aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Parker O-Ring Handbook

ORD 5700

Parker

ENGINEERING YOUR SUCCESS.

WARNING:

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THESE PRODUCTS CAN CAUSE EQUIPMENT FAILURE OR DAMAGE, PERSONAL INJURY OR DEATH.

For safe and trouble-free use of these products, it is important that you read and follow the Parker Seal Group Product Safety Guide. This Safety Guide can be referenced and downloaded free of charge at www.parkerseals.com. It is also printed in major Seal Group product catalogs, and can be ordered by telephone without charge as Parker Publication No. PSG 5004 by calling 1-800-C-PARKER.

Failure, improper selection or improper use of the products and/or systems described herein or related items can cause death, personal injury or property damage.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provides product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through his or her own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

OFFER OF SALE

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance are governed by the provisions stated on the separate page of this document entitled “Offer of Sale.”

50th Anniversary Edition

Since its initial release in 1957, the Parker O-Ring Handbook has become a fixture on the reference shelves of engineers worldwide. This book contains extensive information about the properties of basic sealing elastomers, as well as examples of typical o-ring applications, fundamentals of static and dynamic seal design and o-ring failure modes. It also provides an overview of international sizes and standards, and compatibility data for fluids, gases and solids.

Engineers in every industry choose o-rings made by Parker Hannifin to keep their equipment running safely and reliably. That's because Parker's O-Ring Division, a developer, manufacturer and supplier of precision-engineered o-rings, offers a unique combination of experience, innovation and support.

Value Added Services through Parker O-Ring Division:

- Desktop seal design – InPhorm software
- Free engineering assistance
- Quality assurance – TS 16949 / ISO 9001 / AS 9100 registered
- Premier customer service
- Online tools
  - temperature/dimension converters
  - gland design recommendation charts
  - troubleshooting utility
  - pressure calculator
- ParZap inventory management
- Worldwide distribution
- Extensive product literature, test reports and much more...

Table of Contents

Parker Hannifin Corporation • O-Ring Division
2360 Palumbo Drive, Lexington, KY 40509
Phone: (859) 269-2351 • Fax: (859) 335-5128
www.parkerorings.com

Section I – Introduction

Introduction

inPHorm™ is a trademark of Parker Hannifin Corporation.

Introduction

1.0 How to Use This Handbook

For those who are unfamiliar with O-ring design, it is recommended to first study this introductory section, becoming familiar with the basic principles of O-ring seals, their common uses and general limitations.

Those who are already familiar with O-ring seal design may simply refer to the appropriate design tables for the information needed. Even those who have designed many O-ring seals may profit by reviewing the basics from time to time.

1.1 What is an O-Ring?

An O-ring is a torus, or doughnut-shaped ring, generally molded from an elastomer, although O-rings are also made from PTFE and other thermoplastic materials, as well as metals, both hollow and solid. This handbook, however, deals entirely with elastomeric O-rings.

O-rings are used primarily for sealing. The various types of O-ring seals are described in this section under "Scope of O-Ring Use." O-rings are also used as light-duty, mechanical drive belts. More information, including design criteria on O-ring drive belts and their application will be found in O-Ring Applications, Section III.

1.2 What is an O-Ring Seal?

An O-ring seal is used to prevent the loss of a fluid or gas. The seal assembly consists of an elastomer O-ring and a gland. An O-ring is a circular cross-section ring molded from rubber (Figure 1-1). The gland — usually cut into metal or another rigid material — contains and supports the O-ring (Figures 1-2 and 1-3). The combination of these two elements; O-ring and gland — constitute the classic O-ring seal assembly.

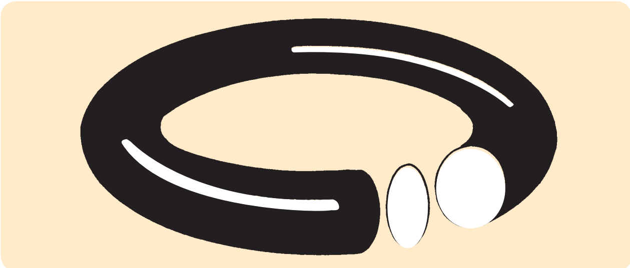

Figure 1-1: Basic O-Rng

1.3 Advantages of O-Rings

- They seal over a wide range of pressure, temperature and tolerance.
- Ease of service, no smearing or retightening.
- No critical torque on tightening, therefore unlikely to cause structural damage.
- O-rings normally require very little room and are light in weight.
- In many cases an O-ring can be reused, an advantage over non-elastic flat seals and crush-type gaskets.
- The duration of life in the correct application corresponds to the normal aging period of the O-ring material.
- O-ring failure is normally gradual and easily identified.
- Where differing amounts of compression effect the seal function (as with flat gaskets), an O-ring is not effected because metal to metal contact is generally allowed for.
- They are cost-effective.

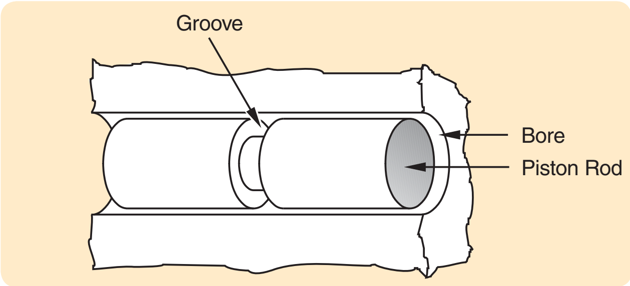

Figure 1-2: Basic Gland

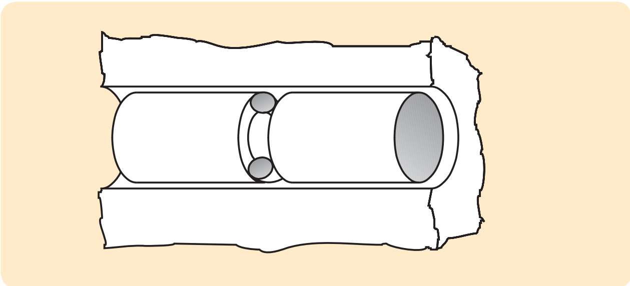

Figure 1-3: Gland and O-Ring Seal

Parker Hannifin Corporation • O-Ring Division
2360 Palumbo Drive, Lexington, KY 40509
Phone: (859) 269-2351 • Fax: (859) 335-5128
www.parkerorings.com

1.4 Operation

All robust seals are characterized by the absence of any pathway by which fluid or gas might escape. Detail differences exist in the manner by which zero clearance is obtained — welding, brazing, soldering, ground fits or lapped finishes — or the yielding of a softer material wholly or partially confined between two harder and stiffer members of the assembly. The O-ring seal falls in the latter class.

The rubber seal should be considered as essentially an incompressible, viscous fluid having a very high surface tension. Whether by mechanical pressure from the surrounding structure or by pressure transmitted through hydraulic fluid, this extremely viscous fluid is forced to flow within the gland to produce "zero clearance" or block to the flow of the less viscous fluid being sealed. The rubber absorbs the stack-up of tolerances of the unit and its internal memory maintains the sealed condition. Figure 1-4 illustrates the O-ring as installed, before the application of pressure. Note that the O-ring is mechanically squeezed out of round between the outer and inner members to close the fluid passage. The seal material under mechanical pressure extrudes into the microfine grooves of the gland. Figure 1-5 illustrates the application of fluid pressure on the O-ring. Note that the O-ring has been forced to flow up to, but not into, the narrow *gap* between the mating surfaces and in so doing, has gained greater area and force of sealing contact. Figure 1-6 shows the O-ring at its pressure limit with a small portion of the seal material entering the narrow gap between inner and outer members of the gland. Figure 1-7 illustrates the result of further increasing pressure and the resulting extrusion failure. The surface tension of the elastomer is no longer sufficient to resist flow and the material extrudes (flows) into the open passage or clearance gap.

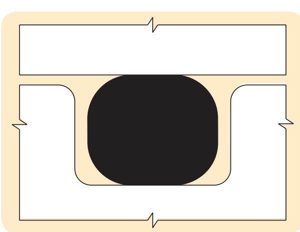

Figure 1-4: O-Ring Installed

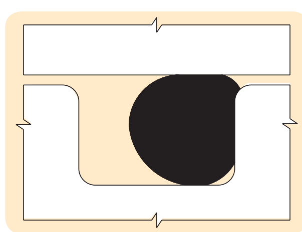

Figure 1-5: O-Ring Under Pressure

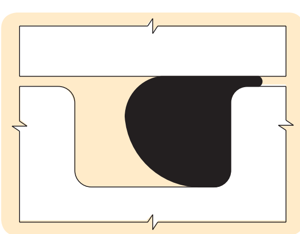

Figure 1-6: O-Ring Extruding

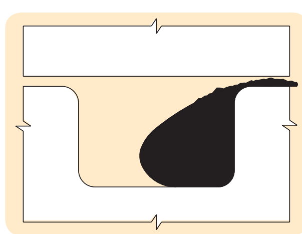

Figure 1-7: O-Ring Failure

(1) **"O-Ring Seals in the Design of Hydraulic Mechanisms", a paper presented at the S.A.E. Annual Meeting, January, 1947 by Mr. D. R. Pearl of Hamilton Standard Prop. Div. of United Aircraft Corp.**

1.5 O-Ring Characteristics

A very early and historically prominent user of O-rings[1] cites a number of characteristics of O-ring seals which are still of interest to seal designers. Extracts of the more general characteristics are listed as follows:

Note: While Parker Seal generally agrees with the author on most of his statements, exception will be taken to certain generalizations due to more recent developments in sealing geometry and improved elastomer technology.

A. The seals can be made perfectly leak-proof for cases of static pistons and cylinders for fluid pressures up to 5000 psi. (Limit of test pressure). The pressure may be constant or variable.

B. The seals can be made to seal satisfactorily between reciprocating pistons and cylinders at any fluid pressure up to 5000 psi. There may be slight running leakage (a few drops per hundred strokes) depending on the film-forming ability of the hydraulic medium. O-rings can be used between rotating members with similar results but in all cases the surface rubbing speed must be kept low.

C. A single O-ring will seal with pressure applied alternately on one side and then on the other, but in cases of severe loading or usage under necessarily unfavorable conditions, seal life can be extended by designing the mechanism so that each seal is subjected to pressure in one direction only. Seals may be arranged in series as a safety measure but the first seal exposed to pressure will take the full load.

D. O-ring seals must be radially compressed between the bottom of the seal groove and the cylinder wall for proper sealing action. This compression may cause the seal to roll slightly in its groove under certain conditions of piston motion, but the rolling action is not necessary for normal operation of the seals.

E. In either static or dynamic O-ring seals under high pressure the primary cause of seal failure is extrusion of the seal material into the piston-cylinder clearance. The major factors effecting extrusion are fluid pressure, seal hardness and strength, and piston-cylinder clearance.

F. Dynamic seals may fail by abrasion against the cylinder or piston walls. Therefore, the contacting surfaces should be polished for long seal life. Moving seals that pass over ports or surface irregularities while under hydraulic pressure are very quickly cut or worn to failure.

G. The shape of the seal groove is unimportant as long as it results in proper compression of the seal between the bottom of the groove and the cylinder wall, and provides room for the compressed material to flow so that the seal is not solidly confined between metal surfaces.

H. The seal may be housed in a groove cut in the cylinder wall instead of on the piston surface without any change in design limitations or seal performance.

Parker Hannifin Corporation • O-Ring Division
2360 Palumbo Drive, Lexington, KY 40509
Phone: (859) 269-2351 • Fax: (859) 335-5128
www.parkerorings.com

I. Friction of moving O-ring seals depends primarily on seal compression, fluid pressure, and projected seal area exposed to pressure. The effects of materials, surfaces, fluids, and speeds of motion are normally of secondary importance, although these variables have not been completely investigated. Friction of O-ring seals under low pressures may exceed the friction of properly designed lip type seals, but at higher pressures, developed friction compares favorably with, and is often less than, the friction of equivalent lip type seals.

J. The effects of temperature changes from +18°C to +121°C (-65°F to +250°F) on the performance of O-ring seals depends upon the seal material used. Synthetic rubber can be made for continual use at high or low temperatures, or for occasional short exposure to wide variations in temperature. At extremely low temperature the seals may become brittle but will resume their normal flexibility without harm when warmed. Prolonged exposure to excessive heat causes permanent hardening and usually destroys the usefulness of the seal. The coefficient of thermal expansion of synthetic rubber is usually low enough so that temperature changes present no design difficulties. (Note: This may not be true for all elastomer compounds, especially FFKM.)

K. Chemical interaction between the seal and the hydraulic medium may influence seal life favorably or unfavorably, depending upon the combination of seal material and fluid. Excessive hardening, softening, swelling, and shrinkage must be avoided.

L. O-ring seals are extremely dependable because of their simplicity and ruggedness. Static seals will seal at high pressure in spite of slightly irregular sealing surfaces and slight cuts or chips in the seals. Even when broken or worn excessively, seals may offer some measure of flow restriction for emergency operation and approaching failure becomes evident through gradual leakage.

M. The cost of O-ring seals and the machining expense necessary to incorporate them into hydraulic mechanism designs are at least as low as for any other reliable type of seal. O-ring seals may be stretched over large diameters for installation and no special assembly tools are necessary.

N. Irregular chambers can be sealed, both as fixed or moving-parts installations.

Note: See paragraph 1.3 for additional advantages.

1.6 Limitations of O-Ring Use

Again citing Mr. D. R. Pearl's paper [1], limitations of O-ring use are given as:

"Although it has been stated that O-rings offer a reasonable approach to the ideal hydraulic seal, they should not be considered the immediate solution to all sealing problems. It has been brought out in the foregoing discussion that there are certain definite limitations on their use, i.e., high temperature, high rubbing speeds, cylinder ports over which seals must pass and large shaft clearances. Disregard for these limitations will result in poor seal performance. Piston rings, lip type seals, lapped fits, flat gaskets and pipe fittings all have their special places in hydraulic design, but where the design specifications permit the proper use of O-ring seals, they will be found to give long and dependable service."

While no claim is made that an O-ring will serve best in all conditions, the O-ring merits consideration for most seal applications except:

A. Rotary speeds exceeding 1500 feet per minute contact speed.

B. An environment completely incompatible with any elastomeric material.

C. Insufficient structure to support anything but a flat gasket.

Note: These points are general statements and there are, of course, numerous exceptions. Details of O-ring seal design in regard to particular situations are discussed in the following sections: Applications, Elastomers, Factors Applying To all O-Ring Types, Static O-Ring Seals, and Dynamic O-Ring Seals can be referenced as needed.

1.7 Scope of O-Ring Use

Further discussion in this chapter and in the remainder of this handbook is based on specific types of O-ring seals and special applications. Definitions of commonly used terms connected with O-ring seals are provided in the glossary contained in the Appendix, Section X. These terms are common to the sealing industry.

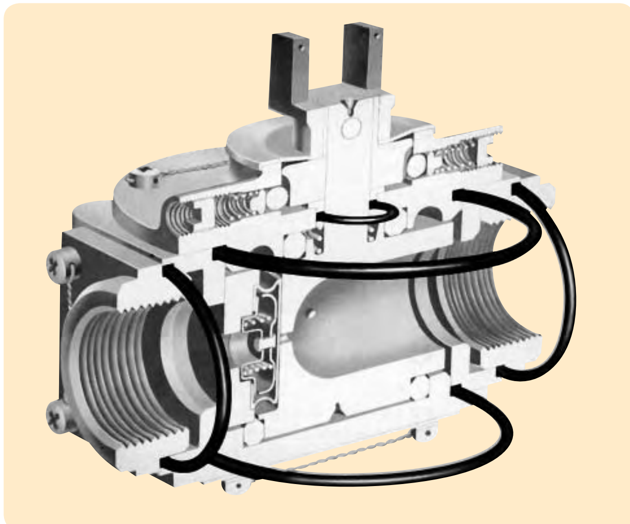

Figure 1-8: Static Seal Application

(1) **"O-Ring Seals in the Design of Hydraulic Mechanisms", a paper presented at the S.A.E. Annual Meeting, January, 1947 by Mr. D. R. Pearl, Hamilton Standard Division of United Aircraft Corp.**

Parker Hannifin Corporation • O-Ring Division
2360 Palumbo Drive, Lexington, KY 40509
Phone: (859) 269-2351 • Fax: (859) 335-5128
www.parkerorings.com

1.7.1 Static Seals

In a truly static seal, the mating gland parts are not subject to relative movement (except for small thermal expansion or separation by fluid pressure), as contrasted from seals in which one of the gland parts has movement relative to the other. Examples of static seals are: a seal under a bolt head or rivet, a seal at a pipe or tubing connection, a seal under a cover plate, plug or similar arrangement or, in general, the equivalent of a flat gasket. Figure1-8 illustrates a typical static seal.

Note: True static seals are generally quite rare. Vibrational movement is present in vitrually all static applications.

1.7.2 Reciprocating Seals

In a reciprocating seal, there is relative reciprocating motion (along the shaft axis) between the inner and outer elements. This motion tends to slide or roll the O-ring, or sealing surface at the O-ring, back and forth with the reciprocal motion. Examples of a reciprocating seal would be a piston in a cylinder, a plunger entering a chamber, and a hydraulic actuator with the piston rod anchored. Figure 1-9 illustrates a typical reciprocating seal.

Note: O-ring seals are generally not recommended for reciprocating installations in which the speed is less than one foot per minute. Consult a Parker Territory Sales Manager for more information on special seals to meet this requirement.

1.7.3 Oscillating Seals

In an oscillating seal, the inner or outer member of the seal assembly moves in an arc (around the shaft axis) relative to the other member. This motion tends to rotate one or the other member in relation to the O-ring. Where the arc of motion exceeds 360°, as in multiple turns to operate a valve handle, the return arc in the opposite direction distinguishes the oscillating seal from a rotary seal. Except for very special cases, any longitudinal motion (as caused by a spiral thread) involved in what is classed as an oscillating seal is not important. An example of an oscillating seal is an O-ring seal for a faucet valve stem. See Figure 1-10.

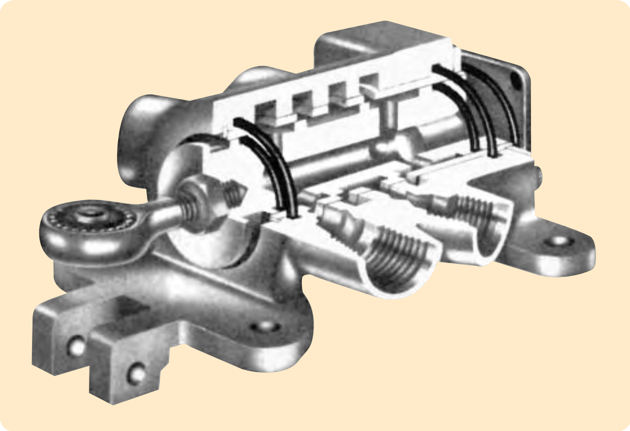

Figure 1-9: Reciprocating Seal Application

1.7.4 Rotary Seals

In a rotary seal, either the inner or outer member of the sealing elements turn (around the shaft axis) in one direction only. This applies when rotation is reversible, but does not allow for starting and stopping after brief arcs of motion, which is classed as an oscillating seal. Examples of a rotary seal include sealing a motor or engine shaft, or a wheel on a fixed axle. See Figure 1-11.

1.7.5 Seat Seals

In a seat seal, the O-ring serves to close a flow passage as one of the contact members. The motion of closing the passage distorts the O-ring mechanically to create the seal, in contrast to conditions of sealing in previously defined types. A sub-classification is closure with impact as compared with non-impact closure. Examples of a seat-seal include O-ring as a "washer" on the face of a spiral threaded valve, a seal on the cone of a floating check valve, and a seal on the end of a solenoid plunger. See Figure 1-12.

1.7.6 Pneumatic Seals

A pneumatic seal may be any of the previously described types of O-ring seals but is given a different classification because of the use of a gas or vapor rather than a liquid. This has a vital affect on the lubrication of the O-ring and thus influences all moving (or dynamic) seal installations. A further point is that pneumatic seals may be affected by the increase in gas temperature with compression. Note that the seal should be defined as "pneumatic-rotary" etc. for complete identification.

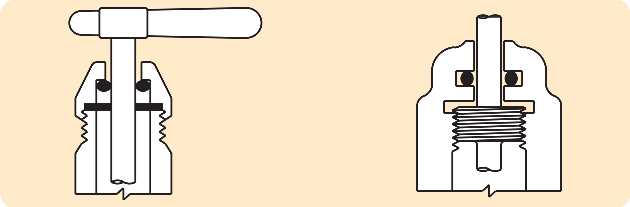

Figure 1-10: Oscillating Seal

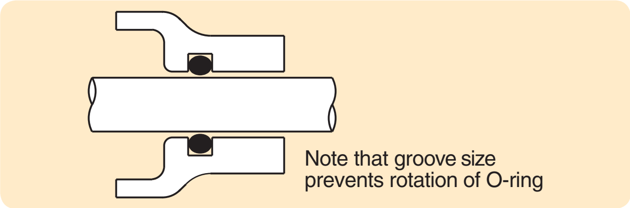

Figure 1-11: Rotary Seal

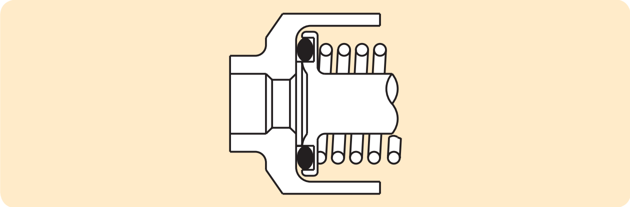

Figure 1-12: Seat Seal

Introduction

1.7.7 Vacuum Sealing

A vacuum seal confines or contains a vacuum environment or chamber. The vacuum seal may be any of the previously defined types (except a pneumatic seal) and as in the case of "pneumatic seals", both terms applicable to the seal should be given for complete identification. This classification is given primarily because, in most cases, the leakage tolerance is less than for pressure seals. In addition, the problem of pressure trapped between multiple O-rings, which increases the load on a single O-ring, does not apply. Multiple O-rings are useful in a vacuum seal to reduce permeation. Additional information on the use of O-rings for sealing in a vacuum environment may be found in Parker Catalog 5705A, Vacuum Sealing. See also Section III, O-Ring Applications.

1.7.8 Cushion Installation

Such an application requires that the O-ring absorb the force of impact or shock by deformation of the ring. Thus, forcible, sudden contact between moving metal parts is prevented. It is essentially a mechanical device. An example is the use of an O-ring to prevent metal-to-metal bottoming of a piston in a cylinder. The O-ring must be properly held in place as otherwise it might shift and interfere with proper operation of the mechanism.

1.7.9 Crush Installation

This use of an O-ring is a variation of the static seal. The O-ring is crushed into a space having a cross-section different from that of a standard gland — for example, triangular. While it is an effective seal, the O-ring is permanently deformed and therefore generally considered non-reusable. See Figure 1-13 and Design Chart 4-6 in Section IV for further information.

1.7.10 Rod Wiper Installation

In this case, the O-ring is used to keep a reciprocating shaft or rod clean to prevent damaging an O-ring seal located inboard from the wiper. The wiper O-ring does not necessarily seal. If there is a possibility of trapping liquid between the wiper and sealing O-rings, the space between the two must be vented. This installation is effective on actuating cylinders of machinery used in dirty, dusty areas. See Figure1-14.

1.8 O-Rings as Drive Belts

O-rings make superior low-power drive belts. See O-ring Applications, Section III for additional information on drive belt design.

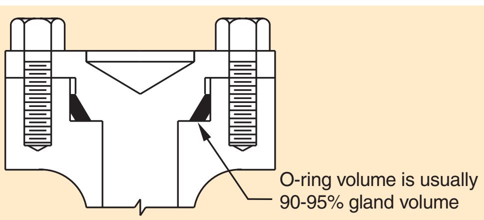

Figure 1-13: Crush Installation

1.9 Custom Molded Shapes

Molded shapes consist of homogenous rubber parts functioning as sealing devices in both dynamic and static applications. Relying on Parker custom designed seals can mean total sealing, cost reduction, fast service, and quality assurance to you. Contact the Parker Engineered Seals Division for more specific information on the availability of custom molded shapes.

1.10 Parker Engineering

Parker's Application Engineering Department personnel are prepared to help you solve your sealing problems in several ways:

Design Assistance
Our engineers will review your application, study all factors involved such as temperatures, pressures, gland design, bolt torque, surface finish, etc., and suggest several alternate designs. They will work with you in researching and testing those selected until the best possible seal is achieved, based on performance and low manufacturing cost.

Compound Development
Although the geometric configuration of the seal is critical, it is also very important to select the most appropriate compound for the specific application. Even though Parker has many compounds available, we are always ready to develop a special compound having its own distinct properties tailored to the needs of a particular application. To insure that these physical properties are achieved with each batch of material, Parker has designed a control system called "C.B.I." The initials "C.B.I." stand for "Controlled Batch Identification". This is a system of batch numbering and traceability developed by Parker Seal Group which ties the quality assurance system together from the masterbatch to the finished seals.

Total Quality Management
The Parker Seal Group employs a TS16949/AS9100 based system to assure a continuing standard of quality that is commensurate with good manufacturing practices. However, in many cases — as in custom designed molded shapes — a special quality assurance procedure will be developed for each individual molded shape with emphasis on the importance of the actual working area (or sealing interface) of the seal.

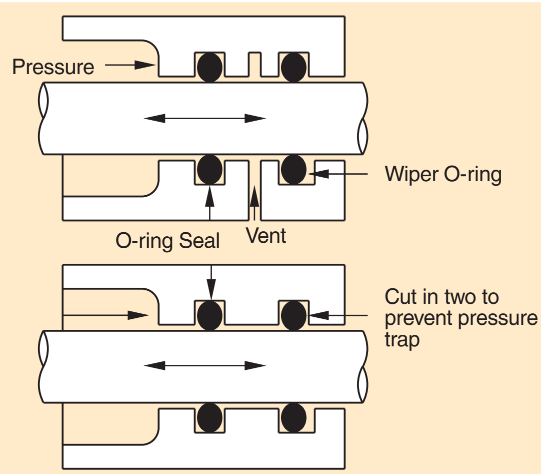

Figure 1-14: Wiper Installation

Parker
Parker Hannifin Corporation • O-Ring Division
2360 Palumbo Drive, Lexington, KY 40509
Phone: (859) 269-2351 • Fax: (859) 335-5128
www.parkerorings.com

1.11 Comparison of Common Seal Types

A number of common seal types, T-Seals, U-Cups, V-Packing and other devices, have been, and are still used for both dynamic and static seals. When compared with an O-ring seal, these other seal types may show one or more design disadvantages which might be overcome by use of an O-ring. As an aid in assessing the relative merits of an O-ring seal, Table1-1 lists several of the important factors that must be considered in the selection of any effective seal geometry.

1.12 Recommended Design Procedure

The following design steps are recommended for the designer/engineer who is not familiar with O-ring seals:

- O-Ring Design Procedure using inPHorm O-Ring Design & Material Selection Software described in paragraph 1.12.1
- Recommended Manual Design Procedure described in paragraph 1.12.2

1.12.1 O-Ring Design Procedure using inPHorm O-Ring Design & Material Selection Software.

Parker recommends utilizing our inPHorm design software to guide the user through the design and selection of an O-ring and corresponding seal gland. Parker's inPHorm not only addresses standard O-ring sizes, but allows the user to custom design O-ring glands and seals specifically for their application. To obtain inPHorm software, contact Parker Product Information at 1-800-C-PARKER or download from www.parkerorings.com. If inPHorm is not readily available manual calculations can be performed using the following guidelines.

1.12.2 Recommended Manual Design Procedure

1. Study the Basic O-Ring Elastomers and O-Ring Applications Sections (II and III, respectively) to see how a compound is selected, learn the effects of various environments on them, and become familiar with those considerations that apply to all O-ring seal glands.
2. Check the Appendix, Section X, for the compound shrinkage class tables. If it is not AN shrinkage, it may be necessary to compensate in the gland design for best sealing results.
3. Find the recommended O-ring size and gland dimensions in the appropriate design table in Static O-Ring Sealing or Dynamic O-Ring Sealing, Sections IV and V, respectively.
4. For industrial use, order the O-rings by the Parker compound number followed by the appropriate size number.

   Example: N0674-70 2-325

For the experienced O-ring seal designer:

1. Determine the gland design for best sealing results.
   (a) If the fluid medium or its specification is known, refer to the Fluid Compatibility Tables in Section VII or to the various material or other specifications listed in Section VIII.
   (b) If the compound specification is known, refer to Table 8-2, Table 8-3 or Table 8-4 in Section VIII as applicable.
2. Check the Appendix, Section X, for the compound shrinkage class tables. If it is not AN shrinkage, it may be necessary to compensate in the gland design for best sealing results.
3. Find the recommended O-ring size and gland dimensions in the appropriate design table in Static O-Ring Sealing or Dynamic O-Ring Sealing, Sections IV and V, respectively.
4. For industrial use, order the O-rings by the Parker compound number followed by the size number.
   Example: N0674-70 2-325

   When ordering parts made with a military, AMS, or NAS specification material, see the Specifications Section VIII.
   Example: M83248/1-325
5. For a design problem that cannot be resolved using the information in this reference guide, fill out a copy of the "Statement of Problem" sheet, Table 1-2, as completely as possible, then Contact the Parker O-Ring Division for problem analysis and design recommendations.

Comparison of Seal Types

Type	Applications Static	Applications Moving	Periodic Adjustment Required	Moving Friction	Tolerances Required (Moving Seals)	Gland Adapters Required	Space Requirements
O-Ring	X	X	No	Medium	Close	No	Small
T-Seal	X	X	No	Medium	Fairly Close	No	Small
U-Packing	—	X	No	Low	Close	No	Small
V-Packing	—	X	Yes	Medium	Fairly Close	Yes	Large
Cup Type Packing	—	X	No	Medium	Close	Yes	Medium
Flat Gasket	X	—	Yes	—	—	No	Large
Compression or Jam Packing	X	X	Yes	High	Fairly Close	Yes	Large

Table 1-1: Comparison of Seal Types

Introduction

Statement of Problem

1. Seal Type			
2. Fluid Sealed (In sequence if multiple)	A.	B.	
	C.	D.	Material Spec.
3. Temperature	High	Low	Working
4. Pressure	High	Low	Working
5. Applied Pressure	Uni-Directional	Steady	Surge
	Bi-Directional	Fluctuating	Frequency
6. Gland Dimensions (If separate, groove wall)	OD	Finish	Material
	ID	Finish	Material
		Finish	Material
7. Max. Stretch at Installation			
8. Assembly Problems	Dirt	Lint	Lube
	Twisted	Blind	Pinching
	Over Threads	Corners, Holes, Etc.	

Moving Seals

9. Length of Stroke (Reciprocating)		Arc of Travel (Oscillating)	
Surface Speed (Rotary)		Frequency (Oscillating or Reciprocating)	
10. Shaft Bearings	No		
Side Loading Effect		Eccentricity	
11. Operating Clearance	Max.	Min.	
12. Leakage Tolerance			
13. Friction Tolerance	Breakaway	Running	
14. Anticipated Overhaul Period			
Ease of Access and Replacement			
15. Lubrication	By Fluid Sealed	External	
16. Cleanliness	Protected	Open	Bad
O-Ring Size No.	And Parker Compound No.	Or Military Part No.	

17. Please include a drawing or sketch if needed to clarify the assembly, and add any other pertinent information.

NOTE: For O-rings molded of compounds having other than standard shrinkage, determine the finished dimensions and tolerances as described in the Appendix (Section X).

Table 1-2: Statement of Problem

Parker Hannifin Corporation • O-Ring Division
2360 Palumbo Drive, Lexington, KY 40509
Phone: (859) 269-2351 • Fax: (859) 335-5128
www.parkerorings.com