11 Technical Summary

Rules of Thumb Summary

- *A stretch greater than 5% on the O-ring I.D. is not recommended because it can lead to a loss of seal compression. (Section 3, p. 7)*
- *A Groove Depth is the machined depth into one surface, whereas a Gland Depth consists of the Groove Depth plus clearance. The Gland Depth is used to calculate seal compression. (Section 3, p. 7)*
- *To create Seal Squeeze, the Gland Depth must be less than the cross section. (Section 3, p. 8)*
- *Static applications are more tolerant of material and design limitations than dynamic applications. (Section 3, p. 9)*
- *The maximum volume of the O-ring should **never** surpass the minimum volume of the gland. (Section 3, p. 10)*
- *For a static crush seal application, it is recommended that the O-ring volume does not exceed 95% of the gland void. (Section 4, p. 12)*
- *For reciprocating seals – passing O-rings over ports is not recommended. Nibbling and premature wear and seal failure will result. (Section 4, p. 13)*
- *The closer the application is to room temperature, the longer an O-ring can be expected to effectively seal. (Section 4, p. 14)*
- *Avoid using graphite-loaded compounds with stainless steel, as they tend to pit the stainless steel surface over time. (Section 4, p. 15)*
- *Before installation, make sure to lightly coat the O-ring with a lubricant that is compatible with the O-ring material, as well as with system chemicals. (Section 4, p. 16)*
- *When using only one back-up ring, be sure to install it on the low pressure side of the O-ring. (Section 5, p. 55)*
- *Static seal cross sections are generally compressed from 10% to 40%, whereas dynamic seals are from 10% to only 30%. (Section 5, p. 57)*
- *When it is said that an elastomer is good for an application it is meant that some compounds which include that material are acceptable, **not all**. For instance, some compounds of **EP** are good for brake fluid applications, but most are not acceptable. (Section 6, p. 63)*
- *Material cost does not correlate with performance, it depends on the application. (Section 6, p. 70)*
- *You must test all seals in their actual environment because every application is unique. (Section 6, p. 71)*
- *Do **not** use a lubricant composed of the same material as the O-ring because "like" will dissolve "like." For example, a silicone lubricant should **not** be used with a silicone O-ring. (Section 7, p. 75)*
- *Resistance of elastomers to chemical attack is greatly reduced at elevated temperatures. (Section 7, p. 76)*

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Formulas

Maximum % Compression =

$$\left[1-\left[\frac{\left(\frac{\text{Min Bore Diameter} - \text{Max Groove Diameter}}{2}\right)}{\text{Max O-Ring CS}}\right]\right] \bullet 100$$

Minimum % Compression =

$$\left[1-\left[\frac{\left(\frac{\text{Max Bore Diameter} - \text{Min Groove Diameter}}{2}\right)}{\text{Min O-Ring CS}}\right]\right] \bullet 100$$

Maximum O-Ring CS =

$$\left[\frac{\left(\frac{\text{Min Bore Diameter} - \text{Max Groove Diameter}}{2}\right)}{1-\left(\frac{\text{Maximum \% Compression}}{100}\right)}\right] - \text{O-Ring CS Tolerance}$$

Minimum O-Ring CS =

$$\left[\frac{\left(\frac{\text{Max Bore Diameter} - \text{Min Groove Diameter}}{2}\right)}{1-\left(\frac{\text{Minimum \% Compression}}{100}\right)}\right] + \text{O-Ring CS Tolerance}$$

% Stretch =

$$\left(\frac{\text{Groove Diameter}}{\text{O-Ring ID}} - 1\right) \bullet 100$$

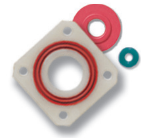
O-Ring CS Reduced Due to Stretch (caluclated) =

$$\text{O-Ring CS} - \left[\text{O-Ring CS}\left(1-\frac{10}{\sqrt{100 + \text{\% Stretch}}}\right)\right]$$

The calculated value assumes the O-ring volume does not change and the cross-section remains round when stretched.

Note: All formulas assume concentricity and most apply to a Piston configuration.

Technical Summary



Maximum O-Ring Volume = $\frac{\pi^2}{4}\left[(\text{Max O-Ring ID} + \text{Max O-Ring CS}) \bullet \text{Max O-Ring CS}^2 \right]$

Minimum Gland Volume = $\frac{\pi}{4}\left(\text{Min Bore Diameter}^2 - \text{Max Groove Diameter}^2\right) \bullet \text{Min Groove Width}$

Minimum Groove Width = $$\left(\frac{\left(\frac{\pi \bullet \text{Max O-Ring CS}^2}{4}\right) \bullet \left[\left(\frac{\%\text{Void}}{100}\right) + 1\right]}{\frac{\text{Min Bore Diameter} - \text{Max Groove Diameter}}{2}} \right)$$

Note: The value “%Void” is typically a minimum of 10%.

Conversion Table

Length	1 mm = 0.039 in. 1m = 3.281 ft.	1 in = 25.4 mm 1 ft = 0.305 m
Temperatures	Temp (°C) = 0.56 (°F -32)	Temp (°F) = (1.8 x °C) +32
Pressure	1 Pa = 1 N / m^2 = 1.4504 x 10^{-4} psi 1 bar = 10^5 N / m^2= 14.5 psi 1 atm = 1.01325 bar = 14.696 psi	1 psi = 6894.8 Pa

$$\frac{ft}{min} = \frac{(\text{rev/min})^* (\text{shaft diameter (inches)})^* \pi}{12}$$

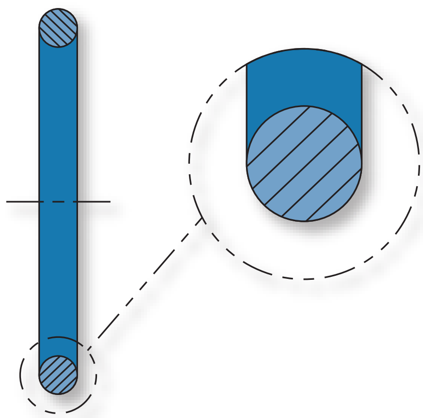
Note: All formulas assume concentricity and most apply to a Piston configuration

Seal Glossary

We have selected the most popular types of seals and given you a basic example of each complete with a brief description of its common use.

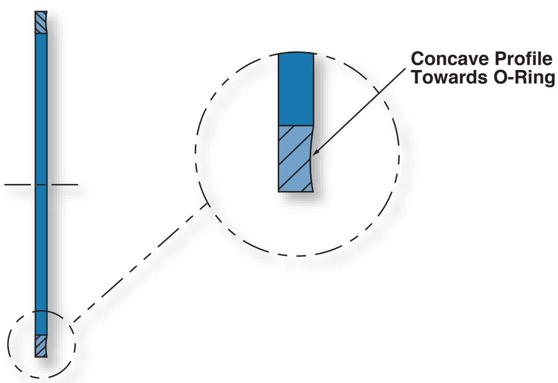
O-Ring

A doughnut-shaped object, or torus, that functions as a seal blocking the passage of liquids or gases. This seal is energized by being compressed between two mating surfaces comprising the walls of the cavity (gland).



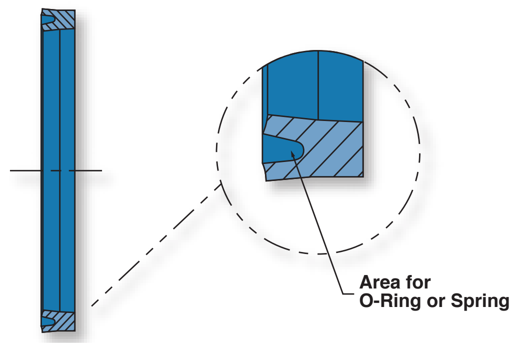
Back-Up Ring

A washer-like device of a relatively hard, tough material installed in the gland on the downstream side of the O-ring to prevent O-ring extrusion into the diametrical gap while under pressure.



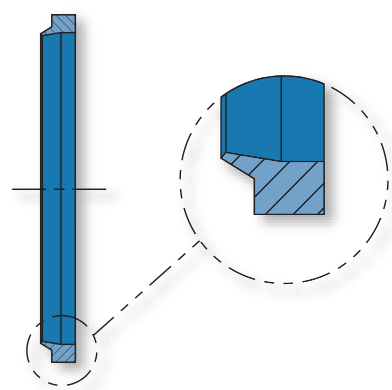
U-Cup

Used extensively throughout the pneumatic and hydraulic industries because of low breakaway force and dynamic friction. Also used for sealing large extrusion gaps. Designed for low speeds/pressures and can be energized with springs or O-rings.



Wiper

Designed to exclude foreign debris from contaminating the sealed system via a long, flexible lip. Should not be considered as the primary seal, only as a secondary seal.



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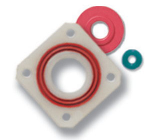
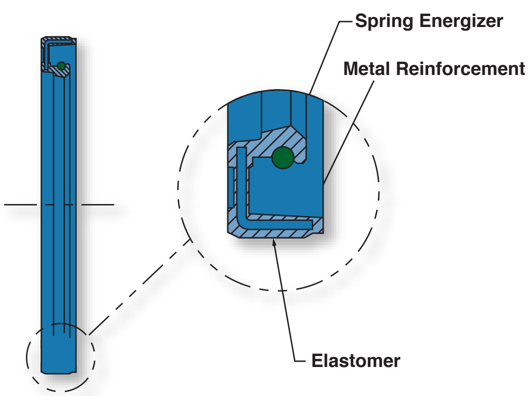


Seal Glossary (Continued)

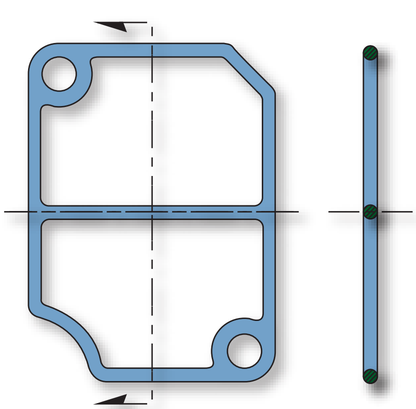
Shaft Seal

Typically employed in engines, pumps, and electric motors. Maximum RPM for effective sealing depends on many factors such as surface speed, shaft finish and hardness, pressure, eccentricity, and lubrication.



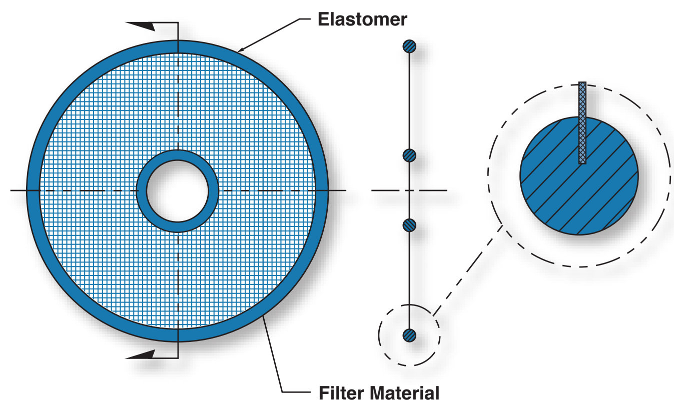
Housing Seal

An alternative to flat gaskets and other gasketing methods for sealing plastic or metal housings. Features round "O-ring" cross section and can be reused after disassembly.



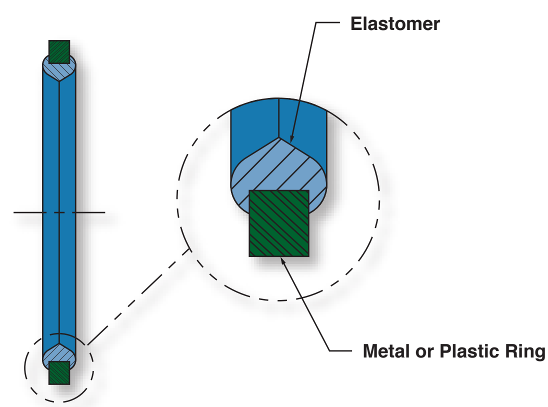
FilterSeal®

Combination of elastomer and fabric that operates as both a seal and a filter.



Composite Seal

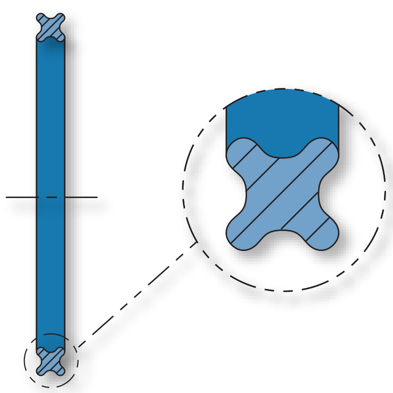
A seal combining the structural advantages of metal or plastic with the sealing advantages of elastomers.



Seal Glossary (Continued)

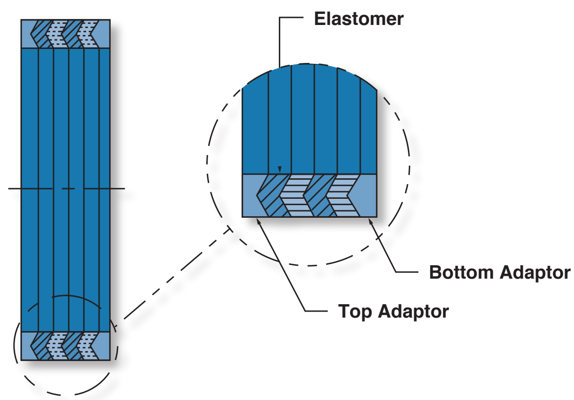
X or Quad-Ring®

A four-lobed profile primarily used in dynamic situations because of reduced friction and increased resistance to spiral failure. The parting line is located away from the sealing surface, unlike O-rings in radial applications.



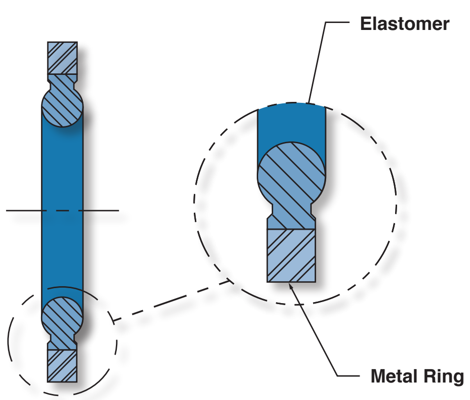
Vee Packing

A set of elastomeric and sometimes non-elastomeric rings which rely on fluid pressure to activate the seal. Primarily used in dynamic applications such as reciprocating shafts.



The adaptors can be elastomeric or non-elastomeric.

Torque Lok™ Seal



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