



**SEAL SCIENCE, INC.**  
Design Engineering & Precision Manufacturing

## **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**

**800-576-SEAL**  
[www.SEALSCIENCE.com](http://www.SEALSCIENCE.com)

## ABOUT US

Seal Science, Inc. SSI offers a complete capability for reciprocating, rotating, and static applications. SSI'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, SSI offers engineers a complete resource for sealing requirements.

For more than 20 years, Seal Science is taking on new challenges by building and expanding its capability and capacity to solve the industries most challenging problems. Seal Science is ISO 9001 and AS 9100 certified and can offer its customers a confident engineering and manufacturing partner for Seals, Gaskets and Vacuum Components.

This brochure focuses on PTFE seal products. SSI 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.

SSI's manufacturing capabilities include; CNC machining of plastics and metals, injection molding, compression molding, close tolerance grinding, custom elastomer and fluoropolymer compounding and molding. Seal Science is perfectly positioned to offer innovative solutions for industries advanced technology challenges. ***SSI has the formula for success.***

**Talk to SSI design engineers about your application:**

**Contact SSI engineering (California): 800 - 576 - SEAL (7325)**

To receive a completely customized proposal for your application, please complete and send in the Application Data Sheet by fax, or submit an application on-line at [www.sealscience.com](http://www.sealscience.com)

### Markets served

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

### Typical Applications

Aircraft controls and instruments	Drug delivery	Pressure switches
Control valves	Blood pumps	Paint dispensing
Surgical handpieces	Metering pumps	Pressure intensifiers
HPLC plunger pumps	Fluid dispensing	Double acting cylinders
Fuel regulators	Cryogenic components	Wafer processing
Flight actuators	Turbo chargers	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 RMA 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 800-576-SEAL (7325).**

## PolySpring™ - Spring-Energized Seals

**Spring energized seals** are uni-directional u-cups seals. An energizer is required to provide a 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
	<b>810V</b>	General purpose, beveled lip on ID and OD. V-Spring energized to create high unit load at sealing interface which provides excellent fluid sealing.
	<b>812V</b>	Double nodes offer seal contact redundancy for better sealing with rough finishes. Ideal for lower friction requirements. V-Spring energized.
	<b>814V</b>	Excellent scraping and sealing and durability in viscous media. Excellent for adhesives, paint, powders, and food.
	<b>836H</b>	Designed for static or very slow speeds, vacuum, and extreme temperatures. Helical wound ribbon spring energizer.
	<b>842 AL 842 AM 842 AH</b>	Angled coil spring energized seal. It is ideal for low, controlled friction applications, Available with light, medium, and heavy load springs.
	<b>High Pressure Seals</b>	For applications above 6000 psi, we recommend consultation with SSI seal design engineers for the best design suitable for the application. SSI provides custom designed polymer and metal backup rings.
	<b>900V</b>	Designed to reduce axial movement and radial shrinkage in cold applications. Excellent for reciprocating and rotary service. Designs available for all spring energizers.
	<b>IF 1100H OF 1100H</b>	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 be designed for slow rotary service also.

# 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.

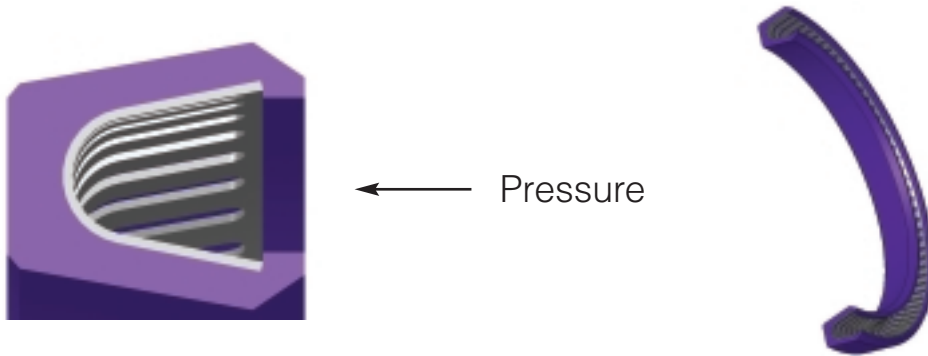
# SELECTING THE PROPER SEAL

The best way to determine the best seal for the application is to contact SSI 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

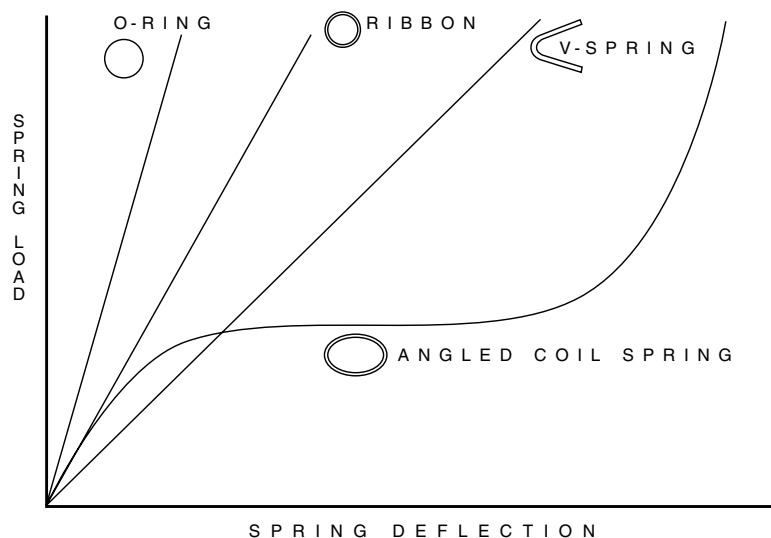


## ENERGIZERS

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

Code	Description
<b>V</b>	<b>V-spring</b> - general duty, low cost, excellent for wiping applications
<b>H</b>	<b>Helical ribbon spring</b> - primarily for static and vacuum service
<b>A</b>	<b>Angled coil springs</b> - for low controllable friction
<b>E</b>	<b>O-ring loaded</b> - 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 SSI standard PTFE and high performance polymers and compounds

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

## ENERGIZERS MATERIALS

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

For a complete design proposal engineered for your application. **FAX to: 949.253.3141**



## 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 SSI design engineers early in the project, SSI 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 crevices 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 controlled conditions with a seal mated against a 16 rms finish achieves a certain life, however by mating against a 8 rms 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 RMS is highly recommended.

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

Fluid	Dynamic	Static
Cryogenic gas	2-4 RMS	4-6 RMS
Gases	4-8 RMS	12-32 RMS
Viscous fluids	12-24 RMS	16- 64 RMS
Thin Fluids	6-12 RMS	16-32 RMS

## 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 warranty 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  $Al_2O_3$  coating. Rc72 is obtainable for very durable surfaces.

**HVOF** is a thermal spray coating obtaining a 70Rc 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.





# SEAL APPLICATION DATA

NAME:			PHONE:
COMPANY:			FAX:
ADDRESS:			EMAIL:
CITY:	STATE:	ZIP:	WEBSITE:

## Application Information

NEW DESIGN <input type="checkbox"/> EXISTING DESIGN <input type="checkbox"/>		WHAT TYPE OF SEAL IS CURRENTLY BEING USED:	
PRICE TARGET:	LIFE TARGET:	FRICT/ TORQ TARGET:	MIN LEAKAGE:
ANNUAL VOLUME:			
EQUIPMENT TYPE:	INDUSTRY:	PROJECT COMPLETION DATE:	

## Application Conditions

<input type="checkbox"/> RECIPROCATING <input type="checkbox"/> ROTATING <input type="checkbox"/> STATIC <input type="checkbox"/> OSCILLATING <input type="checkbox"/> DITHERING	SPEED: CPM/RPM	LENGTH OF STROKE:
	PRESSURE: PSI	VACUUM: IN HG
	PV: PSI*FPM	
	TEMP: F C	
	MEDIA:	

## Hardware

**Mounting:** HOUSING BORE \_\_\_\_\_ PISTON \_\_\_\_\_ FACE SEAL \_\_\_\_\_ INSIDE PRESSURE \_\_\_\_\_ OUTSIDE PRESSURE \_\_\_\_\_

	HOUSING BORE	SHAFT/PISTON GROOVE
MATERIAL		
COATING / PLATING		
HARDNESS		
SURFACE FINISH		
DIAMETER		
TOLERANCE		

Any other considerations?

Sketch /email drawings what format?

Other Projects?

Referrals?

# NOTES



# NOTES





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