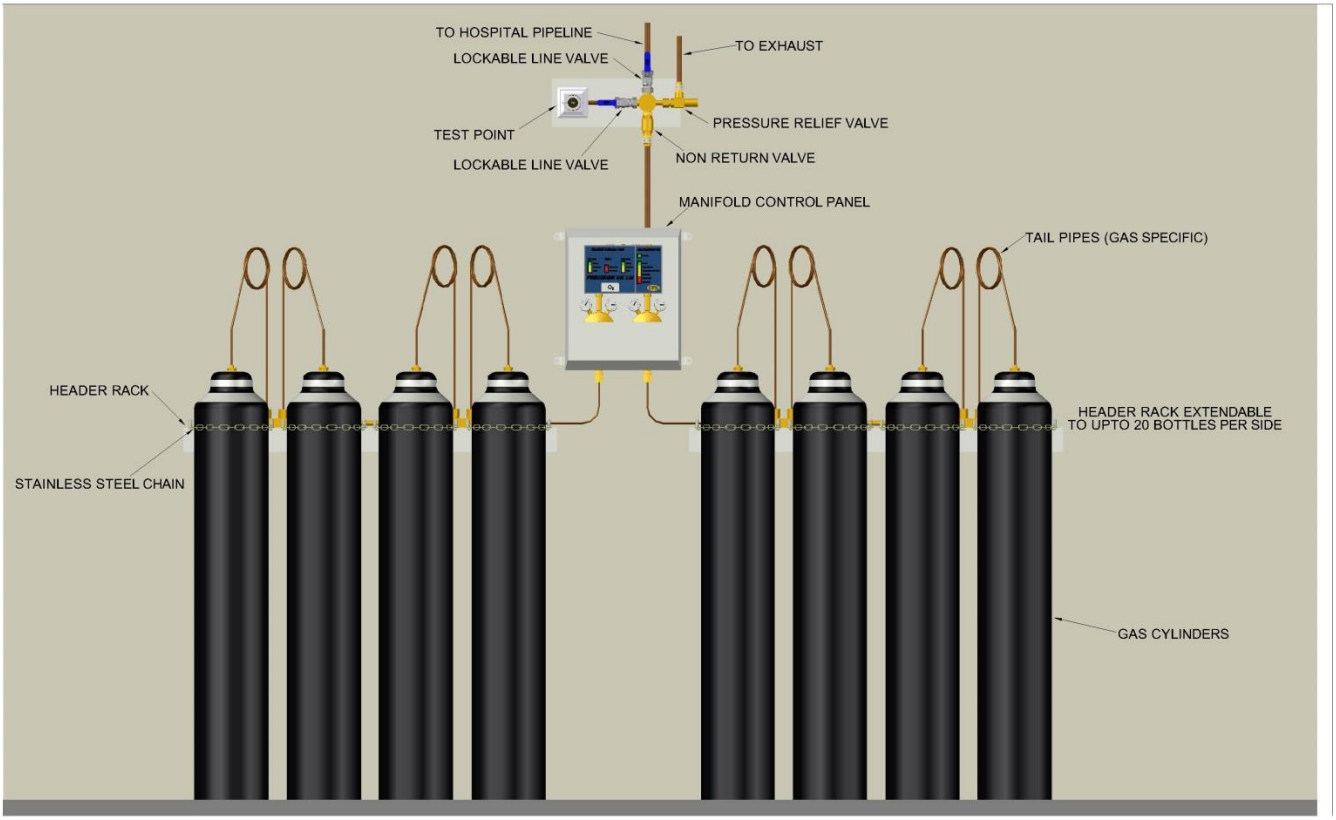
PRECISION UK Ltd

Specialists in HTM02-01 Medical Gas Pipeline Equipment

CPX AUTOMATIC MANIFOLD

INSTALLATION, OPERATIONS & MAINTENANCE MANUAL



VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	*Kevin Pugh*	*02/05/2013*	*Rob Parry*		*1st Issue*

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1 INTRODUCTION

1.1 PURPOSE

The CPX automatic manifold provides a continuous supply of gas from two banks of cylinders to the medical gas pipeline system by changing from the duty bank to the standby bank automatically when the duty bank has become depleted.

1.2 AUDIENCE

PRECISION CPX automatic manifolds comprise a control panel, manifold headers & racks, tailpipes, pigtails, an isolation valve and a pressure relief valve.

Manifolds are available for oxygen, nitrous oxide, 50% oxygen/50% nitrous oxide mixture and compressed air.

2 SYSTEM DESCRIPTION

2.1 KEY FEATURES

The CPX automatic manifold has a number of features including:

Automatic control panel indicates which bank of cylinders is running, which is empty and which is running low if the other bank is empty. The panel will also indicate if the distribution pipeline pressure has risen or fallen beyond acceptable limits. The display incorporates an alarm status indicator and includes volt free contacts for connection to the central alarm system and BMS if required.

Manifold headers high-pressure headers with gas specific tailpipe connections

A non-return valve is incorporated into each point where the tailpipe connects into the header to prevent a whole bank of cylinders becoming depleted in the event of a cylinder being disconnected or a tailpipe rupture.

Isolation and pressure relief valve assembly is provided with copper stub pipes for on-site copper to copper joints to the hospital distribution pipeline and exhaust pipeline.

Tailpipes are available with pin-index or bull nose cylinder connections.

2.2 INVENTORY

Automatic control panels comprise of regulators, changeover solenoid valves, pressure switches, gauges and an integral monitoring and status panel, all housed in a lockable enclosure.

The monitoring & status panel indicates which bank of cylinders is running, which is empty and which is running low if the other bank is empty. The panel will also

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indicate if the distribution pipeline pressure has risen or fallen beyond acceptable limits. The display incorporates an alarm status indicator and includes volt free contacts for connection to the central alarm system and BMS if required.

Manifold headers comprise of high-pressure headers with gas specific tailpipe connections, cylinder tailpipes, support racks and restraining chains for the cylinders.

A non-return valve at each point the tailpipe connects into the header to prevent a whole bank of cylinders becoming depleted.

Tailpipes with pin-index or bull nose cylinder connections.

2.3 ENVIRONMENT

The CPX automatic manifold has been designed and built to enhance the environment of the patient whilst in hospital care.

2.4 SYSTEM OPERATIONS

All cylinders connected to the manifold headers should be open. Gas is from the left hand and right hand banks of cylinders to the automatic control panel. Under normal working conditions, gas is supplied to the hospital distribution pipeline from only one bank at a time. When the cylinder contents falls below the changeover pressure, the solenoid valve for the duty bank closes and the solenoid valve for the standby bank opens ensuring continuity of the gas supply.

In the event of an electrical failure, both solenoid valves open and gas will be supplied from the duty and standby banks simultaneously. Upon restoration of the electrical supply, the control panel will supply gas from the bank of cylinders that was running immediately prior to the loss of power.

Both solenoid valves will also open in the event of a high demand for gas, in order to maintain the distribution pipeline pressure.

All regulators and pressure sensors within the control panel are preset and should require no further adjustment.

The monitoring & status panel incorporates a duty bank push button to enable manual selection of the left or right hand cylinders as the duty bank.

The manifold is fully automatic in operation and requires no manual intervention, other than the replace empty cylinders.

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Pneumatic Operation

The gas from the left hand (LH) bank of cylinders is connected to the LH inlet of the control panel. This is connected to gauge G1, pressure switch P1 and passes through regulator R1, pressure gauge G3 to the solenoid valve S1. Similarly, the gas from the right hand (RH) bank of cylinders is connected to the RH inlet of the control panel. This is connected to gauge G2, pressure switch P2 and passes through regulator R2, pressure gauge G4 to the solenoid valve S2.

Pressure gauges G1 and G2 indicate the cylinder contents pressure in the LH and RH banks respectively. Pressure gauges G3 and G4 indicate the outlet pressure from regulators R1 and R2 respectively.

With the LH bank selected as the duty bank, the solenoid valve S1 is de-energized and opens allowing gas to pass to the distribution pipeline. Solenoid valve S2 is energized and closes to prevent the RH from supplying gas. When the pressure in the LH bank falls below the setting of pressure switch P1, the solenoid valve S1 is energized and closes, whilst the solenoid valve S2 is de-energized and opens thus affecting the changeover from the LH duty bank to the RH standby bank.

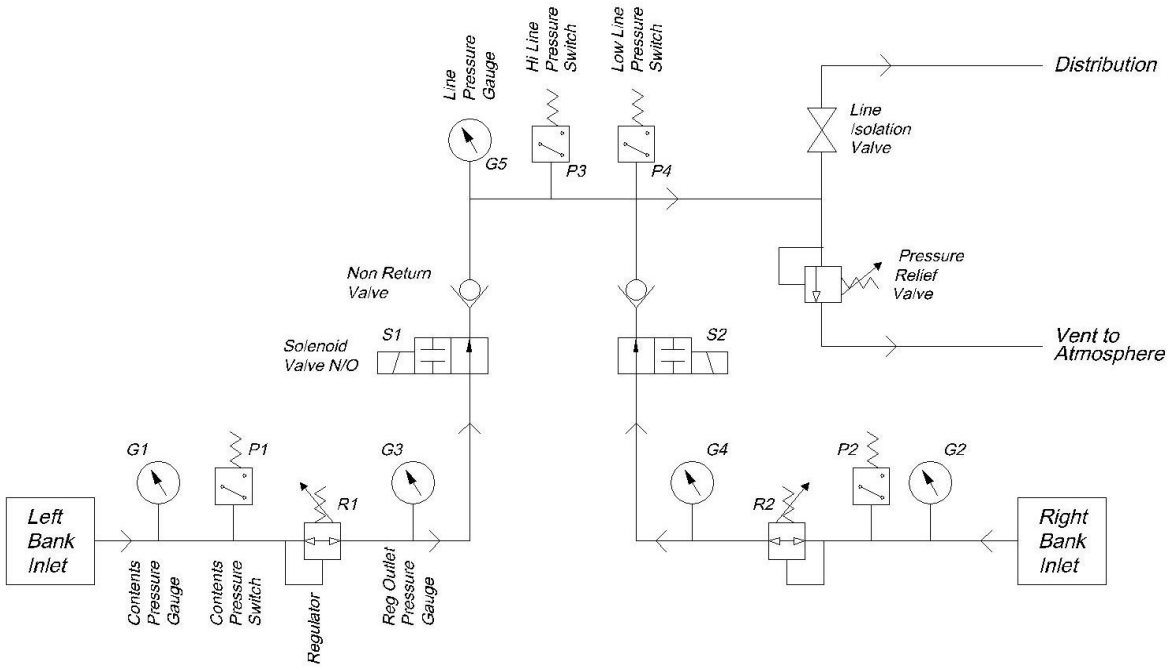
The empty cylinders on the LH bank should now be replaced with full cylinders, ready to continue the supply of gas when the RH bank is depleted.

When the pressure in the RH bank falls below the setting of pressure switch P2, the solenoid valve S2 is energized and closes and solenoid valve S1 is de-energized and opens thus allowing the LH bank (now full) to continue with the gas supply. The empty cylinders on the RH bank should now be replaced with full cylinders. This sequence will continue.

Pressure gauge G5 indicates the distribution pipeline pressure, whilst pressure switches P3 and P4 monitor the distribution pipeline pressure for high or low pressure faults respectively.

Schematic Diagram

Figure 1- Schematic Diagram



Electrical Operation

The control panel requires a 220-240V, 50/60Hz, single-phase supply.

The monitoring & status panel incorporates two sections, one labeled “Manifold Indicator Unit” and one labeled “Alarm Signal Status Unit”. The manifold indicator unit displays the status of the cylinder banks and the distribution pipeline pressure, whilst the alarm signal status unit displays the main central alarm system conditions.

The Manifold Status Unit includes the following indicators.

(a) For each bank, a green LED indicator (RUNNING) illuminates to display which bank is currently running.
(b) For each bank, a yellow LED indicator (LOW PRESSURE) illuminates to display that the bank that is running has fallen to the low pressure setting and the standby bank is still empty.
(c) For each bank, a yellow LED indicator (EMPTY) illuminates to display that a bank of cylinders is empty and changeover to the standby bank has occurred.

(d) A red LED indicator (HIGH PRESSURE) illuminates to display when the distribution pipeline pressure has risen above the pressure sensor setting.
(e) A red LED indicator (LOW PRESSURE) illuminates to display when the distribution pipeline pressure has fallen below the pressure sensor setting.

The Alarm Signal Status Unit includes the following indicators.

(a) A green LED indicator (POWER ON) illuminates to show that the power to the manifold is on.
(b) A green LED indictor (NORMAL) that illuminates when the manifold is operating correctly and no faults exist.
(c) A yellow LED indicator (CHANGE CYLINDERS) which illuminates when changeover from the duty to the standby bank has occurred.
(d) A yellow LED indicator (CHANGE CYLINDERS IMMEDIATELY) which illuminates when the bank that is running has fallen below the pressure sensor setting and the standby bank is empty.
(e) A red LED indicator (RESERVE LOW) which illuminates when the duty bank of the emergency reserve manifold (ESM) has fallen below the low pressure setting.
(f) A red LED indicator (PRESSURE FAULT) which illuminates when the distribution pipeline pressure has risen or fallen beyond the respective pressure sensor settings.
(g) A red LED indicator (SYSTEM FAULT) which illuminates in the event of a cabling fault.

Table 1 - Pressure Settings

Component	O2	N2O	O2/N2O	Medical Air (400 kPa)	Surgical Air (700 kPa)
Regulators (static)	4.5 bar	4.5 bar	4.5 bar	4.5 bar	7.5 bar
Changeover Pressure	12.5 bar	14.0 bar	12.5 bar	12.5 bar	12.5 bar
Pressure Relief Valve	5.5 bar	5.5 bar	5.5 bar	5.5 bar	9.0 bar
Pipeline Pressure, High	5.0 bar	5.0 bar	5.0 bar	5.0 bar	8.0 bar
Pipeline Pressure, Low	3.4 bar	3.4 bar	3.4 bar	3.4 bar	6.5 bar

2.5 SAFETY

- The CPX automatic manifold must be fixed in consultation with the construction manager during installation procedure.
- The methods described for the fixation, gases and power supply are general recommendations and there implementation is to be planned and designed for each individual case by qualified experts.
- **Precision UK automatic manifolds are not suitable for use in potentially explosive areas.**
- CPX automatic manifolds are suitable for continuous duty.
- Automatic manifolds are pre wired in accordance with BS EN 7671 wiring regulations.

This equipment should be kept clean and be free from oil and grease at all times. Oil and grease will ignite spontaneously in the presence of oxygen. If you suspect that any equipment is contaminated.

DO NOT USE IT.

This equipment should be kept clean and be free from water at all times. If you suspect there is any water ingress,

DO NOT USE IT.

Damage to this equipment may lead to OXYGEN leaking from the device, this could increase the risk of fire. If you suspect this equipment is damaged in any way,

DO NOT USE IT.

Check all connections are correctly tightened before opening cylinder valves. If you suspect the connections are not tightened correctly

DO NOT OPEN CYLINDER VALVE

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Before installing this equipment ensure the room has adequate ventilation. If you suspect the room does not have adequate ventilation,

DO NOT INSTALL THIS EQUIPMENT

No attempt should be made to use or modify this equipment for use with gas other than the gas identified.

Care should be taken when drawing conclusions about the contents of cylinders from their pressures. In the case of compressed gases, such as oxygen and medical air, the cylinder pressure is a good indication of the cylinder contents, for example, if the cylinder is half full, it will show half pressure. Liquefied gases, such as nitrous oxide, show full cylinder pressure as long as there is liquid in the cylinder. This may represent a small percentage of the full cylinder contents. It should not be assumed that a cylinder of nitrous oxide is full simply because the gauge shows full pressure.

3 INSTALLATION

The automatic control panel is supplied with all internal electrical connections pre-wired. The only external wiring required for the installation is the connection of the mains power supply, the connection of the ESM pressure switch (if required) and the connection of the central alarm system and BMS wiring (if required).

The Automatic Manifold should be installed by competent personnel who are fully conversant with the requirements of medical gas systems.

All regulators and pressure sensors are preset and no further adjustment of these settings should be required.

Mechanical

(a) Remove the Backplate assembly from the automatic control panel enclosure and store in a safe place. The enclosure will be easier to handle and fix.
(b) Secure the automatic control panel enclosure to the wall using suitable fixings at a suitable height shown in figure 2. Ensure that there is sufficient space either side of the control panel to install the manifold headers.
(c) Replace the Backplate assembly and secure with the retaining screws.
(d) Secure the manifold headers at an appropriate height and position using suitable fixings. Use the header connecting pipes to assist in the accurate alignment of the racks.

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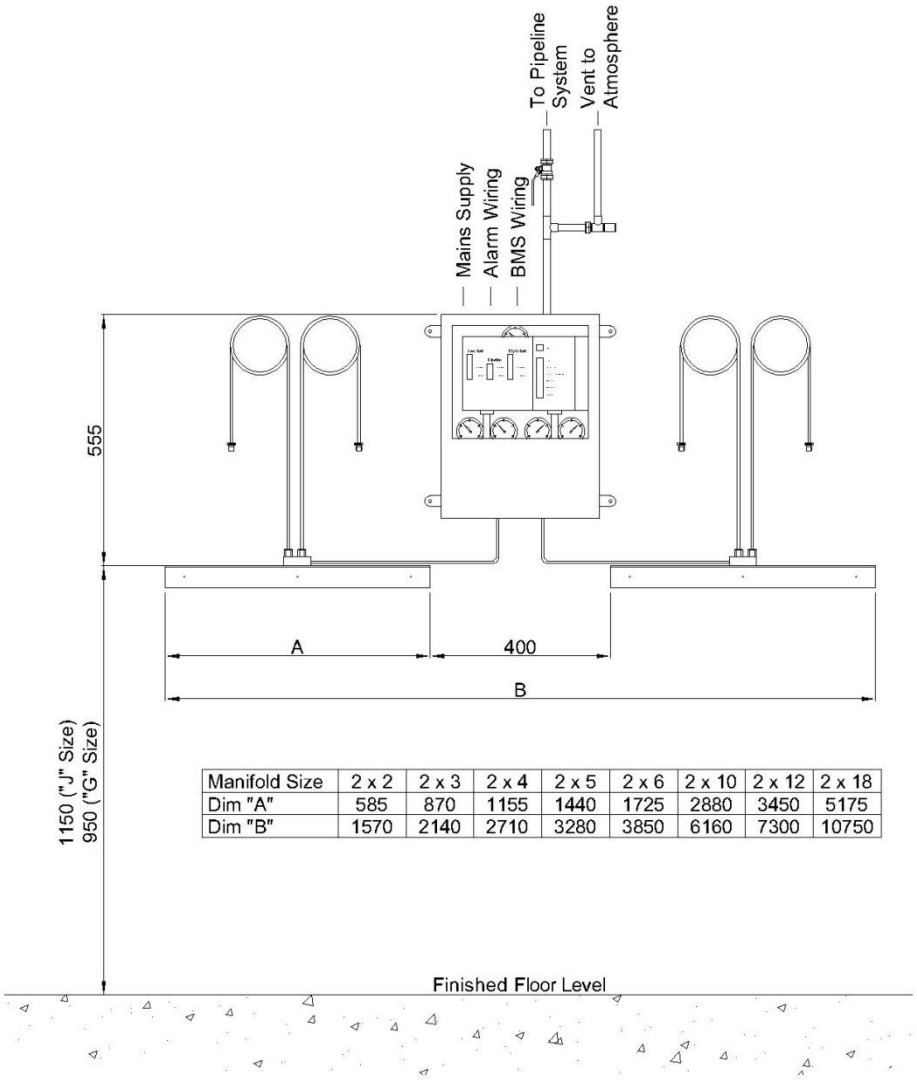
(e) Install the outlet stub pipe, pressure relief valve and isolation valve.
(f) Install the exhaust pipeline from the pressure relief valve to a safe external location.
(g) Install all tailpipes onto the manifold headers.
(h) Check and tighten all mechanical joints.
(i) Connect cylinders, pressurize the manifold and check for leaks. Make sure that the isolation valve is closed if the connection to the distribution pipeline has been made.

Figure 2 – Mechanical Installation



Manifold Size	2 x 2	2 x 3	2 x 4	2 x 5	2 x 6	2 x 10	2 x 12	2 x 18
Dim "A"	585	870	1155	1440	1725	2880	3450	5175
Dim "B"	1570	2140	2710	3280	3850	6160	7300	10750

Electrical

(a) Connect the mains power supply to the connector mounted on the Backplate.

Red or Brown wire to the LIVE (S+) terminal.

Blue or Black wire to the NEUTRAL (N) terminal.

Green/Yellow wire to the EARTH terminal.

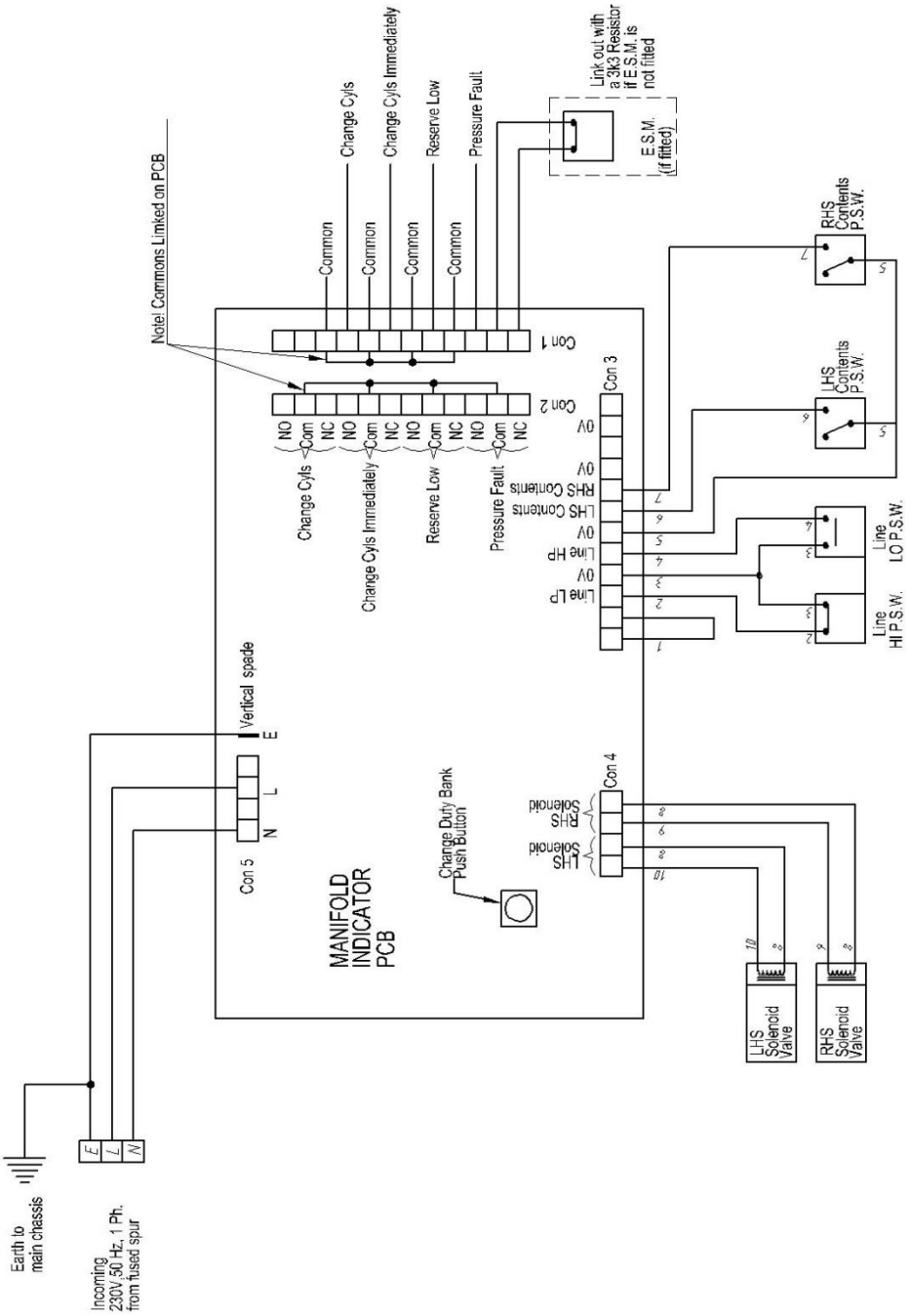
The mains power supply should be via an switched fused spur rated at 5 amps.

(b) Connect the emergency standby manifold (ESM) pressure switch into terminals 1 and 2 of CON1 on the monitoring and status panel PCB. Refer to figure 3. If no ESM is available, ensure that a 3K3 resistor (supplied) is fitted into these terminals to prevent a system fault from illuminating.

(c) Connect the alarm conditions displayed on the alarm signal status unit to the central alarm system by connecting to CON1. Refer to figure 3 for details of each alarm conditions position in the 12-way connector.

(d) Connect the alarm conditions to the building management system (BMS) by connecting to CON2. All alarm conditions have one common (COM) terminal, a normally closed (NC) terminal and a normally open (NO) terminal. Refer to figure 3 for details of each alarm conditions position in the 12-way connector.

Figure 3 – Electrical Installation



4 SYSTEM USAGE

The automatic manifold is used to provide a centalised source of bottled gas. The monitoring & status panel incorporates two sections, one labeled “Manifold Indicator Unit” and one labeled “Alarm Signal Status Unit”. The manifold indicator unit displays the status of the cylinder banks and the distribution pipeline pressure, whilst the alarm signal status unit displays the main central alarm system conditions.

4.1 INSTRUCTIONS

The Manifold Status Unit indicators.

a) A green LED indicator (RUNNING) illuminates to display which bank is currently running.
b) If the yellow LED indicator (LOW PRESSURE) illuminates to display that the bank that is running has fallen to the low pressure setting and the standby bank is still empty. The bottles on the standby bank should be changed for full bottles immediately to allow changeover to occur.
c) If the yellow LED indicator (EMPTY) illuminates to display that a bank of cylinders is empty and changeover to the standby bank has occurred. The bottles on the duty should now be changed to allow continuous flow of gas.
d) If the red LED indicator (HIGH PRESSURE) illuminates to display when the distribution pipeline pressure has risen above the pressure sensor setting. Adjust the pressure with the pressure regulator inside the manifold enclosure.
e) If the red LED indicator (LOW PRESSURE) illuminates to display when the distribution pipeline pressure has fallen below the pressure sensor setting. Adjust the pressure with the pressure regulator inside the manifold enclosure.

The Alarm Signal Status Unit includes the following indicators.

a) The green LED indicator (POWER ON) illuminates to show that the power to the manifold is on.
b) The green LED indictor (NORMAL) that illuminates when the manifold is operating correctly and no faults exist.
c) If the yellow LED indicator (CHANGE CYLINDERS) which illuminates when changeover from the duty to the standby bank has occurred. The bottles should be changed.
d) If the yellow LED indicator (CHANGE CYLINDERS IMMEDIATELY) illuminates, the bottles on the standby require changing immediately.
e) If the red LED indicator (RESERVE LOW) which illuminates when the duty bank of the emergency reserve manifold (ESM) has fallen below the low pressure setting the bottle will require changing.

f) If the RED indicator (PRESSURE FAULT) illuminates the distribution pipeline pressure has risen or fallen beyond the respective pressure sensor settings. Adjust the pressure with the pressure regulator within the manifold enclosure.

g) If the red LED indicator (SYSTEM FAULT) illuminates in the event of a cabling fault. Contact the site engineer for further information and instructions.

5 TESTING

5.1 GENERAL

Prior to testing the manifold installation, please check the following.

(a) All components have been installed are tightened.
(b) The mains power supply has been installed and power is available.
(c) The isolation valves on the automatic manifold and ESM are closed.
(d) Full cylinders have been fitted to all tailpipes.

5.2 TESTING

(a) Slowly open one cylinder on each bank and allow the system to pressurize.
(b) Check all tailpipes and header interconnecting pipes for leaks.
(c) Slowly open one cylinder on the ESM (if available) and check for leaks.
(d) Apply mains power to the panel. The LH bank RUNNING indicator will illuminate, the POWER ON indicator will illuminate and the NORMAL indicator will illuminate.
(e) Close the cylinder on the LH bank. Create a leak between the control panel and the distribution pipeline and very slowly depressurize the system.
(f) At changeover pressure (refer to the settings in table 1), the LH bank RUNNING indicator will extinguish and the EMPTY indicator will illuminate. The RH bank RUNNING indicator simultaneously illuminates as the control panel changes to run from the RH bank. The NORMAL indicator on the alarm signal status unit will extinguish and the CHANGE CYLINDERS will illuminate.
(g) Open the cylinder again on the LH bank. The CHANGE CYLINDERS indicator will extinguish and the NORMAL indicator will illuminate. The LH bank EMPTY indicator will extinguish.
(h) Close the cylinder on the RH bank. Create a leak again and slowly depressurize the system.
(i) At changeover pressure, the RH bank RUNNING indicator will extinguish and the EMPTY indicator will illuminate. The LH bank RUNNING indicator will illuminate. The NORMAL indicator will extinguish and the CHANGE CYLINDERS indicator will illuminate.

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(j) Close the cylinder on the LH bank. Create a leak and slowly depressurize the system.

(k) At changeover pressure, the LH bank RUNNING indicator will extinguish and the LOW PRESSURE indicator will illuminate. Simultaneously, the CHANGE CYLINDERS IMMEDIATELY indicator will illuminate.

(l) Close the cylinder on the ESM (if available). Open the isolation valve on the ESM. Continue to depressurize the system. At the setting of the ESM pressure switch, the RESERVE LOW indicator will illuminate.

(m) Continue to depressurize the system. When the pressure falls to the setting of the low line pressure switch, the LOW PRESSURE indicator on the manifold indicator unit will illuminate and the PRESSURE FAULT indicator on the alarm signal status unit will illuminate.

(n) Close all leaks and isolation valves and re-pressurise the system. All alarm signal indicators will extinguish and the NORMAL indicator will illuminate. The LH bank LOW PRESSURE indicator will extinguish and the RUNNING indicator will illuminate. The RH bank EMPTY indicator will extinguish.

(o) Check all alarm system outputs using an ohmmeter. All outputs are normally closed and as each alarm condition occurs, the respective contact opens circuit.

(p) If any pressure settings differ from those as stated in table 1, adjust as necessary.

6 COMMISSIONING

Demonstrate the manifold installation to the client by repeating the above-mentioned test procedure.

It is advisable to confirm that a central alarm system (if available) is operating correctly at the same time.

The manifold must not be used until all testing & commissioning procedures for the pipeline system as detailed in HTM 2022 have been satisfactorily completed and accepted

7 MAINTENANCE

General

Maintenance of the manifold should be restricted to periodic checking and adjustment and if necessary the replacement of faulty components. It should be noted that although many of the components appear to be standard items, many have been selected and treated to make them suitable for the gases carried and the pressures involved.

8 PREVENTATIVE MAINTENANCE

Regular inspections and maintenance of the manifold will prolong it's life and reduce the possibility of sudden, inconvenient component failures.

Automatic Manifolds should be subjected to regular inspection and testing as detailed below.

- **Monthly;**

(a) Visually inspect the manifold for signs of damage.

(b) Check all mechanical joints for leaks.

(c) Check that changeover from the duty bank to the standby bank is operating correctly.

- **Annually;**

(a) Visually inspect the manifold system for signs of damage.
(b) Check that one bank of cylinders on the ESM is open ready for use.
(c) Check all mechanical joints for leaks.
(d) Test the manifold system as detailed in section 5.2 to confirm correct operation.
(e) Observe that all indicators are working correctly.

All maintenance should be carried out with the knowledge of the hospital engineer and in accordance with the Permit-to-Work system.

It is essential that this equipment is maintained on a regular basis. If you suspect that maintenance has not been carried out.

DO NOT USE THIS EQUIPMENT

9 SPARE PARTS

When ordering spare parts, please quote the batch number of the equipment and a description of the component required, to ensure you receive the component you require!

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10 WARRANTY

The CPX automatic manifolds comes with a 12 month warranty from day if shipment. Within this period Precision UK will repair, replace any part on site, or at the factory, which is proven defective at Precision UK's cost.

Furthermore, Precision UK will warrant its materials to be free from defects for an additional period of four (4) years (five (5) in total from date of shipment).Within this period Precision UK will replace any part, at no charge, which is proven to be defective. Shipping cost after the first twelve (12) months will be borne by the customer.

This warranty is valid when the product has been properly installed according to Precision UK's specifications, used in a normal manner and serviced according to the factory recommendations. It does not cover failure due to damage which occurs in shipments or failures which resulted from accidents, misuse, abuse, neglect, mishandling, alteration, misapplication or damage that may be attributable to acts of god.

Precision UK shall not be liable for incidental or consequential damages resulting from the use of this equipment.

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11 CONTACT US

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12 REGULATORY REQUIREMENTS

The following British, European and International Standards have been consulted during the design, manufacture and testing of the bed head unit.

√	EN ISO 14971	Application of Risk Management to Medical Devices.
√	BS EN 13348	Copper and copper alloys. Seamless round copper tubes for medical gases or vacuum.
√	BS EN 1044	Brazing. Filler metals.
√	BS EN 980	Graphical symbols for use in the labelling of medical devices.
√	BS EN 1089:3	Transportable gas cylinders. Gas cylinder identification (excluding LPG). Colour coding.
√	ISO 7396-1	Medical gas pipeline systems. Pipeline systems for compressed medical gases and vacuum.
√	EN ISO 10524-2	Pressure Regulators for use with Medical Devices Part 2 Manifold and Line Pressure Regulators
√	ISO 11197:2004	Medical Supply Units.
√	BS EN 60601-1	Medical electrical equipment general requirements for basic safety and essential performance.
√	BS EN 60601-1-2	Medical electrical equipment general requirements for basic safety and essential performance collateral standards electromagnetic compatibility.
√	ISO 32	Gas cylinders for medical use. Marking for identification of content.
√	ISO 554	Standard atmospheres for conditioning and/or testing. Specifications.
√	SS 01 91 02	Colour atlas.
√	HTM 2022	Medical gas pipeline systems. Design, installation, validation and verification.
√	HTM 02-01	Medical gas pipeline systems. Design, installation, validation and verification
√	C11	NHS model engineering specification – medical gases.

Appendix A: Operations & Maintenance Manual Approval

The undersigned acknowledge they have reviewed the automatic manifold **Installation, Operations & Maintenance Manual** and agree with the approach it presents. Changes to this **Operations & Maintenance Manual** will be coordinated with and approved by the undersigned or their designated representatives.

Signature: _____ Date: _____
Print Name: _____
Title: _____
Role: _____

Signature: _____ Date: _____
Print Name: _____
Title: _____
Role: _____

Signature: _____ Date: _____
Print Name: _____
Title: _____
Role: _____