Industrial Maintenance

Piston Pump

Courseware Sample

37903-F0

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By the staff of Festo Didactic

Internet: www.festo-didactic.com
e-mail: did@de.festo.com

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Safety and Common Symbols

The following safety and common symbols may be used in this manual and on the equipment:

Symbol	Description
DANGER	**DANGER** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
CAUTION	**CAUTION** used without the *Caution, risk of danger* sign ⚠, indicates a hazard with a potentially hazardous situation which, if not avoided, may result in property damage.
	Caution, risk of electric shock
	Caution, hot surface
	Caution, risk of danger
	Caution, lifting hazard
	Caution, hand entanglement hazard
	Notice, non-ionizing radiation
⎓	Direct current
~	Alternating current
⎓ ~	Both direct and alternating current
3~	Three-phase alternating current

Safety and Common Symbols

Symbol	Description
	Earth (ground) terminal
	Protective conductor terminal
	Frame or chassis terminal
	Equipotentiality
	On (supply)
	Off (supply)
	Equipment protected throughout by double insulation or reinforced insulation
	In position of a bi-stable push control
	Out position of a bi-stable push control

We invite readers of this manual to send us their tips, feedback, and suggestions for improving the book.

Please send these to did@de.festo.com.

The authors and Festo Didactic look forward to your comments.

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To the Instructor

NCCER Accreditation

Contact the National Center for Construction Education and Research (NCCER), at *www.nccer.org*, to obtain the requirements relative to the NCCER accreditation of this course.

Care and Maintenance of the Pumps Training System

Every week

- Check the general condition of the Pumps Training System.
- Check the condition of the snap-grip clamps on the hoses.
- Make sure the expanding work surface is solidly fixed on the bench. Check the condition of the four (4) push-lock fasteners.

Once a month

- Check the operation of the ground fault circuit interrupter (GFCI).
- Make sure that an O-ring is present and in good condition in each hose coupling.

Every 6 months

- Replace the water in the reservoir.
- Add the following solutions to the water in the reservoir:
  – 2 fl oz (60 ml) of Antibacterial solution, Lab-Volt p/n 38097
  – 8 fl oz (240 ml) of Rust inhibitor, Lab-Volt p/n 38096

Sample Work Order

Extracted from

Piston Pump

Piston Pump

Description

The Piston Pump of your training system is shown in Figure 1-1. It consists of a twin piston pump that utilizes a pressure differential to alternately create suction and positive fluid pressure. As shown in Table C-1 in Appendix C, a piston pump is a positive displacement reciprocating pump.

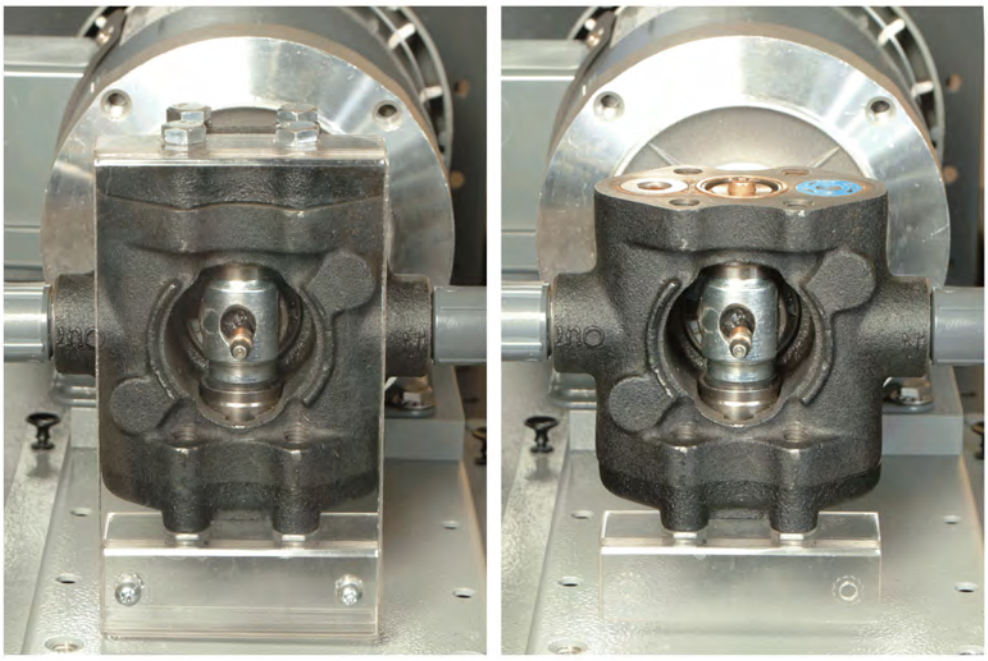

Figure 1-1. Piston Pump with and without protective guard.

How it works

When the piston moves up, cavity C-1 enlarges. This action creates a vacuum drawing in liquid through valve V-1. See Figure 1-2.

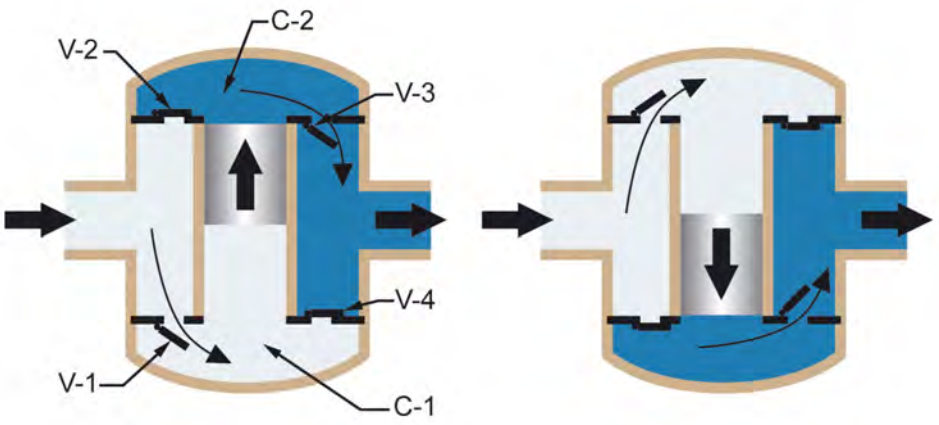

Figure 1-2. Fluid flow in a piston pump.

While cavity C-1 enlarges, cavity C-2 compresses forcing the liquid out through valve V-3.

Once the piston has fully extended to the top, it is redirected to the bottom compressing cavity C-1 and enlarging cavity C-2. Once the piston has fully extended to the bottom, the cycle repeats.

The piston of the Piston Pump of the training system is driven by a crankpin bearing.

Advantages and disadvantages

Advantages: piston pumps can handle high pressures.

Disadvantages: they need a relief or unloader valve, and they generally have pulsing flow. Because internal parts of the pump are in direct contact with the pumped liquid, piston pumps cannot be used for pumping abrasive liquids or chemicals which crystalize.

Applications

Piston pumps are used for high pressure cleaning and spraying of water, soap, and detergents. Applications include farms, home, industrial spraying, and pressure washing, applying nonflammable liquids compatible with pump component materials. They are also used as high volume dosing pumps, and for concrete pumping.

Maintenance

The maintenance required by piston pumps consists in:

- Lubricating the crank bearing as suggested by the manufacturer.
- Inspecting, cleaning, and checking all the components inside the pump when it is disassembled (refer to the manufacturer instructions).

Characteristics of the Piston Pump of the training system

Maximum speed: 1750 r/min
Maximum discharge pressure: 500 psi (3500 kPa)
Maximum flow rate: 2.9 gal US/min at 500 psi (11 l/min at 3500 kPa)
Direction of rotation: reversible

Piston Pump

Task: To lubricate, install, operate, and troubleshoot a piston pump.

PROCEDURE

CAUTION!

Before proceeding with this procedure, complete the safety checklist in Appendix B.

☐ 1. Refer to Figure 1-3 to locate and identify the various components of the Piston Pump.

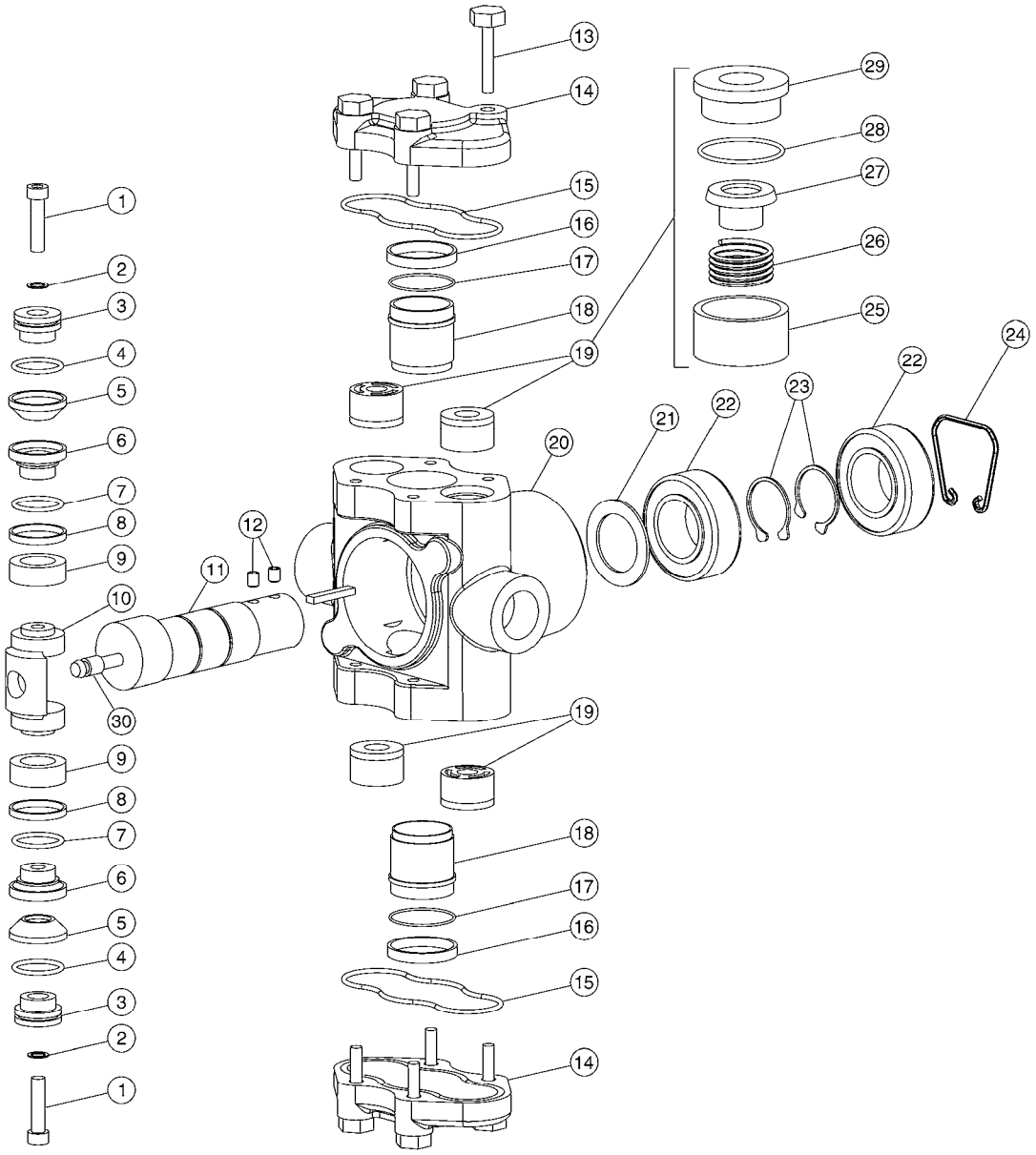

Figure 1-3. Exploded view of the Piston Pump.

1	Screw	16	Retainer ring
2	Washer gasket	17	O-ring
3	Piston cup spreader	18	Cylinder sleeve
4	O-ring cup spreader	19	Valve assembly
5	Rubber cup	20	Cast iron body
6	Cup backing plate	21	Bearing shield
7	O-ring backing plate	22	Bearing
8	Seal ring	23	Retaining ring
9	Piston guide	24	Housing retaining ring
10	Connecting rod	25	Valve spring retainer
11	Crankshaft assembly	26	Valve spring
12	Setscrew	27	Valve poppet
13	Screw	28	O-ring
14	Cast iron cylinder head	29	Valve seat
15	O-ring	30	Grease fitting

Lubrication

☐ 2. Lubricate the pump as follows:

- Make sure that the grease fitting is tightened firmly.
- Wipe off the grease fitting and the grease coupler of the grease gun.
- Press the grease coupler on the grease fitting until it snaps into place.

Note: *Make sure to use the grease supplied with the Lab-Volt Lubrication Kit, Model 46792.*

- Pump the grease. Do not over lubricate.
- Disengage the grease coupler from the grease fitting.
- Wipe off the grease from the fitting and grease coupler.

Circuit setup

☐ 3. Attach the Piston Pump to the Motor shaft as shown in Figure 1-4.

Note: *Use the shaft key (3/32 x 3/16) supplied with the Piston Pump.*

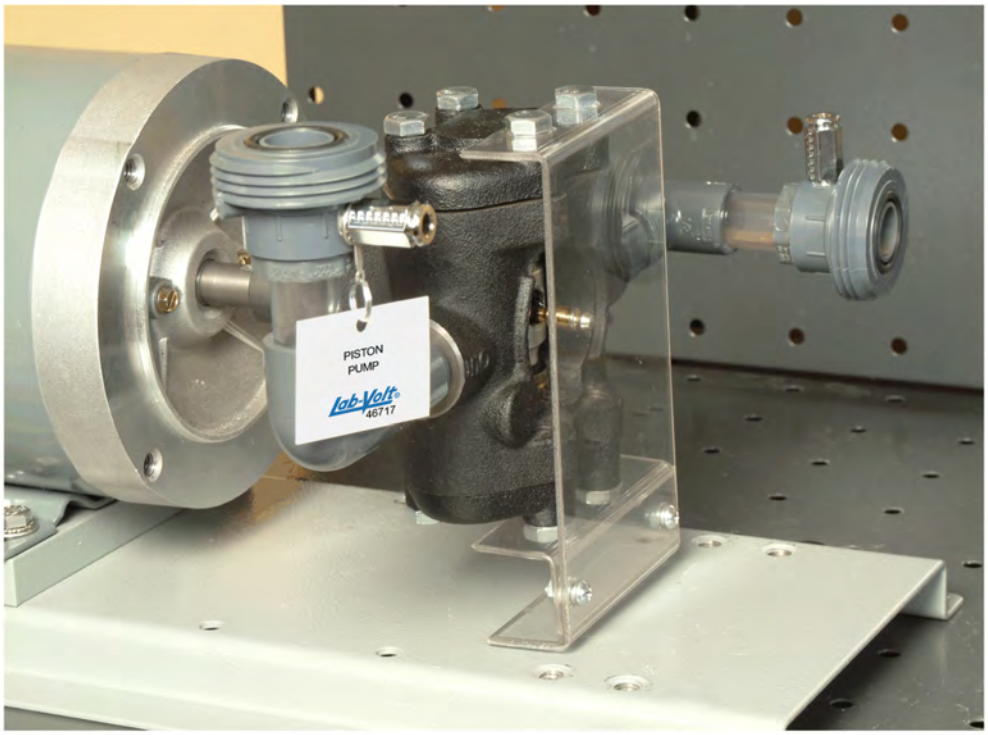

Figure 1-4. Installation of the Piston Pump on the Pump Universal Base.

☐ 4. Install the protective guard.

CAUTION!

Never operate the pump without protective guards.

☐ 5. Set up the pumping circuit shown in Figure 1-5.

Note: *Since the flow rate produced by the Piston Pump is below 5 gal US/min (19 l/min), you should use the optional Paddle Wheel Flowmeter (low range), Model 46731.*

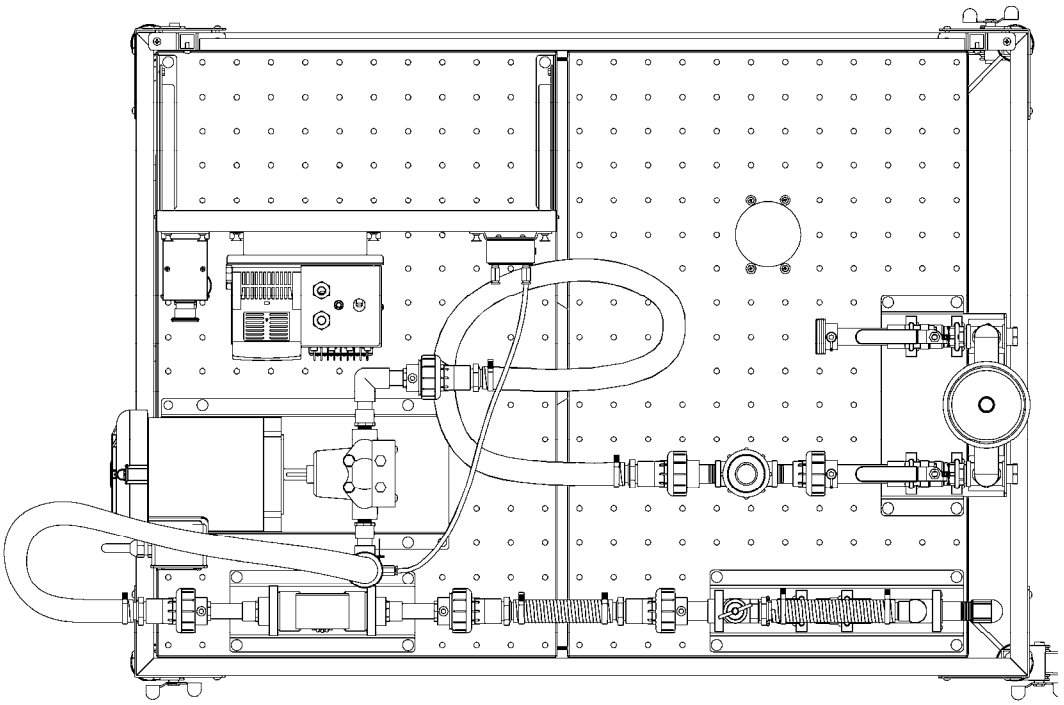

Figure 1-5. Pumping circuit using the Piston Pump.

☐ 6. Connect the Variable Speed Drive and Motor.

☐ 7. Prime the pump.

Note: *The Piston Pump is not designed for self priming.*

CAUTION!

The pump must not run dry for more than 30 seconds.

☐ 8. Perform the following settings on the Variable Speed Drive:

- Set the maximum output frequency to 30 Hz.
- Set the direction of rotation to reverse.

☐ 9. Set the relief valve to limit the pressure in the circuit to 50 psi (350 kPa) when the output frequency is 30 Hz.

Note: *Damage to the piping may occur if the circuit pressure exceeds 50 psi (350 kPa).*

Piston movement

☐ 10. Set the output frequency to 5 Hz and observe the up and down motion of the piston as the cam bearing rotates.

Flow rate versus speed

☐ 11. Determine the flow rate versus speed characteristics as follows:

- Open valve HV-4.
- On the Variable Speed Drive, increase the output frequency from 0 to 30 Hz by increments of 5 Hz. For each setting, measure the flow rate and enter your results in Table 1-1.

OUTPUT FREQUENCY (Hz)	0	5	10	15	20	25	30
FLOW RATE							

Table 1-1. Flow rate versus output frequency.

☐ 12. Plot the flow rate versus speed (30 Hz ≈ 1725 r/min) curve in Figure 1-6.

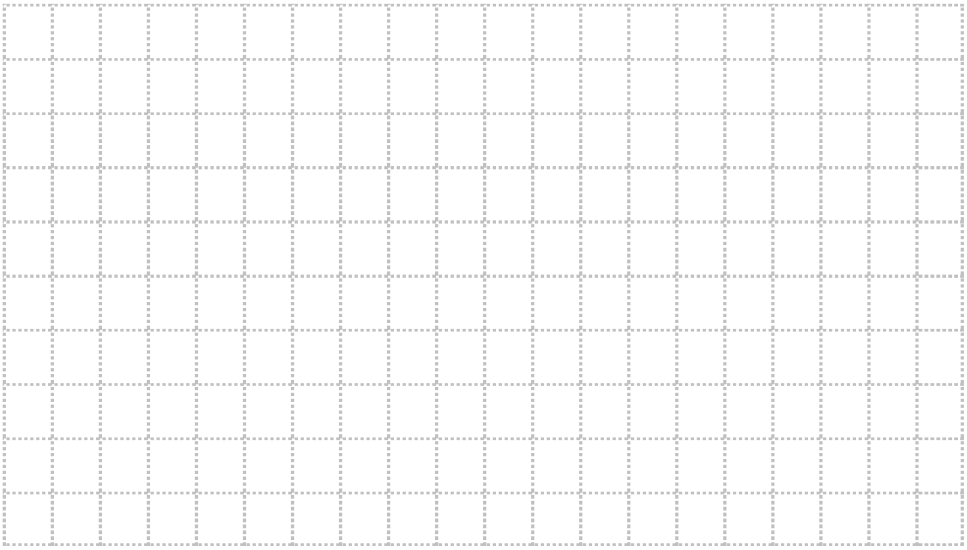

Figure 1-6. Flow rate versus speed curve.

☐ 13. From the curve you obtained, describe the relationship between the flow rate and speed.

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Head versus flow rate

☐ 14. Determine the head versus flow rate characteristics as follows:

- Make sure valve HV-4 is open.
- On the Variable Speed Drive, set the output frequency to 10 Hz.
- Close valve HV-4 to increase the head by increments of 10 ft (3.0 m) from the current value until HV-4 is fully closed. For each setting, measure the flow rate and enter your results in Table 1-2.
- Repeat your measurements for output frequencies of 20 and 30 Hz.

OUTPUT FREQUENCY					
10 Hz		20 Hz		30 Hz	
HEAD	FLOW RATE	HEAD	FLOW RATE	HEAD	FLOW RATE

Table 1-2. Head versus flow rate characteristics.

☐ 15. Stop the pump.

☐ 16. Plot the head versus flow rate curves in Figure 1-7.

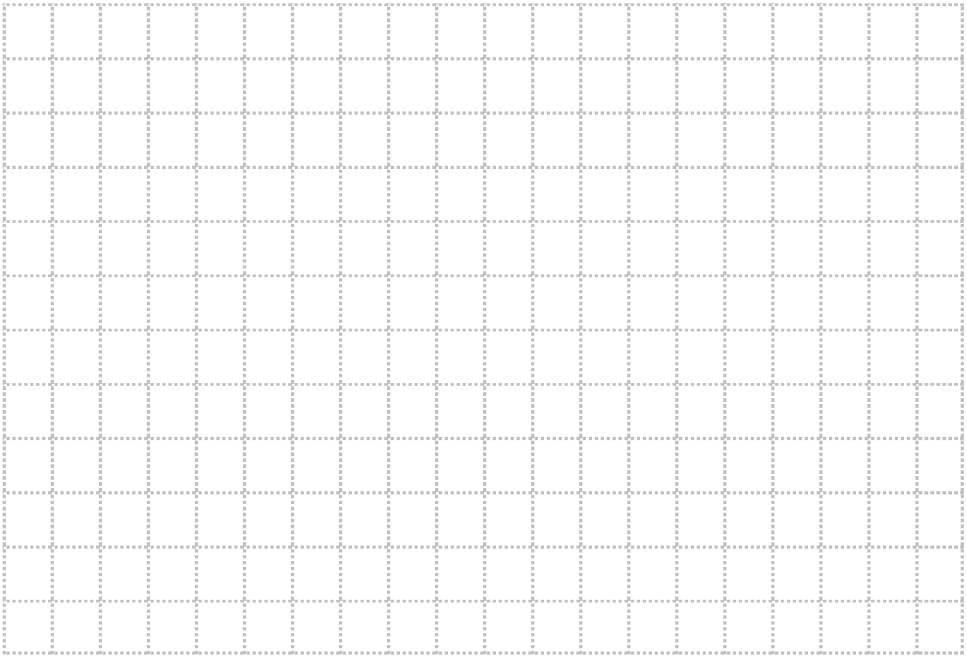

Figure 1-7. Head versus flow rate.

☐ 17. From the curves you obtained, describe how the head varies with flow rate.

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Troubleshooting

☐ 18. By referring to the Troubleshooting Chart in Appendix E, identify one symptom that a worn connecting rod may cause.

_____

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_____

☐ 19. By referring to the Troubleshooting Chart in Appendix E, name eleven possible causes for an erratic flow rate or low pressure.

_____

_____

_____

_____

_____

Directon of rotation

☐ 20. Compare the flow rate produced by the pump for both directions of rotation. Does your observation confirm that the pump rotation is reversible?

☐ Yes ☐ No

☐ 21. Ask your instructor to check your work.

☐ 22. Disconnect your setup, and return the equipment to the storage location.

Name: _____ Date: _____

Instructor's approval: _____