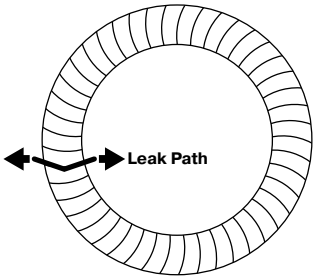
Hardware Design Considerations

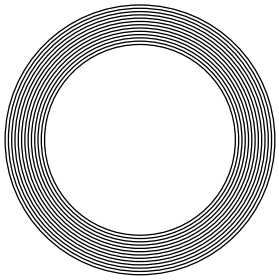
In addition to the required cavity dimensions provided in Section C, there are other important cavity design issues which affect seal performance.

Application/Medium Being Sealed	Surface Roughness, R_a	
	µ inch	µ m
Dynamic Axial Seal Vacuum Applications	4 – 8	0,1 – 0,2
	8 – 16	0,2 – 0,4
Helium Gas Hydrogen Gas Freon	8 – 16	0,2 – 0,4
Air Nitrogen Gas Argon Natural Gas Fuel (aircraft and automotive)	16 – 32	0,4 – 0,8
Water Hydraulic Oil Crude Oil Sealants	16 – 63	0,4 – 1,6

End Mill Surface Finish Example



Circular Lay Surface Finish Example



Surface Roughness Recommendations

The roughness of the mating surfaces directly affects the leak rate when using unplated seals. Selecting high load seals with appropriate plating can substantially offset the effects of rough finishes; however, the guidelines in the table, left should be followed whenever possible. We also recommend a turned finish with a circular lay. This is always preferable to a random or radial lay. Discontinuities, radial scratches or pits may be blended, subject to the flatness recommendations given below.

Surfaces with a smoother finish than recommended may actually impair sealing. With the optimum surface roughness and circular lay, the finish embeds within the seal surface. Each ridge of the surface roughness acts as a stress riser and as an independent, redundant sealing line.

To select the appropriate plating or coating material and thickness refer to Page D-60 in the metal seal material selection section.

Surface Flatness Recommendations

Metal seals can accommodate some degree of waviness, or lack of flatness of the mating surfaces. Spring energized seals offer the greatest amount of compliance since each coil of the spring acts as an independent force to assist the jacket in conforming to the mating surface.

Specific surface flatness recommendations:

- Maximum waviness of the cavity mating surfaces must be with in the limits given in the table below.
- The sum of the flatness tolerances of the opposing mating surfaces shall not exceed 4% of the seal free height.
- The cavity depth limits provided in Section C shall not be exceeded.

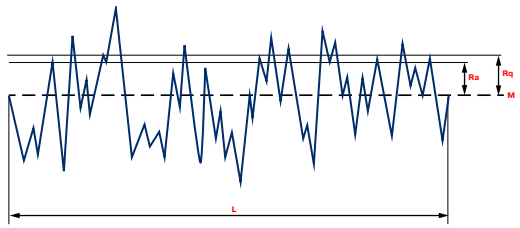
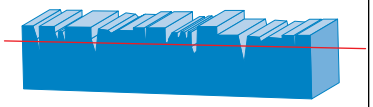
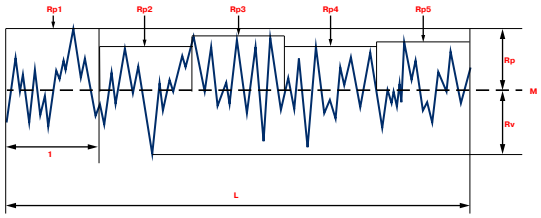
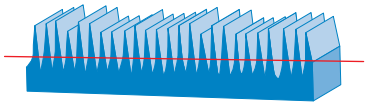
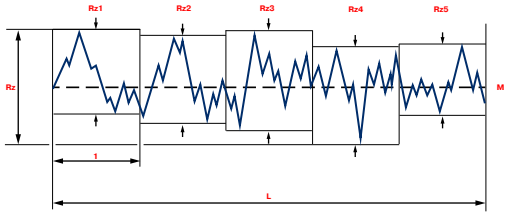
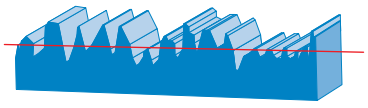
Maximum Waviness of Cavity Mating Surfaces (in/in-circumference of the cavity)					
	 C-Ring	 E-Ring	 O-Ring	 U-Ring	 Spring Energized C-Ring
Seal Free Height	Maximum Gradient				
Less than 0.108 inch	0.002	0.004	0.001	0.002	0.003
Greater than or equal to 0.108 inch	0.004	0.007	0.002	0.004	0.005

Surface Hardness Recommendations

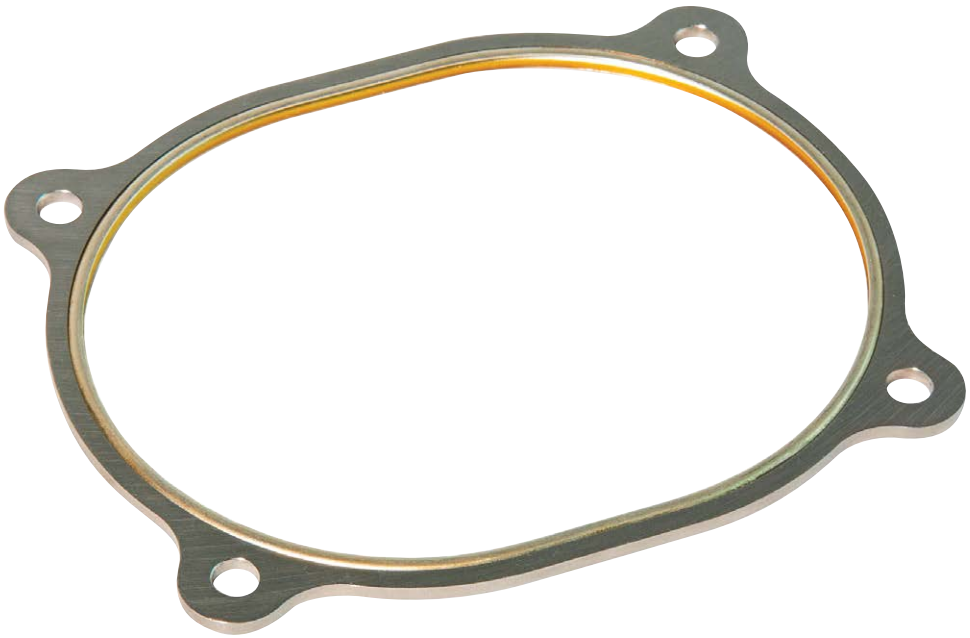
Many metal seals are designed to produce high seating loads againstthe mating surfaces to meet ultra low leakage requirements. To withstand these high compressive stresses, without damage to the sealing surfaces, requires these surfaces to have a hardness of at least 35 Rc. This is particularly important when the seal seating load exceeds 200 lb/inch (35 N/mm) of circumference.

Hardware Surface Finish

The table below provides a graphical representation of the various ways to define surface roughness. Parker has standardized plating finishes to correspond with average surface roughness.

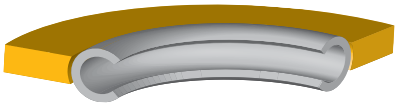
Ra = Roughness Average = the arithmetic average of the absolute values of profile deviations from mean line within the evaluation length.	**Ra, Rq** 	 **Ra = 2.5 µm**
Rp = Maximum Profile Peak Height = the distance between the highest point of the profile and the mean line within the evaluation length.	**Rp, Rpm, Rv** 	 **Ra = 2.5 µm**
Rz = Total profile height across all Rzi samples. This is equal to the difference between the maximum peak of all Rzi samples and the minimum valley of all Rzi samples. Rzi = Maximum Height of the roughness profile within a sampling length = Sum of the largest profile peak height and largest profile valley depth within a sampling length.	**Rt, Rti, Rz, Rz(DIN), Rmax** 	 **Ra = 2.5 µm**

Installation Guidelines

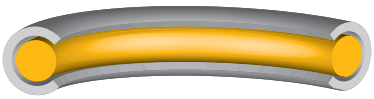


Compression Limiters

Section C provides the required cavity depths for each type of metal seal. Using the specified groove depths results in optimal seal compression with the proper seating load and excellent resiliency. Excessive compression can actually reduce the seal's ability to spring back to the required cavity height and maintain contact load with the sealing gland. In the extreme case, the seal may be crushed so that required springback cannot occur at all. Equally, under -compression results in low contact load and potentially greater leakage than would otherwise be achieved. When it is not possible or practical to machine the required hardware cavity or cavity depth, a compression limiter may be used. Two types of limiters are available:



External Limiter
The external limiter is a metal plate manufactured to a thickness corresponding to the required working height of the seal. This is the preferred type of compression limiter. It is designed with a large surface area which does not compress even under the highest of compressive loads thus always ensuring proper seal compression. This type of limiter also supports the seal against hoop stresses from internal pressures as well as providing convenient centering within a bolt circle.External limiters are available with arelieved inside diameter which allows the seal to snap into the limiter resulting in a convenient one piece assembly.



Internal Limiter
A solid wire installed within the seal serves as an internal limiter and prevents over-compression of the seal. This method is available with all C-Rings, O-Rings, and Spring Energized C-Rings. Because the wire will also compress under high loads, seal compression with this method may not be as consistent as with the external limiter. The internal limiter also offers no support to the seal against pressure induced hoop stresses and will require a groove for high pressure applications.

Availability of Limiters

External and Internal limiters can be custom designed for all applications. Contact Parker for more information.