AUTOMATIC GAS MANIFOLD
200-SERIES LED

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OPERATION MAINTENANCE AND INSTALLATION MANUAL
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SECTION 1 - INTRODUCTION

1.1 DESCRIPTION

1.1.1. The AMICO Manifold was designed to provide high gas flows while requiring minimal maintenance.

1.1.2. It is intended for use in applications which require an uninterrupted flow of gas without fluctuating line pressure.

1.1.3. The manifold is designed in accordance with NFPA 99-1996, “Medical Gas and Vacuum Systems”, and its construction is rugged and will provide long and reliable service.

1.1.4. All control apparatus is housed within an enclosed cabinet to safeguard against tampering. Cylinder extension bars thread into both sides of the cabinet to act as manifold headers for the Left Hand and Right Hand cylinder banks.

1.1.5. One bank of cylinders, the primary supply, operates while the other bank, the secondary supply, waits until a set pressure is reached and change-over to the secondary bank is made automatically without interruption in flow or delivery pressure.

1.1.6 The only manual operation is the periodic replacement of empty cylinders.

1.2 BASIC DATA

1.2.1 The AMICO Manifold is available in five standard models, each specifically designed for its gas service according to NFPA 99-1993 The gas services offered are: oxygen, nitrogen, nitrous oxide, compressed medical air and carbon dioxide. Other gas services, such as argon, may be ordered as special items.

1.2.2 Manifolds may be obtained in these gas services, as standard units, up to a cylinder capacity of 20 per side. Larger manifolds can be ordered.

1.2.3 Input power requirements are: 115VAC or 230VAC, Maximum current draw 0.1 Amps.

1.2.4 Three pressure gauges on the control cabinet door indicate left hand bank contents, right hand bank contents and line pressure.

1.2.5 The control panel incorporates six LED’s, three for the Left Bank and three for the Right Bank. Green for Bank in use, Amber for Bank ready and Red for Bank empty.
1.2.6 Provision has been made to connect the AMICO Manifold to the AMICO Master Alarm. When the manifold operating bank of cylinders becomes depleted, and the shuttle valve has switched over to the secondary bank, an electrical signal is transmitted to the Master Alarm where a sonic alarm and respective warning light indicates that the secondary (reserve) bank is in use.

1.2.7 The standard Amico Manifold is designed for wall mounting, but freestanding floor mounted models are available upon request.
SECTION 2 - FUNCTIONAL DETAILS

2.1 CONTROL COMPONENTS

The AMICO Manifold qualifies as a “Cylinder System Without Reserve Supply” as classified in NFPA 99-1996, Clause 4-3.1.5. This is one category of the broader classification “Central Supply System” which encompasses many types of sources of supply to non-flammable medical gas piping systems.

As such, the AMICO Manifold is comprised of two banks of cylinders which alternately supply the pipeline, each having various control components. When the primary bank is exhausted, the secondary takes over automatically as a normal operating procedure of the equipment.

Figure 1. shows a schematic of the AMICO Manifold and the components shown are in compliance with the requirements of Clause 4-3.1.5 of NFPA 99-1996.

2.1.1 Pressure Gauges

All pressure gauges used in the Amico manifolds are clearly labeled and comply with NFPA 99-1996. Three pressure taps are used to supply pressure to the gauge bracket. The line pressure gauge has a scale of 100 psi for all gases except nitrogen, for which a 400 psi gauge is used.

2.1.2 Pressure Regulators

There are two types of regulators in the AMICO cabinet: the operating (source) pressure regulators and the line pressure regulator. Both types conform to NFPA 99-1996.

There are two operating pressure regulators, one for each bank. These should be set at the time of installation, (Factory preset to “0”). For oxygen, nitrous oxide, compressed medical air and carbon dioxide service the two operating pressure regulators should be set to 150 psig. For nitrogen service they should be set to 275 psig. The line pressure regulator is capable of maintaining a constant dynamic delivery pressure at the maximum design flow rate of the system.

For oxygen, nitrous oxide, compressed medical air and carbon dioxide service the line regulator should be set at 55 psig. For nitrogen service it should be set at 170 psig.

2.1.3 Shut-off and Check Valves
A manually operated shut-off valve is installed upstream of each operating pressure regulator. There are two of these valves in the AMICO Manifold, located outside the control cabinet on the cylinder extension bars. These valves are normally left fully open to allow entry of the gas from the two cylinder banks, however, in case of an emergency they can be closed to isolate one or both banks.

Reverse flow check valves are located in each flexible connection hose assembly between the cylinder and cylinder extension bar to prevent loss of gas from the cylinders connected to the manifold in the event that the safety relief device on an individual cylinder should relieve or a cylinder's pigtail assembly should fail.

Check valves are also located downstream of the operating pressure regulators, between the shuttle valve outlets and the cabinet's main piping.

### 2.1.4 Pressure Relief Valves

Pressure relief valves are installed downstream of all pressure regulators and are set at no more than 50% above the setting of the pressure regulator located immediately upstream. All the pressure relief valves are capable of fully relieving the pressure at the set point and are upstream of any shut-off valve. All pressure relief valves in the AMICO Manifold have piping connections to allow installation of vent lines to outside of facility.

Relief pressure setting vary with gas service as follows:

<table>
<thead>
<tr>
<th></th>
<th>Oxygen</th>
<th>Carbon Dioxide</th>
<th>Nitrous Oxide</th>
<th>Medical Air</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Pressure Relief</td>
<td>75 PSI</td>
<td>75 PSI</td>
<td>75 PSI</td>
<td>75 PSI</td>
<td>225 PSI</td>
</tr>
<tr>
<td>Intermediate Pres.</td>
<td>200 PSI</td>
<td>200 PSI</td>
<td>200 PSI</td>
<td>200 PSI</td>
<td>300 PSI</td>
</tr>
<tr>
<td>Relief valve.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.1.5 Control shuttle valve

The shuttle valve is the “automatic” portion of AMICO Manifolds. It forms the center of the control apparatus to ensure uninterrupted flow of gas without change in the delivery pressure. When the operating bank pressure falls to a predetermined level, the difference in pressures acting on either side of the shuttle valve causes change-over to the secondary cylinder bank.

AMICO has two different types of shuttle valves which are used in AMICO Manifolds. The low delivery pressure gases, carbon dioxide, oxygen, nitrous oxide and medical air use a diaphragm type while nitrogen, with its higher delivery pressure requirement, uses a piston type.
2.1.5.1 Diaphragm type (low pressure type).

This shuttle valve consists of a machined brass body, in two halves, into which are threaded two inlet connections and two outlet connections. Within the mating halves are machined rounded lip type seats recessed into bores which form the pressure chamber in which the shuttling shaft assembly operates. The shaft assembly consists of a stainless steel shaft onto which is placed a nylon reinforced neoprene diaphragm sandwiched between seat plates. Neoprene seats are held against these plates by seat washers secured by nuts. The shaft assembly fits into the chamber formed by the body halves which bolt together and squeeze the diaphragm, sealing one side from the other. The shaft is free to move from side to side with the diaphragm flexing back and forth. When pressure is introduced from one side, the shaft assembly takes up its initial position, with the pressurized side open. As the same pressure is allowed into the closed side, the shaft remains in the same position since the pressure acts on a reduced diaphragm area which does not provide sufficient force to shuttle the shaft assembly. When the operating side pressure falls to a specific pressure, the force on the closed side overcomes the force on the open side and the shuttling occurs, changing the supply from one bank to the other. The change in shaft positions is detected by limit switches which signal that change-over has occurred.

2.1.5.2 Piston type (high pressure type).

The high pressure shuttle valve used in nitrogen service is basically the same as the low pressure one, except for the replacement of the diaphragm type shaft assembly by a piston type shaft assembly. Instead of squeezing a diaphragm between the two body halves to form the two pressure chambers, the sides are separated by an “O”-ring seal around the circumference of a piston. The piston shaft assembly slides back and forth in the cylinder bore, as shuttling occurs.

In both types of shuttle valve, the gas is delivered to them from one of the two operating pressure regulators just upstream. Once passing through the shuttle valve the gas goes to one of the line pressure regulators which is capable of maintaining a constant delivery pressure despite the fluctuating inlet pressure caused as one bank becomes empty and the next takes over.

2.2 WARNING SYSTEM COMPONENTS
Forming an integral part of the AMICO Manifold control cabinet are a number of components whose function is to give continuous visual information as to the state of operation of the system.

2.2.1 **Pressure Gauges**

Three pressure gauges are mounted inside the cabinet behind a window in the front door of the control cabinet. One gives the left hand bank cylinder pressure, one the right hand bank cylinder pressure and the center gauge displays the preset line pressure.

2.2.2 **Bank Change-Over Indicators**

The six LED’s described in Clause 1.2.5. are controlled by pressure switches. The pressure switches mounted on the inlet bars are normally open under cylinder pressure, but when operating bank pressure falls to a pre-set value, (500 psi nitrogen, 225 psi all other gases), the switch closes, thus arming the warning circuit until the shuttle valve switches. As the shuttle valve changes position, the Green “Bank in use” LED switches banks and the now closed pressure switch completes the Red “Bank Empty” LED circuit. Replacing the empty cylinders opens the pressure switch again to make the Red LED go out and turn on the Amber “Bank Ready” LED.

2.3 **OPERATING ALARM SYSTEMS**

Operating Alarm Systems, although they are mandatory according to NFPA 99-1996, are not part of the AMICO Manifold and therefore are not dealt with in detail in this manual.

AMICO does supply a complete range of operating alarm units which can be used in conjunction with the AMICO Manifold to provide the required visual and audible signals, in suitable locations, when change-over from the primary supply to the secondary supply occurs.

The Manifold control cabinet contains the required circuitry to send a signal to the alarm unit when a bank is empty and change-over occurs.

The normally closed cabinet's internal circuitry is designed to alarm on an open circuit. The depletion of a bank triggers a relay, which renders the alarm circuit open and initiates the alarm signal.

2.4 **SAFETY FEATURES**
2.4.1 **Gas Service Identification**

AMICO Manifolds are clearly labeled for the gas that they are intended to be used for. A large nameplate, indicating the appropriate gas, is attached on the cabinet door, all pressure gauge dials are labeled and the two pipes extending from the top of the cabinet (one for mainline pressure, one for the intermediate pressure relief).

2.4.2 **Function Identification**

The indicator LED’s on the door and the pressure gauges through the cabinet door are clearly marked to explain their function.

2.4.3 **Cylinder Connections**

The AMICO Manifold is designed to assure that only cylinders containing the proper gas can be connected to it. All cylinder extension bar connections as well as pigtail hose assemblies comply with CGA Standard B96, “*Compressed Gas Cylinder Valve Outlet and Inlet Connections*”.

2.4.4 **CSA Approved and UL Listing.**

The AMICO Manifold is CSA approved as per File #LR55850, as an electrical device. (Note: CSA approval for a medical manifold is not available from the Canadian Standards Association at this time pending the development of a specific code). UL Listing #6N32.
SECTION 3 - INSTALLATION

3.1 RECEIPT AND LOCATION

3.1.1 The AMICO Manifold should be carefully examined upon receipt. If any damage is found, a claim should be filed with the transport company and AMICO or its authorized dealers or distributors should be notified immediately.

3.1.2 Figure 2, 3 and 4 shows some of the basic dimensions of the Manifold installation.

3.2 ASSEMBLY INSTRUCTIONS

3.2.1 The AMICO Manifolds are shipped in a semi-assembled condition to facilitate packaging and installation.

3.2.2 First position the manifold support wall bracket, then mark the holes, drill and place suitable anchors, (not included), in the supporting wall.

3.2.3 Bolt the manifold support into position.

3.2.4 Attach the Manifold control cabinet to the support using supplied bolts. The cabinet attaches to the front of the wall bracket.

3.2.5 Connect the two High Pressure inlet valve / Header bar assemblies to the CGA connections on either side of the cabinet.

3.2.6 Position the wall brackets, if required, to support the extension bars and bolt in place.

3.2.7 Secure the cylinder extension bar to the support using the U-bolts supplied as part of the assemblies.

3.2.8 Install the single cylinder end connections at each end of the cylinder extension bar.

3.2.9 Attach a plug and chain assembly to each outlet connection on the cylinder extension bar using the curtain rings supplied.

3.2.10 Attach the cylinder pigtails (copper) to the header bar connections, while insuring the check valves are operating in the proper direction.

3.2.11 To avoid contamination with particulate or other potential hazardous materials, keep pigtails contained in plastic wrap until such time as connection to gas cylinder is planned.
3.3 CONNECTION TO PIPING SYSTEM

3.3.1 When the medical gas piping system has been tested in accordance with Part 4-5 Testing of NFPA 99-1996, the manifold can then be connected to it.

3.3.2 The three outlet pipes leading from the AMICO control cabinet should be connected to their respective pipeline system connections. The connection to the relief valves should be made with a union (supplied by others) to facilitate change if required.

3.3.3 As the threaded joints are installed, an appropriate sealing compound that is suitable for the gas being transmitted shall be used.

3.3.4 If downstream joints near the cabinet outlets are to be silver brazed, special attention must be given not to overheat the copper tubing since this may alter the sealing compound used in the threaded joints leading from the control cabinet.
SECTION 4 - AMICO MANIFOLD TESTING

4.1 TESTING FOR LEAKAGE

The following instructions apply to leak testing to be performed on the joints made during assembly and connection of the AMICO Manifold and not to tests previously made on the piping system.

4.1.1 The connections inside the AMICO control cabinet have been inspected at the manufacturing plant and do not require leak testing.

4.1.2 In order to determine whether any leaks exist between cylinder extension bar sections or at the pipeline connections, the system must be pressurized using either oil-free dry air or oil-free dry nitrogen.

4.1.3 In the case of either a medical air or a medical nitrogen AMICO Manifold, the actual service gas may be used to perform the leak tests as follows:

4.1.3.1 Connect a cylinder of the manifold service gas to the end connection on each end of the cylinder extension bar using the copper cylinder connection hose assemblies supplied.

4.1.3.2 Make sure all other outlets are capped with the plug and chain assemblies supplied.

4.1.3.3 Make sure that the high pressure inlet valves of each bank are fully opened.

4.1.3.4 Slowly open the two cylinder valves, closest to the cabinet, one at a time, to pressurize the cylinder extension bar, to pressurize the pipeline.

4.1.3.5 All outlets from the pipeline, downstream of the manifold should be closed and thus there should be no flow from the manifold.

4.1.3.6 Check for leaks at all cylinder extension joints and at the joints where the pipes were connected to the pipeline, using soapy water or a commercial leak detector which is compatible with oxygen.

4.1.3.7 If any leaks are found, the system must be de pressurized by bleeding through a convenient pipeline outlet and the faulty connections must be repaired.

4.1.3.8 The pipe threaded cylinder extension bar connections may be tightened one more turn, maintaining the horizontal location of the cylinder adapters, or a further application of an oxygen service thread sealant may be required.
4.1.3.9 If the brazed pipeline connections leak, they must be removed, cleaned and then re-brazed following the proper technique.

4.1.3.10 All repaired joints must be pressure tested as previously.

4.1.4 In the case of medical oxygen, medical nitrous oxide or carbon dioxide AMICO Manifolds, the actual service gases are not suitable for leak testing due to their inherent dangerous properties. Leak testing must be performed using either oil-free dry air or oil-free dry nitrogen, as states previously in Clause 4.1.2.

4.2 FINAL TESTING

4.2.1 Purging and analyzing of the complete medical gas piping system shall be carried out in accordance with NFPA 99-1996, 4-5 Testing.
SECTION 5 - OPERATION

5.1 ELECTRICAL HOOK-UP TO CLOSED CIRCUIT ALARMS

5.1.1 Once the AMICO Manifold has been installed and the source of supply for the medical gas piping system is completed, the electrical connections can be made.

5.1.2 The input power to the AMICO manifold is 115VAC or 230VAC 50/60Hz.

5.1.3 Connections from the AMICO Manifold to the AMICO Master Alarm must be made from terminals marked C and NC, to the appropriate terminals (RESERVE IN USE) on the Master Alarm.

5.1.4 For a schematic representation of a typical wiring installation, refer to Fig. 5.

5.2 CHECK-OUT OF INDICATOR FUNCTIONS

5.2.1 Introduce power to AMICO Manifold control cabinet then, with the high pressure inlet valves outside the cabinet both OPENED, S-L-O-W-L-Y open the cylinder valves on the cylinders closest to the control cabinet. After one minute, S-L-O-W-L-Y open all other cylinder valves. A pipeline outlet downstream of the manifold cabinet such as purge valve or terminal valve should be opened, and vented safely, to produce a dynamic flow condition for the indicator function check-out.

5.2.2 Since one side was opened first, the bank of cylinders first opened becomes the operating, or primary, supply.

5.2.3 When both banks are open, check the pressure gauges on the control cabinet door to ensure that they give the desired indication. The left hand and right hand Bank Pressures should both read full cylinder pressure while the line pressure should be 55 psig for oxygen, nitrous oxide, carbon dioxide, and medical air manifolds, and 170 psig for nitrogen manifolds.

5.2.4 Check the indicator LED’s for proper functioning. Only one Green LED, on the side which had its valve opened first, should be lit and the other side should have an Amber LED lit.

5.2.5 Close the cylinder valve on the primary bank and watch the pressure gauges and indicator lights to ensure proper functioning. The primary bank pressure should fall while the secondary and line pressures stay constant. When the primary pressure falls to approximately 80 psig for oxygen, nitrous oxide, carbon dioxide, and medical air services 195 psig for nitrogen service, there should be a distinct sound of the shuttle valve switching over to the secondary supply. When the switching occurs, the line pressure should remain constant and the Green LED’s
should reverse, with still only one of them lit. Also, the Red “Bank Empty” LED should become lit on the Bank Empty side.

5.2.6 With the AMICO manifold wired up to the AMICO Master Alarm the changeover from primary to secondary supply should cause an audible alarm buzzer and the appropriate indicator light on the Master Alarm to illuminate.

5.3 NORMAL OPERATING PROCEDURE

5.3.1 Normal operating procedure for the AMICO Manifold entails connecting full cylinders of the proper medical gas to all cylinder extension bar outlets via the appropriate copper cylinder connection hose assemblies.

5.3.2 With the high pressure inlet valves open, SLOWLY open the cylinder valves on the cylinders nearest the inlet valves of both banks. After waiting at least one full minute to allow time for the dissipation of generated heat, SLOWLY open all the rest of the cylinder valves, one at a time.

5.3.3 The bank that was pressurized first will become the primary bank automatically. The High pressure inlet valves should be left open under normal operating conditions. In an emergency these valves can be closed quickly.

5.3.4 Once the header bars have been pressurized, the AMICO Manifold is operating since all regulators and control equipment has been set in 5.2.

5.3.5 When the primary supply bank is exhausted and switch-over to the secondary supply bank occurs, the operating Alarm Unit notifies the person responsible that the cylinders on the primary bank need replacing.

5.3.6 To replace the empty cylinders with full ones, keep the high pressure inlet valves open throughout this procedure, close all empty cylinder valves and remove them. Attach full cylinders in their place, then SLOWLY open the cylinder valve nearest the inlet valve and wait for at least one full minute before SLOWLY opening the remaining cylinder valves, one at a time.

5.3.7 The introduction of full cylinder pressure into the cabinet's main bar opens the appropriate control pressure switch which causes the Red Bank Empty LED to go out. The AMICO Manifold is then ready for the next switch-over.
SECTION 6 - MAINTENANCE

6.1 GENERAL

6.1.1 The tests and inspections specified below apply only to the AMICO Manifold and not to the medical gas pipeline system as a whole. They are intended to help ensure the proper operation of the manifold and not to be interpreted as repair instructions. Fault finding and repair procedures are given in Section 7 - Trouble-Shooting.

6.2 AMICO CONTROL CABINET

Control equipment should be inspected and tested according to the following schedule:

6.2.1 Pressure Regulator:

(A) Observe and record line pressure at least daily.

(B) Test for external leaks at least semi-annually.

6.2.2 Pressure Relief Valves:

(A) Determine the pressure at which relief occurs at least annually and compare with the requirements of clause 4-3.1.8.5. of NFPA 99-1996.

6.2.3 High Pressure Inlet Valves (manifold hand valves):

(A) Inspect semi-annually and test for external leakage and tightness of shut-off.

6.2.4 Ensure that all electrical switches and lights are maintained in proper working condition. Replace all burnt bulbs or defective parts immediately.

6.3 CYLINDER EXTENSION BARS

6.3.1 The following components shall be inspected semi-annually as indicated:
(A) Test check valves of copper pigtails assemblies for proper closure.

(B) Inspect copper pigtail assemblies for apparent damage and thread damage to cylinder connection, replacing all damaged pigtails immediately.

6.3.2 The cylinders and the operating pressure regulators of a nitrous oxide or a carbon dioxide supply system shall be observed daily during peak demand periods to determine whether they show frosting or condensation on the surface; where this is evident, the system shall be further inspected for evidence of leaks. Should excessive condensation or frosting occur, it may be necessary to increase the manifold capacity by installing a heater kit.

6.4 PERIODIC STANDING PRESSURE TEST

At intervals of not more than 5 years, a 1-hour standing pressure test shall be made on each medical gas system to check for excessive leakage.

6.5 SHUTTLE VALVE PREVENTIVE MAINTENANCE

6.5.1 Shuttle valves should be removed from the AMICO cabinet at least once a year for inspection of elastomeric seats and seals.

6.5.2 To permit this to be done without interrupting supply of gas to the service pipeline, an emergency by-pass hose assembly and connection adapter are supplied with the AMICO control cabinet.

6.5.3 By connecting the outlet of one operating pressure regulator directly to the center bar by-pass connection adapter the shuttle valve can be removed for service.

6.5.4 Shuttle Valve by-pass

(A) Ensure that both left hand and right hand cylinder banks are full.

(B) If the manifold is supplying from the left hand cylinder bank, close the high pressure inlet valve on the right hand header.

(C) Remove the right hand supply line connecting the right hand operating pressure regulator outlet to the shuttle valve.

(D) Remove the dust cap from the by-pass inlet connection adapter on the main bar.

(E) Connect the emergency by-pass hose assembly between the right hand operating pressure regulator outlet and the by-pass inlet connection adapter on the center bar.

(F) Slowly open the high pressure inlet valve on the right hand header.

(G) Close the high pressure inlet valve on the left hand header.
NOTE: The manifold should now be operating on the right hand cylinder bank via the emergency by-pass hose assembly. Line pressure should remain at its normal setting.

6.5.5 Removing the Shuttle Valve

(A) Disconnect the left hand supply line from the shuttle valve.

(B) Loosen the round head screws holding the limit switches in place and remove the switches from the shuttle valve adapters.

(C) Disconnect the shuttle valve outlets from the main bar connections to remove the shuttle valve from the cabinet.

6.5.6 Installing the Shuttle Valve

(A) With the manifold still operating via the emergency by-pass hose, install the replacement (or reconditioned) shuttle valve by tightening its outlet connections to the center bar.

(B) Install limit switches and tighten the round head screws to secure the switches in place.

(C) Connect the left hand supply line between the left hand operating pressure regulator outlet and the shuttle valve.

(D) Slowly open the high pressure inlet valve on the left hand header.

(E) Close the high pressure inlet valve on the right hand header.

NOTE: The manifold should now be operating on the left hand cylinder bank via the shuttle valve. Line pressure should remain at its normal setting.

(F) Disconnect the emergency by-pass hose assembly from the right hand operating pressure regulator outlet and the main bar by-pass inlet connection adapter.

(G) Replace dust cap on the by-pass inlet connection adapter.

(H) Re-install the right hand supply line between the right hand operating pressure regulator outlet and the shuttle valve.

(I) Slowly open the high pressure inlet valve on the right hand header.

(J) Inspect all connections previously dismantled for leaks using a commercially available leak detector solution compatible with oxygen.
NOTE: DO NOT UNDER ANY CIRCUMSTANCE APPLY HYDROCARBON BASED LUBRICANTS TO MANIFOLD PARTS OR CONNECTIONS. USE ONLY PRODUCTS SPECIFICALLY APPROVED FOR USE IN OXYGEN SERVICE.

6.5.7 Reconditioning of Shuttle Valves

(A) Two replacement parts kits are available to permit the reconditioning of shuttle valves. They include all the elastomeric seats and seals required.

(B) Kit M-X-LPV-RK is used to recondition low pressure shuttle valves M-SHUTV-LP used in oxygen, nitrous oxide, carbon dioxide and compressed medical air service.

(C) Kit M-X-HPV-RK is used to recondition high pressure shuttle valves M-SHUTV-HP used in nitrogen service.

(D) Detailed instructions for dismantling, cleaning, assembling and testing of shuttle valves are supplied with the replacement parts kits, and are reproduced in Appendix A. (see p. 28)
SECTION 7 - TROUBLE SHOOTING

This section is intended to serve as a general guide for identifying the potential functional problems which occur in operation of AMICO Manifolds.

* When an asterisk appears beside the remedy or check, the recommended procedure is to replace the whole unit in question, with a substitute unit until repairs are completed on the original equipment.

Components removed for maintenance must be serviced, repaired and tested only by personnel qualified to work on equipment used in medical service. Only original manufacturer’s parts, as supplied by AMICO, may be used in the maintenance of AMICO manifolds.

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>PROBABLE CAUSE</th>
<th>REMEDY OR CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>ELECTRICAL FAULTS</td>
<td></td>
</tr>
<tr>
<td>7.1.1</td>
<td>No indicator LED’s on front panel come on when gas is flowing.</td>
<td>Power input.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuse Blown.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power present at J2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power not present at J2</td>
</tr>
<tr>
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</tr>
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*Replace regulator with substitute unit and repair.*
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CYLINDER CHANGING PROCEDURES TO BE USED WITH AMICO OXYGEN MANIFOLDS

1. Keep the HIGH PRESSURE ISOLATION valve OPEN throughout this procedure.

2. Close cylinder valves on all empty cylinders.

3. Disconnect pigtails from cylinder valve outlets using a 1-1/8 inch spanner wrench while holding the pigtail handle.

4. Place protective caps over the cylinder valves of the empty cylinders and move them aside.

5. Remove protective caps of the full cylinders. Visually inspect the cylinder valves for dust and/or grease or oil.

6. Using a clean lint free cloth wipe each cylinder valve outlet clean. DO NOT USE YOUR FINGERS.

7. Standing to one side “crack” the cylinder valves by briefly opening and closing them to blow out any dust. Make sure they are pointing away from you and other personnel.

8. Connect the pigtails to the cylinder valve outlets and hold the pigtail handle while tightening the nut with a 1-1/8 inch spanner wrench.

9. Very S-L-O-W-L-Y open the cylinder valve on the cylinder closest to the control cabinet. Watch the bank pressure gauge on the front of the cabinet to make sure the needle rises slowly to the full cylinder pressure reading.

10. WAIT ONE FULL MINUTE.

11. Proceed to S-L-O-W-L-Y open the remaining cylinder valves one at a time.

12. Warning: High pressure oxygen systems must be handled with caution. Spontaneous combustion may result if oxygen comes into contact with grease or oil. Ensure that hands, gloves, clothing and tools are kept clean and free of oil and grease. Be careful not to introduce dust or other contaminants into the system when changing cylinders. Failure to comply with this procedure may be hazardous.
ORDERING INFORMATION.

The Model number is as follows:

M-200-U-XX-GAS

“U” is for USA colors, only on Oxygen and Medical Air, all other gases are “E” for English. Replace “XX” with the appropriate Total Amount of cylinders, example: 04 = 2 * 2 cylinders. Replace “GAS” with the appropriate Gas service as follows:

Oxygen = OXY
Medical Air = AIR
Nitrous Oxide = N2O
Carbon Dioxide = CO2
Nitrogen = NIT

For example a 4 + 4 cylinder Oxygen manifold: M-200-U-08-OXY.

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<td>18</td>
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<tr>
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<td>Plug &amp; Chain Assembly - N₂O</td>
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<td>Plug &amp; Chain Assembly - N₂</td>
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<td></td>
<td>Copper Pigtail Ass'y c/w Check Valve - N₂</td>
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<td>Copper Pigtail Ass'y c/w Check Valve - Medical Air</td>
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<td>Copper Pigtail Ass'y c/w Check Valve - CO₂</td>
<td>M-X-HB-PTC-CO2</td>
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<tr>
<td></td>
<td>Wall Support Bracket</td>
<td>M-X-MAN-77</td>
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<tr>
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<td>Extension Wall Support</td>
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**Amico Gas Manifold Manual - 200 Series, Mar. 1997**
APPENDIX A (Low pressure valve)

REPLACEMENT PARTS KIT M-X-LPV-RK for LOW PRESSURE VALVE.

FOR: Low pressure shuttle valves M-SHUTV-LP used in oxygen, nitrous oxide, carbon dioxide and compressed medical air service.

Kit comprised of:
- 1 diaphragm M-X-LPV-06
- 2 seats M-X-LPV-07
- 2 O-rings M-X-LPV-09
- KRYTOX Grease Lubricant

I. MAINTENANCE PROCEDURE

A. DISMANTLING THE SHUTTLE VALVE

1. Remove the 4 socket head cap screws from the body (ref. Item 2, Fig. A).

2. Gently separate the two valve body halves.

3. Remove the shaft and diaphragm assembly.

4. Unscrew lock nut (ref. Item 6, Fig B) from shaft assembly and remove seats (ref. Item 4, Fig B) and diaphragm (ref. Item 5, Fig B).

5. Extract O-rings (ref. Item 7, Fig B) from their grooves using a fine pointed instrument (needle), being careful not to scratch the brass valve body halves.

6. Discard the O-rings, seats and diaphragm.

B. CLEANING
1. Clean all metal parts using an ultrasonic cleaning system.

2. Ensure that all traces of solvent are removed by rinsing parts in a hot water bath.

3. Dry parts thoroughly using oil-free compressed air or nitrogen.

C. ASSEMBLING THE SHUTTLE VALVE

1. Using the parts supplied, reassemble the shaft and diaphragm assembly (ref. Fig. B) and tighten the lock nut securely.

2. Install the 2 new O-rings into the grooves in the valve body halves.

3. Apply a very light coating of the lubricant (KRYTOX GREASE, manufactured by DUPONT) supplied, to each end of the shaft, about one inch from each end. This lubricant serves to reduce friction at the shaft O-ring seals to permit easy shuttling of the shaft assembly.

NOTE: DO NOT UNDER ANY CIRCUMSTANCE USE HYDROCARBON BASED LUBRICANTS ON SHUTTLE VALVE PARTS. USE ONLY THE LUBRICANTS SUPPLIED OR A SUITABLE EQUIVALENT PRODUCT SPECIFICALLY APPROVED FOR MEDICAL USE AND OXYGEN SERVICE.

4. Gently insert the shaft into one body half, align the holes in the diaphragm with the holes in the body, and slide the other half onto the shaft.

5. Insert the 4 socket head cap screws and tighten them a turn at a time alternating screws, to apply an even clamping pressure on the diaphragm, until all 4 are tight.

6. Ensure that the shaft assembly moves freely back and forth in the valve body by alternately applying finger pressure to the shaft ends.
II. TEST PROCEDURE

A. TEST EQUIPMENT

- 2 Nitrogen regulators with 10.3 bar (150 psi) delivery pressure capability.
- 2 High Pressure hose assemblies.
- Coupler tee to connect 2 regulators have CGA 555 inlet fittings to one nitrogen cylinder with CGA 555 valve.
- 1 Nitrogen cylinder (2 if coupler tee is not used).

B. SET-UP

1. Install coupler tee on nitrogen cylinder valve outlet.
2. Install regulators on coupler tee outlets.
3. Connect hose assemblies between regulator outlets and shuttle valve inlets.
4. Connect shuttle valve outlets to test adapter and mount on test stand.
5. Release the pressure adjusting screws of the two regulators.

C. TEST

1. Slowly open the nitrogen cylinder valve.
2. Close the outlet valve on the shuttle valve test adapter.
3. Adjust one of the regulators to 150 psi to cause the shuttle valve to take up its initial position, then adjust the other regulator to the same pressure.
4. Crack open the test adapter outlet valve to permit a small flow of nitrogen through the shuttle valve.

NOTE: Ensure that there is adequate ventilation or that a hose is connected to the bleed valve to vent the nitrogen safely. Do not allow the concentration of oxygen in the room to become deficient due to nitrogen enrichment.

5. Gradually reduce the delivery pressure on the regulator supplying the flow of gas by backing out the adjusting screw until the shuttle valve switches sides.
NOTE: The pressure differential between the two regulator settings should be approximately 4.5 bar (65 psi) when shuttling occurs. A greater differential likely indicates excessive friction between shaft and O-ring seals. Ensure that the shaft is properly lubricated at the two O-rings, using only the KRYTOX GREASE supplied, or other suitable equivalent product specifically approved for medical use and oxygen service.

6. Raise the regulator delivery pressure back to 150 psi and gradually lower the other regulator pressure until shuttling occurs again.

7. Repeat steps 5 and 6 to produce a number of shuttle valve changeovers.

8. While the shuttle valve is pressurized check for leaks at body joints and shaft ends using a suitable commercially available leak detector solution compatible with oxygen.

NOTE: At the instant shuttling occurs, a small amount of gas will leak from the shuttle valve shaft end. This is normal and should stop when the shaft reaches the full extent of its travel. If leakage persists at shaft ends it could indicate a leaking check valve at the shuttle valve outlet, a leaking shaft O-ring or a leaking seat.
APPENDIX B (High pressure valve)

REPLACEMENT PARTS KIT M-X-HPV-RK for HIGH PRESSURE VALVE.

FOR: High pressure shuttle valves M-SHUTV-HP used in nitrogen service.

Kit comprised of:

- 2 O-rings M-X-HPV-01
- 1 O-ring M-X-HPV-02
- 1 O-ring M-X-HPV-03
- 1 O-ring M-X-HPV-04
- 2 O-rings M-X-LPV-09
- 2 Seats M-X-LPV-07
- KRYTOX Grease Lubricant

I. MAINTENANCE PROCEDURE

A. DISMANTLING THE SHUTTLE VALVE

1. Remove the 4 socket head cap screws from the body (ref. Item 2 Fig. A).

2. Gently separate the two valve body halves.

3. Remove the piston shaft assembly.

4. Unscrew lock nut (ref. Item 5, Fig B) from shaft assembly and remove Delrin seats (ref. Item 12, Fig B) and valve piston.

5. Extract O-rings (ref. Item 11, Fig B) from their grooves using a fine pointed instrument (needle), being careful not to scratch the brass valve body halves.

6. Discard the O-rings and Delrin seats.
B. CLEANING

1. Clean all metal parts using an ultrasonic cleaning system.

2. Ensure that all traces of solvent are removed by rinsing parts in a hot water bath.

3. Dry parts thoroughly using oil-free compressed air or nitrogen.

C. ASSEMBLING THE SHUTTLE VALVE

1. Using the parts supplied, reassemble the piston shaft assembly (ref. Fig. B) and tighten the lock nut securely.

2. Install the 2 new O-rings (ref. Item 11, Fig. B) into the grooves in the valve body halves.

3. Apply a very light coating of the lubricant (KRYTOX GREASE, manufactured by DUPONT) supplied, to each end of the shaft, about one inch from each end.

4. Apply a very light coating of the lubricant supplied to the piston bore of the larger of the two valve body halves. This lubricant serves to reduce friction at the shaft O-ring seals to permit easy shuttling of the shaft assembly.

NOTE: DO NOT UNDER ANY CIRCUMSTANCE USE HYDROCARBON BASED LUBRICANTS ON SHUTTLE VALVE PARTS. USE ONLY THE LUBRICANTS SUPPLIED OR A SUITABLE EQUIVALENT PRODUCT SPECIFICALLY APPROVED FOR MEDICAL USE AND OXYGEN SERVICE.

5. Gently insert the piston shaft assembly into the larger valve body half.

6. Place O-ring (ref. Item 8, Fig. B) into groove in valve body.

7. Gently slide the other valve body half onto the shaft and align bolt holes.

8. Insert the 4 socket head cap screws and tighten them a turn at a time alternating screws, to apply an even clamping pressure on the O-ring, until all 4 are tight.

9. Ensure that the piston shaft assembly moves freely back and forth in the valve body by alternately applying finger pressure to the shaft ends.
II. TEST PROCEDURE

A. TEST EQUIPMENT

- 2 Nitrogen regulators with 275 psi delivery pressure capability.
- 2 High Pressure hose assemblies.
- Coupler tee to connect 2 regulators have CGA 555 inlet fittings to one nitrogen cylinder with CGA 555 valve.
- 1 Nitrogen cylinder (2 if coupler tee is not used).

B. SET-UP

1. Install coupler tee on nitrogen cylinder valve outlet.
2. Install regulators on coupler tee outlets.
3. Connect hose assemblies between regulator outlets and shuttle valve inlets.
4. Connect shuttle valve outlets to test adapter and mount on test stand.
5. Release the pressure adjusting screws of the two regulators.

C. TEST

1. Slowly open the nitrogen cylinder valve.
2. Close the outlet valve on the shuttle valve test adapter.
3. Adjust one of the regulators to 275 psi to cause the shuttle valve to take up its initial position, then adjust the other regulator to the same pressure.
4. Crack open the test adapter outlet valve to permit a small flow of nitrogen through the shuttle valve.

NOTE: Ensure that there is adequate ventilation or that a hose is connected to the bleed valve to vent the nitrogen safely. Do not allow the concentration of oxygen in the room to become deficient due to nitrogen enrichment.

5. Gradually reduce the delivery pressure on the regulator supplying the flow of gas by backing out the adjusting screw until the shuttle valve switches sides.
NOTE: The pressure differential between the two regulator settings should be approximately 100 psi when shuttling occurs. A greater differential likely indicates excessive friction between shaft and O-ring seals. Ensure that the shaft is properly lubricated at the two O-rings, using only the KRYTOX GREASE supplied, or other suitable equivalent product specifically approved for medical use and oxygen service.

6. Raise the regulator delivery pressure back to 275 psi and gradually lower the other regulator pressure until shuttling occurs again.

7. Repeat steps 5 and 6 to produce a number of shuttle valve changeovers.

8. While the shuttle valve is pressurized check for leaks at body joints and shaft ends using a suitable commercially available leak detector solution compatible with oxygen.

NOTE: At the instant shuttling occurs, a small amount of gas will leak from the shuttle valve shaft end. This is normal and should stop when the shaft reaches the full extent of its travel. If leakage persists at shaft ends it could indicate a leaking check valve at the shuttle valve outlet, a leaking shaft O-ring or a leaking seat.
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Top View

Fig. 3
Side View

Fig. 4

Units of measure
In. [mm]
Control Cabinet wiring schematic.

Fig. 6
Low pressure Shuttle valve.

1. M-X-LPV-01  SHUTTLE LOW PRES. RIGHT BODY
2. M-X-LPV-02  SHUTTLE LOW PRES. LEFT BODY
3. M-X-LPV-03  SHUTTLE LOW PRES. SHAFT
4. M-X-LPV-04  SHUTTLE LOW PRES. LARGHOLDER
5. M-X-LPV-05  SHUTTLE LOW PRES. SMALL HOLDER
6. M-X-LPV-06  SHUTTLE LOW PRES. DIAPHRAGM
7. M-X-LPV-07  SHUTTLE LOW PRES. SEAT
8. M-X-LPV-08  SHUTTLE LOW PRES. SHAFT NUT
9. M-X-LPV-09  SHUTTLE LOW PRES. SHAFT O-RING
10. M-X-LPV-10 SHUTTLE LOW PRES. MICROSWITCH HOLDER
11. H-SS-08NCO4 8-32*1/4" SET SCREW
14. M-X-MAN-08 63 NIPPLE CGA-540 1/4"-2-1/16"
15. M-X-MAN-16A B-51 ADAPTER CGA-540 RHM TO 3/8"
16. H-SC-25NC16 1/4-20*2" SH MS
M-SHUTV-LP  SHUTTLE VALVE FOR OXY, AIR, N20, CO2
M-X-LPV-RK  REPAIR KIT LOW PRESSURE SHUTTLE VALVE

Fig. 7
High pressure Shuttle valve.

OUTLET CONNECTION (M-X-MAN-09) NUT
(M-X-MAN-08) GLAND

SOCKET HEAD CAPSCREWS
(4 REQUIRED)
(H-SC-25NC16)

INLET
CONNECTION
(M-X-MAN-16A)

FIG. A

"O" RING
(M-X-HPV-03)

SEAT
(M-X-HPV-SEAT)

"O" RINGS
(M-X-LPV-09)

SET SCREWS
(2 REQUIRED)
(H-SS-08NC04)

"O" RINGS
(M-X-HPV-02)

"O" RING
(M-X-HPV-01)

"O" RING
(M-X-HPV-04)

LOCK NUT
(M-X-LPV-08)

SHAFT
(M-X-LPV-03)

SHUTTLE VALVE OUTLETS

SHUTTLE VALVE MAINTENANCE KIT
(M-X-HPV-RK) INCLUDES:

2 - M-X-HPV-01 "O" RING
1 - M-X-HPV-02 "O" RINGS
1 - M-X-HPV-03 "O" RING
1 - M-X-HPV-04 "O" RING
2 - M-X-LPV-09 "O" RINGS
2 - M-X-HPV-SEAT SEATS

SHUTTLE VALVE FOR:
- NITROGEN

Fig. B

Fig. 8
Amico Manifold Flow capacity.

Fig. 9