

Switch Heater Solenoid Valves

Inspection and Maintenance Procedures

Electric solenoid valves are used in gas-fired switch heaters to provide a means to effectively control the flow of gas into the burner. A solenoid valve is essentially a combination of two basic functional units:

- a solenoid (electromagnet) with its core; and
- a valve body containing one or more orifices.

Flow through an orifice is shut off or allowed to flow by the movement of the core when the solenoid is energized or de-energized. The force needed to open the valve is proportional to the orifice size and gas pressure. As the orifice size increases so does the force required. For this reason, solenoid valves used in Hovey switch heaters fall into two types of construction: direct acting and internally piloted. The pilot burner solenoid valve is of the direct-acting type where the core directly opens the orifice. On the other hand, the larger main burner solenoid valves are of the internal pilot-operated type where line pressure is used to assist operation.

Troubleshooting Solenoid Valves

Troubleshooting solenoid valves should begin with a check of the line voltage and pressure input. The problem may be caused by an inoperative control system or a fluctuating pressure regulator. If voltage and pressure check out, look to the solenoid valve. The main reasons a solenoid valve fails to operate include:

- a. Low or no voltage;
- b. Burned-out solenoid;
- c. Pressure higher than the valve's rating;
- d. Foreign matter in the valve; or
- e. Binding core or damaged core tube.

To operate properly, a solenoid valve core must move within the core tube and contact the plugnut when the coil is energized. You should hear a sharp metallic click at energization. Absence of the click usually indicates an electrical problem. For most valves, voltage applied to the coil must be at least 85% of the nameplate voltage rating.

If the valve coil is receiving the proper voltage, absence of a click may mean that the line pressure is higher than the valve's rating. Check that next. If line pressure is OK, foreign matter may be preventing the core from moving in the core tube. Core movement can be restricted if the top of the core has been peened over by numerous operations, if the disc is swollen or cut, or if the core itself has been damaged.

A pilot-operated valve might fail to operate when energized even though a click has been heard. A no-flow condition may be caused by:

- a. Insufficient pressure drop across the valve;
- b. Ruptured diaphragm or damaged piston ring; or
- c. Plugged or restricted pilot orifice.

Both pilot-operated and direct-acting valves can fail to operate when de-energized because of:

- a. Faulty control circuit;
- b. Scale or other foreign matter in the valve;
- c. Binding core or damaged core tube; or
- d. Broken spring.

Pilot-operated valves may also malfunction when de-energized due to:

- a. Plugged bleed orifice;
- b. Damaged pilot seat or disc;
- c. Damaged diaphragm or piston; or
- d. Insufficient pressure drop across the valve.

Excessive solenoid noise (hum or chatter) can be caused by:

- a. Low voltage;
- b. Faulty or improper electrical control signal;
- c. Loose solenoid parts;
- d. Foreign matter on core or plugnut face;
- e. Worn core or plugnut face;
- f. Damaged spring; or
- g. Excessive system pressure.

Periodic Inspection and Testing Intervals

Solenoid valves are electromechanical devices which are subject to normal wear and tear. Therefore they should be inspected periodically during the winter operating season to ensure that they are operating properly, watching for smooth burner operation and listening for excessive noise (hum or chatter). A good time to perform this inspection is when you are performing your monthly tests on power-operated switch machines.

(Note: Manufacturers recommend that solenoid valves be operated at least once a month to ensure proper opening and closing. As switch heaters remain shut down for a large portion of the year, monthly solenoid valve actuations are not practicable. As a result, some minor sticking and/or sluggish solenoid valve operation may be experienced when switch heaters are first operated at the start of the winter season. In most cases, the valves will function normally after a few operations.)

To minimize failures, manufacturers recommend periodic inspection of internal valve parts for damage or excessive wear, followed by a thorough cleaning. A good rule of thumb for switch heater main burner solenoid valves would be to inspect and clean internal parts at five-year intervals. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Always follow the instructions supplied with the valve for disassembly, cleaning, and reassembly.

(Note: Solenoid valve Rebuild Kits are available from the valve manufacturer. It is a good idea to have one on hand whenever a valve is opened for visual inspection and cleaning. Use

the Rebuild Kit number stamped on the valve nameplate.)

Solenoid valves should be pressure tested and proven gas tight at the time of installation and at the start of each winter operating season. Gas burners utilizing dual main solenoid valves (main and safety) should be tested using a procedure which ensures that each valve is independently proven to be gas tight.

Figure 1 below illustrates the gas components used in a typical Hovey switch heater gas burner manifold. This particular drawing illustrates a switch heater equipped with two main burner solenoid valves (main and safety) which are required by certification test agencies when burner heat input rating exceeds 400 KBTU/hour. It is important to note that the main and safety solenoid valves are electrically connected in parallel (i.e. they operate simultaneously), but they are piped in series with respect to gas flow.

Test Procedures to Check Main, Safety and Pilot Gas Solenoid Valves

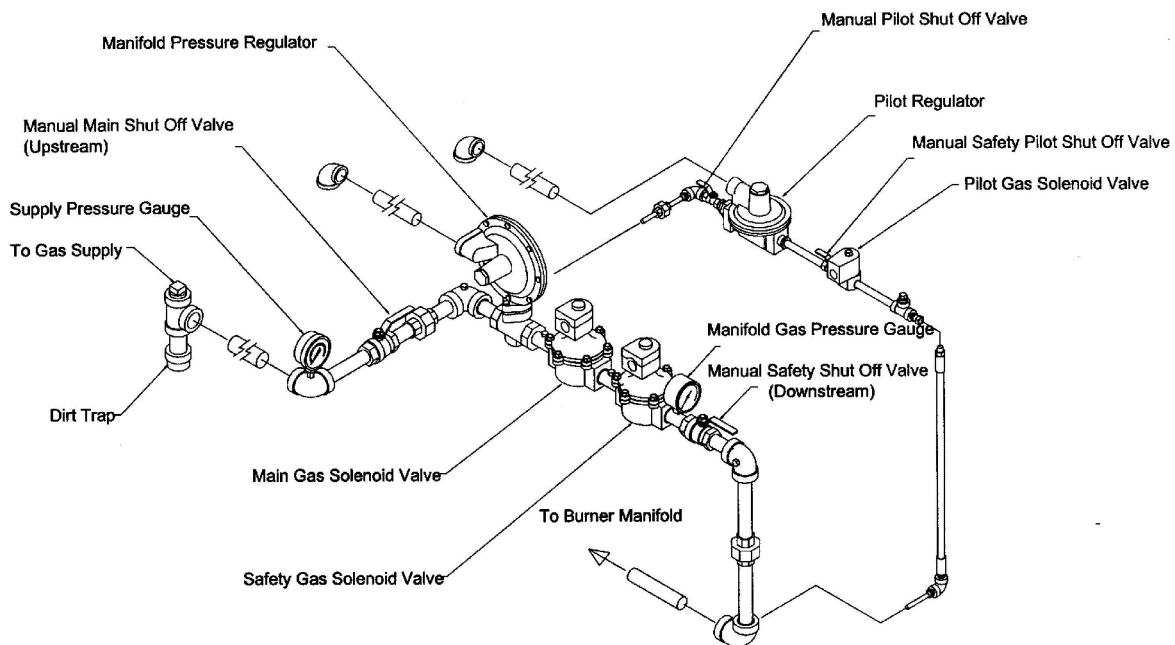


Figure 1 - Typical Hovey Gas Manifold

WARNING: To prevent the possibility of severe personal injury or property damage, extinguish all open flames and avoid any type of sparking or ignition.

1. All Hovey switch heater manifolds are essentially the same as that depicted in Figure 1 (with the exception that not all switch heaters are equipped with dual main gas solenoid valves). The following components should be noted on this drawing:
 - a. **Manual main shut-off valve**
 - b. Manifold pressure regulator
 - c. Main gas solenoid valve
 - d. Safety gas solenoid valve

- e. **Manual safety shut-off valve** (also known as the *burner hand-firing valve*)
- f. **Manual pilot shut-off valve**
- g. Pilot Regulator
- h. **Manual safety pilot shut-off valve**
- i. Pilot gas solenoid valve

(Note: The manual shut-off valves of importance in these procedures are shown in bold.)

- 2. Gas burner manifolds are equipped with strategically located 1/8-inch tapped and plugged holes for testing purposes. These pressure tappings may be located in the bodies of the main burner solenoid valves and in the body of the pilot regulator, or they may be located in manifold nipples (that is, between the valves or components), or they may be provided in both valve bodies and nipples.

(Note: ASCO Series 8214 main burner solenoid valves are equipped with four integral pressure tappings, two on either side of the valve body. The upper two holes are used for upstream pressure testing, while the lower two holes are used for downstream pressure testing. The pilot regulator is equipped with two integral pressure tappings, one for upstream pressure testing and one for downstream pressure testing.)

3. To Test Main Gas Solenoid Valve

- a. Ensure that all manual shut-off valves are in the closed (off) position:
- b. Install a *magnehelic gauge* upstream of the main gas solenoid valve (or in the body of the main gas solenoid valve on switch heaters so equipped).

(Note: Magnehelic gauges will detect extremely low pressures and are recommended for solenoid valve pressure testing. A suitable magnehelic gauge for this test is the Model 2015 supplied by Dwyer Instruments which measures pressure up to 15-inches water column.)

- c. Open the manual main shut-off valve slowly, watching that the pressure on the magnehelic gauge does not exceed the maximum scale of the gauge. If excess pressure exists, bleed off by starting the switch heater and opening the manual pilot shut-off valve momentarily.
- d. Close the manual main shut-off valve.
- e. Remove the test plug in the nipple upstream of the safety gas solenoid valve (or in the valve body of the safety gas solenoid valve on switch heaters so equipped).
- f. Watch the magnehelic gauge for ten minutes. Any drop in pressure would indicate a leak in the main gas solenoid valve.
- g. Replace test plug in the safety gas solenoid valve.

4. To Test Safety Gas Solenoid Valve

- a. To test the safety gas solenoid valve, the main gas solenoid valve must be energized. This

can be accomplished by applying 120-volt AC power to the main gas solenoid valve using jumper wire. When using jumper wire, trace the conduit from the main gas solenoid valve coil back to the junction box. Open the junction box and disconnect the coil leads from the terminal strip. Connect the leads to a suitable length of extension cord and insulate the connections with electrical tape. Plug the extension cord to the 120-volt AC receptacle to energize the solenoid.

(Note: Power may also be applied by removing the solenoid valve coil and substituting with a portable solenoid coil.)

- b. Open the manual safety shut-off valve (burner hand-firing valve).
 - c. Watch the magnehelic gauge for ten minutes. Any drop in pressure would indicate a leak in the safety gas solenoid valve.
 - d. Remove the magnehelic gauge and replace the pipe plug. Reconnect the main gas solenoid coil to its normal power supply.
5. To Test Pilot Gas Solenoid Valve
- a. Install a magnehelic gauge upstream of the pilot gas solenoid valve (in the body of the pilot regulator).
 - b. Open the two manual shut-off valves in the pilot line:
 - i. manual pilot shut-off valve; and
 - ii. manual safety pilot shut-off valve.
 - c. Watch the magnehelic gauge for ten minutes. Any drop in pressure would indicate a leak in the pilot gas solenoid valve.
 - d. Remove the magnehelic gauge and replace the pipe plug.
6. After the above tests, fire up the switch heater and leak test all of the manifold test tappings (use a soapy solution or a commercially available leak detecting solution and check for bubbles).
7. If a solenoid has failed any of the above tests, shut off the manual main shut-off valve and advise your supervisory officer so that arrangements can be made to clean or replace the faulty valve.

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