

Industrial Maintenance

Peristaltic Pump

Courseware Sample

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By the staff of Festo Didactic

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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 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
Peristaltic Pump

Peristaltic Pump - Little Giant

Description

The Peristaltic Pump of your training system is shown in Figure 1-1. It consists of an impeller assembly consisting of two rollers (bearings) squeezing a tube in a cylindrical housing. As shown in Table C-1 in Appendix C, a peristaltic pump, also called tube pump, is a positive displacement rotary pump.

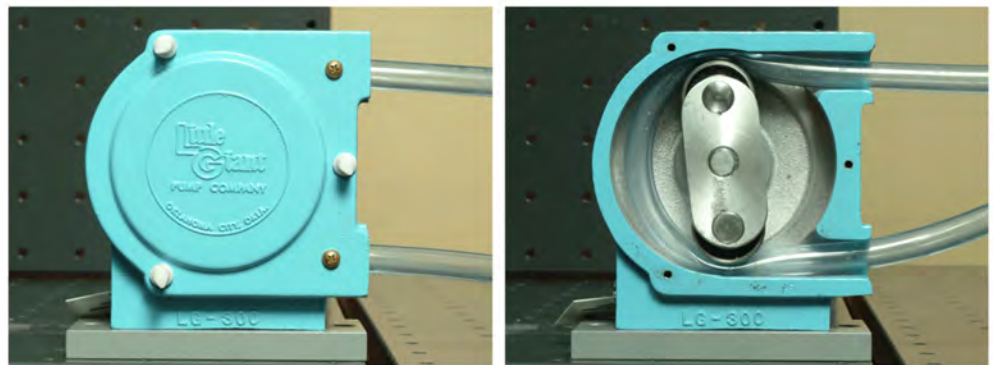


Figure 1-1. Peristaltic Pump with and without cover.

How it works

As the rollers compress the tubing and move away from the inlet, a vacuum is created drawing in liquid. See Figure 1-2.

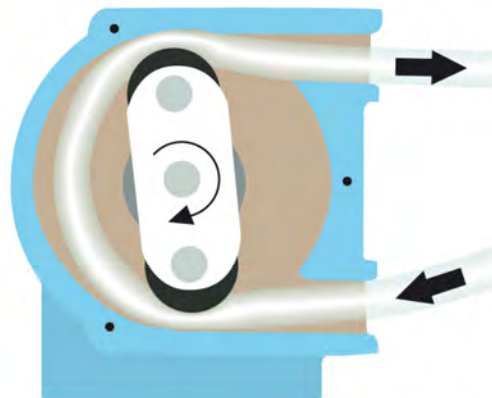


Figure 1-2. Fluid flow in a peristaltic pump.

The rollers work together to capture the liquid between the pinched areas of the tube and move the liquid toward the discharge.

When the front roller leaves the tubing, it opens the captured area while the back roller pushes the liquid out the discharge.

Advantages and disadvantages

Advantages: one of the main advantages of peristaltic pumps is cleanliness. The liquid comes in contact only with the tubing utilized within the pump. In medical applications, fragile blood cells are not damaged by this pump. They are self priming and reversible. They can handle viscous, corrosive, abrasive, and high purity solutions.

Disadvantages: some pulsating in the discharge is unavoidable because of the peristaltic action.

Applications

Peristaltic pumps are typically used to pump clean or sterile fluids because the pump does not contaminate the fluid, or to pump aggressive fluids because the fluid does not contaminate the pump. They have a variety of medical applications. They can be used to add nutrients to blood, to force blood through filters to clean it (such as dialysis machines), or to move blood through the body and lungs during open heart surgery.

Maintenance

The maintenance required by peristaltic pumps consists in:

- Checking the tubing periodically, and replacing when necessary.
- Lubricating the tubing with a silicon lubricant to lengthen tubing life.
- Checking the shaft alignment at regular intervals.
- Inspecting and cleaning the components inside the pump.

Characteristics of the Peristaltic Pump of the training system

Maximum speed: 800 r/min

Maximum discharge pressure: 20 psi (140 kPa)

Direction of rotation: bidirectional

Maximum flow depends on the tubing type and the fluid viscosity.

Characteristics of the flexible tubing supplied with the pump

Resin: PVC

Durometer: 60 (A)

Inside diameter (I.D.): 3/8 in.

Outside diameter (O.D.): 5/8 in.

Peristaltic Pump - Little Giant

Task: To inspect, lubricate, install, operate, and troubleshoot a peristaltic 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 Peristaltic Pump.

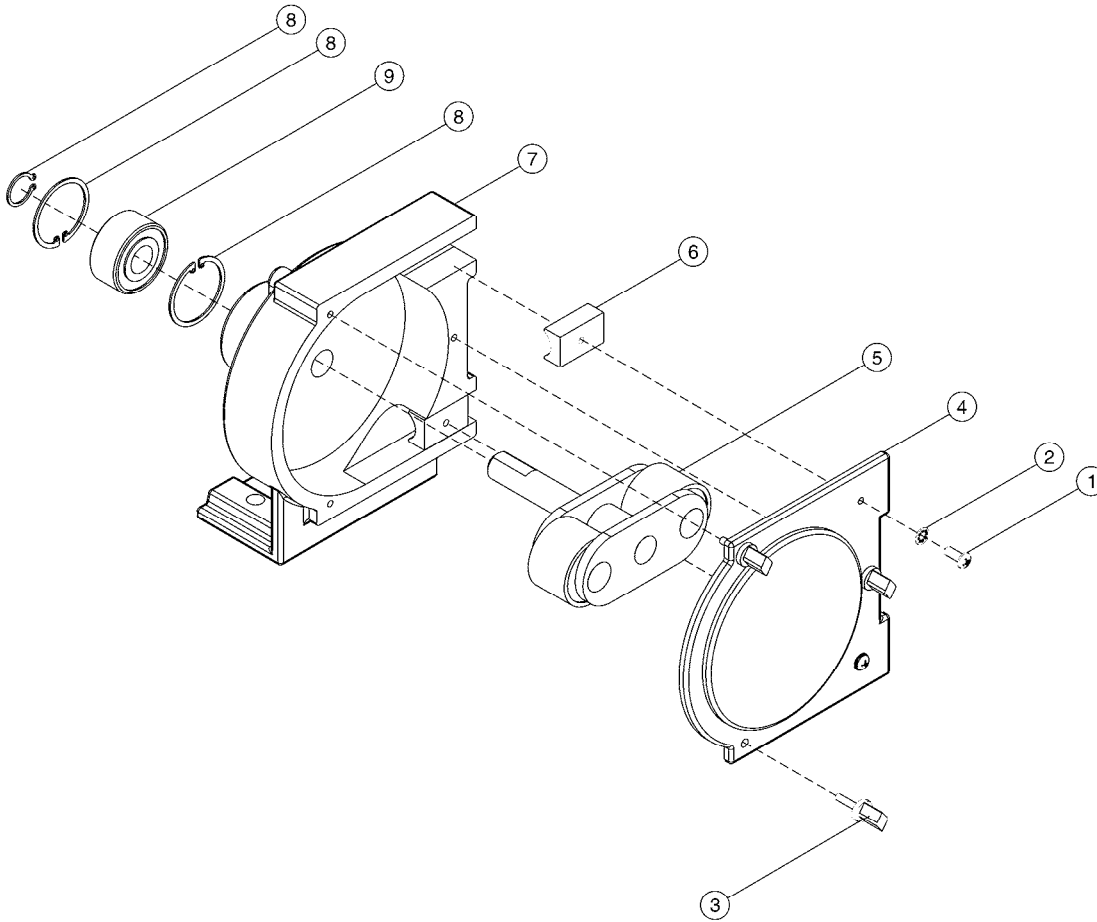


Figure 1-3. Exploded view of the Peristaltic Pump.

- | | | | |
|---|-------------------|---|----------------|
| 1 | Screw | 6 | Tubing clamp |
| 2 | Lock washer | 7 | Housing |
| 3 | Thumb screw | 8 | Retaining ring |
| 4 | Cover | 9 | Bearing |
| 5 | Impeller assembly | | |

Disassembly of the Peristaltic Pump

- 2. Disassemble the pump as follows:
 - Remove the pump cover by removing the 3 cover thumb screws.
 - Remove the tubing.

CAUTION!



Do not remove other components from the pump.

Inspection

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

- 4. Check the components as follows:
 - Inspect the tubing for excessive wear.
 - Inspect the impeller assembly for wear.
 - Make sure each bearing of the impeller assembly rotates freely.

Note: Notify your instructor if any parts seem damaged.

Reassembly of the pump

- 5. Install the tubing as follows:
 - Position the impeller assembly parallel to the pump base.
 - Place the tubing in one of the grooves in the pump housing and rotate the impeller assembly while placing the tubing in the position behind the turning impeller.
 - Seat the tubing fully up against the back of the housing.
 - Be sure the impeller rollers press the tubing evenly against the housing.

CAUTION!

Improper positioning of the tubing will cause wear and tubing will be cut by the impeller rollers.



- Replace the cover.

Note: When replacing the cover, adjust the tubing clamps until they hold the tubing tight enough so that it cannot be pulled through the pump when the cover is installed. If the clamps are too tight, the flow will be restricted.

Lubrication

Note: The section of tubing, where the impeller rollers rub, should be lubricated with a silicon lubricant to increase the tubing life. However, when using the pump for short periods, lubrication is not required.

Circuit setup

- 6. Install the Peristaltic Pump on the Pump Universal Base as shown in Figure 1-4.

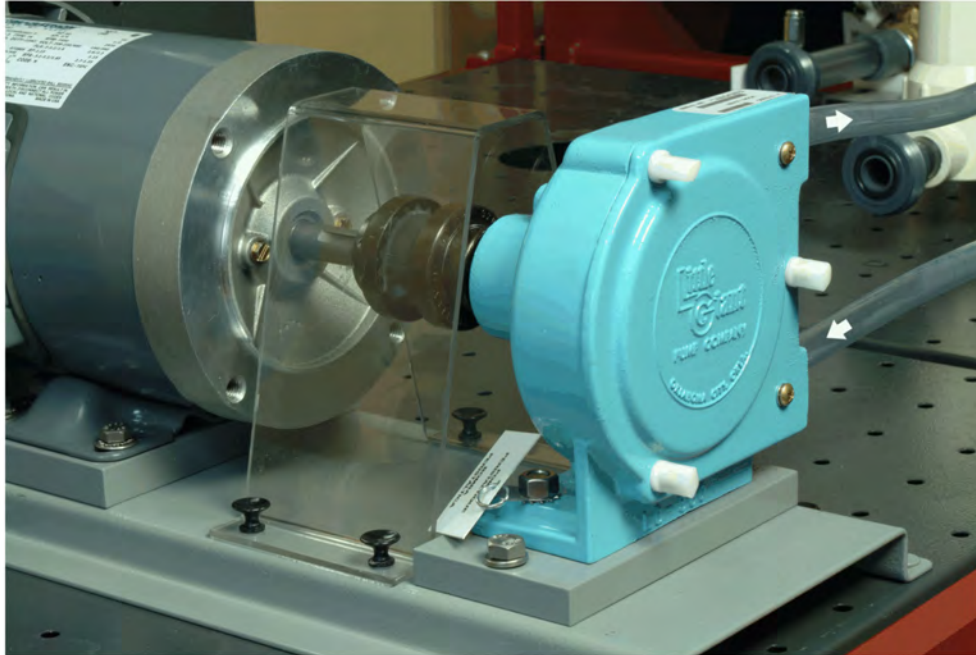


Figure 1-4. Installation of the Peristaltic Pump on the Pump Universal Base.

- 7. Install the coupling and align the shafts.

Note: Position the 5/8-in. coupling hub on the pump shaft so the setscrew faces the flat surface of the shaft.

- 8. Install the coupling guard.

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

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

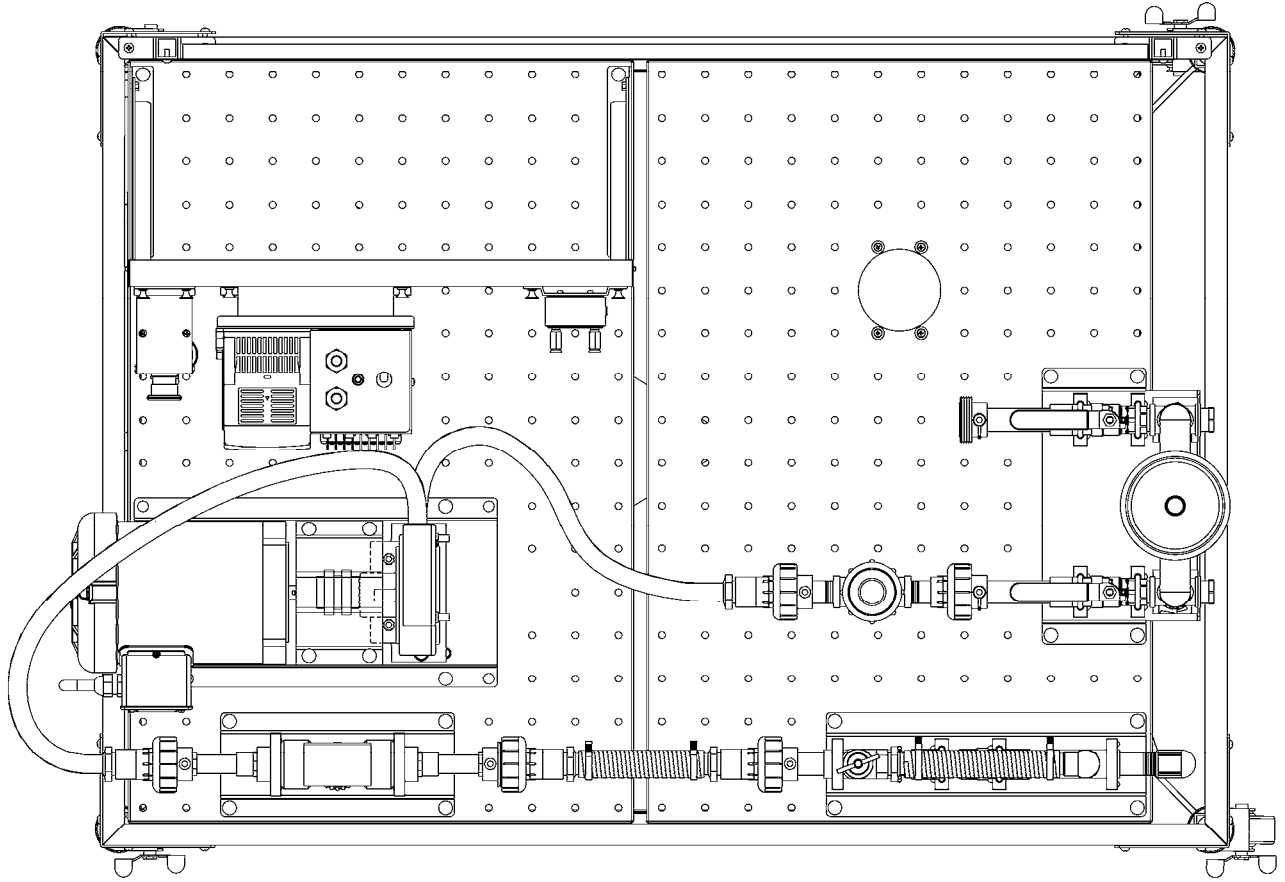


Figure 1-5. Pumping circuit using the Peristaltic Pump.

- 10. Connect the Variable Speed Drive and Motor.
- 11. Perform the following settings on the Variable Speed Drive:
 - Set the maximum output frequency to 12 Hz.
 - Set the direction of rotation to forward.

CAUTION!



Make sure that the direction of rotation is correctly set. If the pump output is returned to the suction line, damage may occur.

- 12. Set the relief valve to limit the pressure in the circuit to 20 psi (140 kPa) when the output frequency is 12 Hz.

Flow rate versus speed

- 13. 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 12 Hz by increments of 3 Hz. For each setting, measure the flow rate and enter your results in Table 1-1.

OUTPUT FREQUENCY (Hz)	0	3	6	9	12
CORRESPONDING SPEED (r/min) (approximate value)	0	173	345	518	690
FLOW RATE					

Table 1-1. Flow rate versus output frequency.

- 14. Plot the flow rate versus speed curve in Figure 1-6.

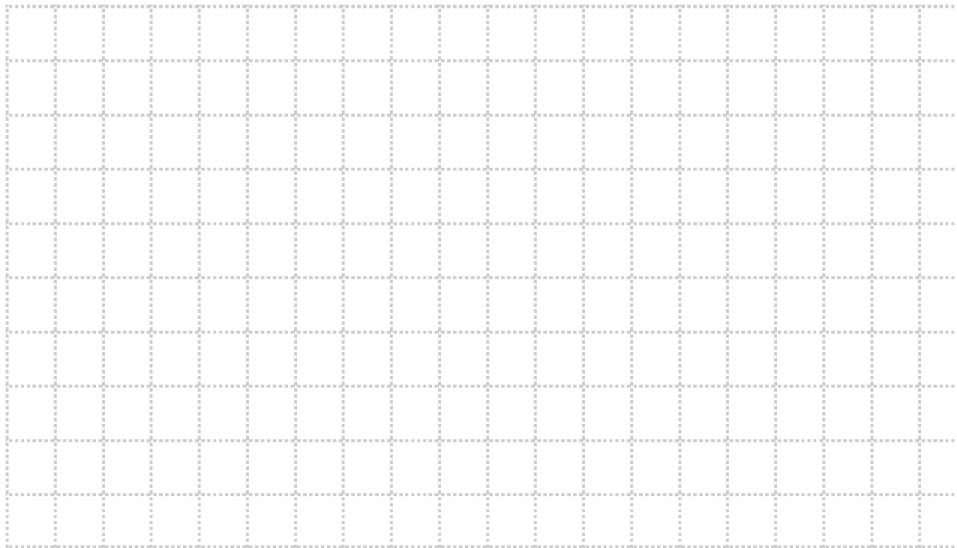


Figure 1-6. Flow rate versus speed curve.

- 15. From the curve you obtained, describe the relationship between the flow rate and speed.

Head versus flow rate

- 16. 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 4 Hz.
 - Close valve HV-4 to increase the head by increments of 5 ft (1.5 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 8 and 12 Hz.

OUTPUT FREQUENCY					
4 Hz		8 Hz		12 Hz	
HEAD	FLOW RATE	HEAD	FLOW RATE	HEAD	FLOW RATE

Table 1-2. Head versus flow rate characteristics.

- 17. Stop the pump.

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

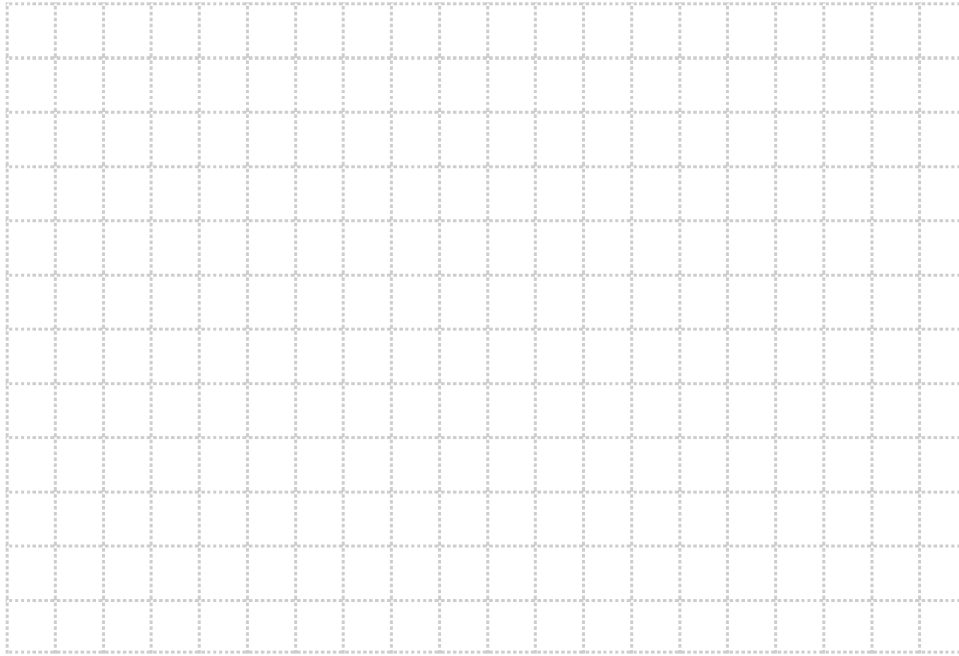


Figure 1-7. Head versus flow rate.

Troubleshooting

- 19. By referring to the Troubleshooting Chart in Appendix E, identify three symptoms that a tubing not properly installed may cause.

- 20. By referring to the Troubleshooting Chart in Appendix E, name five possible causes for a low flow rate.

- 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: _____