Operation and Maintenance Instructions

Manifold Control Systems

Lifeline MCS

Part number 4233400331
Revision 01
MAR 18, 2021

BeaconMedæs®

Operation and Maintenance Manual

Manifold Control Systems - Lifeline MCS

This unit is purchased from:

Date purchased:

Model number:

Serial number:

Option(s) included:

Any information, service or spare parts requests should include the serial number and be directed to:

BeaconMedæs
Telford Crescent, Staveley
Derbyshire S43 3PF

Telephone: +44 (0) 1246 474242
Email: gbn.info@beaconmedaes.com
Website Contacts: www.beaconmedaes.com

Atlas Copco Ltd. trading as Atlas Copco Medical
Telford Crescent, Staveley, Derbyshire S43 3PF UK

Personnel must make themselves familiar with the contents of this manual and the function of the unit before installing, operating or maintaining.

Abbreviations			
Abbreviation	**Full Description**	**Abbreviation**	**Full Description**
BS	British Standard	**kPa**	Kilo pascals
BSP	British Standard Pipe	**Max**	Maximum
CO2	Carbon dioxide	**Med**	Medical
°C	Degree Celsius	**m**	Meter
ø	Diameter	**mm**	Millimetres
ERM	Emergency reserve manifold	**Min**	Minimum
EN	European Standards	**N2**	Nitrogen
1st	First	**N2O**	Nitrous oxide
HTM	Health Technical Memorandum	**NRV**	Non-return valve
ID	Identification	**OD**	Outside Diameter
“	Inch	**O2**	Oxygen
ISO	International Standard Organisation	**%**	Percentage
Kg	Kilograms	**2nd**	Second

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Safety Precautions

⚠ **DO NOT USE OIL OR GREASE** on any Lifeline Manifold Control System (MCS) unit for any reason. This could lead to a FIRE or an EXPLOSION. Only use approved OXYGEN COMPATIBLE lubricants, which can be purchased from BeaconMedæs if necessary.

Pressurised gas from the system may cause personnel injury or property damage if the unit is improperly operated or maintained.

Operator should have carefully read and become familiar with the contents of this manual before maintaining the Lifeline Manifold Control System (MCS).

Operator is expected to use common sense safety precautions, good workmanship practices and follow any related local safety precautions.

Component descriptions and parts lists are available on request.

Identification of symbols

The following symbols apply to this product and are used in these instructions and on the product in question. The meanings of these symbols are as specified below: -

	Read instructions
	Ambient temperature range
	Ambient humidity range
	Ambient pressure range
	Date of manufacture
	Do not dispose of in general waste

Electromagnetic Interference

The panel has been tested to BS EN 60601-1-2: 1993 Medical electrical equipment - Electromagnetic compatibility - Requirements and tests. Ensure that all data cables are physically separated from other mains and data cables.

Environmental Transport and Storage Conditions

All products are separately packaged and stored in controlled conditions.

Environmental Operating Conditions

Adverse environmental conditions and harsh abrasives or chemicals may cause damage to the unit.

⚠ WARNING! Only use approved leak detection fluids with this product. Other leak detection fluids may contain surfactants that can impair the structural integrity of the terminal unit.

Environmental Protection

Discard the unit and/or components in any standard refuse facility. The unit does not contain and hazardous substances.

Cleaning

The manifold should be wiped over with a damp cloth frequently to remove any dust or foreign substances

Electrical Details

⚠ WARNING! It is necessary to check the integrity of the power source for safety at regular intervals. These checks should be carried out annually and replacement power supplies used as necessary.

Power source

Mains operated using 110V-230V, 50/60Hz, alternating current.

Current requirements - 3.0 amps

Type of protection against electric shock.

Class 1 (Mains supplied equipment using a protected earth).

Mode of operation

Continuous (equipment may be left switched on indefinitely).

Safety Notice

Persons undertaking any installation and/or maintenance must be fully trained in specialist work of this nature.

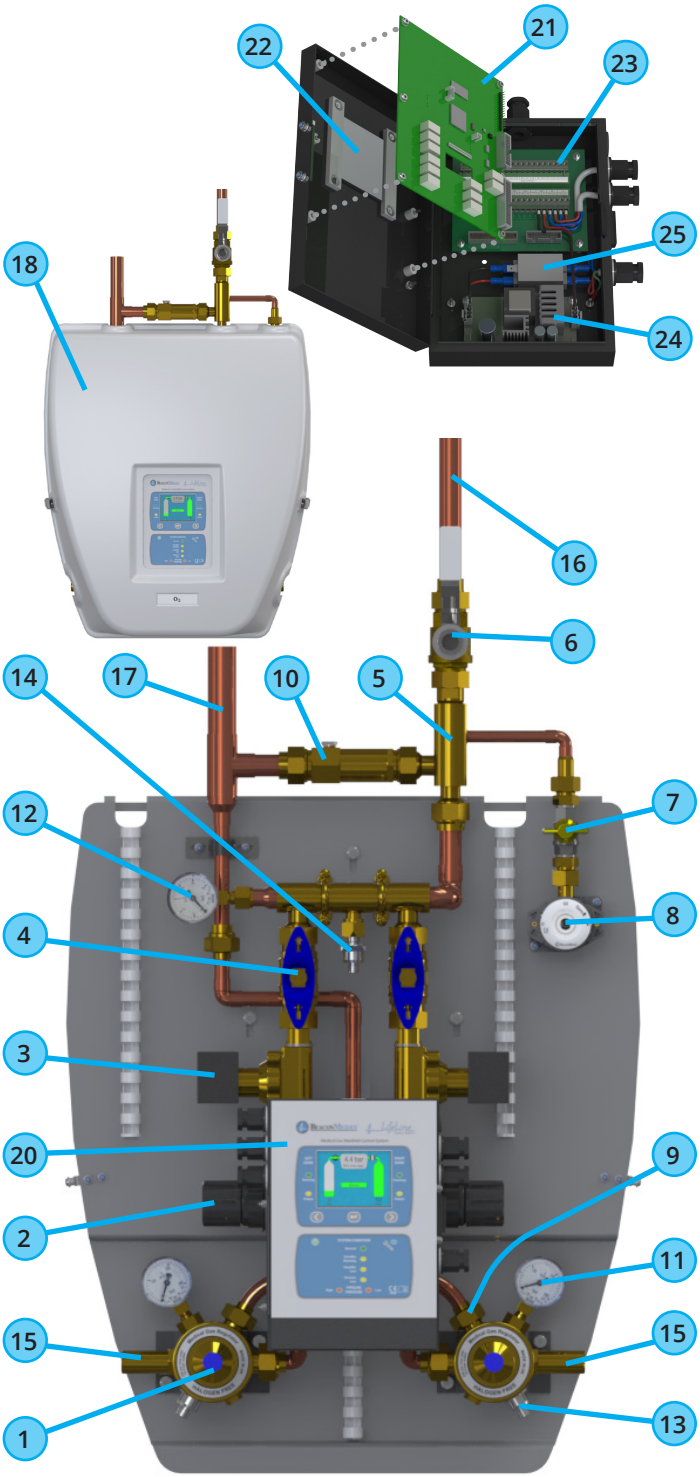
The “PERMIT TO WORK” procedure must be adhered to for all installations once commissioned.

The manifold is designed and built in accordance with HTM 02-01 regulations and therefore should be installed as such.

Oil, grease and jointing compounds must not be used.

Do not attempt to prove the pressure relief valve, under any circumstances, by altering the regulator. Pressure relief valves must be removed and tested off site by a registered test centre and a certificate of conformity issued.

Figure 1 - Lifeline Manifold Control System (MCS).



NOTE - Isolation valves item 6 and 4 are shown in their open position, isolation valve item 7 is shown in its closed position. This is typically the normal operating condition for the manual valves.

1. General Information.

1.1 Introduction.

The BeaconMedæs Lifeline MCS is principally designed for use as a primary or secondary source of supply, or for emergency backup.

The Lifeline MCS supplies one of the following Medical gases to a piped distribution system, Oxygen, Nitrous Oxide, O2/N2O 50%: 50%, Medical Air, Surgical Air, Nitrogen & Carbon Dioxide.

See figure 1 for general arrangement and figure 2 for the schematic diagram.

The Lifeline MCS consists of: -

No.	Description
1	1st Stage Regulator (Cylinder Pressure), c/w inlet filter.
2	2nd Stage Regulator (Distribution Pressure).
3	Solenoid isolation valve.
4	Manual Bank Isolation Valve.
5	Integral Non-return Valve Assembly.
6	Lockable Isolation Valve.
7	Test point Isolation Valve.
8	Medical Gas Sampling Test point (GEM).
9	1st Stage Pressure Relief Valve (Intermediate Pressure).
10	2nd Stage Pressure Relief Valve (Distribution Pressure).
11	Cylinder Pressure Gauges.
12	Gauge for Distribution System Pressure.
13	Cylinder Pressure Sensor.
14	Sensor for Distribution System Pressure.
15	Cylinder Bank Connection, (5/8” BSP flat face C/W O-ring Seal).
16	Pipeline connection point (22mm OD Copper Tube)
17	Pressure Relief Exhaust Connection point (28mm OD Copper Tube).
18	Removable Cover
19	Schematic Diagram and Service Spares Label, (Fitted to the inside of the Cover)
20	Electrical Enclosure.
21	Control PCB
22	LCD Screen
23	Termination Board
24	24V DC Power Supply
25	Power Supply Filter

NOTE - Cylinder Tailpipes are also required but should be ordered separately. Header extensions are available but are also ordered separately.

Figure 2a - Pneumatic Schematic Diagram

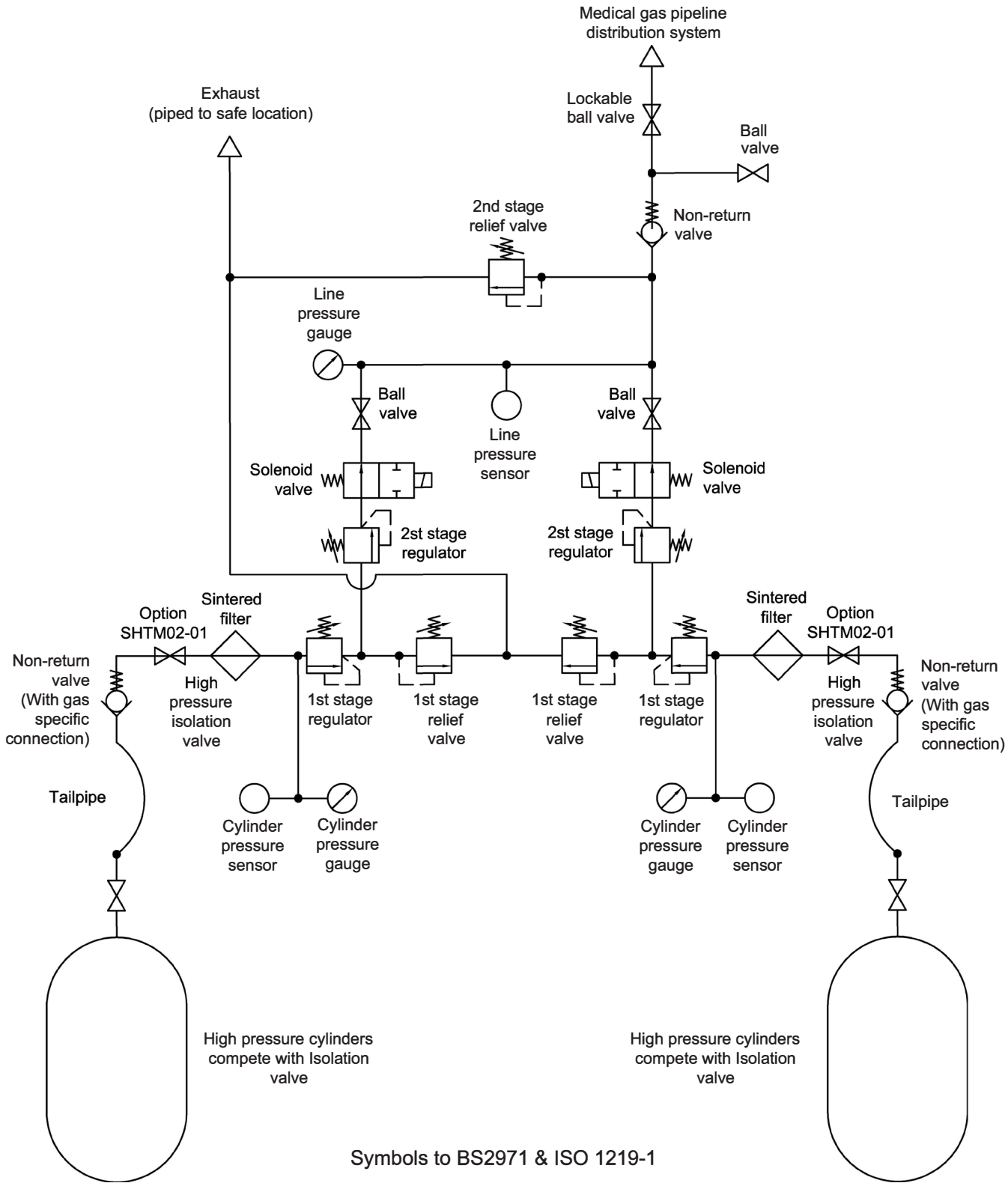
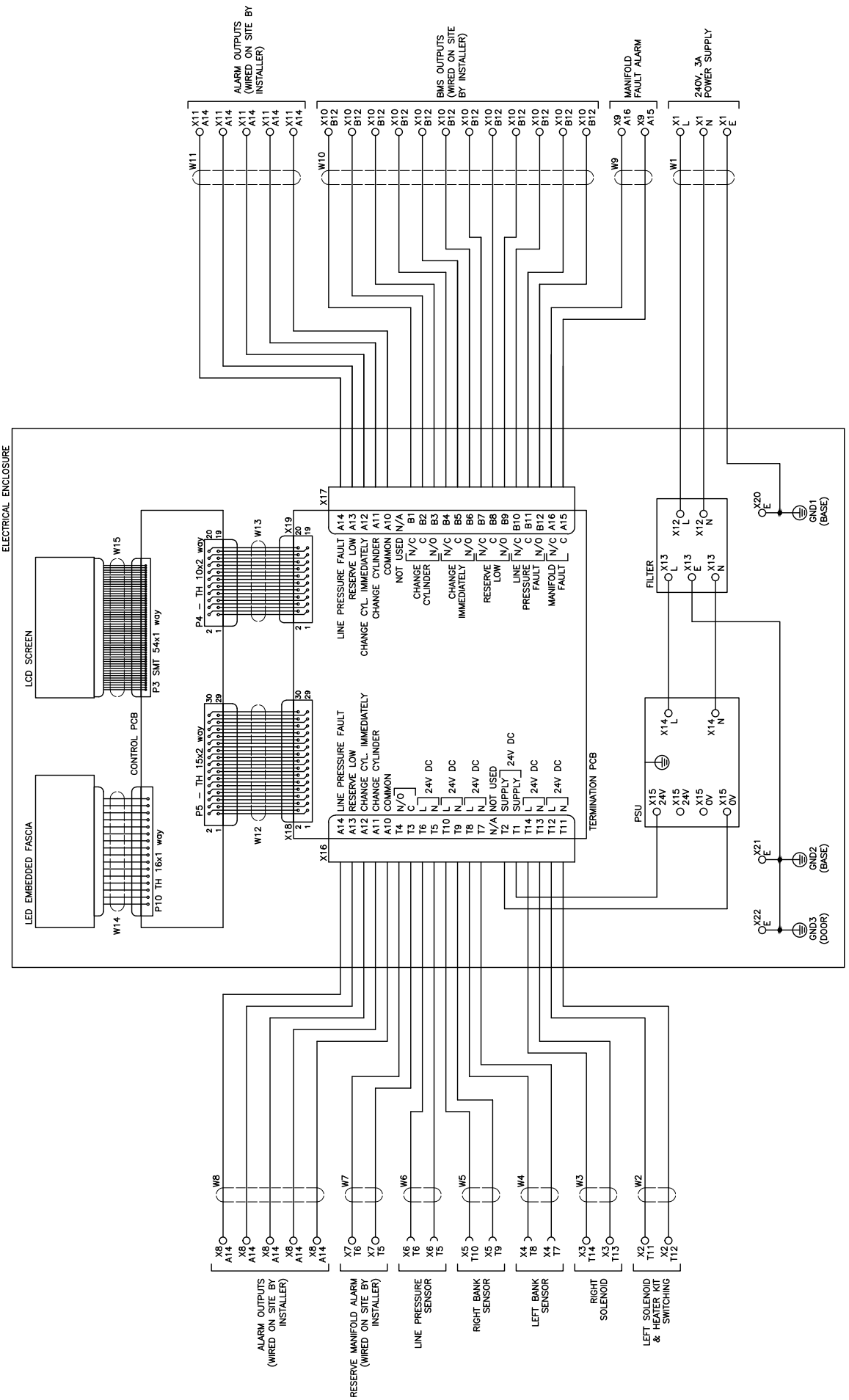


Figure 2b - Electrical Schematic Diagram



Modular manifold headers can be connected to the Lifeline MCS to configure its gas supply capacity.

The manifold is connected to the distribution system upstream of the emergency supply, or downstream of the primary supply system when used as backup. The Lifeline MCS can be isolated from the distribution system by the lockable isolation valve supplied. When used as a backup supply this valve should be left open during normal operation, so the unit will automatically supply the pipeline with medical gas in the event of the primary system failing to supply.

When used as a backup manifold the line pressure regulator should be set slightly lower than the primary supply pressure to prevent the unit from supplying gas during normal operation of the primary system.

1.2 1st Stage Pressure Regulator.

For safe operation with regard to performance, mechanical strength, resistance to ignition in pure high pressure oxygen supply and cleanliness, the unit fully conforms to BS EN ISO 10524-2. A pressure relief valve connected to the regulator protects the downstream pressure and is set a 2000 kPa (20 bar).

1.3 2nd Stage Pressure Regulator.

For safe operation with regard to performance, mechanical strength and contamination the unit fully conforms to BS EN ISO 10524-2, the second stage pressure regulator is a manually set diaphragm type and is used to set the system pressure to suit typical nominal values for 4, 8 and 11 bar pipeline systems.

NOTE - To maximise performance each line regulator is fitted with internal springs specific to match the nominal line pressure.

1.4 Line Pressure Relief Valve.

The line pressure relief valves are preset to the values shown in table 1 for the different distribution pressures.

Table 1: Relief Valve Set Points

Relief Valve Set Point	Nominal Distribution Pressure
530 kPa (5.3 bar)	400 kPa (4 bar)
1100 kPa (11 bar)	800 kPa (8 bar)
1300 kPa (13 bar)	1100 kPa (11 bar)

The line pressure relief valve is fitted between the pressure regulator and the isolation valve (just before the integrated non-return valve), thus protecting the delivery system from over pressurisation by discharging to atmosphere in the event of regulator failure.

1.5 Modular Header for Cylinder Connection.

The Lifeline MCS is compatible with BeaconMedaes standard modular headers supplied up to 2x6 cylinder connections, see table 2 for reference.

Further extensions can be added to match the required gas supply capacity, see referenced in table 3.

Table 3: Cylinder Header Extension Kits (upgrade to beyond 2x2 manifold).

GAS TYPE	1 x Cylinder Extension	2 x Cylinder Extension
Oxygen (O2)	2000232	2000204
Nitrous Oxide (N2O)	2000233	2000205
Oxygen/Nitrous Oxide (O2/N2O)	2000234	2000206
Medical Air	2000235	2000207
Nitrogen (N2)	2000242	2000243
Carbon Dioxide (CO2)	2005110	2005108

NOTE - Kits contain extension headers for one side only (2 off required, 1 per side).

1.6 Halogen Free Components.

The Lifeline MCS contains **NO HALOGENATED** polymers located in the gas stream that may experience pressurised oxygen in excess of 3000 kPa (30 Bar) in normal operation or single fault condition, as recommended for safe practise of the medical gas pipeline system.

Table 2: Cylinder Modular Header

GAS TYPE	2 x 1	2 x 2	2 x 3	2 x 4	2 x 5	2 x 6
Oxygen (O2)	2005226	2000257	2000258	2000259	2000260	2000261
Nitrous Oxide (N2O)	2005227	2000262	2000263	2000264	2000265	2000266
Oxygen/Nitrous Oxide (O2/N2O)	2005228	2000267	2000268	2000269	2000270	2000271
Medical Air	2005229	2000272	2000273	2000274	2000275	2000276
Nitrogen (N2)	2005230	2000277	2000278	2000279	2000280	2000281
Carbon Dioxide (CO2)	2005231	2005209	2005210	2005212	2005213	2005214

Note - Kits contain headers for both sides

2. Installation.

2.1 Installation procedure for Panel.

⚠ CAUTION! Ensure no contaminates, oil or grease come into contact with any of the gas connection/ internals.

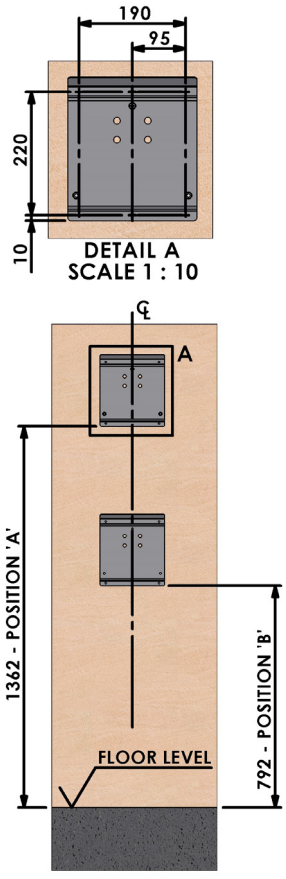
2.1.1 Unpack and inspect all items for damage.

2.1.2 Check wall for suitability.

⚠ CAUTION! Supplied fixings are for use with solid masonry walls only. Alternative fixing types are not suppled with the unit. For securing to alternative wall types, ensure that wall structure and selected fasteners are suitable for supporting the 24 kg weight of the Lifeline MCS.

2.1.3 Identify the centre position of the Lifeline MCS on the wall. Position the mounting bracket as shown and mark the mounting hole positions. See figure 3 for typical mounting heights depending on the cylinder sizes used.

Figure 3 - Mounting Plate Installation Details

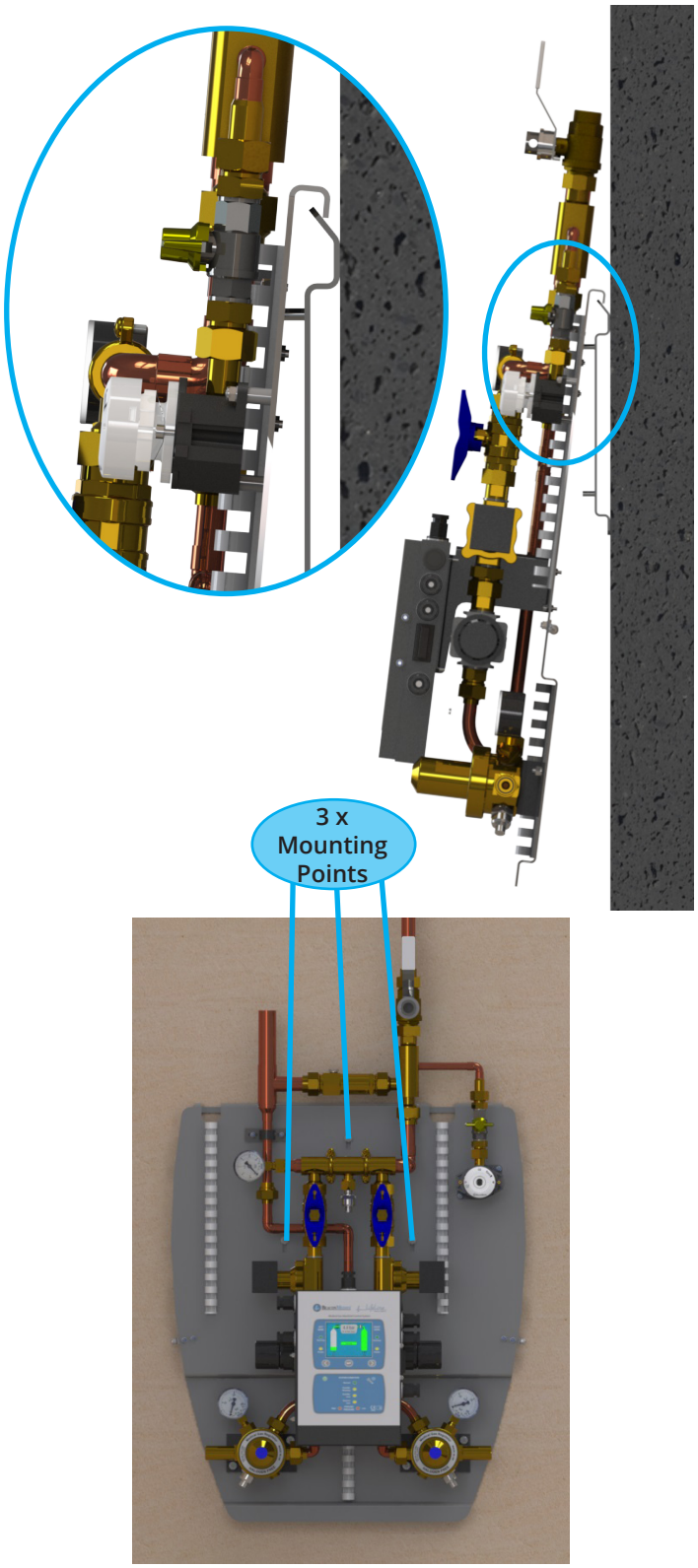


NOTE - Mounting height Position 'A' is typical for 'J' size cylinders and 'VF' size when using the step down connection pipe (see figure 5 & 6). Position 'B' is for 'VF' size cylinders when connecting the headers directly to the Lifeline MCS.

2.1.4 Drill wall and fit wall plugs. Screw the Lifeline MCS bracket to the wall, checking that it is firmly attached.

2.1.5 Hook the Lifeline MCS panel onto the mounting bracket as shown in figure 4. Ensure the studs line up with the holes in the back plate of the Lifeline MCS, then lever down into position. Secure the panel on to the mounting plate with the 3 x M6 shouldered nuts.

Figure 4 - Lifeline MCS Mounting



2.1.6 Loosely connect the supplied ø22mm OD stub pipe (Item 16, figure 1) to the main pipeline isolation valve (Item 7, figure 1). Do not fit the O'ring seal until after brazing.

2.1.7 Braze the pipework using the fluxless brazing technique with nitrogen purge.

⚠ CAUTION! Ensure the brazed connection point is isolated from any other pipeline source of supply.

2.1.8 Undo the securing nuts on the stub pipes and insert the 'O' ring supplied into the connection grooves and tighten.

2.1.9 The pipe work should be secured to the wall using munsen rings (not supplied). It would be recommended to fit the first pipe support to the supplied ø22mm OD stub pipe (Item 16, figure 1). The next support should typically be fitted within 2m of the first support.

2.1.10 The ø28mm exhaust line (Item 17, figure 1) shall be brazed using fluxless brazing technique with nitrogen purge.

⚠ CAUTION! The ø28mm exhaust line (Item 17, figure 1) needs to be piped away from the manifold room to a safe location to prevent buildup of waste gas in an enclosed space in the event of a regulator failure.

⚠ CAUTION! Do not reduce the diameter of the pipe used for the exhaust line.

2.2 Installation procedure for Modular Manifold Header.

⚠ CAUTION! Ensure that all the header rails supplied are the correct gas type. The gas ID is stamped onto the flat section of the NRV caps.

2.2.1 If using the step down connector for VF type or similar sized cylinders, connect to the Lifeline MCS as shown in figure 5. Otherwise proceed to next step.

2.2.2 Connect the primary headers to the Lifeline MCS or drop down connector respectively, as shown in figure 5 & 6. Ensure the header rail is level, mark the header rail mounting holes.

NOTE - The primary headers have the shorter stub pipe. See figure 5.

2.2.3 Disconnect the header rail. Drill the previously marked holes and fit the appropriate wall fixings.

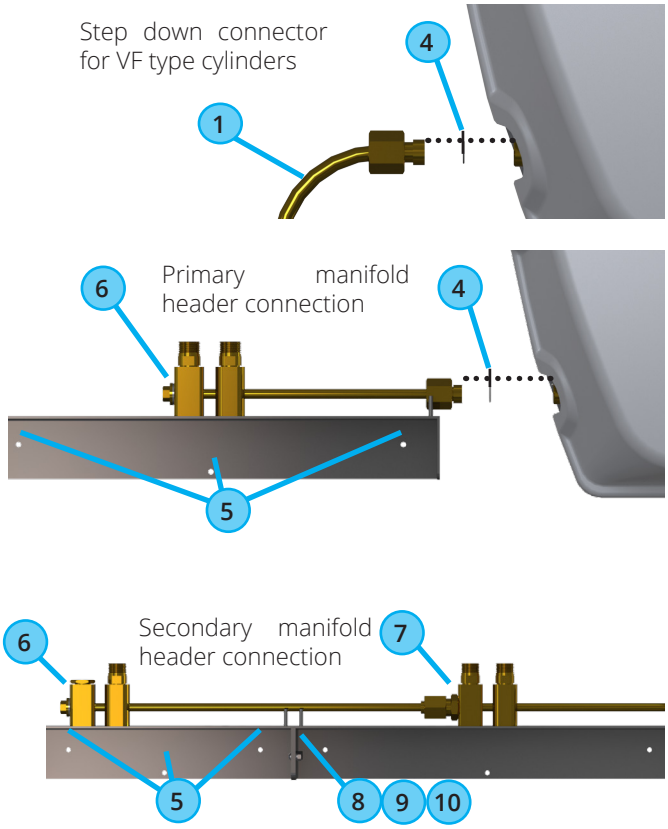
2.2.4 Reconnect the manifold header as shown in figure 5 and secure to the wall using the No. 10 pan head supplied with the kit.

⚠ CAUTION! Supplied fixings are for use with solid masonry type walls only. Typical extension bracket is 2.5kg per side.

2.2.5 If additional headers are to be installed, remove the 3/8" BSP blanking plug and bonded seal from the end of the primary header block (shown in figure 5) and fit 3/8" x 5/8" BSP fitting (supplied with secondary headers, shown in figure 5) complete with O-ring seals for connection of the extension header. Fit M6 fastener, nut and washer as shown in figure 6 to secure between header rails.

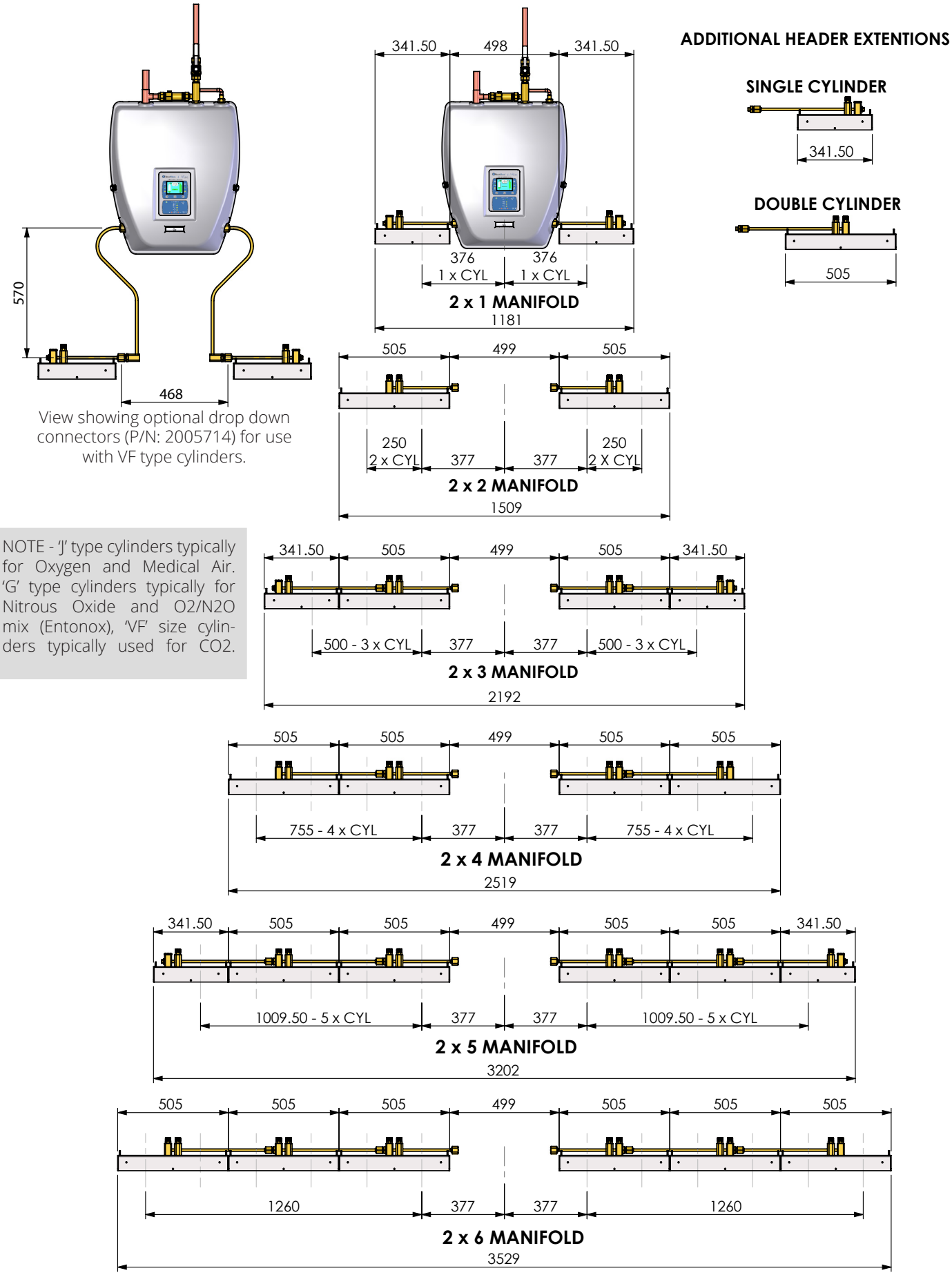
2.2.6 Repeat steps 2.2.2 to 2.2.4 for each additional header. Fit the 3/8" BSP blanking plug and seal previously removed in step 2.2.5 to the last manifold header.

Figure 5 - Manifold Header Installation



Item	Description
1	Drop Down Connector
2	Primary Header
3	Secondary Header
4	Manifold connection o-ring seal
5	Manifold header mounting holes
6	3/8" BSP blanking plug and seal
7	3/8" x 5/8" BSP fitting
8	M6 x 12 Button head
9	M6 Nut
10	M6 Washers

Figure 6 - Lifeline MCS Header Arrangement Details



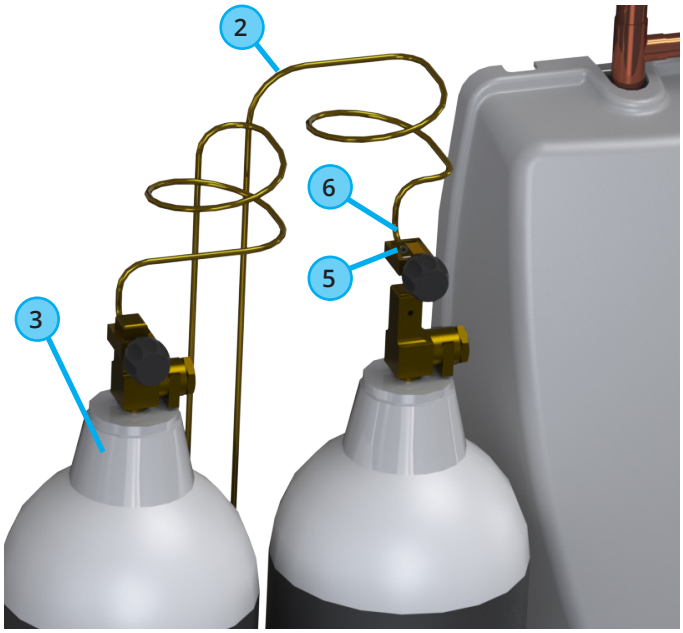
2.3 Cylinder Connection.

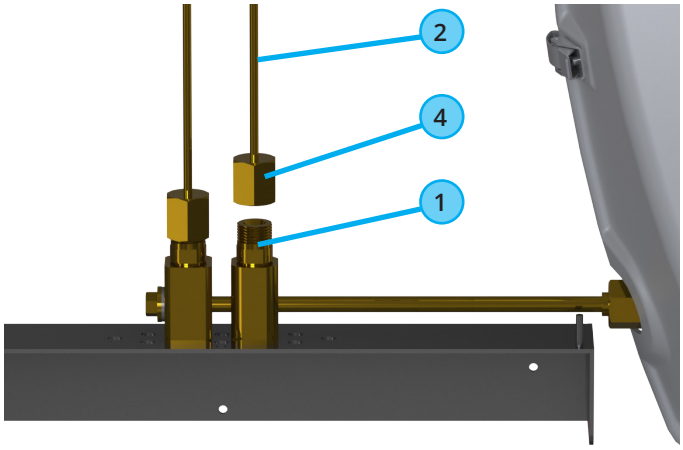
⚠ CAUTION! Ensure that all the tailpipes supplied are the correct gas type. The gas ID is stamped onto the nut that connects to the header non-return valve.

2.3.1 Connect the tailpipes to the non-return valves on the header racks as shown in figure 7.

2.3.2 Refer to hospitals/site policy for safe cylinder handling (See section 4.9 for typical cylinder handling safety check list), move the cylinders into place (see figures 6) ready for connection to the tailpipes.

Figure 7 - Typical Tailpipe & Cylinder Connection





Item	Description
1	Header Non-return Valve (NRV)
2	Tail Pipe
3	Medical Gas Cylinder
4	Tailpipe to NRV connection
5	Tailpipe Pin Index Connection to Cylinder
6	Bodok Seal

⚠ CAUTION! Only persons who have had specific training in the safety of medical gases, manual handling techniques and cylinder changing procedures should be allowed to change cylinders on medical gas manifolds or medical equipment.

2.3.3 Connect the cylinders to the pin indexed clamp on the tail pipe, as shown in figure 7. Ensure the bodok seal is in place at the opposite side to the thumb screw on the pin index clamp before connection.

NOTE - Pipe index tailpipes to BE EN ISO 21969 are supplied as standard. Alternative connection types are available on request.

2.3.4 See section 4.10 for cylinder operation procedure for pressurising the manifold control panel.

2.4 LifeLine MCS Electrical Wiring.

NOTE - See figure 2b, section 1 for full wired diagram

2.4.1 Connection to the mains electrical supply.

2.4.1.1 The Lifeline MCS comes complete with a 2m mains power cable pre-wired to a 24V DC transformer.

2.4.1.2 The lead should be permanently connected to an essential single-phase supply of 240V ac.

2.4.1.3 Ensure the electrical supply is isolated before carrying out any mains connection.

2.4.1.4 Wire the lead into a 3 amp unswitched fused spur.

2.4.1.5 Turn the power on and check that the LED's on the front of the panel and screen is working.

2.4.1.6 Turn the power off.

2.4.2 Medical Gas Alarm Connection.

2.4.2.1 All internal control wiring such as solenoid and sensors are completed during manufacture.

2.4.2.2 If remote alarms are used, run the 5 core alarm cable to the electrical enclosure (Item 20, Figure 1) through the cable gland where shown in Figure 8.

NOTE - Typical alarm cable spec Alphawire 117C 5 core, maximum length of 100m from alarm to manifold control panel.

2.4.2.3 Connect the alarm cable to the terminals shown in figure 7.

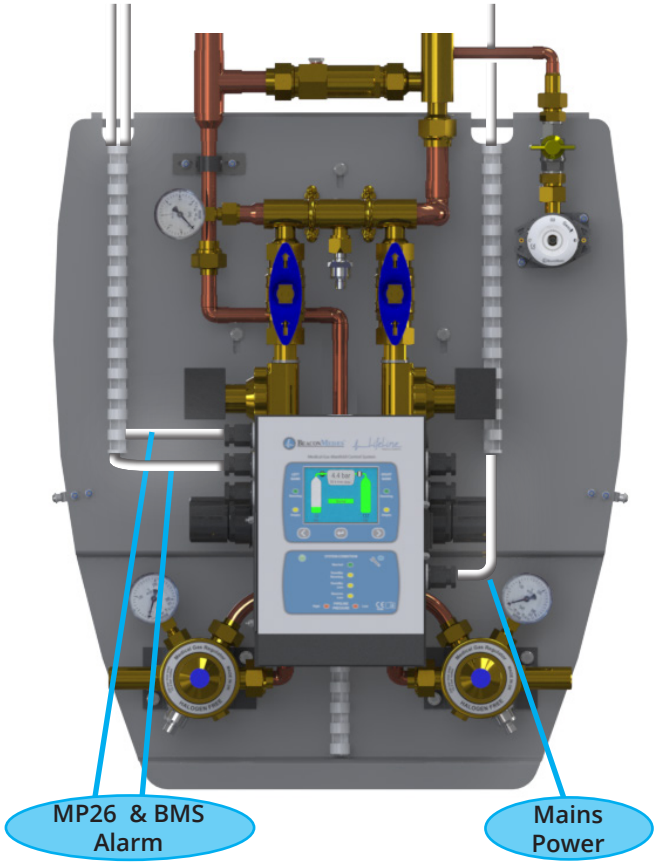
2.4.2.4 If a non BeaconMedæs remote alarm is to be used, the output signal from the Lifeline MCS can be changed from the standard line contact resistors to a closed in normal condition by following the set-up menu detailed in Section 2.5.

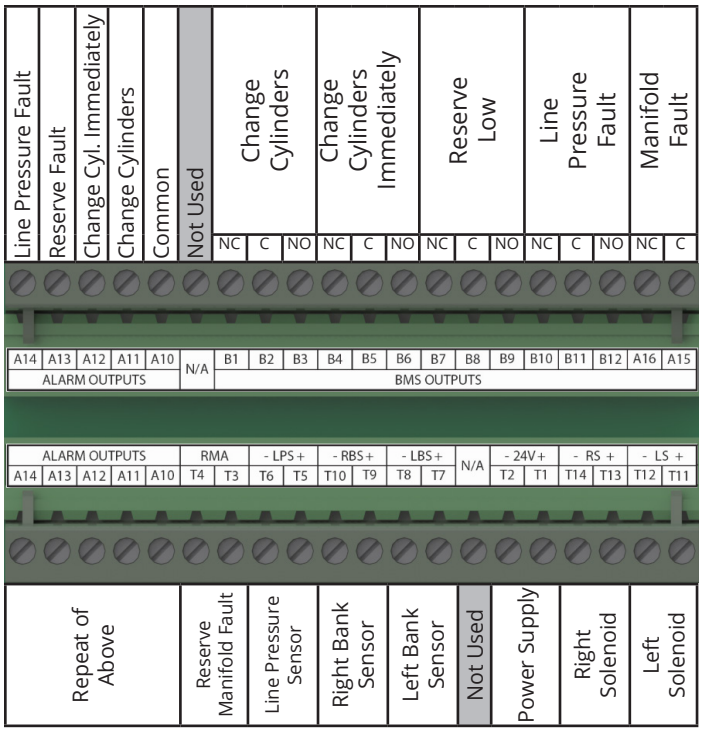
2.4.3 For BMS connection route the cable and connect as shown in figure 8.

2.4.4 When using as a backup manifold use alarm outputs from"change cylinders" A10 & A11. Change alarm output to N/C if connecting to an air plant. Leave LMC output if connecting directly to a Medipoint alarm system.

2.4.5 Optional heater kit should be connected to the left solenoid terminals T11 & T12.

Figure 8 - Lifeline MCS Wiring





Note - Power cable is supplied pre-wired to the 24V DC transformer.

2.5 LifeLine MCS Menu Set-up.

NOTE - See section 4.11 for full set-up menu map.

2.5.1 With the manifold installed as detailed in Sections 2.1 to 2.4, power up the Lifeline MCS controls.

2.5.2 To access the setup menu follow the steps in Figure 9, followed by figure 10-14 to compete the setup. See table 3 for menu controls.

Table 3: Menu Controls

Menu Controls			
Menu Navigation	Down Arrow	Select	Up Arrow
Edit Value	Cycle Value Down	Enter	Cycle Value Up
Navigation Mode	Line Pressure 4.0		
Edit Mode	Line Pressure 4.0		

NOTE - During menu operation, full width bar while navigating the options, focused bar when editing options.

Figure 9 - Accessing The Setup Menu

1. Hold down the [Select] key for 5 seconds to access the set-up menu

2. Scroll down to the Setup Menu option using the [Left Arrow] key, then press [Select] key.

NOTE - Pressing [Select] with the Exit highlighted will take you back to the operating screen.

3. While in the menus screen, use [Left Arrow] to scroll down, [Right Arrow] to scroll up, and [Select] key to select.

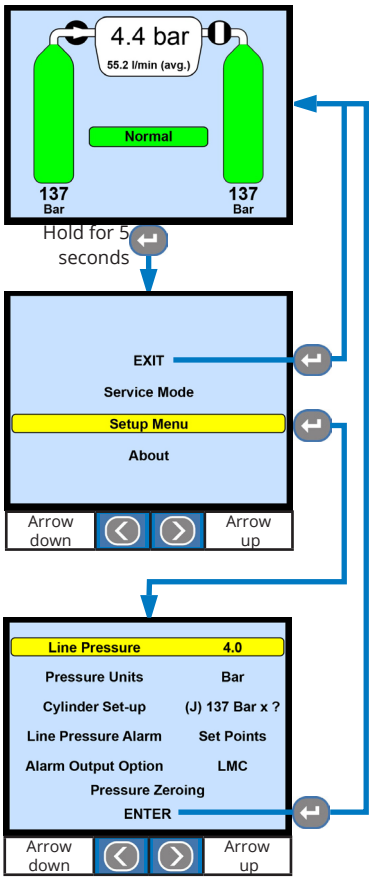


Figure 10 - Set Line Pressure.

NOTE - Line pressure will normally be pre-set from the factory. Options are for nominal 4,8 & 11 bar supply. This setting will not affect the actual supply pressure, it is for setting the default line pressure alarm settings. The line pressure setting is changed from using the regulator controls knob.

1. Press [Select] to change to edit mode.

2. Press [Left Arrow] or [Right Arrow] to cycle the options (4, 8 & 11 bar). Press [Select] to change back to selection mode.

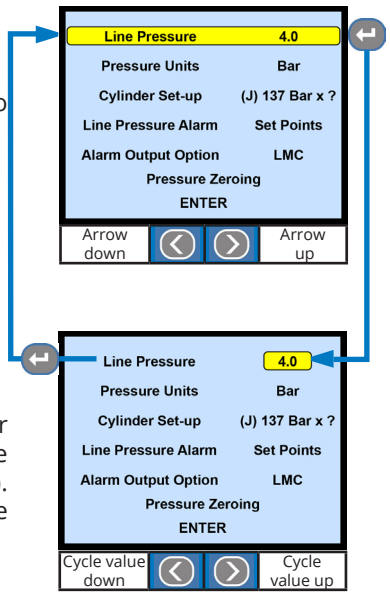


Figure 11 - Set Pressure Units

NOTE - Changing the pressure units will automatically convert all pressure related control variable to the newly selected unit. Options are Bar (default), kPa or PSI.

1. Press the [Left Arrow] key to scroll down to the Pressure Units, press [Select] key to change to edit mode.

2. Press [Left Arrow] or [Right Arrow] to cycle the options (Bar, kPa & PSI). press [Select] key to change back to selection mode.

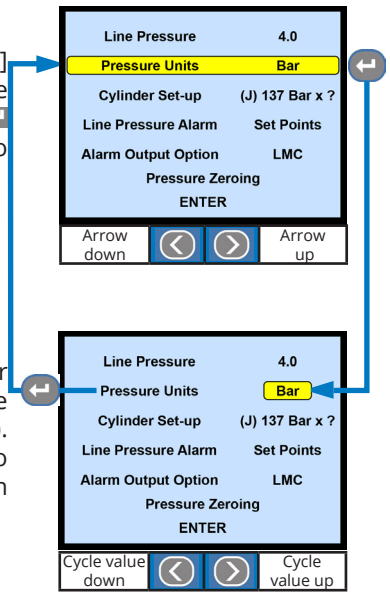
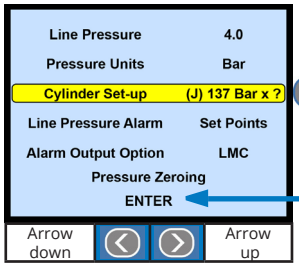


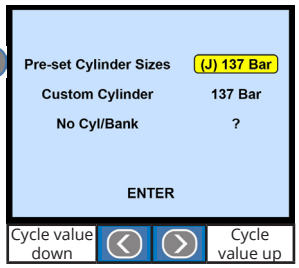
Figure 12 - Cylinder Setup

NOTE - Minimum requirement in the cylinder setup is to set the correct maximum pressure. This will correctly scale the on screen graphic. The cylinder size and number off cylinders per bank is for activating the optional average gas usage only.

NOTE - The typical average gas usage is only for gas cylinders, this calculated value will not convert correctly for liquid cylinders. Leaving the No Cyl/Bank setting as '?' will hide the

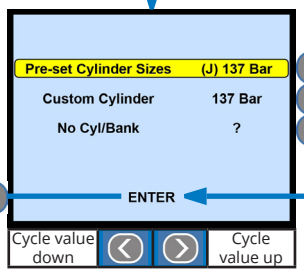


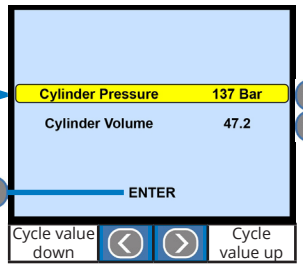
1. Press the [Left Arrow] key to scroll down to the Cylinder Setup, Press [Select] key to go to the cylinder setup menu screen.



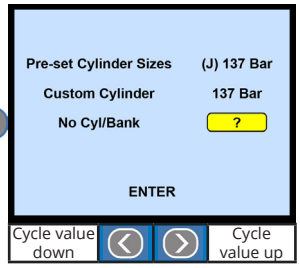
3. Press [Left Arrow] or [Right Arrow] to cycle the options (J-137 bar, VF-50 bar, G-44 bar, G-137 bar, J-44 bar). Press [Select] to change back to selection mode.

2. Press the [Select] key to select a pre-set cylinder size, or press [left Arrow] to scroll down to the Custom Cylinder and press [Select] key to set cylinder pressure and size manually.





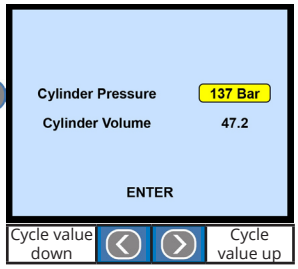
4. Press the [Left Arrow] key to scroll down to the Custom Cylinder option, Press [Select] to go to the custom cylinder setup menu screen.



5. Press [Left Arrow] or [Right Arrow] to adjust the value. Press [Select] to change back to selection mode.

Note - To deactivate the average gas usage (typically for liquid cylinders)on the operating screen set to '?'

6. Press [Left Arrow] or [Right Arrow] to adjust the value, hold down to adjust in steps of 10 units. Press [Select] to change back to selection mode.



7. Press [Left Arrow] or [Right Arrow] to adjust the value, hold down to adjust in steps of 10 units. Press [Select] to change back to selection mode.

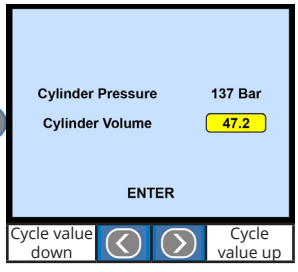


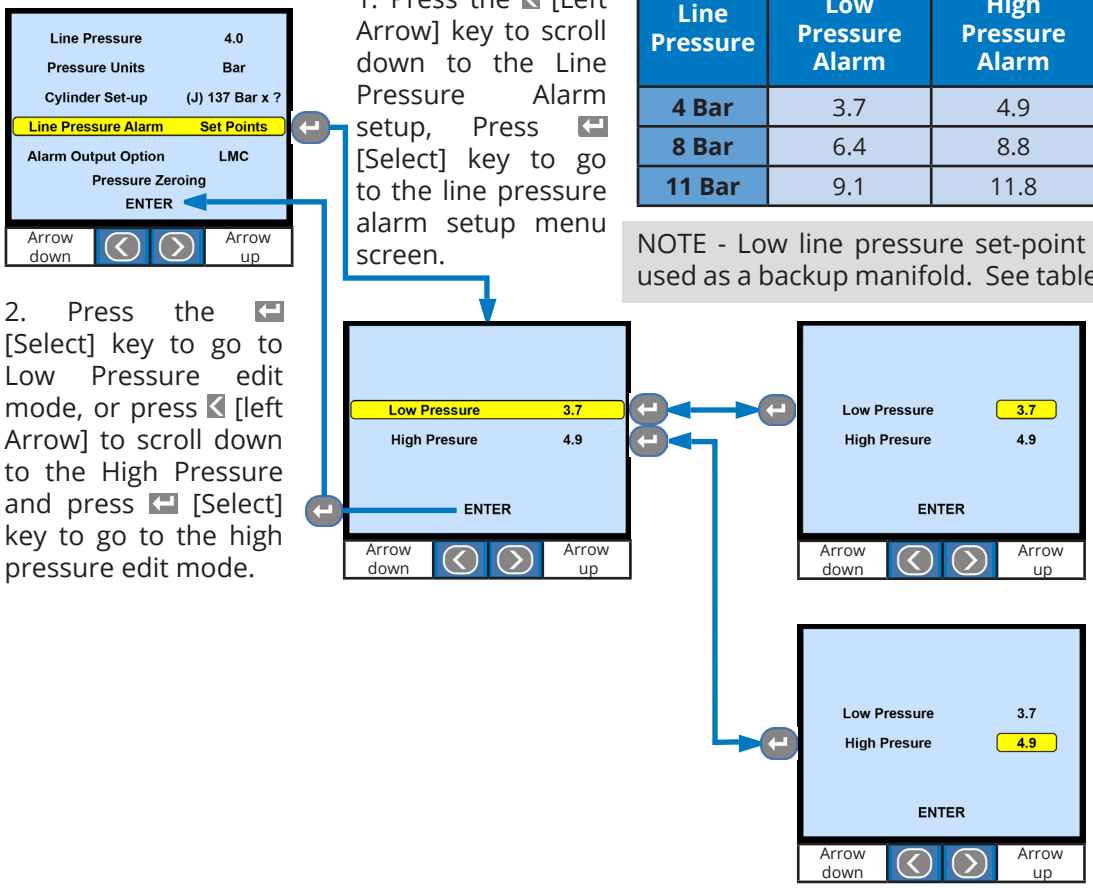
Figure 13 - Line Pressure Alarm Setup

NOTE - Default Line Pressure Alarm setting will be automatically defined when the Nominal Line Pressure is selected. See table 4 below for default values. These values can be manually adjusted as required to suit on site requirements.

Table 4: Default Line Pressure Alarm settings, and adjustment Range.

Nominal Line Pressure	Default Values		Adjustment Range			
	Low Pressure Alarm	High Pressure Alarm	Low Pressure		High Pressure	
			Min	Max	Min	Max
4 Bar	3.7	4.9	2.7	4.0	4.0	6.0
8 Bar	6.4	8.8	5.5	8.0	8.0	12.0
11 Bar	9.1	11.8	7.6	11.0	11.0	16.5

NOTE - Low line pressure set-point may need to be reduced if used as a backup manifold. See table 6 in section 4 for reference.



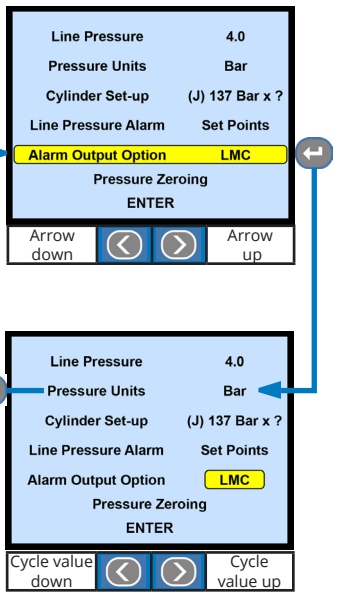
1. Press the [Left Arrow] key to scroll down to the Line Pressure Alarm setup, Press [Select] key to go to the line pressure alarm setup menu screen.

2. Press the [Select] key to go to Low Pressure edit mode, or press [left Arrow] to scroll down to the High Pressure and press [Select] key to go to the high pressure edit mode.

3. Press [Left Arrow] or [Right Arrow] to adjust the value. Press [Select] to change back to selection mode.

4. Press [Left Arrow] or [Right Arrow] to adjust the value. Press [Select] to change back to selection mode.

Figure 14 - Alarm Output Option



1. Press the [Left Arrow] key to scroll down to the Alarm Output Option, press [Select] to change to edit mode.

2. Press [Left Arrow] or [Right Arrow] to cycle the options (LMC & N/C). Press [Select] to change back to selection mode.

2.6 Installation check.

2.6.1 Ensure that all tailpipes are connected to the cylinders and manifolds on both sides and that the restraint chains are secure around the cylinders.

2.6.2 Isolate the panel from the pipeline using the main isolation valve (shown in figure 14, item 2).

2.6.3 Ensure that both bank isolation valves (Figure 14, item 1) are fully open.

2.6.4 Ensure the test point isolation valve (figure 14, item 2) is closed.

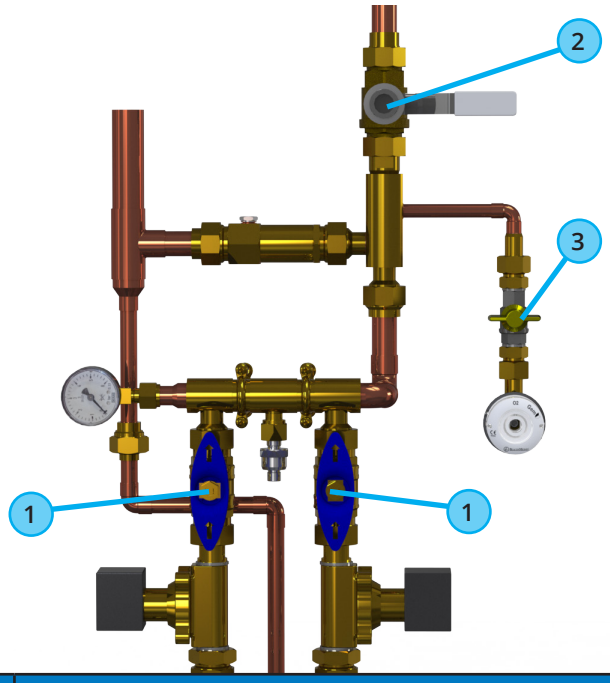
2.6.5 Using 1 cylinder per bank, slowly pressurise the manifold (see section 4.10 - Cylinder operation). Both contents gauges (figure 1, item 11) should indicate full cylinder pressure. The distribution system pressure gauge (figure 1, item 12) should read typically as per table 6, Section 4, adjust as necessary (see section 4.5).

⚠ CAUTION! If used as a backup manifold it would be recommended to set the line pressure at least 0.2 bar below the main supply source pressure at full design flow, to ensure the manifold does not supply the pipeline during normal primary source operation.

2.6.6 Check for leaks, typically by listening for gas escaping or leak detection fluid on joints.

2.6.7 Now ensure all bank cylinder valves are closed ready for pressure drop leak test.

Figure 14 - Leak test valve configuration



No.	Description
1	Manual Isolation Valve.
2	Lockable Isolation Valve.
3	Test point Isolation Valve.

Pressure drop leak test validation notes...

- The Lifeline MCS uses medical regulators approved to BS EN ISO 10524-2 standard, as required by ISO and HTM medical pipeline standards. These standards have a maximum allowable leakage across the regulator seat (internal) and to atmosphere (external) as follows:

1st stage regulator, Internal	0.1 ml/min
1st stage regulator, external	0.2 ml/min
2nd stage regulator, Internal	0.2 ml/min
2nd stage regulator, external	0.2 ml/min

- Therefore, the maximum pressure increase or decrease witnessed at the line pressure will be based on 2 regulators, 0.4ml/min. The maximum pressure drop witnessed at the cylinder pressure will be based on the internal and external leakage from the 1st and 2nd stage regulator on that bank, 0.7ml/min.

- Pressure drop tests are more commonly used on site, as leaks can be difficult to measure. The equivalent water capacity volume under test is used to calculate the pressure drop from an allowable leakage rate.

- From using the manifold water capacity the allowable pressure drop or increase based on a leakage of 0.4ml/min can be calculated as 0.0016 bar/min, or 0.096 bar/hr witnessed at the line pressure. The pressure drop witnessed at the cylinder pressure from a 0.7ml/min leakage would be as follows depending on the number of cylinder connections.

No. Cyl.	1	2	3	4	5
Bar/Hr	1.78	1.09	0.78	0.61	0.5
No. Cyl.	6	7	8	9	10
Bar/Hr	0.42	0.37	0.33	0.29	0.26

- Although the medical regulator allowable leakage is only small the effects can be witnessed within a few hours due to the manifold having a small volume. To put into perspective how small 0.4 ml/min is, if applied to one J-size cylinder it would take nearly 12 weeks for it to drop by 1 bar.

2.6.6 Monitor the pressure drop and assess as per the above notes. Length of time for the test will depend on the accuracy of the gauges used to be able to detected the pressure drop.

2.6.7 Open test point isolation valve (figure 1, item 7) and relieve the pressure from within the manifold, then close test point isolation valve.

2.6.8 The installation must now be purged as per HTM 02-01 for UK installations, or as per relevant standards if installed outside the UK.

3. Commissioning.

3.1 General.

Commissioning of the Lifeline MCS must be carried out in full after initial installation. The object of the commissioning procedure is to ensure that all components are serviceable and that the overall system is operable and set to the correct distribution pipeline pressure. Suitably qualified competent personnel who are familiar with this manual must only undertake commissioning of the Lifeline MCS.

3.2 Preparation.

3.2.1 Ensure that all tailpipes are connected to the cylinders and manifold headers on both sides, and that the restraint chains are secure around the cylinders.

3.2.2 Ensure that the outlet pipe from the Lifeline MCS is connected to the distribution system of the same gas service.

3.2.3 Ensure that the Lifeline MCS isolation valve (shown in figure 1, item 6) is fitted and in the closed position.

3.2.4 Open 1 cylinder valve on each bank of the Lifeline MCS to pressurise the system.

3.2.5 Check connections on the headers, tailpipes, regulator and associated pipework for leaks.

3.2.6 Turn power on to the controls, ensure screen and power on LED's are eliminated.

3.3 Pressure Checks.

3.3.1 Ensure that full gas cylinder pressure is shown on the operating screen and backup contents gauge (figure 1, item 11), the cylinder graphics are shown as full and the appropriate LED's are lit up (see figure 15). See figure 9 & 12 in section 2.5 if setup changes are required.

3.3.2 Check that the pipeline distribution pressure displayed on the screen and back up gauge (figure 1, item 12) is typically as per table 6 in section 4, Principle of Operation . Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

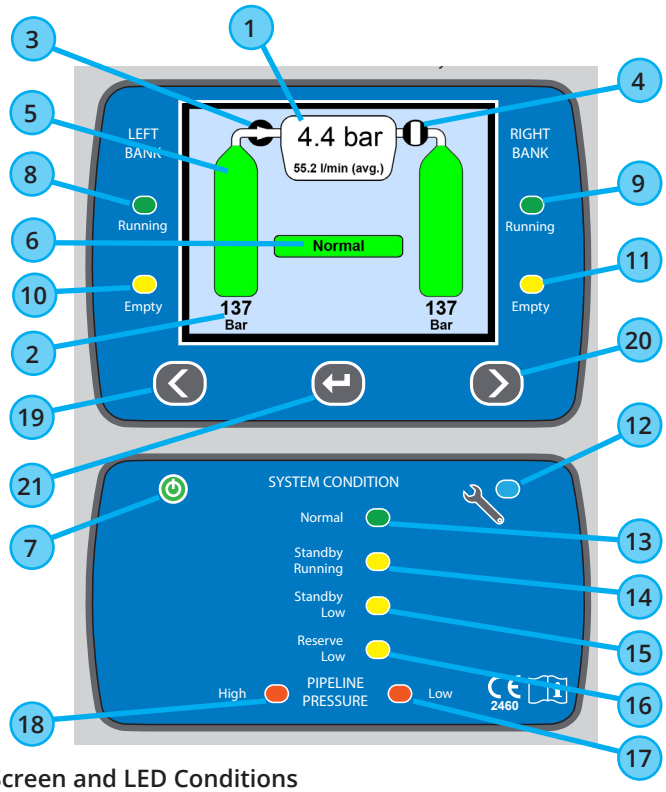
3.4 Function Checks.

3.4.1 With the left bank as duty, press [Left Arrow] to select if necessary. Ensure all left hand cylinders are closed, then slowly drain the pressure from the test point (shown in figure 1, item 8) until the contents pressure is below the bank changeover point (typically 15 bar for 4 & 8 bar supply, 20 bar for 11 bar supply). Stop draining the pressure once the running bank has changed to the right hand side.

Note - As the running bank drops below typically 50%, a message will appear on the screen referencing the bank is below 50%.

Figure 15 - Start up, normal operation

NOTE - The below details are shown with left bank set as duty, if right back is duty any of the bank related graphics and LED's will be mirrored.

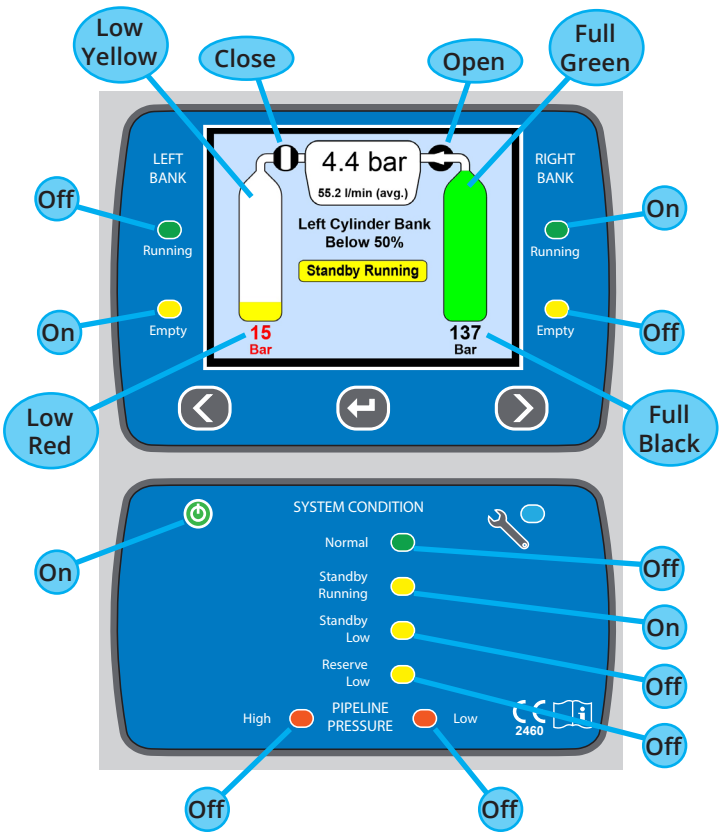


Screen and LED Conditions

No.	Description	Condition
1	Line pressure value	Typically as shown
2	Cylinder contents value	Typically as shown
3	Open bank graphic	Shown as left bank
4	Closed bank graphic	Shown as right bank
5	Cylinder content graphic	Shown full at 137 bar
6	Manifold status graphic	Shown as normal
7	Power on LED	On
8	Left bank running LED	On
9	Right bank running LED	Off
10	Left bank empty LED	Off
11	Right bank empty LED	Off
12	Major service due LED	Off
13	Normal condition LED	On
14	Standby running LED	Off
15	Standby low LED	Off
16	Reserve low LED	Off
17	Low line pressure LED	Off
18	High line pressure LED	Off
19	Left bank duty select	
20	Right bank duty select	
21	Menus (Hold for 5 sec)	

3.4.2 The panel screen, fascia LED's and output alarm condition will change as shown in figure 16.

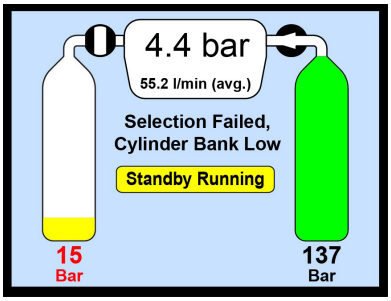
Figure 16 - Left bank low, right bank running.



Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Immediately	Off
Pressure Fault	Off

3.4.3 Press [Left Arrow] to check the low bank lock out safety feature. The running bank will not change to the empty side while the bank is showing low cylinder pressure. A message should be displayed as shown in figure 17.

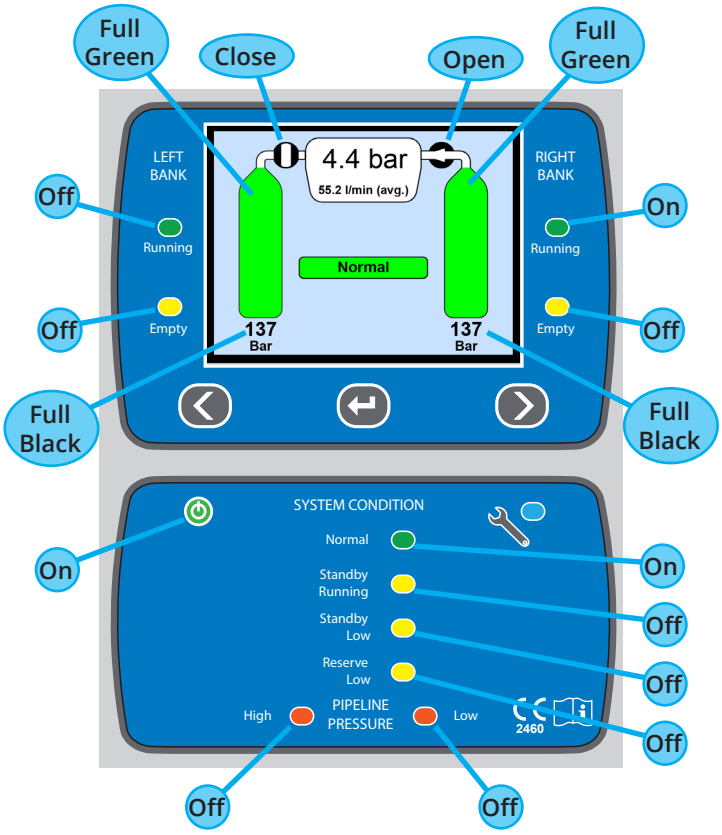
Figure 17 - Change bank lock out, low cylinders.



Typical screen message if operator attempts to change the running bank onto an empty bank of cylinders.

3.4.4 Open 1 cylinder on the left hand bank to re-pressurise. All conditions should return to normal as per figure 18.

Figure 18 - Normal, right bank running.



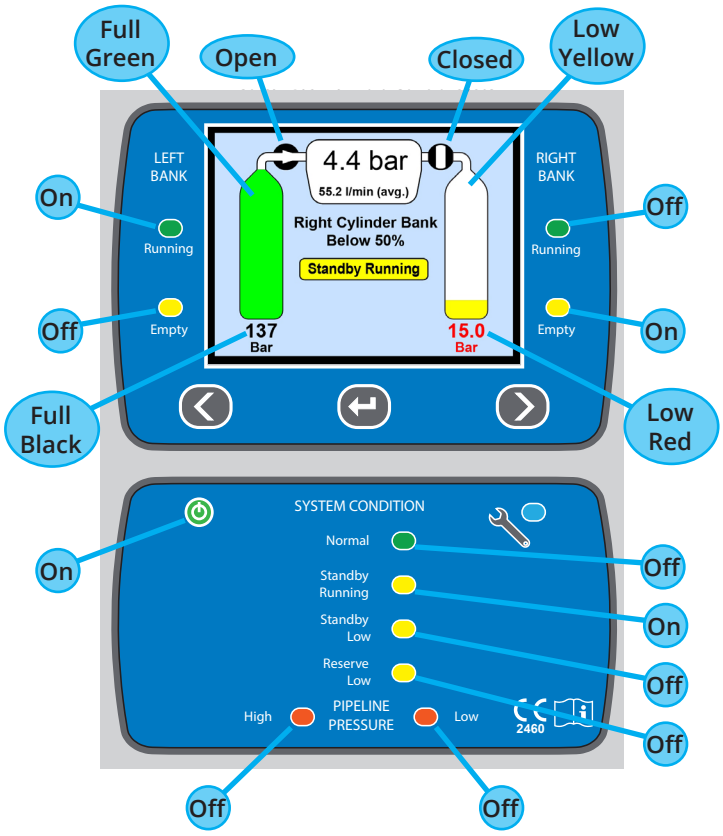
Alarm Output Conditions	
Alarm Description	Condition
Normal	On
Change Cylinders	Off
Change Immediately	Off
Pressure Fault	Off

3.4.5 With the right bank now set as duty (Press [Right Arrow] to select if necessary). Ensure all right hand cylinders are closed, then slowly drain the pressure from the test point (shown in figure 1, item 8) until the cylinder contents pressure is below the bank changeover point (typically 15 bar for 4, 20 bar for 8 & 11 bar supply). Stop draining the pressure once the running bank has changed to the left hand side.

NOTE - As the running bank drops below typically 50%, a message will appear on the screen referencing the bank is below 50%.

3.4.6 The panel screen, fascia LED's and output alarm conditions will change as shown in figure 19.

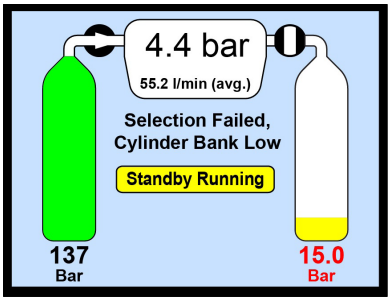
Figure 19 - Right bank low, left bank running.



Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Immediately	Off
Pressure Fault	Off

3.4.7 Press ▶ [Right Arrow] to check the low bank lock out safety feature. The running bank will not change to the empty side while the bank is showing low cylinders pressure. A message should be displayed as shown in figure 20.

Figure 20 - Change bank lock out, low cylinders.

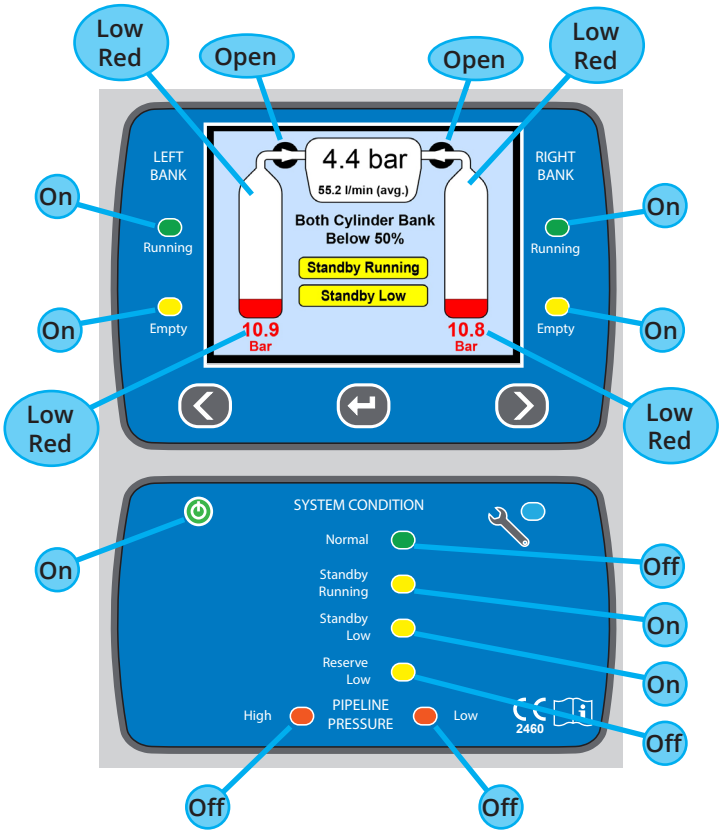


Typical screen message if operator attempts to change the running bank onto an empty bank of cylinders.

3.4.8 Ensure all cylinders are closed on both banks, then slowly drain the pressure from the test point (shown in figure 1, item 8) until the cylinder contents pressure is below the bank changeover point (typically 15 bar for 4 & 8 bar supply, 20 bar for 11 bar supply). Stop draining the pressure once the running bank has changed to the other side.

3.4.9 The panel screen, fascia LED's and output alarm conditions will change as shown in figure 21.

Figure 21 - Both banks low.



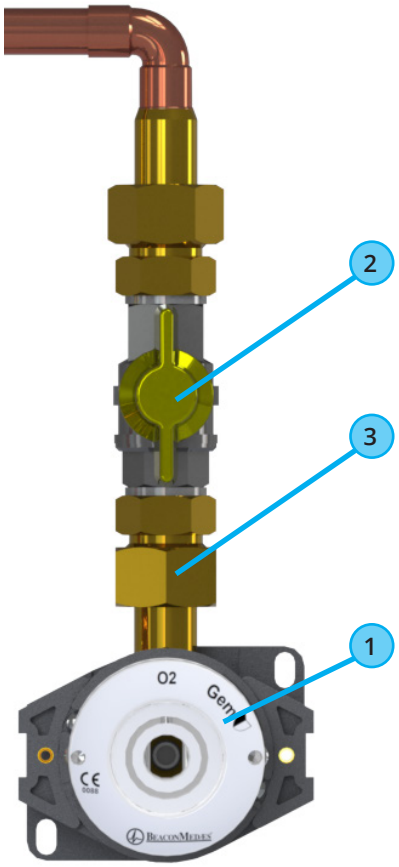
Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Immediately	On
Pressure Fault	Off

3.4.10 Open 1 cylinder valve on each bank of the Lifeline MCS to pressurise the system. The panel screen, fascia LED's and output alarm conditions will change typically as shown in figure 18.

3.4.11 With the left bank selected as duty (Press ◀ [Left Arrow] to select if necessary). Ensure the test point valve is open (see figure 22). Apply a slow bleed to the test point, as shown in figure 22. This will apply a small flow across the 2nd stage regulator. Typically 5-15 l/min will be adequate.

Figure 22 - Apply slow bleed from test point.

Item	Description
1	Test point
2	Test point isolation valve
3	Test point connection



NOTE - Item 2 Valve shown in open position.

There is a number of options for applying a small bleed from the test point.

Option 1. With the valve (item 2) open connect a flow meter to the test point (item 1) to apply a small leak.

Option 2. Alternatively, close the valve (item 2) and attach an open ended probe to the test point (item 1). Partially open the valve (item 2) until there is a small flow from the test point.

Option 3. Final option, close the valve (item 2) and loosen the test point connection (item 3). Partially open the valve (item 2) until there is a small flow from the connection point.

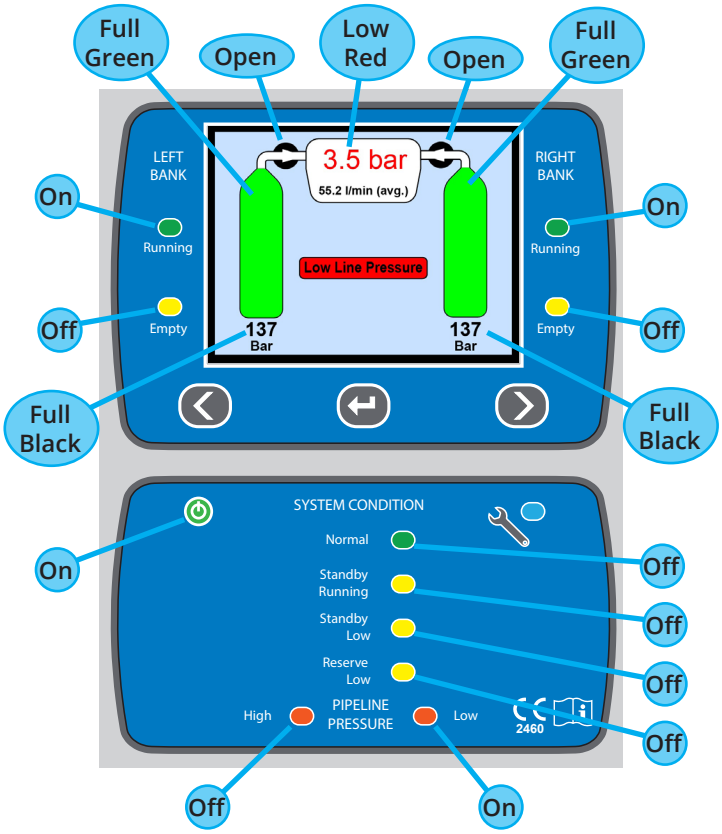
3.4.12 Adjust the left bank regulator set point by pulling the control knob outwards (See section 4.5, Line Pressure Adjustment). Then turn anti-clockwise until the line pressure reading is below the low line pressure set point. Default set points can be seen in table 5.

Table 5: Default Line Pressure Alarm settings

Nominal Line Pressure	Default Values	
	Low Pressure Alarm	High Pressure Alarm
4 Bar	3.7	4.9
8 Bar	6.4	8.8
11 Bar	9.1	11.8

3.4.13 All conditions should return to normal as per figure 23.

Figure 23 - Low line pressure fault.



3.4.14 Adjust the line pressure back to nominal (see table 6, in section 4, principles of operation for typical line pressure settings). The panel screen, fascia LED's and output alarm conditions will change typically as shown in figure 18.

3.4.15 Close off the slow bleed from the test point by closing the valve (figure 22, item 2), remove flowmeter or probe if used from the test point, reseal the test point connection (figure 22, item 3) if required, see figure 22 for reference.

3.4.16 Close all bank cylinder valves.

3.5 Prime the Lifeline MCS.

3.5.1 Complete the steps in section 4.2 - Procedure to prime Lifeline MCS, to bring it online.

4. Principles of Operation.

4.1 General.

The Lifeline MCS line pressure is set typically as per table 6 depending whether its being used as a primary or backup supply manifold.

4.1.1 When the Lifeline MCS is in operation there is a provision for an alarm output to warn when the running bank cylinders are low, or if the line pressure is outside of normal operation.

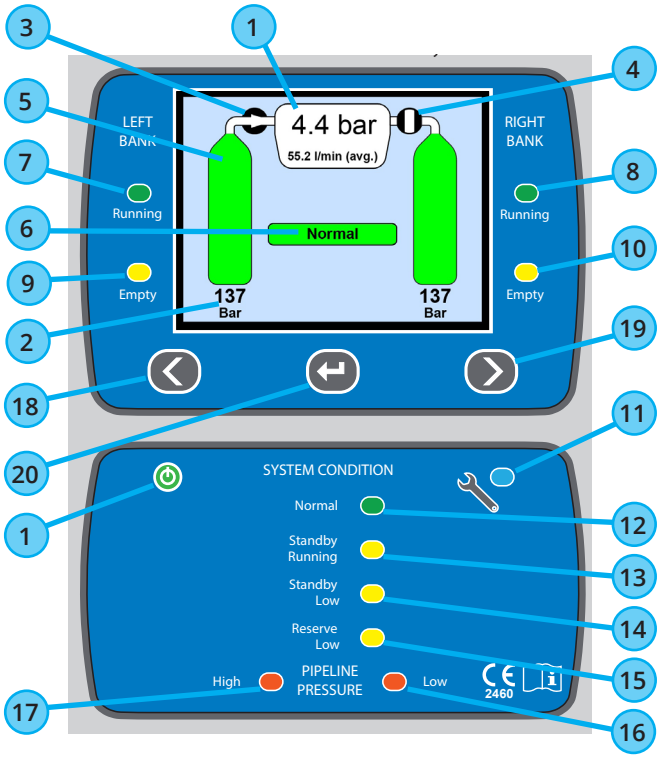
4.1.2 See figure 24 for full manifold visual indicators and meanings.

NOTE - Figure 24 shows typical normal status, with left bank set as duty. If right back is duty any of the bank related graphics and LED's will be mirrored.

Screen and LED Conditions

No.	Description	Condition	Action
1	Line pressure	Pressure Valve	See No. 16 & 17
		ERR	Sensor fault
2	Cylinder contents value	Pressure Valve	See No. 9 & 10
		ERR	Sensor Fault
3	Open bank graphic		No Actions
4	Closed bank graphic		No Action
5	Cylinder content graphic	Zero to full pressure	See No. 9 & 10
6	Manifold status graphic	Normal	No Actions
		Standby Running	See No. 13
		Standby Low	See No. 14
		Reserve Low	See No. 15
		Low Line Pressure	See No. 16
		High Line Pressure	See No. 17
		Manifold Fault	Check sensor or solenoid status
7	Left bank running LED	On	No Action
		Off	No Action
8	Right bank running LED	On	No Action
		Off	No Action
9	Left bank empty LED	Off	No Actions
		On	Change left Bank Cyl.
10	Right bank empty LED	Off	No Actions
		On	Change Right Bank Cyl.
11	Major service due LED	Off	No Actions
		On	5 year Service
12	Normal condition LED	On	No Actions
		Off	See No 13 to 17

Figure 24 - Visual indicators.



NOTE - Contents value and graphic for liquid cylinders will not normally start to drop in pressure until all the liquid has been used, so the remaining contents is pure gas. However, during high flow rates the gas can be used faster than the liquid can evaporate, resulting in the contents pressure dipping.

No.	Description	Condition	Action
13	Standby running LED	Off	No Actions
		On	Change empty cylinders
14	Standby low LED	Off	No Actions
		On	Change empty cylinders
15	Reserve low LED	Off	No Actions
		On	Change Cylinders on ERM
16	Low line pressure LED	Off	No Actions
		On	Check regulator setting
17	High line pressure LED	Off	No Actions
		On	Check regulator setting
18	Left bank duty select		
19	Right bank duty select		
20	Menus (Hold for 5 sec)		

NOTE - Low line pressure fault will switch the duty bank to try and correct the pressure, but the alarm fault will remain along with a message on the screen to indicate which bank is faulty. Once the error has been corrected select the faulty bank as running, if the line pressure remains normal the pressure fault alarm will return to normal.

Table 6: Typical pressure settings for HTM02-01 primary and emergency medical gas supply system, during normal pipeline system operation.

	Pressure (Bar)		
Nominal System Design	**4**	**8**	**11**
Max. Static Pressure Primary Supply	4.6	8.5	11.5
Min. Dynamic Pressure Primary Supply	4.2	7.4	10.3
Max. Static Pressure Backup supply	4.0	7.2	10.0
Min. Dynamic Pressure Backup supply	3.5	6.5	9.0

NOTE - Table 6 shows typical examples. These figures may differ depending on the hospital's pipeline management policy.

NOTE - When used as a backup emergency manifold the line pressure would be set lower than the primary supply to ensure it does not supply to the line while the primary supply is functioning within it's design limits. If the primary supply fails, causing the pipeline pressure to fall to the backup system set point it will automatically start feeding gas to the pipeline, and be manually adjusted to the nominal supply pressure.

⚠ CAUTION! It would be recommended to set the backup manifold line pressure at least 0.2 bar below the main supply source pressure at full design flow to ensure the emergency manifold does not supply the pipeline during normal primary source operation.

⚠ CAUTION! The following procedures 4.2 to 4.10 are only typical guides, where there are conflicts with the hospital's procedure, the hospital's policies will take precedence.

4.2 Procedure to prime Lifeline MCS.

4.2.1 The following procedure must be carried out once the commissioning (section 3) is complete and the system is ready to be put into use.

4.2.2 Ensure the cylinder valves on both banks are fully open. Correct as required, see section 4.10 Cylinder Operation.

4.2.3 Ensure the connecting pipeline is ready for use. Slowly open the line valve (Item 6, figure 1).

NOTE - Section 4.3 & 4.4 are for when the Lifeline MCS is used as a backup emergency manifold only.

4.3 Procedure when primary supply fails (For backup manifolds only).

4.3.1 The following steps relate to figure 1 & 2, and detail how to operate the Lifeline MCS in the event of the main supply system failing to supply to the medical gas pipeline.

4.3.2 Ensure the Lifeline MCS line valve (item 6, figure 1) is open. Close the main supply line valve to the failed primary supply.

4.3.3 Ensure all cylinder valves on both banks are fully open. Correct as required.

The pressure regulator may be set below the nominal distribution system pressure. This should now be manually increased to the full distribution pressure by increasing the line regulator setting, until the correct pressure is being supplied. See section 4.4, Line Pressure Regulator Adjustment.

4.3.4 Once the Lifeline MCS is in operation there is a provision for an alarm output to warn when the running bank contents is typically low. The manifolds contents should then be locally monitored for cycling the cylinder banks for continuous supply (see section 4.6 for bank cylinder cycling procedure).

4.4 Procedure to reinstate Primary supply (For backup manifolds only).

4.4.1 The following steps detail how to reinstate the primary supply once it has returned to normal operation.

4.4.2 Slowly open the primary supply line valve.

4.4.3 Close the backup manifolds supply line valve.

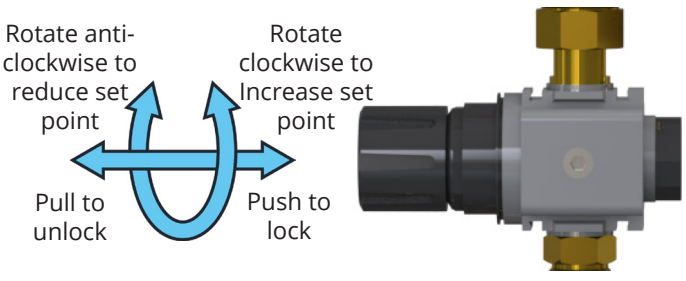
4.4.4 Follow the commissioning steps in section 3.1 to 3.3 resulting in reducing the line pressure back below the primary supply set-point.

4.4.5 Complete steps in section 4.2 to prime the manifold ready for normal backup running.

4.5 Line Pressure Regulator Adjustment.

Adjust the line pressure regulator (item 2, figure 1) set point by pulling the control knob outwards (See figure 25). Then turn anti-clockwise until the line pressure reading is typically set as per table 6.

Figure 25 - Line pressure regulator adjustment.



NOTE - A small flow is required for regulator adjustments, see figure 22 in section 3 for reference.

4.6 Procedure to cycle banks (automatic control) & changing cylinders.

4.6.1 Refer to hospitals/site policy for safe cylinder handling (See section 4.9 for typical cylinder handling safety check list) when moving the cylinders into place ready for connection to the tailpipes.

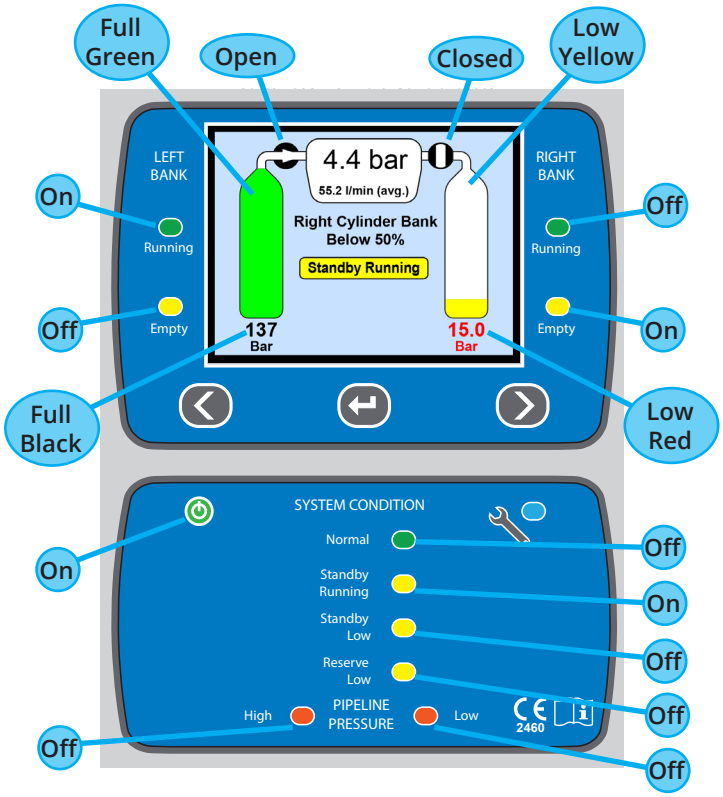
4.6.2 When the running cylinder bank pressure falls to the changeover set-point (for typical changeover pressures see table 8). The running cylinder bank will automatically switch to the standby cylinder bank and provide the following alarm outputs shown in table 7. Figure 26 shows typical screen and LED example for left bank running, right bank low. The running bank LED and screen valve graphic will indicate which bank is running, the pressure indicator, cylinder graphic and empty LED will indicate which bank is empty.

NOTE - If the line pressure drops below the low pressure alarm (see table 4 for reference) both banks will be opened in an attempt to rectify. Notification of this fault will be from the alarm outputs.

Table 7: Change cylinder alarm conditions

Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Immediately	Off
Pressure Fault	Off

Figure 26 - Right bank low, left bank running.



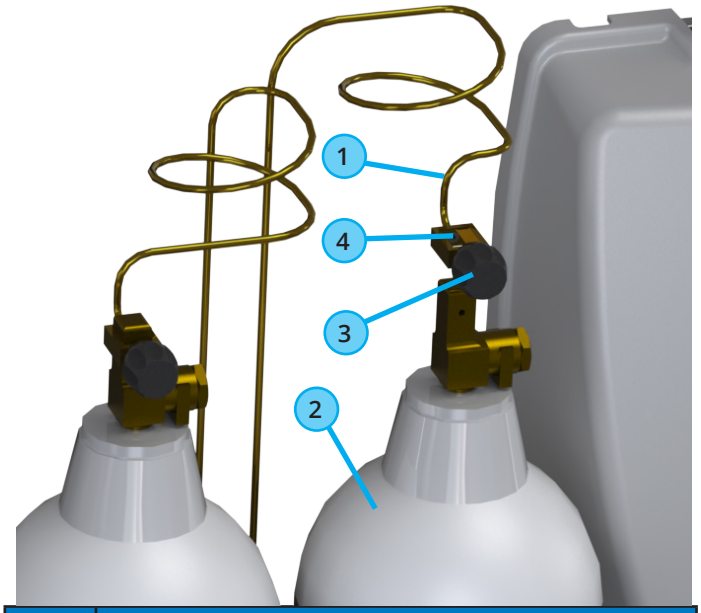
NOTE - This is providing the standby cylinders are full. If the standby cylinders are empty the manifold will automatically open both banks and the "Change Cylinders Immediately" alarm output will become active.

Table 8: Typical cylinder bank changeover pressure.

Nominal Supply pressure	Typical Cylinder changeover
4 Bar	15 Bar
8 Bar	20 Bar
11 Bar	20 Bar

4.6.3 For each empty cylinder, disconnect the tailpipe from the cylinder (see figure 27) by either undoing the hand wheel or unscrewing the nut at the cylinder end, depending on the cylinder connection type.

Figure 27 - Typical cylinder connection.



Item	Description
1	Tail Pipe
2	Medical Gas Cylinder
3	Tailpipe Pin Index Connection to Cylinder
4	Bodok Seal

4.6.4 Replace the empty cylinder and reconnect the tailpipes. The empty cylinder status on the screen and LED will automatically return to normal.

4.6.5 Repeat steps 4.6.3 & 4.6.4 for all the empty cylinders one at a time till all have been replaced.

NOTE - The tailpipe non-return valves are not totally leak tight, therefore to reduce potential gas leakage while changing empty cylinders, ensure all cylinders have been changed before opening the cylinder valves.

4.6.6 Slowly open the cylinder valves (see section 4.10 - Cylinder operation) for all the newly replaced cylinders.

4.6.7 Repeat this section each time the running bank drops to the changeover pressure until the main supply is fully operational.

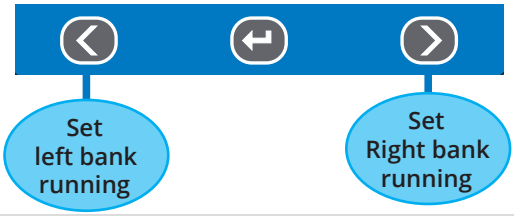
4.7 Procedure for Manual Cylinder Bank Changeover.

4.7.1 To manually cycle the cylinder banks press the left or right bank switch, see figure 28.

4.7.2 Changing empty cylinders is as per section 4.6

NOTE - If the selected cylinder bank is low pressure, the

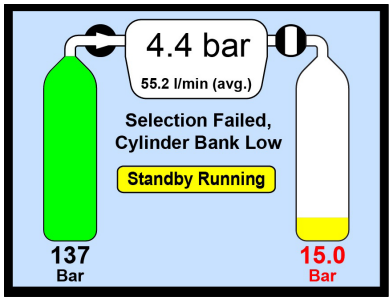
Figure 28 - Manual cylinder bank selection.



selection will not action and show the typical message on screen as shown in figure 29.

4.8 Procedure for operation during power failure.

Figure 29 - Change bank lock out, low cylinders



Typical screen message if operator attempts to change the running bank onto an empty bank of cylinders.

4.8.1 Refer to hospital policy for actions regarding the medical gas supply during the event of electrical power failure.

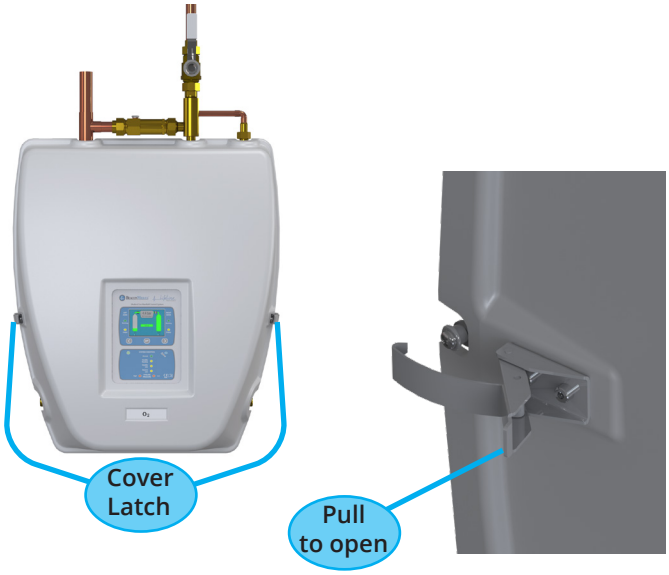
⚠ CAUTION! During power failure the electronic controls will not be in operation, therefore the cylinder banks will not automatic changeover when the pressure has run down.

4.8.2 When the power is lost to the Lifeline manifold all alarm outputs will be active to bring attention to the unit, and both solenoid valves will be open.

NOTE - If the medical gas alarm system is also inoperable the manifold should always be monitored locally as remote status monitoring is lost.

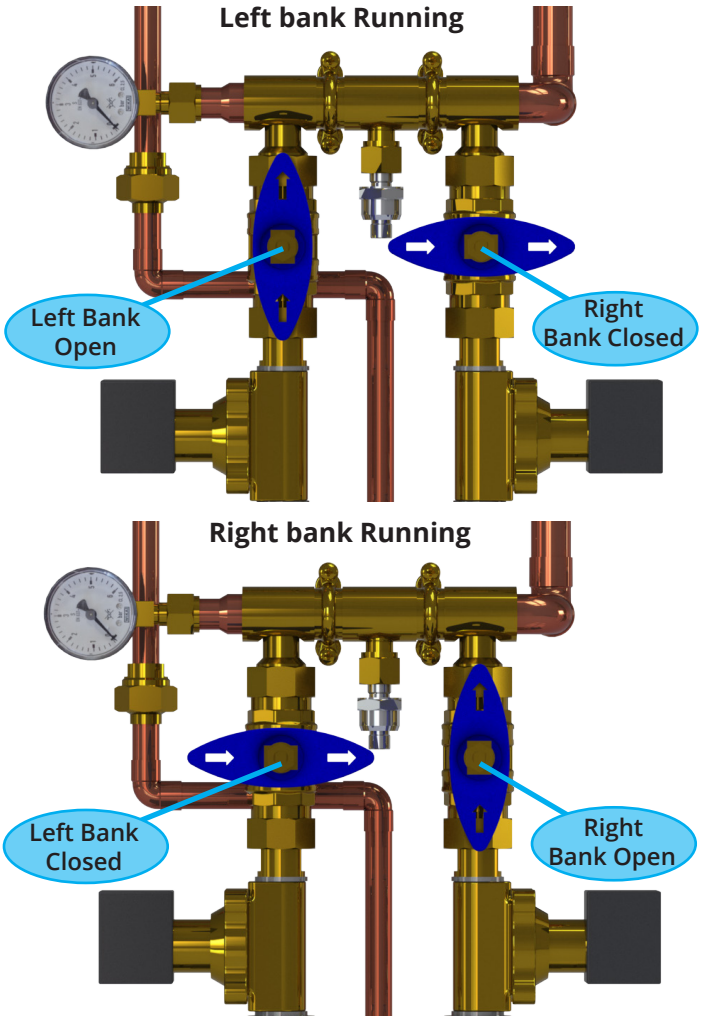
4.8.3 Remove the main cover by unclasping the 2 cover latches to gain access to the manual isolation valves. See figure 30.

Figure 30 - Main cover removal.



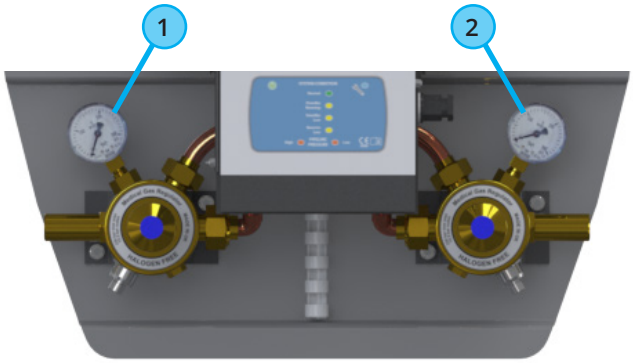
4.8.4 The running bank valve should be left open. Close the standby bank valve to ensure only one side is feeding gas to the pipeline. See figure 31.

Figure 31 - Manual bank isolation valves.



4.8.5 Monitor the bank gauges shown in figure 32 to determine the cylinder pressure stratus. Change banks when the pressure reaches typically 25 bar.

Figure 32 - Cylinder Bank Contents Gauges



Item	Description
1	Left Cylinder Bank Contents Gauge
2	Right Cylinder Bank Contents Gauge

4.8.6 When the running bank cylinder pressure reaches the changeover pressure open the standby bank valve, then close the empty bank.

⚠ CAUTION! To ensure continuous supply of the medical gas when manually controlling cylinder bank changeover from the isolation valves shown in figure 30, NEVER have both valves closed at the same time. Always open the next running bank first, before closing the empty bank ready for changing cylinders.

4.8.7 Changing empty cylinders is as per section 4.6

4.9 Typical Cylinder Handling Checklist.

⚠ CAUTION! Only persons who have had specific training in the safety of medical gases, manual handling techniques and cylinder changing procedures should be allowed to change cylinders on medical gas manifolds or medical equipment.

- Safety shoes should be worn at all times. When moving larger cylinders, wear heavy protective gloves (preferably textile or leather). Keep all items clean and grease/oil free.
- Do not smoke or use naked lights.
- When handling smaller cylinders, the use of protective gloves may be inconvenient. Extra care should be taken to avoid injury and to make sure that hands are free from oil or grease BEFORE the cylinders are handled.
- Do not knock cylinders against each other or other solid objects.
- Do not drop or drag the cylinders.
- Do not use cylinders as rollers or wheel chocks.
- Do not lift any cylinder by its valve or cap.
- Use appropriate trolley for larger cylinders.

4.10 Cylinder Operation.

⚠ CAUTION! Undue force should not be used to open or close cylinder valves, or to attach connectors to cylinders.

⚠ CAUTION! ALL cylinder valves should be opened gently. TAPPING the operating key GENTLY with a soft-faced (copper) mallet is acceptable but undue force should not be used. If it is obvious that injury or damage could arise from trying to open a sticking valve, the cylinder should be removed from service and returned to the supplier as a faulty cylinder.

⚠ CAUTION! Opening cylinder valves SLOWLY will prevent a sudden rise in pressure in the system. It is at this time when there will be most stress on components and when most explosions will occur due to adiabatic compression of any oil or grease that may be present.

4.10.1 The cylinder valve should be FULLY opened (slowly, anti-clockwise) using the appropriate cylinder key or hand wheel where fitted and then turned clockwise a quarter turn.

⚠ CAUTION! If there is any leakage of gas the cylinder should be removed from service and returned as faulty. DO NOT attempt to tighten gland nuts etc, as this may cause damage to the valve.

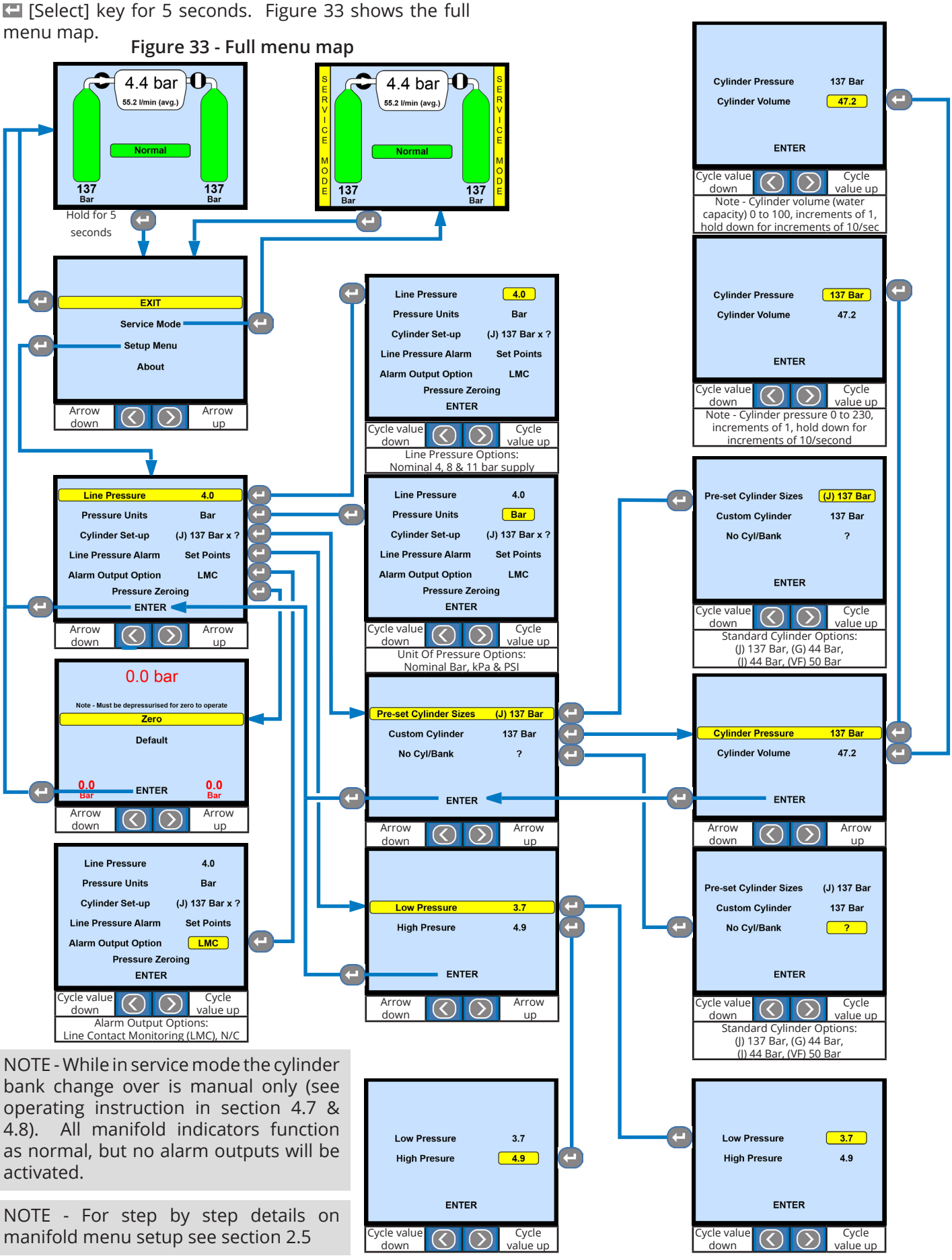
4.10.2 To close the valve, turn the spindle or hand wheel clockwise. Hand pressure only should be used to close the valve.

4.11 Lifeline MCS set-up menus.

Menu Controls			
Menu Navigation	Down Arrow	Select	Up Arrow

4.11.1 To access the setup menu screen hold down the [Select] key for 5 seconds. Figure 33 shows the full menu map.

Figure 33 - Full menu map



NOTE - While in service mode the cylinder bank change over is manual only (see operating instruction in section 4.7 & 4.8). All manifold indicators function as normal, but no alarm outputs will be activated.

NOTE - For step by step details on manifold menu setup see section 2.5

5. Maintenance Procedures.

A competent person who is conversant with the maintenance of high-pressure medical gas installations and any special national conditions, which may apply, must carry out all maintenance. Preventative maintenance contracts are available from BeaconMedæs for installations within the U.K. Overseas distributors will be able to supply similar contracts in other areas.

⚠ WARNING: Obtain a work permit (or equivalent for overseas) before commencing with any work on a medical gas installation.

5.1 Daily Inspection.

5.1.1 Check visual indicators for correct function and damage, see section 4 figure 24 for reference.

5.1.2 If the Lifeline MCS is being used as an emergency backup manifold, and either cylinder bank is observed to be low pressure, replacements for empty cylinders should be made available immediately.

5.1.3 Check manifold pressure gauges for abnormal conditions, see section 4 figure 24 for reference.

5.1.4 Check manifold for unusual noises or vibrations.

5.2 Weekly.

5.2.1 Check that all cylinders are properly secured and that batch labels are correct and in date. Replace as necessary, see section 4.9 for reference.

5.3 Quarterly.

⚠ CAUTION! Before exhausting anaesthetic and oxygen gas from the manifolds during these inspections, ensure that the manifold room is well ventilated and no potential ignition sources are present. Oxygen can be absorbed into clothing etc., so once the test is complete it would be recommended to spend at least 20 minutes outdoors to ensure any potential oxygen absorbed into clothing has released. During this time stay away from naked flame, do not smoke etc. Do not perform these test unless the risks can be kept within an acceptable level.

5.3.1 Pressure and Function Inspection.

5.3.2 Check the line pressure on the running cylinder bank is normal, typically as per section 4.1 table 6. See section 4.5 if adjustments are required.

5.3.3 Switch the supply over to the standby cylinder bank (see section 4.7, figure 28), and check the line pressure is still within normal supply. See section 4.5 if adjustments are required.

5.3.3.1 Switch the cylinder bank back to the original running bank.

NOTE - Step 5.3.2 is only for Lifeline MCS that are used as emergency backup supply.

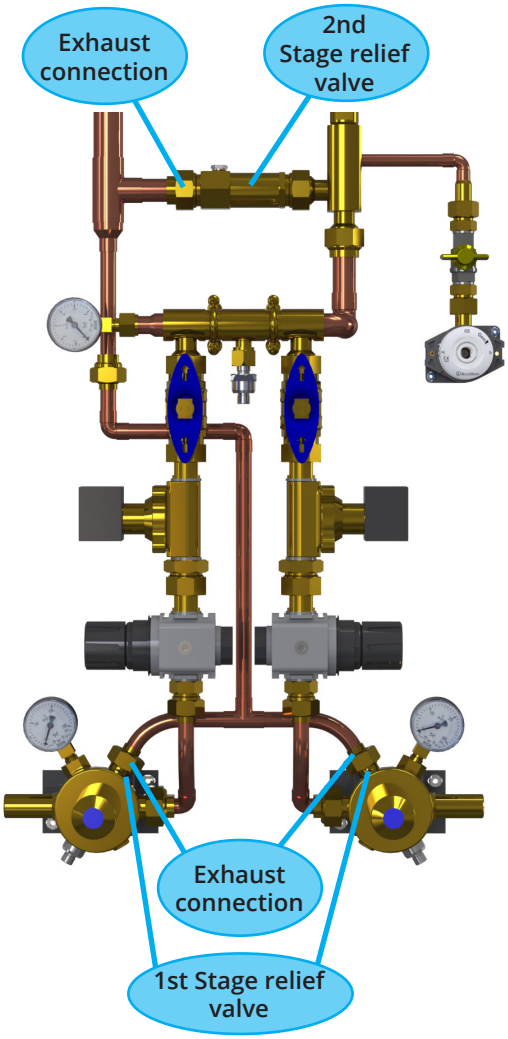
5.3.4 Supply Status Inspection.
(Only perform this step if the manifold is used as an emergency backup supply).

5.3.4.1 Close the line isolating valve (item 6, figure 1) on the manifold slowly and confirm that there is no effect on the line pressure to the hospital. Open the isolation valve when finished.

NOTE - If the line pressure significantly dropped setting off the low line pressure alarm during this inspection, investigate the status of the primary gas supply system.

5.3.5 Check that the manifold safety valves are not passing by disconnecting the downstream exhaust coupling and inspecting for a gas leak Also check the condition of the seals (See figure 34). Replace the valve or seals as necessary, see section 6 for component replacement procedures. Reconnect the exhaust pipework, ensure the O-ring seals correctly in place.

Figure 34 - Relief valve inspection.

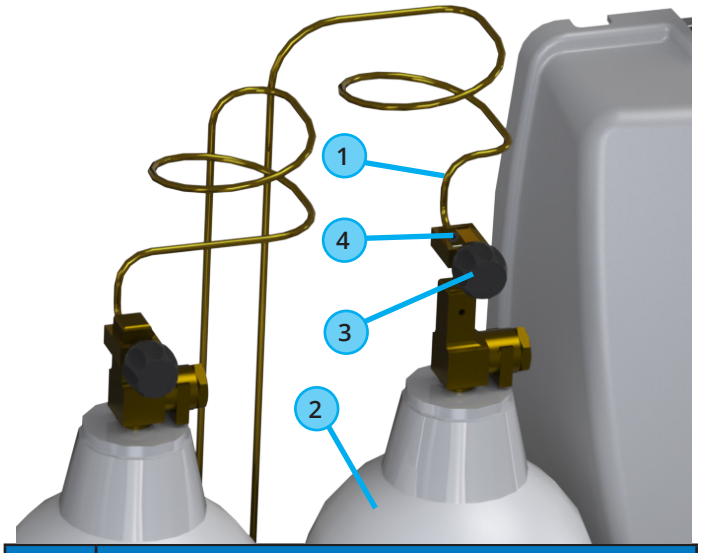


NOTE - If any parts are identified as faulty, see section 6 for replacement procedures.

5.3.4 Cylinder header non-return valve inspection.

5.3.4.1 Close one cylinder valve and disconnect the tailpipe at the cylinder end (see figure 35). Listen for a leak from the tailpipe. A minor leak is permissible and likely but an obvious major leak denotes failure of the manifold non-return valve (NRV). If the latter happens, do not totally detach the tailpipe but instead retighten it and test other tailpipes in the same way. Any failed NRV's can be replaced after all cylinder valves have been closed and the system has been depressurised. Repeat this test when the new NRV's have been fitted.

Figure 35 - Typical cylinder connection



Item	Description
1	Tail Pipe
2	Medical Gas Cylinder
3	Tailpipe Pin Index Connection to Cylinder
4	Bodok Seal

NOTE - If any parts are identified as faulty, see section 6 for replacement procedures.

5.3.6 To test the "reserve low"

5.3.6.1 To simulate the "reserve low" fault disconnect one of the wires to the "Reserve Manifold Fault", see section 2.4 figure 8 for reference. Observe that the alarm fault becomes active. Reconnect the wire and observe the fault returns to normal.

5.3.6.2 See section 4.2 to bring the manifold back on line.

5.4 5 Years.

5.4.1 Replace the non-return valve, pressure safety valve for a new certified relief valve, medical terminal unit capsule and associated seals.

Table 9 give the part numbers for 5 year service kits that contain all the relevant parts.

During the 5 year maintenance it would be recommended to also replace the regulators, as the regulators are only an optional replacement they are not contained withing the 5 year kit and must be ordered separately. See sections 6 for component replacement procedures.

Table 9: 5 year service kits

Part number	Description
8102369640	4 Bar Manifold 5 Year Service Kit
8102369641	8 Bar Manifold 5 Year Service Kit
8102369642	11 Bar Manifold 5 Year Service Kit

5.4.2 Regulator part numbers can be found in section 7.3, table 13.

5.4.3 Further optional spares should be replaced during the 5 year service.

5.4.4 With the main cover removed, open the electrical enclosure. Using a conductor, connect P14 jumper pins together to reset the service light. Close the panel and re-fit the main cover.

Figure 35A - Resetting the service light

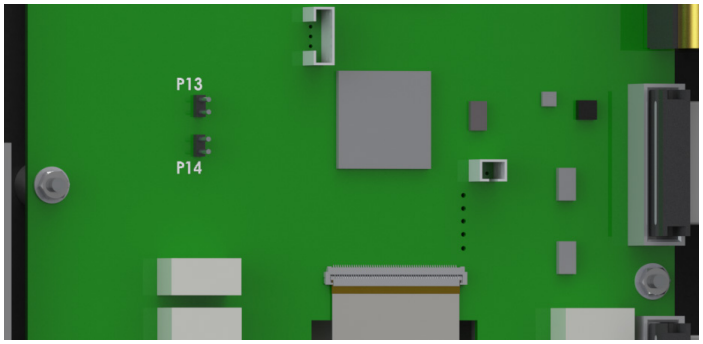


Table 10: Header Non-Return Valves

GAS Type	Part Number
Oxygen (O2)	2000288
Nitrous Oxide (N2O)	2000289
Oxygen/Nitrous Oxide (O2/N2O)	2000290
Medical Air / Surgical Air	2000291
Nitrogen (N2)	2000292
Carbon Dioxide (CO2)	2005850

NOTE - Quantities for the header non-return valves is 1 per cylinder connection.

5.5 As Required.

All other items are to be replaced as required.

NOTE - If any parts are identified as faulty, see section 6 for replacement procedures.

6. Component Replacement Procedures.

⚠ WARNING! It is essential that only genuine BeaconMedæs spare parts are fitted during maintenance.

⚠ CAUTION! Ensure no contaminates, oil or grease come into contact with any of the gas connection/ internals.

6.5.1 Become familiarised with all associated procedures and ensure all requirement parts are available before carrying out any of the following procedures.

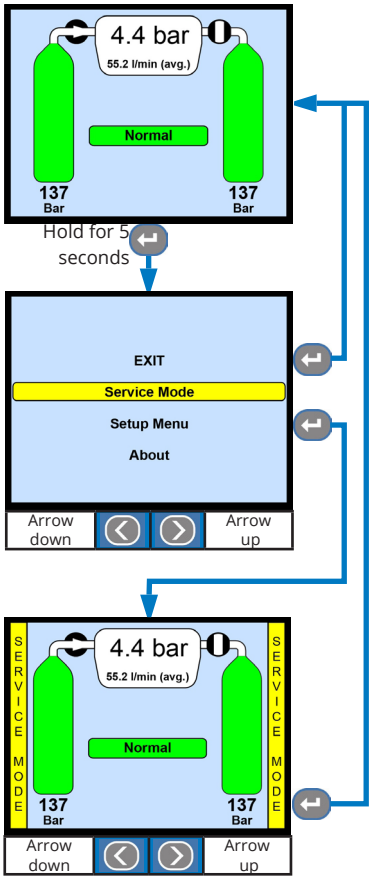
6.1 Optional Service Mode setting.

NOTE - This is an optional setting for servicing the manifold. While in service mode cylinder bank selection is manual only, and all the alarm outputs are deactivated and will appear as normal. All manifold indicators will function as normal.

6.1.1 To access the setup menu screen hold down the ↵ [Select] key for 5 seconds, and follow the steps in figure 36.

Figure 36 - Service Mode Option.

1. Hold down the ↵ [Select] key for 5 seconds to access the set-up menu



2. Scroll down to the Service Mode option using the ← [Left Arrow] key, then press ↵ [Select] key.

NOTE - Pressing ↵ [Select] with the Exit highlighted will take you back to the operating screen.

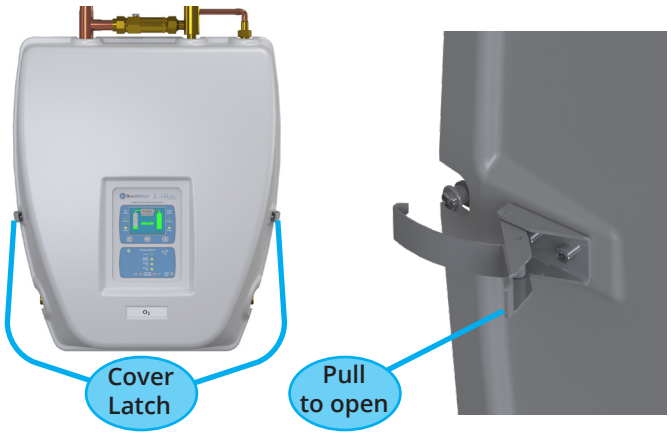
3. To return to normal operation press the ↵ [Select] key.

6.2 Preparation For Component Replacement requiring total manifold isolation.

6.2.1 Ensure alternative gas supply is available and functioning before taking the Lifeline MCS off line.

6.2.2 Remove the front cover by opening the latches as shown in figure 37, and lift away.

Figure 37 - Main cover removal.



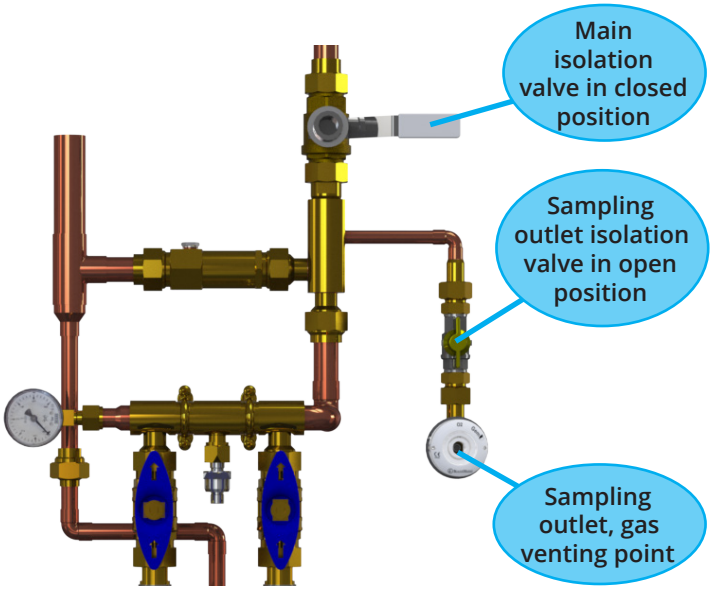
6.2.3 Close the line isolation valve as shown in figure 38, and close all the cylinder valves.

6.2.4 Open the sampling outlet isolation valve as shown in figure 38, and probe the outlet to depressurise the system.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the cylinder contents gauges are not rapidly dropping in pressure, stop draining the system and check all cylinders are correctly isolated.

Figure 38 - Valve isolation and pressure draining.



6.4 Preparation for component replacement requiring single cylinder bank isolation.

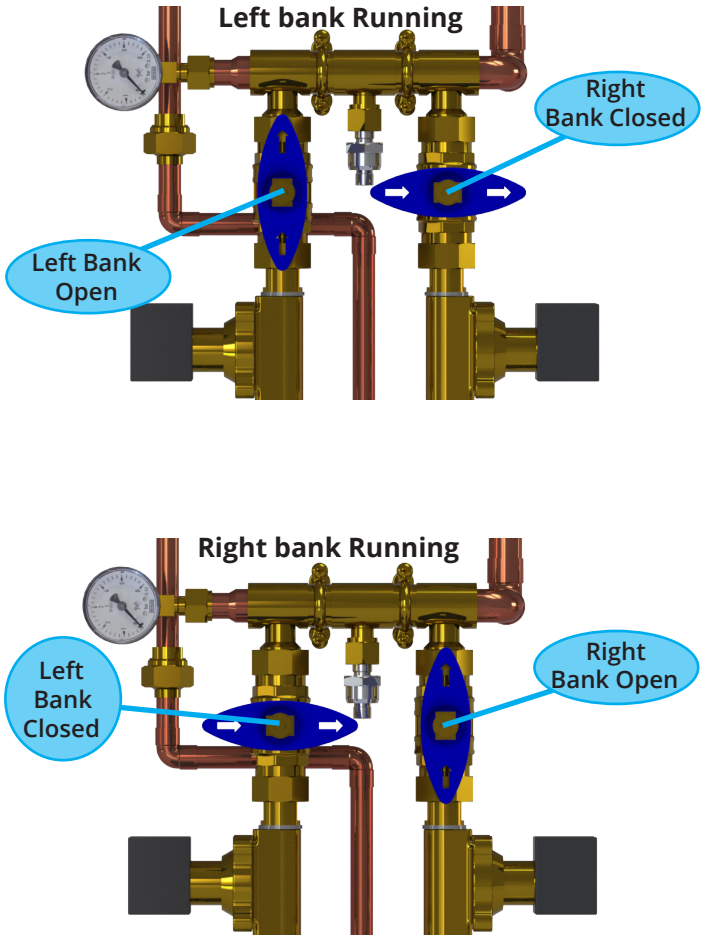
NOTE - If the service being carried out will require purging the manifold before bringing back on line it would be recommended to fully isolate manifold as in section 6.2.

6.4.1 Ensure there is adequate gas remaining in the cylinder bank that will be running during the maintenance procedure. Also ensure alternative gas supply is available and functioning incase maintenance period runs on longer than expected, before taking the Lifeline MCS cylinder bank off line.

6.4.2 Remove the front cover by opening the latches as shown in figure 37, and lift away.

6.4.3 Close the bank isolation valve as shown in figure 39 for the relevant side to be serviced, and close all the cylinder valves on the same bank.

Figure 39 - Cylinder bank isolation.



6.3 Replace line non-return valve.

Kit P/N: 8102369643.

NOTE - Non-return valve replacement requires total isolation of the manifold.

6.3.1 If the optional service mode running is to be used during maintenance complete steps in 6.1.

6.3.2 Complete the steps in 6.2 to isolate and depressurise the manifold ready for maintenance.

6.3.3 Slowly turn the swivel nut of the top 1" connection. If you hear gas escaping do not fully unscrew the joint, refer back to section 6.2 to ensure the system is fully drained.

6.3.4 Fully disconnect all 4 joints as shown in figure 40 and gently remove the unit by sliding it towards you. Take care not to damage the seals.

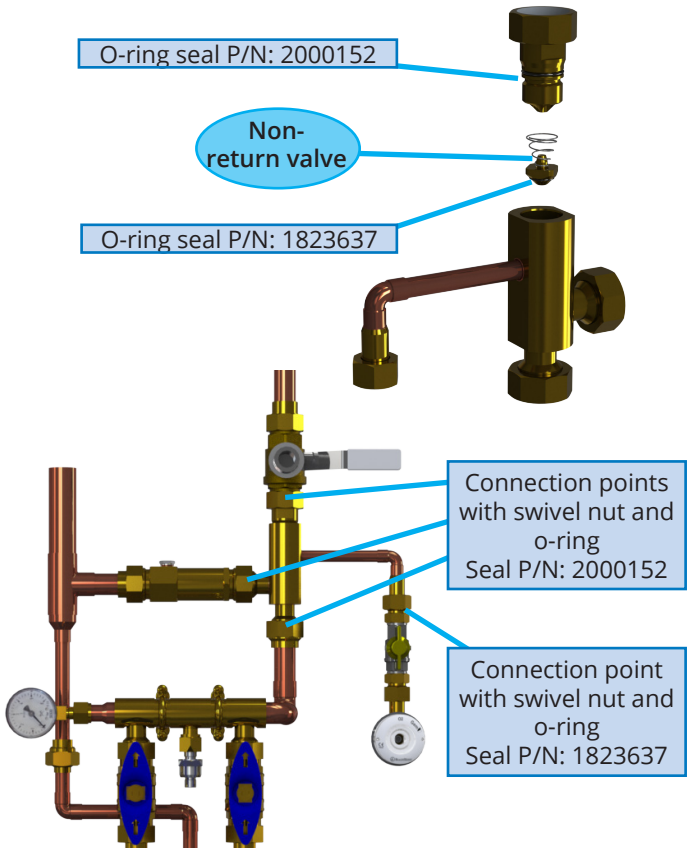
Replace the inner check valve components as shown in figure 40.

6.3.5 Inspect the existing seals and replace if required, see figure 40 for seal part numbers.

6.3.6 Re-connect the non-return valve assembly as shown in figure 40.

6.3.7 Follow section 6.19 to bring the manifold back on line.

Figure 40 - Non-return valve replacement.



6.5 Replace 2nd stage line pressure regulator.

Regulator part numbers as follows (Excludes N2O & CO2):

Nominal Pressure	Part Number
4 Bar	4233400126
8 Bar	2005690
11 Bar	2005691

Part number for replacement regulator kit for N2O & CO2:

Description	Part Number
Regulator Kit	4233400113

NOTE - Regulator replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

6.5.1 If the optional service mode running is to be used during maintenance complete steps in 6.1.

6.5.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.5.3 Slowly turn the fitting marked “venting point” in figure 41 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the cylinder contents gauge is not rapidly dropping in pressure, stop draining the system and check all cylinders are correctly isolated.

6.5.4 Once all the gas has been vented, fully disconnect the regulator from the fittings marked in figure 41.

6.5.5 Remove the 2 fittings as shown in figure 41 from the old regulator, including bonded seals.

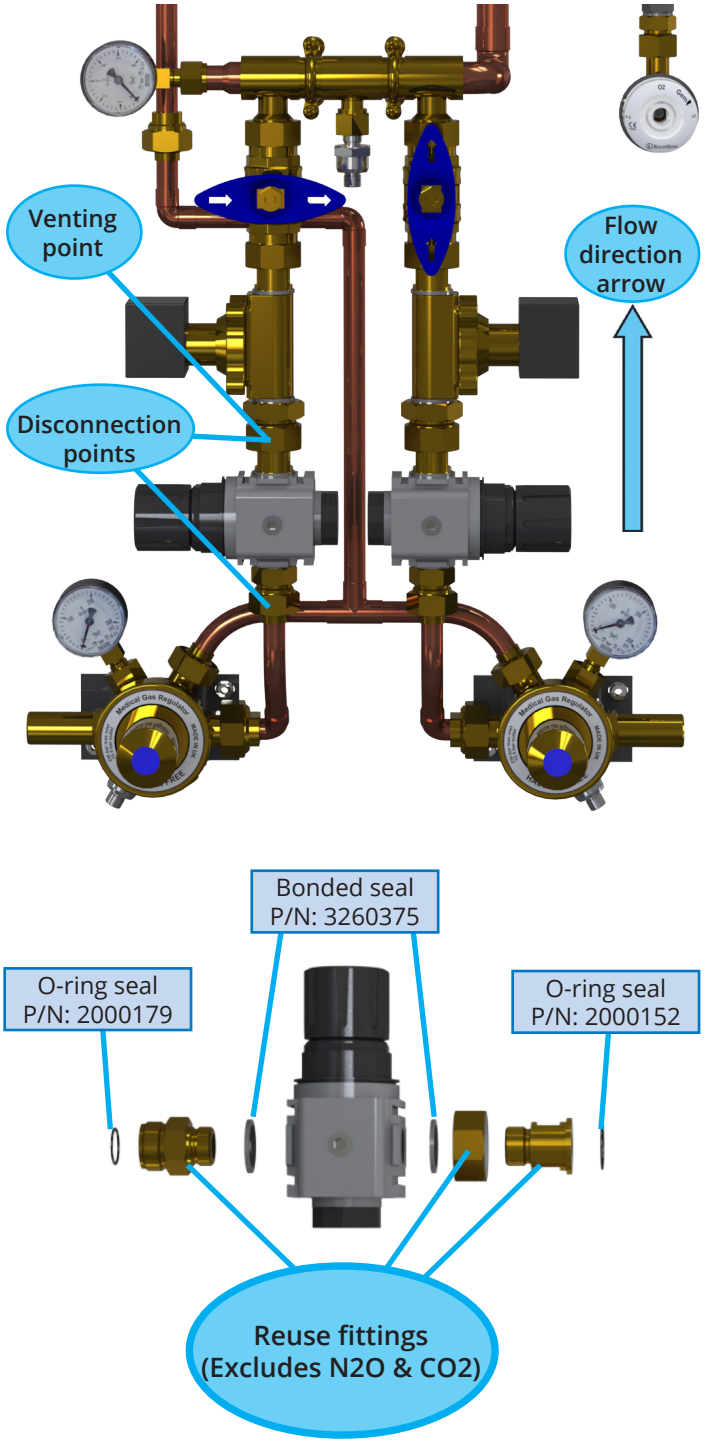
6.5.6 Inspect the existing seals and replace if required, see figure 41 for seal part numbers.

6.5.7 Connect the fittings and seals from the old regulator to the new, then fit the new regulator to the manifold as per the old unit, check that the flow arrow marked on the regulator is in the correct direction.

6.5.8 Follow section 6.19 or 6.20 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

Figure 41 - 2nd stage regulator replacement.

NOTE - Figure 41 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



6.6 Replace 1st Stage cylinder Regulator.

Regulator P/N: 2005383.

NOTE - Regulator replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

6.6.1 If the optional service mode running is to be used during maintenance complete steps in 6.1.

6.6.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.6.3 Slowly turn the fitting marked “venting point” in figure 42 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the cylinder contents gauge is not rapidly dropping in pressure, stop draining the system and check all cylinders are correctly isolated.

6.6.4 Once all the gas has been vented, fully disconnect the regulator from the fittings marked in figure 42. Then disconnect the M6 flange nuts holding the mounting bracket to remove the regulator from the manifold.

6.6.5 Remove the fittings, seals, mounting bracket and fasteners etc from the old regulator as shown in figure 42.

NOTE - Do not disconnect the gauge from the fitting, disconnect with the fitting to be reused.

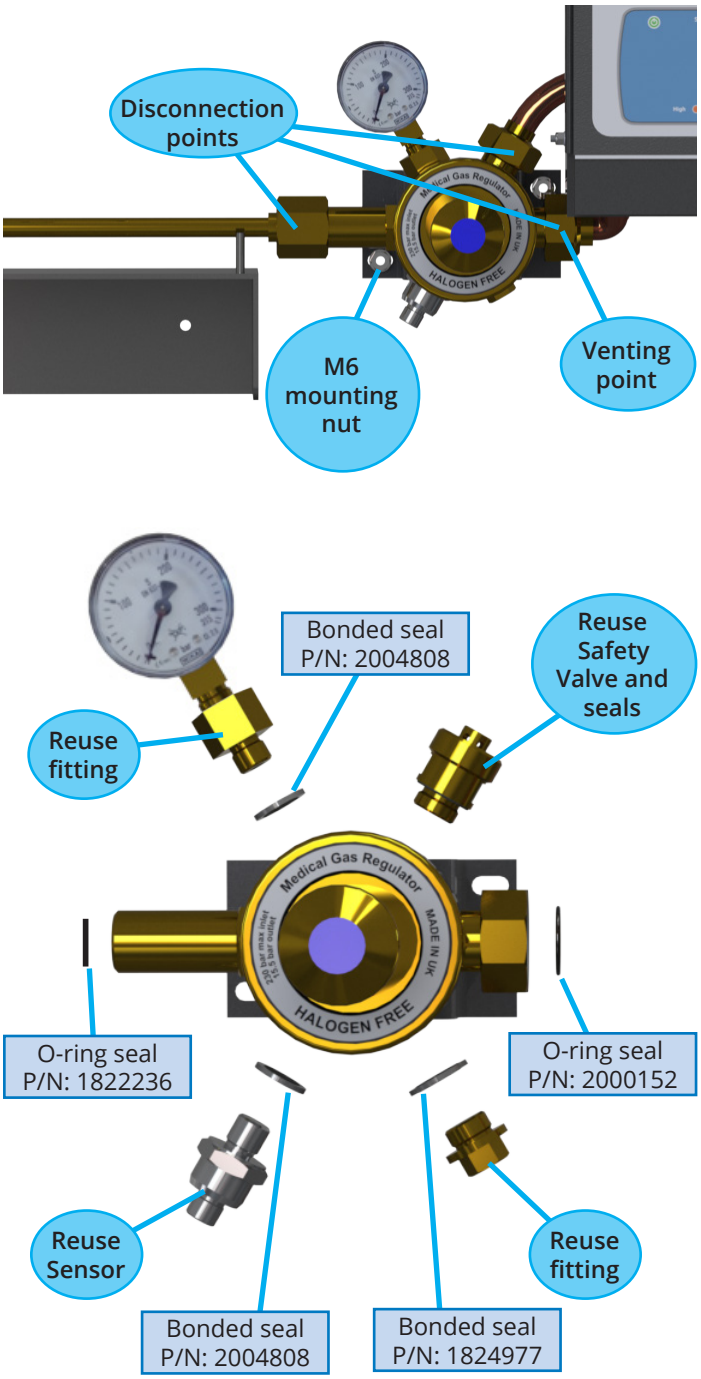
6.6.6 Inspect the existing seals and replace if required, see figure 42 for seal part numbers.

6.6.7 Connect the fittings, seals, mounting bracket and fasteners etc from the old regulator to the new, then fit the new regulator as per the old unit, shown in figure 42.

6.6.8 Follow section 6.19 or 6.20 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

Figure 42 - 1st stage regulator replacement.

NOTE - Figure 42 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



NOTE - Fasteners to disconnect the mounting bracket from the regulator can be found on the underside.

6.8 Replace 2nd stage pressure relief valve.

Relief valve part numbers as follows:

Nominal Pressure	Set Point	Part number
4 Bar	5.3 bar	2000122
8 Bar	11 bar	2000123
11 Bar	13 bar	2000140

NOTE - 2nd stage pressure relief valve replacement requires total isolation of the manifold.

6.8.1 If the optional service mode running is to be used during maintenance complete steps in 6.1.

6.8.2 Complete the steps in 6.2 to isolate and depressurise the manifold ready for maintenance.

6.8.3 Slowly turn the swivel nut of the 1" connection at the right hand side, see figure 43. If you hear gas escaping do not fully unscrew the joint, refer back to section 6.2 to ensure the system is fully drained.

6.8.4 Fully disconnect all joints as shown in figure 43 and gently remove the unit by sliding it towards you. Take care not to damage the seals.

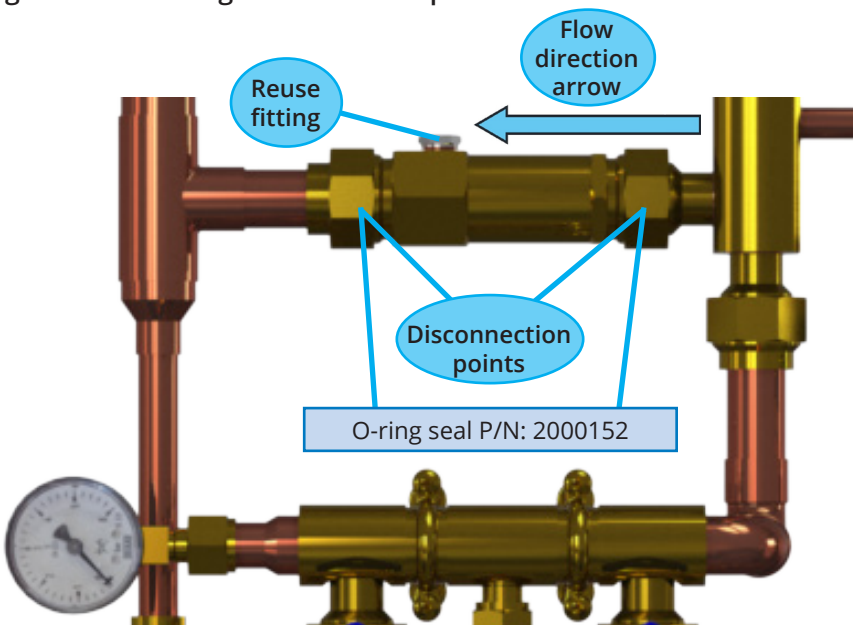
6.8.5 Inspect the existing seals and replace if required, see figure 43 for seal part numbers.

6.8.6 Remove the 1/8" blanking plug from the old relief valve and fit to the new.

6.8.7 Fit the new relief valve, ensure the directions arrow is as per figure 43.

6.8.8 Follow section 6.19 to bring the manifold back on line.

Figure 43 - 2nd stage relief valve replacement.



6.7 Replace 1st stage pressure relief valve.

Relief valve P/N: 2005383.

NOTE - 1st stage Relief valve replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

6.7.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.7.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.7.3 Slowly turn the fitting marked "venting point" in figure 44 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the cylinder contents gauges are not rapidly dropping in pressure, stop draining the system and check all cylinders are correctly isolated.

6.7.4 Once all the gas has been vented, fully disconnect the exhaust pipe from the fittings marked in figure 44.

6.7.5 Remove the relief valve.

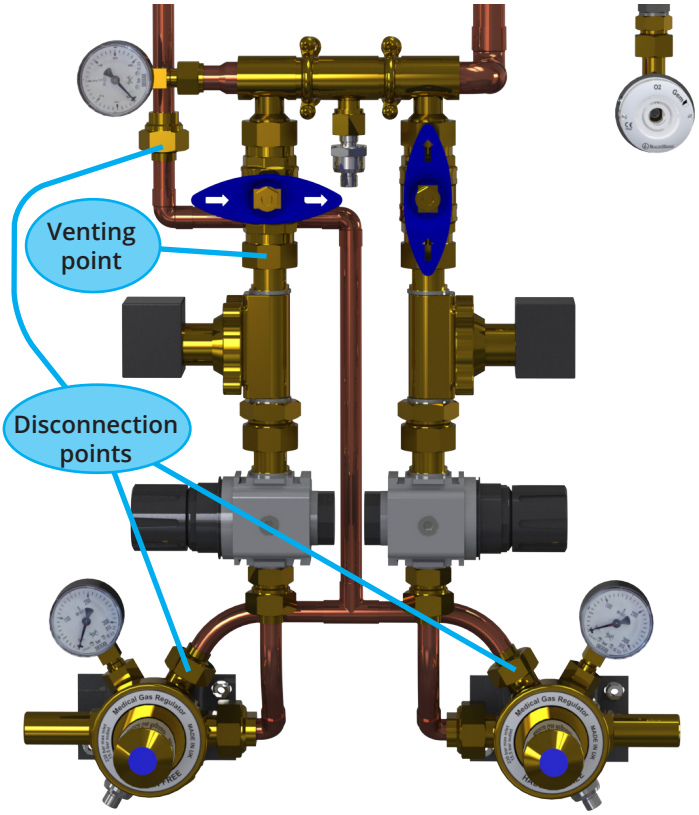
NOTE - 1st stage relief valve is supplied complete with new seals.

6.7.6 Connect the new relief valve, and re-connect the exhaust pipework. Tighten the vent point fitting.

6.7.7 Follow section 6.19 or 6.20 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

Figure 44 - 1st stage relief valve replacement.

NOTE - Figure 44 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



6.9 Replace solenoid valve.

Solenoid valve P/N: 5001178

NOTE - Solenoid replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

6.9.1 If the optional service mode running is to be used during maintenance complete steps in 6.1.

6.9.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.9.3 Slowly turn the fitting marked “venting point” in figure 45 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the cylinder contents gauge is not rapidly dropping in pressure, stop draining the system and check all cylinders are correctly isolated.

6.9.4 Once all the gas has been vented, fully disconnect the solenoid valve from the fittings marked in figure 45.

6.9.5 Disconnect the plug form the old solenoid valve by loosening the fastener on the end face, then pull away.

6.9.6 Disconnect the cables to the old plug and wire to the new.

6.9.7 Remove the 2 fittings as shown in figure 45 from the old solenoid valve, including seals.

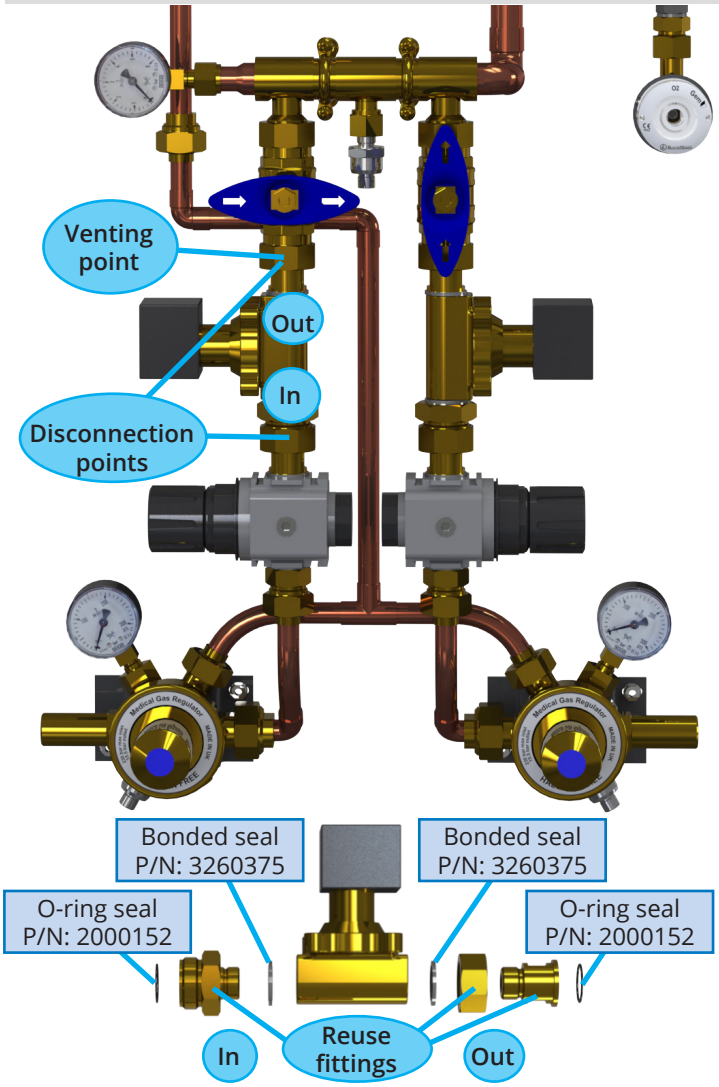
6.9.8 Inspect the existing seals and replace if required, see figure 45 for seal part numbers.

6.9.9 Connect the fittings and seals from the old solenoid valve to the new, then fit the new unit to the manifold as per the old, ensuring that the ‘IN’, ‘OUT’ markings are in the correct positions.

6.9.10 Follow section 6.19 or 6.20 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

Figure 45 - Solenoid valve replacement.

NOTE - Figure 45 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



6.10 Replace medical terminal unit test point.

Terminal unit part numbers as follows:

GAS Type	1st Fix	2nd Fix
Oxygen (O2)	2005810	8102371350
Nitrous Oxide (N2O)	2005811	8102371351
Oxygen/Nitrous Oxide (O2/N2O)	2005812	8102371352
Medical Air	2005813	8102371353
Surgical Air	2005814	8102371354
Nitrogen (N2)	2005816	8102340206
Carbon Dioxide (CO2)	2005815	8102340207

NOTE - The terminal unit test point has its own isolation valve, so the manifold can continue to function as normal while maintaining this unit.

6.10.1 Isolated the terminal unit from the valve shown in figure 46.

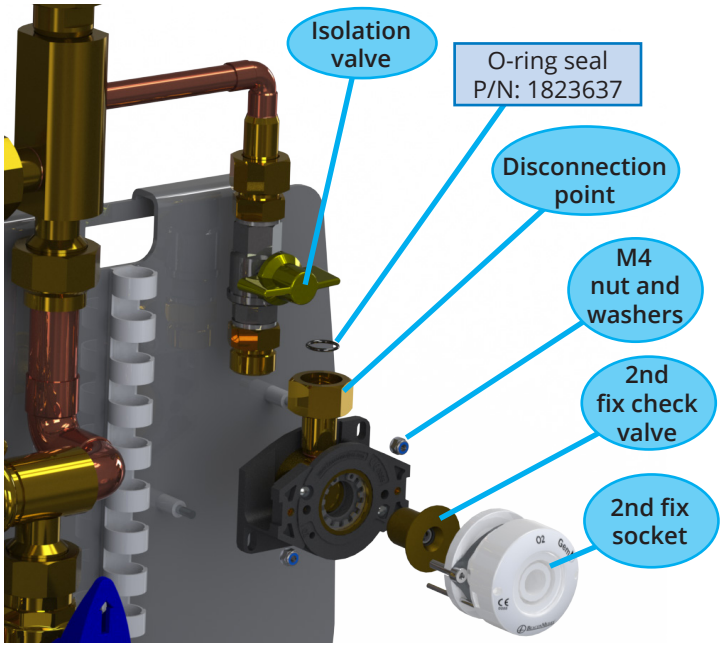
6.10.2 Probe the terminal unit to vent the gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the unit is not fully vented after a few seconds, ensure the isolation valve is closed.

6.10.3 Follow sets in 6.10.4 to replace the complete terminal unit, 6.10.5 for 1st fix only or 6.10.6 for 2nd fix only.

Figure 46 - Terminal unit test point replacement.



NOTE - Isolation valve is shown in its closed position.

6.10.4 Replace the complete terminal unit, see figure 46 for reference.

- Disconnect the 1/2" connection and remove the 2 x M4 nuts and washer.
- Inspect the existing seals and replace if required, see figure 46 for seal part numbers.

⚠ CAUTION! Ensure the replacement unit is the correct gas type.

- Align the new 1st fix with the 1/2" connection, ensure the O-ring is correctly fitted then tighten the connection point.
- Secure the 1st fix in place with the previously removed M4 nut and washers.
- Insert the check valve into the 1st fix, supplied with the new 2nd fix.
- Thread the Allen key tool through the 2nd fix socket to the fasteners. Fasten the 2nd fix to the first fix terminal unit.
- Open the test point isolation valve and probe the terminal unit to ensure there is gas flow.
- Close the terminal unit isolation valve.

6.10.5 Replacing the 1st fix terminal unit only, see figure 46 for reference.

- Thread an Allen key tool through the 2nd fix to the fasteners. Unfasten the 2nd fix socket from the 1st fix terminal unit.
- Remove the check valve from the 1st fix terminal unit.
- Disconnect the 1/2" connection and remove the 2 x M4 nuts and washer.
- Inspect the existing seals and replace if required, see figure 46 for seal part numbers.

⚠ CAUTION! Ensure the replacement unit is the correct gas type.

- Aline the new 1st fix with the 1/2" connection, ensure the O-ring is correctly fitted then tighten the connection point.
- Secure the 1st fix in place with the previously removed M4 nut and washers.
- Insert the check valve from the old unit into the new 1st fix.

- Thread an Allen key tool through the old 2nd fix socket to the fasteners. Fasten the 2nd fix to the first fix terminal unit.
- Open the test point isolation valve and probe the terminal unit to ensure there is gas flow.
- Close the terminal unit isolation valve.

6.10.6 Replacing the 2nd fix terminal unit only, see figure 46 for reference.

- Thread an Allen key tool through the 2nd fix socket to the fasteners. Unfasten the 2nd fix from the 1st fix terminal unit.
- Remove the check valve from the 1st fix terminal unit.

⚠ CAUTION! Ensure the replacement unit is the correct gas type.

- Insert the check valve into the 1st fix, supplied with the new 2nd fix.
- Thread an Allen key tool through the new 2nd fix socket to the fasteners. Fasten the 2nd fix to the first fix terminal unit.
- Open the test point isolation valve and probe the terminal unit to ensure there is gas flow.
- Close the terminal unit isolation valve.

6.11 Replace sensor for distribution system pressure.

Line pressure sensor P/N: 6070002298

NOTE - The line pressure sensor is fitted to a minimum leak connector, therefore the system does not need to be vented for maintaining this item.

NOTE - While the sensor is disconnected the manifold will operate as though line pressure is low. To avoid this set the manifold to service mode.

6.11.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.11.2 Although the sensor is connected to a minimum leak connection allowing safe disconnection while the system is pressured, it might still be preferred to work on the manifold totally isolated and depressurised, in which case follow steps in 6.2.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

6.11.3 Disconnect the sensor cables where shown in figure 47.

6.11.4 Disconnect the sensor where shown in figure 47.

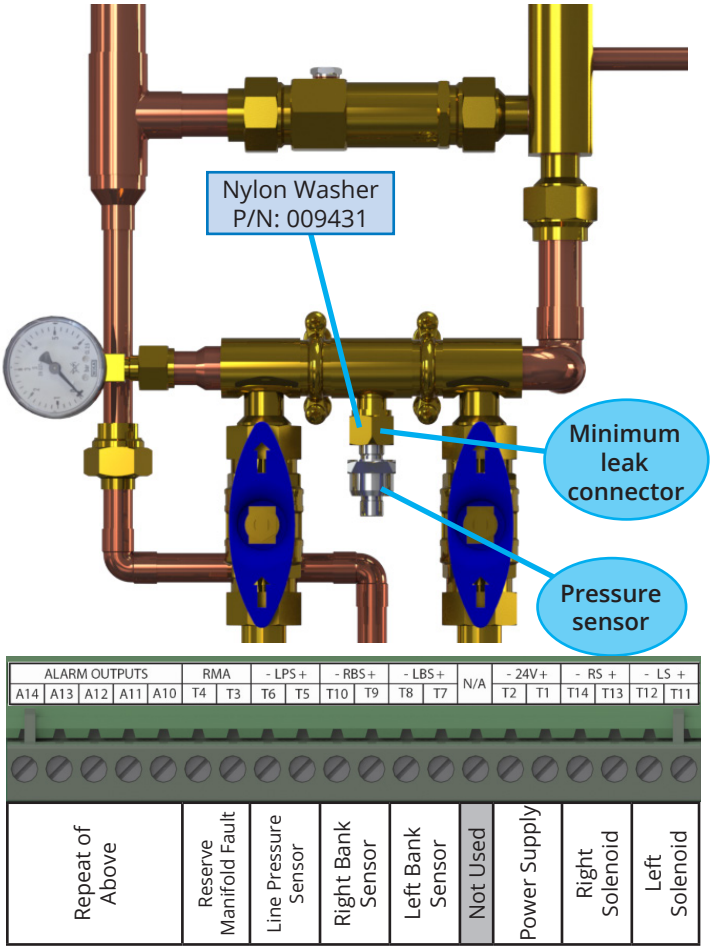
6.11.5 Inspect the sealing washer and re-use/replace as required.

6.11.5 Balance the sealing washer on the nipple at the end of the sensor's connector, and fit to the minimum leak fitting.

6.11.6 Route the cable as per the old sensor and connect to the terminals shown in figure 47.

6.11.7 If this operation was performed with the manifold fully isolated and drained follow section 6.2 to bring the manifold back on line. If this operation was performed with the service mode in operation, press the ↵ [Select] key to return the controls to normal running.

Figure 47 - Line pressure sensor replacement.



Sensor wiring is as follows:

Terminal	Cable colour
T5	Brown
T6	Green
N/A	White (not used)

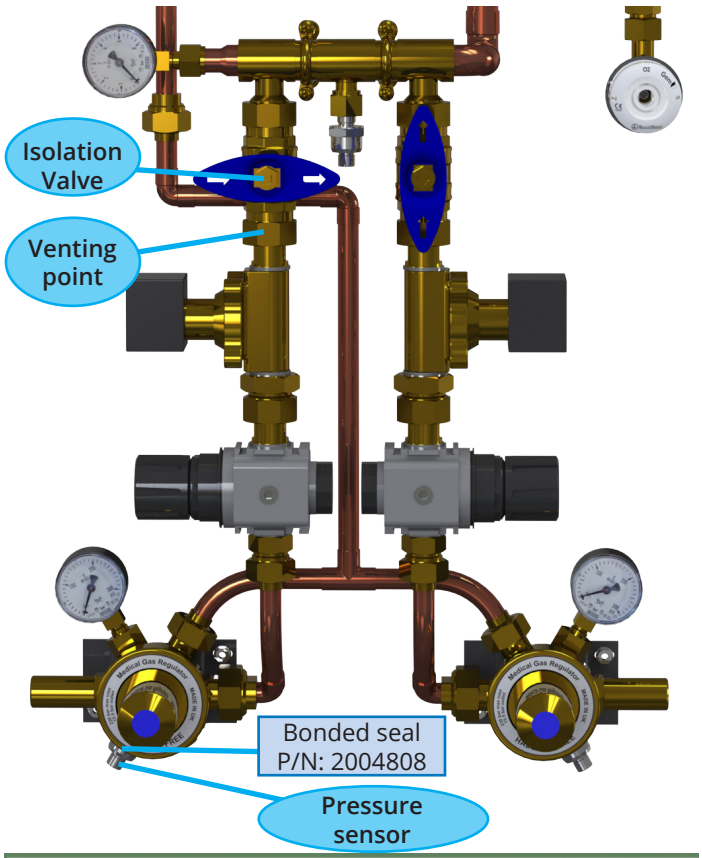
6.12 Replace sensor for cylinder pressure.

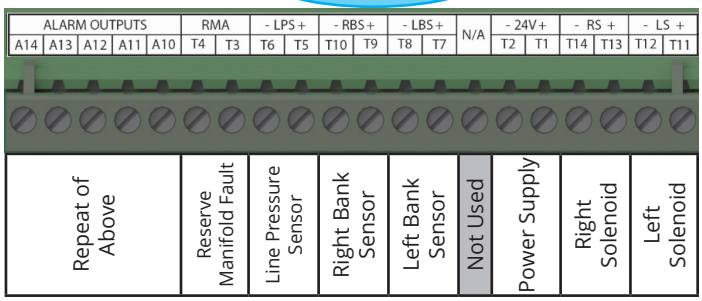
Cylinder pressure sensor P/N: 6070002300

NOTE - Cylinder pressure sensor replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

Figure 48 - Cylinder pressure sensor replacement.

NOTE - Figure 48 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.





Sensor wiring is as follows:

Left Bank Sensor		Right Bank Sensor	
Terminal	Cable colour	Terminal	Cable colour
T7	Brown	T9	Brown
T8	Green	T10	Green
N/A	White (not used)	N/A	White (not used)

6.12.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.12.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.12.3 Slowly turn the fitting marked “venting point” in figure 48 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

6.12.4 Disconnect the sensor cables where shown in figure 48.

6.12.5 Disconnect the sensor where shown in figure 48, if you hear gas venting, go back to steps 6.12.2 to assess the manifold is correctly isolated and depressurised.

6.12.6 Inspect the bonded seal and re-use/replace as required.

6.12.7 Balance the sealing washer on the nipple at the end of the sensor’s connector, and fit to the minimum leak fitting.

6.12.8 Route the cable as per the old sensor and connect to the terminals shown in figure 48.

6.12.9 Tighten the vent point fitting.

6.12.10 Follow section 6.19 or 6.20 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

6.13 Replace gauge for distribution system pressure.

Line pressure gauge part numbers as follows:

Nominal Pressure	Part Number
4 Bar	6070002167
8 Bar	6070002168
11 Bar	6070002169

NOTE - The line pressure gauge is fitted to a minimum leak connector, therefore the system does not need to be vented for maintaining this item.

6.13.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.13.2 Although the gauge is connected to a minimum leak connection allowing safe disconnection while the system is pressured, it might still be preferred to work on the manifold totally isolation and depressurised, in which case follow steps in 6.2.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

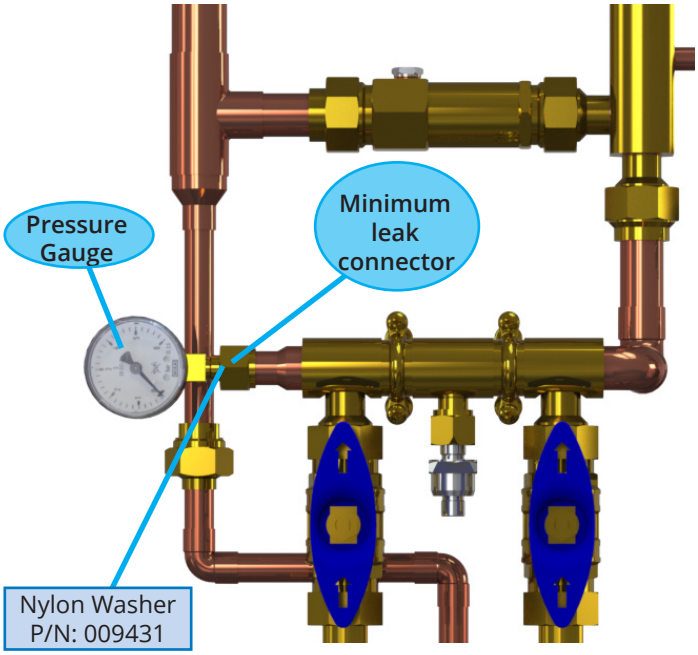
6.13.3 Disconnect the gauge where shown in figure 49.

6.13.4 Inspect the sealing washer and re-use/replace as required.

6.13.5 Balance the sealing washer on the nipple at the end of the gauge's connector, and fit to the minimum leak fitting.

6.13.6 If this operation was performed with the manifold fully isolated and drained follow section 6.19 to bring the manifold back on line. If this operation was performed with the service mode in operation, press the ↵ [Select] key to return the controls to normal running.

Figure 49 - Line pressure gauge replacement.



6.14 Replace gauge for cylinder pressure.

Cylinder pressure gauge part numbers as follows:

Scale Pressure	Part Number
0-100 Bar	6070002170
0-315 Bar	6070002171

NOTE - Cylinder pressure gauge replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

6.14.1 If the optional service mode running is to be used during maintenance complete steps in 6.1.

6.14.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.14.3 Slowly turn the fitting marked "venting point" in figure 50 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

6.14.4 Disconnect the gauge where shown in figure 50.

6.14.5 Inspect the sealing washer and re-use/replace as required.

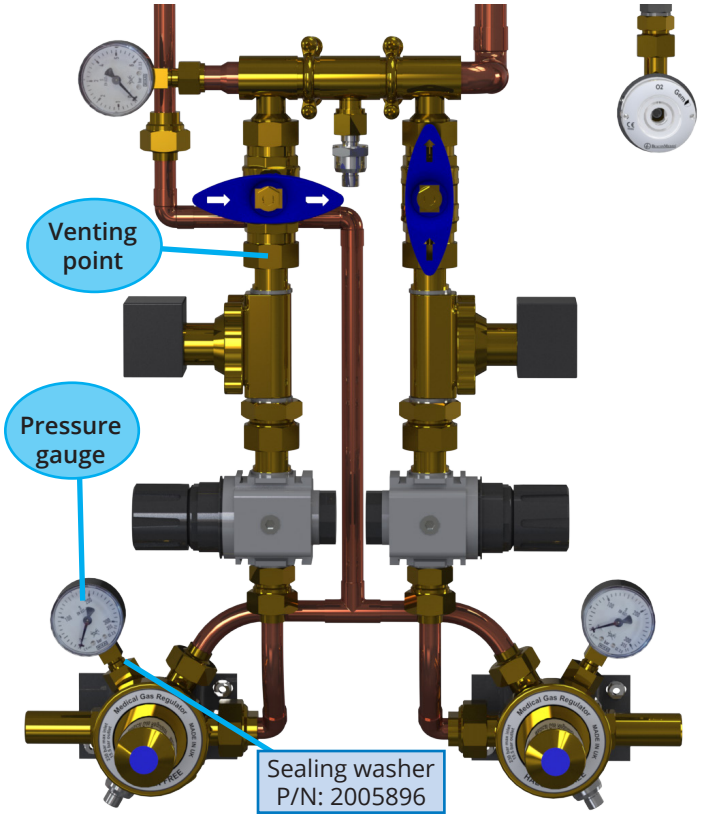
6.14.5 Balance the sealing washer on the nipple at the end of the gauge's connector, and fit to the minimum leak fitting.

6.14.6 Tighten the vent point fitting.

6.14.7 Follow section 6.19 or 6.20 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

Figure 50 - Cylinder pressure sensor replacement.

NOTE - Figure 50 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



6.15 Replace manual bank isolation valves.

Valve P/N: 2003911

NOTE - Bank valve replacement requires total isolation of the manifold.

6.15.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.15.2 Complete the steps in 6.2 to isolate and depressurise the manifold ready for maintenance.

6.15.3 Slowly turn the swivel nut of the top 1" connection see figure 51. If you hear gas escaping do not fully unscrew the joint, refer back to section 6.2 to ensure the system is fully drained.

6.15.4 Fully disconnect all joints as shown in figure 51 for the valve being replaced and gently remove the unit by sliding it towards you. Take care not to damage the seals.

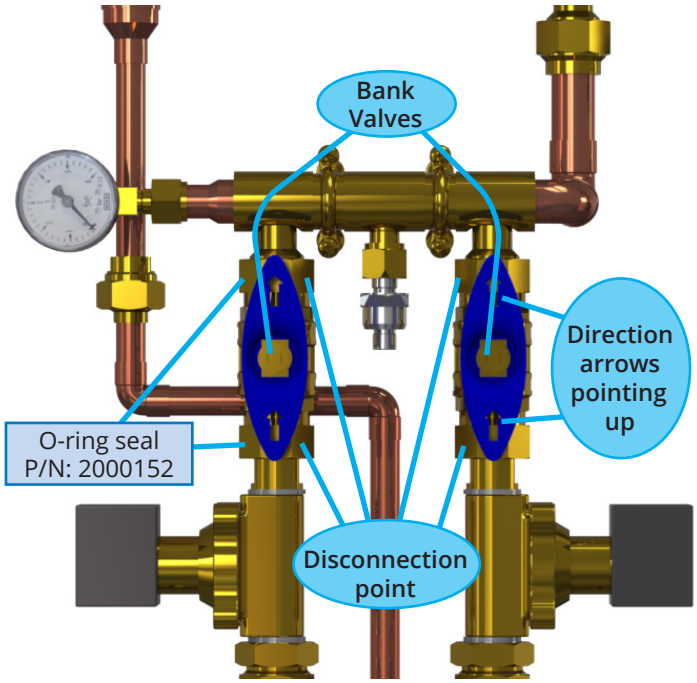
6.15.5 Inspect the existing seals and replace if required, see figure 51 for seal part numbers.

6.15.6 Unfasten the nut securing the handle on the old valve. Remove the hand, insert and washer and re-fit to the new valve.

6.15.7 Fit the new valve, ensure the directions arrows are as per figure 51.

6.15.8 Follow section 6.19 to bring the manifold back on line.

Figure 51 - Cylinder bank valve replacement.



6.16 Replace test point isolation valves.

Valve P/N: 2000172

NOTE - Test point valve replacement requires total isolation of the manifold.

6.16.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.16.2 Complete the steps in 6.2 to isolate and depressurise the manifold ready for maintenance.

6.16.3 Slowly turn the swivel nut of the top connection see figure 52. If you hear gas escaping do not fully unscrew the joint, refer back to section 6.2 to ensure the system is fully drained.

6.16.4 Fully disconnect all joints as shown in figure 52 and gently remove the unit by sliding it towards you. Take care not to damage the seals.

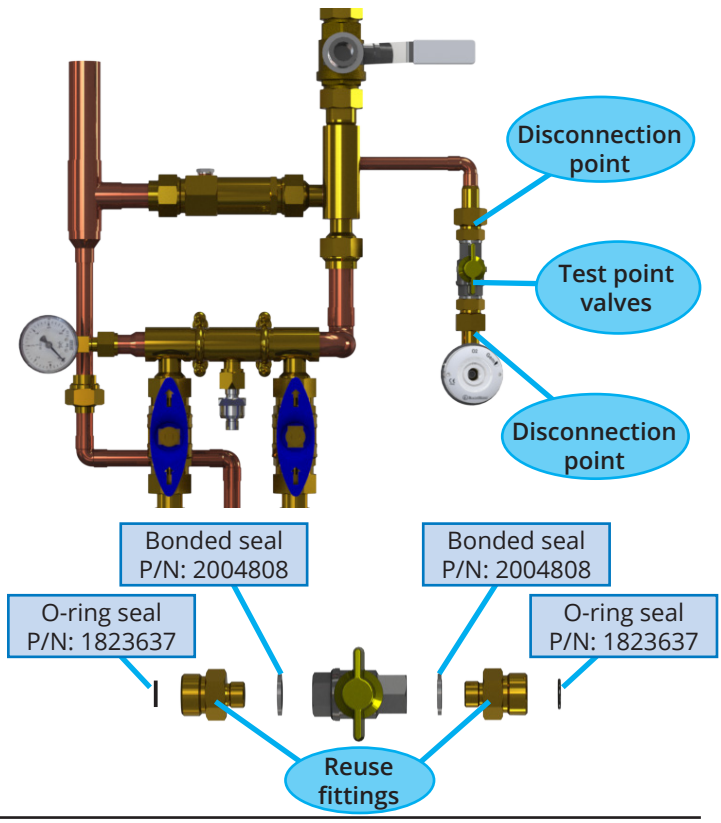
6.16.5 Inspect the existing seals and replace if required, see figure 52 for seal part numbers.

6.16.6 Remove the 2 fittings as shown in figure 45 from the old valve, including seals, and fit to the new.

6.16.7 Fit the new valve as per the old unit.

6.16.8 Follow section 6.19 to bring the manifold back on line.

Figure 52 - Test point valve replacement.



6.17 Manifold header non-return valves.

Header non-return valve:

GAS Type	Part Number
Oxygen (O2)	2000288
Nitrous Oxide (N2O)	2000289
Oxygen/Nitrous Oxide (O2/N2O)	2000290
Medical Air / Surgical Air	2000291
Nitrogen (N2)	2000292
Carbon Dioxide (CO2)	2005850

NOTE - Header non-return valve replacement can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

6.17.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.17.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred follow steps in 6.2.

6.17.3 Slowly turn the fitting marked “venting point” in figure 53 until there is a slow release of gas.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

NOTE - If the cylinder contents gauges are not rapidly dropping in pressure, stop draining the system and check all cylinders are correctly isolated.

6.17.4 Once all the gas has been vented, disconnect the tailpipe connection to the non-return valve that needs replacing.

6.17.5 Remove the non-return valve and O-ring seal.

NOTE - Non-return valve kit is supplied complete with new O-ring seal.

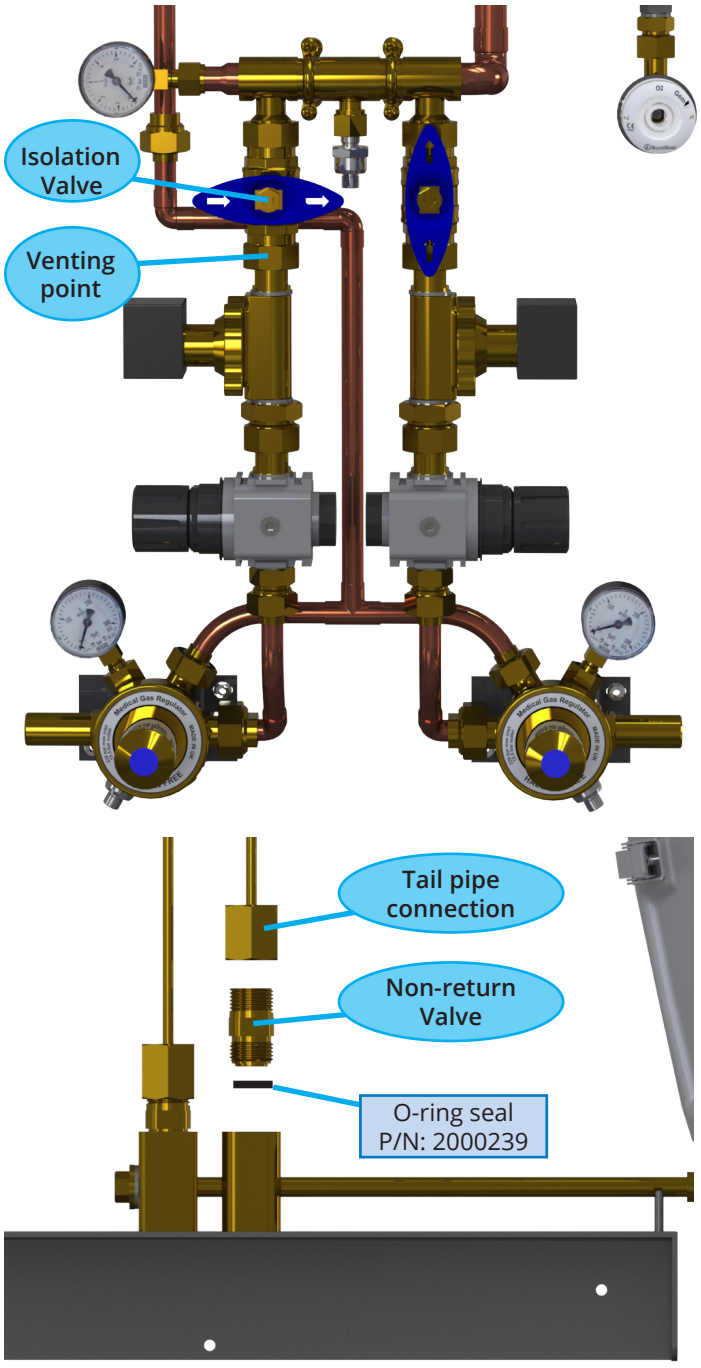
⚠ CAUTION! Ensure the replacement unit is the correct gas type.

6.17.6 Fit the new O-ring seal and connect the new non-return valve, and re-connect the exhaust pipework. Tighten the vent point fitting.

6.17.7 Follow section 6.2 or 6.3 depending whether the maintenance was performed with total or 1 bank isolation to bring the manifold back on line.

Figure 53 - Header non-return valve replacement.

NOTE - Figure 53 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



NOTE - O-ring seal in included in the non-return valve kit.

6.18 Replace lockable line isolation valves.

Valve P/N: 2212020080

NOTE - Line valve replacement requires total isolation of the medical gas supply. Refer to the hospital medical gas pipeline supply operational policy for arranging localised gas supply for patients during this maintenance process.

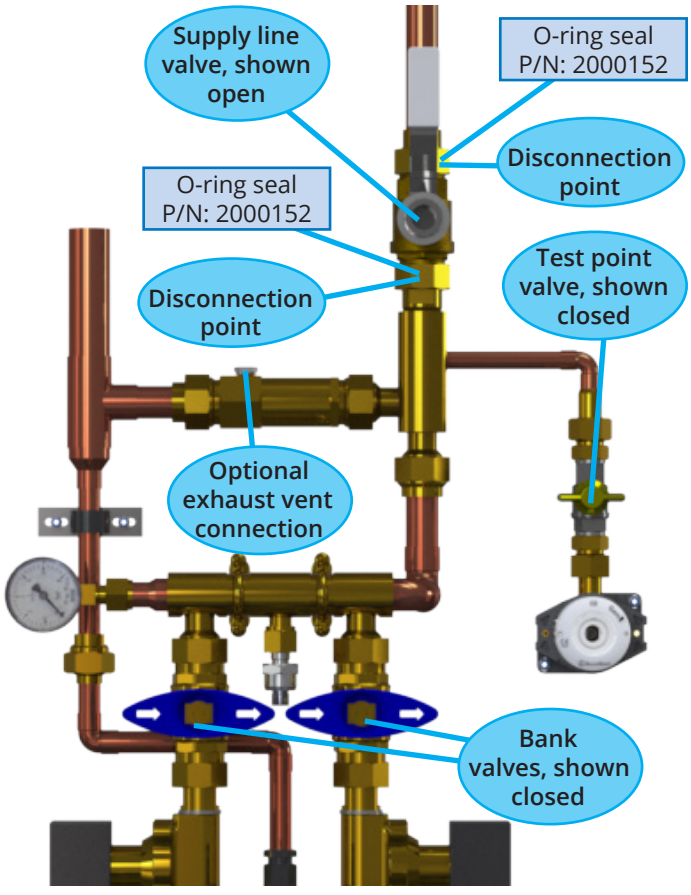
6.18.1 If the optional service mode is selected during maintenance complete steps in 6.1.

6.18.2 Isolate the pipeline as close to the manifold as possible to minimise disruption to the medical gas supply.

6.18.3 Ensure both manual bank and test point valves are closed, and supply line valve is open, see figure 54.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present. Depending on the volume of gas to be vented from the manifold and pipeline combined, provisions may be required to pipe away to a safe location while draining the system.

Figure 54 - Supply line valve replacement.



NOTE - If venting away form the manifold is required for safety, there is the option for fitting a temporary connection from the terminal unit test point to the 1/8" BSPP connection on the line pressure relief valve. This will allow the medical gas to be vented safely through the exhaust pipework, see figure 53 for reference.

6.18.4 Connect appropriate connections/piping to the test point to vent away the exhaust gas if required for safety.

6.18.5 Open the test point valve and exhaust all the gas to be vented from the terminal unit test point.

6.18.6 Slowly turn the swivel nut on connection to the line ball valve. If you hear gas escaping, tighten the joint back up and go back to step 6.17.2 to assess the pipeline and manifold valving and venting.

6.18.7 Fully disconnect all joints as shown in figure 53 and gently remove the unit by sliding it towards you. Take care not to damage the seals.

6.18.8 Inspect the existing seals and replace if required, see figure 53 for seal part numbers.

6.18.9 Fit the new valve as per the old unit.

6.18.10 Remove any venting fittings, piping etc that may have been used for draining the system, and close the test point isolation valve.

6.18.11 Slowly open the manifold bank valves to pressurise the pipeline.

6.18.12 Using suitable leak detection fluid check the line ball valve connections for leaks.

6.18.13 If the service mode has been used switch back to normal operation, see section 6.1 for details.

6.18.14 Purged the manifold and pipeline and test for gas purity as per HTM 02-01 for UK installations, or as per relevant standards if installed outside the UK.

6.18.15 Open the pipeline isolation valves and remove the localised medical gas supply as per the hospital's operational policy to return to the manifold supply.

6.19 Bringing the Lifeline MCS back on line after being fully isolated.

6.19.1 Ensure all cylinder valves are open.

6.19.2 Ensure both bank valves are open.

6.19.3 If required purge the manifold from the test point by completing the following steps:

- Open the test point valve
- Press the [Left Arrow] key to select the left bank.
- Apply a flow to the test point terminal unit to purge the left side of the manifold.
- Press the [Right Arrow] key to select the right bank.
- Apply a flow to the test point terminal unit to purge the right side of the manifold.
- Close the terminal unit test point valve when complete.

⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

6.19.4 Ensure that full gas cylinder pressure is shown on the operating screen and backup contents gauge, the cylinder graphics are shown as full and the appropriate LED's are lit up (see Section 3, figure 15). See figure 9 & 12 in section 2.5 if setup changes are required.

6.19.5 Check that the pipeline distribution pressure displayed on the screen and back up gauge is typically as per table 6 in section 4, Principle of Operation . Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

6.19.6 If the optional service mode has been used during maintenance, refer to section in 6.1 to return to normal running. If resistors have been fitted to the medical alarm during maintenance, remove and reconnect the alarm inputs.

6.19.7 Open the supply line valve to return the gas supply back to the Lifeline MCS.

6.19.8 Return the backup manifold or any temporary gas supply used during maintenance back to normal running.

6.20 Bringing the Lifeline MCS back on line after isolating one bank.

6.20.1 Ensure all cylinder valves are open.

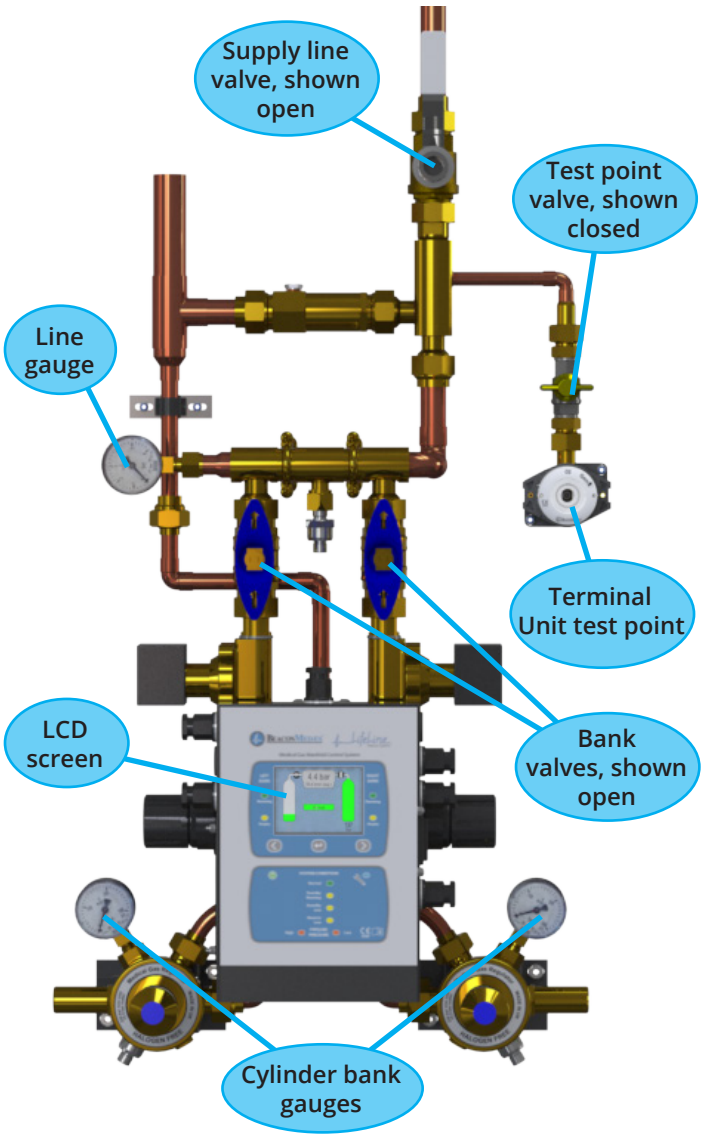
6.20.2 Ensure both bank valves are open.

6.20.3 Ensure that full gas cylinder pressure is shown on the operating screen and backup contents gauge, the cylinder graphics are shown as full and the appropriate LED's are lit up (see Section 3, figure 15). See figure 9 & 12 in section 2.5 if setup changes are required.

6.20.4 Check that the pipeline distribution pressure displayed on the screen and back up gauge is typically as per table 6 in section 4, Principle of Operation . Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

6.20.5 If the optional service mode has been used during maintenance, refer to section in 6.1 to return to normal running. If resistors have been fitted to the medical alarm during maintenance, remove and reconnect the alarm inputs.

Figure 55 - Returning the Lifeline manifold back in use.



6.21 Electrical isolation & manual operation.

NOTE - Although electrical/electronic components can be changed while the manifold is running the automatic function will be lost. Therefore the running bank must be controlled using the manual bank isolation valves while locally monitoring the cylinder pressure gauges.

NOTE - During electrical isolation all alarm outputs will be showing fault conditions. If a Beaconmedaes alarm is used, to show the conditions as normal while the manifold is being serviced, temporarily connect 180 ohm resisters from common to the 4 channels on the alarm inputs.

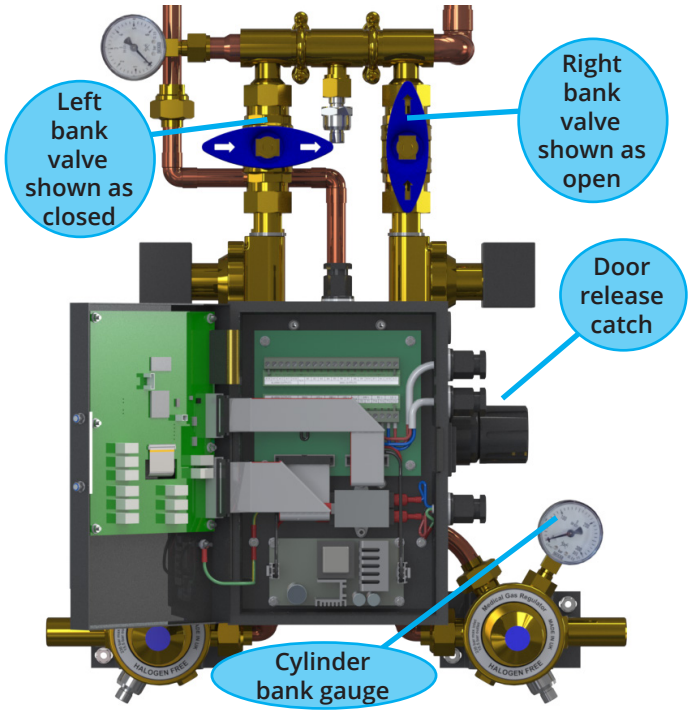
6.21.1 See section 4.8 for full details on manually controlling the manifold during electrical isolation.

6.21.2 Isolate the power supply to the manifold controls. Operate the manual cylinder banks valves to set the running and standby banks. Connect the optional normal condition resisters to the alarm (BeaconMedaes alarm only, see above note) if required.

6.21.3 Press the catch on the side of the electrical enclosure to open the door, see figure 56.

Figure 56 - Electrical isolation & manual operation.

NOTE - Figure 55 shows example of right bank running in manual operation, mirror to opposite side for running on the left bank.



6.22 Replace control PCB.

Control PCB P/N: 6070001215

6.22.1 See section 6.21 for electrical isolation and manual controls during maintenance.

6.22.2 Disconnect the 3 ribbon cables down the right hand side of the control PCB, see figure 57.

6.22.3 To disconnect the screen cable, lift the clamp on the PCB connector, and then slide away.

6.22.4 Disconnect the six M3 nuts and washers which secure the PCB in place. The control PCB can then be removed.

6.22.5 Position the new PCB as per the old unit, and secure using the previously removed M3 nuts and washers.

6.22.6 Connect the 3 ribbon cables as before. Slide the screen cable back into the connector on the PCB, and lower the leaver to clamp in place.

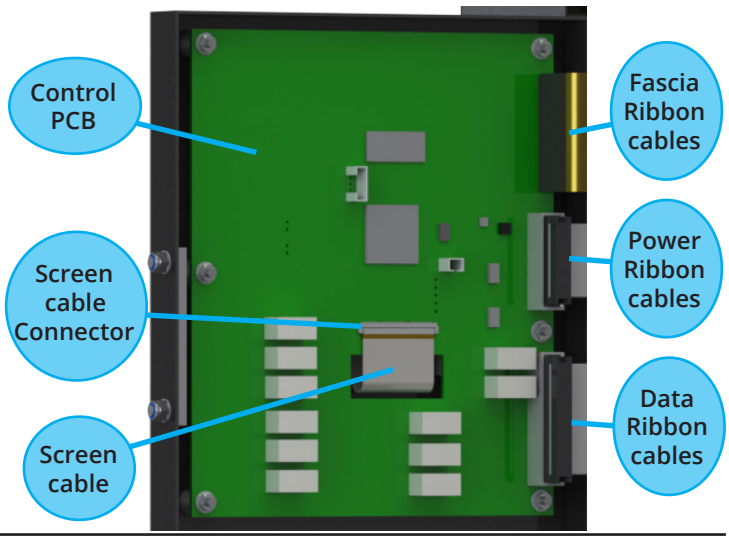
6.22.7 Close the enclosure door, and restore power to the controls.

6.22.8 The unit will initially power up into the setup menu ready to configure the variables. See section 2.5 for set-up instructions, start from figure 10, as you will already be in the setup menu. Ensure both bank isolation valves are open, then exit the setup menus, as the manifold will go back to automatic control once the menu has been exited.

6.22.9 Ensure the running bank is on the correct side, change if required. See section 4.7 for manual cylinder bank selection.

6.22.10 If the medical gas alarm inputs have been blanked out during maintenance, return to normal operation.

Figure 57 - Control PCB replacement.



6.23 LCD Screen replacement.

LCD screen P/N: 2212020058

6.23.1 See section 6.21 for electrical isolation and manual controls during maintenance.

6.23.2 To access the screen the control PCB needs to be removed first. Follow the steps from 6.22.2 to 6.22.4 to remove the control PCB.

6.23.3 Disconnect the 4 M3 nuts from the 2 screen clamps, lift the clamps and screen away. See figure 58 for reference.

6.23.4 Fit the new screen and secure back in place by fastening the previously removed clamps and M3 nuts

6.23.5 Fit the existing control PCB and connect the cables as shown in figure 58.

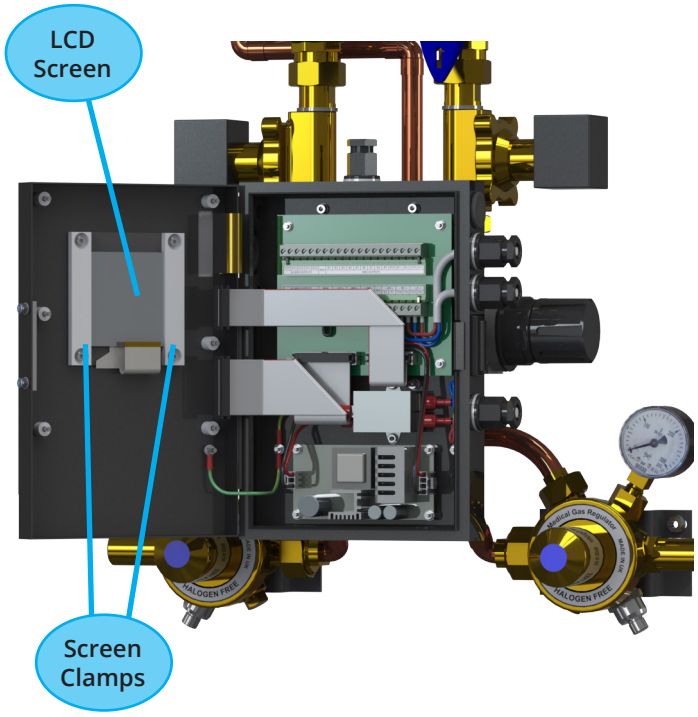
6.23.6 Ensure both bank isolation valves are open.

6.23.7 Close the enclosure door, and restore power to the controls. The manifold will go back to automatic control.

6.23.8 Ensure the running bank is on the correct side, change if required. See section 4.7 for manual cylinder bank selection.

6.23.9 If the medical gas alarm inputs have been blanked out during maintenance, return to normal operation.

Figure 58 - Screen replacement.



6.24 Terminal board replacement.

Terminal board P/N: 6070002648

6.24.1 See section 6.21 for electrical isolation and manual controls during maintenance.

6.24.2 Disconnect the 2 ribbon cables at the bottom of the termination board, see figure 59.

6.24.3 Unplug the 2 terminal strips from the board.

6.24.4 Disconnect the 4 M3 nuts and washers, and remove the termination board.

6.24.5 Fit the new board and secure using the previously removed fasteners.

6.24.6 Plug the terminals back into the new board as before.

6.24.7 Plug the 2 ribbon cables into the new board as before.

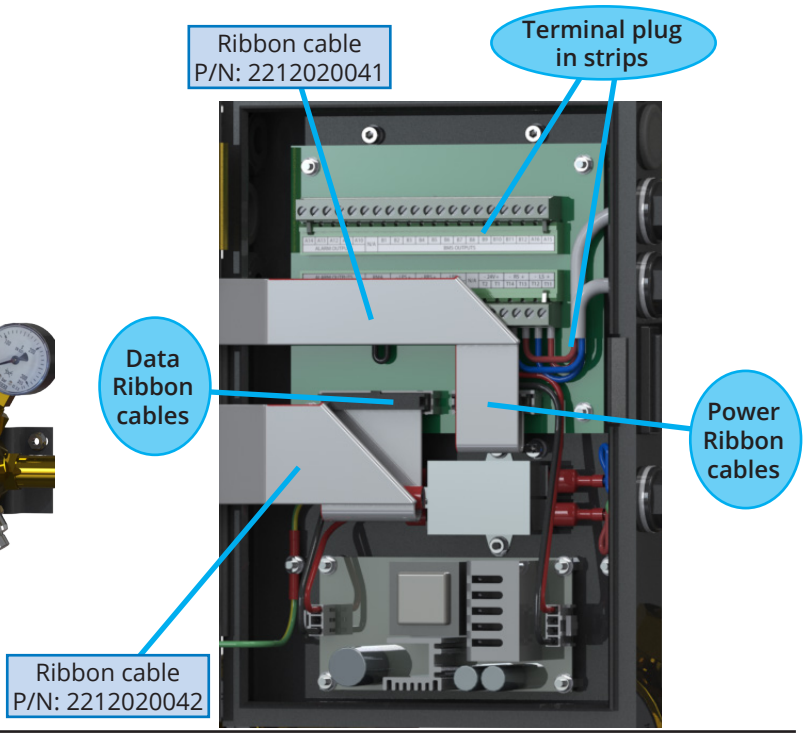
6.24.8 Ensure both bank isolation valves are open.

6.24.9 Close the enclosure door, and restore power to the controls. The manifold will go back to automatic control.

6.24.10 Ensure the running bank is on the correct side, change if required. See section 4.7 for manual cylinder bank selection.

6.24.11 If the medical gas alarm inputs have been blanked out during maintenance, return to normal operation.

Figure 59 - Termination board replacement.



6.25 Power supply filter replacement.

Power supply filter P/N: 2212020129

6.25.1 See section 6.21 for electrical isolation and manual controls during maintenance.

6.25.2 Unplug the connectors from both sides of the filter, see figure 60.

6.25.3 Disconnect the 2 M3 nuts and washers, and remove the filter.

6.25.4 Fit the new filter and secure using the previously removed fasteners.

6.25.5 Plug the connectors back into the new filter as before, see figure 60.

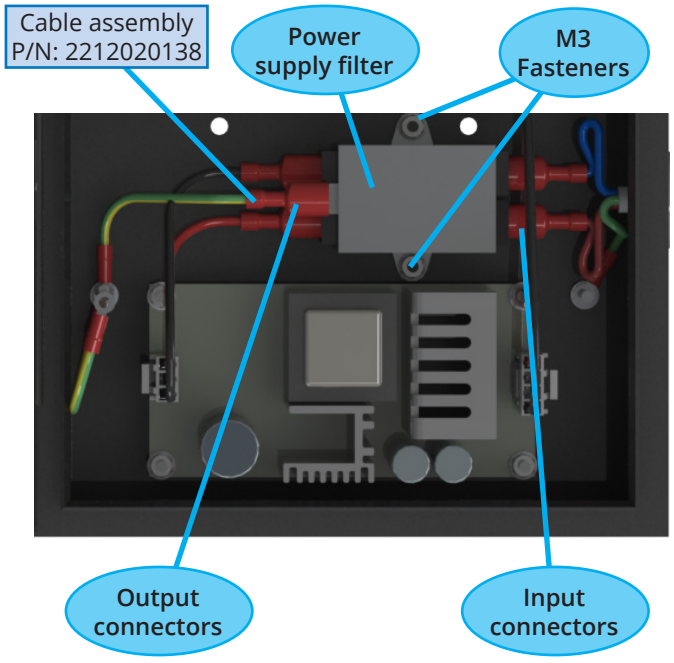
6.25.6 Ensure both bank isolation valves are open.

6.25.7 Close the enclosure door, and restore power to the controls. The manifold will go back to automatic control.

6.25.8 Ensure the running bank is on the correct side, change if required. See section 4.7 for manual cylinder bank selection.

6.25.9 If the medical gas alarm inputs have been blanked out during maintenance, return to normal operation.

Figure 60 - Power supply filter replacement.



6.26 Power supply replacement.

24V DC power supply P/N: 6070002651

6.26.1 See section 6.21 for electrical isolation and manual controls during maintenance.

6.26.2 Unplug the connectors from both sides of the power supply, see figure 61.

6.26.3 Disconnect the 2 M3 nuts and washers, and remove the filter.

6.26.4 Fit the new power supply and secure using the previously removed fasteners.

6.26.5 Plug the connectors back into the new filter as before, see figure 61.

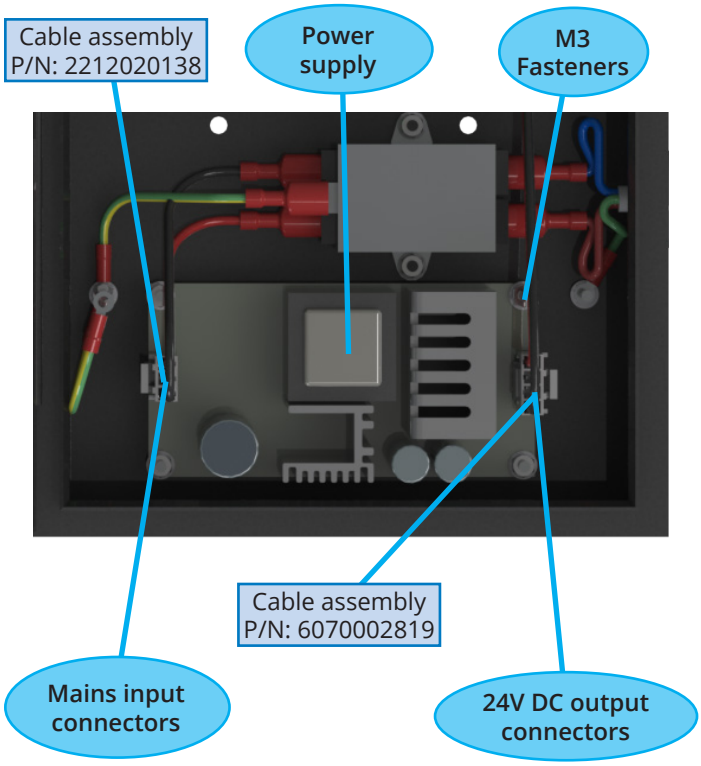
6.26.6 Ensure both bank isolation valves are open.

6.26.7 Close the enclosure door, and restore power to the controls. The manifold will go back to automatic control.

6.26.8 Ensure the running bank is on the correct side, change if required. See section 4.7 for manual cylinder bank selection.

6.26.9 If the medical gas alarm inputs have been blanked out during maintenance, return to normal operation.

Figure 61 - Power supply replacement.



6.27 Membrane fascia replacement.

24V DC power supply P/N: 2212020020

6.27.1 See section 6.21 for electrical isolation and manual controls during maintenance.

6.27.2 Unplug the ribbon cable to the control PCB, see figure 62.

6.27.3 Peal away the fascia from the enclosure door.

6.27.4 Peal away the backing from the new fascia.

6.27.5 Thread the ribbon cable through the cutout in the enclosure door, ensure the edges of the fascia are lined up with the top and sides of the enclosure door, and press into place.

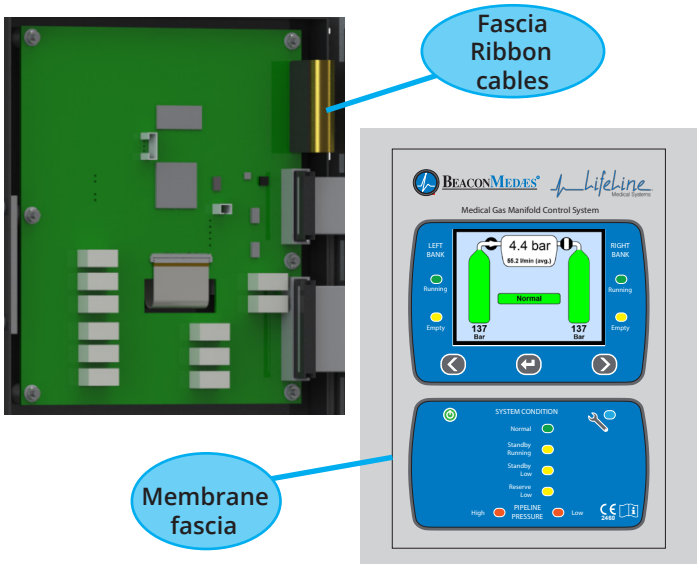
6.27.6 Connect the new fascia ribbon cable to the controls PCB as before.

6.27.7 Ensure both bank isolation valves are open.

6.27.8 Close the enclosure door, and restore power to the controls. The manifold will go back to automatic control.

6.27.9 If the medical gas alarm inputs have been blanked out during maintenance, return to normal operation.

Figure 62 - Membrane fascia replacement.



7. Recommended spares and accessories.

7.1 Accessories.

The following table is the list of cylinder header extension kits available for the Lifeline MCS.

Table 11: Accessories

Part Number	Description
2000232	1 cyl secondary extension - Oxygen (O2)
2000233	1 cyl secondary extension - Nitrous Oxide (N2O)
2000234	1 cyl secondary extension - Oxygen/Nitrous Oxide (O2/N2O)
2000235	1 cyl secondary extension - Medical Air
2000242	1 cyl secondary extension - Nitrogen (N2)
2005110	1 cyl secondary extension - Carbon Dioxide (CO2)
2000204	2 cyl secondary extension - Oxygen (O2)
2000205	2 cyl secondary extension - Nitrous Oxide (N2O)
2000206	2 cyl secondary extension - Oxygen/Nitrous Oxide (O2/N2O)
2000207	2 cyl secondary extension - Medical Air
2000243	2 cyl secondary extension - Nitrogen (N2)
2005108	2 cyl secondary extension - Carbon Dioxide (CO2)

7.2 Spares scheduling - 5 year service kit.

NOTE - It is mandatory to replace 1st and 2nd stage relief valves every 5 years.

NOTE - industrial regulators are recommended to be replaced every 5 years. Whilst the medical standards do not specifically identify the need to replace the regulators within this time scale it should be considered good practice to do so. By replacing the regulators whilst the relief valves are being replaced interruption of supply is minimised.

To accompany the replacement of relief valves an overhaul kit has been defined to include, non-return valve, associated seals and outlet capsule.

Table 12: 5 year service kits

Part number	Description
8102369640	4 Bar Manifold 5 Year Service Kit
8102369641	8 Bar Manifold 5 Year Service Kit
8102369642	11 Bar Manifold 5 Year Service Kit

See tables 14 to 16 for list of component contained within each kit. Table 17 details further optional spares recommended changing during 5 year service.

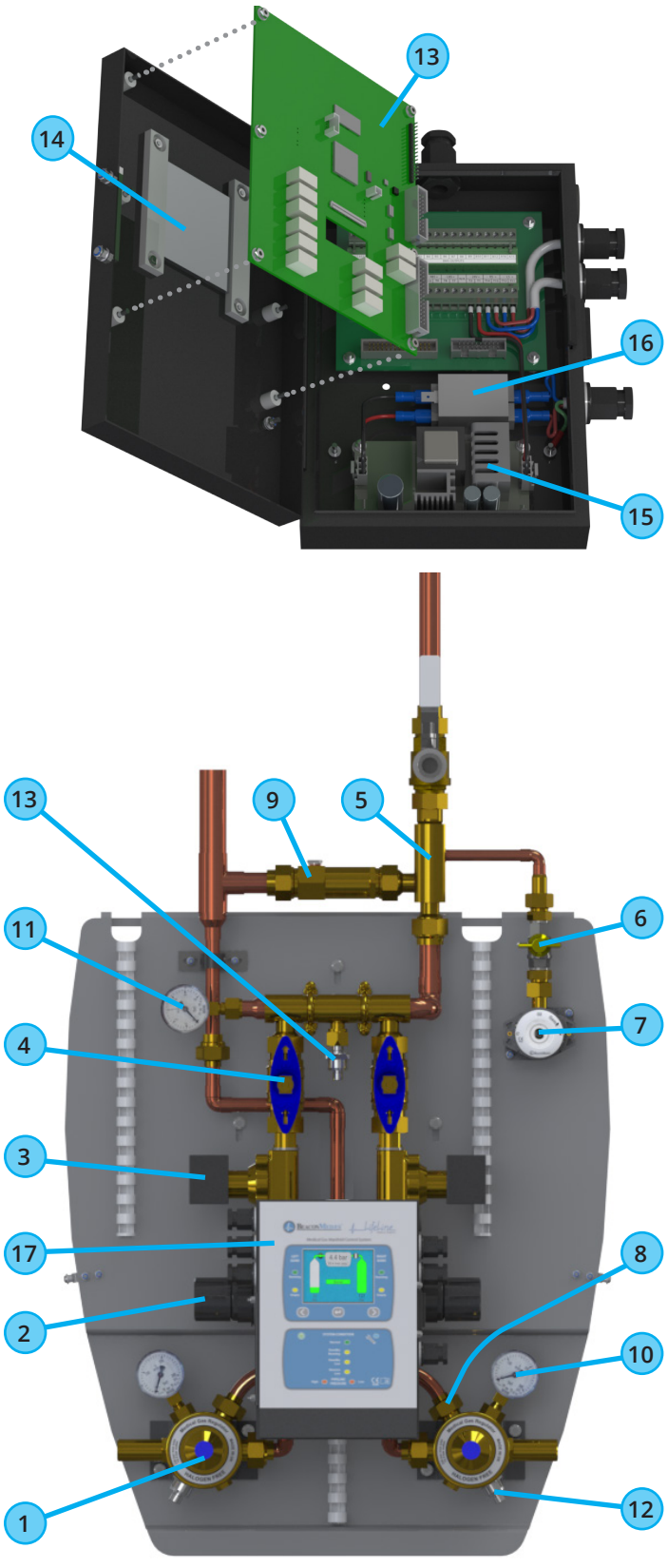
7.3 Spares scheduling.

The following table is the recommended spares holding, the number recommended spares for overseas customers are expressed in brackets and take into account expected transport delays.

Table 13: Spares scheduling

Item ID	Part Number	Description	Quantity req./ Number of Panels	
			<5	>5
1	2005383	1st Stage Regulator	1(2)	2(2)
2	4233400126	Line Regulator – 4.6 bar Outlet	1(2)	2(2)
	2005690	Line Regulator – 8.6 bar Outlet	1(2)	2(2)
	2005691	Line Regulator – 11 bar Outlet	1(2)	2(2)
	4233400113	Line Regulator - N2O & CO2	1(2)	2(2)
3	5001178	Solenoid valve	1(2)	2(2)
4	2003911	Bank Valve	1(2)	2(2)
5	8102369643	Non-return valve	1(2)	2(2)
6	2000172	Test point valve	1(2)	2(2)
7	8102371350	O2 2nd fix terminal unit	1(2)	2(2)
	8102371351	N2O 2nd fix terminal unit	1(2)	2(2)
	8102371352	O2/N2O 2nd fix terminal unit	1(2)	2(2)
	8102371353	MA 2nd fix terminal unit	1(2)	2(2)
	8102371354	SA 2nd fix terminal unit	1(2)	2(2)
	8102340206	N2 2nd fix terminal unit	1(2)	2(2)
	8102340207	CO2 2nd fix terminal unit	1(2)	2(2)
8	2005384	Relief Valve - 20 bar	1(2)	2(2)
9	2000122	Relief Valve – 5.3 bar	2(2)	3(4)
	2000123	Relief Valve – 11 bar	2(2)	3(4)
	2000140	Relief Valve – 13 bar	2(2)	3(4)
10	6070002170	Cylinder gauges - 100 bar	1(2)	2(2)
	6070002171	Cylinder gauges - 315 bar	1(2)	2(2)
11	6070002167	Line gauge - 4 bar system	1(2)	2(2)
	6070002168	Line gauge - 8 bar system	1(2)	2(2)
	6070002169	Line gauge - 11 bar system	1(2)	2(2)
12	6070002300	Cylinder pressure sensor	1(2)	2(2)
	6070002298	Line pressure sensor	1(2)	2(2)
13	6070001215	Control PCB	1(2)	2(2)
14	2212020058	LCD Screen	1(2)	2(2)
15	6070002651	24V DC Power Supply	1(2)	2(2)
16	2212020129	Power Supply Filter	1(2)	2(2)
17	2212020020	Membrane fascia	1(2)	2(2)
	2004808	1/4” bonded seal	6(10)	10(15)
	1824977	3/8” bonded seal	2(4)	4(6)
	3260375	1/2” bonded seal	6(10)	10(15)
	1823637	O-ring REF: 0121-16	2(4)	2(4)
	2000179	O-ring REF: 0171-16	6(10)	10(15)
	2000152	O-ring REF: 0221-16	2(4)	2(4)
	009431	Nylon washer	2(4)	2(4)
	2005896	Copper washer	2(4)	2(4)

Figure 63 - Spares.



Following tables shows the list of parts supplied with the 5 year service kits

Table 14: 5 year service kit - 4 bar supply panel.
Kit Part number: 8102369640

Part number	Description	QTY
1826848	Terminal unit capsule	1
2000122	2nd stage relief valve	1
2005384	1st stage relief valve	2
8102369643	Non-return valve	1
2000152	O-ring REF: 0221-16	3
1823637	O-ring REF: 0121-16	1
2212020058	LCD Screen	1

Table 15: 5 year service kit - 8 bar supply panel
Kit Part number: 8102369641

Part number	Description	QTY
1826848	Terminal unit capsule	1
2000123	2nd stage relief valve	1
2005384	1st stage relief valve	2
8102369643	Non-return valve	1
2000152	O-ring REF: 0221-16	3
1823637	O-ring REF: 0121-16	1
2212020058	LCD Screen	1

Table 16: 5 year service kit - 11 bar supply panel.
Kit Part number: 8102369642

Part number	Description	QTY
1826848	Terminal unit capsule	1
2000140	2nd stage relief valve	1
2005384	1st stage relief valve	2
8102369643	Non-return valve	1
2000152	O-ring REF: 0221-16	3
1823637	O-ring REF: 0121-16	1
2212020058	LCD Screen	1

Further optional 5 years spares.

Table 17: Header Non-Return Valves

GAS Type	Part Number
Oxygen (O2)	2000288
Nitrous Oxide (N2O)	2000289
Oxygen/Nitrous Oxide (O2/N2O)	2000290
Medical Air / Surgical Air	2000291
Nitrogen (N2)	2000292
Carbon Dioxide (CO2)	2005850

NOTE - Quantities for the header non-return valves is 1 per cylinder connection.

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