3.4 High-Pressure Designs - P-Series

High-pressure P-series Bal Seals® withstand pressures to 10,000 psi. Various high-pressure seal designs are shown in Figure 9.

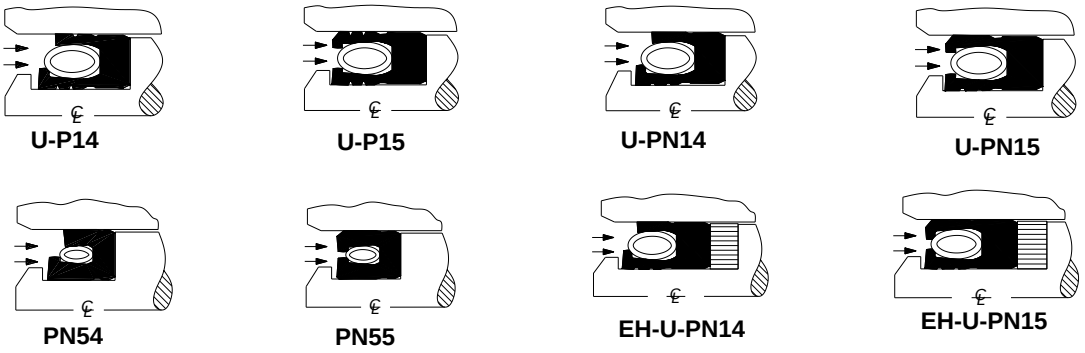


Figure 9 - P-Series High-Pressure Designs

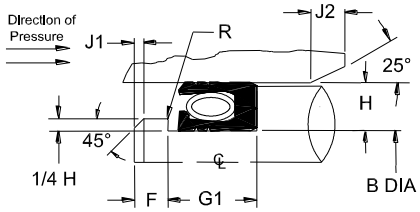


Figure 10 - High-Pressure Gland

Figure 10 shows a standard P-series high-pressure seal gland (¼ step).

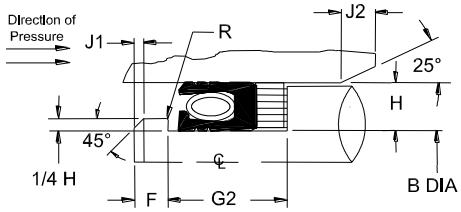


Figure 11 - High-Pressure Gland with Back-up Ring

Figures 11 shows a standard P-series high-pressure seal gland (¼ step) with a PTFE filled backup ring.

Gland dimensions for step-mounted high pressure BAL™ Seals									
Gland height	**Gland width**	**Gland Width**	**Step Radius**	**Step Width**	**Step Width**	**Chamfer Length**		**Min Seal ID ¼ H**	**Max Seal ID ¼ H**
H	**G1**	**G2**	**R**	**F**	**FF**	**J1**	**J2**	**B**	**B**
0 = 1/6 (0.061/063)	0.120/0.125	0.234/0.239	0.002/0.010	0.034/0.044	0.177/0.197	0.015 ± 0.003	0.062 ± 0.005	0.437	1.875
4 = 3/32 (0.093/0.95)	0.183/0.193	0.292/0.302	0.002/0.010	0.055/0.065	0.240/0.260	0.020 ±. 0003	0.093 ± 0.006	0.562	2.875
5 = 1/8 (0.125/0.125)	0.263/0.273	0.372/0.382	0.002/0.010	0.078/0.088	0.365/0.385	0.025 ± 0.003	0.125 ± 0.008	1.000	3.750
6 = 3/16 (0.187/0.189)	0.351/0.366	0.506/0.521	0.002/0.010	0.120/0.130	0.490/0.510	0.030 ± 0.003	0.187 ± 0.010	1.875	5.625

CHART #6 Gland Dimensions for Step-Mounted High-Pressure Bal Seals

4.0 SEAL INSTALLATION TOOLS

4.1 Availability of Assembly Tools

We do **NOT** make assembly tools for step piston-mounted seals.

Information to make assembly tools is provided in this document. However, Bal Seal Engineering accepts no responsibility for the performance of these tools; this information is provided as a service.

4.2 Assembly Tools – Description and Dimensions

Installation of a Bal Seal® into a stepped piston groove requires the following equipment: a collet, an adapter, and a sizing tool. Refer to Figure 12

The collet tool pushes and stretches the Bal Seal along the adapter tool, stretching the seal onto the piston shaft, and forward into the groove. The sizing tool pushes the deformed Bal Seal down into the groove, and compacts it to its initial size.

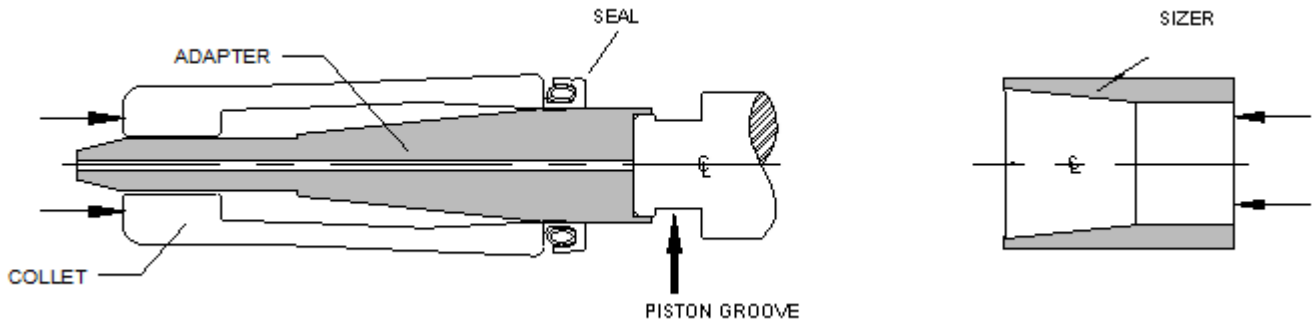


Figure 12: Assembly Tools

4.2.1 Adapter

The adapter tool eases assembly of the Bal Seal® into the piston groove. The seal stretches gradually and evenly over the adapter tool until it drops into the groove on the piston.

The adapter tool should be smooth and free from scratches or marks, which could damage the seal during installation. In addition, cutter tool grooves from the machining process can damage the seal if the finish is too coarse; there should be no sharp edges or rough surfaces.

The end of the adapter that fits over the piston step should be as thin as possible to minimize stretching the seal. Typical construction materials for the adaptor tool are Delrin®, nylon, and ultra-high-molecular-weight polyethylene.

Figure 13 and Charts #7 and #8 provide detailed data to construct an adapter.

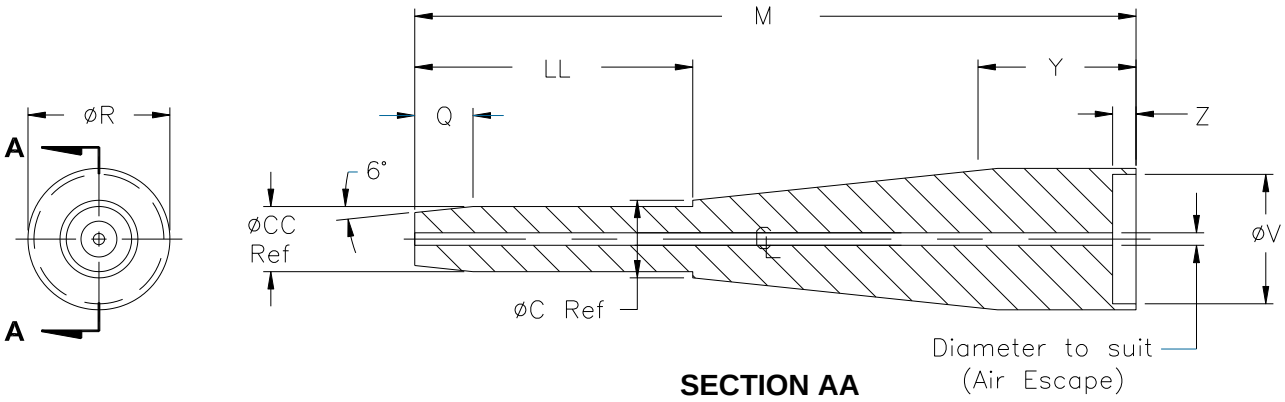


Figure 13
Adapter Tool

Diameters	C	CC	R	V
Tolerances	+0.003 -0.003	REF	+0.002 -0.002	Or Slip Fit With Shaft

Adapter Formulae	
C Diameter	Seal ID – 2 X Cross Section
V Diameter	Slip Fit Diameter
R Diameter	V Diameter + T
CC Diameter	Seal ID – 3 X Cross Section
Y Length	4 X Cross Section
Q Length	5 X Cross Section
Z Length	"C" Bore Depth To Suit Piston Step Length (1)
LL Length	30% Of M Dimension

CHART #7

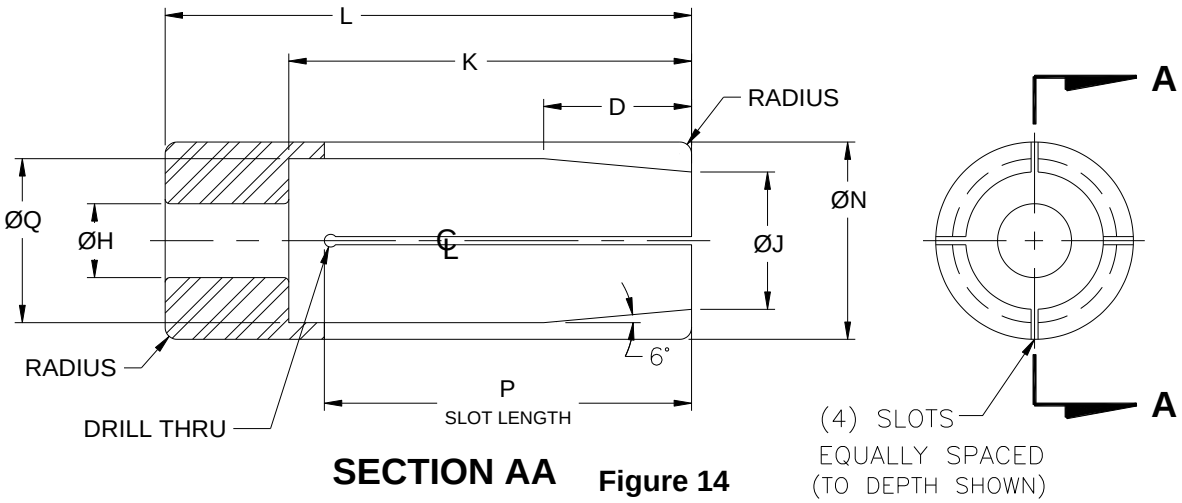
Constant Adapter Dimensions			
Series Code	Cross Section	T	M
101	0.031	0.016	1.620
100	0.063	0.018	2.292
104	0.094	0.020	2.969
105	0.125	0.022	3.765
106	0.188	0.024	5.105
107	0.250	0.026	6.692

CHART #8

4.2.2 Collet

The collet tool pushes the Bal Seal® over the adapter until the seal drops into the groove. Typical collet tool materials are Delrin®, nylon, and ultra-high-molecular-weight polyethylene.

Figure 13 and Charts #9 and #10 provide detailed data to construct the collet.



SECTION AA

Figure 14
Collet Tool

CHART #9

Dia.	Formula	Tolerance
Q	Seal OD	+0.004 / -0.004
J	Seal ID	+0.004 / -0.004
H	Seal ID – YY	+0.004 / -0.004
N	Q + NN	+0.004 / -0.004

CHART #10

Constant Collet Dimensions and Factors							
Series code	Cross section	D REF	K	L	S	NN	YY
101	0.031	0.297	1.144	1.390	1.080	0.062	0.037
100	0.063	0.595	1.614	1.860	1.490	0.125	0.083
104	0.094	0.892	2.088	2.340	1.900	0.187	0.272
105	0.125	1.189	2.646	2.890	2.270	0.250	0.365
106	0.188	1.784	3.584	3.830	3.000	0.375	0.546
107	0.250	2.376	4.694	4.940	3.940	0.500	0.735

4.2.3 Sizer

The sizer tool squeezes the seal into the groove after installation. The taper and inside diameter of the sizing tool must be smooth and free from scratches, marks, or sharp edges, which could damage the seal during assembly, creating leakage paths.

Interference must be present between the seal OD and the ID of the sizing tool at assembly.

PTFE is a suitable material because it is soft and flexible, and can force the seal towards the bottom of the groove better than other materials.

Figure 15 and Chart #11 provides detailed data to construct the sizer.

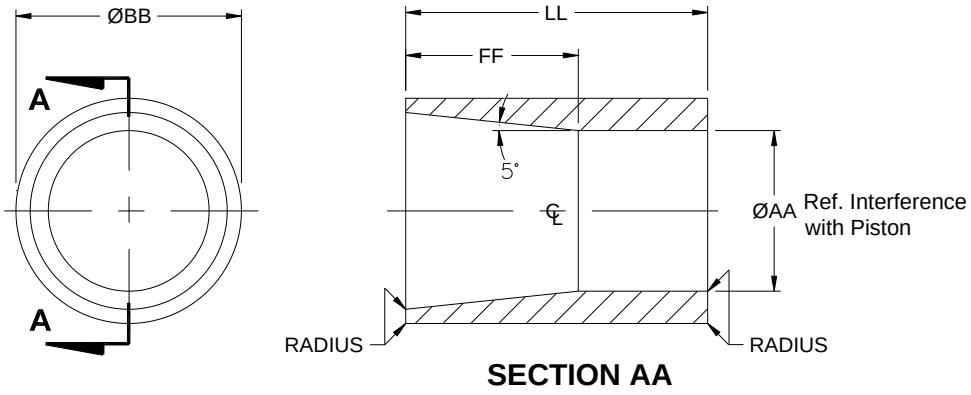


Figure 15
Sizer Tool

Diameter tolerances	ØBB	ØAA
	+0.010 -0.005	Interference with piston

Sizer And Constant Dimensions				
Series Code	**Cross Section**	**LL**	**FF**	**ØBB Tolerance**
101	0.031	0.750	0.180	AA +0.060
100	0.063	1.050	0.360	AA +0.142
104	0.094	1.250	0.540	AA +0.243
105	0.125	1.750	0.720	AA +0.363
106	0.188	1.880	1.070	AA +0.605
107	0.250	2.000	1.430	AA +0.885

CHART #11

5.0 SEAL INSTALLATION INSTRUCTIONS

5.1 Cautions

A stepped gland makes seal assembly easier because it stretches the seal less than a full gland. It is more difficult to return a seal to its original diameter the more it is stretched. The seal will be permanently deformed for all stepped glands.

A large ratio of the Bal Seal® inside diameter to the seal cross-section will ease this process. In addition, a thin film of wet lubricant facilitates Bal Seal assembly by lowering the friction between the seal and the mating parts.

5.2 Bal Seal Installation and Sizing

Install Bal Seals in two steps as follows:

Step 1 - Figure 16: Use the collet to slide the Bal Seal over the adapter until the seal drops into the piston groove. A thin film of wet lubricant facilitates assembly.

Step 2 - Figure 17: Work the seal into the bottom of the seal groove using the sizing tool.

Assembly requires interference between the piston and sizing tool, so substantial force may be required. Larger sizes may require a worm screw clamp around the outside of the sizing tool to force the seal into the bottom of the groove.

Leave the sizing tool in place for a minimum of one hour, preferably 24 hrs. The seal should be seated tightly in the bottom of the groove. Tim

Figure 16: Step 1

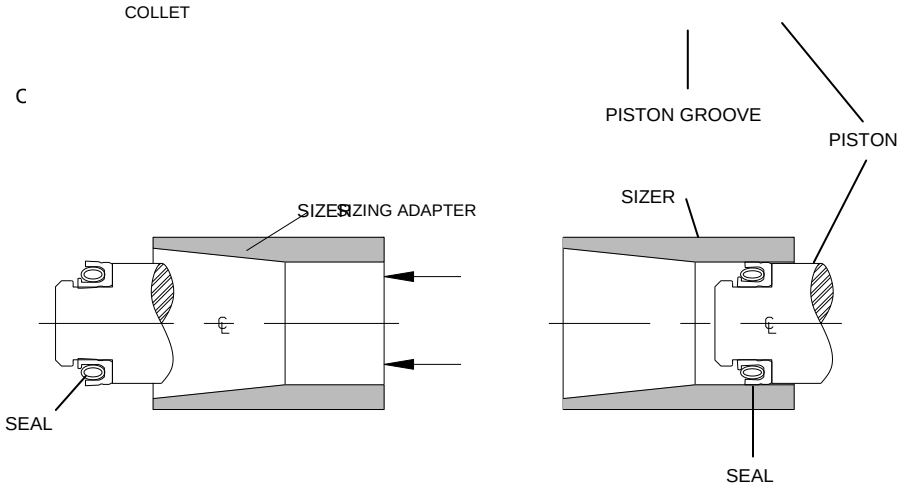


Figure 17: Step 2