

Industrial Maintenance

Pneumatic Diaphragm Pump

Courseware Sample

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By the staff of Festo Didactic

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



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








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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 indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
	WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
	CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
	CAUTION used without the <i>Caution, risk of danger</i> 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
	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
Pneumatic Diaphragm Pump

Pneumatic Diaphragm Pump

Description

The Pneumatic Diaphragm Pump of your training system is shown in Figure 1-1. It consists of an air operated double diaphragm pump that utilizes a pressure differential to alternately create suction and positive fluid pressure. As shown in Table C-1 in Appendix C, a pneumatic diaphragm pump is a positive displacement reciprocating pump.

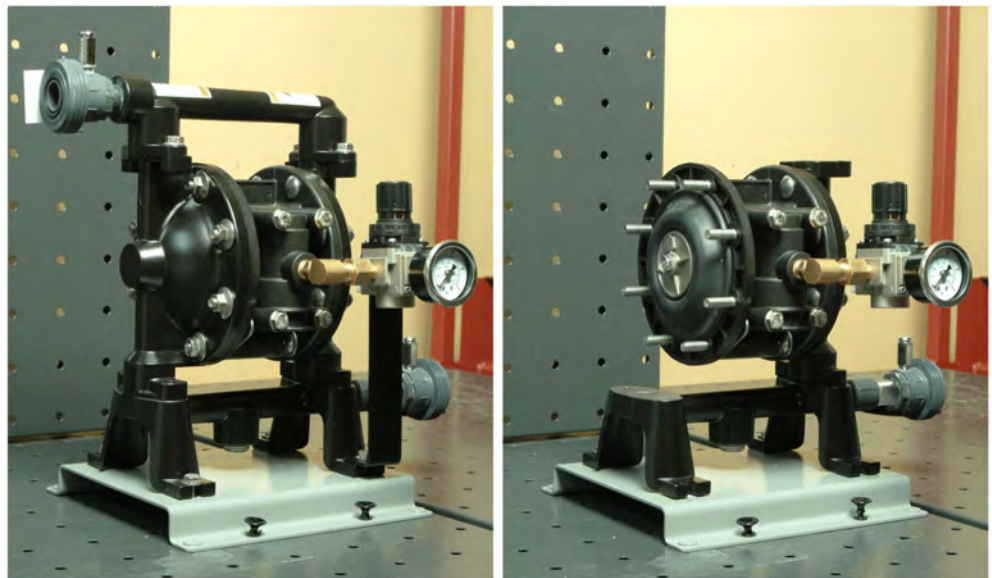


Figure 1-1. Pneumatic Diaphragm Pump with and without a fluid cap.

How it works

Compressed air powers a diaphragm rod to move to the right or left. When moving to the right, cavity C-1 enlarges. This action creates a vacuum drawing in liquid through check valve CV-1. See Figure 1-2.

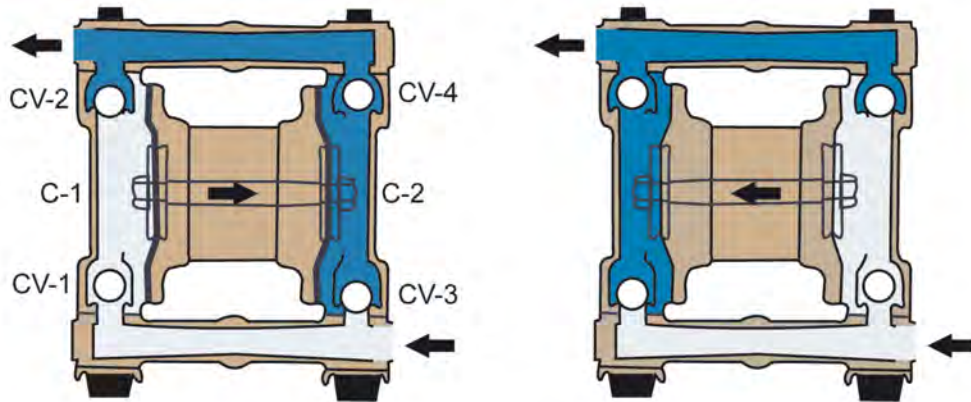


Figure 1-2. Fluid flow in a pneumatic diaphragm pump.

While cavity C-1 enlarges, cavity C-2 compresses forcing the liquid out through check valve CV-4.

Once the diaphragm rod has fully extended to the right, it is redirected to the left compressing cavity C-1 and enlarging cavity C-2. Once the diaphragm rod has fully extended to the left, the cycle repeats.

A pilot spool is pushed back and forth whenever the diaphragm rod reaches the end of its throw. The pilot spool allows air to move the diaphragm rod back and forth.

Advantages

Pneumatic diaphragm pumps can run dry without damage, they will not be damaged if the discharge is blocked, and are self priming (in vertical position). They can pump a wide variety of viscous and impure liquids. Their installation is easy and they require low maintenance. Air powered convenience for use in a variety of installations with no electrical hazard.

Applications

Pneumatic diaphragm pumps are suitable for pumping fluids with particles, and various liquids, which are highly viscous, volatile, corrosive or toxic, as well as colloids. They are widely used in the petroleum, chemical, electronic, ceramic, and textile industries. Sanitary double diaphragm pumps, often made of plastic and/or stainless steel, are used in the food industry to pump everything from sliced fruit, to sausage, to chocolate.

Maintenance

The maintenance required by pneumatic diaphragm pumps consists in:

- Inspecting and cleaning the components inside the pump.

Note: *The components inside the Pneumatic Diaphragm Pump are shown in Figures 1-3 and 1-4.*

- Always flush the pump with a solvent compatible with the material being pumped if this material is subject to setting up when not in use for a period of time.

Characteristics of the Pneumatic Diaphragm Pump of the training system

Maximum flow rate: 13 gal US/min (49.2 l/min)

Maximum discharge pressure: 100 psi (700 kPa)

Displacement/cycle @100 psi (700 kPa): 0.04 gal US/min (0.15 l/min)

Air supply: 3.1 CFM (71 l/min) @ 90 psi (630 kPa) or more

Pneumatic Diaphragm Pump

Task: To inspect, lubricate, install, operate, and troubleshoot a pneumatic diaphragm pump.

PROCEDURE

CAUTION!



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

- 1. Refer to Figures 1-3 and 1-4 to locate and identify the various components of the Pneumatic Diaphragm Pump.

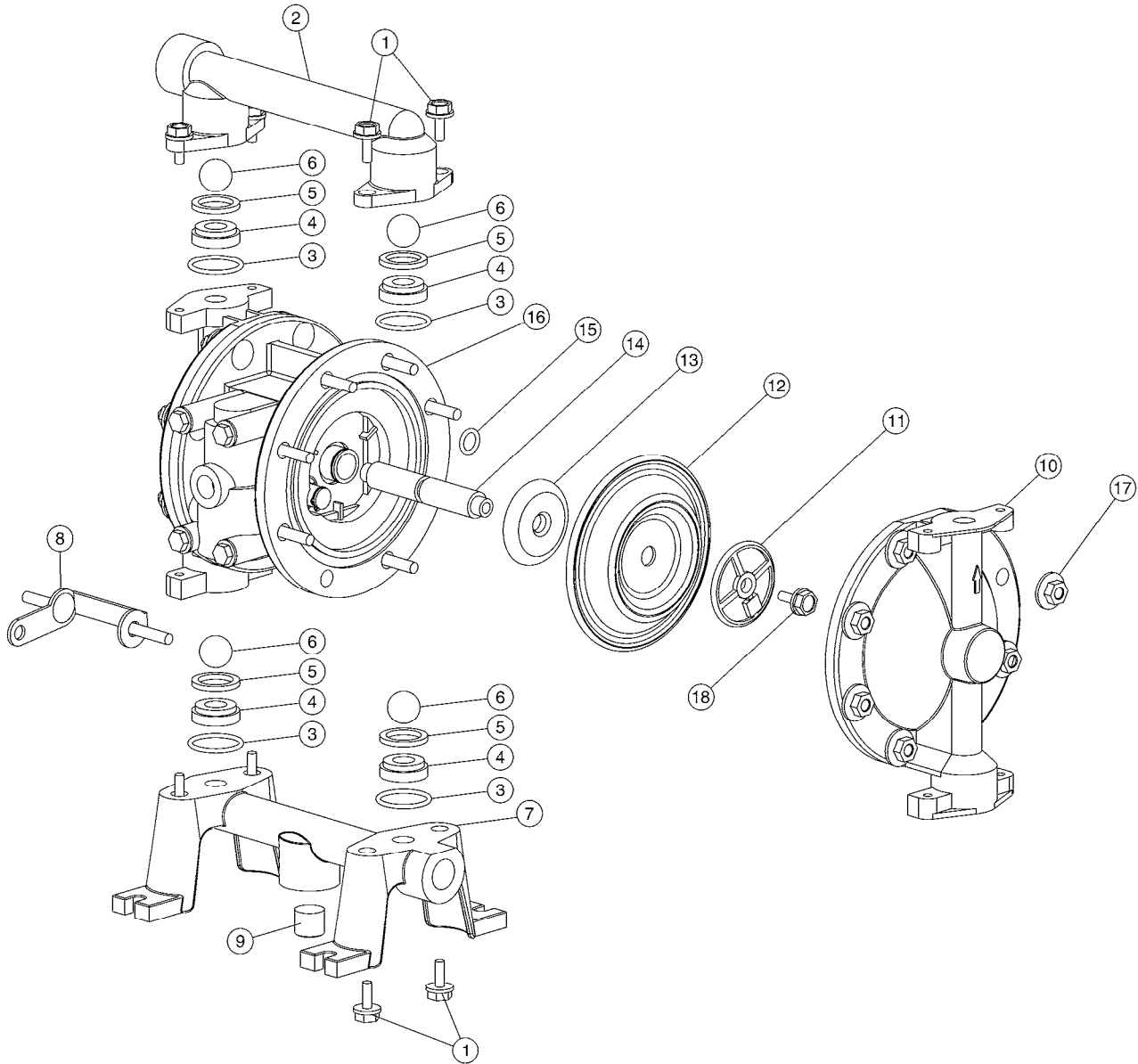


Figure 1-3. Exploded view of the fluid section of the Pneumatic Diaphragm Pump.

- | | | | |
|----|-------------------------|----|------------------------|
| 1 | Screw | 11 | Diaphragm washer (ext) |
| 2 | Manifold outlet (top) | 12 | Diaphragm |
| 3 | O-ring | 13 | Diaphragm washer (int) |
| 4 | Seat | 14 | Diaphragm rod |
| 5 | Washer | 15 | O-ring |
| 6 | Ball | 16 | Pump body |
| 7 | Manifold inlet (bottom) | 17 | Flange nut |
| 8 | Ground strap | | |
| 9 | Drain plug | | |
| 10 | Fluid cap | | |

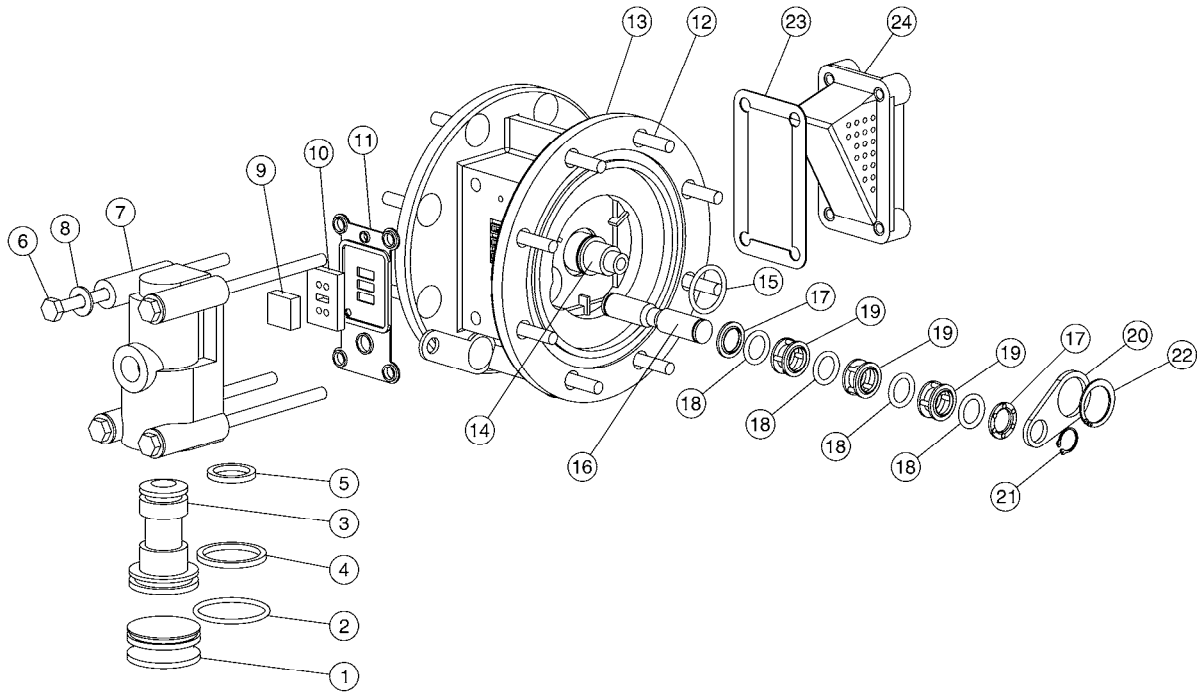


Figure 1-4. Exploded view of the valve section of the Pneumatic Diaphragm Pump.

1	Plug	9	Valve insert	17	Washer
2	O-ring	10	Valve plate	18	O-ring
3	Spool	11	Gasket	19	Spacer
4	U-cup	12	Bolt	20	Plate
5	U-cup	13	Pump body	21	Retaining ring
6	Screw	14	Sleeve	22	Snap ring
7	Valve block	15	O-ring	23	Gasket
8	Washer	16	Pilot spool	24	Muffler

Disassembly of the fluid section of the Pneumatic Diaphragm Pump

□ 2. Disassemble the pump as follows:

- Remove the pump from the base plate.
- Remove the manifold outlet (top).
- Remove the O-rings, seats, washers, and balls.
- Remove the inlet manifold (bottom).
- Remove the O-rings, seats, washers, and balls.
- Remove the fluid caps.
- Remove the screw, diaphragm washer (ext), diaphragm, and diaphragm washer (int).
- Remove the diaphragm rod and remaining screw, diaphragm washer (ext), diaphragm, and diaphragm washer (int).

Note: Do not remove the diaphragm washers, diaphragm, and O-ring from the diaphragm rod.



CAUTION!

Do not remove the pilot valve and the main valve assemblies.

Inspection

- 3. Clean all components, remove all hardened residues.

- 4. Check the components as follows:
 - Inspect the pump housing for excessive wear.
 - Look for scratches on metallic surfaces, and nicks or cuts in O-rings.

Note: Notify your instructor if any parts seem damaged.

Reassembly of the pump

Torque requirements

- Fluid cap nuts: 50-60 lbf•in (5.6-6.8 N•m)
- Manifold screws: 50-60 lbf•in (5.6-6.8 N•m)
- Diaphragm rod screws: 95-105 lbf•in (10.7-11.9 N•m)

Note: Re-torque the fluid cap nuts after initial run in.

- 5. Reassemble the pump as follows:
 - Lubricate the O-rings.

Note: Make sure to use the grease supplied with the Lab-Volt Lubrication Kit, Model 46792, or a grease recommended by the pump manufacturer.
 - Install the diaphragm rod with screw, diaphragm washer (int), diaphragm, and diaphragm washer (ext) in the pump housing.
 - Install the remaining screw, diaphragm washer (int), diaphragm, and diaphragm washer (ext).
 - Install the fluid caps.
 - Install the O-rings, seats, washers, and balls in the inlet manifold (bottom), then install the inlet manifold (bottom).
 - Install the O-rings, seats, washers, and balls in the outlet manifold (top), then install the outlet manifold (top).
 - Attach the pump to the base plate.

Lubrication

Note: There is no lubrication required other than the O-ring lubricant that is applied during assembly or repair.

Circuit setup

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

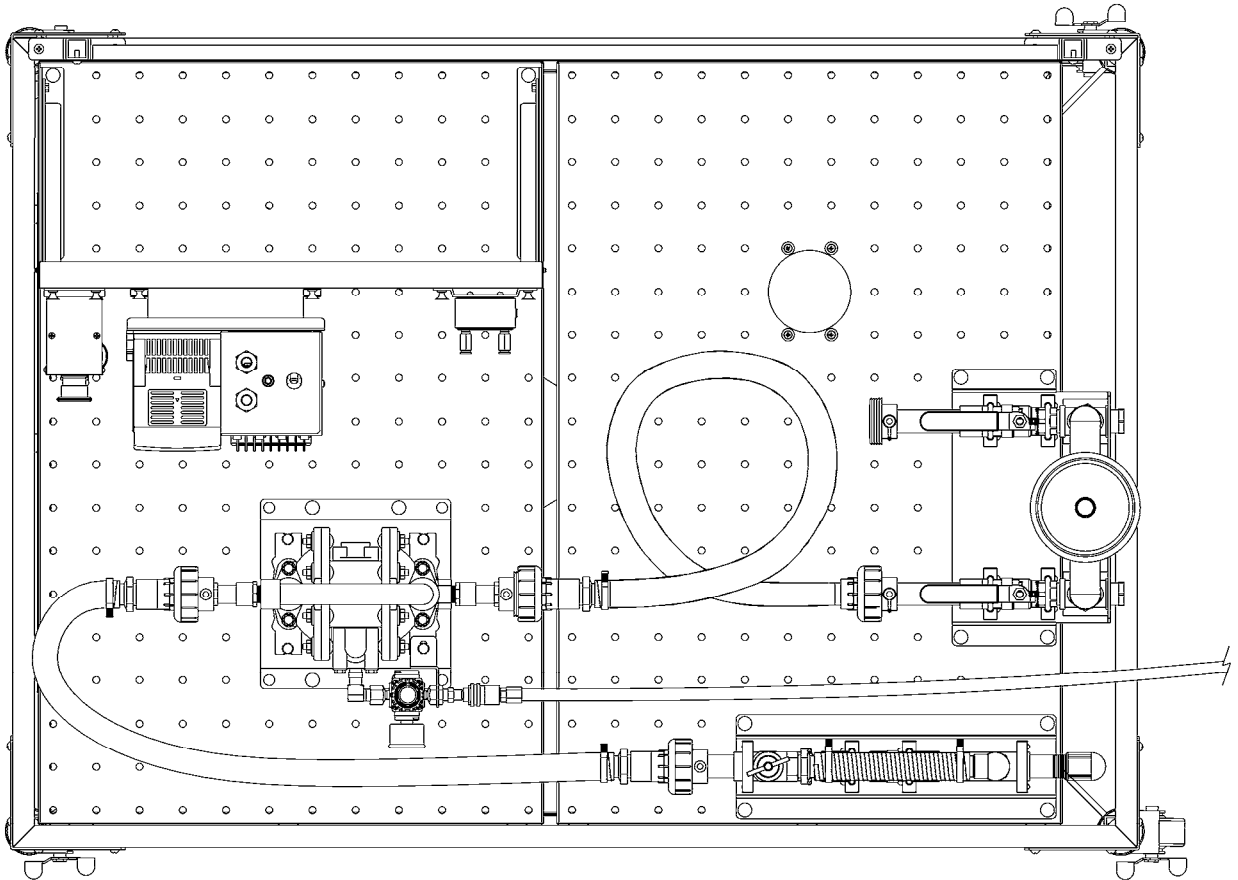


Figure 1-5. Pumping circuit using the Pneumatic Diaphragm Pump.

Note: The circuit does not include a flowmeter. The flow produced by pneumatic diaphragm pumps is pulsated.

- 7. Perform the following settings:
 - Close valve HV-1.
 - Open valves HV-3 and HV-4.
 - Block the alternate flow path of the relief valve module by turning the knob fully clockwise.

- 8. Connect the pump to an air supply.

Note: Refer to Appendix E to learn how to use the air pressure regulator.

- 9. Set the air pressure regulator to 20 psi (140 kPa).

- 10. Describe what happens to the pump operation.

- 11. Close valve HV-4.

Describe what happens to the pump operation.

- 12. Open valves HV-4 and HV-1.

Describe what happens to the pump operation.

- 13. Close valve HV-1.

Describe what happens to the pump operation.

- 14. Familiarize yourself with the operation of the Pneumatic Diaphragm Pump by varying the position of valves HV-3 and HV-4, and the pressure set by the pressure regulator.

Note: Do not exceed 50 psi (350 kPa) on the pressure regulator.

- 15. Stop the pump.

Troubleshooting

- 16. By referring to the Troubleshooting Chart in Appendix D, identify two symptoms that loose fluid caps may cause.

- 17. By referring to the Troubleshooting Chart in Appendix D, name seven possible causes for a low output volume.

- 18. Ask your instructor to check your work.

- 19. Disconnect your setup, and return the equipment to the storage location.

Name: _____ Date: _____

Instructor's approval: _____