SEALING
SYSTEMS

Pantecnica®
ENGINEERED SOLUTIONS

Springflon® Description and Function

Springflon®

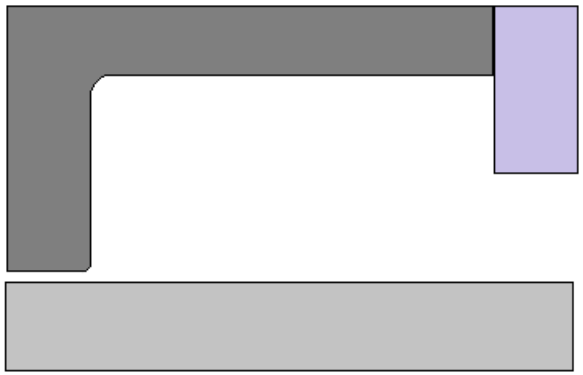
Springflon® are single-acting, spring-energized seals used in dynamic and static applications under extreme conditions for pressure, temperature, and/or with aggressive fluids.

The principle of this type of seal is based on:

1. U-shaped profile responsive to pressure
2. A metal spring with a constant preload function
3. Compound with high characteristics and performance

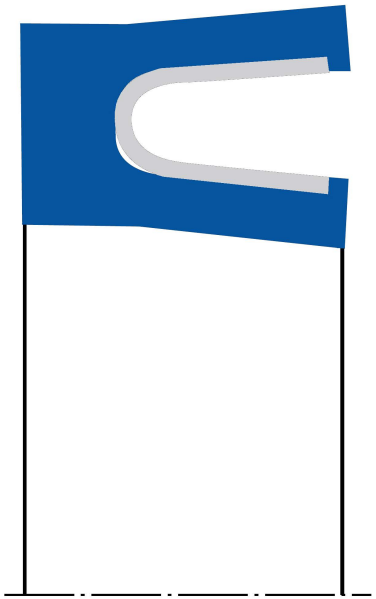
Seal Function (1-2)

1)



The seal is designed to fit a standard O-Ring groove

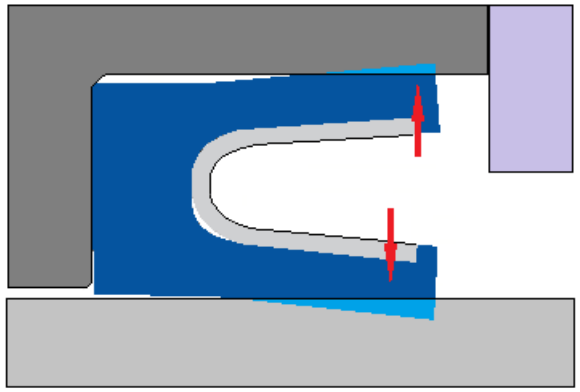
2)



The seal is sized to be larger than the groove in cross section to ensure right preload

Seal Function (3)

3)

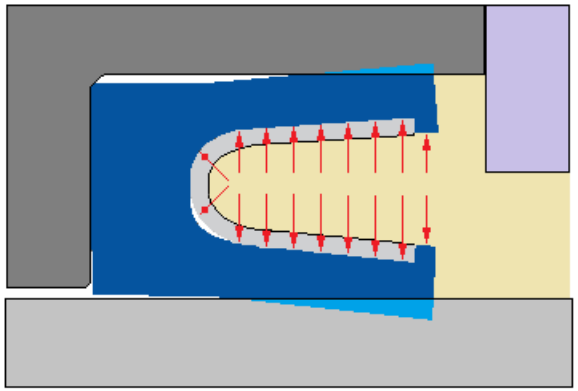


The sealing lips are compressed in the groove during assembling; the spring force counteracts the compression and pushes the sealing lips against the groove ensuring perfect preload.

This preload and contact provides sealing function also at "zero" pressure.

Seal Function (4)

4)



When the seal is subjected to system pressure, this produces an additional load on the sealing lips. The combined force between the working pressure and the spring load increases the load of the lips in the groove.

All Springflon® are based on the same operating principle and differ only in the profile form and the metallic spring used.

Material-Based Comparison

Properties	Elastomeric Seals	Springflon®
Low Static and Dynamic Friction	High friction, Stick-slip and Heat generation	Very low friction, No stick-slip, Self lubricating, Runs cooler
Fluid Compatibility and Chemical Resistance	Compatibility to be verified, Problems at high temperatures	Virtually total chemical compatibility even at high temperature
Temperature Range	Often very expensive for high and low grades	No problem from -200°C to +260°C
Resilience and Elasticity	Resilient, but prone to compression set	Low resilience enhanced by metallic springs. No ageing
Extrusion Resistance	Good with back-Up Ring, poor with high clearance	Excellent, even with high clearance
Shelf Life	Risk of vulcanisation of elastomer to surfaces	No vulcanisation to metal in contact. Long shelf life

Material-Based Comparison

Properties	Elastomeric Seals	Springflon®
No Media Contamination No outgassing	Limited use in food and pharma sectors	Ideal for use in food/pharma/medical sector
Dynamic Sealing	High friction limits speed. Heat generation limits life	High speeds up to 15m/sec.
Wear Resistance	Good in lubricated service, no in dry service.	Excellent lubricated or dry service with high or low pressure
Light Gas, Low Pressure Sealability	Excellent at tightly or minimal pressures. Easily seals vacuum.	Good. Requires heavy spring for high vacuum.

Design and Flexibility

Properties	Elastomeric Seals	Springflon®
Groove dimension standard	Standard Specification groove sizes	Standard Specification groove sizes
Design Flexibility	Moulds required	Full design flexibility. No fitting into closed grooves
Wide Pressure range	Not for high pressure. Use of Back-Up improves limits	Excellent from vacuum to 300MPa pressure
Relative cost	From very low to moderate for most compounds. Very high for perfluorinated	Higher cost is offset by performance benefits against elastomeric capabilities

Standard Seals

SEALING SYSTEMS

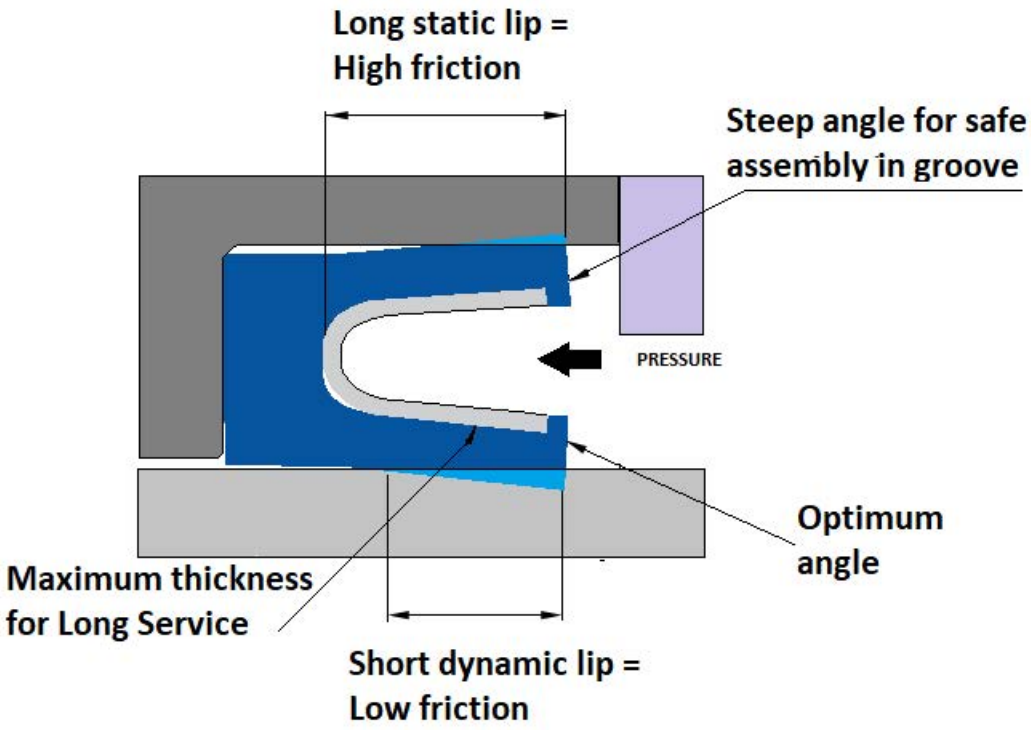
Springflon® URS

URS-B / URS-A

Advantages:

- Execution for rod (B) and for piston (A)
- Medium spring load
- Good flexibility
- For dynamic linear applications with long life
- Limited in rotary applications

Springflon® URS



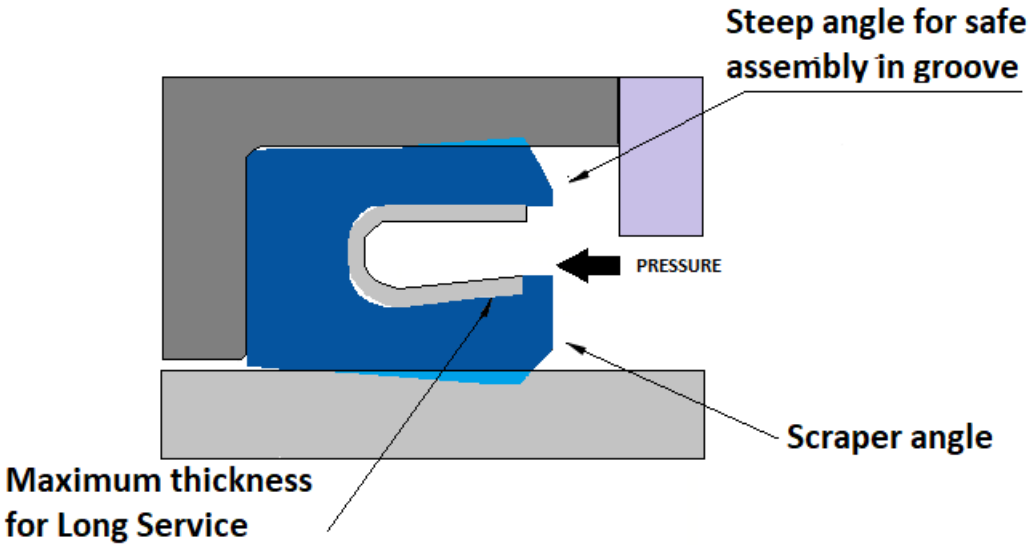
Springflon® URI/A

URI - URA

Advantages:

- Execution for rod (I) and for piston (A)
- Similar to URS
- Optimised for scraping
- For sticky or particle filled fluids

Springflon® URI/A



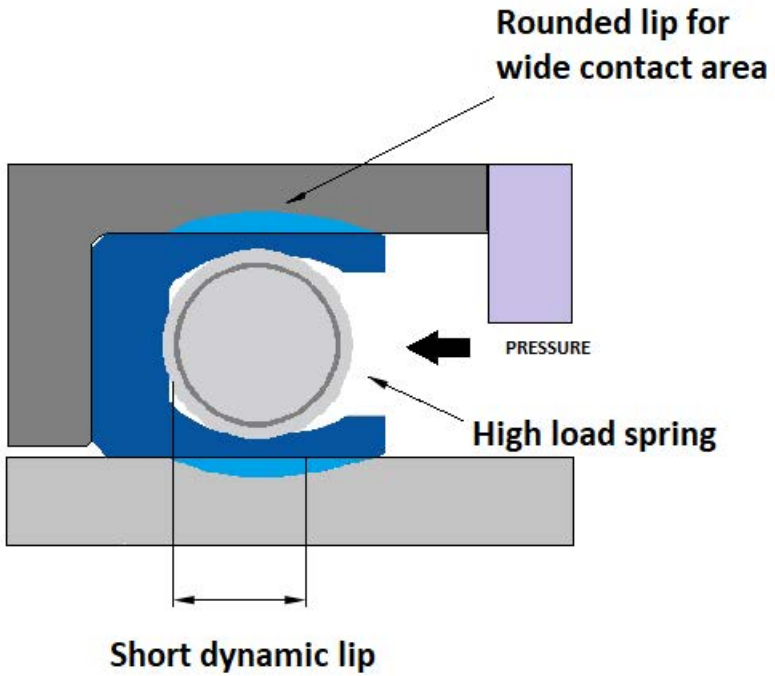
Springflon® CRS

CRS-B / CRS-A

Advantages

- Execution for rod (B) and for piston (A)
- Spring with high force
- For sealing gasses and low viscosity fluids
- Good low temperature performance
- For static or low speed applications

Springflon® CRS



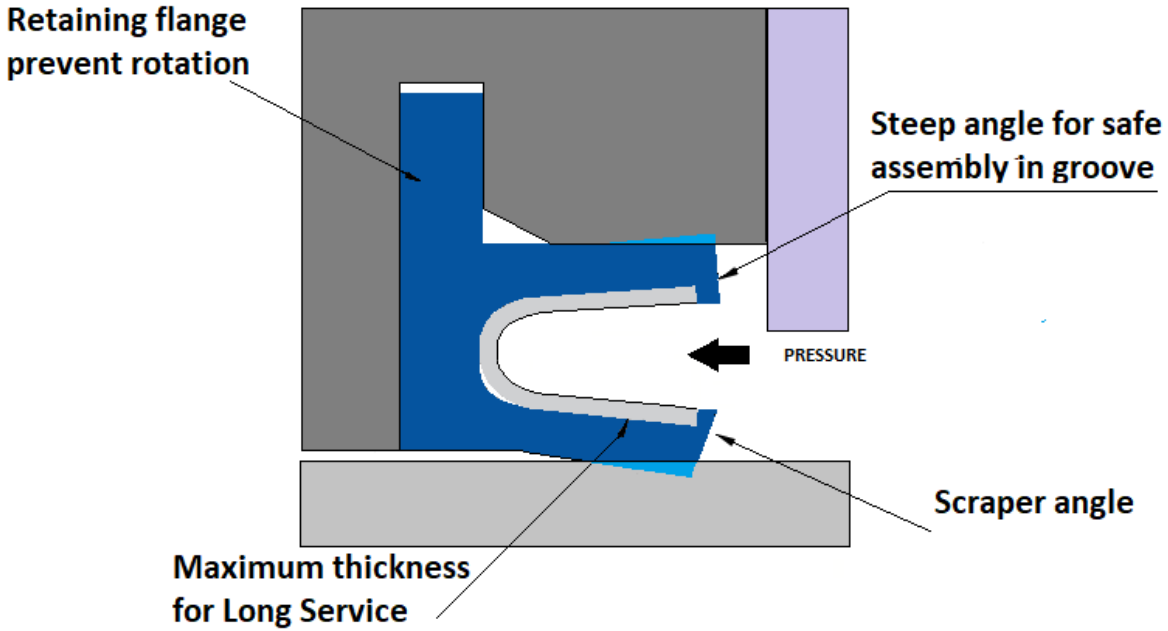
Springflon® URF

URF

Advantages:

- For rotary dynamic applications on rod
- Speed up 2m/s, Pressure up to 25MPa
- Positively fixed in the groove by the flange

Springflon® URF



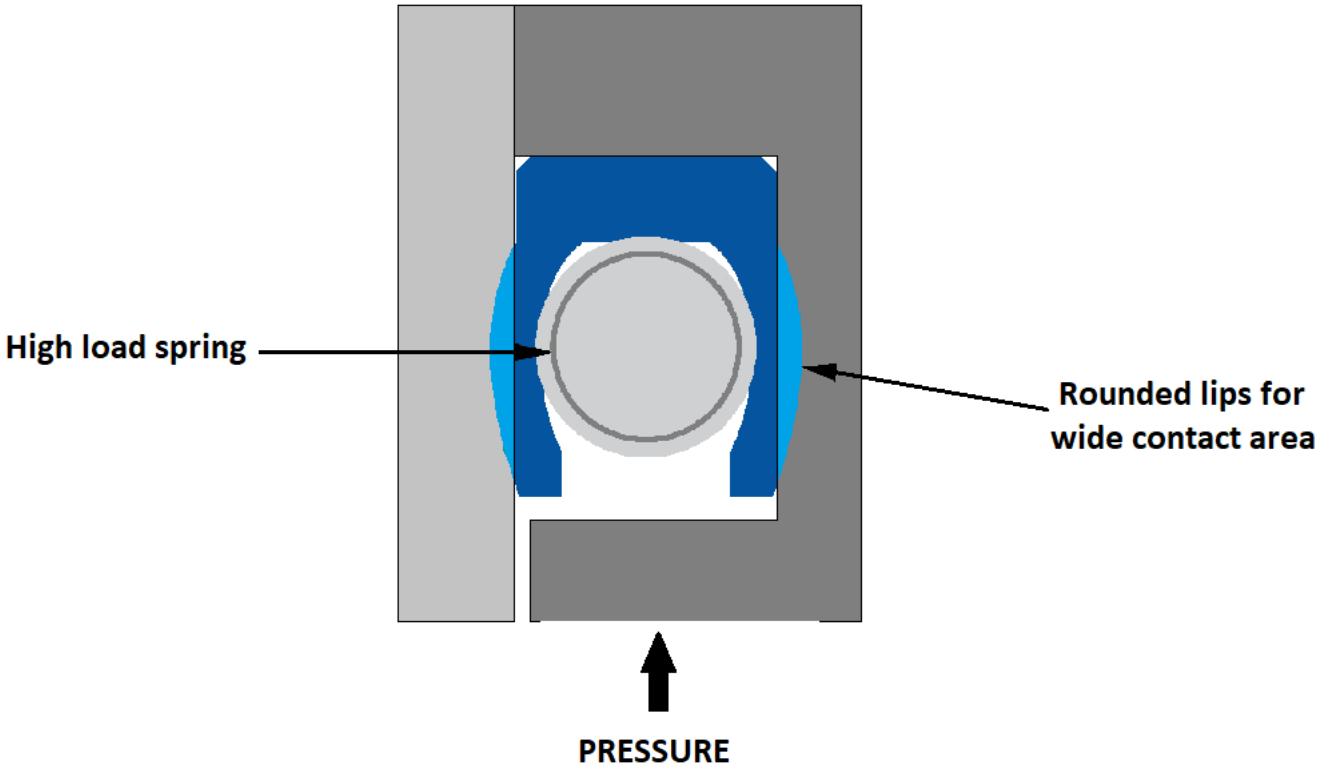
Springflon® CAI/A

CAI / CAA

Advantages:

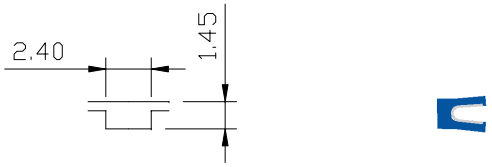
- Face sealing version of CRS-A/CRS-B types
- Spring with high force
- For flange sealing
- Internal (I) and external (A) sealing versions

Springflon® CAI/A

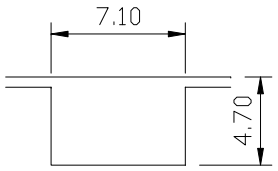


Standard Seal Series

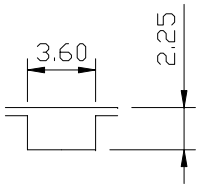
Dimensions in mm



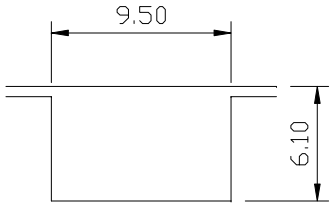
116 series



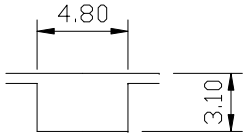
316 series



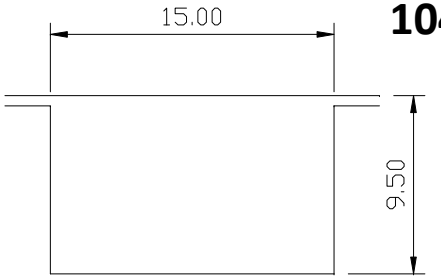
332 series

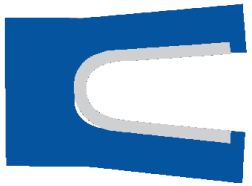


104 series



108 series



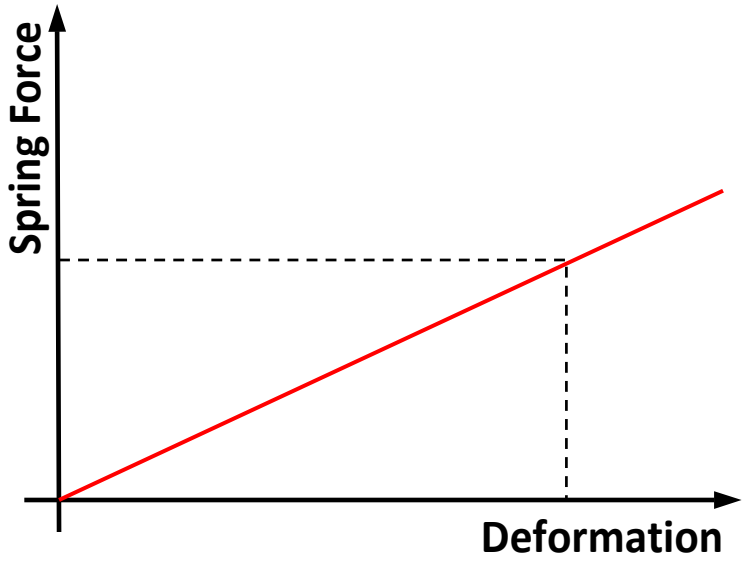


308 series

Based on ORing standard grooves

Springs

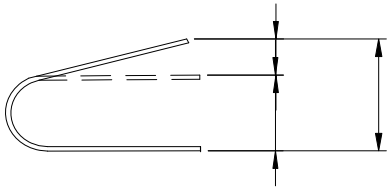
V Spring



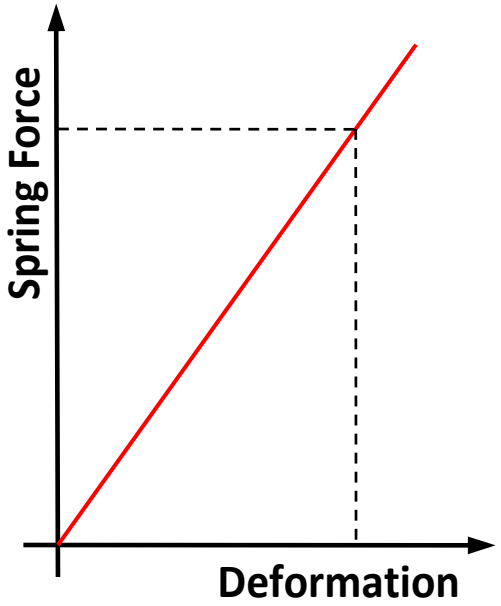
Advantages:

STANDARD = MEDIUM SPRING LOAD

- Medium deflection versus change in spring force
- Good all round performanceLoad rises proportionally as deflection increases
- Spring load and seal deflection will reduce as the seal wears



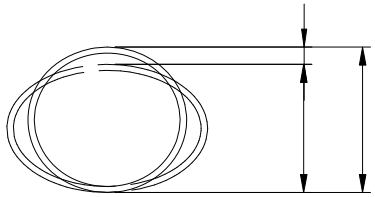
Coil Spring



Advantages:

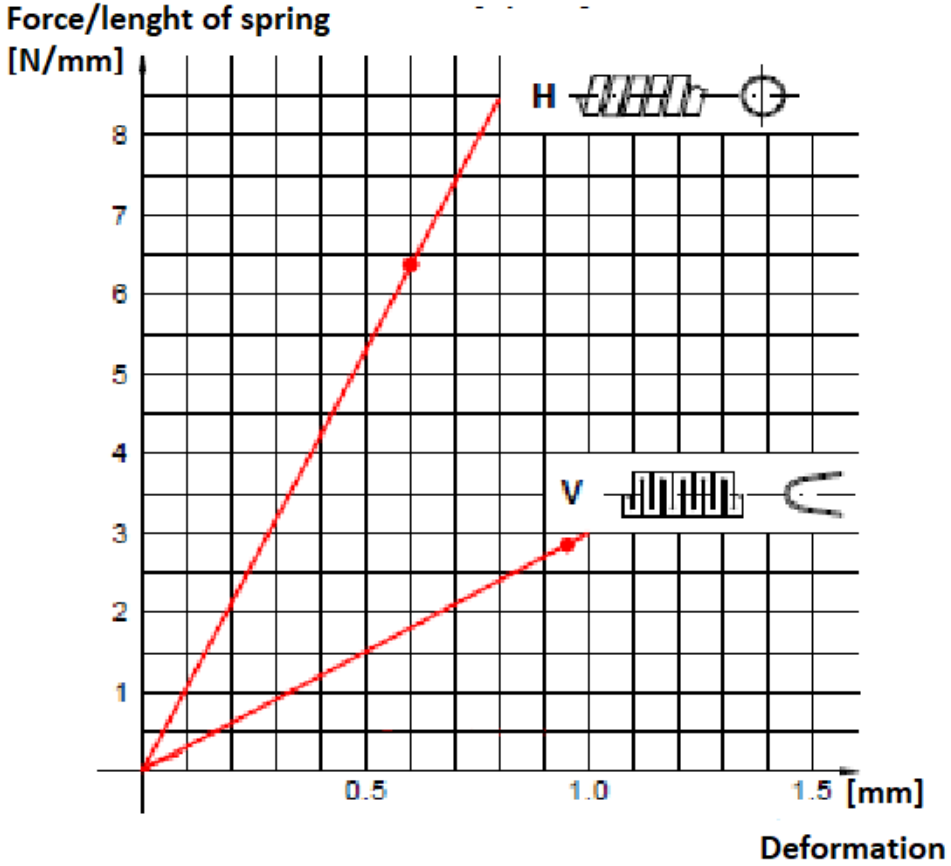
STANDARD = HEAVY SPRING LOAD

- Small deflection with large change in spring force
- Requires careful installation to avoid overcompression
- Excellent for static applications



Comparison of Spring Characteristics

Stainless Steel Springs



● Spring deformation in standard seal groove

Springs Material Selection

Material code	Material Description	Application
C	Stainless Steel Material: 1.4310 - X12Cr NI177 - AISI 301	General use e.g.: Air / Gasses, Water / Steam / Food / Drugs / Oil / Grease / Solvents
H	Hastelloy® C-276 Material: 2.4819 - Ni Mo 16Cr-15W - UNS N 10276	Corrosive media e.g.; Acids, Caustics, Sea water, Steam
E	Elgiloy® Material: 2,4711 - Co Cr20 Ni15 Mo - UNSR 30003	Petrochemical use e.g.: Sour gasses (Hydrogen Sulphide H2S), Crude Oil

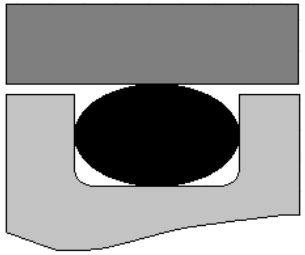
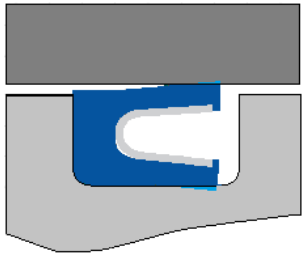
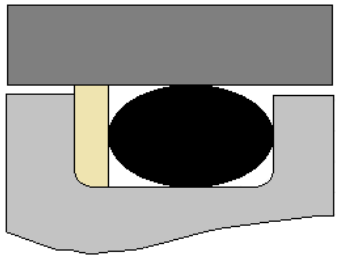
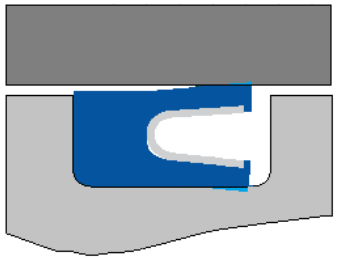
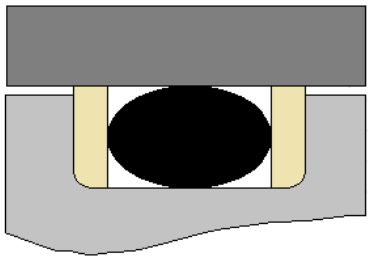
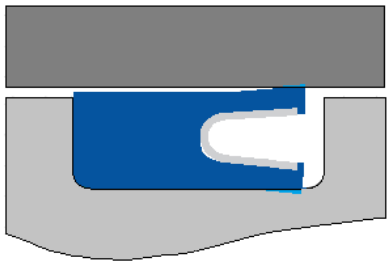
Spring: Silicone Filling

HiClean

Advantages:

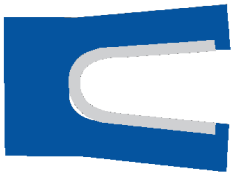
- Excellent in food and pharma applications
- Provides easy cleaning, in CIP and SIP conditions
- Rejects dirt

Standard Seal Width

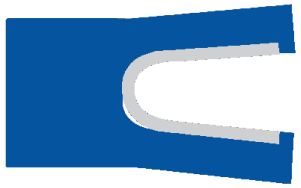
ORing		**Springflon®**
Only ORing		 Standard Heel
ORing with 1 Back-up		 Extended Hell
ORing with 2 Back-up		 Double Extended Heel

Sizes to ISO recommendations (DIN 3771)

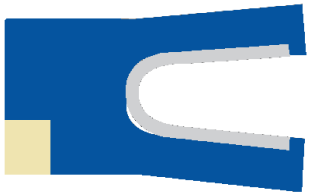
Selection of Extended Hell and Corner Reinforcement



Standard Heel - Pressure up to 20MPa

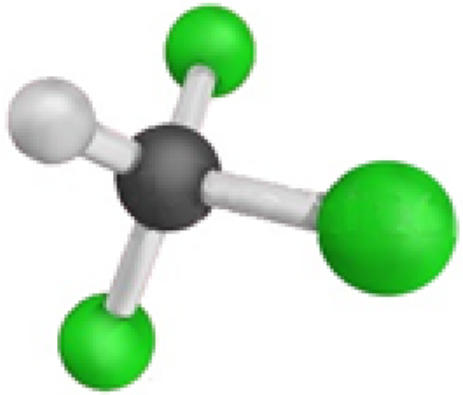


Extended Heel - Pressure up to 40Mpa



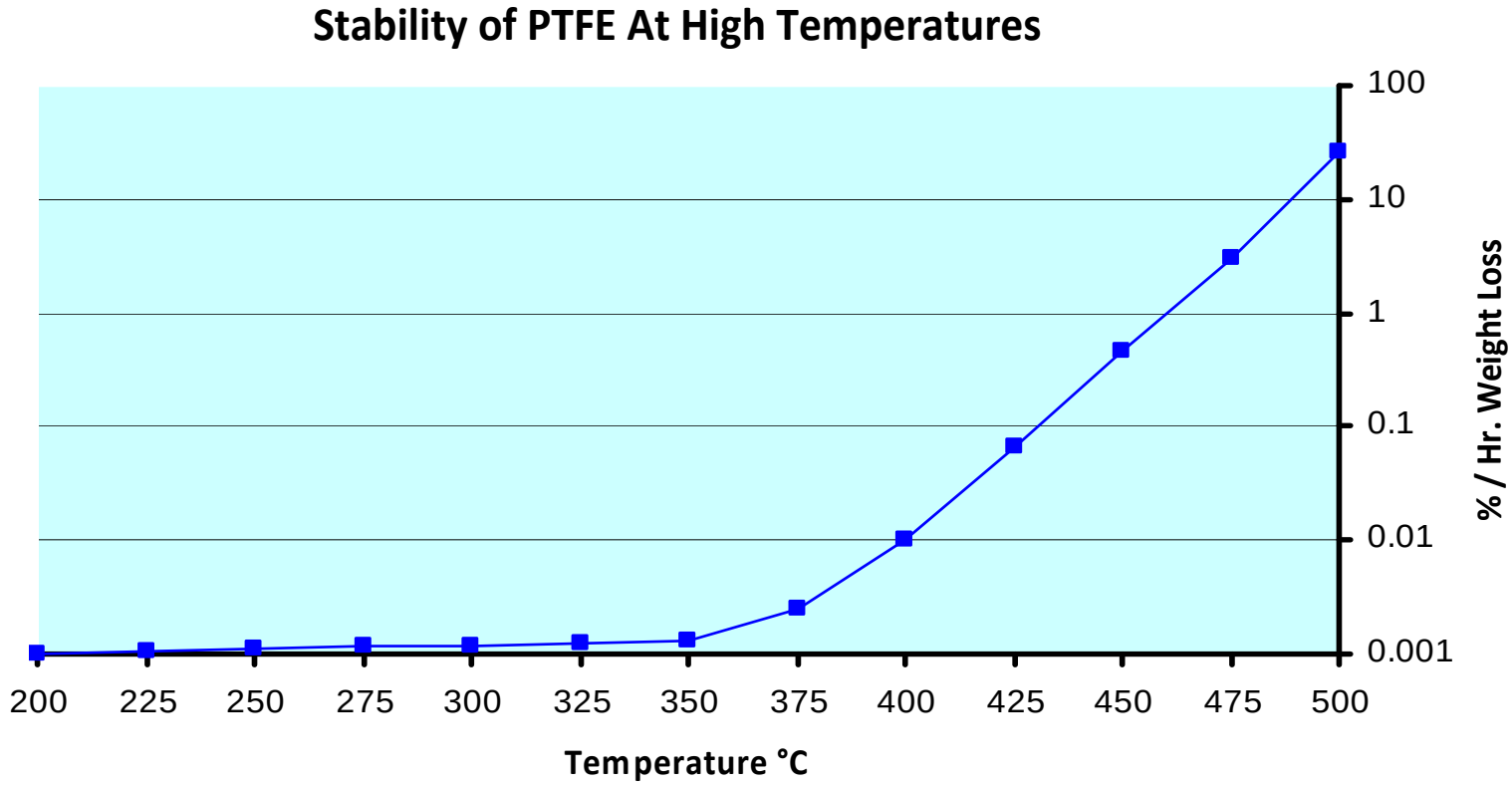
Extended Heel + Corner Back-up- Pressure in excess of 40MPa

A corner Back-up should also be selected if the extrusion gap is in excess of recommendations data.



Compounds

High Temperature Stability



The graph details the percentage weight loss of material per hour at elevated temperatures

SEALING SYSTEMS

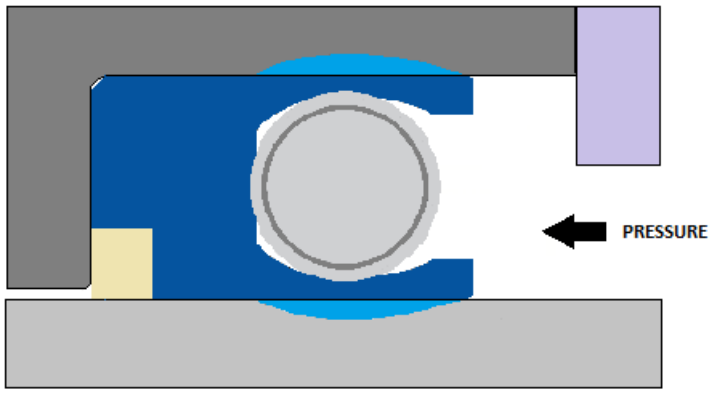
Material Selection

Commonly Selected Compounds

Material Code	Application
N.1 - F1	Generally used in static, slow dynamic or light duty applications. For food and pharma applications requiring FDA approval.
N.32	Light duty material with greater wear resistance than N.1. Used for reciprocating and rotary applications.
N.25	Recommended for dynamic applications, particularly dry running media, e.g. air, gas and sea water.
N.28	Excellent wear and low friction, is suited to both reciprocating and rotary applications. Requires hardened dynamic hardware surface. Not recommended for gasses and low viscosity liquids.
N.21	Recommended for high pressure and demanding dynamic applications. Also good for sea water and steam use
N.10 - F40	Especially suited to low pressure dynamic and rotary applications and running against unhardened surfaces.
N.8 - F8	Outstanding wear and abrasion resistance. Good lubricity in water based media. Upper service temperature limit of 80ºC.
K129	Back-up ring and corner reinforcement ring material with high extrusion resistance and low friction coefficient.

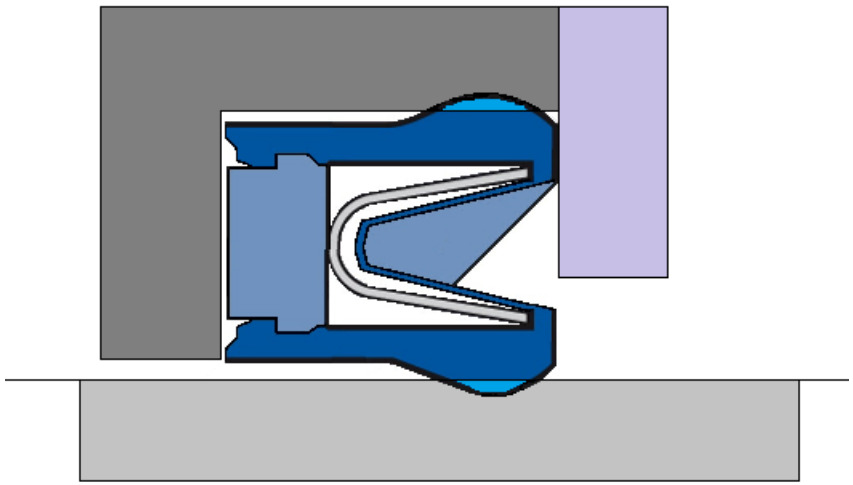
Special Seals

Corner Back-Up



A Springflon CRA with Corner Back-Up for High Pressure or big clearance

Springflon® Sanitary URS-C



Advantages:

Symmetric PTFE lip seal energized by "V" spring in AISI 301 DIN1.4310 and totally covered, suitable for linear and rototranslating movements.

- Symmetrical design of sealing lips.
- Good scraping action together with good dynamic sealing even in the presence of high-viscosity fluids.
- Suitable also for light rotary applications
- Excellent in food and pharma sectors with CIP and SIP conditions

Springflon® Sanitary URS-C

Technical data:

T: -75°C to +260°C
P: up to 25MPa
V linear: up to 5 m/s
V rotating: up to 1 m/s

Limitations:

Certain size limitations
Certain material limitations

- Good sealing efficiency
- Wide thermal working range
- No aging
- Low coefficient of friction
- Simple seat design
- Compatible with almost all fluids
- No contamination of fluids
- No sticking to mating surface
- Good wear resistance
- No stick-slip
- CIP (Clean in Process) and SIP (Sterilization in Process) sterilizable
- Can be supplied from 20mm rod up to 630mm

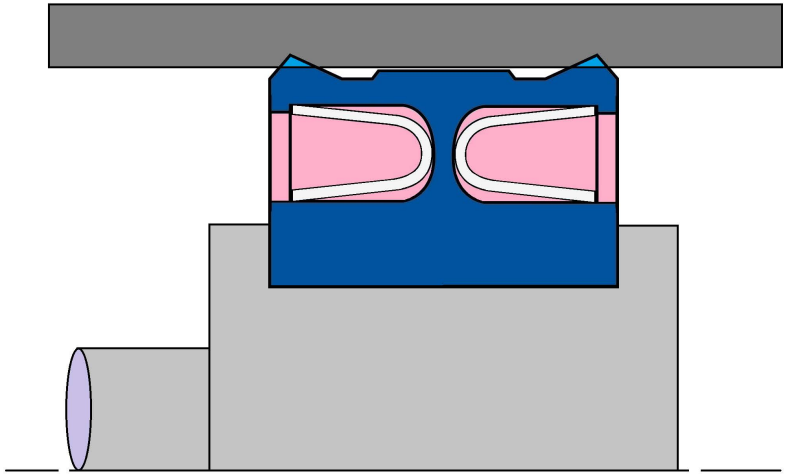
Springflon® Double URS

Double springed Springflon URS which can be designed for any groove dimension.

Roto Springflon® URI-OR

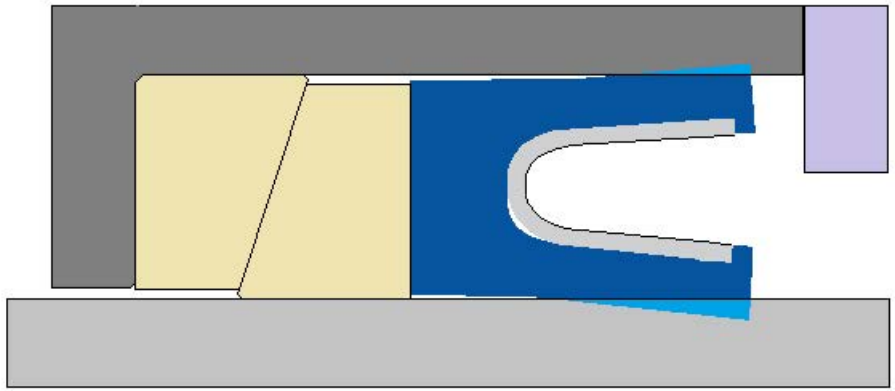
The ORing prevents seal shrinkage, leakage on the outer diameter, and stabilizes the seal by preventing it from rotating in place in applications with wide temperature variations.

Springflon® Double Acting Piston Seal

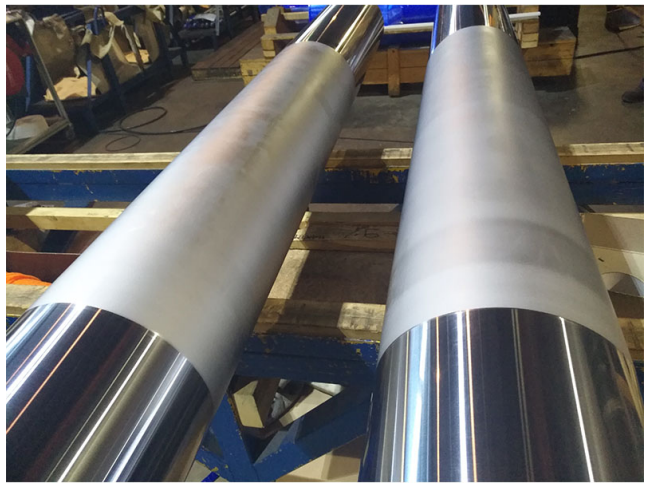


Springflon® double acting piston seal which is clamped on the I/D.
HiClean version shown is specified for food filling machines

Special Springflon® for High Pressure



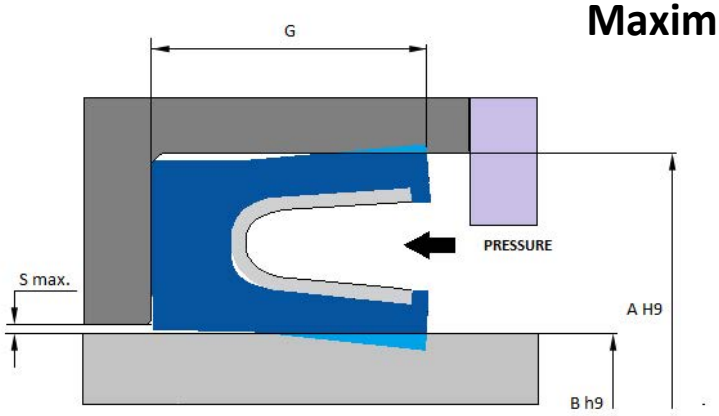
A sealing solution designed to take extreme pressures and/or large extrusion gaps



Hardware Recommendations

Extrusion Gap

Maximum Extrusion Gap



S max. Radial Clearance				
Pressure / Series	**2,0MPa**	**10,0MPa**	**20,0MPa**	**40,0MPa**
116	0,20	0,10	0,08	0,05
332	0,25	0,15	0,10	0,07
108	0,35	0,20	0,15	0,08
316	0,50	0,25	0,20	0,10
104	0,60	0,30	0,25	0,12
308	0,90	0,50	0,40	0,20

If isn't possible to meet these values, it is recommended a Back-Up reinforcement

Surface Finish

Maximum Surface Roughness

Media	Rotary Surface	Reciprocating Surface	Static Surface
Cryogenic & Low Molecular Gasses Hydrogen, Helium, Freon, Oxygen	Ra = 0,1µm	Ra = 0,2µm	Ra = 0,3µm
	CLA = 4 µin.	CLA = 8 µin.	CLA = 12 µin.
Low Viscosity Fluids & Gasses, Air, Alcohol's, Hydrazine, Gaseous Nitrogen, Natural Gas	Ra = 0,2µm	Ra = 0,3µm	Ra = 0,6µm
	CLA = 8 µin.	CLA = 12 µin.	CLA = 24 µin.
Medium to High Viscosity Fluids Water, Hydraulic Oil, Crude Oil, Skydrol, Gear Oil, Sealants	Ra = 0,2µm	Ra = 0,4µm	Ra = 0,8µm
	CLA = 8 µin.	CLA = 16 µin.	CLA = 32 µin.

For an optimal solution of the surface roughness in contact with the dynamic sealing lip an Rmr > 70% is strongly recommended

Surface Finish

The Influence of Surface Roughness on Seal Friction

Surface Profile	Surface Finish Ra	Interlocking Friction	Adhesive Friction	Total Friction
	0,4 - 0,8µm (16 – 32µin)	Medium	None	Medium
	0,2 - 0,4µm (8 – 46µin)	Low	None	Low
	0,1 - 0,2µm (4 – 6µin)	Very Low	None	Very Low

Surface Hardness

Minimum Surface Hardness

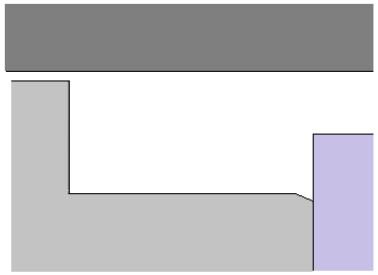
Type of Motion	Surface Speed	Lubrication	Rockwell C Hardness				
			At 0 MPa	1 MPa	5 MPa	10 MPa	<35 MPa
Reciprocating	Up to 0,50 m/s	Good	28	28	30	35	44
		Poor	30	30	35	40	50
	Over 0,50 m/s	Good	35	35	40	44	50
		Poor	44	44	48	50	60
Rotary	Up to 0,75 m/s	Good	35	35	50	50	70
		Poor	44	50	55	60	70+
	Up to 2,50 m/s	Good	55	58	65	70	70+
		Poor	60	65	70	70+	
	Over 12,70 m/s	Good	58	65	70	70+	
		Poor	65	70	70+		

Groove Design

Split Groove

Rod

Piston



Advantages:

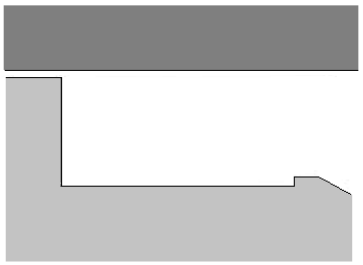
- Easy assembling operation
- No stretching of the seal during assembling
- Seals can be reinstalled without damage
- No installation tools required

Groove Design

Half Open Groove

Rod

Piston



Advantages:

- One piece construction
- Seals can not be removed without damageed
- No installation tools required
- Minimal stretching and distortion during assembling

Shaft Materials

Shaft Materials Used In Contact With Springflon®

Material		Hardness RC	Applications
Stainless Steels	Type 303	20	Very soft, for low speeds and pressures, moderate corrosion resistance.
	Type 304	28	Soft, for low speeds and pressures, moderate corrosion resistance.
	Type 316	28	Soft, for low speed and pressures, excellent corrosion resistance.
	Type 440C	44	Hardest stainless steels, for higher speeds and pressures, lower corrosion resistance.
Carbon Steel	SAE 1045	58	Higher strength than other low carbon steels. Use in non-corrosive media only.
Alloy Steel	4340	50	Applications in non-corrosive media, for moderate speeds and pressures.
Tool Steel	D-2	62	High hardness and wear resistance, low corrosion resistance. For high speeds at low pressures.
Soft Metals	Hard-anodised Al 6061-T6	70+	Excellent low-friction bore surface for reciprocating applications. Not recommended for rotary service.
	Bronze	85 Rockwell B	Light-duty service at low speeds and pressures, where friction and corrosion are not concerns.
	Mild Steel	-	Light-duty service in non-corrosive media only.
Non-Metallics	Ceramic	70	High wear resistance at high pressures or high speeds.

Plating & Coating

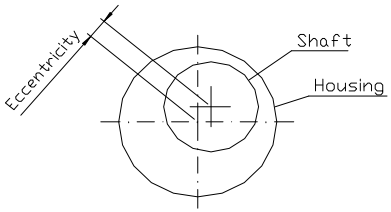
Typical Platings & Coatings used in contact with Springflon®

Coating Type		Hardness Rockwell C	Suggested Thickness	Corrosion Resistance	Abrasiveness to Seal
Chrome Plating	Hard Chrome	65	0,02-0,127mm	Fair to Good	High
	Thin Dense Chrome	70	0,005-0,015mm	Excellent	Low
Electroless Nickel Plating	Nickel as Deposited	48 - 52	0,025mm.min.	Excellent	Low
	Nickel Fully Hardened	58 - 70	0,025mm.min.	Good	High
Plasma Spray Coating	Chromium Oxide	71	0,127-0,762mm	Excellent	Low
	Al Oxide	60 - 69	0,127-0,762mm	Excellent	Low
HVOF2 (High velocity oxygen fuel)	Tungsten Carbide	67 - 74	0,127-0,762mm	Excellent	Low
Anodising	Hard Anodised Al	Over 70	0,013-0,114mm	Excellent	Low

Shaft Alignment

Recommendations For Springflon® URF

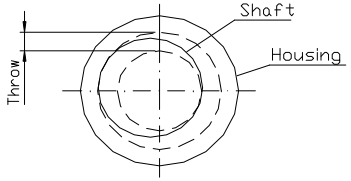
Eccentricity



Eccentricity is where the shaft rotates about its own axis but is offset from the centerline of the housing. Hereunder the maximum recommended values:

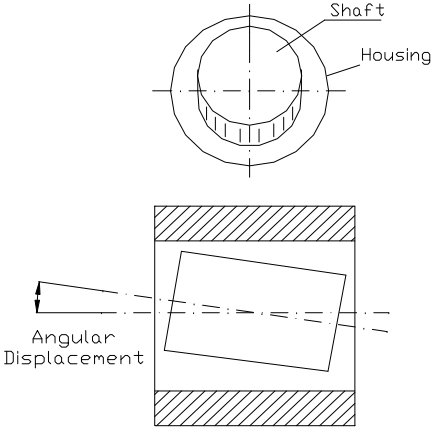
Series	Max. Deviation
URF-332	0,05
URF-964	0,10
URF-732	0,15
URF-932	0,20

Runout

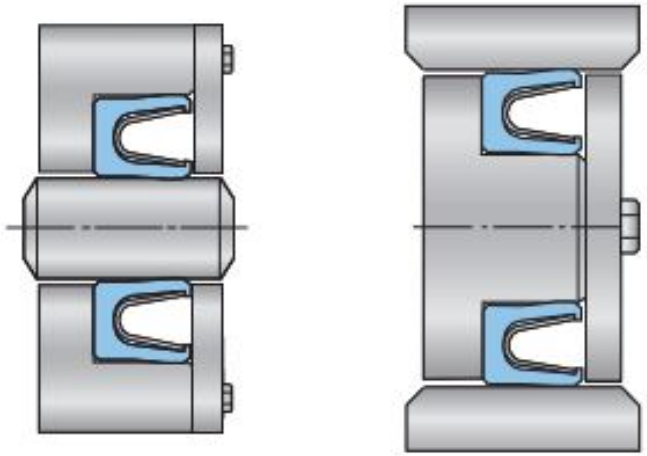


Runout is when the shaft is misaligned to the housing, but is rotating about the housing center, causing a wobble. This should be minimised !

Angular Displacement

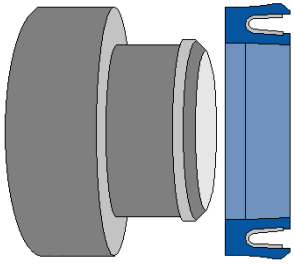


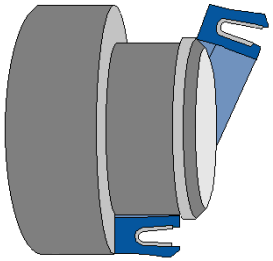
Angular displacement is when the axis moves at an angle away from the true centerline. This should be minimised too it will lead to a premature seal wear.

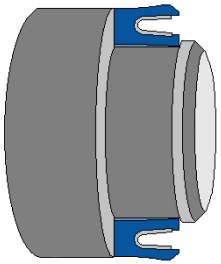


Springflon® Installation

Half Open Groove: Piston



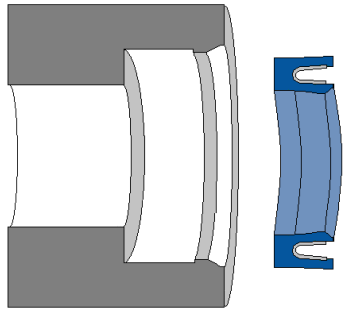


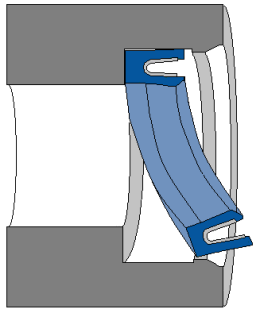


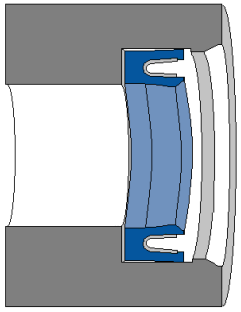
Press one part of the seal in place into the groove.

Push the remaining seal over the lip and into the groove by carefully pushing with fingers

Half Open Groove: Rod





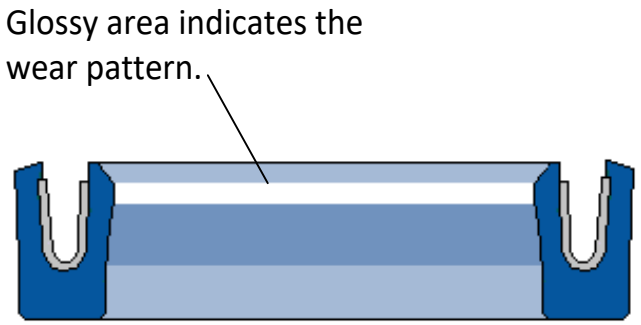


Place a section of seal in place within the groove

Pushing firmly with fingers, work the remaining seal in place into the groove.

Troubleshooting

Wear Dynamic Sealing Surface



Even Wear Pattern

Normal wear, no problem

Even Wear Pattern Across Entire Seal Length

- If high pressure is normal wear
- If with low pressure mean excessive interference

Wear Dynamic Sealing Surface

Normal Wear Pattern With Areas of Reduced Wear

Yielded spring area

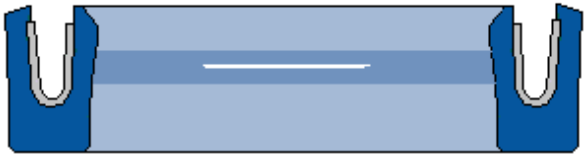
Heavy Wear Pattern On One Side Of The Seal

Shaft or bore misalignment

Wear Dynamic Sealing Surface

Normal Wear Pattern With One Heavy Wear Spot

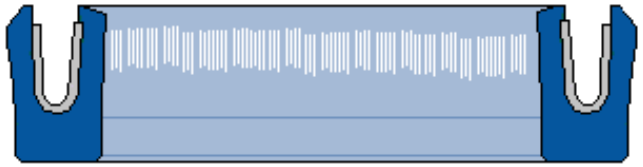
- Misaligned spring weld
- Object lodged in spring groove



Crack Or Hole

- Improper support of seal at high pressure
- Flaw in jacket material

Wear Dynamic Sealing Surface



Axial Scratches With Metal Flakes Embedded In Lip

- Rough mating surface
- Poor quality plating
- Abrasive media

Circumferential Scratches

- Rough mating surface
- Poor quality plating
- Abrasive media
- Excessive wear on a soft shaft

Wear Dynamic Sealing Surface

Axial Nicks, Cuts Or Scratches

- Damage during installation
- Burs or nicks on the hardware

Extrusion

Slight Crease Or Witness Mark At Heel

- Normal in pressurised service

Heavy Extrusion At Heel Of The Seal

- Excessive Extrusion Gap
- Seal material is too soft

Extrusion

Heavy Extrusion At Heel Of The Seal

- Excessive Extrusion Gap
- Seal material is too soft

Thin Strip Extending Forward On The Dynamic Lip

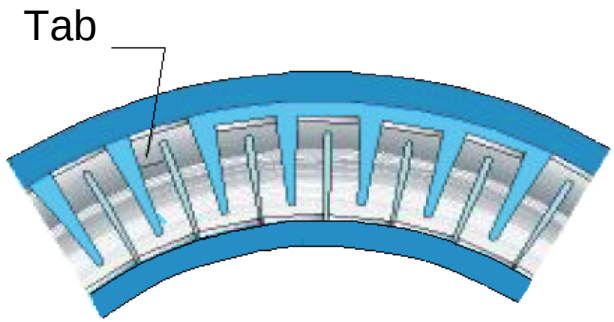
- Seal was pinched in the hardware during assembly

Extrusion

Thin Strip Extending Forward On The Dynamic Lip With Heel Distortion

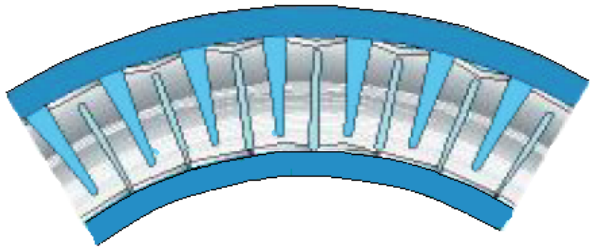
- Pressure behind the seal

Spring Damage



Gap Between Spring Tabs And Inside Lip

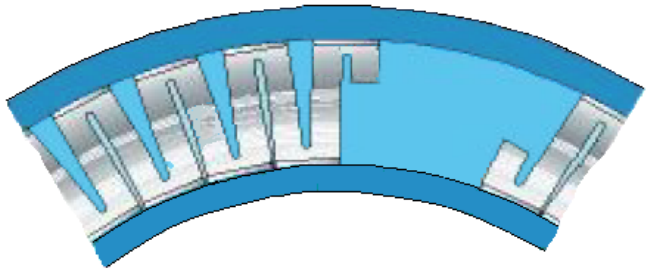
- Spring has been overcompressed in service or during installation



Distortion Or Damage To The Spring Tabs

- Excessive stretching, bending or twisting during installation

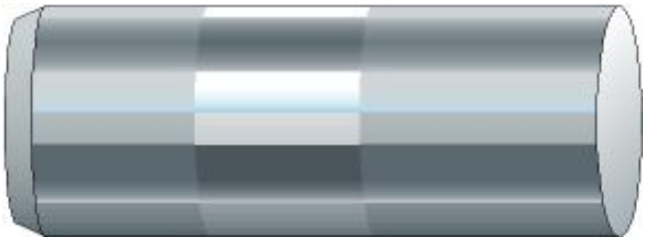
Spring Damage



One Or More Spring Tabs Missing

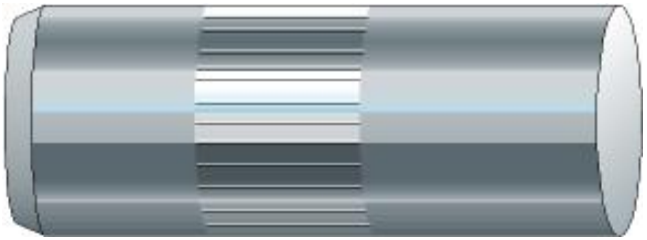
- Fatigue failure due to repetitive side loading

Wear - Reciprocating Rod or Bore



Some Polishing In Contact Area With Seal Material Residue

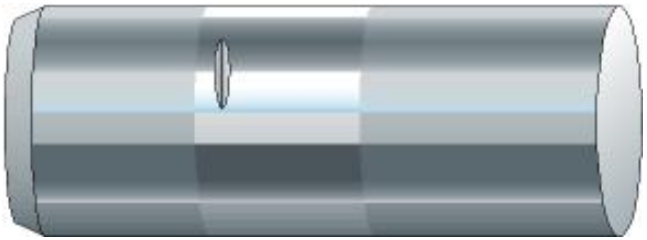
- Normal Condition



Axial Scratches On Contact

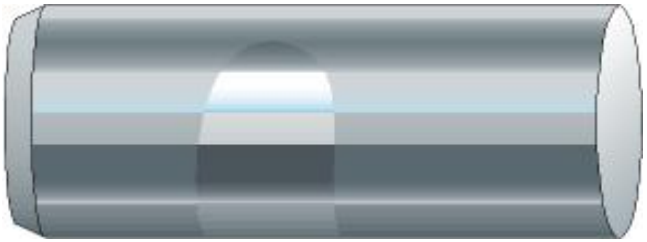
- Particles from the shaft or media embedded into the seal

Wear - Reciprocating Rod or Bore



Nicks Or Burrs On The Installation Path

- May cause seal damage during installation



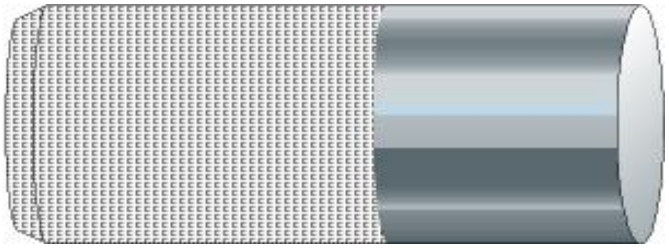
Irregular Wear Pattern

- Out of round surface
- Shaft misalignment
- Shaft wobble

Wear - Reciprocating Rod or Bore

Galling Caused By Bearing Or Bush Contact

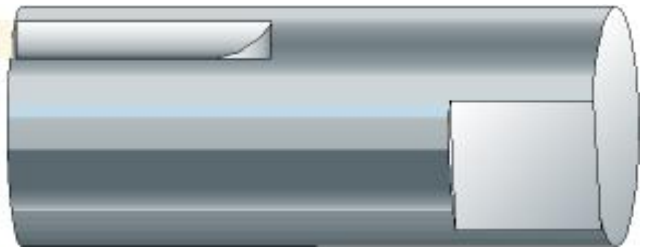
- May create particles that can damage the seal



Corrosion Of Hardware On The Media Side Of The Seal

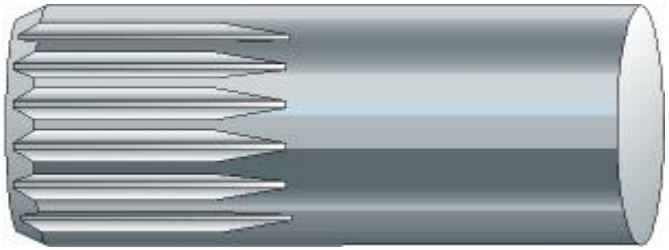
Rod or bore material incompatible with the media

Wear - Reciprocating Rod or Bore



Sharp Corners, Key-ways, Or Flat Areas

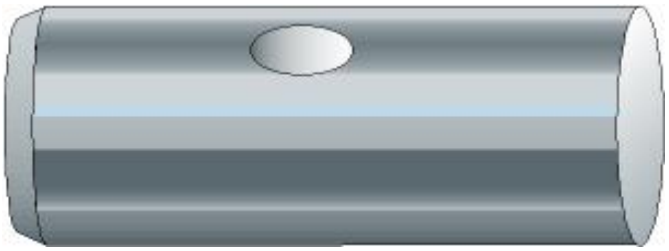
- May scratch the seal during installation



Splines, Threads, Or Knurls

- May scratch the seal during installation

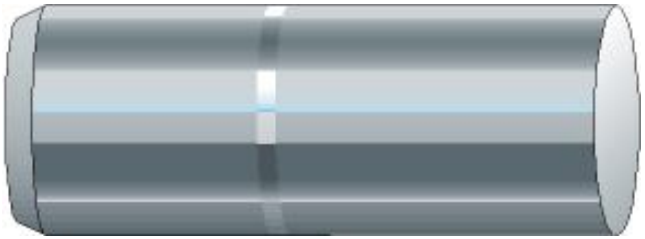
Wear - Reciprocating Rod or Bore



Sharp Edge On Ports Or Grooves

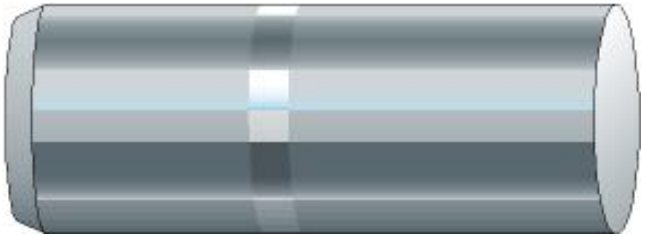
- May damage the seal during installation

Wear - Rotary Shaft



Polishing In Contact Area With Some Seal Residue

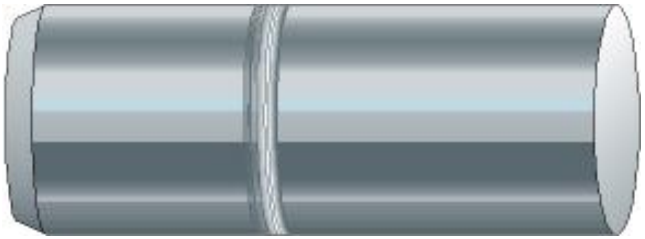
- Normal condition



Polishing In Wider Contact Area With Some Seal residue

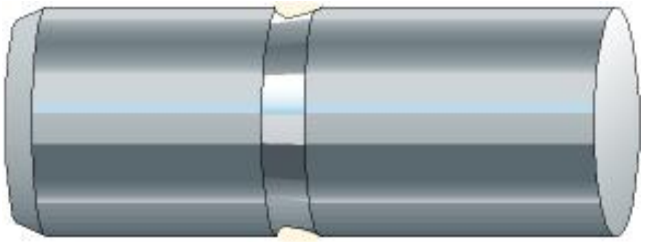
- Normal for high pressure conditions

Wear - Rotary Shaft



Circumferential Scoring

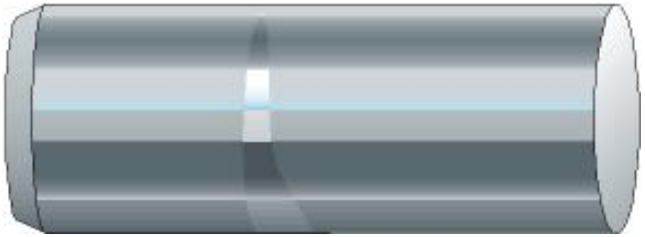
- Insufficient shaft hardness
- Seal material too abrasive for shaft
- No lubrication



Groove Cut Into Shaft By Seal

- Insufficient shaft hardness
- Seal material too abrasive for shaft
- No lubrication

Wear - Rotary Shaft



Inconsistent Polish Pattern

- Out of round surface
- Shaft misalignment
- Shaft wobble

PANTECNICA S.p.A.
Via Magenta, 77/14A - 20017 RHO (MI) Italia
T: +39 02 93261020 – E: info@pantecnica.it
www.pantecnica.it