



# *Plunger (Glutton) Pumps Concept and Theory*

# Glutton Pump

The generic name of the pump described in this module is a plunger pump and the trade name is Glutton™. At Graco you will hear the plunger pump commonly referred to by its trade name, so for the purposes of this module we will use the trade name Glutton when referring to the plunger pump.

The Glutton pump operates with a compressed air motor that provides reciprocating motion that loads and dispenses fluid.

## Component Identification and Function

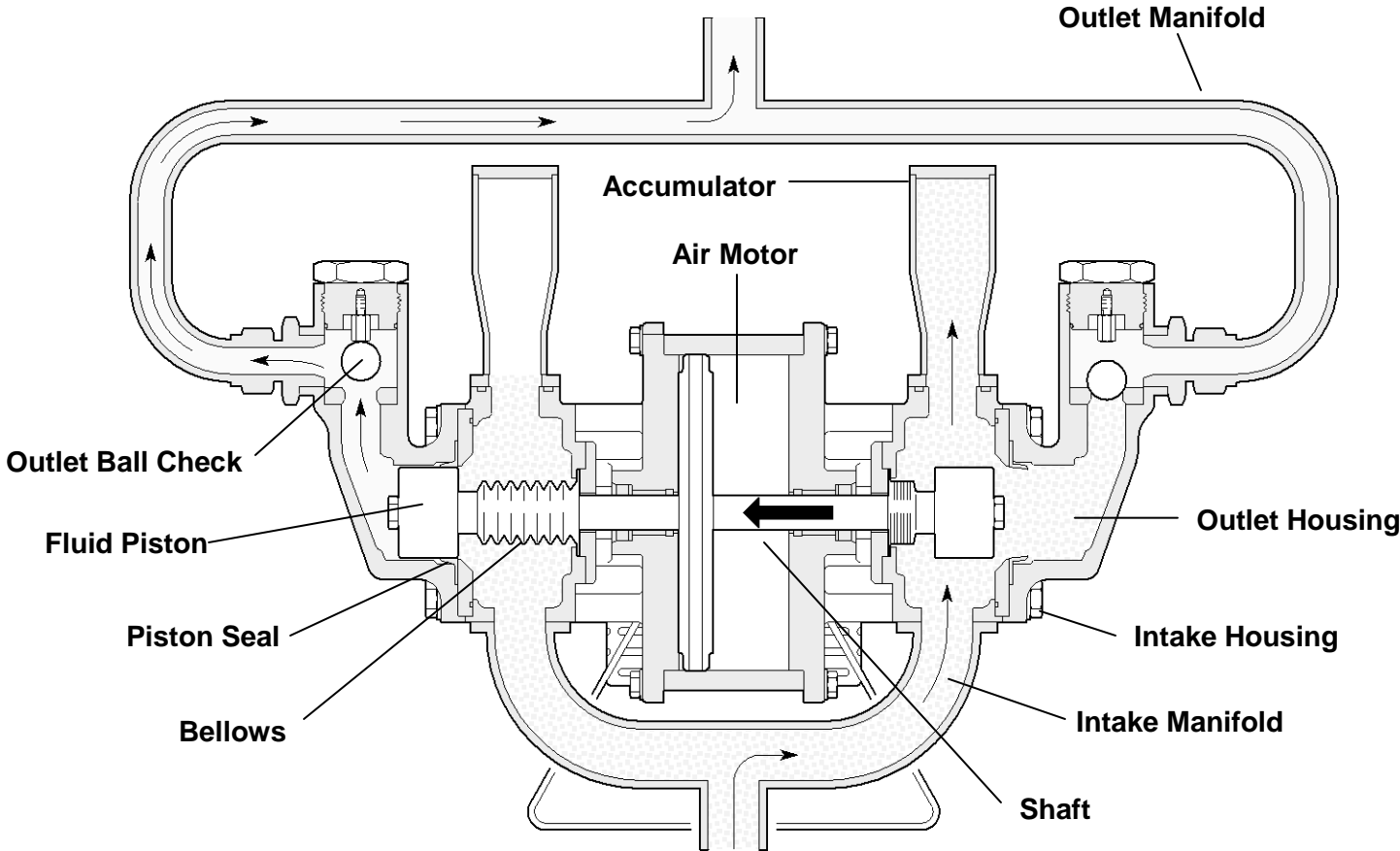


Figure 1 Fluid Section Component ID and Function

## **Fluid section**

### **Fluid piston**

The fluid piston loads or discharges fluid from the outlet housing.

### **Fluid piston seal**

The fluid piston seal creates a seal around the fluid piston, allowing a pressure or vacuum to be formed in the outlet housing.

### **Outlet Housing**

The fluid loads into and discharges from the outlet housing by the reciprocating motion of the fluid piston.

### **Bellows**

The bellows seals each fluid section preventing it from leaking externally during the operation of the pump making the pump leak-free for the life of the bellows.

### **Accumulator**

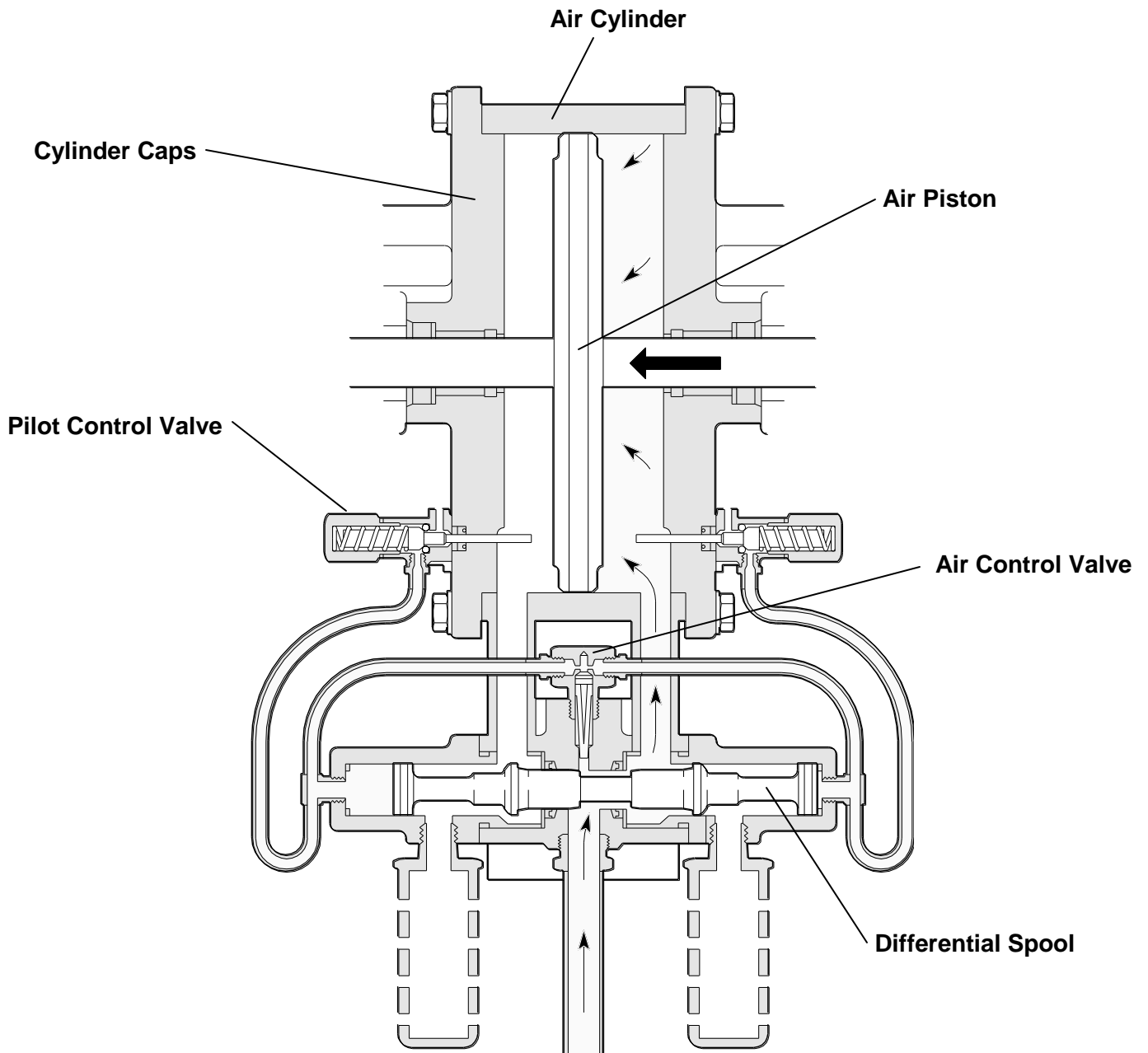
The accumulator acts as a material reservoir allowing the pump to fully prime without cavitation.

### **Intake Housing**

The fluid flows through the intake housing on its way to the outlet housing.

### **Shaft**

The pump shaft connects the fluid pistons to the air piston.



**Figure 2** Air Section Component ID and Function

05101

## **Air section**

### **Air motor**

The air motor, which is the driving mechanism of the pump, is composed of the cylinder caps, air motor cylinder, air piston, pilot valves, and air valve. The air piston travels back and forth in the air motor cylinder between two caps.

### **Air control valve**

The air control valve alternates the direction of air flow to either side of the air piston.

### **Pilot valve assembly**

The pilot valve assembly acts as a triggering mechanism to activate the air control valve.

### **Muffler**

The mufflers reduce the noise of the exhausting air.

# 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.***

1. Glutton pumps can be driven by air, hydraulic, or electric motors.
  - a. True
  - b. False
2. The Glutton pump is virtually leak-free because of the bellows design.
  - a. True
  - b. False
3. The pilot valve assembly is in contact with the pumped fluid during normal pump operation.
  - a. True
  - b. False

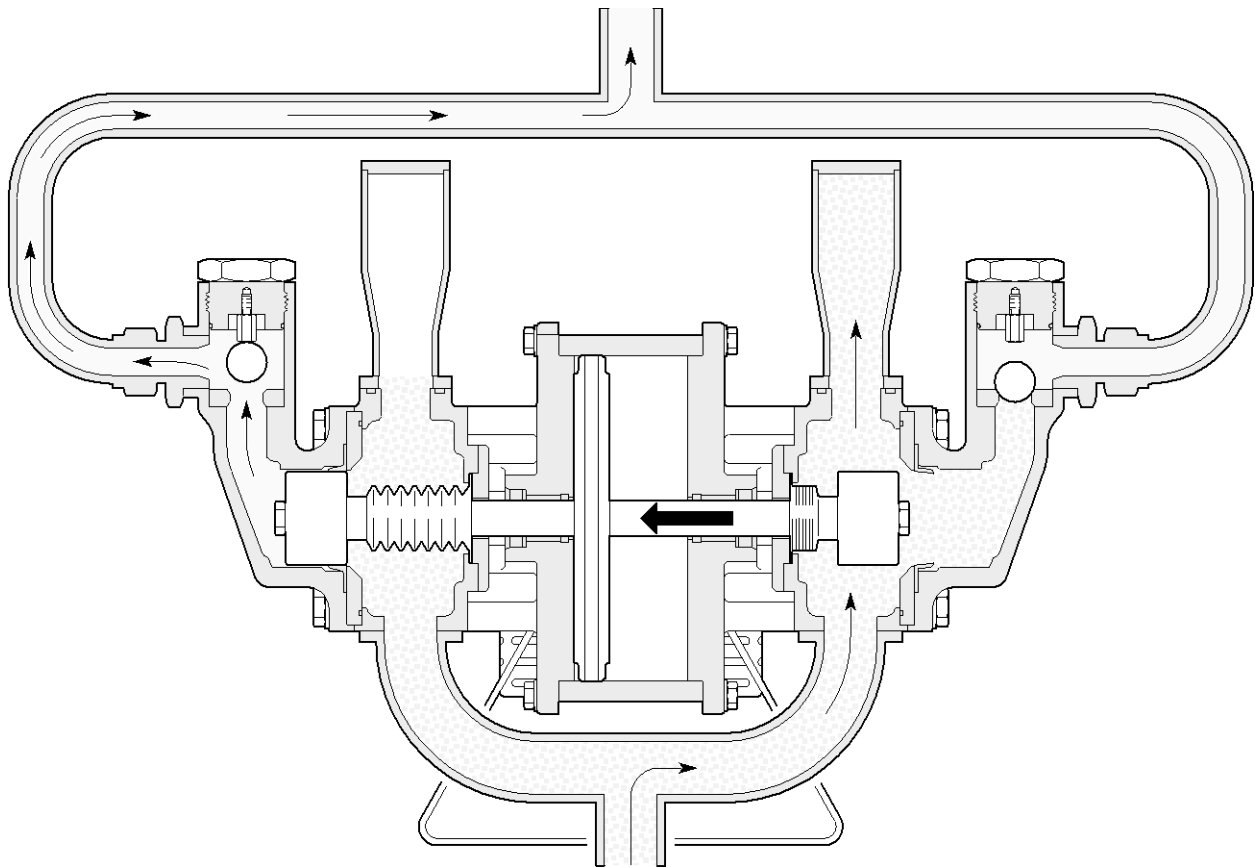
## ***Answers to Progress Check***

1. False
2. True
3. False

# Operation of the Glutton Pump

## *Fluid system*

As the pump shaft moves to the left, it forces the right fluid piston to retract from the piston seal. See Figure 3. This creates a vacuum which draws fluid through the intake manifold and intake housing. On the left side, the fluid piston is forced through the piston seal and into the outlet housing which creates pressure, forcing the check ball to unseat. Fluid flows out the outlet manifold. On the right side, the check ball is forced onto the seat. When the pump reaches the end of its stroke, the air valve causes the pump shaft to change directions.



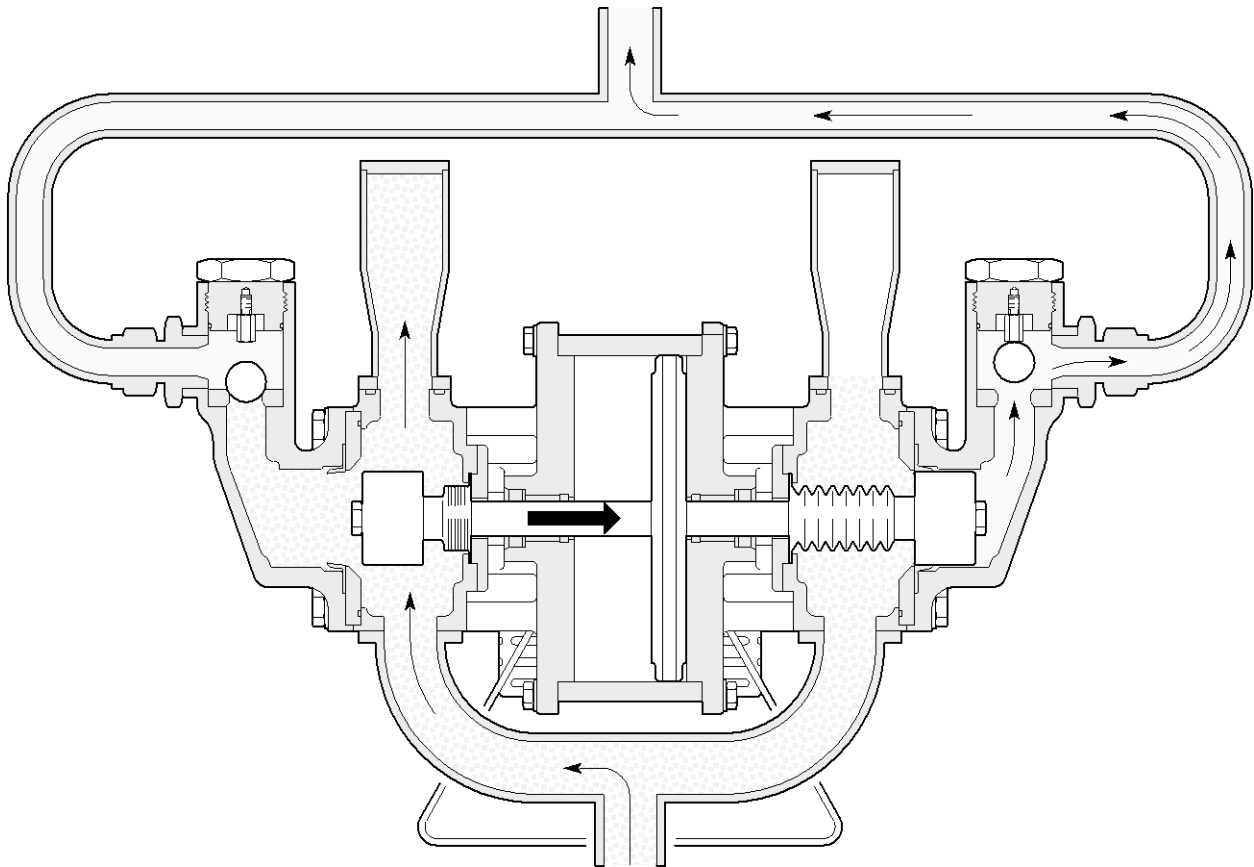
**Figure 3** Fluid Section Operation – Shaft moving left

05100



As the pump shaft moves right, it forces the left fluid piston to retract from the piston seal. This creates a vacuum which draws fluid through the in intake manifold and housing. On the right side the fluid piston is forced into the outlet housing which creates pressure, forcing the check ball to unseat. Fluid flows out the outlet manifold. On the left side the check ball is forced onto the seat. At the end of the stroke, the air motor piston changes direction and the operating cycle repeats itself.

The Glutton air motor drives two single-acting fluid sections. As one section is pumping fluid, the other is loading fluid.



**Figure 4** Fluid Section Operation – Shaft moving right

## Air System

The Glutton is an air operated pump. Compressed air drives the air piston to the right or left based on the position of the spool. The illustration shows the air flowing into the right air chamber driving the air piston to the left.

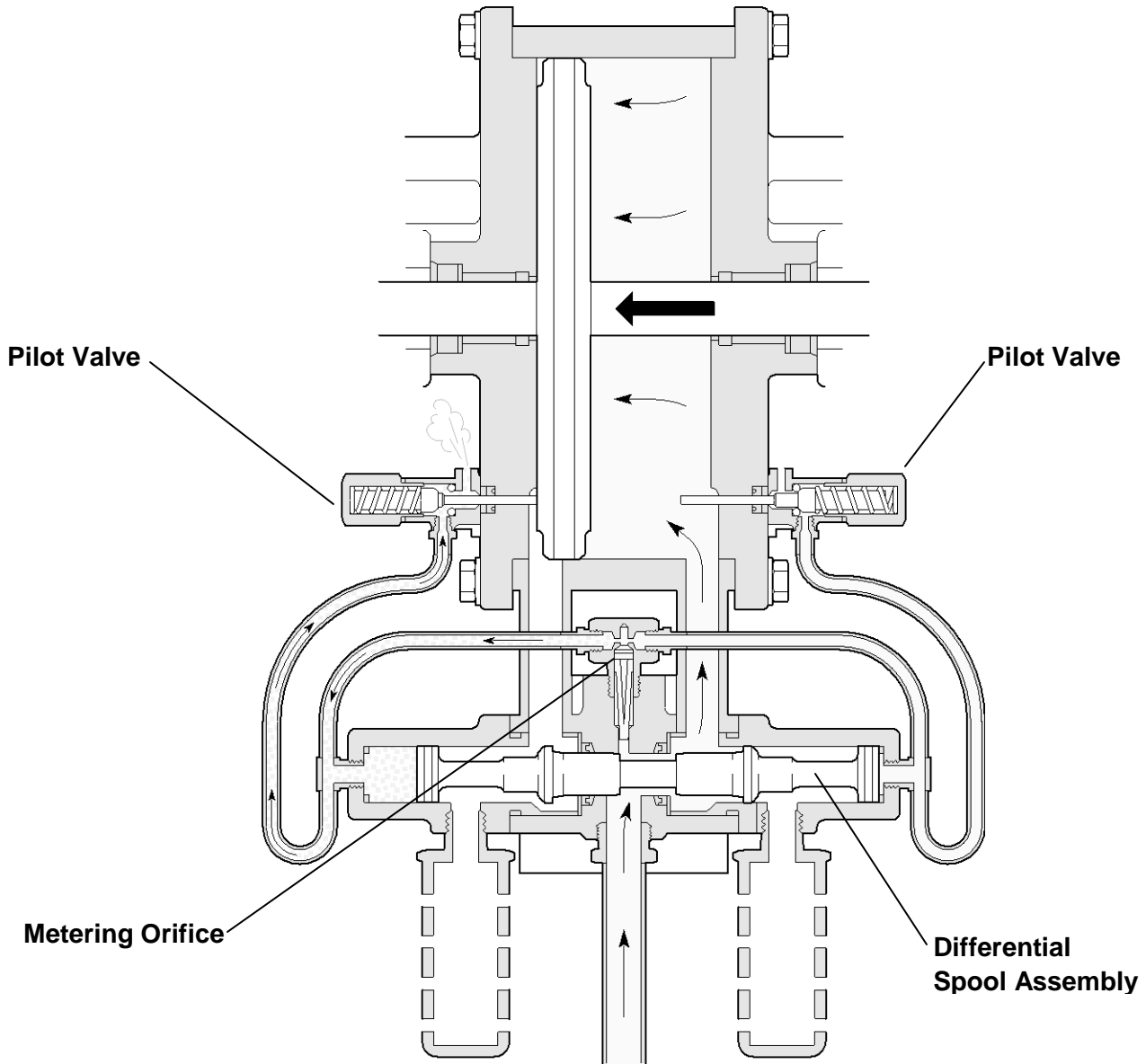
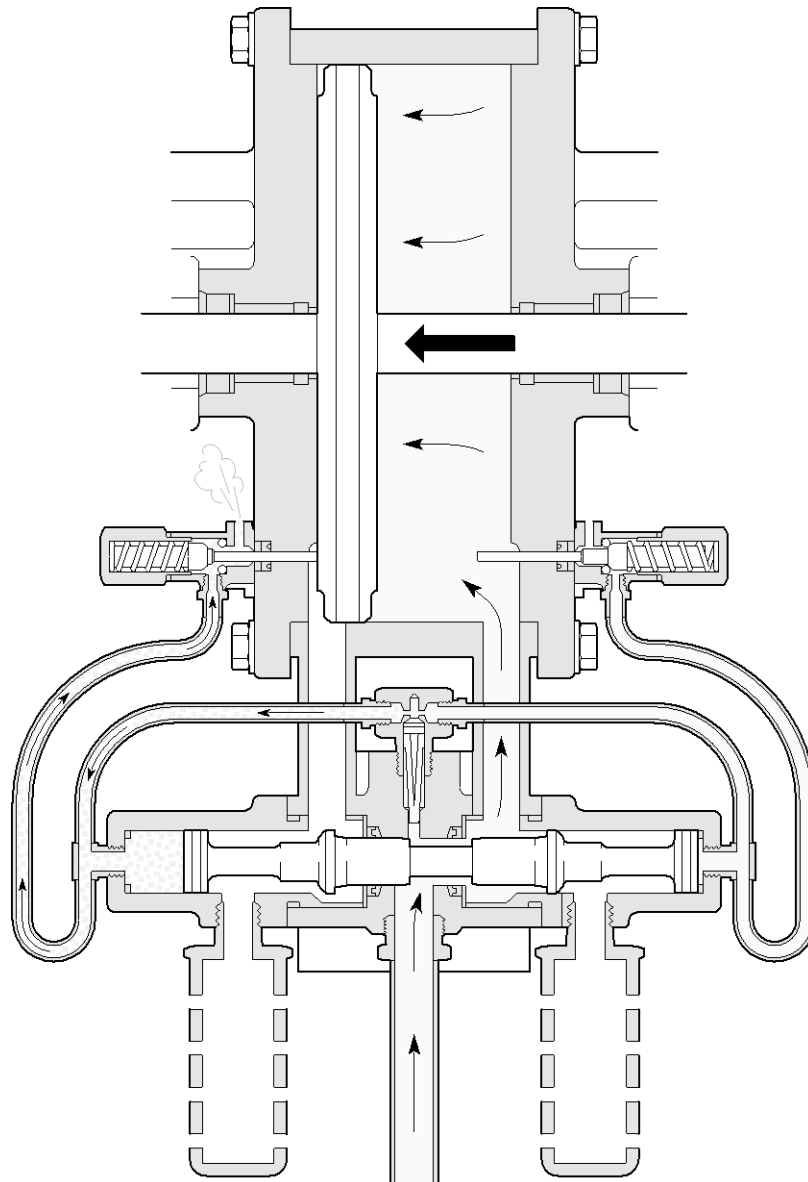


Figure 5 Air system

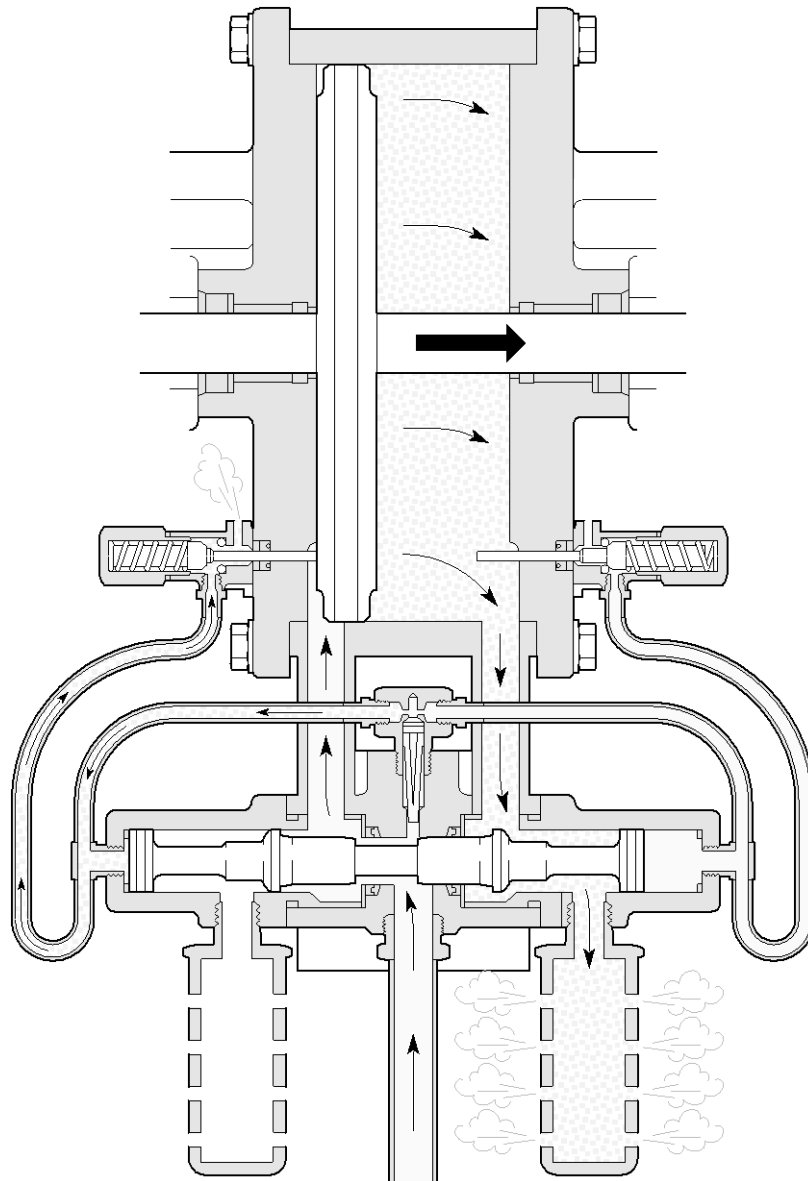
05102

The direction of air piston movement depends on the position of the spool in the air control valve. The pilot valves control the air pressure at the ends of the differential spool assembly.

As the air piston depresses the left pilot valve stem as in Figure 6, the pilot valve stem must overcome an internal spring compression force. When the mechanical force of the piston exceeds the spring force, the valve opens, exhausting the pilot air line to atmosphere. A metering orifice controls the air flow to the pilot lines. The metered air flows through a hole in the pilot valve causing a lower pressure at the left side of the spool. The air pressure on the right side of the spool is now greater, causing the spool to shift left.



**Figure 6** Pilot valve operation



05103

**Figure 7** Pilot valve operation with exhaust

The air on the right of the piston exhausts through the muffler. The mufflers reduce the noise of the exhausting air. Compressed air is directed to the left side of the air piston and the piston and shaft move to the right.

The air control valve spool directs the regulated inbound air to either side of the air motor piston. The pilot valves signal the spool to shift for proper air motor operation.

## ***Summary***

The Glutton pump uses a compressed air motor as its driving medium to provide the reciprocating motion to load and dispense fluid. The direction of motion changes by the pilot valve signaling the air control valve to change position. This directs the inlet air to flow into the opposite side of the air motor.

# 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.***

1. Fluid flow is directed by:
  - a. A fluid piston and four ball checks
  - b. Two fluid pistons and two ball checks
  - c. Flexible diaphragms
  - d. Two pilot valves and differential spool
2. The Glutton pump is comprised of two single acting fluid sections.
  - a. True
  - b. False
3. Air flow is directed by:
  - a. A fluid piston and four ball checks
  - b. Two fluid pistons and two ball checks
  - c. Flexible diaphragms
  - d. Two pilot valves and differential spool

## ***Answers to Progress Check***

1. B.
2. True
3. D.

## ***Materials of Construction***

The following is a list of materials used in the Graco Glutton Pump. The list tells you the components and material options, with advantages or disadvantages of each. See product literature for availability of materials by model number.

### **Urethane – piston seals**

- Available as an option for all models
- Water-based abrasive materials like ceramic frit or slurries

### **Carbide – ball and seat**

- Severely abrasive fluids
- Available as an accessory kit for all models

### **Ultra high molecular weight polyethylene – piston seal**

- Standard on all models
- Designed to wear with the fluid piston
- Three times more wear life than nylon in some applications

### **Nylon – piston seal option**

- Solvent/paint applications
- Available on all models

### **Polypropylene – bellows**

- Provides long service life without repairs

### **Carbon steel – wetted parts**

- All models
- High strength
- Non-corrosive fluids

### **Stainless steel – wetted parts**

- All models
- Corrosive fluids

### **Polytetrafluoroethylen (PTFE) – most wetted parts (not piston steel)**

- Chemical compatibility with a wide range of materials



## ***Pump Application***

When fluid characteristics tend to be abrasive or when the advantage of a leak proof design is important, the Glutton would be an excellent pumping option for a customer.

The fluid pressure of the Glutton is equal to the air pressure applied to the air motor multiplied by the pump ratio. To calculate the pump ratio divide the area of the air motor piston by the area of the fluid piston.

- The Glutton 400 with a pump ratio of 4:1 has a maximum working pressure of 400 psi (2.8 MPa, 28 bar) and will deliver about 6 gpm (22.7 lpm) at 60 cycle/min.
- The Glutton 1200 with a pump ratio of 12:1 has a maximum working pressure of 1200 psi (8.3 MPa, 83 bar) and will deliver about 2 gpm (7.6 lpm) at 60 cycles/min.
- The Glutton 2500 with a pump ratio of 25:1 has the highest maximum working pressure of 2500 psi (17.3 MPa, 173 bar) and will deliver nearly 1 gpm (3.8 lpm) at 60 cycles/min.

## ***Advantages***

- The Glutton pump is available in three models that provide a wide pressure and volume range to meet a variety of customer application requirements.
- All models have a “divorced” design, meaning the air motor is separate from the fluid sections. This prevents the risk of air motor contamination from the fluid should a bellows seal leak.
- The visible piston rods in a divorced design make troubleshooting the Glutton easier.
- The patented center air valve design provides a long service life with little risk of stalling. The long bleed time of the pilots provides a very positive shift of the air valve spool for reliable pump operation.
- The Glutton pumps have a vertical ball check design. Gravity and fluid pressure provides a positive seal between the ball and seat. This design allows the balls to tumble freely with the ball guides for more uniform wear, proving a long service life.
- The stainless steel ball seats are reversible, providing a long service life without replacement; lowering customers’ maintenance costs.
- Customers that pump severely abrasive materials can use the carbide seat accessory kit for a longer service life.
- The Glutton Pump design uses static seals made of PTFE to accommodate the chemical compatibility of a wide range of fluids.
- The co-polymer polypropylene construction of the bellows provides long service life without repair.
- The bellows seal makes the Glutton extremely leak-proof for the life of the bellows. The bellows prevents environmental contamination, reducing the customer’s maintenance costs with the added advantage of handling moisture-sensitive materials.
- Graco engineers designed the standard ultra-high molecular weight polyethylene piston seal to wear with the fluid piston. The flexible sealing surface of the piston seal allows it to maintain a positive seal as the fluid piston wears. This is unlike traditional piston pumps and can provide up to three times more wear life in some applications.
- This unique piston seal design makes the Glutton especially useful for abrasive materials such as: high solids in excess of 50%, gel, coats for fiberglass, acid catalyzed varnish and lacquer, water-based for can coating, and many other materials.

- Glutton pumps come in an option of electro-polished stainless steel for water-based coatings
- The optimal urethane piston seal kit accessory allows the customer to pump abrasive materials like ceramic frit or flurries
- The outlet manifold can face forward or reverse to simplify the customers plumbing installation requirements
- The Glutton mounting bracket fits all current Graco covers and brackets. The Glutton pump can be wall, drum, bulk tank, cart, stand, or floor mounted.
- The air filter, regulator and lubricator accessories provide the customer fast installation and immediate on-line operation with clean, regulated, and lubricated air.
- The air operated Glutton is explosion proof for use in hazardous areas.
- The external air valving allows quick access for servicing, reducing a customer's downtime concerns.
- The Glutton is a positive displacement pump that will stall against pressure and respond demand for material. Since the Glutton pump does not run continuously, like some other pump technologies, the pump achieves a longer service life.

### ***Limitations***

- Graco does not recommend that the Glutton pump be used with more than 15 psi (.1 MPa, 1 bar) of inlet pressure. If the inlet pressure is too high, it may damage the bellows.
- Glutton pumps cause fluid surges at changeover. Surge control devices are needed for some applications.

# Progress Check

**Instructions: Answer each of the following questions. The answer to this progress check are at the end. Cover the answers while completing the progress check. If you get less than 80% correct, you may want to review the module for reinforcement.**

1. The Glutton pump can handle \_\_\_\_\_ of inlet pressure.
  - a. 0 psi (0 MPa, 0 bar)
  - b. 15 psi (.1 MPa, 1 bar)
  - c. 100 psi (.7 MPa, 7 bar)
  - d. None of the above
2. The Glutton pump has a high output pressure with low input pressure.
  - a. True
  - b. False
3. The Glutton pump is a good choice for fluids that are abrasive in nature.
  - a. True
  - b. False
4. A Glutton pump will load both fluid chambers at the same time.
  - a. True
  - b. False
5. The accumulator allows the pump to prime without cavitation.
  - a. True
  - b. False
6. The air flow in the pilot lines is controlled by:
  - a. Metering orifice
  - b. Pilot valve
  - c. Differential spool
  - d. None of the above
7. Check valves will prevent pump fluid from flowing back into source container/
  - a. True
  - b. False

## ***Answers to Progress Check***

1. B.
2. True
3. True
4. False
5. True
6. A.
7. True