

Four-Check Piston Pumps

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Introduction

Module Purpose

The purpose of this module is to help you understand the design and operational characteristics of *Four-Check Piston Pumps*.

Primary Audience

The primary audience for this module is for anyone who would like a better understanding of Four-Check Piston Pumps.

Benefits to You

The benefits to you of successfully completing this module include:

- gaining knowledge of Four-Check Piston Pumps design and operation.
- being able to understand and satisfy the customer's pumping application requirements.

Objectives

After completing this module, you should be able to:

- Explain the theory of operation of Graco Four-Check Piston Pumps.
- Know the advantages of the Graco Four-Check Piston Pumps.

How Do I Use This Module?

This module is designed for you to use at your own pace and at the time you most need it in your job. You can also use the module as a reference after completing it.

What Materials Do I Need?

In addition to this booklet, you will also need these items to complete this module:

- Fluid Basics, Form No. 321-026
- Moving Fluids, Form No. 321-037

You may want to obtain copies of the following resources to gain a better understanding of this topic:

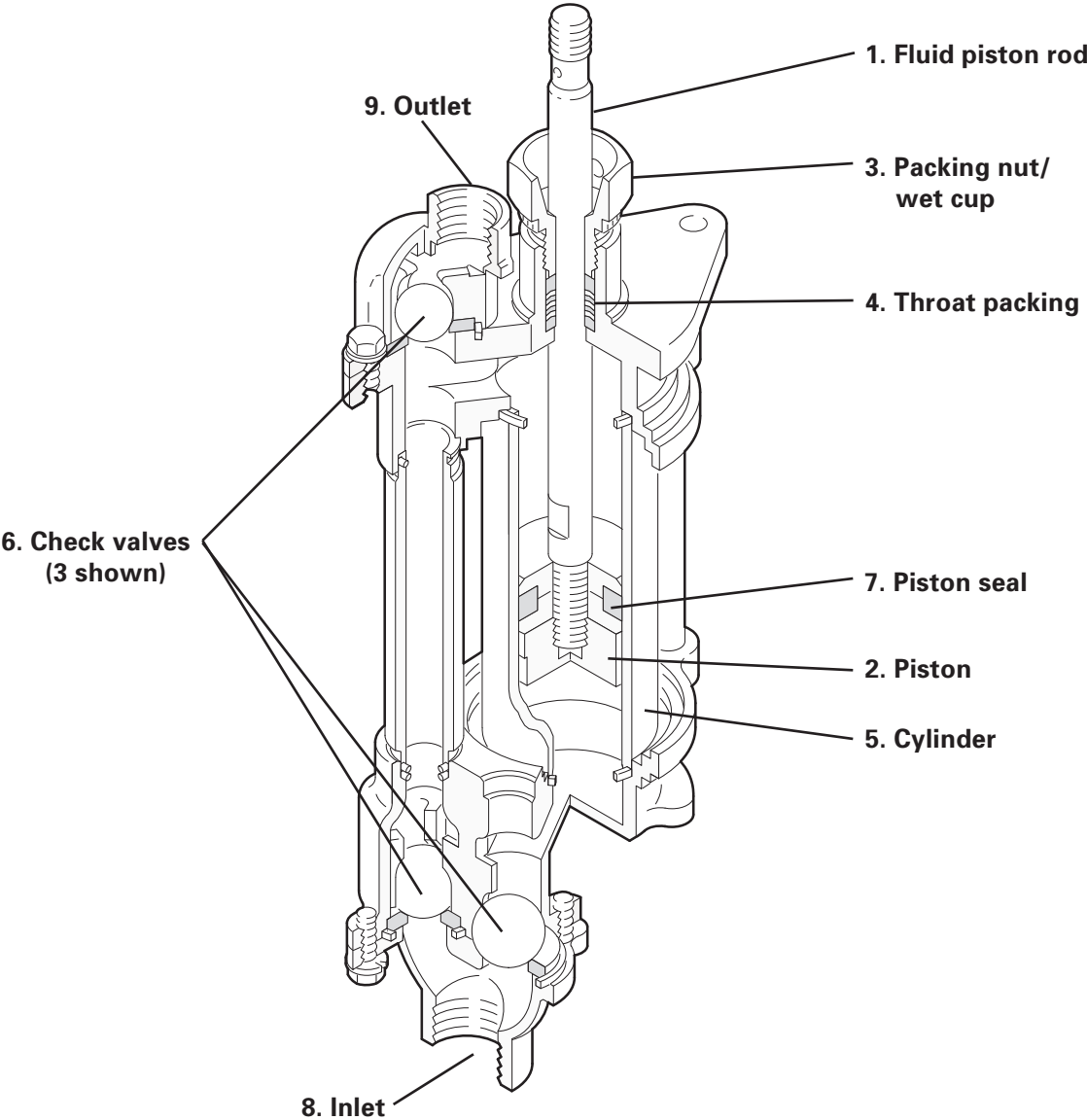
- Videotape titled *High-Flo Pump Training* (Tape number G05-V88)



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



04499

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

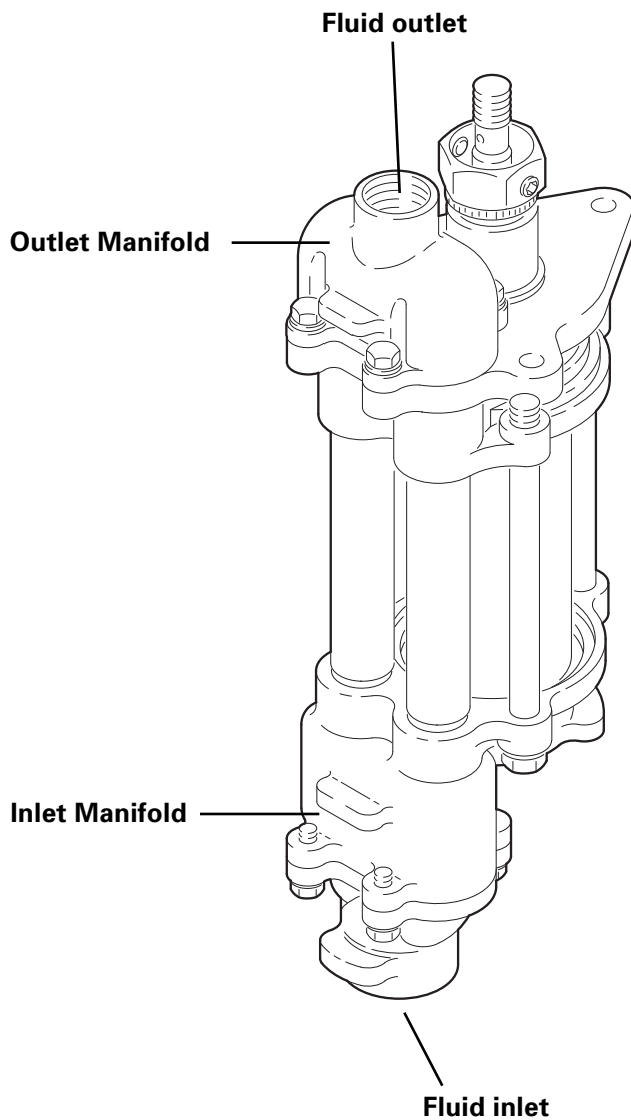
Fluid flows through the inlet into the pump on both the up and down strokes of the pump.

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.



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Figure 1b

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 pump is leaking
 - b. lubricate the throat packings
 - c. to aid in priming the pump
 - d. all of the above

Answers to Progress Check

1. False
2. False
3. b.

Operation of the Four Check Piston Pump

The word pump has two meanings. It can mean the pump and motor together. It can also refer to the fluid displacement pump alone. The fluid displacement pump is also known as the pump, pump lower, lower, or fluid section. For the rest of this discussion, when we say pump, we mean the fluid displacement pump. The motor drives the pump and the pump moves the fluid.

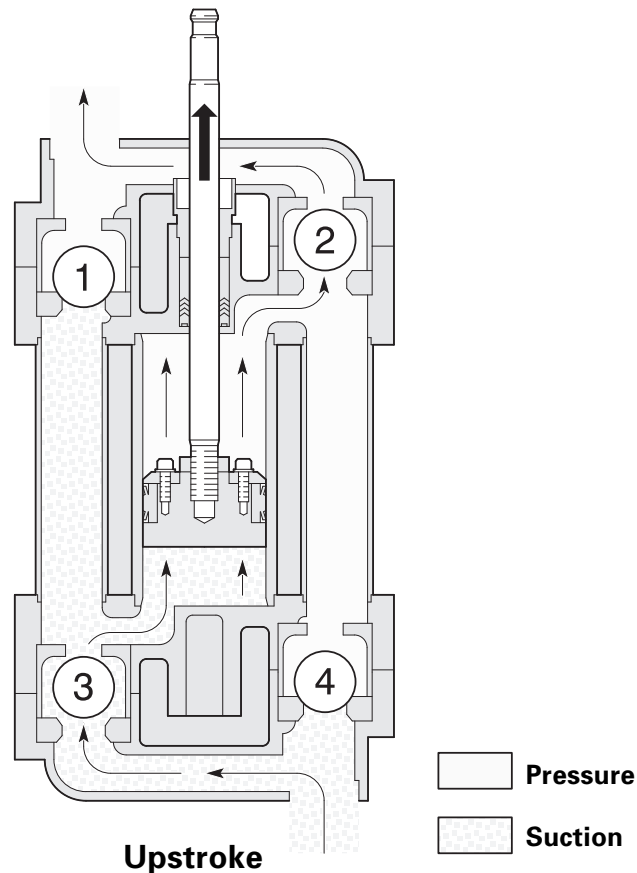
Pump Operation

We will discuss the operation of the Four Check 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.



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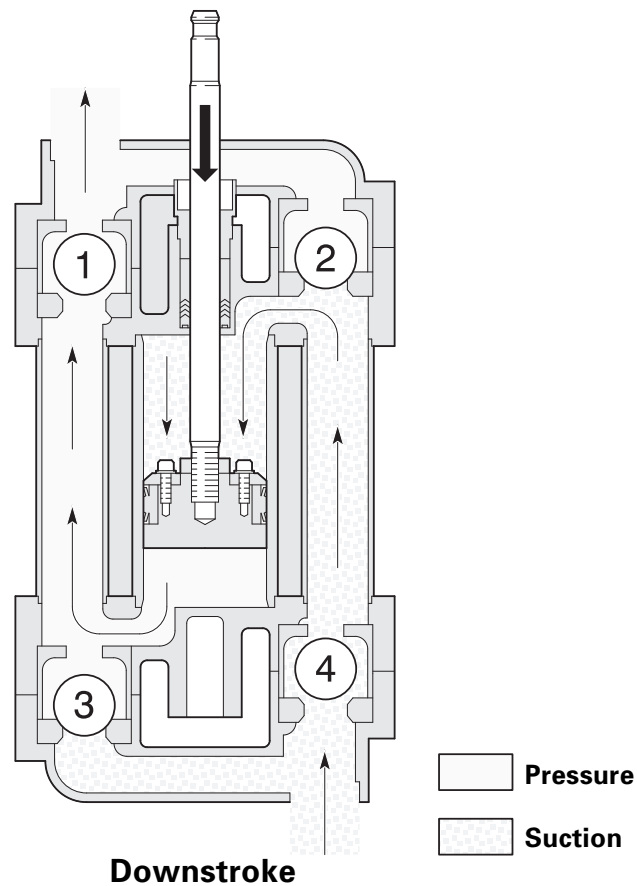
Figure 2 (fluid flow cutaway, upstroke).

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.



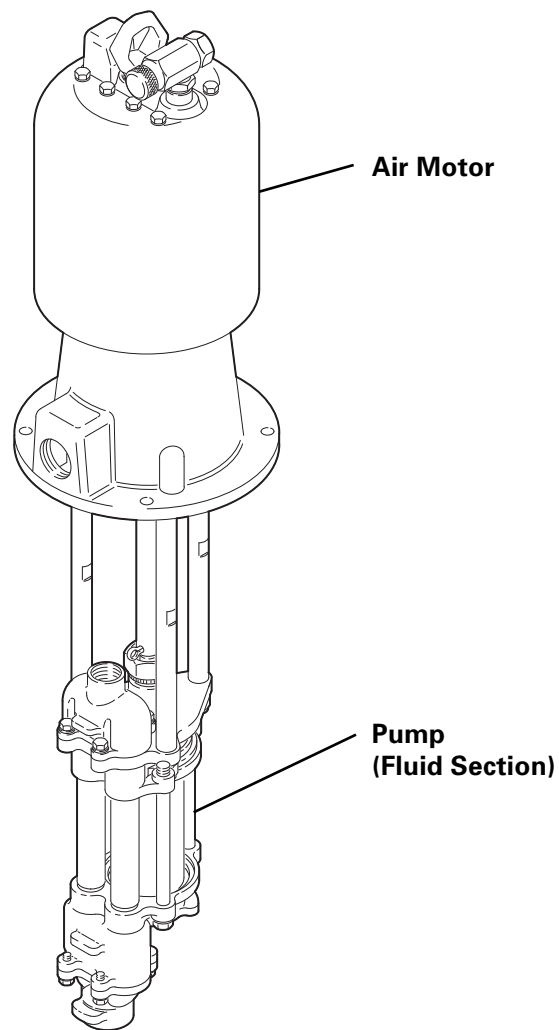
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Figure 3 (fluid flow cutaway, down stroke).

Motor Operation

Air and Hydraulic Driven Piston Pump Operation

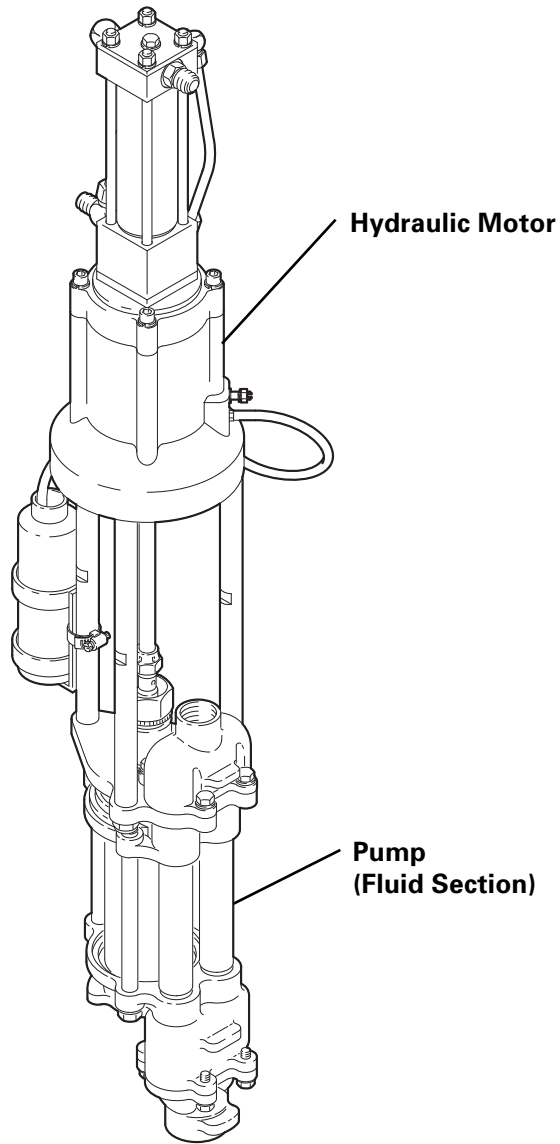
Air or hydraulic oil powered motors can be used to drive these pumps. The air or hydraulic motor provides reciprocating motion to the fluid piston rod. As the piston rod reciprocates, fluid enters the fluid inlet and dispenses from the fluid outlet of the pump.



Air Powered Pump

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Figure 4 (pump with air motor).



Hydraulic Powered Pump

04502

Figure 5 (pump with hydraulic motor).

Electric Driven Piston Pump Operation

Electric motors can also be used to drive Four-Check Piston Pumps. A series of gears, a cam, and carriage convert the rotating motion of the motor drive shaft into reciprocating motion of the fluid piston rod.

The pump will determine the fluid output. The force the motor can apply will provide the output pressure. The combination of pump and motor will determine the output pressure and flow rate. See the product literature for specifics on which motor and pump combinations which will give the fluid delivery rates and output pressures.

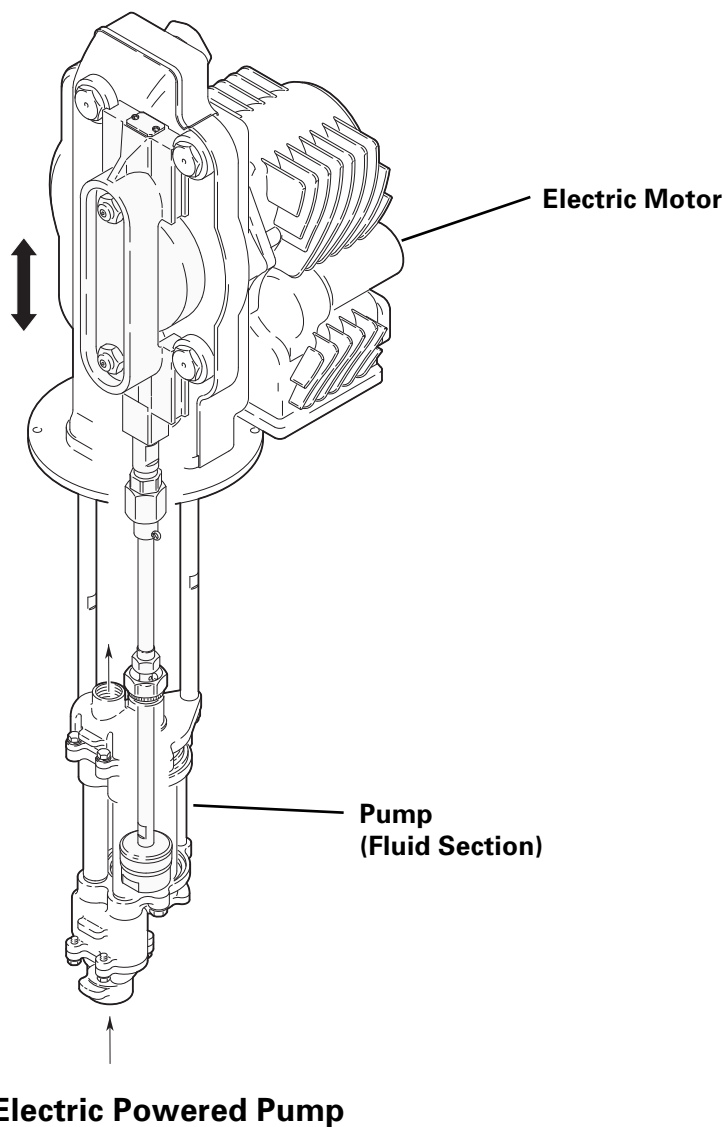


Figure 6 (pump with electric motor).

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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 made of two main parts: _____ and _____.
2. Four-Check Piston Pumps can be driven by _____.
 - a. electric motors
 - b. hydraulic motors
 - c. air motors
 - d. all of the above
 - e. some of the above
3. The pump determines the fluid capacity output
 - a. True
 - b. False
4. The combination of the pump and motor determine the fluid _____ and _____.

Answers to Progress Check

1. Lower and motor
2. d.
3. True
4. delivery rates and output pressures

Summary

The pump has an air, hydraulic, or electric motor that powers a four check piston pump.

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

Materials of Construction

Wetted Parts

- Carbon steel — general use, usually solvent borne paints and finishes.
- Stainless steel — corrosive fluids.

Piston Seals

- Ultra-high molecular weight polyethylene (UHMWPE)
- Teflon

Throat Packings

- Leather
- UHMWPE
- Teflon

Balls

- Stainless steel

Pump Application

Graco sells several Four Check Piston Pump models in a wide volume range. You can obtain a range of fluid pressure (150 - 600 psi or 10.3 - 41.3 bars) combinations by attaching different capacity motors to them. Typical applications include transfer and paint circulation applications.

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 Pump.

Limitations

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

Trade Names

The trade name for Graco four check pumps is High-Flo.

Self Check

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

1. Four-Check Piston Pumps are medium to large volume pumps with a wide range of pressures.
 - a. True
 - b. False

2. Mechanical force is applied to the throat packing seal by the packing nut.
 - a. True
 - b. False

3. Identify the major market application(s) for Four-Check Piston Pumps.
 - a. Paint circulation
 - b. Sealants and adhesive
 - c. Transfer
 - d. Foods

4. What is Graco's trade name for Four-Check Piston Pumps?
 - a. Check Mate
 - b. Dura-Flo
 - c. Husky
 - d. High-Flo

5. A four check piston pump will load and dispense on the same stroke?
 - a. True
 - b. False

6. A four check piston pump can pump a higher volume than a two check piston pump.
 - a. True
 - b. False

Answers to Self Check

1. True
2. True
3. a and c
4. d.
5. True
6. True

Notes

Module Evaluation

The purpose of this Module Evaluation is to help the Graco Technical Communications department determine the usefulness and effectiveness of the module.

*Instructions: Please complete the evaluation, tear it on the perforation, and return to:
Graco Technical Communications Department, P.O. Box 1441, Minneapolis, MN 55440-1441, USA.*

1. *Based on the objectives, this module:*

- Significantly exceeded my expectations
- Exceeded my expectations
- Met my expectations
- Was below my expectations
- Was significantly below my expectations

2. *Why did you select the above rating?*

3. *How do you plan to use the module information in your job?*

4. *How do you think the module could be improved?*

I verify that I have successfully completed Module No. 321-045, Four-Check Piston Pumps

Signature _____

Date _____

Graco

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This module was developed by the Graco Technical Communications Department with assistance from the following individuals:

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Kurt Thostenson

The Graco Concept and Theory Training program consists of the following topics:

Fluid Basics
Atomization
Electrostatic Spray Finishing
Safety
Airspray Technology
Fluid Types: Paints and Other Coatings
Fluid Types: Lubricants
Fluid Types: Sealants and Adhesives
Airless Atomization
Spraying Techniques
Transfer Efficiency
Fluid Movement
Fluid Controls
Pumps
Motors and Power Sources
Plural Component Paint Handling
Plural Component Sealant and Adhesive Handling
Paint Circulating Systems
Automatic Finishing
Lube Reels and Dispense Valves
Lube Metering Systems
Electronic Fluid Management Systems

