

Industrial Maintenance

External Gear 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
External Gear Pump

External Gear Pump

Description

The External Gear Pump of your training system is shown in Figure 1-1. It consists of two gears meshing together and revolving in opposite directions within the housing. As shown in Table C-1 in Appendix C, an external gear pump is a positive displacement rotary pump.

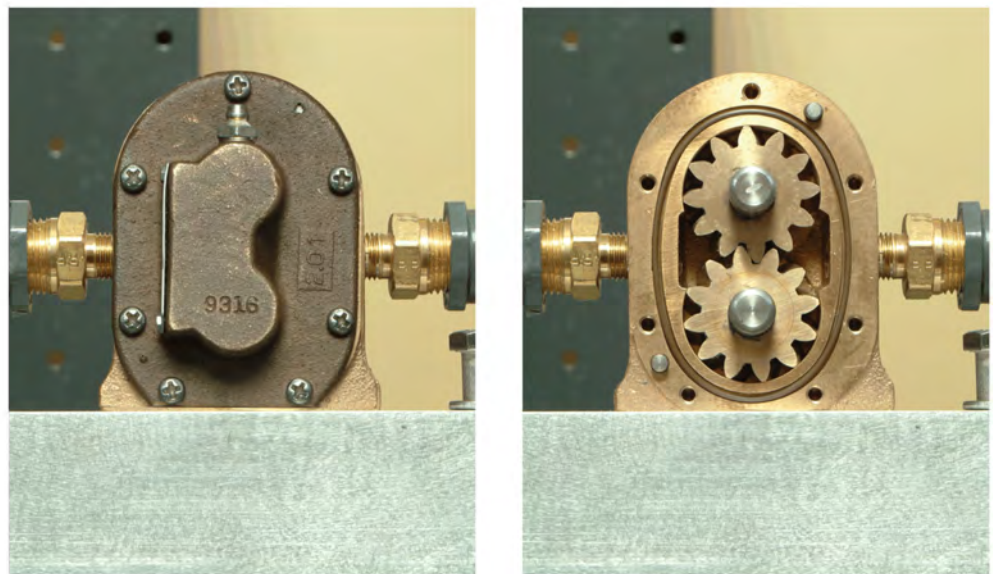


Figure 1-1. External Gear Pump with and without cover.

How it works

As the gears separate on the inlet side of the pump, cavities are created between the gear teeth, which create a vacuum that draws in the liquid. See Figure 1-2.



Figure 1-2. Fluid flow in an external gear pump.

Once the teeth clear the inlet port, the liquid is captured between the gear teeth and the housing. As the teeth mesh, the liquid is squeezed out of the cavity and forced out of the discharge port.

Gear pumps can be damaged when operating against a closed discharge and, therefore, a pressure relief valve is necessary.

Advantages and disadvantages

Advantages: most external gear pumps are self priming, create low pressure pulsations, and are reversible. They have little flow variation with change of viscosity or pressure.

Disadvantages: they cannot run dry, and are only suitable for clean fluids. They need close tolerances to operate, so fits and alignment are critical.

Applications

External gear pumps are very popular. They are commonly used for high-pressure applications such as hydraulic applications. They are also used in industrial and mobile applications, fuel and lubrication, mixing and blending, precise metering applications, and low-volume transfers.

Maintenance

The maintenance required by external gear pumps consists in:

- Lubricating the pump as suggested by the manufacturer. Lubricate the pump with water pump grease at least every 8 operating hours when pumping water.

Note: *The lubrication of external gear pumps depends on the liquid being pumped. As an example, lubrication is not required when the pump is used to pump oil. However, it can be damaged if it is run dry.*

- Checking the pump to motor shaft alignment at regular intervals.
- Adjusting the packing nut to allow drippage for cooling and lubricating the shaft.
- Inspecting and cleaning the components inside the pump.

Note: *The packing nut and the components inside the External Gear Pump are shown in Figure 1-3.*

Characteristics of the External Gear Pump of the training system

Maximum speed: 1750 r/min

Maximum discharge pressure: 125 psi (875 kPa)

Maximum flow rate: 2.8 gal US/min (10.6 l/min) at 125 psi (875 kPa)

Direction of rotation: reversible

Sealing element: packing seal

External Gear Pump

Task: To inspect, lubricate, install, adjust the packing nut, operate, and troubleshoot an external gear 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 External Gear Pump.

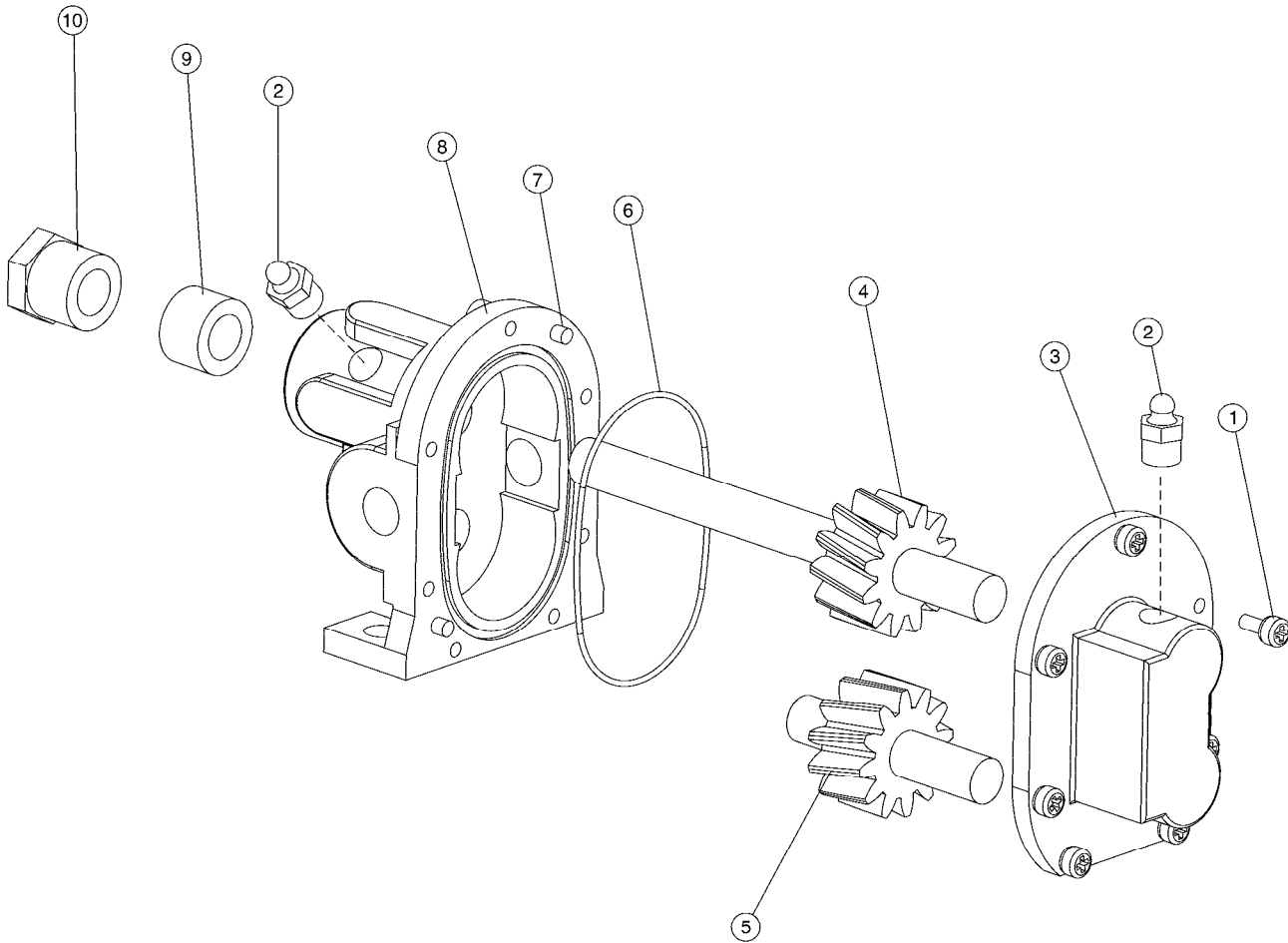


Figure 1-3. Exploded view of the External Gear Pump.

- | | | | |
|---|----------------------------|----|-------------|
| 1 | Screw | 6 | O-ring |
| 2 | Grease fitting | 7 | Dowel pin |
| 3 | Cover | 8 | Housing |
| 4 | Drive gear-shaft assembly | 9 | Packing |
| 5 | Driven gear-shaft assembly | 10 | Packing nut |

Disassembly of the External Gear Pump

2. Disassemble the pump as follows:

- Remove the packing nut.
- Remove the screws and the cover.

Note: *Be careful not to damage the O-ring when removing the cover.*

- Remove the drive gear-shaft assembly.

Note: *Do not remove the packing.*

- Remove the driven gear-shaft assembly.

Inspection

3. Clean all components, remove all hardened residues.

4. Check the components as follows:

- Inspect the pump housing for excessive wear in the shaft holes.
- Inspect the shaft-gear assemblies for wear.
- Inspect the teeth of the gears for wear or irregular shape.
- Inspect the O-ring.

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

Reassembly of the pump

5. Reassemble the pump as follows:

- Insert the driven gear-shaft assembly.
- Insert the drive gear-shaft assembly. Rotate the shaft during the insertion to prevent damage to the packing.
- Install the cover.

Note: *Make sure the O-ring is correctly installed.*

- Install the screws and tighten in an opposing sequence.

Note: *As the cover is tightened, the shaft should be rotated to prevent binding.*

- Install the packing nut, hand tighten.

Lubrication

- 6. Lubricate the pump as follows (for each fitting):
 - 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 fittings and grease coupler.

Circuit setup

- 7. Install the External Gear Pump on the Pump Universal Base as shown in Figure 1-4.



Figure 1-4. Installation of the External Gear 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 grease may circulate in the piping, install the strainer at the pump outlet to prevent water contamination.

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

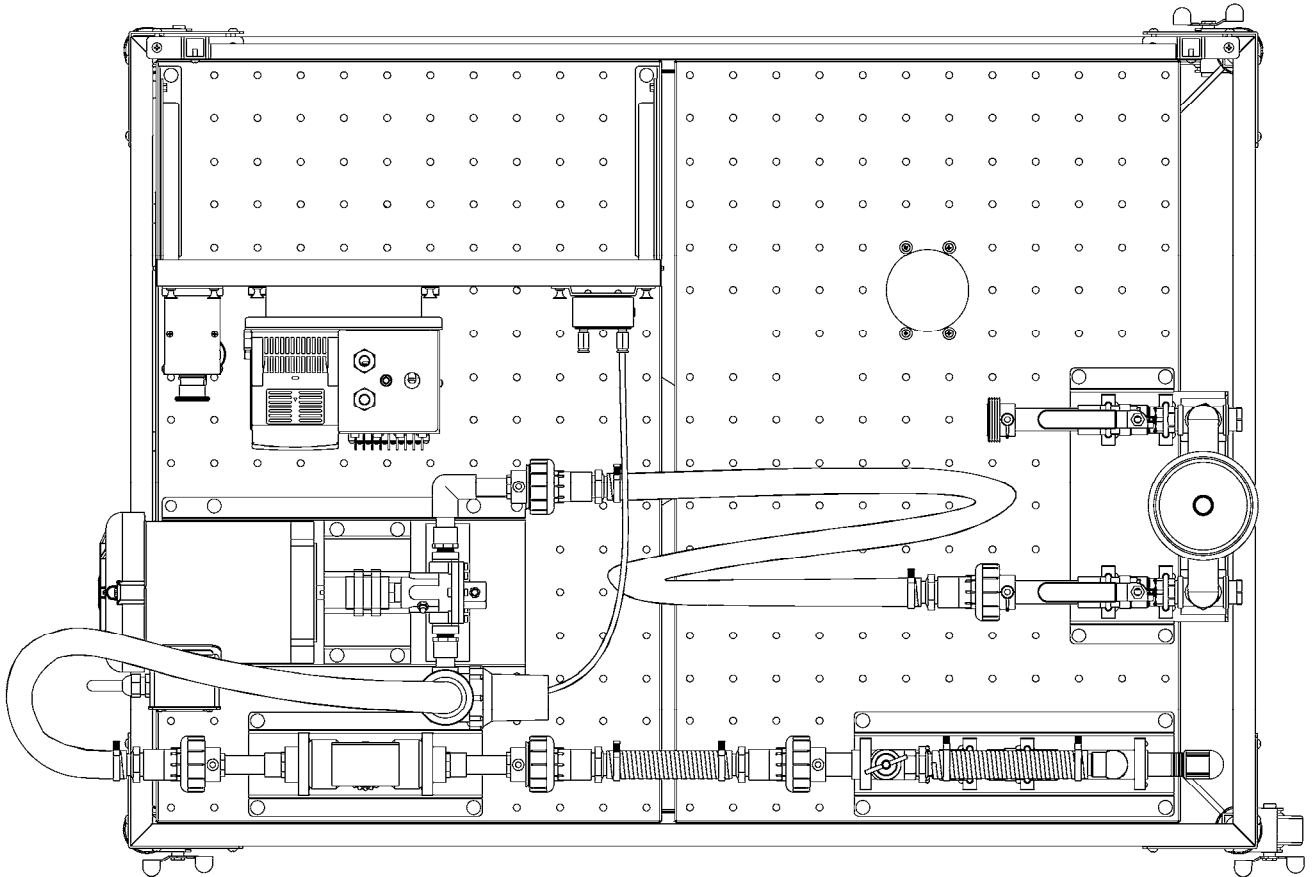


Figure 1-5. Pumping circuit using the External Gear Pump.

- 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. If the pump output is returned to the suction line, damage may occur.

- 13. 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).

Packing nut adjustment

- 14. Run the pump at 50 psi (350 kPa) when the output frequency is 30 Hz while observing if water leaks from the packing.

CAUTION!



Do not adjust the packing nut while the pump is running.

- 15. Stop the pump, then adjust the pressure applied to the packing by screwing or unscrewing the packing nut to allow drippage of 2 to 4 drips per minute. Repeat the setting until you obtain the desired flow rate.

Note: Over tightening the packing nut will cause premature shaft wear and increased horsepower requirements, possibly resulting in overheating.

Packing nut adjustment compresses or decompresses the packing to set desired leakage for cooling and lubricating of the shaft.

Flow rate versus speed

- 16. 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.

17. Plot the flow rate versus speed (30 Hz \approx 1725 r/min) curve in Figure 1-6.

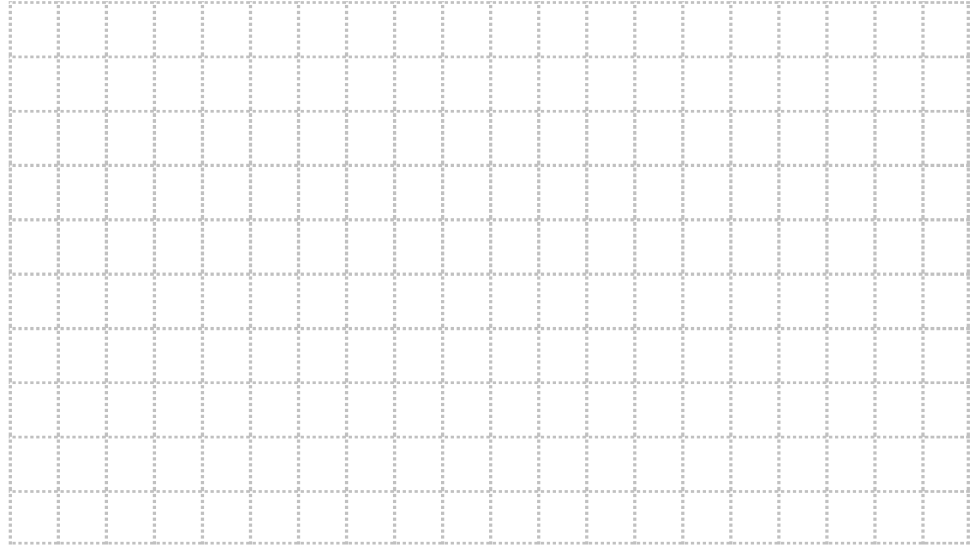


Figure 1-6. Flow rate versus speed curve.

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

Head versus flow rate

19. Determine the head versus flow rate characteristics as follows:
- Open valve HV-4.
 - 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.

- 20. Stop the pump.

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

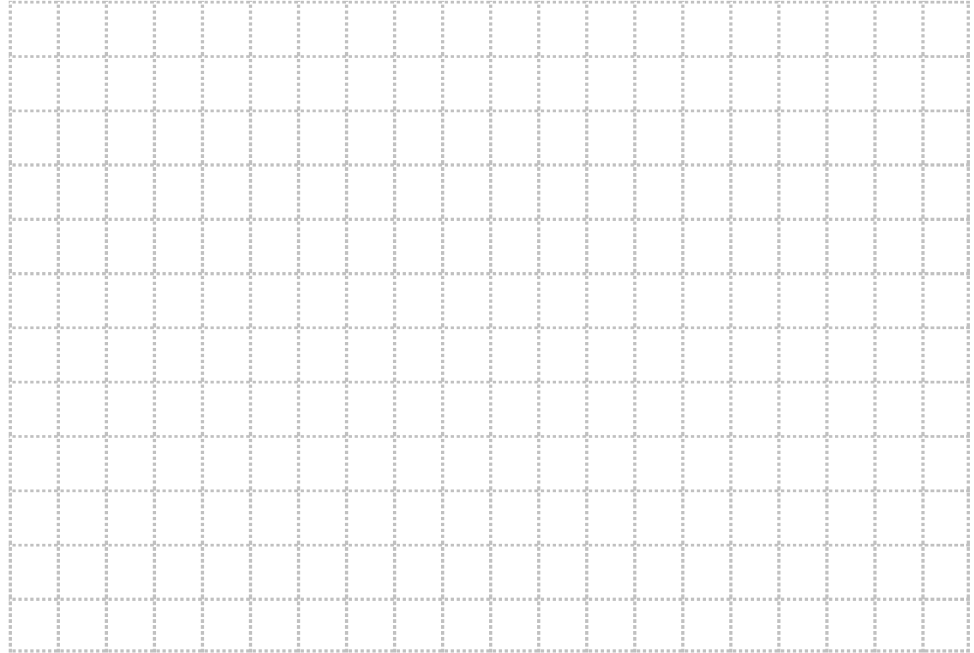


Figure 1-7. Head versus flow rate.

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

Troubleshooting

23. By referring to the Troubleshooting Chart in Appendix E, identify four symptoms that worn gears may cause.

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

- 25. Ask your instructor to check your work.

- 26. Disconnect your setup, clean the strainer, and return the equipment to the storage location.

Name: _____ Date: _____

Instructor's approval: _____