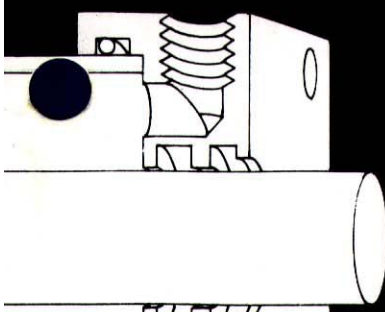
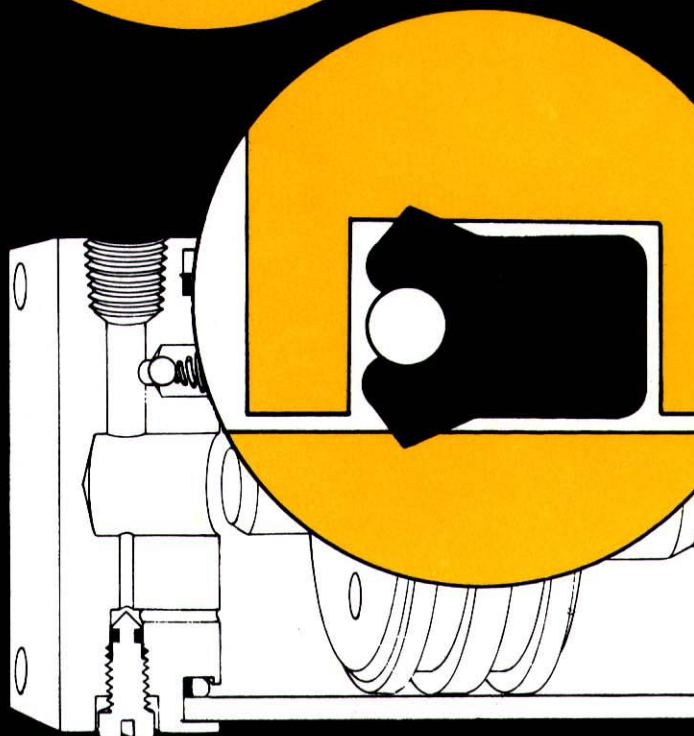
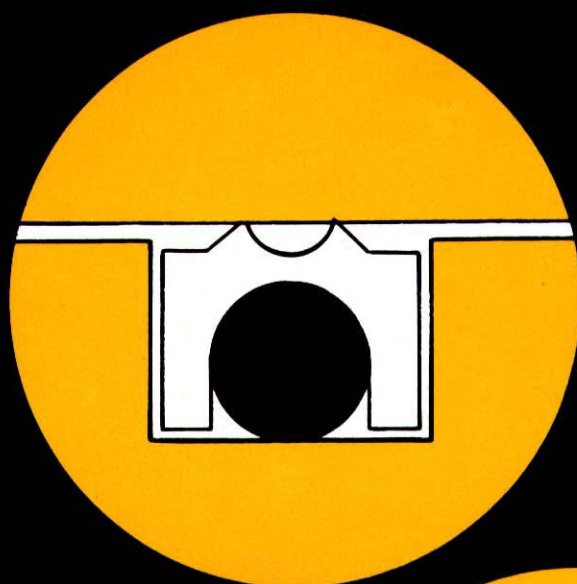
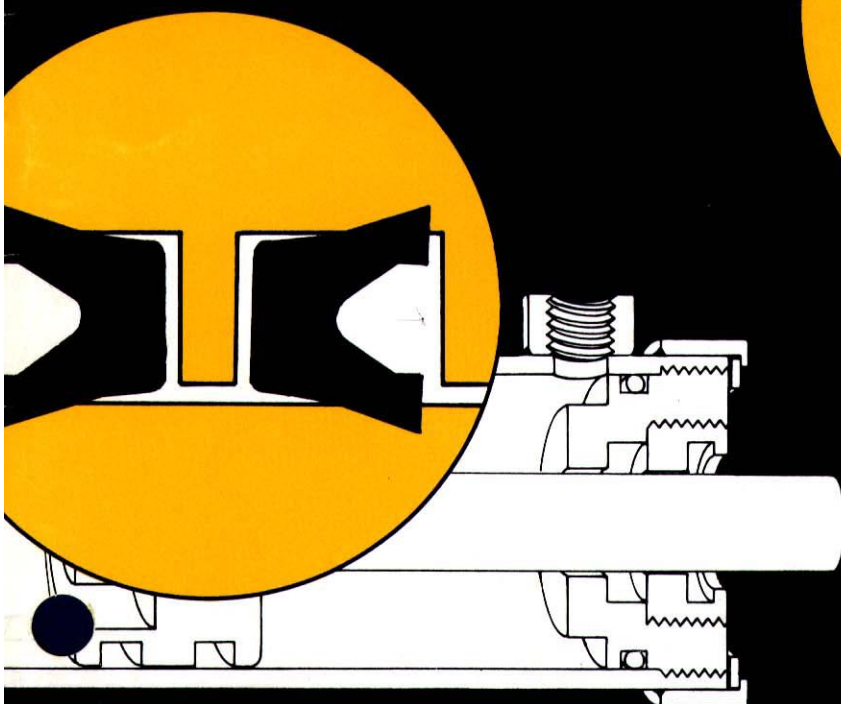




Parker
Seals



**TOTAL
HYDRAULIC/
PNEUMATIC
SEALING
SYSTEMS**

CYLINDERS — VALVES — PUMPS — ACTUATORS — ACCUMULATORS

PARKER TOTAL SEALING SYSTEMS

CYLINDERS — VALVES — PUMPS — ACTUATORS — ACCUMULATORS

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INTRODUCTION

The cost-effective sealing of modern Hydraulic or Pneumatic Cylinders is no longer a simple matter of ordering a stock seal, designing the proper gland and hoping for the best.

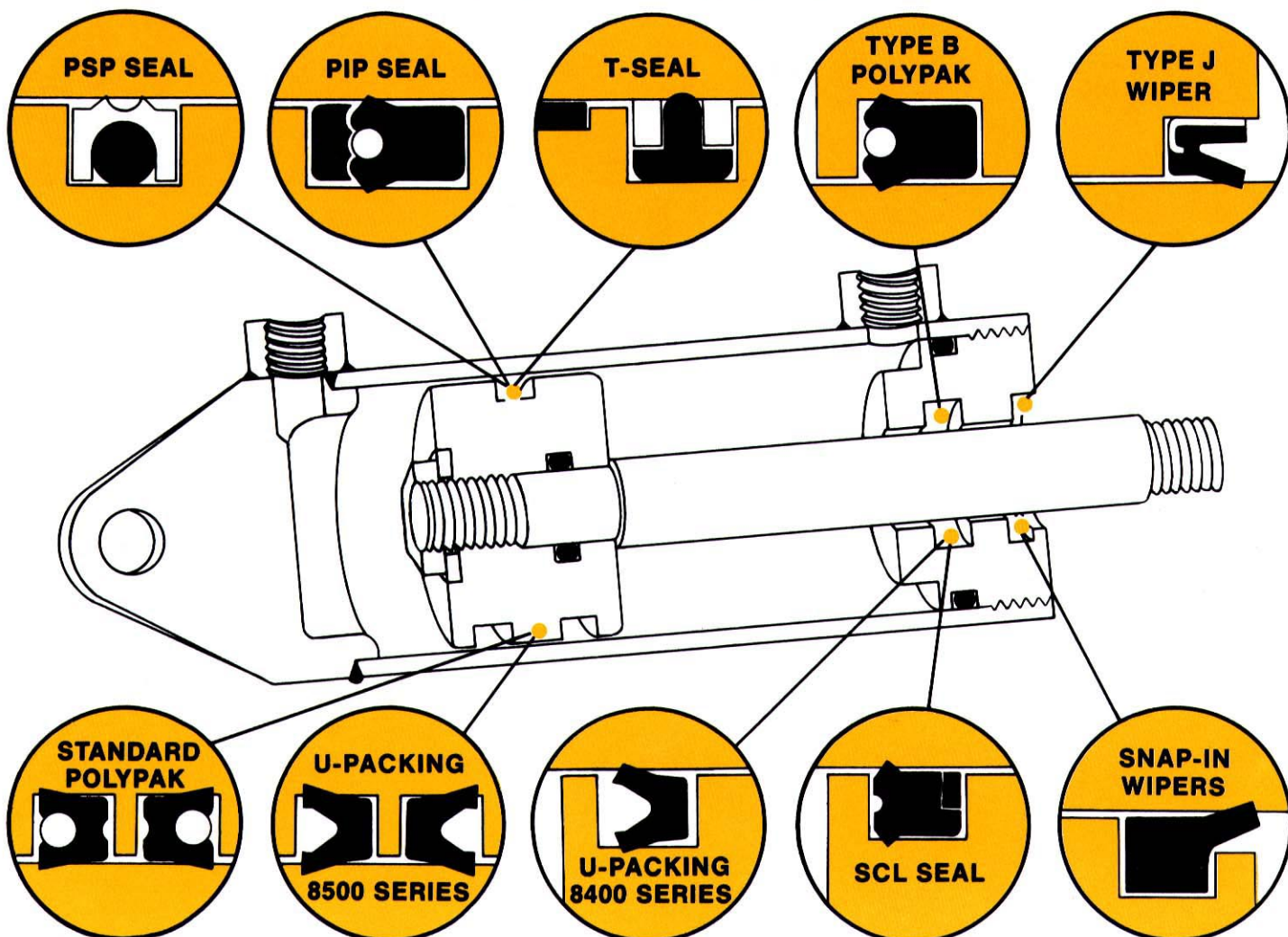
The introduction of high energy systems, increased operating pressures and a host of special purpose hydraulic fluids has effectively eliminated the casual selection of sealing devices for all but the most non-critical applications.

Parker Seal has been the leader in developing advanced seal designs and materials to keep pace with the need for increased reliability and performance levels in hydraulic and pneumatic devices.

The Parker "TOTAL SEALING SYSTEM" allows the designer or user the widest latitude in selecting the most effective combination of seal geometry and material to insure performance and reliability.



THE PARKER TOTAL SEALING SYSTEM

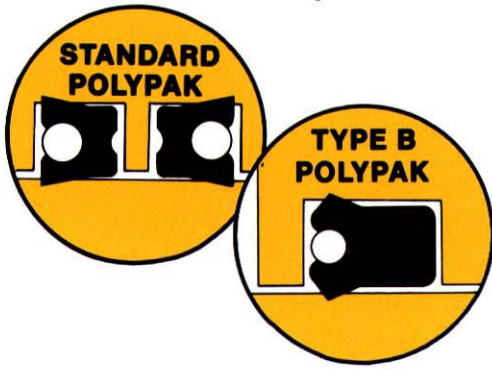


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... AND MORE

PARKER PolyPak SEALS



GENERAL The Parker PolyPak is a patented precision molded multi-purpose seal. The Parker PolyPak combines an O-ring type synthetic rubber O-Spring with a conventional lip-type seal (see Figure 1.) to produce a unique sealing device capable of sealing both vacuum, high and low pressure.

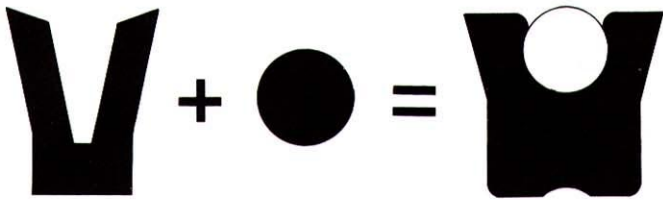
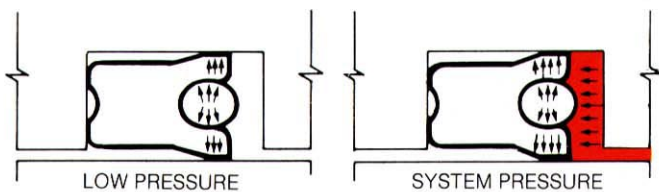


FIGURE 1

POLYPAK THEORY Conventional lip seals, such as the standard U-Packing are prone to leakage under low pressure because little or no LIP LOADING is inherent in the basic seal design.

The Parker PolyPak however, is a squeeze type seal and provides high sealability at low pressure. As system pressure increases, additional force is applied to the PolyPak's seal interface and as pressure continues to increase, lip loading is automatically increased to compensate for this higher pressure and thus maintain a positive, leak-free seal from hard vacuum to over 60,000 psi with proper design and auxiliary devices (see Figure 2.).



O-SPRING IS SQUEEZED CREATING A POSITIVE UNIT LOAD ON POLYPAK INDEPENDENT OF SYSTEM PRESSURE. POLYPAK THUS SEALS EFFECTIVELY AT LOW PRESSURE OR VACUUM.

FIGURE 2

LIPS ARE FORCED AGAINST SURFACES TO BE SEALED AS A FUNCTION OF APPLIED SYSTEM PRESSURE PLUS THE INITIAL O-SPRING SQUEEZE. O-SPRING PRESSURE REMAINS CONSTANT FROM ZERO PRESSURE TO INFINITY.

POLYPAK ADVANTAGES In addition to providing superior sealing in vacuum, low and high pressure applications, the PolyPak offers a number of distinct advantages over conventional symmetrical or non-symmetrical U-Packings.

(1) The PolyPak's O-Spring stabilizes the seal under extreme pressures, preventing seal lip distortion and rolling or twisting in the gland.

(2) At low or high temperature extremes, the O-Spring maintains lip loading on both I.D. and O.D. of the seal interface.

(3) The PolyPak seal can be stretched or squeezed to accommodate oversize cylinder bores and undersize rods. As long as the seal CROSS-SECTION is correct in relation to the radial groove dimensions, the PolyPak will compensate and maintain proper lip loading.

(4) The range of materials available to the user of the Parker PolyPak insures the proper combination or abrasion, extrusion, temperature resistance and fluid compatibility which produces high sealability and long seal life.



- HIGH CONFORMABILITY
- EXCELLENT SEALABILITY
- HIGH MEMORY OF O-SPRING
- LONG SERVICE LIFE
- HIGH STABILITY
- CHOICE OF STYLES
- CHOICE OF MATERIALS
- EASILY RETROFITS OTHER SEALS

PARKER POLYPAK STYLES

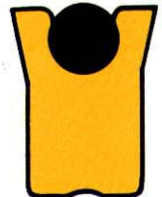
STANDARD

Standard PolyPak seals are square in cross-section and are suitable for a wide variety of rod and piston applications. Available in cross-sections from 1/8" to 1" and diameters to 90", the Standard PolyPak is ideal for retrofit of existing seal grooves.



DEEP

Deep PolyPak seals are rectangular versions of the Standard PolyPak. The added length improves stability in high-shock, heavy duty applications. Available in cross-sections from 1/8" to 1" and diameters to 90".



TYPE "B"

Type "B" PolyPak seals add a back-bevel lip to the Deep PolyPak shape and thus align the seal interface near the centerline of the O-Spring to provide increased squeeze (and sealability). This highly stable configuration provides excellent low pressure sealing as well as "super-pressure" capability. Available in all sizes from 1/8" to over 90" diameter.



PolyPak DESIGN DATA

INTRODUCTION. This section covers the basics of PolyPak Seal design and is intended to give the designer/engineer a brief overview of the requirements for reliable seal performance. **Complete design and engineering assistance is available by calling the Parker Seal Technical Service Group at (801) 972-3000 during normal business hours.**

ROD SEALING WITH POLYPAK As a general rule, rod seals are more critical in nature than their companion piston seals. As most equipment manufacturers require "dry rod" capability, both to conserve system fluid and to avoid leakage for cosmetic and environmental reasons, the design and selection of the rod seal can be rather more difficult than it's piston counterpart.

Parker recommends the use of the **Type B PolyPak for rod seal applications.** First, because of the excellent film-breaking capability of the back-beveled design. Second, the higher level of lip loading provided by the Type B offers maximum sealability and finally because the long body of the design provides maximum stability and extrusion resistance.

PISTON SEALING WITH POLYPAK Piston Seals can be classed in two categories, SINGLE ACTING and DOUBLE ACTING. The single acting seal is only required to seal in a single direction as system pressure is seen on only one side of the cylinder (return of the piston in a single acting system is accomplished either by gravity or spring loading). The double acting cylinder requires that the piston be sealed in both directions of stroke as system fluid is applied to one side or the other to achieve movement.

Parker recommends the use of either (1) two Standard (2) two Deep PolyPak or (3) one Type B PolyPak with PIP ring (see PIP SEAL) on double acting cylinders. **DO NOT USE TWO TYPE B POLYPAKS in double acting applications** as the extreme sealing ability of the Type B PolyPak is such that a PRESSURE TRAP (see pressure trap, page 6) may be created.

PISTON & ROD SEAL DESIGN HINTS Some other things to remember when considering piston & rod seal design are:

1. Surface Finish—An 10–16 rms finish is preferred on all dynamic surfaces and a 10–32 rms finish for static (see SURFACE FINISH on page 6).
2. Adequate Bearing surface — Be sure to allow for sufficient bearing surface to protect against side loading.
3. Wear Bands — Use of wear bands can cause unexpected problems with rod & piston seal geometry. Consult factory for assistance.
4. Seal Cross-Section — Use the largest seal cross-section that your design and good installation practice will allow. Parker PolyPaks are available in a number of C/S dimensions to suit your requirements.

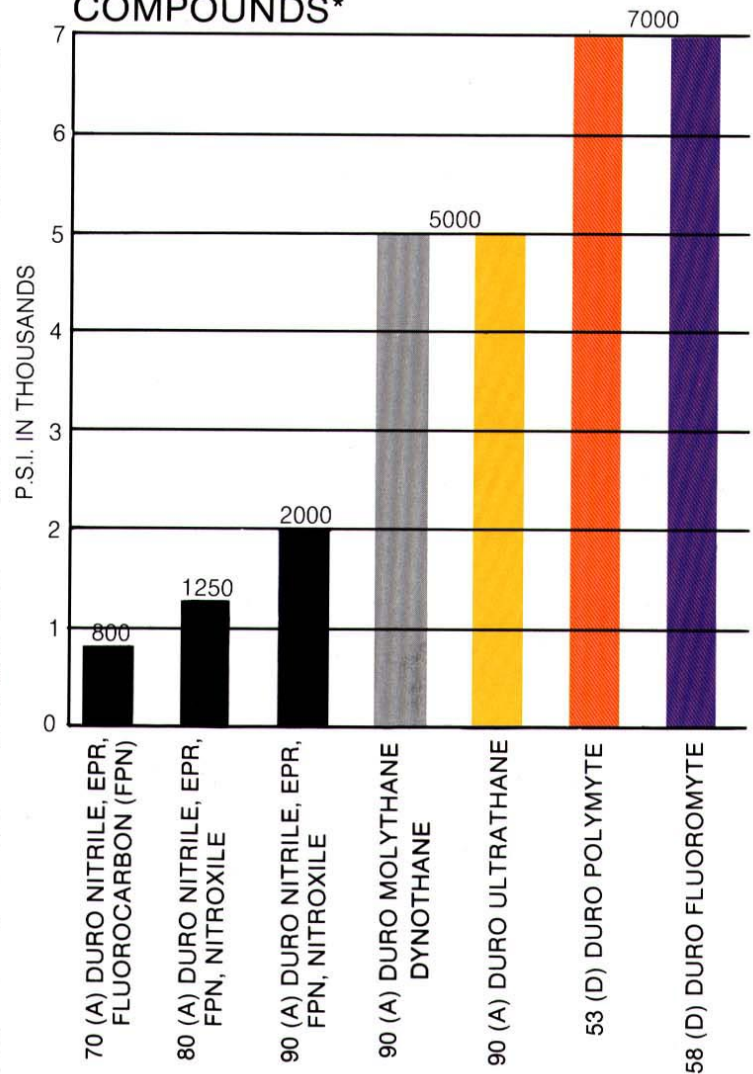
SUGGESTED CROSS SECTIONS:

Up to 2" Dia.— $\frac{3}{16}$ in. 5" to 10"— $\frac{3}{8}$ "
2" to 5" Dia.— $\frac{1}{4}$ in. Above 10"— $\frac{1}{2}$ in.

5. Installation — Break all sharp edges on metal components to prevent damage to seal lip during assembly and use adequate lubrication. See Chamfer Data, page 6).

SYSTEM PRESSURE The ability of seal materials to withstand the pressure of hydraulic system fluids varies with the compound. The chart below lists the MAXIMUM recommended operating pressure to which the material may be exposed without special back-up devices or reduced clearances with minimum risk of extrusion.

MAXIMUM RECOMMENDED PRESSURE FOR PARKER PACKING COMPOUNDS*



*TEST CONDITIONS

1. 100,000 PRESSURE CYCLES AT RATE OF 60 PER MINUTE FROM ZERO TO INDICATED PRESSURE.
2. TEST TEMPERATURE +160°F.
3. TESTS CONDUCTED WITH NO BACK-UP DEVICES.
4. MAXIMUM .010 DIAMETRICAL & .005 RADIAL CLEARANCE.

ENGINEERED DESIGN CHARTS. There are complete design labels available for all PolyPak Seals. We have included sufficient information at the end of this catalog to allow the designer or user to select the PolyPak needed for his application. Both Piston and Rod design information are shown.

MATERIAL SELECTION

INTRODUCTION This section briefly covers the wide range of basic seal materials available to the user of the Parker TOTAL Sealing System.

MATERIAL COLOR CODE Following each material type there is a color description indicating the base color of the polymer for identification purposes.

WHY DIFFERENT MATERIALS? New hydraulic fluids are being introduced into service at a rapid rate and system operating parameters (Pressure & Temperature) are changing to meet user needs. To keep pace with these changing conditions, Parker is constantly testing and developing new seal materials to extend service life. The material types listed below are general categories only. For complete technical information, ask Parker for test reports covering your specific fluid or application.

MOLYTHANE ● GRAY

Parker Molythane is the oldest and most generally specified seal material for hydraulic service. This unique material is a superior blend of Polyurethane and internal additives (to provide lubrication) developed for long service in all petroleum based fluids. The temperature range of Molythane is -65 °F to +200 °F (-54 °C to +107 °C); 140 °F in water and high water-based fluids. Parker's Molythane offers excellent resistance to extrusion and abrasion. The most popular compound is P4615A90.

rev. 10/2005

DYNOTHANE ○ CLEAR

Parker Dynothane is a polyurethane material with improved physical properties. Dynothane offers improved compression set resistance, higher rebound resilience and tensile strength resulting in improved seal performance. Fluid compatibility same as Molythane. Temperature range is -65°F to +200°F (-54°C to +107°C). The Dynothane compound number is P4693A90.

ULTRATHANE K-24 ● YELLOW

Ultrathane is a new polyurethane material from Parker offering up to 43% reduced friction over conventional urethane materials. Because of this reduced friction and the resulting lowering of frictional heat build-up at the seal interface, the operating temperature of this material is -65°F to +225°F (-54°C to +107°C). Ultrathane fluid compatibility is the same as Parker's other high tensile urethane materials and is good for service to 5000 psi at recommended dimensions and tolerances. The Ultrathane compound number is P4622A90.

NITROXILE ● BLACK

Nitroxile is a Carboxylated Nitrile material offering 3 to 5 times greater resistance to abrasion than conventional nitrile compounds. This material is also available with internal lubrication to reduce friction. Nitroxile is suitable for general hydraulic service in petroleum based fluids, water-oil emulsions, water-glycol fluids and water base fluids (HWBF). Nitroxile's temperature range is -40°F to +250°F (-40°C to +121°C). The most popular of the Nitroxile materials are N4257A80 (w/internal lubrication), N4274A85 (ELF) for extreme low friction requirements.

POLYMYTE ● ORANGE

Parker PolyMyte is an "elastoplastic" material with exceptionally high tear strength and abrasion resistance. PolyMyte's high modulus and high durometer (53 & 65 Shore D) make it very suitable for high pressure service where extrusion is a problem. PolyMyte is suitable for service in petroleum based fluids, water base fluids (HWBF)*, phosphate ester fluids, some chlorinated fluids and solvents. Temperature range is -65°F to +275°F (-54°C to +135°C), 180°F in water and water based fluids. The standard compound is Z4651D53. * (under 180°F)

FLUOROMYTE ● PURPLE

FluoroMyte was developed to meet seal needs in high pressure hydraulic systems. FluoroMyte has exceptionally high tear strength and abrasion resistance. It also has lower friction than PolyMyte due to special lubricants disbursed in the base material. FluoroMyte has excellent resistance to oxygen, ozone, petroleum and phosphate ester based fluids. The temperature range of this material is -65°F to +300°F (-54°C to +149°C). The FluoroMyte compound number is Z4653D58.

FLUOROCARBON ● BLACK

Fluorocarbon materials offer the user a wide range of fluid compatibility and broad temperature range often resulting in reduced seal inventory requirements. Fluorocarbon is suitable for use in most hydraulic fluids (except Skydrol types and some ester/ether fluids). Temperature range is -20°F to +400°F (-29°C to +204°C). The standard Fluorocarbon compounds are V4208A90 and V42266A95 (+450°F).

NITRILE ● BLACK

Nitrile is one of the oldest and most popular seal compounds. Nitrile compounds have good resistance to abrasion, extrusion and compression-set and are generally suitable for service in petroleum, water-oil emulsions and water-glycol fluids. The temperature range of Nitrile is -40°F to +250°F (-40°C to +121°C). Special Nitrile materials may have a higher upper limit (to +300°F). The general usage Nitrile compound is N4121A90 for PolyPak seals.

ETHYLENE PROPYLENE ● BLACK

Ethylene Propylene or EPR is a useful seal material for sealing phosphate ester type hydraulic fluids such as Skydrol. Ethylene Propylene is also suitable for use with automotive brake fluids, weak caustics, acids and Methyl Ethyl Keytone. This material SHOULD NEVER BE EXPOSED TO ANY TYPE PETROLEUM BASE FLUID OR LUBRICANT. Ethylene Propylene has a temperature range of -65°F to +300°F (-54°C to +149°C) and to +400°F in steam. The standard EPR compounds are E4207A90 and E4183A80. E4270A90 is a newly developed geothermal EPR material for service to 600°F in steam applications. Also has good explosive decompression resistance in CO₂.

PARKERTHANE ○ WHITE

Parkerthane is an improved formulation of polyurethane materials with extreme resistance to extrusion and abrasion. Parkerthane is suitable for use in most petroleum based fluids. The temperature range of Parkerthane is -65°F to +200°F (-54°C to +93°C). Parkerthane is identified by compound number P4611A90.

MATERIAL SELECTION (con't)

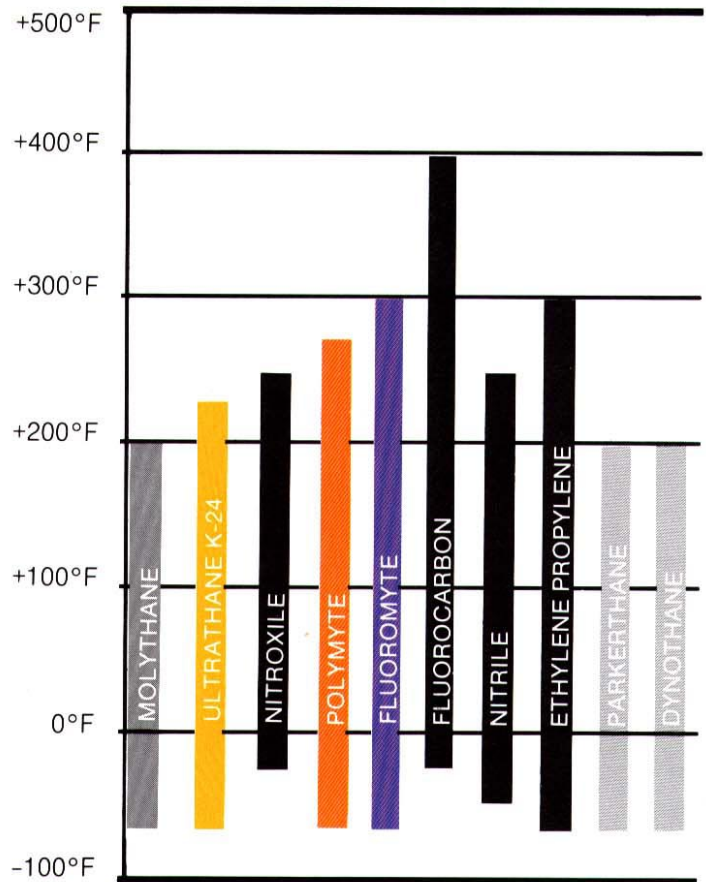
TEMPERATURE COMPATIBILITY is one of the prime considerations involved in seal material selection. In selecting a seal material, the user must determine both the upper and lower EXTREMES at which the seal will be expected to function and also take into account the TIME (duration) to which these extremes of temperature excursion will be experienced, bearing in mind that compression set (and therefore sealability) is a function of the time/temperature relationship. The general temperature capabilities for Parkers hydraulic and pneumatic seal materials are shown in the chart at right.

PRESSURE COMPATIBILITY is another consideration when selecting a seal material. This characteristic is determined by the durometer (hardness) of the material and by its internal chemistry. Pressure limitations for Parker compounds are shown on page 2 and are based on our recommended dimensions and tolerances.

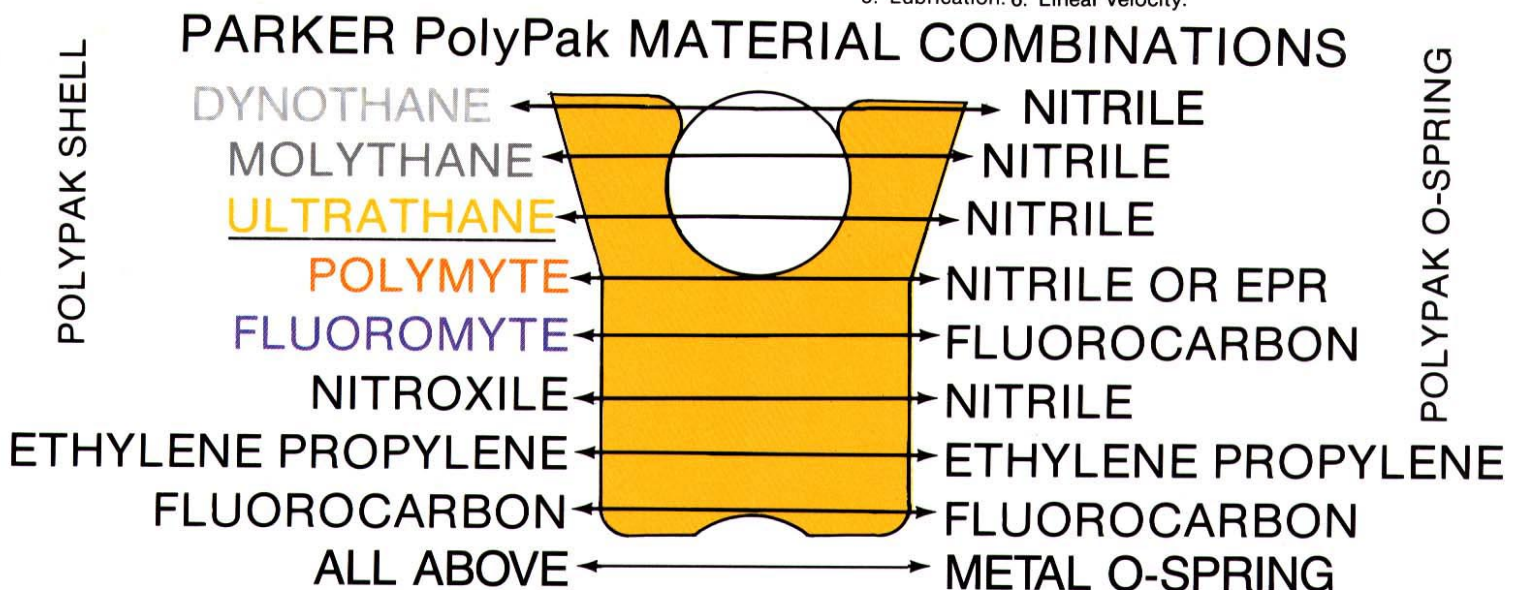
FLUID COMPATIBILITY is the final requirement for material selection. As all elastomers are affected to some degree by their fluid environment, it is vital that a material be selected that will be affected the LEAST by the fluid and again, there is the factor of TIME to be considered, a material which may be fine for 100 hours @ 200° F in the specified fluid may soften just enough @ 400 hours to extrude during a high pressure excursion. For your information, a short fluid compatibility table is provided on the next page.

TESTING of all sealing materials is recommended as there are many factors which may effect seal life. Parker suggests that all new and replacement materials and seal geometries be fully evaluated under actual service conditions before production and/or major retrofit programs are finalized.

RECOMMENDED TEMPERATURE LIMITS FOR PARKER PACKING COMPOUNDS.



- Note: Factors that influence temperature in dynamic applications.
1. Surface roughness.
 2. Bearing design and location.
 3. Size and design of seal(s).
 4. Coefficient of friction at seal interface.
 5. Lubrication.
 6. Linear Velocity.



The Material combinations shown above are the "standard" combinations available in Parker PolyPak Seals. Check to insure that both the PolyPak Shell AND It's companion O-Spring are compatible with your system temperature and fluid requirements.

FLUID COMPATIBILITY TABLE

This Table is a brief guide to some of the more common hydraulic, pneumatic and general service fluids. For more detailed information on these fluids or others not listed, contact Parker Technical Services at (801) 972-3000 during normal business hours.

CHEMICAL/FLUID MEDIA

GENERAL FLUIDS

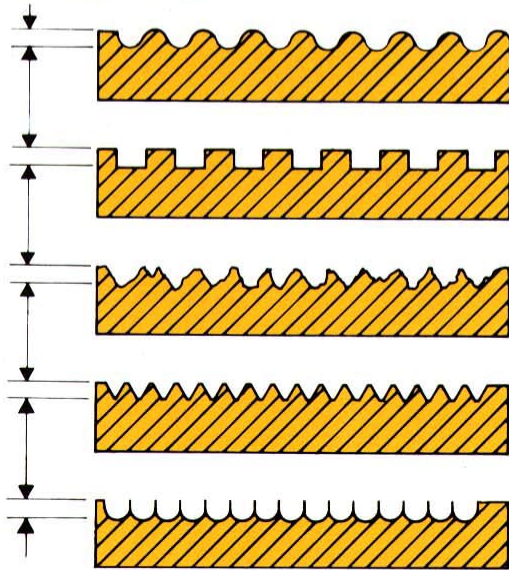
	N4115A75	N4180A80	N4181A85	N4182A75	E4183A80	V4205A75	E4207A90	E4270A90	V4208A90	V4266A95	N4257A80	N4274A85	N4263A90	P4615A90	P4611A90	P4617D65	P4622A90	P4693A90	W4650NHH	Z4651D53	Z4653D58	W4655NHH	
Air & Dry Gas																							
Acid, weak <50% conc.																							
Alcohols																							
Brake Fluid																							
Chlorine, dry																							
Ethers																							
Gasoline																							
Glycols, ethylene base																							
Hydrogen																							
Hydroxides, weak <50% conc.																							
Jet Fuel, JP-4, JP-5, JP-6																							
Ketones																							
Oil, Mil-H-5606, R-3065, Std. 417, Petroleum Base																							
Oil, mineral base																							
Water, hot 180°F																							
Water, cold under 150°F																							
WATER-GLYCOL FLUIDS																							
Fyre-Safe 160, 225																							
Fyreguard 150, 200, G-200																							
Houghto-Safe 500, 600																							
Hydrolube 150LT, 200LT, 275LT, 300LT																							
Santosafe W/G15, W/G20, W/G30																							
WATER-IN-OIL EMULSION FLUIDS																							
Fyre-Safe 500																							
Gulf FR Fluid																							
Houghto-Safe 5000																							
Hulsafe 500, 600																							
Inverse Emulsion																							
Invert Emulsion																							
AIRCRAFT TYPE FLUIDS																							
Aerosafe 2300, ER																							
Phosphate Ester Hydraulic Fluid																							
Skydrol 500B, 500B4, 500C																							
Hyjet W, III, IVA																							
INDUSTRIAL PHOSPHATE ESTER FLUIDS																							
Fyrquel Blend G, Pydraul 10E																							
Chevron FR-32, FR-46, FR-66, FR-150																							
Fyrquel 90, 150, 220, 300, 550, 550RC, 1000, 149ELT, 140RO, 220RO, GT																							
Houghto-Safe 1000, 1010, 1055, 1120																							
P-37, P-40, P-43, P-45, P-47																							
PE-15, PE-22, PE-30, PE-55																							
Phosphate Ester Hyd. Fluid																							
Pydraul 29E-LT, 30-E, 50-E, 65-E, 90E, 115E																							
PHOSPHATE ESTER-OIL BLENDS																							
Phosphate Ester, Base Fluid																							
Pydraul 230-C, 312-C, 540-C, MC																							
Sunguard 350 Safety Fluid																							
Vital Hydraulic Fluid																							

- GENERALLY ACCEPTABLE
 –CHECK SPECIFIC FLUID WITH PARKER TECHNICAL SERVICE.
- CONSULT PAGE 4 (OPPOSITE) FOR TEMPERATURE RATINGS.
- RECOMMENDATIONS SHOULD BE TESTED IN SERVICE BEFORE PRODUCTION.

MECHANICAL DESIGN CONSIDERATIONS

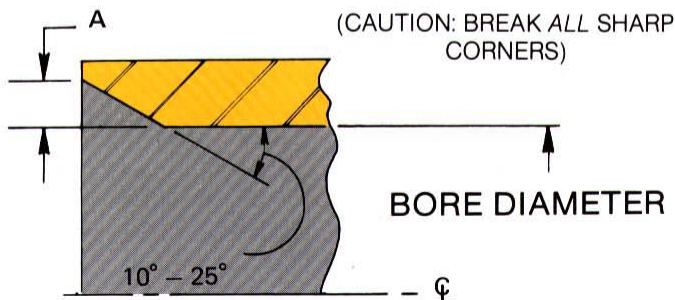
SURFACE FINISH is a subject of much controversy in the hydraulic industry. The current "RMS" method of defining surface finish leaves much to be desired as the "RMS" measurement alone can be deceiving. The graphic example below illustrates the problem. All the surface finishes shown measure 10 rms but as you can see, the actual microscopic surfaces are quite different. A low rms finish alone is not enough to insure good seal performance. In some cases, an 8 rms finish will cause more wear than a 30 rms finish. Be sure you specify the "type" of finish as well as it's RMS value.

10 RMS MICROFINISH



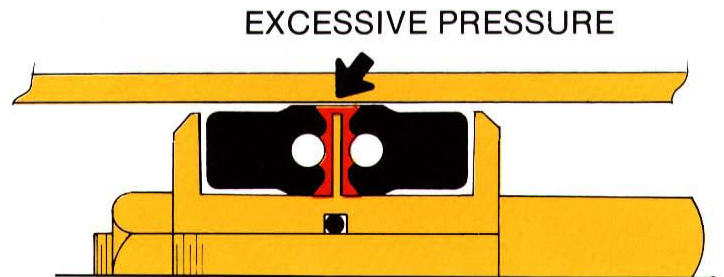
INSTALLATION CHAMFER Chamfers are used as a guide to aid in seal installation. The "A" dimension shown below will allow the PolyPak to enter the cylinder bore. The "A" dimension is the minimum width required which can be larger. Refer to page 8 for Piston Gland Dimensions.

NOM. SEAL C/S	"A" STD. PolyPak	"A" DEEP PolyPak	"A" TYPE B PolyPak
1/8	.031	.036	.046
3/16	.046	.050	.062
1/4	.050	.062	.078
5/16	.062	.071	.078
3/8	.062	.078	.083
1/2	.094	.100	.109
9/16	.100	.125	.125
5/8	.100	.125	.125
3/4	.109	.125	.143
7/8	.120	.156	.156
1	.133	.163	.172



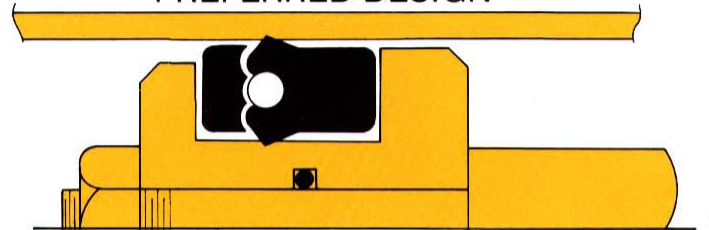
PRESSURE TRAPPING A pressure trap is created during the operation of double acting cylinders in which have been installed a set of seals that, because of their geometry, seal equally well in either direction of stroke (The Type B PolyPak is such a seal) and in consequence "Trap" pressurized system fluid *between* the two seals. This confined pressure can multiply itself (due to some basic laws of hydraulics) and can reach as high as 10,000 psi and above. At such excessive pressures, seal extrusion is severe, excessive friction and heat build-up occur and in some cases, metal components of the system such as piston washers and cylinder walls are distorted and often destroyed beyond repair. Pressure trapping can be avoided by the use of uni-directional seals such as Standard and Deep PolyPaks which allow trapped system fluid to escape out the non-pressurized side of the piston or a PIP, PSP or T-Seal for bidirectional sealings which requires only one seal groove.

BASIC PRESSURE TRAP



NOTE: Seals not to scale in drawings.

PREFERRED DESIGN



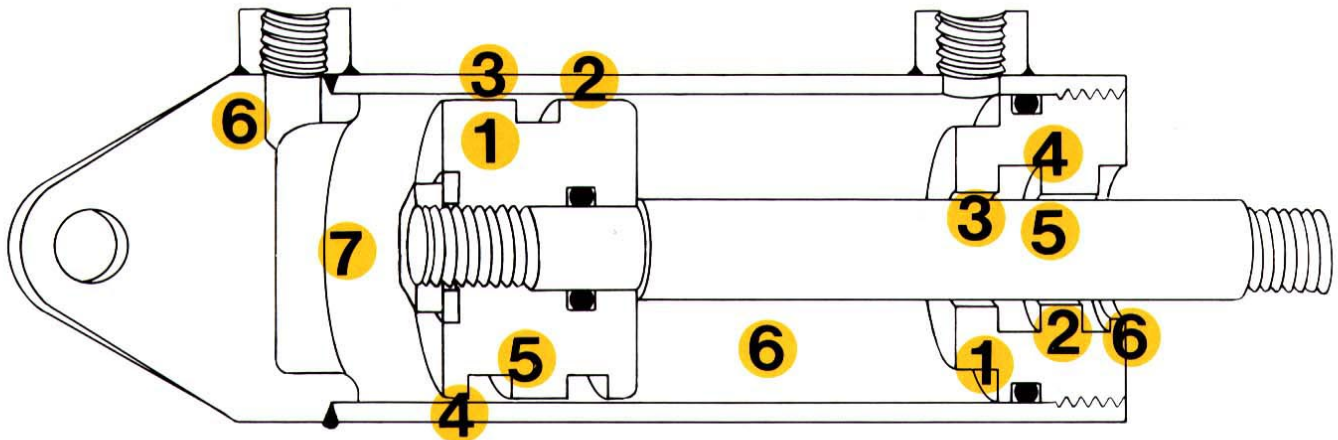
NOTE: Seals not to scale in drawings.

EXCLUSION DEVICES The use of wipers or wiper/scrapers to protect rod seals is recommended by Parker on all Hydraulic rods. The use of exclusion devices will insure that your equipment performs it's function with improved reliability, less seal, rod, piston and bore wear and decreases the chance of contamination of the system fluid by outside contaminants. Parker makes a number of wiper and wiper/scrapper styles to cover all types of requirements.

Parker
Seals

SPECIAL PROBLEM AREAS

For additional information on possible causes of seal failure, see section on "Trouble Shooting" on page 17.



WHEN IN TROUBLE There is a simple process to follow in correcting any type of seal failure.

1. REEXAMINE YOUR SEAL SELECTION PROCESS.
2. EXAMINE COMPLETE SYSTEM.
3. CAREFULLY EXAMINE FAILED SEAL FOR EVIDENCE OF:
 - a. Softening or hardening of seal material.
 - b. Dimensional changes in seal.
 - c. Surface tears, scratches, extrusion or other physical damage.
 - d. Obtain sample of system hydraulic fluid.
4. CONTACT PARKER ENGINEERING TO ASSIST IN ANALYSIS OF FAILURE AND RECOMMENDED SOLUTION.

1. SPIRAL FAILURE is often the result of a combination of factors such as basic seal geometry, long stroke and/or too soft an elastomer. The classic spiral failure usually is found in a simple O-ring type seal but will sometimes be evident in unsupported lip type seals as well. The use of Parker T-Seals, harder durometer materials, and seals with rectangular cross-sections will usually solve this problem.

2. EXTRUSION of the seal element is usually caused by excessive clearances in metal components, high axial loading, high pressure and use of too low a durometer seal material. Extrusion causes a loss in seal volume and stability. The prevention of extrusion usually requires a type of seal with built-in back-up rings or use of special high durometer "extrusion-resistant" materials. Parker Seals for this purpose include Hard-Heel PolyPaks, SCL Seals, T-Seals and auxiliary devices such as modular back-ups.

3. SLIP-STICK is an expression of the differential between the static and dynamic coefficient of friction as it relates to start-up of a sliding mechanism. Slip-Stick occurs when the seal "hangs-up" in the transition period between static and dynamic modes or there is a variation in the system fluid pressure, or shock loads cause the piston to jump back to the static mode. The most noticeable result of Slip-Stick is erratic or jerky movement of the actuator rod. Slip-Stick often creates an audible noise and excessive heat and seal wear can occur. To prevent this problem, consider the use of Parker's internally lubricated compounds and/or change to seal design with lower friction potential and better bearing-to-stroke ratio.

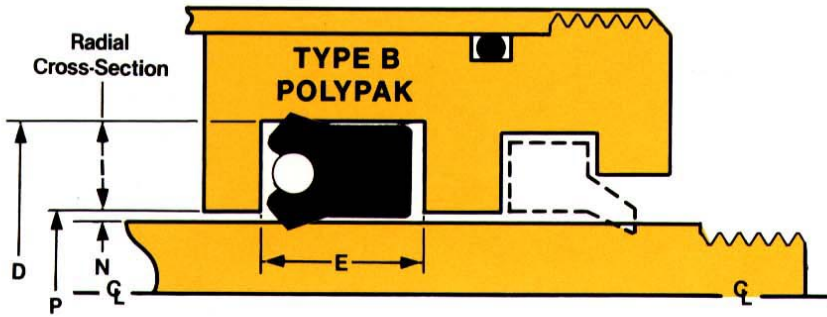
4. HEAT DEGRADATION is to be suspected when the failed seal exhibits a hard, brittle appearance and/or shows a breaking away of parts of the seal lip or body. Heat degradation results in loss of sealing lip effectiveness through excessive compression set and/or loss of seal material. Causes of this condition may be use of incorrect seal material, high dynamic friction, excessive lip loading, no heel clearance and proximity to outside heat source. Correction of heat degradation problems may involve reducing seal lip interference, increasing lubrication, change of seal material. In borderline situations consider all upper temperature limits to be increased by 50°F in dynamic reciprocating seals at the seal interface due to running friction.

5. IMPROPER INSTALLATION is a major cause of seal failure. The three broad areas to be watched during seal installation are: cleanliness, protecting the seal from nicks and cuts and proper lubrication. Other problem areas are overtightening of the seal gland where there is an adjustable gland follower or folding over a seal lip during installation. The solution to these problems is common sense and reasonable care during assembly.

6. SYSTEM CONTAMINATION is usually caused by external elements such as dirt, grit, mud, dust, even ice and internal contamination from circulating metal chips, breakdown products of the fluid, hoses or other degradable system components. As most external contamination enters the system during rod retraction, the proper installation of a rod wiper/scrapper is the best solution. Internal contamination is best prevented by proper filtering of system fluid. Contamination is indicated by scored rod and cylinder bore surfaces, excessive seal wear and leakage.

7. CHEMICAL BREAKDOWN of the seal material is most often the result of incorrect material selection in the first place or subsequent change of system fluid. Misapplication or use of non-compatible materials can lead to chemical attack on seal by fluid additives, hydrolysis and oxidation /reduction of seal elements. Chemical breakdown can result in loss of seal lip interface, softening of seal durometer, excessive swelling or shrinkage. The solution to chemical breakdown problems may be found with the use of Parker's special compounds such as Elastalloys, Nitroxiles, Fluorocarbons.

PolyPak ROD DESIGN TABLE



Rod Seal Example:

Given desired rod diameter of 2½" with a nominal seal cross-section of ¾".

$$\text{Rod Dia. (N)} = 2.500 \pm .002$$

$$\text{Throat Dia. (P)} = N_{\text{max}} + .001 \pm .003 = 2.500 + .001 = 2.501 \pm .003$$

$$\text{Groove Dia. (D)} = N_{\text{max}} + 2(I) \pm .003 = 2.500 + 2(.250) = 3.00 \pm .003$$

$$\text{Axial Groove Length (E)} = \text{Given } .413 \pm .013$$

N Nominal Rod I.D. Range	Nominal Radial Cross-Section	E Axial Groove Length Deep & Type B		P Throat Diameter	D Groove O.D.
		I	Standard		
¼" - 2⅛" ± .001	⅝	.125	.138 ± .015 ± .000	.275 ± .015 ± .000	$N_{\text{max}} + .001 \pm .002$ $N_{\text{max}} + 2(I) \pm .002$
⅜" - 4¼" ± .002	⅞	.187	.206	.343 .413	$N_{\text{max}} + .001 \pm .002$ $N_{\text{max}} + 2(I) \pm .002$
½" - 12¾" ± .002	¼	.250	.275	.413 .618	$N_{\text{max}} + .001 \pm .003$ $N_{\text{max}} + 2(I) \pm .003$
¾" - 9⅞" ± .002	⅞	.312	.343	.550 .688	$N_{\text{max}} + .002 \pm .003$ $N_{\text{max}} + 2(I) \pm .004$
1½" - 14¾" ± .002	⅝	.375	.412	.550 .688	$N_{\text{max}} + .002 \pm .004$ $N_{\text{max}} + 2(I) \pm .005$
2¼" - 5" ± .003	⅞	.437	.481	.688 .825	$N_{\text{max}} + .002 \pm .004$ $N_{\text{max}} + 2(I) \pm .006$
1¾" - 24¾" ± .003	½	.500	.550	.825	$N_{\text{max}} + .002 \pm .005$ $N_{\text{max}} + 2(I) \pm .007$
2¾" - 19¾" ± .003	⅝	.625	.688	1.100 1.375	$N_{\text{max}} + .003 \pm .006$ $N_{\text{max}} + 2(I) \pm .009$
7¼" - 31" ± .004	¾	.750	.825	1.238 1.375	$N_{\text{max}} + .003 \pm .007$ $N_{\text{max}} + 2(I) \pm .011$
15" - 39" ± .005	1	1.000	1.100	1.650	$N_{\text{max}} + .004 \pm .009$ $N_{\text{max}} + 2(I) \pm .015$

F₁

F₂

F₃

F₄

F₅

Notes:

F₁—The Nominal Rod Diameter spread shown is taken from price list PPD3701. Available sizes fall in cross-section range. Consult PPD 3701 Price List for specific size availability. Rod size range given based on Type B Poly Pak availability.

F₂—The Radial Cross-Section I is shown as a fraction for Seal Reference and as a three place decimal for Gland Reference.

F₃—There may be two possible Axial Groove Lengths for some cross-sections. Consult price list PPD3701 for availability.

F₄—The throat diameters are simply figured by taking the maximum Rod Diameter plus the noted clearance.

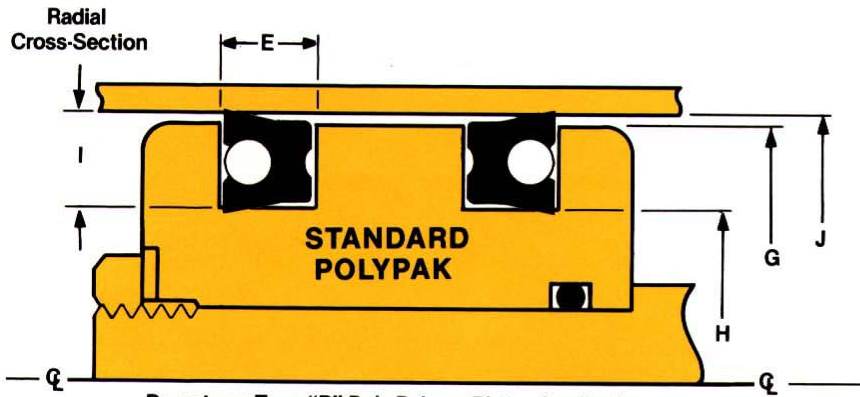
F₅—The Groove Outside Diameter is calculated by taking the maximum Rod Diameter plus two radial cross-sections I.

Note:

1—Molythene parts can be stretched up to 5% of its diameter or compressed up to 2% for rod applications. Therefore if odd size rods or bores are encountered, existing sizes can be used without special non-available seals. Careful attention must be taken when using the 5% rule so that the radial cross-section "I" must be maintained no matter what dimension the rod or piston actually measures. Careful attention must be taken to select a size that requires 5% max **stretch** on the diameter in piston applications, and 2% max. **compression** on the diameter in rod applications.

2—Axial groove lengths for Poly Paks with non-positively actuated modular back-ups are calculated by: (nominal radial c/s desired × 1.100) + "E".

PolyPak PISTON DESIGN TABLE



Piston Seal Example:

Given desired bore diameter of 6" with a nominal seal cross-section of $\frac{3}{8}$ ".

$$\text{Bore dia. (J)} = 6.000 \pm .000$$

$$\text{Piston O.D. (G)} = J_{\text{min}} - .002 \pm .002 = 6.000 - .002 = 5.998 \pm .002$$

$$\text{Groove I.D. (H)} = J_{\text{min}} - 2(I) \pm .005 = 6.000 - 2(.375) = 5.250 \pm .005$$

$$\text{Axial groove length (E)} = \text{Given } .550 \pm .015$$

J Nominal Bore O.D. Range	Nominal Radial Cross-Section	I	E Axial Groove Length Standard	Deep	G Piston O.D. Formula	H Groove I.D. Formula
$\frac{5}{16}$ " - 6" $\pm .002$ $\pm .000$	$\frac{3}{8}$	.125	.138 $\pm .015$ $\pm .000$	.275 $\pm .015$ $\pm .000$	$J_{\text{min}} - .001 \pm .000$ $\pm .001$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .002$
$\frac{3}{8}$ " - 6 $\frac{1}{16}$ " $\pm .002$ $\pm .000$	$\frac{7}{16}$	.187	.206	.343 .413	$J_{\text{min}} - .001 \pm .000$ $\pm .002$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .002$
$\frac{1}{4}$ " - 14" $\pm .003$ $\pm .000$	$\frac{1}{4}$	.250	.275	.413 .618	$J_{\text{min}} - .001 \pm .000$ $\pm .002$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .003$
1" - 15 $\frac{1}{2}$ " $\pm .003$ $\pm .000$	$\frac{7}{16}$	.312	.343	.550 .688	$J_{\text{min}} - .002 \pm .000$ $\pm .002$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .004$
1 $\frac{1}{4}$ " - 20 $\frac{1}{4}$ " $\pm .004$ $\pm .000$	$\frac{3}{8}$	.375	.412	.550 .688	$J_{\text{min}} - .002 \pm .000$ $\pm .002$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .005$
1 $\frac{3}{8}$ " - 6 $\frac{3}{8}$ " $\pm .005$ $\pm .000$	$\frac{7}{16}$	.437	.481	.688 .825	$J_{\text{min}} - .002 \pm .000$ $\pm .002$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .006$
1 $\frac{1}{2}$ " - 52 $\frac{1}{2}$ " $\pm .005$ $\pm .000$	$\frac{1}{2}$	.500	.550	.688 .825	$J_{\text{min}} - .002 \pm .000$ $\pm .003$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .007$
3 $\frac{3}{8}$ " - 5 $\frac{1}{2}$ " $\pm .006$ $\pm .000$	$\frac{7}{16}$	.562	.618	.963	$J_{\text{min}} - .002 \pm .000$ $\pm .003$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .008$
2 $\frac{1}{2}$ " - 26" $\pm .006$ $\pm .000$	$\frac{3}{8}$	.625	.688	1.100 1.375	$J_{\text{min}} - .003 \pm .000$ $\pm .003$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .009$
4 $\frac{1}{2}$ " - 27 $\frac{1}{2}$ " $\pm .007$ $\pm .000$	$\frac{1}{4}$	.750	.825	1.238 1.375	$J_{\text{min}} - .003 \pm .000$ $\pm .004$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .011$
6" - 21 $\frac{3}{4}$ " $\pm .008$ $\pm .000$	$\frac{3}{8}$	.875	.963	1.375 1.513	$J_{\text{min}} - .004 \pm .000$ $\pm .005$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .012$
4" - 18" $\pm .009$ $\pm .000$	1	1.000	1.100	1.650	$J_{\text{min}} - .004 \pm .000$ $\pm .005$	$J_{\text{min}} - 2(I) \pm .000$ $\pm .011$

(F₁)

(F₂)

(F₃)

(F₄)

(F₅)

Notes:

F₁—The nominal bore diameter spread shown is taken from price list PPD3701. Available sizes fall in these sizes. Consult PPD3701 price list for specific size availability.

F₂—The radial cross-section I is shown as a fraction for Seal Reference and a three place decimal for Gland Reference.

F₃—There may be two possible axial groove lengths for some cross-sections. Consult price list PPD3701 for availability.

F₄—The piston outside diameters are simply figured by taking the minimum bore diameter minus the noted clearance.

F₅—The groove inside diameter is calculated by taking the minimum bore diameter minus two radial cross-sections I.

Note:

1—Molythane parts can be stretched up to 5% of its diameter or compressed up to 2% for rod applications. Therefore if odd size rods or bores are encountered, existing sizes can be used without special non-available seals. Careful attention must be taken when using the 5% rule so that the radial cross-section "I" must be maintained no matter what dimension the rod or piston actually measures. Careful attention must be taken to select a size that requires 5% max **stretch** on the diameter in piston applications, and 2% max. **compression** on the diameter in rod applications.

2—Axial groove lengths for Poly Paks with non-positively actuated modular back-ups are calculated by: (nominal radial c/s desired \times 1.100) + "E".

THE PARKER TOTAL SEALING SYSTEM

"ALTERNATIVE SEAL SOLUTIONS"



GENERAL In addition to Parker PolyPak seals, there are a number of specialized Parker sealing devices which are designed to overcome difficult or unusual applications. By the use of the Parker TOTAL Sealing System, the most efficient combination of seal geometry and material may be employed. The following pages briefly describe our complete seal selection for reliable hydraulic or pneumatic sealing.



The Parker PIP Seal combines a Type B PolyPak with a "pressure inverting pedestal which will convert the Type B Seal into a Bi-directional device. The PIP Seal needs only a single seal groove and can be installed on one-piece pistons in most cases, thus saving space, increasing the bearing length of the piston and

reducing the number of piston components involved. A Parker PIP Seal can be installed in a Bi-directional seal system replacing two standard PolyPaks at a considerable savings in both machining and seal cost. **For complete data on the Parker PIP Seal, ask for Parker Flyer PPD3500F.**



The Parker PSP Seal is a Bidirectional "squeeze" type seal ideal for use as a piston seal in fluid power cylinders.

The PSP Seal's geometry provides a fluid reservoir between the two sealing lips which traps system fluid, resulting in a reduced breakaway and running friction. The PSP Seal is suitable for direct substitution with O-

rings, Parker T-Seals and Cap seals in Industrial No-Back-Up O-ring Grooves.

Parker PSP Seals are molded in our Ultrathane (polyurethane) material exhibiting excellent wear, abrasion resistance and low friction properties. This high performance material, combined with a high memory O-Spring provides positive, no-drift sealing in a wide variety of cylinder piston applications.

PSP Seals are suitable for use in systems with pressures up to 5000 psi (at recommended groove dimensions and tolerances). The built-in stability of the PSP design also resists spiral failure. In addition, the PSP Seal is easy to install and can be employed on one-piece pistons. **For complete data on the Parker PSP Seal, ask for Parker Flyer PPD3928.**



Parker SCL (Special Cut Lip) Seals are unidirectional seals designed for use in reciprocating devices such as cylinders and spool valves. Standard SCL seals are directly interchangeable with O-rings and T-Seals in MIL-G-5514F grooves and provide better low pressure sealing, improved stability, excellent extrusion resistance

and offer a superb balance between wear resistance and low friction for long, smooth operation. Parker SCL Seals are available without back-up rings or with back-up rings and are generally used as rod seals. **For more information on Parker SCL Seals ask for Parker Catalog PPD 3550.**



The Parker T-Seal is designed for direct replacement of O-rings in long stroke hydraulic applications where spiral failure due to rolling of the O-ring in the seal groove has occurred. The T-Seal is also useful where extrusion of the seal element is probable as the back-up components of the T-Seal function as anti-extrusion

devices. Because of the extrusion resistance of T-Seal geometry, higher system pressures may be employed with greatly reduced probability of seal failure.

The Parker T-Seal may be used in most popular Industrial direct substitution for O-rings. The Parker T-Seal is available in sizes from 3/8" thru 21" Outside Diameter for piston applications and from 3/16" thru 11" Inside Diameter for rod applications.

Parker also produces a special series of T-Seals designed especially for use in aircraft fluid power systems in the standard and radiused configuration.

For complete information on Parker Aircraft T-Seals, ask for Parker Catalog PPD3005 and for complete engineering data on standard piston and rod T-Seals, ask for Parker Catalog PPD3001.



Parker 8400 Series U-Packings are especially adapted to low speed-low pressure situations. The compact configuration of the 8400 style and its inherent low friction make this an ideal pneumatic seal. Although basically a low to medium pressure seal, the pressure range may be extended somewhat by the use of supporting

back-up rings. (Back-ups are required where clearances are excessive or where pressures exceeds 1000 psi.)

For more information on Parker 8400 Series U-Packings ask for Parker Catalog PPD3300.

THE PARKER TOTAL SEALING SYSTEM (con't)



Parker BS (Better Sealing) Profile "Double Lip" Rod Seals are virtually leak free. The unique "BS" geometry is highly resistant to side loading and insensitive to pressure spikes. This design reduces or eliminates leakage under severe operating conditions. FEA engineered configuration accurately controls the lubricating film

thickness on the rod in a wide range of temperature/pressure hydraulic applications. Secondary sealing lip primarily stabilizes seal in groove; prevents outside air from getting past primary seal lip; relieves fluid pressure buildup between rod seal and wiper; carries reservoir of fluid between sealing lips for lower break away and running friction, has lower running temperature at sealing interface. The BS Profile Rod Seal is the latest State of the Art in hydraulic rod sealing. **For complete information ask for Catalog PPD3923.**



Parker Type J canned wipers are designed for press-fit in open face rod wiper glands and do not require additional retention devices such as snap-rings or face plates.

Type J wipers are an excellent choice for use in severe rod wiper environments such as frozen or dried mud and even light weld splatter. The tough black polyurethane wiper element has excellent wear and abrasion resistance and by using a material of 90 shore A hardness, the wiper lips become extremely sensitive to even the smallest contaminants.

The steel retainer is phosphatized to resist corrosion in service as well as to provide an improved chemical bonding surface for the polyurethane wiper element.

The wiper material formulation includes special friction reducing components as well as stabilizers to maintain lip flexibility in severe service yet resist wear.

For more information on Parker J Type Wipers, ask for Parker Catalog PPD3600.



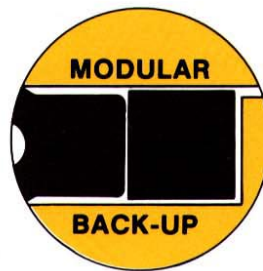
New! Improved! Single lip U-Cups used mainly for sealing piston rods and cylinder bores for heavy duty applications in mobile and industrial hydraulic cylinders. Available in Dynothane, P4693A90, which has superior abrasion and extrusion resistance, excellent memory (low compression set—high rebound resilience.)

For more info ask for Parker Catalog PPD3923.

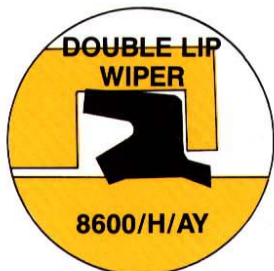


Parker 8500 Series U-Packings have the same advantages as the 8400 Series and have the same I.D., O.D. and cross-section as the 8400 series U-Packings. The major difference between the 8400 and 8500 is the long squared off lips of the 8500 configuration. This series also makes an ideal pneumatic seal. Both the

8400 and 8500 series are available in Parker's low friction materials to provide even less friction and longer life. **For more information on Parker 8500 Series U-Packings ask for Parker Catalog PPD3300.**



Parker Modular Back-ups are devices designed to prevent extrusion. Modular Back-ups are generally installed to absorb shock loads and to prevent extrusion of PolyPak Seals in High Pressure applications. **For more information on Parker Modular Back-ups, contact factory.**



Parkerthane Type H/8600/AY Double Lip Wiper/Seal rings are one-piece snap-in type rod wipers. These wipers can provide both sealing and wiping action in the one component in low pressure systems. As the external lip scrapes foreign matter from the rod, the other lips act as an effective pressure seal in low pressure

pneumatic applications or as a secondary seal to trap slight leakage in high pressure hydraulic systems. Available in Nitrile, EPR, Fluorocarbon, Nitroxile and Polyurethane. **For complete information on all Parker Wiper/Scrapers, ask for Parker Catalog PPD3600, or contact factory.**



Parker Wear Bands are nylon bearings especially compounded of high strength/reinforced material to prevent metal-to-metal contact of moving parts in reciprocating piston and rod applications. Use of Wear Bands may allow the use of lighter weight components such as aluminum pistons and heads and in addition act to

maintain centering on pistons and rods thus avoiding scoring and overstressed conditions caused by side loading. **For complete information on Parker Wear Bands, ask for Parker Catalog PPD3400.**

THE PARKER TOTAL SEALING SYSTEM (con't)



Parker Series 5000 Piston Rings consist of a PTFE slide ring with Parker's high quality elastomer O-Ring expander. The gold colored Parker PTFE compound is available as standard with 15% fiberglass reinforcement. 60% bronze filled PTFE is also available upon request. The standard elastomer expander ring is Parker's

well accepted, high quality N674-70 Nitrile. Other Parker elastomer compounds could be supplied where application constraints exist. **Ask for Parker Brochure ORD5350 for details.**



Parker 8700 Series PolyMyte Back-up Rings are designed as antiextrusion devices for 8400 and 8500 Series U-Cups. The Parker 51 Dash Series PolyMyte Backup Rings are designed for O-Rings as antiextrusion devices. The 8700 Series match nominal inch size grooves and therefore can be used with any seal design where nominal

inch dimensions are found. 51 Dash numbers can only be used with O-Rings. **For more information on PolyMyte 8700/5100 Back-up rings ask for Parker Flyer PPD3870F.**



Parker Spring Loaded PolyPak Seals offer new improved sealing. This design will give reduced leakage. The spring allows the seal shell to withstand wider temperature ranges. The spring is not subject to compression set therefore extended seal life can occur. The spring gives almost constant compression force no matter how much it is

compressed giving lower seal friction. **For more information on Parker Spring Loaded PolyPak Seals ask for Flyer PPD3850F.**



There is an ever increasing demand for specialized "hard" metric seals and packing devices for use in domestic and imported hydraulic and pneumatic equipment. Parker Seal can supply many metric profiles and sizes from stock and can manufacture needed metric parts through our European facility, Parker-Pradifa, in

Germany. **For more information on Parker's complete line of Metric Seals, ask for Parker Flyer PPD3101F.**



Parker SCL-Pak is considered a multiple lip seal. A nitroxile rubber sealing element is snapped into a PolyPak shell. This two seal pak can be made of various compound combinations. PolyMyte in particular makes a good PolyPak shell material or in this case the backup seal because of its tremendous extrusion resistance. The SCL-

Pak requires a greater groove length than customary PolyPak designs. Multiple lip seals minimize seal leakage where excessive tolerances must be used or where worn or older equipment must be replaced.



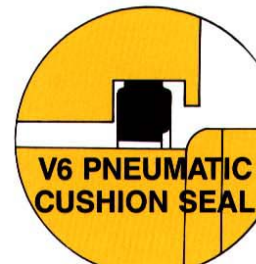
Parker Series E4 and E5 U-Cups are designed with rounded sealing lips which interface with the dynamic metal surface. In pneumatic applications, the rounded lip will not scrape critical lubricants from the cylinder bore or rod which aids in reducing friction. Parker can combine the rounded lip profile with N4274A80 ELF material, to provide

the lowest friction pneumatic seal available. E4 is a piston seal, E5 is a rod seal. Available in AN6226 sizes and 8400/8500 series. **For more information ask for Parker Catalog PPD3300.**



Parker's Slotted Heel Wiper designs offer excellent rod wiping action and contamination resistance. The unique slot design in the heel area of the wiper prevents a fluid buildup from rod seal seepage. As rod seal leakage increases pressure builds to a point where wipers can be blown out of their grooves. Relief slots prevent pressure trapping

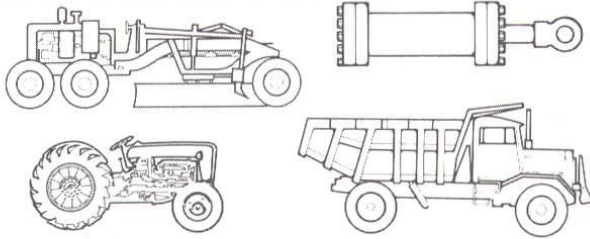
between rod seal and rod wiper. Current slotted heel designs include SHD/SHU and SH959/SH940 styles. **For more information on groove design for Slotted Heel Wipers ask for Catalog PPD3600.**



The V6 pneumatic cushion seal is specially designed for cushioning pneumatic cylinders. Due to its special profile design this seal provides the following advantages: The seal functions as a non-return valve, so no separate valve is necessary; housing size nearly equal to that for O-rings; easy installation; small housings, simple

grooves; consistent cushioning properties. Available in Nitroxile and Ultrathane. **For more information on V6 Pneumatic Cushion Seals, contact factory.**

MATERIAL SELECTION BY SEAL TYPE

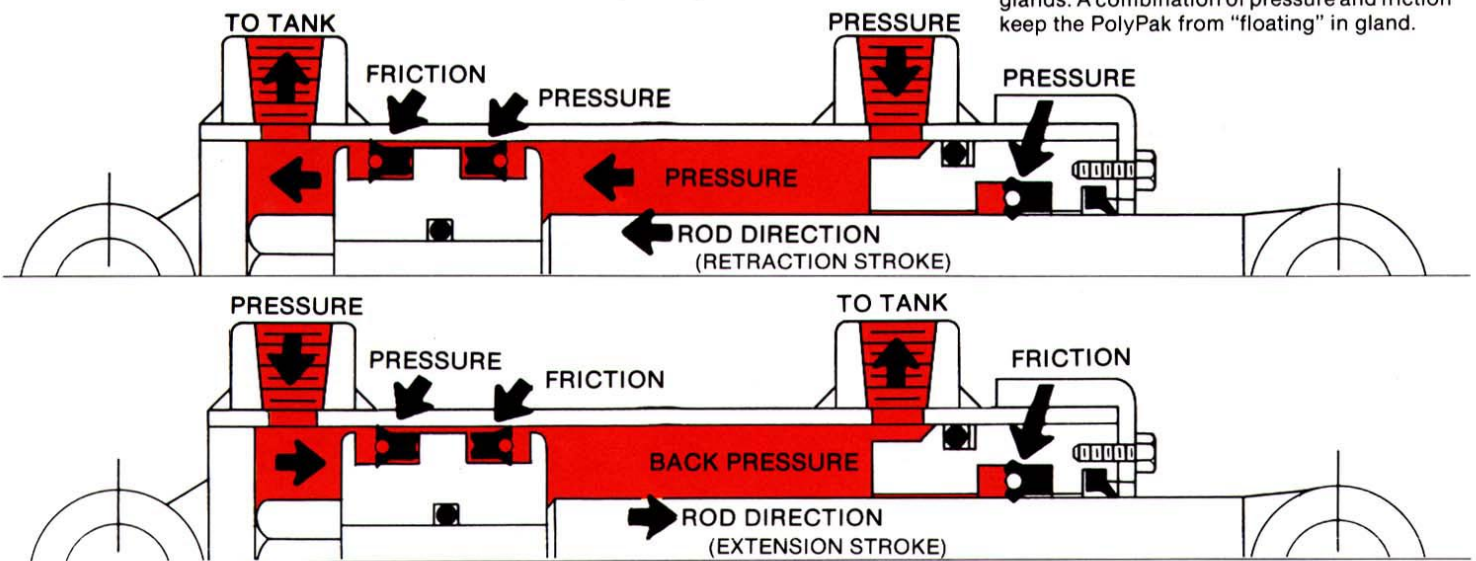


The following chart was compiled to provide the hydraulic/pneumatic seal user and designer with a quick reference to the complete range of materials offered by Parker and the availability of these materials within the Parker Seal Geometry best suited to the application.

COMPOUND NUMBER	MATERIAL DESCRIPTION	SPRING LOADED POLYPAK	SCL PAK	8700 SERIES BACK-UP RING	WEAR RING	PSP SEAL	959 & D WIPER	H & K WIPER	CANNED WIPER	940 & U WIPER	8600 WIPER	SCL SEAL	AIRCRAFT T-SEAL	T-SEAL	PISTON CUP	VEE ADAPTER	V-PRESSURE RING	ANTI-EXTRUSION DEVICE	MODULAR BACK-UP	PIP SEAL	POLY-BI-PAK	8400/8500 U-CUP	U-CUP (US, UNR & UNP)	POLYPAK (STD, DEEP & TYPE B)				
N4107A75	Neoprene	*												*														
N4115A75	Nitrile													*														
N4180A80	Nitrile		*	*										*		*												
N4181A85	Nitrile										*																	
N4182A75	Nitrile		*	*								*		*														
E4183A80	Ethylene Propylene	*	*								*	*		*														
N4187A70	Nitrile	*	*											*	*													
V4205A75	Fluorocarbon											*		*														
E4207A90	Ethylene Propylene	*		*										*												*		
V4208A90	Fluorocarbon	*	*	*								*	*	*	*											*		
N4218A70	Clean Grade Nitrile	*	*									*	*	*														
N4242A75	Nitrile	*	*										*	*														
E4248A75	Ethylene Propylene	*	*											*														
N4249A75	Nitrile												*															
N4257A80	Nitroxile	*	*	*								*	*	*	*											*	*	
E4259A80	Ethylene Propylene	*	*											*												*	*	
N4263A90	Nitroxile	*										*	*	*												*	*	
V4266A95	Fluorocarbon	*										*														*	*	
V4267A75	Fluorocarbon/Brown		*																									
E4268A70	Clean Grade EPR	*	*											*													*	
E4270A90	Ethylene Propylene	*	*	*								*	*	*	*											*	*	
N4274A85 ELF	Nitroxile	*	*	*								*	*	*	*											*	*	
N4280A70	Nitrile													*														
P4611A90	Parkerthane		*								*	*			*													
P4612A80	Parkerthane		*								*	*			*													
P4615A90	Molythane	*		*											*											*	*	
P4616D57	Parkerthane													*	*	*										*	*	
P4617D65	Molythane													*	*	*	*									*	*	
P4622A90	Ultrathane K-24	*	*	*	*									*	*	*										*	*	
W4650NHH	Molygard													*												*	*	
Z4651D53	Polymyte	*	*	*										*	*	*										*	*	*
Z4652D65	Polymyte													*	*	*	*									*	*	*
Z4653D58	Fluoromyte	*	*	*										*	*	*										*	*	*
Z4654D67	Fluoromyte													*	*	*	*									*	*	*
W4655NHH	Nylatron													*												*	*	*
Z4658D48	Polymyte	*	*											*												*	*	*
P4661A90	Parkerthane													*												*	*	*
P4662A90	Parkerthane													*												*	*	*
W4671NHH	Glass-Filled TFE													*												*	*	*
W4683NHH	Virgin PTFE													*												*	*	*
W4689NHH	PEEK	*												*	*	*										*	*	*
P4693A90	Dynothane	*		*										*	*	*										*	*	*

RETROFIT APPLICATIONS

PolyPak Seals can retrofit many existing glands. A combination of pressure and friction keep the PolyPak from "floating" in gland.



Substantial cost savings, improved performance and reduced downtime may often be obtained by replacing conventional sealing devices with Parker's PolyPak. Often no equipment modification is required when replacing Vee-packing, O-rings and U-cups although some types of seals may require some minor machining to provide the proper gland for the new PolyPak.

When retrofitting with a PolyPak, the following procedure is recommended:

1. Remove all old packing material, spacers, springs, back-up devices from the gland.
2. Provide a flat surface for the PolyPak to back up against. For example, where a Vee-packing gland has the female adapter machined into the gland, it will be necessary to install a male Vee-packing adapter or machine to flat surface to provide the required base for the PolyPak to rest against.
3. Machine packing gland if required. This step may not be necessary as the PolyPak is available in over 2000 stock sizes to fit a very wide range of gland dimensions.

A PolyPak seal should be chosen which has the same nominal I.D. and O.D. as the packing gland. For example to seal a 2" rod with a 2 1/2" O.D. gland, a 2" I.D x 2 1/2" O.D. PolyPak should be selected.

The length of the gland (dimension parallel with the axis of the cylinder) should be a minimum of 10% greater than the PolyPak depth. For example if a Type B PolyPak with a 1 1/2" depth is selected, the minimum gland length should be .500" plus .050" for a total of .550". If a modular back-up or more than one PolyPak is used in a stack this 10% added gland length should be calculated on the TOTAL stack length.

This 10% added length is needed to compensate for thermal expansion and any slight swelling of the seal and should be considered a MINIMUM requirement.

4. Modular Back-ups (which may be bevel-cut for ease of installation) require the same gland dimensions as Standard PolyPaks having the same I.D. and O.D. dimensions.

5. Proceed to install the correct PolyPak in the gland. Whether you select a Standard, Deep or Type B PolyPak depends on the operating parameters and the results required. Generally speaking, the Standard PolyPak is more than satisfactory for most applications (especially where minimum friction is desirable such as low pressure hydraulic and pneumatic applications).

Where there is a need for increased sealability, greater ability to resist spiralling and shock loads, the Deep PolyPak will provide longer seal life. Finally specify the Type B PolyPak for rod seals where the sealability of the Deep PolyPak is required plus a minimum of leakage.

6. Always be sure that the O-Spring faces the pressure side of the seal gland and read section on installation hints (page 16) to prevent damage to PolyPak seal lips.
7. A combination of system pressure and friction will keep the PolyPak at the same end of the gland in almost all cases. It is NOT necessary to fill the gland with spacers. In fact, filling the gland may result in Axial mechanical pressure being applied to the PolyPak which almost always results in early seal failure.

8. All adjustable glands should be tightened to bottom out and here again, care must be taken to avoid any axial squeeze on the seal itself.

9. Should it be necessary to split the PolyPak in order to facilitate installation, a minimum of three stacked PolyPak seals are recommended with the seal joints displaced at 180° from adjacent seal joints and each O-Spring joint at 180° from it's seal joint. Normally the Standard PolyPak should be used in applications where either continuous or split seal are used for stacked applications. Type B PolyPaks are NOT recommended for this type of seal.

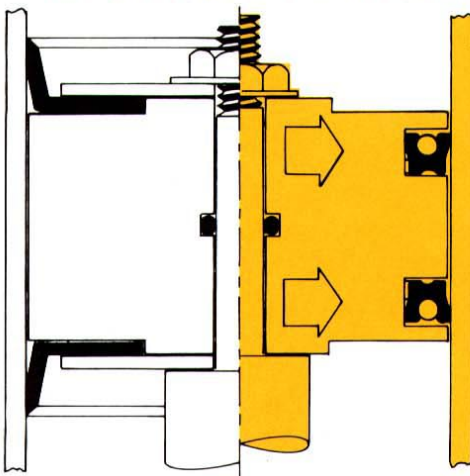
10. Finally, should you require a PolyPak size which is not available from stock tooling to seal an undersize or oversize bore, it is possible that a stock seal can be stretched or squeezed to fit but remember . . . THE SEAL CROSS-SECTION MUST MATCH THE RADIAL GLAND CROSS-SECTION. PolyPak Seals may be stretched 5% for pistons or squeezed for rods up to 2% of the seal diameter.

PARKER RETROFIT ALTERNATIVES

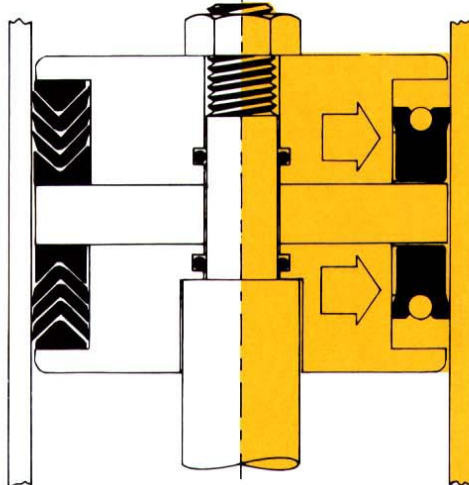
The Following illustrations show a few of the seal types which may be replaced with Parker PolyPaks. If you have any questions feel free to call your Local Parker Seal Distributor for assistance.

As there are many factors which may effect seal life, Parker recommends that all new or replacement materials and seal designs be tested under actual service conditions before production and/or major retrofit programs are finalized.

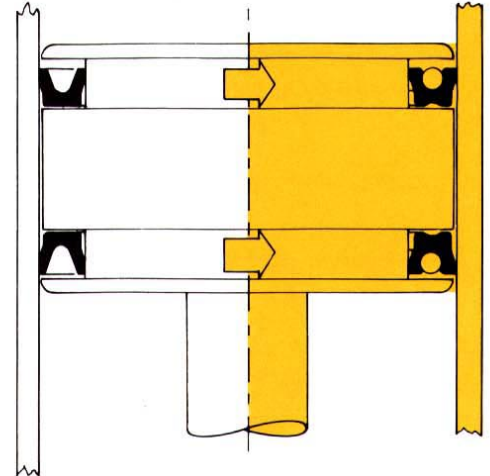
PISTON SEAL RETROFIT



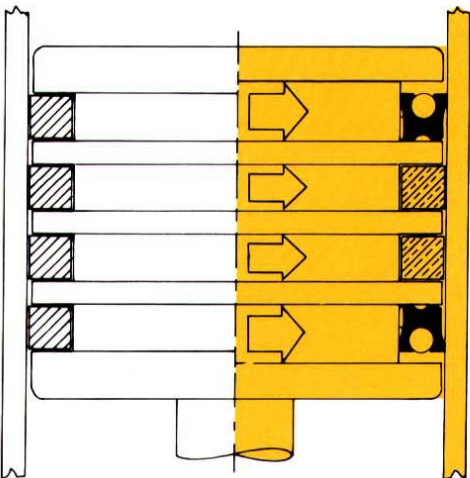
Replace Piston Cups with Standard PolyPak
Note: Machined New Groove for PolyPak



Replace Dual V-Packing with Two Deep PolyPak

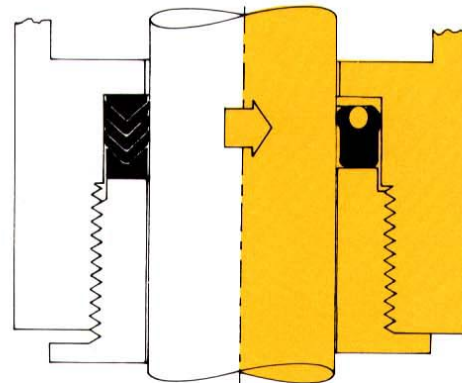


Replace U-Cups with Standard PolyPak

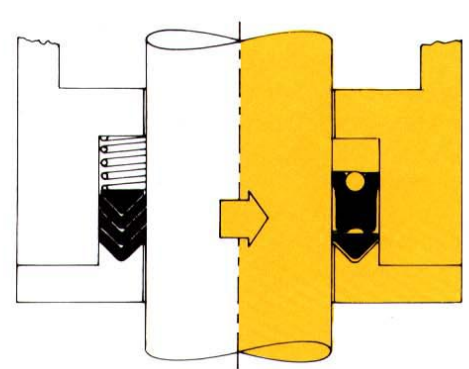


Replace Metal Piston Rings with Two Standard PolyPak
Note: Larger Groove Length Requires Machining to Incorporate PolyPak

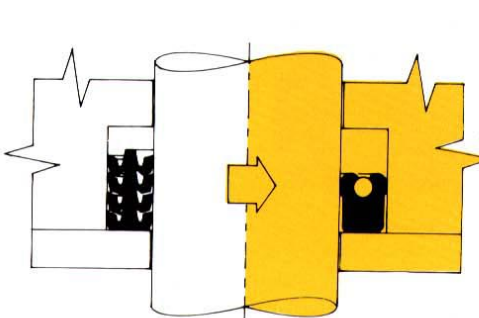
ROD SEAL RETROFIT



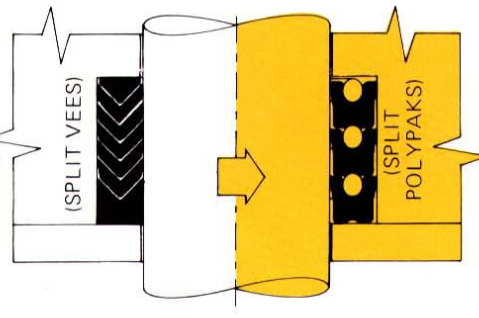
Replace V-Packing with Type B PolyPak



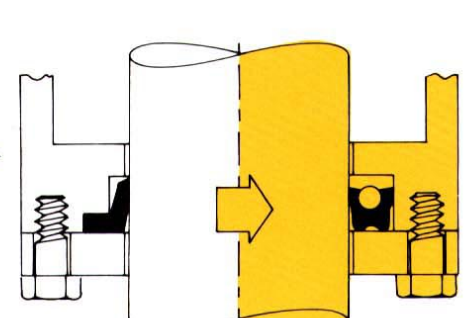
Replace Spring Loaded V-Packing with Type B PolyPak
Note: Use Male Adapter to Fill Space in Female Gland Follower



Replace Stacked Packing with Type B PolyPak



Replace Split V-Packing with Split Standard PolyPak



Replace Flange Packing with Standard PolyPak
Note: Machined New Groove for PolyPak

INSTALLATION

GENERAL The use of proper installation techniques during assembly and retrofit of hydraulic and pneumatic seals is of paramount importance if the full sealing potential of the devices is to be realized. Examination of failed seals will often show damage that could only have occurred at assembly and Parker stresses the necessity for training and supervision of personnel to avoid the problems caused by improper or careless installation. In addition, forethought given to proper gland design and seal cross-section is one of the most effective methods of minimizing installation damage (see page 6).



INSTALLATION TECHNIQUES may vary considerably from case to case, depending on whether the seal is being replaced as a maintenance procedure or is being installed by the OEM of hydraulic or pneumatic devices. Variations also arise from differences in gland design and location; A "slip-in" open end groove posing far fewer problems than a "snap-in" groove deep inside the body of a long rod gland. In production situations or where there is frequent maintenance of similar or identical units, custom tools may be developed to assist in fitting the seal into its groove without overstressing or causing nicks and cuts during insertion.

Whatever the mechanical method employed to install the seal, the following common denominators of all good seal installation procedures apply:

1. **CLEANLINESS** The ENTIRE sealing device AND all surfaces which it will traverse on its way to the groove MUST BE FREE OF ALL FOREIGN MATERIAL. Cleaning procedure should include a solvent degrease of all components (including any tools needed) followed by a wipe-down with a clean, lint-free cloth.

2. **LUBRICATION** Both the seal and its installation path must be lubricated prior to assembly. The lubricant used MUST BE SELECTED FOR ITS COMPATIBILITY WITH THE SEAL MATERIAL AND THE SYSTEM WORKING FLUID IT WILL LATER ENCOUNTER. In the case of some specific system fluids, the working fluid itself may be used as the lubricant.

3. **PROTECTION OF SEAL LIPS** is of extreme importance if an effective seal is to be obtained. All sharp corners which the seal might encounter during installation should be blunted with small-radius shouldered where possible or masked with tape or special insertion tooling. A good check for sharp edges is to "lightly" run fingers over all suspect surfaces and deburr and polish any which feel the least bit rough or sharp. Any nicks and/or cuts at the seal lip interface are potentials for leak paths when the system is fully pressurized.

4. **CHECK AND DOUBLE-CHECK** the components required for completing the assembly. All required items should be itemized and checked off as installed. Many seal failures in hydraulic and pneumatic devices have been traced to the omission of some small item which provided a by-pass for fluid, rendering the main seal ineffective.

5. **BASIC CARE AND COMMON SENSE** are probably two of the least employed items in seal installation by untrained personnel. Lack of these two requisites probably account for the majority of seal failures attributed to incorrect installation. **WHEN IN DOUBT . . . ASK.**

AVOID OVERFILL of the packing gland. The Parker Seals described in this brochure ARE NOT COMPRESSION ACTIVATED DEVICES. Axial loading of seals, overtightening or overfilling of the gland is a sure way to bring on early seal failure. This practice results in excessive friction, compression set and extreme wear on both elastomer and metal components.

INSPECT SEAL BEFORE INSTALLATION

CRITICAL



NON-CRITICAL

1. Check seal lip to insure clean, continuous sharp edges.
2. Examine entire seal cavity for contamination such as metal chips, weld splatter, grit or other foreign material.
3. Double check nominal heel I.D., O.D., and Cross-section of seal to insure a correct match with groove dimensions.

TROUBLE SHOOTING

Any discussion of sealing technology would not be complete without a brief review of "service problems". All the possible environmental and operating considerations are seldom available when initial seal selection is undertaken and, as a result, it is sometimes necessary to reevaluate the seal selection in light of actual field performance.

When seal problems do occur, a visual examination of the worn or damaged seal is generally sufficient to allow the necessary corrective action to be initiated. Following are some of the more common types of problems which may be the cause of seal failure:

1. SLOW, UNIFORM LEAKAGE

- A. Poor low-pressure sealability (esp. if a lip seal)
- B. Too little initial interference (if squeeze type seal)
- C. Loss of interference or squeeze due to wear or compression set
- D. Seal shrinkage after installation (possibly chemically induced, or by leaching of plasticizers by solvent action)
- E. Possible omission or failure of static seal(s)
- F. Microscopic debris lodged under seal lip (lint, fiber, etc.)
- G. Scored lip due to passage of sharp particle under seal, leaving cut or nick
- H. Seal lip nicked or cut during installation (note whether leak starts immediately after seal installation)
- I. Non-repetitive overheating hardens compound (which loses its ability to conform to dynamic surface deviations)
- J. Off-center alignment puts all clearance on one side, all compression on the other (due to bearing wear, excessive side loads, etc.)
- K. Check *static* surfaces of dynamic seal (groove surfaces). They may have problems F, G or H hidden from view, and without self-cleaning tendency.

2. GRADUALLY INCREASING LEAKAGE

- A. Progressive wear
- B. Increasing compression set
- C. Progressive tear or erosion from initial nick
- D. Fine score mark on dynamic surface abrades seal lip progressively

3. SUDDEN, COPIOUS LEAKAGE

- A. Extruded seal
- B. Torn seal lip (see 1-D, -E, -F, -G, -H, and -I; and 2-D)
- C. Twisted seal
- D. Dramatic bearing failure due to excessive side load, shock, etc.
- E. Spiral Failure
- F. Massive infusion of contamination (due to incorrect fluid added to system, or to upstream introduction of dirt or wear debris)
- G. Slow rod seal leakage builds up behind tight wiper, then dumps . . . giving *appearance* of catastrophic seal failure. If leak rate then diminishes, look for slow leak or erratic leak causes. If high leak rate continues, look for true catastrophic leak origin
- H. Reverse-pressure blowout of piston seal due to pressure trap or failure of opposed seal

4. ERRATIC (START-STOP) LEAKAGE

- A. Cold start-up shrinks seal; friction/fluid heating restores size
- B. Intermittent eccentric loading
- C. Fibrous contamination working its way past seal lips
- D. Unstable seal (twists & returns, cocks, etc.) usually caused by shock loading
- E. Rod seal leaks slowly, tight wiper periodically dumps accumulated leakage (see 3-G)
- F. Fluid viscosity changes as temperature cycles (e.g., fork lift truck alternately entering and leaving cold storage area)

5. STICK-SLIP OPERATION

- A. Worn-away low-friction surface treatment
- B. Breakdown of fluid lubricity due to contamination or deterioration of fluid
- C. Viscosity change due to temperature
- D. Excessive burnishing of dynamic surface to finer finish destroys ability of surface to maintain lube film (e.g., may go from 12 RMS to 4 RMS)

6. SEIZING

- A. Seal & bearing swell due to incompatible fluid and compound (possibly running hotter than temp. at which fluid is compatible)
- B. Thermal expansion of compound
- C. Pressure trap between dual squeeze seals or incorrectly installed lip seals
- D. Wedging of seal or back-up device into extrusion gap (if used, it is usually the back-up device that extrudes)
- E. In low-pressure systems, shock or other factors cock, cant or misorient the seals in grooves. This may become more common as OSHA rulings force reduction of pneumatic pressures
- F. Bent rod, cocked head, etc., often due to unreported accident

7. SCORED ROD OR RAM

- A. Internally generated contamination, or
- B. Externally introduced rod dirt, dirty make-up, or disassembly/re-assembly dirt
- C. Misoriented exclusion devices (wiper/scrapper); eccentric installation
- D. Misaligned (eccentric) loads cock ram into metal-to-metal contact with head
- E. Wiper in vertical ram forms catch-all pocket

8. DRIFT

- A. Inspect valve for leakage and full closure BEFORE disassembly. (Disconnect return line on valve & inspect visually for leakage)
- B. See problems 1 and 2, as applied to piston seals
- C. Misapplied cast iron rings in a "hold" cylinder (right ring in the wrong job)
- D. In "Retract-Mode" creep, check rod seal as well as piston seal
- E. Static internal seals may provide leakage path past piston

9. INCREASING CYLINDER DRAG

- A. Seal swell caused by improper (incompatible) *installation* lubricant (e.g., EPR seal lubed with petro-based grease or oil)
- B. Packing of contaminants into wiper groove of vertical ram
- C. Thermal expansion of bearings and/or seals
- D. APPARENT drag increase due to undetected flow restriction in supply or return line . . . or by-passing of pressure through improperly closing valve . . . or obstructed check valve, etc.
- E. Cocked or twisted seal by-passing fluid and wedging into extrusion gap.

10. INCREASING CYLINDER/ROD TEMP

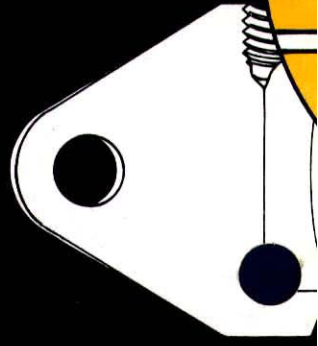
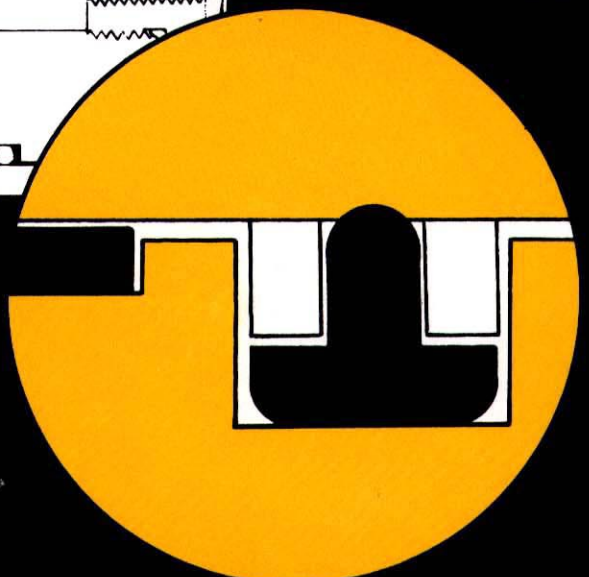
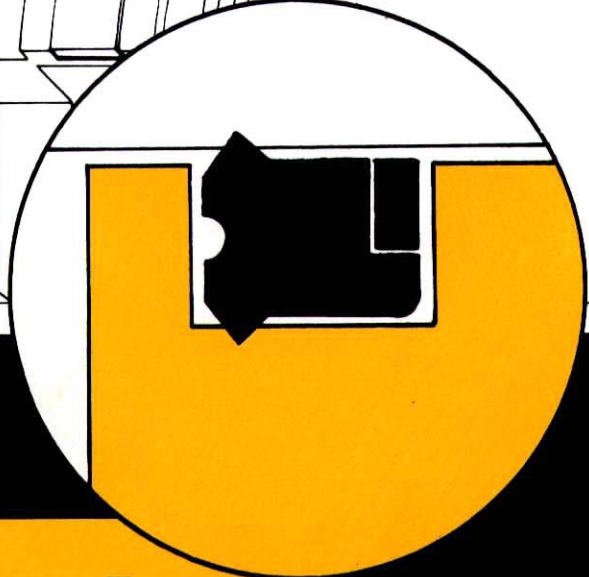
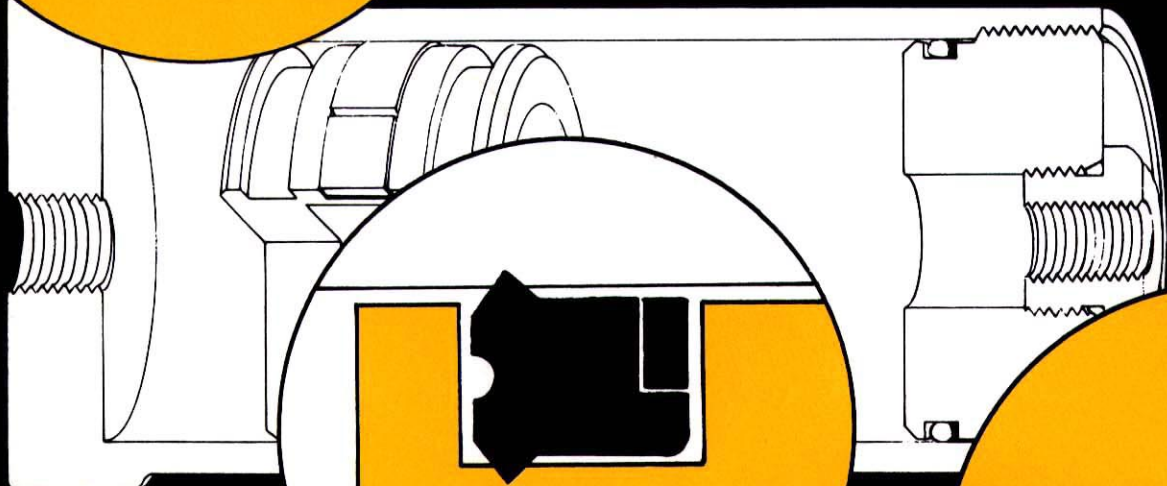
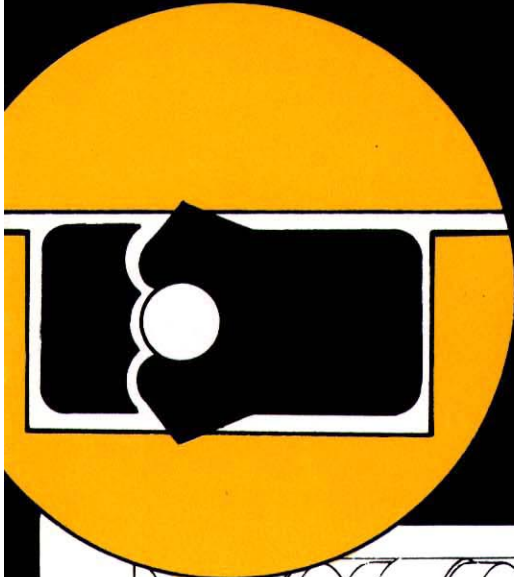
- A. See causes for problem 9. In their earlier stages, these problems may appear as hotter-running cylinders
- B. Internal leakage "throttling" past seals can cause rapid heating
- C. Decreased lubricity of fluid can boost friction & heating (hotter fluid has lower viscosity = lower lubricity = higher friction = hotter fluid = lower viscosity, etc.). Contaminated or deteriorated fluid can cause same cycle
- D. Diluted fluid can boost friction, etc.
- E. Condensation in reservoirs can emulsify or hit cylinder as slugs of fluid with near-zero lubricity. Also, hot water can *swell* compounds such as urethanes, increasing friction.

WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

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