Quality features, proven reliability

Parker cylinders...The Cylinders

Parker cylinders have proven themselves in the only “test” that matters...the one you give it on the job.

Year after year, in all types of industrial applications, Parker Cylinders give reliability you can count on with minimum maintenance. The benefits to you are increased productivity at lower operating costs.

Parker offers an unmatched combination of quality features in the widest selection of industrial cylinders available. All to give you job-matched top performance and proven reliability.

For example, the piston rod is case-hardened and chrome-plated to guarantee a smooth, hard, dent and scratch resistant surface. This increases seal and bearing life, reduces maintenance costs and assures dependable long-life service.

The high strength rod end stud has rolled threads providing threads reducing the possibility of fatigue failure. Interchangeability, easy conversion and/or repair of rod ends allow low cost modification or on-the-job repair. Anaerobic adhesive is used to permanently lock the stud to the piston rod.

Tie rods are also high strength material with rolled threads for a stronger cylinder assembly and greater product reliability.

The long, full size piston-to-rod thread connection acts as a shock absorber and helps resist side loading. For added strength the piston-to-rod thread increases with the rod diameter thereby increasing the thread strength up to 314% for safety-assured performance in a given bore size.

Square Steel heads and caps provide concentricity for mating parts. Both the steel head and cap are bored and grooved to assure concentricity to a common centerline for the cylinder body.

Cylinder bodies Hard chrome plated bore, steel tubing honed to a 15 micro inch finish.

Parker cushions are the longest in the industry, providing the finest cushioning control available in a standard cylinder. The floating, self-centering bushing delivers high efficiency by increasing “out-stroke” speed. This all adds up to a no-compromise design that provides longer machine life, safer deceleration and greater reliability. Cushions are furnished when ordered without increasing overall cylinder length.

Parker’s new adjustable, floating stepped cushion design is economical and flexible for even the most demanding applications. It provides superior performance in reducing hydraulic shock. Cushioning time is reduced up to 50%, permitting faster machine operating cycles for increased productivity. It reduces machine noise for less downtime and lower maintenance costs.

For additional information – call your local Parker Cylinder Distributor.
Design Features

The one-piece, wide surface, nodular iron piston reduces bearing loads. The piston is piloted to ensure concentricity. Loctite is used to permanently lock the piston to the rod.

Static O-ring body seals are pressure energized, compensating and positive sealing for less maintenance cost and downtime saving oil losses and allowing quick, easy repair.

Parker spherical bearings virtually eliminate alignment problems normally associated with the use of pivoting cylinders. Spherical bearings simplify difficulties with machine alignment. Even with misalignment of up to 4.5° performance remains satisfactory without creating any excessive cylinder wear.

Air cylinders are factory pre-lubricated with Parker Lube-A-Cyl for normal operation and provide millions of trouble-free cycles. This greatly reduces both operating and maintenance costs.

Feature after feature, the Parker story is the same. Parker cylinders are premium quality cylinders and have what it takes to give you the top performance you require. Cylinders designed and engineered for greater production profitability to save you unnecessary cost in downtime. To make sure every cylinder is premium quality, we subject each one, not just batch samples to tough inspection and performance tests.

More selection and availability. Parker offers you the largest selection of sizes, bores, strokes, mountings, options, and accessories available. The kind of selection that lets you "customize" cylinders to fit your application. There are over 5 million different cylinders in our standard line alone. Parker's engineering capabilities are backed by over 60 years of manufacturing experience to meet all your cylinder requirements of today...and tomorrow.

Specials? Absolutely! Parker has the Sales, Engineering and Manufacturing capability and experience to provide special cylinders to meet your custom specifications and requirements. Let your imagination be your guide. We're ready to give you any technical assistance you might need. We will help turn your ideas into reality by providing special cylinder designs for you to create new machinery...solve a difficult production problem...or improve existing equipment.

The best in factory-trained fluidpower technical help is available from your Parker distributor's servicemen who are as close as your phone. They receive intensive training in cylinder design, application and maintenance at Parker facilities and regional training centers. They're always ready, eager and able to service all your cylinder requirements.

For Cylinder Division Plant Locations – See Page II.
Parker Pneumatic Check Seal Cushion

New Series MA air cylinder check seal cushions provides fast response, low wear, and low pressure drop.

Parker engineers have developed a new concept in air cylinder cushions…the “check seal”. The new Parker check seal cushion combines the sealing capabilities of a lipseal for efficient capture of air for effective cushioning with check valve action for quick stroke reversal.

The lipseal design also provides “floating cushions” to assure cushion repeatability and long life. At the start of the stroke in each direction, the check valve design allows full fluid flow to piston face with a minimum pressure drop for maximum power stroke.

Additional benefits of the new check seal cushions are increased productivity and top performance for faster cycle time, minimum wear, easy adjustment, and low pressure drop.

The basic cushion design, is optional on the Series "MA" cylinder and is available on either the head end, cap end or both ends without change in envelope or mounting dimensions. A cushion adjusting needle is supplied for easy, precise adjustment on all bore sizes.

At the head end of the cylinder, the check seal is assembled into a groove in the central bore of the head, with the groove being slightly wider and larger in diameter than the check seal, so that it floats laterally and radially within predetermined limits. The check seal has four grooves molded into the fact to provide flow passages; the assembly is put together with the lip of the seal facing toward the inside of the cylinder.

A cushion sleeve is mounted on the piston rod, so that as the rod extends, air ahead of the piston flows freely out the head-end port. When the end of the cushion sleeve reaches the lip of the check seal, it seals on the wall of the groove, trapping air for cushioning.

As pressure is applied to the head-end port on retraction, the air forces the seal towards the inside of the cylinder. The air then flows around the O.D. of the seal and through the flutes of the seal washer. Full-flow, quick starts with little or no pressure drop is just one of the major benefits of the design.

At the cap end of the cylinder, the check seal is assembled into a cavity in the face of the cap with four beads molded on the O.D. to provide a flow passage. A fluted washer and retaining ring, rather than a groove, and a cushion spear which extends from the rear face of the piston complete the cap end assembly. When the rounded, tapered portion of the cushion spear reaches the lip of the seal, the seal seats against the rear wall of the cavity, trapping air for cushioning.

The configuration of the check-seal lip, and the controlled shape of the cushion sleeve together prevent the lip from rolling over or extruding. A check seal used at both ends provides the benefits of floating cushions with check valve action for maximum cushion effectiveness and quick stroke reversal. This new check-seal design has been tested in millions of cycles, in the lab and in the field.

Series MA cushions are the longest in the industry and are designed for maximum customer benefit.

For additional information – call your local Parker Cylinder Distributor.
the Great Shape

a new cushion design that makes Parker hydraulic cylinders perform even better

- Faster cushioning time
- Reduced hydraulic shock
- Reduced machine noise
- Lower machine maintenance
Hydraulic Cylinder Cushioning:
The control of kinetic energy

Moving loads faster with heavy-duty hydraulic cylinders – In today’s machinery and machine tools, hydraulic cylinders are required to stop heavy loads at increasingly faster rates. Every second saved can increase productivity and reduce costs. So the machine designer must find ways to operate cylinders as fast as possible.

Merely speeding up a cylinder eventually leads to unacceptable hydraulic shock loads. The high inertial forces developed at the end of the stroke must be stopped without damaging the cylinder or the load.

Cushioning to control kinetic energy – One way to maintain a higher average velocity in cylinders is to incorporate cushions at the end of the stroke. These integral deceleration devices are designed to minimize excessive deceleration forces and peak hydraulic pressures which result from a sudden change of velocity.

Ideally, the cushion should achieve constant deceleration by developing constant pressure during the time of deceleration. In hydraulic cylinders, special shaping or contouring of the cushion spear or sleeve has been employed to provide programmed deceleration for the unit.

Design of Cylinder Cushions – In cushioning of hydraulic cylinders, the spear or sleeve closes the main exhaust passage in the cylinder head or cap, confining the fluid between the piston and the head or cap. The trapped fluid is metered at a somewhat controlled rate around the cushion spear and through bypass orifice that is adjusted with a needle valve. In the reverse direction, fluid bypasses the needle valve by means of check valve in the cylinder. The cushion must center itself properly regardless of the piston and bore clearance situation. To facilitate mechanical engagement with the mating orifice, a short taper is used on the leading portion of the cushion spear or sleeve. In addition, the clearance annulus must be concentric so the fluid flow characteristics remain consistent from one stroke to the next. Parker cylinders use floating bushings and floating cushion sleeves to assure concentricity of the flow annuli. Some designs, however, do not provide the floating feature, thereby increasing the chances of eccentricity of mating cushion parts. When cushion parts do not mate concentrically on each cycle, undercushioning or erratic cushioning results.

The most common cushion design is a straight spear or sleeve with a fixed clearance. The straight cushion has been used in a broad range of cylinder applications. It is economical to produce, but provides cushioning in a relatively narrow combination of loads and speeds.

Another common cushion design is the tapered configuration. Most often, it consists of a 1/2 degree taper for 2/3 the length of the cushion stroke, followed by a straight diameter for the last 1/3 of the stroke. Although economical to produce, the tapered cushion normally requires a series of multiple tapers to achieve the desired performance.

In conventional hydraulic cylinders, the theoretical shape for a constant deceleration cushion is an inverted parabola properly sized for the cylinder. This design is extremely expensive to machine, so cannot be economically used on a broad range of products.

Another design, using a series of orifice holes in the cushion sleeve or spear, can also achieve constant deceleration. This multiple orifice or piccolo type cushion is also very expensive to machine and control. As a result, it is only used on specially engineered cylinders.

For additional information – call your local Parker Cylinder Distributor.
The Stepped Cushion
A new shape with great performance advantages

Stepped cushions combine the best features of known cushion technology – The stepped cushion (patent applied for) is a totally new approach in cushioning of hydraulic cylinders. By engineering a new design configuration, Parker has developed a cushion that increases performance over conventional straight and tapered cushions used in heavy duty cylinders.

Advantages of hydraulic cylinders equipped with the Parker stepped cushion include:
- Faster cushioning time
- Reduced internal and external shock
- Reduced machine noise
- Lower machine maintenance

Success of the new design lies in a stepped spear or sleeve which for specific load and velocity conditions, achieves deceleration curves that come very close to the ideal performance curve. The ideal cushioning curve is one which is developed through the use of an inverted parabola cushion which achieves rapid reduction of orifice area near the end of the cushion stroke. With the stepped cushion, a series of steps are calculated to approximate the theoretical orifice area curve. The shape of the cushion allows kinetic energy to be absorbed gradually and smoothly over the entire cushioning stroke.

New standard option in Parker heavy duty hydraulic cylinders – The stepped cushion replaces the straight cushion as a standard option on Parker Series 2H heavy duty hydraulic cylinders. And they’re available at the same price as the previous straight cushions.

The new cushions can be supplied at the head end, cap end or on both ends. The cushion spear or sleeve is machined to close tolerances, assuring that the steps provide the proper deceleration characteristics.

Three types of spear and sleeve designs are employed on Series 2H cylinders. They are required, because in analyzing bore sizes to maximize performance, tests showed that more steps were needed for the higher energy absorption common to larger bore cylinders.

Specify the Stepped Cushion to meet demanding performance requirements – Evaluate all the facts about the new stepped cushion from Parker. And consider its performance advantages when you specify heavy duty hydraulic cylinders.

More details are available in the Parker Series 2H Catalog.

For Cylinder Division Plant Locations – See Page II.
Cushion Performance:
Designing for effective deceleration

Performance of the various cushion designs can be measured by the pressure changes that occur as the cushion stroke takes place. Since cushion pressure is a measure of the retarding force, it shows the resulting deceleration forces.

Pressure curves developed by the various cushion designs demonstrate cushioning performance. The theoretically ideal pressure-stroke curve is a straight line, showing that cushion action had constant pressure characteristics. The total area under the curve represents the kinetic energy absorbed. This constant deceleration curve can be produced with the ideal inverted parabola and multiple orifice cushion designs. However, neither of these designs are economical for most hydraulic cylinder applications in industry today.

The straight cushion typically develops a very high initial pressure peak. Then, it degrades gradually as the stroke continues with fluid being metered through the fixed clearance annulus. As a result of high peak pressure, the straight cushion produces high shock levels, contributing to machine vibration, noise, and wear.

A single taper cushion develops lower initial shock than the straight design, but often delays pressure development, resulting in under cushioning.

The new Parker stepped cushion design (with a three-step spear) develops three pressure pulses which more closely approximate the constant deceleration curve. Pressure peaks are lower than those of both the straight and tapered cushions, resulting in significantly lower hydraulic shock.

A comparison of actual pressure traces produced by a stepped cushion versus a straight cushion under the same conditions further demonstrates advantages of the new design. The stepped cushion not only reduces internal and external shock, it also saves time during the cushion stroke. It can reduce shock up to 90% and reduce cushioning time up to 50% — a dramatic performance improvement. As a result, faster machine operating cycles are possible. And lower shock reduces machine noise and maintenance.

For additional information – call your local Parker Cylinder Distributor.
Acceleration and Deceleration Force Determination

The uniform acceleration force factor chart and the accompanying formula can be used to rapidly determine the forces required to accelerate and decelerate a cylinder load. To determine these forces, the following factors must be known: total weight to be moved, maximum piston speed, distance available to start or stop the weight (load), direction of movement, i.e. horizontal or vertical, and load friction. By use of the known factors and the “g” factor from the chart, the force necessary to accelerate or decelerate a cylinder load may be found by solving the formula (as shown in chart below) applicable to a given set of conditions.

The chart represents ideal conditions and makes no allowance for losses. Possible losses due to leakage past the cushion fits or through the adjustable needle valve result in a .85 efficiency factor for deceleration in cushioning.

Nomenclature

- $V$ = Velocity in feet per minute
- $S$ = Distance in inches
- $F$ = Force in pounds
- $W$ = Weight of load in pounds
- $g$ = Force factor
- $f$ = Friction of load on machine ways in pounds

To determine the force factor “g” from the chart, locate the intersection of the maximum piston velocity line and the line representing the available distance. Project downward to locate “g” on the horizontal axis. To calculate the “g” factor for distances and velocities exceeding those shown on the chart, the following formula can be used:

$$g = \frac{V^2}{S} \times 0.000517$$

EXAMPLE: Horizontal motion of a free moving 6,000 pound load is required with a distance of 1/2” to a maximum speed of 120 feet per minute. Formula (1) $F = Wg$ should be used.

$$F = 6,000 \text{ pounds} \times 1.50 \text{ (from chart)} = 9,000 \text{ pounds}$$

Assuming a maximum available pump pressure of 1,000 pounds p.s.i., a 4” bore cylinder should be selected, operating on push stroke at approximately 750 p.s.i. pressure at the cylinder to allow for pressure losses from the pump to the cylinder.

Assume the same load to be sliding on ways with a coefficient of friction of 0.15. The resultant friction load would be 6,000 x 0.15 = 900 lbs. Formula (2) $F = Wg + f$ should be used.

$$F = 6,000 \text{ pounds} \times 1.5 \text{ (from chart)} + 900 = 9,900 \text{ lbs}.$$ Again allowing 750 p.s.i. pressure at the cylinder, a 5” bore cylinder is indicated.

EXAMPLE: Horizontal deceleration of a 6,000 pound load is required by using a 1” long cushion in a 5” bore cylinder having a 2” diameter piston rod. Cylinder bore area (19.64 Sq. In.) minus the rod area (3.14 Sq. In.) results in a minor area of 16.5 Sq. In. at head end of cylinder. A 1,000 p.s.i. pump delivering 750 p.s.i. at the cylinder is being used to push the load at 120 feet per minute. Friction coefficient is 0.15 or 900 lbs.

In this example, the total deceleration force is the sum of the force needed to decelerate the 6,000 pound load, and the force required to counteract the thrust produced by the pump.

$$W = \text{Load in pounds} = 6,000$$

$$S = \text{Deceleration distance in inches} = 1$$

$$V = \text{Maximum piston speed in feet per minute} = 120$$

$$g = 0.74 \text{ (from chart)}$$

$$f = 900 \text{ pounds}$$

Use formula (3) $F = Wg - f$

$$F = 6,000 \times 0.74 - 900 = 3,540 \text{ Pounds}$$

The pump is delivering 750 p.s.i. acting on the 19.64 Sq. In. piston area producing a force (F1) of 14,730 pounds. This force must be included in our calculations. Thus $F + F_1 = 3,540 + 14,730 = 18,270$ pounds total force to be decelerated. Correct for cushion delivery of .85 or 18,270 x .85 = 21,495.

The total deceleration force is developed by the fluid trapped between the piston and the head. The fluid pressure is equal to the force (21,495 pounds) divided by the minor area (16.5 Sq. In.) equals 1303 p.s.i. This pressure should not exceed the non-shock rating of the cylinder.

Cushioning practice is to select a “g” factor of between .2 and 1.5.
Specify
The Parker
Stepped Cushion

For
- reduced shock up to 90%
- less noise
- less maintenance
- cushioning time reduced up to 50%

We're In Great Shape To Serve You!

For additional information – call your local Parker Cylinder Distributor.
The “Jewel” Gland
An exclusive feature of Parker cylinders
Now with Parker Cylinder’s Exclusive TS-2000 Rod Sealing System

• What Is It?  • Why Is It Required?  • How Does It Work?
What Is It?

The Parker “Jewel” gland cartridge is a combination of elements designed exclusively for sealing fluids when used in conjunction with reciprocating shafts.

Why Is It Required?

Throughout the history of fluid power, the one seemingly insurmountable problem faced by the user of reciprocating hydraulic equipment was a “wet rod”. The problem had been lived with for so many years that the sight of a puddle of oil under the rod end of the cylinder was almost characteristic, and no one seemed to be doing anything about it. With the increase in demand for the advantages of fluid power in such industries as food, medical instruments, etc, plus the increasing costs of maintenance, it became obvious that the old, previously accepted standards were no longer acceptable.

How Does It Work?

The “Jewel” gland assembly consists of the cartridge gland, serrated TS-2000 rod seal, and patented Wiperseal. Each has a multiple job to perform.

Let’s start from the beginning. The fluid approaches the rod end of the cylinder and tends to follow the rod out. The fluid has a natural tendency to grip the rod (adhesion) with a force depending upon the viscosity (among other factors) of the fluid. Now note that the gland bearing is inboard of the sealing members. This not only keeps the bearing lubricated, which is in itself an important feature, but it also results in an initial shearing of the viscous fluid which occurs as the rod passes through the bearing.

This leading edge of the bearing also acts as a pressure snubber when subjected to high hydraulic shocks from the system, and it tends to tame the pressure variations felt by the TS-2000 rod seal.

The serrated TS-2000 rod seal is a truly pressure compensating unitary rod seal. Look for a moment at the conventional seals.

The block vee and hat packing are both low friction type seals and depend upon fine line contact with the rod to effect the seal at a minimum friction value. By scientific optical methods, investigation has indicated this “theory” is short lived as pressure increases. As the pressure increases, the critical edge lifts from the rod, or you might say the line of contact moves away from the pressure.

Essentially, what you now have is an O-ring type contact. The critical shearing edge is gone.

As an example of this, hold a tablet of paper with one edge on the desk. A single sheet of paper will not pass under. Roll the edge of the tablet up and the single sheet easily passes under.

In the compression type packing, (multiple vee) the natural inclination of the maintenance man is to increase the compressive force on the seal gland in an effort to seal off the leak, but this only makes matters worse. The additional friction adds to the wear and the seals quickly wear out and have to be replaced. Multiple vee’s tend to wedge open and throw the point of maximum contact pressure of the seal against the rod, away from the theoretical sealing edge.

For additional information – call your local Parker Cylinder Distributor.
The serrated TS-2000 rod seal, on the other hand, has three shearing edges on a common lip. As the pressure increases and the line contact moves forward, a “new” shearing edge takes over. The increase in friction with increase in pressure is held to a minimum, yet the sealing qualities of the unitary seal are constant throughout the pressure range.

The only fluid adhering to the rod at this point is that very thin layer which is usually “scraped” off the rod on the return stroke by the rugged rod wiper. The solution to this is relatively simple. Don’t let it get out.

We can accomplish this with the Parker developed double-lip Wiperseal. Note the sturdy inner lip. This, in essence, is a scraper. It removes the “last” layer of oil that clings to the bitter end, and traps it between the Wiperseal and TS-2000 rod seal. The rod emerges from the cylinder dry. (Note: “Dry” is a relative term. In our usage, we mean that there is not enough excess oil left on the rod to be scraped off and “collar”. In reality, due to the mirror-structure of the ground, polished and plated surface of the rod, some lubrication remains, which cannot be wiped off.) There is nothing left to be removed by the wiper lip on the return stroke except the dirt and grit which it is designed to remove.

Let’s look at the return stroke now. What happens to the fluid trapped between the Wiperseal and TS-2000 rod seal? (Note the general configuration of the TS-2000 rod seal.)

With the rod extending, the seal is rigid, digging in, resisting the motion of the rod. Now look at it from the other direction, with the rod retracting. It is flexible, able to move out of the way and ride over the oil clinging to the rod on the way back. It acts like a built-in check valve. The fluid trapped in the chamber between the seal is thus carried back into the cylinder on the return stroke. In addition to the oil “carried” back, if sufficient oil gets past the TS-2000 on the way out to build up a pressure between the seals, the pressure “pops” the oil back at the end of the stroke in normal applications when pressure in the head end of the cylinder drops to a low value during reversal.

Now, let’s look at the gland in general. The O-ring seal provided for the O.D. of the gland also serves as a prevailing torque locking device, to prevent rotation of the gland when in service.

Realizing that the gland and seal combination is subject to normal wear and will eventually need attention, the gland has been designed to minimize down time and maintenance costs. The threaded design is far superior for several reasons. The snap ring retained type always has some end play. This results in wipeage of the hydraulic fluid past the O.D. sealing ring. The totally retained type requires the cylinder tie rod nuts to be removed and, in reality, the cylinder almost disassembled. With the threaded design, the gland assembly can be removed without disturbing the rest of the cylinder, and yet is securely held during service.
Look at a cross-section of the “JEWEL.” As the rod strokes out from the seal, the rod motion and its friction tend to dynamically flex the inner edge of the TS-2000 rod seal in contact with the rod. This provides a cutting action to shear the oil from the rod, allowing the rod to pass out of the TS-2000 rod seal practically dry. Imagine that some oil wipes past the TS-2000 rod seal as the piston rod strokes out. It won’t get far for it is stopped by the inner lip of the Wiperseal and is held between it and the TS-2000 rod seal. As the rod returns, any dirt or foreign matter which has collected on the rod is wiped off by the leading edge, or outer lip of the Wiperseal.

At the same time, any oil which may be trapped between the Wiperseal and the TS-2000 rod seal tends to adhere to the rod; and because of the rod motion, a dynamic flexing action of the TS-2000 rod seal occurs which causes the oil to be returned past the TS-2000 rod seal into the cylinder proper. In other words, we have an automatic check valve that prevents any appreciable amount of oil to leak past the seals, and then returns any that has managed to wipe by the TS-2000 rod seal.

The location of the bearing area of this remarkable gland is unique. Note that the major bearing surface is on the cylinder side of the seals. This assures optimum lubrication and cooling of this vital surface by the fluid used in the cylinder.

The O-ring seal on the O.D. of the gland also serves as a prevailing torque locking device to prevent rotation of the gland when in service.

Realizing that even the best gland and seal combination will eventually need attention, Parker-Hannifin engineers have designed the gland to minimize down time and maintenance costs. A threaded gland is more expensive to make than a snap ring retained type. However, we feel that the threaded design is far superior for at least two reasons. First, the snap ring retained type always has some end play. This results in wipeage of the hydraulic fluid past the O.D. sealing ring. Second, the threaded construction is preferred by hydraulic maintenance men. They prefer to unscrew a part rather than to “fish it out” (providing they have managed to locate the tools to remove a snap ring.)

Almost every hydraulic engineer to whom we have shown the “Jewel” has exclaimed… “This makes SENSE!”

Why Is The Parker “Jewel” The Best Gland On The Market?

Because it is designed with superior oil and water resisting seals of the fully dynamic type. The TS-2000 Rod Seal compensates automatically for pressure, temperature and wear conditions. This feature, coupled with our method of retaining these seals in the gland, results in a practically tamper-proof seal.

For additional information – call your local Parker Cylinder Distributor.