

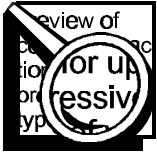
N-02

MAINTENANCE MECHANIC TRAINING

SKILL DEVELOPMENT GUIDE

Duty N: System Troubleshooting
N-02: Troubleshoot Pneumatic System

Issued 6/01/98



Task Preview

Troubleshoot Pneumatic System

The Maintenance Mechanic, or an apprentice with supervision, troubleshoots a pneumatic system when a Machine Operator or Line foreman turns in a ticket for a pneumatic system problem. Troubleshooting is performed to identify the problem and to suggest a corrective action that will return the machine to normal operation.

The Maintenance Mechanic must know basic pneumatic principles, and the procedures for repairing or replacing gages and valves to correctly troubleshoot a pneumatics system. The quality of the product will suffer, coolant for the machine will not work, a part on the machine may not operate, or the machine itself may not operate, if this task is not performed according to the task standards.

The first step in troubleshooting is to communicate with the Machine Operator about the problem. Check the system pressure and verify valve and actuator operation. Check the filter, regulator, and lubricator operation then check the components according to the circuit for the pneumatic system on which you are working.

How your skills will be checked

The Skill Check will require you to troubleshoot a pneumatic system. All tools, materials, and resources will be available. The Evaluator will verify that your demonstration meets the skill objective by observing or measuring each task standard. You must demonstrate safe work practices during the Skill Check. Contact your Evaluator when you are ready for the Skill Check.



Skill Objective

Given a pneumatic system that is not operating according to manufacturer's specifications, troubleshoot pneumatic system.

Task Standards

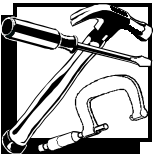
1. The fault must be identified.
2. The recommended corrective action must return the pneumatic system to normal operating conditions as shown on the pneumatic print or manufacturer's specifications.

What You Will Need

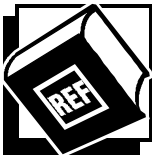
This section contains the safety information, tools, and resources you will need before troubleshooting a pneumatic system.



- Follow all Caterpillar facility safety standards when performing this task.
- Perform lockout/tagout when checking operation of the three-way solenoid valve. There is 110 VAC or 24 VDC supplied to the valve.



- Maintenance Mechanic hand tools



- pneumatic print, if available
- manufacturer's specifications

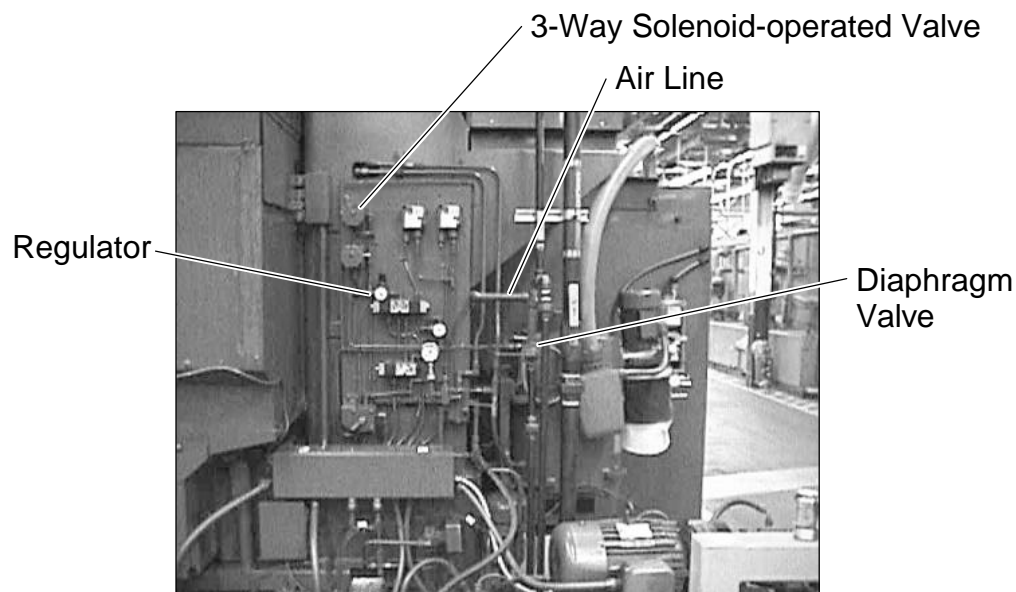


Task Steps

Troubleshoot Pneumatic System

Note: A pneumatic actuator may include a valve, motor, or cylinder.

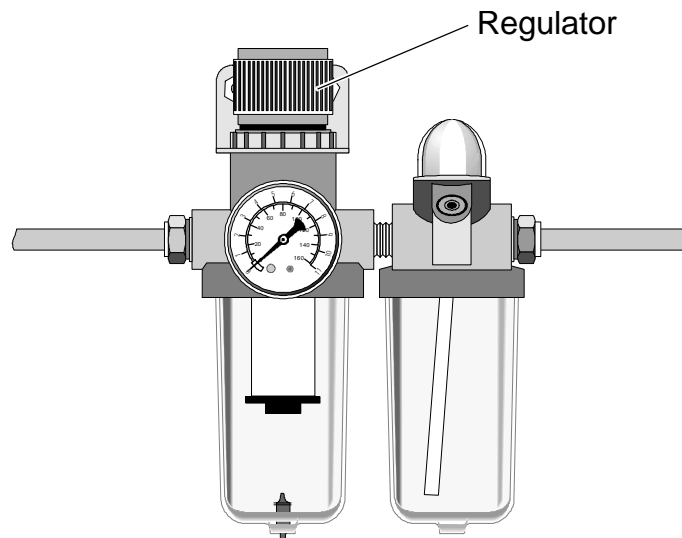
1. Ask the Machine Operator to describe the problem.
 - Note the problems and when they happen.
2. Check the system air pressure for normal machine readings.
 - Check the gage pressure reading at the pneumatic control center.



Pneumatic Control Center

- Check for air from the air hose.
3. Verify the operation of the filter, regulator, and lubricator.
 - The filter is operating correctly if air is flowing to the solenoid-activated valve.

- The regulator must be set at equal or greater psi than the fluid pressure.

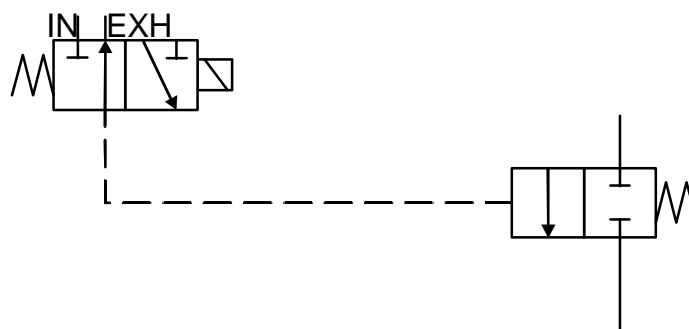


Filter-Regulator-Lubricator (F-R-L)

- Visually check the lubricator during operation to verify that it is dripping oil into the air supply. A circuit with a diaphragm valve may not be equipped with a lubricator.

Note: Most pneumatic systems consist of the components from the previous steps. The pneumatic systems most commonly used in Caterpillar facilities are actuating some other process (i.e., turning coolant flow on or off). This procedure is divided into three sections from this point. The three types of pneumatic circuits used in a pneumatic system: 1) Diaphragm Valve Circuit, 2) Pneumatic Motor Circuit, and 3) Pneumatic Cylinder Circuit.

Troubleshooting a Diaphragm Valve Circuit



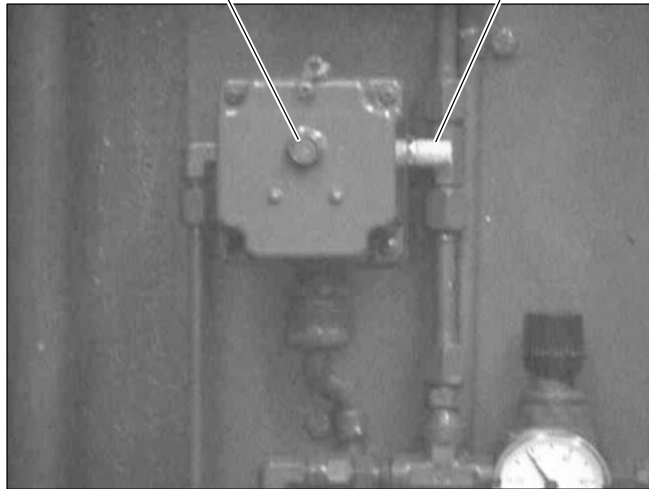
Basic Pneumatic Valve Circuit

1. Verify that the three-way solenoid operated valve is functioning.

- Push in the manual solenoid override button, if equipped, to operate the valve.

Manual Solenoid Override

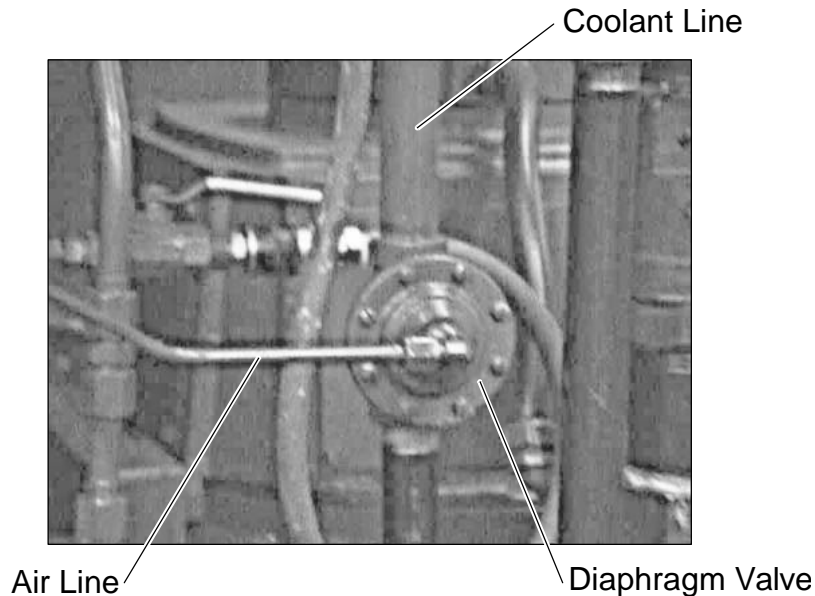
Muffler



Three-Way Valve

- Follow the procedure to repair/replace the valve if the spool sticks when manually operated.
- Ask an Electrician to check the electrical supply to the solenoid, if the manual override energizes the valve and allows air to flow through the valve, to the diaphragm valve.
- Follow the procedure to repair/replace the valve if the Electrician verifies the electrical supply to the solenoid.
- Remove the muffler from the valve to check the air flow, and clean the muffler while it is out.

2. Verify the diaphragm valve operation.

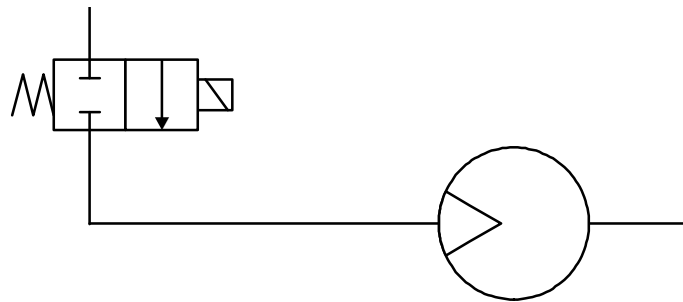


Diaphragm Valve

- “Crack” (open enough to verify air flow) the air line to the diaphragm valve. Verify that there is air flowing from the solenoid operated valve to the diaphragm valve.
- Follow the procedures to repair/replace the valve if no air is flowing from the solenoid operated valve.
- Shut off the air supply, if there is air from the solenoid operated valve, and follow the procedure to troubleshoot fluid control devices. Look for an obstruction in the line or a faulty diaphragm valve.
- Follow the procedure to replace a cylinder or rotary actuator if the fluid control device is operating normally.

Troubleshoot Pneumatic Motor Circuit

Symptoms: A rotating machine part has stopped operating or is operating improperly (i.e., a grinding wheel has stopped turning).

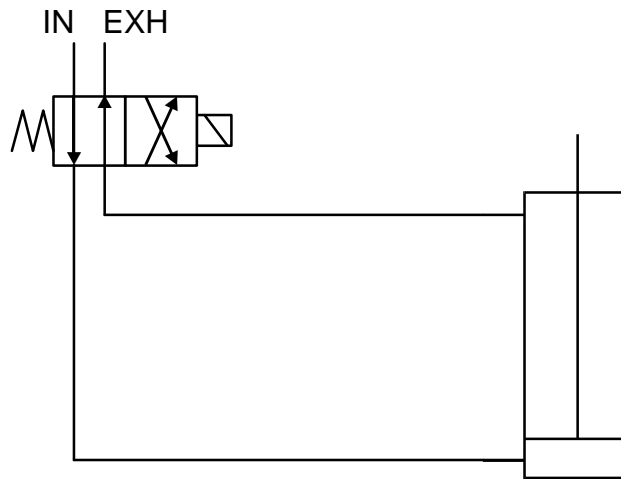


Basic Pneumatic Motor Circuit

1. Verify that the two-way solenoid operated valve is functioning.
 - Push the manual override button, if equipped, to operate the valve.
 - Follow the procedure to repair/replace the valve if the spool sticks when manually operated.
 - Ask an Electrician to check the electrical supply to the solenoid, if the manual override energizes the valve and allows air to flow through the valve to the motor.
 - Also ask the Electrician to verify that the coil is not burned up.
 - Follow the procedure to repair/replace valve, if the Electrician verifies electrical supply to the solenoid.
2. Energize the solenoid to operate and check the motor shaft rotation.
 - Check for a blown fuse; ask an Electrician to check the circuit.
 - Check for a blocked air line or plugged filter.
 - Check the muffler on the motor for plugs.
 - Follow the procedure to troubleshoot a motor, if the shaft is still not rotating.
3. Replace the solenoid-operated valve, if the motor shaft rotates when the valve is de-energized.

Troubleshoot Pneumatic Cylinder Circuit

Symptoms: Cylinder fails to extend or return (depending upon circuit requirements) when the solenoid operated valve is energized.



1. Verify that the four-way solenoid operated valve is functioning.
 - Push the manual override button, if equipped, to operate the valve.
 - Follow the procedures to repair/replace a valve if the spool sticks when manually operated.
 - Ask an Electrician to check the electrical supply to the solenoid, if the manual override energizes the valve and allows air to flow through the valve to the cylinder.
 - Also ask the Electrician to verify that the coil is not burned up.
 - Follow the procedures to repair/replace a valve, if the Electrician verifies electrical supply to the solenoid.
2. Check the cylinder.
 - Check the exhaust port on the cylinder for clogs.
 - Follow the procedures to replace a cylinder if the cylinder does not extend and retract correctly as you energize and de-energize the solenoid operated valve.



Concept Check

Troubleshoot Pneumatic System

Answer the following questions to check your understanding of troubleshooting a pneumatic circuit. Circle the correct answer in each question. Then compare your responses with the answers at the bottom of this page. Some of the questions may have more than one correct answer. If you have difficulty answering a question, review the Skill Development Guide or ask your Trainer for assistance.

1. If the Maintenance Mechanic does not troubleshoot the system correctly:
 - a. the quality of the product will suffer.
 - b. coolant for the machine may not work.
 - c. a part on the machine may not operate.
 - d. the machine may not operate.

2. The _____ must be set to have equal or more psi as the fluid pressure of the air operated diaphragm valve.
 - a. lubricator
 - b. regulator
 - c. filter
 - d. diaphragm valve

3. The _____ is operating correctly if air is flowing to the solenoid-activated valve.
 - a. lubricator
 - b. regulator
 - c. filter
 - d. diaphragm valve

4. Visually check the _____ during operation to verify it is dripping oil into the air supply.
 - a. lubricator
 - b. regulator
 - c. filter
 - d. diaphragm valve

Answers: (1. a, b, c, d 2. b 3. b,c 4. a)

Next Step

If you are ready to demonstrate the task now, ask your Evaluator or Trainer to schedule the Skill Check. However, if you need to practice some of the steps first, continue to the next section.



Practice

The following practice will help prepare you for the Skill Check. Ask your Trainer to set up the practice for you. After you complete a practice, ask your Trainer to check your work.

Practice

Ask your Trainer to set up a machine for troubleshooting the pneumatic system.

Tools and equipment for Practice

Machine with a pneumatic system

Machine pneumatic print

Practice Objective

You must identify the fault in the system. You must recommend a corrective action that the Trainer agrees will restore the pneumatic system to normal operating conditions. All safe work practices must be demonstrated.

Next Step

Continue to practice until you are ready for the Skill Check. When you are ready to demonstrate the task, ask your Evaluator or Trainer to schedule the Skill Check.

