Two-Check and Priming Piston Pumps Concept and Theory

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Two-Check Piston Pumps: Components

A two-check piston pump (shown in Figure 1) is a reciprocating displacement pump in which two check valves – the piston check valve and the intake check valve – control the flow of fluid through the fluid section.

Different types of check valve designs are used in two-check piston pumps, depending on the viscosity and other characteristics of the fluid to be pumped. The most common design is the ball check, so these pumps are often referred to as two-ball pumps. One trade name used for Graco's two-check pumps is Dura-Flo™.

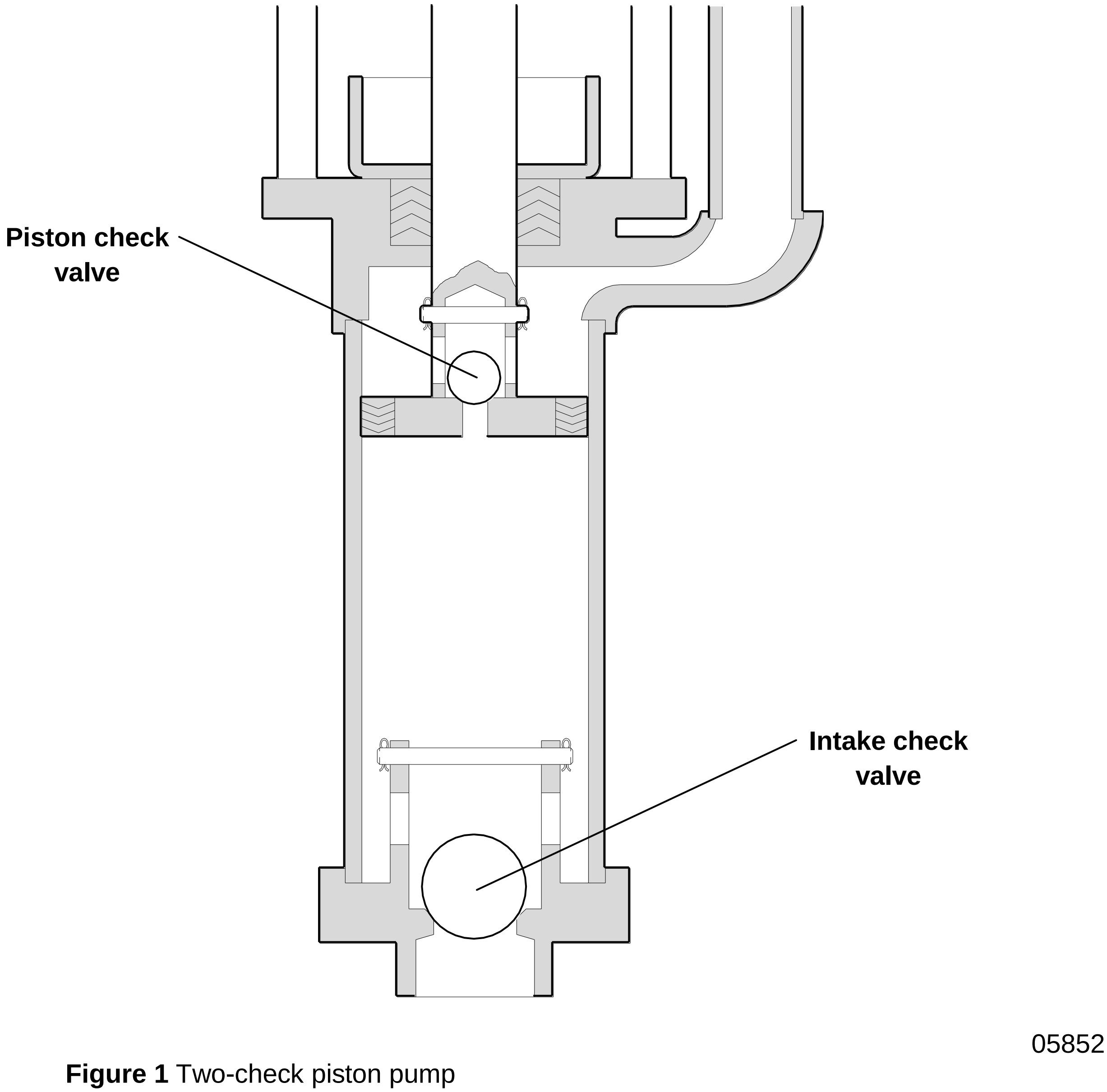


Figure 1 Two-check piston pump

Standard two-check piston pumps contain the basic components shown in Figure 2.

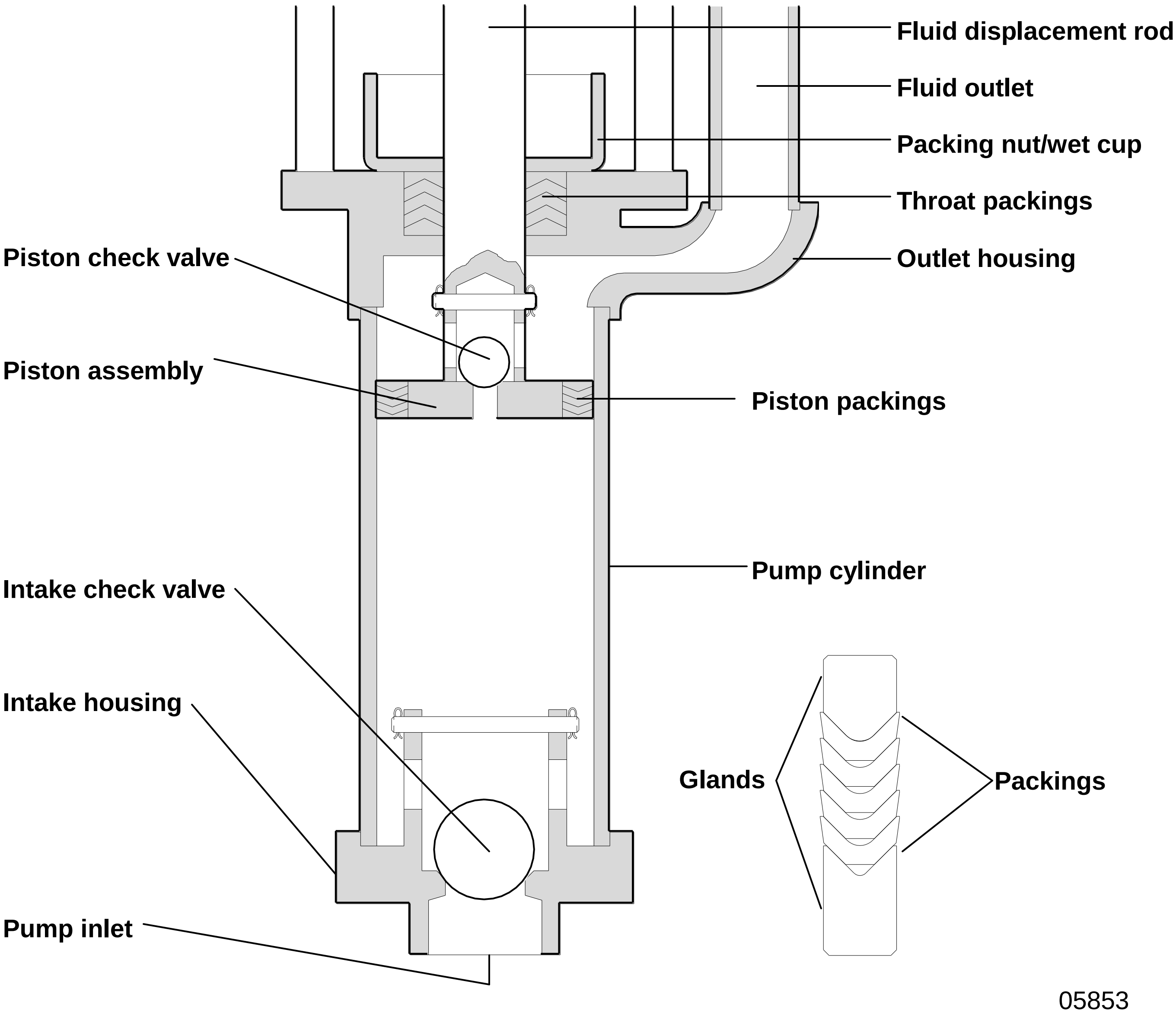


Figure 2 Components of a two-check piston pump

These components function as follows:

The **fluid displacement rod**, or piston rod, connects the internal components of the pump to the motor. It moves up and down with the action of the motor, transferring the motor's power and motion to the pump piston. During both the upstroke and downstroke, it displaces fluid out of the pump.

The **throat packings** seal the fluid displacement rod to the outlet housing of the pump, preventing pressurized fluid from leaking out of the pump when the fluid displacement rod reciprocates. As the throat packings wear, there may be leakage into the wet cup. This leakage indicates that the packing nut must be tightened or that the throat packing seals and/or other fluid section components must be serviced.

The **packing nut/wet cup** has a dual function:

- The *packing nut* can be adjusted to apply pressure to the throat packings to help prevent fluid leaks past the fluid displacement rod. As the throat packings wear, the packing nut is tightened to stop packing leaks. It is only used with V-shaped packing seals and not with any other seal designs, such as U-cup.
- The *wet cup* is a reservoir that can be filled with either throat seal liquid (TSL) or iso pump oil (IPO) to extend the life of the throat packing seals.
    - TSL is used for coatings to minimize fluid buildup on the fluid displacement rod. TSL is not filled in sanitary applications; however, vegetable oil or an equivalent may be used.
    - ISO is used for moisture-sensitive isocyanate to prevent crystals from forming on the fluid displacement rod. Reciprocation of a displacement rod that contains these crystals can cause premature wear of the throat packings.

The **outlet housing** is the pump structure that contains the fluid outlet and fitting, the throat packings, and packing nut/wet cup.

The **fluid outlet** is the opening where fluid exits from the pump. It contains a fitting. On some fluid sections, the diameter of this fitting may be tailored for the application.

The **pump cylinder** forms the outside wall of the pump cavity. It is where the fluid goes when the pump loads.

The **piston assembly** seals the fluid displacement rod to the inside wall of the pump cylinder. It consists of the piston check valve, ball housing, piston packings, and piston glands. In some pumps, a U-cup may be used in place of the glands and packings.

- The *ball housing* is attached to the end of the fluid displacement rod. It contains the piston check valve.
- The *piston packings* are the seals that seal the piston to the pump cylinder.
- The *piston glands* are metal pieces that are placed on each end of the packings to uniformly load them and help maintain their V shape. Figure 2A shows a close-up of piston packings and glands.

The piston check valve, which consists of the piston ball and piston seat, operates in conjunction with the fluid displacement rod inside the pump cylinder. It opens and closes, controlling the flow of material through the pump.

- When the fluid displacement rod moves up, the piston check valve closes and seals tightly on a seat. Fluid trapped above the piston check valve is forced out of the pump through the fluid outlet. A low pressure area is created below the piston check valve in the pump cylinder cavity. This low-pressure area helps to open the intake check valve and draw fluid into the pump.
- When the fluid displacement rod moves down, the piston check valve opens. Its opening allows the fluid below the piston check valve to flow freely through the piston check to the fluid section above and out of the pump.

The **intake check valve**, or foot valve, also opens and closes with the action of the fluid displacement rod. Intake check valve designs may vary. Most pumps use ball-type checks, but some may use a flat plate instead of a ball. The components of the ball-type intake check valve are the intake ball and intake seat.

- When the fluid displacement rod moves up, the intake check valve opens, allowing fluid to enter into the pump cylinder.
- When the fluid displacement rod moves down, the intake check valve closes, preventing the loaded fluid in the pump cylinder from being forced back out the pump inlet.

The **intake housing** is the pump structure that contains the intake check valve.

The **pump inlet** is where the fluid enters the pump.

Some two-check pumps also have a bleed valve that is used to vent, or bleed, air that is trapped within the fluid section. The pump primes easier when there is no air inside the pump.

Progress Check

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

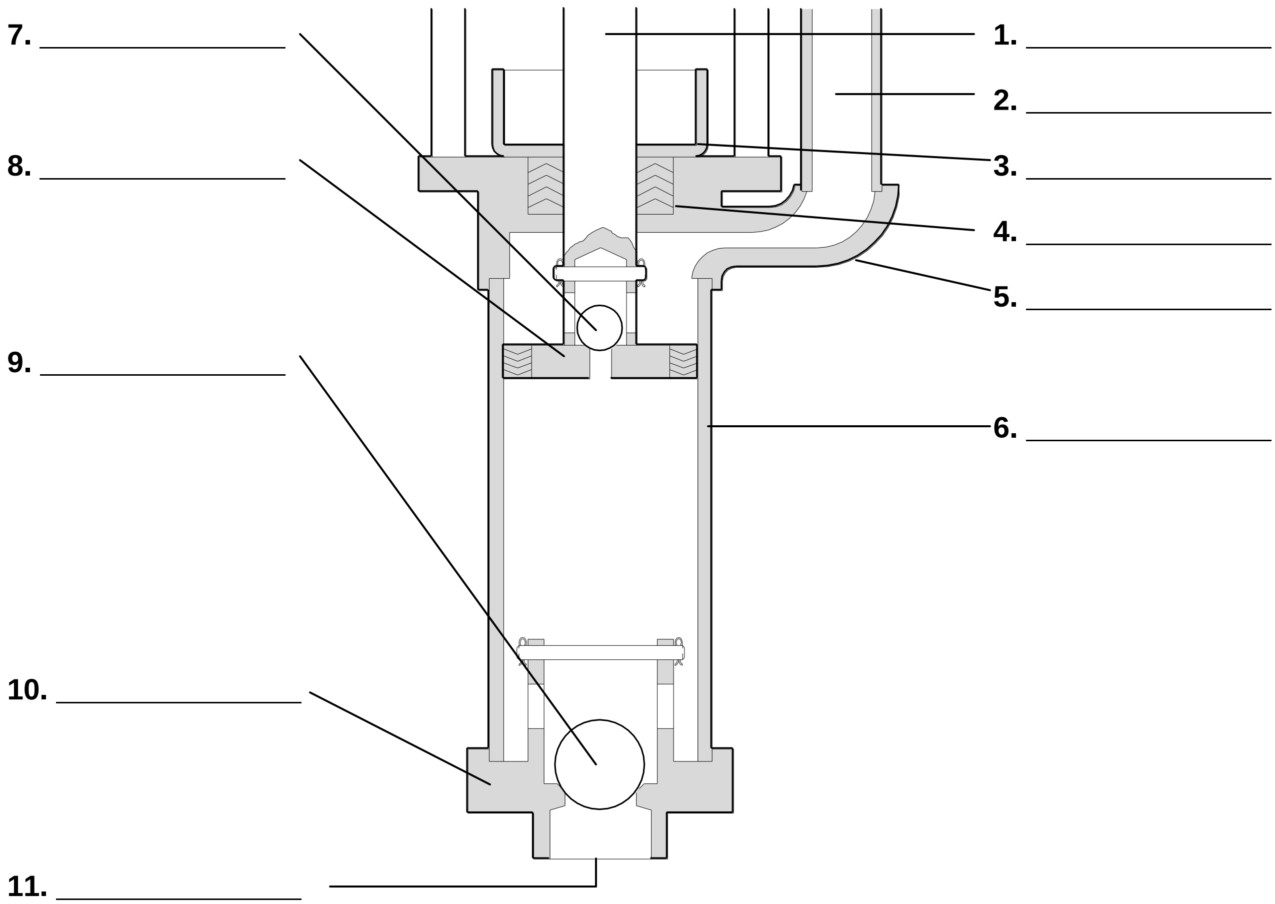
1. Which statement(s) describe(s) a two-check piston pump?

   You may select one or more answers.

   a. It is a reciprocating displacement pump.
   b. It is the most common type of centrifugal pump.
   c. Entry and exit check valves control the flow of fluid through the fluid section.
   d. Piston and intake check valves control the flow of fluid through the fluid section.
   e. Its most common check valve design is the chop and check.
   f. Its most common check valve design is the ball check.

2. *Write the name of the correct two-check piston pump component in the blank following each number. Choose from the list below.*

Fluid displacement	Packing nut/wet	Throat packings
rod	cup	Intake housing
Outlet housing	Pump inlet	Piston check valve
Pump cylinder	Intake check valve	
Fluid outlet	Piston assembly	



7. ______
8. ______
9. ______
10. ______
11. ______
1. ______
2. ______
3. ______
4. ______
5. ______
6. ______

3. *In each blank, write the name of the two-check piston pump component (s) that match(es) the described function. Choose from the list in the previous question.*
    a. ________________ Contains the fluid outlet and fitting, the throat packings, and packing nut/wet cup.
    b. ________________ Seals the fluid displacement rod to the inside wall of the pump cylinder.
    c. ________________ Open and close with the action of the fluid displacement rod, controlling the flow of material through the pump.
    d. ________________ Contains the intake check valve.
    e. ________________ Where the fluid enters the pump.
    f. ________________Where the fluid goes when the pump primes.
    g. ________________ Connects the internal components of the pump to the drive source.
    h. ________________Where the fluid exits the pump.
    i. ________________ Seal the fluid displacement road to the outlet housing.
    j. ________________ Can be adjusted to apply pressure to the throat packings to prevent leaks past the fluid displacement rod.

Answers to Progress Check

1. A, d, and f are correct. A two-check piston pump is a reciprocating displacement pump in which two check valves – the piston check valve and the intake check valve – control the flow of material through the fluid section. The most common type of check valve design used in a two-check piston pump is the ball check.
2. The correct answers are:

   [1] Fluid displacement rod

   [2] Fluid outlet

   [3] Packing nut/wet cup

   [4] Throat packings

   [5] Outlet housing

   [6] Pump cylinder

   [7] Piston check valve

   [8] Piston assembly

   [9] Intake check valve

   [10] Intake housing

   [11] Pump inlet
3. The correct answers are:
   a. The <u>outlet housing</u> contains the fluid outlet and fitting, the throat packings, and packing nut/wet cup.
   b. The <u>piston assembly</u> seals the fluid displacement rod to the inside wall of the pump cylinder.
   c. The <u>piston and intake check valves</u> open and close with the action of the fluid displacement rod, controlling the flow of material through the pump.
   d. The <u>intake housing</u> contains the intake check valve.
   e. The <u>pump inlet</u> is where the fluid enters the pump.
   f. The <u>pump cylinder</u> is where the fluid goes when the pump primes.
   g. The <u>fluid displacement rod</u> connects the internal components of the pump to the drive source.
   h. The <u>fluid source</u> is where the fluid exits the pump.
   i. The <u>throat packings</u> seal the fluid displacement rod to the outlet housing.

j. The <u>packing nut</u> can be adjusted to apply pressure to the throat packings to prevent leaks past the fluid displacement rod.

Priming Piston Pumps: Components

Priming piston pumps are reciprocating, two-check displacement pumps that include a priming piston assembly, or shovel, at the bottom. They are designed to pump highly viscous, non-flowable, fiber- or chunk-filled materials and greases more efficiently than standard two-check piston pumps.

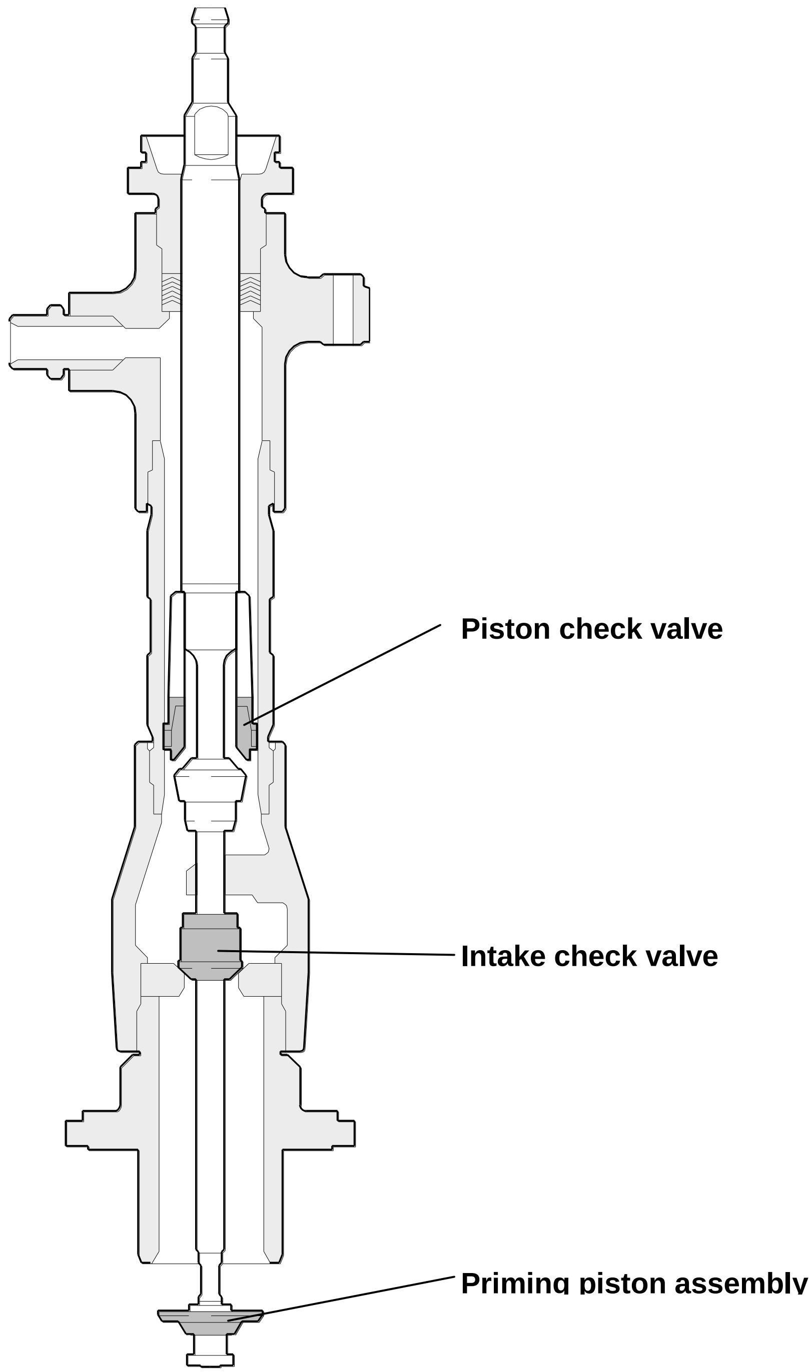


Figure 3 Priming piston pump

Figure 4 shows the components of a priming piston pump. As you can see, priming piston pumps contain the same basic components that standard two-check piston pumps do. Those components function in essentially the same way.

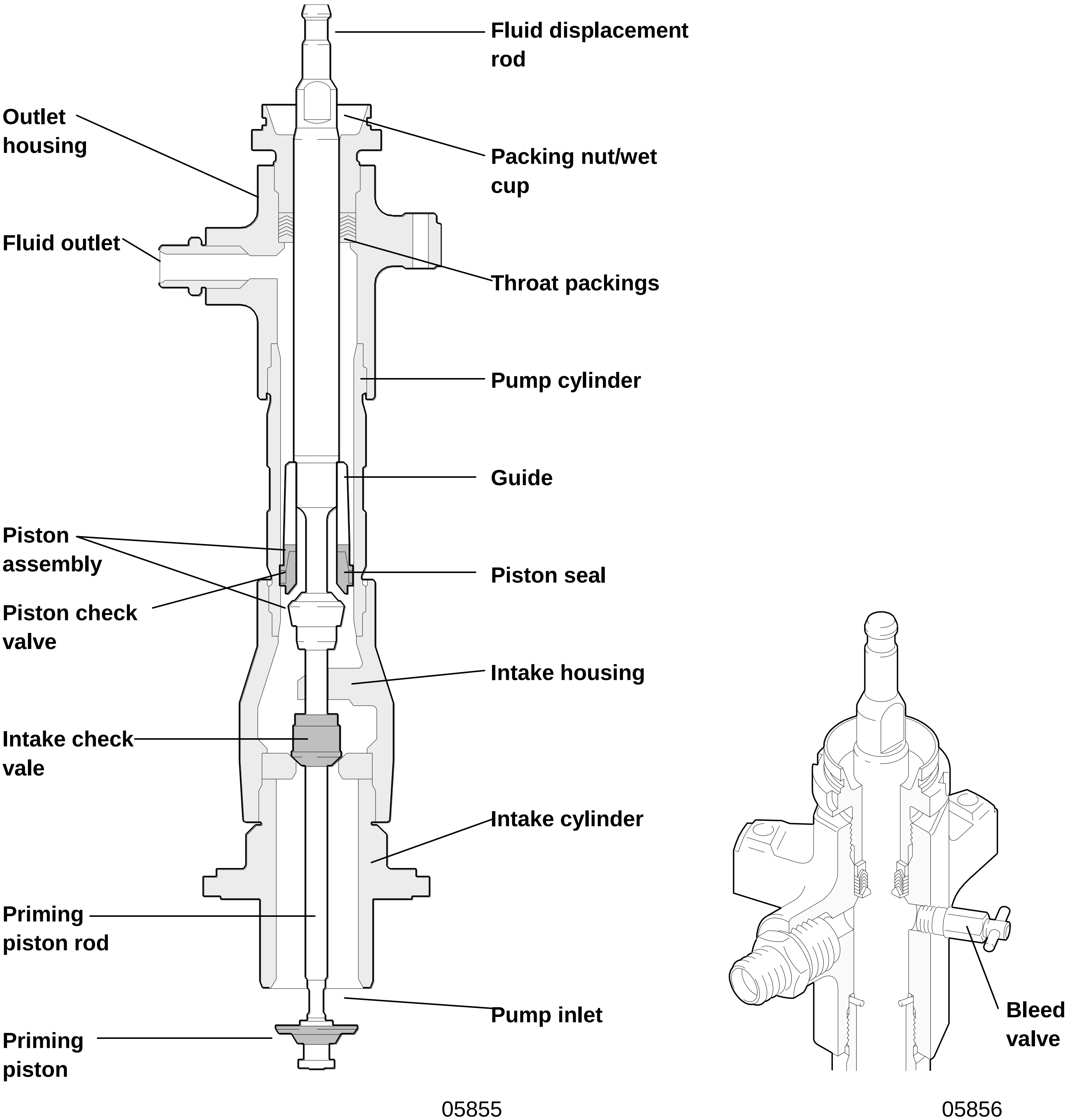


Figure 4 Components of a priming piston pump

Priming piston pumps contain these additional components, which function as follow:

- The **priming piston** loads fluid through the intake cylinder, past the intake check valve, and into the pump cylinder during the upstroke. Various designs are used based on the type of fluid being pumped.
- The **priming piston rod** is the shaft that connects the priming piston to the bottom of the fluid displacement rod.
- The **intake cylinder** contains the priming piston assembly (the priming piston and priming piston rod). It provides the mounting surface for floor stands, drums, and inductor plates.

This design for the intake check valve (shown in Figure 5) includes a valve that is mounted on the priming piston rod and a stationary seat that is part of the intake housing. The check valve components are designed so that the seating surfaces are always properly aligned.

During downstroke, as the valve is driven down by friction with the priming piston rod seal, it chops through the material, then seals against the seat. Fluid pressure above the check valve helps seat the valve, ensuring a complete “chop and check.” Fifty percent of the fluid trapped above the intake check valve is displaced from the pump by the descending displacement rod.

During upstroke, the valve is lifted off the seat by friction with the priming piston rod seal. Fluid is pushed past the open check valve by the priming piston.

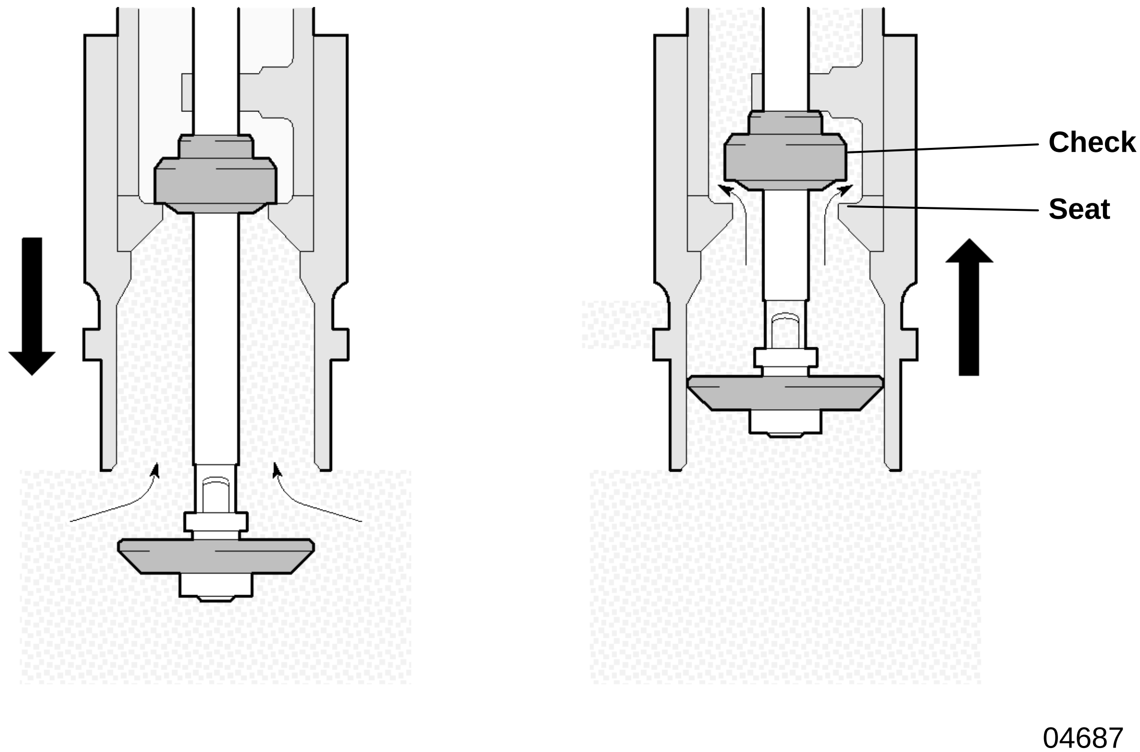
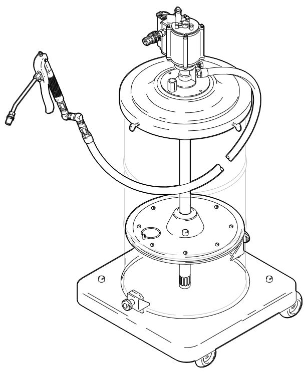


Figure 5 Chop and check intake valve

Priming piston pumps require a positive fluid pressure in order to load. Because these pumps are used with highly viscous materials, they require the use of more complex feed methods than some other types of pumps. The positive fluid pressure required for loading by priming piston pumps is created by follower plates, inductor, or ram feed methods, all of which are described briefly in Figure 6.



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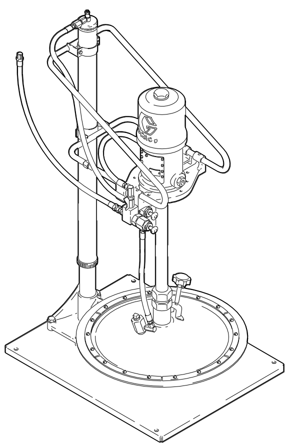
Follower Plates – Immersion Feed

Heavy follower plates float on the surface of the fluid to be pumped. Their weight exerts a positive pressure on the fluid that helps to prime the pump.

Figure 6a Follower Plates – Immersion Feed



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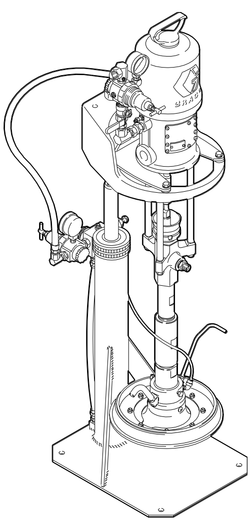
Inductor System – Pressure Feed

An inductor system consists of a pump, motor, inductor plate, elevator ram, and stand. Atmospheric pressure on the inductor plate plus the weight of the plate and pump exert a positive pressure on the fluid that helps to prime the pump.

Figure 6b Inductor System – Pressure Feed



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Ram System – Pressure Feed

A ram system consists of a pump, motor ram, plate, ram cylinder(s), and stand. Atmospheric pressure on the ram plate, the weight of the plate and pump, and the down force from one or more ram cylinders exert a positive pressure on the fluid that helps to prime the pump. Heated ram plates, or platens, may also be used to reduce the viscosity of certain fluids so that they can be pumped.

Figure 5c Ram System – Pressure Feed

Figure 6 Feeding methods used for priming piston pumps

Progress Check

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

1. *Fill in the blank to make the statement about priming piston pumps true.*

   Priming piston pumps are reciprocating, two-check displacement pumps with a ______________________________ at the bottom.

2. *True or False:* Priming piston pumps are designed to pump high-viscosity materials more efficiently than standard two-check piston pumps.

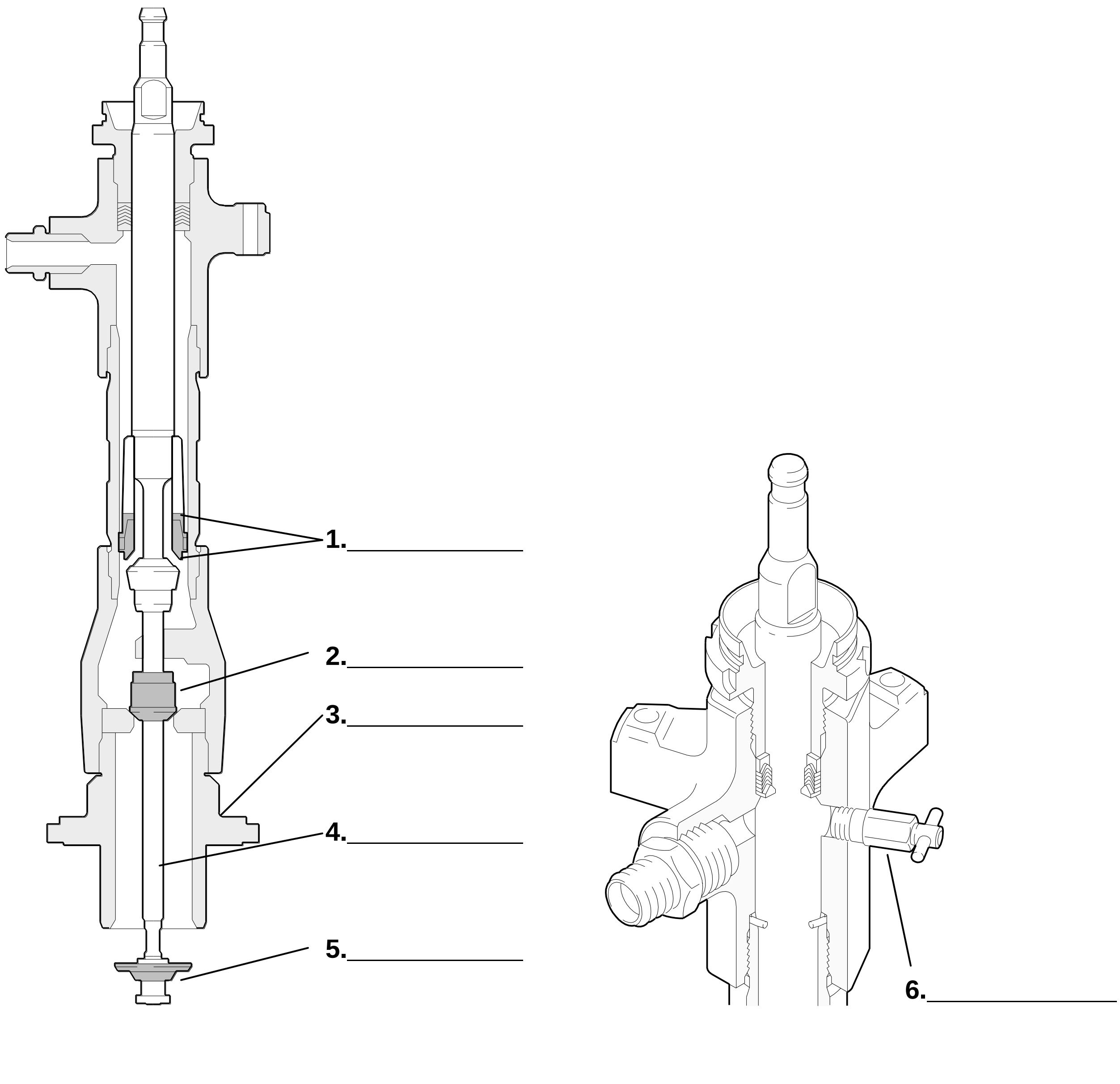
   a. True

   b. False

3. *Write the name of the correct priming piston pump component in the blank following each number. Choose from the list below.*

Bleed valve	Intake cylinder	Priming piston
Intake check valve	Piston assembly	Priming piston rod

Hint: Each component marked here represents a difference from the standard two-check piston pump.



4. *In each blank, write the name of the priming piston component that matches the described function. Choose from the list in the previous question.*
    a. ______________________ Seals the fluid displacement rod to the inside wall of the pump cylinder.
    b. ______________________Loads material into the pump cylinder during the upstroke phase of pump operation.
    c. ______________________ Contains the priming piston assembly.
    d. ______________________ Open and close with the action of the fluid displacement rod, controlling the flow of fluid through the pump.
    e. ______________________Vents air trapped within the fluid section.
    f. ______________________Connects the priming piston to the fluid displacement rod.
5. For priming piston pumps to load, the required positive fluid pressure must be created by these feeding methods:
    a. ____
    b. ____
    c. ____

Answers to Progress Check

1. Priming piston pumps are reciprocating, two-check displacement pumps with a priming piston assembly at the bottom.
2. True. Priming piston pumps are designed to pump high-viscosity, non-flowable, fiber- or chunk-filled materials more efficiently than standard two-check piston pumps.
3. The correct answers are:

   [1] Piston assembly

   [2] Intake check valve

   [3] Intake cylinder

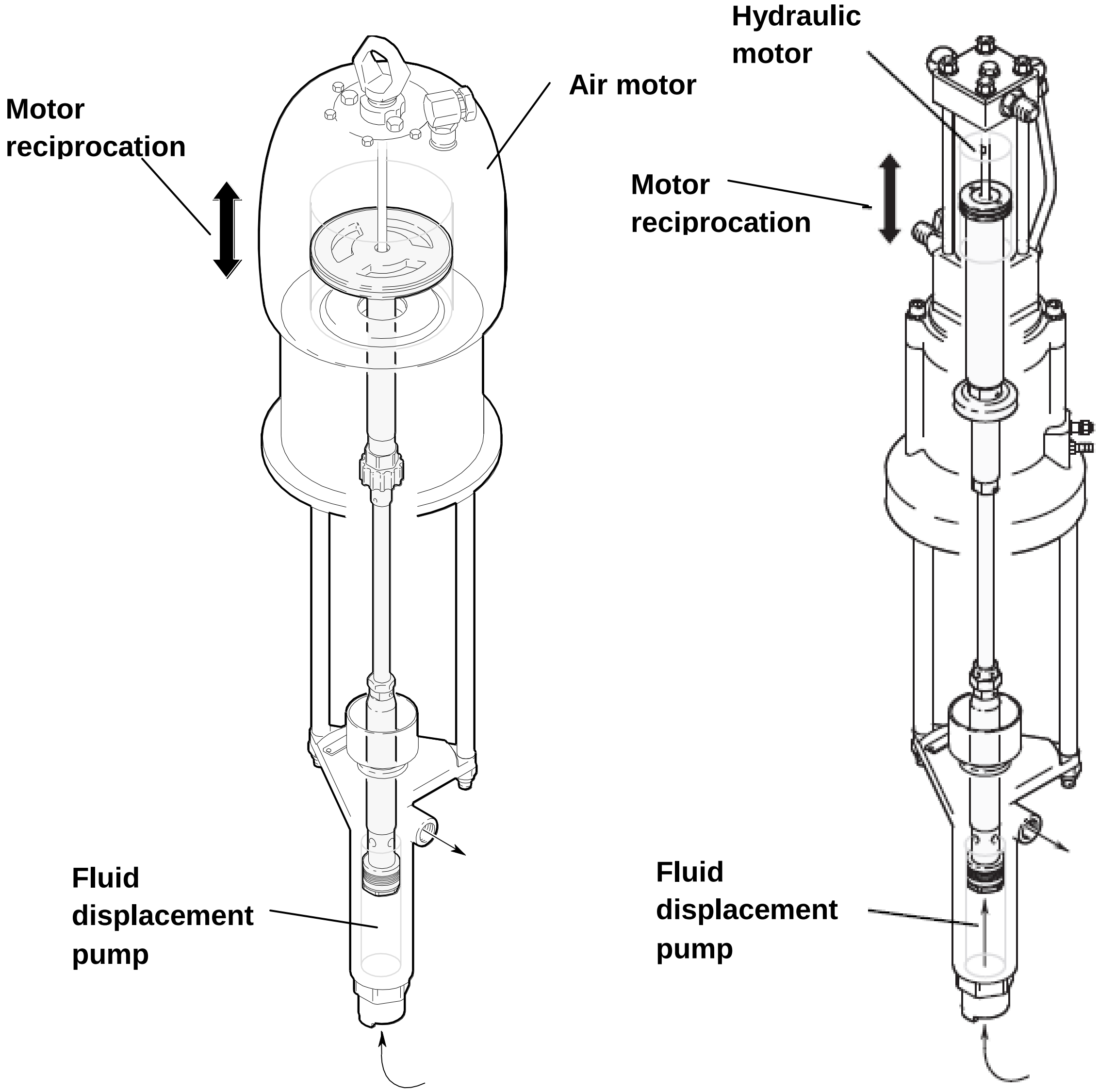
   [4] Priming piston rod

   [5] Priming piston

   [6] Bleed valve
4. The correct answers are:
   a. The piston assembly seals the fluid displacement rod to the inside wall of the pump cylinder.
   b. The priming piston loads material into the pump cylinder during the upstroke phase of pump operation.
   c. The intake cylinder contains the priming piston assembly.
   d. The piston and intake check valves open and close with the action of the fluid displacement rod, controlling the flow of fluid through the pump.
   e. The bleed valve vents air trapped within the fluid section.
   f. The priming piston rod connects the priming piston to the fluid displacement rod.
5. The correct answers are, in any order:
   a. Follower plates
   b. Inductor systems
   c. Ram systems

Motors

Two-check and priming piston pumps are most commonly powered by air motors and hydraulic motors.



Air Motor Driven Pump **Hydraulic Motor Driven Pump**

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Figure 7 Air and hydraulic motor-driven pumps

As shown in Figure 7, when an air motor is powered by compressed air or a hydraulic motor is powered by pressurized hydraulic oil, the flow of the air or the hydraulic oil through the motor causes the motor piston and rod to move up and down. This reciprocating motion is then transferred from the motor rod to the fluid displacement rod in the pump.

Drive sources may be attached to two-check and priming piston pumps and other types of fluid sections or pump lowers in the two basic ways shown in Figure 9.

In the in-line design, the motor rod is connected to the fluid displacement rod in the pump and the pump body is attached directly to the motor base. This design is used exclusively for lubrication pumps. Leakage of the pumped fluid, an oil or grease, from the throat packings into the motor is not a problem, but a benefit.

The divorced design, in which the motor and pump are attached by a connecting rod and held together by tie rods, is used in all other types of pumps to prevent fluid leaks from the throat packings in the pump from contaminating the motor.

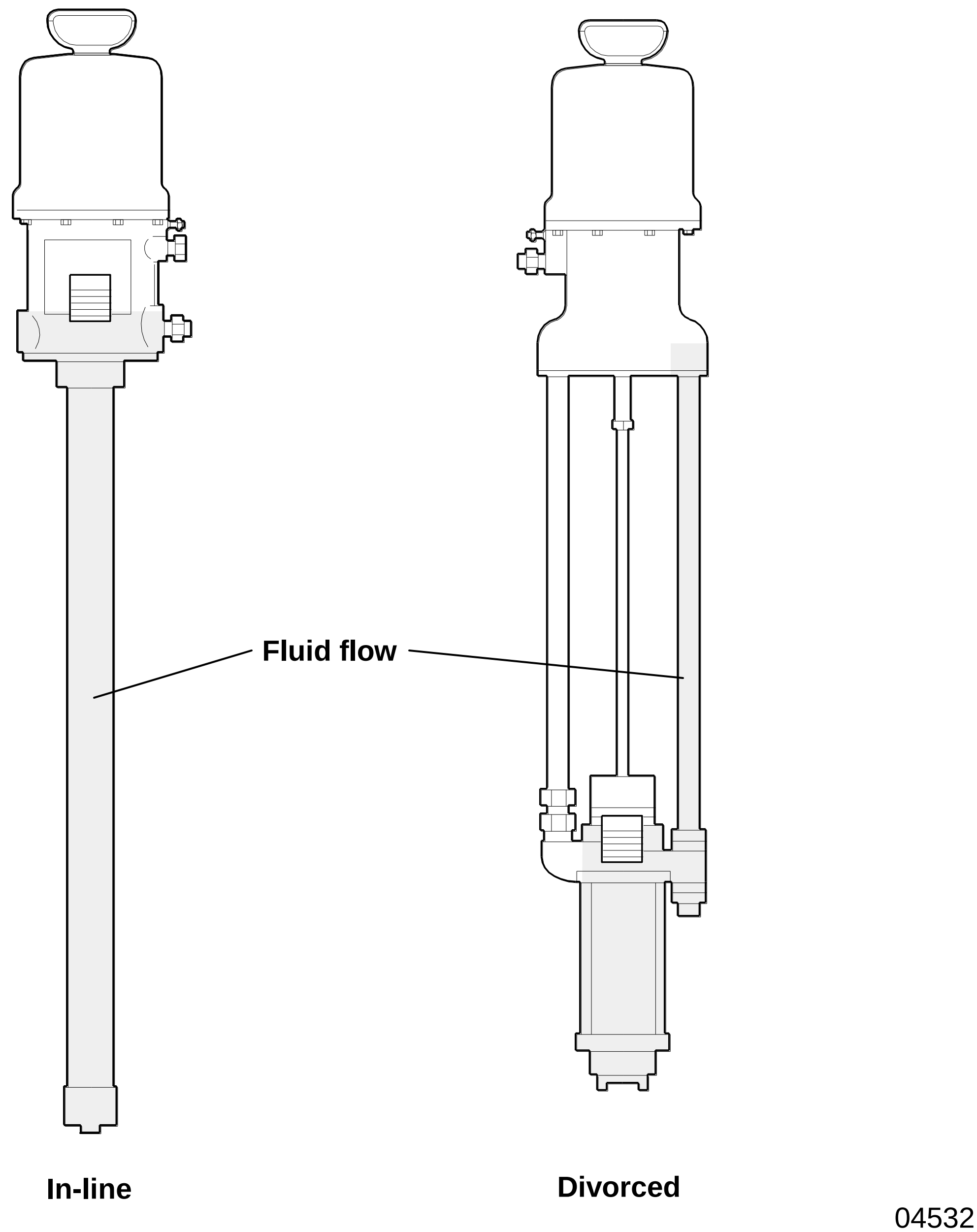

Figure 9 In-line and divorced pump designs

Two-Check Piston Pumps: Operating Cycle

The two-check piston pump's operating cycle consists of upstroke and downstroke phases. During upstroke, the two-check piston pump components work as shown in Figure 10:

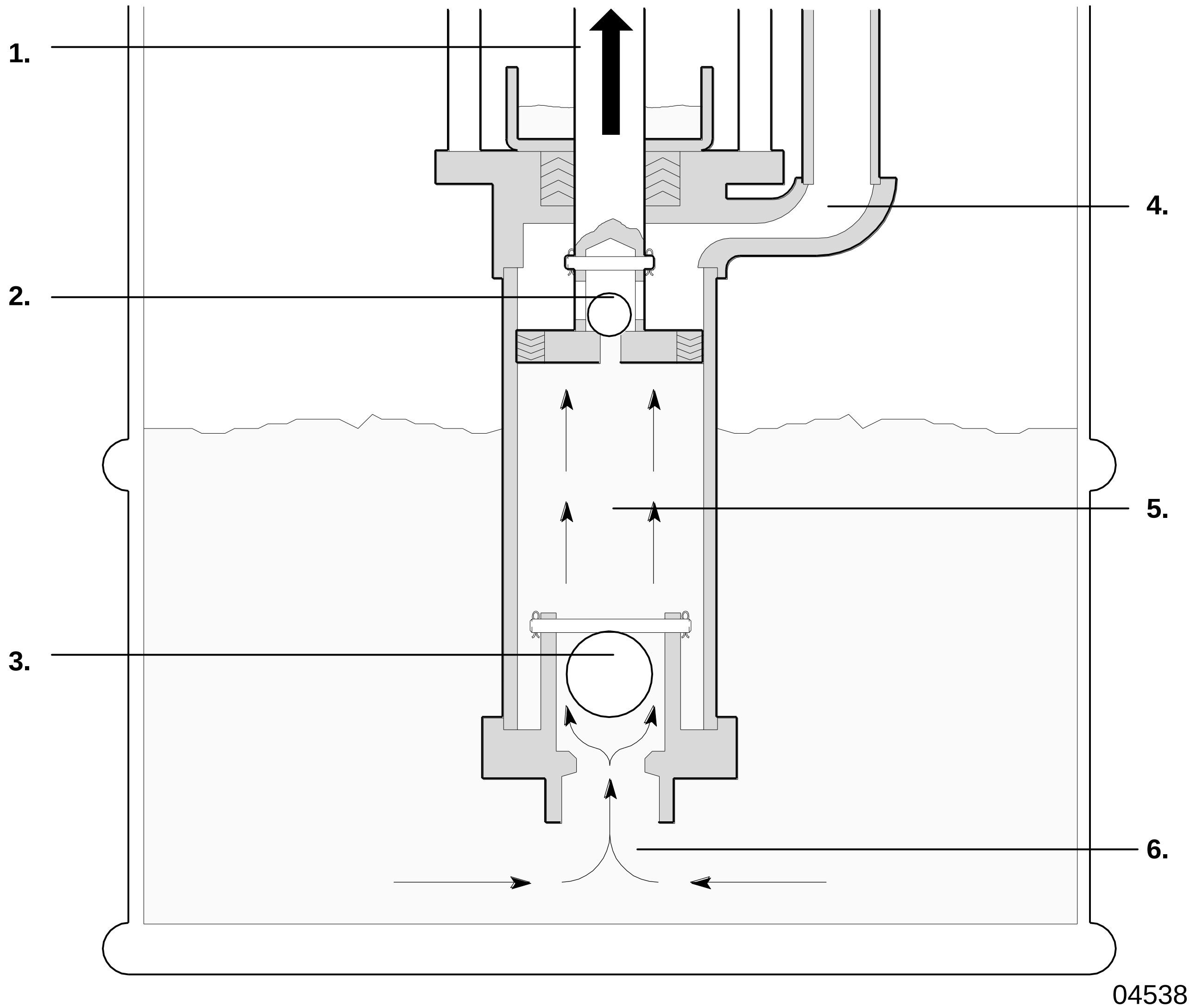

Figure 10 Upstroke, two-check piston pump

1. The motor pulls the fluid displacement rod up.
2. The piston check valve closes.
3. The intake check valve closes.
4. Any fluid above the piston check valve in the pump cylinder is trapped there. As the fluid displacement rod moves up, it forces half of the trapped fluid out of the pump through the fluid outlet. This occurs since the volume of the rod is half the volume of the pump cylinder.
5. A low-pressure area is created inside the pump cylinder below the piston assembly.
6. Atmospheric pressure pushes fluid from the supply container past the open intake check valve into the pump cylinder. Fluid fills 100 percent of the volume of the pump cylinder.

During downstroke, two-check piston pump components work as shown in Figure 11:

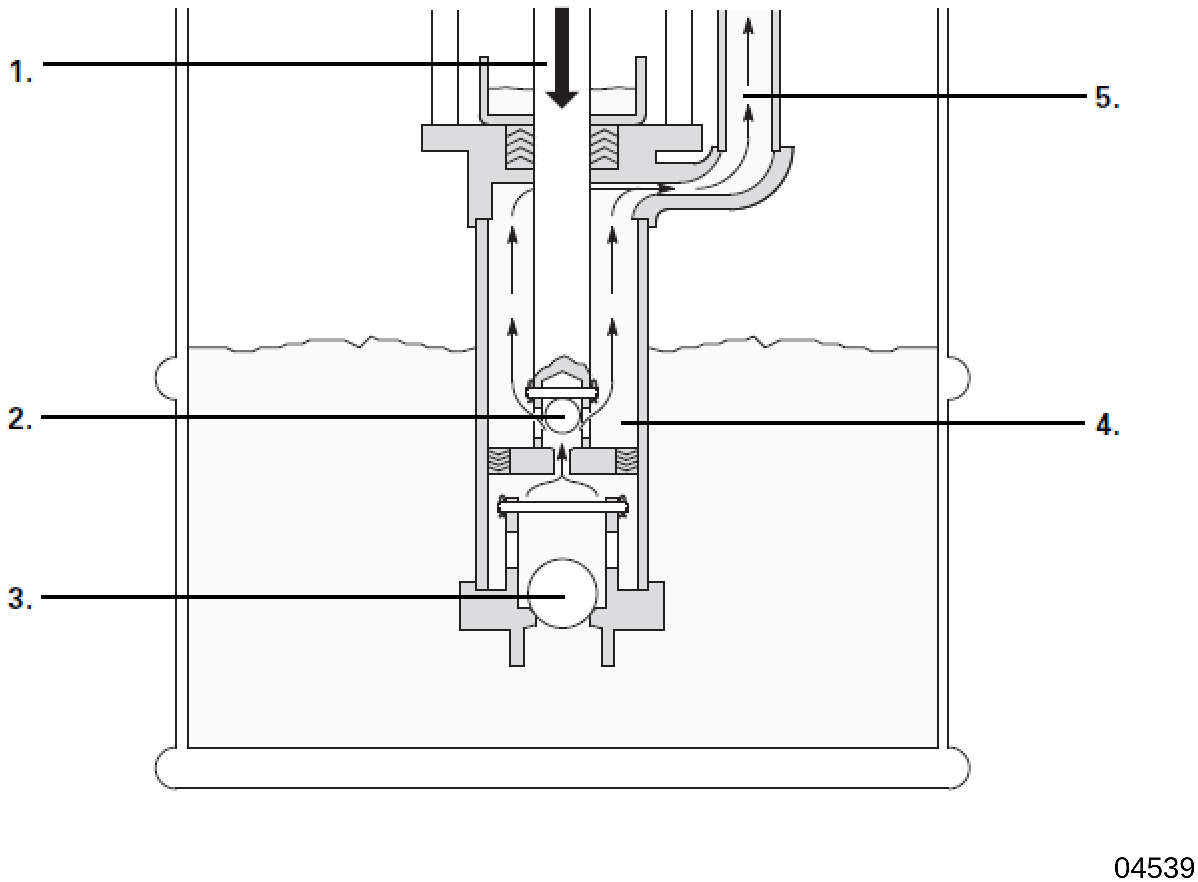

Figure 11 Downstroke, two-check piston pump

1. The motor pushes the fluid displacement rod down.
2. The piston check valve opens.
3. The intake check valve closes.
4. The fluid that was loaded into the pump cylinder during the upstroke is trapped inside the pump cylinder. It flows through the piston check valve.
5. Because the fluid displacement rod is half the volume of the pump cylinder, half the fluid transferred through the piston check valve in the pump cylinder is forced out of the pump through the fluid outlet. The other half of the fluid transferred through the piston check valve will be displaced out of the pump with the next upstroke.

Priming Piston Pumps: Operating Cycle

The priming piston pump's operating cycle is similar to that of the standard two-check piston pump. It consists of these phases – the upstroke, top changeover, downstroke, and bottom changeover. During upstroke, the pump components work as shown in Figure 12.

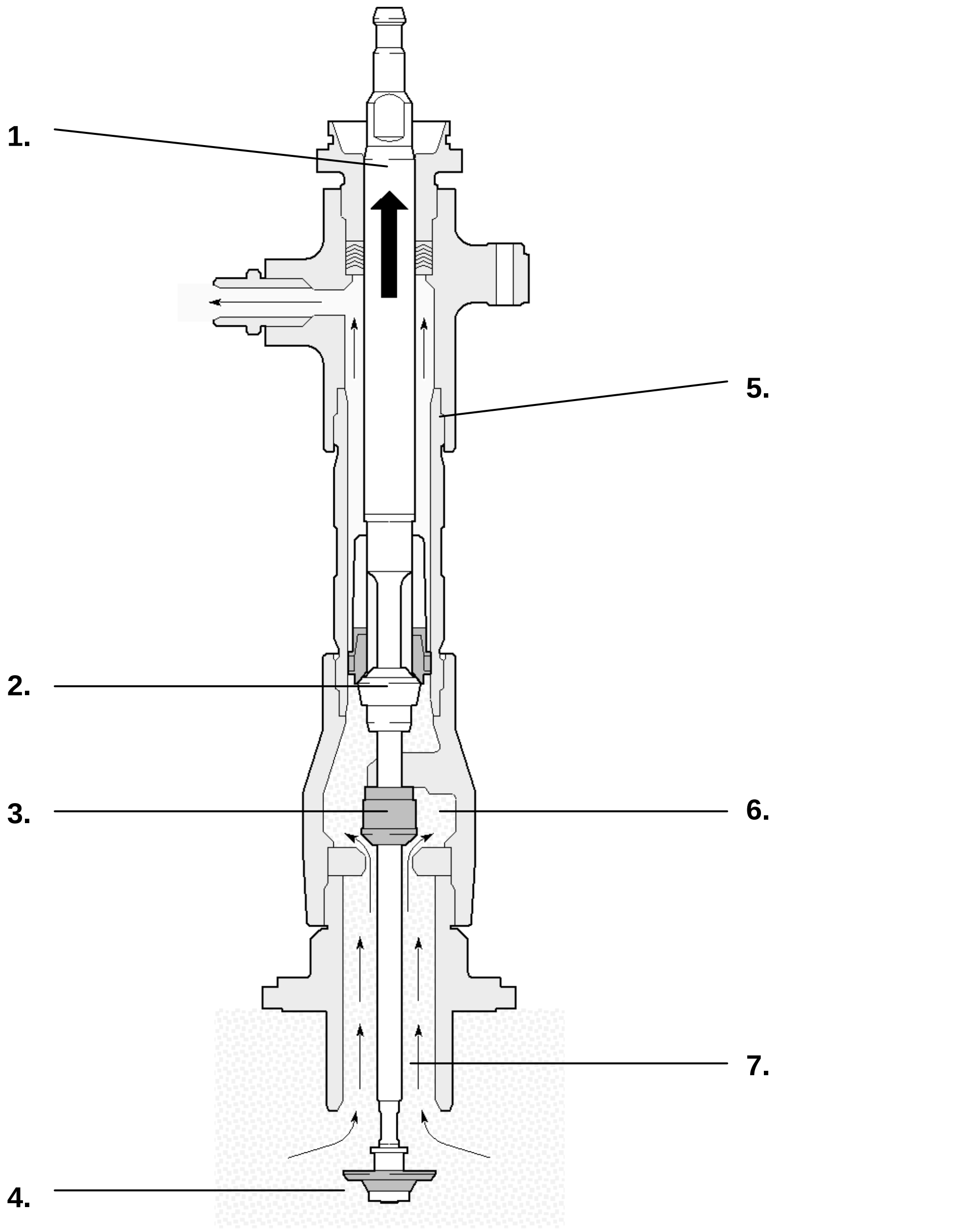

Figure 12 Upstroke, priming piston pump

1. The motor pulls the fluid displacement rod up.
2. The piston check valve opens.
3. The intake check valve opens.
4. The priming piston is pulled up into the intake cylinder.
5. Any fluid above the piston check valve in the pump cylinder is trapped there. As the fluid displacement rod moves up, it forces half of the trapped fluid out of the pump through the fluid outlet. This occurs since the volume of the rod is half the volume of the pump cylinder.
6. A low-pressure area is created inside the pump cylinder below the piston assembly.
7. The priming piston and positive pressure push fluid from the supply container past the open intake check valve into the pump cylinder. Fluid fills 100 percent of the volume of the pump cylinder.

During top changeover, as the fluid displacement rod begins to move down, the priming piston pump components work as shown in Figure 13:

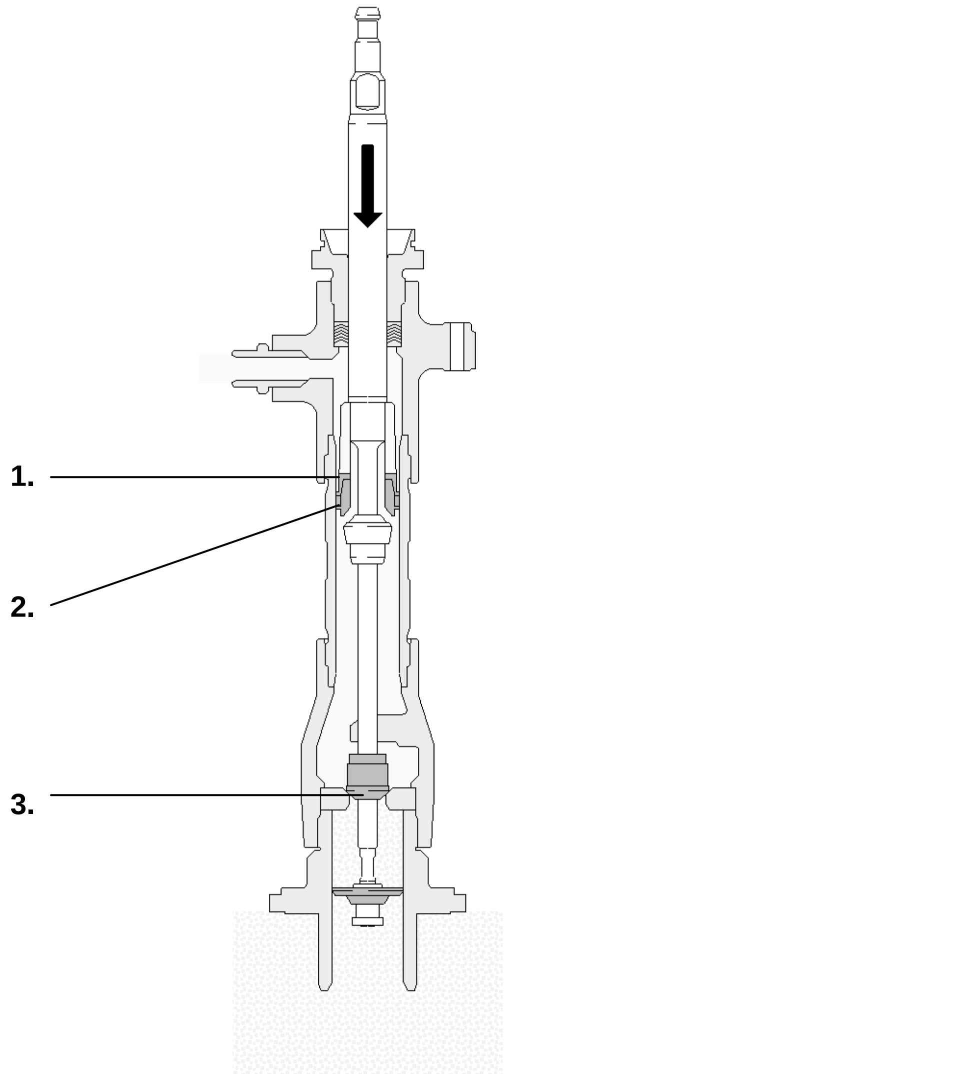

Figure 13 Top changeover, priming piston pump

1. The piston bearing seal remains stationary due to frictional contact with the pump cylinder wall.
2. The piston check valve opens until the bottom of the fluid displacement rod contacts the top of the piston guide. Then the piston assembly moves down with the fluid displacement rod.
3. The intake check valve is in frictional contact with the priming piston rod. It moves down with the rod until it seats. Then the priming piston rod slides through the intake check valve and continues downward.

During downstroke, priming piston pump components work as shown in Figure 14

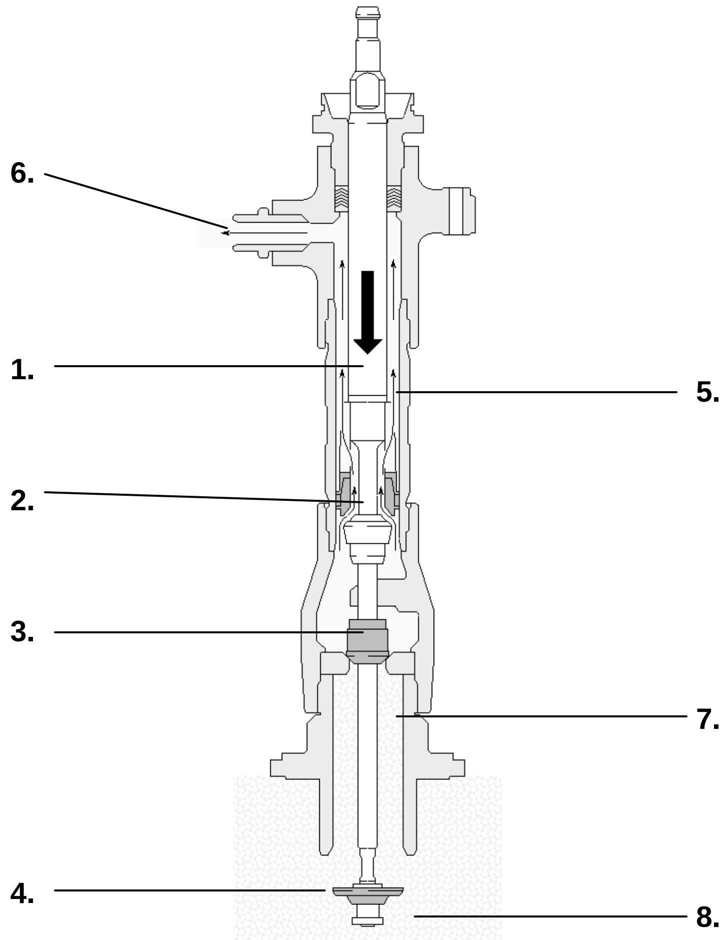

Figure 14 Downstroke, priming piston pump

1. The motor pushes the fluid displacement rod down.
2. The piston check valve opens.
3. The intake check valve closes.
4. The priming piston is pushed out of the intake cylinder.
5. The fluid that was loaded into the pump cylinder during the upstroke is trapped inside the pump cylinder. It flows through the piston check valve.
6. Because the fluid displacement rod is half the volume of the pump cylinder, half the fluid transferred through the piston check valve in the pump cylinder is forced out of the pump through the fluid outlet. The other half of the fluid transferred through the piston check valve will be displaced out of the pump during the next upstroke.
7. A low-pressure area is created inside the intake cylinder.
8. Positive pressure pushes fluid from the supply container into the intake container.

During bottom changeover, as the fluid displacement rod begins to move up, the priming piston pump's components work as shown in Figure 15:

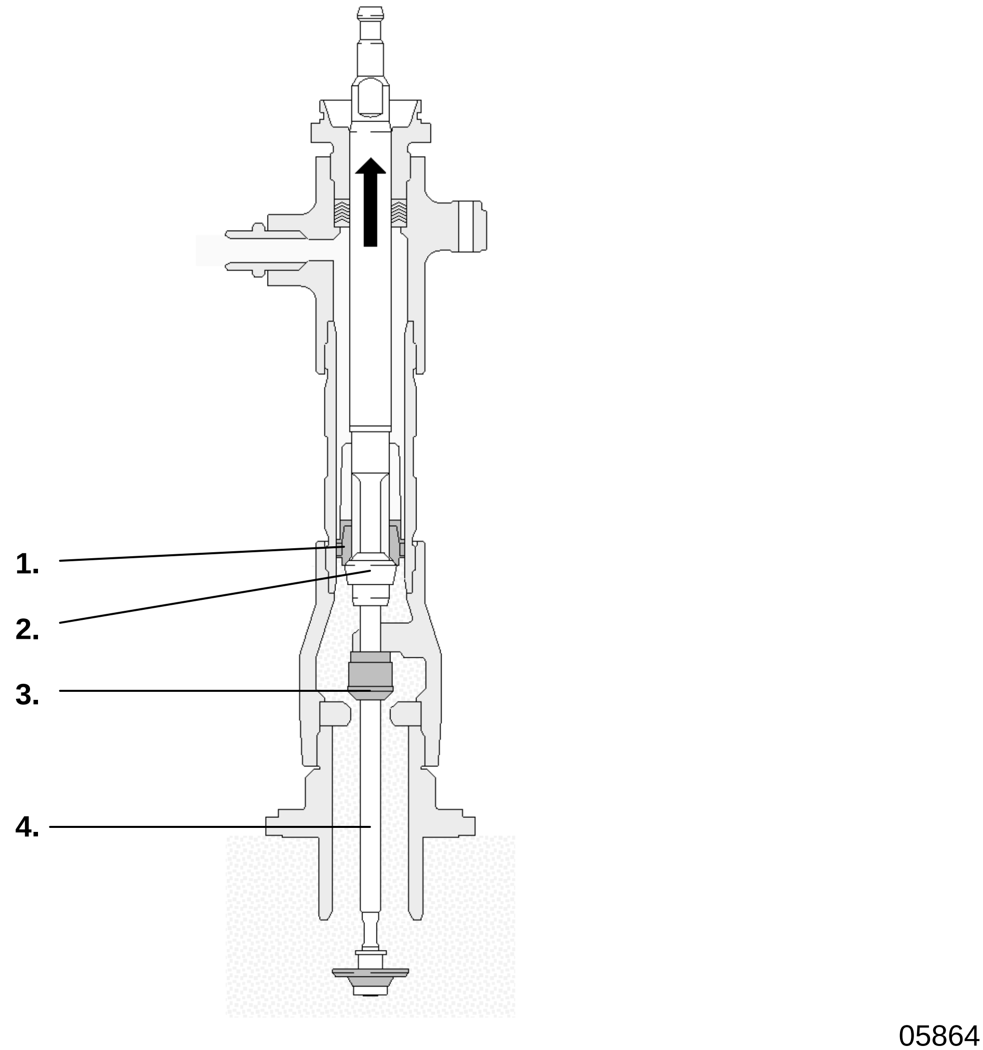

Figure 15 Bottom changeover, priming piston pump.

1. The piston bearing seal remains stationary due to frictional contact with the pump cylinder wall.
2. The piston seat moves up and closes against the piston check. Then the piston assembly is pulled up with the fluid displacement rod.
3. The intake check valve is in frictional contact with the priming piston rod. It moves up with the rod and the intake check opens. The upward movement of the intake check is stopped by the priming piston rod guide located inside the intake housing.
4. The priming piston rod slides through the intake check valve and continues upward.

Progress Check

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

Fill in the blanks to answer the following questions about the upstroke and downstroke phases of the two-check piston pump's operating cycle. Refer to the graphics for help.

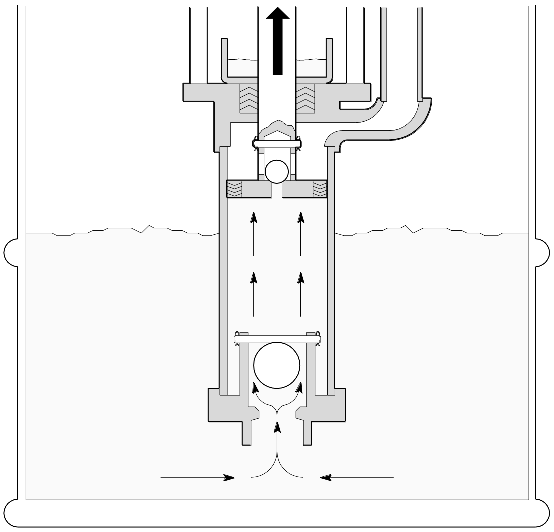

Figure 10 Upstroke, two-check piston pump

1. During upstroke:
    a. The motor pulls the _______________________ up.
    b. The piston check valve ____________________.
    c. The intake check valve_____________________.
    d. ______ percent of the fluid above the piston check valve is displaced from the pump.
    e. ______ percent of the volume of the pump cylinder fills with fluid from the supply container.

2. During downstroke:
    a. The motor pushes the _____________________ down.
    b. The piston check valve ____________________.
    c. The intake check valve ____________________.
    d. ______ percent of the fluid above the piston check valve is displaced from the pump.
    e. ______ percent of the volume of the pump cylinder fills with fluid from the supply container.

Now fill in the blanks to answer the following questions about the upstroke, downstroke, and changeover phases of the two-check piston pump's operating cycle. Again, refer to the graphics for help.

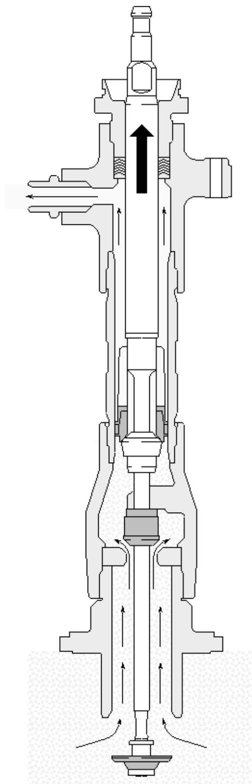

Figure 12 Upstroke, priming piston pump

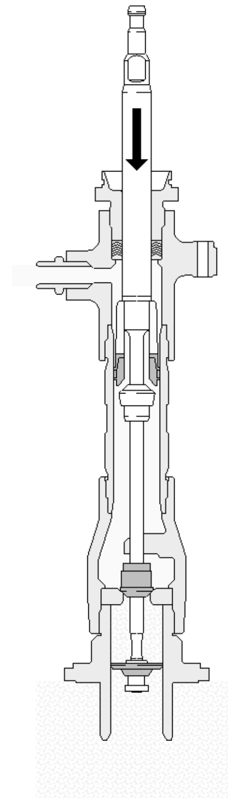

Figure 13 Top changeover, priming piston pump

3. During upstroke:
    a. The motor pulls the _____________________________ up.
    b. The piston check valve __________________________.
    c. The intake check valve __________________________.
    d. The ________________________ is pulled up into the intake cylinder.
    e. ______ percent of the fluid above the piston check valve is displaced from the pump.
    f. ______ percent of the volume of the pump cylinder fills with fluid from the supply container.
4. During top changeover:
    a. The ___________________ remains stationary.
    b. The piston check valve _______________ until the fluid displacement rod contacts the ________________. Then the piston assembly moves __________ with the fluid displacement rod.
    c. The intake check valve moves _______________ with the priming piston rod until it ______________. Then the ____________ slides through the intake check valve and continues ________________.

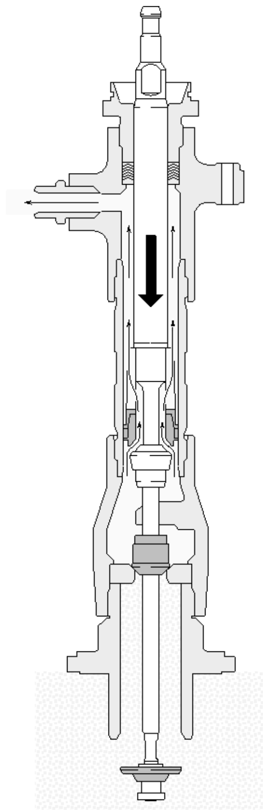

Figure 14 Downstroke, priming piston pump

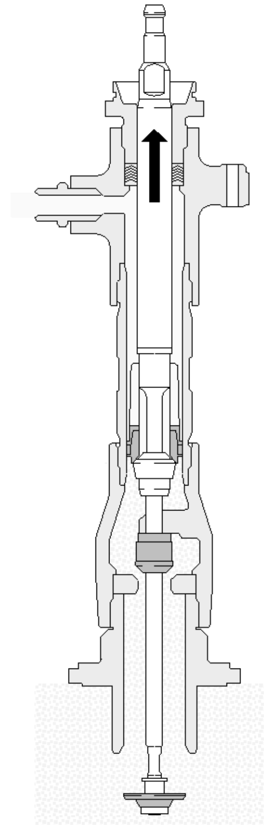

Figure 15 Bottom changeover, priming piston pump

5. During downstroke:
    a. The motor pushes the ___________________________ down.
    b. The piston check valve __________________________.
    c. The intake check valve __________________________.
    d. The ____________________ is pushed down and out of the intake cylinder.
    e. ______ percent of the fluid piston check valve is displaced from the pump.
    f. ______ percent of the volume of the pump cylinder fills with fluid from the supply container.
6. During bottom changeover:
    a. The __________________ remains stationary.
    b. The piston check valve ____________________. Then the piston assembly moves ______________ with the fluid displacement rod.
    c. The intake valve __________, moving __________ with the priming piston rod until it meets the ____________________. Then the __________________ slides through the intake check valve and continues _____________.

Answers to Progress Check

1. The correct answers are:

   During the two-check piston pump's upstroke:

   a. The motor pulls the fluid displacement rod up.
   b. The piston check valve closes.
   c. The intake check valve opens.
   d. 50 percent of the fluid above the piston check valve is displaced from the pump.
   e. 100 percent of the volume of the pump cylinder fills with fluid from the supply container.

2. The correct answers are:

   During the two-check piston pump's downstroke:

   a. The motor pushes the fluid displacement rod down.
   b. The piston check valve opens.
   c. The intake check valve closes.
   d. 50 percent of the fluid above the piston check valve is displaced from the pump.
   e. 0 percent of the volume of the pump cylinder fills with fluid from the supply container.

3. The correct answers are:

   During the priming piston's upstroke:

   a. The motor pulls the fluid displacement rod up.
   b. The piston check valve closes.
   c. The intake check valve opens.
   d. The priming piston is pulled up into the intake cylinder.
   e. 50 percent of the fluid above the piston check valve is displaced from the pump.
   f. 100 percent of the volume of the pump cylinder fills with fluid from the supply container.

4. The correct answers are:

   During the priming piston pump's top changeover:

   a. The piston bearing seal remains stationary.
   b. The piston check valve opens until the fluid displacement rod contacts the piston guide. Then the piston assembly moves down with the fluid displacement rod.

c. The intake check valve moves down with the priming piston rod until it closes. Then the priming piston rod slides through the intake check valve and continues downward.

5. The correct answers are:

   During the priming piston pump's downstroke:

   a. The motor pushes the fluid displacement rod down.
   b. The piston check valve opens.
   c. The intake check valve closes.
   d. The priming piston is pushed down and out of the intake cylinder.
   e. 50 percent of the fluid above the piston check valve is displaced from the pump.
   f. 0 percent of the volume of the pump cylinder fills with fluid from the supply container.

6. The correct answers are:

   During the priming piston pumps' bottom changeover:

   a. The piston bearing seal remains stationary.
   b. The piston check valve closes. Then the piston assembly moves up with the fluid displacement rod.
   c. The intake check valve opens, moving up with the priming piston rod until it meets the priming piston rod guide. Then the priming piston rod slides through the intake check valve and continues upward.

Factors to Consider

Proper selection of a pump's wetted parts maximizes pump life, while improper selection can increase the frequency for necessary maintenance and repair. A pump's wetted parts (shown in Figure 16) are any that come in contact with the fluid being pumped. Most often, these are the seals and packings and the metal wear parts, which include the fluid displacement rod and the pump cylinder. Other wetted parts are ball checks and guides and intake and outlet housings.

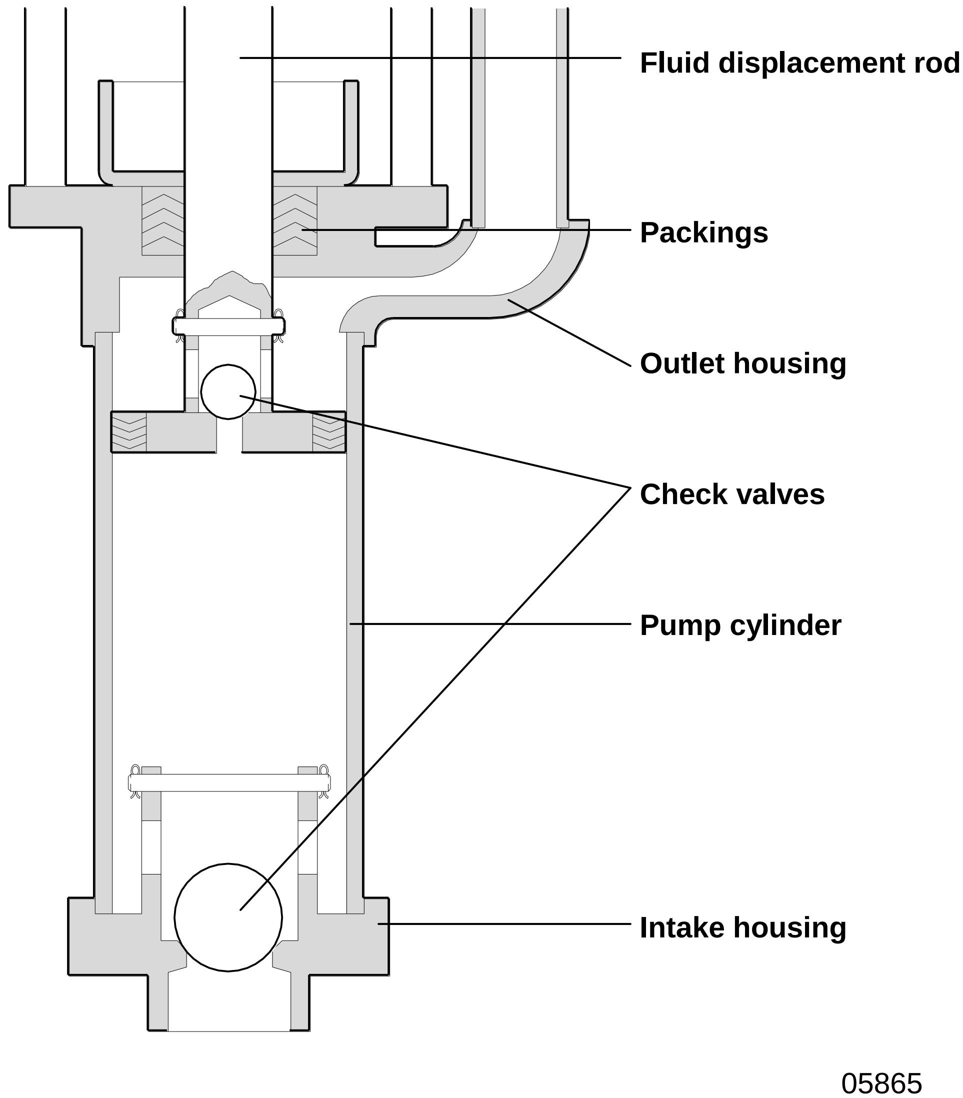

Figure 16 Wetted parts of a pump

Two-Check & Priming Piston Pumps: Advantages & Limitations

Two-Check Piston Pumps: Advantages and Limitations

As stated previously, two-check piston pumps comprise a large percentage of Graco's product line. Figure 19 shows the main advantages and limitations of this pump design.

Two-Check Piston Pumps

Advantages	**Limitations**
They are versatile: • Can operate at higher pressures than other pumping technologies • Can be used to pump abrasive and corrosive materials • Are relatively low-shear compared to other pumping technologies • Do not require complex pump feed methods • Can stall under pressure • Work well in explosive environments when driven by air motors They are reliable: • Require little maintenance • Are relatively easy to repair	• They cannot handle highly viscous, non-flowable, fiber- or chunk-filled materials, or greases • They have a lower flow-rate limit than other pumping technologies • Pulsation caused by changeover may require use of surge tanks, fluid regulators, or other fluid control devices

Figure 19 Advantages and limitations of two-check piston pumps

As you can see, the main advantages are:

Versatility

Two-check piston pumps can be used to pump flowable liquids in a wide variety of market applications. They can operate at higher pressures than other pumping technologies. That means they can be used for more things, such as spray applications or long-distance pumping. Two-check piston pumps can be used to economically pump abrasive and corrosive materials compared to other pumping technologies. Also, they are relatively low-shear compared to other pumping technologies, and so can handle paint and other materials without causing degradation. Two-check piston pumps do not need to be immersion or pressure fed. Siphon or gravity feed methods may be used. They have the ability to stall without damage under pressure, eliminating the need for recirculation. And, since most two-check piston pumps are powered by air motors, they work well in explosive environments, for example, in pumping flammable solvents or solvent-based materials.

Reliability

Two-check piston pumps are low-maintenance pumps that are relatively easy to repair. They last a long time even when used to pump abrasive, corrosive fluids.

Limitations of a two-check piston pump design are:

- They cannot be used to pump high-viscosity, non-flowable, fibrous, filled materials or greases
- They have a low flow rate limit compared to some other pumping technologies. If a high flow rate is needed, for example, for high-volume transfer applications, a diaphragm pump must be used.
- They may require the use of surge tanks, fluid regulators, or other fluid control devices due to the pulsation caused by changeover.

The bottom line or customers is that two-check piston pumps represent a reliable, cost-effective means of pumping a wide variety of fluids.

Priming Piston Pumps: Advantages and Limitations

Figure 20 shows the main advantages and limitations of a priming piston pump design, some of which are similar to those of the standard two-check piston pump:

Versatility

Priming piston pumps can handle high-viscosity, non-flowable, fiber- or chunk-filled materials and greases better than any other kind of pumping technology. They can also handle some thinner fluids. Like standard two-check piston pumps, priming piston pumps can operate at higher pressure than other pumping technologies, so they can be used for more things, such as pumping semi-solid materials. And, like standard two-check piston pumps, priming piston pumps can be used to economically pump abrasive and corrosive materials. New designs are relatively low-shear compared to other pumping technologies. They can handle fluids and semi-solid materials without causing degradation.

Reliability

Like standard two-check piston pumps, priming piston pumps are low-maintenance pumps that are relatively easy to repair. They last a long time even when sued to pump abrasive, corrosive fluids.

Priming Piston Pumps

Advantages	**Limitations**
They are versatile: • Can handle highly viscous, non-flowable, fiber- or chunk-filled materials and greases better than any other kind of pumping technology • Can operate at higher pressures than other pumping technologies • Can be used to pump abrasive and corrosive materials. Are relatively low-shear compared to other pumping technologies. They are reliable: • Require little maintenance • Are relatively easy to repair	• They are more expensive to manufacture than standard piston pumps because they have more components • They require more complex pump feed methods (immersion or pressure feed) for loading viscous materials

Figure 20 Advantages and limitations of priming piston pumps

The limitations of a priming piston pump design are that:

- They are more expensive to manufacture than standard two-check piston pumps because they have more components
- They involve the use of more complex pump feed methods, such as follower plates or inductor or ram systems, to load viscous materials into the pump
- For customers, priming piston pumps represent the only means available to pump high-viscosity, non-flowable, fiber- or chunk-filled materials and greases. They are reliable, long-lasting, and require little maintenance.