of the wear surface.

For sleeve bearings the surface speed V is .262 x RPM x diameter in inches. P is equal to the load on the bearing in pounds divided by the projected area in square inches. For sleeve bearings the projected area is the length times the diameter of the bearing.

PV is then obtained by multiplying the P x V as shown in the following example:

3/4" Shaft @ 341 RPM; 90 lb. total load, bearing length 1"

V = .262 x RPM x Diameter
or .262 x 341 x .750 = 67 ft/min
P = Total load ÷ projected area
area = .750 x 1.0 = .75 in²
P = 90 lbs ÷ .75 = 120 psi
PV = 120 psi x 67 fpm = 8040 PV

Mechanical Properties

The RULON CJ bearing has withstood static loads in excess of 50,000 psi (345 MPa) at room temperature. However, we do not generally recommend static loads in excess of 35,000 psi (241 MPa). At the recommended load limits, minimal crushing will occur. As the temperature increases, the load capacity of the bearing decreases. The composite backing tends to act as a shock absorber and reduces vibration. The maximum speed is 150 surface feet per minute for dry running applications.

Corrosion Resistance

The RULON CJ bearing is not affected by corrosive environments. Some solutions of highly concentrated acids will attack the backing material. Specific information can be obtained from our Technical Service Department. The shaft should be stainless steel or chrome-plated if an alloy steel is used. The RULON CJ bearing cannot rust, but when using a lubricant, it should contain a rust inhibitor to protect the shaft.

Installation Procedures

Proper installation of components is critical to achieving the best results. Saint-Gobain recommends the following methods to ensure optimum bearing material performance.

Installation

RULON composite bearings install easily. Use a shouldered arbor plug for standard press-fit installation. The diagram below shows arbor, housing, bearing, and shaft relationships.

Press Fit Installation Using Standard Housings

The dimensions recommended here ensure proper interference fits. Using these standard bearings, shaft, and housing dimensions usually eliminates the need for further machining or reaming of the bearing.

Press Fit Installation Using Non-Standard Housings

When using non-standard housings, you can machine a small amount of material from the O.D. of RULON CJ bearings. Be sure the bearing is mounted on a pin of the proper diameter to prevent out-of-roundness. Saint-Gobain Performance Plastics recommends carbide or diamond tipped tool bits.

When replacing only the bearing, be sure to clean the existing housing. Thoroughly machine it to size if necessary. Take care to remove sharp edges and add proper chamfers.

Other Installation Methods

You can use other means of retention like staking, retainer rings, or bonding.

Fabrication & Machining Fabric Lined Bearings

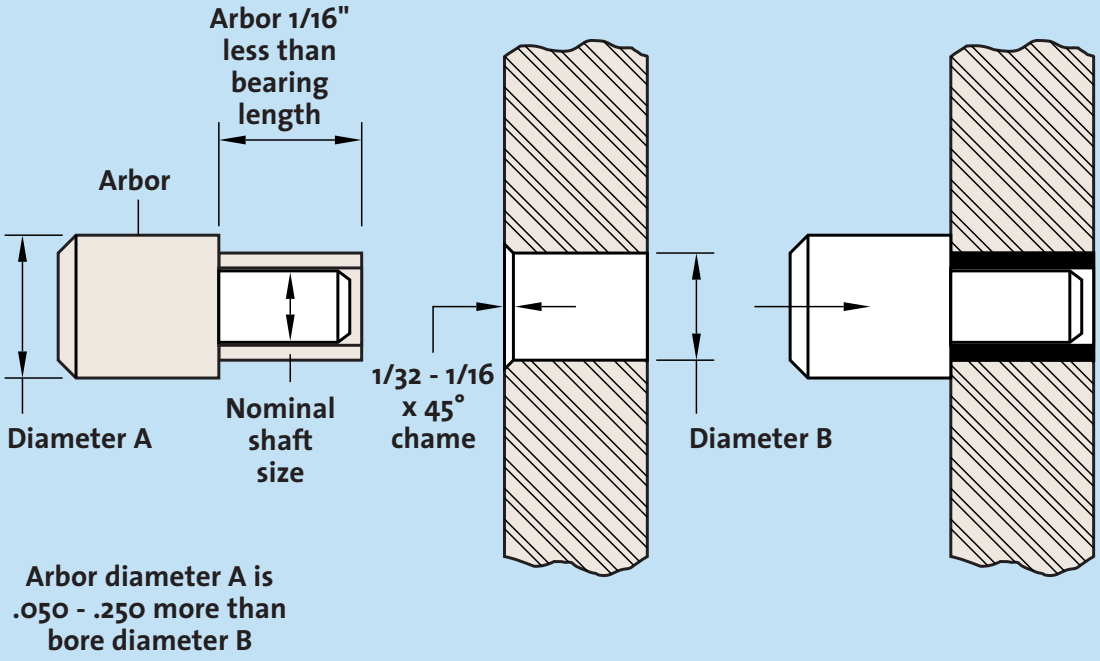
O.D. Machining: Rulon CJ bearings can be ground or turned to finished size. Saint-Gobain Performance Plastics recommends carbide or diamond tipped tools for cutting.

Drilling: Cross drilling is acceptable for lubrication and installation, but take care not to damage the synthetic fiber/PTFE liner. Contact Saint-Gobain for assistance in drilling radial through holes.

Cutoff: Saint-Gobain Performance Plastics recommends using a diamond wheel for abrasive cutoff. Chamfer I.D. and O.D. edges with a high-speed grinder.

I.D. Machining: Machining the I.D. of CJ bearings is not recommended. Broaching, reaming, grooving, honing or boring destroy the synthetic fiber/PTFE liner. If the bore must be modified, contact Saint-Gobain Performance Plastics for guidance.

Bonding: Bond to housing using standard epoxies. No special surface treatment is required. Clean and degrease prior to bonding.



Rulon® CJ and Rulon® FCJ Typical Applications

RULON CJ:

- Back hoes
- Front end loaders
- Pay loaders
- Valve stem bushings
- Hitches
- Hydraulic cylinder pivots
- Graders
- Mining equipment
- Vending machines

RULON FCJ:

- Material handling equipment
- Packaging machinery
- Transport wheel bearings
- Farm implements
- Spreaders
- Marine pivots
- Robotics
- Business machines
- Linear bearings

Rulon® CW & CWW Thrust Bearings

One Wear Surface

The RULON CW composite laminate washer series is constructed of a Nomex®/Teflon® fabric which is bonded onto one side of a strong cotton fabric. The cloth is then impregnated with a special phenolic resin system. Under heat and pressure, a unique laminated board is made up that has a very low coefficient of friction relationship with any other mating surface while maintaining an exceptional load capacity. Washers made from the CW material will slip against the mating surface with the lowest coefficient of friction of any similar bearing system while sticking to the surface that rests against the non-Teflon surface. The CW series allows for up to .015" wear on the face. RULON CW series utilizes the Nomex/Teflon surface on a single face to satisfy functional requirements with the most economical design.

Two Wear Surfaces

RULON CWW is for applications in which a double-faced thrust bearing is a desirable design feature. The CWW composite washer is composed of a Nomex and Teflon fiber fabric, which is bonded onto both sides of a strong cotton fabric. The cloth in its entirety is then impregnated with a special compounded phenolic resin system. Under heat and pressure, a unique laminated board is made that has an extremely low coefficient of friction relationship with any other surface on each side of its design; while at the same time, maintaining good load capability. Washers made from the CWW will slip on the surface with the lowest combined interface coefficient of friction characteristic. If for some reason in the design or during the operation there is a change in this coefficient of friction, the other side slips and in effect gives you a constantly maintained lowest potential torque requirement in any given design. The CWW series will allow wear up to .015" on each face of the bearing.

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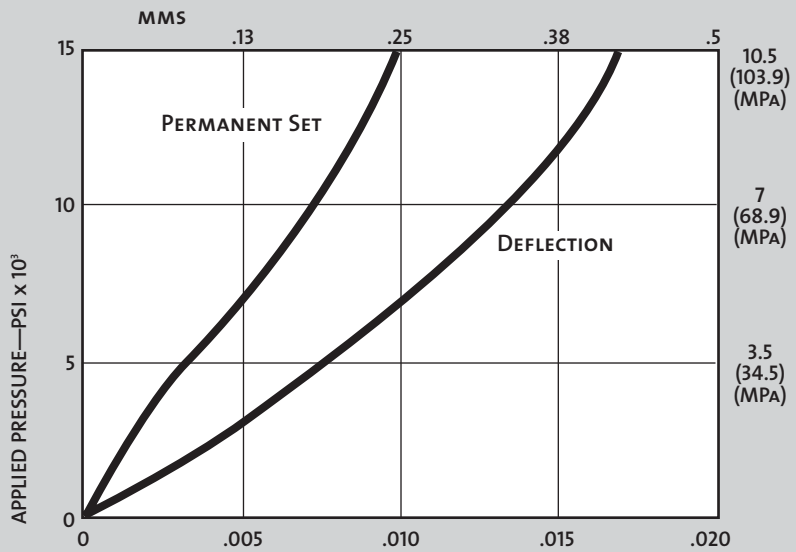
FIGURE G: DEFLECTION AND PERMANENT SET (INCHES) CW & CWW COMPOSITE MATERIAL



Thermal Properties

The operating range for RULON CW and CWW composite is –65° F. to +250° F. (-55° C. to 120° C). The material has been heat-stabilized at temperatures above +300° F (+150°C) and minimal dimensional changes will occur in the bearing during operation.

Mechanical Properties

When RULON CW and CWW laminate is utilized on a smooth flat surface, it is capable of supporting dynamic or static compressive loads of 100,000 psi at –15° F (24° C). Typical load deflection curves are shown in Figure G. As temperature increases, the ability to carry load decreases slightly.

Dynamic Properties

Mating surface roughness of 16 RMS or less, and a hardness of Rc 50 or greater produces optimum wear life. If the mating surface is less then Rc 50, more mating surface wear will occur. If the mating surface is hard and flat the composite will glaze and continually lap itself to the flatness of the mating surface, resulting in low wear and long life. The coefficient of friction against a hardened Rc 50 steel plate, with a 16 RMS surface or less, will vary from .02 to .25 depending on the load, the relative sliding velocity and the bearing surface temperature. Generally, friction decreases with increasing load, increasing sliding velocity, and increasing temperature. The smoother the mating surfaces the lower the friction. It is also important that the mating surfaces have no sharp edges.

Operating without lubrication, RULON CW and CWW washers perform best at speeds less than 150 SFM under light or heavy loads. With lubrication, speeds may be increased appreciably and the coefficient of friction may decrease by 90 percent.

The presence of clean lubricants in and around the CW and CWW composite generally will reduce the wear rate and increase the service life. Circulating fluid lubricants can remove heat. At high speeds, grease is an ineffective coolant. Dirt is naturally undesirable and will reduce bearing life.

Corrosion Resistance

The RULON CW and CWW laminate is unaffected by most corrosive environments; however, some acids are a problem. The bearing laminate eliminates fretting corrosion that normally occurs in metal bearings. Although the laminate has corrosion resistance, the mating surface may not. Therefore, it is recommended, for dry operation, that stainless steel or corrosion resistant materials be used. Carbon steels should be chrome plated for maximum protection and minimum wear. Lubricants or preservatives can be used to prevent rusting of the metals. Since the RULON CW and CWW parts are non-metallic, they cannot rust.

PV for Thrust Bearings

CALCULATIONS OF PV:

P (Unit Pressure) = Load (lb.)/Bearing Area (in.^{2})

V= (Surface Velocity in Feet/Minute)

(a) Rotational Motion (Against Circular Washer)

where r^2 = radius of the thrust washer (inches)

where r^1 = radius of the thrust washer bore (inches)

RPM = Revolutions Per Minute

$V = .52\ (RPM)\ (.6r^2 + .4r^1)$

(b) Oscillating Motion

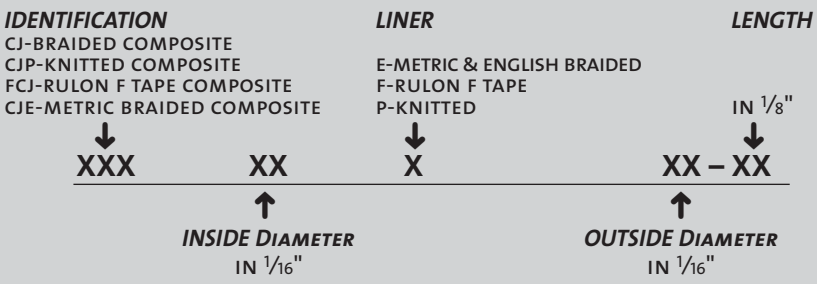
where: N = Number of degrees per cycle as total travel. One cycle equals two reversals, i.e., for ± 25° oscillation N = 100.

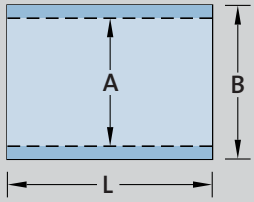
CPM = Cycles Per Minute

$V = .0014N\ (CPM)\ (.6r^2 + .4r^1)$

Standard Sizes for Rulon® CJ Bearings

The Rulon CJ Part Numbering System:





ALL CORNERS ARE BROKEN
TO PERMIT PROPER INSTALLATION

Only braided and RULON D tape lined bearings are available as standard sizes listed in this catalog.
Knitted liners and other RULON tapes are available as special orders.

THIN WALL — 1/16"

NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	LENGTH ±.005 (L)	CJ PART NUMBER
1/2 x 5/8	.5040 .5020	.6265 .6255	.6250 .6245	.0020 .0005	.4990 .4985	1/4 1/2 1	CJ08E10-2 CJ08E10-4 CJ08E10-8
5/8 x 3/4	.6290 .6270	.7515 .7505	.7500 .7495	.0020 .0005	.6240 .6235	1/4 1/2 1	CJ10E12-2 CJ10E12-4 CJ10E12-8
3/4 x 7/8	.7555 .7525	.8765 .8755	.8750 .8745	.0020 .0005	.7490 .7485	1/2 3/4 1	CJ12E14-4 CJ12E14-6 CJ12E14-8
7/8 x 1	.8805 .8775	1.0025 1.0005	1.0000 .9995	.0030 .0005	.8745 .8740	Up to 12"	CJ14E16-
1 x 1-1/8	1.0055 1.0025	1.1275 1.1255	1.1250 1.1245	.0030 .0005	.9990 .9985	1 1-1/4 1-1/2	CJ16E18-8 CJ16E18-10 CJ16E18-12
1-1/8 x 1-1/4	1.1335 1.1305	1.2525 1.2505	1.2500 1.2495	.0030 .0005	1.1250 1.2480	Up to 12"	CJ18E20-
1-1/4 x 1-3/8	1.2555 1.2525	1.3785 1.3765	1.3750 1.3745	.0040 .0010	1.2490 1.2485	Up to 12"	CJ20E22-
1-3/8 x 1-1/2	1.3830 1.3790	1.5025 1.5005	1.5000 1.4995	.0030 .0005	1.3745 1.3735	Up to 18"	CJ22E24-
1-1/2 x 1-5/8	1.5080 1.5040	1.6285 1.6265	1.6250 1.6245	.0040 .0015	1.4995 1.4990	Up to 18"	CJ24E26-
1-5/8 x 1-3/4	1.6330 1.6290	1.7535 1.7515	1.7500 1.7495	.0040 .0015	1.6245 1.6240	Up to 18"	CJ26E28-
1-3/4 x 1-7/8	1.7580 1.7540	1.8785 1.8765	1.8750 1.8745	.0040 .0015	1.7495 1.7490	Up to 18"	CJ28E30-
2 x 21/8	2.0080 2.0040	2.1285 2.1265	2.1255 2.1245	.0040 .0010	1.9995 1.9985	Up to 18"	CJ32E34-

Size not listed above may be quoted upon request.

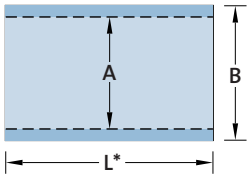
This series is designed to replace SAE sized porous powdered metal bearings below 3" ID.

STANDARD WALL — 1/8"

NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	LENGTH* (L)	CJ PART NUMBER
1/2 x 3/4	.5040 .5020	.7515 .7505	.7500 .7495	.0020 .0005	.4990 .4985	1/2 3/4 1	CJ08E12-4 CJ08E12-6 CJ08E12-8
5/8 x 7/8	.6290 .6270	.8765 .8755	.8750 .8745	.0020 .0005	.6240 .6235	1/2 3/4 1	CJ10E14-4 CJ10E14-6 CJ10E14-8
3/4 x 1	.7555 .7525	1.0025 1.0005	1.0000 .9995	.0030 .0005	.7490 .7485	1/2 3/4 1	CJ12E16-4 CJ12E16-6 CJ12E16-8

Standard Sizes for Rulon CJ Bearings Continued

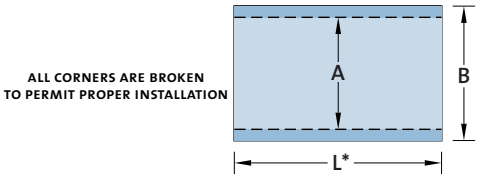
ALL CORNERS ARE BROKEN TO PERMIT PROPER INSTALLATION



STANDARD WALL — 1/8"

NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	LENGTH* (L)	CJ PART NUMBER
7/8 x 11/8	.8805 .8775	1.1275 1.1255	1.1250 1.1245	.0030 .0005	.8745 .8740	Up to 12"	CJ14E18-
1 x 1-1/4	1.0055 1.0025	1.2525 1.2505	1.2500 1.2495	.0030 .0005	.9990 .9985	1/2 5/8 3/4 1 1-1/4	CJ16E20-4 CJ16E20-5 CJ16E20-6 CJ16E20-8 CJ16E20-10
11/8 x 1-3/8	1.1335 1.1305	1.3785 1.3765	1.3750 1.3745	.0040 .0015	1.1250 1.1245	1/2 1 2	CJ18E22-4 CJ18E22-8 CJ18E22-16
1-1/4 x 1-1/2	1.2555 1.2525	1.5025 1.5005	1.5000 1.4995	.0030 .0005	1.2490 1.2485	1 1-1/2 2	CJ20E24-8 CJ20E24-12 CJ20E24-16
1-3/8 x 1-5/8	1.3830 1.3790	1.6285 1.6265	1.6250 1.6245	.0040 .0015	1.3745 1.3735	Up to 18"	CJ22E26-
1-1/2 x 1-3/4	1.5080 1.5040	1.7535 1.7515	1.7500 1.7495	.0040 .0015	1.4995 1.4990	1-1/2 2 3	CJ24E28-12 CJ24E28-16 CJ24E28-24
1-5/8 x 1-7/8	1.6330 1.6290	1.8785 1.8765	1.8750 1.8745	.0040 .0015	1.6245 1.6240	Up to 18"	CJ26E30-
1-3/4 x 2	1.7580 1.7540	2.0035 2.0015	2.0000 1.9995	.0040 .0015	1.7495 1.7490	Up to 18"	CJ28E32-
2 x 2-1/4	2.0080 2.0040	2.2535 2.2515	2.2505 2.2495	.0040 .0010	1.9995 1.9985	1-1/2 2 3	CJ32E36-12 CJ32E36-16 CJ32E36-24
2-1/2 x 2-1/2	2.2580	2.5040 2.2540	2.5005 2.5020	.0045 2.4995	2.2490 .0015	Up to 18" 2.2485	CJ36E40-
2-3/8 x 2-5/8	2.3850 2.3810	2.6290 2.6270	2.6255 2.6245	.0045 .0015	2.3750 2.3740		CJ38E42-
2-1/2 x 2-3/4	2.5100 2.5060	2.7540 2.7520	2.7505 2.7495	.0045 .0015	2.4995 2.4985	1-1/2 2 3	CJ40E44-12 CJ40E44-16 CJ40E44-24
2-5/8 x 2-7/8	2.6370 2.6330	2.8790 2.8770	2.8755 2.8745	.0045 .0015	2.6245 2.6235	Up to 18"	CJ42E46-
2-3/4 x 3	2.7620 2.7580	3.0040 3.0020	3.0005 2.9990	.0050 .0015	2.7495 2.7485	Up to 18"	CJ44E48-
3 x 3-1/4	3.0140 3.0100	3.2540 3.2520	3.2505 3.2490	.0050 .0015	2.9995 2.9985	Up to 18"	CJ48E52-
3-1/4 x 3-1/2	3.2640 3.2600	3.5040 3.5020	3.5010 3.4990	.0050 .0010	3.2495 3.2485	Up to 18"	CJ52E56-
3-1/2 x 3-3/4	3.5140 3.5100	3.7540 3.7520	3.7510 3.7490	.0050 .0010	3.4995 3.4985	Up to 18"	CJ56E60-
3-3/4 x 4	3.7640 3.7600	4.0040 4.0020	4.0010 3.9990	.0050 .0010	3.7495 3.7485	Up to 18"	CJ60E64-
4 x 4-1/4	4.0140 4.0100	4.2540 4.2520	4.2510 4.2490	.0050 .0010	3.9995 3.9985	Up to 18"	CJ64E68-
4-1/4 x 4-1/2	4.2640 4.2600	4.5040 4.5020	4.5010 4.4990	.0050 .0015	4.2495 4.2485	Up to 18"	CJ68E72-
4-1/2 x 4-3/4	4.5140 4.5100	4.7540 4.7520	4.7510 4.7490	.0050 .0010	4.4995 4.4985	Up to 18"	CJ72E76-
4-3/4 x 5	4.7640 4.7600	5.0040 5.0020	5.0010 4.9990	.0050 .0010	4.7495 4.7485	Up to 18"	CJ76E80-
5 x 5-1/4	5.0140 5.0100	5.2540 5.2520	5.2510 5.2490	.0050 .0010	4.9995 4.9985*	Up to 18"	CJ80E84-

*Length tolerance is +.005"/-.005" up to 2½" I.D.; +.008"/-.007" on I.D. 2½" and over.
Sizes not listed above may be quoted upon request.

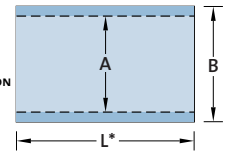


HEAVY WALL — 1/4"

NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	LENGTH* ±.005 (L)	CJ PART NUMBER
1/2 x 1	.5040 .5020	1.0025 1.0005	1.0000 .9995	.0030 .0005	.4990 .4985	Up to 12"	CJ08E16-
5/8 x 1-1/8	.6290 .6270	1.1275 1.1255	1.1250 1.1245	.0030 .0005	.6240 .6235	Up to 12"	CJ10E18-
3/4 x 1-1/4	.7555 .7525	1.2525 1.2505	1.2500 1.2495	.0030 .0005	.7490 .7485	Up to 12"	CJ12E20-
7/8 x 1-3/8	.8805 .8775	1.3785 1.3765	1.3750 1.3745	.0040 .0015	.8745 .8740	Up to 12"	CJ14E22-
1 x 1-1/2	1.0055 1.0025	1.5025 1.5005	1.5000 1.4995	.0030 .0005	.9990 .9985	1 1-1/4	CJ16E24-8 CJ16E24-10
1-1/8 x 1-5/8	1.1335 1.1305	1.6285 1.6265	1.6250 1.6245	.0040 .0015	1.1250 1.1245	Up to 12"	CJ18E26-
1-1/4 x 1-3/4	1.2555 1.2525	1.7535 1.7515	1.7500 1.7495	.0040 .0015	1.2490 1.2485	1 2	CJ20E28-8 CJ20E28-16
1-3/8 x 1-7/8	1.3830 1.3790	1.8785 1.8765	1.8750 1.8745	.0040 .0015	1.3745 1.3740	Up to 18"	CJ22E30-
1-1/2 x 2	1.5080 1.5040	2.0035 2.0015	2.0000 1.9995	.0040 .0015	1.4995 1.4990	1-1/2 2	CJ24E32-12 CJ24E32-16
1-5/8 x 2-1/8	1.6330 1.6290	2.1285 2.1265	2.1255 2.1245	.0040 .0015	1.6246 1.6240	Up to 18"	CJ26E34-
1-3/4 x 2-1/4	1.7580 1.7540	2.2535 2.2515	2.2505 2.2495	.0040 .0010	1.7495 1.7490	Up to 18"	CJ28E36-
2 x 2-1/2	2.0080 2.0040	2.5040 2.5020	2.5005 2.4995	.0045 .0015	1.9995 1.9985	1-1/2 2	CJ32E40-12 CJ32E40-16
2-1/4 x 2-3/4	2.2580 2.2540	2.7540 2.7520	2.7505 2.7495	.0045 .0015	2.2490 2.2480	Up to 18"	CJ36E44-
2-3/8 x 2-7/8	2.3850 2.3810	2.8790 2.8770	2.8755 2.8745	.0045 .0015	2.3750 2.3740	Up to 18"	CJ38E46-
2-1/2 x 3	2.5100 2.5060	3.0040 3.0020	3.0005 2.9990	.0050 .0015	2.4995 2.4990	Up to 18"	CJ40E48-
2-5/8 x 3-1/8	2.6370 2.6330	3.1290 3.1270	3.1255 3.1240	.0050 .0015	2.6245 2.6240	Up to 18"	CJ42E50-
2-3/4 x 3-1/4	2.7620 2.7580	3.2540 3.2520	3.2505 3.2490	.0050 .0015	2.7495 2.7485	Up to 18"	CJ44E52-
3 x 3-1/2	3.0140 3.0100	3.5040 3.5020	3.5010 3.4990	.0050 .0010	2.9995 2.9985	Up to 18"	CJ48E56-
3-1/4 x 3-3/4	3.2640 3.2600	3.7540 3.7520	3.7510 3.7490	.0050 .0010	3.2495 3.2485	Up to 18"	CJ52E60-
3-1/2 x 4	3.5140 3.5100	4.0040 4.0020	4.0010 3.9990	.0050 .0010	3.4995 3.4985	Up to 18"	CJ56E64-
3-3/4 x 4-1/4	3.7640 3.7600	4.2540 4.2520	4.2510 4.2490	.0050 .0010	3.7495 3.7485	Up to 18"	CJ60E68-
4 x 4-1/2	4.0140 4.0100	4.5040 4.5020	4.5010 4.4990	.0050 .0010	3.9995 3.9985	Up to 18"	CJ64E72-
4-1/4 x 4-3/4	4.2640 4.2600	4.7540 4.7520	4.7510 4.7490	.0050 .0010	4.2495 4.2485	Up to 18"	CJ68E76-
4-1/2 x 5	4.5140 4.5100	5.0040 5.0020	5.0010 4.9990	.0050 .0010	4.4995 4.4985	Up to 18"	CJ72E80-
4-3/4 x 5-1/4	4.7640 4.7600	5.2540 5.2520	5.2510 5.2490	.0050 .0010	4.7495 4.7485	Up to 18"	CJ76E84-
5 x 5-1/2	5.0140 5.0100	5.5040 5.5020	5.5010 5.4990	.0050 .0010	4.9995 4.9985	Up to 18"	CJ80E88-

*Length tolerance is +.005"/-.005" up to 2½" I.D.; +.008"/-.007" on I.D. 2½" and over.
Sizes not listed above may be quoted upon request.

Standard Sizes for Rulon CJ Bearings Continued



2.5 MM WALL SERIES METRIC DIMENSIONS (MM)

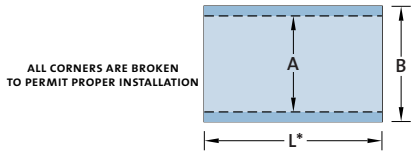
NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	CJ PART NUMBER
12 x 17	12.143 12.093	17.068 17.043	17.018 17.000	.068 .025	12.000 11.982	CJE12E17-
15 x 20	15.146 15.096	20.071 20.046	20.021 20.000	.071 .025	15.000 14.982	CJE15E20-
18 x 23	18.201 18.121	23.096 23.046	23.021 23.000	.096 .025	18.000 17.982	CJE18E23-
20 x 25	20.201 20.121	25.096 25.046	25.021 25.000	.096 .025	20.000 19.979	CJE20E25-
22 x 27	22.201 22.121	27.096 27.046	27.021 27.000	.096 .025	22.000 21.979	CJE22E27-
25 x 30	25.205 25.125	30.100 30.050	30.025 30.000	.100 .029	25.000 24.979	CJE25E30-
30 x 35	30.205 30.125	35.100 35.050	35.025 35.000	.100 .025	30.000 29.979	CJE30E35-
35 x 40	35.225 35.125	40.100 40.050	40.025 40.000	.100 .025	35.000 34.975	CJE35E40-
40 x 45	40.225 40.125	45.100 45.050	45.025 45.000	.100 .025	40.000 39.975	CJE40E45-
45 x 50	45.230 45.130	50.105 50.055	50.025 50.000	.105 .030	45.000 44.975	CJE45E50-
50 x 55	50.225 50.155	55.105 55.055	55.030 55.000	.105 .025	50.000 49.975	CJE50E55-

5.0 MM WALL SERIES METRIC DIMENSIONS (MM)

NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	CJ PART NUMBER
30 x 40	30.205 30.125	40.100 40.050	40.025 40.000	.100 .025	30.000 29.979	CJE30E40-
35 x 45	35.225 35.125	45.100 45.050	45.025 45.000	.100 .025	35.000 34.975	CJE35E45-
40 x 50	40.225 40.125	50.100 50.050	50.025 50.000	.100 .025	40.000 39.975	CJE40E50-
45 x 55	45.230 45.130	55.105 55.055	55.030 55.000	.105 .025	45.000 44.975	CJE45E55-
50 x 60	50.225 50.155	60.105 60.055	60.030 60.000	.105 .025	50.000 49.975	CJE50E60-
55 x 65	55.255 55.155	65.105 65.055	65.030 65.000	.105 .025	55.000 54.970	CJE55E65-
60 x 70	60.255 60.155	70.105 70.055	70.030 70.000	.105 .025	60.000 59.970	CJE60E70-
65 x 75	65.255 65.155	75.105 75.055	75.030 75.000	.105 .025	65.000 64.970	CJE65E75-
70 x 80	70.305 70.205	80.105 80.055	80.030 80.000	.105 .025	70.000 69.970	CJE70E80-
75 x 85	75.310 75.210	85.110 85.060	85.035 85.000	.110 .025	75.000 74.970	CJE75E85-
80 x 90	80.310 80.210	90.110 90.060	90.035 90.000	.110 .025	80.000 79.970	CJE80E90-
85 x 95	85.360 85.260	95.110 95.060	95.035 95.000	.110 .025	85.000 84.965	CJE85E95-
90 x 100	90.360 90.260	100.110 100.060	100.035 100.000	.110 .025	90.000 89.965	CJE90E100-
100 x 110	100.360 100.260	110.110 110.060	110.035 110.000	.110 .025	100.000 99.965	CJE100E110-
100 x 120	100.360 100.260	120.110 120.060	120.035 120.000	.110 .025	110.000 109.965	CJE110E120-
120 x 130	120.365 120.265	130.115 130.065	130.040 130.000	.115 .025	120.000 119.965	CJE120E130-

*Length tolerance: +0/-.25 mm for I.D. up to and including 55 mm, +0/-.40 mm for I.D. 60 mm and larger
Sizes not listed above may be quoted upon request.

Standard Sizes for Rulon® FCJ Bearings



STANDARD WALL — 1/8"

NOMINAL I.D. x O.D.	I.D. (A)	O.D. (B)	RECOMMENDED HOUSING BORE	PRESS FIT	RECOMMENDED SHAFT SIZE	LENGTH* (L)	CJ PART NUMBER
1/2 x 3/4	.504 .502	.7515 .7505	.7500 .7495	.0020 .0005	.4995 .4985	1/2 3/4 1	FCJ08F12-4 FCJ08F12-6 FCJ08F12-8
5/8 x 7/8	.629 .627	.8765 .8755	.8750 .8745	.0020 .0005	.6245 .6235	1/2 3/4 1	FCJ10F14-4 FCJ10F14-6 FCJ10F14-8
3/4 x 1	.7555 .7525	1.0025 1.0005	1.0000 .9995	.0030 .0005	.7495 .7485	Up to 12"	FCJ12F16-
7/8 x 1-1/8	.8805 .8775	1.1275 1.1255	1.1250 1.1245	.0030 .0005	.8745 .8735	Up to 12"	FCJ14F18-
1 x 1-1/4	1.0055 1.0025	1.2525 1.2505	1.2500 1.2495	.0030 .0005	.9995 .9985	5/8 3/4 1 1 -1/4	FCJ16F20-5 FCJ16F20-6 FCJ16F20-8 FCJ16F20-10
1-1/8 x 1-3/8	1.1335 1.1305	1.3785 1.3765	1.3750 1.3745	.0040 .0015	1.1245 1.1235	1/2 1 2	FCJ18F22-4 FCJ18F22-8 FCJ18F22-16
1-1/4 x 1-1/2	1.2555 1.2525	1.5025 1.5005	1.5000 1.4995	.0030 .0005	1.2495 1.2485	1 1 -1/2 2	FCJ20F24-8 FCJ20F24-12 FCJ20F24-16
1-3/8 x 1-5/8	1.3830 1.3790	1.6285 1.6265	1.6250 1.6245	.0040 .0015	1.3745 1.3735	Up to 18"	FCJ22F26-
1-1/2 x 1-3/4	1.5080 1.5040	1.7535 1.7515	1.7500 1.7495	.0040 .0015	1.4995 1.4980	Up to 18"	FCJ24F28-
1-3/4 x 2	1.7580 1.7540	2.0035 2.0015	2.0000 1.9995	.0040 .0015	1.7495 1.7480	Up to 18"	FCJ28F32-
2 x 2-1/4	2.0080 2.0040	2.2535 2.2515	2.2505 2.2495	.0040 .0015	1.9995 1.9980	1 -1/2 2 3	FCJ32F36-12 FCJ32F36-16 FCJ32F36-24
2 x 2-1/2	2.0080 2.0040	2.5040 2.5020	2.5005 2.4995	.0045 .0015	1.9995 1.9980	1- 1/2 2	FCJ32F40-12 FCJ32F40-16
2-1/2 x 2-3/4	2.5100 2.5060	2.7540 2.7520	2.7505 2.7495	.0045 .0015	2.4995 2.4975	1- 1/2 2 3	FCJ40F44-12 FCJ40F44-16 FCJ40F44-24
2-1/2 x 3	2.5100 2.5060	3.0040 3.0020	3.0005 2.9990	.0050 .0015	2.4995 2.4975	Up to 18"	FCJ40F48-
3 x 3-1/4	3.0410 3.0100	3.2540 3.2520	3.2505 3.2490	.0050 .0015	2.9995 2.9975	Up to 18"	FCJ48F52-
3 x 3-1/2	3.0140 3.0100	3.5040 3.5020	3.5010 3.4990	.0050 .0010	2.9995 2.9975	Up to 18"	FCJ48F56-
3-1/2 x 4	3.5140 3.5100	4.0040 4.0020	4.0010 3.9990	.0050 .0010	3.4995 3.4965	Up to 18"	FCJ56F64-
4 x 4-1/2	4.0140 4.0100	4.5040 4.5020	4.5010 4.4990	.0050 .0010	3.9995 3.9965	Up to 18"	FCJ64F72-
5 x 5-1/2	5.0140 5.0100	5.5040 5.5020	5.5010 5.4990	.0050 .0010	4.9995 4.9960	Up to 18"	FCJ80F88-

*Length tolerance is +.005"/-.005" up to 2½"I.D.; +.008"/-.007" on I.D. 2½" and over.
Sizes not listed above may be quoted upon request.

		INJECTION MOLDING	AGRICULTURAL PLASTICS	NORGLIDE® BEARINGS	NORSLIDE®	OMNILIP™ & XT & OMNIFLEX™	OMNISEAL® & XT	MELDIN®	RULON®	RAM EXTRUSION	MACHINED & MOLDED COMPONENTS
NORTH AMERICA											
* Saint-Gobain Performance Plastics Corporation Wayne, New Jersey • USA	Phone: (1) 973-696-4700 Fax: (1) 973-696-4056			•	•					•	
* Saint-Gobain Performance Plastics Corporation Bristol, Rhode Island • USA	Phone: (1) 401-253-2000 Fax: (1) 401-253-1755	•						•	•	•	•
* Saint-Gobain Performance Plastics Corporation Mundelein, Illinois • USA	Phone: (1) 847-949-0850 Fax: (1) 847-949-0198								•		•
* Saint-Gobain Performance Plastics Corporation Garden Grove, California • USA	Phone: (1) 714-995-1818 Fax: (1) 714-688-2701					•	•				•
EUROPE											
* Saint-Gobain Performance Plastics Pampus Gmbh Willich • Germany	Phone: (49) 2154 600 Fax: (49) 2154 60310			•	•				•	•	
* Saint-Gobain Performance Plastics N.V. Kontich • Belgium	Phone: (32) 34 58 28 28 Fax: (32) 34 58 26 69	•				•	•	•	•	•	•
Saint-Gobain Performance Plastics Asti Nanterre • France	Phone: (33) 1490 70205 Fax: (33) 1490 69762			•	•						
Saint-Gobain Performance Plastics Agrate Brianza (Mi) • Italy	Phone: (39) 03 96 50 070 Fax: (39) 03 96 52 736	•		•	•	•	•	•	•		
Saint-Gobain Performance Plastics Espana, S.A. Barcelona • Spain	Phone: (34) 93 682 8138 Fax: (34) 93 682 8143			•	•						
* Saint-Gobain Performance Plastics Espana, S.A. Logrono • Spain	Phone: (34) 94 14 86 035 Fax: (34) 94 14 37 095	•				•	•	•	•		•
SOUTH AMERICA											
* Saint-Gobain (Bearing & Wear Technology) Ceramicas Industrias Ltda. (Agricultural Plastics) Vinhedo-SP • Brazil	Phone: (55) 19 3876 8153 Phone: (55) 19 3876 8070 Fax: (55) 19 3876 8077	•	•	•	•	•	•	•	•		
ASIA											
* Saint-Gobain Norton KK Nagano • Japan	Phone: (81) 266 79 6400 Fax: (81) 266 70 1001	•	•	•	•	•	•	•	•		
* Saint-Gobain Performance Plastics Korea Co., Ltd. Seoul • South Korea	Phone: (82) 25 08 82 00 Fax: (82) 25 54 15 50	•	•	•	•	•	•	•	•		
* Saint-Gobain Performance Plastics Shanghai Co., Ltd. Shanghai • China	Phone: (86) 21 64 62 2800 Fax: (86) 21 64 62 27 81	•	•	•	•	•	•	•	•		
* Saint-Gobain Advanced Materials (Taiwan) Co., Ltd. Taipei • Taiwan	Phone: (886) 22 50 34 201 Fax: (886) 22 50 34 202	•	•	•	•	•	•	•	•		
* Grindwell Norton Ltd. Bangalore • India	Phone: (91) 80 847 2900 Fax: (91) 80 847 2905	•	•	•	•	•	•	•	•		
Saint-Gobain Advanced Materials (M) Sdn.Bhd Selangor Darul Ehsan • Malaysia	Phone: (60) 37 36 40 82/81 Fax: (60) 37 36 40 99	•	•	•	•	•	•	•	•		

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