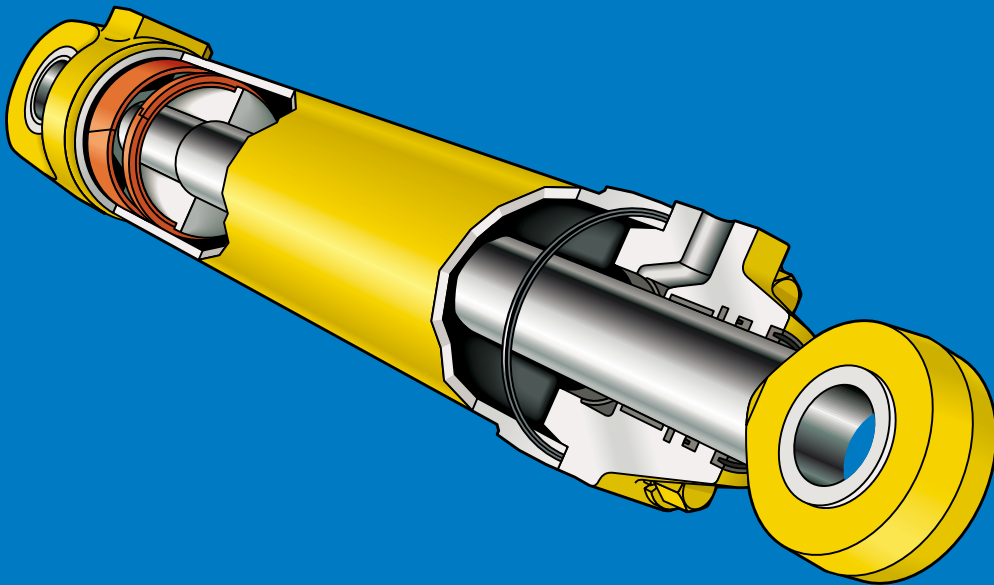


# Hydraulic Cylinder and Seal Reference Guide

6th Edition



**CATERPILLAR®**

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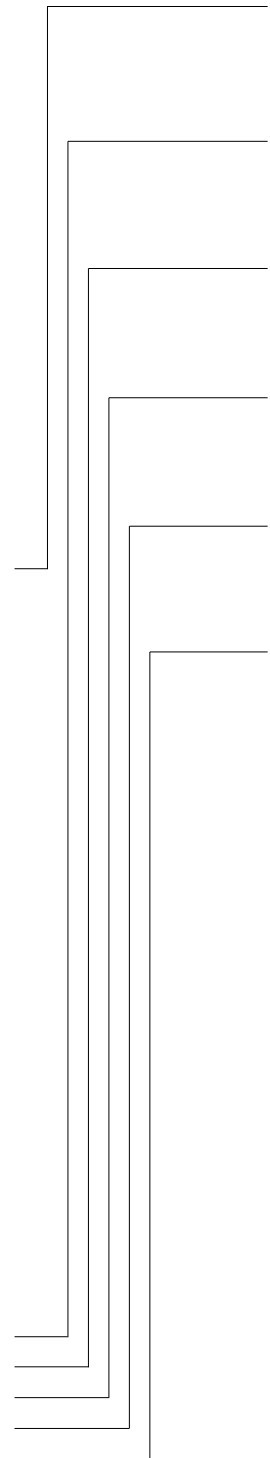
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## Caterpillar is Committed to Lowering Your Hydraulic Cylinder Repair Costs!

Caterpillar is committed to keeping your hydraulic cylinder repair costs as low as possible. That's why we're constantly adding to our exchange program and seal kit offering.

This Cylinder and Seal Reference Guide is designed to serve as a quick reference for information regarding:

- Cylinder Seals
- Standard and Oversize Cylinders
- Remanufactured Cylinders and Rods
- Standard and Oversize Seal Kits

The first section of this reference guide provides information regarding cylinder seals. This information includes seal identification, applications, oversize seals, part numbers for each type of seal, troubleshooting when a failure occurs, and installation.

The second section of this reference guide provides general information regarding Cat cylinders. This information includes the cylinder group part number, standard and oversize remanufactured cylinder part number, rod assembly part number, and standard and oversize seal kit part numbers.

Preventive maintenance is a cost-effective way to extend the life of your Cat equipment. It is important to take good care of your hydraulic cylinders, including frequent inspection for worn rod seals or other damage. The key is to catch any possible failures **before** they occur! This simple step can minimize unexpected downtime tremendously.



## Cat® Reman Program

Caterpillar's Remanufactured Products program is an exchange program. For each remanufactured unit sold, the core (scratched or damaged cylinder or rod) must be returned. Even if ruptured or broken the core can qualify for partial core credit.

## Cat® Hydraulic Cylinder Seal Kits

Cat Hydraulic Cylinder Seal Kits are a quick and economical solution to leaky cylinders. One part number provides you with all the seals necessary to reseal a Cat cylinder . . . at a price less than the cost of the individual seals.

# Seal Identification

## What is a Seal?

A seal is a device which prevents the escape or passage of a fluid (liquid or gas). A hydraulic cylinder seal is used to seal two surfaces under fluctuating pressure conditions.

## Hydraulic Cylinders:

The hydraulic cylinder is the tool which converts hydraulic fluid pressure into work. Even though there are many different designs of hydraulic cylinders, they are relatively similar in the way they are sealed and repaired. Because of this similarity, this guidebook will not address different types of designs. It will suffice to mention that Caterpillar manufactures three different designs: bolt-on head, threaded crown and threaded gland cylinders.

## Hydraulic Cylinder Seals:

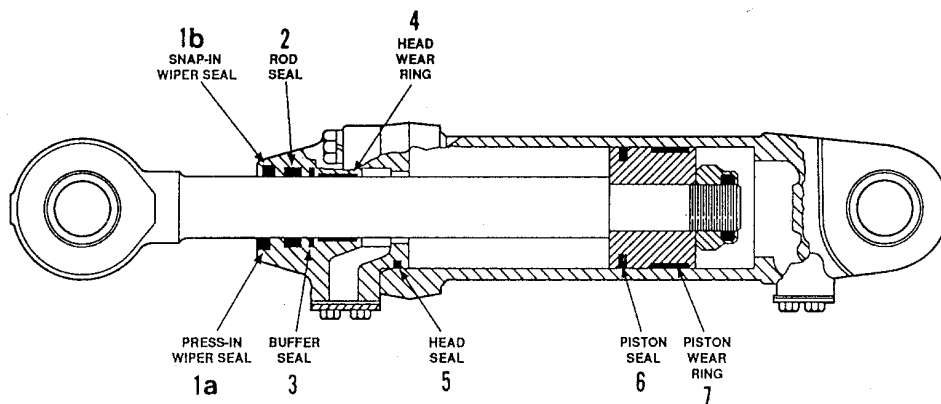
Caterpillar seals are available as either individual pieces or kits. Kits offer a convenience as well as a cost-savings, priced substantially below the sum of the individual pieces.

Caterpillar hydraulic seals can be used on other makes of cylinders. Cat also offers some of the most popular seal configurations and sizes designed solely for other makes of hydraulic cylinders.\*

\*Note: Check for availability in your subsidiary.

## Identifying Hydraulic Cylinder Seals

Refer to the hydraulic cylinder illustration below. The seals in this Caterpillar cylinder are those typically found in hydraulic cylinders.



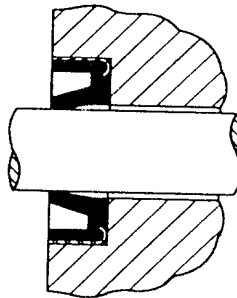
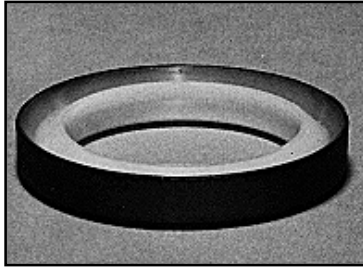
Use the seal pictures, cross-sections, cutaway illustrations and descriptions on the following pages to help you identify the different types of hydraulic cylinder seals.

# Hydraulic Cylinder & Seals

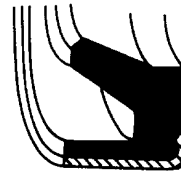
## IDENTIFICATION

**1a. Press-in Wiper Seal** - prevents external contaminants from entering the system. Single-lip (the lip is the projecting rim or edge of the seal) wipers clean the rod as it retracts. Double-lip wipers clean the rod as it retracts and seals oil, eliminating "weeping" (cosmetic leakage). The double-lip wipers are secured in place with a bearing mount. These urethane wipers are metal-encased for added strength. They are often referred to as "canned" wipers (metal-encased) or "J" wipers (the metal often forms a "J" shape when viewed in the cross-section).

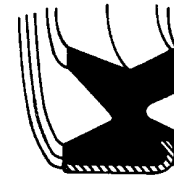
4J8932



Type A  
Single-lip wiper



Type C  
Modified



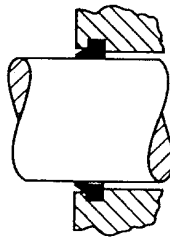
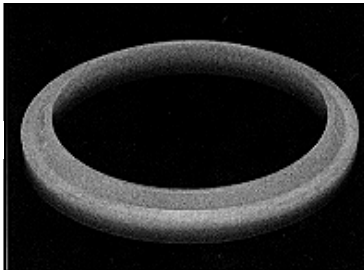
Type B  
Double-lip wiper



Type D  
Modified Single

**1b. Snap-in Wiper Seal** - prevents external contaminants from entering the system, but used in less severe environmental conditions and lighter duty hydraulic applications than its press-in counterpart.

5J8156

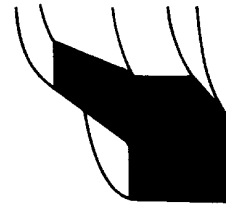
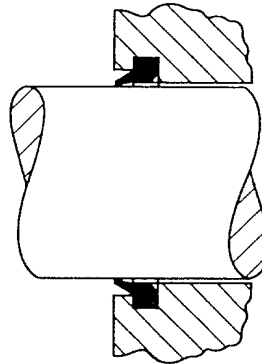
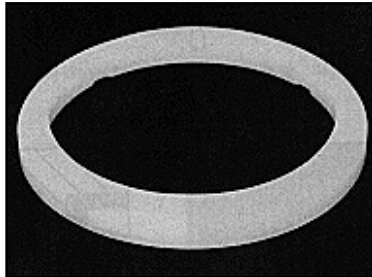


Type Reg

The following various types of snap-in wipers are available for use on other makes of hydraulic cylinders.

“Type SHU” wipers are slotted heel, universal style urethane wipers. The slotted heel acts as a relief slot to prevent a pressure trap occurring between the rod seal and the wiper. A pressure trap is excessive fluid pressure “trapped” between two seals.

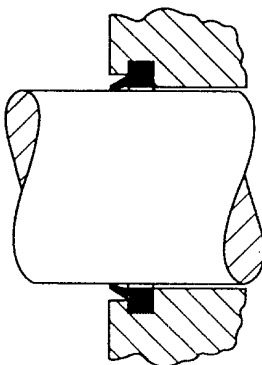
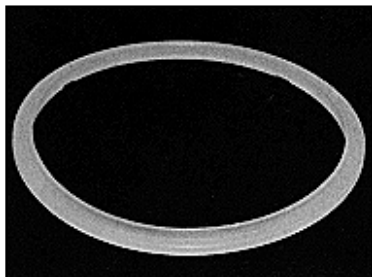
3E4108



Type SHU

“Type AN” wipers are a non-current design, originally made for the military (AN refers to Army/Navy). This single-lip wiper is made of urethane.

3E4145



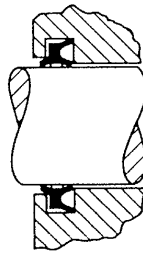
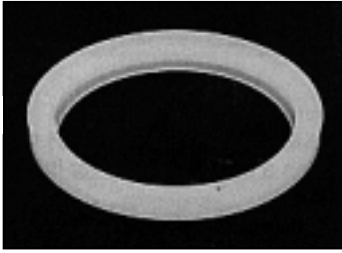
Type AN

# Hydraulic Cylinder & Seals

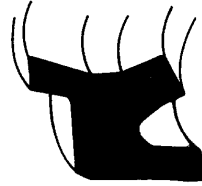
## IDENTIFICATION

“Type H” and “Type K” wipers are double-lip, urethane wipers.

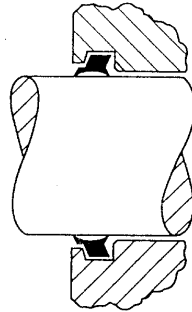
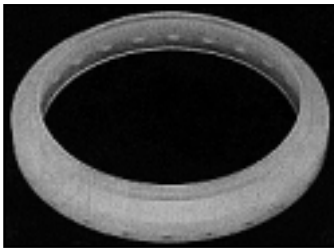
3E4130



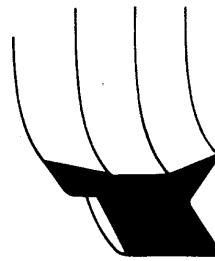
Type H



3E4153

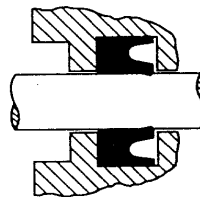
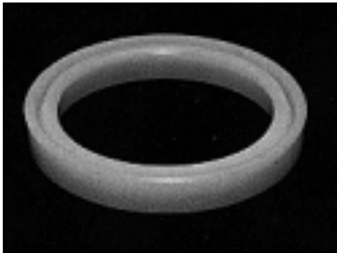


Type K



**2. Rod Seal** - commonly known as a “u-cup” and performs as the primary rod seal. The u-cup is made of urethane or nitrile. The nitrile u-cup is used with a backup ring in water-glycol hydraulic systems. The backup ring prevents the seal from extruding (forced movement of a seal under pressure into the clearance between the metal parts being sealed).

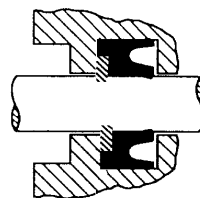
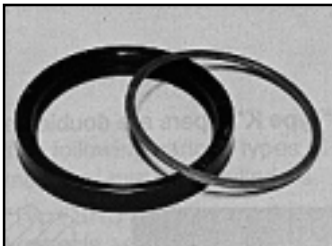
5J8200



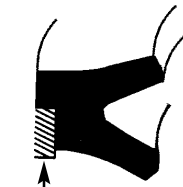
Type A



7J4824

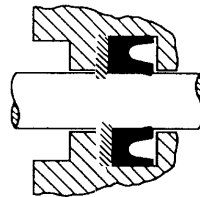


Type B

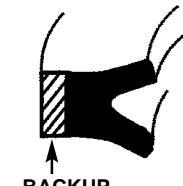


BACKUP RING

996996

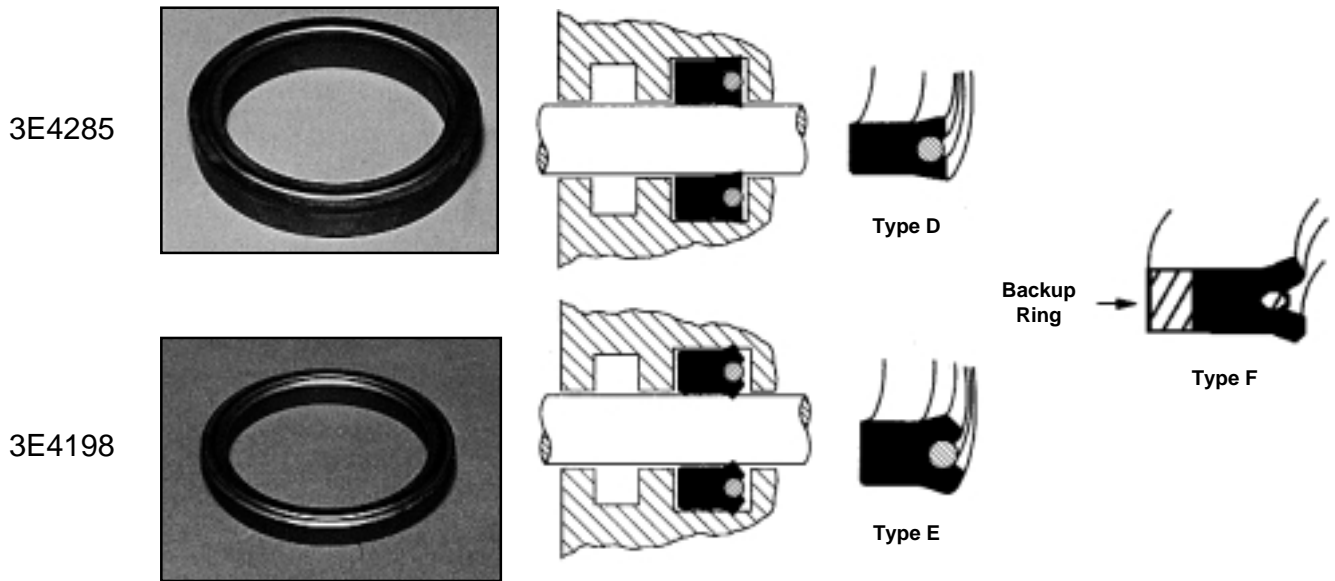


Type C

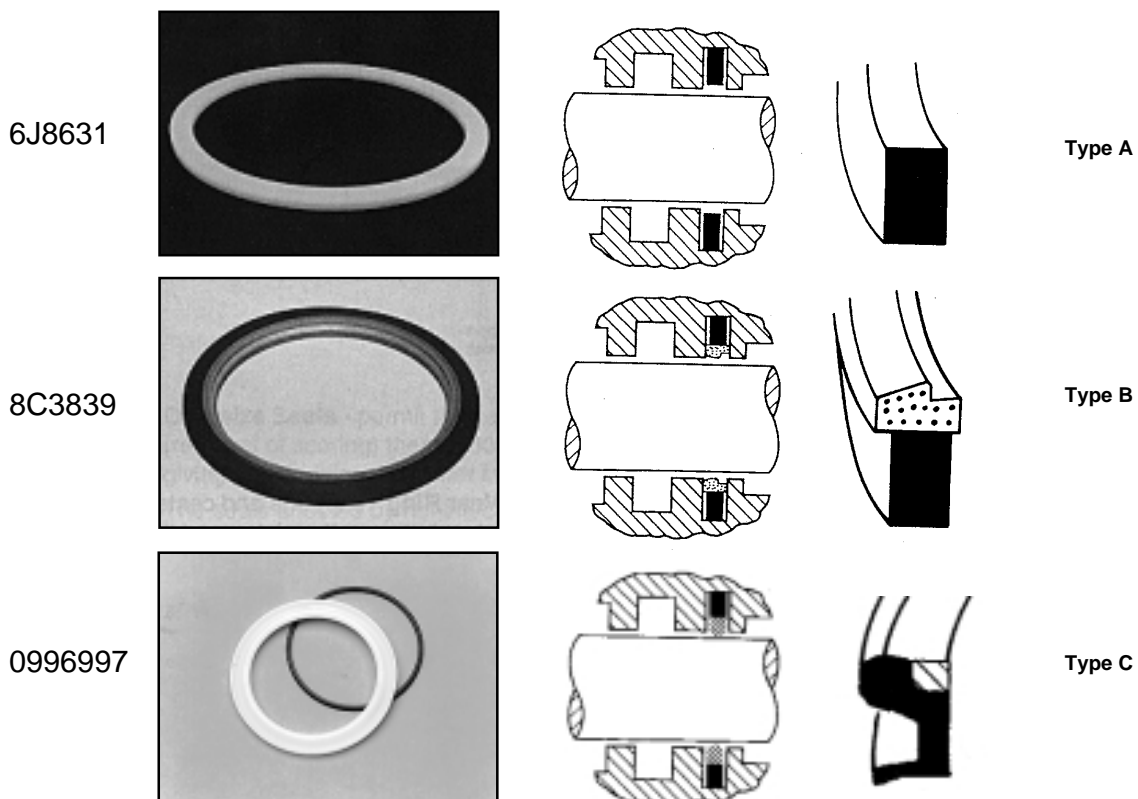


BACKUP RING

Loaded u-cups are also available for use on other makes of cylinders. The "Type E" loaded u-cup has a back-bevel lip for increased sealability.



3. **Buffer Seal** -acts as a secondary rod seal and protects the rod from sudden increases in system pressure. There are currently three types of buffer seals. Type A is a one-piece seal made of urethane. Type B is a two-piece bronze filled PTFE seal with a nitrile expander. The notched view in the cross section must face the pressure side for maximum seal performance. Type C is a two-piece urethane seal with a thermoplastic backup ring. This design allows the seal to withstand higher pressures. Type B and Type C buffer seals are designed to prevent seal extrusion and pressure trapping.



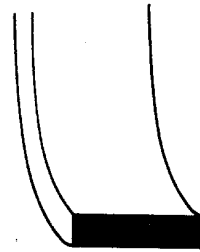
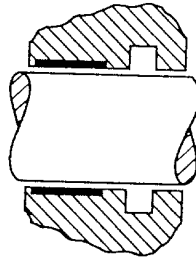


# Hydraulic Cylinder & Seals

## IDENTIFICATION

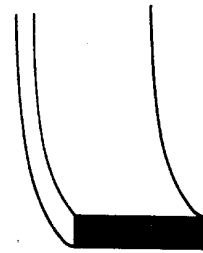
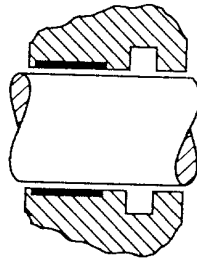
4. **Head Wear Ring** - eliminates metal-to-metal contact between the head and rod and prevents scoring (scratching) of the rod by the head.

8T0785



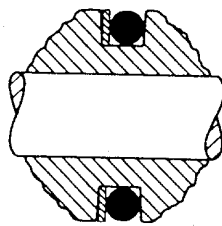
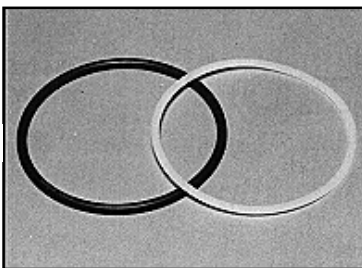
- 4a. **Bronze Bearing for 300 HEX** - used instead of plastic head wear ring for many 300 HEX hydraulic cylinder groups. The coated bearing is pressed into the cylinder group head and held in place with a split metal retaining ring. This bearing supports the hydraulic cylinder rod and prevents metal-to-metal contact between the head and the cylinder rod.

114-0761



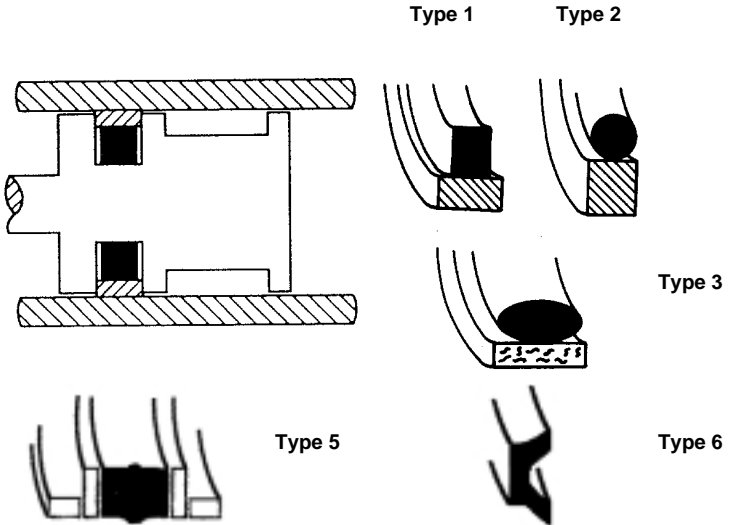
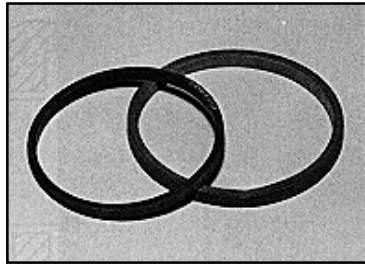
5. **Head Seal** - a two-piece seal, consisting of a nitrile o-ring and a backup ring, which seals the head to the cylinder wall.

5H8848



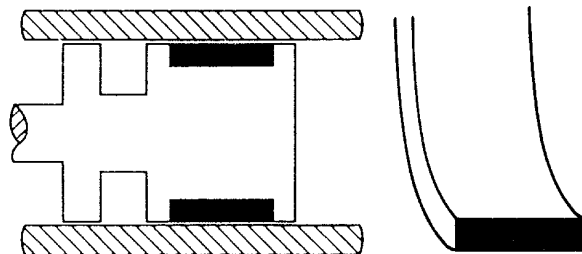
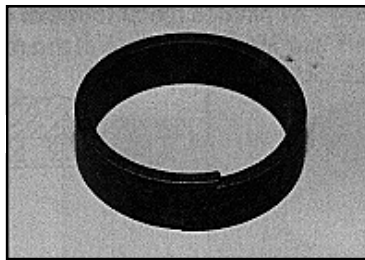
6. **Piston Seal** - a two-piece seal, consisting of a piston ring and an expander, which prevents oil transfer between the rod end of the cylinder and the cap end. The piston seal is usually made of Teflon, with nylon available for pressures greater than 3000 psi (20,670 kpa). The various shaped expanders are nitrile. Type 4 consists of a teflon piston ring with a nitrile rubber expander. Type 5 consists of a rubber expander surrounded by bronze filled Teflon on both sides. Type 6 is a urethane u-cup seal used in single acting cylinders.

8T6213



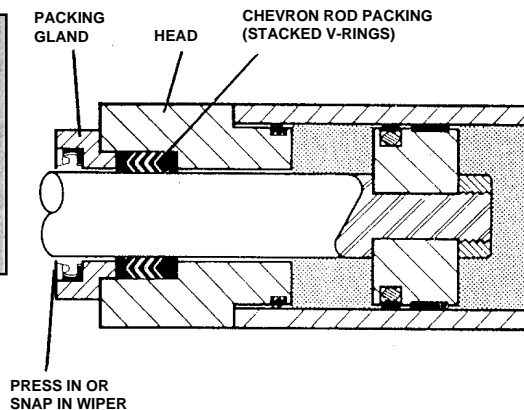
7. **Piston Wear Ring** - supports and centers the piston to prevent metal-to-metal contact between the piston and the cylinder wall.

5J7942



**Chevron Packing** - used as gland packing in place of rod seals for high pressure applications. This non-current seal is made of a multi-compounded material (usually cotton duck cloth and nitrile). It is often referred to as V-Packing, the shape formed by its cross-section. The end adapters can be tightened down, making the seal adjustable.

4F8420



## Seal Applications

Hydraulic cylinder seals perform their functions under difficult conditions, being constantly subjected to friction and wear. It is important, therefore, to have the best seal design and material to achieve maximum seal life and performance. The following guidelines will assist you in choosing the best seal for an application when more than one design or material is offered.

### General:

- Hydraulic cylinder seals beginning with a “3E” prefix are designed for use in other than Caterpillar hydraulic cylinders.
- Use nitrile rubber (a synthetic, oil-resistant elastomer). An elastomer is any synthetic or natural material with resilience sufficient to return to its original shape after distortion.
- Do not use urethane (a very tough, abrasion-resistant synthetic elastomer) in water-glycol hydraulic systems.

### Wipers:

- Follow proper installation procedures for the double-lip, press-in wiper to achieve maximum seal performance (see Seal Installation section).
- Do not use double-lip wipers with loaded u-cup rod seals.

### Rod Seals:

- When using a nitrile u-cup in high pressure hydraulic systems, a backup ring is needed to prevent the u-cup from extruding out of its groove.
- The lips of the u-cups should always face the pressure.
- Loaded u-cups and “Type B” loaded u-cups are interchangeable. The “Type B” loaded u-cup, because of its back-bevel lip, will provide better sealability at lower pressures.

### Updated Rod Seals:

Most kits listed in this handbook contain new-design rod seal part numbers. If the rod seals in your kit do not match the part numbers listed in the parts book, refer to the following chart to see if a “missing” seal has been replaced by an improved seal.

### Rod Seal Part Number Changes - Chart 1

Rod Size	New Step Buffer	Former Ring Buffer	New Double-Lip Wiper	Former Single-Lip Wiper	U-Cup Seal
1.50	8C9122	6J9733	8C9131	4J8979	5J8150
1.62	8C9117			4T0486	4T0488
1.75	8C9123	6J9178	8C9132	4J8980	5J8175
1.88		4T6778		4T6777	4T6898
2.00	8C9124	6J6917	8C9133	1K6981	5J8200
2.25	8C9125	5J3616	8C9134	4J3515	5J8225
2.38	8C9138	6J6916		6J3892	5J8238
2.50	8C3839	5J3620	8C3840	1K6982	5J0964
2.75	8C3841	6J6553	8C3842	1J3540	5J8275
3.00	8C9126	6J6915	8C5218	2J1411	5J8300
3.25	8C9121	6J7167	8T8389	6J4169	5J8325
3.50	8C9127	6J6736	8C5219	4J8981	5J8350
3.75	8C9128	8J6070	8C9135	8J6069	5J8375
4.00	8C9129	8J4627	8C5220	7J5673	5J8400
4.50	8C9144	3G8507		3J4458	6J1450
6.75	8C9145	3G8506	8C9146	3J4460	3G4627
7.00	8C9130	9J2495	8C9136	2J4779	6J1700

### Buffer Seals:

- Use Caterpillar designed buffer seals in conjunction with u-cups in Caterpillar hydraulic cylinders.
- The slope or notch of the buffer seal must face the pressure (toward the piston) to avoid creating a pressure trap.
- Do not use Caterpillar's two-piece Teflon buffer seals with loaded u-cups; too little lubrication or a pressure trap may occur.

### Head Wear Ring:

- Head wear rings are used in all current production Caterpillar hydraulic cylinders. Some seal kits may not include a head wear ring if the cylinder did not originally have a wear ring groove. Machining a groove for a wear ring may be appropriate if a Caterpillar non-current cylinder or another make of cylinder will benefit from a wear ring.
- The location of the wear ring in the head will vary according to the space available for the groove. In some Caterpillar heads, the ring is positioned between the wiper seal and the u-cup seal; other Cat® heads may have the ring located after the buffer seal. When repairing other makes of cylinders which do not use a buffer seal, the ring may be located after the rod seal.
- If a wear ring is too wide for the groove but is the correct thickness, the width of the wear ring can be cut down to fit the width of the groove. The clearance between the groove width and the wear ring should not exceed 0.010 inches (0.25 mm).

### Metal Bearing for 300 HEX:

- Many 300 HEX hydraulic cylinder groups include a steel backed, coated bronze bearing in the cylinder group head instead of the plastic split wear ring used in other Cat machine hydraulic cylinder groups.
- These metal bearings can be reused when the cylinder group is being resealed if they are not damaged. If the bearing is broked, it should be removed and replaced. If the bearing coating is scratched, or worn through to the underlying metal, the bearing should be removed and replaced. The coating on new bearings is approximately 0.04mm thick.
- Metal bearings are serviced separately and are NOT part of Cat hydraulic cylinder seal kits available to reseal 300 HEX cylinder groups. Since metal bearings can be reused if not severely damaged, their exclusion from seal kits prevents customers from paying for bearings they may not use. If bearings are damaged and need to be replaced, they need to be ordered separately in addition to the appropriate seal kit. Refer to "Metal Bearings for 300 HEX" chart for a list of bearings and retaining rings.

### Head Seals:

- Use nitrile o-rings with temperatures from -29° F to 225° F continuous or 250° F intermittent (-34° C to 107° C continuous or 121° C intermittent).
- When repairing a cylinder assembly which has a chamfer , remember that an oval head seal can be used in the chamfer if the required size head seal (O-ring and backup ring) is not offered.

### Piston Seals:

- Teflon® piston seal rings with nitrile expanders are available for use with system pressures under 3000 psi. Nylon piston seal rings with carboxylated nitrile rubber (abrasion-resistant form of nitrile rubber) expanders are designed for use in hydraulic systems where pressures are equal to or exceed 3000 psi. The nylon piston seal will also offer better resistance to extrusion.
- Never trim piston seals to make installation easier. The sealability depends on the tight interference fit. Trimming any amount off the seal will cause it to leak.
- Loaded u-cups can be used as piston seals on other makes of hydraulic cylinders provided they do not have a back-bevel lip (Type B). When using loaded u-cups as piston seals, be sure to face the lips of the seals away from each other. This will prevent pressure traps from occurring. Never install two Type B loaded u-cups on a piston as lubricant will not reach the second seal, causing it to fail.

#### **Piston Wear Rings:**

- Caterpillar threaded gland cylinders and the 966 lift cylinders have the piston wear ring positioned away from the piston nut; all other Cat cylinders have the piston wear ring located closest to the nut or bolt.
- If a wear ring is too wide for the groove but is the correct thickness, the width of the wear ring can be cut down to fit the width of the groove. The clearance between the width of the groove and the wear ring should not exceed 0.010 inch (0.25 mm).

## Oversize Cylinders, Head Seals, Chamfer Sizes

Depending on operating pressure, Caterpillar offers oversize remanufactured cylinders of 0.76 and 1.52 mm (.030 and .060 in) for three types of Caterpillar cylinders: threaded-gland, threaded-crown, and bolted-head. All three types of oversize cylinders use standard size rod seals, but use oversize piston seals and wear rings. Oversize piston seals and wear rings differ from the standard seals only by their increase in size. Remember that piston seals will not seal if the ends are trimmed to make installation easier (See Piston Seals). The three types of cylinders differ in the method used to seal the head to the cylinder. These are covered in the following sections.

### Oversize Identification

After a cylinder has been honed oversize, it must be identified as having an oversize bore. One identification method is to stamp “.030 OS” or “.060 OS” on the tube OD close to its open end. If possible, locate stamp so it can be read after cylinder is installed on machine.

Another method of identifying oversize cylinders is to stamp the amount of oversize on the metal tag which identifies the cylinder group part number. The stamp should be a minimum of 6.4 mm (.25 in) high.

Cylinders that have been remanufactured by Caterpillar have a metal tag welded to the outside of the cylinder tube. The tag indicates the part number and oversize designation of the cylinder. The oversize designation is also stamped into the casting at the closed end of the cylinder.

### Oversize Threaded-Gland Cylinder

The head seal for the oversize threaded-gland cylinder is the standard O-ring and back-up ring. See Illustration 1.

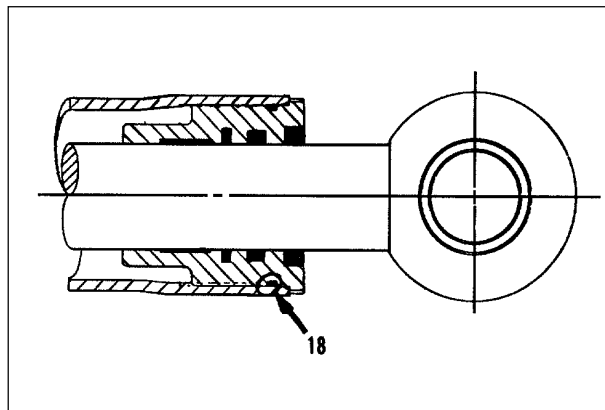


Illustration 1. Threaded gland with standard head seal.

18. Head seal.

### Override Threaded-Crown Cylinder

The head seal for the oversize threaded-crown cylinder is an oval cross-section seal that locates in the lead-in chamfer at the open end of the cylinder. The O-ring and back-up ring groove in the head is left empty. See Chart 2 for part numbers.

**Chart 2**  
**Override Seals**

Standard Bore Size	Override Head Seal
2.50	8C4889
2.75	8C4890
3.00	8T8367
3.25	8C4891
3.50	8T8368
3.75	8T8369
4.00	8T8370
4.25	8T8371
4.50	8T8372
4.75	8T8373
5.00	8T8374
5.25	8T8375
5.50	8T8376
6.00	8T8377
6.25	8T8378
6.50	8T8379
7.00	8T8380
7.25	8T8381
7.50	8C0553
7.75	8C4892
8.25	8T8382
8.50	8C4893
9.25	8T8383
10.00	8C4895
10.25	8C4896
10.50	8C4897]
11.50	8C4898

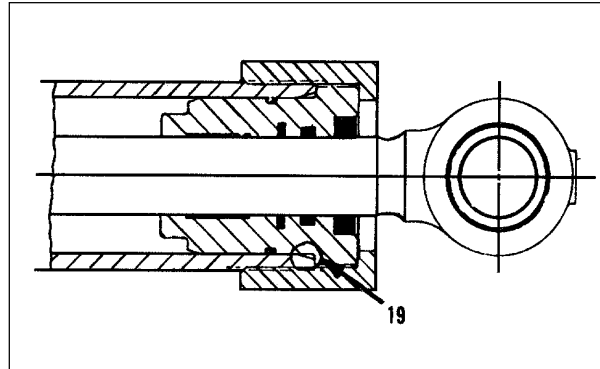


Illustration 2. Threaded crown with oval seal.  
19. Oval seal.

## Cylinder Assembly Chamfer Dimensions

Oversize threaded crown cylinders are sealed by using an oval head seal that locates in the lead-in chamfer of the cylinder bore. After the cylinder has been honed, compare the chamfer to the specifications in Illustration 4.

**Note:** Chamfers that do not meet specifications will cause leaks.

If the chamfer is too deep, it can be shortened by machining a maximum of 3.0 mm (.12 in) from the end of cylinder tube (2). If the end of the cylinder is machined, during assembly, check to make sure the crown can be fully threaded onto the cylinder and the threads do not bottom before the head is seated against the cylinder. If the chamfer is not concentric with the cylinder bore, the chamfer must be re-machined so that it is concentric and perpendicular to the bore.

### Chamfer Dimensions for Oval Head Seals

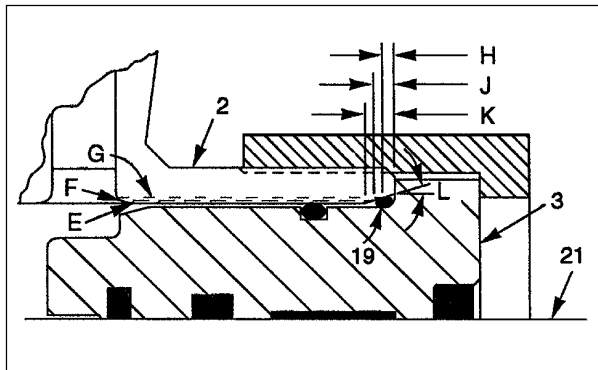


Illustration 4.

Chamfer Dimensions	
Item	Dimension
E	Standard bore
F	0.76 (.030) oversize
G	1.52 (.060) oversize
H	9.7 (.38) max. on standard size bore
J	8.1 (.32) max. on 0.76 (.030) oversize bore
K	6.4 (.25) max. on 1.52 (.060) oversize bore
L	15°
Item	Description
2	Tube
3	Head
19	Oval Head Seal
21	Rod



## Hydraulic Cylinder & Seals

### OVERSIZE CYLINDERS

#### Cylinders that Cannot Use Oval Head Seals

Some cylinders cannot accept oval head seals. These cylinders use heads that have a "relief" machined into the square corner where the oval head seal normally locates. Because of the relief, the oval head seal will not fill the cavity and seal the joint. If the cylinder uses a head listed in Column A, it should not be oversized. Instead, offer the customer the retube option through your shop or a Caterpillar Remanufactured Standard Cylinder. If the cylinder uses a head listed in Column B, the cylinder may be honed oversize and oversize seals used.

**Oval Head Seals – Chart 3**

Cylinder Group No.	Column A	Column B Current Non- Relieved Head	Effective "In"
	Former Relieved Head		Change Level of Current Head
3G2221	9J1747	9T3968	9
3G2221	1U1807	9T3968	9
3G2222	9J1747	9T3968	9
3G2222	1U1807	9T3968	9
3G4598	9J3379	9T3509	11
3G4599	9J3379	9T3509	9
3G5712	9J3379	9T3509	3
6J7810	6J7804	9T6541	5
7J1487	9J0499	9T5896	4
7J1488	9J0499	9T5896	4
			<b>Group Cancelled &amp; Replaced by 4T7585</b>
8J5779	8J5780		
8J6337	8J6225	9T6543	4
8J6338	8J6225	9T6543	4
9J3632	9J3626	9T3501	4
1U1766	9J3379	9T3509	5
1U1767	9J3379	9T3509	5
1U1771	3G4415	9T3509	3
			<b>Group Cancelled &amp; Replaced by Multiple Numbers</b>
1U4679	8J5780		

## Oversize Bolted-Head Cylinder

Formerly, the head seal for the oversize bolted-head cylinder was the same oval seal that is used in an oversize threaded-crown cylinder. The oversize bolted-head cylinder is now sealed at the head joint by an O-ring which provides a more effective seal than the oval head seal. An oversize bolted-head cylinder that has successfully operated with the oval seal may be re-sealed without machining the O-ring groove into the flange face. However, it is recommended that the oval seal be replaced by the flange face O-ring seal. Most oversize seal kits include both the oval seal and the O-ring seal in order to accommodate re-seal requirements of both former and current designed cylinders. Caterpillar's current remanufactured oversize cylinders (bolted-head type) have the O-ring groove machined into the flange face of the cylinder assembly.

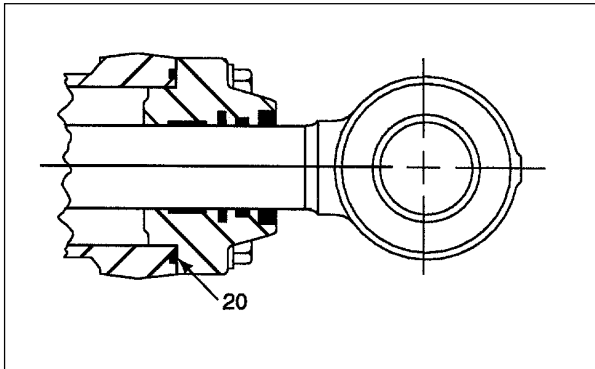


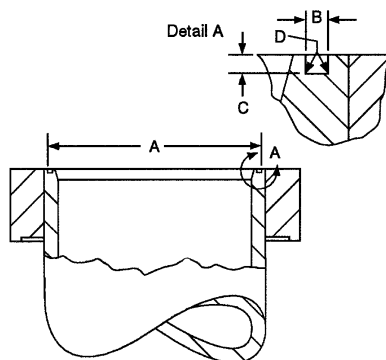
Illustration 3. Bolted head with face O-ring seal.  
20. Face O-ring seal.

## New Groove Dimensions for O-ring Part Numbers

Oversize bolted-head cylinders that lack the flange face o-ring groove can be reworked to add the groove. Recommended dimensions for the cylinder o-ring face seal grooves have been modified to increase the nominal compression of the o-ring face seal. Recommended groove widths have increased and groove depths have decreased. Recommended groove diameters have not changed. O-ring face seal part numbers also have not changed. The recommended o-ring face seal part numbers and o-ring face seal groove dimensions are listed in Chart 4. Refer to Illustration 5 for clarification.

Dealers who salvage cylinder assemblies of bolted-head cylinder groups by honing the bore oversize will need to use the new dimension recommendations to machine grooves for o-ring face seals. Bolted head cylinder assemblies already having o-ring face seal grooves should not be re-worked to the new groove dimensions.

**Note:** Some cylinder assemblies have been dealer re-worked to add an o-ring groove to the flange face of the head rather than the cylinder. Do not assemble a cylinder that would mate a cylinder and head both having an o-ring groove.



- A. Groove Diameter
- B. Groove Width
- C. Groove Depth
- D. Radius

Illustration 5. Seal Groove Width Dimensions  
See Chart 4 for item reference and dimensions.

Chart 4  
Seal Part Numbers and Groove Dimensions

Cyl. Nominal Bore Dia.	O-ring Face Seal Part No.	Groove Dia. (A)	Groove Width (B)	Groove Depth (C)	Radius (D)
76.20 (3.000)	5P2931	87.12 ± 0.50 (3.430 ± .020)	2.40 ± 0.05 (.094 ± .002)	1.33 ± 0.05 (.052 ± .002)	0.4 ± 0.05 (0.16 ± .002)
88.90 (3.500)	4F4097	101.96 ± 0.05 (4.014 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
95.25 (3.750)	7X5494	106.30 ± 0.50 (4.185 ± .020)	2.40 ± 0.05 (.094 ± .002)	1.33 ± 0.05 (.052 ± .002)	0.4 ± 0.05 (.016 ± .002)
101.60 (4.000)	9X7357	112.52 ± 0.50 (4.430 ± .020)	2.40 ± 0.05 (.094 ± .002)	1.33 ± 0.05 (.052 ± .002)	0.4 ± 0.05 (.016 ± .002)
107.95 (4.250)	6S3002	121.00 ± 0.50 (4.764 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
114.30 (4.500)	9X7566	127.36 ± 0.50 (5.014 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
120.00 (4.720)	1330128	136.00 ± 0.50 (5.354 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
120.65 (4.750)	3F5792	136.45 ± 0.50 (5.372 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
127.00 (5.000)	1313716	137.92 ± 0.50 (5.430 ± .020)	2.40 ± 0.05 (.094 ± .002)	1.33 ± 0.05 (.052 ± .002)	0.4 ± 0.05 (.016 ± .002)
133.35 (5.250)	2D8009	149.15 ± 0.50 (5.872 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
139.70 (5.500)	9X7358	152.76 ± 0.50 (6.014 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
140.00 (5.510)	2K8257	155.50 ± 0.50 (6.122 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.020 ± .008)
152.40 (6.000)	8T6404	165.46 ± 0.50 (6.514 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
158.75 (6.250)	9X7391	171.81 ± 0.50 (6.764 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
160.00 (6.300)	9D8042	176.15 ± 0.50 (6.935 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
165.10 (6.500)	9D8042	179.17 ± 0.50 (7.054 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
170.00 (6.690)	9X7725	187.50 ± 0.50 (7.382 ± .020)	3.53 ± 0.08 (.139 ± .003)	1.95 ± 0.08 (.077 ± .003)	0.4 ± 0.10 (.016 ± .004)
177.80 (7.000)	5J2383	198.98 ± 0.50 (7.834 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
180.00 (7.090)	5J2383	196.50 ± 0.50 (7.736 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
184.15 (7.250)	5J2383	198.98 ± 0.50 (7.834 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
190.50 (7.500)	1J2176	211.68 ± 0.50 (8.334 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
196.85 (7.750)	1J2176	209.47 ± 0.50 (8.247 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
200.00 (7.87)	5P3092	225.00 ± 0.50 (8.858 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
209.55 (8.250)	4K6804	224.38 ± 0.50 (8.834 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
215.90 (8.500)	1T0132	241.22 ± 0.50 (9.496 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)
220.00 (8.66)	1M9015	253.92 ± 0.50 (9.997 ± .020)	9.35 ± 0.25 (.368 ± .010)	5.20 ± 0.25 (.207 ± .006)	1.6 ± 0.40 (.063 ± .016)
234.95 (9.250)	5S3676	253.92 ± 0.50 (9.997 ± .020)	4.75 ± 0.13 (.187 ± .005)	2.64 ± 0.13 (.104 ± .005)	0.8 ± 0.20 (.031 ± .008)

**Chart 4**  
**Seal Part Numbers and Groove Dimensions**

<b>Cyl. Nominal Bore Dia.</b>	<b>O-ring Face Seal Part No.</b>	<b>Groove Dia. (A)</b>	<b>Groove Width (B)</b>	<b>Groove Depth (C)</b>	<b>Groove Radius (D)</b>
254.00 (10.000)	3S3074	276.15 ± 0.50 (10.872 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
266.70 (10.500)	5P2236	288.85 ± 0.50 (11.372 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
279.40 (11.00)	1309108	310.50 ± 0.50 (12.224 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
292.10 (11.50)	6V3263	314.25 ± 0.50 (12.372 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
317.50 (12.50)	1309109	360.50 ± 0.50 (14.193 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
330.20 (13.00)	1309110	381.50 ± 0.50 (15.020 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)
342.90 (13.50)	1309110	381.50 ± 0.50 (15.020 ± .020)	7.40 ± 0.20 (.291 ± .008)	3.95 ± 0.20 (.155 ± .008)	1.6 ± 0.40 (.063 ± .016)