Industrial Maintenance

Progressive Cavity Pump

Courseware Sample

37899-F0

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By the staff of Festo Didactic

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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

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

The authors and Festo Didactic look forward to your comments.

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Table of Contents

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

Progressive Cavity Pump

Progressive Cavity Pump

Description

The Progressive Cavity Pump of your training system is shown in Figure 1-1. It consists of a screw rotating in a rubber stator. As shown in Table C-1 in Appendix C, a progressive cavity pump, also called slurry pump, is a positive displacement rotary pump.

Figure 1-1. Progressive Cavity Pump with and without stator.

How it works

Liquid is drawn into the suction of the pump as the corkscrew shaped rotor revolves within the rubber stator. See Figure 1-2.

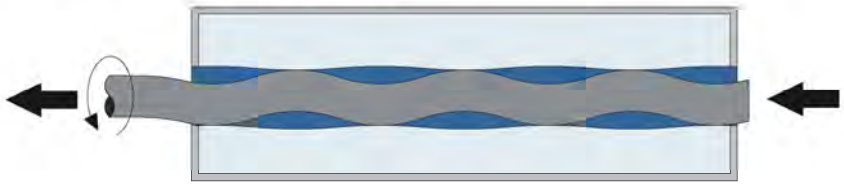

Figure 1-2. Fluid flow in a progressive cavity pump.

Liquid is captured in the cavity between the rotor and stator. This cavity travels toward the discharge during rotation.

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The cavity opens into the discharge chamber and delivers its contents as it reduces in size. Liquid is forced out the discharge as more liquid is delivered by continued rotation.

Advantages and disadvantages

Advantages: most progressive cavity pumps are self priming, and create low pressure pulsations. They can handle gaseous fluids, liquids containing large particles in suspension, and abrasive slurries.

Disadvantages: they cannot run dry.

Applications

Progressive cavity pumps are used for pumping from shallow wells, creeks, ponds, spraying, water systems, and lawn sprinkling. They are also used to pump high viscosity fluid such as peanut butter and glue.

The slurry pumps are used for transporting thick fluids in the chemical, food and brewery, paper and pulp industries.

Maintenance

The maintenance required by progressive cavity pumps consists in:

- Checking the pump to motor shaft alignment at regular intervals.
- Should be checked for proper operation as needed. If the pump makes noise or leaks, it should be removed and the components examined and repaired.

Characteristics of the Progressive Cavity Pump of the training system

Maximum speed: 1750 r/min
Maximum discharge pressure: 40 psi (275 kPa)
Direction of rotation: clockwise (when facing the shaft)
Sealing element: mechanical seal

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Progressive Cavity Pump

Task: To inspect, lubricate, install, operate, and troubleshoot a progressive cavity 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 Progressive Cavity Pump.

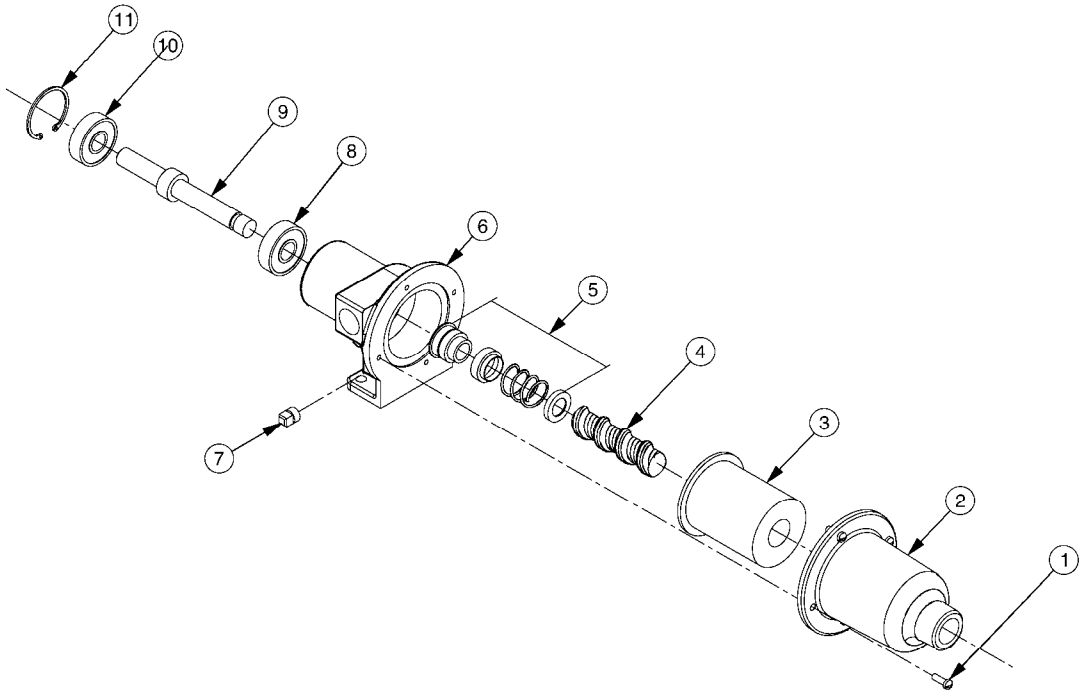

Figure 1-3. Exploded view of the Progressive Cavity Pump.

1	Screw	7	Drain plug
2	Suction housing	8	Bearing
3	Stator	9	Shaft
4	Rotor	10	Bearing
5	Mechanical seal	11	Retaining ring
6	Pump body		

Disassembly of the Progressive Cavity Pump

☐ 2. Disassemble the pump as follows:

- Drain the pump.
- Remove the screws.
- Remove the suction housing and stator.

CAUTION!

To prevent damage to the mechanical seal, do not remove other components of the pump.

Inspection

☐ 3. Clean the components, and remove all hardened residues.

☐ 4. Check the components as follows:

- Inspect the suction housing and stator for excessive wear.
- Inspect the rotor for wear.

Note: *Notify your instructor if any parts seem damaged.*

Reassembly of the pump

☐ 5. Reassemble the pump as follows:

- Apply a light coating of soapy water to the stator and slide the stator onto the rotor.
- Push the stator against the pump body so it is touching and mushrooming slightly.
- Attach the suction housing to the pump body by tightening the screws evenly in a crisscross pattern.

Lubrication

☐ 6. Lubricate the pump as follows:

- Lubricate the rotor and stator by filling the suction and discharge housings with water.

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CAUTION!

Never run the Progressive Cavity Pump dry.

Circuit setup

☐ 7. Install the Progressive Cavity Pump on the Pump Universal Base as shown in Figure 1-4.

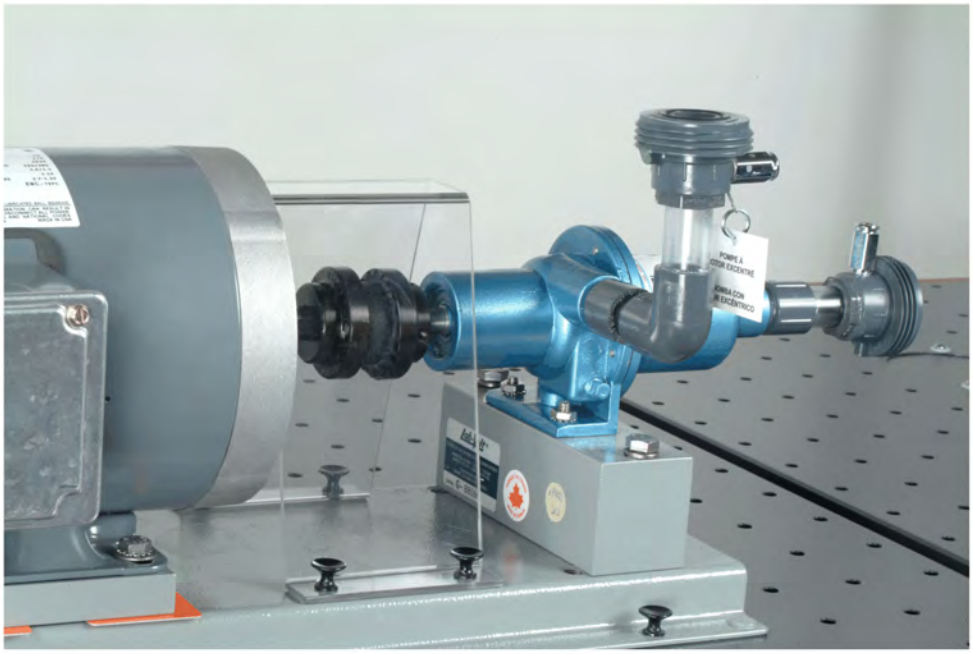

Figure 1-4. Installation of the Progressive Cavity Pump on the Pump Universal Base.

☐ 8. Install the coupling and align the shafts.

Note: *Position the 1/2-in. coupling hub on the pump shaft so the setscrew faces the flat surface of the shaft.*

☐ 9. Install the coupling guard.

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

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

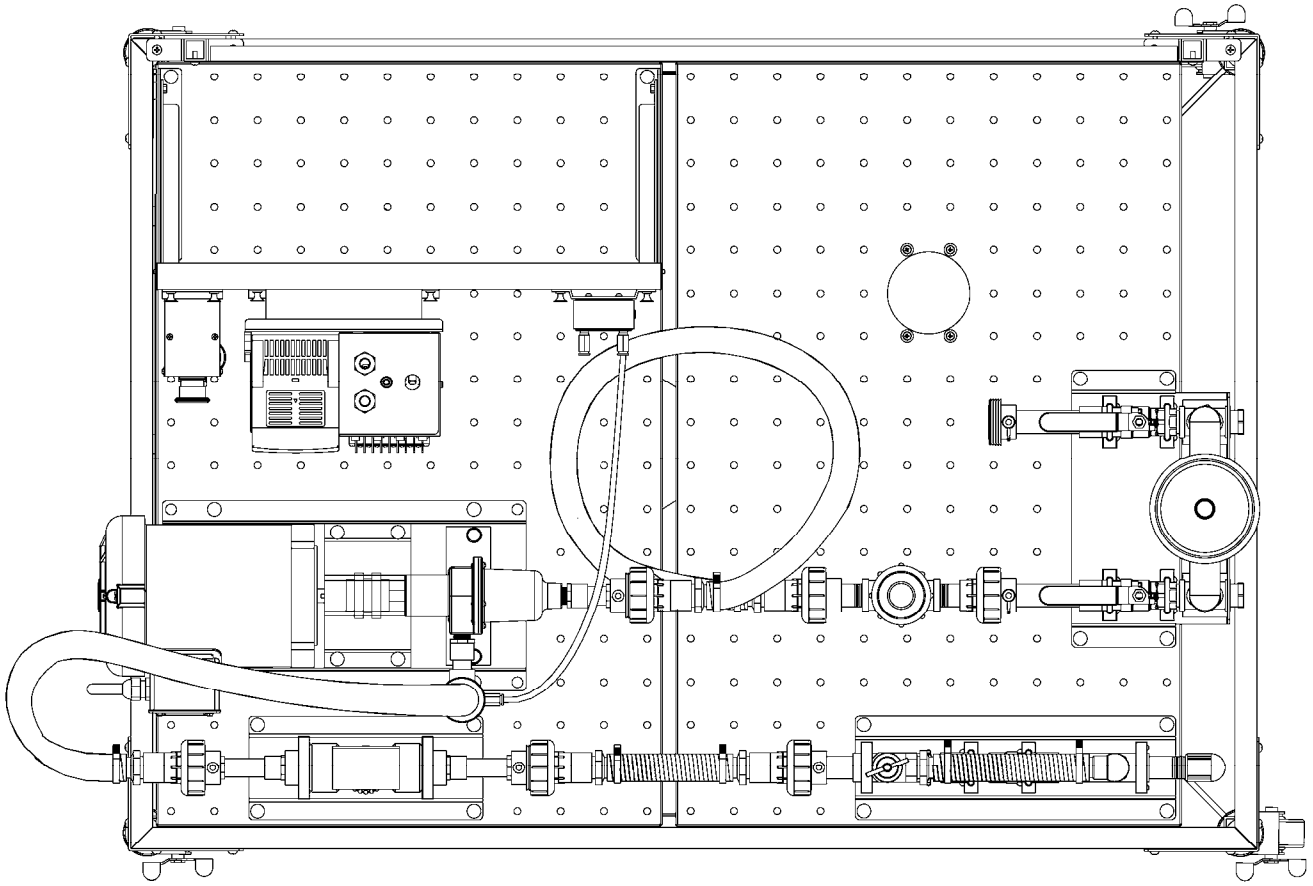

Figure 1-5. Pumping circuit using the Progressive Cavity Pump.

☐ 11. Connect the Variable Speed Drive and Motor.

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

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

CAUTION!

Make sure that the direction of rotation is correctly set to prevent the rotor from unscrewing from the shaft.

☐ 13. Set the relief valve to limit the pressure in the circuit to 40 psi (275 kPa) when the output frequency is 30 Hz.

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Flow rate versus speed

☐ 14. 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.

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

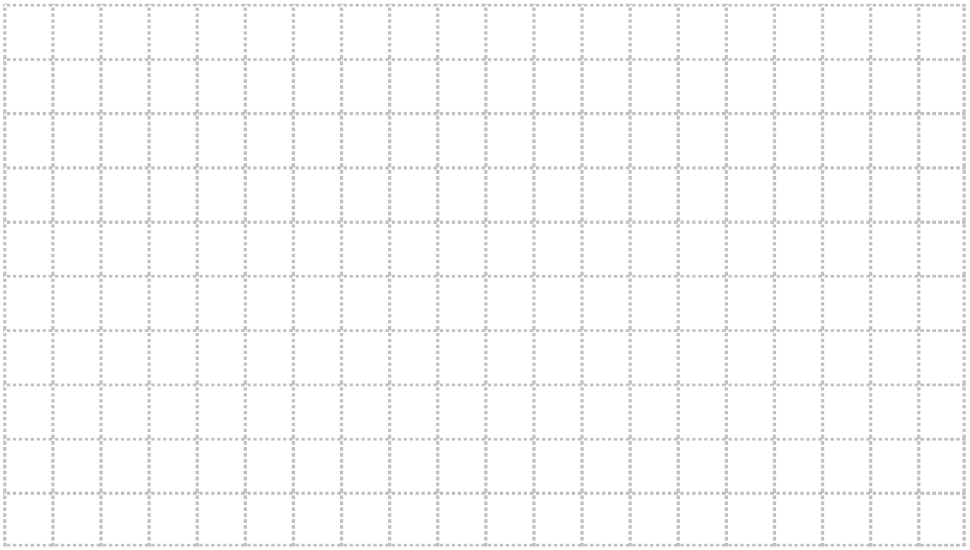

Figure 1-6. Flow rate versus speed curve.

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

Head versus flow rate

☐ 17. 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.

☐ 18. Stop the pump.

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

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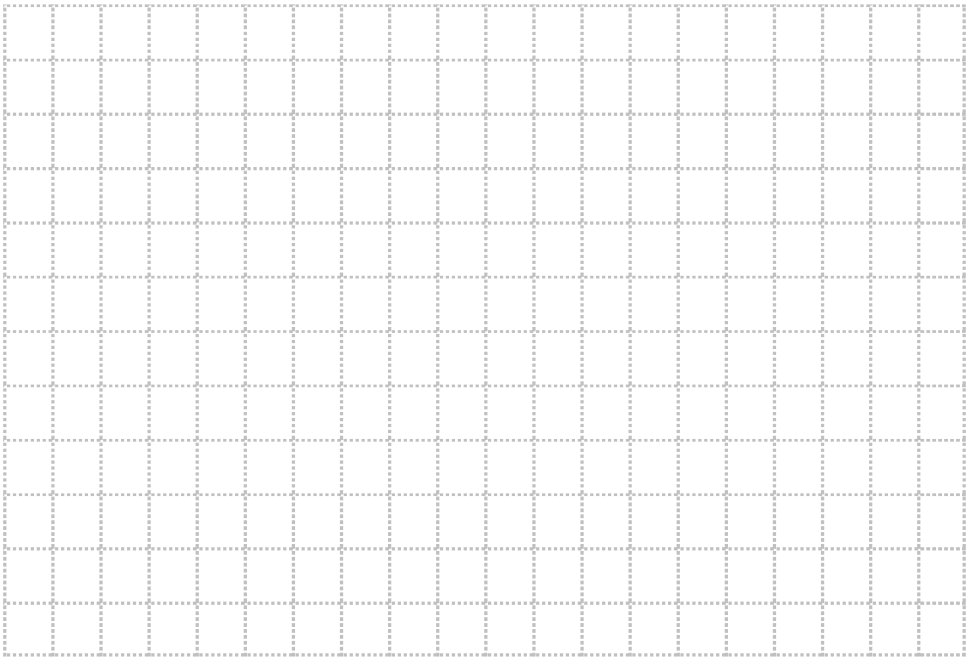

Figure 1-7. Head versus flow rate.

Troubleshooting

☐ 20. By referring to the Troubleshooting Chart in Appendix E, identify two symptoms that an air leak in a suction line may cause.

_____

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_____

☐ 21. By referring to the Troubleshooting Chart in Appendix E, name four possible causes for a loss of suction.

_____

_____

_____

☐ 22. Ask your instructor to check your work.

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

Name: _____ Date: _____

Instructor's approval: _____

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