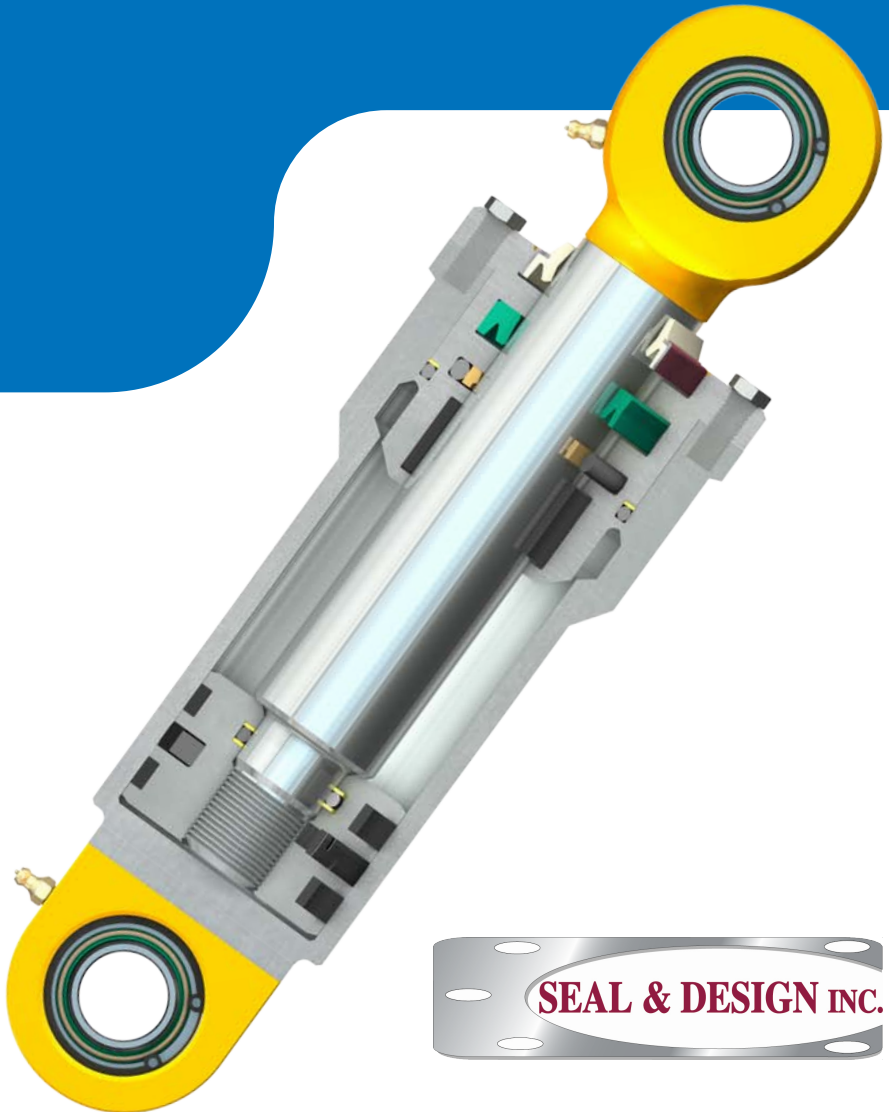














# Hydraulic Seals Piston Seals






# Profile overview

Profile	Description
<div>MPV</div> 	Polyurethane slide ring, nitrile rubber energizer; suitable for heavy duty applications
<div>DPV</div> 	Polyurethane slide ring, nitrile rubber energizer; fits wide, shallow inch size housings; suitable for heavy duty applications
<div>LPV</div> 	Polyether based polyurethane slide ring, nitrile rubber energizer; suitable for light to medium duty applications
<div>CPV</div> 	Polyurethane slide ring, nitrile rubber energizer; fits wide, shallow inch size housings; suitable for light to medium duty applications
<div>GH</div> 	PTFE slide ring, nitrile rubber energizer; low breakaway friction
<div>APR</div> 	PTFE slide ring with incorporated rubber X-ring, nitrile rubber energizer
<div>LCP</div> 	PTFE slide ring supported by polyamide anti-extrusion rings, nitrile rubber energizer; very good gap extrusion resistance; suitable for high pressures
<div>LTP</div> 	Sealing ring made of nitrile rubber, supported by polyamide anti-extrusion rings; good gap extrusion resistance; suitable for high pressures

Profile	Description
CUT 	Step cut polyamide slide ring, nitrile rubber energizer; suitable for high pressures
SCP 	Step cut polyamide slide ring, oval nitrile rubber energizer; fits wide, shallow inch size housings; suitable for extreme pressures
MD-L 	One-piece nitrile rubber sealing ring integrated polyester elastomer support rings and POM guide rings; common in older cylinder designs
UNP 	Polyurethane U-cup profile; single-acting; may be used in double-acting cylinders when facing in opposite directions

**Rod seals that can be used as piston seals**

PTB 	These rod seal profiles are designed with similar inside and outside sealing geometry and, therefore, can also be used as piston seals.
STD 	
DZ 	

### Basics

Piston seals (→ **fig. 1**) maintain sealing contact in sliding motion between the piston and the cylinder bore. Differential pressures acting on the piston to extend or retract the piston rod can be in excess of 400 bar (5 800 psi). The pressure acting on the piston seal increases contact forces between the piston seal and cylinder surface. Therefore, the surface properties of the sealing surfaces are critical to proper seal performance

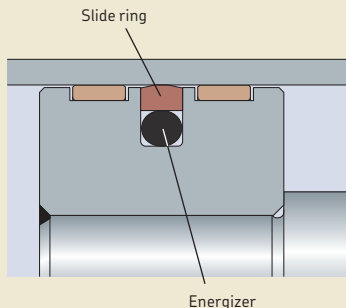
Piston seals are typically classified into single-acting (pressure acting on one side only) and double-acting (pressure acting on both sides) seals.

#### Materials

Depending on the profile and the required characteristics of its components, a piston seal can consist of one or several materials. Common materials used for piston seals are thermoplastic polyurethane (TPU), polytetrafluoroethylene (PTFE), polyamide (PA), and nitrile rubber (NBR).

Fig. 1

Typical piston seal arrangement for double-acting cylinders



#### Gap extrusion

External forces acting on the piston rod, reacted by the fluid inside the cylinder, can result in abrupt pressure peaks. These peaks can be far in excess of the system operating pressure and may press a piston seal into the gap between the piston and bore, thereby causing damage to the seal and adversely affecting seal performance and cylinder operation. Seal materials must be carefully chosen to avoid gap extrusion.

This risk of gap extrusion can also be minimized by using seals with anti-extrusion rings.

#### Piston guidance

Guide rings avoid sliding metal-to-metal contact between the piston and cylinder bore and accommodate the radial loads of forces acting on the cylinder assembly. Although piston seals are designed to accommodate slight radial motion between the piston and bore, effective guide ring function to accurately centre the piston within the bore is important for piston seal performance.

Fig. 2

Piston welded to the rod end tap

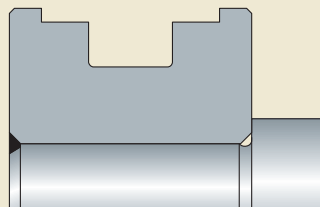
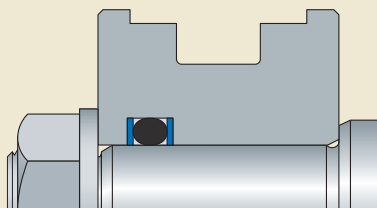


Fig. 3

Piston fixed to the rod by a lock nut and with a static seal and two back-up rings between piston and rod end



## Piston drift

When the piston rod is at rest and held in position by fluid, any amount of flow passing the piston can result in an unintended movement of the piston rod and cause drift. Although piston seal leakage is a possible source of drift, internal valve leakage, external system leakage and flow between the piston and rod static connections should also be carefully checked. In some applications, a minimal amount of flow passing the piston seal within specified limits is permitted. This tolerance allows the use of piston seals of low friction designs and materials or split slide rings for simple installation.

## Sealing between piston and rod

The piston can be welded to the rod (→ **fig. 2**) if the disassembly of the cylinder can be done by removing the rod end attachment. The piston can also be fixed to the rod end by a lock nut (→ **fig. 3**), which enables removing the piston from the rod during complete disassembly of the cylinder. When using a lock nut, static sealing is required between the piston and the rod end.

### Double-acting piston seals

Double-acting cylinders are the most widely used cylinder types. They operate with pressure on both sides and, therefore, require double-acting seal arrangements (→ **fig. 1, page 48**).

Double-acting piston seals have a symmetrical profile (cross section) and identical sealing functions in both directions. Typically, double-acting piston seals consist of a slide ring and an energizer. The deformation of the rubber energizer when installed provides adequate force to keep the slide ring in dynamic sealing contact with the cylinder bore, while sealing statically against the seal housing groove.

A double-acting cylinder typically has the same fluid on both sides of the piston. Therefore, a relatively thick lubrication film can be permitted between the piston seal and the cylinder bore to minimize friction and wear. The transportation of fluid occurring during dynamic operation is, however, small and insignificant in most applications.

SKF supplies double-acting piston seals in many different profiles and in a wide range of series and sizes, which make them appropriate for a wide variety of operating conditions and applications.

### Piston seals with polyurethane slide rings

Piston seals with thermoplastic polyurethane (TPU) slide rings have a nitrile rubber (NBR) energizer. The wear-resistant slide ring has a profiled dynamic sealing surface optimized to reduce friction and resist gap extrusion. Notches in the slide ring edges ensure rapid pressurization of the seal to react to abrupt changes in pressure. These profiles can usually be installed without special equipment and are resistant to damage during installation and cylinder assembly.

#### MPV profiles

MPV profiles (→ **fig. 4**) have slide rings made of hard X-ECOPUR PS (TPU) developed for pressures up to 400 bar (5 800 psi). They are suitable for high fluid temperatures and in heavy duty applications, such as earthmoving equipment. MPV profiles are available in metric sizes and some fit seal housings in accordance with ISO 7425-1.

Fig. 4

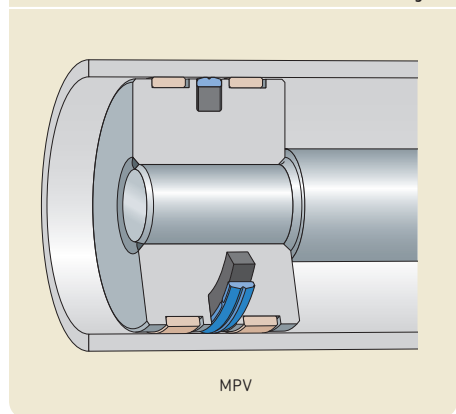


Fig. 5

**DPV profiles**

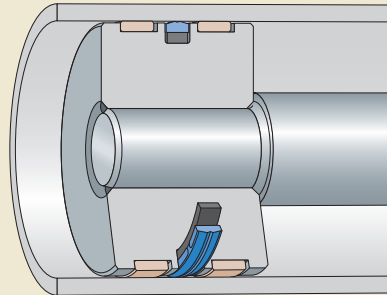
DPV profiles (→ **fig. 5**) have slide rings made of hard X-ECOPUR PS (TPU) developed for pressures up to 400 bar (5 800 psi). They are suitable for high fluid temperatures and for heavy duty applications, such as earthmoving equipment. DPV profiles are available in inch sizes where wider, shallower seal housings are used.

**LPV profiles**

LPV profiles (→ **fig. 6**) have a polyether base polyurethane (EU) slide ring that provides resistance to hydrolysis (attack from moisture) and good low temperature flexibility. The O-ring energizer provides a cost-effective sealing solution. These profiles are developed for pressures up to 250 bar (3 625 psi) and suitable for light to medium duty applications, such as agriculture and material handling applications. They are available in metric sizes.

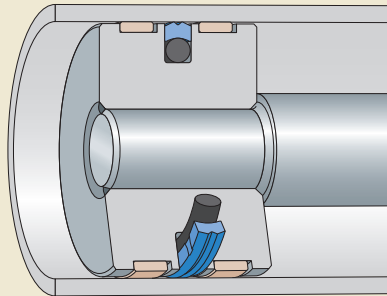
**CPV profiles**

CPV profiles (→ **fig. 7**) have a polyester base polyurethane (AU) slide ring. These profiles are developed for pressures up to 345 bar (5 000 psi) and suitable for light to medium duty applications. They are available in inch sizes where wider, shallow seal housings are used.



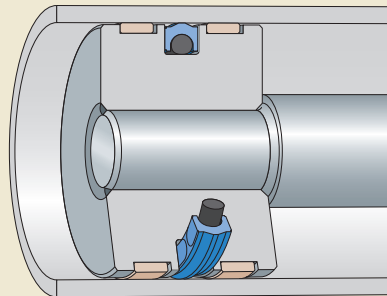
DPV

Fig. 6



LPV

Fig. 7



CPV

## Piston seals

### Piston seals with PTFE slide rings

PTFE slide rings may be preferred in applications with demands for low breakaway friction and when it comes to chemical and thermal resistance. Notches in the slide ring edges ensure rapid pressurization of the seal to react to abrupt changes in pressure. PTFE is hard and non-elastic when compared with polyurethane and rubber materials. Therefore, PTFE slide rings are combined with an energizer that provides the necessary sealing force and the static sealing function in the seal housing.

#### GH profiles

GH profiles (→ **fig. 8**) have a nitrile rubber (NBR) energizer, which is an O-ring as standard. Square ring expanders are available on request. These profiles are suitable for pressures up to 400 bar (5 800 *psi*) and are available in metric and inch sizes. Some metric sizes fit seal housings in accordance with ISO 7425-1.

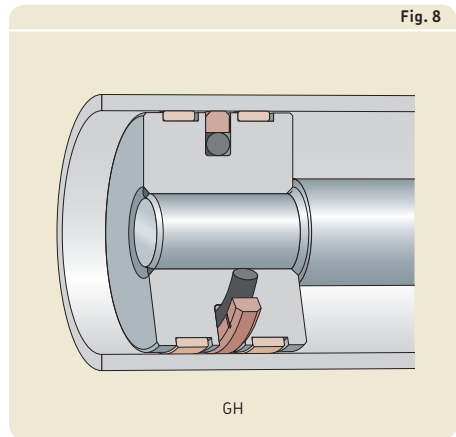


Fig. 8

#### APR profiles

APR profiles (→ **fig. 9**) have a nitrile rubber (NBR) O-ring energizer. The PTFE slide ring incorporates a NBR X-ring to improve sealing performance. They are suitable for pressures up to 350 bar (5 075 *psi*) and are available in metric and inch sizes. Some metric sizes fit seal housings in accordance with ISO 7425-1.

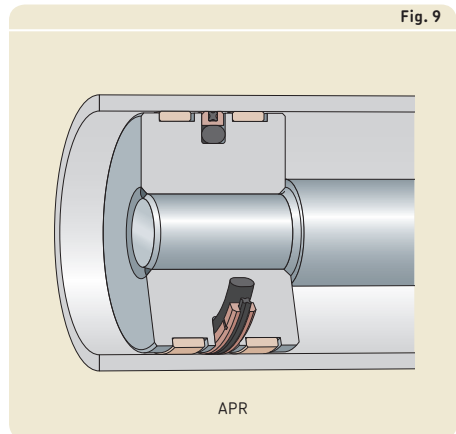


Fig. 9



Fig. 10

### Piston seals incorporating anti-extrusion rings

These SKF piston seals incorporate patented locking anti-extrusion rings (→ **fig. 10**) made of polyamide (PA). They are split for simple installation. Their snap-in design makes it easy to identify the correct mounting direction, holds them in place when mounted and prevents damage during assembly.

Piston seals incorporating anti-extrusion rings have an improved high pressure performance and minimize the risk of gap extrusion at abrupt pressure peaks.

#### Patented locking anti-extrusion rings

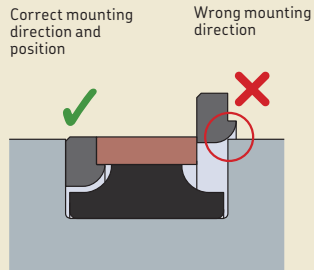
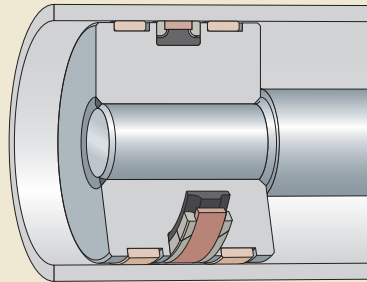


Fig. 11

### LCP profiles

LCP (→ **fig. 11**) profiles have a PTFE slide ring supported by harder PA anti-extrusion rings (→ **fig. 10**) and a nitrile rubber (NBR) energizer. These capped T-seals are suitable for pressures up to 690 bar (10 000 psi) and available in various industry common metric and inch sizes. Some metric sizes fit seal housings in accordance with ISO 5597.

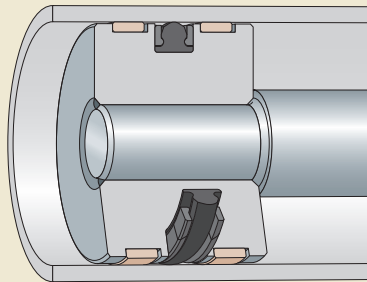


LCP

Fig. 12

### LTP profiles

LTP profiles (→ **fig. 12**) have a nitrile rubber (NBR) sealing ring supported by harder PA anti-extrusion rings on both sides. The sealing ring serves as a slide ring and also seals statically against the seal groove. These T-seals are suitable for pressures up to 345 bar (5 000 psi) and are available in inch sizes.



LTP

## Piston seals

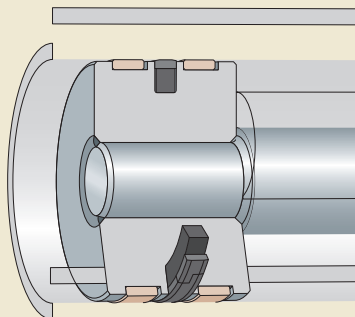
### Piston seals with rigid split slide rings

These SKF piston seals have a rigid split slide ring made of glass fibre reinforced polyamide (GFR PA) and a nitrile rubber (NBR) energizer. The rigid slide ring has high resistance to wear and gap extrusion and provides low friction, even under high pressure. The split slide ring design facilitates the mounting process into a closed seal housing.

### CUT profiles

CUT profiles (→ **fig. 13**) have a step cut slide ring and a rectangular energizer. They are suitable for pressures up to 500 bar (7 250 psi). They can be used for short pressure pulses up to 1 000 bar (14 500 psi) with proper system design. For additional information, contact SKF. These profiles are available in metric sizes and some fit seal housings in accordance with ISO 7425-1.

Fig. 13

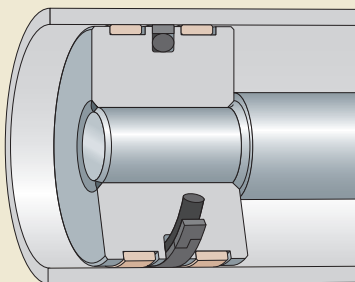


CUT

### SCP

SCP profiles (→ **fig. 14**) have a step cut slide ring and an oval energizer. They are suitable for pressures up to 690 bar (10 000 psi). SCP profiles are available in inch sizes where wider, shallower seal housings are used.

Fig. 14



SCP

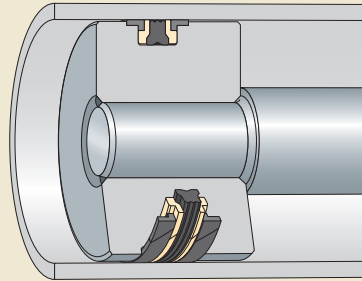
### Piston seals with integrated guide rings

These seals are designed as compact sets that incorporate the piston seal and guide rings into one assembly. Typically, they are applied in older cylinder designs. For designing new cylinders, SKF recommends using guide rings and piston seals in separate grooves.

#### MD-L profiles

MD-L profiles (→ **fig. 15**) have a nitrile rubber (NBR) sealing ring with polyester thermoplastic elastomer (TPC) support rings on both sides, which incorporate the POM guide rings. The sealing ring serves as a slide ring and also seals statically against the seal groove. The support rings protect the sealing ring against gap extrusion. The guide and support rings are split for simple installation. MD-L profiles are suitable for pressures up to 250 bar (3 625 psi) and are available in metric sizes. Some sizes fit seal housings in accordance with ISO 6547.

Fig. 15



MD-L

### Single-acting piston seals

A single-acting piston seal is designed for cylinders where pressure is applied from one side only. The piston in single-acting cylinders may have oil on the pressure side only, while the opposite side is open to atmosphere. Therefore, the piston seal must leave a minimum of oil film when passing along the cylinder bore since the transportation of oil otherwise would result in a leakage to the exterior.

In single-acting cylinders, the open end may push air out and draw air in as the piston reciprocates. This air may carry moisture and contaminants into the cylinder, which can lead to seal damage. Vent filters may be fitted to the open side of the cylinder to reduce contaminants entering the inside of the cylinder. The cylinder bore may be hard chromium plated to prevent corrosion.

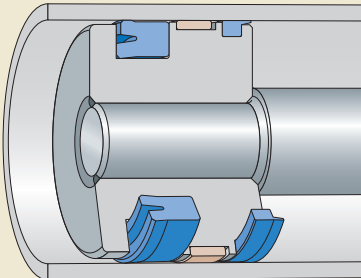
In addition, to prevent damage to the cylinder bore or piston seals, SKF can supply special piston wiper seals on request. For additional information, contact SKF.

#### UNP profiles

UNP profiles (→ **fig. 16**) are single-acting U-cup seals made of thermoplastic polyurethane (TPU). They are suitable for pressures up to 350 bar (5 075 psi) and are available in metric and inch sizes. Appropriate full-face anti-extrusion rings for these profiles, for example BUS profile, are not covered in this catalogue, but are available on request. For additional information, contact SKF.

Fig. 16

UNP profile piston seal with a wiper seal



### Single-acting piston seals in double-acting cylinders

Two single-acting U-cup profile seals, facing in opposite directions, can be used in a double-acting cylinder. It is important to select seal designs which can relieve reverse pressure for such arrangements to prevent build-up of pressure between the two seals. UNP profiles are suitable for such double-acting arrangements because the dynamic seal lip can flex to relieve reverse pressure.

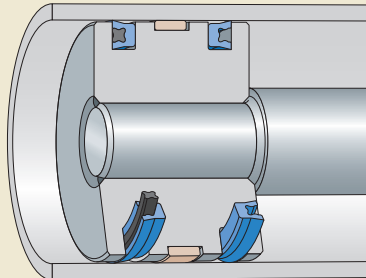
### Rod seals used as single-acting piston seals

Some rod seal profiles are designed with similar inside and outside sealing geometry and, therefore, can also be used as single-acting piston seals in single- or double-acting cylinders (→ **fig. 17**). PTB, STD and DZ rod seal profiles can be used for those applications.

Rod seals with loaded-lip U-cup profiles may not relieve reverse pressure, but it is possible to remove their expander (X-ring) from one of the seals to allow reverse pressure relief (→ **fig. 17**).

Fig. 17

STD profiles used as piston seals (in a double-acting arrangement)





A detailed 3D cutaway rendering of a mechanical assembly, likely a pump or motor. The central shaft is highlighted in light blue. The assembly is housed in a grey metal casing with various internal components like bearings, seals, and gears visible. A yellow circular component is attached to the end of the shaft. The background is a light grey gradient.

**SEAL & DESIGN INC.**

**Seal & Design**  
**Corporate Headquarters**  
Ph: (716)-759-3344  
Info@SealAndDesign.com  
[www.SealAndDesign.com](http://www.SealAndDesign.com)



**SKF**

[www.SealAndDesign.com](http://www.SealAndDesign.com)