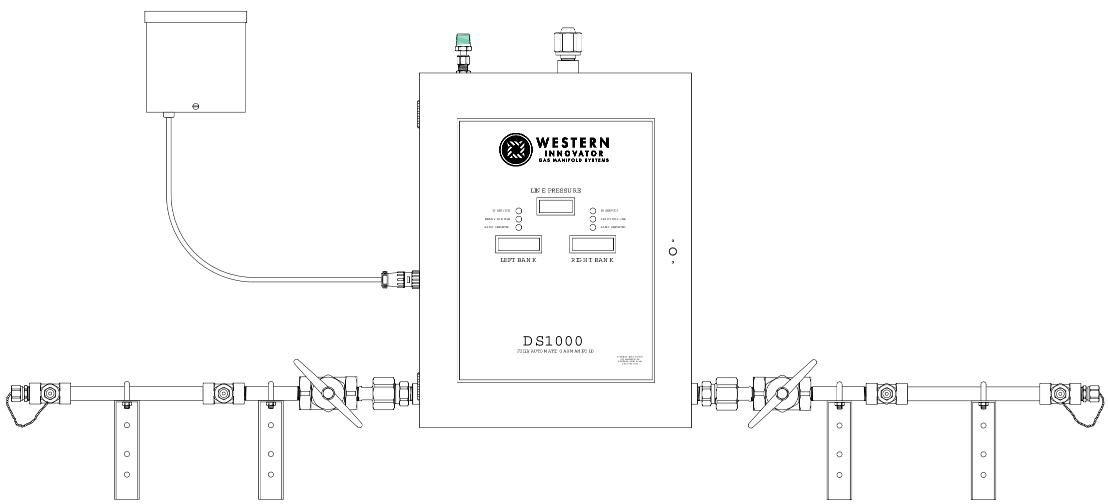
AUTOMATIC CHANGEOVER MANIFOLD
DS1000, DS1000HL, & DS1000HP SERIES

SERVICE MANUAL



SAFETY

Statements in this manual preceded by the following safety signal words are of special significance. Definitions on the SAFETY signal words follow

DANGER
Means a hazard that will cause death or serious injury if the warning is ignored.

WARNING
Means a hazard that could cause death or serious injury if the warning is ignored.

CAUTION
Means a hazard that may cause minor or moderate injury if the warning is ignored. It also means a hazard that will only cause damage to property.

NOTE
Indicates points of particular interest for more efficient and convenient operation.

.INTRODUCTION

This manual provides the information needed to service the Western Enterprises DS1000, DS1000HL, and DS1000HP series manifolds. This information is intended for use by technicians or personnel qualified to repair and service manifold equipment.

The information contained in this document, including performance specifications, is subject to change without notice.

WARRANTY

Western Enterprises makes no warranty of any kind with regard to the material in this manual. Including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Refer to the **Installation and Operation Instructions** manual for warranty information.

CAUTION

- Failure to adhere to the following instructions may result in person injury or property damage:
- Never permit oil, grease, or other combustible materials to come in contact with cylinders, manifold, and connections. Oil and grease may react and ignite when in contact with some gases-particularly oxygen and nitrous oxide.
- Cylinder, header, and master valves should always be opened very s-l-o-w-l-y. Heat of recompression may ignite combustible materials.
- Pigtails should never be kinked, twisted, or bent into a radius smaller than 3 inches. Mistreatment may cause the pigtail to burst.
- Do not apply heat. Some materials may react while in contact with some gases-particularly oxygen and nitrous oxide.
- Cylinders should always be secured with racks, chains, or straps. Unrestrained cylinders may fall over and damage or break off the cylinder valve which may propel the cylinder with great force.
- Oxygen manifolds and cylinders should be grounded. Static discharges and lightning may ignite materials in an oxygen atmosphere, creating a fire or explosive force.
- Welding should never be performed near nitrous oxide piping. Excessive heat may cause the gas to dissociate, creating an explosive force.

ABBREVIATIONS

C	Common	NFPA	National Fire Protection Association
CGA	Compressed Gas Association	OSHA	Occupational Safety & Health Administration
FT-LBS	Foot-Pounds	PSIG	Pounds per Square Inch Gauge
IN-LBS	Inch-Pounds	SCFH	Standard Cubic Feet per Hour
N/C	Normally Closed	VAC	Voltage, Alternating Current
N/O	Normally Open	VDC	Voltage, Direct Current
NPT	National Pipe Taper	PCB	Printed Circuit Board

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INTRODUCTION & GENERAL INFORMATION

PRODUCT DESCRIPTION

The fully automatic changeover manifold is designed to provide a reliable uninterrupted supply of gas to a gas pipeline system.

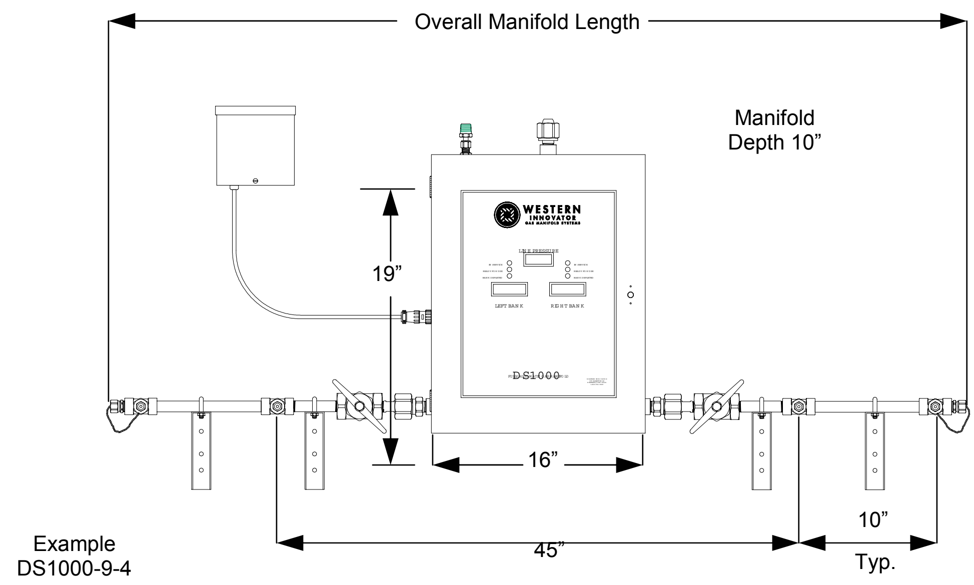
The manifold has an equal number of cylinders in its “Service” supply and “Secondary” supply banks, automatically switching to the “Secondary” supply when the “Service” supply becomes depleted. When the manifold changes to “Secondary” supply, it changes the light status and sends a signal to the gas alarm (optional) alerting the personnel of the need for the exhausted bank of cylinders to be replaced with full cylinders. After new cylinders are in place and turned on, no manual resetting of the manifold is necessary.

INSTALLATION INFORMATION

Manifolds should be installed in accordance with guidelines stated by the National Fire Protection Association, the Compressed Gas Association, OSHA, and all applicable local codes. The carbon dioxide and nitrous oxide manifolds should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 20°F (-7°C). The manifolds for all the other gases should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below -20°F (-29°C). A manifold placed in an open location should be protected against weather conditions. During winter, protect the manifold from ice and snow. In summer, shade the manifold and cylinders from continuous exposure to direct rays of the sun.

Leave all protective covers in place until their removal is required for installation. This precaution will keep moisture and debris from the piping interior, avoiding operational problems.

CAUTION:
- Remove all protective caps prior to assembly. The protective cap may ignite due to heat of recompression in an oxygen system.



Total number of cylinders	4	6	8	10	12
Overall manifold length	5’ - 11”	7’ - 7”	9’ - 3”	10” - 11”	12’ - 7”

Figure 1-1 Installation Dimensions

MANIFOLD SPECIFICATIONS

Flow Capability

Oxygen:	2200 SCFH at 50 psig delivery with a 15 psi pressure drop and 2000 psig inlet pressure. 800 SCFH at 50 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Nitrogen:	4650 SCFH at 160 psig delivery with a 15 psi pressure drop and 2000 psig inlet pressure. 400 SCFH at 160 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Nitrous Oxide:	The flow capability of a Nitrous Oxide cylinder manifold will depend upon conditions at the installation site, demands of the delivery system and the number of cylinders in supply service. Capability is 500 SCFH at 50 psig delivery and 750 psig inlet pressure. Installing a Nitrous Oxide manifold in a location which exposes it to ambient temperatures below 20°F (-7°C) is not recommended.
Breathing Air:	2500 SCFH at 50 psig delivery with a 15 psi pressure drop and 2000 psig inlet pressure. 650 SCFH at 50 psig with a 5 psi pressure drop and 2000 psig inlet pressure.
Helium:	2500 SCFH at 50 psig delivery with a 15 psi pressure drop and 2000 psig inlet pressure. 650 SCFH at 50 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Carbon Dioxide:	The flow capability of a Carbon Dioxide cylinder manifold will depend upon conditions at the installation site, demands of the delivery system and the number of cylinders in supply service. Capability is 500 SCFH at 50 psig delivery and 750 psig inlet pressure. Installing a Carbon Dioxide manifold in a location which exposes it to ambient temperatures below 20°F (-7°C) is not recommended.

Power Source Requirements

A 115 VAC / 24 VAC power supply is provided with the manifold to operate the status lights on the manifold. Under normal operation the manifold will draw a maximum of 1.5 amperes.

A five terminal remote alarm terminal strip is on the right side of the circuit board in the power supply box for remote alarm interfacing. The top three terminals on this strip (N/C, N/O, and C) provide dry contacts for hookup to the hospital or clinic's medical gas alarm system. Contacts are rated up to 3 amps, 30 VDC or 2 amps 250 VAC.

Nitrous Oxide and Carbon Dioxide systems include a 500 SCFH capacity heater. The thermostatically controlled heater warms the gas before entering the primary regulator, preventing "freeze-up". The heater operates at 115 VAC and draws 4 amperes.

Piping Connections

Header Inlets:	Carbon Dioxide	CGA 320
	Nitrous Oxide	CGA 326
	Air	CGA 346
	Oxygen	CGA 540
	Helium	CGA 580
	Nitrogen	CGA 580

Manifold Outlet: 1/2 NPT male pipe thread (located on the top center of the cabinet).

Relief Valve: 1/2 NPT male pipe thread (located on the top left side of the cabinet).

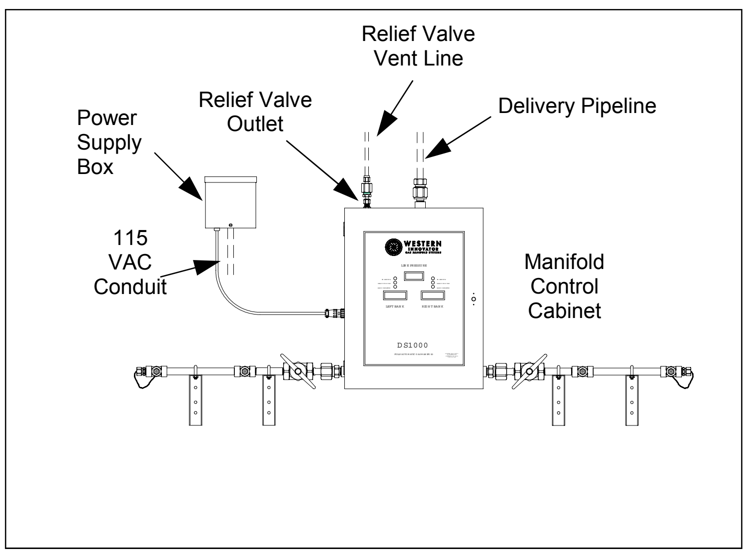


FIGURE 1-2 Connection Locations

ADJUSTMENT SPECIFICATIONS

MODEL	Primary Regulator	Intermediate Pressure Relief Valve	Pressure Switch	Line Regulators
DS1000	*195-205	300	120-125	50-55
DS1000HP	*295-305	450	220-225	*160-165 (v4.0.x and up) **170-175 (v2.02)
DS1000HL	*235-245	300	120-125	50-55

Units above are PSIG

* All testing must be done with full cylinders. Primary regulator set pressure will vary with changing inlet pressures.
**Software version is located on back of circuit board.

CAUTION:

- Resetting/adjusting manifold components with cylinders that are <u>not</u> full may cause the manifold to function improperly.

RECOMMENDED TOOLS AND TEST EQUIPMENT

Volt/Ohm meter	Available from local source
Isopropyl alcohol	Available from local source
Phillips screwdriver	Available from local source
Flat blade screwdriver	Available from local source
Needle nose pliers	Available from local source
Wire cutters	Available from local source
5/32" hex key wrench	Available from local source
5/8" hex socket wrench	Available from local source
13/16" hex socket wrench	Available from local source
Set of combination wrenches 1/4" thru 1", 1-1/8", 1-3/8", 1-1/2", and 1-3/4"	Available from local source
Krytox® 240 AC	Available from E.I. Du Ponte Wilmington, Delaware
Liquid leak detector	Available from Western Enterprises Part number LT-100
Teflon® tape	Available from Western Enterprises Part number MTT-1 or MTT-2

Teflon® is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.).
Krytox® is a register trademark of E. I. du Ponte de Nemours & Co. (Inc.)

THEORY OF OPERATION

GENERAL INFORMATION

This section concentrates on the basic theory of operation of the components of the fully automatic changeover manifold.

The first part of this section is an operating summary and traces the flow of gas through the various components of the manifold. The second part of this section explains in detail the operation of the individual components contained in the manifold control section.

MANIFOLD OPERATION

The automatic changeover manifold consists of a manifold control and two supply bank headers, one service and one secondary supply, to provide an uninterrupted supply of gas for the specific gas application. The manifold control includes the following components and features: green “in service”, yellow “ready for use”, and red “bank depleted” indicator lights, digital readouts for both cylinder pressure and line pressure, internal intermediate pressure gauges and internal line regulator. Supply banks consist of a header with 24" stainless steel flexible pigtails with check valves, individual check valve bushings, master shut-off valves, and union connections for attachment to the control unit. The main components of the manifold are shown in Figures 2-1 through 2-3. Figures 2-4 and 2-5 show the piping schematics. Figure 2-6 is the schematic diagram of the electrical system of the manifold. Figure 2-7 is the heater schematic.

The cylinder bank that supplies the piping system is known as the “Service” supply while the cylinder bank on stand-by is referred to as the “Secondary” supply. Gas flows from the cylinder through the pigtails, check valves, headers, and shut-off valves into the left and right inlets of the control section.

Gas enters the manifold cabinet and enters a pressure transducer. The pressure transducer displays the bank pressure on the front of the cabinet. The transducer also monitors bank pressure and signals all connected alarms when the system changes from the service to the secondary bank.

Gas then flows to the primary regulators on all manifolds except those for Nitrous Oxide and Carbon Dioxide service (Nitrous Oxide and Carbon Dioxide systems include a 500 SCFH capacity heater). The thermostatically controlled heater warms the gas before entering the regulator, preventing “freeze-up” and loss of pressure due to the extreme low temperatures generated when these gases rapidly expand.

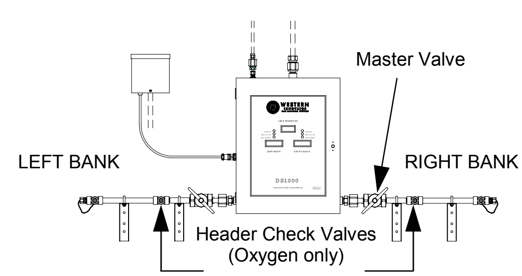


FIGURE 2-1 External Components

Pressure is regulated in the primary regulators to the pressures noted in the adjustment specification chart in Section 1. Both primary regulators are factory preset to deliver the same pressure. The primary regulators have two ports on the low pressure side. One port is connected to the intermediate relief valve and intermediate pressure gauge. The other port is the outlet port and is connected via fittings to the solenoid valves.

The gas flows from the primary regulators to the solenoid valves. The solenoid valves are either open or closed depending on which side is in “Service” and whether the “Reserve” cylinders have adequate pressure. The solenoid valve on the side that is in “Service” will be open. The solenoid valve on the “Reserve” side will be closed if the cylinder pressure on that side is above the pressure transducer setting. The “Service side is determined by whichever side of the manifold is initially pressurized.

Gas on the “Reserve” side is stopped at this point by the closed solenoid valve. The gas from the “Service” side continues to flow, entering a check valve after leaving the solenoid valve. The check valve prevents the gas from flowing backward toward the solenoid valve when the reserve side is in use.

LEGEND

1– Outlet Adaptor

2– Line Regulator

3– Intermediate Relief Valve

4– Pressure Switch

5– Intermediate Check Valves

6– Left Inlet Block

7– Primary Regulator

8– Intermediate Gauge

9– High Pressure Transducer

10– Line Pressure Transducer

11– Intermediate Pressure
Relief Connection

12– Intermediate Block

13– Relief Outlet Connection

14– Solenoid Bypass Check Valve

15– Right Inlet Block

16– Solenoid Valve

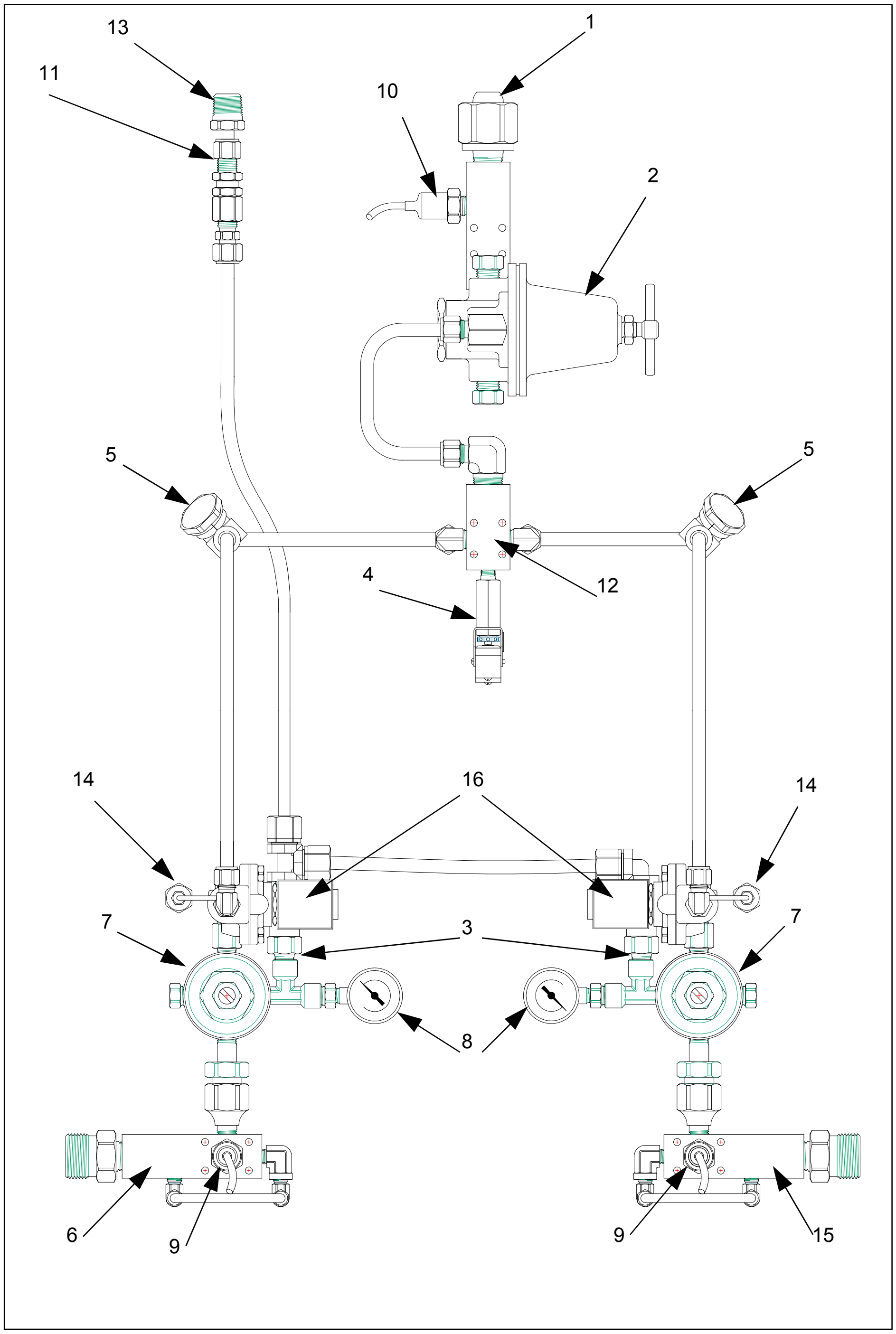


FIGURE 2-2 Internal Components – DS1000 & DS1000HP

LEGEND

1– Outlet Adaptor

2– Line Regulators

3– Intermediate Relief Valve

4– Pressure Switch

5– Intermediate Check Valves

6– Left Inlet Block

7– Primary Regulator

8– Intermediate Gauge

9– High Pressure Transducer

10– Line Pressure Transducer

11– Intermediate Pressure Relief Connection

12– Intermediate Block

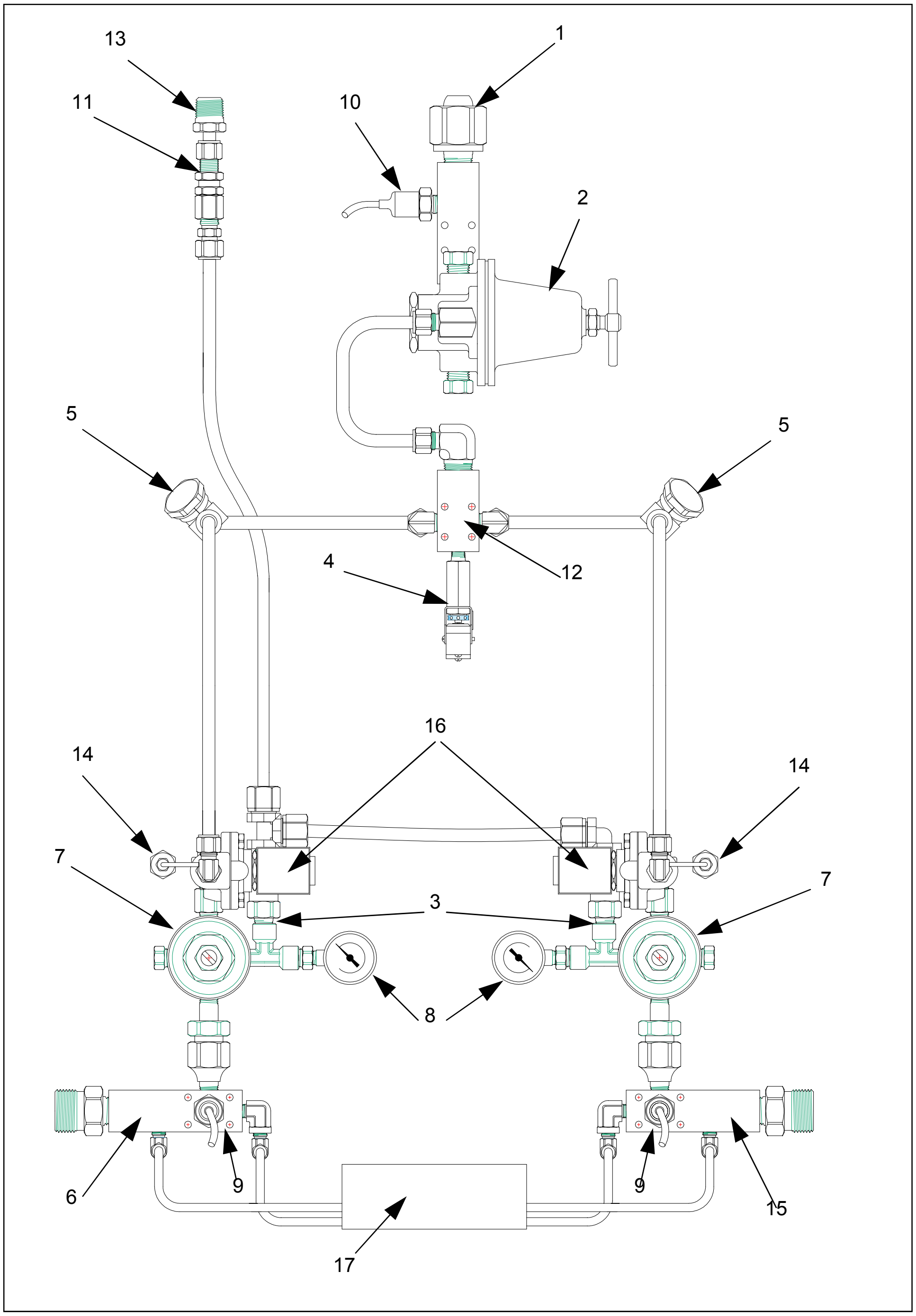
13– Relief Outlet Connection

14– Solenoid Bypass Check Valve

15– Right Inlet Block

16– Solenoid Valve

17– Heater Unit*



*Note: Carbon Dioxide an Nitrous Oxide units ordered without a heater do not include item 17.

FIGURE 2-3 Internal Components – DS1000HL

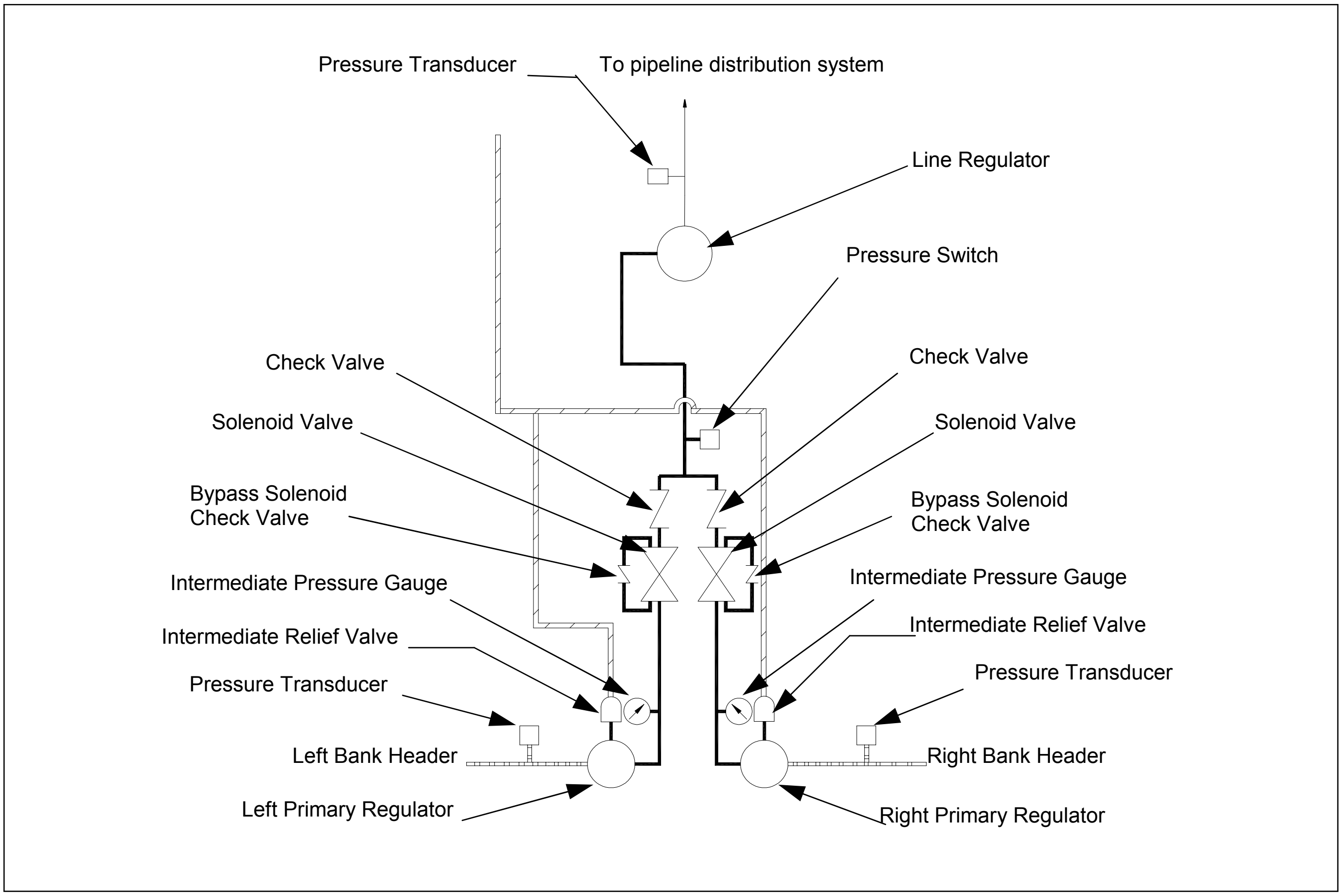


FIGURE 2-4 Piping Schematic – DS1000 & DS1000HP

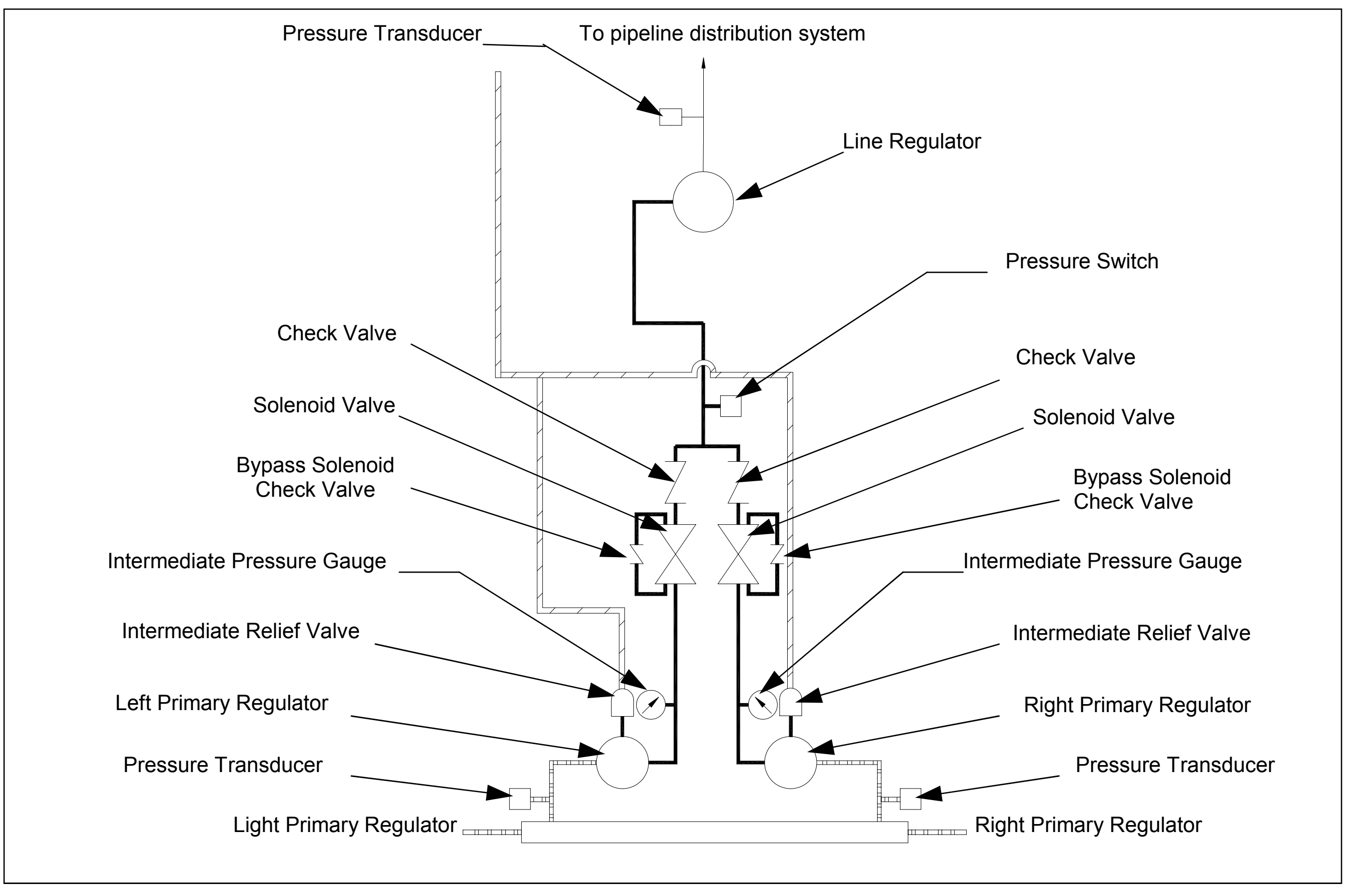


FIGURE 2-5 Piping Schematic - DS1000HL

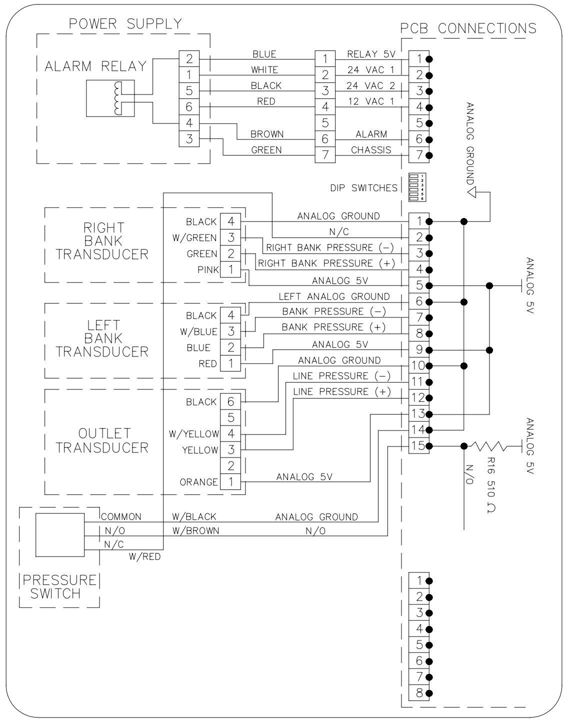


FIGURE 2-6 Electrical Schematic (less heater)

The gas from the open solenoid valve is routed through the check valve to the intermediate block assembly. The intermediate block has 4 ports all connected to the same chamber. The gas pressure at all 3 ports is the same as the pressure at the inlet to the block. Gas enters the intermediate block from the “Service” supply through the tubing connected at either the right or left side, depending on which side is in service. The opposite side would then be the reserve side. The top port connects to the inlet of the line regulator. The bottom port is connected to a pressure switch.

The pressure switch monitors the intermediate pressure. Should the intermediate pressure drop below a preset level the switch will indicate an alarm condition that changeover has occurred. The switch provides a redundant feature to ensure proper changeover and alarming has taken place. The intermediate pressure relief valves prevents over-pressurization of the intermediate controls of the manifold should the primary regulators fail. The relief valve settings are noted in the adjustment specification chart in Section 1.

Gas enters the line regulator and then flows through the regulator where the pressure is reduced to the line pressure which is shown on the digital display on the front of the cabinet. The gas then flows to the outlet block, past the line transducer and on to the downstream equipment.

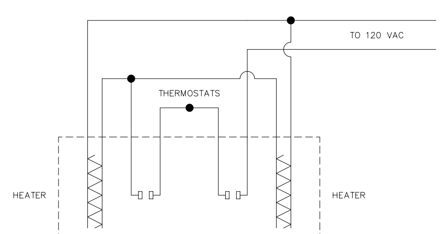


FIGURE 2-7 Heater Electrical Schematic

When both cylinder banks are full, the transducers and the switch complete the electrical circuit to display the green “system normal” light of the primary bank, and a yellow “ready for use“ light for the secondary bank. Cylinder pressures for each bank are indicated on the readouts on the manifold front cover. As stated, the “Service” supply is determined by which bank is pressurized first. The intermediate pressure is indicated by the gauges located on the respective primary regulator. The line pressure is indicated by the digital readout on the front of the cabinet.

As the gas from the “Service” supply is depleted, the gas pressure to the “Service” primary regulator will begin to fall. Simultaneously, the pressure to the pressure switch, intermediate block, and the line regulator also falls. When the “Service” side pressure falls below the set point of the bank pressure transducer, the red “bank depleted” light comes on and the green “in service” light is extinguished. Any remote alarms are activated at this time. When the “Service” pressure falls to the set point of the pressure transducer, the solenoid valve opens and the secondary supply begins to supply the system.

After replacing empty cylinders and opening the cylinder valves, the pressure transducer will extinguish, the red “bank depleted” light, and the yellow “ready for use” light will come on energizing the secondary bank solenoid valve. The system incorporates a *fail-safe* configuration so that the red light can only be extinguished when sufficient pressure is supplied from both banks.

PRIMARY REGULATORS

The primary regulator’s function is to reduce the cylinder pressure of the supply banks to a more usable regulated pressure.

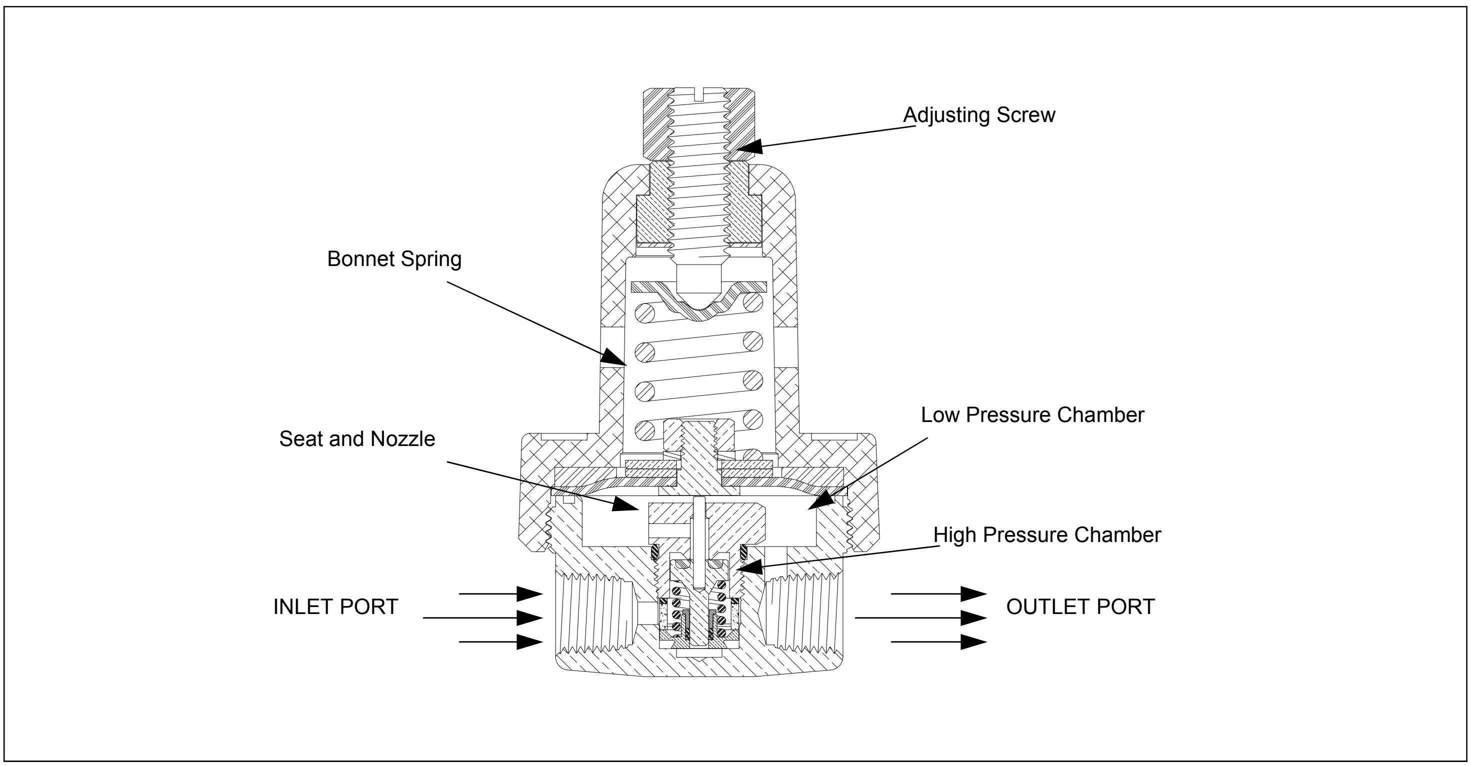


FIGURE 2-8 Primary Regulator

Gas enters the regulator through the inlet port and fills the high pressure chamber and the port to the cylinder contents gauge with gas. See Figure 2-8. Gas in these areas is at the same pressure as the gas in the cylinders. The gas is sealed in this chamber by the seat holder and stem being pushed against the nozzle seal by gas pressure and the body spring. An o-ring seals between the nozzle and the regulator body.

The next area of the regulator is the low (regulated) pressure area of the regulator. This chamber is sealed from the high pressure area by the seat/nozzle assembly and the o-ring around the nozzle and is isolated from the atmospheric pressure by the diaphragm sub-assembly forming a seal around the body of the regulator. The diaphragm is squeezed between the body of the regulator, a slip ring, washer, and the regulator bonnet as the bonnet is tightened down on the body.

The third chamber of the regulator is open to atmospheric pressure. This chamber contains the regulator bonnet, adjusting screw, pivot, bonnet spring, washer, and the top side of the diaphragm sub-assembly.

As the adjusting screw is turned in against the pivot, the bonnet spring is compressed and puts a downward force on the diaphragm sub-assembly. The bottom of the diaphragm sub-assembly is in direct contact with the seat holder and stem. When the diaphragm is forced down by the spring, the stem is pushed away from the nozzle and gas can then flow from the high pressure chamber to the low pressure chamber.

When the low pressure chamber fills with gas, the gas will push upward against the diaphragm sub-assembly. As the pressure continues to build in the low pressure chamber, more upward force will be exerted against the diaphragm and the diaphragm will push up against the bonnet spring compressing the bonnet spring. As the diaphragm is gradually raised by the gas pressure, the seat and nozzle gradually come closer together filling the low pressure chamber slowly and eventually the upward pressure exerted by the gas will be slightly greater than the downward pressure of the bonnet spring and the seat nozzle will close. As gas is released from the low pressure chamber, a proportional amount of gas will be let into the low pressure area from the high pressure chamber. As the adjusting screw is turned in farther and the bonnet spring compressed, the gas pressure required to lift the diaphragm increases, resulting in a higher delivery pressure from the outlet port of the regulator.

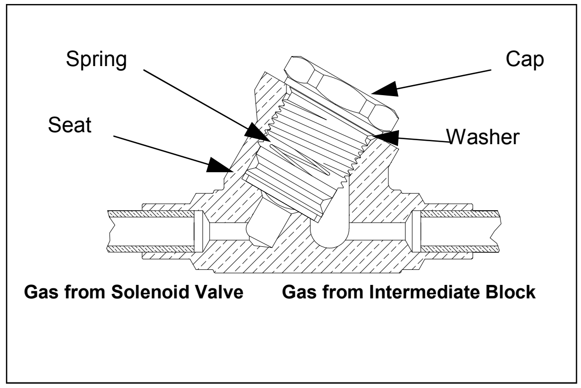


FIGURE 2-9 Check Valve

CHECK VALVES

The check valves prevent gas from flowing backward, See Figure 2-9.

Gas enters the check valve from the solenoid valves and pushes the check valve seat assembly away from the sealing surface of the valve body. This allows the gas to flow to the outlet port of the valve. When the gas flow stops, the spring of the check valve pushes the valve seat down on the sealing surface preventing any gas flow backward through the valve.

SOLENOID BYPASS

The bypass is to provide gas to the outlet of the solenoid in case the outlet fitting leaks. The bypass will ensure that the maximum pressure differential across the solenoid is not exceeded.

Gas enters the inlet of the bypass check valve from the solenoid inlet. Gas also enters the outlet of the bypass from the outlet of the solenoid. During normal operation the inlet and the outlet pressures are equal. The bypass check valve is set around 130 psig, (it takes 130 psig differential from the inlet to the outlet to open the bypass check valve). The only time this check valve will open is if the solenoid outlet fitting leaks. If the outlet fitting leaks, the bypass check valve will open and permit gas to flow. This flow of gas will ensure that the maximum allowable differential pressure of the solenoid is not exceeded.

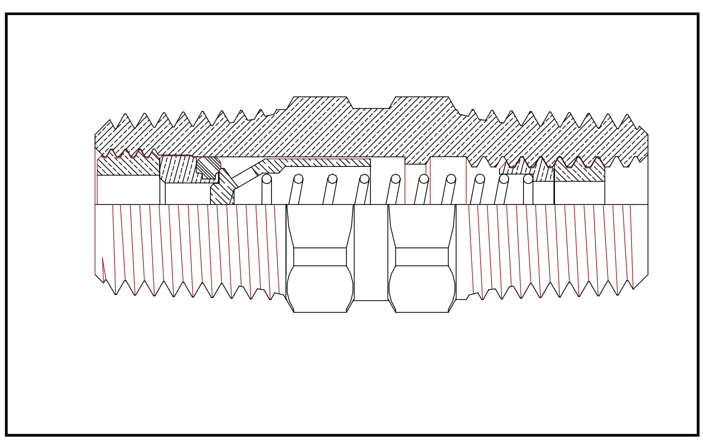


FIGURE 2-10 Solenoid Bypass Valve

SOLENOID VALVES

The solenoid valves are the heart of the manifold for maintaining the stand-by or reserve bank. The solenoid valves are constructed of two basic functional units: a solenoid (electromagnet) with its core and a valve body containing one or more orifices. See Figure 2-11. Flow through an orifice is stopped or allowed by the action of the core when the solenoid is energized or de-energized. The solenoid is mounted directly on the valve body. The core is enclosed and free to move in a sealed tube providing a compact, packless assembly.

The valve has a pilot and bleed orifice and utilizes the line pressure for operation. When the solenoid is energized, the pilot orifice is closed and full line pressure is applied to the top of the diaphragm through the bleed orifice, thereby providing a seating force for tight closure. When the solenoid is de-energized, the core opens the pilot orifice and relieves pressure from the top of the valve diaphragm to the outlet side of the valve. This results in an unbalanced pressure which causes the line pressure to lift the diaphragm off the main orifice, thereby opening the valve.

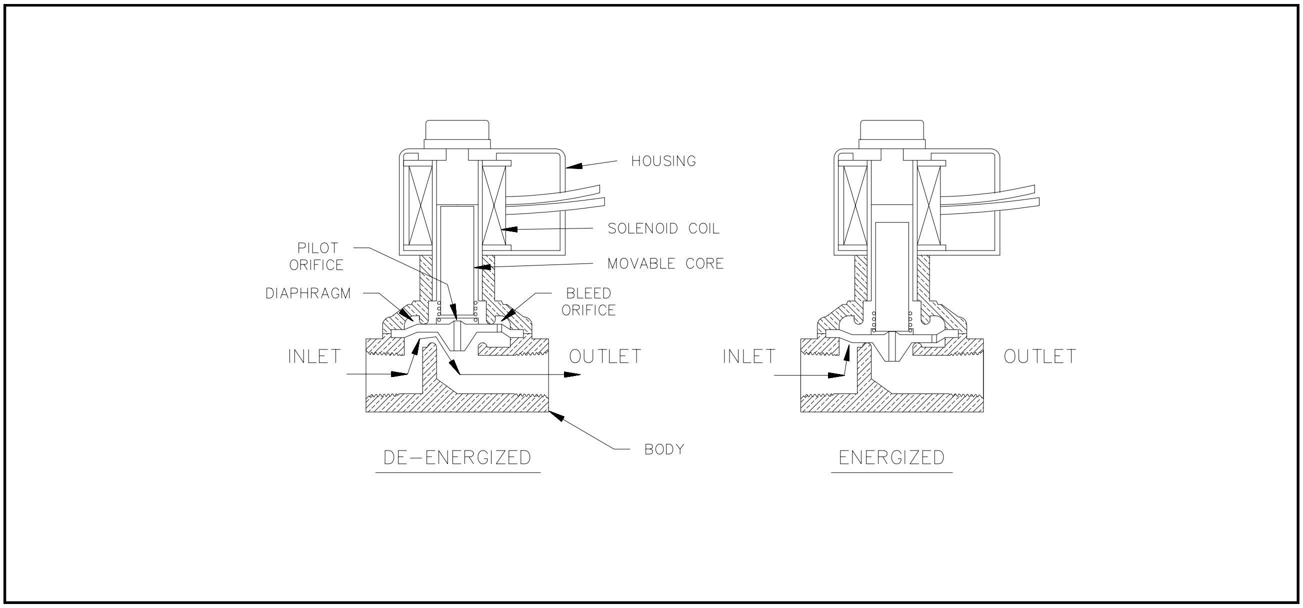


FIGURE 2-11

PRESSURE SWITCH

The pressure switch is used as a redundant safety feature to signal “Secondary in Use”. The switch is a piston type with one common contact, one normally closed contact, and one normally open contact. See Figures 2-12 and 2-13.

When the manifold is pressurized to the normal pressures, the piston in the switch is pushed up. The piston pushes the activator of the switch up.

This action closes the normally open contact and opens the normally closed contacts. As gas from the cylinder banks is depleted, the piston moves down, releasing the force against the switch activator. The contacts of the switch then return to the normally open and normally closed positions.

The switch completes the electrical circuits to the indicators on the front of the control section and to the remote alarm interface board in the power supply box.

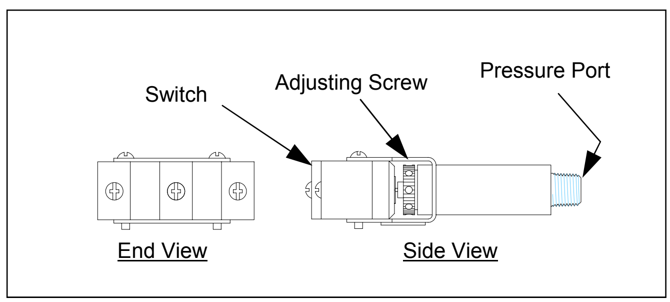


FIGURE 2-12 Low Pressure Switch

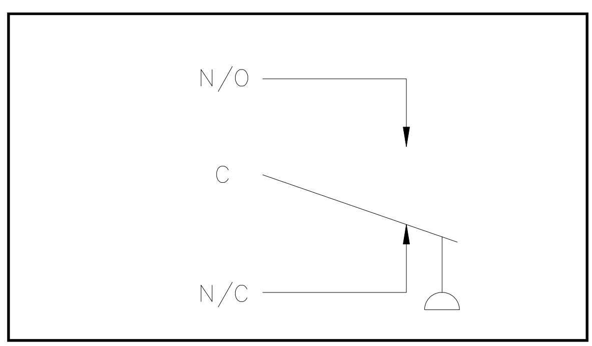


FIGURE 2-13 Switch Schematic

LINE PRESSURE REGULATOR

The line pressure regulator used in the manifold is a single stage, four port adjustable regulator (Refer to Figure 2-14). It has one inlet port and three outlet ports. The inlet port is piped to the outlet of the manifold control assembly. One outlet port is piped to the main pipeline. The other two outlet ports are plugged.

Gas enters the regulator through the inlet port and with the adjusting screw backed away from the spring, is sealed in the high pressure chamber of the regulator by the seat and nozzle.

As the adjusting screw is turned in, it compresses the spring and puts a downward force on the diaphragm sub-assembly. When the diaphragm is forced down by the spring, it pushes on the stem of the seat assembly. The seat is pushed away from the nozzle and gas can then flow from the high pressure chamber to the low pressure chamber.

When the low pressure chamber fills with gas, the gas will push upward against the diaphragm sub-assembly. As the pressure continues to build in the low pressure chamber, more upward force will be exerted against the diaphragm and the diaphragm will push up against the bonnet spring compressing the bonnet spring. As the diaphragm is gradually raised by the gas pressure, the seat and nozzle gradually come closer together filling the low pressure chamber slowly and eventually the upward pressure exerted by the gas will be slightly greater than the downward pressure of the bonnet spring and the seat nozzle will close. As gas is released from the low pressure chamber, a proportional amount of gas will be let into the low pressure area from the high pressure chamber. As the adjusting screw is turned in farther and the bonnet spring compressed, the gas pressure required to lift the diaphragm increases, resulting in a higher delivery pressure from the outlet port of the regulator.

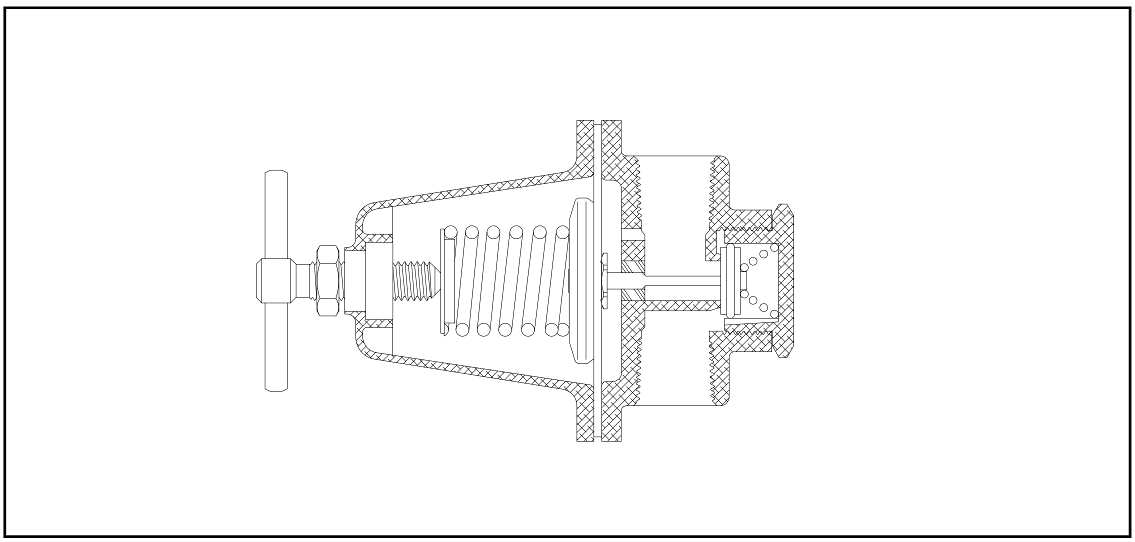


FIGURE 2-14 Line Regulator

PRESSURE TRANSDUCER

The pressure transducers vary their outlet voltage depending on the pressure being supplied. The voltage output is monitored by the manifold PCB. The voltage is converted to a pressure reading which is displayed on the PCB.

The line pressure transducer is used only to display the delivery pressure of the manifold. The bank pressure transducers display inlet pressures, opens and closes the solenoid valves, and signals when changeover has occurred.

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FIELD TESTING & TROUBLE SHOOTING

The manifold performance tests are used to verify the manifold functional performance. When used in conjunction with the troubleshooting charts, the technician can verify proper performance or rapidly identify the probable source of the problem.

NOTE:

- All testing should be done using full cylinders. Using partially full cylinders may result in improperly set components.

PERFORMANCE VERIFICATION PROCEDURE

1. Open the manifold as explained in Section 4.
2. Connect the electrical power source to the manifold and verify that the 2 red, 2 yellow, and 2 green lights are on and the 3 pressure displays are illuminated. (The manifold will go through a start up sequence that lasts about 15 seconds when power is supplied)
3. Open the master valves located on the cylinder header prior to pressurizing the manifold.
4. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.
5. **S-l-o-w-l-y** open cylinder valve on the right bank of cylinders.
6. Using a leak detect solution, verify that there are no leaks present at the connections.
7. Close the cylinder valves on the left and right banks of cylinders.
8. Create a slight gas flow downstream of the manifold. Vent the system until all gas has been removed from the manifold.
9. Turn off the flow of gas through the manifold.
10. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.
11. Create a slight flow of gas downstream of the manifold. The left bank intermediate gauge should settle and remain constant.
12. Turn off the flow of gas through the manifold.
13. Verify that the intermediate gauge indicated the pressure as shown in the specification chart in Section 1 for the primary regulator.
14. Observe the test gauge for two minutes. Verify that the primary regulator does not exhibit “creep” and/or increase in pressure.
15. Verify that the left side cylinder contents gauge indicates a minimum of 2000 psig for Oxygen, Nitrogen, Air, or gas mixtures. Nitrous Oxide and Carbon Dioxide systems should indicate a minimum of 750 psig. Adjust to the proper line pressure if necessary.
16. Verify the line pressure gauges is indicating a minimum of 50 psig on all system except Nitrogen. Nitrogen should indicate a minimum of 160 psig. Adjust to the proper line pressure if necessary.
17. Create a slight flow of gas downstream of the manifold.
18. Observe the intermediate gauge and verify the primary regulator setting under a flow condition. Adjust the left primary regulator as necessary to obtain the required pressure.
19. Turn off the left cylinder valve and allow all gas to vent from the manifold.
20. Turn off the flow of gas through the manifold.

21. **S-l-o-w-l-y** open one cylinder valve on the right bank of cylinders.

22. Complete steps 11-21 for the right primary regulator.

23. Turn off the flow of gas through the manifold.

24. Pressurize the right bank by opening one cylinder valve.

25. Verify that the line pressure regulator is functioning properly by observing the digital line pressure reading for two minutes. The reading should indicate the same pressure at the end of the two minute period.

26. Create a slight flow of gas downstream of the manifold.

27. Verify that the line pressure regulator maintains a constant pressure by observing the digital line pressure reading.

28. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.

29. Observe the cylinder contents pressure gauges to verify cylinder pressure.

30. Close the cylinder valve on the right bank of cylinders.

31. Observe the cylinder contents readouts: the right cylinder bank pressure should begin to drop; the left cylinder bank reading should remain constant

32. Observe the right intermediate gauge as the right side pressure continues to drop. As the cylinder pressure drops on the right side, the intermediate area also loses pressure. Verify that the pressure falls to 208 psig before the opposite solenoid valve opens. (see Specification Chart in Section 1)

33. **S-l-o-w-l-y** open one cylinder valve on the right bank of cylinders.

34. Verify that the intermediate gauge has returned to the set pressure of the primary regulator.

35. Close the cylinder valve on the left bank of cylinders.

36. Observe the cylinder contents gauges: the left bank gauge should begin to drop; the right cylinder bank should remain constant.

37. Observe the intermediate gauge as the right side pressure continues to drop. As the cylinder pressure drops on the left side, the intermediate area also loses pressure. Verify that the pressure falls to 208 psig before the opposite solenoid valve opens. (see specification chart in Section 1)

38. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.

39. Verify that the intermediate gauge has returned to the set pressure of the primary regulator.

40. Turn off the flow of gas through the manifold.

41. Disconnect the 3 wires from the manifold wiring harness that leads to the intermediate pressure switch. Note: Alarm will sound and red indicator lights will be lit.

42. Connect an ohmmeter across the black and brown wires of the wiring harness. The ohmmeter should indicate approximately zero (0) ohms resistance. If the ohmmeter does not indicate approximately zero (0) ohms, connect the meter across the normally open (N/O) and common (C) terminal on the pressure switch. The ohmmeter should register approximately zero (0) ohms resistance when connected to the switch. Adjust or replace the faulty switch. (See Section 4 for servicing the pressure switches). Disconnect the ohmmeter leads from the black and brown wires.

43. Close the Cylinder valve on the left bank of cylinders.

44. Create a slight flow of gas downstream of the manifold.

45. Verify an ohmmeter reading of infinite resistance as soon as the intermediate gauge pressure drops to the value for the pressure switch setting indicated in the specification chart in Section 1.

46. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.

47. Verify that the ohmmeter returns to approximately zero (0) ohms resistance.

48. Remove the ohmmeter leads from the black and brown wires.

49. Connect the switch wires to the manifold wiring harness.

50. Close all cylinder valves and vent all remaining gas from the manifold.

51. Turn off the flow of gas through the manifold.

52. Observe the cabinet status indicators. Verify that both the green indicators and both the red indicators are illuminated.

53. **S-l-o-w-l-y** open the cylinder valve on the left and right banks of cylinders.

54. Observe the cabinet status indicator. Verify that the green and yellow indicators are lit and both red indicators are off .

55. Close the cylinder valve on the service bank of cylinders.

56. Create a slight flow of gas downstream of the manifold.

57. Verify that the red light illuminates and the yellow light on the secondary bank changes to green when the manifold changes over from service to secondary supply.

58. **S-l-o-w-l-y** open one cylinder valve on the depleted bank of cylinders.

59. Observe the cabinet system status indicators. Verify that the green and yellow indicators are lit and the red indicators are off.

60. Close the cylinder valve on the service bank of cylinders.

61. Verify that the red light illuminates and the yellow light is extinguished when the manifold changes over from service to secondary supply.

62. Turn off the flow of gas through the manifold.

63. **S-l-o-w-l-y** open all cylinder valves on the left and right banks of cylinders.

64. Reinstall the manifold section cover as explained in Section 4.

Trouble-Shooting

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
PRIMARY REGULATOR		
Venting at relief valve.	Over pressure due to creeping or faulty regulation of primary regulator.	Replace regulator seat and nozzle components.
Gas leakage around primary valve body halves.	Loose bonnet	Tighten bonnet.
Pressure regulator body and bonnet	Diaphragm leak.	Replace diaphragm.
LINE PRESSURE REGULATOR		
Gas leakage around regulator body/bonnet.	Loose bonnet.	Tighten bonnet.
Pipeline not at desired pressure.	Line regulator not set correctly.	Set delivery pressure per specifications.
Required gas flow not available.	Line regulator not set correctly.	Set delivery pressure per specifications.
	Flow capacity too high.	Reduce flow capacity.
SOLENOID VALVES		
Gas leakage through a closed solenoid	Solenoid faulty.	Replace solenoid.
	Power not reaching the solenoid.	Check all wiring connections.
Solenoid not actuating properly (not “clicking” during power-up - v4.0.x and up).	Power not reaching the solenoid.	Check all wiring connections.
	PBC not driving the solenoid.	Component failure on PCB.
		Replace PCB.
	PCB configured for HGM2.	Check DIP switch setting.
	Solenoid faulty.	Replace solenoid.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
Electrical System		
No indicator lights or displays on front panel come on when power is hooked up.	Power Input.	Check electrical power supply.
Red indicator light(s) on but both banks are full.	Master valve, header valves, or cylinder valves on bank are closed.	Slowly open valves.
	Wiring to pressure transducer not correct.	Check internal leads to the pressure transducer.
Red indicator light does not come on when one bank is empty and changeover occurs.	Change-over occurring at too high a pressure.	Check transducers and pressure switch setting.
Green indicator light does not come on even though both banks are full.	New “service” side set without changing empty cylinders.	Replace depleted cylinders.
	Pressure transducer wiring incorrect or disconnected.	Check pressure transducer wiring.
	Pressure transducer reading too high a pressure.	Replace pressure transducer.
Display reads “0” even when pressure is present.	Pressure transducer wiring disconnected or faulty.	Check pressure transducer and controller board connections.
Display incorrect.	Pressure transducer faulty. Dip switches set incorrectly.	Replace transducer Check setting of the Dip switches.
One or both of the red indicators are blinking.	Pressure transducer faulty. Non-volatile memory failure	Replace transducer Replace the controller board.
No display on the green indicator flashing.	Input out of range during calibration routine.	Adjust the line and primary regulators prior to calibration.
No displays.	Excessive exposure to moisture.	Examine all connections for security and moisture content.
		Replace PCB.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
"RESERVE IN USE" SIGNAL		
Remote alarm signal stays in one mode constantly regardless of changeover status.	Power supply wiring is incorrect.	Check wiring connection on both power supply terminal strips.
	Flow demand too high.	Reduce flow demand.
	Power supply PCB defective.	Replace power supply PCB.
Remote alarm signals are opposite of manifold status.	Faulty connection to remote alarm unit.	Check input from alarm unit to terminal strip.
"ABNORMAL" LINE PRESSURE SIGNAL		
Low pressure alarm activated.	Line pressure regulator improperly adjusted	Readjust line pressure regulator.
	Closed master valves, header valves, or cylinder valves.	Slowly open valves.
	Empty cylinders.	Replace with full cylinders.
High pressure alarm activated.	Line regulator setting too high.	Readjust line pressure regulator.
	Regulator freeze-up. (Nitrous Oxide or Carbon Dioxide)	Reduce the flow demand or increase the number of supply cylinders.
	Faulty pressure transducer.	Replace pressure transducer.
	Faulty PCB.	Replace PCB.
LOSS OF CYLINDER CONTENTS		
Audible or inaudible gas leakage (origin unknown).	Leakage at manifold piping connections.	Tighten, reseal or replace.
	Leakage in downstream piping connections.	Tighten, reseal or replace.
	Leakage at manifold tubing system.	Repair as necessary.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
LOSS OF CYLINDER CONTENTS (continued)		
Audible or inaudible gas leakage (unknown origin). (continued)	Leakage at cylinder valve.	Replace cylinder valve.
	Gauge leaks.	Reseal or replace.
	Regulator leaks.	Repair or replace.
Venting at relief valve.	Overpressure due to creeping or faulty regulation by primary regulator.	Replace regulator seat and nozzle components.
	Regulator freeze-up. (Nitrous oxide or Carbon Dioxide)	Reduce the flow demand or increase the number of supply cylinders.
	Heater failure. (Nitrous oxide or Carbon Dioxide)	Reduce the flow demand or increase the number of supply cylinders.
Gas leakage around regulator body or bonnet.	Loose bonnet.	Tighten bonnet.
	Diaphragm leak.	Replace diaphragm.
Gas leakage around valve stem or packing nut on master valve or header valve.	Valve packing leaks.	Tighten packing nut.
	Faulty valve.	Repair or replace valve.
LOSS OF RESERVE BANK CONTENTS.		
Both banks feeding.	Solenoid valve seat leak.	Replace solenoid valve.
	Faulty primary regulator.	Replace regulator seat and nozzle components.
	Loss of electrical power.	Check electrical power supply.
	Faulty primary regulator.	Replace regulator seat and nozzle components.
	Faulty solenoid bypass check valve.	Replace solenoid bybass.
Opposite bank feeding.	Solenoid valve wiring incorrect.	Swap wiring from one solenoid valve to the other.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
Premature changeover to reserve bank.	Flow demand too high.	Readjust line pressure regulator.
	Faulty Transducer	Replace Transducer.
	Faulty PCB.	Replace PCB.
PIPELINE DISTRIBUTION		
Pipeline not at desired pressure.	Line regulator not set correctly.	Adjust line regulator.
Required gas flow not available.	Line regulator not set correctly.	Adjust line regulator.
	Flow demand too high.	Consult factory.
MANIFOLD LOCKS UP OR WON'T FLOW		
Reserve bank won't flow, or the manifold locks up and neither bank will flow.	Leakage at outlet fitting of the solenoid that will not open.	1. Remove power from the system. 2. Close valves on the cylinders. 3. Deplete gas from the headers by cracking open a fitting. 4. Tighten solenoid outlet fitting. 5. Open the cylinder valves. 6. Reconnect power to the manifold.
	Primary regulator set pressure 150 psig higher than the change over pressure.	1. Remove power from the system. 2. Close valves on the cylinders 3. Deplete gas from the headers by cracking open a fitting. 4. Reset the primary regulator. 5. Open the cylinder valves. 6. Reconnect power to the manifold.

SERVICE PROCEDURES

GENERAL MAINTENANCE

1. Main section
   a) Daily
      1) Record line pressure.

   b) Monthly
      1) Check regulators, valves and compression fittings for external leakage.
      2) Check valves for closure ability.

   c) Annually
      1) Check relief valve pressures.
      2) Check primary regulator seats.

2. Manifold header
   a) Daily
      1) Observe Nitrous Oxide and Carbon Dioxide systems for cylinder frosting or surface condensation. Should excessive condensation or frosting occur it may be necessary to increase manifold capacity.

   b) Monthly
      1) Inspect valves for proper closure.
      2) Check cylinder pigtails for cleanliness, flexibility, wear, leakage, and thread damage. Replace damaged pigtails immediately.
      3) Inspect pigtail check valves for closure ability.

SAFETY PRECAUTIONS

WARNING
- Repairs to manifold high pressure regulators, valve connections and piping should be made only by qualified personnel. Improperly repaired or assembled parts could fly apart when pressurizing causing **death** or serious **injury**.

1. Examine all parts before repair. **Note: Because manifold parts may be exposed to high pressure Oxygen and Nitrous Oxide and the condition of the unrepaired parts is unknown, a repair-inspection should be performed before exposing the parts to high pressure gas.**

2. Keep manifold parts, tools and work surfaces free of oil, grease and dirt. These and other flammable materials may ignite when exposed to high pressure Oxygen or Nitrous Oxide.

3. Use only proper repair tools and parts. Parts for Western manifolds are shown in this instruction. Special tools are called out as needed.

4. Before connecting the cylinder to the manifold, momentarily open and close the cylinder valve to blow out any dirt or debris.

5. After connecting the cylinder to the manifold, open the cylinder valve **s-l-o-w-l-y** to allow the heat of compression to dissipate.

6. Use only cleaning agents, sealants, and lubricants as specified in this instruction.

CLEANING, LUBRICATION, AND SEALING

Clean metal parts of the manifold with isopropyl alcohol or oxygen compatible media prior to assembly. Dry thoroughly.

Teflon® Tape Application

Threaded pipe connections should be sealed with Teflon® tape.

Remove the old sealant from both male and female threads. Apply Teflon® tape to the male pipe thread. Approximately 1 1/2 turns of tape should be sufficient. Do not cover the first thread with tape. Assemble the fittings wrench tight to effect a gastight seal.

Assembly and Disassembly of Compression Fittings

> **NOTE:**
> - Incorrect re-assembly of fittings may initially seal, however they may start to leak over time.

Mark the fitting and nut prior to disassembly. Before re-tightening, make sure the assembly has been inserted into the fitting until the ferrule seats in the fitting. Retighten the nut by hand. Tighten the nut with an appropriate wrench until the marks line up, which indicates that the fitting has been tightened to its original position. A noticeable increase in mechanical resistance will be felt indicating the ferrule is being resprung into sealing position. Then snug the nut 1/12 of a turn (1/2 of a wrench flat) past the original position.

Leak Testing

There are four types of manifold piping connections: sealed (soldered), threaded (unions and elbows), compression (tubing connections), and gasket (diaphragms and o-rings).

When a leak is suspected and cannot be easily located, a leak detector solution should be applied to all connections (in the event of leaks at more than one connection). Be certain to wipe fittings dry after testing. (Western's LT-100 leak detector dries clean and will not harm apparatus).

If a leak is detected at:

sealed connections**,** replace the assembly which is joined by the leaking connection.

threaded connections**,** union sealing surfaces may have burrs or nicks which may be polished out. Be certain to clean parts before reassembly. If the surface will not seal, replace the union. Elbows and tees may be cleaned of old sealant and resealed with Teflon® tape. Refer to cleaning, sealing, and lubricating instructions.

compression fittings**,** sealing surfaces of fittings or brass ferrules may be damaged and must be replaced. Refer to the parts list for appropriate part numbers.

gasket seals**,** leaks may occur at seals made by gaskets such as diaphragms or o-rings. Gas may leak to atmosphere or across the seal into the opposite pressure circuit. External leaks are evidenced by application of leak detector while leaks across the seal are detected by faulty manifold function. When replacing seals, use care not to damage sealing surfaces.

GENERAL REPAIR PROCEDURES

Be sure all pressure and electrical power is removed from the system prior to initiating any repair procedures.

WARNING

- Do not shutdown the manifold until personnel have been advised of the intended service and all patients requiring medical gas are being supplied from portable supplies. Patients still on the pipeline will not receive gas.

Note: When servicing a manifold component with a repair kit, use <u>all</u> components supplied with the kit.

HOW TO OPEN THE MANIFOLD

Door Open

1. Turn the latch counter-clockwise and open the door.

Door Closed

1. Close door and rotate knob clockwise until secure.

MANIFOLD CABINET COVER REMOVAL

Disassembly

1. Open the manifold as explained in the "How to open the manifold" section.
2. Disconnect the three wire harness terminal blocks from the manifold PCB.
3. Using the appropriate screwdriver (or 1/4" hex wrench) remove the 4 screws (2 on each side) holding the cover in place.
4. Carefully pull the cover straight out to clear the components.

Reassembly

1. Reverse order of disassembly

HOW TO DEPLETE THE SECONDARY BANK

1. Open the manifold as explained in the "How to Open the Manifold" section.
2. Close the cylinder on the "secondary" bank.
3. Mark the compression fitting at the outlet of the primary regulator per compression fitting instructions on page 4-2.
4. Crack open the compression fitting and allow the reserve bank to deplete.

CAUTION:
- The compression fitting on the secondary bank primary regulator should be used to deplete pressure from the reserve bank. If a different fitting is used, there may be pressure trapped in the secondary bank.

5. Once pressure has been depleted, retighten the fitting per the instructions on page 4-2.

HOW TO SHUTDOWN THE MANIFOLD

1. Turn off the piping system isolation valve, if present. If an isolation valve is not present, the entire buildings gas piping system will be reduced to atmospheric pressure.

WARNING
- Do not shutdown the manifold until all personnel have been advised of the intended service.

2. Open the manifold as explained in the "How to Open the Manifold" section.
3. Turn off right and left supply bank cylinder valves.
4. Vent gas from the system by creating a flow downstream of the manifold.
5. Close the usage point once all gas has depleted.

GAUGE REPLACEMENT

Removal

1. Shutdown the manifold and open the manifold as explained in the "How to Open the Manifold" and "How to Shut down the Manifold" sections
2. Using a 9/16 open end wrench remove the subject pressure gauge from the system.
3. Remove old sealant from the 1/4 NPT female pipe threads.

Replacement

1. Apply Teflon® tape to the 1/4 NPT male pipe thread on the new gauge and reassemble in the reverse order of the removal procedure.
2. Make sure gauge face is properly oriented.
3. Re-assemble the case per the "How to Shut down the Manifold" and "How to Open the Manifold" sections

PRIMARY REGULATOR REPAIR

NOTE:

- Removal and Replacement procedures are to be followed only if the primary regulator assembly is to be discarded. All service may be performed to the primary regulator without removing it from the manifold, as long as the regulator is properly supported.

Shutdown the manifold and open the manifold as explained in the “How to Open the Manifold” and “How to Shut down the Manifold” sections.

NOTE:

- This item may be repaired/replaced without shutting down the manifold completely. To work on the manifold while it is still in service, follow the steps outlined in “How to Deplete the Secondary Bank”.

Removal

1. Mark the compression fittings per the instructions on page 4-2. Using an 11/16" open end wrench, disconnect the outlet tubing and relief tubing from the regulator at the compression fitting joints.

2. Using two 1-1/8” hex wrenches disconnect the regulator from the inlet block at the CGA union connection.

Disassembly

1. Remove the nut from the regulator by turning it counterclockwise using a 3/4" hex wrench.

2. Using a flat blade screwdriver, turn the adjusting screw counterclockwise until it turns freely and all compression is removed from the bonnet spring.

3. Using a 1-3/8" hex wrench, rotate the bonnet counterclockwise and remove it along with the pivot, bonnet spring, washer, slip ring, and diaphragm sub-assembly.

4. Using a 13/16" hex socket wrench, rotate the nozzle counterclockwise and remove it along with the seat holder and stem, compensating spring, and the spring retainer.

5. Clean all interior surfaces of the regulator body with isopropyl alcohol or oxygen compatible media.

6. Blow out the regulator body and ports with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

CAUTION:

- Do not stand directly in front of the body or ports when performing the next step. Eye protection should be worn to protect the service technician. Chips of debris may be propelled into unprotected eyes.

Reassembly

1. Apply a thin coating of Krytox® lubricant or oxygen compatible equivalent to the o-rings.

NOTE:
• See section 5 for a picture showing the proper assembly of the regulator.

2. Assemble small o-rings with the spring retainer. Push the smaller o-ring to the bottom of the bore it rests in.
3. Assemble the large o-ring with the nozzle.
4. Insert the new seat holder and stem into the nozzle.
5. Place the spring filter and Teflon® gasket over the seat holder and stem.
6. Place the spring retainer on the compensating spring. The boss on the retainer will enter the internal diameter of the spring.
7. Grasp the flats of the nozzle with one hand and carefully guide the seat/nozzle assembly into the body of the regulator until the threads are engaged. Rotate the nozzle clockwise and hand tighten.
8. Using the 13/16" hex socket and torque wrench, tighten the nozzle to approximately 5 ft-lbs. torque.
9. Lubricate the outer (regulator body to diaphragm) sealing surface of the regulator body with a small amount of water. Do not allow water to enter the low pressure chamber of the regulator.
10. Hold the bonnet upside down and place the pivot and bonnet spring in the bore provided. The small diameter of the pivot should enter the internal diameter of the spring.
11. Place the washer in the large bonnet cavity, beveled side up.
12. Lay the slip ring on top of the washer.
13. Insert the diaphragm sub-assembly in the bonnet cavity. The side marked “UP” should be against the slip ring.
14. Carefully place the bonnet on the regulator body. Rotate the bonnet clockwise and tighten to 85-95 ft-lbs. torque.

Replacement

1. Connect the inlet of the regulator to the CGA bushing located on the inlet block handtight.
2. Connect the compression fitting to the primary regulator finger tight.
3. Tighten the CGA connection on the regulator inlet using two 1 1/8 wrenches.
4. Using an 11/16” open end wrench, connect the outlet and relief tubing to the 3/8” tube compression fittings. When retighting the compression fittings, follow the procedure outlined on page 4-2.

PRIMARY REGULATOR ADJUSTMENT

1. If not already done, open the manifold by following the “How to open the manifold“ as explained earlier in this section.

2. Remove the nut from the primary regulator.

3. If the bank is not pressurized, **s-l-o-w-l-y** open the cylinders on the side of the regulator to be adjusted.

4. Verify the cylinder pressure readout indicates a minimum pressure of 2000 psig for Oxygen, Air, and Nitrogen systems or a minimum of 700 psig on Nitrous Oxide and Carbon Dioxide systems.

5. Create a slight flow of gas downstream of the manifold.

6. Using a flat blade screwdriver, turn the adjusting screw of the regulator while observing the test gauge. (rotating the set screw clockwise will increase the regulator setting, while rotating it counterclockwise will lower the regulator setting). Set the regulator to the pressure indicated on the Adjustment Specification chart in Section 1.

7. Stop the gas flow. The test gauge will go up slightly higher than the flowing adjusted pressure.

8. Verify that the regulator does not creep by observing the intermediate gauge for two minutes. The gauge must indicate the same pressure at the end of the two minute period.

9. Install the nut on the primary regulator.

PRESSURE SWITCH REPLACEMENT

Removal

1. Open and shutdown the manifold as explained in the “How to Open the Manifold” and “How to Shut down the Manifold” sections.

2. Label the three wires attached to the switch. Loosen the slot head screws on the pressure switch using a flat blade screwdriver and remove the wires.

3. Using an open end wrench, remove the pressure switch from the intermediate block.

CAUTION:
- The alarm will trigger upon disconnecting the wires.

Replacement

1. Apply Teflon® tape to the male threads, making sure not to cover the first thread.

2. Using an open end wrench; install the pressure switch on the intermediate block and tighten to effect a gastight seal.

3. Complete the adjustment instructions below prior to installing the signal wires to the pressure switch.

Pressure Switch Adjustment

1. Mark and disconnect the three wires from the pressure switch.

2. Connect an ohmmeter to the normally closed and common electrical contacts on the switch. The ohmmeter should register zero resistance.

3. Begin pressurizing the service bank manifold by opening one cylinder valve on the service side of the manifold. At the actuation pressure, the ohmmeter reading will jump from zero resistance to infinite resistance.

4. Close the cylinder valve.

5. Create a flow of gas downstream to relieve pressure from the manifold while observing the test gauge and ohmmeter to determine switch setting. At actuation pressure, the ohmmeter reading should drop from infinite resistance to zero resistance.

6. Stop the gas flow.

7. Using a allen wrench, turn the knurled adjustment screw on the pressure switch clockwise to raise the set point or counterclockwise to lower the set point. The pressure switch should be set per the Adjustment Specification chart in Section 1.

8. Cycle between actuation and re-actuation signal and make adjustments as required to achieve the signal setting. The setting should be made on descending pressure. Make adjustments in response to the reading obtained in step 4.

WARNING:

- Be sure power is off when electrical connections are made. Current flowing though the wires may shock the service technician, or damage the Ohmmeter or pressure switch.

9. After the setting has been made, connect the signal wires to the appropriate contacts on the pressure switch.

CHECK VALVE REPAIR – INTERMEDIATE

Removal

1. Open and shutdown the manifold as explained in the “How to Open the Manifold“ and “How to Shut down the Manifold” sections.

2. Mark the compression fittings per the instructions on page 4-2. Disconnect the tubing at the compression fittings from the solenoid valve and the intermediate block using an 11/16" open end wrench.

3. Remove the check valve and tubing assembly from the control section.

Disassembly

1. Secure the check valve in a vise or similar holding fixture. Using a 1 1/8" hex wrench, rotate the valve cap counterclockwise and remove.

2. Remove the seal washer from the valve cap.

3. Pull the spring from the valve body.

4. Using a small needle nose pliers or tweezers, grasp the valve poppet and remove it from the valve body.

5. Clean the interior of the valve body with isopropyl alcohol or oxygen compatible media.

CAUTION:

- Do not stand directly in front of the valve when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

6. Blow out the check valve body with oil free Air or Nitrogen to remove all foreign material and dry all surfaces.

Reassembly

1. Insert a new valve poppet into the valve body.

2. Insert the spring into the valve body.

3. Position the new seal washer in the groove of the valve body.

4. Place the valve cap over the spring and push the cap towards the body until the threads engage. Rotate the cap clockwise and tighten to 35 ft-lbs. torque.

Replacement

1. Position the check valve and tube assembly in the control section with the check valve flow arrow pointing towards the back of the manifold.

2. Connect the compression fittings to the solenoid valve and intermediate block using an 11/16" open end wrench and tighten to effect a gastight seal. When retightening the compression fitting, follow the procedure outlined on page 4-2.

SOLENOID VALVE REPLACEMENT

Removal

1. Shutdown the manifold as explained earlier in this section.

2. Disconnect the electrical wires at the wire nut attachment points.

3. Mark the compression fittings per instructions on page 4-2, disconnect the tubing at the compression fittings using as 11/16” open end wrench.

4. Remove the solenoid assembly from the control section.

5. Remove the four valve bonnet screws, valve bonnet, disc holder sub-assembly, disc holder spring, diaphragm/spring sub-assembly, and body gasket. It may be necessary to bend body assembly and tubing to clear mounting bracket to ease removal of some parts.

Replacement

1. Position the solenoid assembly with the inlet end connected to the primary regulator outlet tubing.

NOTE:
- Should diaphragm/spring sub-assembly become disassembled, be sure to replace the diaphragm/spring support with the lip facing upward towards the valve bonnet.

2. Connect the compression fittings using an 11/16” open end wrench and tighten to effect gas tight seal. When retightening the compression fitting follow the procedure outlined on page 4-2.

Reassembly

1 Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts (see Figure 4-8).

2. Replace body gasket and diaphragm/spring sub-assembly. Locate bleed hole in diaphragm/spring sub-assembly approximately 45º from valve outlet. Replace the disc holder spring and disc holder sub-assembly.

3. Replace valve bonnet and bonnet screws, sliding valve under mounting bracket and lining up screw mounting holes. Torque bonnet screw in a crisscross manner to 110 ± 10 in-lbs.

4. Install solenoid base gasket, plugnut assembly and plugnut gasket. Position core, small end up, on plugnut assembly.

5. Replace solenoid base sub-assembly and torque 117 ± 25 in-lbs.

WARNING:

- Be sure power is off when electrical connections are made. Current flowing through the wires my shock the service technician.

6. Replace solenoid enclosure and retaining cap or clip.

7. Connect the wires to the appropriate wires coming from the manifold controller PCB.

8. After maintenance, restore power to the system and operate the valve several times to be sure of proper opening and closing.

LINE REGULATOR REPAIR

Refer to Figure 4-9

Removal

1. Shut down the manifold and open the manifold as explained in the “How to Open the Manifold” and “How to Shut down the Manifold” sections.
2. Loosen the lock nut and remove the adjusting screw completely from the regulator.
3. Using an 11/16” wrench, disconnect the tube that connects the intermediate block to the line regulator.
4. Remove the 3/8” tube elbow from the intermediate block assembly.
5. Rotate the regulator counter-clockwise and carefully remove from the manifold.

Disassembly

1. Place the regulator in a vise or similar holding fixture.
2. Using an 11/16” open end wrench, loosen the locknut on the regulator adjusting screw and back off the adjusting screw until it turns freely and all compression is removed from the bonnet spring.
3. Using a 1-1/2” hex wrench, remove the backcap and conical spring from the regulator.
4. Remove the gasket from the backcap and discard.
5. Use a phillips head screwdriver to remove the six screws attaching the bonnet to the body. Lift the bonnet off of the body and set aside the bonnet, pivot, bonnet spring, and screws.
6. The diaphragm assembly and the seat/stem assembly are attached at each end of the stainless steel rod. The stainless steel rod is threaded on both ends. Using a 5/8” hex wrench to stabilize the diaphragm assembly, reach under the regulator with a 1/4” open end wrench, placing it over the wrench flats provided on the bottom of the seat assembly, and loosen the seat assembly. The seat can be unscrewed by hand after loosening. Remove and discard the diaphragm and seat assemblies.

Reassembly

1. Set the new diaphragm assembly on the body with the spring retainer facing up.
2. Insert the new stem/seat assembly through the backup port and screw into the diaphragm assembly by hand. Stabilize the diaphragm assembly using one hand and snug up the seat/stem assembly with the other hand using a 1/4” open wrench. Do not over tighten.
3. Place the new gasket in the backcap groove.
4. Place the conical spring, large end first, into the backcap cavity.
5. Carefully line up the spring small end so that it slides over the wrench flats on the seat/stem assembly and screw the backcap into position. Tighten with a 1-1/2” hex wrench.
6. Line up the diaphragm holes with the screw holes in the body.
7. Set the bonnet spring in the retainer on the diaphragm assembly.

8. Set the pivot on top of the spring, pointed end down.

9. Set the bonnet carefully over the spring and pivot and line up the screw holes in the bonnet with the screw holes in the body.

10. Insert the screws in the screw holes and tighten by hand. Use a phillips head screwdriver and tighten the screws in a crisscross manner.

11 Remove the regulator from the vice.

Replacement

1. Install the regulator in the manifold, following the removal procedure in reverse order.

2. Leak test all of the line regulator connections and the connections on the check valve.

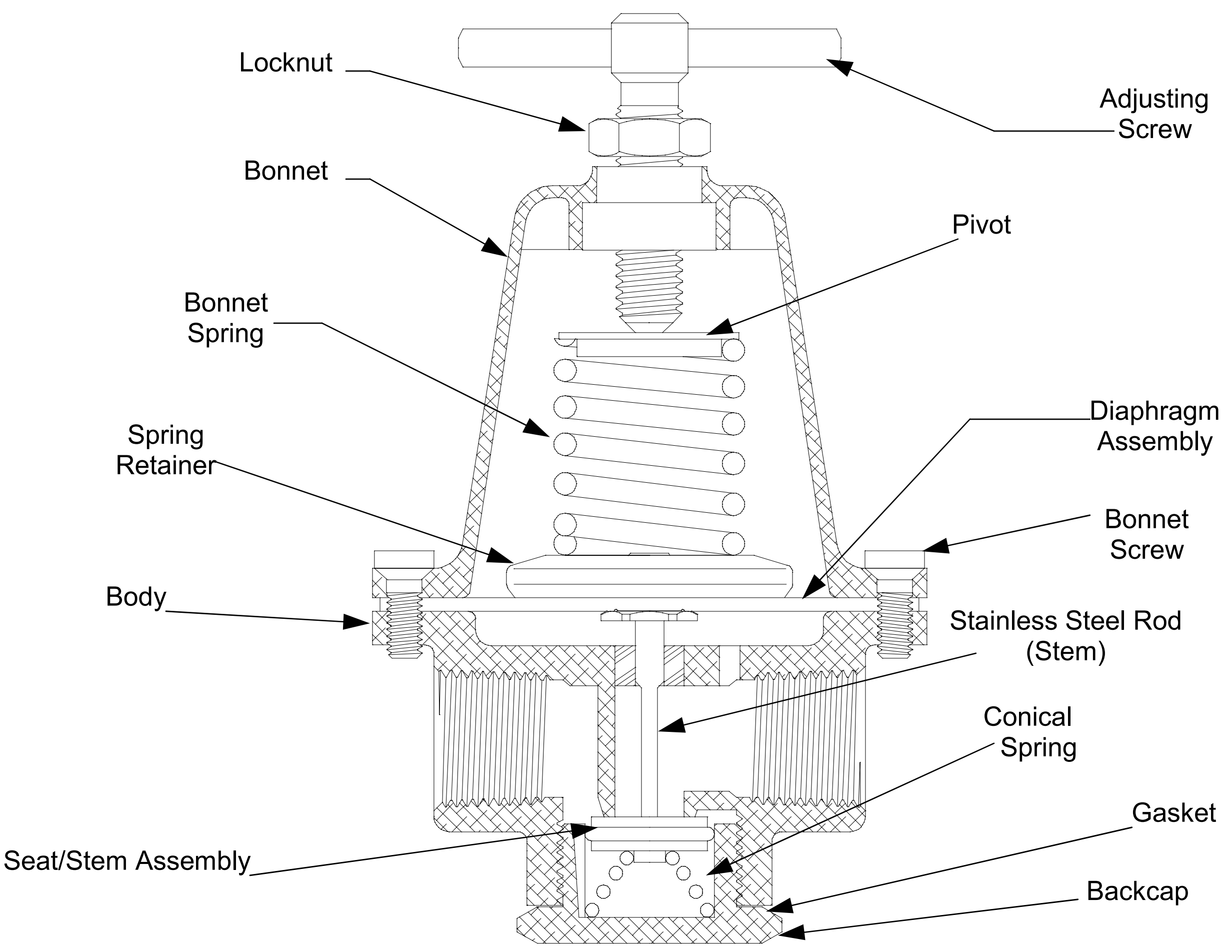


FIGURE 4-9 Line Regulator

PCB Replacement

Removal

1. Open the manifold as explained in the “How to Open the Manifold” section.
2. Remove power by disconnecting the cable from the power supply.
3. Remove the 4 hex nuts holding the PCB cover in place.
4. Remove the 3 wire clips from the PCB.
5. Pop the PCB off the door.

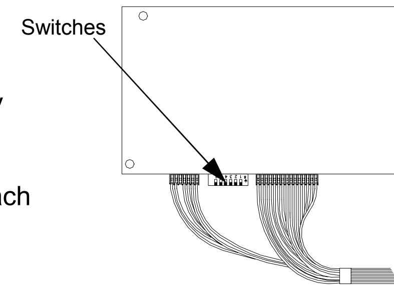
Replacement

1. Align the PCB on the standoffs and carefully press into place.
2. Install the 3 wire clips to the PCB.
3. Install the PCB cover and tighten the 4 hex nuts.
4. Reconnect power.

ELECTRICAL POWER-UP

Software version 4.0.x and higher*:

1. When power is applied to the manifold, the displays will cycle through a power-up sequence before displaying pressure. This process takes approximately 12 seconds.
   - All six status indication lights will be lit.
   - A solenoid test will be performed on each bank. The left green status light will turn off and on, followed by the right green status light. A noticeable “click” can be heard from each solenoid valve.
   - The state of the DIP switches will be shown on the right bank display and right most digits of the left bank display. A “1” represents each open switch; a “0” for closed.
   - The status lights will extinguish in the order: green, yellow, red for each bank.
   - Each digit of the displays will read “8”.
   - A pressure switch status test will be conducted. If the red and green status lights are on, the pressure switch is in an open state (no inlet pressure, wired incorrectly, broken connection). Otherwise, no status lights will be on.
   - Each digit of the display will be lit individually.



2. The displays and status indicators will then be allowed to operate normally.

Software version 2.02*:

1. When power is applied to the manifold, the displays will first cycle through a power-up sequence before displaying pressure. This process takes approximately 16 seconds.
   - All six status indication lights will be lit.
   - The lights will turn off sequentially.
   - The status of the DIP switches will be shown on the digits of the right bank display and the right most digits of the left bank display. A “1” represents each open switch; a “0” for closed.
   - Each digit of the displays will read “8”.
   - Each digit of the displays will be lit individually.

2. The displays and status indicators will then be allowed to operate normally.

* Software version located on back of PCB

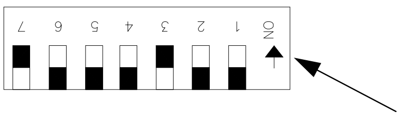
UNITS OF MEASURE

1. The DS1000 manifold can be configured to display pressure in PSI, KPa or BAR. The manifold is shipped with PSI as the default unit of measure. To switch the units, proceed to step 2. If PSI units are desired, no changes are necessary and step 2 may be skipped.

2. To change the units, perform the following steps:
   - Remove power to the manifold (switches are only read during power-up).
   - Open the door of the manifold.
   - Locate the DIP switches at the bottom edge of the PC Board on the door.

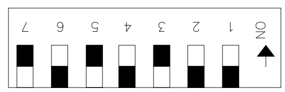
- For PSI set the switches as shown:

Model DS1000

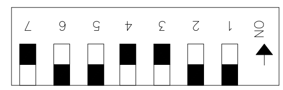


(Switch Position)

Model DS1000HL

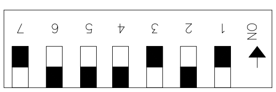


Model DS1000HP:

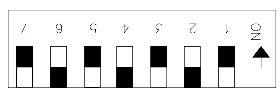


- For KPa set the switches as show:

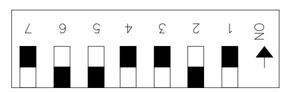
Model DS1000



Model DS1000HL

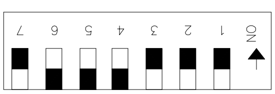


Model DS1000HP:

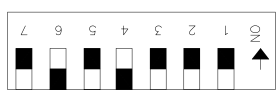


- For BAR set the switches as shown:

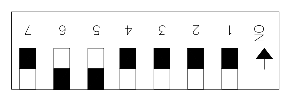
Model DS1000



Model DS1000HL



Model DS1000HP:



- Close the cover and reconnect power to the manifold.
- Verify that during power-up the status of the switches are displayed on the digits of the right bank display and the right most digit of the left bank display as a series of “1”s and “0”s as follows:

DIP SWITCH/DISPLAY OPTION

- For PSI:

Model DS1000

Left Display

			1	1

Right Display

0	1	0	1	0

Model DS1000HL

Left Display

			1	1

Right Display

0	1	0	1	0

Model DS1000HP:

Left Display

			1	1

Right Display

0	0	1	1	0

- For KPa:

Model DS1000

Left Display

			0	1

Right Display

0	1	1	1	0

Model DS1000HL

Left Display

			0	1

Right Display

0	1	0	1	0

Model DS1000HP:

Left Display

			0	1

Right Display

0	0	1	1	0

- For BAR:

Model DS1000

Left Display

			0	0

Right Display

0	1	1	1	0

Model DS1000HL

Left Display

			0	0

Right Display

0	1	0	1	0

Model DS1000HP:

Left Display

			0	0

Right Display

0	0	1	1	0

TRANSDUCERS – HIGH PRESSURE
Removal

1. Shutdown and open the manifold as explained in the “How to Shut down the Manifold” and “How to Open the Manifold” sections.

> **NOTE:**
> - This item may be replaced without shutting down the manifold completely. To work on the manifold while it is still in service follow the steps in “How to Open the Manifold” and “How to Deplete the Service Bank” sections.

2. Using a 7/8” open end wrench turn the high pressure transducer counter-clockwise. If gas is heard escaping, stop rotating the transducer and wait for the trapped pressure to deplete.

3. Clean any remnant of Teflon® tape from the port on the inlet block.

Replacement

1. Apply Teflon® tape to the 1/4 NPT thread on the new transducer, leaving the first thread exposed.

2. Using a 7/8” open end wrench thread the transducer into the inlet block.

TRANSDUCER – LINE PRESSURE
Removal

1. Shutdown and open the manifold as explained in the “How to Shut down the Manifold” and “How to Open the Manifold” sections.

> **NOTE:**
> - The manifold must be fully shut down in order to replace the line pressure transducer.

2. Using a 7/8” open end wrench turn the high pressure transducer counter-clockwise. If gas is heard escaping, stop rotating the transducer and wait for the trapped pressure to deplete.

3. Clean any remnants of Teflon® tape from the port on the inlet block.

Replacement

1. Apply Teflon® tape to the 1/4 NPT thread on the new transducer, leaving the first thread exposed.

2. Using a 7/8” open end wrench thread the transducer into the inlet block.

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NOTE:

- Western manifold systems are designed and tested for optimal performance and adherence to safety specifications. We recommend the use of Western replacement components to maintain the standards of performance and the safety of the product.

REPLACEMENT PIGTAILS

24” Stainless Steel Flexible Braid with Check Valves

PF-320CV-24..................CGA 320 for Carbon Dioxide (CO_2) Service
PF-326CV-24..................CGA 326 for Nitrous Oxide (N_2O) Service
PF-63CV-24....................CGA 540 for Oxygen (O_2) Service
PF-92CV-24....................CGA 580 for Inert Gas Service (N_2) except Helium
PF-346CV-24..................CGA 346 for Air Service

24” Synthetic Fiber Braid Hose with Check Valve

PFS-92CV-24..................CGA 580 for Helium (He) Service

GAUGES – 1.5” Diameter, 1/4” NPT Bottom Port

G-15-400W ....400 psi…..Intermediate Gauge

REGULATORS

Primary Regulators

WMS-14-41.....................Left Primary Regulator for DS1000HL (CO_2 & N_2O)
WMS-14-42.....................Right Primary Regulator for DS1000HL (CO_2 & N_2O)
WMS-14-43.....................Left Primary Regulator for DS1000 (Air, He, N_2)
WMS-14-44.....................Right Primary Regulator for DS1000 (Air, He, N_2)
WMS-14-45.....................Left Primary Regulator for DS1000HP (Air, He, N_2)
WMS-14-46.....................Right Primary Regulator for DS1000HP (Air, He, N_2)
WMS-14-47.....................Left Primary Regulator for DS1000HP (Oxygen)
WMS-14-48.....................Right Primary Regulator for DS1000HP (Oxygen)
WMS-14-49.....................Left Primary Regulator for DS1000 (Oxygen)
WMS-14-50.....................Right Primary Regulator for DS1000 (Oxygen)

Line Regulators

8431................................Line Regulator for DS1000 & DS1000HL – series manifolds
8430................................Line Regulator for DS1000HP – series manifolds

REGULATOR REPAIR KITS

Primary Regulator Kits

RK-1037..........................Repair Kits for WMS-14-41(L & R), WMS-14-42 (L & R), WMS-14-43 (L & R), WMS-14-44 (L & R)
WMS-14-45 (L & R), WMS-14-46 (L & R) Primary Regulators
RK-1038..........................Repair Kits for WMS-14-47 (L & R), WMS-14-48 (L & R)
WMS-14-49 (L & R), WMS-14-50 (L & R) Primary Regulators

REGULATOR REPAIRS KITS (continued)

Line & Intermediate Regulator Kits

RK-1100M…………..Repair Kit for all line regulators

VALVES AND VALVE REPAIR KITS

WMV-2-7 ....CGA 320 Cylinder Valve
WMV-2-14 ....CGA 326 Cylinder Valve
WMV-2-4 ....CGA 346 Cylinder Valve
WMS-1-53 ....CGA 540 Check Valve Bushing
WMV-2-3 ....CGA 580 Cylinder Valve
WMV-2-16 ....Master Valve
RK-1041 ....Repair Kit for Low Pressure Check Valve
RK-1085 ....Repair Kit for WMV-2-16

PRESSURE SWITCHES

WME-4-4 ....All Gases except Oxygen
WME-4-4C............... For Oxygen Manifolds

POWER SUPPLY REPLACEMENT PARTS

WMS-13-23 ....Power Supply Assembly (transformer, PCB with dry contacts, case, and cable)
WME-8-85 ....Power Supply PCB for WMS-13-23 (includes dry contact for remote alarms)

TRANSDUCERS

WME-9-1A................Inlet Transducer
WME-9-2A................Line Transducer for DS1000HP
WME-9-3A................Line Transducer for DS1000 & DS1000HL

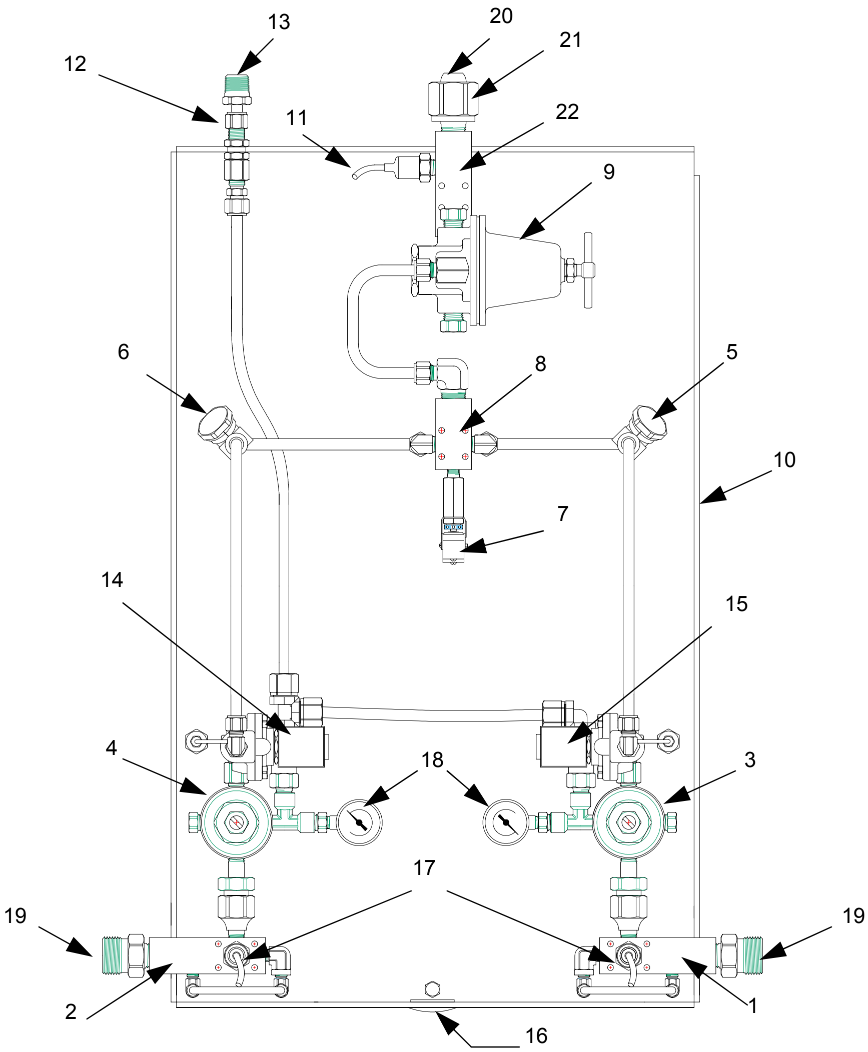
MANIFOLD PCB

WME-8-98A..............Manifold PCB for DS1000
WME-8-98B…………Manifold PCB for DS1000HL
WME-8-98C………...Manifold PCB for DS1000HP

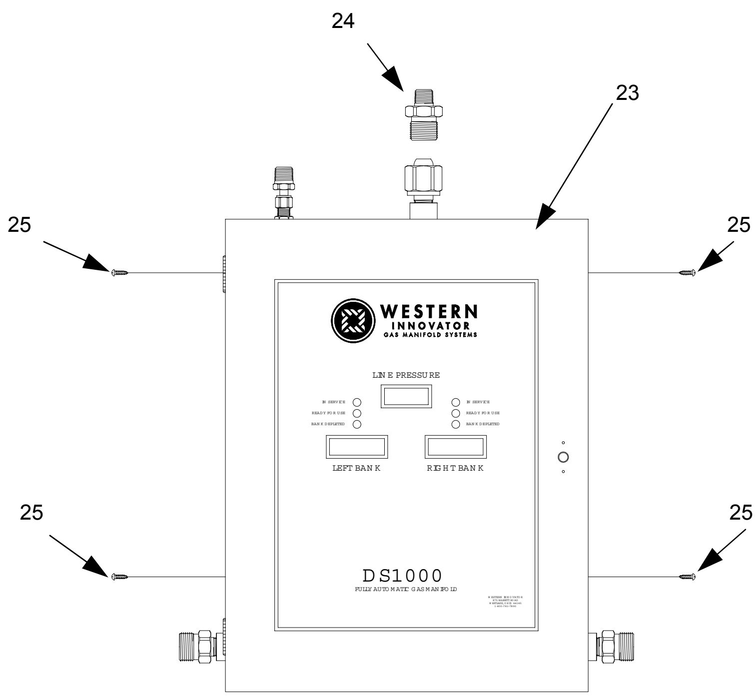
SOLENOIDS

8423 ....Solenoid Valve for oxygen, nitrogen, and air systems
8422 ....Solenoid Valve for CO_2 and N_2O systems

WMV-5-15 ....Solenoid Bypass Check Valve

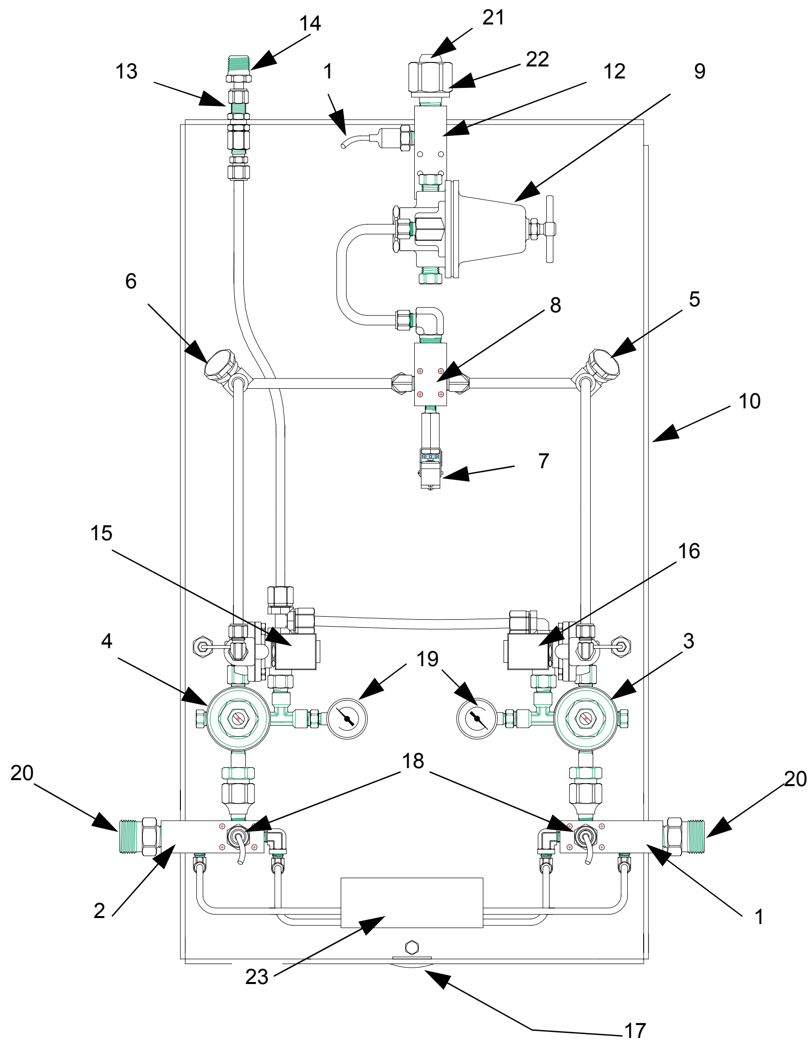


KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Right Inlet Block Assembly	WMS-13-3	11	Line Transducer	
2	Left Inlet Block Assembly	WMS-13-4		DS1000	WME-9-3A
3	Right Primary Assembly	WMS-14-31		DS1000HP	WME-9-2A
4	Left Primary Assembly	WMS-14-30	12	Bulkhead Connector	WLF-3-49
5	Right Side Check Valve Assembly	WMS-14-20R	13	Relief Tube Adaptor	WLF-3-12
6	Left Side Check Valve Assembly	WMS-14-20L	14	Left Solenoid Valve Assembly	WMS-14-6
7	Pressure Switch		15	Right Solenoid Valve Assembly	WMS-14-7
	DS1000, DS1000HL, DS1000HP	WME-4-4	16	Hole Plug	WME-8-97
	Oxygen	WME-4-4C	17	Inlet Transducer	WME-9-1A
8	Center Block Assembly	WMS-14-2	18	Intermediate Gauge	G-15-400W
9	Line Regulator		19	Inlet Union	WMS-1-40
	DS1000	8431	20	Nipple	D-20
	DS1000HP	8430	21	Nut	D-7
10	Backplate Assembly	WMS-14-24	22	Exit Block	WMC-3-46

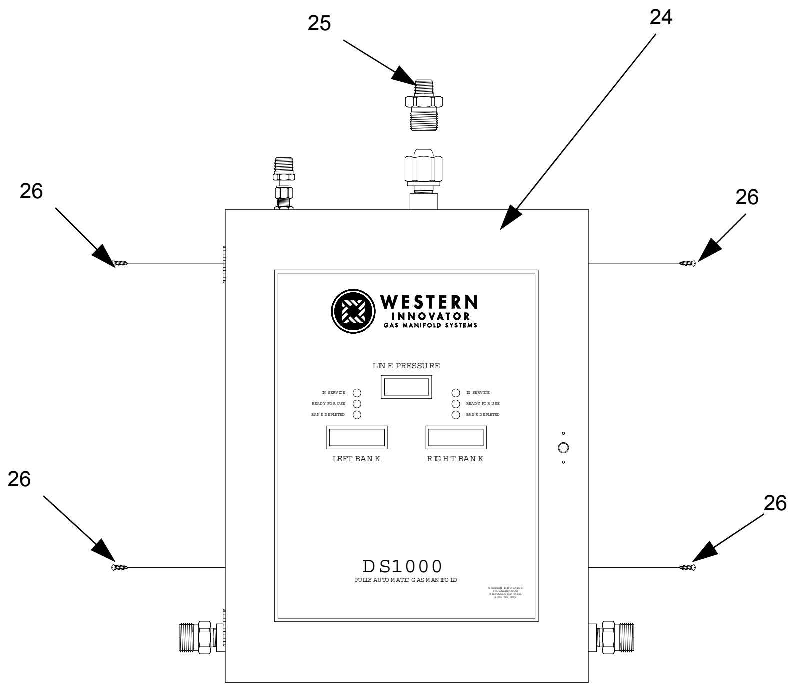


KEY #	DESCRIPTION	PART #
23	Case	WMC-2-59A
24	Outlet Union	D-34
25	# 8 Sheet Metal Screw	WMC-6-23
*	Case Wiring Harness	WMS-13-51
*	Switch Wiring Harness	WMS-1-13
*	Power Supply Box	WMS-13-23
*	Manifold PCB	WME-8-98

* Item Not Pictured



KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Right Inlet Block Assembly	WMS-13-3	12	Exit Block Assembly	WMS-3-46
2	Left Inlet Block Assembly	WMS-13-4	13	Bulkhead Connector	WLF-3-49
3	Right Primary Assembly	WMS-14-31	14	Relief Tube Adaptor	WLF-3-12
4	Left Primary Assembly	WMS-14-30	15	Left Solenoid Valve Assembly	WMS-14-12
5	Right Side Check Valve Assembly	WMS-14-20R	16	Right Solenoid Valve Assembly	WMS-14-13
6	Left Side Check Valve Assembly	WMS-14-20L	17	Hole Plug	WME-8-97
7	Pressure Switch	WME-4-4	18	Inlet Transducer	WME-9-1A
8	Center Block Assembly	WMS-14-2	19	Intermediate Gauge	G-15-400
9	Line Regulator		20	Inlet Union	WMS-1-40
	DS1000HL	8431	21	Nipple	D-20
10	Backplate Assembly	WMS-14-24	22	Nut	D-7
11	Line Transducer	WME-9-3A	23	Heater	WMS-13-37



KEY #	DESCRIPTION	PART #
24	Case	WMC-2-59A
25	Outlet Union	D-34
26	# 8 Sheet Metal Screw	WMC-6-23
*	Case Wiring Harness	WMS-13-51
*	Switch Wiring Harness	WMS-1-13
*	Power Supply Box	WMS-13-23
*	Manifold PCB	WME-8-98

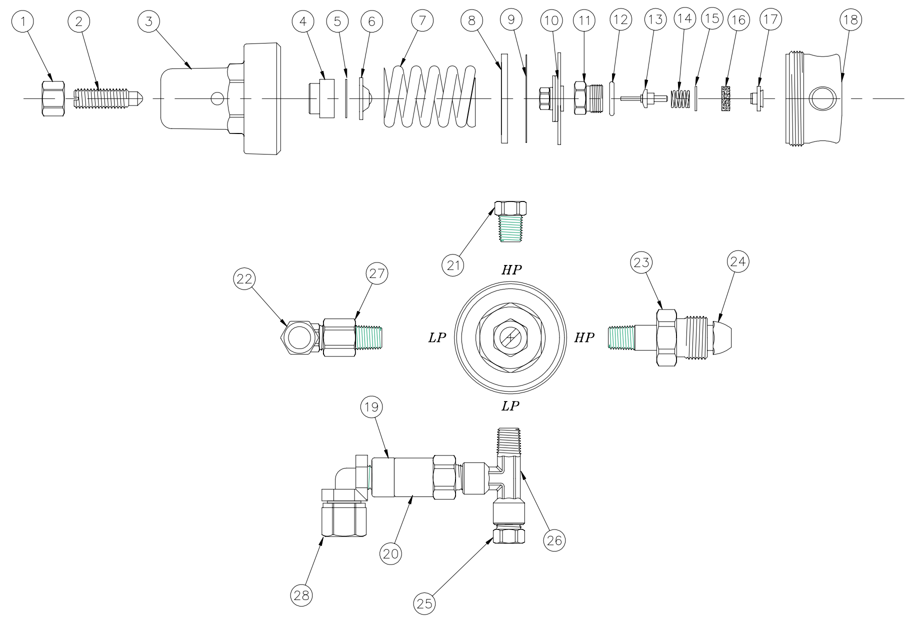
* Item Not Pictured

Western Enterprises

Automatic Changeover Manifold
DS1000, DS1000HL, & DS1000HP Series

Repair Drawing

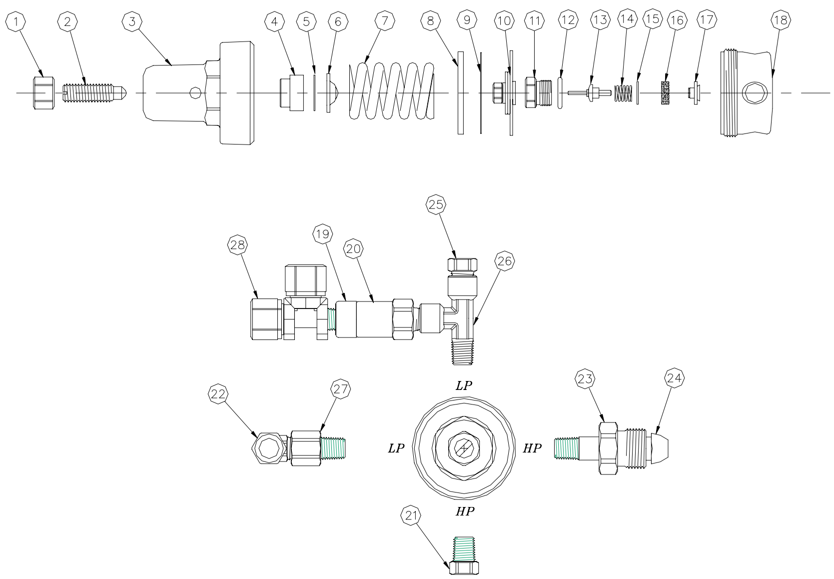
Left Regulator Components



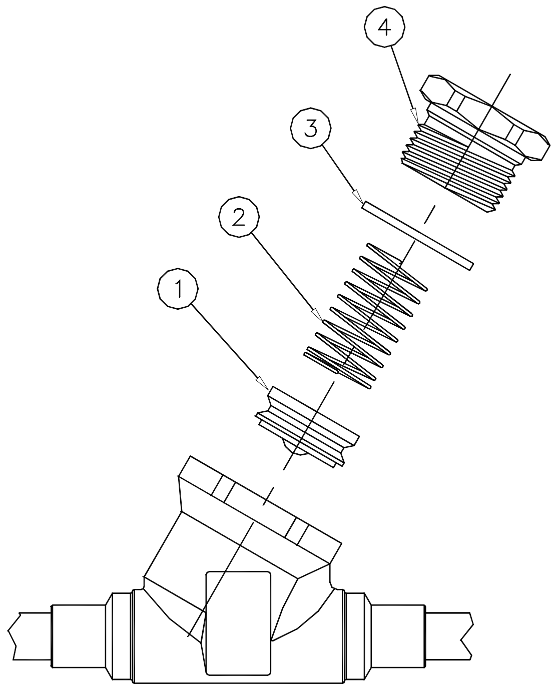
KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Nut	WMC-6-90	15*	Teflon Ring	RWS-3-47
2	Preset Adjusting Screw	RWS-3-3	16*	Filter	S-5
3	Regulator Bonnet	RWS-2-3P	17*	Spring Retainer	RWS-3-81
4	Bonnet Bushing	RWC-3-12	18	Regulator Body	RWS-1-3
5	Bushing Retainer	RWC-3-14	19	Pipe Away Adaptor	WMV-4-7
6	Pivot	RWC-2-8P	20	Relief Valve	
7	Bonnet Spring	RWS-1-12		DS1000, DS1000HL	WMV-4C-300
8*	Washer	RWS-3-26		DS1000HP	WMV-4C-450
9*	Slip Ring	RWS-3-17	21	1/4 NPT Plug	P-4HP
10*	Diaphragm Assembly	RWS-3-28	22	90º Elbow 3/8 Tube	WLF-3-6
11*	Nozzle	WLR-14-200L	23	CGA 580 Nut	92
	for DS1000-9 Series	RWS-5-1	24	CGA 580 Nipple	15-8
	for all other models	RWS-6-9	25	Bushing 1/8 x 1/4	BB-2-4HP
12*	Large O-Ring	RO-015E	26	Tee	BST-4LP
13*	Seat Holder and Stem for		27	1/4 x 1/4 Adaptor	BA-4LP
	DS1000, DS1000HL, DS1000HP	RWS-6-8	28	3/8 Tube Elbow	WMF-1-7
	DS1000-9 Series	RWS-6-3			
14*	Valve Spring				
	for DS1000-9 Series	RWS-6-5			
	for all other models	RWS-1-8	*	Item included in repair kits	

Repair Drawing

Right Regulator Components



KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Nut	WMC-6-90	15*	Teflon Ring	RWS-3-47
2	Preset Adjusting Screw	RWS-3-3	16*	Filter	S-5
3	Regulator Bonnet	RWS-2-3P	17*	Spring Retainer	RWS-3-81
4	Bonnet Bushing	RWC-3-12	18	Regulator Body	RWS-1-3
5	Bushing Retainer	RWC-3-14	19	Pipe Away Adaptor	WMV-4-7
6	Pivot	RWC-2-8P	20	Relief Valve	
7	Bonnet Spring	RWS-1-12		DS1000, DS1000HL	WMV-4C-300
8*	Washer	RWS-3-26		DS1000HP	WMV-4C-450
9*	Slip Ring	RWS-3-17	21	1/4 NPT Plug	P-4HP
10*	Diaphragm Assembly	RWS-3-28	22	90º Elbow 3/8 Tube	WLF-3-6
11*	Nozzle	WLR-14-200L	23	CGA 580 Nut	92
	for DS100-9 Series	RWS-5-1	24	CGA 580 Nipple	15-8
	for all other models	RWS-6-9	25	Bushing 1/8 x 1/4	BB-2-4HP
12*	Large O-Ring	RO-015E	26	Tee	BST-4LP
13*	Seat Holder and Stem for		27	1/4 x 1/4 Adaptor	BA-4LP
	DS1000, DS1000HL, DS1000HP	RWS-6-8	28	3/8 Tube Tee	WMF-1-8
	DS1000-9 Series	RWS-6-3			
14*	Valve Spring				
	for DS1000-9 Series	RWS-6-5			
	for all other models	RWS-1-8	*	Item included in repair kits	



KEY #	DESCRIPTION	PART #
1*	Poppet	WMV-1-5
2*	Spring	WMV-1-6
3*	Washer	WMV-1-7
4*	Cap	WMV-1-8
	Repair Kit for DS1000, DS1000HL DS1000HP series	RK-1041

* All items included in repair kit.