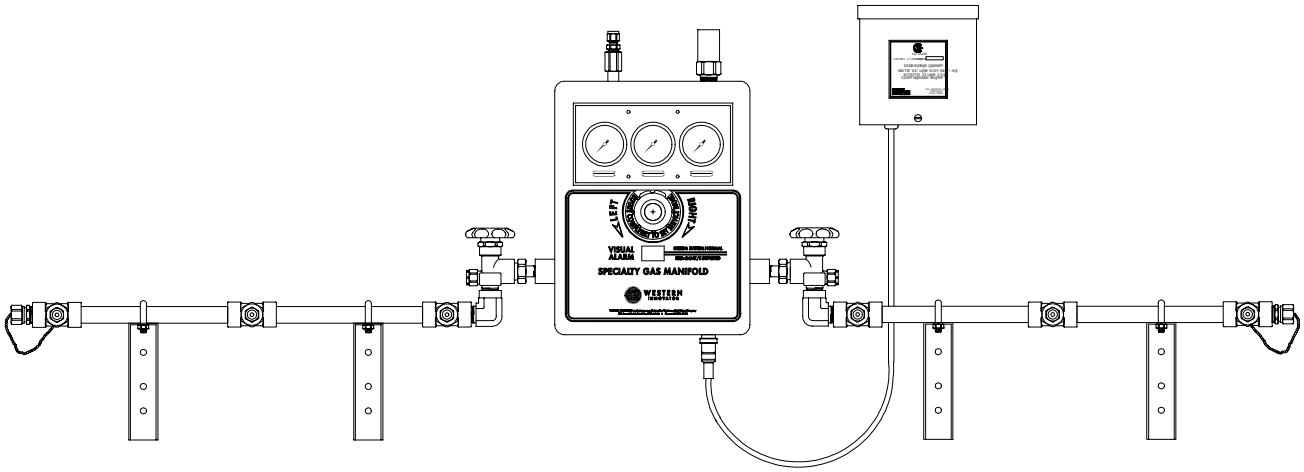
WESTERN
INNOVATOR

SERVICE MANUAL
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2, HBAC2HP & HBAC2HL SERIES



SAFETY

Statements in this manual preceded by the following safety signal words are of special significance. Definitions of 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 may mean 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 HBAC2, HBAC2HL and HBAC2HP 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 Operating Instructions** manual for warranty information.

CAUTION

- Failure to follow the following instructions can result in personal 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 with explosive force when ignited while 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 re-compression may ignite combustible materials.
- Pigtails should never be kinked, twisted, or bent into a radius smaller than 5 inches. Mis-treatment may cause the pigtail to burst.
- Do not apply heat. Some materials may react and ignite 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 not be performed near nitrous oxide piping. Excessive heat may cause the gas to dissociate, creating an explosive force.

ABBREVIATIONS

C _____ Common
CGA_____ Compressed Gas Association
FT-LBS __ Foot-Pounds
IN-LBS___ Inch-Pounds
N/C _____ Normally Closed
N/O _____ Normally Open
NPT _____ National Pipe Taper
OSHA ___ Occupational Safety & Health Administration
PSIG ____ Pounds per Square Inch Gauge
SCFH ___ Standard Cubic Feet per Hour
VAC_____ Voltage, Alternating Current
VDC_____ Voltage, Direct Current
PCB_____ Printed Circuit Board

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INTRODUCTION & GENERAL INFORMATION

PRODUCT DESCRIPTION

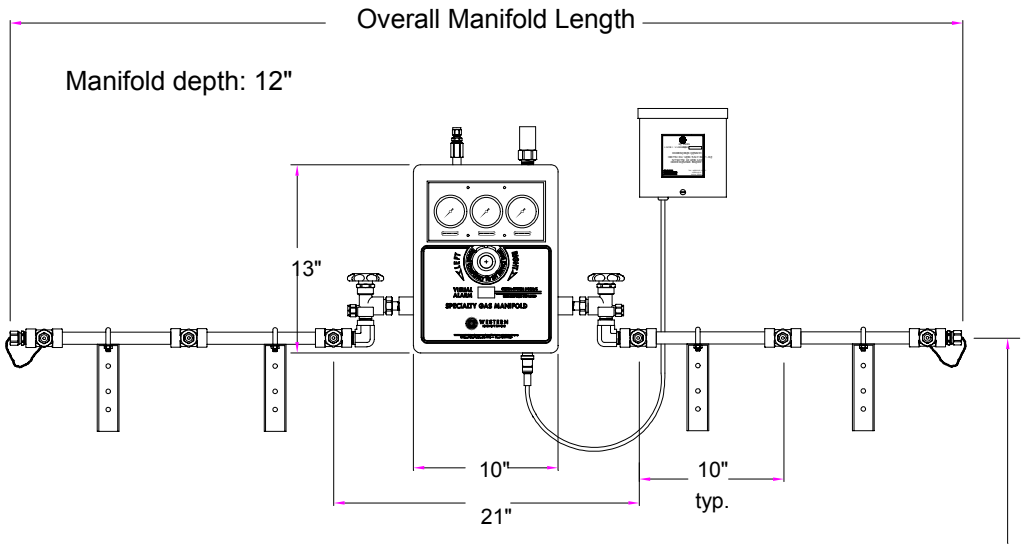
The automatic changeover manifold is designed to provide a reliable uninterrupted supply of gas to a gas pipeline system in a laboratory installation.

The manifold has an equal number of cylinders in its “Service” supply and “Reserve” supply banks, automatically switching to the “Reserve” supply when the “Service” supply becomes depleted. When the manifold changes to “Reserve” supply, it sends a signal to the gas alarm system 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 except for turning the control knob.

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 other gases should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 0°F (-18°C). A manifold placed in an open location should be protected against weather conditions, including direct contact with rain, snow, and heavy moisture. 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.



Note: All dimensions are approximate

Total number of cylinders	4	6	8	10	12
Overall manifold length	3’ - 11"	5’ - 7"	7’ - 3"	8’ - 11"	10’ - 7"
Acetylene manifold length	4’ - 5"	6’ - 7"	8’ - 9"	10" - 11"	13’ - 1"

Figure 1-1

MANIFOLD SPECIFICATIONS

Flow Capability

Oxygen:	250 SCFH maximum at 80 psig delivery with a 12 psi pressure drop and 2000 psig inlet pressure. 30 SCFH maximum at 80 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Nitrogen:	250 SCFH maximum at 80 psig delivery with a 12 psi pressure drop and 2000 psig inlet pressure. 30 SCFH maximum at 80 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Nitrous Oxide & Carbon Dioxide:	The flow capability of a Nitrous Oxide or Carbon Dioxide cylinder manifold will depend upon conditions at the installation site, demands of the delivery system and the number of cylinders in service. Maximum capability is 35 SCFH at 80 psig delivery and 750 psig inlet pressure. Higher flow rates up to 250 SCFH can be obtained using the HBAC2HL series manifolds. The HBAC2HL manifold includes an internal heater. Installing a Nitrous Oxide or Carbon Dioxide manifold in a location which exposes it to ambient temperatures below 20°F (-7°C) is not recommended.
Air, Argon:	250 SCFH maximum at 80 psig delivery with a 12 psi pressure drop and 2000 psig inlet pressure. 30 SCFH maximum at 80 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Helium & Hydrogen:	250 SCFH maximum at 80 psig delivery with a 12 psi pressure drop and 2000 psig inlet pressure. 30 SCFH maximum at 80 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.
Acetylene:	75 SCFH maximum at 15 psig delivery with a 5 psi pressure drop and 200 psig inlet pressure.

Power Source Requirements

A 115 VAC to 24 VAC power supply is provided with the manifold to operate the alarm lights on the manifold. Under normal operation the manifold will draw a maximum of 40 milliamperes (.040 amperes).

HBAC2HL series 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". The heater operates at 115 VAC and draws four amperes.

Piping Connections

Header Inlets:	Acetylene	CGA 300 or 510
	Carbon Dioxide	CGA 320
	Nitrous Oxide	CGA 326
	Air	CGA 346
	Hydrogen	CGA 350
	Oxygen	CGA 540
	Argon	CGA 580
	Helium	CGA 580
	Nitrogen	CGA 580
Manifold Outlet:	1/4 tube compression fitting (located on the left side on top of the cabinet)	
Relief Valve:	1/2 NPT female pipe thread (located on the right side on top of the cabinet)	

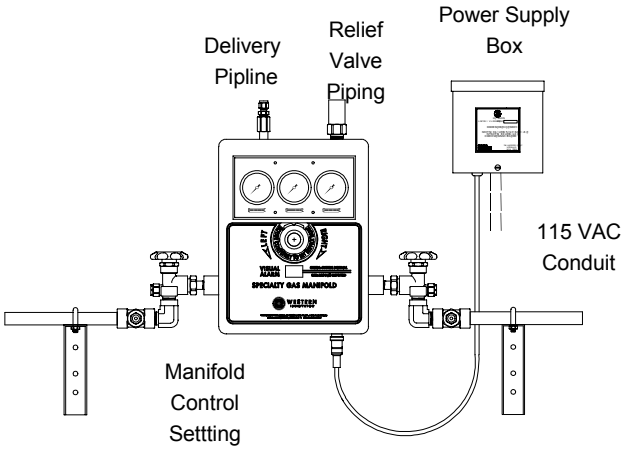


FIGURE 1-2 Connection Location

ADJUSTMENT SPECIFICATIONS

Gas	Primary Change-Over Regulator		Primary Intermediate Regulator	Pressure Switches	Pressure Relief Valve	Line Regulator
	Low Side Setting	High Side Setting				
HBAC2	120-125	200 min.	170-175**	205-215	300	75-80
HBAC2HL	120-125	200 min.	170-175**	205-215	300	75-80
HBAC2 Acetylene	50-55	110 max.	85-90**	120-125*	N/A	10-15
HBAC2HP	220-225	300 max	270-275**	305-315	450	150-170

Unit of measure: all units are in psig N/A = Not Applicable

* Part of the optional fuel gas alarm kit.
** This is the approximate setting. This setting should be the midpoint of the changeover regulator settings ±5 psig.

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
3/32", 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
Liquid leak detector	Available from Western Enterprises Part number LT-100
Teflon® tape	Available from Western Enterprises Part number MTT-1 or MTT-2
Krytox Lubricant	Available from Miller Stevenson Chemical Co., Inc.

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

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THEORY OF OPERATION

GENERAL INFORMATION

This section concentrates on the basic theory of operation of the components of the 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 reserve supply, to provide an uninterrupted supply of gas for the specific gas application. The manifold control includes the following components and features: green “system normal” and red “replace depleted bank” indicator lights, cylinder pressure gauges, line pressure gauge, and intermediate safety relief valve. Supply banks consist of a header with 24" stainless steel inner core flexible pigtails with check valves, individual header check valves, 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 2-4. Figures 2-5, 2-6, 2-7 and 2-8 show the piping schematics. Figure 2-9 is the schematic diagram of the electrical system of the manifold. Figure 2-10 is the heater schematic.

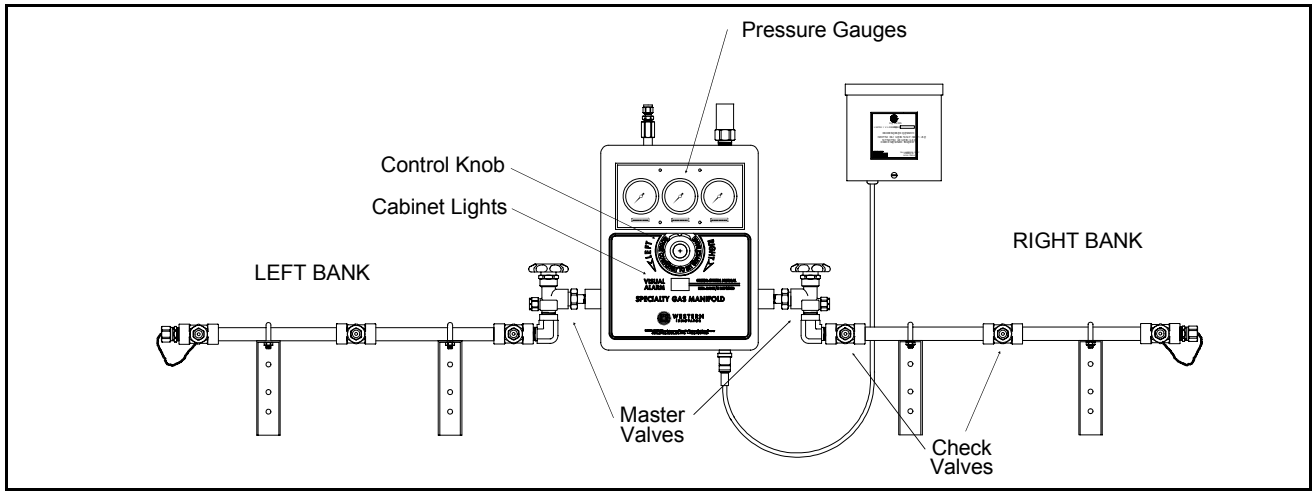


FIGURE 2-1 External Components

The cylinder bank that supplies the piping system is known as the “Service” supply while the cylinder bank on standby is referred to as the "Reserve" 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 flows into the manifold control and to the pressure switches located on the left and right inlet blocks. In manifolds incorporating a heater (Nitrous Oxide and Carbon Dioxide HBAC2HL systems) the gas flows through the heater and then through check valves. On all other manifolds the gas flows directly to the check valves. 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.

The gas on the right bank flows from the check valve into the intermediate primary regulator while gas from the left bank flows into the change-over primary regulator. Tubing is connected from the high pressure port on these regulators to the cylinder pressure gauges to sense the pressure of the gas in the cylinders.

Pressure is regulated in these primary regulators to the pressures noted in the adjustment specification chart in Section 1. The intermediate primary regulator is set midway between the maximum and minimum settings of the change-over regulator. The position of the change-over regulator knob determines which bank is in service. When the regulator knob is rotated clockwise (arrow pointing to the left) the change-over regulator setting is higher than the intermediate regulator setting. Therefore, the left bank will be in "Service" and the right bank will be in "Reserve". When the regulator knob is rotated counterclockwise (arrow pointing to the right) the change-over regulator setting is lower than the intermediate regulator setting. Therefore, the right bank will be in "Service" and the left bank will be in "Reserve".

The intermediate regulator setting and the low pressure setting of the change-over regulator determines at which pressure the manifold will switch from "Service" to "Reserve". Gas will flow through the regulator that has the highest setting. When the change over knob is turned clockwise (pointing left) the change-over regulator setting is greater than the intermediate regulator setting. Therefore gas will flow from the left bank. When the gas pressure on the left bank drops to the set pressure of the intermediate regulator, the right bank will start to flow. Conversely, when the change-over regulator knob is rotated counterclockwise (pointing right) the intermediate regulator setting is higher than the change-over regulator set pressure. Therefore gas will flow from the right bank. When the gas pressure on the right bank drops to the set pressure of the change-over regulator, the left bank will start to flow. (When rotating the control knob you are altering the pressure setting of the change-over regulator above and below the intermediate regulator setting. If the knob is not rotated until it stops the manifold will not function correctly).

The outlet port of each of these regulators is connected via tubing to the intermediate block. The intermediate block has six ports all connected to the same chamber. The gas pressure at all ports is the same as the pressure at the inlet to the block. Gas enters the lower right port of the intermediate block from the change-over regulator. The upper right port of the block is connected to the intermediate pressure relief valve for all gases except acetylene. The port on the right end of the intermediate block is plugged. The intermediate pressure gauge is connected to the left end of the block. The lower left port is connected via tubing to the intermediate regulator. The left top port connects to the inlet of the line pressure regulator.

The intermediate pressure relief valve prevents over-pressurization of the intermediate controls of the manifold should the "Service" or "Reserve" primary regulator fail. The relief valve setting is noted in the adjustment specification chart in Section 1.

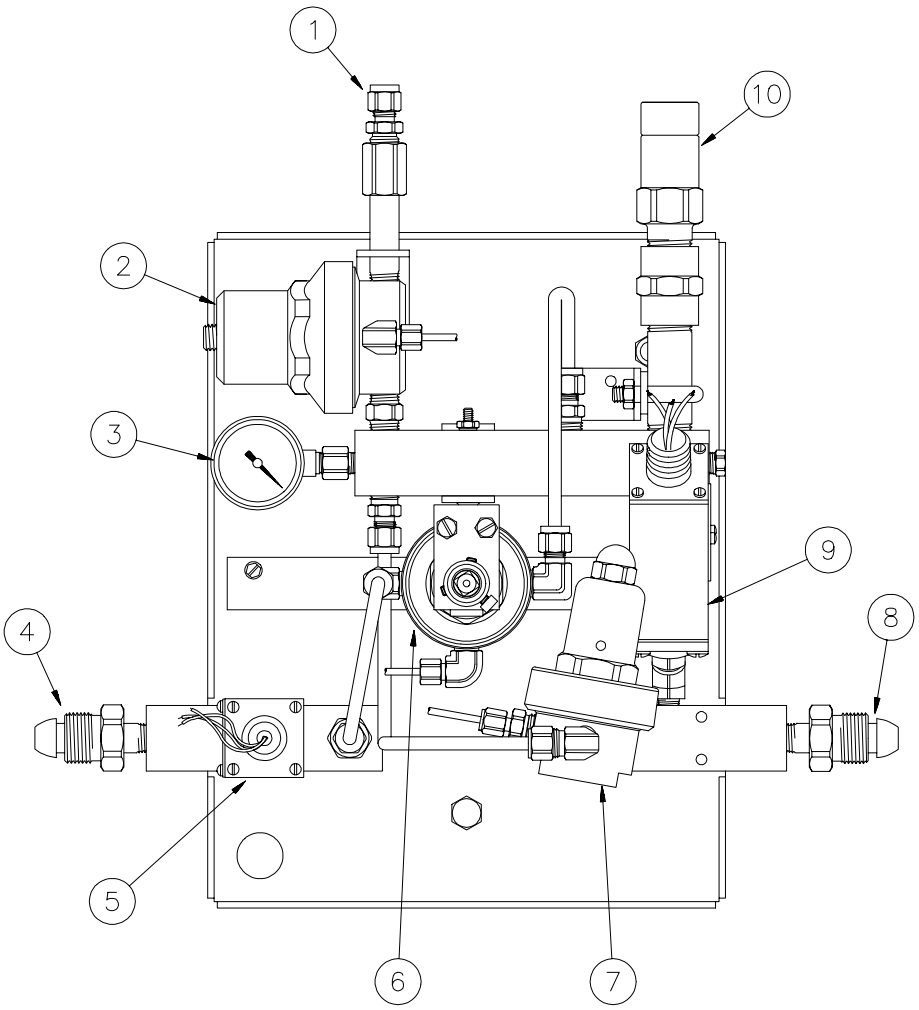
The line pressure regulator further reduces the pressure to the final pressure delivered to the gas piping system. The regulator has one inlet port and three outlet ports. One outlet port is plugged. Tubing is connected from the second port to the line pressure gauge to sense the pressure of the gas on the downstream side of the regulator. The other port is the outlet and is located 180° from the inlet.

The gas flows from the line regulator outlet to the pipeline distribution system.

When both cylinder banks are full, the switches complete the electrical circuit to the green "system normal" light. Cylinder pressures for each bank are indicated on the gauges on the manifold front cover. The "Service" supply is indicated by the position of the control knob. The line pressure is indicated by the center gauge on the manifold front cover.

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, and the check valve and the line regulator also falls. When the "Service" side pressure falls below the set point of the pressure switch, the red "replace depleted cylinders" light comes on and the green "system normal" light is extinguished. Any remote alarms are activated at this time. When the "Service" pressure falls to the set point of the intermediate regulator, gas will flow from the intermediate regulator (i.e. the "Reserve" supply begins to supply the system).

After replacing empty cylinders and opening the master valve and cylinder valves, the cylinder pressure will actuate the pressure switch, the red "replace depleted cylinders" light will be extinguished and the green "system normal" light will come on. The operator should then turn the control knob to the opposite cylinder bank. This will make the partially used "Reserve" bank the "Service" supply and the newly installed cylinders will become the "Reserve" supply.



LEGEND

1 Outlet adaptor

2 Line regulator

3 Intermediate pressure gauge

4 Left side inlet

5 Left side inlet pressure switch

6 Change-over primary regulator

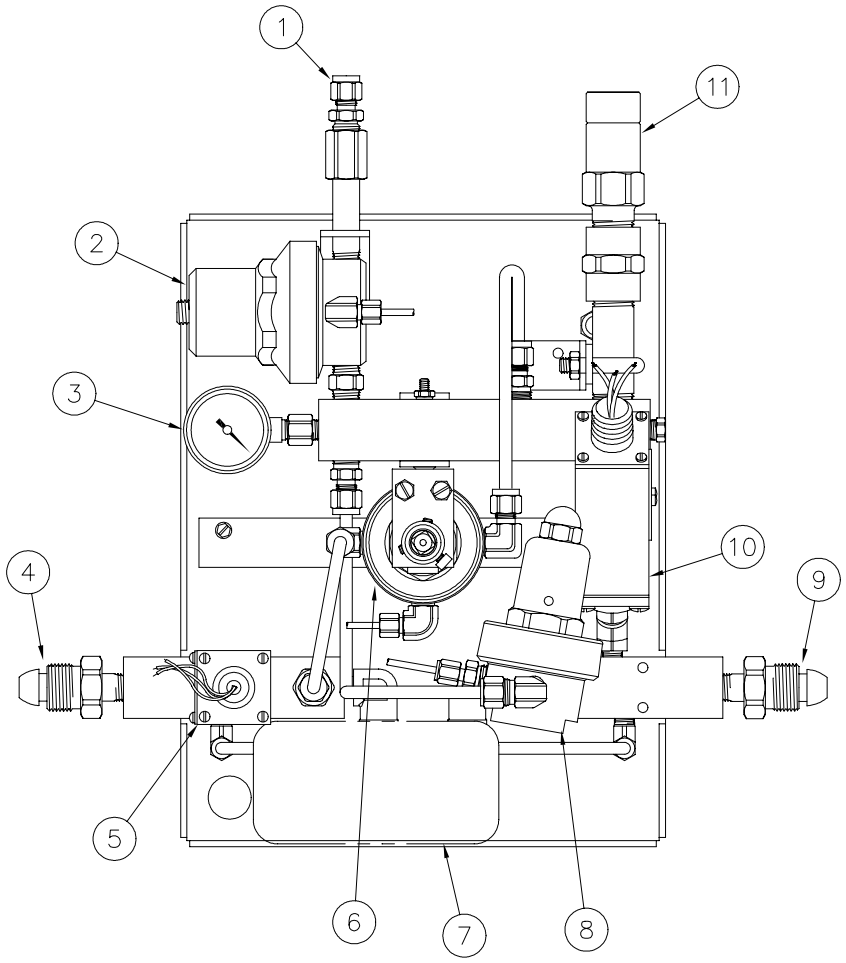
7 Intermediate primary regulator

8 Right side inlet

9 Right side inlet pressure switch

10 Intermediate relief valve

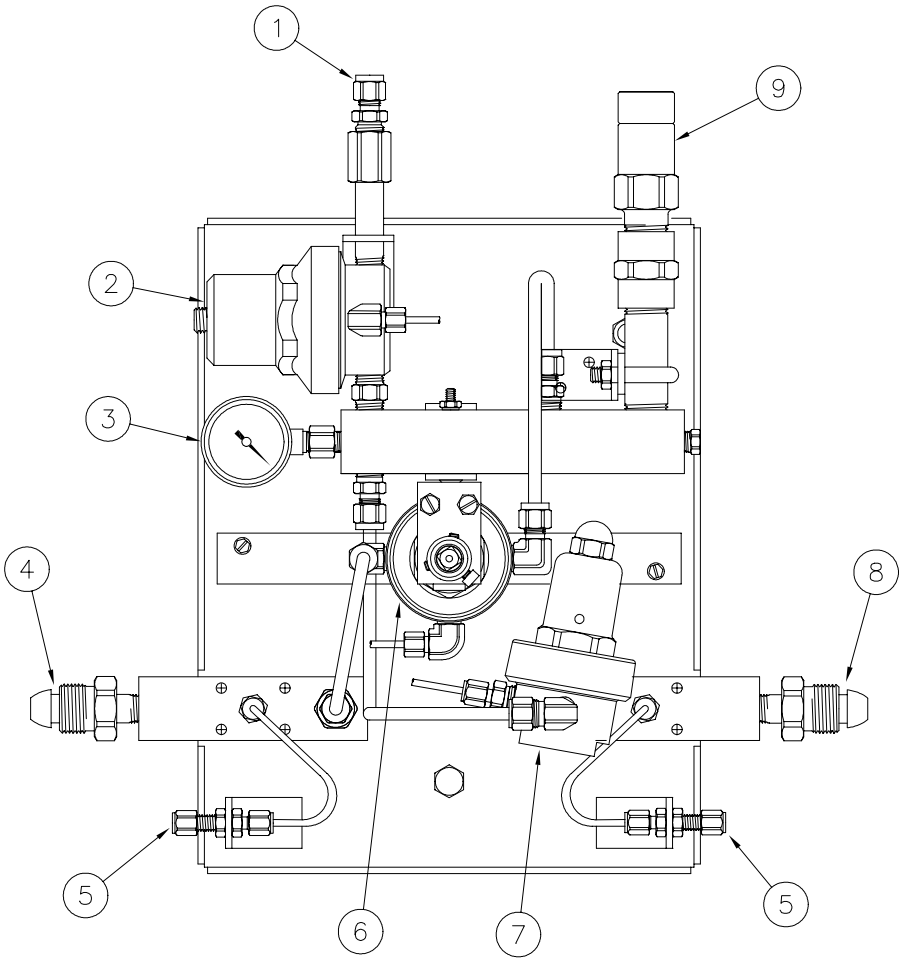
FIGURE 2-2 Internal Components - HBAC2



LEGEND

1 Outlet adaptor
2 Line regulator
3 Intermediate pressure gauge
4 Left side inlet
5 Left side inlet pressure switch
6 Change-over primary regulator
7 Heater assembly
8 Intermediate primary regulator
9 Right side inlet
10 Right side inlet pressure switch
11 Intermediate relief valve

FIGURE 2-3 Internal Components - HBACHL



LEGEND

1 Outlet adaptor

2 Line regulator

3 Intermediate pressure gauge

4 Left side inlet

5 Explosion proof pressure switch connection

6 Change-over primary regulator

7 Intermediate primary regulator

8 Right side inlet

9 Intermediate relief valve

(Acetylene manifolds do not incorporate the relief valve)

FIGURE 2-4 Internal Components - HBAC (fuel gases)

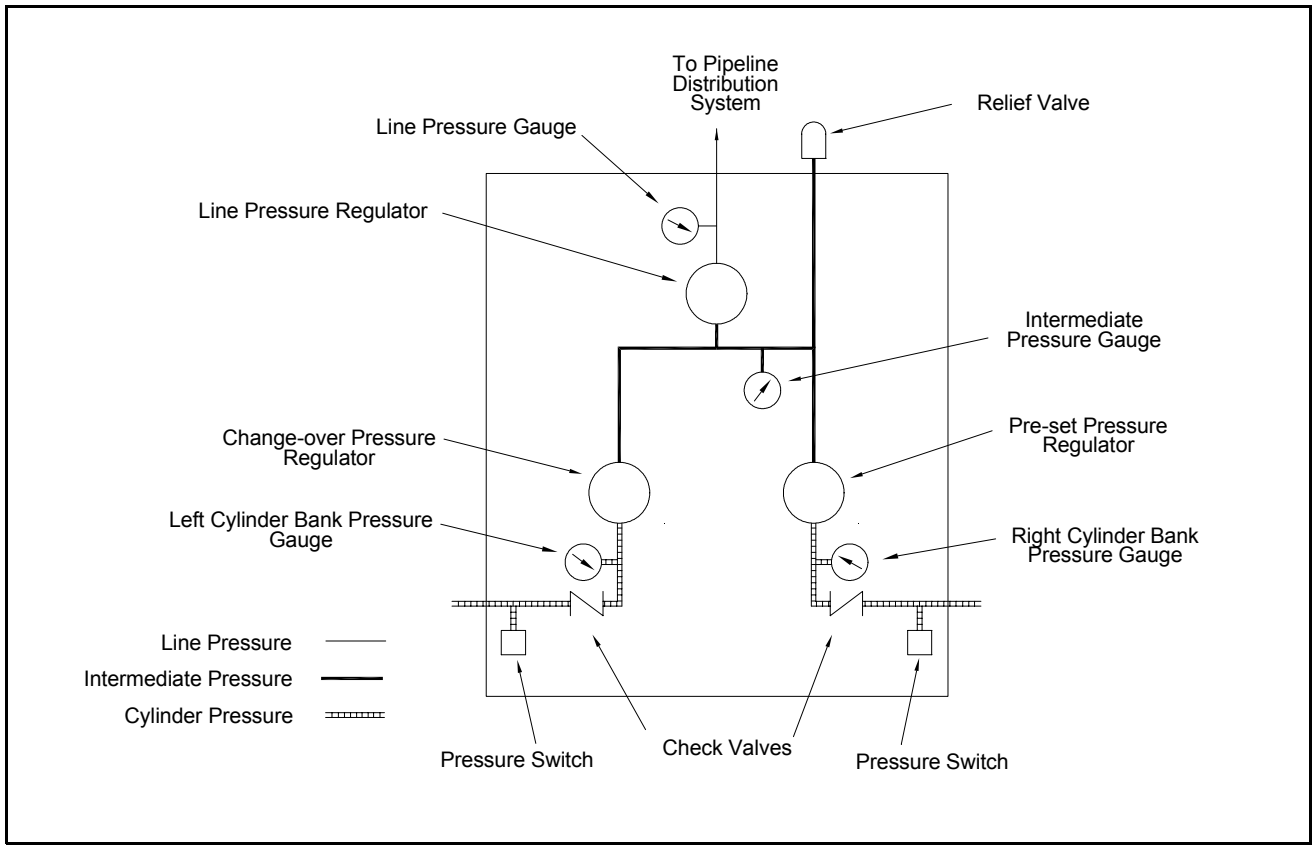


FIGURE 2-5 Piping Schematic - HBAC2

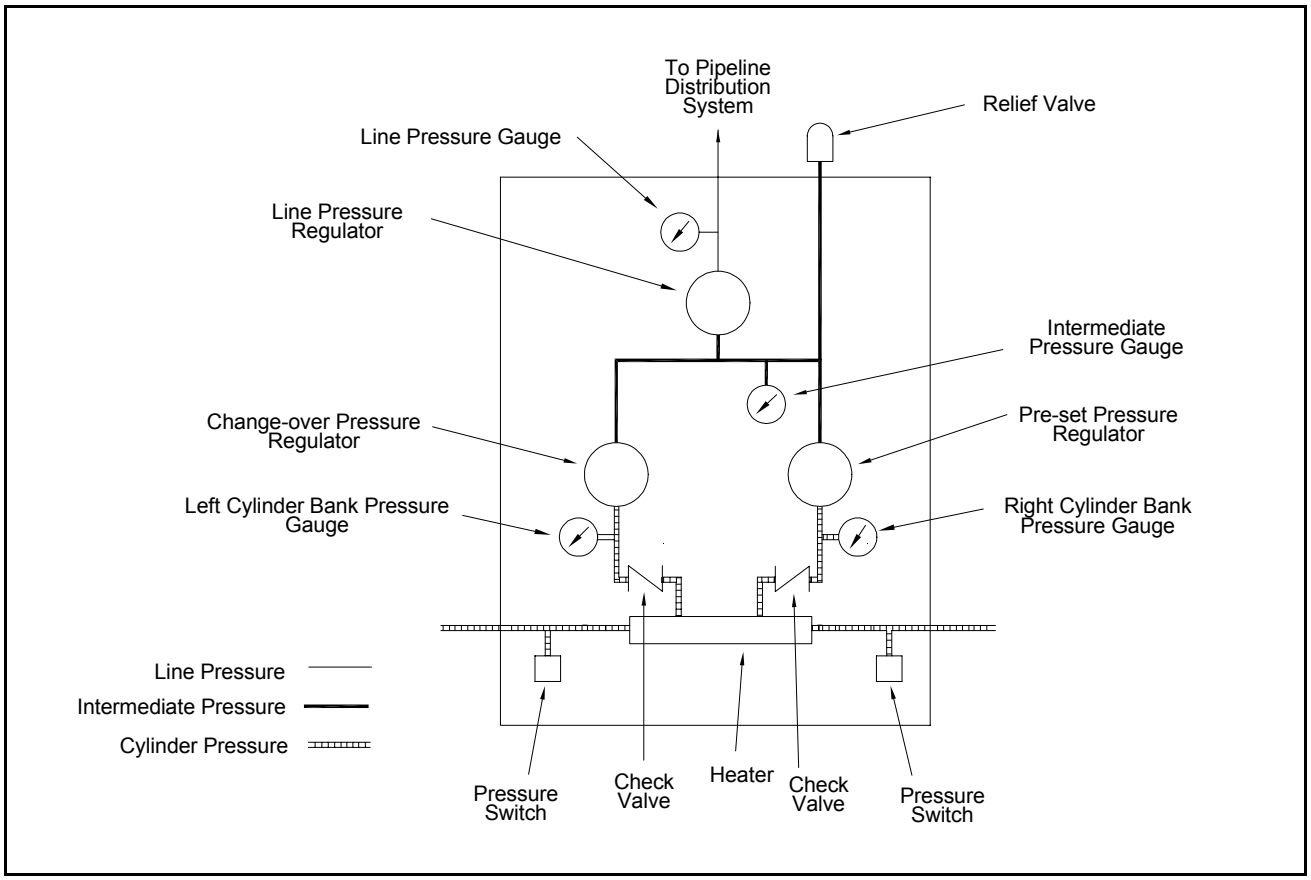


FIGURE 2-6 Piping Schematic - HBAC2HL

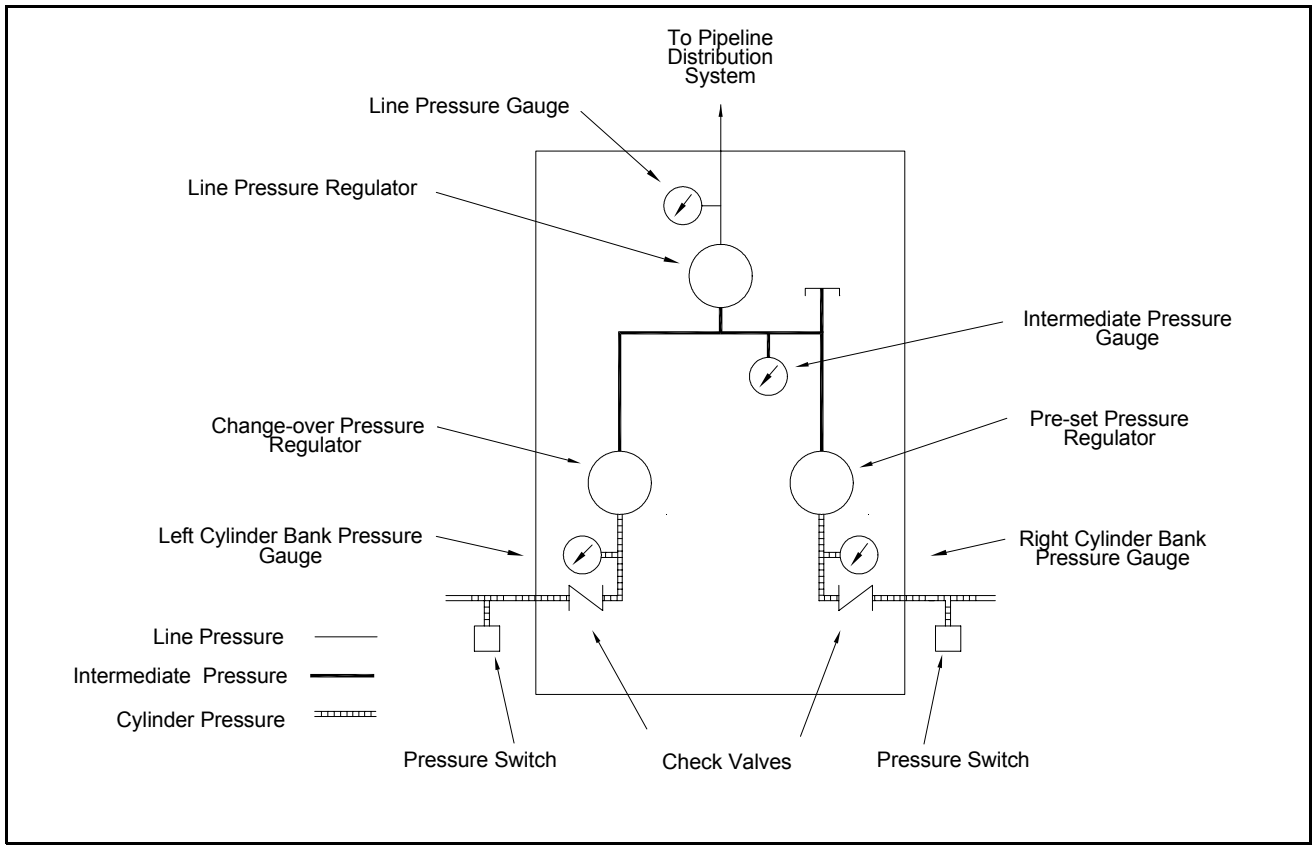


FIGURE 2-7 Piping Schematic - HBAC2 - Acetylene

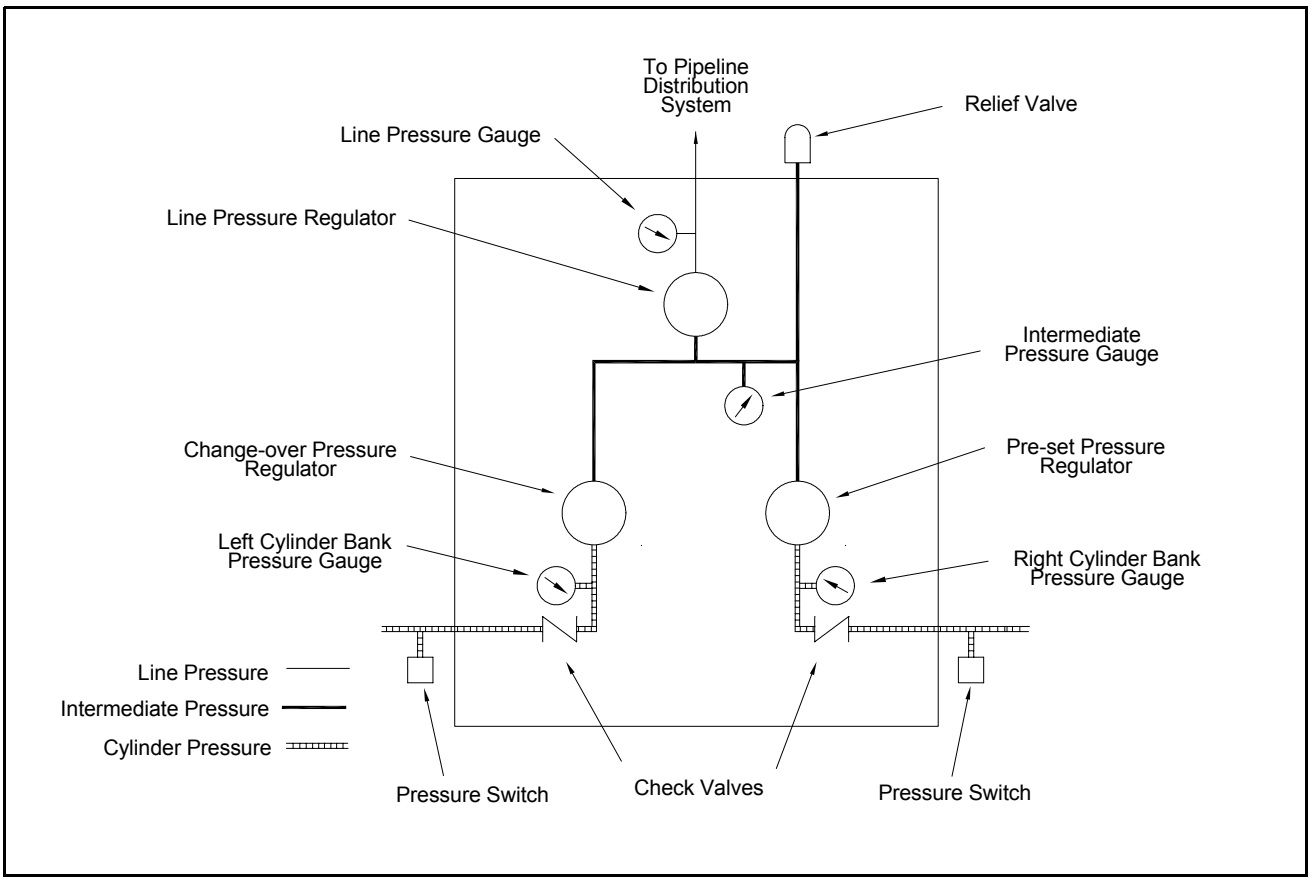


FIGURE 2-8 Piping Schematic - HBAC2 - Hydrogen

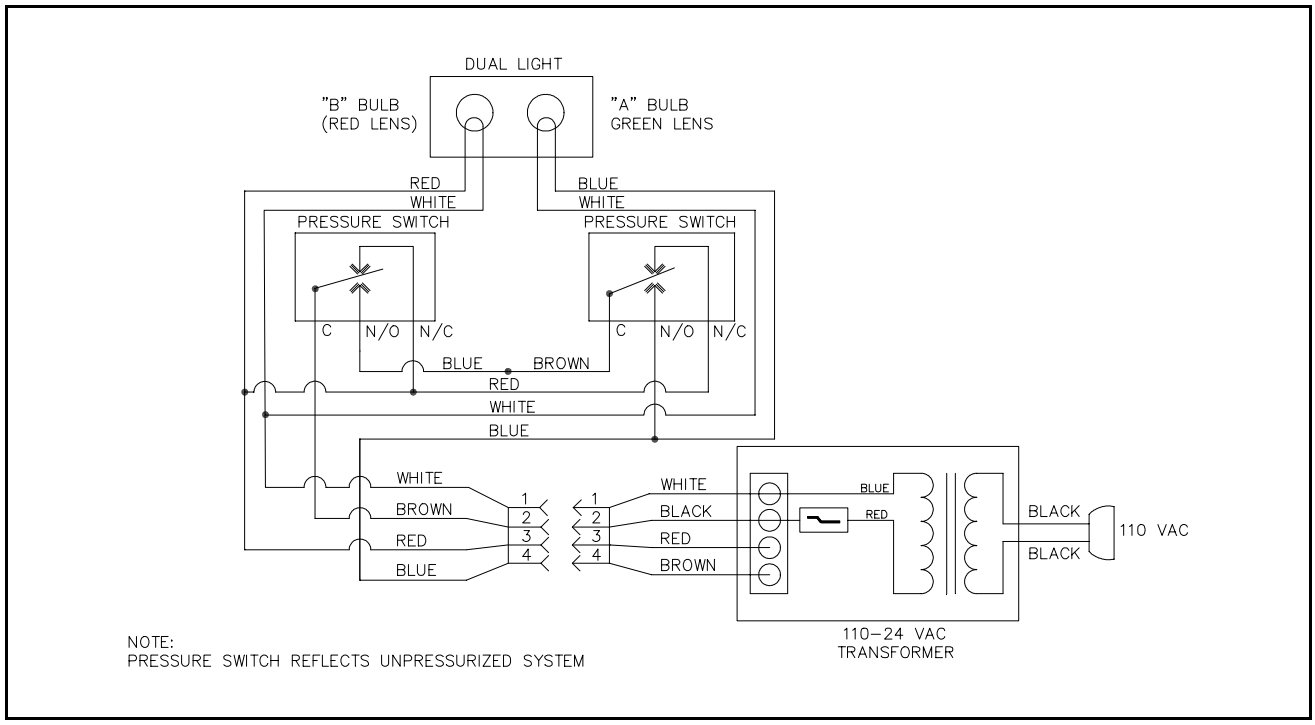


FIGURE 2-9 Electrical Schematic (less heater)

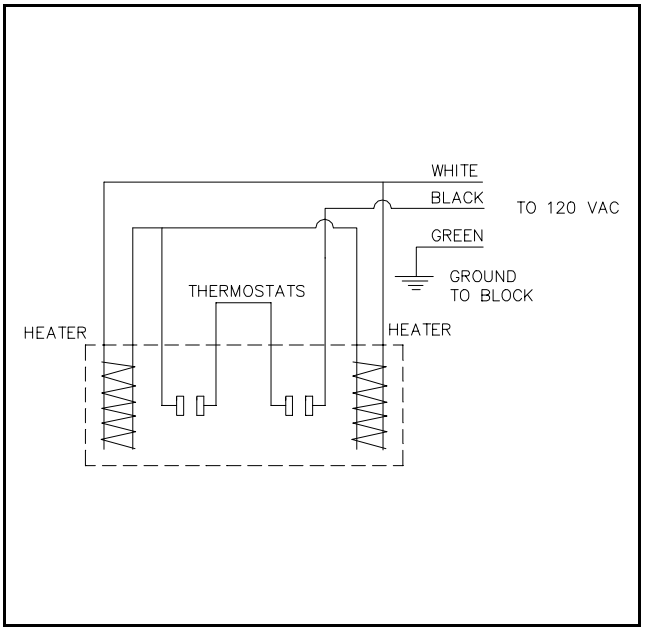


FIGURE 2-10 Heater Electrical Schematic

PRIMARY REGULATOR (change-over and intermediate)

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

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 2-11 and 2-12. 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.

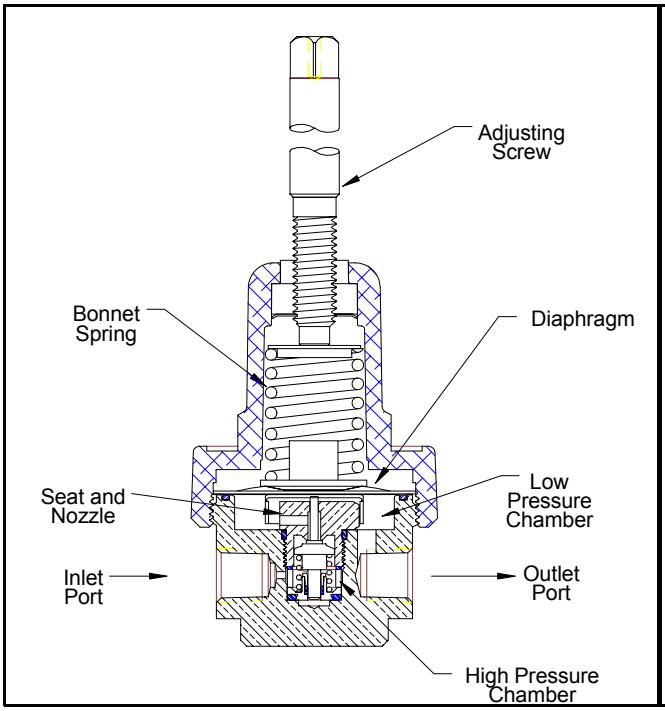


FIGURE 2-11 Primary Change-over Regulator

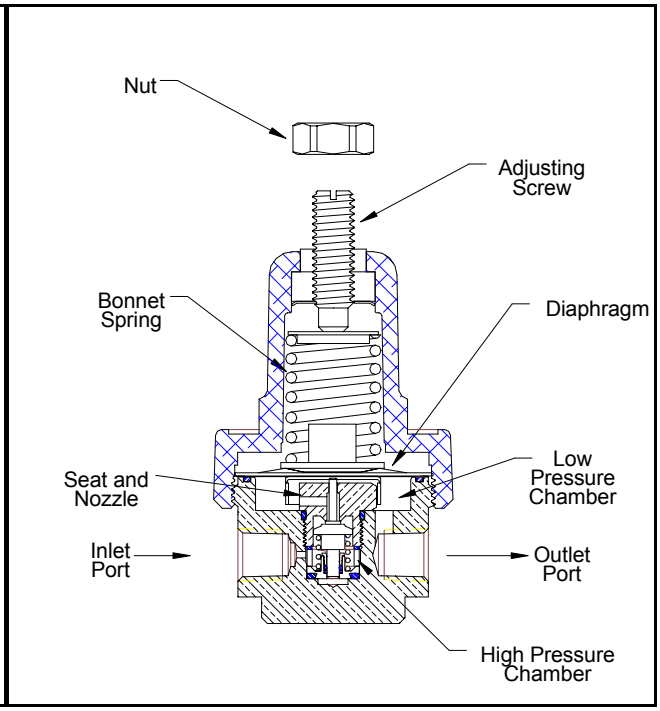


FIGURE 2-12 Primary Intermediate Regulator

CHECK VALVES

The check valves prevent gas from flowing backward from one bank to the opposite bank. See Figures 2-13 and 2-14.

Gas enters the check valve 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.

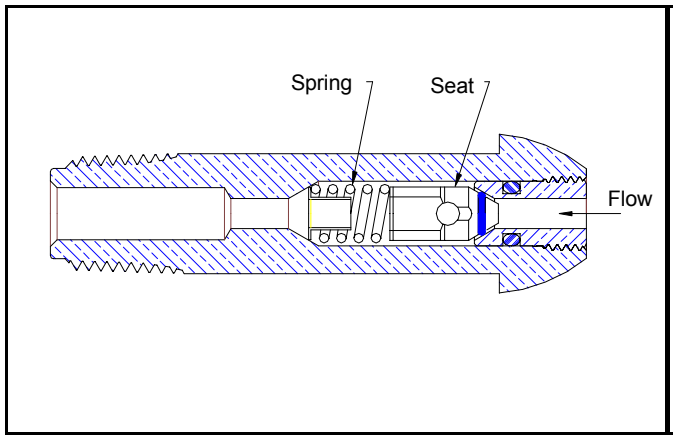


Figure 2-13 CGA 580 nipple check valve

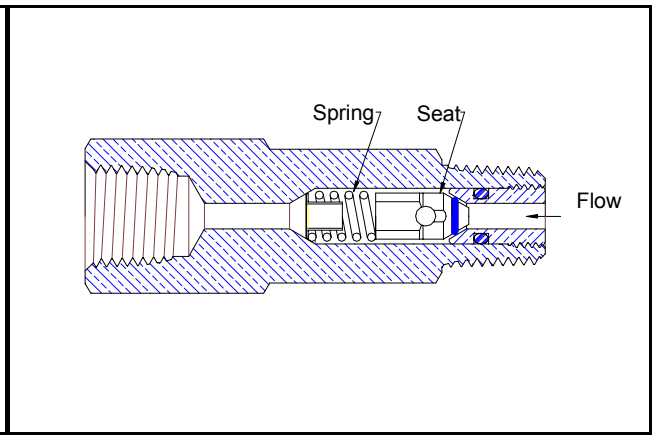


Figure 2-14 Inline check valve

PRESSURE SWITCH

The pressure switch used to signal "Reserve in Use" is a diaphragm type with one common contact, one normally closed contact, and one normally open contact. See Figures 2-15 and 2-16.

When the manifold is pressurized to the normal pressures, the diaphragm in the switch is pushed up. The diaphragm 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 diaphragm 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 circuit to the indicators on the front of the control section and to the remote alarm terminal strip in the power supply box.

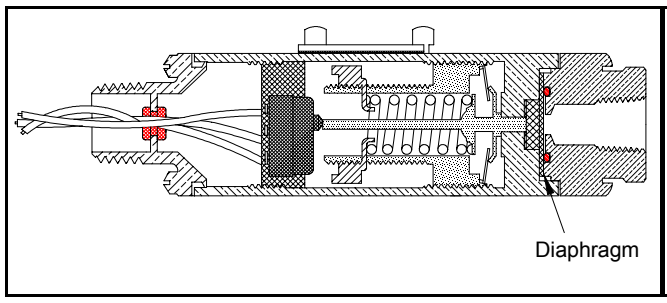


FIGURE 2-15 Pressure Switch

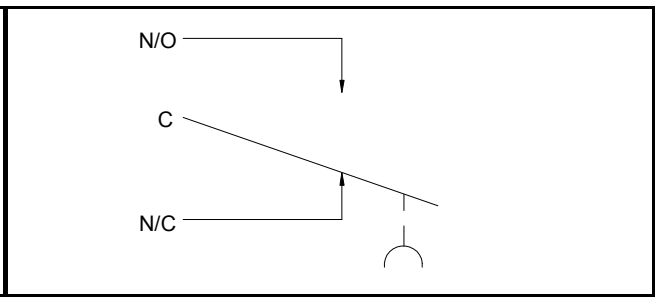


FIGURE 2-16 Switch Schematic

LINE PRESSURE REGULATOR

The line pressure regulator used in the manifold is a single stage, four port adjustable regulator. Refer to Figure 2-17. It has one inlet port and three outlet ports. The inlet port is piped to an intermediate pressure port in the manifold block. One outlet port is piped to the outlet of the manifold for connection to the main pipeline. One port is connected to the delivery line pressure gauge and the other outlet port is 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.

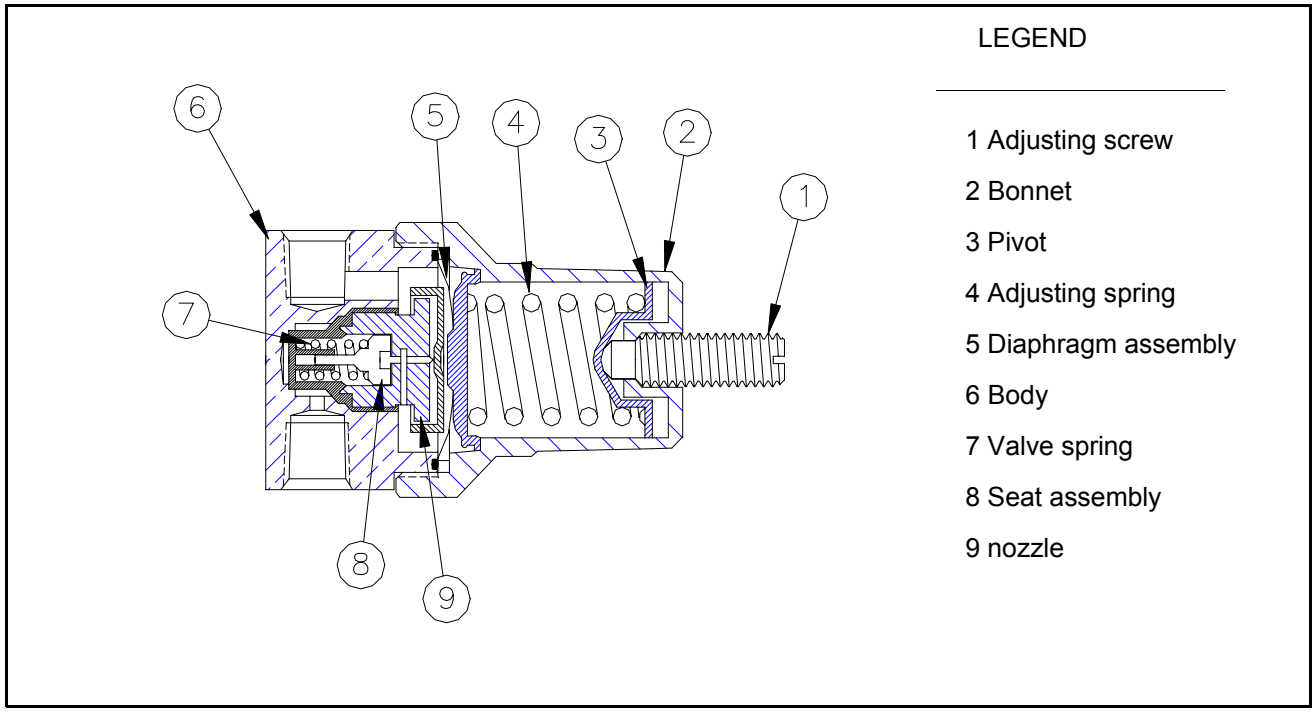


FIGURE 2-17 Line Pressure Regulator

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FIELD TESTING & TROUBLE-SHOOTING

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

PERFORMANCE VERIFICATION PROCEDURE

1. Remove the control section cover as explained in Section 4.
2. Reinstall the control knob on the shaft of the change-over primary regulator.
3. Rotate the control knob counter clockwise to make the left cylinder bank the "Reserve" supply and the right bank the "Service" supply.
4. Open the master valves located on the cylinder headers prior to pressurizing the manifold.
5. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.
6. **S-l-o-w-l-y o**pen one cylinder valve on the right bank of cylinders.
7. Using a leak detect solution, verify that there are no leaks present.
8. Close the cylinder valves on the left and right banks of cylinders.
9. Deplete the gas from the manifold. The gas must be expelled through the exit of the manifold. Do not attempt to bleed gas from the control inlet or headers. This will cause gas to be trapped in the manifold by check valves.
10. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.
11. Verify that the intermediate gauge indicates the low pressure setting as shown in the specification chart in Section 1 for the change-over primary regulator.
12. Observe the intermediate gauge for two minutes. Verify that the change-over primary regulator does not exhibit "creep" or an increase in pressure.
13. Verify that the left side cylinder contents gauge indicates a minimum of 1500 psig for Oxygen, Nitrogen, Air, or gas mixtures systems. Nitrous Oxide and Carbon Dioxide systems should indicate a minimum of 600 psig.
14. Verify that the line pressure gauge is indicating a minimum of 30 psig on all systems except acetylene. Acetylene should indicate a minimum of 10 psig or a maximum of 15 psig. Adjust to the proper line pressure if necessary.
15. Create a slight flow of gas through the manifold.
16. Observe the test gauge and verify the change-over regulator setting under a flow condition. Adjust the change-over primary regulator as necessary to obtain the required pressure.
17. Rotate the knob clockwise so the change-over regulator is at its maximum setting.
18. Verify that the intermediate gauge indicates the high pressure setting as shown in the specification chart in Section 1 for the change-over primary regulator.
19. Turn off the left cylinder valve and allow all gas to vent from the manifold. Once gas has depleted close the outlet used to create the flow.
20. Rotate the control knob to its fully counter-clockwise position.
21. **S-l-o-w-l-y** open one cylinder valve on the right bank of cylinders.
22. Verify that the intermediate gauge indicates the pressure setting as shown in the specification chart in Section 1 for the intermediate primary regulator.
23. Observe the intermediate gauge for two minutes. Verify that the intermediate primary

regulator does not exhibit "creep" or an increase in pressure.

24. Verify that the right side cylinder contents gauge indicates a minimum of 1500 psig for Oxygen, Nitrogen, Air, or gas mixtures systems. Nitrous Oxide and Carbon Dioxide systems should indicate a minimum of 600 psig.

25. Verify that the line pressure gauge is indicating a minimum of 30 psig on all systems except acetylene. Acetylene should indicate a pressure between 10 and 15 psig. Adjust to the proper line pressure if necessary.

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

27. Observe the test gauge and verify the intermediate regulator setting under a flow condition. Adjust the intermediate primary regulator as necessary to obtain the required pressure.

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

29. Create a slight flow of gas through the manifold.

30. Verify that the line pressure regulator maintains a constant pressure by observing the line pressure gauge.

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

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

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

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

35. Observe the 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 the low set point of the change-over regulator (see the specification chart in Section 1). Adjust the intermediate regulator as necessary to obtain the required pressure.

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

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

38. Rotate the control knob clockwise to make the left bank the service supply.

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

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

41. Observe the intermediate gauge as the left 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 the set point of the intermediate regulator (see the specification chart in Section 1).

42. Close the outlet used to create the flow.

43. Verify that the intermediate regulator is functioning properly by observing the intermediate gauge for two minutes. The gauge should indicate the same pressure at the end of the two minute period.

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

45. Verify that the test gauge has returned to the set pressure of the change-over primary regulator.

46. 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) terminals 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 switch. Reconnect the ohmmeter to the black and brown wires.

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

48. Loosen the union connection to the main supply line to create a slight flow of gas through the manifold.

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

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

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

52. Rotate the control knob counterclockwise to make the right bank of cylinders the service supply.

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

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

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

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

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

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

59. Close the outlet used to create the flow.

60. Remove the control knob from the changeover regulator.

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

62. Connect the electrical power source and supply electrical power to the manifold.

63. Observe the cabinet system status indicators. Verify that the green indicator is off and the red indicator is lit.

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

65. Observe the cabinet system status indicators. Verify that the green indicator is lit and the red indicator is off.

66. Readjust the line regulator setting if it was modified during cover installation.

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

68. Create a slight flow of gas through the manifold.

69. Verify that the red light illuminates and the green light is extinguished when the manifold changes over from service to reserve supply.

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

71. Rotate the control knob clockwise to make the left cylinder bank the service supply.

72. Observe the cabinet system status indicators. Verify that the green indicator is lit and the red indicator is off.

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

74. Verify that the red light illuminates and the green light is extinguished when the manifold changes over from service to reserve supply.

75. Close the outlet used to create the flow.

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

77. Rotate the control knob to select the bank of cylinders supplying the system before service was performed.

TROUBLE-SHOOTING (Only qualified repair personnel should make repairs)

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
CABINET INDICATOR LIGHTS		
No indicator lights on front panel come on when power is hooked up.	Power Input.	Check electrical power supply.
	Bulb burned out.	Replace bulb or lamp assembly.
	Internal wiring disconnected.	Check all wiring connections.
Red Indicator light is on but both banks are full.	Master valve, header valves, or cylinder valves on bank are closed.	Slowly open valves.
Red indicator light does not come on when one bank is empty and changeover occurs.	Bulb burned out.	Replace bulb or lamp assembly.
	Pressure switch wiring disconnected.	Check connections.
	Pressure switch set at too low a pressure.	Adjust pressure switch or return faulty unit for factory setting.
Green indicator light does not come on but both banks are full.	Bulb burned out.	Replace bulb or lamp assembly.
	Pressure switch wiring disconnected.	Check connections.
Green indicator light comes on even though one bank of cylinders is empty.	Pressure switch wiring disconnected.	Check wiring connections.
	Pressure switch set at too low a pressure.	Adjust pressure switch or return faulty unit for factory setting.
"RESERVE IN USE" SIGNAL		
Remote alarm signal stays in one mode constantly regardless of changeover status.	Power supply wiring is incorrect.	Check wiring connections on both power supply terminal strips.
	Flow demand too high.	Reduce flow demand.
Remote alarm signals are opposite of manifold status.	Faulty connection to remote alarm unit.	Check input from alarm unit to terminal strip.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
"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.
	Primary regulator setting too low.	Set delivery pressure to specifications.
	Faulty line pressure gauge.	Replace line pressure gauge.
	Faulty alarm pressure switch.	Readjust or replace pressure switch as necessary.
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.
		Add an internal heater to convert the manifold from a HBAC2 to a HBAC2HL.
	Faulty line pressure gauge.	Replace line pressure gauge.
	Faulty alarm pressure switch.	Readjust or replace pressure switch as necessary.
LOSS OF CYLINDER CONTENTS	Leakage at manifold piping connections.	Tighten, reseal or replace.
Audible or inaudible gas leakage (unknown origin).	Leakage at manifold tubing connections.	Tighten, reseal or replace.
	Leakage in downstream piping system.	Repair as necessary.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
LOSS OF CYLINDER CONTENTS (continued)	Leakage at cylinder valve.	Replace cylinder.
	Gauge leaks.	Reseal or replace.
Audible or inaudible gas leakage (unknown origin). (continued)	Regulator leaks.	Repair or replace.
Venting at relief valve.	Line regulator setting too high.	Set delivery pressure to specifications.
	Overpressure due to creeping or faulty regulation by primary regulator.	Replace regulator seat and nozzle components.
	Overpressure due to creeping or faulty regulation by line 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 on regulator.	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.	Intermediate regulator seat leak.	Repair or replace regulator.
	Intermediate regulator set to open at too high a pressure.	Adjust intermediate regulator per specifications.
	Flow demand too high.	Reduce flow demand.
Opposite bank feeding.	Faulty primary regulator and/or intermediate regulator.	Replace regulator seat and nozzle components.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
LOSS OF RESERVE BANK CONTENTS (continued)		
Premature changeover to reserve bank.	Flow demand too high.	Reduce flow demand.
	Leaks in the manifold system.	Leak test, tighten, reseal or replace fittings as necessary.
	Intermediate regulator set to open at too high a pressure.	Adjust intermediate regulator per specifications.
No changeover	Closed cylinder or shutoff valves.	Open valves.
	Intermediate regulator defective.	Replace or repair regulator.
	Empty reserve bank cylinders.	Replace cylinders.
PIPELINE DISTRIBUTION		
Pipeline not at desired pressure.	Line regulator not set correctly.	Readjust line pressure regulator.
Required gas flow not available.	Line regulator not set correctly.	Readjust line pressure regulator.
	Flow demand too high.	Consult factory.

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SERVICE PROCEDURES

GENERAL MAINTENANCE

1. Main section

   a) Daily - record line pressure.

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

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

2. Manifold header

   a) Daily - 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.

   c) Every 4 Years
      1) Replace pigtails.

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 pressurized causing death or serious injury.

SAFETY PRECAUTIONS

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 (except for hydrogen manifolds).

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 1,1,1 Trichloroethylene solvent prior to assembly. Dry thoroughly. Do not clean o-rings with this solvent (Freon TF is acceptable).

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 gas tight seal.

Assembly and Disassembly of Compression Fittings

NOTE

- Incorrect reassembly 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. Torque the nut with a wrench until the marks line up, which indicates that the fitting has been tightened to its original 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 to prevent corrosion (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 tubing.

*gasket seals, l*eaks 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 all personnel have been advised of the intended service and all systems requiring industrial gas are being supplied from portable or alternate supplies.

Replace parts with all components in the repair kit.

HOW TO SHUTDOWN THE MANIFOLD

1. Turn **off** the piping system isolation valve, if present. If an isolation valve is not present, the entire gas system will be reduced to atmospheric pressure. WARNING: Do not shutdown the manifold until all personnel have been advised of the intended service and all systems requiring industrial gas are being supplied from portable or alternate supplies.

2. Turn **off** right and left supply bank cylinder valves.

3. Deplete gas from the system. The gas must be expelled through the exit of the manifold. Do not attempt to bleed gas from the control inlet or headers. This will cause gas to be trapped in the manifold by check valves.

4. Disconnect electrical power from the manifold at the main power source.

MANIFOLD CABINET COVER REMOVAL

Disassembly

1. Cut lead seal wire with wire cutters and remove.

2. Remove the control knob on the front of the cabinet. Peal back the service arrow label and remove screw with a Phillips screwdriver.

3. Using a flat blade screwdriver or a 5/16" hex wrench, unscrew the four screws holding the gauge plate to the cabinet. Remove the cover plate.

4. Unscrew the electrical connector at the bottom of the unit and unplug the cord.

5. Unscrew the three screws attaching the cover to the backplate using an appropriate screwdriver.

6. Carefully pull the cover straight out to clear internal components.

7. Locate and disconnect the three male/female wire terminals to detach the cover electrical wiring from the pressure switch wiring.

8. Lift the cover completely off the backplate.

Reassembly

Reverse order of disassembly. Connect internal wiring by matching up color-coded wires.

GAUGE REPLACEMENT

Removal

> **CAUTION**
>
> - Be careful not to kink or damage the tubing connected to the gauges. Damaged tubing may burst when pressurized

1. Shutdown the manifold and remove cover as explained earlier in this section.

2. Pull the mounting plate up so that it provides easy access to the gauge screws on the underside of the gauge plate.

3. Mark the compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the tubing from the defective gauge. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed.

4. Using a 3/8" hex wrench, remove the two nuts holding the gauge brackets. Slide the gauge brackets off of the screw posts.

5. Slide the gauge out through the front of the gauge plate.

6. Using a 3/4" hex wrench, remove the compression fitting from the gauge. Use a 9/16" open end wrench to stabilize the gauge.

7. Remove the old sealant from the 1/4 NPT female pipe thread on the compression fitting.

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 through the front of the gauge plate.

3. If the gauge needle is not on zero, unscrew the gauge bezel and adjust the needle using a flat blade screwdriver.

INTERMEDIATE PRIMARY REGULATOR REPLACEMENT

NOTE

- Removal and Replacement procedures are to be followed for repair or replacement. To ensure proper torques and that nothing is damage the regulator should always be removed from the system.

Shutdown the manifold and remove cover as explained earlier in this section.

Removal

1. Mark the compression fittings on both ends of the tubing per the instructions on page 4-2. Using an 9/16" open end wrench, disconnect the outlet tubing from the regulator at the compression fittings.

2. Mark the compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the gauge tubing from the regulator at the compression fitting.

3. Using two 1 1/8" hex wrenches disconnect the regulator from the inlet block at the union connection.

4. Remove the intermediate primary regulator from the control section and clamp the regulator assembly in a vise.

Replacement

1. Position the regulator assembly in the control section and hand tighten the inlet nut and nipple. Do not tighten completely until all other connections have been made.

2. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed. Using a 7/16" open end wrench, connect the gauge tubing to the 1/8" tube compression fitting located on the left side of the regulator, 90° from the regulator inlet.

3. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed. Using an 11/16" open end wrench, connect the outlet tubing to the 3/8" tube compression fitting located on the top of the regulator, 180° from the regulator inlet.

4 Tighten the inlet nut and nipple connection using two 1-1/8 open end wrenches.

Intermediate Primary Regulator Adjustment

1. If not already done, shutdown the manifold as explained earlier in this section, remove the manifold cover, attach a test gauge to the left side of the intermediate pressure block, and remove the acorn nut from the intermediate primary regulator.

2. **S-l-o-w-l-y** open one cylinder on the right bank.

3. Verify the cylinder pressure gauge indicates a minimum pressure of 1500 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.

4. Using a flat blade screwdriver, turn the adjusting screw of the regulator in while observing the test gauge. Set the regulator to the pressure indicated on the Adjustment Specification chart in Section 1.

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

6. Readjust the regulator to the proper specifications if necessary.

7. Close the valve used to create the 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 test gauge for two minutes. The gauge must indicate the same pressure at the end of the two minute period.

9. Close the cylinder valve.

10. Create a flow of gas through the manifold and vent all remaining gas from the manifold.

11. Close the valve used to create the flow.

12. Install the acorn nut on the intermediate primary regulator.

CHANGE-OVER PRIMARY REGULATOR REPLACEMENT

NOTE

- Removal and Replacement procedures are to be followed for repair or replacement. To ensure proper torques and that nothing is damage the regulator should always be removed from the system.

Shutdown the manifold and remove cover as explained earlier in this section.

Removal

1. Mark the compression fittings on both ends of the 1/4" tubing per the instructions on page 4-2. Using an 9/16" open end wrench, disconnect the outlet tubing from the regulator at the compression fittings.

2. Mark the compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the gauge tubing from the regulator at the compression fitting.

3. Mark the compression fittings on both ends of the 1/4" tubing per the instructions on page 4-2. Using an 9/16" open end wrench, disconnect the inlet tubing from the regulator at the compression fittings.

4. Using 5/32 Allen wrench remove the cap screw from the regulator set screw collar.

5. Using 3/32 Allen wrench loosen but do not remove the two remaining set screws in the collar. Remove the collar from the regulator set screw

6. Using a flat head screw driver remove the two screws holding the stop bracket from the mounting bracket.

7. Remove the four screws holding the mounting bracket to backplate.

8. Remove the change-over primary regulator from the control section

9. Remove the two screws holding the brackets to the regulator.

10. Clamp the regulator assembly in a vise.

Replacement

1. Position the new regulator in a vise (the vice need not be tightened).

2. Position the brackets on the new regulator. The order of the brackets should remain the same. Tighten the two screws to mount the brackets onto the regulator.

3. Mount the regulator onto the backplate using the 4 self tapping screws.

4. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed. Using a 7/16" open end wrench, connect the gauge tubing to the 1/8" tube compression fitting located in the front of the regulator, 90° from the regulator inlet.

5. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed. Using an 11/16" open end wrench, connect the outlet tubing to the 3/8" tube compression fitting located on the right side of the regulator, 180° from the regulator inlet.

6. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed. Using an 9/16" open end wrench, connect the inlet tubing to the 1/4" tube compression fitting located on the left side of the regulator.

7. Connect the stop plate to the brackets using two screws.

8. Thread the set screw into the bonnet hand tight.

9. Place the collar onto the set screw.

10. Proceed to the adjustment section to set the regulator correctly.

Change-Over Primary Regulator Adjustment

1. If not already done, shutdown the manifold as explained earlier in this section and remove the manifold cover.

2. Reinstall the control knob on the regulator.

3. **S-l-o-w-l-y** open one cylinder on the left bank.

4. Verify the cylinder pressure gauge indicates a minimum pressure of 1500 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.

5. Turn the adjusting screw of the regulator in while observing the test gauge. Set the regulator to the pressure high pressure setting indicated on the Adjustment Specification chart in Section 1.

6. Create a slight flow of gas through the manifold.

7. Readjust the regulator to the proper specifications if necessary.

8. Close the valve used to create the flow. The test gauge will go up slightly higher than the flowing adjusted pressure.

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

10. Tighten the cap screw into the collar using a 5/32 Allen wrench. The side of the cap screw should be against the right side of the stop bracket. (Once tight the knob should not be able to rotate clockwise).

11. Tighten the two remaining set screws using the 3/32 Allen wrench.

12. Create a slight flow of gas.

13. Turn the knob counter clockwise until the cap screw hits the left side of the stop plate.

14. Close the valve used to create the flow

15. The pressure on the test gauge should indicate indicated the pressure listed in the Adjustment Specification chart in Section 1.

16. Close the left cylinder valve.

17. Vent all remaining gas from the manifold.

18. Close the valve used to create the flow after the gas pressure has been exhausted from the manifold.

19. The label indicating service bank will need to be repositioned. See the "manifold cabinet cover removal" - reassembly procedure.

PRESSURE SWITCH REPLACEMENT

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.

2. Label the three wires attached to the switch. Remove the wires by grasping and pulling the connector. Do not attempt to pull the wire. This may pull the wire out of the connector.

3. Use a 1-1/2" open end wrench to remove the pressure switch.

Replacement

> **CAUTION**
>
> - Do not stand directly in front of the ports 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.

1. Remove all old sealant from thepipe fitting. Blow out the inlet block with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

2. Apply Teflon® tape to the 1/4 NPT male pipe threads on the fitting. Start the threads of the fitting into the pressure switch. Using a 1-1/12" open end wrench to tighten to effect a gas tight seal.

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

Pressure Switch Adjustment

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

2. Begin pressurizing the manifold by opening one cylinder valve on the side of the manifold the switch is on: At the actuation pressure, the ohmmeter reading will jump from zero resistance to infinite resistance.

3. Close the cylinder valve after at least 500 psig has been reached.

4. Create a slight flow of gas out of 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.

5. Close the valve used to create the flow. The test gauge will go up slightly higher than the flowing adjusted pressure.

6. Lift the adjustment cover on the pressure switch.

7 Using a flat blade screwdriver, turn 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 signals and make adjustments as required to achieve the signal setting. The setting should be made on descending pressure. Make adjustments response to the reading obtained in step 4.

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

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

CHECK VALVE REPLACEMENT (Right Side)

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.

2. Remove the intermediate regulator as explained earlier in this section.

3. Put the regulator in a vice.

4. Using an 11/16 open end wrench remove the check valve nipple from the regulator body.

Replacement

> **CAUTION**
>
> - Do not stand directly in front of the ports 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.

1. Remove all old sealant from the regulator. Blow out the regulator with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

2. Apply Teflon® tape to the 1/4 NPT male pipe threads on the check valve. Start the threads of the check valve into the regulator. Using an 11/16" open end wrench to tighten to effect a gas tight seal.

3. Install the regulator into the manifold as explained earlier in this section..

CHECK VALVE REPLACEMENT (Left Side)

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.

2. Mark the compression fittings on both ends of the 1/4" tubing per the instructions on page 4-2. Using an 9/16" open end wrench, disconnect the inlet tubing from the regulator at the compression fittings.

3. Using a 3/4 open end wrench to stabilize the assembly while using a 9/16 open end wrench to remove the compression fitting from the check valve.

4. Using a 3/4 open end wrench remove the check valve from the inlet block.

Replacement

> **CAUTION**
>
> - Do not stand directly in front of the ports 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.

1. Remove all old sealant from the inlet block and the compression fitting. Blow out the inlet block and compression fitting with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

2. Apply Teflon® tape to the 1/4 NPT male pipe threads on the check valve. Start the threads of the check valve into the inlet block. Using an 3/4" open end wrench to tighten to effect a gas tight seal.

3. Apply Teflon® tape to the 1/4 NPT male pipe threads on the compression fitting. Start the threads of the compression fitting into the check valve. Using an 9/16" open end wrench to tighten to effect a gas tight seal.

4. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed. Using an 9/16" open end wrench, connect the inlet tubing to the 1/4" tube compression fitting located on the left side of the regulator.

LINE REGULATOR REPLACEMENT

Shutdown the manifold and remove cover as explained earlier in this section.

Removal

1. Mark the 3/8 tube compression fittings, located on the intermediate block, per the instructions on page 4-2. Using an 11/16" open end wrench, disconnect the compression nut.
2. Mark the 1/8 tube compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the line pressure gauge tubing from the line regulator.
3. Disconnect the intermediate pressure relief valve from the building's vent line.
4. Disconnect the main supply line from the manifold at the 1/4 tube compression fitting.
5. Using a 3/4" hex wrench, remove the nipple from the outlet of the line regulator.
6. Using a 7/16" hex wrench, remove the U-bolt from the bracket.
7. Using a 3/8" hex wrench, remove the nut and washer from the carriage bolt holding the intermediate block to the bracket and remove the bolt and the intermediate block.
8. Secure the intermediate block in a vise or similar holding fixture.
9. To remove the regulator from the intermediate block, grasp the bonnet of the regulator and rotate the regulator counterclockwise.

Replacement

1. Secure the intermediate block in a vise or similar holding fixture.
2. Remove all old sealant from the regulator inlet nipple. Clean all interior surfaces with isopropyl alcohol or 1,1,1 Trichloroethylene solvent.

> **CAUTION**
>
> - Do not stand directly in front of the ports 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.

3. Remove all old sealant from the intermediate block. Blow out the intermediate block with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.
4. Apply Teflon® tape to the 1/4 NPT male pipe threads on the regulator inlet nipple. Start the threads of the nipple into the intermediate block.
5. Position the inlet of the regulator over the nipple and rotate the regulator clockwise to tighten the threads. The inlet of the regulator is stamped **IN**.
6. Grasp the bonnet of the regulator and rotate the regulator clockwise until tight. The bonnet of the regulator must be parallel to the test gauge on the left end of the intermediate block.
7. Remove the intermediate block from the vise and using the carriage bolt, reinstall the intermediate block to the bracket on the backplate. Assemble the nut and washer to the carriage bolt. Tighten loosely.
8. Remove all old sealant from the union nipple. Clean all interior surfaces with isopropyl alcohol or 1,1,1 Trichloroethylene solvent.

9. Apply Teflon® tape to the 1/4 NPT male pipe threads on the nipple. Start the threads of the nipple into the outlet of line regulator.

10. Using a 3/4" hex wrench, install the nipple to the outlet of the line regulator.

11. Using a 7/16" hex wrench, reassemble the U-bolt to the bracket.

12. When re-tightening the 3/8 tube fittings, the procedure outlined on page 4-2 shall be followed. Using an 11/16" open end wrench, reconnect the tubing.

13. When re-tightening the 1/8 tube fitting, the procedure outlined on page 4-2 shall be followed. Using an 7/16" open end wrench, reconnect the line pressure gauge tubing to the line regulator.

14. Reconnect the intermediate pressure relief valve to the building's vent line.

15. Reconnect the main supply line to the manifold at the 1/4 compression fitting.

Line Regulator Adjustment

1. Reinstall the manifold cover as explained at the beginning of this section.

CAUTION

- Be sure to backout the adjusting screw on the line regulator prior to pressurizing the system. If the adjusting screw position was changed it may overpressurize causing something to burst or rupture.

2. **S-l-o-w-l-y** open one cylinder on the system.

3. Verify the cylinder pressure gauge indicates a minimum pressure of 1500 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.

4. Turn the adjusting screw of the regulator in while observing the line pressure gauge. Set the regulator to the desired pressure.

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

6. Readjust the regulator to the proper specifications if necessary.

7. Tighten the union connection to the main supply line. The line pressure gauge will go up slightly higher than the flowing adjusted pressure.

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

9. Close the cylinder valve.

10. Loosen the main supply line union and vent all remaining gas from the manifold.

11. Tighten the union connection to the main supply line after the gas pressure has been exhausted from the manifold.

LIGHT SOCKET REPLACEMENT

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.

2. Label and disconnect the four connectors attached to the back of the light socket.

3. Using a small flat blade screwdriver, pry off the two metal clips securing the light socket to the manifold cover.

4. Slide the defective socket out through the front of the manifold cover.

Replacement

1. The new light socket will have two sets of terminals labeled "A" and "B". Insert the back of the new light socket through the rectangular opening in the front of the manifold cover approximately 3/4" with the "+" terminal of the "A" set on the top.

2. Grasp the back of the light socket on the sides and pull the socket in until the front of the socket is flush with the front of the manifold cover.

3. Reattach the connectors to the terminals on the socket.

4. Reinstall the manifold cover and connect electrical power to the manifold. Test for proper function by following the Performance Verification Procedure in Section 3.

INDICATOR LAMP REPLACEMENT

Removal

1. Remove indicator lens cover by pulling lens cover forward. A small depression is molded into the top and bottom of the lens cover to facilitate removal. A flat blade screwdriver can be wedged in the depression and twisted to pry the lens cover off.

2. Remove the faulty lamp by pulling the built-in extractor. The clear plastic tab marked **lamp pull** is the extractor.

Replacement

1. Insert the replacement lamp and push on the lamp until it snaps into place.

CAUTION

- Too much force used to install the lamp could break the socket bezel and allow the socket to be pushed completely through the front of the manifold cover.

2. Reinstall the indicator lens cover with the green lens above the red lens.

CAUTION

- Too much force used to install the lens cover could break the socket bezel and allow the socket to be pushed completely through the front of the manifold cover.

MAINTENANCE & REPAIR PARTS

REPLACEMENT PIGTAILS

24" Stainless Steel Inner Core Flexible with Check Valve

HPF-16CVFA-24 .... CGA 300 with flash arrestor for Acetylene Service
HPF-320CV-24..... CGA 320 for Carbon Dioxide (CO_2) Service
HPF-326CV-24..... CGA 326 for Nitrous Oxide (N_2O) Service
HPF-346CV-24..... CGA 346 for Breathing Air (Air) Service
HPF-83CV-24..... CGA 350 for Hydrogen (H_2) Service
HPF-15CVFA-24 .... CGA 510 with flash arrestor for Acetylene Service
HPF-63CV-24..... CGA 540 for Oxygen (O_2) Service
HPF-92CV-24..... CGA 580 for Inert Gas Service (Argon, Helium, and Nitrogen)

REGULATORS & REGULATOR REPAIR KITS

Intermediate Primary Regulators

WMS-11-104 ..... Intermediate Primary Regulator for HBAC2 & HBAC2HL -series CO_2, N_2O (S/N > 21583)
WMS-11-120 ..... Intermediate Primary Regulator for HBAC2-series Oxygen, Air, H_2, Ar, He, N_2 (S/N > 21583)
WMS-11-105 ..... Intermediate Primary Regulator for HBAC2-series Acetylene (S/N > 21583)
WMS-11-120 ..... Intermediate Primary Regulator for HBAC2HP-series Oxygen, Air, H_2, Ar, He, N_2 (S/N > 21583)
WMS-11-122 ..... Intermediate Primary Regulator for HBAC2 & HBAC2HL-series CO_2, N_2O (S/N < 21584)
WMS-11-123 ..... Intermediate Primary Regulator for HBAC2-series Oxygen, Air, H_2, Ar, He, N_2 (S/N < 21584)
WMS-11-121 ..... Intermediate Primary Regulator for HBAC2-series Acetylene(S/N < 21584)
WMS-11-123 ..... Intermediate Primary Regulator for HBAC2HP-series Oxygen, Air, H_2, Ar, He, N_2 (S/N < 21584)

Change-Over Primary Regulators

WMS-11-119 ..... Change-over Primary Regulator for HBAC2-series Oxygen, Air, H_2, Ar, He, N_2 (S/N > 21583)
WMS-11-103 ..... Change-over Primary Regulator for HBAC2 & HBAC2HL -series CO_2, N_2O(S/N > 21583)
WMS-11-115 ..... Change-over Primary Regulator for HBAC2-series Acetylene(S/N > 21583)
WMS-11-119 ..... Change-over Primary Regulator for HBAC2HP-series Oxygen, Air, H_2, Ar, He, N_2 (S/N > 21583)
WMS-11-126 ..... Change-over Primary Regulator for HBAC2-series Oxygen, Air, H_2, Ar, He, N_2 (S/N < 21584)
WMS-11-125 ..... Change-over Primary Regulator for HBAC2 & HBAC2HL -series CO_2, N_2O(S/N < 21584)
WMS-11-124 ..... Change-over Primary Regulator for HBAC2-series Acetylene(S/N < 21584)
WMS-11-126 ..... Change-over Primary Regulator for HBAC2HP-series Oxygen, Air, H_2, Ar, He, N_2 (S/N < 21584)

Line Regulators

WMS-11-19 ..... Line Regulator for HBAC2 & HBAC2HL-series Acetylene and Liquefied Fuel Gas
WMS-11-20 ..... Line Regulator for HBAC2-series except Acetylene and Liquefied Fuel Gas manifolds
WMS-11-39 ..... Line Regulator for HBAC2HP-series manifolds

PANEL MOUNT GAUGES — 2" Diameter, 1/4" NPT Back Port

WMG-3-7 ..... 30 psi
WMG-3-9 ..... 60 psi
WMG-3-3 ..... 100 psi
WMG-3-2 ..... 200 psi
WMG-3-14 ..... 300 psi
WMG-3-4 ..... 400 psi
WMG-3-8 ..... 2000 psi
WMG-3-12 ..... 4000 psi

VALVES AND CHECK VALVES

WMV-2-56 ..... Master Valve
WMS-1-65 ..... CGA 320 Header Check Valve
WMS-1-99 ..... CGA 350 Header Check Valve
WMS-1-53 ..... CGA 540 Header Check Valve
WMS-1-59 ..... CGA 326 Header Check Valve
WMS-1-62 ..... CGA 346 Header Check Valve
WMS-1-100 ..... CGA 510 Header Check Valve
WMS-1-54 ..... CGA 580 Header Check Valve

INDICATOR LAMP REPLACEMENT PARTS

Square Style

WME-8-42 ..... Light Bulb
WME-8-41 ..... Bulb Receptacle
WME-8-40 ..... Red/Green Lens
MK-1010 ..... Heater light Repair Kit

PRESSURE SWITCHES

WME-4-28 ..... Pressure Switch Explosion Proof (adjustable 150-375 psi) HBAC2, HBAC2HL & HBAC2HP
WME-4-5 ..... Explosion Proof Pressure Switch (adjustable 30-300 psi) Acetylene
WME-4-29 ..... Bracket for WME-4-28 switch

POWER SUPPLY REPLACEMENT PARTS

WMS-11-31 ..... Power Supply Assembly (transformer, PCB with dry contacts, case, and cable)
WME-8-1 ..... Power Supply PCB for WMS-11-31 and WMS-11-36 (includes dry contacts for remote alarms)

REMOTE ALARMS — 24 VAC Service

BIA-1 ..... Visual - 1 Gas
BIA-2 ..... Audio/Visual - 2 Gases
BIA-3 ..... Audio/Visual - 1 Gas
WMS-11-36 ..... Optional 115 to 24 VAC Power Supply for above Remote Alarms

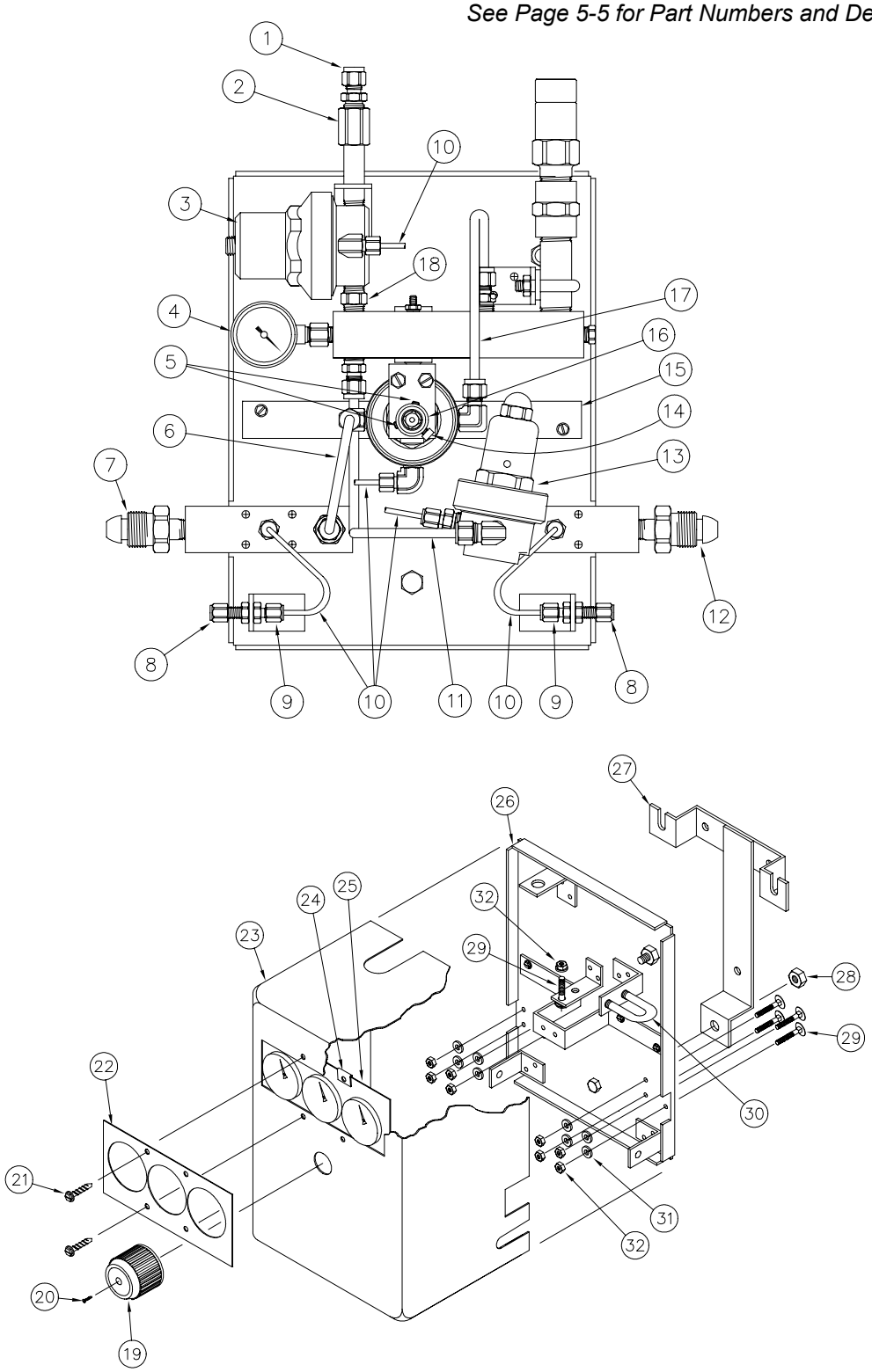
Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2 & HBAC2HP Series — Hydrogen Manifolds

Components & Miscellaneous Hardware

See Page 5-5 for Part Numbers and Descriptions



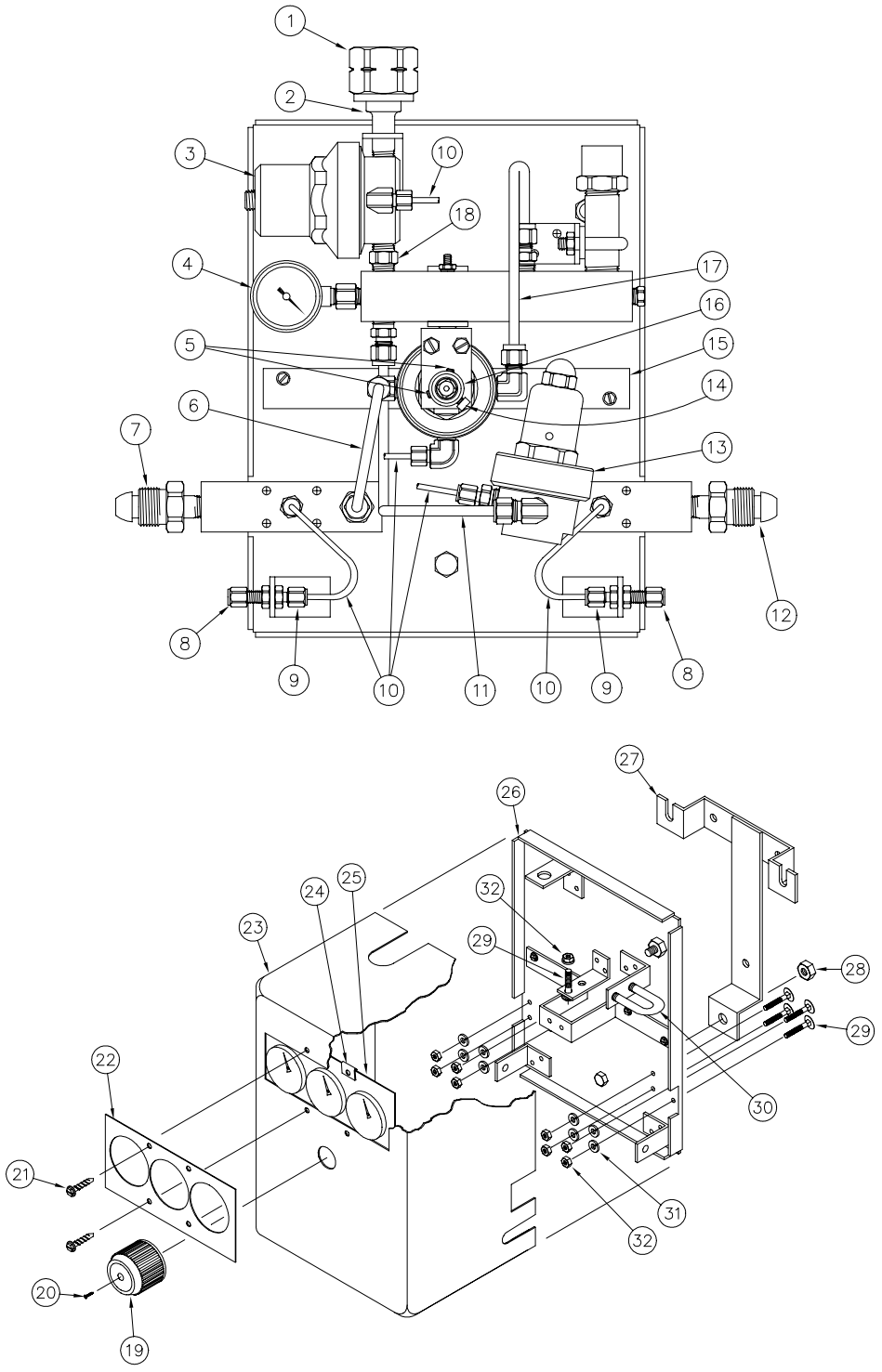
Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2 Series — Acetylene Manifolds

Components & Miscellaneous Hardware

See Page 5-5 for Part Numbers and Descriptions



KEY #	DESCRIPTION	PART #
1	Outlet	
	HBAC2-1 Series Nut	D-8
	HBAC2-6 Series Tube Fitting	WLF-3-30
	HBAC2HP-6 Series Tube Fitting	WLF-3-30
2	Outlet	
	HBAC2-1 Series Nipple	WLF-5-4
	HBAC2-6 Series Tube Extender	WMS-11-24
	HBAC2HP-6 Series Tube Extender	
3	Line Regulator	
	for HBAC2-1 Series	WMS-11-19
	for HBAC2-6 Series	WMS-11-20
	for HBAC2HP-6 Series	WMS-11-39
4	Intermediate Block	
	for HBAC2-1 Series	WMS-11-48
	for HBAC2-6 Series	WMS-11-49
	for HBAC2HP Series	WMS-11-51
5	#10-32 Set Screw	WMC-6-58
6	Inlet Tube	WMS-11-45
7	Left Inlet	WMS-11-71
8	1/4" Tube Plug	WLF-3-32
9	1/8" Tube Bulkhead Fitting	WLF-3-33
10	1/8" Tubing	
	for HBAC2-1, 1A Series	WLF-6-19
	for HBAC2-6 & HBAC2HP-6 Series	
11	Intermediate Tubing	WMS-11-47
12	Right Inlet	WMS-11-29
13	Primary Int. Regulator	
	for HBAC2-1 Series	**
	for HBAC2-6 Sereis	**
	for HBAC2HP-6 Series	**
14	#10-32 Cap Screw	WMC-6-59
15	Change-over Regulator	
	for HBAC21 Series	**
	for HBAC2-6 Series	**
	for HBAC2HP-6 Series	**

KEY #	DESCRIPTION	PART #
16	Stem Locking Nut	WMS-11-25
17	Change-over to Block Tube	WMS-11-46
18	1/4 NPT Adaptor	B-4HP
19	Control Knob	RWC-3-19
20	Control Knob Screw	RWC-3-60
21	#10-1" Self -tapping Screw	WMC-6-39
22	Outer Gauge Plate	WMC-8-2
23	Case	
	for HBAC2-1 Series	WMC-8-14
	for HBAC2-6 & HBAC2HP-6 Series	
24	Screw Receptacle	WMC-6-35
25	Inner Gauge Plate	
	for HBAC2-1 Series	WMS-8-7
	for HBAC2-6 Series	WMS-1-12
	for HBAC2HP-6 Series	WMS-5-4
26	Backplate Assembly	WMS-11-28
27	Tee Mounting Bracket	WMC-6-7
28	3/8-16 Hex Nut	WMC-6-6
29	3/16" Hex Nut	WMC-6-11
30	3/16" Lock Washer	WMC-6-12
31	1/2" Nominal U-bolt	WMC-6-13
32	3/16-24 x 1 3/4" Carr. Bolt	WMC-6-10
*	Case Lead Seal	WEM-1-27
*	#8 Sht. Metal Case Screw	WMC-6-23

* Item not pictured.

** See Maintenance & Repair Parts list on page 5-1.

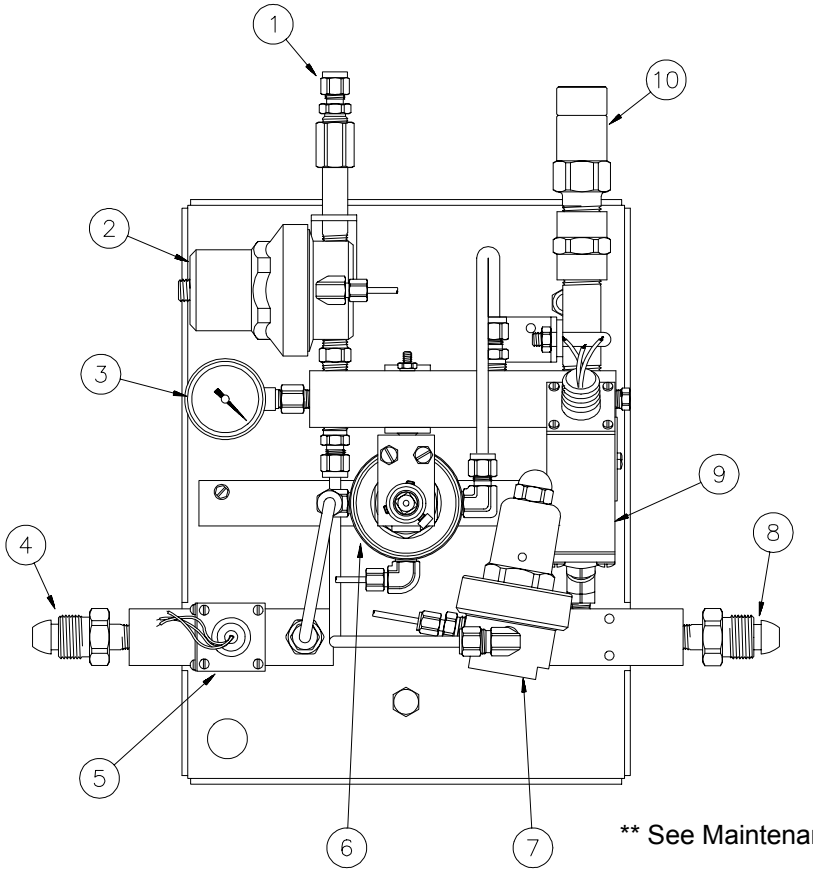
Piping Schematics for HBAC2-1, HBAC2-1A and HBAC2-6 are shown on page 2-7

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2 & HBAC2HP Series — Except Fuel Gas

Components & Miscellaneous Hardware



** See Maintenance & Repair Parts list

KEY #	DESCRIPTION	PART #
1	1/4" Tube Fitting	WLF-3-30
2	Outlet Extender	WMS-11-24
3	Line Regulator	
	for HBAC2 Series	WMS-11-20
	for HBAC2HP Series	WMS-11-39
4	Intermediate Block	
	for HBAC2 Series	WMS-11-49
	for HBAC2-4, -8 Series	WMS-11-50
	for HBAC2HP Series	WMS-11-51
5	#10-32 Set Screw	WMC-6-58
6	Inlet Tube	WMS-11-45
7	Left Inlet	
	for HBAC2 Series	WMS-11-52
	for HBAC2-4, -8 Series	WMS-11-53
	for HBAC2HP Series	WMS-11-52
8	1/8" Tubing	WLF-6-17

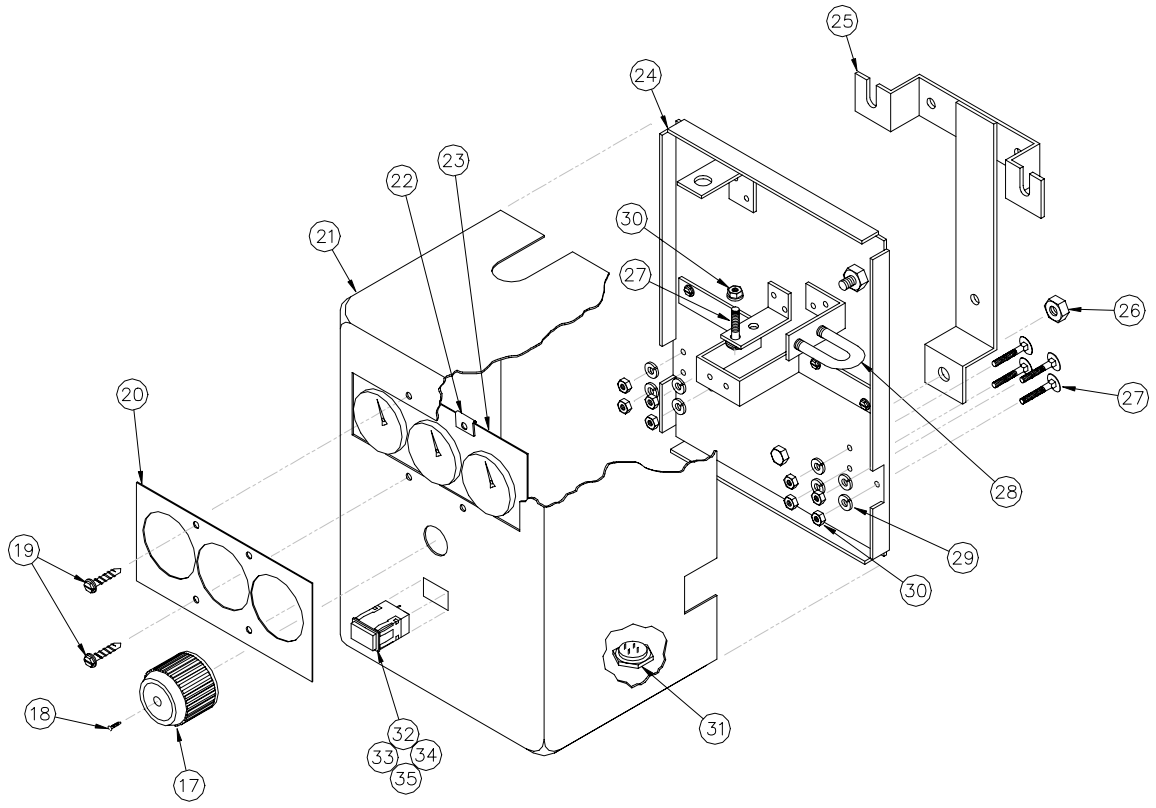
KEY #	DESCRIPTION	PART #
9	Intermediate Tubing	WMS-11-47
10	Primary Int. Regulator	
	for HBAC2 Series	**
	for HBAC2-4, -8 Series	**
	for HBAC2HP Series	**
11	Right Inlet	
	for HBAC2 Series	WMS-11-68
	HBAC2-4,-8 Series	WMS-11-68
	for HBAC2HP Series	WMS-11-68
12	#10-32 Cap Screw	WMC-6-59
13	Stem Locking Nut	WMS-11-25
14	Change-over Regulator	
	for HBAC2 Series	**
	for HBAC2-4, -8 Series	**
	for HBAC2HP Series	**
15	Change-over to Block Tube	WMS-11-46
16	1/4 NPT Adaptor	B-4HP

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2 & HBAC2HP Series — Except Fuel Gas

Components & Miscellaneous Hardware



KEY #	DESCRIPTION	PART #
17	Service Control Knob	RWC-3-19
18	#6-32 Flat Head Screw	RWC-3-60
19	#10-1 Washer head Screw	WMC-6-39
20	Outer Gauge Plate	WMC-8-2
21	Case	WMC-8-9
22	Screw Receptacle	WMC-6-35
23	Inner Gauge Plate	
	for HBAC2 Series	WMS-1-12
	for HBAC2-4, -8 Series	WMS-2-3
	for HBAC2HP Series	WMS-5-4
24	Backplate Assembly	WMS-11-1
25	Tee Mounting Bracket	WMC-6-7
26	3/8-16 Hex Nut	WMC-6-6
27	3/16-24 x 1 3/4" Carr. Bolt	WMC-6-10
28	1/2" Nominal U-bolt	WMC-6-13
29	3/16" Lock Washer	WMC-6-12

KEY #	DESCRIPTION	PART #
30	3/16" Hex Nut	WMC-6-11
31	Case Wiring Harness	WMS-11-72
32	Dual Light Lens	WME-8-40
33	Dual Light Base	WME-8-41
34	24 V Bulb (#85)	WME-8-42
35	Dual Light Label	WME-8-54
*	Case Lead Seal	WEM-1-27
*	#8 Sht. Metal Case Screw	WMC-6-23
*	Power Supply Box	WMS-11-31

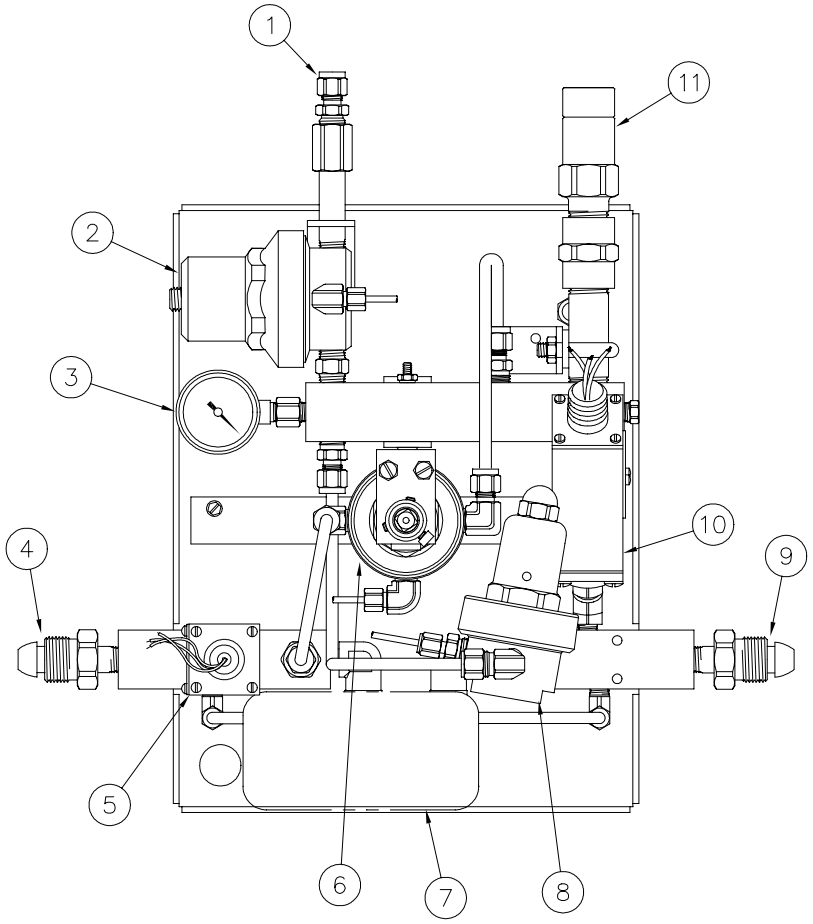
* Item not pictured.

Western Enterprises

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2HL Series

Repair Drawing

Components & Miscellaneous Hardware



** See Maintenance & Repair Parts list

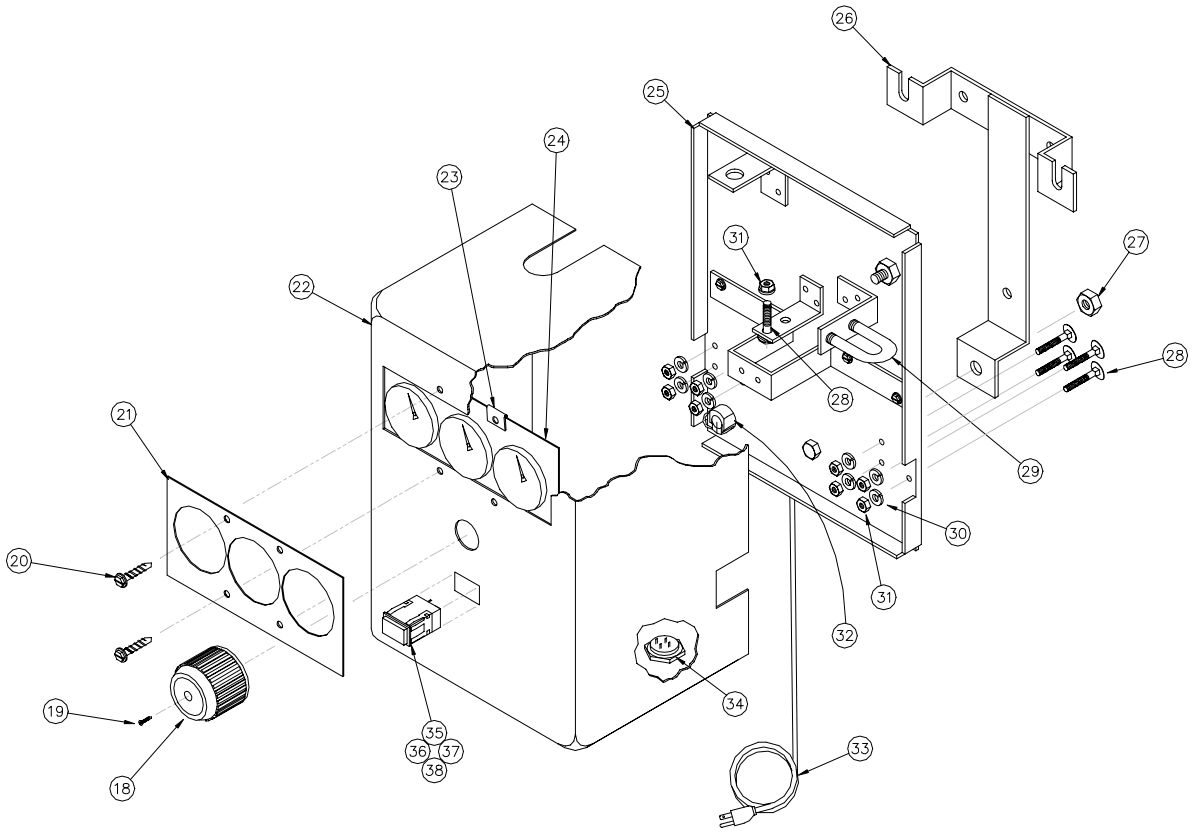
KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	1/8" Tube Fitting	WLF-3-30	10	Intermediate Tubing	WMS-11-47
2	Outlet Extender	WMS-11-24	11	Primary Int. Regulator	**
3	Line Regulator	WMS-11-20	12	Right Inlet	WMS-11-69
4	Intermediate Block	WMS-11-50	13	#10-32 Cap Screw	WMC-6-59
5	#10-32 Set Screw	WMC-6-58	14	Stem Locking Nut	WMS-11-25
6	Inlet Tube	WMS-11-45	15	Change-over Regulator	**
7	Left Inlet	WMS-11-54	16	Change-over to Block Tube	WMS-11-7
8	Heater	WMS-11-42	17	1/4 NPT Adaptor	B-4HP
9	1/8" Tubing	WLF-6-17			

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2HL Series

Components & Miscellaneous Hardware



KEY #	DESCRIPTION	PART #
18	Control Knob	RWC-3-19
19	Control Knob Screw	RWC-3-60
20	Gauge Plate Screw	WMC-6-39
21	Outer Gauge Plate	WMC-8-2
22	Case	WMC-8-9
23	Screw Receptacle	WMC-6-35
24	Inner Gauge Plate	WMS-2-3
25	Backplate Assembly	WMS-11-1
26	Tee Mounting Bracket	WMC-6-7
27	3/8-16 Hex Nut	WMC-6-6
28	3/16-24 x 1 3/4" Carr. Bolt	WMC-6-10
29	1/2" Nominal U-bolt	WMC-6-1

KEY #	DESCRIPTION	PART #
30	3/16" Lock Washer	WMC-6-12
31	3/16" Hex Nut	WMC-6-11
32	Strain Relief Bushing	WME-8-34
33	7’ Heater Cord	WME-8-33
34	Case Wiring Harness	WMS-11-72
35	Dual Light Lens	WME-8-40
36	Dual Light Base	WME-8-41
37	Dual Light Bulb	WME-8-42
38	Dual Light Label	WME-8-54
*	Case Lead Seal	WEM-1-27
*	#8 Sht. Metal Case Screw	WMC-6-23
*	Wire Nut	WME-8-58
*	Power Supply Box	WMS-11-31

* Item not pictured.

Western Enterprises

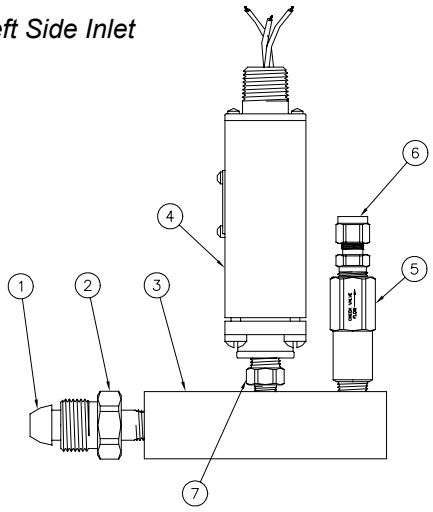
Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2 and HBAC2HP Series

Inlet Block Components

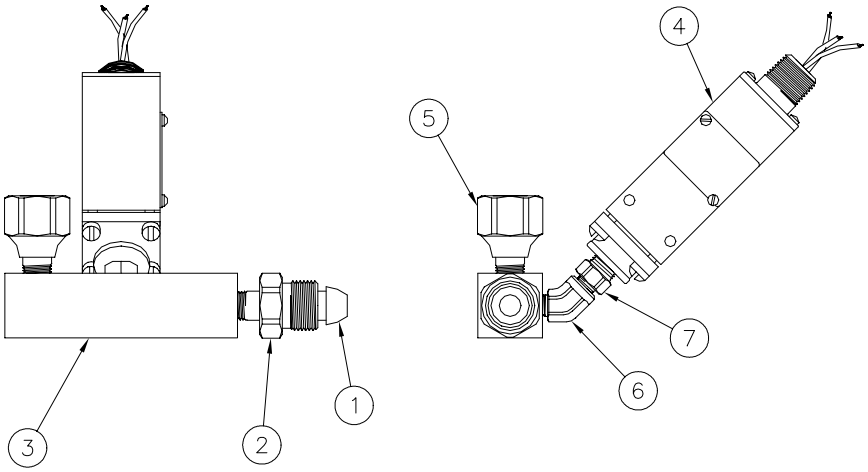
KEY #	DESCRIPTION	PART #
1	CGA 580 Nipple	15-8SF10
2	CGA 580 Nut	92
3	Inlet Block	WMC-2-34
4	Pressure Switch	
	For HBAC2 Series	WME-4-28
	For HBAC2HP Series	WME-4-28
5	Check Valve	
	For HBAC2-4 & HBAC2-8 Series	CVM-4F
	For all others	CVM-4FV
6	1/4 Tube Connection	WLF-3-30SS
7	1/4 x 1/8 NPT Adaptor	B-4-2HP
Not shown: Female Wire Connector		WME-8-11

Left Side Inlet



KEY #	DESCRIPTION	PART #
1	CGA 580 Nipple	15-8SF10
2	CGA 580 Nut	92
3	Inlet Block	WMC-2-37
4	Pressure Switch	
	For HBAC2 Series	WME-4-28
	For HBAC2HP Series	WME-4-28
5	CGA 580 Adaptor	B-70
6	1/8 NPT Elbow	BSL-2HP
7	1/4 x 1/8 NPT Adaptor	B-4-2HP
Not shown: Female Wire Connector		WME-8-11

Right Side Inlet



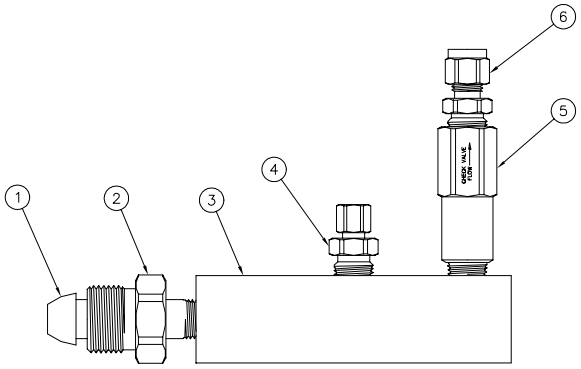
Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2-1, -1A and -6 Series

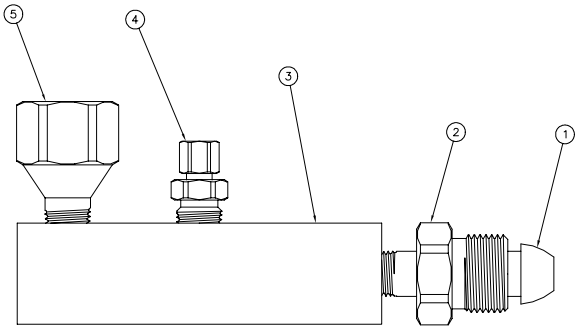
Inlet Block Components

Left Side Inlet



KEY #	DESCRIPTION	PART #
1	CGA 580 Nipple	15-8SF10
2	CGA 580 Nut	92
3	Inlet Block	WMC-2-34
4	1/8 Tube Connection	WLF-3-11
5	Check Valve	CVM-4FV
6	1/4 Tube Connection	WLF-3-30SS

Right Side Inlet



KEY #	DESCRIPTION	PART #
1	CGA 580 Nipple	15-8SF10
2	CGA 580 Nut	92
3	Inlet Block	WMC-2-34
4	1/8 Tube Compression Fitting	WLF-3-11
5	CGA 580 Adaptor	B-70

Western Enterprises

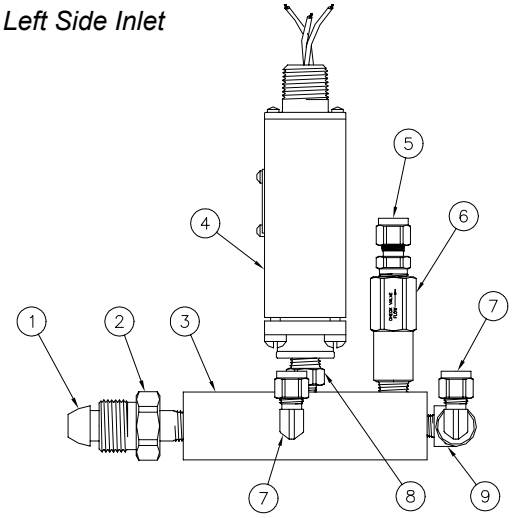
Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2HL Series

Inlet Block Components

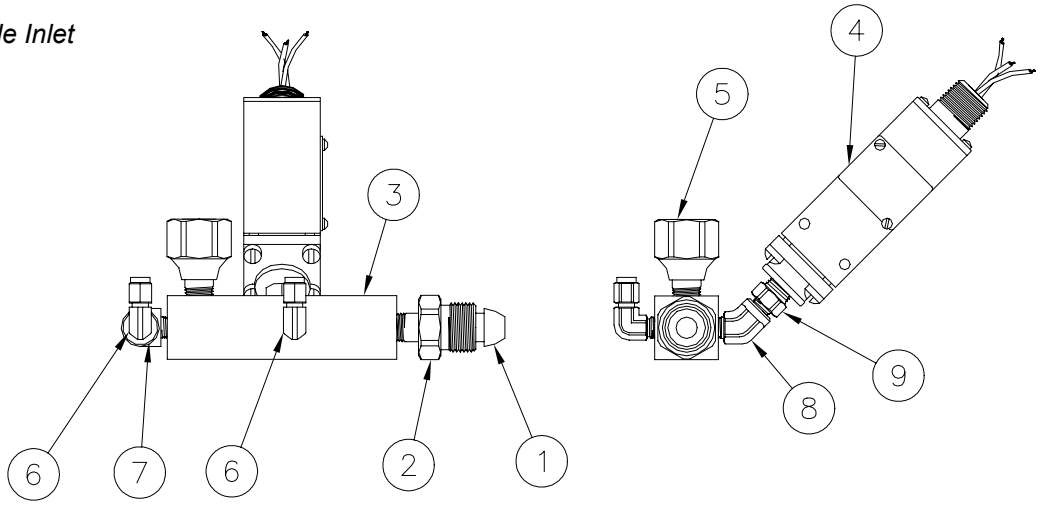
KEY #	DESCRIPTION	PART #
1	CGA 580 Nipple	15-8SF10
2	CGA 580 Nut	92
3	Inlet Block	WMC-2-33
4	Pressure Switch	WME-4-28
5	1/4 Tube Fitting	WLF-3-30SS
6	Check Valve	CVM-4F
7	1/4 Tube Fitting	WLF-3-3
8	1/8 x 1/4 NPT Adaptor	B-4-2HP
9	1/8 NPT Street Elbow	BL-2HP
Not shown: Female Wire Connector		WME-8-11

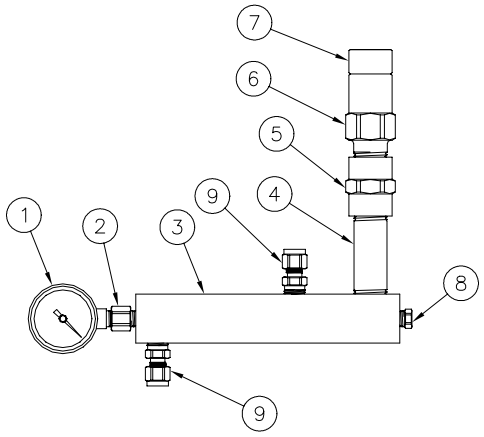
Left Side Inlet



KEY #	DESCRIPTION	PART #
1	CGA 580 Nipple	15-8SF10
2	CGA 580 Nut	92
3	Inlet Block	WMC-2-38
4	Pressure Switch	WME-4-28
5	CGA 580 Adaptor	B-70
6	1/4 Tube Connection	WLF-3-3
7	1/8 NPT Street Tee	BL-2HP
8	1/8 NPT Eblow	BSL-2HP
9	1/8 x 1/4 NPT Adaptor	B-4-2HP
Not show: Female Wire Connector		WME-8-11

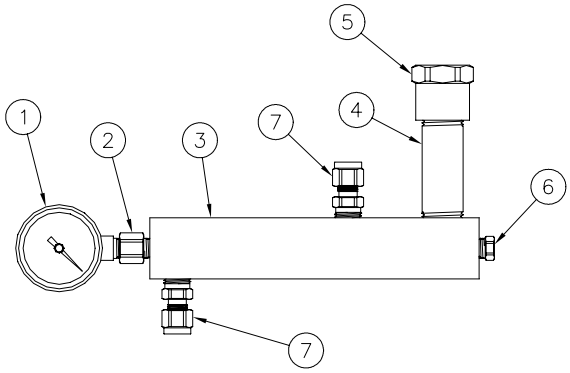
Right Side Inlet





KEY #	DESCRIPTION	PART #
1	400 PSI Gauge	G-15-400W
2	1/8 NPT Bushing	BA-2HP
3	Intermediate Block	WMC-2-36
4	1/2 NPT Pipe Fitting	WLF-1-15
5	1/2 NPT Coupler	BF-8HP
6	Safety Relief Valve	
	for HBAC2HL Series (300 psig)	WMV-8C-300
	for HBAC2HP Series (450 psig)	WMV-8V-450
	for HBAC2 Series (300 psig)	WMV-8V-300
7	Pipe-away Adaptor	WMV-8-7
8	1/8 NPT Plug	P-2HP
9	3/8" Tube x 1/4 NPT	WLF-3-30SS

HBAC2-1 and -1A Series



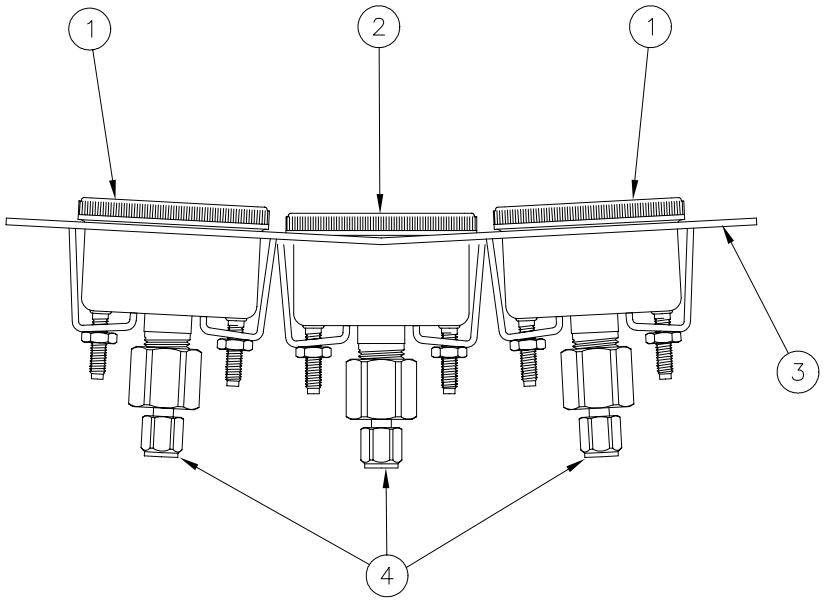
KEY #	DESCRIPTION	PART #
1	400 PSI Gauge	G-15-400W
2	1/8 NPT Bushing	BA-2HP
3	Intermediate Block	WMC-2-36
4	1/2 NPT Pipe Fitting	WLF-1-15
5	HBAC2-1 Series 1/2 NPT Plug	PC-8HP
6	1/8 NPT Plug	P-2HP
7	3/8" Tube x 1/4 NPT	WLF-3-30SS

Western Enterprises

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HBAC2, HBAC2HL, & HBAC2HP Series

Repair Drawing

Gauge Plate Components



KEY #	DESCRIPTION	PART #
1	Cylinder Contents Gauge	
	for HBAC2-1 (400 psi)	WMG-3-4
	for other HBAC2 & HBAC2HP Series (4000 psi)	WMG-3-12
	for HBAC2HL and HBAC2-4, -8 Series (2000 psi)	WMG-3-8
2	Line Pressure Gauge	
	for HBAC2-1,-1A (30 psi)	WMG-3-7
	for other HBAC2 & HBAC2HL Series (200 psi)	WMG-3-2
	for HBAC2HP Series (400 psi)	WMG-3-4
3	Gauge Plate	WMC-8-11
4	1/8" Tube x 1/4 NPT Female	WLF-3-4