SEAL DESIGN MANUAL

www.sfcseals.com

SPECIALTY FLUID COMPONENTS

INTRODUCTION

Specialty Fluid Components (SFC) is a global Leader in the Manufacturing of High Performance Seals and Polymer Components. With over 45 years of combined industry experience, Specialty Fluid Components provides Engineering and Design solutions for your difficult and challenging applications.

Our Excelon™ Polymer Seals are used in many types of Gaseous, Fluid, and Vacuum applications. From Deep Cryogenics to extremely high temperatures, our sealing devices are applied to many applications where elastomeric O-rings, "U" Packings, "V" rings, and gaskets fail from exposure to chemistry, pressures, or extreme temperatures and motions.

Our trademark Excelon™ refers to our excellence and care in designing and manufacturing of our Excelon™ spring energized seals. Our engineered Excelon™ polymer seals are utilized in all types of gas, fluid power and fluid control devices. In fact our seals are applied to almost all devices where elastomeric O-rings, U-packings and gaskets were used previously.

Our philosophy of excellence in customer service, engineering, design, superior quality, and manufacturing expertise, SFC is committed to be a continuous quality driven manufacturer in numerous industries backed with our ISO:9001 & AS9100D Certification and standards. As an integrated engineered sealing component and machined component supplier, we offer our customers complete solutions in a controlled Raw Material-to-Final Product facility.

"CUSTOMERS TRUST US WITH THE SUCCESS OF THEIR COMPANY"

"MANUFACTURING & QUALITY IS WHAT WE DO. "

EN 9100:2018
BUREAU VERITAS
Certification

ISO 9001: AND AS9100D CERTIFIED

TABLE OF CONTENTS

EXCELON™ SEALS

COMMON APPLICATIONS




- Aircraft Fuel, De-Icers, Hydraulics
- Aircraft Brake Cylinders
- Bearings
- Bicycle Low Friction Seals
- Cryogenics, LCO2, LCH4, LN2, Refrigerants
- Deep Cryogenics, LOX, LH2, LHe,LAr, LNe
- Diesel Engines
- Filling Machines
- Food Processing Seals
- Food Processing Surfaces
- Gas & Liquid Chromatography (HPLC/UPLC)
- Gas Turbine Engine Fuel or Hot Gasses
- Hydrogen Containment
- Hot Melt Glue Dispensers
- Lens and View Glass Holders/Seals
- Infrared Optical Systems
- Laboratory Instruments
- Machined Engineering Plastic Parts
- Medical Instruments
- Metering Valves
- Plastic Extrusion Machines
- Pumps and Compressors
- Reaction Tanks
- Rotary Swivel Joints
- Robotics
- Satellite Systems
- Semiconductor Sputter Chambers
- Turbo Pumps
- Ultra Pure Fluid
- Vacuum Systems/Chambers
- Valve Bonnet Seals, Stem Seals, and Seats

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EXCELON™ SEALS
SEALING SOLUTIONS

Sealing Solutions

Our diverse range of product materials stands out for its exceptional quality, featuring high-performance polymers such as PTFE and other meticulously blended high purity polymers. These materials are tailored to exhibit specific and desirable characteristics, including chemical inertness, low friction, low wear, and exceptional resistance to high pressure and distortion.

The outstanding inert nature of many of these polymers positions our products as essential components in highly regulated industries. Our materials are instrumental in sectors such as Food, Beverage, Biochemistry/Drug Manufacturing, and Medical Devices, where stringent quality and safety standards are paramount.

In our pursuit of innovation, we utilize advanced manufacturing techniques, including both Injection Molding and Compression Molding. The latter, in particular, allows us to precisely tailor the properties of our materials, enhancing structural integrity and ensuring that our products meet the highest standards of performance and reliability.

Moreover, our reach extends to critical industries such as LNG, Hydrogen, Aerospace, and Semiconductor. In the LNG sector, our materials are employed in cryogenic applications, ensuring resilience in extreme low-temperature environments. In the Hydrogen field, our products contribute to the integrity of systems dealing with high-pressure hydrogen storage and transportation. In Aerospace, our materials find applications in critical components where lightweight, high strength, and resistance to extreme conditions are paramount. Additionally, our involvement in the Semiconductor industry extends to providing materials that meet the rigorous demands of semiconductor manufacturing processes.

Our Injection Molding process stands out for its advanced and proprietary techniques, proving especially advantageous in these challenging environments. The materials we offer excel where others may falter, particularly in low molecular weight gases and cryogenic applications.

Beyond our commitment to delivering superior products, we pride ourselves on providing unparalleled service through our dedicated Technical Support staff. They are ready to assist you in finding the optimal solution for your sealing applications. We eagerly anticipate the opportunity to serve you and address your unique needs with a combination of top-tier products, advanced manufacturing techniques, and cost-effective solutions.

SOLID CONTACT
SPRING ENERGIZED SEALS

ETCHED SPRING
ENERGIZED SEALS

HELICAL WOUND
SPRING ENERGIZED SEALS

DW SPRING
ENERGIZED SEALS

MANUFACTURING
UNIQUE COMPONENTS

CANTILEVER
SPRING ENERGIZED SEALS

UNI-DIRECTIONAL
SPRING ENERGIZED SEALS

ROTARY LIP
SEALS

HOW EXCELON™ SEALS FUNCTION

How Excelon™ Seals Function

Seals are integral components in engineering applications, tasked with preventing the undesired escape of fluids or gases. An exemplary solution in this realm is the energized polymer seal, also known as a spring-energized seal. Manufactured in-house by SFC with cutting-edge precision machinery, Excelon™ Seals are crafted to order, offering a hands on approach to design and manufacturing for a myriad of applications.

Excelon™ Seals derive their efficacy from the use of high-performance polymer materials, such as PTFE or UHMWPE. Renowned for their remarkable chemical resistance and low friction properties, these materials form the basis of the primary sealing element, often taking the form of a lip. Excelon™ Seal jackets are precision machined from a variety of materials specifically made to perform in your specific chemistry, pressure range, temperature range, motion and hardware material.

Excelon™ Seals are available with a variety of spring energizer types as well. The choice of a perfect spring will depend on your requirements of friction, deflection, leak rate, and media chemistry. Springs are fabricated from a selection of metal alloys ranging from 17-4 Stainless Steel to Cobalt Nickel and Inconel for more exotic applications. In some applicatioins, Excelon™ seals can be equipped with elastomer energizers if so desired.

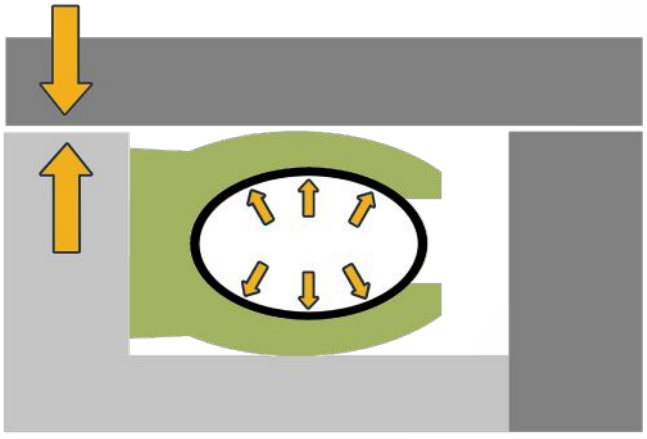
Upon installation, these seals seamlessly integrate into a housing or gland, establishing a dynamic seal against moving components like shafts. The energized polymer lip's constant contact with the mating surface persists during motion, courtesy of the energizing spring. For added performance, lubrication is employed to mitigate friction and wear, especially in high-speed scenarios.

A distinctive trait of energized polymer seals is their adaptability to diverse clearances and surface irregularities. This feature makes them particularly well-suited for dynamic applications where shaft movement or misalignment is prevalent. SFC's commitment to high precision manufacturing ensures these seals excel in challenging environments, offering a reliable solution across various industries.

HOW EXCELON™ SEALS FUNCTION

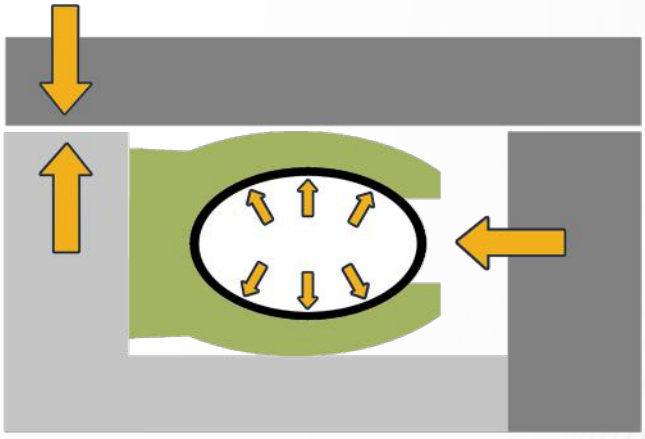
Excelon™ Seals are chosen for their resilience in extreme temperatures and resistance to a spectrum of chemicals, attesting to their versatility. The low coefficient of friction in the polymer material not only minimizes wear but also enhances the overall efficiency of the sealing system. As a testament to SFC's dedication to customization, these seals can be tailored for specific applications by adjusting parameters such as spring force, lip geometry, and material composition, optimizing their performance to meet unique requirements. In conclusion, SFC's in-house manufacturing of energized polymer seals underscores their commitment to precision and customization, providing tailor-made solutions for diverse applications in fluid and gas containment.

EXTRUSION GAP



SPRING FORCE

EXTRUSION GAP



SPRING FORCE & SYSTEM PRESSURE

SEAL SELECTION BY APPLICATION

Static or Dynamic Applications

- Static glands have NO MOTION between the Seal and the hardware. Examples would be bolted pipe flanges, vessel covers, and viewing ports.

- Dynamic glands are where motion occurs, and the motion can be rotary, linear, or both.

- Linear dynamic seal applications are found in air and hydraulic cylinders, robotics, and rod pumps.

- Rotary dynamic motion is most often radial shaft seals, but also occurs in face applications such as swivels or weather shields.

Both linear and rotary motion is less common but occurs in ball screws or rotary actuators.

SFC manufactures Excelon™ Seals for these applications and many others. Frequently the basic seal designs can be interchanged and can be altered to benefit certain high priority issues such as runout, wear, friction changes with media pressure,changes, high temperatures (or low, cryogenics).

The recommendations following are intended as a general guide and should be considered with the other tables and charts on the following pages to guide you through the selection process.

Face Seals, Static Service

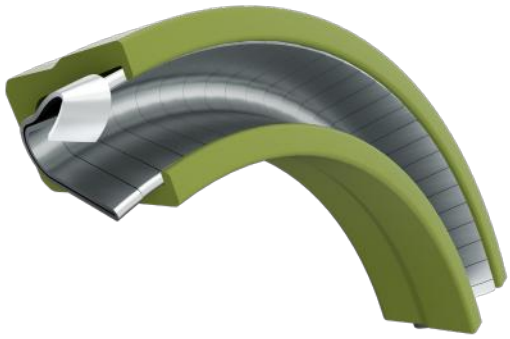
For most static service face applications, Specialty Fluid's H088 Inside Face or H089 Outside Face Helical Spring Seals are a good choice (See Pg 31). They create moderate to high spring

CANTILEVER SPRING SEAL

ROTARY LIP SEAL

HELICAL WOUND SPRING SEAL

DOUBLE WRAPPED SPRING SEAL



SEAL SELECTION BY APPLICATION

loads and will seal a wide range of pressure and temperature. spring loads are easily customized.

For tighter leakage requirements, and most often used in high vacuum, chemical or cryogenic applications, the S030 Inside Face, or S031 Outside Face are a excellent choice (See Pg 35). These seals have high seal contact load, and a gap-less spring load circle, creating a tight seal.

Cantilever Spring Seal Types C098 Inside Face and C099 Outside Face, can be used in places where light loading is required (See Pg 30). Sealing ability of this spring type is not as effective as the above types, but can be useful where the gland is easily distorted and pressure is low.

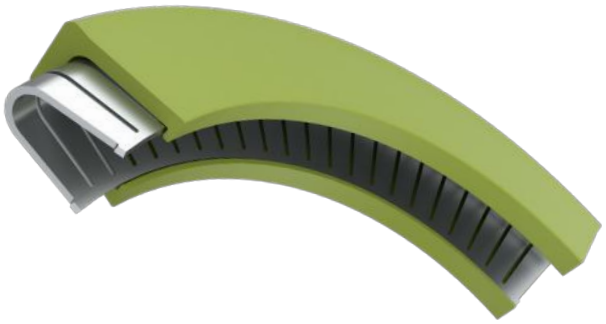
Face Seals, Rotary Service

Cantilever Spring Seal Types C098 Inside Face and C099 Outside Face, used in places where light loading is required for low friction where speeds are slow to moderate. We can customize these for friction values and higher speeds, consult us for details.

Specialty Fluid's H088 Inside Face or H089 Outside Face Helical Spring Seals are a good choice for slow oscillatory or rotary motion where high torque is available. They create moderate to high spring loads and will seal a wide range of pressure and temperature. Applications are typically rotary swivels and pivot joints for cryogenic loading systems and vacuum chamber articulating arms.

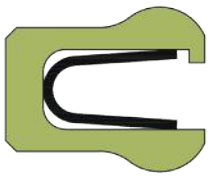
UNI-DIRECTIONAL SPRING SEAL

SOLID CONTACT SPRING SEAL



ETCHED SPRING SEAL

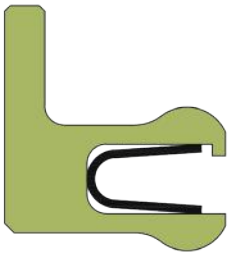
SEAL SELECTION BY APPLICATION



E90 AND C90
(CANTILEVER SHOWN)

Radial Seals in Static Applications

Static Radial Seals are best serviced by using the Helical Wound H080 Series of seals (see Page 35). The H080 offers moderate spring loads, and can be custom machined into an infinite variety of diameters and cross sections. This seal works well in heat or cryogenics, or both, within certain limits. This seal type offers a wide variety of spring alloys to match your chemistry, and is easily modified for spring loads.

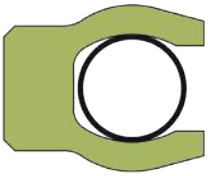


E96 AND C96
(FLANGED)

Radial Seals in Reciprocating Motion

This type of application is the most popular use of Excelon™ Seals. Rod and piston glands mostly use the Cantilever Spring seals, E090 Series Etched for small diameter uses, and C090 Series for most applications over ¾ inch or 20mm diameter. These types of seals are low to moderate load, which gives you low friction and long service life. The Cantilever U-Shape spring lends itself well for sealing edge loading and makes a good scraping action when combined with a skived edge found with our E091, C091, E092 and C092 types. The U-shaped Spring seals are also easily filled with FDA Silicone to create food service seals with no entrapping volume.

For more robust requirements, Excelon™ Helical Wound Spring Seals Work well in standard or skived edge configurations. These are commonly used for aircraft hydraulics for rods and pistons. They are somewhat distortable to install in blind bore grooves where the bore is 15X larger than the gland cross section or greater.



H080
(HELICAL)

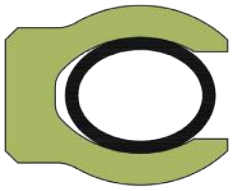
The Excelon™ DW Seal is a very robust seal for glands 1/8 inch (3.2mm) and greater. This type of seal has high deflection, great wear capacity, good scraping ability. It is a good choice for use in dirty places with limited access.

Some high pressure applications such as liquid chromatography, benefit from a flanged seal design, a readily available option.

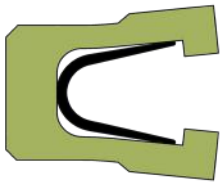
Applications needing extended seal heels or back up rings are also readily available. Extrusion resistant back up rings matrerials such as filled Excelon™ E1500 PEEK™ are readily supplied as well.

SEAL SELECTION BY APPLICATION

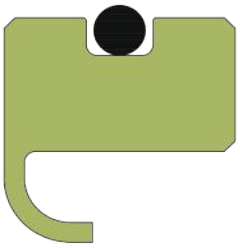
Radial Seals, Rotary Service



U070
(UNIDIRECTIONAL)



W060
(DOUBLE WRAPPED)



L040
(LIP SEAL)

All Excelon™ Seals except for the solid contact 'S' series seals, will work well for radial seals, taking consideration spring loads, friction, and shaft surface velocity.

In rotating and oscillatory motion use, after a wearing period, a seal will tend to rotate with the shaft to varying degrees. If this is an issue, we recommend designing a gland for a flanged seal, which locks the seal jacket to the gland.

The most commonly used Excelon™ seals in rotary motion use are the Etched and Cantilever E and C type spring seals, and the Uni-Directional wire spring seals. The Cantilever Spring Seals have an edge contact for good fluid or particle control, added with low friction.

The Unidirectional Wire Spring Seals have high wear and deflection capacity with low spring loads, primarily in smaller cross sections under 1/8 inch (3.2mm). Their high deflection capacity helps for runput, ovality, and misalignment issues.

Both Cantilever E and C type seals, plus the unidirectional wire seals are great for media pressures under 2000 PSI, and shaft surface velocities under 200ft/min. At higher speeds, the pressure should be reduced to achieve long seal life.

Excelon™ DW Spring Seals (W series) or Helical Wound Spring Seals (H) will work for very slow applications, typically under 50ft/min.

The Helical Wound Spring Seal seals higher pressures and is an excellent seal for actuator shaft sealing in valves and chambers that can handle wide temperature changes, such as cryogenic use.

The DW Spring Seals in "C" and larger glands has high deflection capacity and handles misalignment and runout well. The shielding the spring creates for the seal jacket protects from particulates and heat exposure.

For High Speed, low pressure applications requiring ultra-low friction, Specialty Fluid offers machined Lip Seals in a variety of single and dual lip types, some are Bidirectional.

SEAL FRICTION

Friction Considerations

Friction is best described as the resistance crested between two surfaces in relative motion. In seals it occurs between the seal contacting surface and the moving hardware, be it a flat surface, ball Sphere, or a shaft (sliding or rotating). Surface finish, temperatures (at the contact surface), media, and pressure all come into play.

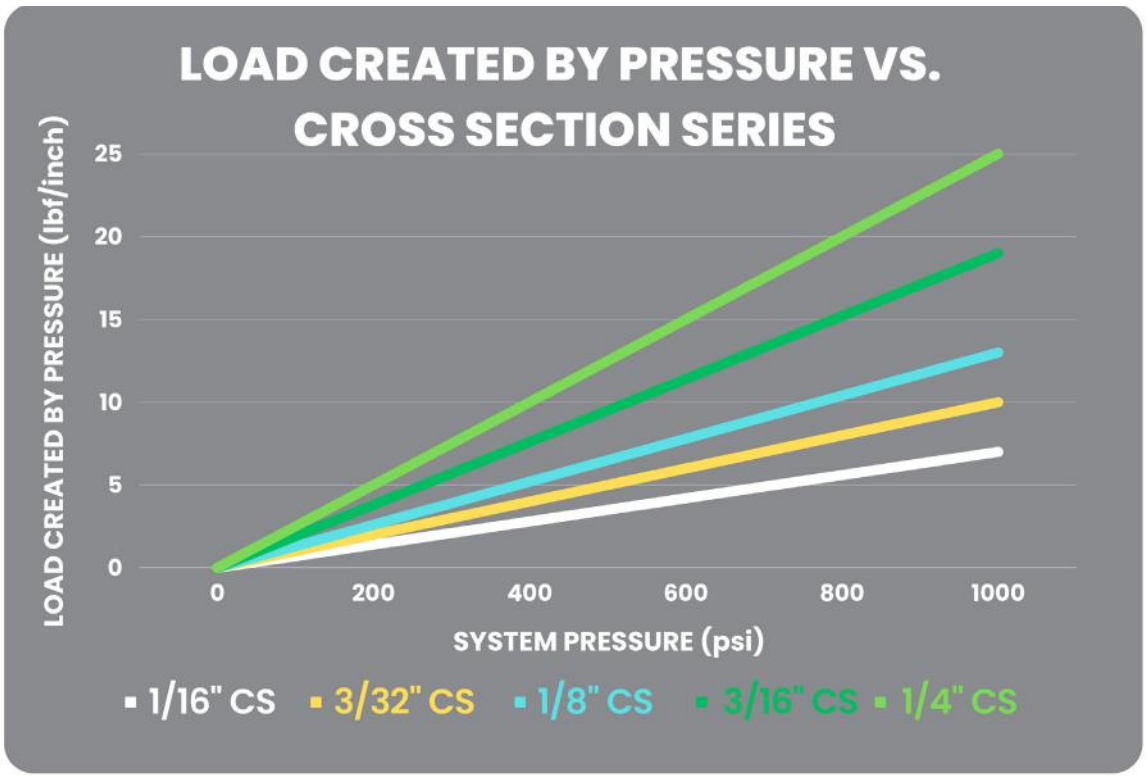
Approximating dry friction can be calculated using the below informational charts, and a coefficient of friction for your selected material on page 24. Again, the result will be approximate.

A new seal usually has a narrow edge of contact, and the friction new will usually be higher than a seal that has worn even a few minutes.

The seal material will also alter friction as it may deposit on the dynamic surfaces.

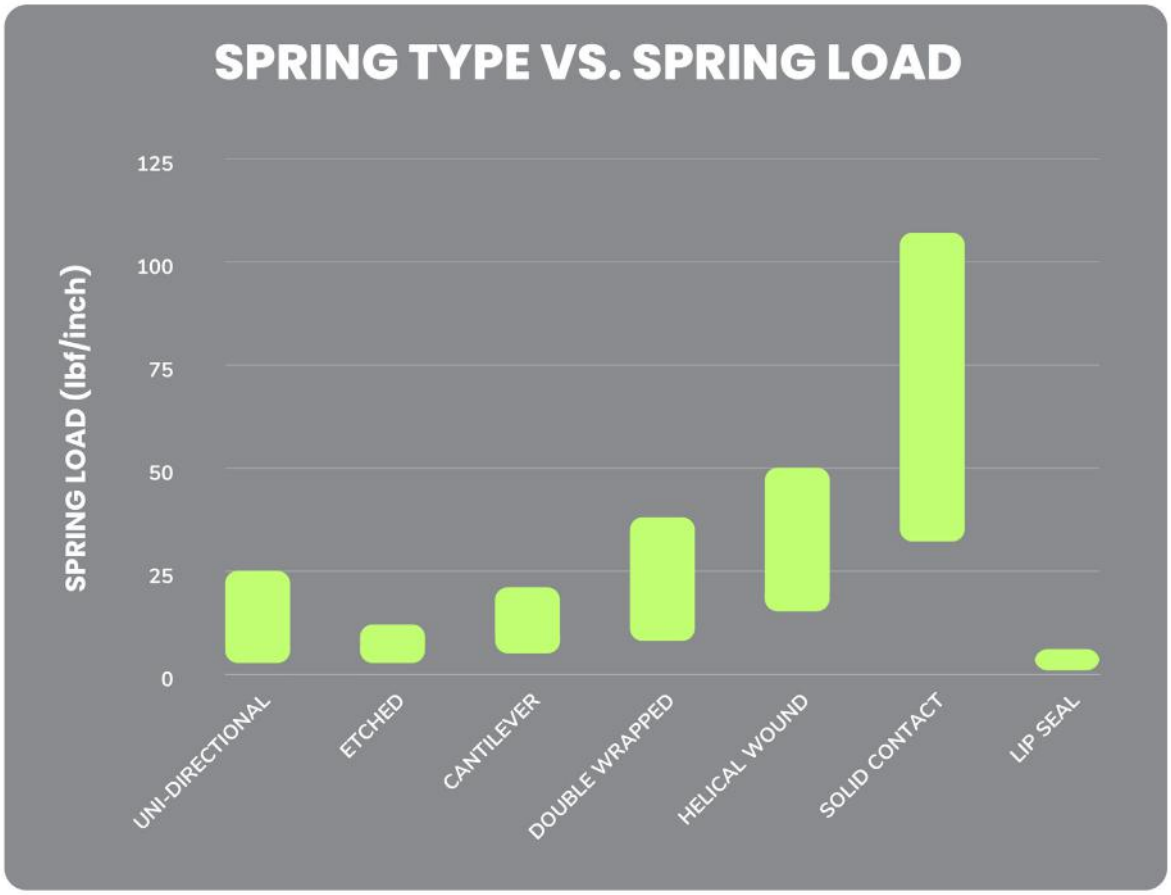
Media pressure typically increases friction and drag, sometimes substantially. Consult SFC engineering for more accurate friction data by finite element analysis if needed.

This chart shows the approximate additional seal lip load that pressure creates.



*The data stated on these pages are average values ascertained by statistical tests on a regular basis. The data above is provided purely for information and shall not be regarded as binding unless expressly agreed in a contract of sale.

SEAL FRICTION



Rotating Torque (In.-Lbf.) = (S+P) x D x μ x R x Π

P = Pressure Load From Media Pressure Graph, **left**

μ = Coefficient of Friction From Material Page 24

Linear Friction (Lbf.) = (S+P) x D x μ x Π

S = Spring Load From Spring Graph, **above**

D= Diameter of Dynamic Surface

R = D/2

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SEAL EXTRUSION GAPS

Seal Extrusion Gaps

Sealing at high pressures and other harsh design conditions, the amount of the extrusion gap behind the seal becomes very important for a seal's life expectancy. This extrusion gap is the clearance between the housing and the shaft. At high pressures and/or high temperatures an excessive clearance can allow the seal material to be extruded into the gap causing premature seal failure. The extrusion gap should be held to the minimum at all times to enhance the seal's life. By increasing the heel thickness of the seal, this will improve resistance to extrusion. Also, the extrusion gap can be minimized by the use of a separate back-up ring arrangement. Generally, the back-up ring should be of a harder material than the seal material.

Back-up Ring Materials - Typical back-up ring materials are as follows:

1. Unfilled PEEK
2. Glass fiber reinforced PEEK
3. Graphite/PTFE filled PEEK
4. High Carbon filled PTFE
5. High Glass Fiber PTFE
6. Bronze filled PTFE

The items/materials 1 thru 3 are the premium grade back-up ring materials that have a minimum of 16,000 psi to 23,000 psi of tensile strength and the temperature range can be up to 250 degrees C. These materials are highly recommended for extreme cases such as temperatures and pressures at large extrusion gap configurations. The design pressures can be up to 60,000 psi depending upon the hardware designs. In addition, these are excellent materials under very harsh chemical environments.

The items/materials 4 to 6 are designed for lesser harsh applications where extrusion gap is more controlled to smaller values. Typically used in applications where cost is utmost important factor. These back-up rings are typically used for pressures up to 4,000 psi depending upon the hardware designs. Typically, these materials exhibit tensile strengths range from 2,200 psi to 3,200 psi. These materials are inert to most chemicals including acids and alkalis.

Elevated or Cryogenic Temps

High pressure, with or without elevated temperature, the hardware extrusion gap that is downstream from the seal is paramount. The extrusion gap is best defined as the clearance or gap that is behind the seal and is at lower pressure than the front side of the seal. In hardware designs without centering bearings, this gap becomes the difference of the diameters, and can become greater with temperature and pressure distortion of the hardware.

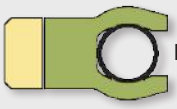
The addition of high pressure and or high temperature combined with excess clearance can contribute to extrusion of seal material and seal failure.

The extrusion gap needs to be held to a minimum, and SHOULD NOT EXCEED the values shown in the charts and graphs on the next page.

SEALS EXTRUSION GAPS

Extrusion gap considerations below about -60F is different. The cold creates thermal shrinkage in the polymer seal that can be many times greater than the metallic hardware.

Face type sealing systems are less affected than radial types. Radial seals require special designs, and back-up rings may require gaps or angled cuts. Please Contact Specialty Fluid Engineering if you have a need for a cryogenic seal system. friction and drag, sometimes substantially or need accurate Friction Data by Finite Element Analysis.

		UP TO 2000 PSI	AND UP TO 4000 PSI	AND UP TO 6000 PSI	AND UP TO 15000PSI
 H WIDTH	STANDARD SEAL	.004	.003	.002	.0015
 H1 WIDTH	EXTENDED HEEL	.007	.005	.003	.002
 H2 WIDTH	WITH SINGLE BACK-UP	.009	.007	.005	.0025
 H2 WIDTH	EXTENDED OR CAMMED BACK-UP	.012	.009	.007	.003

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SEAL SURFACE FINISH

Seal Gland Characteristics

The seal gland is actually half of the sealing system, and factors such as surface finish, hardness, and porousoity, play directly into the seal's leakage and wearing life in dynamic use.

Low molecular weight gasses like Helium, can permeate through a porous metal casting, as well as the seal Jacket. Such issues can be helped with penetrant sealers and alternative seal jacket materials.

Surface finish contributes to both leakage rate and the wearing life of the seal jacket, particully in dynamic applications. Typically, the better the finish, the better the sealing and seal life. Another notable, a polished finish will yield better results than a ground finish of the same tested roughness value.

Dynamic gland surface hardness as a general rule, the higher the hardness, the better. Dynamic seals need a Rockwell 43 or higher hardness. Harder surfaces hold their fine finishes longer, and the seal performs better and lasts longer.

Surface Finish

Static seals are not so critical for surface finish as dynamic seals are. For both, follow the chart below. Note that the finish for FACE SEALS should be a circular lay, the finish lines should be concentric with the hardware centerline.

Dry dynamic seals tend to last the longest if the finish is 8 to 12 RMS Micro-Inch. Wear material from the seal deposits into the microsurface structure and adds lubrication to the contact interface.

Wetted seals tend to last the longest with finer finishes.

Hard coatings applied to metals, electroplated, chemical deposit, or flame spray, need to be smooth and polished, without porousity and pits. Ground surface coating micro pits and voids are sharp edged 8Ra Micro-Inch or better finish is desired.

See the Chart on next page.

SEAL SURFACE FINISH

MEDIA BEING SHARED		SURFACE FINISH	
		DYNAMIC APPLICATIONS	STATIC APPLICATIONS
CRYOGENICS DEEP VACUUM HELIUM HYDROGEN	AMMONIA TOXIC GASSES LIQUID METHANE	2 TO 6 RMS	4 TO 8 RMS
AIR METHANOL, ETHANOL ARGON GAS NITROGEN GAS	GASEOUS METHANE CARBON DIOXIDE LIGHT PETROLEUM FUELS	4 TO 12 RMS	8 TO 16 RMS
CRUDE OIL WATER	HYDRAULIC FLUIDS SEALERS	8 TO 16 RMS	8 TO 32 RMS

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Surface Finish for Lip Seals

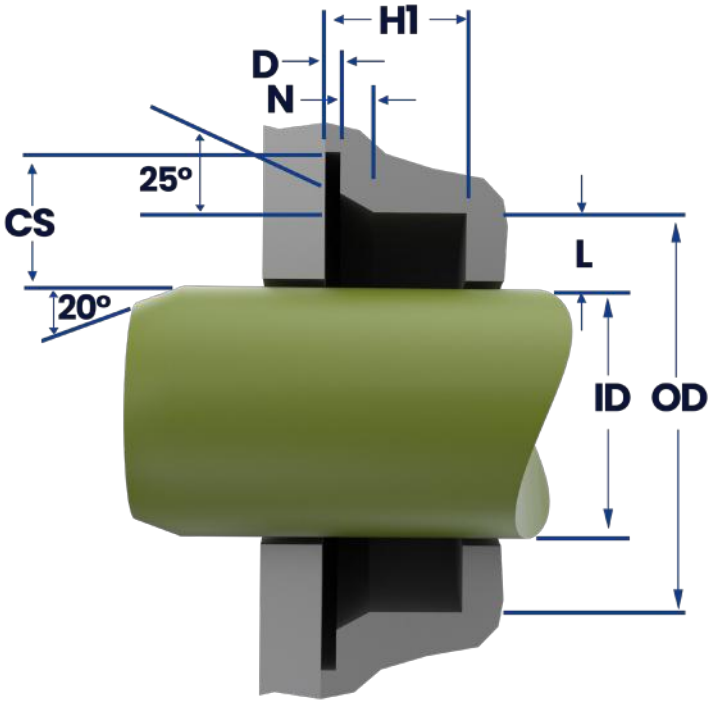
Rotary lip seals run at higher surface velocities than typical spring energized seals. Lip seals also are usually made with higher fill compsites that are often abrasive. These seals require a 8Ra finish or better, and hard surfaces, 48 Rockwell C and higher are not uncommon. Shafts for transmissions, gearboxes, compressors, and pumps are best 55 Rockwell C or more.

Platings and coatings are common. Coatings like HVOF, Hard Nickel, Hard Chrome,. and flame spray carbides will need grinding and polishing, or the coating will destroy the best seal materials rapidly.

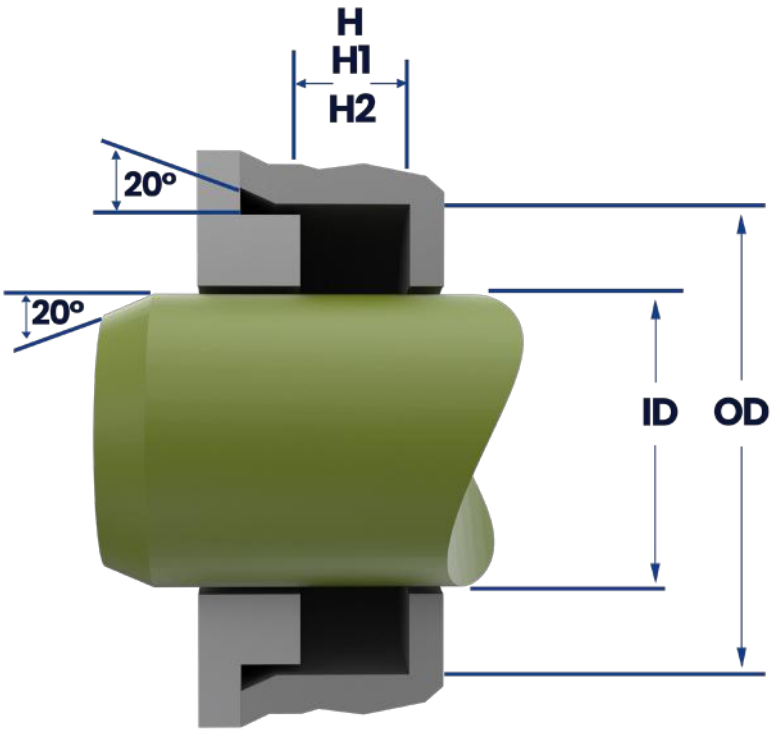
SPRING ENERGIZED SEAL TYPES

HARDWARE CONFIGURATIONS

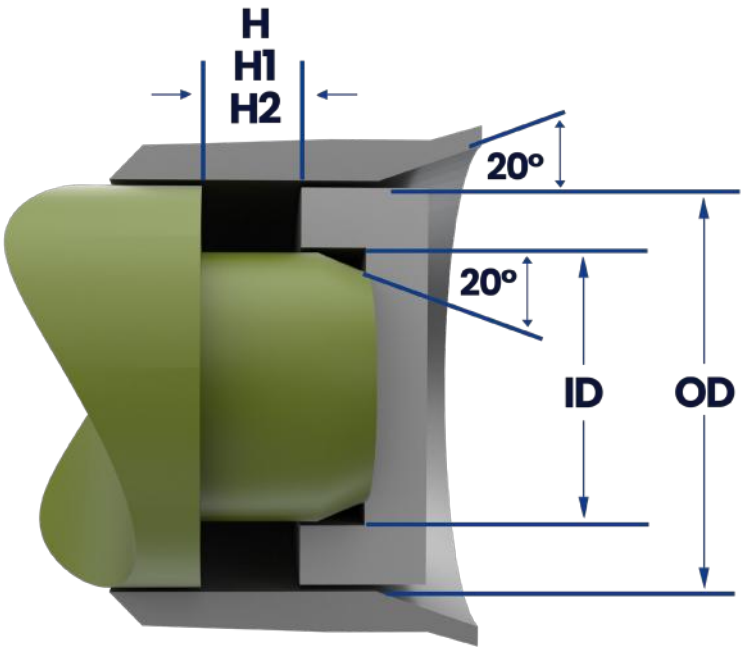
FLANGED SEAL CONFIGURATION



ROD SEAL CONFIGURATION

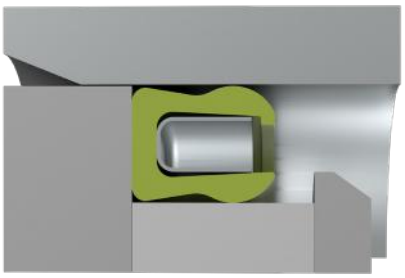


PISTON SEAL CONFIGURATION

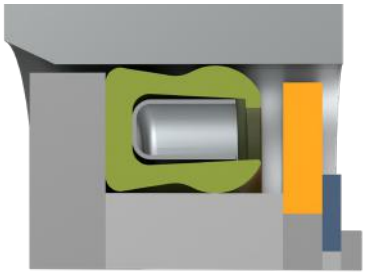


SPRING ENERGIZED SEAL TYPES

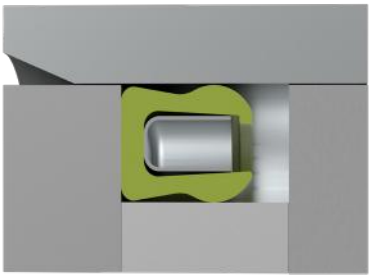
PISTON SEAL CONFIGURATION



STEP GLAND

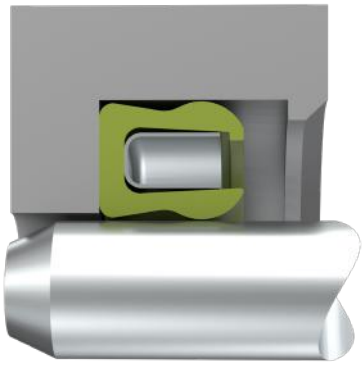


OPEN GLAND



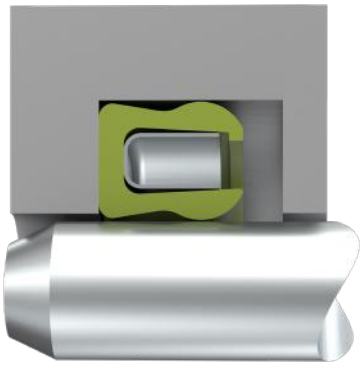
CLOSED GLAND

ROD SEAL CONFIGURATION



STEP GLAND

OPEN GLAND



CLOSED GLAND

RECOMMENDED HARDWARE DIMENSIONS VS CROSS-SECTION						
NOMINAL CROSS SECTION	**H +.010 -.000**	**H1 +.010 -.000**	**H2 +.010 -.000**	**CS ±.005**	**D ±.002**	**N ±.005**
1/16	.094	.149	.207	.137	.017	.032
3/32	.141	.183	.245	.170	.024	.037
1/8	.188	.235	.304	.219	.028	.052
3/16	.281	.334	.424	.333	.033	.072
1/4	.325	.475	.579	.458	.048	.092

For ID and OD dimensions, please refer to the standard charts on pages 41-60.

EXCELON™
SEALING MATERIALS

PEEK™
NATURAL VIRGIN

PEEK™
CARBON FILLED

PEEK™
BEARING GRADE

PEEK™
GLASS FILLED

PTFE, UHMW, FEP
NYLON 6/6, TPE, PPS

PVDF, ECTFE, PFA
ACETAL & MANY MORE

SEAL & BACKUP RING MATERIALS

Seal Materials

Seal Jacket Materials are selected to match the application's needs for: temperature range, media chemistry, pressure, dynamic surface hardness, surface velocity, and more. A seal material needs to be soft enough to seal against the gland surface yet be hard enough to last. Selection is often difficult, so contact us for advice for the best possible choice.

Many Specialty Fluid Seal Jacket materials are manufactured onsite, so we control all aspects of the material's cleanliness and quality. We also supply custom blended filled materials besides these more common types. If you seek a blend not below, Please Contact Us.

Back-Up Ring Materials

Back-up ring materials tend to be more rigid and hard, since their use is more structural and do not need to perform sealing duties, although in cases like chevron rings, they can seal. Typically ring materials are highly filled with granular or fiber fillers making them strong and resistant to distortion even when approaching 600° F. These are perfect for closing extrusion gaps.

Like seal materials, we also offer materials beyond the below list, contact us if you have a particular situation you need to solve!

Many materials can be injection molded, creating a superior performing pure virgin or blended polymer composite with higher strength and lower permeability than common compression molded stock. contact us if a superior injection molded material will be a better choice for you!

- PTFE
- PTFE compounds
- UHMWPE
- PEEK®
- TPE
- PPS
- Acetal
- Delrin®
- PVDF
- KYNAR®
- ECTFE
- ETFE
- TPE
- HYTREL®
- FEP
- PFA
- Melt processible fluoropolymers

MATERIALS: POLYMERS

MATERIAL	NAME	DESCRIPTION	TEMPERATURE RANGE DEGREES °F
01	VIRGIN PTFE	Pure PTFE, Static seals, Chemicals, Deep Cryogenic LOX, LH2, LHe, N2O4, H2O2, UDMH, LCH4, other Chemical plant uses. FDA uses, low gas permeability, hard vacuum seals.	550°F TO -450°F
01S	VIRGIN TFM MODIFIED PTFE	Modified PTFE. Harder than PTFE, less Gas Permeability. Gaseous or Cryogenic low molecular weight chemicals. FDA Approved. Wears slower than PTFE, nearly as inert.	550°F TO -450°F
02	CARBON/PPS FILLED PTFE	Excellent low wearing material for Dynamic uses cold or hot. Use in light oils, water solutions or dry. Can be abrasive running on soft metals.	500°F TO -450°F
03	POLYIMIDE FILLED PTFE	Best in high speed, high pressure hydraulic applications. Wears well dry or lubricated, soft to hard metals. Heat resistant, good for dry or lubricated hot service.	600°F TO -200°F
04	EKONOL FILLED PTFE	High temperature PTFE blend, great in hot synthetic oil. Does not damage soft metals. Runs dry or on oil, at high speeds. Used in Turbine Engines, Bearing Covers, Hot Gas Actuators.	600°F TO -350°F
05	GRAPHITE FILLED PTFE	Graphite filled PTFE, excellent for dry, water, or steam use. Usable dry or in oil/grease applications as well.	600°F TO -450°F
06	BRONZE FILLED PTFE	Used often for low to medium speed hydraulic applications. Wears well on actuator shafts as wear bands and seal rings. Easy on medium hard steel cylinder bores when lubricated.	550°F TO -50°F
07	MINERAL FDA FILLED PTFE	FDA approved material for hot or cold use in consumables. White color and inertness compatable with most media. Use for Moderate speed applications, seals, lipseals, slingers.	600°F TO -450°F

MATERIALS: POLYMERS

MATERIAL	NAME	DESCRIPTION	TEMPERATURE RANGE DEGREES °F
08	GLASS/MoS_2 (MOLY) FILLED PTFE	Great for high speed seals, lipseals, rings, bearings, Oil use. Usable hot or cold, very wear resistant. Use with moderate to hard metal alloys Rc 42+, best lubricated.	600°F TO -450°F
09	BRONZE/MoS_2 (MOLY) FILLED PTFE	Moly Lubed version of 06, better wearing dry or wet uses. Great for hydraulics as seals, wear bands, or back-up rings. Lower friction than 06, good on steel, wider temperature range.	600°F TO -300°F
10	VIRGIN UHMWPE	A tough material for water and hydraulic use, abrasion resistant. Does not damage soft surfaces. Impact resistant. FDA APPROVED	180°F TO -450°F
10H	UHMWPE HIGH TEMP	Higher temperature version of 10 for warmer uses. Good on soft surfaces, impact and abrasion resistant. FDA APPROVED	200°F TO -320°F
11	VIRGIN PEEK/PEK	A harder polymer, heat and abrasion resistant and strong. Great for Back-Up rings, precision seals, structural parts. Works in Hot applications like Hot Melt Glue and valve seats.	550°F TO -200°F
12	GLASS PEEK/PEK	Hard strong reinforced material for back-up and lantern rings. An Engineering composite for structural Hot application parts. Abrasive on soft metals Rc 47+ lubed, Rc 55+ dry.	550°F TO -100°F
13	CARBON FIBER PEEK/PEK	The premium reinforced material for back-up & lantern rings. Called 'Black Steel', for difficult structural Hot application parts. Abrasive on soft metals Rc 47+ lubed, Rc 55+ dry.	550°F TO -150°F

MATERIALS: SPRING ALLOYS

Spring Energizer Alloys

Specialty Fluid Seals are offered with a large variety of spring metal alloys that need to be selected to perform in your particular media chemistry without corroding or eroding away over time.

With the plethora of media solutions possible, SFC recommends consulting our engineering dept. or a metals corrosion guide to select a spring alloy that best works for your application.

ETCHED SPRING

SOLID CONTACT SPRING

HELICAL WOUND SPRING

DOUBLE WRAPPED SPRING

UNI-DIRECTIONAL SPRING

CANTILEVER SPRING

MATERIALS: SPRING ALLOYS

SPRING TYPE								
SPRING ALLOY	MATERIAL CODE	ETCHED SPRING CANTILEVER	CANTILEVER	HELICAL WOUND	UNI DIRECTIONAL WOUND COIL	DOUBLE WRAPPED	SOLID CONTACT	LIP SEAL GARTER SPRING
17-7 PH STAINLESS STEEL	7S			●				
301 STAINLESS STEEL	1S	●	●			●	●	
302 STAINLESS STEEL	2S				●			●
304 STAINLESS STEEL	4S	●	●	●		●	●	
316 STAINLESS STEEL	6S	●	●	●	●		●	●
ELGILOY®	EL	●	●	●			●	
HASTELLOY®	HA	●	●	●	●	●	●	
INCONEL®	IN	●	●	●	●	●	●	
TITANIUM	TI	●	●		●	●	●	

Elgiloy is a registered trademark of Elgiloy LTD. Partnership.
Hastelloy is a registered trademark of Haynes International.
Inconel is a registered trademark of Inco Alloys International, Inc.

METAL TYPES	SPRING CHARACTERISTICS AND FEATURES
301 STAINLESS STEEL	Suitable for general use, not advisable for extremely corrosive substances.
304 STAINLESS STEEL	Resists corrosion in most environments, general app w moisture & mild chemicals.
316 STAINLESS STEEL	General applications, enhanced corrosion resistance at lower temperatures.
17-7 STAINLESS STEEL	Enhanced retention of mechanical properties under elevated temperatures
INCONEL 625®	Widely used in petrochemical application, excellent corrosion resistance
ELGILOY®	Widely used in crude oil and sour gas, excellent corrosion resistant alloy
HASTELLOY®	Excellent resistance to hot mineral acids, solvents, chloring contaminated acids

*The data stated above are average values ascertained by statistical tests on a regular basis. The data above is provided purely for information and shall not be regarded as binding unless expressly agreed in a contract of sale.

TYPICAL HARDWARE
& SEAL ASSEMBLY

EXCELON™ SEALS
PART NUMBERS & DIMENSIONS

1. CHOOSE SEAL TYPE – When deciding on a seal type, please remember to choose between a radial shaft type or a face seal type that best suits your application. For a list of seal type numbers, you can consult pages 33 to 39.

2. CHOOSE GLAND SIZES – Addressing the appropriate gland sizes during the initial design phase can help prevent avoidable installation issues. You have the flexibility to select from various gland sizes and types (MIL-G-5514, INDUSTRIAL, AS4716) on pages 41 to 60.

3. CHOOSE SEAL MATERIAL – We manufacture the majority of our polymer seal materials in-house, enabling us to provide faster turnaround times and surpass industry standards, ultimately delivering superior performance. For material selection, please consult our list on page 24.

4. CHOOSE SPRING MATERIAL – When selecting the right spring material, it's crucial to consider factors like corrosion, erosion, and performance. We provide a variety of alloy options on pages 26. Given the numerous potential media solutions, SFC advises consulting our engineering department or referring to a metals corrosion guide to help you choose the most suitable spring alloy for your specific application.

5. CALL US FOR QUESTIONS! – Our highly skilled and knowledgeable engineering department and customer service staff will be happy to answer any of your quesitons.
Call us at 832-813-8405 or email us at sales@sfcseals.com

CREATING A STANDARD PART NUMBER

STANDARD SEAL PART # EXAMPLE

CANTILEVER ENERGIZED SPRING ENERGIZED SEAL

C090B-205-01S-6S

- C090B — SEAL TYPE
- 205 — GLAND SIZES
- 01S — SEAL MATERIAL
- 6S — SPRING MATERIAL

1. Selecting An Excelon Standard Seal Type

XXXXX - XXX - XXX - XX

BASIC SEAL TYPE
PAGES 33 TO 39

First, Learn about Our Excelon Seals by their type and Spring Characteristics. This becomes the first block of 4 or 5 digits of the part number. Refer to seal types on Page 33-39. Be sure to Select a Radial Shaft Type or a Face Type Seal.

2. Selecting Gland Cross Section and Diameter

XXXXX - XXX - XXX - XX

SEAL GLAND DASH #
PAGES 41 TO 60

Select a Seal Cross Section and Diameter that matches your Application from Pages 41 to 47 for Radial Glands, Pages 47 to 57 for Face Seal Glands. Be Certain you DO NOT order a Mil-Spec Gland size Seal for an Industrial Gland or vise-versa.

3. Selecting a Jacket Material

XXXXX - XXX - XXX - XX

MATERIAL DASH #
PAGE 24

Select a Excelon Seal Jacket Polymer from Page 24 that best suits your application.
Consider:
A. Friction
B. Temperature Range
C. Pressure
D. Chemistry

4. Selection a Spring Metal

XXXXX - XXX - XXX - XX

SPRING METAL DASH #
PAGE 26

Select a Excelon Spring Material from the Chart on Page 26. This determines the last 4 digits of the Part Number.

This SFC Parts Guide was created to give you the information to quickly and accurately determine what type of Excelon™ Seal you will need. Selecting spring and jacket materials, seal type, and sizing by standard gland configurations.

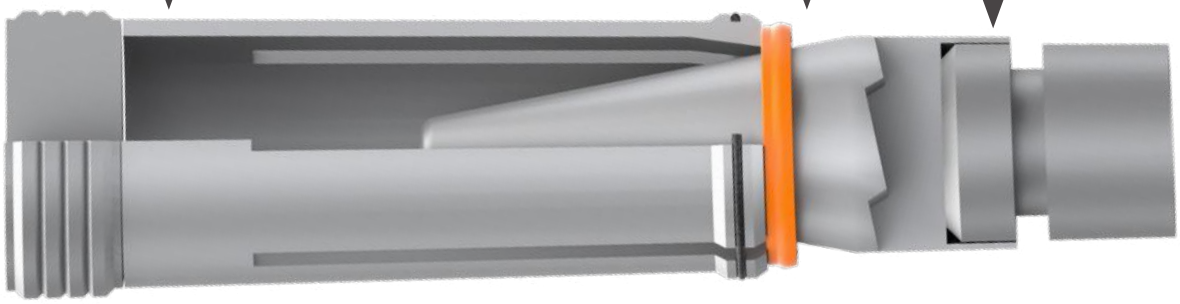
TOOLS FOR CLOSED GLANDS

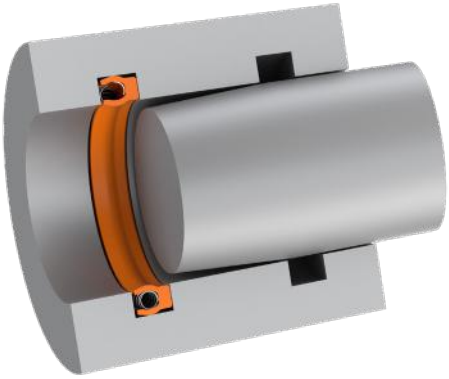
INSTALLATION TOOLS FOR CLOSED GLANDS

When Spring Energized seals need to be installed over hardware into a closed groove, special tooling is needed. This also helps when ports, grooves, and splines are present on the shaft. Most of the best Seal Materials do not stretch well and recover more than about 5% depending on the material. So this means special ramps and resizing tools are needed to install a seal, and also reduce the post-installed seal back down to a bore installable size. Specialty Fluids can make these tools for you, so your new seals are not scratched, cut, or amaged when installed.

In some instances, warming the seal to 150F to 210F in hot water, oil, or air, will make the seal more pliable and will stretch and resize better. This especially applies to filled Jacket materials.

The Ramp is a conical shaped bullet that when used with the pusher evenly stretches the seal, and then provides a smooth surface to slide the seal over shaft grooves, splines, keyways, and grooves. Once the seal drops into the gland groove, it will recover somewhat depending on the overall stretch percentage. Performing this operation with the seal warmed in hot water just before installing will help. Often a Re-sizing tool is needed (below).





RESIZING TOOL

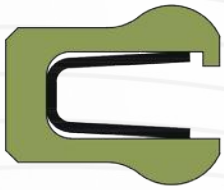
The re-sizing tool in this example is a “Funnel” and when slid into the seal presses it back into a bore installable inside diameter.

EXCELON™ SEALS
GLAND SIZES

CHOOSING THE CORRECT GLAND SIZES

When choosing the correct gland sizes you should keep in mind that the gland sizes are sorted first by seal type, Each seal will have a part number referring to it's industry (military, industrial, and aerospace). Each seal will also list its heel and lip specification.

SEAL DESIGN P/N		
MILITARY	**INDUSTRIAL**	**AS4716**
E090A	E090B	E090C



STANDARD LIP
STANDARD HEEL

INDUSTRY TYPE

SEAL PART NUMBER

LIP & HEEL SPECIFICATION

Etched Spring Energized Seals

This type of seal is often used when miniature sized seals are needed for various design conditions. Because the springs are chemically etched and formed, seal sizes can be manufactured as small as 0.020 inches in ID. This seal type is strongly recommended for high pressure applications and small size dynamic applications.

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E090A	E090B	E090C

STANDARD LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E091A	E091B	E091C

SCRAPER I.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E092A	E092B	E092C

SCRAPER O.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E093A	E093B	E093C

STANDARD LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E094A	E094B	E094C

SCRAPER I.D LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E095A	E095B	E095C

SCRAPER O.D LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E096A	E096B	E096C

STANDARD LIP
FLANGED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
E097A	E097B	E097C

SCRAPER I.D. LIP
FLANGED HEEL

Cantilever Spring Energized Seals

Cantilever spring energized seals have shallow, but linearly rising load curve. As a result, force decreases as the seal wears. For this reason, they are typically designed for highly dynamic applications. This is one of the most popular spring energized seal designs due to the unique attributes that help to maximize seal and hardware life.

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C090A	C090B	C090C

STANDARD LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C091A	C091B	C091C

SCRAPER I.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C092A	C092B	C092C

SCRAPER O.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C093A	C093B	C093C

STANDARD LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C094A	C094B	C094C

SCRAPER I.D. LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C095A	C095B	C095C

SCRAPER O.D. LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C096A	C096B	C096C

STANDARD LIP
FLANGED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
C097A	C097B	C097C

SCRAPER I.D. LIP
FLANGED HEEL

SEAL DESIGN P/N
C098

INSIDE
FACE SEAL

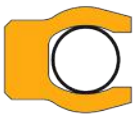
SEAL DESIGN P/N
C099

OUTSIDE
FACE SEAL

Helical Wound Spring Energized Seals

Helical wound spring energized seals generate substantially higher load per inch deflection values as compared to other spring energized seals. These types of designs are primarily used for static or lower dynamic seal applications. This seal type is well suited for applications that require tight sealing, such as an environment with light gases.

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H080A	H080B	H080C



STANDARD LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H081A	H081B	H081C

SCRAPER I.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H082A	H082B	H082C

SCRAPER O.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H083A	H083B	H083C

STANDARD LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H084A	H084B	H084C

SCRAPER I.D. LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H085A	H085B	H085C

SCRAPER O.D. LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H086A	H086B	H086C

STANDARD LIP
FLANGED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
H087A	H087B	H087C

SCRAPER I.D. LIP
FLANGED HEEL

SEAL DESIGN P/N
H088

INSIDE
FACE SEAL

SEAL DESIGN P/N
H089

OUTSIDE
FACE SEAL

Uni-directional™ Spring Energized Seals

This type of seal is utilized for applications requiring a high tolerance run-out. The unique characteristic of the spring provides a constant load as the deflection increases. In addition, this seal will provide a larger amount of deflection range, as well as continuous friction over a working deflection range, to provide almost constant friction.

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U070A	U070B	U070C

STANDARD LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U071A	U071B	U071C

SCRAPER I.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U072A	U072B	U072C

SCRAPER O.D. LIP
STANDARD HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U073A	U073B	U073C

STANDARD LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U074A	U074B	U074C

SCRAPER I.D. LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U075A	U075B	U075C

SCRAPER O.D. LIP
EXTENDED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U076A	U076B	U076C

STANDARD LIP
FLANGED HEEL

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
U077A	U077B	U077C

SCRAPER I.D. LIP
FLANGED HEEL

SEAL DESIGN P/N
U078

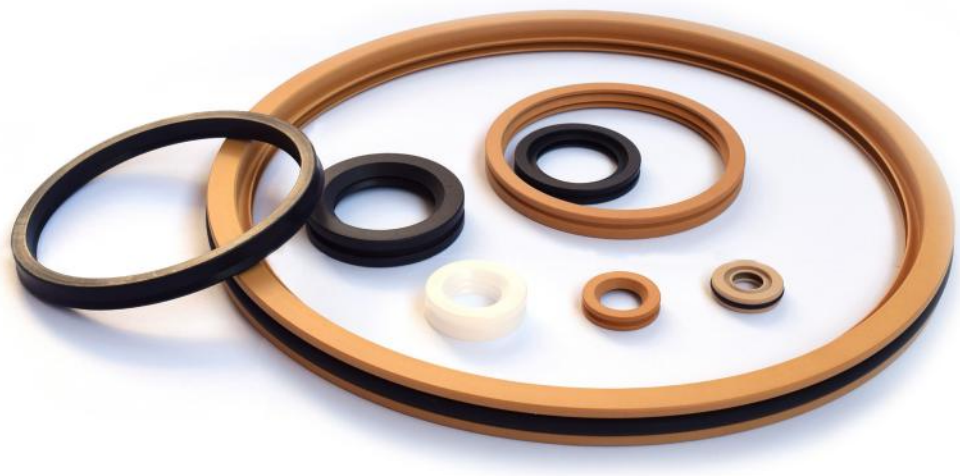
INSIDE
FACE SEAL

SEAL DESIGN P/N
U079

OUTSIDE
FACE SEAL

Rotary Lip Seals

Rotary lip seals are designed using PTFE and PTFE blend sealing elements, and are custom engineered for dynamic rotary sealing applications. When metal cased lip seals are not the best choice for a particular hardware configuration, 100% polymer-based seals are used.



SEAL DESIGN P/N	
METRIC	INCH
L040A	L040B

SINGLE LIP SEAL

SEAL DESIGN P/N	
METRIC	INCH
L041A	L041B

SINGLE LIP SEAL WITH HORSESHOE

SEAL DESIGN P/N	
METRIC	INCH
L042A	L042B

MACHINED SINGLE LIP SEAL

SEAL DESIGN P/N	
METRIC	INCH
L043A	L043B

SINGLE LIP SEAL WITH GARTER SPRING

SEAL DESIGN P/N	
METRIC	INCH
L044A	L044B

DOUBLE LIP SEAL

SEAL DESIGN P/N	
METRIC	INCH
L045A	L045B

BIDIRECTIONAL LIP SEAL

SEAL DESIGN P/N	
METRIC	INCH
L046A	L046B

BIDIRECTIONAL MACHINED LIP SEAL

Need Help With Designing Your Seal?

If your cross section, seal angle, or gland diameter are special CALL US! +1 832-813-8405. We can do the selection for you, if you so desire. See the Engineering Design Request Form on Page 65, gather all the data you can, and CALL US!

Double Wrapped™ Spring Energized Seals

The Double Wrapped Seal is a ribbon spring that is wrapped and formed and is considered one of our most toughest seals for your mechanical applications. The design of the double wrapped seal can be used for rotary motion in dynamic and static uses.

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
W060A	W060B	W060C
		
STANDARD LIP FLANGED HEEL		

SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
W061A	W061B	W061C
		
STANDARD LIP FLANGED HEEL		

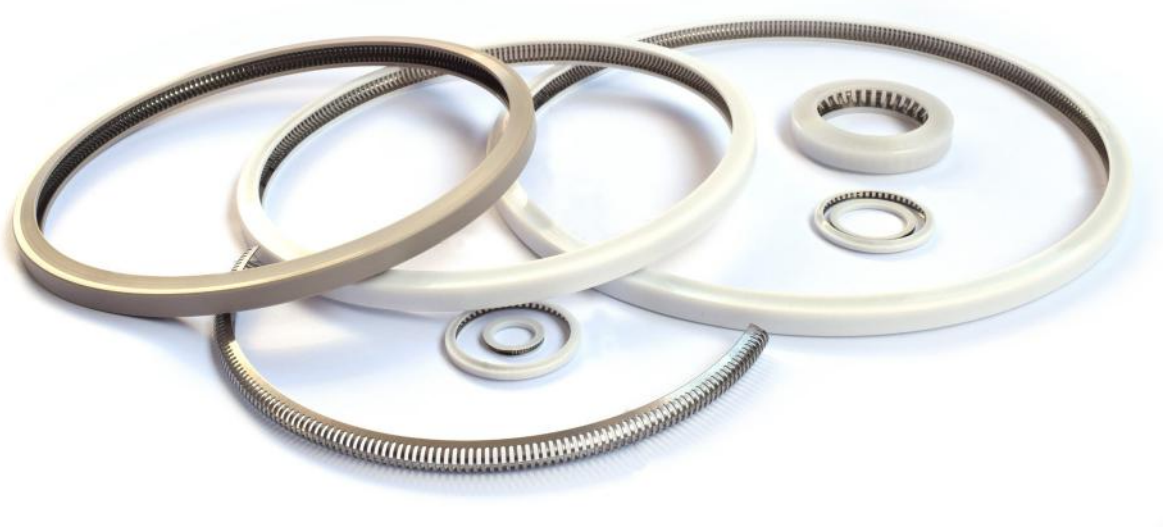
SEAL DESIGN P/N		
MILITARY	INDUSTRIAL	AS4716
W062A	W062B	W062C
		
STANDARD LIP FLANGED HEEL		

Special Cross Sections or Diameter?

Because Specialty Fluid machines each part to order, creating a special cross section, high precision, or a non-standard diameter is common, and easily done, without long lead times or sacrificing quality!

Solid Contact™ Spring Energized Seals

This type of seal is often used in cryogenic applications where the solution requires a heavy load to provide utmost sealing forces. The geometry of the spring prevents the seal from shrinking inward or outward, therefore, it is an ideal seal for applications requiring extreme temperature fluctuation. In addition, this seal is also used in applications maintaining high vacuum conditions due to the seal's heavy spring load.



SEAL DESIGN P/N	SEAL DESIGN P/N
S030	S031
	
INSIDE FACE SEAL	OUTSIDE FACE SEAL

Need A Full Custom Shape or Design?

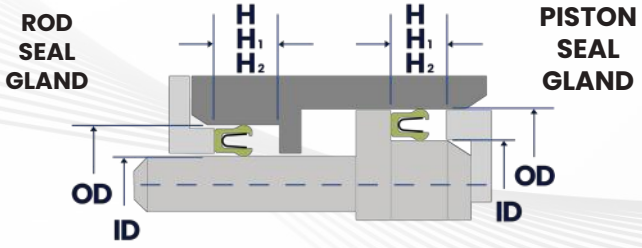
Contact Us First! Our Engineering Team would approach your challenge as their own, and work with your Engineering Team as a decisive unit. Confidentiality is highly honored, and your project puccess is paramount to us.

RADIAL SEAL
GLAND DIMENSIONS

SPECIALTY FLUID COMPONENTS

1/16" NOMINAL CROSS SECTION

H = .094/.104 H1 = .149/.159 H2 = .207/.217									
	MILITARY L = .056/.058		INDUSTRIAL L = .061/.063		CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
SIZE	OD	ID	OD	ID					
DASH #	+.001/-.000	+.000/-.001	+.001/ -.000	'+.000/ -.001					
004	0.190	0.076	0.203	0.078		•	•	•	
005	0.221	0.108	0.234	0.109		•	•	•	
006	0.235	0.123	0.250	0.125		•	•	•	
007	0.266	0.154	0.281	0.156		•	•	•	
008	0.297	0.185	0.312	0.187	•	•	•	•	
009	0.329	0.217	0.343	0.218	•	•	•	•	
010	0.360	0.248	0.375	0.250	•	•	•	•	
011	0.422	0.310	0.437	0.312	•	•	•	•	
012	0.485	0.373	0.500	0.375	•	•	•	•	
	+.002	+.002	+.002	+.002					
	-.000	-.000	-.000	-.000					
013	0.550	0.438	0.562	0.437	•	•	•	•	
014	0.613	0.501	0.625	0.500	•	•	•	•	
015	0.675	0.563	0.687	0.562	•	•	•	•	
016	0.738	0.626	0.750	0.625	•	•	•	•	
017	0.800	0.688	0.812	0.687	•	•	•	•	
018	0.863	0.751	0.875	0.750	•	•		•	
019	0.925	0.813	0.937	0.812	•	•		•	
020	0.993	0.881	1.000	0.875	•	•		•	
021	1.055	0.943	1.062	0.937	•	•		•	
022	1.118	1.006	1.125	1.000	•	•		•	
023	1.180	1.068	1.187	1.062	•	•		•	
024	1.243	1.131	1.250	1.125	•	•		•	
025	1.305	1.193	1.312	1.187	•	•		•	
026	1.368	1.256	1.375	1.250	•	•		•	
027	1.430	1.318	1.437	1.312	•	•		•	
028	1.493	1.381	1.500	1.375	•	•		•	
029	1.617	1.505	1.625	1.500	•	•		•	
030	1.739	1.627	1.750	1.625	•	•		•	
031	1.864	1.752	1.875	1.750	•	•		•	
032	1.989	1.877	2.000	1.875	•	•		•	
033	2.114	2.002	2.125	2.000	•	•		•	
034	2.239	2.127	2.250	2.125	•	•		•	
035	2.364	2.252	2.375	2.250	•	•		•	
036	2.489	2.377	2.500	2.375	•	•		•	



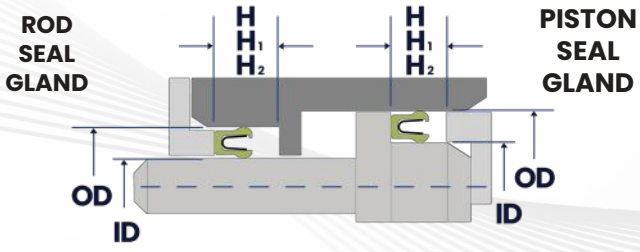
RADIAL GLAND DIMENSIONS

3/32" NOMINAL CROSS SECTION

H = .141/.151 H1 = .183/.193 H2 = .245/.255									
SIZE	MILITARY L = .089/.091		INDUSTRIAL L = .094/.096		CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
DASH #	OD +.002/-.000	ID +.000/-.002	OD +.002/ -.000	ID +.000/ -.002					
106	0.302	0.124	0.312	0.125		•	•	•	
107	0.364	0.186	0.375	0.187		•	•	•	•
108	0.427	0.249	0.437	0.250		•	•	•	•
109	0.489	0.311	0.500	0.312		•	•	•	•
110	0.551	0.373	0.562	0.375	•	•	•	•	•
111	0.613	0.435	0.625	0.437	•	•	•	•	•
112	0.676	0.498	0.687	0.500	•	•	•	•	•
113	0.738	0.560	0.750	0.562	•	•	•	•	•
114	0.801	0.623	0.812	0.625	•	•	•	•	•
115	0.863	0.685	0.875	0.687	•	•	•	•	•
116	0.926	0.748	0.937	0.750	•	•	•	•	•
117	0.993	0.815	1.000	0.812	•	•	•	•	•
118	1.056	0.878	1.062	0.875	•	•	•	•	•
119	1.118	0.940	1.125	0.937	•	•		•	•
120	1.181	1.003	1.187	1.000	•	•		•	•
121	1.243	1.065	1.250	1.062	•	•		•	•
122	1.306	1.128	1.312	1.125	•	•		•	•
123	1.368	1.190	1.375	1.187	•	•		•	•
124	1.431	1.253	1.437	1.250	•	•		•	•
125	1.493	1.315	1.500	1.312	•	•		•	•
126	1.558	1.380	1.562	1.375	•	•		•	•
127	1.620	1.442	1.625	1.437	•	•		•	•
128	1.683	1.505	1.687	1.500	•	•		•	•
129	1.742	1.564	1.750	1.562	•	•		•	•
130	1.805	1.627	1.812	1.625	•	•		•	•
131	1.867	1.689	1.875	1.687	•	•		•	•
132	1.930	1.752	1.937	1.750	•	•		•	•
133	1.992	1.814	2.000	1.812	•	•		•	•
134	2.055	1.877	2.062	1.875	•	•		•	•
135	2.118	1.940	2.125	1.937	•	•		•	•
136	2.180	2.002	2.187	2.000	•	•		•	•
137	2.243	2.065	2.250	2.062	•	•		•	•
138	2.305	2.127	2.312	2.125	•	•		•	•
139	2.368	2.190	2.375	2.187	•	•		•	•
140	2.430	2.252	2.437	2.250	•	•		•	•
141	2.493	2.315	2.500	2.312	•	•		•	•
142	2.555	2.377	2.562	2.375	•	•		•	•
143	2.618	2.440	2.625	2.437	•	•		•	•
144	2.680	2.502	2.687	2.500	•	•		•	•
145	2.743	2.565	2.750	2.562	•	•		•	•
146	2.805	2.627	2.812	2.625	•	•		•	•
147	2.868	2.690	2.875	2.687	•	•		•	•
148	2.930	2.752	2.937	2.750	•	•		•	•

1/8" NOMINAL CROSS SECTION

H = .188/.198 H1 = .235/.245 H2 = .304/.314					CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
SIZE	MILITARY L = .121/.123 OD	MILITARY L = .121/.123 ID	INDUSTRIAL L = .125/.127 OD	INDUSTRIAL L = .125/.127 ID					
DASH #	+.002/-.000	+.000/-.002	+.002/ -.000	+.000/ -.002					
202	0.491	0.249	0.500	0.250		•	•	•	•
203	0.553	0.311	0.562	0.312		•	•	•	•
204	0.615	0.373	0.625	0.375		•	•	•	•
205	0.677	0.435	0.687	0.437		•	•	•	•
206	0.740	0.498	0.750	0.500	•	•	•	•	•
207	0.802	0.560	0.812	0.562	•	•	•	•	•
208	0.865	0.623	0.875	0.625	•	•	•	•	•
209	0.927	0.685	0.937	0.687	•	•	•	•	•
210	0.991	0.748	1.000	0.750	•	•	•	•	•
211	1.053	0.810	1.062	0.812	•	•	•	•	•
212	1.116	0.873	1.125	0.875	•	•	•	•	•
213	1.178	0.935	1.187	0.937	•	•	•	•	•
214	1.241	0.998	1.250	1.000	•	•	•	•	•
215	1.303	1.060	1.312	1.062	•	•		•	•
216	1.366	1.123	1.375	1.125	•	•		•	•
217	1.428	1.185	1.437	1.187	•	•		•	•
218	1.491	1.248	1.500	1.250	•	•		•	•
219	1.553	1.310	1.562	1.312	•	•		•	•
220	1.616	1.373	1.625	1.375	•	•		•	•
221	1.678	1.435	1.687	1.437	•	•		•	•
222	1.741	1.498	1.750	1.500	•	•		•	•
223	1.868	1.625	1.875	1.625	•	•		•	•
224	1.993	1.750	2.000	1.750	•	•		•	•
225	2.118	1.875	2.125	1.875	•	•		•	•
226	2.243	2.000	2.250	2.000	•	•		•	•
227	2.368	2.125	2.375	2.125	•	•		•	•
228	2.493	2.250	2.500	2.250	•	•		•	•
229	2.618	2.375	2.625	2.375	•	•		•	•
230	2.743	2.500	2.750	2.500	•	•		•	•
231	2.868	2.625	2.875	2.625	•	•		•	•
232	2.993	2.750	3.000	2.750	•	•		•	•
233	3.118	2.875	3.125	2.875	•	•		•	•
234	3.243	3.000	3.250	3.000	•	•		•	•
235	3.368	3.125	3.375	3.125	•	•		•	•



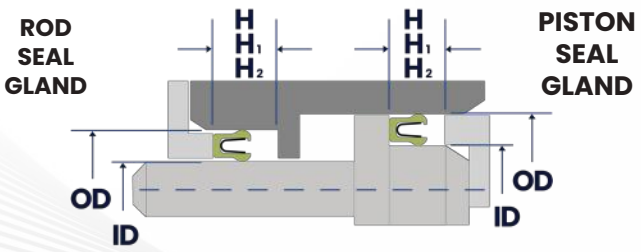
RADIAL GLAND DIMENSIONS

1/8" NOMINAL CROSS SECTION

H = .188/.198 H1 = .235/.245 H2 = .304/.314									
	MILITARY L = .121/.123		INDUSTRIAL L = .125/.127						
SIZE	OD	ID	OD	ID					
DASH #	+.002/-.000	+.000/-.002	+.002/ -.000	+.000/ -.002	CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
242	4.243	4.000	4.250	4.000	•	•		•	•
243	4.368	4.125	4.375	4.125	•	•		•	•
244	4.493	4.250	4.500	4.250	•	•		•	•
245	4.618	4.375	4.625	4.375	•	•		•	•
246	4.743	4.500	4.750	4.500	•	•		•	•
247	4.868	4.625	4.875	4.625	•	•		•	•
248	4.992	4.750	5.000	4.750	•	•		•	•
249	5.117	4.875	5.125	4.875	•	•		•	•
250	5.242	5.000	5.250	5.000	•	•		•	•
251	5.367	5.125	5.375	5.125	•	•		•	•
252	5.492	5.250	5.500	5.250	•	•		•	•
253	5.617	5.375	5.625	5.375	•	•		•	•
254	5.742	5.500	5.750	5.500	•	•		•	•
255	5.867	5.625	5.875	5.625	•	•		•	•
256	5.992	5.750	6.000	5.750	•	•		•	•
257	6.117	5.875	6.125	5.875	•	•		•	•
258	6.242	6.000	6.250	6.000	•	•		•	•
259	6.492	6.250	6.500	6.250	•	•		•	•
260	6.742	6.500	6.750	6.500	•	•		•	•
261	6.992	6.750	7.000	6.750	•	•		•	•
262	7.242	7.000	7.250	7.000	•	•		•	•
263	7.492	7.250	7.500	7.250	•	•		•	•
264	7.742	7.500	7.750	7.500	•	•		•	•
265	7.992	7.750	8.000	7.750	•	•		•	•
266	8.242	8.000	8.250	8.000	•	•		•	•
267	8.492	8.250	8.500	8.250	•	•		•	•
268	8.742	8.500	8.750	8.500	•	•		•	•
269	8.992	8.750	9.000	8.750	•	•		•	•
270	9.242	9.000	9.250	9.000	•	•		•	•
271	9.492	9.250	9.500	9.250	•	•		•	•
272	9.742	9.500	9.750	9.500	•	•		•	•
273	9.992	9.750	10.000	9.750	•	•		•	•
274	10.242	10.000	10.250	10.000	•	•		•	•
275	10.742	10.500	10.750	10.500	•	•		•	•

3/16" NOMINAL CROSS SECTION

H = .281/.291 H1 = .334/.344 H2 = .424/.434									
SIZE	MILITARY L = .186/.188		INDUSTRIAL L = .188/.190		CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
DASH #	OD +.002/-.000	ID +.000/-.002	OD +.002/ -.000	ID +.000/ -.002					
313	0.870	0.498	0.875	0.500		•		•	•
314	0.932	0.560	0.937	0.562		•		•	•
315	0.995	0.623	1.000	0.625	•	•		•	•
316	1.057	0.685	1.062	0.687	•	•		•	•
317	1.120	0.748	1.125	0.750	•	•		•	•
318	1.182	0.810	1.187	0.812	•	•		•	•
319	1.245	0.873	1.250	0.875	•	•		•	•
320	1.307	0.935	1.312	0.937	•	•		•	•
321	1.370	0.998	1.375	1.000	•	•		•	•
322	1.495	1.123	1.500	1.125	•	•		•	•
323	1.620	1.248	1.625	1.250	•	•		•	•
324	1.745	1.373	1.750	1.375	•	•		•	•
325	1.870	1.498	1.875	1.500	•	•		•	•
326	1.995	1.623	2.000	1.625	•	•		•	•
327	2.120	1.748	2.125	1.750	•	•		•	•
328	2.245	1.873	2.250	1.875	•	•		•	•
329	2.370	1.998	2.375	2.000	•	•		•	•
330	2.495	2.123	2.500	2.125	•	•		•	•
331	2.620	2.248	2.625	2.250	•	•		•	•
332	2.745	2.373	2.750	2.375	•	•		•	•
333	2.870	2.498	2.875	2.500	•	•		•	•
334	2.995	2.623	3.000	2.625	•	•		•	•
335	3.120	2.748	3.125	2.750	•	•		•	•
336	3.245	2.873	3.250	2.875	•	•		•	•
337	3.368	2.997	3.375	3.000	•	•		•	•
338	3.494	3.122	3.500	3.125	•	•		•	•
339	3.619	3.247	3.625	3.250	•	•		•	•



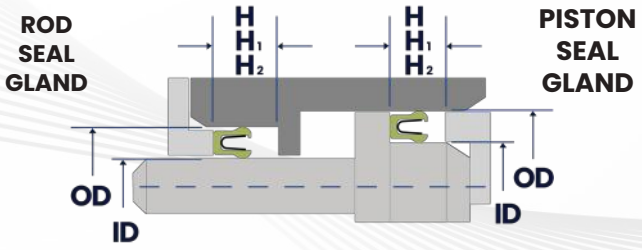
RADIAL GLAND DIMENSIONS

3/16" NOMINAL CROSS SECTION

H = .281/.291 H1 = .334/.344 H2 = .424/.434									
	MILITARY L = .186/.188		INDUSTRIAL L = .188/.190						
SIZE	OD	ID	OD	ID	CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
DASH #	+.002/-.000	+.000/-.002	+.002/ -.000	+.000/ -.002					
340	3.744	3.372	3.750	3.375	•	•		•	•
341	3.869	3.497	3.875	3.500	•	•		•	•
342	3.994	3.622	4.000	3.625	•	•		•	•
343	4.119	3.747	4.125	3.750	•	•		•	•
344	4.244	3.872	4.250	3.875	•	•		•	•
345	4.369	3.997	4.375	4.000	•	•		•	•
346	4.494	4.122	4.500	4.125	•	•		•	•
347	4.619	4.247	4.625	4.250	•	•		•	•
348	4.744	4.372	4.750	4.375	•	•		•	•
349	4.869	4.497	4.875	4.500	•	•		•	•
350	4.997	4.625	5.000	4.625	•	•		•	•
351	5.122	4.750	5.125	4.750	•	•		•	•
352	5.247	4.875	5.250	4.875	•	•		•	•
353	5.372	5.000	5.375	5.000	•	•		•	•
354	5.497	5.125	5.500	5.125	•	•		•	•
355	5.622	5.250	5.625	5.250	•	•		•	•
356	5.747	5.375	5.750	5.375	•	•		•	•
357	5.872	5.500	5.875	5.500	•	•		•	•
358	5.997	5.625	6.000	5.625	•	•		•	•
359	6.122	5.750	6.125	5.750	•	•		•	•
360	6.247	5.875	6.250	5.875	•	•		•	•
361	6.372	6.000	6.375	6.000	•	•		•	•
362	6.622	6.250	6.625	6.250	•	•		•	•
363	6.872	6.500	6.875	6.500	•	•		•	•
364	7.122	6.750	7.125	6.750	•	•		•	•
365	7.372	7.000	7.375	7.000	•	•		•	•
366	7.622	7.250	7.625	7.250	•	•		•	•
367	7.872	7.500	7.875	7.500	•	•		•	•
368	8.122	7.750	8.125	7.750	•	•		•	•
369	8.372	8.000	8.375	8.000	•	•		•	•
370	8.622	8.250	8.625	8.250	•	•		•	•
371	8.872	8.500	8.875	8.500	•	•		•	•
372	9.122	8.750	9.125	8.750	•	•		•	•
373	9.372	9.000	9.375	9.000	•	•		•	•

1/4" NOMINAL CROSS SECTION

H = .375/.385 H1 = .475/.485 H2 = .579/.589									
SIZE	MILITARY L = .238/.241		INDUSTRIAL L =.250/.253		CANTILEVER	HELICAL WOUND	ETCHED	UNIDIRECTIONAL	DOUBLE WRAPPED
	OD	ID	OD	ID					
DASH #	+.003/-.000	+.000/-.003	+.003/ -.000	+.000/ -.003					
409	2.977	2.500	3.000	2.500	•	•		•	
410	3.102	2.625	3.125	2.625	•	•		•	
411	3.227	2.750	3.250	2.750	•	•		•	
412	3.352	2.875	3.375	2.875	•	•		•	•
413	3.477	3.000	3.500	3.000	•	•		•	•
414	3.602	3.125	3.625	3.125	•	•		•	•
415	3.727	3.250	3.750	3.250	•	•		•	•
416	3.852	3.375	3.875	3.375	•	•		•	•
417	3.977	3.500	4.000	3.500	•	•		•	•
418	4.102	3.625	4.125	3.625	•	•		•	•
419	4.227	3.750	4.250	3.750	•	•		•	•
420	4.352	3.875	4.375	3.875	•	•		•	•
421	4.477	4.000	4.500	4.000	•	•		•	•
422	4.602	4.125	4.625	4.125	•	•		•	•
423	4.727	4.250	4.750	4.250	•	•		•	•
424	4.852	4.375	4.875	4.375	•	•		•	•
425	4.974	4.497	5.000	4.500	•	•		•	•
426	5.099	4.622	5.125	4.625	•	•		•	•
427	5.224	4.747	5.250	4.750	•	•		•	•
428	5.349	4.872	5.375	4.875	•	•		•	•
429	5.474	4.997	5.500	5.000	•	•		•	•
430	5.599	5.122	5.625	5.125	•	•		•	•
431	5.724	5.247	5.750	5.250	•	•		•	•
432	5.849	5.372	5.875	5.375	•	•		•	•
433	5.974	5.497	6.000	5.500	•	•		•	•
434	6.099	5.622	6.125	5.625	•	•		•	•
435	6.224	5.747	6.250	5.750	•	•		•	•
436	6.349	5.872	6.375	5.875	•	•		•	•
437	6.474	5.997	6.500	6.000	•	•		•	•
438	6.724	6.247	6.750	6.250	•	•		•	•
439	6.974	6.497	7.000	6.500	•	•		•	•
440	7.224	6.747	7.250	6.750	•	•		•	•
441	7.474	6.997	7.500	7.000	•	•		•	•
442	7.724	7.247	7.750	7.250	•	•		•	•
443	7.974	7.497	8.000	7.500	•	•		•	•
444	8.224	7.747	8.250	7.750	•	•		•	•
445	8.474	7.997	8.500	8.000	•	•		•	•
446	8.974	8.497	9.000	8.500	•	•		•	•
447	9.474	8.997	9.500	9.000	•	•		•	•
448	9.974	9.497	10.000	9.500	•	•		•	•
449	10.474	9.997	10.500	10.000	•	•		•	•



RADIAL GLAND DIMENSIONS

INSIDE FACE SEAL
GLAND DIMENSIONS

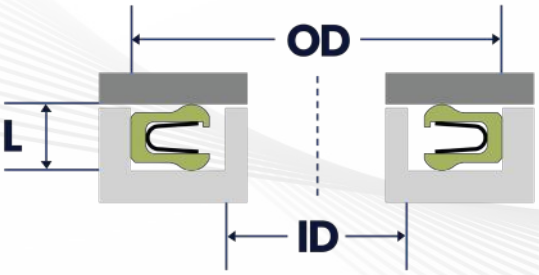
SPECIALTY FLUID COMPONENTS

1/16" NOMINAL CROSS SECTION

L = .056/.058			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
008	2.977	2.500		•		•
009	3.102	2.625		•		•
010	3.227	2.750	•	•		•
011	3.352	2.875	•	•		•
012	3.477	3.000	•	•		•
013	3.602	3.125	•	•		•
014	3.727	3.250	•	•		•
015	3.852	3.375	•	•		•
016	3.977	3.500	•	•		•
017	4.102	3.625	•	•		•
018	4.227	3.750	•	•		•
019	4.352	3.875	•	•		•
020	4.477	4.000	•	•		•
021	4.602	4.125	•	•		•
022	4.727	4.250	•	•		•
023	4.852	4.375	•	•		•
024	4.974	4.500	•	•		•
025	5.099	4.625	•	•		•
026	5.224	4.750	•	•		•
027	5.349	4.875	•	•		•
028	5.474	5.000	•	•		•
029	5.599	5.125	•	•		•
030	5.724	5.250	•	•		•
031	5.849	5.375	•	•		•
032	5.974	5.500	•	•		•
033	6.099	5.625	•	•		•
034	6.224	5.750	•	•		•
035	6.349	5.875	•	•		•
036	6.474	6.000	•	•		•
037	6.724	6.250	•	•		•
038	6.974	6.500	•	•		•
039	7.224	6.750	•	•		•
040	7.474	7.000	•	•		•
041	7.724	7.250	•	•		•
042	7.974	7.500	•	•		•
043	8.224	7.750	•	•		•
044	8.474	8.000	•	•		•
045	8.974	8.500	•	•		•

3/32" NOMINAL CROSS SECTION

L = .089/.091			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
110	0.562	0.280	•	•		•
111	0.625	0.343	•	•		•
112	0.687	0.405	•	•		•
113	0.750	0.468	•	•	•	•
114	0.812	0.530	•	•	•	•
115	0.875	0.593	•	•	•	•
116	0.937	0.655	•	•	•	•
117	1.000	0.718	•	•	•	•
118	1.062	0.780	•	•	•	•
119	1.125	0.843	•	•	•	•
120	1.187	0.905	•	•	•	•
121	1.250	0.968	•	•	•	•
122	1.312	1.030	•	•	•	•
123	1.375	1.093	•	•	•	•
124	1.437	1.155	•	•	•	•
125	1.500	1.218	•	•	•	•
126	1.562	1.280	•	•	•	•
127	1.625	1.343	•	•	•	•
128	1.687	1.405	•	•	•	•
129	1.750	1.468	•	•	•	•
130	1.812	1.530	•	•	•	•
131	1.875	1.593	•	•	•	•
132	1.937	1.655	•	•	•	•
133	2.000	1.718	•	•	•	•
134	2.062	1.780	•	•	•	•
135	2.125	1.843	•	•	•	•
136	2.187	1.905	•	•	•	•
137	2.250	1.968	•	•	•	•
138	2.312	2.030	•	•	•	•
139	2.375	2.093	•	•	•	•
140	2.437	2.155	•	•	•	•
141	2.500	2.218	•	•	•	•
142	2.562	2.280	•	•	•	•
143	2.625	2.343	•	•	•	•
144	2.687	2.405	•	•	•	•
145	2.750	2.468	•	•	•	•
146	2.812	2.530	•	•	•	•
147	2.875	2.593	•	•	•	•
148	2.937	2.655	•	•	•	•
149	3.000	2.718	•	•	•	•
150	3.062	2.780	•	•	•	•
151	3.187	2.905	•	•	•	•
152	3.437	3.155	•	•	•	•
153	3.687	3.405	•	•	•	•
154	3.937	3.655	•	•	•	•
155	4.187	3.905	•	•	•	•
156	4.437	4.155	•	•	•	•
157	4.687	4.405	•	•	•	•
158	4.937	4.655	•	•	•	•



INSIDE FACE SEAL GLAND DIMENSIONS

1/8" NOMINAL CROSS SECTION

L = .121/.123			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
210	1.000	0.625	•	•	•	•
211	1.062	0.687	•	•	•	•
212	1.125	0.750	•	•	•	•
213	1.187	0.812	•	•	•	•
214	1.250	0.875	•	•	•	•
215	1.312	0.937	•	•	•	•
216	1.375	1.000	•	•	•	•
217	1.437	1.062	•	•	•	•
218	1.500	1.125	•	•	•	•
219	1.562	1.187	•	•	•	•
220	1.625	1.250	•	•	•	•
221	1.687	1.312	•	•	•	•
222	1.750	1.375	•	•	•	•
223	1.875	1.500	•	•	•	•
224	2.000	1.625	•	•	•	•
225	2.125	1.750	•	•	•	•
226	2.250	1.875	•	•	•	•
227	2.375	2.000	•	•	•	•
228	2.500	2.125	•	•	•	•
229	2.625	2.250	•	•	•	•
230	2.750	2.375	•	•	•	•
231	2.875	2.500	•	•	•	•
232	3.000	2.625	•	•	•	•
233	3.125	2.750	•	•	•	•
234	3.250	2.875	•	•	•	•
235	3.375	3.000	•	•	•	•
236	3.500	3.125	•	•	•	•
237	3.625	3.250	•	•	•	•
238	3.750	3.375	•	•	•	•
239	3.875	3.500	•	•	•	•
240	4.000	3.625	•	•	•	•
241	4.125	3.750	•	•	•	•
242	4.250	3.875	•	•	•	•
243	4.375	4.000	•	•	•	•
244	4.500	4.125	•	•	•	•
245	4.625	4.250	•	•	•	•

1/8" NOMINAL CROSS SECTION

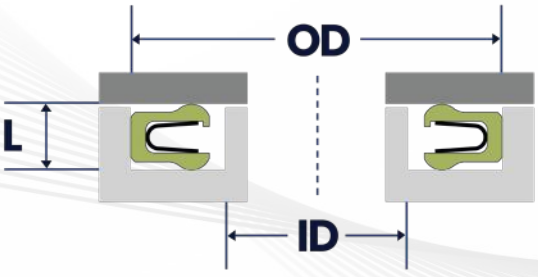
L = .121/.123			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
246	4.750	4.375	•	•	•	•
247	4.875	4.500	•	•	•	•
248	5.000	4.625	•	•	•	•
249	5.125	4.750	•	•	•	•
250	5.250	4.875	•	•	•	•
251	5.375	5.000	•	•	•	•
252	5.500	5.125	•	•	•	•
253	5.625	5.250	•	•	•	•
254	5.750	5.375	•	•	•	•
255	5.875	5.500	•	•	•	•
256	6.000	5.625	•	•	•	•
257	6.125	5.750	•	•	•	•
258	6.250	5.875	•	•	•	•
259	6.500	6.125	•	•	•	•
260	6.750	6.375	•	•	•	•
261	7.000	6.625	•	•	•	•
262	7.250	6.875	•	•	•	•
263	7.500	7.125	•	•	•	•
264	7.750	7.375	•	•	•	•
265	8.000	7.625	•	•	•	•
266	8.250	7.875	•	•	•	•
267	8.500	8.125	•	•	•	•
268	8.750	8.375	•	•	•	•
269	9.000	8.625	•	•	•	•
270	9.250	8.875	•	•	•	•
271	9.500	9.125	•	•	•	•
272	9.750	9.375	•	•	•	•
273	10.000	9.625	•	•	•	•
274	10.250	9.875	•	•	•	•
275	10.750	10.375	•	•	•	•
276	11.250	10.875	•	•	•	•
277	11.750	11.375	•	•	•	•
278	12.250	11.875	•	•	•	•
279	12.750	12.375	•	•	•	•
280	13.250	12.875	•	•	•	•
281	13.750	13.375	•	•	•	•

3/16" NOMINAL CROSS SECTION

INSIDE FACE SEAL GLAND DIMENSIONS

L = .186/.188			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
322	1.500	0.937	•	•	•	•
323	1.625	1.062	•	•	•	•
324	1.750	1.187	•	•	•	•
325	1.875	1.312	•	•	•	•
326	2.000	1.437	•	•	•	•
327	2.125	1.562	•	•	•	•
328	2.250	1.687	•	•	•	•
329	2.375	1.812	•	•	•	•
330	2.500	1.937	•	•	•	•
331	2.625	2.062	•	•	•	•
332	2.750	2.187	•	•	•	•
333	2.875	2.312	•	•	•	•
334	3.000	2.437	•	•	•	•
335	3.125	2.562	•	•	•	•
336	3.250	2.687	•	•	•	•
337	3.375	2.812	•	•	•	•
338	3.500	2.937	•	•	•	•
339	3.625	3.062	•	•	•	•
340	3.750	3.187	•	•	•	•
341	3.875	3.312	•	•	•	•
342	4.000	3.437	•	•	•	•
343	4.125	3.562	•	•	•	•
344	4.250	3.687	•	•	•	•
345	4.375	3.812	•	•	•	•
346	4.500	3.937	•	•	•	•
347	4.625	4.062	•	•	•	•
348	4.750	4.187	•	•	•	•
349	4.875	4.312	•	•	•	•
350	5.000	4.437	•	•	•	•
351	5.125	4.562	•	•	•	•
352	5.250	4.687	•	•	•	•
353	5.375	4.812	•	•	•	•

L = .186/.188			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
354	5.500	4.937	•	•	•	•
355	5.625	5.062	•	•	•	•
356	5.750	5.187	•	•	•	•
357	5.875	5.312	•	•	•	•
358	6.000	5.437	•	•	•	•
359	6.125	5.562	•	•	•	•
360	6.250	5.687	•	•	•	•
361	6.500	5.937	•	•	•	•
362	6.750	6.187	•	•	•	•
363	7.000	6.437	•	•	•	•
364	7.250	6.687	•	•	•	•
365	7.500	6.937	•	•	•	•
366	7.750	7.187	•	•	•	•
367	8.000	7.437	•	•	•	•
368	8.250	7.687	•	•	•	•
369	8.500	7.937	•	•	•	•
370	8.750	8.187	•	•	•	•
371	9.000	8.437	•	•	•	•
372	9.250	8.687	•	•	•	•
373	9.500	8.937	•	•	•	•
374	9.750	9.187	•	•	•	•
375	10.000	9.437	•	•	•	•
376	10.250	9.687	•	•	•	•
377	10.500	9.937	•	•	•	•
378	10.750	10.187	•	•	•	•
379	11.000	10.437	•	•	•	•
380	11.500	10.937	•	•	•	•
381	12.000	11.437	•	•	•	•
382	12.500	11.937	•	•	•	•
383	13.000	12.437	•	•	•	•
384	13.500	12.937	•	•	•	•



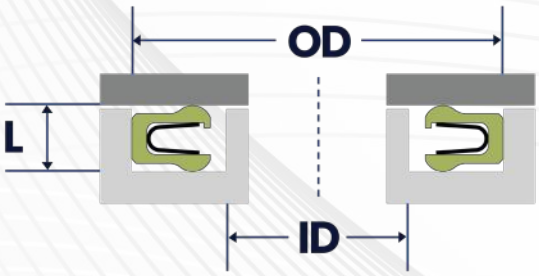
INSIDE FACE SEAL GLAND DIMENSIONS

1/4" NOMINAL CROSS SECTION

L = .238/.241			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
409	3.000	2.250		•		•
410	3.125	2.375		•		•
411	3.250	2.500	•	•		•
412	3.375	2.625	•	•		•
413	3.500	2.750	•	•		•
414	3.625	2.875	•	•		•
415	3.750	3.000	•	•		•
416	3.875	3.125	•	•		•
417	4.000	3.250	•	•	•	•
418	4.125	3.375	•	•	•	•
419	4.250	3.500	•	•	•	•
420	4.375	3.625	•	•	•	•
421	4.500	3.750	•	•	•	•
422	4.625	3.875	•	•	•	•
423	4.750	4.000	•	•	•	•
424	4.875	4.125	•	•	•	•
425	5.000	4.250	•	•	•	•
426	5.125	4.375	•	•	•	•
427	5.250	4.500	•	•	•	•
428	5.375	4.625	•	•	•	•
429	5.500	4.750	•	•	•	•

1/4" NOMINAL CROSS SECTION

L = .238/.241			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	+.005/-.000	MAX. REF.				
430	5.625	4.875	•	•	•	•
431	5.750	5.000	•	•	•	•
432	5.875	5.125	•	•	•	•
433	6.000	5.250	•	•	•	•
434	6.125	5.375	•	•	•	•
435	6.250	5.500	•	•	•	•
436	6.375	5.625	•	•	•	•
437	6.500	5.750	•	•	•	•
438	6.750	6.000	•	•	•	•
439	7.000	6.250	•	•	•	•
440	7.250	6.500	•	•	•	•
441	7.500	6.750	•	•	•	•
442	7.750	7.000	•	•	•	•
443	8.000	7.250	•	•	•	•
444	8.250	7.500	•	•	•	•
445	8.500	7.750	•	•	•	•
446	9.000	8.250	•	•	•	•
447	9.500	8.750	•	•	•	•
448	10.000	9.250	•	•	•	•
449	10.500	9.750	•	•	•	•
450	11.000	10.250	•	•	•	•
451	11.500	10.750	•	•	•	•
452	12.000	11.250	•	•	•	•
453	12.500	11.750	•	•	•	•
454	13.000	12.250	•	•	•	•
455	13.500	12.750	•	•	•	•
456	14.000	13.250	•	•	•	•
457	14.500	13.750	•	•	•	•
458	15.000	14.250	•	•	•	•
459	15.500	14.750	•	•	•	•
460	16.000	15.250	•	•	•	•



OUTSIDE FACE SEAL

GLAND DIMENSIONS

SPECIALTY FLUID COMPONENTS

OUTSIDE FACE SEAL GLAND DIMENSIONS

1/16" NOMINAL CROSS SECTION

L = .056/.058			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
008	0.375	0.187				•
009	0.406	0.218		•		•
010	0.437	0.250	•	•		•
011	0.500	0.312	•	•		•
012	0.562	0.375	•	•		•
013	0.625	0.437	•	•		•
014	0.687	0.500	•	•		•
015	0.750	0.562	•	•		•
016	0.812	0.625	•	•		•
017	0.875	0.687	•	•		•
018	0.937	0.750	•	•		•
019	1.000	0.812	•	•		•
020	1.062	0.875	•	•		•
021	1.125	0.937	•	•		•
022	1.187	1.000	•	•		•
023	1.250	1.062	•	•		•
024	1.312	1.125	•	•		•
025	1.375	1.187	•	•		•
026	1.437	1.250	•	•		•
027	1.500	1.312	•	•		•
028	1.562	1.375	•	•		•
029	1.687	1.500	•	•		•
030	1.812	1.625	•	•		•
031	1.937	1.750	•	•		•
032	2.062	1.875	•	•		•
033	2.187	2.000	•	•		•
034	2.312	2.125	•	•		•
035	2.437	2.250	•	•		•
036	2.562	2.375	•	•		•
037	2.687	2.500	•	•		•
038	2.812	2.625	•	•		•
039	2.937	2.750	•	•		•
040	3.062	2.875	•	•		•
041	3.187	3.000	•	•		•
042	3.437	3.250	•	•		•
043	3.687	3.500	•	•		•
044	3.937	3.750	•	•		•
045	4.187	4.000	•	•		•

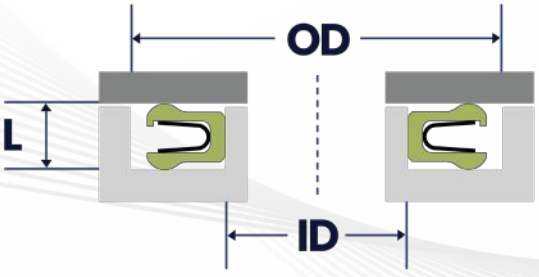
3/32" NOMINAL CROSS SECTION

L = .089/.091			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
110	0.657	0.375		•		•
111	0.719	0.437	•	•		•
112	0.782	0.500	•	•		•
113	0.844	0.562	•	•	•	•
114	0.907	0.625	•	•	•	•
115	0.969	0.687	•	•	•	•
116	1.032	0.750	•	•	•	•
117	1.094	0.812	•	•	•	•
118	1.157	0.875	•	•	•	•
119	1.219	0.937	•	•	•	•
120	1.282	1.000	•	•	•	•
121	1.344	1.062	•	•	•	•
122	1.407	1.125	•	•	•	•
123	1.469	1.187	•	•	•	•
124	1.532	1.250	•	•	•	•
125	1.594	1.312	•	•	•	•
126	1.657	1.375	•	•	•	•
127	1.719	1.437	•	•	•	•
128	1.782	1.500	•	•	•	•
129	1.844	1.562	•	•	•	•
130	1.907	1.625	•	•	•	•
131	1.969	1.687	•	•	•	•
132	2.032	1.750	•	•	•	•
133	2.094	1.812	•	•	•	•
134	2.157	1.875	•	•	•	•
135	2.219	1.937	•	•	•	•
136	2.282	2.000	•	•	•	•
137	2.344	2.062	•	•	•	•
138	2.407	2.125	•	•	•	•
139	2.469	2.187	•	•	•	•
140	2.532	2.250	•	•	•	•
141	2.594	2.312	•	•	•	•
142	2.657	2.375	•	•	•	•
143	2.719	2.437	•	•	•	•
144	2.782	2.500	•	•	•	•
145	2.844	2.562	•	•	•	•
146	2.907	2.625	•	•	•	•
147	2.969	2.687	•	•	•	•
148	3.032	2.750	•	•	•	•
149	3.094	2.812	•	•	•	•
150	3.157	2.875	•	•	•	•
151	3.282	3.000	•	•	•	•
152	3.532	3.250	•	•	•	•
153	3.782	3.500	•	•	•	•
154	4.032	3.750	•	•	•	•
155	4.282	4.000	•	•	•	•
156	4.532	4.250	•	•	•	•
157	4.782	4.500	•	•	•	•
158	5.032	4.750	•	•	•	•

1/8" NOMINAL C ROSS SECTION

L = .121/.123			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
208	1.000	0.625	•	•		•
209	1.063	0.687	•	•		•
210	1.125	0.750	•	•	•	•
211	1.188	0.812	•	•	•	•
212	1.250	0.875	•	•	•	•
213	1.313	0.937	•	•	•	•
214	1.375	1.000	•	•	•	•
215	1.438	1.062	•	•	•	•
216	1.500	1.125	•	•	•	•
217	1.563	1.187	•	•	•	•
218	1.625	1.250	•	•	•	•
219	1.688	1.312	•	•	•	•
220	1.750	1.375	•	•	•	•
221	1.813	1.437	•	•	•	•
222	1.875	1.500	•	•	•	•
223	2.000	1.625	•	•	•	•
224	2.125	1.750	•	•	•	•
225	2.250	1.875	•	•	•	•
226	2.375	2.000	•	•	•	•
227	2.500	2.125	•	•	•	•
228	2.625	2.250	•	•	•	•
229	2.750	2.375	•	•	•	•
230	2.875	2.500	•	•	•	•
231	3.000	2.625	•	•	•	•
232	3.125	2.750	•	•	•	•
233	3.250	2.875	•	•	•	•
234	3.375	3.000	•	•	•	•
235	3.500	3.125	•	•	•	•
236	3.625	3.250	•	•	•	•
237	3.750	3.375	•	•	•	•
238	3.875	3.500	•	•	•	•
239	4.000	3.625	•	•	•	•
240	4.125	3.750	•	•	•	•
241	4.250	3.875	•	•	•	•
242	4.375	4.000	•	•	•	•
243	4.500	4.125	•	•	•	•
244	4.625	4.250	•	•	•	•

L = .121/.123			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
245	4.750	4.375	•	•	•	•
246	4.875	4.500	•	•	•	•
247	5.000	4.625	•	•	•	•
248	5.125	4.750	•	•	•	•
249	5.250	4.875	•	•	•	•
250	5.375	5.000	•	•	•	•
251	5.500	5.125	•	•	•	•
252	5.625	5.250	•	•	•	•
253	5.750	5.375	•	•	•	•
254	5.875	5.500	•	•	•	•
255	6.000	5.625	•	•	•	•
256	6.125	5.750	•	•	•	•
257	6.250	5.875	•	•	•	•
258	6.375	6.000	•	•	•	•
259	6.625	6.250	•	•	•	•
260	6.875	6.500	•	•	•	•
261	7.125	6.750	•	•	•	•
262	7.375	7.000	•	•	•	•
263	7.625	7.250	•	•	•	•
264	7.875	7.500	•	•	•	•
265	8.125	7.750	•	•	•	•
266	8.375	8.000	•	•	•	•
267	8.625	8.250	•	•	•	•
268	8.875	8.500	•	•	•	•
269	9.125	8.750	•	•	•	•
270	9.375	9.000	•	•	•	•
271	9.625	9.250	•	•	•	•
272	9.875	9.500	•	•	•	•
273	10.125	9.750	•	•	•	•
274	10.375	10.000	•	•	•	•
275	10.875	10.500	•	•	•	•
276	11.375	11.000	•	•	•	•
277	11.875	11.500	•	•	•	•
278	12.375	12.000	•	•	•	•
279	13.375	13.000	•	•	•	•
280	14.375	14.000	•	•	•	•
281	15.375	15.000	•	•	•	•



OUTSIDE FACE SEAL GLAND DIMENSIONS

OUTSIDE FACE SEAL GLAND DIMENSIONS

3/16" NOMINAL CROSS SECTION

L = .186/.188			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
325	2.062	1.500		•	•	•
326	2.187	1.625		•	•	•
327	2.312	1.750	•	•	•	•
328	2.437	1.875	•	•	•	•
329	2.562	2.000	•	•	•	•
330	2.687	2.125	•	•	•	•
331	2.812	2.250	•	•	•	•
332	2.937	2.375	•	•	•	•
333	3.062	2.500	•	•	•	•
334	3.187	2.625	•	•	•	•
335	3.312	2.750	•	•	•	•
336	3.437	2.875	•	•	•	•
337	3.562	3.000	•	•	•	•
338	3.687	3.125	•	•	•	•
339	3.812	3.250	•	•	•	•
340	3.937	3.375	•	•	•	•
341	4.062	3.500	•	•	•	•
342	4.187	3.625	•	•	•	•
343	4.312	3.750	•	•	•	•
344	4.437	3.875	•	•	•	•
345	4.562	4.000	•	•	•	•
346	4.687	4.125	•	•	•	•
347	4.812	4.250	•	•	•	•
348	4.937	4.375	•	•	•	•
349	5.062	4.500	•	•	•	•
350	5.187	4.625	•	•	•	•
351	5.312	4.750	•	•	•	•
352	5.437	4.875	•	•	•	•
353	5.562	5.000	•	•	•	•
354	5.687	5.125	•	•	•	•

3/16" NOMINAL CROSS SECTION

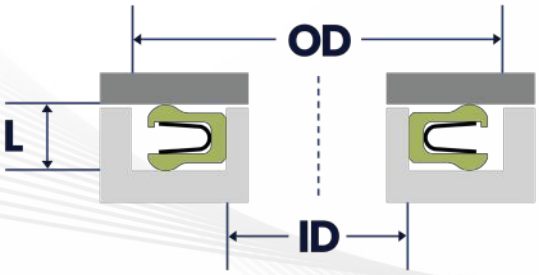
L = .186/.188			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
355	5.812	5.250	•	•	•	•
356	5.937	5.375	•	•	•	•
357	6.062	5.500	•	•	•	•
358	6.187	5.625	•	•	•	•
359	6.312	5.750	•	•	•	•
360	6.437	5.875	•	•	•	•
361	6.562	6.000	•	•	•	•
362	6.687	6.125	•	•	•	•
363	6.812	6.250	•	•	•	•
364	7.062	6.500	•	•	•	•
365	7.312	6.750	•	•	•	•
366	7.562	7.000	•	•	•	•
367	7.812	7.250	•	•	•	•
368	8.062	7.500	•	•	•	•
369	8.312	7.750	•	•	•	•
370	8.562	8.000	•	•	•	•
371	8.812	8.250	•	•	•	•
372	9.062	8.500	•	•	•	•
373	9.312	8.750	•	•	•	•
374	9.562	9.000	•	•	•	•
375	9.812	9.250	•	•	•	•
376	10.062	9.500	•	•	•	•
377	10.312	9.750	•	•	•	•
378	10.562	10.000	•	•	•	•
379	10.812	10.250	•	•	•	•
380	11.062	10.500	•	•	•	•
381	11.312	10.750	•	•	•	•
382	11.562	11.000	•	•	•	•
383	12.062	11.500	•	•	•	•
384	12.562	12.000	•	•	•	•

1/4" NOMINAL CROSS SECTION

OUTSIDE FACE SEAL GLAND DIMENSIONS

L = .238/.241			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
409	3.250	2.500		•		•
410	3.375	2.625		•		•
411	3.500	2.750	•	•		•
412	3.625	2.875	•	•		•
413	3.750	3.000	•	•		•
414	3.875	3.125	•	•		•
415	4.000	3.250	•	•		•
416	4.125	3.375	•	•		•
417	4.250	3.500	•	•		•
418	4.375	3.625	•	•		•
419	4.500	3.750	•	•		•
420	4.625	3.875	•	•		•
421	4.750	4.000	•	•		•
422	4.875	4.125	•	•		•
423	5.000	4.250	•	•		•
424	5.125	4.375	•	•		•
425	5.250	4.500	•	•		•
426	5.375	4.625	•	•		•
427	5.500	4.750	•	•		•
428	5.625	4.875	•	•		•
429	5.750	5.000	•	•		•

L = .238/.241			CANTILEVER	HELICAL WOUND	SOLID CONTACT	UNIDIRECTIONAL
SIZE	OD	ID				
DASH #	MIN. REF.	+.000/-.005				
430	5.875	5.125	•	•	•	•
431	6.000	5.250	•	•	•	•
432	6.125	5.375	•	•	•	•
433	6.250	5.500	•	•	•	•
434	6.375	5.625	•	•	•	•
435	6.500	5.750	•	•	•	•
436	6.625	5.875	•	•	•	•
437	6.750	6.000	•	•	•	•
438	7.000	6.250	•	•	•	•
439	7.250	6.500	•	•	•	•
440	7.500	6.750	•	•	•	•
441	7.750	7.000	•	•	•	•
442	8.000	7.250	•	•	•	•
443	8.250	7.500	•	•	•	•
444	8.500	7.750	•	•	•	•
445	8.750	8.000	•	•	•	•
446	9.250	8.500	•	•	•	•
447	9.750	9.000	•	•	•	•
448	10.250	9.500	•	•	•	•
449	10.750	10.000	•	•	•	•
450	11.250	10.500	•	•	•	•
451	11.750	11.000	•	•	•	•
452	12.250	11.500	•	•	•	•
453	12.750	12.000	•	•	•	•
454	13.250	12.500	•	•	•	•
455	13.750	13.000	•	•	•	•
456	14.250	13.500	•	•	•	•
457	14.750	14.000	•	•	•	•
458	15.250	14.500	•	•	•	•
459	15.750	15.000	•	•	•	•
460	16.250	15.500	•	•	•	•



LIP SEAL
GLAND DIMENSIONS

SPECIALTY FLUID
COMPONENTS

LIP SEAL GLAND DIMENSIONS 001 – 068

SIZE	DIAMETER		SEAL WIDTH		
DASH #	SHAFT	BORE	W	W1	W2
001	.500	.999	.250	.313	.375
002	.500	1.124	.250	.313	.375
003	.500	1.250	.250	.313	.375
004	.625	1.124	.250	.313	.375
005	.625	1.250	.250	.313	.375
006	.625	1.375	.250	.313	.375
007	.625	1.499	.250	.313	.375
008	.750	1.250	.250	.313	.375
009	.750	1.375	.250	.313	.375
010	.750	1.499	.250	.313	.375
011	.750	1.624	.250	.313	.375
012	.875	1.375	.250	.313	.375
013	.875	1.499	.250	.313	.375
014	.875	1.624	.250	.313	.375
015	.875	1.752	.250	.313	.375
016	1.000	1.499	.250	.313	.375
017	1.000	1.624	.250	.313	.375
018	1.000	1.752	.250	.313	.375
019	1.000	1.874	.250	.313	.375
020	1.125	1.624	.313	.375	.438
021	1.125	1.752	.313	.375	.438
022	1.125	1.874	.313	.375	.438
023	1.125	2.000	.313	.375	.438
024	1.250	1.752	.313	.375	.438
025	1.250	1.874	.313	.375	.438
026	1.250	2.000	.313	.375	.438
027	1.250	2.125	.313	.375	.438
028	1.375	2.000	.313	.375	.438
029	1.375	2.125	.313	.375	.438
030	1.375	2.250	.313	.375	.438
031	1.375	2.374	.313	.375	.438
032	1.500	2.125	.313	.375	.438
033	1.500	2.250	.313	.375	.438
034	1.500	2.374	.313	.375	.438

SIZE	DIAMETER		SEAL WIDTH		
DASH #	SHAFT	BORE	W	W1	W2
035	1.500	2.502	.313	.375	.438
036	1.625	2.250	.313	.375	.438
037	1.625	2.374	.313	.375	.438
038	1.625	2.502	.313	.375	.438
039	1.625	2.623	.313	.375	.438
040	1.750	2.374	.313	.375	.438
041	1.750	2.502	.313	.375	.438
042	1.750	2.623	.313	.375	.438
043	1.750	2.750	.313	.375	.438
044	2.000	2.623	.375	.437	.500
045	2.000	2.750	.375	.437	.500
046	2.000	2.875	.375	.437	.500
047	2.000	3.000	.375	.437	.500
048	2.000	3.125	.375	.437	.500
049	2.125	2.750	.375	.437	.500
050	2.125	2.875	.375	.437	.500
051	2.125	3.000	.375	.437	.500
052	2.125	3.125	.375	.437	.500
053	2.125	3.251	.375	.437	.500
054	2.250	3.000	.375	.437	.500
055	2.250	3.125	.375	.437	.500
056	2.250	3.251	.375	.437	.500
057	2.250	3.371	.375	.437	.500
058	2.375	3.125	.375	.437	.500
059	2.375	3.251	.375	.437	.500
060	2.375	3.371	.375	.437	.500
061	2.375	3.500	.375	.437	.500
062	2.500	3.251	.375	.437	.500
063	2.500	3.371	.375	.437	.500
064	2.500	3.500	.375	.437	.500
065	2.500	3.623	.375	.437	.500
066	2.625	3.371	.375	.437	.500
067	2.625	3.500	.375	.437	.500
068	2.625	3.623	.375	.437	.500

BORE DIAMETER	BORE TOLERANCE
.001 TO 3.000	± .001
3.001 TO 6.000	±.0015
6.001 TO 8.000	±.002
8.001 TO 10.000	±.0025

SHAFT DIAMETER	SHAFT TOLERANCE
.001 TO 4.000	±.003
4.001 TO 6.000	±.004
6.001 TO 10.000	±.005
10.001 AND ABOVE	±.006

LIP SEAL GLAND DIMENSION 069 – 135

SIZE	DIAMETER		SEAL WIDTH		
DASH #	SHAFT	BORE	W	W1	W2
069	2.625	3.751	.375	.437	.500
070	2.750	3.500	.375	.437	.500
071	2.750	3.623	.375	.437	.500
072	2.750	3.751	.375	.437	.500
073	2.750	3.875	.375	.437	.500
074	2.875	3.623	.375	.437	.500
075	2.875	3.751	.375	.437	.500
076	2.875	3.875	.375	.437	.500
077	2.875	4.003	.375	.437	.500
078	3.000	3.751	.375	.437	.500
079	3.000	3.875	.375	.437	.500
080	3.000	4.003	.375	.437	.500
081	3.000	4.125	.375	.437	.500
082	3.125	4.125	.375	.437	.500
083	3.125	4.249	.375	.437	.500
084	3.125	4.376	.375	.437	.500
085	3.125	4.500	.375	.437	.500
086	3.250	4.249	.375	.437	.500
087	3.250	4.376	.375	.437	.500
088	3.250	4.500	.375	.437	.500
089	3.250	4.626	.375	.437	.500
090	3.375	4.249	.375	.437	.500
091	3.375	4.376	.375	.437	.500
092	3.375	4.500	.375	.437	.500
093	3.375	4.626	.375	.437	.500
094	3.500	4.376	.437	.500	.625
095	3.500	4.500	.437	.500	.625
096	3.500	4.626	.437	.500	.625
097	3.500	4.751	.437	.500	.625
098	3.625	4.626	.437	.500	.625
099	3.625	4.751	.437	.500	.625
100	3.625	4.876	.437	.500	.625
101	3.625	4.999	.437	.500	.625
102	3.875	4.876	.437	.500	.625

SIZE	DIAMETER		SEAL WIDTH		
DASH #	SHAFT	BORE	W	W1	W2
103	3.875	4.999	.437	.500	.625
104	3.875	5.125	.437	.500	.625
105	3.875	5.251	.437	.500	.625
106	4.000	4.999	.437	.500	.625
107	4.000	5.125	.437	.500	.625
108	4.000	5.251	.437	.500	.625
109	4.000	5.375	.437	.500	.625
110	4.250	5.251	.437	.500	.625
111	4.250	5.375	.437	.500	.625
112	4.250	5.501	.437	.500	.625
113	4.250	5.625	.437	.500	.625
114	4.500	5.501	.437	.500	.625
115	4.500	5.625	.437	.500	.625
116	4.500	5.751	.437	.500	.625
117	4.750	5.751	.437	.500	.625
118	4.750	6.000	.437	.500	.625
119	5.000	6.000	.500	.625	.750
120	5.000	6.250	.500	.625	.750
121	5.000	6.375	.500	.625	.750
122	5.250	6.250	.500	.625	.750
123	5.250	6.375	.500	.625	.750
124	5.250	6.500	.500	.625	.750
125	5.250	6.625	.500	.625	.750
126	5.500	6.500	.500	.625	.750
127	5.500	6.625	.500	.625	.750
128	5.500	6.750	.500	.625	.750
129	5.500	6.875	.500	.625	.750
130	5.750	6.750	.500	.625	.750
131	5.750	6.875	.500	.625	.750
132	5.750	7.000	.500	.625	.750
133	5.750	7.125	.500	.625	.750
134	6.000	7.125	.500	.625	.750
135	6.000	7.500	.500	.625	.750

BORE DIAMETER	BORE TOLERANCE
.001 TO 3.000	± .001
3.001 TO 6.000	±.0015
6.001 TO 8.000	±.002
8.001 TO 10.000	±.0025

SHAFT DIAMETER	SHAFT TOLERANCE
.001 TO 4.000	±.003
4.001 TO 6.000	±.004
6.001 TO 10.000	±.005
10.001 AND ABOVE	±.006

CASE STUDY: NUCLEAR INDUSTRY

SFCM boasts a distinguished clientele, with one notable entity occupying a preeminent position as a premier purveyor of goods and services to the Nuclear Industry. This prominent client serves entities such as the U.S. Department of Energy, nuclear steam supply system (NSSS) suppliers, and nuclear power plants. By virtue of their unwavering dedication to nuclear operations, they have emerged as a trusted supplier, adept at surmounting impediments stemming from supply chain delays.

Their remarkable commitment to quality assurance, coupled with an unwavering pursuit of innovation, is evidenced by their cultivation of robust partnerships with renowned manufacturers and companies that devote their resources to the multifaceted realm of nuclear technology.

CHALLENGE

The foremost purveyor of nuclear provisions encountered a predicament when their former supplier failed to meet their exigent requirements, pertaining to both lead time and quality concerns, particularly with regards to the seals encompassing their flanges and valves. Alarming findings revealed that a significant number of these seals exhibited recurrent instances of cracking, attributable to the deficient production practices employed by the previous supplier.

Regrettably, the supplier proved incapable of rectifying these issues, thereby prompting our client to terminate the association. It was determined that their manufacturing process of the “Tefzel” material proved susceptible to cracking during operational service. Furthermore, the supplier’s adherence to promised lead times displayed an inconsistent and unreliable pattern at best.

SOLUTION

Upon being solicited by our client, SFCM was tasked with devising an enhanced resolution to this persistent quandary. Following meticulous scrutiny by our team of engineers, it was discerned that the utilization of TEFZEL material in crafting their specialized flanges and valves had been subjected to a molding technique notorious for its proclivity to fracture. Drawing upon our engineers’ extensive expertise years, a bespoke methodology was formulated to serve as the definitive antidote to this predicament.

Moreover, our unwavering commitment to excellence is underscored by our AS9100D certification, a testament to our adherence to stringent quality standards. This prestigious accreditation has empowered us to optimize our manufacturing processes, consequently affording us an unrivaled position in the industry with regards to expedient delivery times for our shipments.

RESULTS

- Seals performed to the client’s stringent requirements
- Lead times were met to the client’s satisfaction.

CASE STUDY: HPLC/UPLC APPLICATION

Our client is a leading manufacturer of spectroscopy and chromatography equipment and products with a strong presence and rich history in these fields. They have served the globe as a trusted supplier for the analytical instrumentation industry while demonstrating quality and reliability in the products and services they produce.

The client was working on a new pump project involving UPLC and HPLC pumps which requires higher pressure performance.

THE CHALLENGE

The client's challenge was to find a custom seal manufacturer that could proce a solution that will enhance the seal performance of their UPLC/HPLC pumps at higher pressures and smaller diameters while generating minimal particles. Due to the high pressure, lengthy stringers were generated out of the seal material they were using causing the check valve to be clogged. The same issue involving the seal type material being used also resulted in the seal life degradation in a much more rapid span than desired. A solution that could be produced in a timely manner was needed to correct this issue with a safe, reliable seal while meeting pressure and life requirements for the new pumps.

SOLUTION

Specialty Fluid Components MFG was tasked with coming up with the solution after being selected as a preferred manufacturer of this leader in Chromatology and Spectroscopy. Recognizing the importance of this issue with our client, our engineers came up with a solution to scrap the existing design of the seal along with the material type.

The engineers at our facility, with their vast expertise, realized that the new seal material would have to be made of a specially formulated and chemically modified Ultra High Molecular Polyethylene (UHMWPE). This new compound is an advanced material that has a higher wear property while minimizing the particle generations. In addition, utilizing our specially molded PEEK back up rings would also enhance the efficiency of the seal by preventing extrusion from the primary seal. Furthermore, this new formulated UHMWPE would also increase the life span of the seal 2 to 4 times longer than the previous seal.

RESULTS

- Particle generation minimized.
- Lifespan has met the customer's requirement for the UPLC/HPLC pump.
- Customer Satisfaction.

CASE STUDY: BLOWER INDUSTRY

Industrial blowers are an essential part of any type of production or manufacturing operation to increase airflow and create positive air pressure. Specialty Fluid Components engineer's have vast experience with sealing solutions for the Blower industry.

One of our clients were having issues with the lifespan and installation of seals in their blowers and tasked SFCM with coming up with a solution to solve their ongoing issues.

CHALLENGE

The blower industry plays a pivotal role in various sectors by providing essential equipment that generates airflow for ventilation, cooling, and transportation of materials. Blowers are commonly used in applications ranging from HVAC systems to manufacturing processes. Recently, one of our clients in the industrial sector has encountered a significant issue with a blower seal. The blower seal, which is responsible for maintaining an airtight enclosure, has started to exhibit problematic issues, leading to decreased efficiency and compromised performance of the blower system. This issue not only hampers the client's production processes but also results in energy wastage and increased operational costs. The client has stressed to us that the seals were not installing properly, seal lifespan was not up to par, and inefficient lubrication was a main problem.

SOLUTION

To address the issues faced by our client in the blower industry concerning the blower seal, we have devised a comprehensive solution strategy. Firstly, we recommend the incorporation of a static O-ring to help facilitate proper seal assembly installation. Additionally, we propose the implementation of a grease pack to ensure continuous lubrication of the lip seal, even under high rotary velocities, enhancing longevity and reducing wear and tear. To eliminate the possibility of improper seal assembly installation, a bi-directional design is advised. This design will enhance the ease of installation while minimizing the risk of incorrect positioning. Lastly, a dual rotary lip configuration is recommended, offering a combined lip seal and excluder function. This configuration will provide a versatile and reliable sealing solution, optimizing performance and minimizing maintenance requirements by keeping foreign contaminants out of the sealed areas. Through these innovative solutions, we aim to resolve the blower seal issues comprehensively and enhance the client's operational efficiency and productivity.

RESULTS

- Seals performed with more efficiency, longer lifespan
- Proper installation was easily performed

MANUFACTURED
COMPONENTS

WE OFFER DESIGN AND MANUFACTURING OF POLYMERIC COMPONENTS

BRING YOUR APPLICATION TO US AND OUR ENGINEERS WILL PROVIDE YOU A DURABLE, WELL DESIGNED SOLUTION.

WE HAVE DISTRIBUTORS OF OUR SEALS ALL ACROSS THE WORLD. MADE IN THE USA.

CALL US TODAY 832.813.8405
EMAIL US AT SALES@SFCSEALS.COM

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ENGINEERING DESIGN REQUEST FORM

CUSTOMER INFORMATION

COMPANY NAME_____ PURCHASING CONTACT_____
PHONE_____ EMAIL_____
STREET_____ CONTACT PHONE_____
CITY, ST, ZIP_____
COUNTRY_____ ENGINEERING CONTACT_____
EMAIL_____
COMPANY WEBSITE_____ PHONE_____

PROJECT NOTES DESCRIBE YOUR PROJECT HERE

_____
_____
_____

SALES INFORMATION

QUOTE QUANTITIES OF_____
DEVICE SEALED_____
DATE PROTOTYPES REQUIRED_____
TARGET PRICE $_____

IS THERE A SOURCE OR SPEC CONTROL DRAWING (Y/N)?
_____
IF YES, PLEASE EMAIL THE HARDWARE DRAWING ALONG WITH THIS FORM TO SALES@SFCSEALS.COM

DO NOT FILL THIS SECTION OUT - FOR OFFICE USE ONLY

APPLICATION/PART INFO

EDR NO. _____
APPLICATION (NEW, EXISTING)_____
CUSTOMER (NEW, EXISTING)_____
PRODUCT:
__SES __RLS __EES __MACHINE COMPONENT
__DRAWING CHANGE __NEW DESIGN

WRITTEN BY_____ DATE_____

SEAL STYLE AND MATERIAL

SIMILAR TO P/N_____
SEAL TYPE_____
SEALING ELEMENT MATERIAL_____
ENERGIZING MATERIAL_____
SEAL CASE MATERIAL_____
BACK-UP RING MATERIAL_____

OPERATING CONDITIONS

OPERATING CONDITION DATA

				MINIMUM	OPERATING	MAXIMUM
#	___ °K	___ °F	___ °C	_____	_____	_____
PRESSURE:	___ PSI	___ Bar	___ MPa	_____	_____	_____
STROKE LENGTH:	___ inch	___ mm		_____	_____	_____
CYCLE RATE:	___ /min	___ /hr Hz		_____	_____	_____
OSCILLATORY:	___ deg.	___ rad.		_____	_____	_____
VACUUM:	___ in.Hg	___ torr		_____	_____	_____
VELOCITY	___ ft/min.	___ m/sec.		_____	_____	_____
RPM						

_____

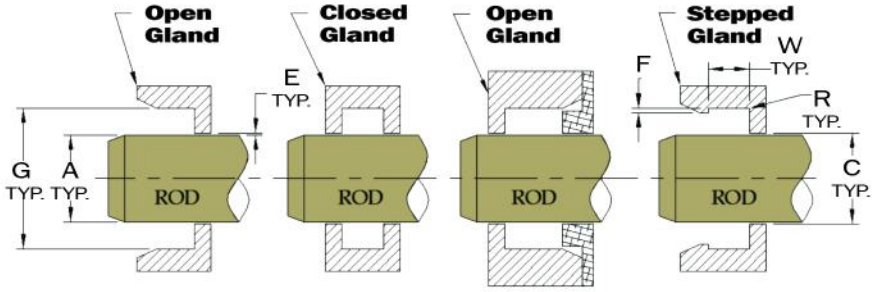
SHAFT ROTATION: (AS VIEWED FROM AIR SIDE OR LOW PRESSURE SIDE OF SEAL)_____
PV (psi-ft/min, MPa-m/sec)_____
PROOF PRESSURE (UNITS)_____
BURST PRESSURE (UNITS)_____
ALLOWABLE LEAKAGE (UNITS) (DROPS, cc/mm)_____
MEDIA TO BE SEALED_____
FRICTION: ___ lbs. ___ oz. ___ gms BREAKOUT:_____ DYNAMIC:_____
FRICTION: ___ lbs. ___ oz. ___ gms BREAKOUT:_____ DYNAMIC:_____
TORQUE: ___ ft-lbs ___ in-oz ___ gm-cm BREAKOUT:_____ DYNAMIC:_____
LIFE REQUIREMENT (CYC., HRS., YRS.)
DUTY CYCLE_____
TYPE OF SEAL EVALUATION: ___ BENCH ___ FIELD ___ BOTH ___ EXPLAIN
MOST CRITICAL PERFORMANCE CRITERIA:_____
CONTAMINATION (TYPE):_____
SEAL TYPE (ROD, PISTON, FACE):_____

GLAND TYPE:
___ SPLIT ___ OPEN ___SOLID
___ STEPPED ___IRREGULAR
___ REF. 1ST PAGE ___ REF. 4TH PAGE

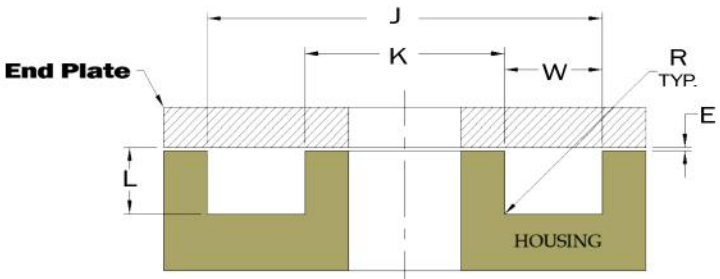
CAN HARDWARE BE CHANGED? ___ YES ___ NO
IF YES, PLEASE EXPLAIN._____
_____
_____

METRIC: ___ YES ___ NO

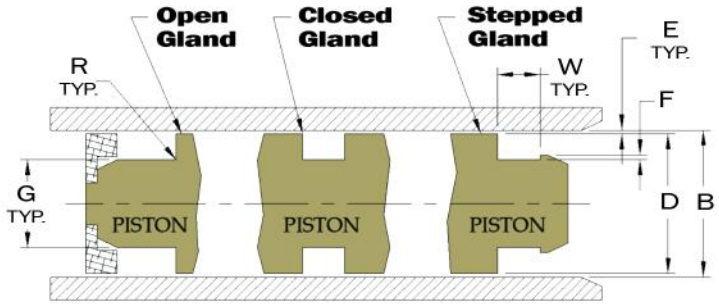
OPERATING CONDITIONS



ROD SEALS



FACE SEALS



PISTON SEALS

GLAND SPECS	MINIMUM	OPERATING	MAXIMUM	FINISH	HARDNESS	COATING
A -Rod Diameter						
B -Bore Diameter						
G -Groove Diameter						
C -Rod Bore						
D -Piston Diameter						
J -Gland O.D.						
K -Groove I.D.						
L -Groove Depth						
W -Groove Width						
R -Groove Radii						
E -Extrusion Gap						
F -Step Height						
Runout (TIR)						
Sideload(lbs, Newtons)						

DOWNLOAD THE EDR AT WWW.SFCSEALS.COM

Specialty Fluid Components - Terms And Conditions

I. ENTIRE AGREEMENT/ORDERS.

This agreement is between Speciality Fluid Components Manufacturing ("SFC") and Purchaser. No order for SFC's goods or services shall be binding upon SFC until acknowledged in writing by SFC. That acknowledgement and these Terms and Conditions constitute the entire agreement between SFC and Purchaser. Any purchase order, offer or counter-offer made by Purchaser before or after SFC's acknowledgement is rejected and all documents exchanged prior to SFC's acknowledgement are merely preliminary negotiations and not part of any Agreement between the parties. For example, orders submitted on Purchaser's own purchase order forms modifying, adding to, contrary to, or inconsistent with these Terms and Conditions are expressly rejected and of no force or effect and acceptance is expressly made conditional upon assent to these terms. In no event will SFC be deemed to have in any way changed, enlarged or modified its liabilities or obligations as fixed by these Terms and Conditions including, without limitation, situations in which SFC satisfies an order submitted on Purchaser's own purchase order form.

Purchaser shall have been deemed to agree to these Terms and Conditions upon the earlier of acceptance of SFC's quotation, acceptance of delivery of the goods or services or the issuance of a purchase order to SFC.

No acknowledgement by SFC and no provision of SFC's Terms and Conditions shall be subject to change in any manner except as agreed to in writing by an officer of SFC.

2. PRICES.

Until the written confirmation of acceptance of a purchase order by SFC, all prices are subject to change without notice and quoted in U.S. dollars unless otherwise noted. Alt prices for goods are quoted FOB point of shipment unless otherwise noted by SFC. Written quotations expire thirty (30) calendar days from the date of quotation unless specified otherwise. Verbal quotations are non-binding on SFC. Prices do not include sales, excise, municipal, state or any other government taxes. All taxes and other governmental charges upon the production, manufacture, distribution, sale or use of goods or services to the extent required or not forbidden by law to be collected by SFC from Purchaser, shall be paid by Purchaser to SFC unless Purchaser furnishes SFC with exemption certificates acceptable to the relevant taxing authorities. SFC reserves the right to revise prices of work in process due to any change in the order on the part of the Purchaser or any factor beyond the control of SFC. Typographical and/or clerical errors made by SFC are subject to correction.

3. TERMS OF PAYMENT.

Invoices are net thirty (30) days from the date of invoice unless specified otherwise and approved in writing by SFC. Past due accounts will bear interest at the rate of 3% per month of the invoiced amount. All invoices are payable in U.S. dollars, unless specified otherwise and approved. Acceptance of bank drafts, checks or other form of payment shall be subject to immediate collection of the full face amount thereof. SFC may, at its discretion, impose a transaction fee on payments processed via wire transfer or by Letter of Credit.

SFC reserves the right at any time and in its sole discretion to demand full or partial payment before proceeding with an Agreement of sale. If delivery is delayed or deferred by Purchaser beyond the scheduled date, payment shall be due in full when SFC is prepared to ship the goods or perform the services. The goods may thereafter, at SFC's option, be stored at the risk and expense of Purchaser, If Purchaser defaults when any payment is due or becomes insolvent, the whole Agreement price shall become due and payable upon demand or SFC, at its option, without prejudice to other lawful remedies, may defer delivery or cancel the Agreement.

In the event of nonpayment of an invoice when due, SFC shall have the right to suspend further work or the delivery of future goods under this Agreement or any Agreement with Purchaser until such invoice is paid in full; provided, however, that if such invoice remains unpaid for more than five (5) days after written demand by SFC, SFC may terminate this Agreement without penalty.

Order cancellations by the Purchaser are subject to an order cancellation fee as stated with the quotation and

incorporated herein.

4. DELIVERY.

SFC shall not be liable for any damage as a result of any non-delivery or delay due to any cause beyond SFC's reasonable control, including, without limitation, an act of God; act of Purchaser; embargo; other government act, regulation or request; fire; accident; strike; war; boycott; slowdown; riot; or delay in transportation or inability to obtain necessary labor, materials, or manufacturing facilities.

SFC reserves the right to substitute suitable alternative materials and components where necessary.

Where the services are to be performed on Purchaser's premises, Purchaser agrees to provide SFC on a timely basis with such access, machine downtime, utilities and equipment as SFC shall reasonably require in order to perform the services in accordance with the Agreement. If Purchaser fails to perform its obligations or shall fail to perform them in a timely manner, Purchaser acknowledges and agrees that SFC shall be entitled to delay performance of the services until such time as Purchaser has complied in all respects with its obligations and to increase the price for the services to reflect any increased cost to SFC caused by Purchaser's failure to perform or late performance.

5. SHIPMENT/RISK OF LOSS.

All shipments of goods are subject to an overrun or shortage of 5% of the quantity specified. Unless otherwise noted, all sales of goods are made FOB point of shipment. Delivery dates given in advance of actual shipment of goods or performance of services are estimates and shall not be deemed to represent fixed or guaranteed delivery dates. Method and route of shipment will be at the discretion of SFC unless specified otherwise by Purchaser and agreed by SFC, and any additional expense of the method or route of shipment specified by Purchaser shall be borne by Purchaser. Claims for shortage or other quantity errors must be made in writing to SFC within five (5) days after receipt of shipment. Failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Purchaser.

SFC reserves the right to make delivery of goods in installments, unless otherwise expressly stipulated in the agreement for sale. Such installments, when separately invoiced, shall be paid for when due per invoice without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Purchaser of its obligations to accept remaining deliveries.

6. TOOLS/DIES.

All tools, patterns and other equipment used in the manufacture of any of SFC's goods or performance of any of SFC's services shall remain the property of SFC unless otherwise expressly agreed in writing. Purchaser shall not permit any third party to use such equipment nor disclose to any third party any technical, dimensional or design details, or any other information in respect of such equipment at any time.

7. WARRANTY/CLAIMS.

Purchaser acknowledges that it has selected and ordered goods based on its own skill and judgment and agrees that it is responsible for ensuring that the goods selected are fit for Purchaser's purpose. SFC warrants only that such goods have been produced in accord with SFC's standard practices with regard to materials and workmanship and no samples or prior description of goods shall constitute an express warranty. If goods are non-conforming, SFC, at its option and subject to the terms of this paragraph 7 and paragraph 9, will either (i) allow Purchaser to return the goods and receive repayment of the price or (ii) repair or replace the goods. No goods are to be returned to SFC without prior written consent of SFC and the assignment of a return goods authorization number by SFC.

Purchaser is liable to pay for all associated costs incurred by SFC due to its selection of noncompliant products. These associated costs are based on any additional costs incurred by SFC in managing the noncompliant products, including, but not limited to, all reworks, investigations and other consequential costs.

SFC shall not be responsible for any selection made by Purchaser and will not have any liability to Purchaser for any loss, damages, costs or expenses suffered by Purchaser as a result thereof.

(a) THIS WARRANTY IS IN LIEU OF ANY EXPRESSED OR IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ANY OTHER OBLIGATION ON THE PART OF THE SELLER.

(b) SFC shall have no obligation under this warranty if damage to the good occurs because of improper handling or operation, modification of the good, abuse, misuse, unauthorized repairs made or attempted and/or where equipment is operated above rated capacity.

(c) No agent, employee or representative of SFC has authority to bind SFC to any affirmation, representation or warranty concerning the goods sold.

(d) Upon receipt, Purchaser shall inspect the goods. All notice of claims, including claims for alleged defective goods, must be made within (i) thirty (30) days of receipt of such goods; or (ii) prior to the installation of such goods into any other products, whichever period is shorter. If no notice of claim is made within such inspection period, the goods are irrevocably accepted by Purchaser and all claims against SFC are waived and forever barred. Purchaser agrees that any litigation or arbitration relating to any claim must be commenced within one (1) year after date of shipment by SFC. Purchaser hereby expressly assumes all liability for all damage and injury occurring before and after said time periods if notice is not made pursuant to this agreement.

8. PURCHASER SUPPLIED MATERIALS.

Purchaser warrants that any materials, inserts, or parts supplied to SFC will conform to all indicated specifications and will be timely delivered. SFC shall not be liable for any damages related to parts or materials supplied by Purchaser, including damage to the part or material itself, or damage caused by defective materials, inserts, or parts. SFC extends no warranty and shall not be liable for any SFC goods that are defective as a result of Purchaser supplied materials, inserts, or parts and Purchaser shall be required to purchase any goods into which SFC incorporates any Purchaser supplied materials, inserts, or parts at the then applicable price for such goods.

9. LIMITATION OF LIABILITY/

INDEMNITY.

SFC's liability on any claim for loss or damage arising out of this transaction or from the performance or breach thereof or connected with any goods or services supplied hereunder, or the sale, resale, operation or use of goods, whether based on Agreement, warranty, tort (including negligence) or other grounds, shall not exceed the price allocable to such goods or services or part thereof involved in the claim, regardless of cause or fault. Purchaser's remedies are limited to the return of non- conforming goods and repayment of the price or to the repair and replacement of non-conforming goods, subject to the provisions of paragraph 6. This limitation of liability and remedies reflects a deliberate and bargained-for allocation of risks between SFC and Purchaser and constitutes the basis of the parties' bargain, without which SFC would not have agreed to the price or terms of this transaction. SFC shall not, under any circumstances, be liable for any charges without its prior written consent.

SFC SHALL NOT IN ANY EVENT BE LIABLE WHETHER AS A RESULT OF BREACH OF AGREEMENT, WARRANTY, TORT (INCLUDING NEGLIGENCE) OR OTHER GROUNDS FOR INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF GOODS OR ASSOCIATED PRODUCTS, BUSINESS INIERRUPTION, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES OR SERVICES, DOWNTIME COSTS, OR CLAIMS OF CUSTOMERS OF PURCHASER FOR SUCH DAMAGE. In addition, if SFC furnishes Purchaser with advice or other assistance regarding any goods or services supplied hereunder, or any system or equipment in which any such goods may be installed, and which is not required pursuant to this transaction, the furnishing of the advice or assistance will not subject SFC to any liability, whether based on Agreement,

warranty, tort (including negligence) or other grounds.

In the event Purchaser modifies SFC goods or incorporates SFC goods into another product or component part, Purchaser agrees to hold harmless and indemnify SFC from any and all claims, liabilities, losses, costs and expenses (including reasonable attorneys' fees) involving personal injury or property damage. Purchaser also agrees to hold harmless and indemnify SFC from any patent or other intellectual property claims related to (i) any SFC goods made in accordance with Purchaser's designs or specifications; or (ii) the use of any drawings provided to SFC by Purchaser for use in the manufacture, production or assembly of such goods.

10. WAIVER AND CHOICE OF LAW.

The failure of SFC to insist in any one or more instances, upon the performance of any of the Terms and Conditions as set forth herein or the failure of SFC to exercise any of its rights hereunder shall not be construed as a waiver or relinquishment of any such terms, conditions or rights thereunder and shall not effect SFC's right to insist on strict performance and compliance with regard to any future performance of these Terms and Conditions. All transactions shall be governed by the laws of the State of Texas, United States of America, excluding conflict law rules. The provisions of the United Nations Convention on Agreements for the International Sale of Goods shall not apply.

11. DISPUTE RESOLUTION/ATTORNEYS' FEES.

Any dispute, controversy or claim arising out of or related to this transaction where the matter in controversy does not exceeds the sum of $50,000, exclusive of interest and costs, shall be resolved by binding arbitration. A demand for arbitration shall be served on the other by certified mail. Within forty-five (45) days after a party demands arbitration, the parties shall select a single arbitrator. The selected arbitrator shall conduct the arbitration in a manner substantially similar to the procedures set forth in the Commercial Arbitration Rule of the American Arbitration Association ("AAA"). If the parties are unable to agree on an arbitrator, the party demanding arbitration shall file a demand for arbitration with the AAA and the arbitration shall then proceed in accordance with the Commercial Arbitration Rules of the AAA. In all circumstances, the arbitration shall take place in Houston, Texas.

Any dispute, controversy or claim arising out of this transaction where the matter in controversy exceeds the sum of $50,000, exclusive of interest and costs, shall be adjudicated exclusively by a court of competent jurisdiction in Houston, Texas. Purchaser consents to personal jurisdiction and venue in Houston, Texas and agrees not to take any action to challenge such jurisdiction or venue. SFC may bring an action against Purchaser in any jurisdiction or venue.

In the event of any action or proceeding related to this transaction, and SFC is determined to be the prevailing party with regard to some or all claims, Purchaser agrees to pay all of SFC's attorney's fees and litigation costs up through and including any appeal.

12. ASSIGNMENT, WAIVER, ENTIRE AGREEMENT, SEVERABILITY.

Purchaser shall not assign or delegate any of its rights or obligations under this Agreement without the prior written consent of SFC. SFC may assign the Agreement or any part of it to any person, firm or company without notice to Purchaser. SFC may terminate this Agreement upon written notice to Purchaser without any further liability to Purchaser if there is a change of control of Purchaser. The Agreement constitutes the entire agreement between the parties with respect to its subject matter, and supersedes all prior oral or written representations or agreements by the parties with respect to the subject matter of this Agreement. Neither the Agreement nor any of its provisions may be modified, amended or waived, whether orally, through the parties' course of performance, course of dealing or course of conduct, or manifested in any other way, unless in writing and signed by an authorized officer of SFC. It is the express intention of the parties that such requirement for written modifications, amendments or waivers be strictly enforced notwithstanding judicial precedent or statutory provisions to the contrary. Any provision found invalid or unenforceable will not affect the validity or enforceability of any other provision and the invalid provision may be judicially modified to the extent enforceable. Any changes or revisions made to an order is considered accepted by the customer with the issuance of a signed purchase order. The customer also accepts all responsibility for any adverse effects a part may experience due to changes or revisions made to an order that the customer has issued a signed purchase order for.

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