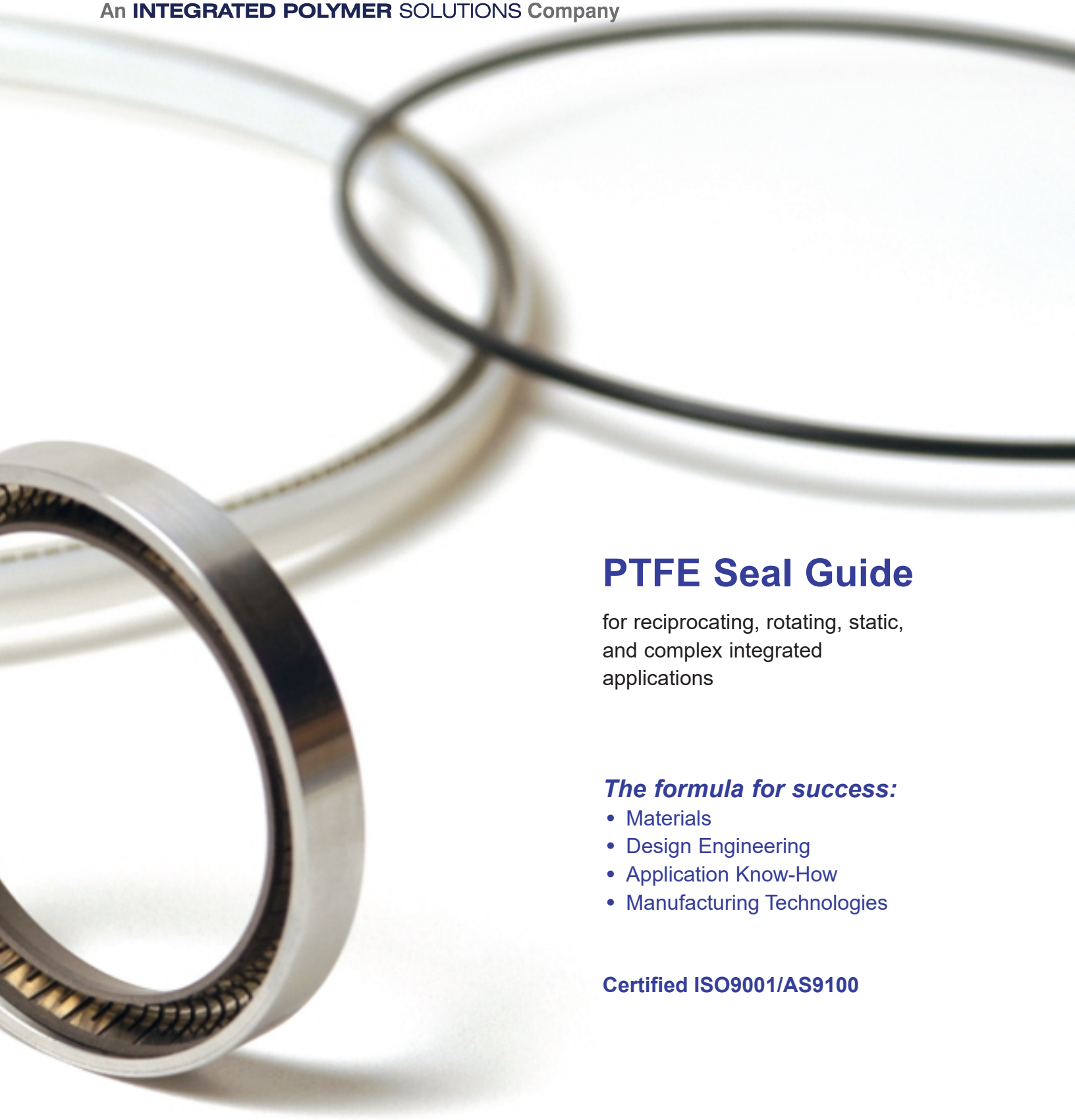
RUBBERCRAFT

An INTEGRATED POLYMER SOLUTIONS Company



PTFE Seal Guide

for reciprocating, rotating, static, and complex integrated applications

The formula for success:

- Materials
- Design Engineering
- Application Know-How
- Manufacturing Technologies

Certified ISO9001/AS9100

562-354-2800

www.RUBBERCRAFT.com

ABOUT US

Rubbercraft (RCC) offers a complete capability for reciprocating, rotating, and static applications. RCC's emphasis has always been to provide its customers with the best possible solution at the most competitive price, offering tremendous value, quality, and reliability. With excellent material science, design engineering, application experience, and precision manufacturing techniques at its core, RCC offers engineers a complete resource for sealing requirements.

Rubbercraft is ISO 9001 and AS 9100 certified and can offer its customers engineered solutions for Seals, Gaskets, and Vacuum Components.

This brochure focuses on PTFE seal products. RCC offers a wide variety of sealing solutions depending on operating conditions. PTFE products are typically specified where chemical compatibility, extreme temperatures, and low friction are primary considerations. These products were historically offered by Seal Science, Inc. which has now been acquired by Rubbercraft.

RCC's manufacturing capabilities include; injection molding, compression molding, close tolerance grinding, custom elastomer, fluoropolymer compounding, and molding. Rubbercraft is perfectly positioned to offer innovative solutions for industries advanced technology challenges. RCC has the formula for success.

Talk to RCC design engineers about your application:

Contact Rubbercraft: 562–354–2800 or email us at info@rubbercraft.com

Markets Served

Aerospace
Chemical Processing
Medical
Industrial Flow Controls
Scientific Laboratory Instruments
Oil/Gas Exploration
Semiconductor
Cryogenic Fluid Control
Military/Defense
Alternative Energy
Adhesive Dispensing
Food and Beverage
Bio/Pharmaceutical

Typical Applications

Aircraft controls and instruments
Control valves
Surgical handpieces
HPLC plunger pumps
Fuel regulators
Flight actuators
Drug delivery
Blood pumps
Metering pumps
Fluid dispensing
Cryogenic components
Turbochargers
Pressure switches
Paint dispensing
Pressure intensifiers
Double acting cylinders
Wafer processing
Adhesive dispensing

SEAL SELECTION GUIDE

This listing shows examples of the many different families of seals available. Most series are available for industrial, AS4716, Mil-G-5514 glands, as well as o-ring grooves, and lip seal glands. There are infinite combinations of inside lip and outside lip designs, lengths of seal, spring energizers, operating parameters, materials, and performance criteria. Below is a brief overview of seal types, materials, spring energizers, and hardware design criteria. For a complete design proposal based on your application, **call 562-354-2800**

PolySpring™ - Spring-Energized Seals

Spring energized seals are uni-directional u-cups seals. An energizer is required to p pre-load for low pressure sealing and to maintain intimate lip contact with the mating hardware. As the seal wears the spring continues to exert pressure on the lip until the useful performance of the seal is exhausted. The seal is designed to have the pressure entering the “U”. Seals can be used from high vacuum to over 100,000 psi (combined with the appropriately designed back-up ring).

Profile	Series	Description
	**810V**	General purpose, beveled lip on ID and OD. V-Spring energized to create high unit load at sealing interface which provides excellent fluid sealing.
	**812V**	Double nodes offer seal contact redundancy for better sealing with rough finishes. Ideal for lower friction requirements. V-Spring energized.
	**814V**	Excellent scraping and sealing and durability in viscous media. Excellent for adhesives, paint, powders, and food.
	**836H**	Designed for static or very slow speeds, vacuum, and extreme temperatures. Helical wound ribbon spring energizer.
	**842 AL** **842 AM** **842 AH**	Angled coil spring energized seal. It is ideal for low, controlled friction applications, Available with light, medium, and heavy load springs.
	**High Pressure Seals**	For applications above 6000 psi, we recommend consultation with seal design engineers for the best design suitable for the application. RCC provides custom designed polymer and metal backup rings.
	**900V**	Designed to reduce axial movement and radial shrinkage in cold applications. Excellent for reciprocating and rotary service. Designs available for all springs energizers.
	**IF 1100H** **OF1100H**	Ideal for applications with axial loads. Face seals can be designed for inside pressure (IF1100H) or outside pressure (OF1100H). Spring cavity faces highest pressure. Loaded with helical precision wound ribbon spring for high static load. Can also be designed for slow rotary service.

SEAL SELECTION GUIDE

PolyLip - Rotary Seals

Rotary Lip Seals – are designed to be retained in the housings to minimize the possibility of the seal rotating with the shaft. This is accomplished with a press fit metal can, metal retaining ring, or backing plate.

Profile	Series	Description
	**SL**	These low cost seals are ideal for low profile, small cross section, and small diameters. Designed for high speed and pressures less than 7 psi.
	**CL**	Metal canned seal designed to retrofit traditional oil seals in high speed, low pressure applications. Relies on PTFE lip memory to maintain sealing ability.
	**CV**	Designed for medium speeds and higher pressures. Securely mounts in the housing. Metal retainer minimizes effects of thermal cycling and prevents seal from rotating in the housing. Can be supplied with back-up ring integrated into seal (as shown).
	**900AL**	Flanged seal is designed to be clamped firmly in the housing to minimize the possibility of the seal rotating in the housing. Series callout shown with a light load angled coils spring.

PolyKing - Elastomer-energized Seals

This family of seals can be provided with different styles and foot prints depending on your application, Many more types are available. **Elastomer Energized Seals** - Cap Seals, T-seals and other elastomer energized seals are excellent bi-directional seals, used largely in hydraulic, fluid power, power transmission and aerospace applications.

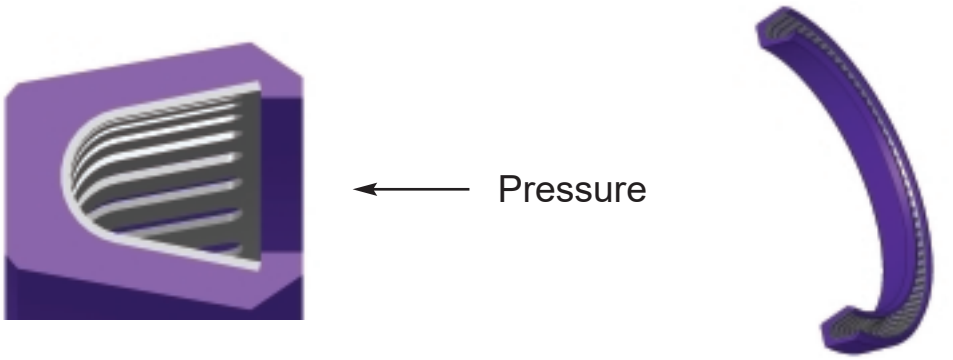
Profile	Series	Description
	**60**	Cap Seals use an O-ring energizer and PTFE slipper rings for excellent bi-directional sealing. For piston and rods. Low cost solution with chemical and friction limitations.
	**70**	Channel Seals offer low profile industrial or o-ring gland and better support for the elastomer to minimize cold flow.
	**80**	T-seals incorporate back-up rings for anti-extrusion. Back-ups help compress elastomer to enhance sealing.

SELECTING THE PROPER SEAL

The best way to determine the best seal for the application is to contact RCC application engineering and have them review your operating conditions and design criteria.

Use Spring energized PTFE seals for:

- Chemical resistance
- Low friction
- Extreme temperatures
- Harsh environments
- Lubrication free environments
- Long shelf life requirements
- Extreme tolerance applications
- Non lubricated applications
- Applications that require low compression set
- Diverse operating conditions

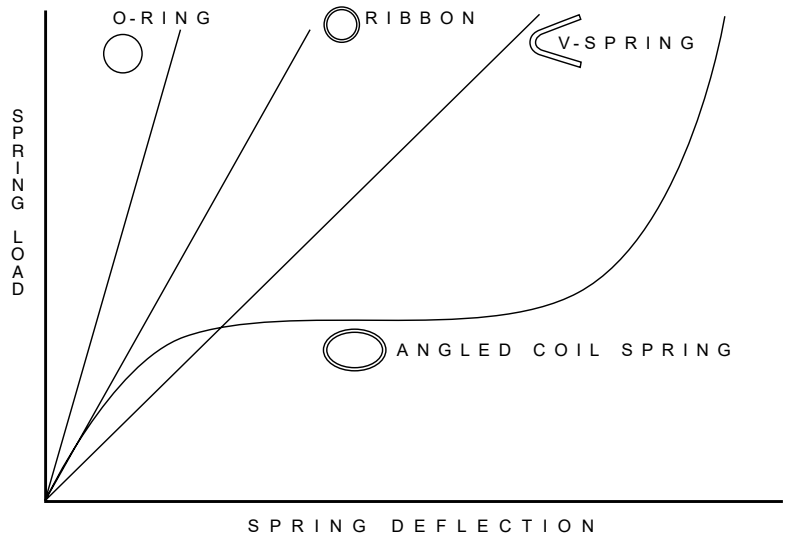


ENERGIZERS

Seal Science has four spring energizers to use depending on operating conditions.

Code	Description
V	**V-spring** - general duty, low cost, excellent for wiping applications
H	**Helical ribbon spring** - primarily for static and vacuum service
A	**Angled coil springs** - for low controllable friction
E	**O-ring loaded** - for low dead volume applications

Other options include, RTV filled V-spring, perfluorelastomer o-rings are available for better compatibility.



SEAL MATERIALS

The seal jackets and lips can be made from a vast selection of materials. Below are RCC standard PTFE and high performance polymers and compounds

Code	Description	Temp. Range
T00	**Virgin PTFE** Use in light duty, very slow reciprocating, and static applications. Subject to high wear. Meets AMS3678/1A	**-320 - 450°F**
T21	**Carbon filled PTFE (light)** More wear resistance than T00, Can be used in lubricated High PV applications. Mating materials should be hardened above 50Rc.	**-100 - 500°F**
T22	**Graphite filled PTFE (heavy)** High performance material, with excellent wear resistance. Meets AMS3678/2	**-100 - 550°F**
T24	**Graphite-carbon PPS filled PTFE** Extremely wear resistant material with excellent creep resistance. Meets AMS3678/7	**-100 - 450°F**
T16	**Glass-moly filled PTFE** High wear resistance but can be abrasive to mating parts. Will burnish a rough surface. Meets AMS3678/3	**-100 - 500°F**
T12	**Glass Filled PTFE** Excellent in cryogenics, H_e, H_2 and O_2.	**-320 - 500°F**
T61	**Polymer filled PTFE** Non-abrasive, use with soft shafts, air and vacuum applications, low out gassing and high temp capability, excellent wear resistance.	**-100 - 550°F**
T40	**Mineral - Moly filled PTFE** For long wearing - dry environments.	**-100 - 500°F**
W00	**Clear UHMW Polyethylene** Excellent wear and abrasion resistance. Best in aqueous solutions and cryogenic temperatures. Limited, temperature and PV.	**-450 - 180°F**
P00	**Virgin PEEK** Used at operating temperatures above 350°F.	**-100 - 600°F**

ENERGIZERS MATERIALS

Code	Type	Standard Material	Alternatives
V	V-spring	17-4	Elgiloy
H	Helical ribbon	301 SS	Hastelloy
A	Angled coil	302 SS	Hastelloy, Inconel
E	O-rings	Nitrile, Viton, etc.	Perfluorolastomer

For a complete design proposal engineered for your application: **info@rubbercraft.com**

Factors affecting PTFE seal performance

Many factors affect seal performance. Some of the more commonly discussed factors include; pressure, temperature, and speed. Other factors include; surface finish and hardness of mating materials. Often the ultimate seal performance is compromised by economic factors. By contacting RCC design engineers early in the project and can offer suggestions to meet your target objectives for life, friction, sealing ability, and cost.

Surface Finish - PTFE wears in layers, and typically will deposit a coating on the mating surface. When the surface is rough, more wear occurs until the cr and valleys are filled with PTFE. Much less wear occurs when PTFE is sliding on PTFE – which is also a dry lubricant. PTFE will wear in direct proportion to the surface finish. For example, testing has shown that under c conditions with a seal mated against a 16 ra finish achieves a certain life, however by mating against a 8 ra finish seal life can be doubled. Results will vary depending on pressure, temperature, and speed.

Surface finish also affects sealing ability. A rough finish creates a microscopic “line of sight” channels allowing a flow path through mating parts. When sealing gases with small molecules, such as, hydrogen, helium, or oxygen, a 2-4 Ra is highly recommended.

In summary, a smoother finish will reduce friction, increase life, and improve sealing ability.

Fluid	Dynamic	Static
Cryogenic Gas	2-4 Ra	4-6 Ra
Gases	4-8 Ra	12-32 Ra
Viscous Fluids	12-24 Ra	16-64 Ra
Thin Fluids	6-12 Ra	16-32 Ra

Dynamic Surface Hardness

When two surfaces, one hard (a metal shaft) and one soft (a seal) are in contact, there is an exchange of ions. Cross-ionization leads to adhesion, also known as sticktion. This results in higher break-out forces. A smooth mating surface will also increase the area of contact between the mating surfaces, resulting in higher break-out force. Adhesion and adhesive wear, can be overcome by increasing the hardness of the dynamic metal surface, either by changing to a harder metal or by coating/plating the mating surface.

Achieving higher hardness with platings and coatings. There are many types of material treatments; including Chrome plating, Thin Dense Chrome, Electrolyzing, Electro-less Nickel Plating, Plasma coating, Ion implantation and new thermal processing which will offer hardened surfaces. Each has an economic factor which must be balanced with performance, maintenance, and warrantee considerations compared to seal replacement costs and downtime.

Chrome Plating, for instance, though relatively inexpensive, and a common process, should never be used in rotary service or in reciprocating service under high pressure, temperatures and speeds. Chrome can fatigue and create micro-fissures and cracks that can flake off and grossly shorten seal life. Chrome is an excellent light duty, low cost plating. A hardness of Rc 62 is possible.

Thin Dense Chrome is a much better chrome plate generally used in aerospace. The process creates a micro-nodular structure that adheres better to the base material and creates a smoother, harder and more homogeneous surface. A hardness of Rc 65-68 is possible.

Electro-less Nickel Plating is an excellent process for improving bores and hard-to-reach grooves. It is ideal for corrosion resistance. It can maintain the same surface finish before and after the process. A hardness of around Rc 55-58 is possible.

Hard Anodizing is a common process for aluminum coating; achieving a high hardness for excellent wear resistant parts. Performs well in salt water environments.

Plasma Spray Coating is an extremely hard Al3O2 coating. Rc 72 is obtainable for very durable surfaces.

HVOF is a thermal spray coating obtaining a Rc 70 surface hardness.

Lubrication is essential even though PTFE is a self lubricating material. By maintaining a hydrodynamic lubrication less wear occurs. Thicker fluids tend to be easier to seal and can provide ideal low wearing conditions.

Pressure X Velocity (PV) is the ultimate guide for determining seal reliability in extreme conditions. While most companies will rate the seal design to a particular pressure and speed, it is related to the combination of speed, pressure, and temperature which offers snapshots into how a seal will perform. Both pressure and velocity will generate heat. Heat is the major cause of wear. By reducing heat, friction pressure, and speed and combinations thereof seal duration will improve.

High Pressure considerations must also include hard materials, small extrusion gaps, and a hardware material selection of appropriate thickness to avoid hoop stress.

Rotary Data Application

Name:	Phone:
Company:	Fax:
Address:	Email:
City:	Website:

Equipment Type

Application is used for:

☐ Prototype ☐ Production ☐ Retrofit ☐ Other

Arrange the priority by numbers (1 to 5)

Application is used for:

☐ Friction ☐ Cost ☐ Compatibility

☐ Sealing performance ☐ Service life

Media

☐ Gas ☐ Abrasives ☐ Liquid

☐ Solid particles size:

☐ Viscous ☐ Other

Viscosity ☐ cP ☐ cSt

Hardware Dimensions ☐ **Inches** ☐ **mm**

	Dimensions	Tolerance (+/-)	Modifiable
Shaft Diameter			☐
Bore Diameter			☐
Gland Length			☐
Gland Height			☐
Radial shaft/bore clearance			☐

Pressure ☐ psi ☐ MPa ☐ kg/cm2 ☐ bar

Min: Max: Operating: Cycling(+/-):

Service

☐ Continuous ☐ Intermittent ☐ Oscillating

☐ Other

Speed

☐ fpm ☐ cpm ☐ rpm ☐ m/s

Temperature ☐ °C ☐ °F ☐ °K

Min: Max: Operating:

Maximum temperature that maximum pressure will see:

Torque

☐ lbs ☐ N

Breakout: Running:

Bore	**Shaft**
Material	Material
Plating/coating	Plating/coating
Hardness (Rc)	Hardness (Rc)
Surface finish (Ra)	Surface finish (Ra)

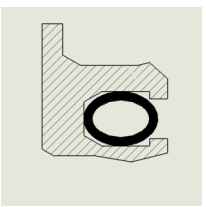
Alignment

Shaft to Bore Misalignment:

Total Indicator Runout:

Seal Configuration

900



Reciprocating Data Application

Name:	Phone:
Company:	Fax:
Address:	Email:
City:	Website:

Equipment Type

Application is used for:

☐ Prototype ☐ Production ☐ Retrofit ☐ Other

Arrange the priority by numbers (1 to 5)

Application is used for:

☐ Friction ☐ Cost ☐ Compatibility

☐ Sealing performance ☐ Service life

Media

☐ Gas ☐ Abrasives ☐ Liquid

☐ Solid particles size:

☐ Viscous ☐ Other

Viscosity ☐ cP ☐ cSt

Hardware Dimensions ☐ Inches ☐ mm

	Dimensions	Tolerance (+/-)	Modifiable
Shaft Diameter			☐
Bore Diameter			☐
Gland Length			☐
Gland Height			☐
Radial shaft/bore clearance			☐

Pressure ☐ psi ☐ MPa ☐ kg/cm2 ☐ bar

Min: Max: Operating: Cycling(+/-):

Service

☐ Continuous ☐ Intermittent ☐ Oscillating

☐ Stroke Length ☐ Other

Speed

☐ fpm ☐ cpm ☐ rpm ☐ m/s

Temperature ☐ °C ☐ °F ☐ °K

Min: Max: Operating:

Maximum temperature that maximum pressure will see:

Friction Force

☐ lbs ☐ N

Breakout: Running:

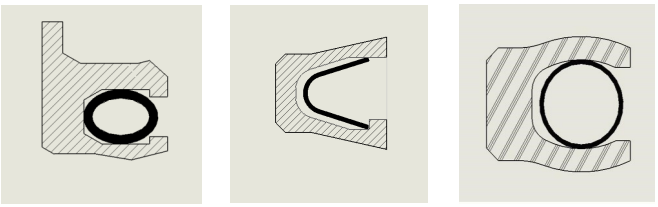
Bore	Shaft
Material	Material
Plating/coating	Plating/coating
Hardness (Rc)	Hardness (Rc)
Surface finish (Ra)	Surface finish (Ra)

Alignment

Shaft to Bore Misalignment:

Gland Configuration

900V 814 836H



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