



Four-Check Piston Pumps Concept and Theory

Four Check Piston Pump

Four-Check Piston Pumps deliver medium to large fluid volume within a range of pressures. The pump uses a piston and four ball checks to dispense the fluid. The pump loads and dispenses on each stroke.

Component Identification and Function

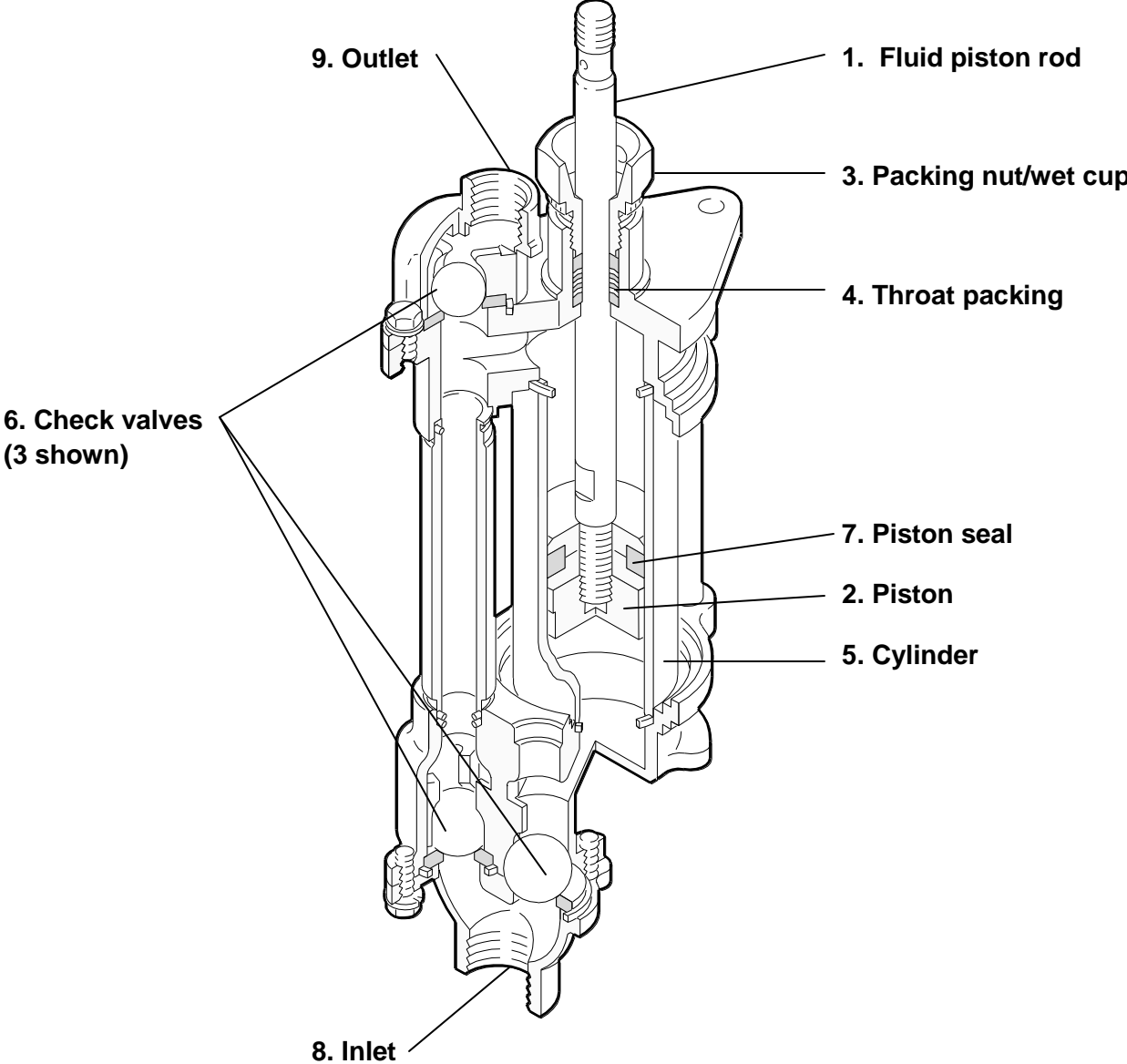


Figure 1a Pump cutaway

Fluid Piston Rod

The motor moves the fluid piston rod up and down.

Piston

The piston is attached to the fluid piston rod and is moved up and down by the fluid piston rod.

Packing Nut/Wet Cup

This part has two names and two functions. The packing nut applies a mechanical force to the throat packing (item 4). This force flares out multiple “V” shaped seals or packings to minimize fluid leakage past the throat packing seals.

The wet cup is a reservoir filled with throat seal liquid (TSL) or iso pump oil (IPO) to extend the life of the throat packing seals. TSL minimizes fluid coating build-up on the fluid piston rod and lubricates the throat packings improving throat packing seal life. IPO is used for moisture sensitive isocyanate to prevent crystals from forming on the fluid piston rod.

Throat Packings

The throat packing keeps the fluid inside the pump as the fluid piston rod reciprocates. As the throat packing wears, there may be some leakage of pumped fluid into the wet cup. This indicates that either the packing nut needs tightening, or the throat packing or fluid piston rod needs replacement.

Cylinder

Fluid fills the cylinder as the pump loads with fluid. The cylinder will wear through pump usage. Three cylinder sizes are available to provide different flow rates.

Check Valves

The four ball checks move up and down with the movement of the piston and rod allowing the pump to load and dispense fluid.

Piston Seal

The piston seal is a modified U-cup. The seal prevents material from passing by the piston as the piston rod moves up and down.

Inlet

Fluid flows through the inlet into the pump on both the up and down strokes of the pump.

Outlet

Fluid flows through the outlet as it leaves the pump during the up and down strokes of the pump.

Inlet and Outlet Manifolds

The manifolds are the regions between the cylinder and inlet or outlet that house the ball check valves.

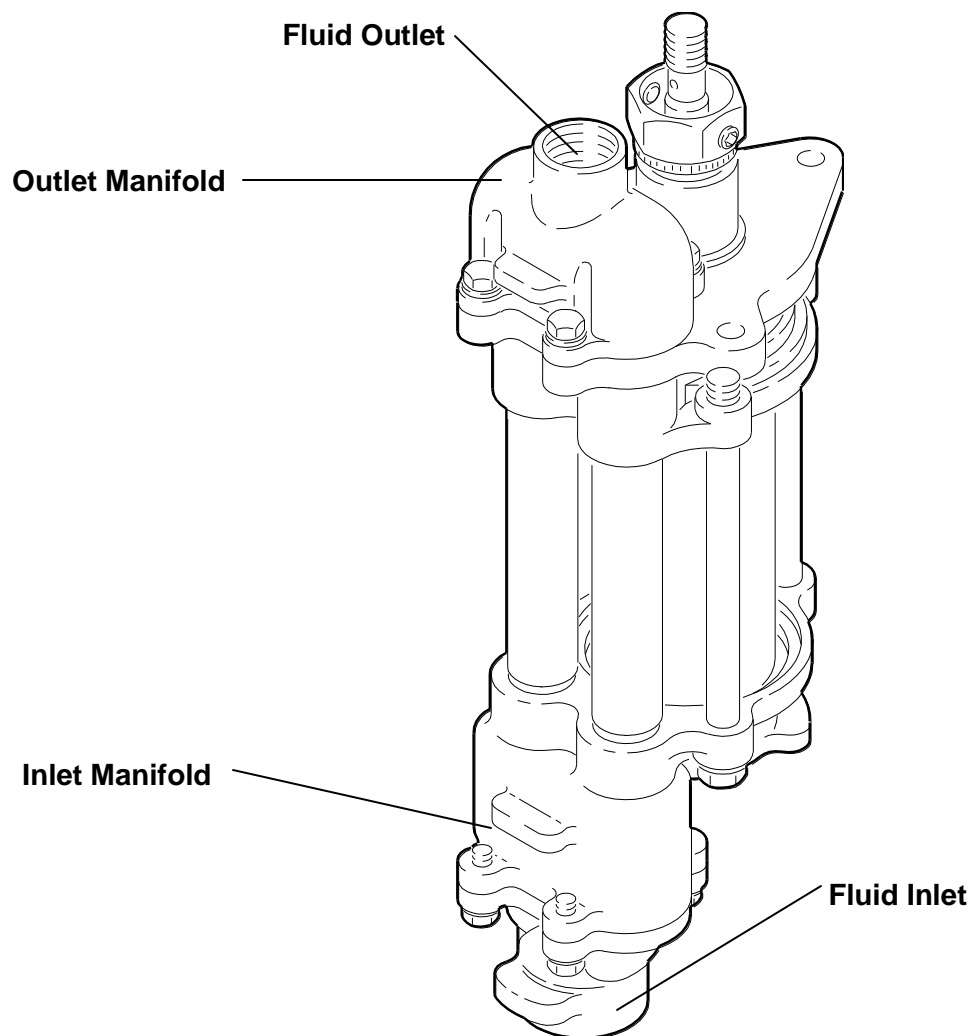


Figure 1b

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Progress Check

Directions: After answering the following questions, compare your answers with those provided in the answer key following the progress check. If you respond to any items incorrectly, return to the text and review the appropriate topics.

1. The four check piston pump is not suitable for large flow rates.
 - a. True
 - b. False
2. The four check piston pump loads on one stroke and dispenses on the next.
 - a. True
 - b. False
3. The function of TSL is to:
 - a. Determine if the pump is leaking
 - b. Lubricate the throat packings
 - c. To aid in priming the pump
 - d. All of the above

Answer to Progress Check

1. False
2. False
3. B.

Operation of the Four Check Piston Pump

Pump Operation

We will discuss the operation of the Four Check Piston Pump as two operations, first upstroke and then down stroke.

Part 1. Upstroke (See Fig. 2)

During upstroke, the motor pulls the fluid piston rod and piston up. Check #2 and check #3 open and #1 and #4 close. This creates a vacuum inside the cylinder below the piston and atmospheric pressure pushes fluid into this chamber through the inlet. As the rod continues to move up, the entire cylinder fills with fluid.

The fluid loaded above the piston on the previous stroke is pressurized by the upward movement of the piston and is pushed out past check #2 and through the pump outlet.

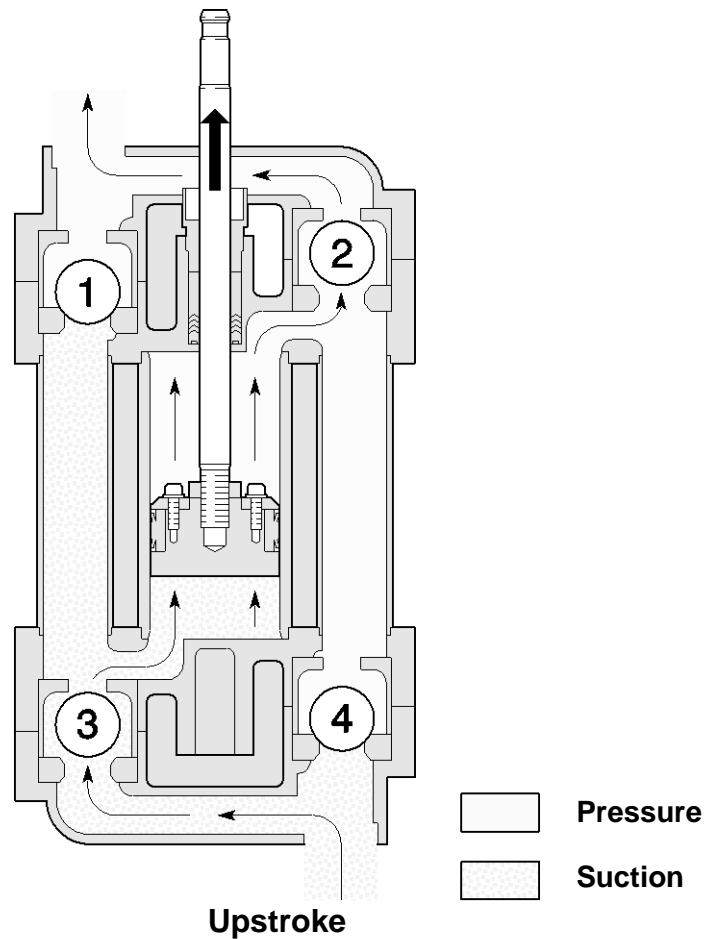


Figure 2 Fluid flow cutaway, upstroke

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Part 2. Down Stroke

On the down stroke, the motor pushes the fluid piston rod and piston down. Check #1 and check #4 open and #2 and #3 close. As the rod travels down, the piston pushes the fluid that is below the piston past check #1 and through the outlet of the pump.

Down stroke creates a vacuum above the piston. This allows atmospheric pressure to push the fluid from the supply container past check #4. As the rod continues to move down, the entire cylinder volume above the piston fills with fluid.

A Four Check Piston Pump dispenses and loads 100% of the cylinder volume on both the upstroke and the down stroke.

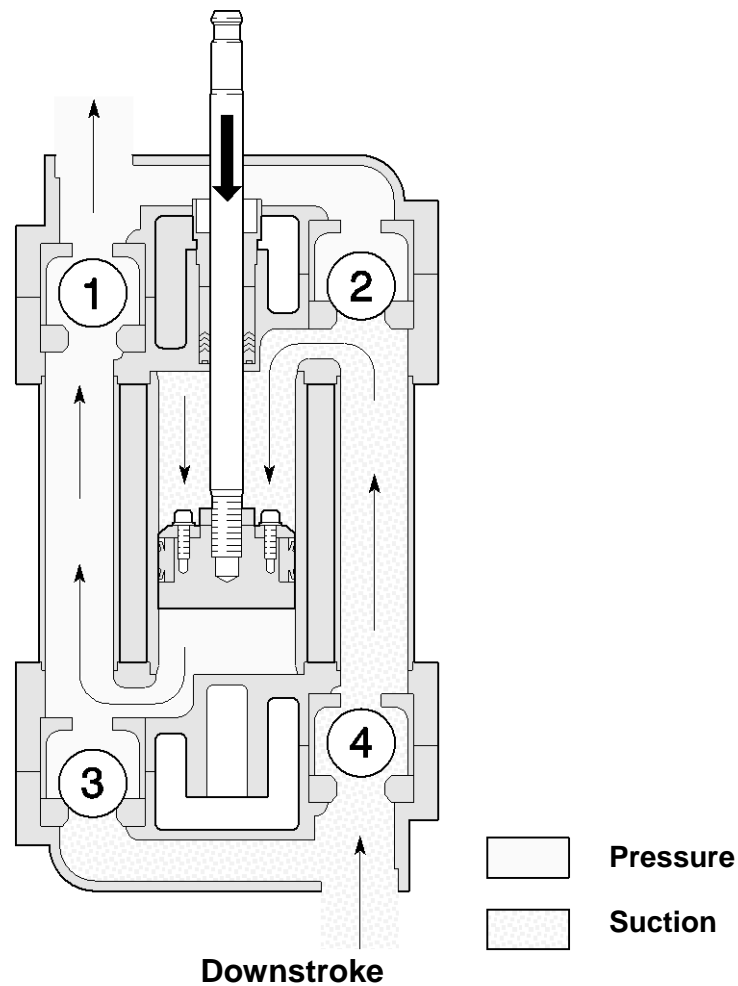


Figure 3 Fluid flow cutaway, down stroke

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Summary

A four check piston pump will prime and dispense 100% of its cylinder volume on both the upstroke and then the down stroke.

These pumps provide medium to high volume at low to medium pressures based on the combination of the motor and pump. These pumps are ideal for the transfer and paint circulating markets.

Advantages

- Higher volume than two check pumps
- Can handle corrosive materials
- Lower pulsation than Two Check Piston Pump
- Less leaking in the throat packing area due to smaller rod and seal than Two Check Piston Pump
- Less wear because of fewer pump cycles compared to Two Check Piston Pumps

Limitations

- Maximum pressure output of 600 psi (4.13 MPa, 41.3 bar)
- Not good for very low pressures