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Checking Fuel Train Safety Shutoff Valves

By David Farthing

The fuel gas and fuel oil that runs through your system has more in it than just fuel. Both gas and oil systems are susceptible to corrosion due to condensate, piping scale and other foreign materials that will either damage or block the safety valve from fully closing. Add to this the fact that diaphragm valves are susceptible to embrittlement, aging, and rupture, then the need for safety valve testing becomes quit apparent.



Dirt and Scale in a Fuel Gas Safety Shutoff Valve

Oklahoma State Boiler law 380:25-7-17 specifically requires that all equipment on a boiler be maintained as per the manufacturer's recommendations.

Manufacturers recommend that the fuel train safety shutoff valves and associated High Pressure and Low Pressure safety switches should have the ASME/ANSI 21.21 Leak Test performed at least once per year. Normally this task is accomplished during the boiler's annual inspection. If you have a low-pressure boiler and perform a semi-annual inspection, then this test should be put on your annual preventative maintenance checklist.

The testing is not difficult, but does require some special tooling that can be acquired in your shop. *It is strongly recommended that this testing be performed by qualified technicians familiar with the code requirements of the state and flame safeguard systems in general.*

Gashed Rubber Seat in a Diaphragm type Safety Shutoff Valve.



Equipment required to perform the ASME/ANSI 21.21 Safety Valve Leak Test.



1. Nitrogen or Compressed Air source
2. Test Hose & Bleed Hose
3. Up-Stream and Down-Stream Testing Valves
4. Gauge Harness assembly with bleed valve
5. Test Pressure Gauge & Volt Ohm Meter
6. Bucket of water

If your valves came with specific testing instructions from the manufacture, use these instructions to perform the Leak Test. If not the following is a good set of generic instructions that will accomplish the ASME Testing procedure.

➤ **! Safety First – Disconnect all power to the boiler and boiler control system and place it under LOTO. Shut and LOTO the utility fuel manual shutoff valve and the fuel train manual shutoff valves (up and down stream). NOTE: Fuel is now trapped in the fuel train, you will bleed this off during the first portion of your testing procedures.**

Test the Low Gas and High Gas Pressure Switches

1] Provided you have followed the safety procedures you are ready to begin.

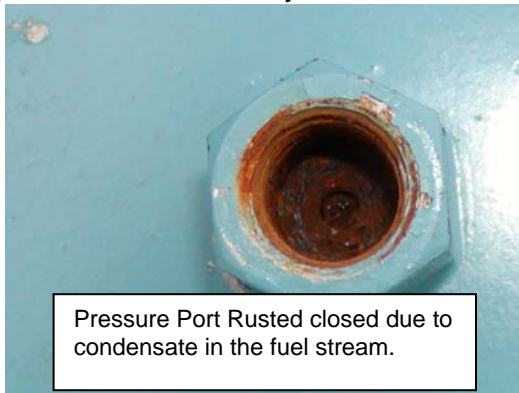
2] Remove the covers to the Low and High Gas Pressure Switches (LGPS/HGPS) and check for voltage across the wiring terminals. Voltage should read zero volts.

3] Remove one wire from the terminals and switch your VOM to OHM position. Read across the terminals, you should read 0.00 ohms, i.e. switch closed.

4] Carefully remove the upstream test port on the first safety valve and bleed the trapped gas. If your system is equipped with test valves connect a test hose to the valve first and bleed the gas into the bucket of water.

5] Using the VOM in the Ohm position read across the LGPS, you should read infinity – OPEN circuit.

6] Now connect the air compressor test valves and Inches Water Gauge to the upstream test port on the first Safety Shutoff Valve. Carefully introduce air to the train while monitoring the LGPS and record the pressure when the switch closes.



7] Close the test valve and disconnect the pressure source monitoring the LGPS to insure that it does not trip until you do the blowdown test.

8] Slowly open the test-valve and observe the test gauge and VOM. Record the pressure when the LGPS opens. Check this against the set pressure of the LGPS. Replace the switch if the trip pressure is greater than 10% out of spec.

9] Remove the pressure test instruments and repeat the procedure for the HGPS.



Test the Safety Shutoff Valves

NOTE: If the LGPS and HGPS are not rated for the test pressure of the safety valves, you must remove the switches and plug the switch ports before proceeding, otherwise you will damage the switches and distort the set pressure.

1] Locate the Vent Valve electrical terminals and remove them from the circuit and install a temporary electrical pigtail to the Vent Valve. Be sure to include the ground in your pigtail.

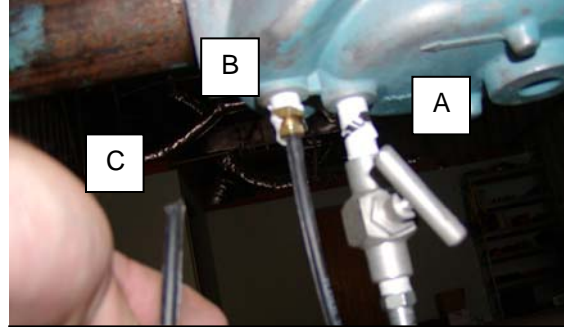
2] Install the pressure test valve and bleed line to the valve test ports. These ports are normally located on the bottom of diaphragm style valves and on the side of the body on knife gate style valves.

3] Energize the Vent Valve and listen for it to close.

4] Adjust the pressure test source to the test pressure before applying the source to the valve train.



- 5] Apply the pressure source to the test valve and slowly open the valve to admit the test air to the train.
- 6] Submerge the Bleed Line ½ inch deep into the pail of water and observe for bubbles.
- 7] Allow the test to stabilize then count the number of bubbles during a 10-second period. See the chart below to determine if the valve is defective.



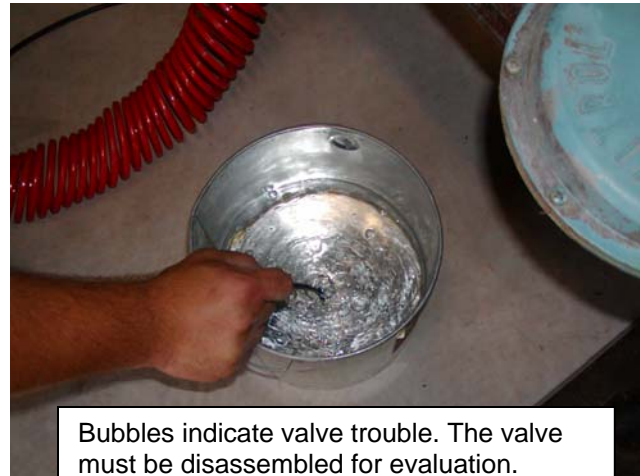
A] Test Valve and B] Bleed Line mounted in test ports of a diaphragm valve. C] Bleed Line tip.

To meet U.S. requirements, leakage must not exceed ANSI Z21.21, Section 2.4.2. Based on air at standard conditions a maximum of 235 cc/hr per inch of seal-off diameter. Seal-off diameter is not to be confused with pipe size. The following chart gives expected maximum bubble count for the following valve sizes.

Valve Size (Inches)	Allowable Leakage (cc/hr)	Maximum Bubbles per 10 Sec Test.
¾, 1, 1-1/4, 1-1/2	458 cc/hr	16
2, 2-1/2, 3	752	26
4 inch and larger	1003	35

After the Test

- 1] Close the test valves, remove the test apparatus, and replace all test tap plugs.
- 2] Remove the electrical pigtail from the Vent Valve and reconnect the Vent Valve to the burner management circuitry.
- 3] Remove the LOTO from the control power, utility-gas manual shutoff valve and the upstream manual shutoff valve.
- 4] Open the upstream manual fuel shutoff valve and energize the safety shutoff valves by cycling the burner management system. Do not fire the burner.
- 5] Leak Test all test fittings with a soap solution and correct as required.
- 6] Remove the LOTO from the downstream manual fuel shutoff valve and open the valve.
- 7] Restore the system to normal operation.



Bubbles indicate valve trouble. The valve must be disassembled for evaluation.

ASME ANSI 21.21 Safety Valve Leak Test Record

Location _____
Address _____
City/State _____
Technician _____
Phone # _____

National Board # _____
State # _____
BTU Input _____

Fuel Train UL CSD1 GECAP
FM NFPA IRI

Fuel Type Oil Gas Switch Test
PASSED
LGPS Set _____ HGPS Set _____ FAILED

Valve Type Diaphragm Knife
Valve Mfg _____
Model # _____
Serial # _____

Valve Size _____ Valve Test Pressure _____

Valve Test Passed Failed Date _____