Hallite

HALLITE
THE OPTISEAL® SYSTEM DESIGN GUIDE

OPTISEAL®

HALLITE SPRING-ENERGIZED SYSTEM

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TECHNICAL DETAILS

The OptiSeal® system is a high-performance, low-friction, full-spectrum sealing solution. This widely used spring-energized seal offers performance benefits ranging from enhanced media compatibility to superior performance in broad temperature ranges. The basic design consists of a U-shaped jacket made from inert thermoplastic materials specifically selected for the application. The addition of a metal spring actuates the jacket material used in the system, which provides sealing at low system pressures. At higher system pressures, the seal becomes pressure-energized by the fluid media—a sealing combination that ensures adequate sealing throughout the entire pressure range. By coupling the OptiSeal® system with other specialty components such as anti-extrusion devices, PakRings, V-Rings, adapters, bushings, and bearings, users can achieve an expanded operational envelope.

With diameters from 0.040in (1mm) to 110in (2.8m), customizable heights and special geometries, the OptiSeal® system can be configured to fit in almost any hardware, making it the ideal choice for critical-service sealing.

F E A T U R E S

- Thermal stability across broad temperature range
- Low coefficient of friction
- Inherent lubricating properties
- Excellent chemical and corrosion capabilities
- Reduced stick-slip
- Unlimited shelf life
- No explosive decompression
- No swelling due to moisture absorption
- Safe for vacuum conditions
- Excellent dielectrical properties
- Sealing across broad pressure range
- Static and dynamic applications
- Flanged and rotating applications

COMMON PTFE JACKET MATERIALS

COMPOUND	POLYMER	FILLER	COLOR	ABRASIAN RESISTANCE	METAL MATING WEAR	RELATIVE SEALABILITY	RELATIVE EXTRUSION RESISTANCE	MEDIA RESISTANCE						OPERATING TEMPATURES	
								NORSOK M710 COMPOUND	HYDROCARBONS	OXYGENATED SOLVENTS	STEAM	ACIDS	BASES	F°	C°
700	PTFE	None	White	P	L	E	P	Yes	E	E	E	S	S	-300 to 400°F	-184 to 204°C
701	PTFE	25% Glass	White	E	H	G	E	Yes	E	E	E	S	S	-100 to 550°F	-73 to 288°C
702	PTFE	Glass, MoS_2	Gray	E	H	G	G	-	E	E	E	S	S	-100 to 500°F	-73 to 260°C
711	PTFE	25% Carbon/ Graphite	Black	G	M	G	E	Yes	E	E	E	S	S	-100 to 550°F	-73 to 288°C
777	MPTFE	Premium Virgin	White	P	L	E	G	Yes	E	E	E	S	S	-300 to 450°F	-184 to 232°C
HLX	PTFE	Special Bronze	Gold	G	M	G	G	-	E	E	E	S	S	-100 to 550°F	-73 to 288°C
HCF	PTFE	Carbon Fiber	Gray/ Black	G	M	G	G	-	E	E	E	S	S	-100 to 500°F	-73 to 260°C

KEY

E = Excellent **H** = High **NR** = Not Recommended
G = Good **M** = Medium **W** = Resistant to weak acid/base
P = Poor **L** = Low **S** = Resistant to strong acid/base

Conditions shown are approximate. Actual operating conditions are contingent upon media, pressure, and design factors as well as polymer types. Testing in your assembly is always recommended, especially when applications approach or exceed the conditions shown above.

SPECIALTY JACKET MATERIALS

COMPOUND	POLYMER	FILLER	COLOR	ABRASIAN RESISTANCE	METAL MATING WEAR	RELATIVE SEALABILITY	RELATIVE EXTRUSION RESISTANCE	MEDIA RESISTANCE						OPERATING TEMPATURES	
								NORSOK M710 COMPOUND	HYDROCARBONS	OXYGENATED SOLVENTS	STEAM	ACIDS	BASES	F°	C°
703	PTFE	PPS, Carbon, MoS_2	Black	E	M	G	E	-	E	E	E	S	S	-100 to 550°F	-73 to 288°C
712	PTFE	5% MoS_2	Gray	A	L	E	A	-	E	E	E	S	S	-200 to 450°F	-129 to 232°C
716	PTFE	15% Graphite	Black	A	M	E	G	Yes	E	E	E	S	S	-100 to 500°F	-73 to 260°C
720	PTFE	2% Carbon	Black	A	L	E	A	-	E	E	E	S	S	-200 to 500°F	-129 to 260°C
733	PTFE	15% Carbon/ Graphite	Black	G	M	G	G	-	E	E	E	S	S	-100 to 500°F	-73 to 260°C
734	PTFE	10% Carbon/ Graphite	Black	G	M	G	G	-	E	E	E	S	S	-100 to 500°F	-73 to 260°C
780	PTFE	None	Turquoise	A	L	E	A	-	E	E	E	S	S	-300 to 450°F	-184 to 232°C
728	ACETAL	None	Black	A	M	A	G	-	E	E	E	W	W	-70 to 300°F	-56 to 149°C
Arylex™ 745	PEEK	None	Beige	A	M	G	G	Yes	E	E	E	S	S	-70 to 500°F	-56 to 260°C
748	UHMWPE	None	Translucent	E	L	E	G	-	E	E	E	S	S	-300 to 180°F	-184 to 82°C
HLA	PTFE	Mineral	White	G	M	G	G	-	E	E	E	W	S	-100 to 500°F	-73 to 260°C
HCV	PTFE	Carbon Fiber	Gray/ Black	G	M	G	G	-	E	E	E	S	S	-100 to 500°F	-73 to 260°C
7HP	UHMWPE	None	Translucent	E	L	E	G	-	E	E	E	S	S	-22 to 275°F	-30 to 135°C

KEY

E = Excellent **H** = High **NR** = Not Recommended
G = Good **M** = Medium **W** = Resistant to weak acid/base
A = Average **L** = Low **S** = Resistant to strong acid/base
P = Poor

Conditions shown are approximate. Actual operating conditions are contingent upon media, pressure, and design factors as well as polymer types. Testing in your assembly is always recommended, especially when applications approach or exceed the conditions shown above.

FILLERS

To enhance performance capabilities, a range of fillers and additives can be added to materials. Reinforcing fibers, conductive fillers, and colorants are among the additives available.

COMMON FILLERS

Glass Fibers
The most common filler. Minor effect on electrical properties. Increased abrasion on mating metal surfaces.

Carbon/Carbon Fibers
Low abrasion and wear. Good deformation and extrusion resistance.

Graphite
Non-abrasive. Low friction. Minor effect on deformation properties.

MoS_2
Lowers break-in wear and starting friction.

Bronze
Very high wear resistance and load-bearing capability. Poor chemical resistance.

Stainless Steel
High wear resistance and load-bearing capability. Wider chemical resistance than bronze.

PPS
Low wear and abrasion. Excellent deformation and extrusion resistance. Large reduction in tensile and elongation values.

CAF_2
Hydrofluoric acid service.

Mineral
Properties similar to glass, but less abrasive.

While maintaining its inherent properties and characteristics in material compounds, PTFE can benefit from the improved mechanical strength, stability, and wear resistance provided by an additive. The various mechanical properties of PTFE can be enhanced by adding a range of fillers, including glass fiber, carbon, and bronze.

FILLERS AND THEIR RELATIVE EFFECTS ON PTFE	WEAR RESISTANCE	FRICTION	CREEP RESISTANCE	THERMAL CONDUCTIVITY	METAL MATING WEAR	ELECTRICAL RESISTANCE
GLASS FIBERS	▲▲▲	▲▲	▲▲	▲	▲▲▲	▲
CARBON	▲▲▲	▲	▲▲▲	▲▲	▲	▼
GRAPHITE	▲▲	◆	▲▲	▲▲	◆	▼▼
MoS_2	▲	◆	◆	▲	◆	▼
BRONZE	▲▲▲	▲▲	▲▲	▲▲▲	▲	▼▼
CARBON FIBERS	▲▲▲	▲	▲▲	▲▲	▲	▼
MINERAL	▲▲▲	▲▲	▲▲	▲▲	▲▲	◆
STAINLESS STEEL	▲▲▲	▲▲	▲▲	▲▲▲	▲▲	▼▼
HIGH-TEMPERATURE POLYMERS	▲▲▲	▲	▲▲▲	◆	◆	◆

KEY
◆ = No Effect
▲ = Slight Increase
▲▲ = Moderate Increase
▲▲▲ = Significant Increase
▼ = Slight Decrease
▼▼ = Moderate Decrease
▼▼▼ = Significant Decrease

JACKET MATERIAL SUGGESTIONS

The Hallite material portfolio contains additional compounds that are not mentioned in this listing. Our specialists can work with you to provide the ideal engineering solution for your specific needs. If your application requires a custom compound or material that is not listed, visit Hallite.com to submit your inquiry, or submit an inquiry at sales@hallite.com, or contact your Hallite representative.

APPLICATIONS	STATIC			ROTATING				OSCILLATING				RECIPROCATING			
				LOW SPEED		HIGH SPEED		LOW SPEED		HIGH SPEED		LOW SPEED		HIGH SPEED	
	LOW PRESSURE	MEDIUM PRESSURE	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE
Hydrocarbon Oils and Lubrication Typically fuels and lubricants of petroleum-based products	700	777 711	703 745 701	716 720 780	HLX HCF	755 HCF	HLX HCF	716 720 780	HLX HCF 711	HCF 755	HLX HCF	780 720 712	HLX 702 7HP 711 748	HLX 711	HLX 7HP 748
Pneumatic and Gases Primarily for air and other gases	700 777 7HP 748	777 7HP 748	777 7HP 745 748	780 777	755 HCF	711 755 HCF	HCF 756	780 777	755 HCF	HCF 755	HCF 756	780 777	7HP 777 PS3 748	711 HCF	HLX 711
Chemical Processing Typical service includes the handling and dispensing of acidic and basic products	700 711	777 7HP 748	703 745 701	716 720	HCF 711	755 HCF	711 703	716 720 712	HCF 711	HCF 755	711 703	720 712	7HP 711 748	711 703	7HP 703 748

Conditions shown are approximate. Actual operating conditions are contingent upon media, pressure, and design factors as well as polymer types. Testing in your assembly is always recommended, especially when applications approach or exceed the conditions shown above.

SPRING TYPES

The addition of a metal spring or elastomer actuates the jacket material used in the system. Upon seal installation, the spring energizer responds with an outward force, thereby energizing the jacket material and providing positive sealing. Characteristics such as load value, deflection range, and corrosion resistance are among the primary spring factors that affect seal performance in a given application.

V-SPRING

The most versatile of all the spring types, the V-Spring design is suited for use in a wide range of applications and services, from static applications to those with rotary or reciprocating motion. The materials used in this design option enhance sealing performance without degradation of material properties. Available in our internal and external pressure face seal design, the V-Spring energizer features a wide deflection range and can be designed with medium or heavy spring loads. This spring is a good choice for glands with wide tolerance variations.

FLAT BAND HELICAL

For applications with less dynamic operating conditions, the flat band helical spring design is an ideal choice because of its small deflection range. The high unit load of this spring-energized design makes it the optimal solution for static applications where wear and friction are not great concerns. In addition, it is the preferred design for cryogenic services.

CANTED COIL

This spring offers light constant loading over a wide deflection range, reducing frictional drag and seal wear. Typically, applications include measurement and instrumentation, high-speed/low pressure, and single-seal applications.

J-SPRING

The J-spring has been designed to allow for high flexibility while also providing high loads. Primarily used in large rotating equipment such as FPSO swivels, the J-spring allows for a more robust, heavy cross-section design that can withstand the extremes of high pressure in applications for decades.

FULL CONTACT SPRING

This heavy-duty spring provides a constant ultra high load over the entire sealing lip. Available in either internal or external face seal configurations, this spring provides the high sealing loads needed for cryogenic fluids, tight gas sealing, and ultra-high vacuum applications.

SPRING MATERIALS

MATERIAL	APPLICATION DESCRIPTION	MEDIA RESISTANCE					OPERATING TEMPATURES		SPRING TYPE	
		HYDROCARBONS	OXYGENATED SOLVENTS	STEAM	ACIDS	BASES	F°	C°	V	HELICAL
301 Stainless Steel*	General Service Hydraulics	E	E	E	W	S	-300 to 400°F	-184 to 204°C	Yes	Yes
Elgiloy Alloy	Harsh Service, NACE MR-01-75	E	E	E	S	S	-300 to 800°F	-184 to 427°C	Yes	Yes
301 SS/Silicone Filled	Food and Pharmaceuticals	P	E	E	W	W	-300 to 400°F	-184 to 204°C	Yes	No
Hastalloy		E	E	E	S	S	-300 to 800°F	-184 to 427°C	No	Yes

KEY

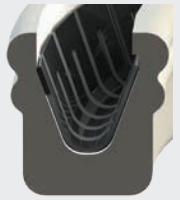
E = Excellent
P = Poor
W = Resistant to weak acid/base
S = Resistant to strong acid/base

**Certain applications require higher grades of stainless steel; grades such as 300, 304/316 are available.*

OPTISEAL®

V-SPRING LIP PROFILES

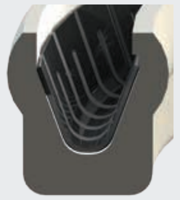
Seal characteristics such as sealability, wear, and friction are greatly affected by lip-profile construction and seal geometry. In addition to our standard forms, lip profiles can be customized for specific gland configurations such as highly abrasive environments and rough surface finishes.



S LIP DOUBLE RADIUS LIP

The S lip is the standard lip profile design. It offers redundant sealing surfaces with radiused contact areas for medium unit loading. This design feature provides the best combination of wear and sealability, making the S lip suitable for the widest range of applications.

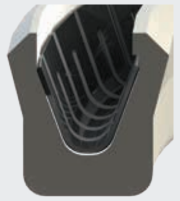
SEALABILITY = Medium **WEAR** = Medium **FRICTION** = Medium



A LIP SINGLE RADIUS LIP

The A lip employs a large radius, and therefore low unit loading, resulting in low friction and low wear. This lip profile is recommended for applications with high surface speeds or those that require low friction. The profile also facilitates installation in glands with insufficient lead-in chamfers.

SEALABILITY = Low **WEAR** = Low **FRICTION** = Low



B LIP BEVEL LIP

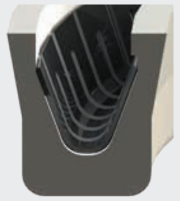
The B lip profile produces the highest unit loading of all of the lip profiles offered by Hallite. The B lip is recommended for use in static applications and is required when the OptiSeal® component diameter is less than 3/16" (4.7mm).

SEALABILITY = High **WEAR** = High **FRICTION** = High

C LIP FLAT LIP

The C lip provides a flat sealing surface which allows for a constant wear rate over the life of the seal, making it ideal for rotary applications where extending seal life is the primary goal.

SEALABILITY = High **WEAR** = High **FRICTION** = High



D LIP SCRAPER LIP

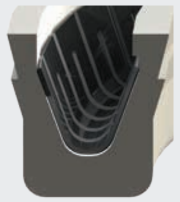
The D lip profile's low unit loading characteristics offer long wear, with somewhat less effective sealing than higher unit loaded seals. This design is particularly well-suited for reciprocating applications.

SEALABILITY = Medium **WEAR** = Low **FRICTION** = Medium

E LIP RADIUS END LIP

The E lip profile is a radiused lip profile similar to the S lip, but with a single point of contact. This lip profile generates the lowest friction of any V-Spring Optiseal® and has extremely high sealability. This lip is best suited for static sealing applications and light oscillating applications where tight sealing is required.

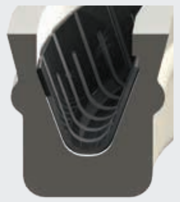
SEALABILITY = Medium **WEAR** = Low **FRICTION** = Medium



F LIP DUAL SCRAPER LIP

The F lip features a profile suitable for systems contaminated with abrasives. Lower unit loadings offer extended seal life in rotary applications.

SEALABILITY = Medium **WEAR** = Medium **FRICTION** = Low



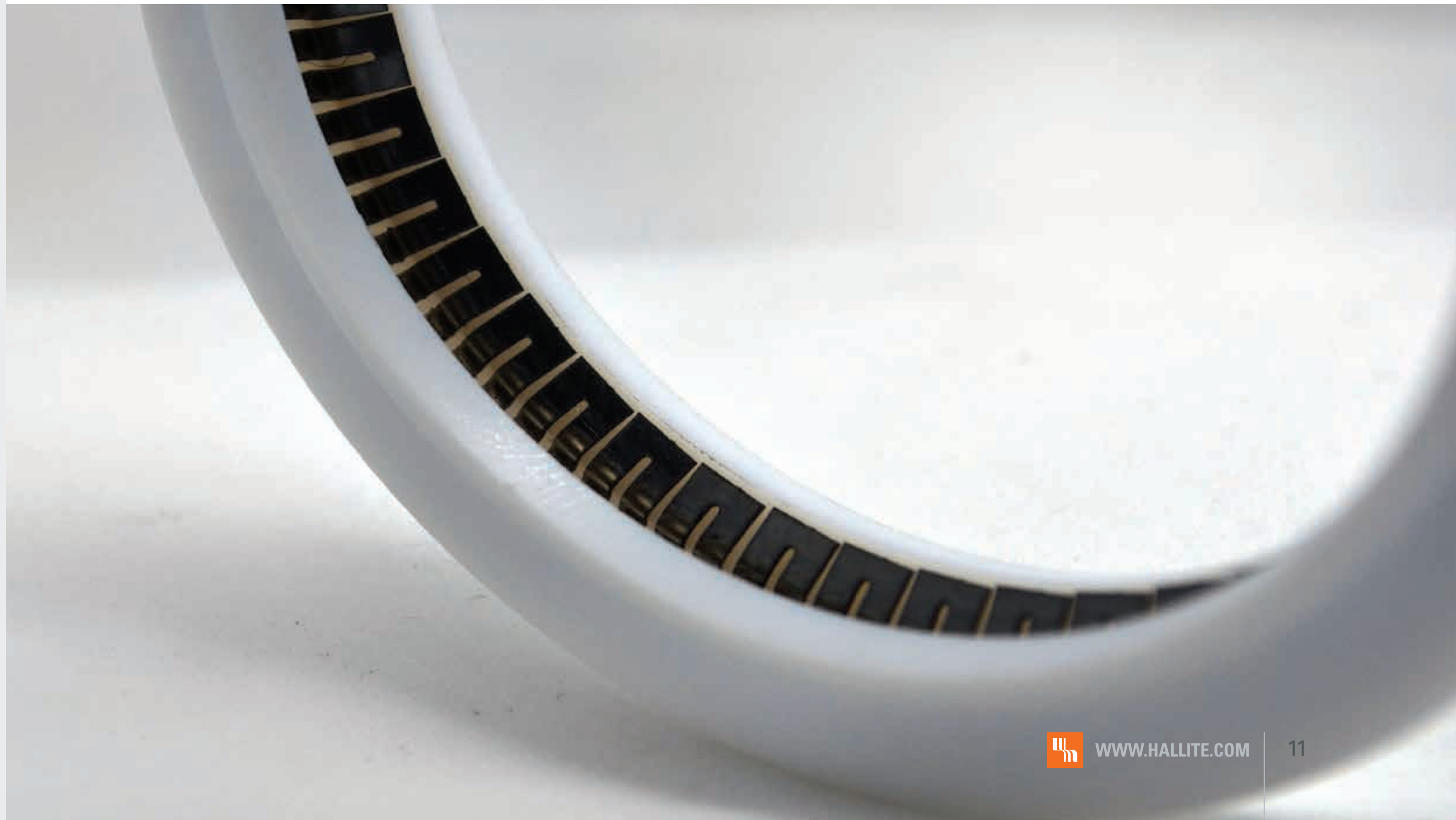
J LIP SCRAPER RADIUS LIP

The J lip also has redundant sealing surfaces, with the sharp front edge protecting the secondary, radiused surface from abrasive media. Besides use in scraping applications, this lip is also used with step-cut glands and is the preferred profile for use with high-viscosity media.

SEALABILITY = Medium **WEAR** = Medium **FRICTION** = Medium

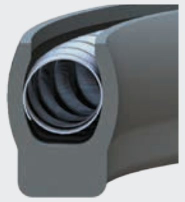
V-SPRING PROFILE USAGE GUIDE

PROFILE & CODE	S	A	B	C	D	E	F	J
RECIPROCATING	Preferred	Preferred	Preferred	Preferred	Preferred	Preferred	Preferred	Preferred
ROTATING	Preferred	Preferred	Neutral	Preferred	Neutral	Neutral	Preferred	Preferred
STATIC	Preferred	Neutral	Preferred	Neutral	Neutral	Neutral	Neutral	Neutral
OSCILLATING	Preferred	Preferred	Neutral	Preferred	Neutral	Neutral	Preferred	Preferred
HIGH SEALABILITY	Preferred	Neutral	Preferred	Neutral	Neutral	Neutral	Neutral	Neutral
EXCLUSION	Neutral	Neutral	Neutral	Neutral	Preferred	Preferred	Preferred	Preferred
LOW-FRICTION	Neutral	Preferred	Neutral	Neutral	Preferred	Preferred	Neutral	Neutral
STEP GLAND	Do Not Use	Neutral	Neutral	Neutral	Preferred	Preferred	Preferred	Preferred
<3/16" ID	Do Not Use	Do Not Use	Preferred	Do Not Use	Preferred	Preferred	Do Not Use	Do Not Use



LIP PROFILES

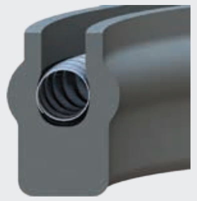
Seal characteristics such as sealability, wear, and friction are greatly affected by lip-profile construction and seal geometry. In addition to our standard forms, lip profiles can be customized for specific gland configurations such as highly abrasive environments and rough surface finishes.



K LIP SINGLE RADIUS LIP

The K lip is similar to the A lip for V-Springs but designed for circular springs in mind. The radiused lip profile provides low unit loading which results in low friction. The radius also allows for easy installation in glands with insufficient lead-in chamfers. Typical applications include high-speed rotary, gas sealing, and cryogenics.

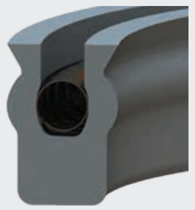
SEALABILITY = Medium **WEAR** = Medium **FRICTION** = Medium



L LIP SINGLE RADIUS LIP FOR BACK PRESSURE

The L lip is designed for applications where a single seal is desired and significant back pressure will be seen. The extended lips of this seal protect the sealing surfaces from damage as pressure is reversed. Radial slots through the lips allow pressure to re-energize the seal once normal pressure is restored, preventing fluid blow-by.

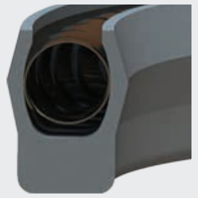
SEALABILITY = Low **WEAR** = Low **FRICTION** = Low



M LIP SCRAPER RADIUS LIP

The M lip is similar in function to the J lip but designed for use with circular springs. The scraper lip helps to protect the radius lip from damage by abrasive media and acts as a redundant sealing surface. Additionally, the scraper portion of the lip allows this seal to be installed in step cut glands.

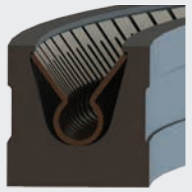
SEALABILITY = High **WEAR** = High **FRICTION** = High



N LIP POINT CONTACT LIP

The N lip profile features a pointed contact surface, ensuring minimal contact area and maximum unit loading. This profile, when used in conjunction with a helical coil spring, allows for tight sealing of gas and low-viscosity liquids in static applications.

SEALABILITY = Medium **WEAR** = Low **FRICTION** = Medium



P LIP SUPPORTED HEEL FLAT LIP

The P lip untilizes a flat sealing surface, allowing for a constant wear rate over the life of the seal. The high load spring is ideal for heavy cross-section geometries used in large rotating equipment. The heel support ensures that seals made from softer materials like PTFE remain parallel to gland walls without distortion.

SEALABILITY = Medium **WEAR** = Medium **FRICTION** = Low

R LIP FLAT LIP

The R lip is similar to the P lip, but does not have the additional heel support. This geometry is ideal when used with more rigid materials like UHMW-PE. Additionally, the lack of heel support makes this geometry lower friction than the P lip.

SEALABILITY = Medium **WEAR** = Medium **FRICTION** = Medium

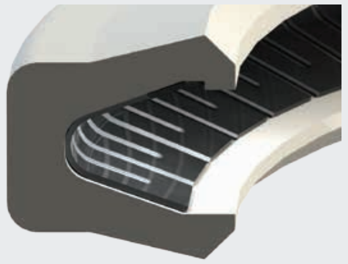
LIP PROFILE USAGE GUIDE

PROFILE & CODE	K	L	M	N	P	R
RECIPROCATING	Neutral	Preferred	Preferred	Neutral	Preferred	Preferred
ROTATING	Neutral	Neutral	Neutral	Neutral	Preferred	Preferred
STATIC	Preferred	Neutral	Preferred	Preferred	Preferred	Preferred
OSCILLATING	Preferred	Preferred	Preferred	Neutral	Preferred	Preferred
HIGH SEALABILITY	Neutral	Neutral	Neutral	Preferred	Neutral	Neutral
EXCLUSION	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
LOW-FRICTION	Preferred	Preferred	Preferred	Neutral	Neutral	Neutral
STEP GLAND	Neutral	Neutral	Preferred	Do Not Use	Neutral	Neutral
<3/16” ID	Do Not Use	Do Not Use	Do Not Use	Preferred	Do Not Use	Do Not Use

OPTISEAL®

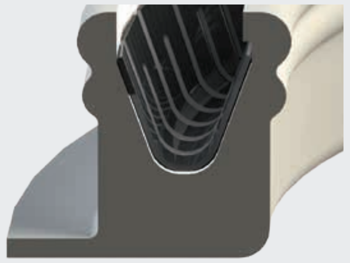
SPECIALITY TYPES

Components based on the basic seal design can be further customized to provide sealing performance that is application- and industry-specific. Our engineering team is able to incorporate a variety of shapes and geometries to optimize seal performance and versatility.



OPTIFACE™ SEAL

OptiFace seals are used in static seal applications and feature an axial squeeze design offered for either external or internal pressure. As compression against the seal is increased, the lips of the jacket are pressed against the gland surface, providing resistance and sealability while ensuring stability within the gland. The beveled lip featured in this design provides excellent sealability in applications that require high unit loading. The internal or external preload is based on the application. For components such as flanges and swivel joints, the design is configured for internal pressure. In sealing vacuum applications, the design can be configured for external pressure.



FLANGED OPTISEAL® COMPONENT

Best suited for rotary applications, this seal is designed to prevent seal movement on the static gland surface. The clamped flange prevents seal movement and blocks potential leak paths. In cryogenic applications, the clamped flange also reduces the thermal contraction of the seal OD away from the gland.

OPTI-OIL™ SEAL

The Opti-Oil seal is the ideal choice for low-pressure, dynamic shaft seals. The outer diameter of this configuration is tightly sealed with an O-ring, reducing slippage on the static surface in rotary applications. The inner diameter contact surface of this seal features a low-friction, spring-loaded jacket, enabling adequate sealing along the surface of the shaft.

A6R OPTISEAL®

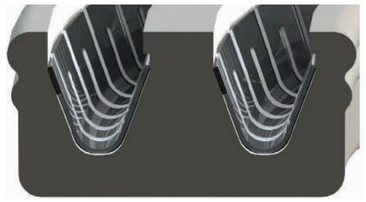
When tight shutoff is required and space is limited, the A6R Optiseal® outperforms PTFE seals. This hybrid elastomer/PTFE seal couples the high sealing capabilities of elastomers with the low-friction characteristics of PTFE. The PTFE ID limits the amount of elastomer contact on the running surface, resulting in significantly lower friction.

CUSTOM SEAL CHARACTERISTICS

In addition to jacket and material customization, the standard OptiSeal® design can be further customized based on the service conditions of the individual application, enabling it to perform in a wide range of services and applications.

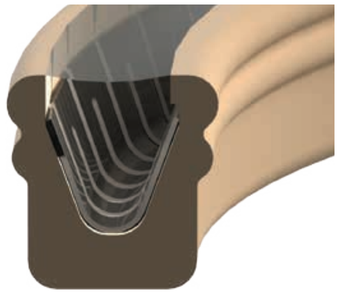
NESTED SPRINGS OPTISEAL®

Multiple or nested springs are used when greater sealing force is required, such as in low-pressure or low-temperature applications. This design is able to increase the force exerted by the sealing lips without increasing the lip interference. Examples of such applications are valve stems, choke seals, and low-pressure systems.



LARGE CROSS SECTION OPTISEAL®

In larger diameter applications where existing glands have radial cross sections greater than 0.600” (15.2mm) or have limited axial lengths, two springs may be radially spaced. Dual springs are also used when retrofitting existing glands where the axial gland length is less than the radial gland cross section. This allows the sealing system to be employed in cross sections that are greater than 1” (25.4mm).



SILICONE-FILLED CAVITY OPTISEAL®

In sanitary applications, the spring cavity of the OptiSeal® system can feature a silicone filling to effectively protect against contamination. This configuration prevents media from becoming trapped in the cavity, enabling excess media to be completely flushed out if necessary.

ADDITIONAL CUSTOM DESIGNS

BIDIRECTIONAL SPRING-ENERGIZED FLOATING PISTON SEAL

FLANGED SEAL WITH INTERNAL SPRING ENERGIZER

OptiSeal® design principles can be applied to a variety of custom configurations. For custom seal geometries, please contact your Hallite representative.

BACK-UP RINGS/ANTI-EXTRUSION DEVICES

BACK-UP AND ADAPTER MATERIAL SELECTION

The materials and compounds selected in a seal's design will differ in their ability to resist seal extrusion once installed in a given application. The effects that temperature, pressure, and media have on the compound used are key considerations. When determining whether or not a sealing system requires the use of a back-up ring or anti-extrusion device, the magnitude of pressure a seal must contain and the clearance gap should be considered. The properties of the jacket materials used in the seal design provide varying levels of resistance to seal extrusion in a given application.

FDA APPROVED	COMPOUND	POLYMER	FILLER	COLOR	ABRASIAN RESISTANCE	METAL MATING WEAR	RELATIVE SEALABILITY	RELATIVE EXTRUSION RESISTANCE	MEDIA RESISTANCE					OPERATING TEMPATURE	
									HYDROCARBONS	OXYGENATED SOLVENTS	STEAM	ACIDS	BASES	F°	C°
Yes	728	ACETAL	None	Black	A	M	A	G	E	G	G	W	W	-70 to 300°F	-56 to 149°C
No	744	PPS	Glass	Grey	G	H	P	E	E	E	E	S	S	-70 to 500°F	-56 to 260°C
Yes	Arylex™ 745	PEEK	None	Beige	A	M	G	G	E	E	E	S	S	-70 to 500°F	-56 to 260°C
No	Arylex™ 747	PEEK	Glass	Beige	G	H	P	E	E	E	E	S	S	-70 to 550°F	-56 to 288°C
Yes	748	UHMWPE	None	Translucent	E	L	E	G	G	G	P	S	S	-300 to 180°F	-184 to 82°C
No	Arylex™ 754	PEEK	Carbon	Black	G	H	P	E	E	E	E	S	S	-70 to 550°F	-56 to 288°C

KEY

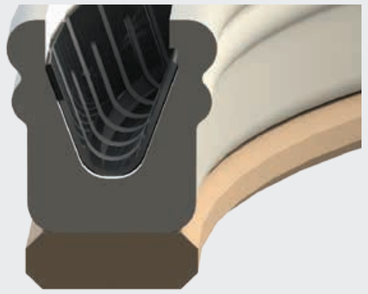
E = Excellent
G = Good
A = Average
P = Poor

H = High
M = Medium
L = Low

NR = Not Recommended
W = Resistant to weak acid/base
S = Resistant to strong acid/base

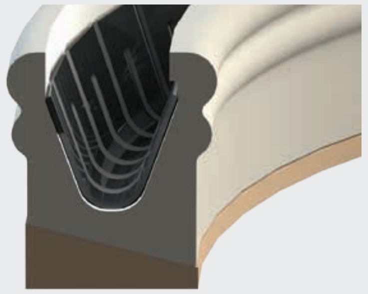
BACK-UP RING DESIGN OPTIONS

When back-up or auxiliary devices are required, Hallite can provide a range of components that prevent seal extrusion. Several geometries are used for anti-extrusion devices that allow the extrusion-resistant material to move into the clearance gap quickly and efficiently. Constructed from materials that are stronger than the seal jacket, the back-up ring blocks extrusion paths, allowing for maximum seal life in high-temperature and high-pressure applications.



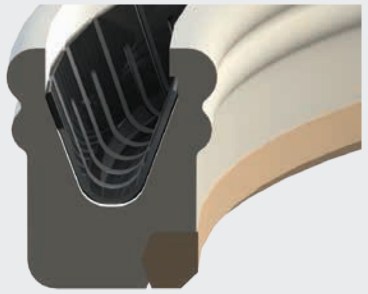
OPTIBACK™ COMPONENT

The standard back-up ring offered by Hallite features a close-tolerance rectangular OptiBack design. The chamfered edges on the OptiBack ring aid in installation.



DELTA BACK-UP RING

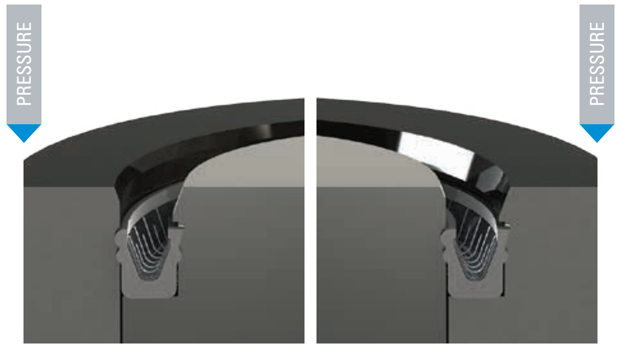
The Delta Back-Up uses system pressure to prevent seal extrusion when using the OptiSeal® system. The force induced by the system pressure will cause the Delta Back-Up to move into the extrusion gap and close it off.



INTEGRAL BACK-UP RING

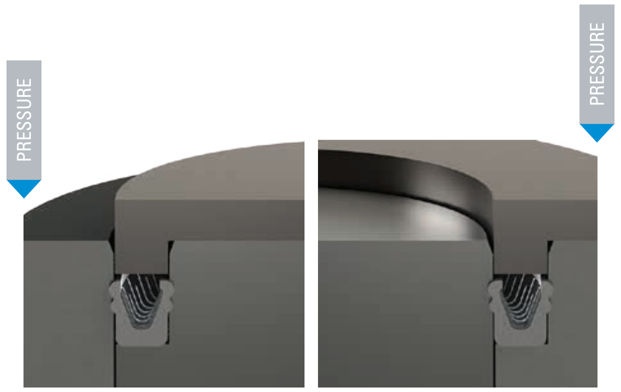
The Integral Back-Up is placed at the corner of the seal where the extrusion gap is located. This configuration is ideal when the axial gland length is so short as to prevent the use of a standard back-up. Its snap-in feature also eliminates loose components, thereby providing easier installation.

GLAND DESIGN OPTIONS



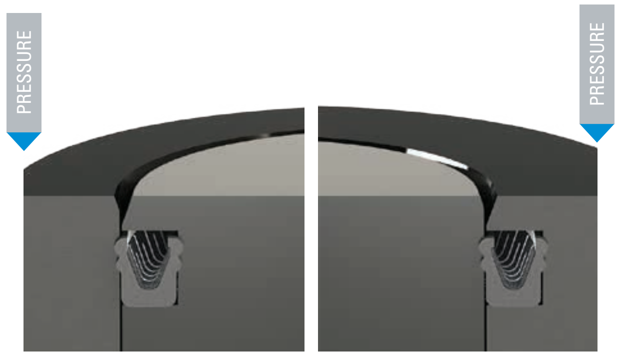
STEP-CUT GLAND

This modification of the one-piece gland minimizes the deformation of the OptiSeal® jacket during installation and eliminates the need for a separate retaining piece. Dimensions for step-cut glands are available upon request.



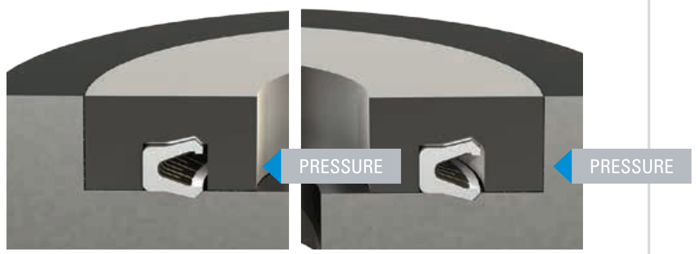
TWO-PIECE GLAND

The two-piece gland eliminates deformation during installation and is required for small-diameter or large cross-section designs. In reciprocating applications, the gland must be carefully designed, or a PakRing must be used to prevent the sealing lips from shifting on to the installation bevel.



ONE-PIECE GLAND

The one-piece gland is used only for OptiSeal® systems with larger diameters or small cross sections to prevent damage from stretching or buckling during installation. Please consult Hallite for installation tools and instruction before installing OptiSeal® components into this gland configuration.



FACE SEAL GLAND

Face seal gland design and seal design are different from the design of radial seals. Gland recommendations are available from Hallite for individual applications, or OptiFace seals may be proposed based upon existing gland dimensions.

GLAND RECOMMENDATIONS: OPTIGLAND

Larger gland diameters require greater tolerances to manufacture at reasonable and comparable costs. OptiSeal® components have a "designed-in" squeeze on the cross section, but manufacturing tolerances determine the minimum and maximum. If the minimum squeeze is too small, the seal can tolerate less wear before it fails. If the maximum squeeze is too large, the friction and wear will be unacceptable.

The Hallite OptiGland system of gland dimension recommendations is centered around the active gland diameter (the bore diameter for piston seals and the rod diameter for rod seals) and takes into account manufacturing capabilities, wear and friction concern, extrusion gaps, and expenses incurred during manufacturing. The OptiGland system calculates the optimal cross-section for a given active gland diameter or, working backwards, the optimal active diameter for a given cross section, giving consideration to the rationale of tolerance selection.

The result is a set of gland dimensions that balances the best seal performance and longevity with the lowest manufacturing costs required for that gland. The processes and examples below demonstrate how to effectively use OptiGland measurements.

PISTON SEALS: 8-STEP PROCESS

A	S	B	L	F	E	C
Active gland diameter	Minimum gland cross section	Non-active gland diameter	Minimum axial gland length	Minimum installation bevel length	Diametrical clearance	Gland clearance diameter

Step 1: Determine the active gland diameter. For piston seals, "A" equals the bore diameter and is the minimum gland OD.

Step 2: Determine the minimum gland cross section. This value is based on A and can be found in the Gland Dimension Examples tables on the following pages.

Step 3: Determine the non-active gland diameter. For piston seals, "B" equals A-2S and is the maximum gland ID.

Step 4: Determine tolerances for gland diameters. Tolerances are given in the Gland Dimension Examples tables on the following pages, dependent only upon cross section in order to control seal squeeze.

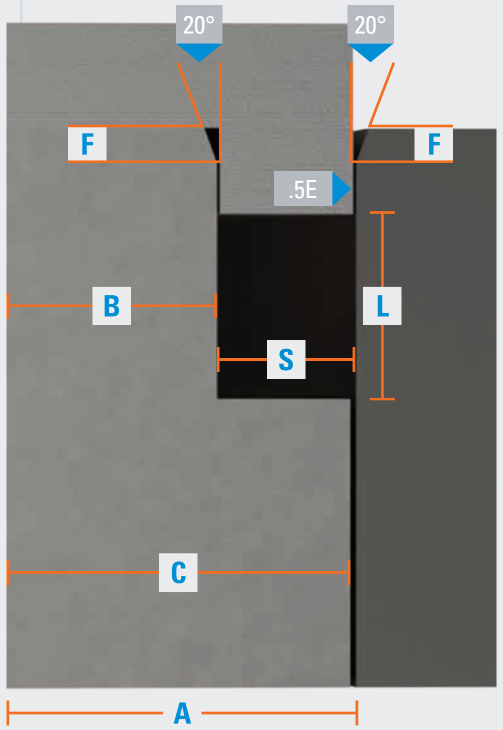
Step 5: Determine the minimum axial gland length. For pressures less than 10,000 psi (690 bar), use the value L_1. Value L_2 accommodates the addition of an OptiBack back-up ring and can be used for pressure above 10,000 psi (690 bar) up to 17,000 psi (1,172 bar). For pressures above 17,000 psi (1,172 bar), please consult Hallite. The tolerance for both L_1 and L_2 is 0.010in (0.25mm).

Step 6: Determine the minimum installation bevel length. This value is also given in the Gland Dimension Examples tables on the following pages, according to the cross section.

Step 7: Determine the minimum and maximum diametrical clearance. These values are shown in the table. The minimum diametrical clearance will be used to calculate "C"—the gland clearance diameter.

Step 8: Determine the gland clearance diameter and tolerance. For piston seals, C equals A-E minimum and is the maximum clearance diameter. Shaft and hole tolerances can be applied to these values using the table.

DIAGRAM 1
PISTOL SEAL RECOMMENDATION



ROD SEALS: 8-STEP PROCESS

A	S	B	L	F	E	C
Active gland diameter	Minimum gland cross section	Non-active gland diameter	Minimum axial gland length	Minimum installation bevel length	Diametrical clearance	Gland clearance diameter

Step 1: Determine the active gland diameter. For rod seals, "A" equals the rod diameter and is the maximum gland ID.

Step 2: Determine the minimum gland cross section. This value is based on A and can be found in the Gland Dimension Examples tables on the following pages.

Step 3: Determine the non-active gland diameter. For rod seals, "B" equals A+2S and is the minimum gland ØD.

Step 4: Determine tolerances for gland diameters. Tolerances are given in the Gland Dimension Examples tables on the following pages, dependent only upon cross section in order to control seal squeeze.

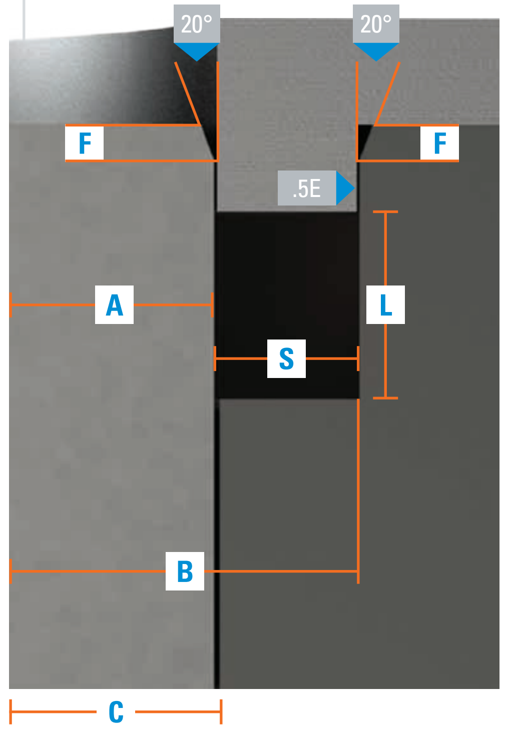
Step 5: Determine the minimum axial gland length. For pressures less than 10,000 psi (690 bar), use the value L_1. Value L_2 accommodates the addition of an OptiBack back-up ring and can be used for pressure above 10,000 psi (690 bar) up to 17,000 psi (1,172 bar). For pressures above 17,000 (1,172 bar), please consult Hallite. The tolerance for both L_1 and L_2 is 0.010in (0.25mm).

Step 6: Determine the minimum installation bevel length. This value is also given in the Gland Dimension Examples tables on the following pages, according to the cross section.

Step 7: Determine the minimum and maximum diametrical clearance. These values are shown in the table. The minimum diametrical clearance will be used to calculate "C"—the gland clearance diameter.

Step 8: Determine the gland clearance diameter and tolerance. For rod seals, C equals A+E min and is the minimum clearance diameter.

DIAGRAM 2
ROD SEAL RECOMMENDATION



SUGGESTED GLAND SURFACE FINISHES

STATIC	DYNAMIC
Ra 32 max	Ra 16 max
Ra 0.8 μm max.	Ra 0.4 μm max.

GLAND DIMENSION EXAMPLES

These examples show a relationship between active diameter and gland cross section.

METRIC

ROD DIAMETER OR CYLINDER BORE	NOMINAL GLAND CROSS SECTION	MINIMUM GLAND CROSS SECTION	MINIMUM AXIAL GLAND LENGTH	MINIMUM AXIAL GLAND LENGTH	MINIMUM INSTALLATION BEVEL LENGTH	MINIMUM DIAmetricAL CLEARANCE	MAXIMUM DIAmetricAL CLEARANCE	SHAFT TOLERANCE	HOLE TOLERANCE
A		S	$L_1 + 0.25$	L2 + 0.25	F min.	E min.	E max.	-.xxx	+.xxx
5.0 - 14.9	3.00	2.98	4.06	5.45	0.86	0.02	0.11	0.03	0.06
15.0 - 24.9	4.00	3.97	5.37	7.19	1.14	0.04	0.17	0.05	0.08
25.0 - 59.9	5.00	4.96	6.64	8.92	1.43	0.05	0.20	0.06	0.09
60.0 - 169.9	7.50	7.44	9.82	13.24	2.14	0.09	0.33	0.10	0.14
170.0 - 409.9	10.00	9.92	13.01	17.53	2.85	0.12	0.45	0.15	0.18
410.0 - 500.0	12.50	12.41	16.16	21.81	3.56	0.17	0.60	0.20	0.23

INCH

ROD DIAMETER OR CYLINDER BORE	NOMINAL GLAND CROSS SECTION	MINIMUM GLAND CROSS SECTION	MINIMUM AXIAL GLAND LENGTH	MINIMUM AXIAL GLAND LENGTH	MINIMUM INSTALLATION BEVEL LENGTH	MINIMUM DIAmetricAL CLEARANCE	MAXIMUM DIAmetricAL CLEARANCE	SHAFT TOLERANCE	HOLE TOLERANCE
A		S	$L_1 + .010$	$L_2 + .010$	F min.	E min.	E max	-.xxx	+.xxx
0.215 - 0.749	0.125	0.124	0.169	0.226	0.036	0.001	0.004	0.001	0.002
0.750 - 2.499	0.188	0.186	0.250	0.336	0.054	0.002	0.009	0.003	0.004
2.500 - 6.499	0.250	0.248	0.329	0.443	0.071	0.003	0.012	0.004	0.005
6.500 - 16.999	0.375	0.372	0.488	0.658	0.107	0.005	0.018	0.006	0.007
17.000 - 20.000	0.500	0.496	0.646	0.872	0.142	0.007	0.023	0.007	0.009

Notes: For pressures less than 10,000 psi (690 bar), the OptiSeal® system can be used without back-up ring and axial gland length L_1. For pressures greater than or equal to 10,000 psi (690 bar) but less than 17,000 psi (1,172 bar), the OptiBack back-up ring can be used with the OptiSeal® system and axial gland length L_2. Contact Hallite regarding: all pressures exceeding 17,000 psi (1,172 bar), and regarding piston seals with bore diameters of .500in/.254m or less.

GLAND DIMENSION EXAMPLES

METRIC

NOMINAL GLAND CROSS SECTION	200mm ROD, 125 bar	
	DIMENSION	TOLERANCE
Max. Gland ID	181.16	-0.15
Min. Gland OD	200.00	+0.18
Nom. Gland Cross Section	10.00	Nominal
Min. Gland Cross Section	9.92	Minimum
Min. Axial Gland Length	13.01	+0.25
Min. Installation Bevel Length	2.85	Minimum
Min. Diametrical Clearance	0.12	Minimum
Gland Clearance Diameter	199.88	+0.15
Max. Diametrical Clearance	0.45	Maximum

INCH

NOMINAL GLAND CROSS SECTION	4" ROD, 15,000 PSI	
	DIMENSION	TOLERANCE
Max. Gland ID	4.000	-0.004
Min. Gland OD	4.496	+0.005
Nom. Gland Cross Section	0.250	Nominal
Min. Gland Cross Section	0.248	Minimum
Min. Axial Gland Length	0.443	0.010
Min. Installation Bevel Length	0.071	Minimum
Min. Diametrical Clearance	0.003	Minimum
Gland Clearance Diameter	4.003	+0.005
Max. Diametrical Clearance	0.012	Maximum

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This edition supersedes all previous brochures.

HALLITE SEALS

As a global provider of high-performance sealing solutions, Hallite's reputation is backed by 100 years of excellence in engineering, manufacturing, sustained technical support, and customer service. With some of the industry's shortest lead times, we bring to market a diverse portfolio of cataloged and customized sealing solutions made from materials that are formulated for performance-critical environments. From the off-highway equipment used in construction and infrastructure to the landing gear used in aerospace, Hallite fluid seals are key components utilized in the most demanding applications.

To meet growing worldwide demand, Hallite combines carefully chosen and managed inventory in local markets, supported by fast-track molding and machining capabilities to provide high service levels. Hallite offers a broad range of catalog products, OEM custom molded and machined designs and custom on-demand machining capabilities from design to shipment.

Hallite operations can be found in strategic geographies throughout Asia Pacific, Western Europe, and North America. Combining an expansive global footprint with a dense network of strategic service partners completes our global presence; ensuring that the full range of Hallite products, capabilities, and expertise are always available when and where you need them most.

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