BAL SEAL® ENGINEERING, INC.

Reciprocating Seal Catalog
DM-6

Sealing Solutions for Reciprocating and Static Applications

- Low Friction
- Chemical Compatibility
- Vacuum to High Pressure
- Extreme Temperatures
- Engineered for High Performance

Bal Seal Engineering, Inc. is an industry leader providing innovative, custom-engineered sealing, connecting, conducting and shielding solutions to OEM design engineers around the world.

Since 1999, we have maintained our ISO-9001 Certification and received numerous supplier performance awards

We encourage you to use this Reciprocating Seal Catalog as a general design guide. When you have determined your engineering needs, you can contact our Engineering Team to discuss specific application parameters.

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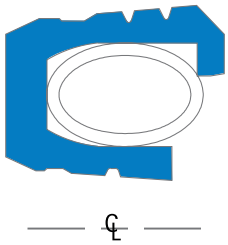
Design Features and Benefits

SHORTENED DYNAMIC LIP (reciprocating)

Series 13 for Housing Mounting / Series 14 for Piston Mounting

Features short dynamic sealing lip. This feature improves overall seal performance by providing:

- Improved sealing ability
- Better wiping
- Reduced friction
- Reduced heat build-up for longer life

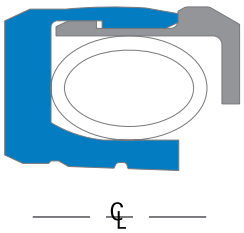


METAL RETAINING RING (reciprocating)

Series KS13

A self-retaining seal with metal-to-metal contact between housing material and metal locking ring.

- Good retention
- Suitable for high and low temperatures
- Greater thermal stability

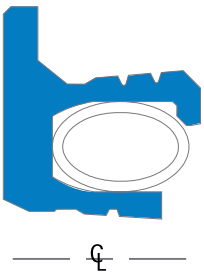


FLANGED SEAL (reciprocating)

Series R13

Reduces seal shuttling and provides secondary sealing on the flange.

- Well-suited for cryogenic applications
- Long term sealing applications

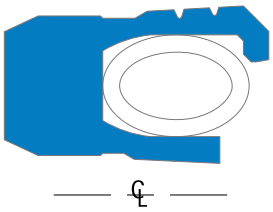


HIGH PRESSURE SEAL (reciprocating)

Series UN13, UN14, UN15,

High pressure reciprocating service.

- Excellent sealing ability
- Extended heel zone for increased seal strength
- Longer seal life with better resistance to extrusion
- Improved stability/performance at high temperatures and pressures

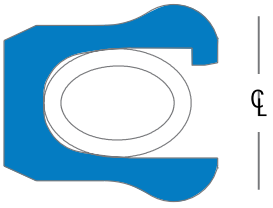


FACE SEAL

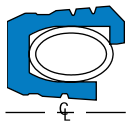
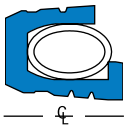
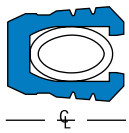
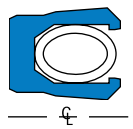
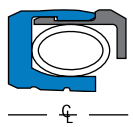
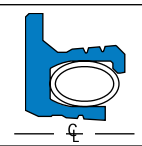
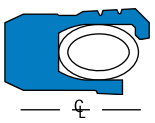
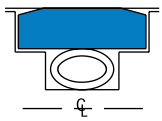
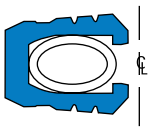
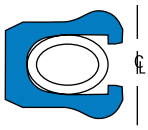
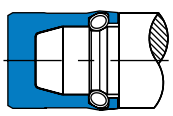
Series S2, for internal pressure / IS2 for external pressure

Radial shape sealing lips create higher sealing ability.

- Suitable for cryogenic applications
- Suitable for oscillatory and slow rotary applications



Reciprocating/Static Canted-Coil™ Spring Energized Seals

Seal Design	Series	Features/Applications	Pressure Limit (psi)	Cross Section Range (inch)	Inside Diameter Range (inch)
	**13** 14	Wiping, low friction, longer life.	3,000	.031 - .500	.062 - 74.00
	**P14** P15	One piece pistons with 1/4 step. Better seal retention into groove.	3,000	.062 - .187	.312 - 1.875
	**15**	Symmetrical design for piston or sealing rod.	3,000	.031 - .500	.062 - 74.00
	**CC13** CC15 CC14	Very small diameters and small cross-sections.	2,000	.016 - .062	.016 - .093
	**KS13***	For thermal cycling and self-retaining with a metal locking ring. High and low temperatures.	3,000	.062 - .500	.125 - 34.00
	**R13** IR14	Flange-mounted. Reduces seal movement. Low friction, longer life.	3,000	.031 - .500	.062 - 74.00
	**UN13** UN14 UN15	For high pressure, low friction.	10,000	.031 - .500	.062 - 74.00
	**PW** HW	Spring-energized guide ring for better piston guidance and alignment.	NA	.031 - .500	.062 - 60+
	**S15** IS15	For use in internal or external pressure conditions.	3,000	.062 - .250	.188 - 72.00
	**S2** IS2	Face seal for static sealing and slow rotary applications.	3,000 (static)	.062 - .250	.188 - 72.00
	**64**	Low dead volume. Excellent chemical compatibility. Vacuum to low pressure. Snap-on assembly. Seal permanently locks onto piston.	60	.031 - .125	OD Range .063 and up

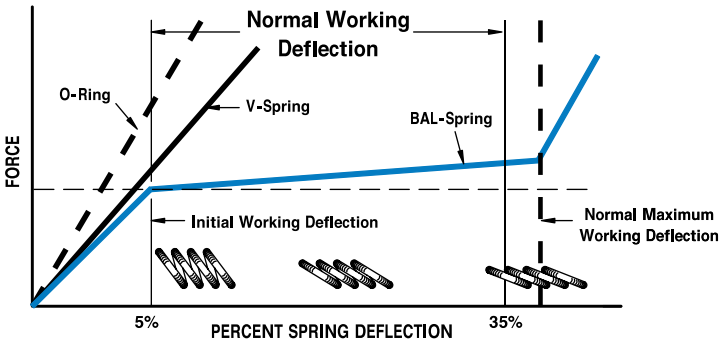
Pressure limits are based on UHMWPE. PTFE material pressure limits will be lower.
*See DM-5 for complete information

Bal Seal Materials

	Material Code/Description	Material Temperature Range °F @ ATM	Wear Resistance 5=Excellent 1=Fair	Pressure/Extrusion Resistance 5=Excellent 1=Fair	Abrasion to Shaft
UNFILLED	**T VIRGIN PTFE** Light duty service. Lowest friction. Excellent chemical compatibility. FDA compliant. Color: White	-450 to 450 (-270 to 230)	1	1	Low
UNFILLED	**TA PTFE - LOW PERMEABILITY/DEFORMATION** Superior mechanical properties with good surface finishes, good sealing ability in gases and vacuum. Suitable for semiconductor applications. FDA compliant. Color: White	-450 to 450 (-270 to 230)	2	2	Low
FILLED	**G GRAPHITE-FILLED PTFE** Light duty service. Low friction. Very good chemical compatibility. Good wear resistance in liquids, humid conditions. Color: Black	-450 to 450 (-270 to 230)	2	2	Low
FILLED	**GC GRAPHITE-CARBON-FILLED PTFE** General light duty. Low friction. Very good chemical compatibility. Good wear resistance in liquids, humid conditions. Color: Black	-450 to 475 (-270 to 250)	3	3	Low
FILLED	**GFP GRAPHITE FIBER REINFORCED PTFE** Moderate to extreme service conditions of high pressure, high temperature at moderate speed. Color: Black	-320 to 500 (-200 to 260)	4	5	Medium
FILLED	**GFP HT GRAPHITE FIBER REINFORCED PTFE** Similar to GFP. Provides greater stability at higher temperatures to 550°F (288°C). Color: Black	-320 to 550 (-200 to 290)	5	5	High
FILLED	**GFPM MOS2-REINFORCED PTFE** Severe dry and liquid service. Excellent wear and extrusion resistance in liquids, inert gases, vacuum. Color: Black	-320 to 500 (-200 to 260)	5	5	Medium
FILLED	**GLMO-4 GLASS-MOLY FILLED PTFE** For severe conditions, excellent extrusion resistance. May be abrasive to soft mating materials. Color: Black	-320 to 500 (-200 to 260)	4	5	High
FILLED	**GL-20 GLASS-FILLED PTFE** Severe dry/vacuum service. Excellent wear and extrusion resistance, and low outgassing. Color: Off White	-320 to 475 (-200 to 250)	5	5	High
FILLED	**SP-45 POLYMER FILLED PTFE** Good wear resistance in liquid or dry environments. Low abrasion to dynamic mating surfaces. Suitable for high speed low pressure and vacuum service. FDA compatible. Color: Light Green	-320 to 475 (-200 to 250)	5	4	Low
FILLED	**SP-50 POLYMER FILLED PTFE** General service applications. Excellent wear resistance in gases, air. Limited wear resistance in water. Low abrasion to dynamic surfaces. Suitable for high speed low pressure. FDA compatible. Color: Grayish Brown	-320 to 475 (-200 to 250)	4	4	Low
POLYETHYLENE	**UPC-10 POLYETHYLENE** Aqueous service. Good wear and extrusion resistance in aqueous media. For general service. FDA compliant. Color: Translucent White	-450 to 180 (-270 to 80)	4 (Aqueous Solutions)	5	Low
POLYETHYLENE	**UPC-16 POLYETHYLENE** High purity, high wear resistance in water and aqueous solutions. FDA compliant. Color: Translucent White	-450 to 180 (-270 to 80)	4 (Aqueous Solutions)	5	Low
POLYETHYLENE	**UP-40 UHMW POLYETHYLENE BLEND** Suitable for very high pressure low speed reciprocating applications such as HPLC. FDA compatible. Color: Gold	-450 to 180 (-270 to 80)	5 (Aqueous Solutions)	5	Low
OTHER	**P-41 HT / P-43 HT HIGH PERFORMANCE POLYMERS** High performance materials for high temperature service. FDA compliant. Color: Beige	-70 to 600 (-60 to 300)	5	5	Medium

Bal-Spring™

Bal Seal Engineering is the original developer of the Canted-coil™ Bal-Spring™. Our patented design holds the spring force nearly constant over a wide deflection range. As the seal jacket wears, the spring continues to provide the same sealing force. Spring loads are interchangeable, enabling the customer to optimize friction, sealing and performance life.

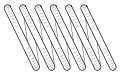
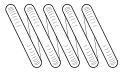
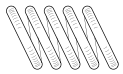


SPRING MATERIALS

Spring Material*	Code	Corrosion Resistance	High Temp. Performance
302 Stainless Steel	302	Fair	Fair
316 Stainless Steel	316	Good	Fair
316L Stainless Steel	316L	Very Good	Fair
Beryllium Copper	BEC	Very Good	Excellent
Hastelloy® C-276 Nickel Alloy	HST	Very Good	Excellent
MP35N Nickel Alloy	MPN	Excellent	Fair
Inconel® X-750 Nickel Alloy	INC	Very Good	Excellent
Titanium Grade 5	TNM5	Excellent	Good

*Other materials are available to meet specific conditions.

BAL SEAL ENERGIZERS

Energizer	Code	Friction	Sealing	Wear	High Speed	Vacuum Gas	High Pressure
	LB	Low	Low	Low	Excellent	Not Recommended	Good
	MB	Moderate	Moderate	Moderate	Good	Fair	Excellent
	HB	High	High	High	Not Recommended	Good	Excellent
	OR (O-Ring)	High	High	High	Not Recommended	Excellent	Fair

Bal Seal Part Description Information

CALL OUT: XXX X XX - XXX - XXX - XXX - XXX
STEP NO: ① ②③ ④ ⑤ ⑥ ⑦

Example: 13 4 LB-.625-GFP-10-HST

① Seal Design
13, 14, 15, P14, P15, CC13, CC14, CC15, KS13, R13, IR14, UN13, UN14, UN15, UR13 and others. Refer to Bal Seal Selection Guide page 3.

② Seal Cross Section
2, 1, 0, 4, 5, 6, 7, 8, and 9 Refer to Standard Cross Sections table on this page below.

③ Spring Force
LB, MB, HB and others. Refer to page 5 for description of standard spring loads.

④ Size
Enter the desired seal ID, example; (1.000) or (.250). Refer to page 7 for size ranges. Contact Bal Seal for sizes not shown.

⑤ Seal Material
T, TA, GL-20, G, GC, GFP-10, GFP-10 HT, GFPM-10, GLMO-4, SP-45, SP-50, UPC-10, UPC-16 and others. Refer to Bal Seal Materials Guide on page 4.

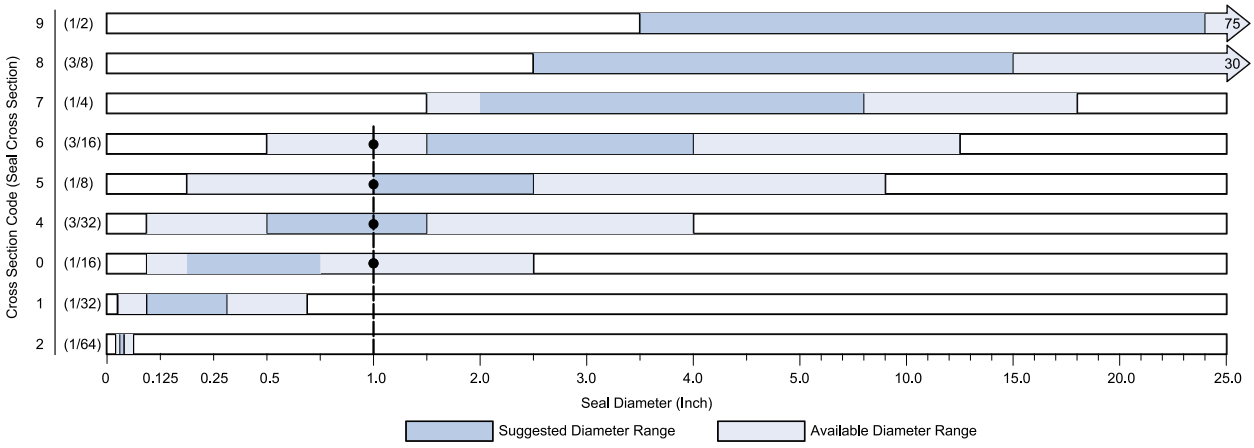
⑥ Spring Material
302, 316, 316L, HST, MPN, INC, TNM, and others. Refer to page 5 for description of standard spring materials.

⑦ Welding
Cut Length of Spring (no call out), SOW (single overlap weld), and PW (point weld). Consult Bal Seal for other welding options.

SUGGESTED STANDARD CROSS SECTIONS AND SEAL INSIDE DIAMETER CHART/DIAGRAM

Cross sections range from .015 (1/64) to .500 (1/2). Seal cross section and seal inside diameter are divided into available and suggested size ranges. Suggested sizes will generally result in better seal performance.

Cross Section Code	Nominal Cross Section	SEAL INSIDE DIAMETER SIZE RANGES			
		Available Sizes	Suggested Sizes		Available Sizes
		Min	Min	Max	Max
2	.015 (1/64)	.016	.031	.040	.062
1	.031 (1/32)	.025	.041	.312	.687
0	.062 (1/16)	.050	.187	.750	2.500
4	.094 (3/32)	.094	.500	1.500	4.000
5	.125 (1/8)	.187	1.000	2.500	9.000
6	.187 (3/16)	.500	1.500	4.000	12.500
7	.250 (1/4)	1.500	2.000	8.000	18.000
8	.375 (3/8)	as requested	2.500	15.000	30.000
9	.500 (1/2)	as requested	3.500	24.000	75.000



Example: A 1.0" seal diameter is available in cross sections 1/16, 3/32, 1/8, and 3/16.

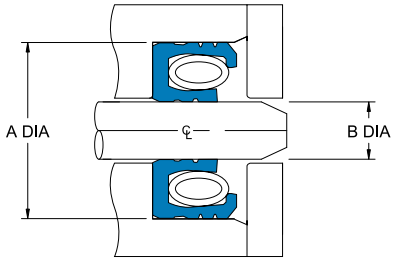
All dimensions shown on all pages are in inches.
Other seal cross sections are available. Millimeter cross sections are also available as standards.
Bal Seal Engineering, Inc. can retrofit its seal designs featuring the Canted-coil™ spring for most glands. Call our Technical Sales Department for details.

Reciprocating/Slow Rotary—Common Industrial Sizes and Gland Diameters

BORE/HOUSING MOUNTED

SEAL DESIGNS*

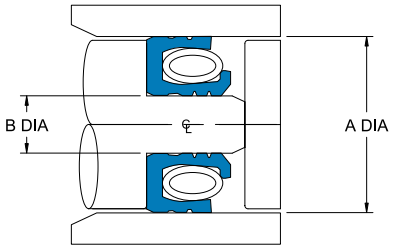
13	UN13
15	UN15
CC13	CCU13
R13	UR13
KS	



SHAFT/PISTON MOUNTED

SEAL DESIGNS*

14	UN14
15	UN15
OCC14	OCCU14
IR14	UIR14
KSP	



B Diameter	A Diameter
CC-Designs Only Cross Section Code 2 1/64-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.016 to .062	.047 to .094
CC-Designs Only Cross Section Code 1 1/32-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.025 to .062	.088 to .125
All Designs Cross Section Code 1 1/32-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.062 to .375	.125 to .437
+.000 -.001	+.001 -.000
.437 to .687	.500 to .750
CC-Designs Only Cross Section Code 0 1/16-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.050 to .093	.175 to .219

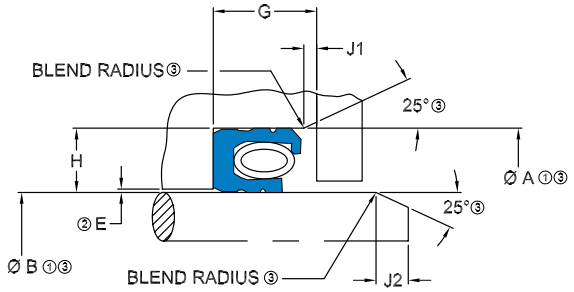
B Diameter	A Diameter
All Designs Cross Section Code 0 1/16-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.094 to .375	.219 to .500
+.000 -.001	+.001 -.000
.437 to 1.500	.562 to 1.625
+.0000 -.0015	+.0015 -.0000
1.625 to 2.500	1.750 to 2.625
All Designs Cross Section Code 4 3/32-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.094 to .375	.281 to .562
+.000 -.001	+.001 -.000
.437 to 1.500	.625 to 1.687
+.0000 -.0015	+.0015 -.0000
1.750 to 2.500	1.937 to 2.687
+.000 -.002	+.002 -.000
2.812 to 4.000	3.000 to 4.187

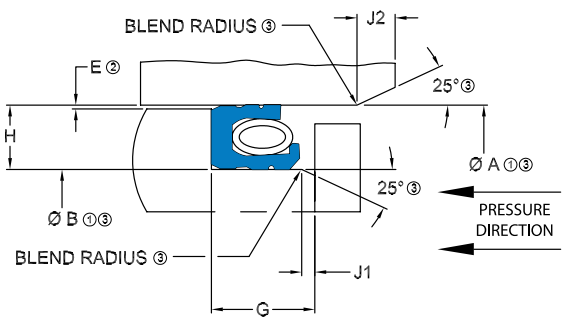
B Diameter	A Diameter
All Designs Cross Section Code 5 1/8-Inch Nominal	
+.0000 -.0005	+.0005 -.0000
.187 to .375	.437 to .625
+.000 -.001	+.001 -.000
.437 to 1.500	.687 to 1.750
+.0000 -.0015	+.0015 -.0000
1.625 to 2.500	1.875 to 2.750
+.000 -.002	+.002 -.000
2.625 to 4.000	2.875 to 4.250
+.000 -.003	+.003 -.000
4.125 to 9.000	4.375 to 9.250
All Designs Cross Section Code 6 3/16-Inch Nominal	
+.000 -.001	+.001 -.000
.500 to 1.500	.875 to 1.375
+.0000 -.0015	+.0015 -.0000
1.625 to 2.500	2.000 to 2.875

B Diameter	A Diameter
All Designs Cross Section Code 6 3/16-Inch Nominal	
+.000 -.002	+.002 -.000
2.625 to 4.000	3.000 to 4.375
All Designs Cross Section Code 7 1/4-Inch Nominal	
+.0000 -.0015	+.0015 -.0000
1.500 to 2.500	2.000 to 3.000
+.000 -.002	+.002 -.000
2.750 to 4.000	3.250 to 4.500
+.000 -.003	+.003 -.000
4.500 to 18.000	5.000 to 18.500
All Designs Cross Section Code 8 3/8-Inch Nominal	
+.000 -.003	+.003 -.000
2.500 to 40.000	3.250 to 40.750
All Designs Cross Section Code 9 1/2-Inch Nominal	
+.000 -.003	+.003 -.000
3.500 to 75.000	4.500 to 76.000

*Other seal designs are available. Contact our Technical Sales Department for more information.

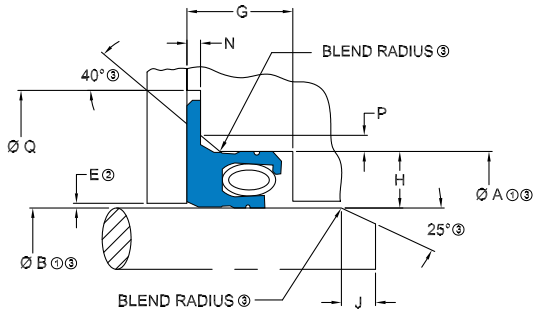
Reciprocating/Slow Rotary—Seal Gland Dimensions

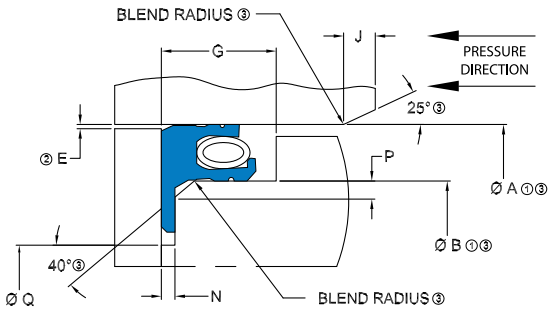




Cross Section Code	H Gland Height (Nominal)	G GLAND LENGTH		CHAMFER LENGTH	
		Standard Seals	U Seals	J1	J2
2	.015 (1/64)	.029/.034	.055/.058	.005±.001	.015±.003
1	.031 (1/32)	.053/.058	.071/.076	.007±.001	.031±.004
0	.062 (1/16)	.098/.103	.120/.125	.010±.002	.062±.005
4	.094 (3/32)	.144/.154	.183/.193	.015±.003	.093±.006
5	.125 (1/8)	.183/.193	.263/.273	.020±.003	.125±.008
6	.187 (3/16)	.263/.273	.351/.366	.025±.003	.187±.010
7	.250 (1/4)	.351/.366	.523/.543	.035±.003	.250±.012
8	.375 (3/8)	.523/.543	.686/.711	.045±.004	.375±.015
9	.500 (1/2)	.686/.711	.911/.931	.060±.006	.500±.020

①Check pages 8 and 9 for gland diameters of common seal sizes. ②Radial clearance varies with service conditions. A recommended radial clearance is shown on Bal Seal design proposal drawings. Refer to page 9 for recommended radial clearance. ③Refer to page 9 for recommended surface finishes. ④For KS13x and 64x series gland dimensions, consult with Bal Seal technical sales.





Cross Section Code	H Gland Height (Nominal)	G GLAND LENGTH		N Flange Depth	P Chamfer Height	Q BORE/SHAFT DIA		J Chamfer Length
		R/IR Seals	UR/UIR Seals			R/UR Seals +xxx/-0	IR/UIR Seals +0/-xxx	
1	.031 (1/32)	.075/.095	.092/.112	.012/.013	.012/.017	A + .096	B - .096	.031±.004
0	.062 (1/16)	.117/.137	.138/.158	.012/.013	.017/.023	A + .135	B - .135	.062±.005
4	.094 (3/32)	.171/.191	.203/.223	.019/.020	.028/.035	A + .143	B - .143	.093±.006
5	.125 (1/8)	.220/.240	.259/.279	.026/.027	.040/.049	A + .155	B - .155	.125±.008
6	.187 (3/16)	.280/.300	.351/.371	.031/.032	.057/.067	A + .246	B - .246	.187±.010
7	.250 (1/4)	.375/.395	.489/.509	.044/.045	.069/.080	A + .306	B - .306	.250±.012
8	.375 (3/8)	.565/.585	.741/.761	.088/.090	.080/.092	A + .384	B - .384	.375±.015
9	.500 (1/2)	.743/.763	.980/1.000	.088/.090	.092/.103	A + .480	B - .480	.500±.020

Radial clearance varies with service conditions. A recommended radial clearance is shown on Bal Seal design proposal drawings. ①Refer to page 9 for recommended radial clearance. ②Refer to page 9 for recommended surface finishes. ③For KS13x and 64x series gland dimensions, consult with Bal Seal technical sales.

Design Parameters

When designing the seal gland, the following areas should be considered in order to maintain and increase the performance and life of the seal. There are many factors that affect the seal performance, all of which should be considered when determining the most suitable design parameters for the application. Refer to Bal Seal Technical Report TR-78 (Factors that Affect Seal Performance).

Radial Clearance

Extrusion is the flowing of the seal ring material into the radial ("E") clearance of the seal gland, which is due to the media pressure acting on the seal's internal cavity. Excessive extrusion can result in seal lip blowout and failure. The extrusion of the seal material increases as the pressure and/or radial ("E") clearance increases, as well as other factors such as temperature and seal material. A Bal Seal backup ring should be used if the "E" clearance cannot be controlled as required. Refer to Bal Seal PN-228 for additional extrusion information.

TYPICAL RADIAL CLEARANCE "E" @ 70° F

Code	Cross Section	Pressure (psi)			
		150	1,500	3,000	10,000
2	1/64 (.016)	0.001	0.001	0.0005	0.0005
1	1/32 (.031)	0.002	0.002	0.001	0.0005
0	1/16 (.062)	0.004	0.003	0.002	0.001
4	3/32 (.094)	0.005	0.003	0.002	0.001
5	1/8 (.125)	0.006	0.004	0.003	0.0015
6	3/16 (.187)	0.007	0.004	0.003	0.0015
7	1/4 (.250)	0.008	0.005	0.004	0.002
8	3/8 (.375)	0.01	0.006	0.005	0.002
9	1/2 (.500)	0.012	0.007	0.006	0.003

Dynamic Surface Hardness

A dynamic surface with a higher hardness will reduce adhesion of the seal ring material onto that surface, thereby reducing friction and consequently premature seal wear. Refer to Bal Seal Technical Report TR-1 (Treatments of Metal Surfaces to Improve Bal Seal Performance in Dynamic Applications).

Surface Finish

The surface finish of the dynamic material has a substantial effect on the seal performance. In general, the better the surface finish, the better the seal performance. A good surface finish results in better sealing ability, lower abrasive wear and longer seal life. Small imperfections such as scratches, cutter tool marks, porosity and eccentricities can create leakage paths, depending on the media type and pressure, and should be reduced to minimum. Refer to Bal Seal Technical Report TR-4 (Influence of Surface Finish on Bal Seal Performance).

RECOMMENDED SURFACE FINISHES

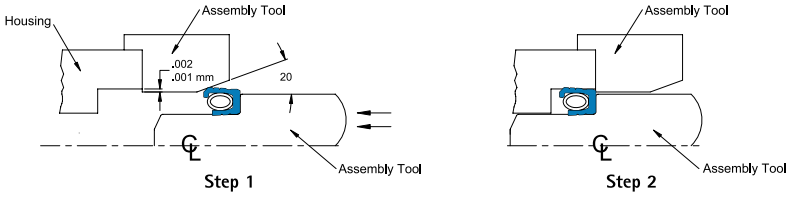
Media/Conditions	Dynamic Surface	Static Surface
Cryogenic Conditions	2 - 4 RMS (1.8 - 3.6 Ra)	4 - 8 RMS (3.6 - 7.2 Ra)
Gases (Air, N_2, O_2 etc.)	6 - 12 RMS (5.4 - 10.8 Ra)	12 - 32 RMS (10.8 - 28.8 Ra)
Liquids (Hydraulic Fluid, Water, etc.)	8 - 16 RMS (7.2 - 14.4 Ra)	16 - 32 RMS (7.2 - 28.8 Ra)

Assembly and Installation Configurations

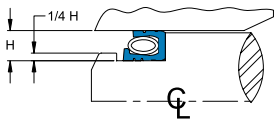
Assembly of Bal Seals into 1/4, 1/2, and solid piston grooves may permanently deform the seal, thereby reducing the sealing ability and seal life. Therefore, Bal Seal recommends the use of a split gland whenever possible. Refer to options 1 through 4 below; Option 1 is preferred and Option 4 is the least desirable, incurring the most deformation during assembly.

To reduce the risk of seal damage during installation into a housing or bore without an adequate lead chamfer, we suggest using assembly tools similar to those shown in the illustrations. The plastic assembly tools guide the seal into the bore, and provide a suitable lead-in taper. Collet assembly tools gradually stretch the seal over the piston and into the gland. For details on assembly procedures and limitations, request Bal Seal 6.2 literature. At the user's request, Bal Seal Engineering will supply dimensional information for fabricating of assembly tools for specific applications.

Assembly into Housing
(Option 1)



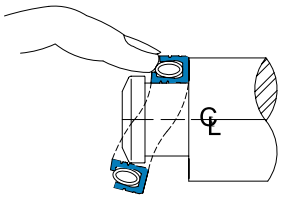
Stepped Glands, Manual Assembly
(Option 2)

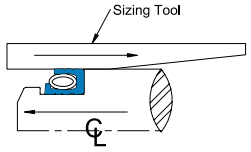


1/4H Step Piston

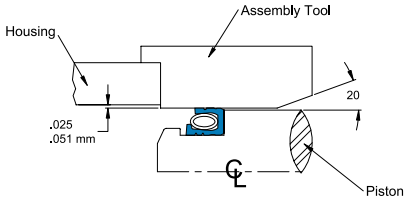
SEAL ID RANGE FOR MANUAL ASSEMBLY
Based on cross section and 1/4 H piston step.

Code	1/4 H Step Gland Min.	1/4 H Step Gland Max.
0	.312	1.875
4	.438	2.875
5	.750	3.750
6	1.125	5.625


Step 1
Insert large diameter seal in piston groove with fingers

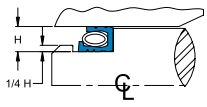


Step 2
Place sizing tool over the seal and leave minimum 1 hour, preferably 24 hours.

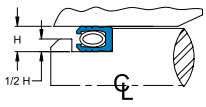


Step 3
Remove sizing tool and assemble piston into the bore

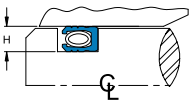
Stepped and Solid Glands, Tool Assembly
(Options 2,3 and 4)



1/4H Step Piston (Option 2)



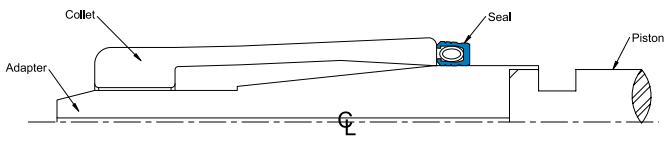
1/2H Step Piston (Option 3)



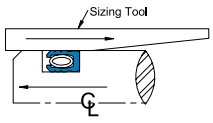
Solid Piston (Option 4)

SEAL ID RANGE FOR ASSEMBLY WITH TOOLS
Based on cross section and piston step configuration.

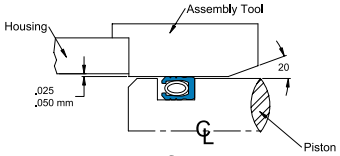
Cross Section Code	1/4 H Step Gland Min.	1/4 H Step Gland Max.	1/2 H Step Gland Min.	1/2 H Step Gland Max.	Solid Gland Min.	Solid Gland Max.
0	.219	1.875	.312	1.875	.500	1.875
4	.312	2.875	.375	2.875	.625	2.875
5	.625	3.750	1.000	3.750	1.250	3.750
6	1.000	5.625	1.250	5.625	1.500	5.625



Step 1
Using a seal assembly adapter, push the seal into the piston gland with an assembly collet



Step 2
Place sizing tool over the seal and leave minimum 1 hour, preferably 24 hours.



Step 3
Remove sizing tool and assemble piston into the bore

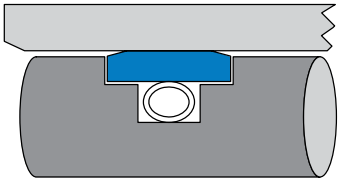
Other specialized assembly methods are available. Contact our Technical Sales Department for more details.

BAL SEAL GUIDE RINGS

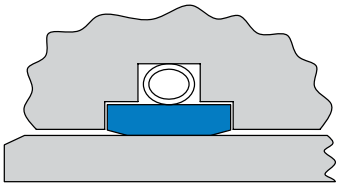
Bal Seal Guide Rings Give Piston Support

Bal-Spring™ energized guide rings used with Bal Seal fluid seals help prevent metal-to-metal contact and provide piston guidance and support. Bal Seal guide rings differ from conventional wear rings in one major respect: our unique Canted-coil™ Bal-Spring supports the weight of the piston or rod evenly around the circumference and compensates for wear.

Selection between light, medium, and heavy spring forces tailor the guide ring for a suitable mix of friction and piston support. Provide our technical sales staff with your application details, so we can propose the optimum ring material and spring force combination. Contact our Technical Sales Department for more information.



PW GUIDE RING
PISTON MOUNTED

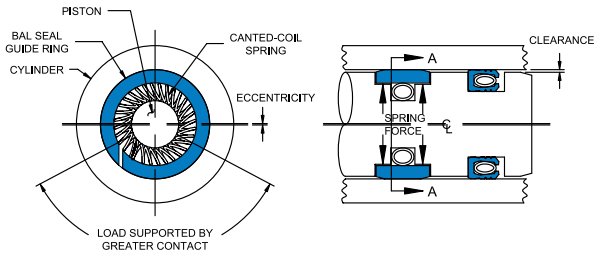


HW GUIDE RING
HOUSING MOUNTED

PISTON SUPPORT

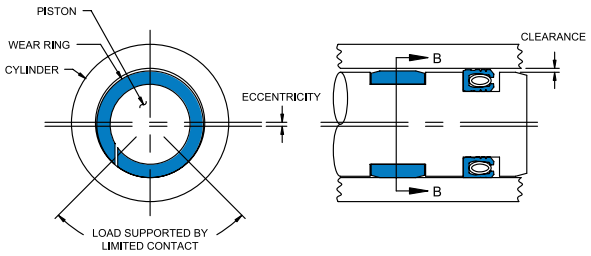
Bal Seal Guide Rings vs. Conventional Wear Rings

FEATURES OF BAL SEAL GUIDE RING



- Supports piston weight
- Reduces bearing load
- Reduces cylinder scoring
- Minimizes side loading
- Compensates for wear

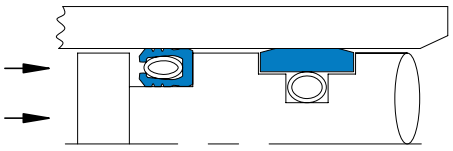
LIMITATIONS OF CONVENTIONAL WEAR RING



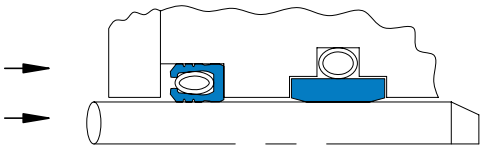
- Overcome by weight of piston
- Increases stress
- Allows metal-to-metal contact
- Succumbs to side loading
- Accelerates wear

IMPROVED SEAL PERFORMANCE

Bal Seal Guide Rings Improve Seal Performance



PISTON MOUNTED PW GUIDE RING
WITH A LOW FRICTION BAL SEAL

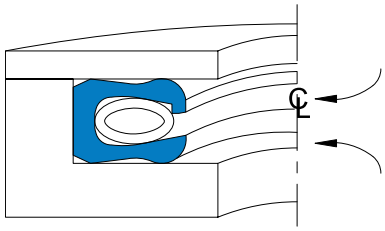


HOUSING MOUNTED HW GUIDE RING
WITH A LOW FRICTION BAL SEAL

Bal Seal static face seals assemble into a gland, flange, or counterbore for internal or external pressure, static or dynamic sealing. Because the Bal Seal Canted-coil™ energizing spring provides nearly constant load over a wide range of deflection, variations in gland depth tolerance have a minor effect on seal load. PTFE-based seal materials make the seal compatible with a substantial variety of liquid and gas applications.

INTERNAL PRESSURE

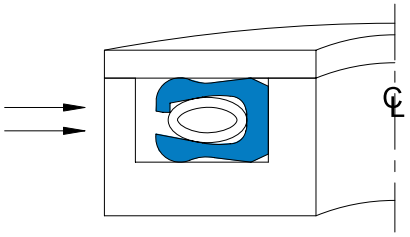
Spring cavity on the seal ID allows the internal pressure to aid in providing a positive seal as pressure increases. A heavy spring force is typical for static applications. Lighter spring forces can customize the load for dynamic service and applications needing a lighter force.



Seal Designs:
S15, S2, US15, US2

EXTERNAL PRESSURE

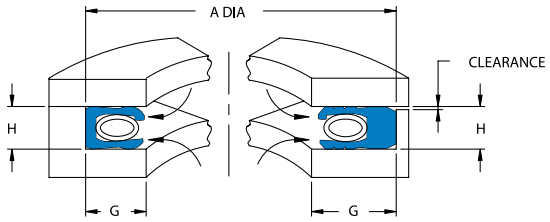
Spring cavity on the seal OD aids in providing a positive seal under external pressure or vacuum. A heavy spring force is typically specified for static and vacuum service. Lighter spring forces can customize the load for dynamic service and applications needing a lighter closing force.



Seal Designs:
IS15, IS2, UIS15, UIS2

FACE SEAL GLAND DIMENSIONS

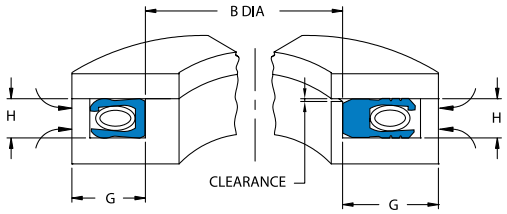
INTERNAL PRESSURE



S2/S15
STATIC GLAND
(IS2 SHOWN)

U-S2/U-S15
DYNAMIC GLAND
(U-IS15 SHOWN)

EXTERNAL PRESSURE



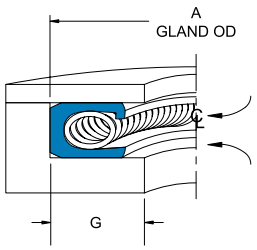
IS2/IS15
STATIC GLAND
(IS2 SHOWN)

U-IS2/U-IS15
DYNAMIC GLAND
(U-IS15 SHOWN)

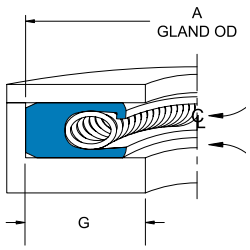
Cross Section Code	H Gland Height	G Gland Length	
		S/IS Seals (Min.)	US/UIS Seals (Min.)
0	.061/.063	.115	.155
4	.093/.095	.155	.195
5	.125/.127	.195	.275
6	.187/.189	.275	.365
7	.250/.252	.365	.535
8	.375/.377	.535	.715
9	.500/.502	.715	.935

The larger gland height (H) for dynamic applications reduces breakout and dynamic friction. Smaller gland height for static applications improves sealing reliability.

Static Seals—Internal Pressure



S SEALS



US* SEALS

*Extended Heel

Internal Pressure	
A Gland OD and Tolerance	
Cross Section 0 1/16-Inch Nominal	
+.001 -.000	
.312 to .625 S Series	.437 to .625 U-S Series
Cross Section 4 3/32-Inch Nominal	
+.001 -.000	+.002 -.000
.875 to 1.500	1.750 to 2.250
Cross Section 5 1/8-Inch Nominal	
+.001 -.000	+.002 -.000
1.125 to 1.625	1.750 to 2.500
Cross Section 6 3/16-Inch Nominal	
+.003 -.000	+.004 -.000
3.000 to 3.750	4.000 to 4.500

Internal Pressure	
A Gland OD and Tolerance	
Cross Section 7 1/4-Inch Nominal	
+.004 -.000	+.005 -.000
4.000 to 5.000	5.250 to 6.000
Cross Section 8 3/8-Inch Nominal	
+.001 -.000	
6.500 to 72.000	
Cross Section 9 1/2-Inch Nominal	
+.015 -.000	
12.500 to 72.000	

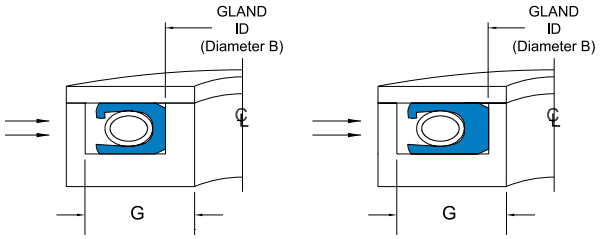
Due to space limitations, only common sizes are shown. For special cross sections and diameters, contact our Technical Sales Department.

Examples of Internal Face Seal Part Description

CALL OUT:	S2x	XX	- (A Diameter) -	XXX	-	XXX	-	XXX
STEP NO:		③		⑤		⑥		⑦

Example: S2x LB -.312-GFP-10-HST

Static Seals—External Pressure



IS SEALS | **UIS* SEALS**

*Extended Heel

External Pressure	
B Gland ID and Tolerance	
Cross Section 0 — 1/16-Inch Nominal	
+.000 -.001	
.187 to .750	
Cross Section 4 — 3/32-Inch Nominal	
+.000 -.001	+.000 -.002
.625 to 1.500	1.750 to 2.250
Cross Section 5 — 1/8-Inch Nominal	
+.000 -.001	+.000 -.002
1.125 to 1.625	1.750 to 2.500
Cross Section 6 — 3/16-Inch Nominal	
+.000 -.003	+.000 -.004
3.000 to 3.750	4.000 to 4.500

External Pressure	
B Gland ID and Tolerance	
Cross Section 7 — 1/4-Inch Nominal	
+.000 -.004	+.000 -.005
4.000 to 5.000	5.250 to 6.000
Cross Section 8 — 3/8-Inch Nominal	
+.000 -.010	
6.500 to 8.000	
Cross Section 9 — 1/2-Inch Nominal	
+.000 -.015	
12.500 to 17.000	

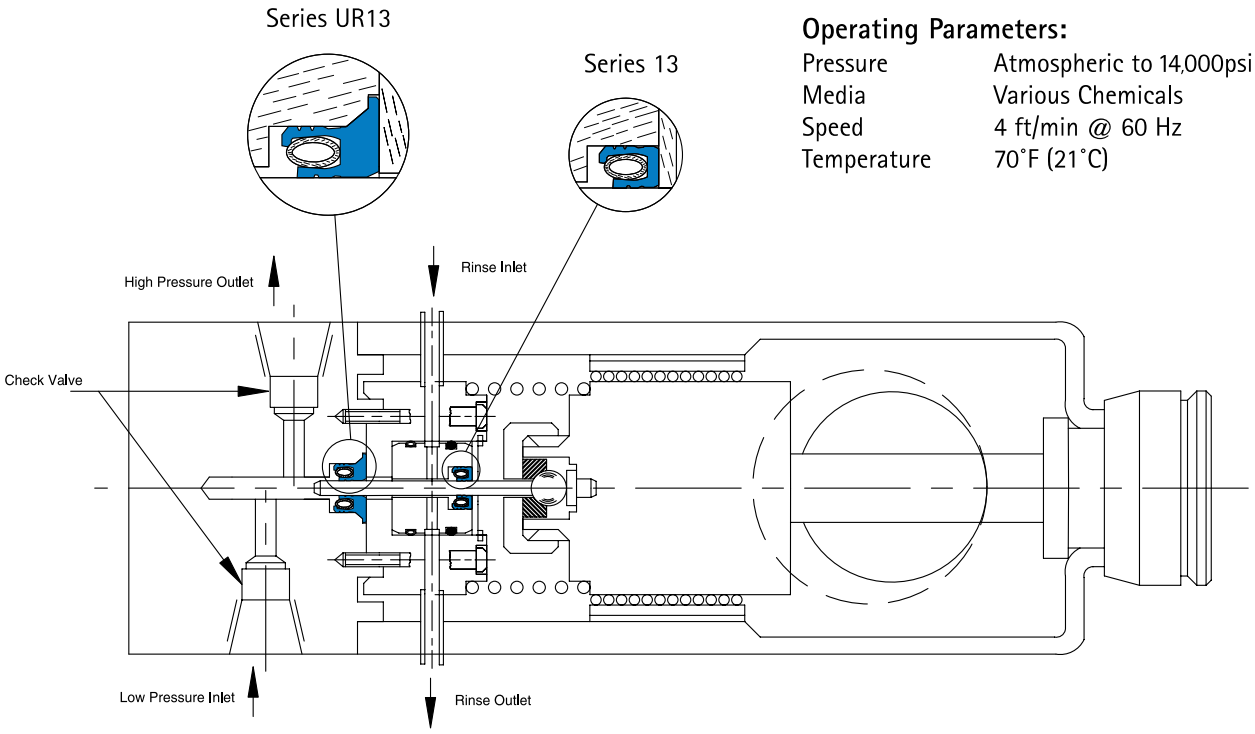
Due to space limitations, only common sizes are shown. For special cross sections and diameters, contact our Technical Sales Department.

Examples of External Face Seal Part Description

CALL OUT:	IS2x	XX	- (B Diameter) -	XXX	-	XXX	-	XXX
STEP NO:		③		⑤		⑥		⑦

Example: IS2x LB -.187-GFP-10-HST

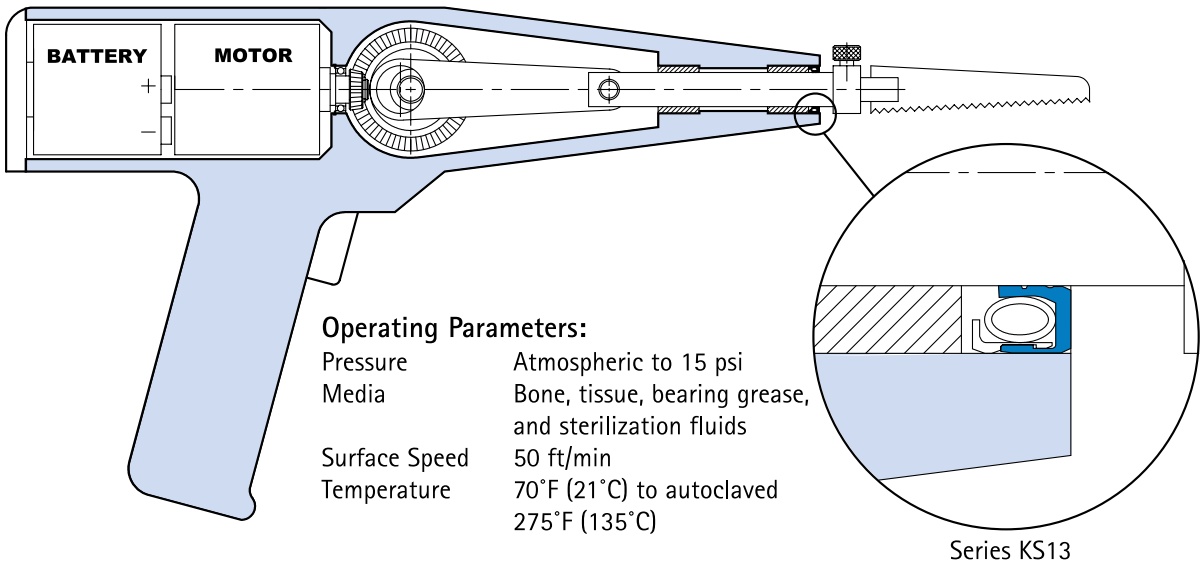
HPLC Plunger Pump



Operating Parameters:

Pressure	Atmospheric to 14,000psi
Media	Various Chemicals
Speed	4 ft/min @ 60 Hz
Temperature	70˚F (21˚C)

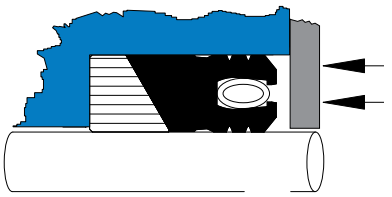
Surgical Saw



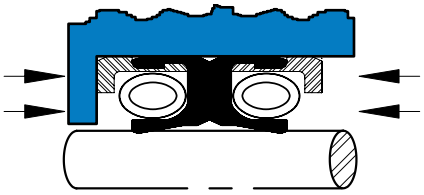
Operating Parameters:

Pressure	Atmospheric to 15 psi
Media	Bone, tissue, bearing grease, and sterilization fluids
Surface Speed	50 ft/min
Temperature	70˚F (21˚C) to autoclaved 275˚F (135˚C)

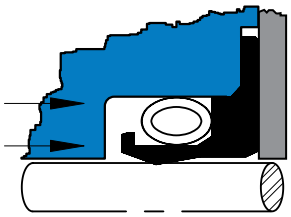
Customized Solutions To Suit Your Application



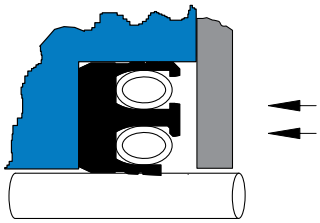
High Pressure Seal
With Tapered Backup



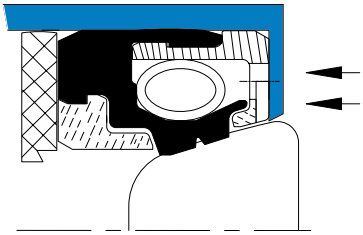
Bi-directional At Low Pressure



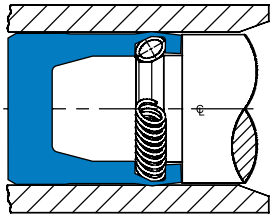
Cryogenic, Very Low Pressure



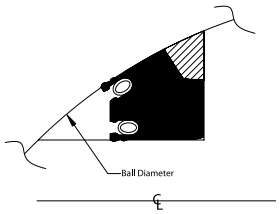
Double Spring Seal



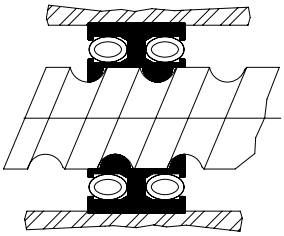
Anti-Blowout Seal



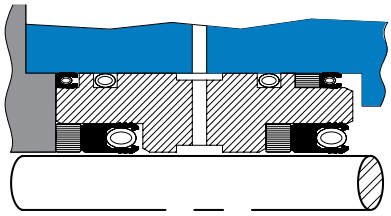
Cover Seal



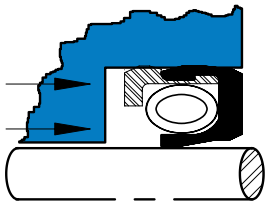
Ball Valve Seal



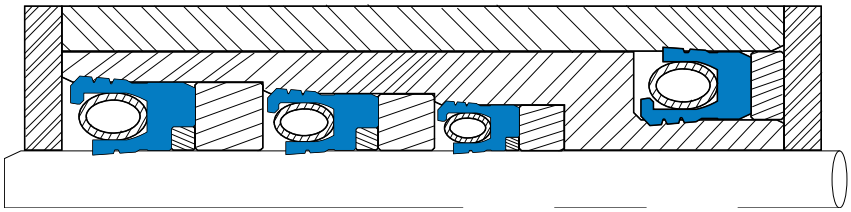
Ball Screw Seal



Bearing-Seal Package

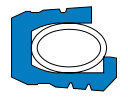


Reciprocating/Rotary

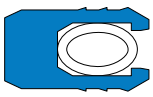


High Pressure Cartridge Assembly

Bal Seal Design Selection Guide (continued from page 3)



14



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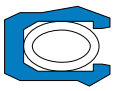

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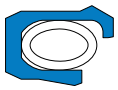

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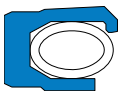
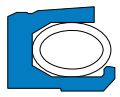
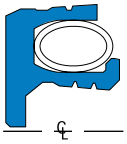


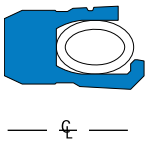
CC13



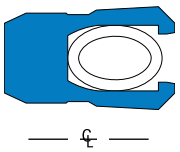
CC14



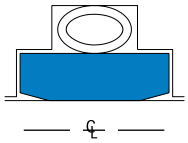
IR14



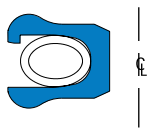
UN14



UN15



HW



IS2

RECIPROCATING OR STATIC SEAL APPLICATION DATA SHEET

Bal Seal provides immediate technical suport. We encourage you to complete the application in as much detail as possible and fax it to our Technical Sales Department at 949.460.2300. Bal Seal will be able to provide the best solution possible to meet your requirements by means of a seal design proposal and technical information.

Name: _____ Date: _____

Company: _____ Title: _____

Address: _____ Dept.: _____

City, State & Zip: _____ Telephone: _____

Email: _____ Fax: _____

PRODUCT DATA: Equipment Type:_____

☐ Prototype ☐ Retrofit
☐ Production ☐ Other

Annual usage:_____ Reason:_____

SERVICE: ☐ Continuous ☐ Intermittent

☐ Reciprocating ☐ Oscillating/Dithering
☐ Static ☐ Other:

Travel Length:_____ Degrees Rotated:_____

CRITICAL FACTORS: Prioritize by number

	Low				High
☐ Sealing: cc/min	☐	☐	☐	☐	☐
☐ Life: hrs.,cyc	☐	☐	☐	☐	☐
☐ Friction: Force,Torque	☐	☐	☐	☐	☐
☐ Cost Target:	☐	☐	☐	☐	☐
☐ Compatibility:	☐	☐	☐	☐	☐
☐ Other:_____	☐	☐	☐	☐	☐

TEMPERATURE: ☐ °F ☐ °C ☐ °K

Min:_____ Oper:_____ Max:_____

Does the seal reach operating temperature before pressure is applied? ☐ Y ☐ N

Does the seal reach cold temperatures prior to pressurizing? ☐ Y ☐ N

Maximum temperature that the maximum pressure will see. _____

SPEED: ☐ Continuous ☐ Intermittent

fpm (m/s) _____

Hz_____

rpm _____ cpm _____

Cycling _____

PRESSURE: _____ ☐ Pa ☐ PSI ☐ Kg/cm² ☐ Bar ☐ Torr ☐ inches Hg

☐ Environmental Pressure: Avg._____

DIFFERENTIAL PRESSURE ACROSS THE SEAL: (Into spring cavity)

Forward shaft travel
Min:_____
Oper:_____
Max:_____

Reverse shaft travel (If Different)
Min:_____
Oper:_____
Max:_____

Other: (Explain Cycle)_____

MEDIA TYPE:

Media Name:_____

☐ Gas ☐ Solids
☐ Liquid ☐ Corrosive
☐ Viscous ☐ Contamination
☐ Abrasives ☐ Other

Solid Particles:_____ mm in size
Description:_____
Viscosity:_____ ☐Centipoise ☐Centistokes

SHAFT DATA: ☐ inch ☐ mm

Diameter:_____ Tolerance:_____
Material:_____ Hardness:_____Rc
Surface:_____☐Ra ☐ RMS ☐ Ry
Plating/Coating:_____
Modifications Allowed:_____

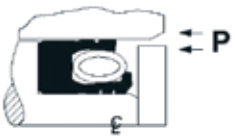
GLAND/BORE DATA: ☐ inch ☐ mm

Diameter:_____ Tolerance:_____
Width:_____ Radial Shaft Bore Clearance:_____
Material:_____ Hardness:_____Rc
Surface:_____☐Ra ☐ RMS ☐ Ry
Plating/Coating:_____
Modifications Allowed:_____

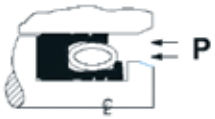
GLAND CONFIGURATIONS:

☐ TWO-PIECE HOUSING

☐ TWO-PIECE PISTON



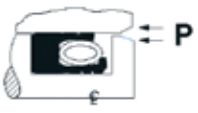
☐ ONE-PIECE PISTON (Stepped Gland)



☐ TWO-PIECE HOUSING (Reverse pressure With Support)

☐ TWO-PIECE PISTON (Reverse pressure With Support)

☐ ONE-PIECE PISTON (Solid Gland)



FLEXIBLE DELIVERY SCHEDULES AVAILABLE ☐ **Will Supply Drawings**

Bal Seal products are custom made. Standard delivery for larger quantity orders is four to six weeks, though we can expedite small quantity and prototype orders. We can accommodate JIT, MRP planning, and special scheduling and we encourage scheduling of blanket orders. Expedited deliveries are possible for a nominal extra charge. Products are shipped from our factory in California, U.S.A.

IMPORTANT INFORMATION

CLEANING: Bal Seal Engineering products may require cleaning and/or sterilization before use, depending on the application.

TESTING: It is essential that the Customer run evaluation tests to determine if the proposed, supplied, or purchased, Bal Seal Engineering products are suitable for the intended purpose. Run tests under actual service conditions with an adequate safety factor.

Welded springs have an increased probability of breaking or failing at or near the weld. This probability is magnified if the spring is used in an application involving extension of the spring. In addition, temperature affects the properties of the spring (i.e., tensile, elongation, etc.) Failure of Bal Seal Engineering products can cause equipment failure, property damage, personal injury, or death. Equipment containing Bal Seal Engineering products must be designed to provide for any eventuality that may result from a partial or total failure of Bal Seal Engineering products.

Bal Seal Engineering products must be tested with a sufficient safety factor after installation and they must be subjected to a program of regular maintenance and inspection. The Customer, through its own analysis and testing, is solely responsible for making the final selection of the products and for assuring that all performance, safety, and other requirements of the application are met.

All information and recommendations contained herein are based on tests Bal Seal Engineering believes to be reliable, but the accuracy or completeness is not guaranteed. The use of any such information or recommendations is given solely for purposes of illustration and is not to be construed as a warranty that any goods will conform to such information or recommendations. No one, including Bal Seal Engineering employees, salespersons, representatives, wholesalers, or distributors is authorized to make any warranty or representation and no Customer or other user may rely on any such warranty or representation. Bal Seal Engineering reserves the right to make any changes without notice in its products and in the contents of this document such as dimensional data, force, torque, materials, pressures, temperatures, surface finishes, surface speed, etc.

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PATENTS: The products described herein include those which are the subject of pending and issued patents, both foreign and domestic, including patents 4,804,290; 4,805,943; 4,826,144; 4,906,109; 4,893,795; 4,876,781; 4,961,253; 4,915,366; 4,964,204; 5,108,073; 5,079,388; 5,139,276; 5, 082,390; 5, 474,305; 5,545,842; 5,411,348; 5,599,027; 5, 979,904; 5,984,316; 5,992,856; 6,264,205; 6,161,832; 6,641,141 (LE-173 Rev. Ø).

DM-6 (621-7)

Commitment to Quality

We have maintained our **ISO-9001** Certification since 1999.

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