CE 1639

MD

Installation, Operation and Maintenance Instructions

Medical Gas Supply System

Cylinder Manifold System and Manifold Changeover System

MAT-S (HTM/ISO)

Part number 4109992485

Revision 00

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BeaconMedæs®

Installation, Operation and Maintenance Manual

Atlas Copco (Wuxi) Compressor Co., Ltd.
No.45 XiMei Road, Xinwu District, Wuxi City, Jiangsu Province, 214111, China

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

⚠ WARNING! **DO NOT USE OIL OR GREASE** on any components in Manifold Changeover System for any reason. This could lead to a FIRE or an EXPLOSION. Only use approved OXYGEN COMPATIBLE lubricants, which can be purchased from BeaconMedaes if necessary.

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

Operator should carefully read and become familiar with the contents of this manual before install and maintain the Medical Gas Supply System.

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

Component descriptions and spare part 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
	Temperature limitation
	Humidity limitation
	Atmospheric pressure limitation
	Date of manufacture
	Do not dispose of in general waste

Electromagnetic Interference

The panel has been tested to IEC 61326-1: 2020 Electrical equipment for measurement, control and laboratory use –EMC requirements - Part 1: General requirements. 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 any hazardous substances.

Cleaning

The device 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 100-250V, 50/60Hz, alternating current.

Current requirements - 0.3A

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.

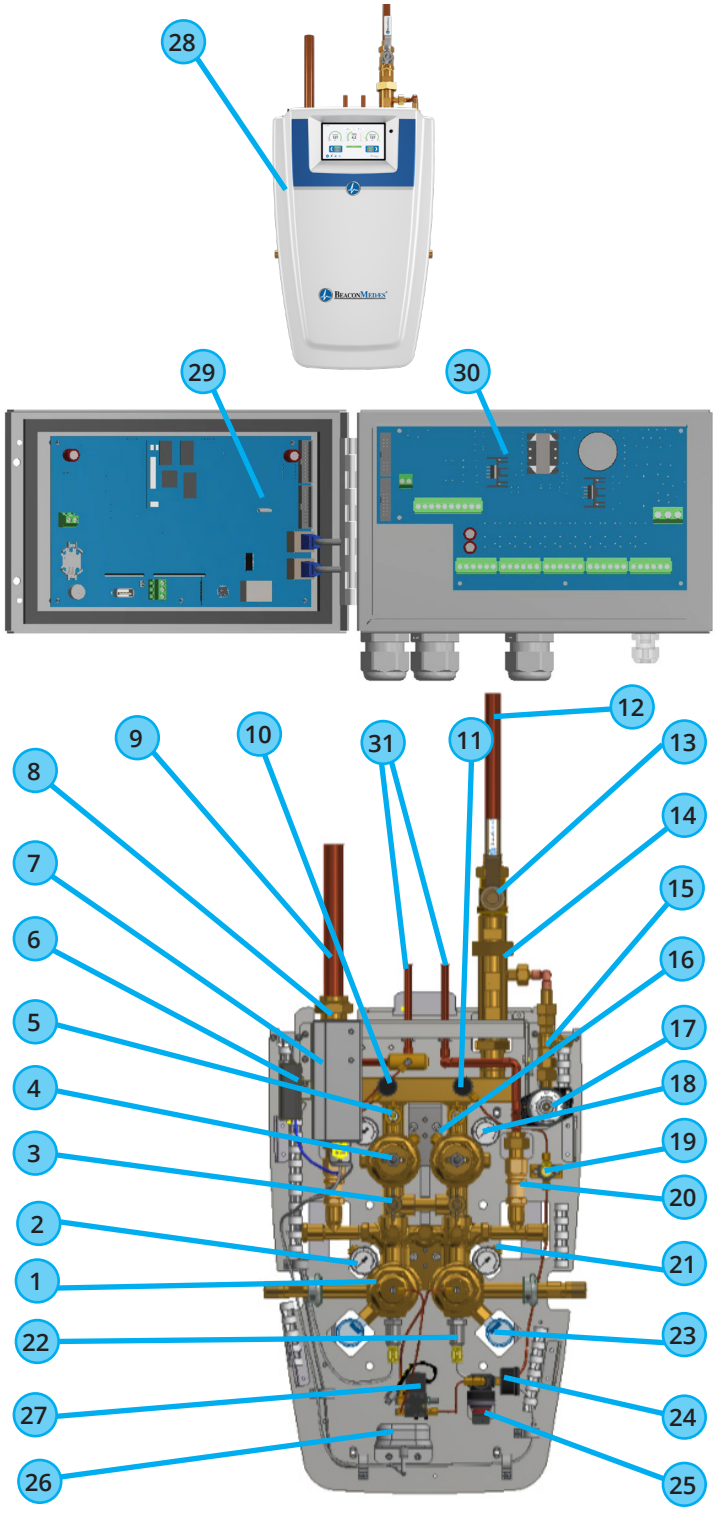
The device is designed and built in accordance with HTM 02-01 and ISO 7396-1 regulations and therefore should be installed as such.

Oil, grease and jointing compounds must not be used.

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

Figure 1 - Manifold Changeover System (MAT-S).

1. General Information.



NOTE - Isolation valves item 3, 5 and 12 are shown in their open position, isolation valve item 14 is shown in its closed position. This is typically the normal operating condition for the manual valves.

1.1 Introduction.

The BeaconMedaes Medical Gas Supply System, mainly consists of cylinder manifold system, manifold changeover system, header & tailpipe and other necessary components, is intended to work in conjunction with other devices within the medical gas pipeline system (MGPS) to assist with maintaining continuity of supply throughout the hospital to local connection points for eventual introduction into the human body. The device controls the gas pressure within the specification as required by the MGPS. In all cases other devices outside of this scope are connected downstream of the MGPS are required to control the final gas pressure and flow requirements for safe supply to the patient. Therefore, this device is not intended to control supply parameter hazards directly to the patient, only to the MGPS.

The device including Cylinder Manifold System and Manifold Changeover System (abbreviate as manifold below) is principally designed for use as a primary or secondary source of supply, or for emergency backup.

The Medical Gas Supply System 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.

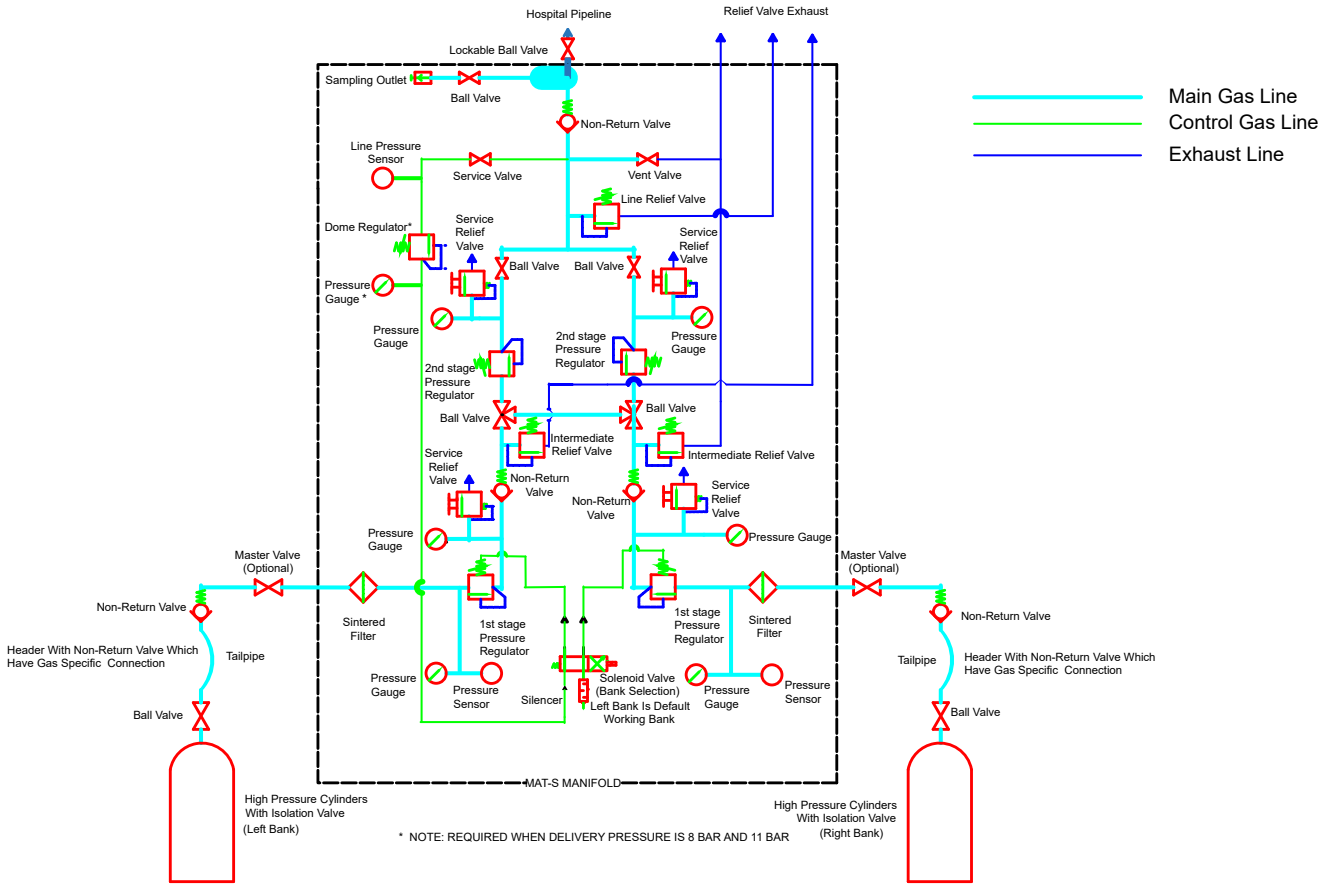
See figure 1 for general arrangement and figure 2 for the schematic diagram.

The Manifold Changeover System consists of:

No.	Description
1	1st Stage Pressure Regulator
2	Intermediate Pressure Gauge
3	Intermediate Isolation Valve (Three Way)
4	2nd Stage Pressure Regulator
5	Line Isolation Valve
6	Smart Box
7	Touch Screen Controller
8	Line Relief Valve
9	Line Pressure Relief Exhaust Connection point (28 mm OD Copper Tube).
10	Vent Valve
11	Service Valve
12	Pipeline Connection Point (22 mm OD Copper Tube)
13	Lockable Isolation Valve
14	Non-Return Valve
15	Test Point Isolation Valve
16	Service Relief Valve
17	Terminal Unit
18	Line Pressure Gauge
19	Line Pressure Sensor

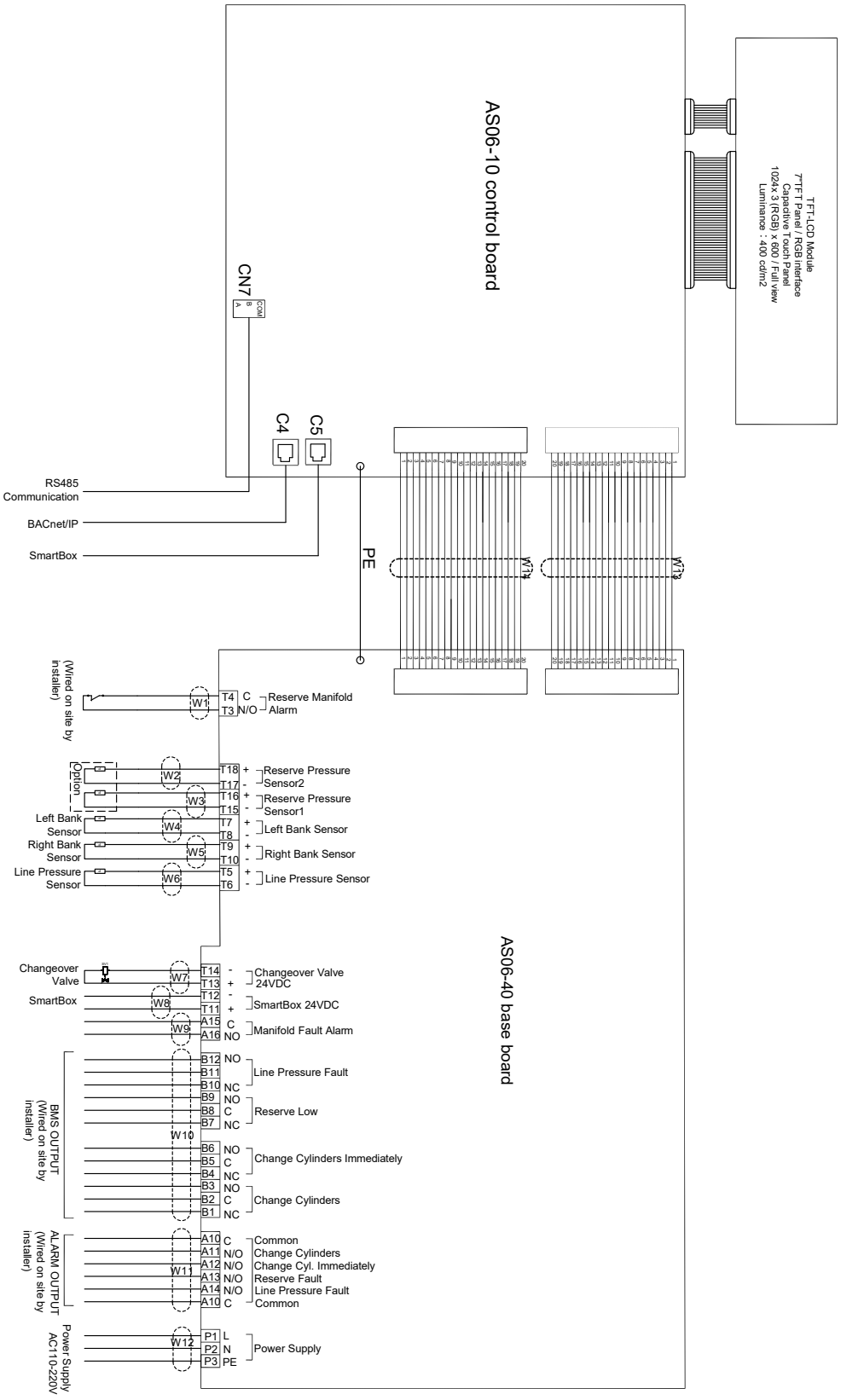
No.	Description
20	Intermediate Relief Valve
21	Service Relief Valve
22	Cylinder Pressure Sensor
23	Cylinder Pressure Gauge
24	Dome Regulator Pressure Gauge
25	Dome Regulator (8 and 11 bar Delivery Pressure Manifolds Only)
26	Smart Box Antenna
27	Solenoid Valve
28	Manifold Cover
29	Manifold Screen PCB
30	Manifold Power PCB
31	Intermediate Pressure Relief Exhaust Connection Point (12 mm OD Copper Tube).

Figure 2a - Pneumatic Schematic Diagram.



Symbols to BS2971 & ISO 1219-1

Figure 2b - Electrical Schematic Diagram.



Modular manifold headers for gas cylinders can be connected to the Manifold Changeover System to configure its gas supply capacity.

The Manifold Changeover System is connected to the pipeline distribution system upstream of the emergency supply, or downstream of the primary supply system when used as backup. It can be isolated from the pipeline 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 distribution system with medical gas in the event of the primary system failing to supply.

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

1.2 1st Stage Pressure Regulator.

For safe operation regarding performance, mechanical strength, resistance to ignition in pure high pressure oxygen supply and cleanliness, the device fully conforms to BS EN ISO 10524-2. A pressure relief valve connected to the regulator protects the downstream pressure and is set a 2410 kPa (24.1 bar).

1.3 2nd Stage Pressure Regulator.

For safe operation regarding performance, mechanical strength and cleanness the device 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 2nd stage pressure 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 line distribution pressures.

Table 1: Line Pressure Relief Valve Set Points.

Relief Valve Set Point	Nominal Distribution Pressure
520 kPa (5.2 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, 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 Medical Gas Supply System is compatible with BeaconMedaes standard modular headers supplied up to 2x6 cylinder connections, see table 2 for reference.

1.6 Halogen Free Components.

The Medical Gas Supply System 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)	4109150303	4109150304	4109150305	4109150306	4109150307	4109150308
Nitrous Oxide (N2O)	4109150309	4109150310	4109150311	4109150312	4109150313	4109150314
Oxygen/Nitrous Oxide (O2/N2O)	4109150315	4109150316	4109150317	4109150318	4109150319	4109150320
Medical Air & Surgical Air	4109150321	4109150322	4109150323	4109150324	4109150325	4109150326
Nitrogen (N2)	4109150327	4109150328	4109150329	4109150330	4109150331	4109150332
Carbon Dioxide (CO2)	4109150333	4109150334	4109150335	4109150336	4109150337	4109150338

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.

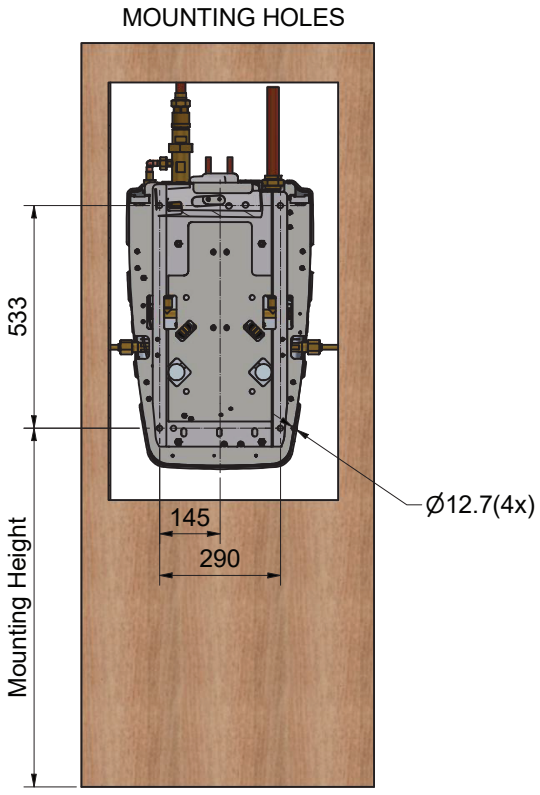
2.1.1 Unpack and inspect all items for damage.

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 35 kg weight of the Manifold Changeover System.

2.1.3 Identify the centre position of the manifold System 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. Refer to installation drawing (P/N 4109992438) for more details.

Figure 3 - Mounting Plate Installation Details.

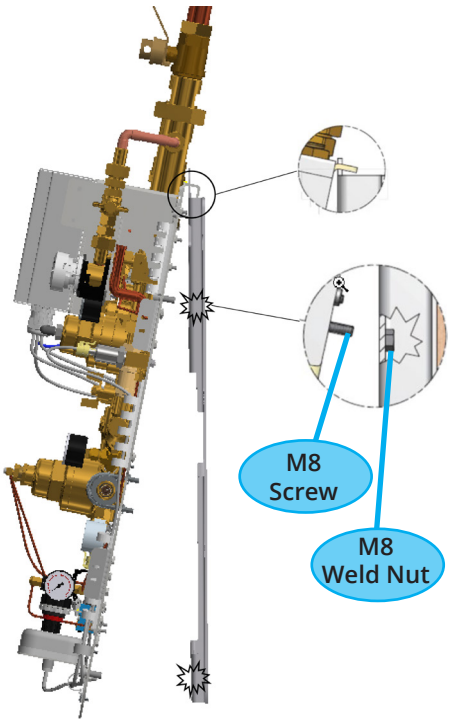


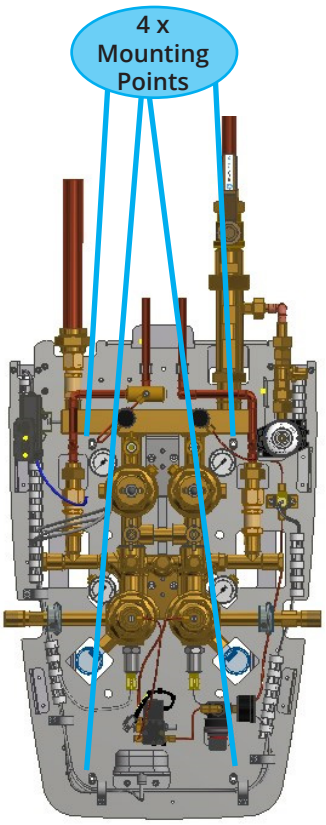
NOTE - Mounting height Position for 'J' size cylinders is 859 mm and 'VF' size when using the step-down connection pipe (see figure 5 & 6). Mounting heights for 'VF' size cylinders is 289 mm.

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

2.1.5 Hook the manifold panel onto the mounting bracket as shown in figure 4. Ensure the studs line up with the holes in the back plate, then lever down into position. Secure the panel on to the mounting plate with the 4 x M8 shouldered nuts.

Figure 4 - Manifold Changeover System Mounting.





2.1.6 Loosely connect the supplied ø22 mm OD stub pipe (Item 12, figure 1) to the main pipeline isolation valve (Item 13, 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 ø22 mm OD stub pipe (Item 12, figure 1). The next support should typically be fitted within 2 m of the first support.

2.1.10 The ø28 mm exhaust line (Item 9, figure 1) shall be brazed using fluxless brazing technique with nitrogen purge.

2.1.11 The ø12 mm exhaust line (Item 31, figure 1) shall be brazed using fluxless brazing technique with nitrogen purge.

⚠ CAUTION! The ø28 mm exhaust line (Item 9, figure 1) and ø12 mm exhaust line (Item 31, 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 manifold as shown in figure 5. Otherwise proceed to next step.

2.2.2 Connect the primary headers to the manifold 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.

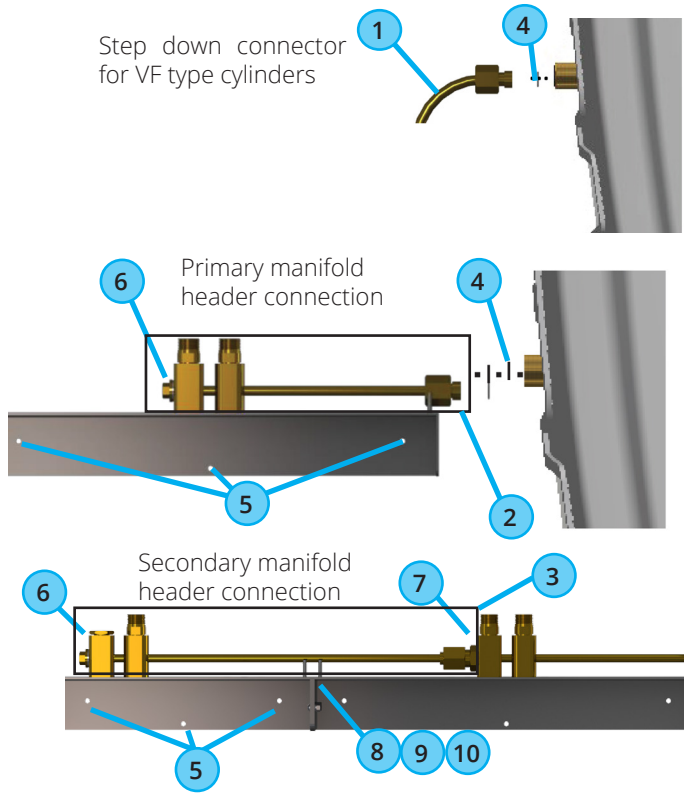
2.2.4 Reconnect the manifold header as shown in figure 5 and secure to the wall using the No. 10 pan head supplied with the kit.

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

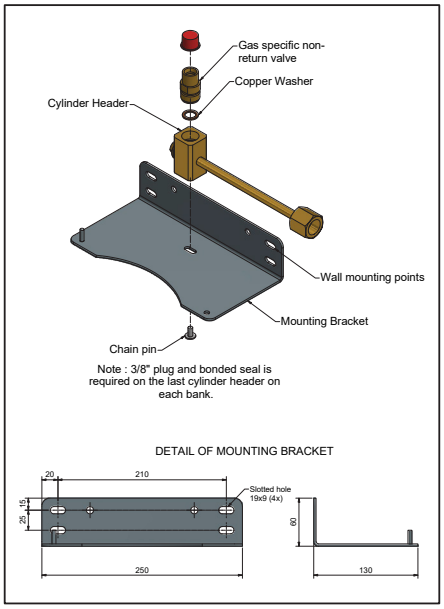
2.2.6 Repeat steps 2.2.2 to 2.2.4 for each additional header. Fit the 3/8" BSP blanking plug and seal previously removed in step 2.2.5 to the last manifold header.

Figure 5 - Manifold Header Installation.

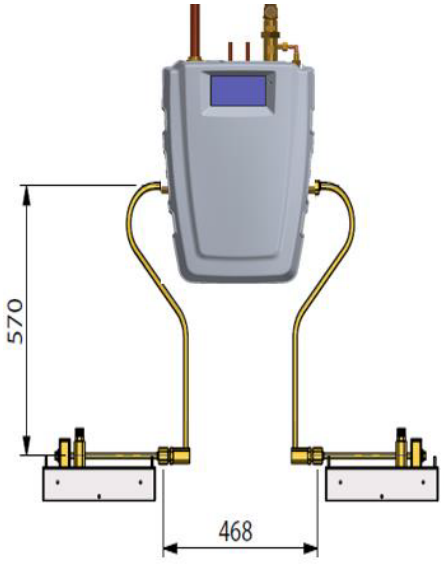


Item	Description
1	Drop Down Connector
2	Primary Header
3	Secondary Header
4	Manifold Connection O-ring Seal
5	Manifold Header Mounting Holes
6	3/8" BSP Blanking Plug and Seal
7	3/8" x 5/8" BSP Fitting
8	M6 x 12 Button Head
9	M6 Nut
10	M6 Washers

Figure 6 - Manifold Changeover System Header Arrangement Details.



NOTE - 'J' type cylinders typically for Oxygen and Medical Air. 'G' type cylinders typically for Nitrous Oxide and O2/N2O mix (Entonox), 'VF' size cylinders typically used for CO2.



View showing optional drop down connectors
(P/N: 4109150436) for use with VF type cylinders

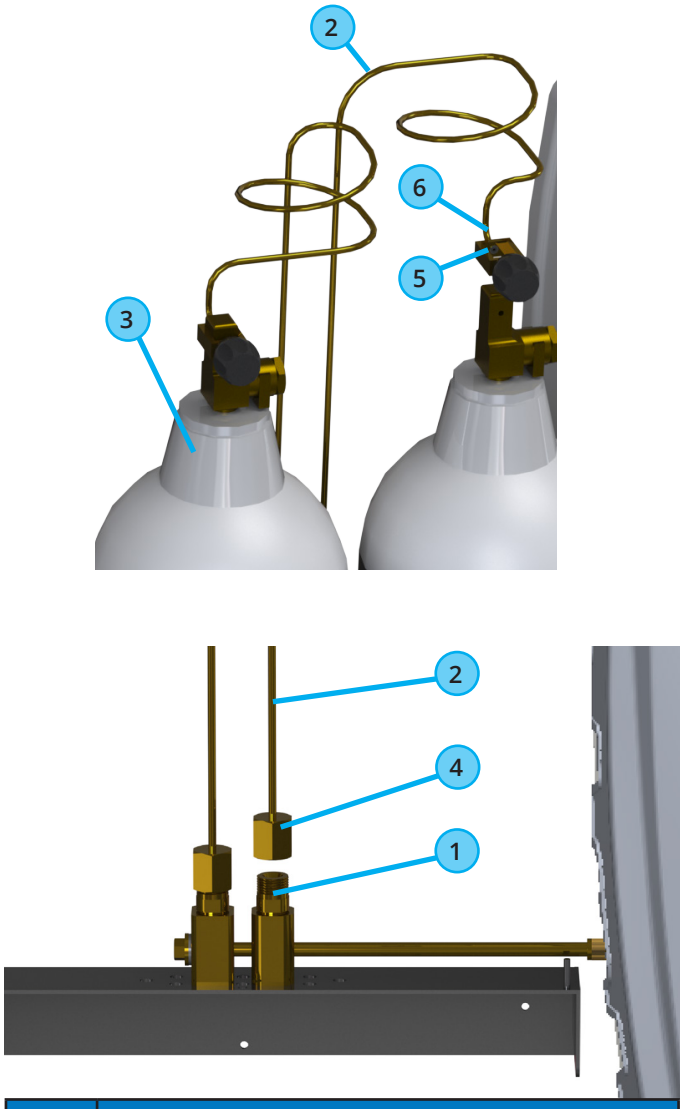
2.3 Cylinder Connection.

⚠ 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 figure 6) ready for connection to the tailpipes.

Figure 7 - Typical Tailpipe & Cylinder Connection.



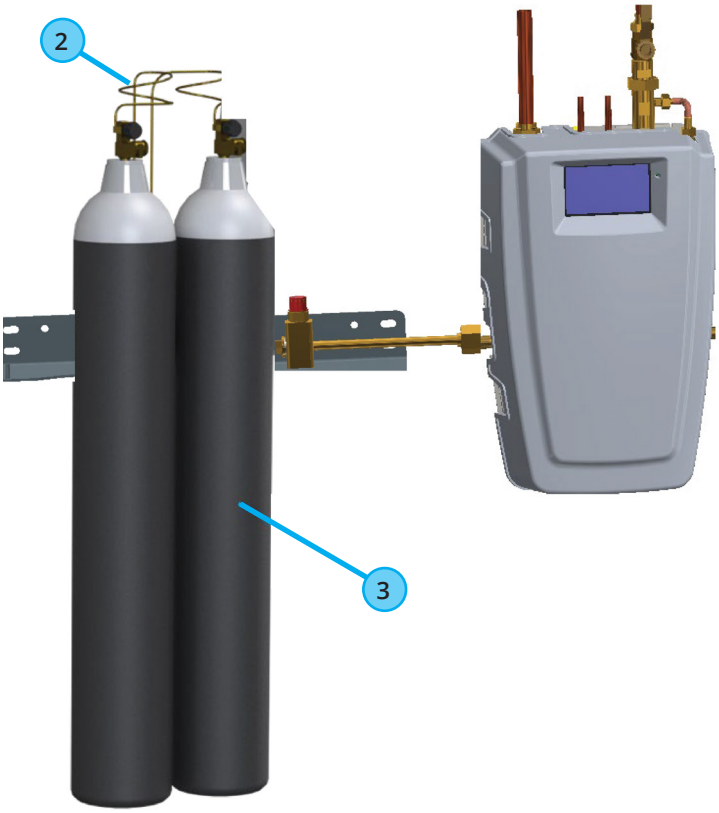
Item	Description
1	Header Non-return Valve (NRV)
2	Tail Pipe
3	Medical Gas Cylinder
4	Tailpipe to NRV Connection
5	Tailpipe Pin Index Connection to Cylinder
6	Bodok Seal

⚠ 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 pressurizing the manifold.



2.4 Manifold Changeover System 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 manifold power is supplied by a mains power cable, providing 24V DC for the electronic component. It is not needed for the extra 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 LCD screen 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 power PCB (Item 30, Figure 1) through the cable gland where shown in Figure 8.

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

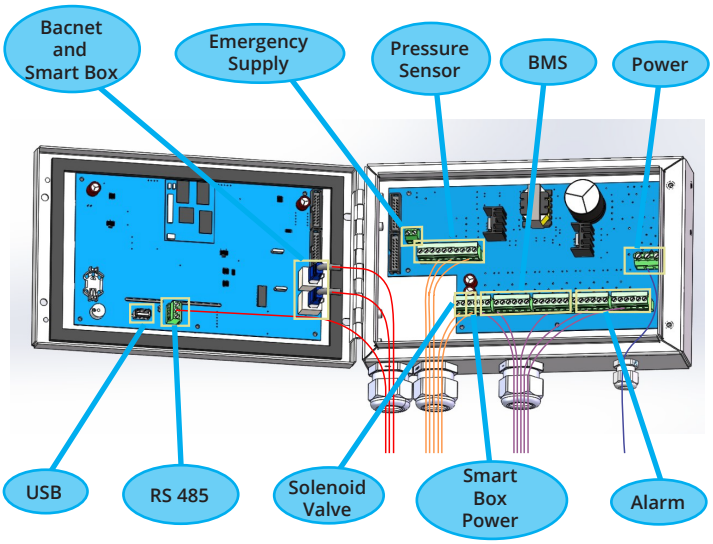
2.4.2.3 Connect the alarm cable to the terminals shown in figure 8.

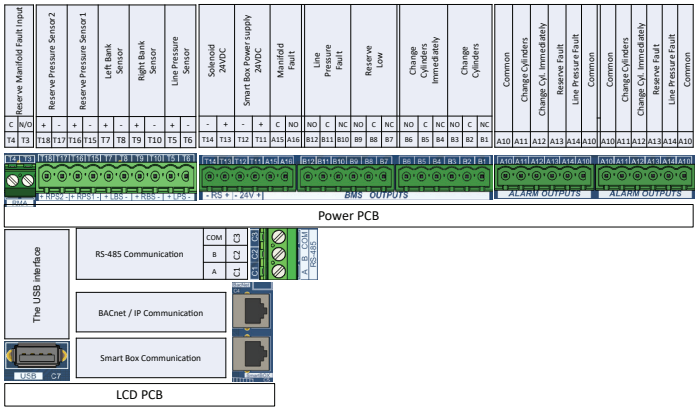
2.4.2.4 If a non BeaconMedaes remote alarm is to be used, the output signal from the manifold can be changed from the standard line contact resistors to a closed in normal condition by following the set-up menu detailed in Section 2.5.

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. Select LMC output if connecting directly to a Medipoint alarm system. Refer to section 2.6, figure 14 for how to set up.

Figure 8 - Manifold Changeover System Wiring.





2.5 Manifold Control 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 manifold controller.

2.5.2 To access the set-up menu, follow the steps in Figure 9, followed by figure 10-14 to complete the set-up. See table 3 for the descriptions on the icons in the menu.

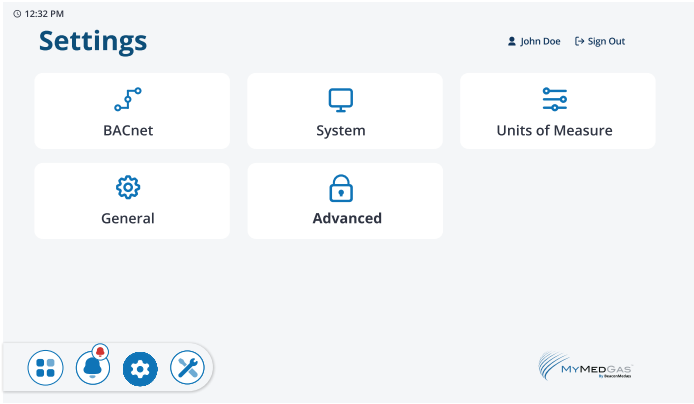
Table 3: Icon Description.

Icon	Description
	General icon. Move to the general setting screen.
	Advanced icon. Takes you to the advanced seeting screen, need password.
	Save icon. Press-confirm the input settings .
	Cancel icon. Press-cancel the input settings .
	Set up system information. Press-set up system information.
	Enable/Disable icon. Press-enable/disable the relative function.
	Switch icon. Press-switch different parameter.
	Events hstory icon. Takes you to the events history screen.
	Maintence icon. Takes you to the maintenance screen.
	User Manuals icon. Takes you to the user manuals screen.
	System information icon. Takes you to the system information screen.
	Special setting icon. Takes you to the pressure zeroing or service mode screen.
	Home icon. Takes you to the home screen and system flow screen.
	Alarm icon. Move to the alarm screen.
	Setting icon. Move to the setting screen.
	Service icon. Takes you to the service screen.
	Changeover icon. Press-Manual changeover to the left cylinder.
	Changeover icon. Press-Manual changeover to the right cylinder.
	Previous icon. Takes you to the previous screen.
	Next icon. Takes you to the next screen.
	Scroll bar. Drag the scroll bar to search the item.
	Bacnet icon. Takes you to bacnet menu screens.
	System icon. Move to the system menu screen.
	Units of measure icon. Move the units setting screen.

Figure 9 - Accessing the Set-Up Menu.

1. Press the setting icon in the home page.

2. Press the system icon in the setting page.



3. Press the value which need update, and use the keyboard to modify.

Figure 10 - Set Line Pressure.

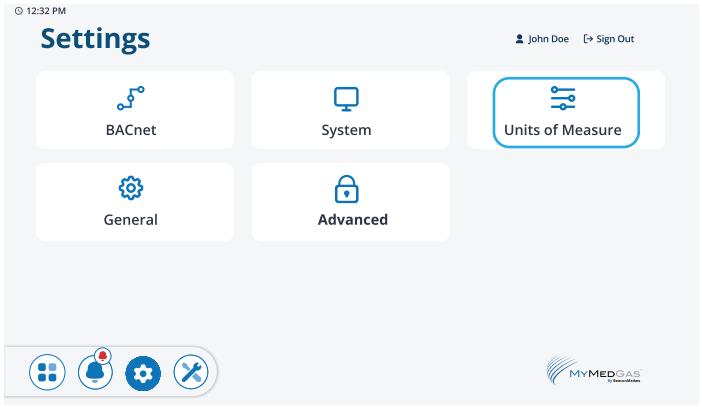
NOTE - Line pressure will normally be pre-set from the factory. Options are for nominal 4, 8 & 11 bar supply. This setting will not affect the actual supply pressure, it is for setting the default line pressure alarm. The line pressure setting is changed by adjusting the regulator knob.

1. Press the line pressure value and use the keyboard to change the number.

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 icon unit of measure.



2. Press the downward arrow to change the unit.

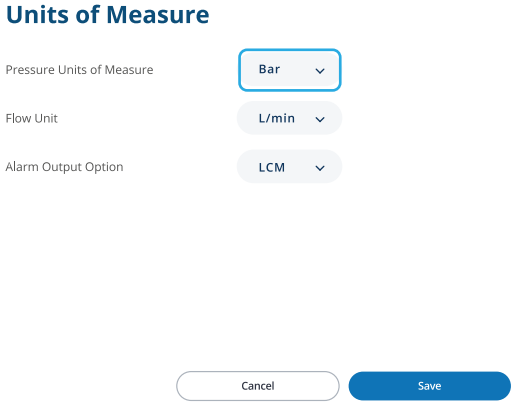
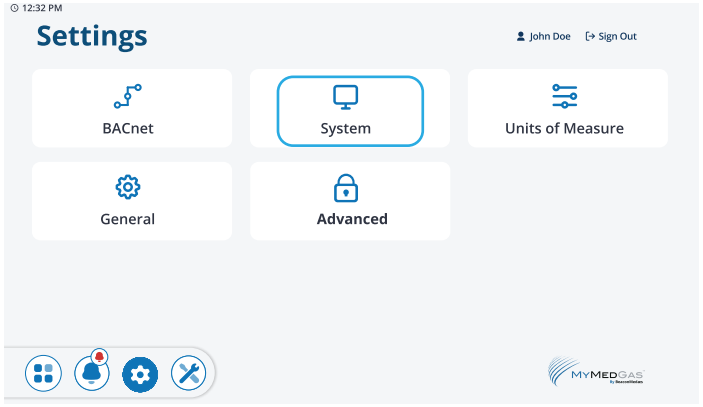


Figure 12 - Cylinder Set-Up.

NOTE - Minimum requirement in the cylinder set-up is to set the correct maximum pressure. This will correctly scale the graphic on the display. The size and number of cylinders per bank is for calculating the average gas usage only.

1. Press the system icon in the setting page.



2. Press the Cylinder Pressure and Cylinder Volume to modify the value by the keyboards.

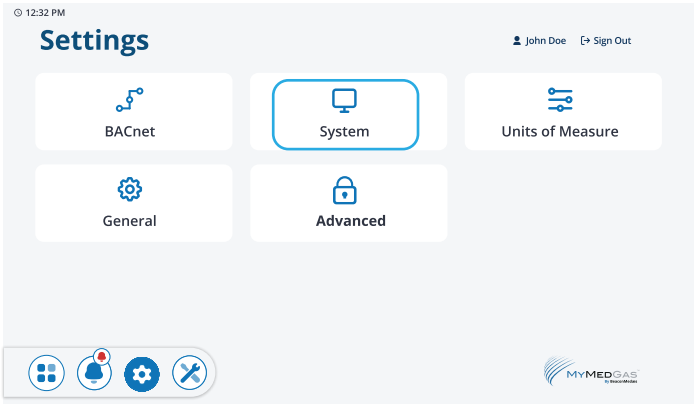
3. Press the NO. Cyl (Left) and NO. Cyl (Right) to modify the quantity keyboards.

NOTE - The typical average gas usage is only for gas phase in the cylinders. This calculated value will not convert correctly for liquid phase in the cylinders. Leaving the No Cyl/Bank setting as '0' will hide the calculated flow on main page.

Figure 13 - Line Pressure Alarm Set-up.

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.

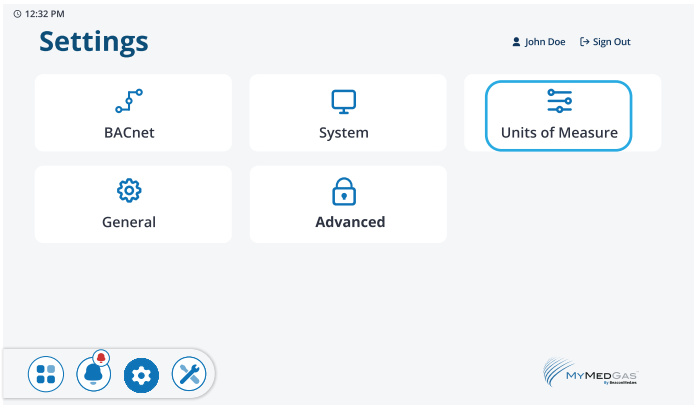
1. Press the system icon in the settings page.



2. Press the Low Line Pressure Alarm and High Line Pressure Alarm and modify the value by keyboard.

Figure 14 - Alarm Output Option.

1. Press the Units of Measure icon in the settings page.



2. Press the downward arrow to change the alarm output option.

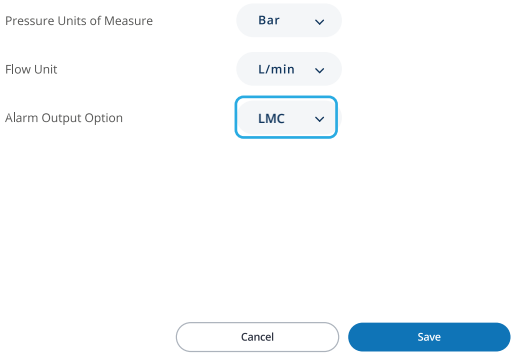


Table 4: Default Line Pressure Alarm Settings, and Adjustment Range.

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	5.0	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 the device is used as a backup manifold. See table 6 in section 4 for reference.

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 device from the pipeline using the main isolation valve (shown in figure 15, item 3).

2.6.3 Ensure that both bank isolation valves (Figure 15, item 1 and 2) are fully open.

2.6.4 Ensure the test point isolation valve (figure 15, item 4) is closed.

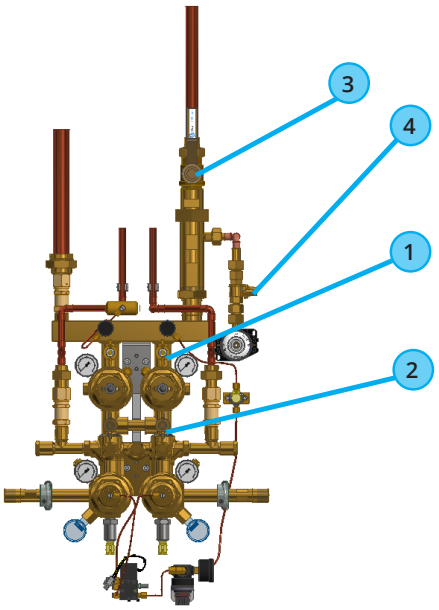
2.6.5 Use 1 cylinder per bank, slowly pressurise the manifold (see section 4.10 - Cylinder operation). Both cylinder gauges (figure 1, item 23) should indicate full cylinder pressure. The line pressure gauge (figure 1, item 18) should read typically as per table 6, Section 4, adjust as necessary (see 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 15 - Leak Test Valve Configuration.



No.	Description
1	Line Isolation Valve
2	Intermediate Isolation Valve (Three Way)
3	Lockable Isolation Valve
4	Test Point Isolation Valve

Pressure drop leak test validation notes:

- The Manifold Changeover System 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, 0.4 ml/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, 0.7 ml/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 0.4 ml/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 0.7 ml/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.

2.6.8 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 detect the pressure drop.

2.6.9 Open test point isolation valve (figure 1, item 15) and relieve the pressure from within the manifold, then close test point isolation valve.

2.6.10 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 Manifold Changeover System 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 Manifold Changeover System.

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 Manifold Changeover System is connected to the distribution system of the same gas service.

3.2.3 Ensure that the manifold lockable isolation valve (shown in figure 1, item 13) is fitted and in the closed position.

3.2.4 Open 1 cylinder valve on each bank of the manifold to pressurize 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 enlightened.

3.3 Pressure Checks.

3.3.1 Ensure that full gas cylinder pressure is shown on the controller screen and backup cylinder gauge (figure 1, item 23), the cylinder graphics are shown as full and the appropriate LED and icons are lit up (see figure 16). See figure 9 to 12 in section 2.5 if setup changes are required.

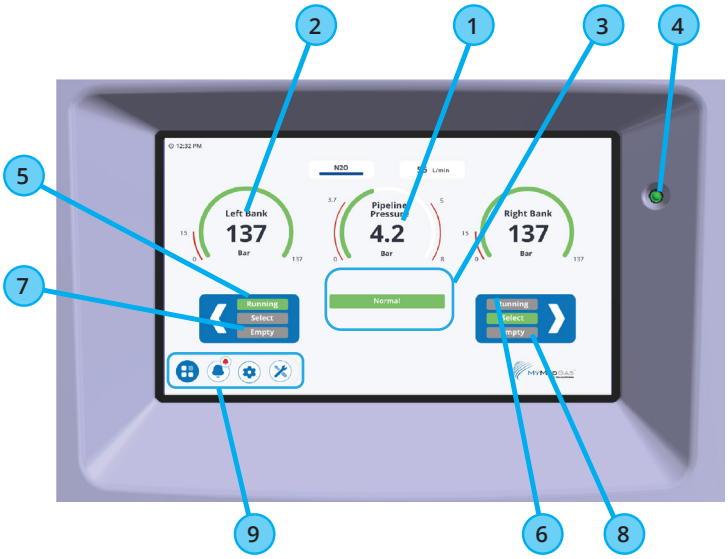
3.3.2 Check that the pipeline distribution pressure displayed on the screen and back up gauge (figure 1, item 18) is typically as per table 6 in section 4, Principles of Operation. Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

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 17) until the cylinder contents pressure is below the bank changeover point (typically 10 bar for 4 bar supply, 20 bar for 8 and 11 bar supply). Stop draining the pressure once the running bank has changed to the right-hand side.

Figure 16 - 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	icon	Condition
1	Line pressure value	N/A	Typically as shown
2	Cylinder pressure valve	N/A	Typically as shown
3	Manifold status graphic	Normal	Shown As Normal
		Standby Running	Standby Running
		Standby Low	Standby Low
		Reserve Low	Reserve Low
		Pipeline Pressure Low	Low Line Pressure
		Pipeline Pressure High	High Line Pressure
4	Power LED		On
			Off
5	Left Bank Running icon	Running	On
		Running	Off

No.	Description	icon	Condition
6	Right Bank Running Icon	Running	On
		Running	Off
7	Left Bank Empty Icon	Empty	On
		Empty	Off
8	Right Bank Empty Icon	Empty	On
		Empty	Off
9	MENU Zone		Home Page
			Alarm Page
			Setting page
			Service page

3.4.2 The controller screen alarm condition will change as shown in figure 17.

Figure 17 - Left Bank Low, Right Bank Running.

Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Cylinders Immediately	Off
Low line pressure	Off
High line pressure	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. At this situation the left select icon background is gray. It can't be pushed to change over.

Figure 18 - Change Bank Lock Out, Low Cylinders.

3.4.4 Open 1 cylinder on the left hand bank to re-pressurise. All conditions should return to normal as per figure 19.

Figure 19 - Normal, Right Bank Running.

Alarm Output Conditions	
Alarm Description	Condition
Normal	On
Change Cylinders	Off
Change Cylinders Immediately	Off
Pressure Fault	Off
High line pressure	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 17) until the cylinder contents pressure is below the bank changeover point (typically 10 bar for 4 bar, 20 bar for 8 & 11 bar supply). Stop draining the pressure once the running bank has changed to the left hand side.

3.4.6 The controller screen and output alarm conditions will change as shown in figure 20.

Figure 20 - Right Bank Low, Left Bank Running.

Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Cylinders Immediately	Off
low line pressure	Off
High line pressure	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 cylinder pressure, as shown in figure 21.

Figure 21 - Change Bank Lock Out at Low Cylinder Bank.

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 17) until the cylinder contents pressure is below the bank changeover point (typically 10 bar for 4 bar supply, 20 bar for 8 and 11 bar supply). Stop draining the pressure once the running bank has changed to the other side.

3.4.9 The controller screen output alarm conditions will change as shown in figure 22.

Figure 22 - Both Banks Low.

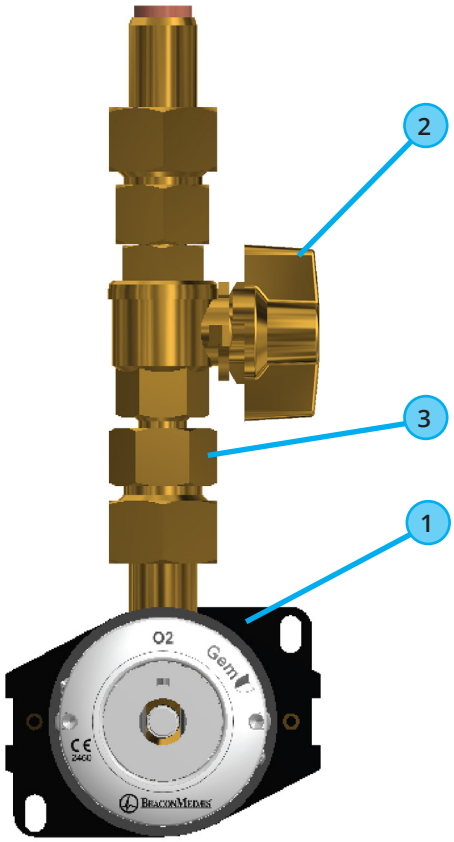
Alarm Output Conditions	
Alarm Description	Condition
Normal	Off
Change Cylinders	On
Change Cylinders Immediately	On
low line pressure	Off
High line pressure	Off

3.4.10 Open 1 cylinder valve on each bank of the manifold. The controller screen output alarm conditions will change typically as shown in figure 19.

3.4.11 With the left bank selected as duty (Press [Left Arrow] to select if necessary). Ensure the test point isolation valve is open (see figure 23). Apply a slow bleed to the test point, as shown in figure 23. This will apply a small flow across the 2nd stage regulator. Typically 5-15 l/min will be adequate.

Figure 23 - Apply Slow Bleed from Test Point.

Item	Description
1	Terminal Unit
2	Test Point Isolation Valve
3	Test Point Connection



NOTE - Item 2 Valve shown in open position.

There are 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 2nd stage pressure regulators set point by turning the adjustment screw (See section 4.5, Pressure Regulator 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 The controller screen output alarm conditions will show as per figure 24.

Figure 24 - 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 controller screen and output alarm conditions will change typically as shown in figure 16.

3.4.15 Close off the slow bleed from the terminal unit by closing the valve (figure 23, item 2), remove flowmeter or probe if used from the test point, reseal the test point connection (figure 23, item 3), if required.

3.4.16 Close all bank cylinder valves.

3.5 Prime the Manifold Changeover System.

3.5.1 Complete the steps in section 4.2 - Procedure to prime Manifold Changeover System, to bring it online.

4. Principles of Operation.

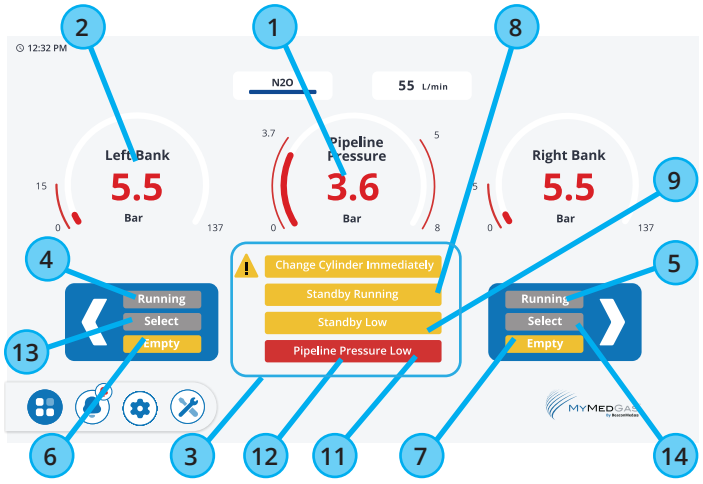
4.1 General.

The Manifold Changeover System pressure is set typically as per table 6 depending on whether it's being used as a primary or backup supply manifold system.

When the Medical Gas Supply System 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.

See figure 25 for full manifold visual indicators and meanings.

Figure 25 - Visual Indicators.



Screen Conditions

No.	Description	Condition	Action
1	Line Pressure Value	Pressure Value	See No. 11 & 12
		ERR	Sensor fault
2	Cylinder Pressure Value	Pressure Value	See No. 9 & 10
		ERR	Sensor fault
3	Manifold status graphic	Normal	No actions
		Change Cylinder Immediately	Change empty cylinders
		Standby Running	See No. 8
		Standby Low	See No. 9
		Reserve Low	See No. 10
		Low Line Pressure	See No. 11
		High Line Pressure	See No. 12
		Manifold Fault	Check sensor or solenoid status
4	Left bank running icon	On	No actions
		Off	No actions
5	Right bank running icon	On	No actions
		Off	No actions
6	Left bank empty icon	Off	No actions
		On	Change left bank Cylinder
7	Right bank empty icon	Off	No actions
		On	Change right bank Cylinder

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.

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
8	Standby running icon	Off	No Actions
		On	Change empty cylinders
9	Standby low icon	Off	No Actions
		On	Change empty cylinders
10	Reserve low icon	Off	No Actions
		On	Change Cylinders on ERM
11	Low line pressure icon	Off	No Actions
		On	Check regulator setting
12	High line pressure icon	Off	No Actions
		On	Check regulator setting
13	Left bank duty select		
14	Right bank duty select		

Item 10 condition status is shown below, only effective when ERM connected.

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

	Pressure (Bar)		
Nominal System Design	**4**	**8**	**11**
Max. Static Pressure Primary Supply	4.8	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 emergency manifold line pressure at least 0.2 bar below the main supply source pressure at full design flow to ensure the backup 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 Manifold Changeover System.

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

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

4.2.2 Ensure the connecting distribution pipeline is ready for use. Slowly open the line valve (Item 13, figure 1).

NOTE - Section 4.3 & 4.4 are for when the Manifold Changeover System is used as a backup emergency manifold only.

4.3 Procedure when Primary Supply Fails (For Backup Manifolds Only).

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

4.3.1 Ensure the manifold line valve (item 13, figure 1) is open. Close the main supply line valve on the failed primary supply.

4.3.2 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 2nd stage pressure regulator setting, until the correct pressure is being supplied. See section 4.5, Pressure Regulator Adjustment.

4.3.3 Once the Manifold Changeover System is in operation there is a provision for an alarm output to warn when the running bank cylinder pressure is typically low. The manifold 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 Manifold Only).

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

4.4.1 Slowly open the primary supply line valve.

4.4.2 Close the backup manifold supply line valve.

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

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

4.5 Pressure Regulator Adjustment.

4.5.1 1st stage pressure regulator adjustment

Adjust the 1st stage pressure regulator (item 1, figure 1) (See figure 26). Then turn anti-clockwise until the line pressure reading is typically set as per table 6.

Figure 26 Pressure Regulator Adjustment.

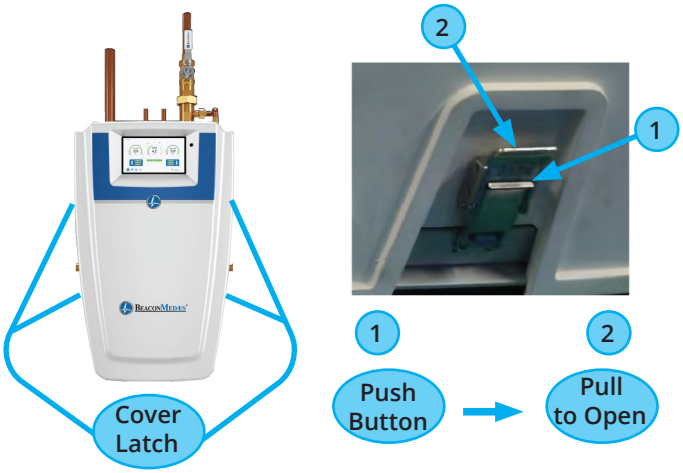
Rotate anti-clockwise to reduce set point

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

The following procedure describes process of setting 1st stage pressure regulator's "base" pressure. This procedure should only need to be performed if 1st stage pressure regulator pressures were not within acceptable limits during performance verification procedure or after servicing regulator.

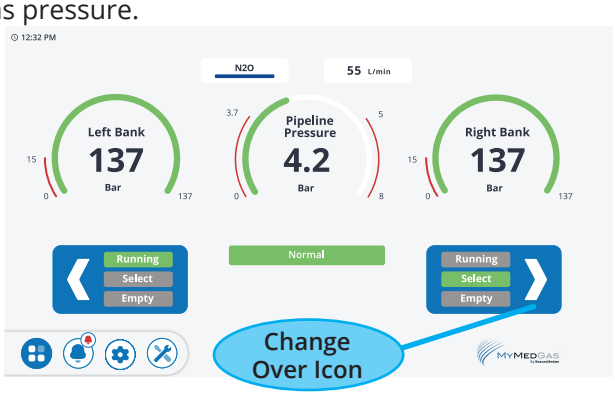
Base pressure setting is a mechanical adjustment controlled by regulator's internal adjusting spring and is regulator's output pressure without any dome bias. Recommended settings are listed in Table 7 under heading of "Intermediate Pressure - Standby Bank". After base pressure has been set, pressure will be increased by amount of dome bias pressure.

4.5.1.1 Remove front cover of manifold system (Item 28, figure 1).



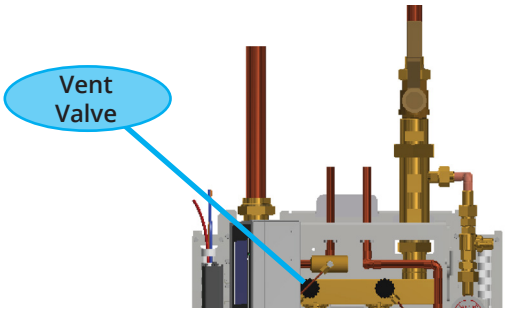
4.5.1.2 Close service valve for the control pressure line (Item 11, figure 1).

4.5.1.3 Press manual changeover icon ❯ on the screen. Cycle manifold from bank to bank to vent residual dome bias pressure.

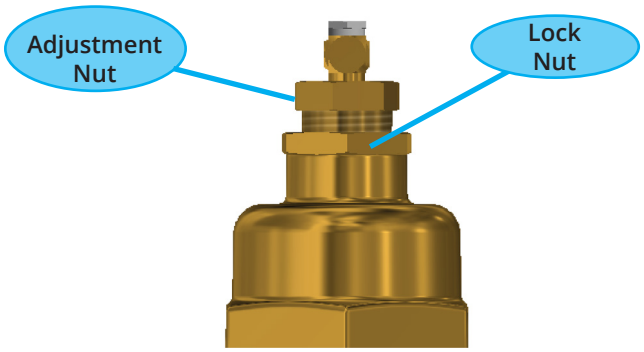


4.5.1.4 Shut off all cylinders on the bank at the opposite side of the regulator to be adjusted.

4.5.1.5 Slightly open vent valve (less than 1/4 turn) to create a small flow of gas through manifold.



4.5.1.6 Use 26 mm wrench, loosen 1st stage pressure regulator Locknut.



4.5.1.7 Use 19 mm wrench, set 1st stage pressure regulator to the value specified in Table 7 (Intermediate Pressure – Standby Bank). Turn anti-clockwise to reduce the set point and turn clockwise to increase the set point.

Table 7: Regulator Pressure Setting.

Nominal System Design	4 bar	8 bar	11 bar
Intermediate Pressure (Standby Bank)	4.8 bar	14.5 bar	14.5 bar
Dome Bias Pressure	4 bar	2.7 bar	2.7 bar
Intermediate Pressure (Running Bank)	8.8 bar	17.2 bar	17.2 bar

4.5.1.8 Tighten the 1st stage pressure regulator Locknut.

4.5.1.9 Close the vent valve.

4.5.1.10 If the other 1st stage pressure regulator also needs to be adjusted, repeat steps 4 through 9.

4.5.1.11 Slowly open all cylinders on both manifold banks.

4.5.1.12 Open service valve and reset dome regulator (Item 25, figure 1) to 2.7 bar (if dome regulator included).

NOTE - By closing service valve, manifold's line pressure sensor (item 19, figure 1) is also isolated. Cycling manifold to vent residual dome bias pressure will also vent pressure shown on manifold's line pressure sensor. Actual outlet pressure supplied by manifold is not affected by following procedure.

NOTE - Dome regulator's red locking ring must be pulled out away from regulator body before adjustment knob can be turned. After adjustment, push locking ring inward to lock knob. Since dome regulator is self-relieving, it is recommended dome regulator always be increased to desired pressure. For example, if dome regulator pressure is too high, first lower pressure to approximately 2 bar. Then increase pressure to between 2.7-3.1 bar.

4.5.2 2nd stage pressure regulator adjustment

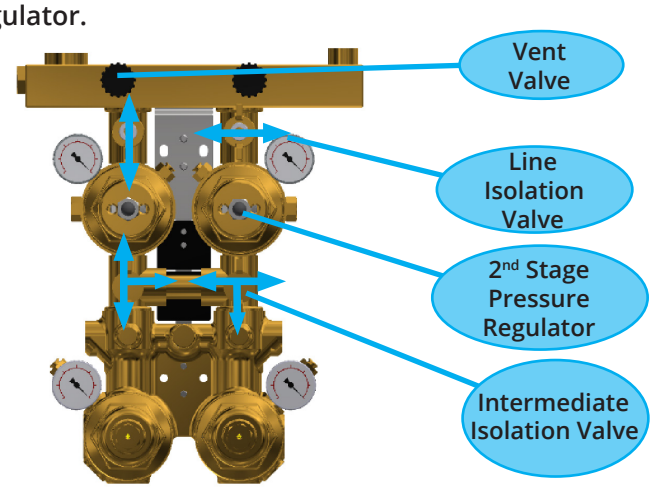
Following procedure describes process of setting 2nd stage pressure regulator pressure. This procedure should only need to be performed if 2nd stage pressure regulator pressures are not within acceptable limits during performance verification procedure or after servicing the 2nd stage pressure regulator with service kit. When shipped from factory, both sides line isolation valves and intermediate isolation valves are in open position. Refer to Figure 15 for location of components called out in this procedure.

NOTE - If both sides line isolation valves and intermediate isolation valves are open, manifold's line pressure gauge will indicate pressure of 2nd stage pressure regulator with highest setting. Verify setting of each regulator individually as described in following procedure.

4.5.2.1 Remove the front cover.

4.5.2.2 Open the left side line isolation valve and intermediate valve to keep the left 2nd stage regulator online and close the right side isolation valve and intermediate valve to isolate the right 2nd stage pressure regulator. See figure 27.

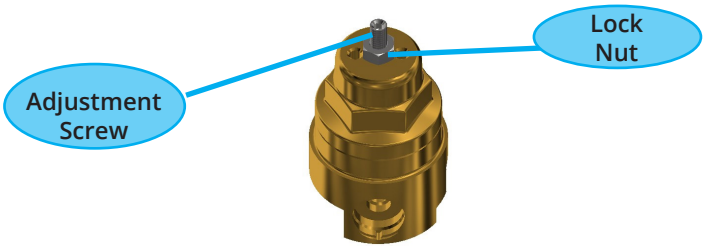
Figure 27 - Isolating the Right 2nd Stage Pressure Regulator.



4.5.2.3 Slightly open vent valve (less than 1/4 turn) to create a small flow of gas through manifold.

4.5.2.4 Using 16 mm wrench, loosen the left 2nd stage pressure regulator locknut.

4.5.2.5 Using 5 mm Hex Key wrench, turn the left 2nd stage pressure regulator. Turn anti-clockwise to reduce the set point and turn clockwise to increase the set point.

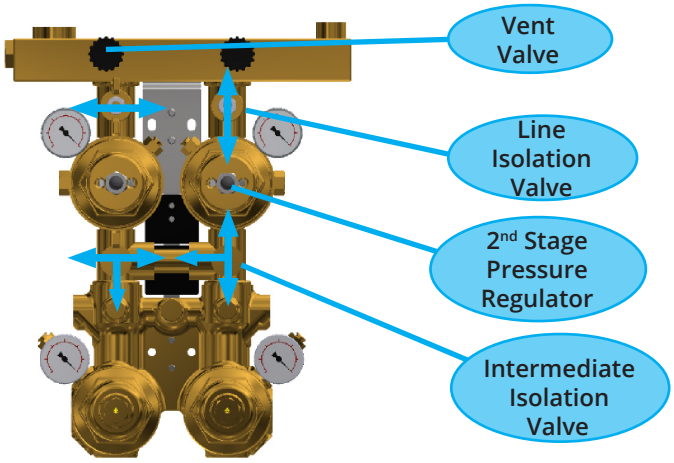


4.5.2.6 Adjust Screw to achieve an appropriate line pressure gauge reading. Note reading for later use. Refer to Table 6 for typical pressure settings.

⚠ 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.

4.5.2.7 Tighten the left 2nd stage pressure regulator locknut.

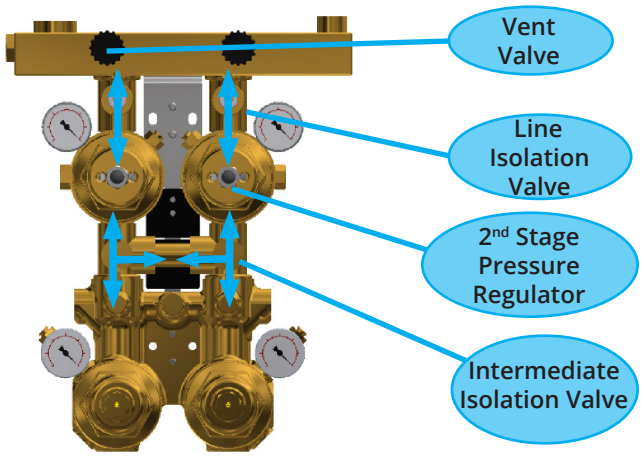
4.5.2.8 Rotate both the left and right isolation ball valves handle to below position, and set the right 2nd stage pressure regulator to the same pressure with the left one.



4.5.2.9 Tighten the right 2nd stage pressure regulator locknut.

4.5.2.10 Close the vent valve.

4.5.2.11 Open left side 2nd stage pressure regulator isolation valve as below position.



4.5.2.12 Verify the manifold operation.

4.5.2.13 Install and secure front cover with the four latches.

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 9). The running cylinder bank will automatically switch to the standby cylinder bank and provide the following alarm outputs shown in table 8. Figure 28 shows typical operation status on the display: left bank running, right bank empty.

NOTE - If the line pressure drops below the low pressure alarm (see table 4 for reference), solenoid valve will change to the other side in attempt to rectify. Notification of this fault will be sent from the alarm outputs.

Table 8: Change Cylinder Alarm Conditions.

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

Figure 28 - Left Bank Running, Right Bank Empty.

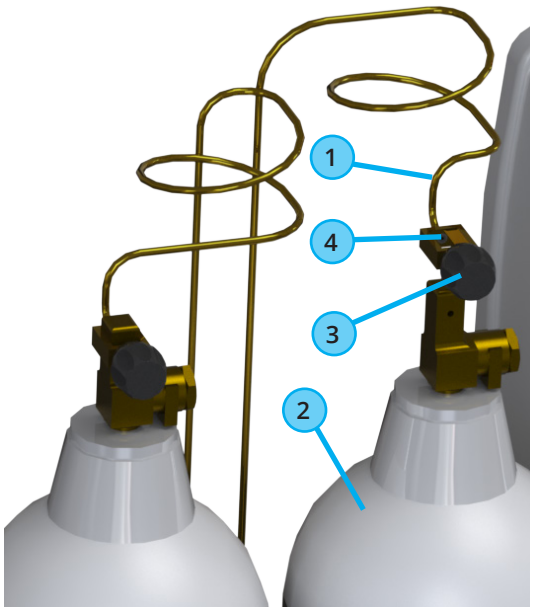
NOTE - This is providing the standby cylinders are full. If the standby cylinders are empty, the manifold will stay in the standby side, and will automatically changeover after the cylinders are replaced by filled cylinders and the "Change Cylinders Immediately" alarm output will become active.

Table 9: Typical Cylinder Bank Changeover Pressure.

Nominal Supply Pressure	Typical Cylinder Changeover
4 Bar	10 Bar
8 Bar	20 Bar
11 Bar	20 Bar

4.6.3 For each empty cylinder, disconnect the tailpipe from the cylinder (see figure 29) by either undoing the hand wheel or unscrewing the nut at the cylinder end, depending on the cylinder connection type.

Figure 29 - 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 status icon will automatically return to normal.

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

NOTE - 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.

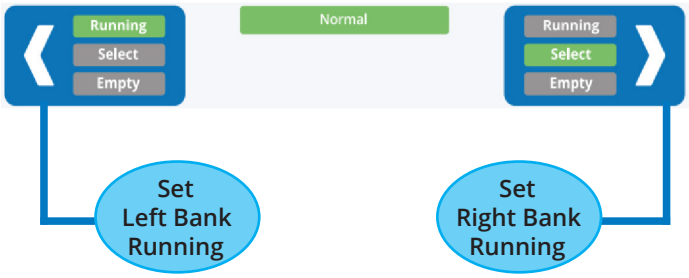
4.6.7 Repeat this section each time when the running bank drops to the changeover pressure until the main supply is fully operational.

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 30.

4.7.2 Change empty cylinders as per section 4.6

Figure 30 - Manual Cylinder Bank Selection.



NOTE - If the selected cylinder bank is in low pressure, the selection will not be activated.

4.8 Procedure for Operation During Power Failure.

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

4.8.2 During power failure the electronic controls will not be in operation, but cylinder banks can automatically changeover due to the balanced mechanical design.

4.8.3 When the power is lost to the manifold control, all alarm outputs will be active to bring attention to the alarm system, and the solenoid valve on the gas control line will switch to left bank as primary bank by default.

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

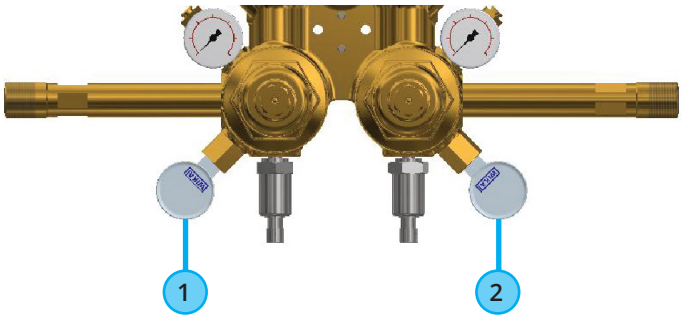
4.8.4 In the event of power failure, the left bank supply is the primary source, with full supply pressure and flow continuity. The right bank supply will take over when the left bank is below 4.8 bar. Once the primary left bank is refilled, it will remain as the primary source. Upon power restoration, the device reverts to left bank of cylinders. Once a changeover has occurred, and the cylinders have been replaced, the system automatically resets alarm conditions.

4.8.5 As the left bank will always be the primary bank during power failure event, so when the left bank is empty, the cylinders should be replaced immediately.

4.8.6 The right bank cylinders should have enough pressure reservation before the left bank cylinder is replaced to ensure the flow continuity.

4.8.7 Monitor the bank gauges shown in figure 31 to determine the cylinder pressure status.

Figure 31 - Cylinder Pressure Gauges.



Item	Description
1	Left Cylinder Pressure Gauge
2	Right Cylinder Pressure Gauge

4.8.8 Changing empty cylinders is as per section 4.6

⚠ CAUTION! To ensure continuous supply of the medical gas, NEVER have both line isolation valves (item 5, figure 1) closed at the same time. NEVER close both side of the intermediate three way isolation valve (item 3, figure 1).

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 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 Manifold Control Menus.

Figure 32 - Full Menu Map.

NOTE - While in service mode the cylinder bank changeover 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.

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 BeaconMedaes for installations within UK. The 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 Before Installation.

5.1.1 Check all the parts clean and oil-free, especially for the parts contacting with the gas of high pressure.

5.1.2 Check gas specific connections to match the right type of the gas.

5.1.3 Don't use chemicals, lubricants or sealants unless specified in these instructions.

5.1.4 Before connecting cylinder to manifold system, momentarily open and close cylinder valve to blow out dirt and debris.

5.1.5 After connecting cylinder to manifold, open cylinder valve slowly to allow heat of compression to dissipate.

5.1.6 Don't use flame or "sniff" test for leaking inspection.

5.1.7 Don't apply heat to any part of manifold system.

5.1.8 Always secure cylinders with racks, straps, or chains. Unrestrained cylinders may fall over and damage or break off cylinder valve.

5.1.9 Don't repeatedly bend, sharply bend, or twist copper tailpipes as damage to tubing may occur.

5.1.10 Don't bend flexible tailpipes into a radius smaller than 3'.

5.1.11 Visually inspect each tailpipe for cleanliness and pipe damage. Don't use and immediately replace dirty or damaged tailpipes.

5.1.12 Check leaks at the connections of cylinder to tailpipe using oxygen compatible leak detector solution.

5.2 During Cylinder Replacement.

5.2.1 Visually inspect each tailpipe for cleanliness and pipe damage. Don't use and immediately replace dirty or damaged tailpipes.

5.2.2 Check leaks at the connections of cylinder to tailpipe using oxygen compatible leak detector solution.

5.3 Daily Inspection.

5.3.1 Visually inspect manifold for normal operation. Record controller display status (e.g. running bank).

5.3.2 Record left and right bank pressure gauge readings.

5.3.3 Record line pressure gauge reading.

5.3.4 Check visual indicators for correct function and message, see section 4 figure 25 for reference.

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

5.3.5 Check manifold pressure gauges for abnormal conditions, see section 4 figure 25 for reference.

5.3.6 Check manifold for unusual noises or vibrations.

5.3.7 Check that all cylinders are properly secured and that batch labels are correct and in date. Replace as necessary.

5.4 Monthly.

5.4.1 Verify the operation of manifold changeover system using Performance Verification Procedure.

5.4.2 Perform pressure and function inspection.

5.4.3 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.

5.4.4 Switch the supply over to the standby cylinder bank (see section 4.7, figure 30), and check the line pressure is still within normal supply.

5.4.5 Close the line isolating valve on the manifold slowly and confirm that there is no effect on the line pressure to the hospital. Open the isolation valve when finished.

5.4.6 Check that the manifold relief 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 33). Replace the valve or seals as necessary. Reconnect the exhaust pipework, ensure the O-ring seals correctly in place.

5.4.7 Close one cylinder valve and disconnect the tailpipe at the cylinder end (see figure 34). 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 depressurized. Repeat this test when the new NRV's have been fitted.

5.4.8 To simulate the "reserve low" fault. Disconnect one of the wires to the "Reserve Manifold Fault". Observe that the alarm fault becomes active. Reconnect the wire and observe the fault returns to normal. See section 4.2 to bring the manifold back on line.

5.5 Yearly.

5.5.1 Visually inspect each tailpipe for cleanliness and pipe damage. Don't use and immediately replace dirty or damaged tailpipes.

5.5.2 Check leaks at the connections of cylinder to tailpipe using oxygen compatible leak detector solution.

5.5.3 Verify the operation of manifold changeover system using Performance Verification Procedure.

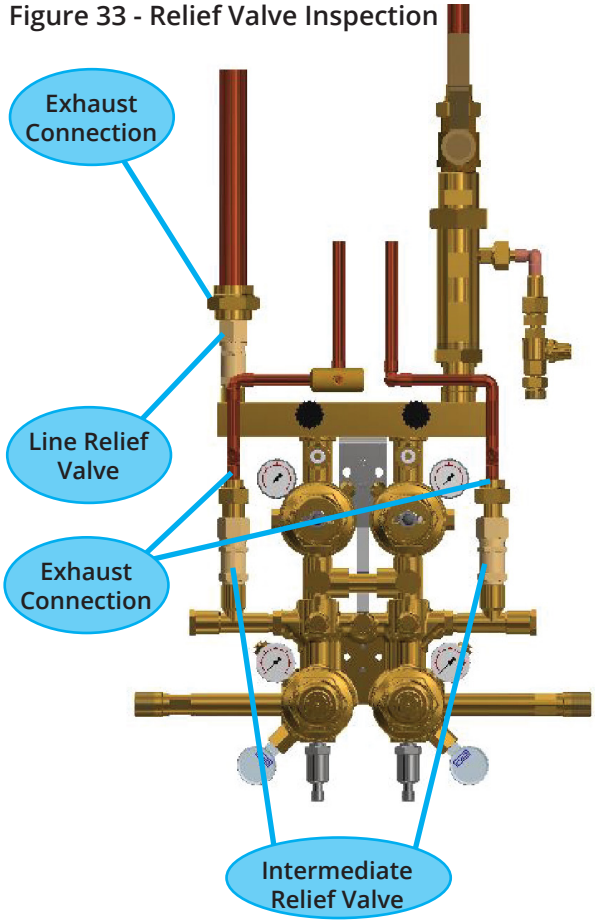
5.5.4 Calibrate the gauge and relief valve refer to the local law.

5.5.5 Check the power supply.

5.5.6 Replace the tailpipes, see table 12.

⚠ 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.

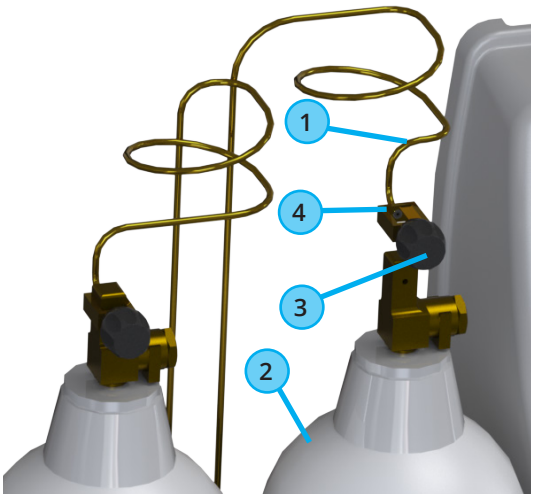
Figure 33 - Relief Valve Inspection



NOTE - Step 5.3.5 and 5.4.5 is only for manifold changeover system that are used as emergency backup.

Figure 34 - Typical Cylinder Connection.

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



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

5.6 5 Years.

Refer to section 6 for operation procedures.

5.6.1 Service the regulators.

5.6.2 Replace the relief valves.

5.6.3 Replace the capsule in the terminal unit.

5.6.4 Replace the non-return valves in header. See table 11 for the kit numbers of the gas dedicated non-return valves.

5.6.5 Replace the tailpipes.

5.6.6 Replace inlet sintered filter.

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

Table 10 give the part numbers for 5-year service kits that contain all the relevant parts.

Table 10: 5-Year Service Kits.

Kit Number	Description
4109150498	Intermediate Relief Valve Kit
4109150509	Line Pressure Relief Valve Kit-5.2 bar
4109150510	Line Pressure Relief Valve Kit-11 bar
4109150511	Line Pressure Relief Valve Kit-13 bar
4109150499	1st Stage Regulator Kit
4109150500	2nd Stage Regulator Kit
4109150507	Terminal Unit Capsule Kit
4109150508	Screen Inlet Filter Kit

Table 11: Header Non-Return Valves.

GAS Type	Kit Number
Oxygen (O2)	4109150501
Nitrous Oxide (N2O)	4109150502
Oxygen/Nitrous Oxide (O2/N2O)	4109150503
Medical Air / Surgical Air	4109150504
Nitrogen (N2)	4109150505
Carbon Dioxide (CO2)	4109150506

⚠ CAUTION! It is mandatory to replace intermediate relief valves and line pressure releif valves every 5 years.

⚠ WARNING! It is recommended to service the 1st and 2nd stage regulators every 5 years to replace the worn parts inside, The operation can be performed when the manifold is in working status. This should only be done by qualified technicians experienced in servicing medical equipment.

Table 12: Tailpipe Kit Numbers.

Kit Number	Description
4109150344	Oxygen Pin-Index Tailpipe
4109150352	N2O Pin-Index Tailpipe
4109150357	O2-N2O Pin-Index Tailpipe
4109150360	Air Pin-Index Tailpipe
4109150370	CO2 Pin-Index Tailpipe
4109150345	Oxygen Extended Pin Index
4109150358	O2-N2O Extended Pin-Index
4109150361	Air Extended Pin-Index
4109150346	Bull Nose (ISO5145) Side Entry O2
4109150359	Bull Nose (ISO5145) Side Entry O2/N2O
4109150347	Oxygen BullNose Top Entry
4109150363	Air Bullnose Top Entry
4109150368	Pmgs N2 BullNose Tailpipe
4109150348	Oxygen BullNose Side Entry
4109150353	N2O Bullnose Side Entry
4109150364	Air BullNose Side Entry
4109150371	CO2 BullNose Side Entry
4109150349	Oxygen Extended BullNose
4109150354	N2O Extended BullNose Tailpipe
4109150365	Air Extended BullNose Tailpipe
4109150372	CO2 Extended BullNose Tailpipe
4109150350	PMGS Oxygen CGA 540 Tailpipe
4109150355	PMGS N2O CGA 326 Tailipipe
4109150366	PMGS Air CGA 346 Tailpipe
4109150351	Oxygen Chinese Bullnose
4109150356	N2O Chinese Bullnose Tailpipe
4109150367	Air Chinese Bullnose Tailpipe
4109150369	N2 Chinese Bullnose Tailpipe
4109150374	CO2 Chinese Bullnose Tailpipe

6. Component Replacement Procedures.

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

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

Become familiarized with all associated procedures and ensure all required parts are available before carrying out any of the following procedures.

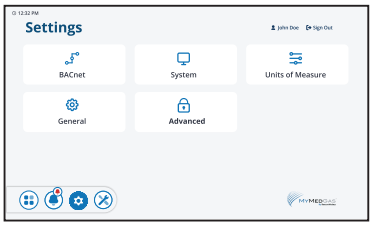
6.1 Optional Service Mode Setting.

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.

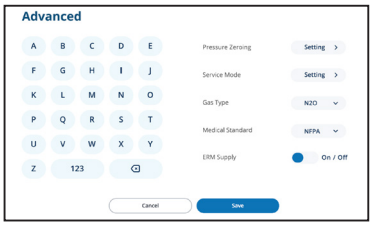
Figure 35 - Service Mode Option.

1. In the home page , push the setting button.

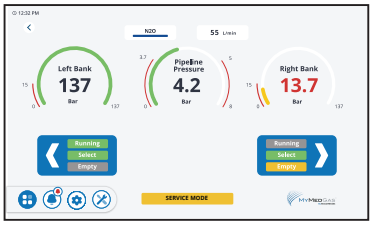
2. In setting page, push the Advanced button .



3. Click the Setting of service Mode.



4. Enter the service mode page.



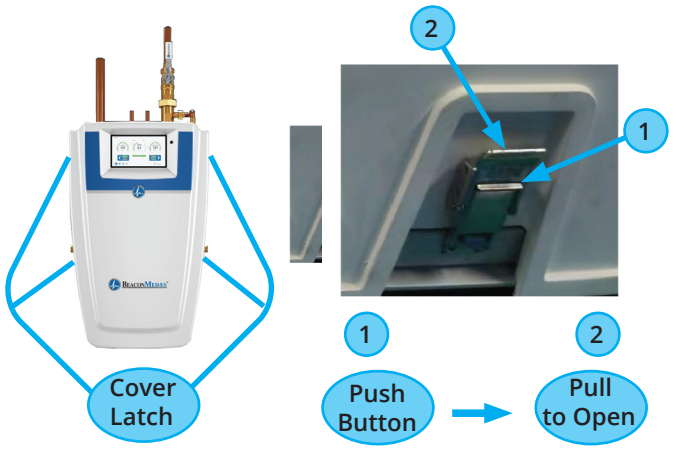
5. Press the home button or previous icon to quit the service mode.

6.2 Preparation for Component Replacement and Maintenance Requiring Total Manifold Isolation.

6.2.1 Ensure alternative gas supply is available and functioning before taking the manifold offline.

6.2.2 Remove the front cover by opening the 4 latches as shown in figure 36 and lift away.

Figure 36 - Main Cover Removal.



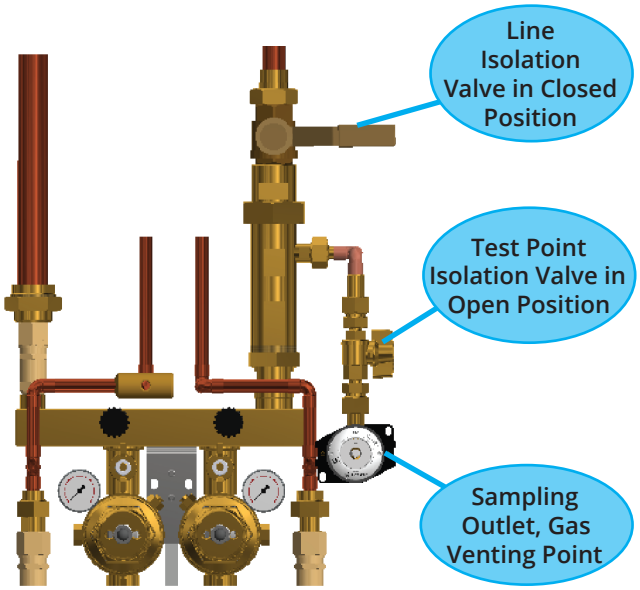
6.2.3 Close the line isolation valve as shown in figure 37 and close all the cylinder valves.

6.2.4 Open the test point isolation valve as shown in figure 37 and probe the outlet to depressurise the system.

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

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

Figure 37 - Valve Isolation and Pressure Draining.



6.3 Preparation for Component Replacement and Maintenance Requiring Single Cylinder Bank Isolation.

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

6.3.1 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 Manifold Changeover System bank offline.

6.3.2 Remove the front cover by opening the latches as shown in figure 36, and lift away.

6.3.3 Close the isolation valves as shown in figure 38 and figure 39 for the relevant side to be serviced and close all the cylinder valves on the same bank.

Figure 38 - Isolating the Left 1st Stage Regulator.

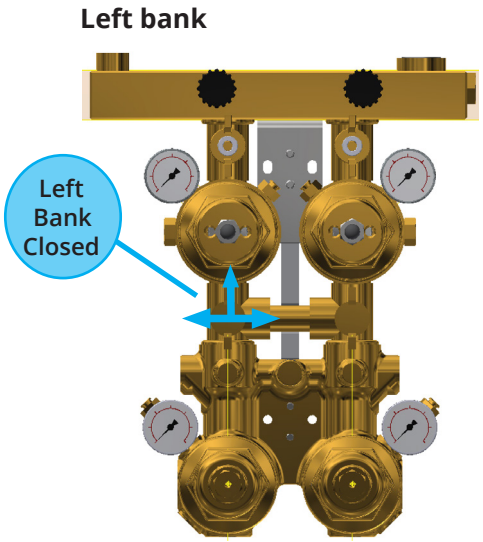
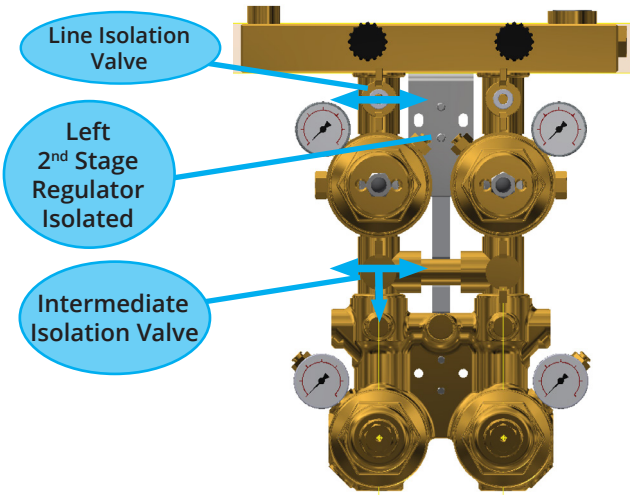


Figure 39 - Isolating the Left 2nd Stage Regulator.



6.4 1st Stage Pressure Regulator Maintenance.

⚠ WARNING! Vent all inlet pressure and outlet pressure to 0 bar prior to servicing the regulator.

⚠ WARNING! Service must be performed in a clean environment, free of any oils and grease (hydrocarbons).
- Gloves must be worn to preserve cleanliness of internal regulator components.
- Use care to not damage the regulator's sealing surfaces. Scratches or other damage to certain surfaces may render regulator non-repairable.

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

Following procedure describes process to service 1st stage pressure regulator. If necessary, regulator service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Internal repair of regulator is not recommended.

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

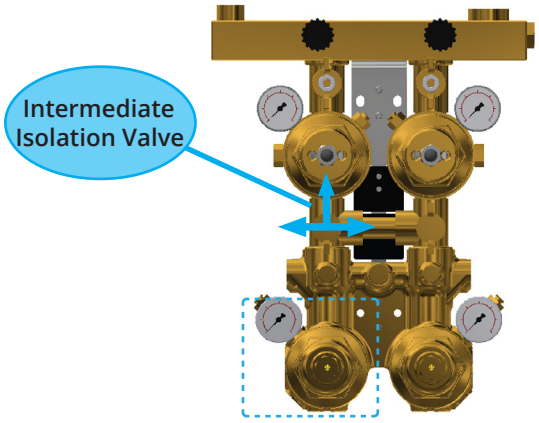
6.4.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred, follow steps in 6.2.

NOTE - Figure 40 shows example of left 1st stage regulator maintenance, mirror to opposite side for working on the right bank.

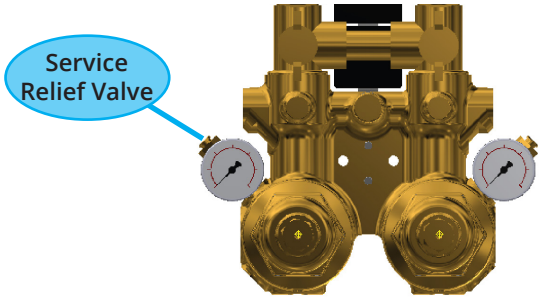
6.4.3 Close all cylinders on side of manifold where 1st stage pressure regulator will be repaired.

6.4.4 Rotate the ball valve handle on the same side after the 1st stage pressure regulator to isolate the 1st stage pressure regulator.

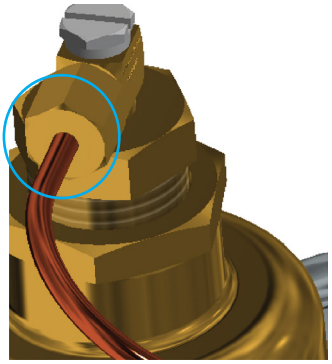
Figure 40 - Isolating the Left 1st Stage Regulator.



6.4.5 Vent pressure from bank that was shut off in step 1 by pressing the service relief valve.



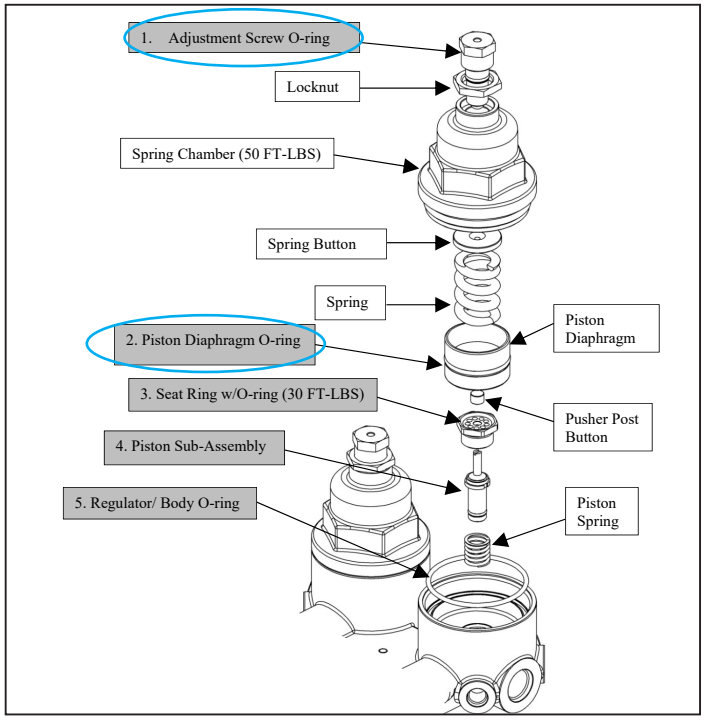
6.4.6 Disconnect tubing from 1st stage pressure regulator by loosening the connector.



6.4.7 Using a 2" Socket, remove the Spring Chamber.

6.4.8 Using a 19 mm wrench, turn the 1st stage pressure regulator Adjustment Screw counter-clockwise to release all spring tension. Remove Adjustment Screw/ Locknut and set aside in clean area.

6.4.9 Using a 51 mm Socket, remove the Spring Chamber.



6.4.10 Using a Screwdriver, insert into top of Spring Chamber past Adjustment Screw threads and push on the Spring Button to push out Piston Diaphragm, Spring and Spring Button. Set components aside in a clean area.

6.4.11 Remove Pusher Post Button and set aside.

6.4.12 Using a Plastic Pick, remove the Regulator/ Body O-ring. Discard O-ring.

6.4.13 Using a 23 mm Socket, remove the Seat Ring by turning counter-clockwise.

6.4.14 Discard Seat Ring w/O-ring.

6.4.15 Remove Piston Sub-Assembly and discard.

6.4.16 Verify the Piston Spring remains in place within regulator body.

6.4.17 Insert new Piston Sub-Assembly.

6.4.18 Install new Seat Ring by screwing it in by hand while pressing in on the Piston Sub-Assembly. Once hand tight, use torque wrench to finish tightening to 40 Nm.

6.4.19 Assemble Pusher Post Button.

6.4.20 Insert new Regulator/Body O-ring. Use care to place uniformly in groove.

6.4.21 Using Plastic pick, remove old O-ring from Piston Diaphragm and install new one included in kit.

6.4.22 Stack Piston Diaphragm, Spring and then the Spring Button together.

6.4.23 Place Spring Chamber on top of these components to capture them. The O-ring on the Piston Diaphragm should hold all the components in the Spring Chamber.

6.4.24 Assemble Spring Chamber to the Regulator Body. Tighten to 68 Nm.

6.4.25 Using a Plastic Pick, remove the Adjustment Screw O-ring. Discard O-ring.

6.4.26 Assemble new Adjustment Screw O-ring.

6.4.27 Put Locknut on Adjustment Screw and assemble to Spring Chamber.

6.4.28 Turn the Adjustment Screw until desired set pressure.

6.4.29 Tighten the Locknut.

6.4.30 Verify the manifold operation.

6.5 2nd Stage Pressure Regulator Maintenance.

⚠ WARNING! Vent all inlet pressure and outlet pressure to 0 bar prior to servicing the regulator.

⚠ WARNING! Service must be performed in a clean environment, free of any oils and grease (hydrocarbons).
- Gloves must be worn to preserve cleanliness of internal regulator components.
- Use care to not damage the regulator's sealing surfaces. Scratches or other damage to certain surfaces may render regulator non-repairable.

NOTE - 2nd stage regulator maintenance can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

Following procedure describes process to service 2nd stage pressure regulator. If necessary, regulator service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Internal repair of regulator is not recommended.

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

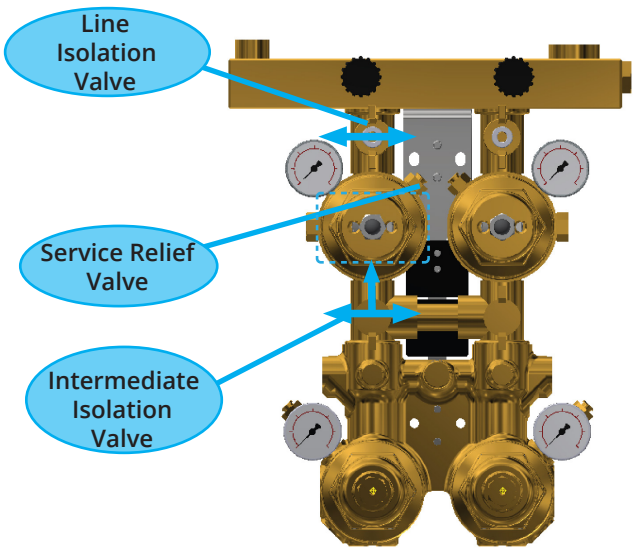
6.5.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred, follow steps in 6.2.

NOTE - Figure 41 shows example of left 2nd stage regulator maintenance, mirror to opposite side for working on the right bank.

6.5.3 Vent all inlet and outlet pressure of line regulator to 0 bar by pressing the service relief valve.

6.5.4 Using a 16 mm Wrench, loosen 2nd stage pressure regulator locknut.

Figure 41 - Isolating the Left 2nd Stage Regulator.



6.5.5 Using a 5 mm Hex Key Wrench, turn 2nd stage pressure regulator Adjustment Screw counter-clockwise to release all spring tension. Remove Adjustment Screw/ Locknut and set aside in clean area.

6.5.6 Using a 51 mm Socket, remove Spring Chamber.

6.5.7 Using a Screwdriver, insert into top of Spring Chamber past Adjustment Screw threads and push on Spring Button to push out Piston Diaphragm, Spring and Spring Icon. Set components aside in a clean area.

6.5.8 Remove Pusher Post Button and set aside.

6.5.9 Using a Plastic Pick, remove Regulator/Body O-ring. Discard O-ring.

6.5.10 Using the 23 mm Socket, remove Seat Ring by Discard Seat Ring w/O-ring.

6.5.11 Discard Seat Ring w/O-ring.

6.5.12 Remove Piston Sub-Assembly and discard.

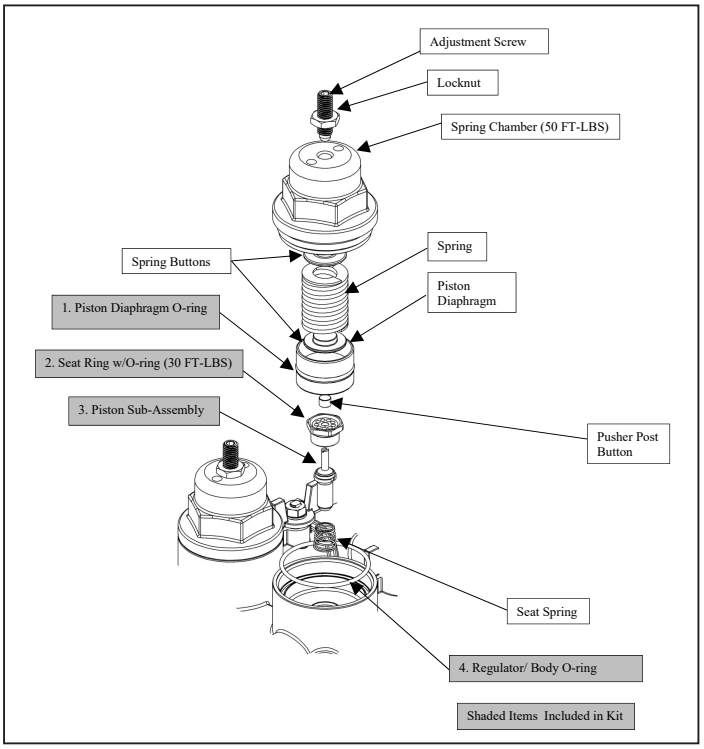
6.5.13 Assemble Pusher Post Button.

6.5.14 Verify that the Seat Spring and O-ring remains in place within regulator's body.

6.5.15 Install new Seat Ring by screwing it in by hand while pressing in on the Piston Sub-Assembly. Once hand tight, use torque wrench to finish tightening to 40 Nm.

6.5.16 Insert new Seat Ring and remove spring pressure from seat ring during installation by pressing on piston sub-assembly while screwing in the seat ring.

6.5.17 Assemble Pusher Post Button.



6.5.18 Insert new Regulator/Body O-ring. Use care to place uniformly in groove.

6.5.19 Using Plastic Pick, remove old O-ring from Piston Diaphragm and install new one included in kit.

6.5.20 Stack Piston Diaphragm, Spring and Spring Icon together.

6.5.21 Place Spring Chamber on top of these components to capture them. The O-ring on Piston Diaphragm should hold all components in Spring Chamber.

6.5.22 Assemble Spring Chamber to the Manifold Body. Tighten to 68 Nm.

6.5.23 Put Locknut on Adjusting Screw and assemble to Spring Chamber.

6.5.24 Turn Adjustment Screw until desired set pressure is reached.

6.5.25 Tighten the Locknut.

6.5.26 Verify the manifold operation.

6.6 Replace Line Pressure Relief Valve.

Line pressure relief valve kit numbers, see table 13, chapter 7.

NOTE - Line pressure relief valve replacement requires total isolation of the manifold.

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

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

6.6.2 Slowly turn the swivel nut of connection in the upper position, see figure 42. Loosen the relief valve nut at the below position see figure 42. If you hear gas escaping do not fully unscrew the joint, refer back to section 6.2 to ensure the system is fully drained.

6.6.3 Remove the existing relief valve carefully and replace it with the new relief valve together with the new connector from the service kit.

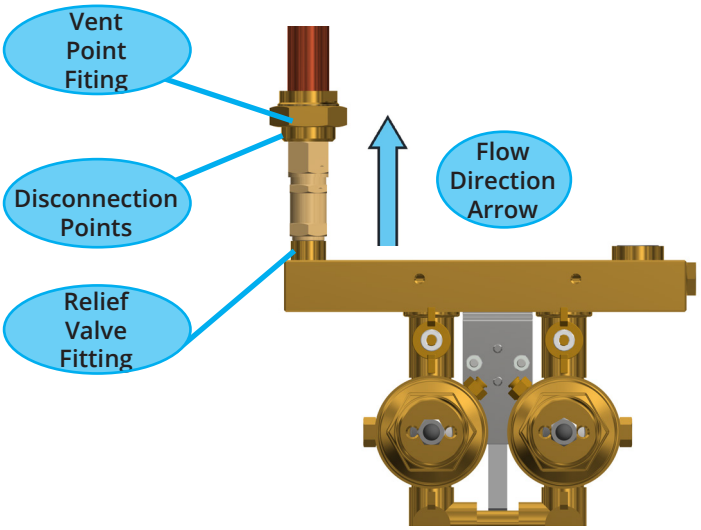
6.6.4 Fit the new relief valve, ensure the direction arrow is as per figure 42.

6.6.5 Fit the vent point fitting.

6.6.6 Follow section 6.17 to bring the manifold back online.

6.6.7 Verify the manifold operation.

Figure 42 - Line Pressure Relief Valve Replacement.



6.7 Replace Intermediate Pressure Relief Valve.

Intermediate pressure relief valve kit number, see table 13, chapter 7.

NOTE - Intermediate pressure relief valve can be performed with the associated bank isolated, while running on the opposite bank of the manifold.

Following procedure describes process to service intermediate pressure relief valve. If necessary, replacement service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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.

NOTE - Figure 43 shows example of left intermediate pressure relief valve replacement, mirror to opposite side for working on the right bank.

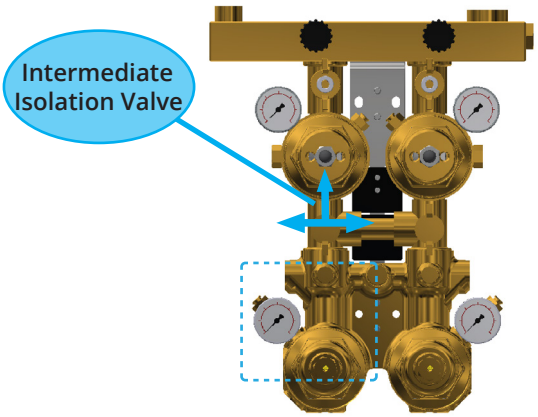
⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

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

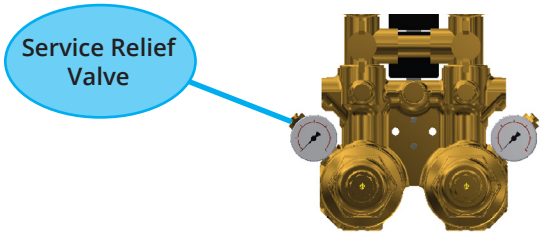
6.7.3 Switch the duty bank to the side where the intermediate relief valve will not be replaced. Then close all the cylinders on one bank of manifold where the intermediate relief valve will be replaced.

6.7.4 Rotate the intermediate isolation valve to isolate the 1st stage regulator and the intermediate relief valve on the same side. Refer to Figure 40 for isolating the 1st stage regulator on the left side.

Figure 40 - Isolating the Left 1st Stage Regulator.



6.7.5 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the service relief valve as shown in below figure.



6.7.6 Once all the gas has been vented, fully disconnect the exhaust pipe from the fittings marked in figure 43.

6.7.7 Remove the relief valve and old connector.

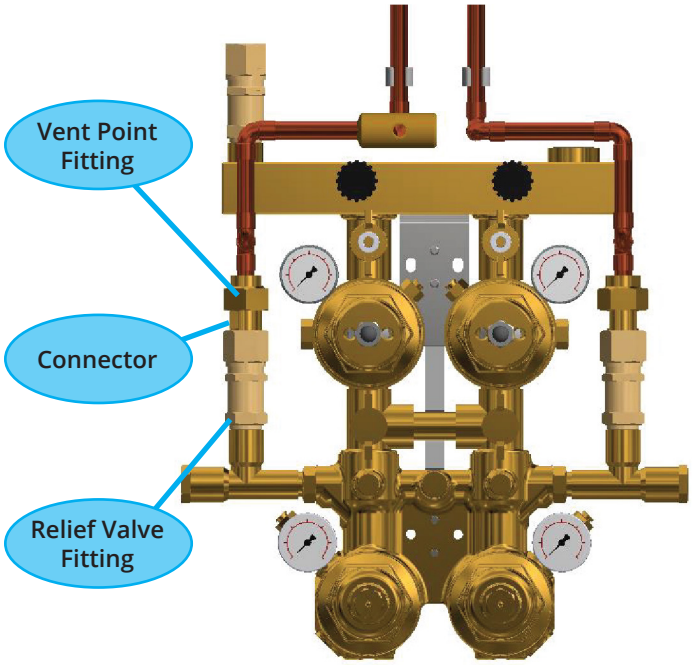
6.7.8 Connect the new relief valve with the new connector and re-connect the exhaust pipework. Tighten the vent point fitting.

6.7.9 Follow section 6.17 or 6.18 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.7.10 Verify the manifold operation.

Figure 43 - Intermediate Relief Valve Replacement.

NOTE - Figure 43 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



6.8 Replace Medical Terminal Unit Test Point.

Terminal unit capsule kit number, see table 13, chapter 7.

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

6.8.1 Isolated the terminal unit from the valve shown in figure 44.

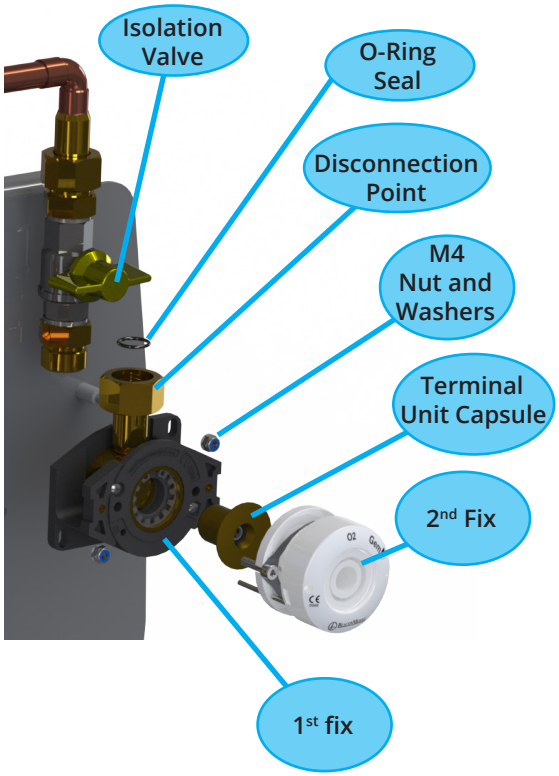
6.8.2 Probe the terminal unit to vent the gas.

⚠ 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.

6.8.3 Follow steps in 6.8.4 for 1st fix only, 6.8.5 for 2nd fix only or 6.8.6 for terminal unit capsule only.

Figure 44 - Terminal Unit Test Point Replacement.



NOTE - Isolation valve is shown in its closed position.

6.8.4 Replace the 1st fix terminal unit only, See figure 44 for reference.

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

6.8.4.2 Remove the check valve from the 1st fix terminal unit.

6.8.4.3 Disconnect the 1/2” connection and remove the 2 x M4 nuts and washer.

6.8.4.4 Replace the O-ring with the new one in the service kit.

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

6.8.4.5 Align the new 1st fix with the 1/2” connection, ensure the O-ring is correctly fitted then tighten the connection point.

6.8.4.6 Secure the 1st fix in place with the previously removed M4 nut and washers.

6.8.4.7 Insert the check valve from the old unit into the new 1st fix.

6.8.4.8 Thread an Allen key tool through the old 2nd fix socket to the fasteners. Fasten the 2nd fix to the 1st fix terminal unit.

6.8.4.9 Open the test point isolation valve and probe the terminal unit to ensure there is gas flow.

6.8.4.10 Close the terminal unit isolation valve.

6.8.5 Replacing the 2nd fix terminal unit only, see figure 44 for reference.

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

6.8.5.2 Remove the check valve from the 1st fix terminal unit.

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

6.8.5.3 Insert the check valve into the 1st fix, supplied with the new 2nd fix.

6.8.5.4 Thread an Allen key tool through the new 2nd fix socket to the fasteners. Fasten the 2nd fix to the 1st fix terminal unit.

6.8.5.5 Open the test point isolation valve and probe the terminal unit to ensure there is gas flow.

6.8.5.6 Close the terminal unit isolation valve.

6.8.6 Replacing the terminal unit capsule only, see figure 44 for reference.

⚠ CAUTION! It is mandatory to replace terminal unit capsule every 5 years.

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

6.8.6.2 Remove the terminal unit capsule from the 1st fix terminal unit.

6.8.6.3 Insert the new terminal unit capsule into the 1st fix.

6.8.6.4 Thread an Allen key tool through the new 2nd fix socket to the fasteners. Fasten the 2nd fix to the 1st fix terminal unit.

6.8.6.5 Open the test point isolation valve and probe the terminal unit to ensure there is gas flow.

6.8.6.6 Close the terminal unit isolation valve.

6.9 Replace Manifold Header Non-Return Valves.

⚠ CAUTION! It is mandatory to replace headers non-return valves every 5 years.

Header non-return valve kit numbers, see table 13, chapter 7.

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

Following procedure describes process to service header non-return valve. If necessary, header non-return valve service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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

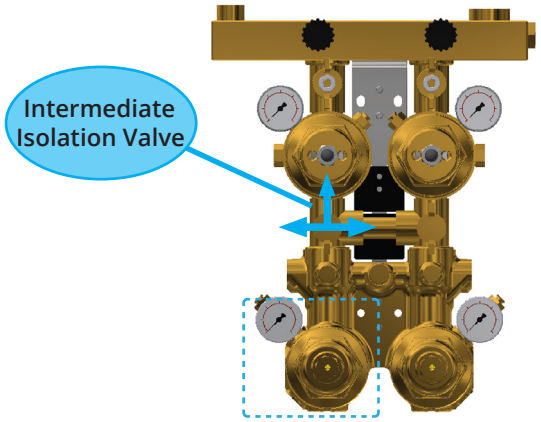
6.9.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred, follow steps in 6.2.

NOTE - Figure 45 shows example of left header non-return valve maintenance, mirror to opposite side for working on the right bank.

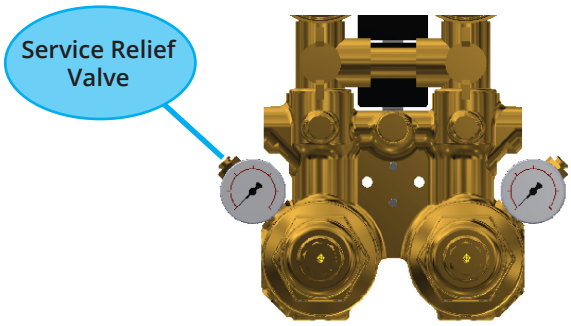
6.9.3 Close all cylinders on side of manifold where non-return valves will be repaired.

6.9.4 Rotate the intermediate isolation valve to isolate the 1st stage regulator at the same side for the non-return valve replacement.

Figure 40 - Isolating the Left 1st Stage Regulator.

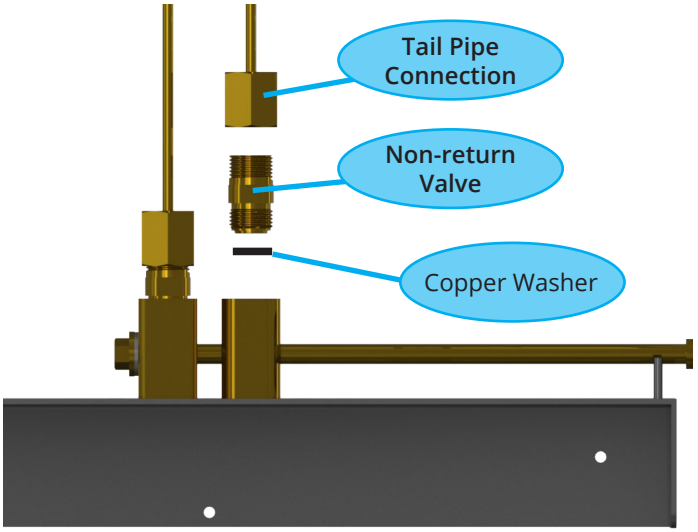


6.9.5 Vent pressure in the bank and 1st stage regulator that is isolated in the last step by pressing the service relief valve on the 1st stage regulator.



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

Figure 45 - Header Non-Return Valve Replacement.



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

6.9.7 Remove the non-return valve and washer.

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

NOTE - Non-return valve kit is supplied complete with new washer.

6.9.8 Fit the new washer and connect the new non-return valve.

6.9.9 Follow section 6.18 or 6.19 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.10 Replace Solenoid Valve.

Solenoid valve kit number, see table 13, chapter 7.

NOTE - Solenoid replacement can be performed with the service valve closed (Item 11, figure 1), while running on both banks of the manifold.

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

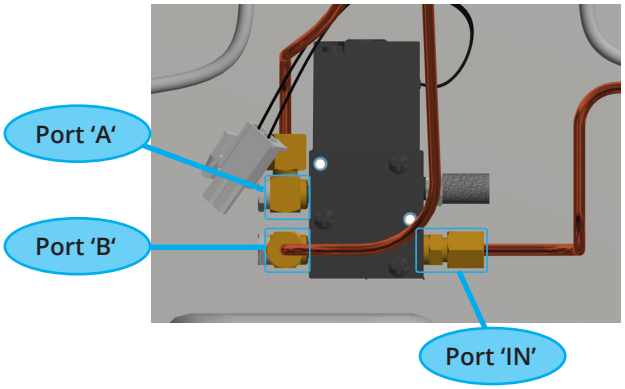
6.10.2 Close the service valve (Item 11, figure 1).

6.10.3 Enter the service mode in the controller.

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

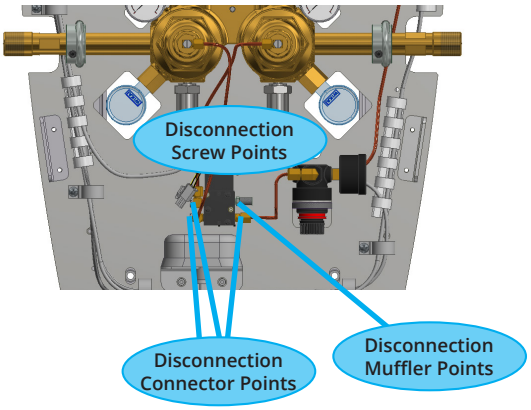
6.10.4 Disconnect the cables for the solenoid valve.

6.10.5 Slowly loosen connector of the 'IN' port position to vent the gas inside the solenoid valve.



6.10.6 Remove the 3 fittings connectors and , 2 screws and 1 muffler as shown in figure 46 from the old solenoid valve.

Figure 46 - Solenoid Valve Replacement.



6.10.7 Connect the fittings connectors and muffler and seals from the old solenoid valve to the new one,. Then fit the new solenoid valve unit to the manifold as per the old one, ensuring that the 'B' port is connected to left bank and 'A' port is connected to right bank.

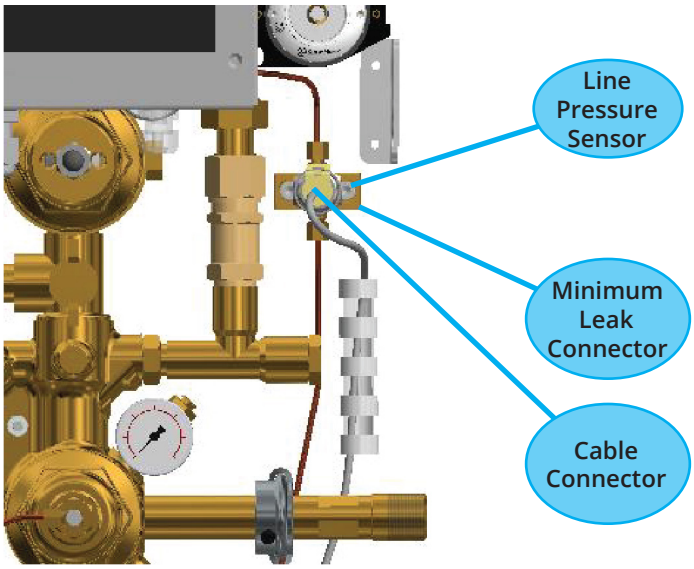
6.10.8 Wire the new solenoid valve cable to the controller cables.

6.10.9 Open the service valve.

6.11 Replace Sensor for Distribution System Pressure.

NOTE - Line pressure sensor replacement can be performed with the service valve closed (Item 11, figure 1), can read the line pressure by line pressure gauge (Item 18, figure 1) at that time, in condition of running on any bank of the manifold.

Figure 47 - Line Pressure Sensor Replacement.



6.11.1 Enter the service mode in the controller, touch the left or right arrow to switch to the standby bank, this purpose is to release the pressure inside the line pressure sensor connection.

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.

6.11.2 Close the service valve.

⚠ 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 cable connector with old sensor.

6.11.4 Replace the old sensor with the new one, and fit sensors to the minimum leak fitting. Connect the cable connector with new sensor.

6.11.5 Open the service valve.

6.11.6 Press the home icon or the previous icon to quit the service mode.

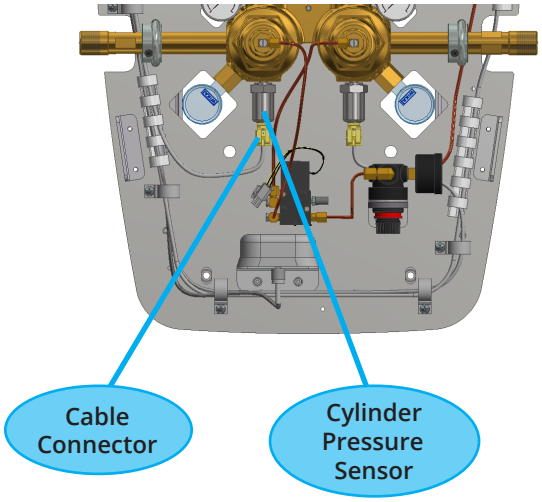
6.12 Replace Sensor for Cylinder Pressure.

Cylinder pressure sensor part number is 4109506200.

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

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

Figure 48 - Cylinder Pressure Sensor Replacement.



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

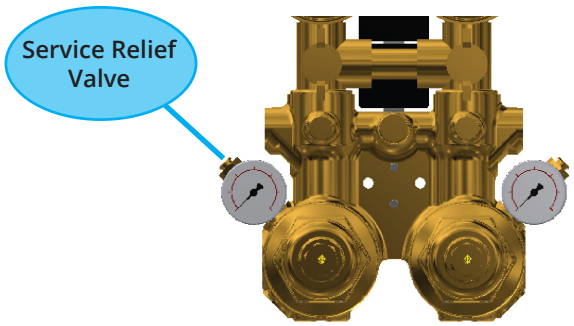
Following procedure describes process to service cylinder pressure sensor. If necessary, sensor service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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 Close all cylinders on the side of manifold where the cylinder pressure sensor will be replaced. Rotate the intermediate isolation valve on the same side downstream the 1st stage regulator to isolate the 1st stage regulator. Refer to figure 40.

6.12.4 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the service relief valve as shown in below figure.



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

6.12.5 Disconnect the sensor connector.

6.12.6 Replace the new sensor which is shown in figure 48, and tighten the sensor screw fitting.

6.12.7 Connect the cable connector with the new sensor.

6.12.8 Follow section 6.17 or 6.18 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.12.9 Verify the manifold operation.

6.13 Replace Gauge for Distribution System Pressure.

Line pressure gauge kit number, see table 13, chapter 7.

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

Following procedure describes process to service line pressure gauge. If necessary, regulator service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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

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

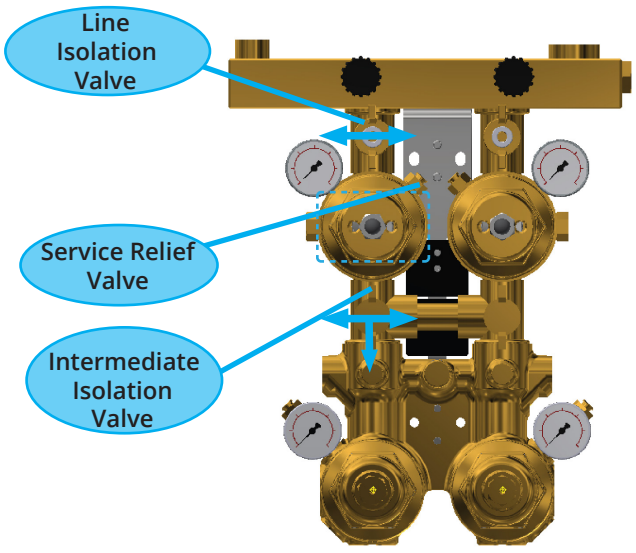
NOTE - Figure 49 shows example of left line pressure gauge maintenance, mirror to opposite side for working on the right bank.

6.13.3 Close the line isolation valve and the intermediate isolation valve upstream and downstream of the 2nd stage regulator to isolate the regulator. Refer to Figure 41.

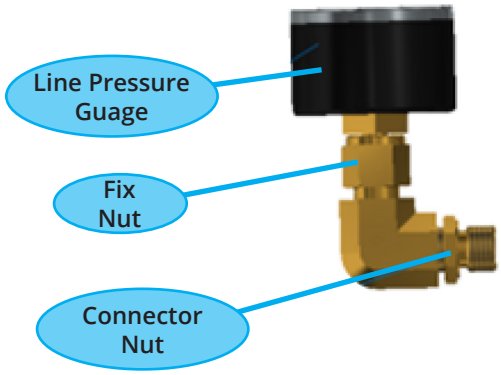
6.13.4 Vent the pressure in the 2nd stage regulator which is isolated from last step to 0 bar by pressing the service relief valve on the regulator.

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

Figure 41 - Isolating the Left 2nd Stage Regulator.



6.13.5 Loosen the line pressure gauge fix nut, then loosen the line pressure gauge connector nut.

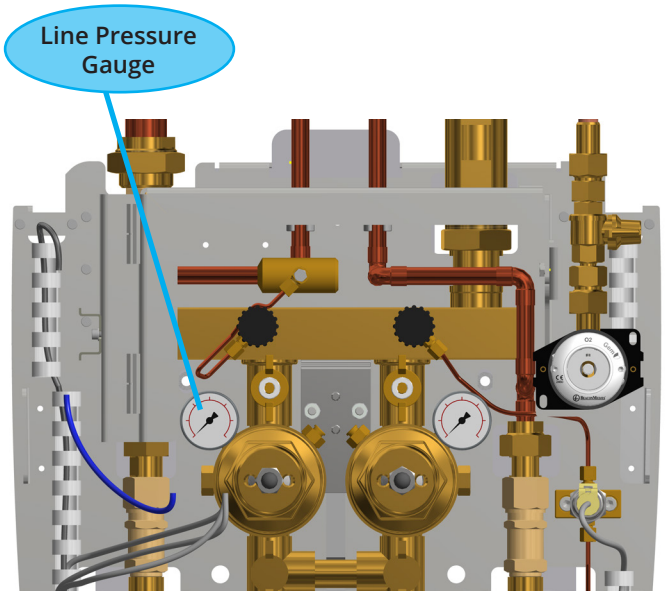


6.13.6 Replace the new gauge and new connector.

6.13.7 Follow section 6.17 or 6.18 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.13.8 Verify the manifold operation.

Figure 49 - Line Pressure Gauge Replacement.



6.14 Replace Gauge for Cylinder Pressure.

Cylinder pressure gauge kit number, see table 13, chapter 7.

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

Following procedure describes process to service cylinder pressure gauge. If necessary, cylinder pressure gauge service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

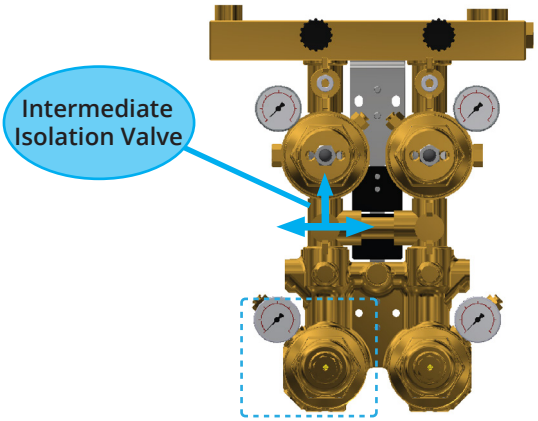
6.14.1 If the optional service mode is selected during maintenance, complete steps in 6.1.

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.

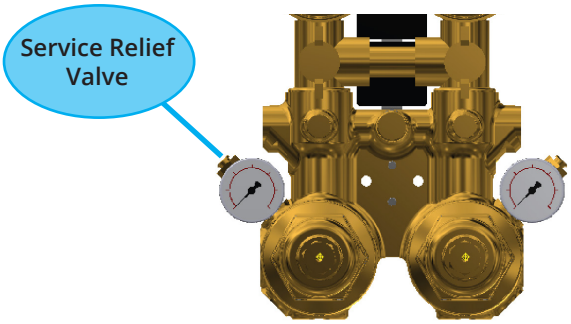
6.14.3 Close all cylinders on the side of manifold where the cylinder pressure gauge will be replaced.

6.14.4 Rotate the intermediate isolation valve on the same side downstream the 1st stage regulator to isolate the 1st stage regulator. Refer to figure 40.

Figure 40 - Isolating the Left 1st Stage Regulator.



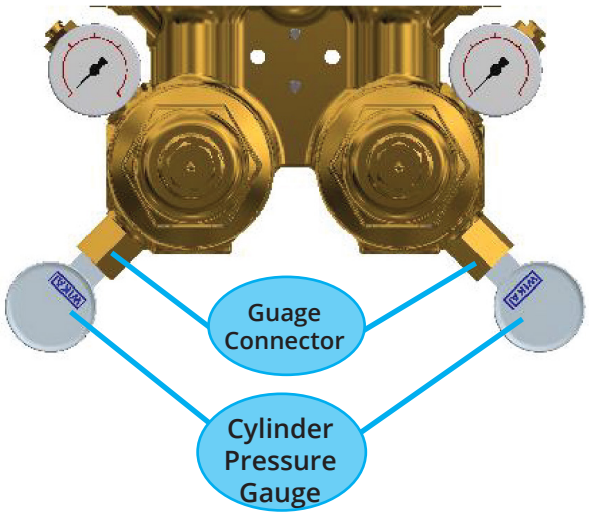
6.14.5 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the service relief valve as shown in below figure.



6.14.6 Loosen the old pressure gauge from the connector referring to figure 50, and remove the old washer.

6.14.7 Balance the new copper washer on the end of the gauge's connector and tighten the new gauge with the connector.

Figure 50 - Cylinder Pressure Gauge Replacement.



6.14.8 Follow section 6.17 or 6.18 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.14.9 Verify the manifold operation.

6.15 Replace Intermediate Pressure Gauge.

Intermediate pressure gauge kit number, see table 13, chapter 7.

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

Following procedure describes process to service intermediate pressure gauge. If necessary, pressure gauge service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

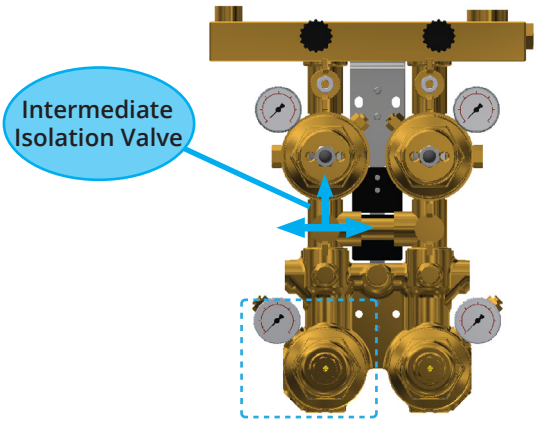
6.15.1 If the optional service mode is selected during maintenance complete steps in 6.1.

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

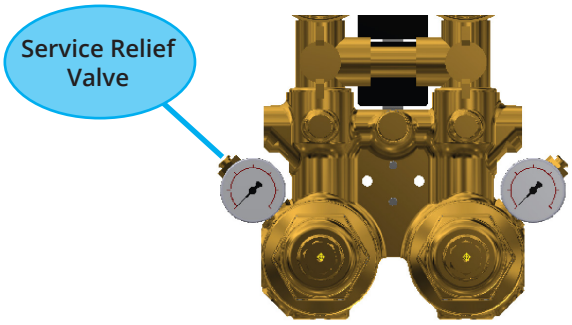
6.15.3 Close all cylinders on the side of manifold where intermediate pressure guage will be repaired.

6.15.4 Rotate the intermediate isolation valve on the same side downstream the 1st stage regulator to isolate the 1st stage regulator. Refer to figure 40.

Figure 40 - Isolating the Left 1st Stage Regulator.

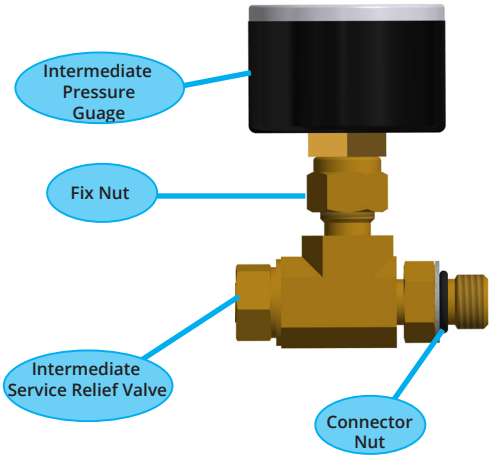


6.15.5 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the service relief valve as shown in below figure.



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

Figure 51 - Intermediate Pressure Gauge Replacement.



6.15.6 Disconnect the intermediate pressure gauge, fix nut, service relief valve and connector nut, referring to figure 51.

6.15.7 Replace the new gauge and new connector, fasten the intermediate service relief valve.

6.15.8 Recover the intermediate and line isolation valves to normal open position.

6.15.9 Follow section 6.17 or 6.18 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.15.10 Verify the manifold operation.

6.16 Replace Manifold Dome Regulator.

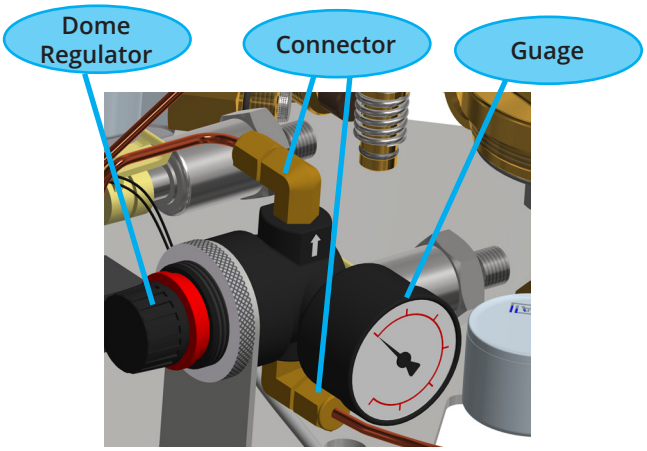
Dome regulator kit number, see table 13, chapter 7.

NOTE - Dome regulator replacement can be performed with the service valve closed (Item 11, figure 1), while running on both banks of the manifold.

6.16.1 Enter the service mode in the controller referring to section 6.1. Touch the left or right arrow to switch to the other side bank to release the pressure inside the dome regulator.

6.16.2 Close the service valve.

6.16.3 Disconnect the dome regulator fixture and connector.



6.16.4 Replace the new dome regulator, gauge and connectors.

6.16.5 Open the service valve.

6.16.6 Press the home icon or the previous icon to quit the service mode.

6.17 Bringing the Manifold Back On line After Being Fully Isolated.

6.17.1 Ensure all cylinder valves are open.

6.17.2 Ensure both line isolation valves and intermediate isolation valves are open.

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

6.17.3.1 Open the test point valve.

6.17.3.2 Press the left arrow on home page key to select the left bank.

6.17.3.3 Apply a flow to the test point terminal unit to purge the left side of the manifold.

6.17.3.4 Press the [right Arrow] key to select the right bank.

6.17.3.5 Apply a flow to the test point terminal unit to purge the right side of the manifold.

6.17.3.6 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.

6.17.4 Ensure that full gas cylinder pressure is shown on the operating screen and backup cylinder gauge, the cylinder graphics are shown as full and the appropriate icons are lit up (see Section 3, figure 16). See figure 9 to 12 in section 2.5, if setup changes are required.

6.17.5 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.

6.17.6 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.

6.17.7 Open the lockable isolation ball valve (Item 13, Figure 1) to return the gas supply back to the medical gas distribution system.

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

6.18 Bringing the Manifold Back On line After Isolating One Bank.

6.18.1 Ensure all cylinder valves are open.

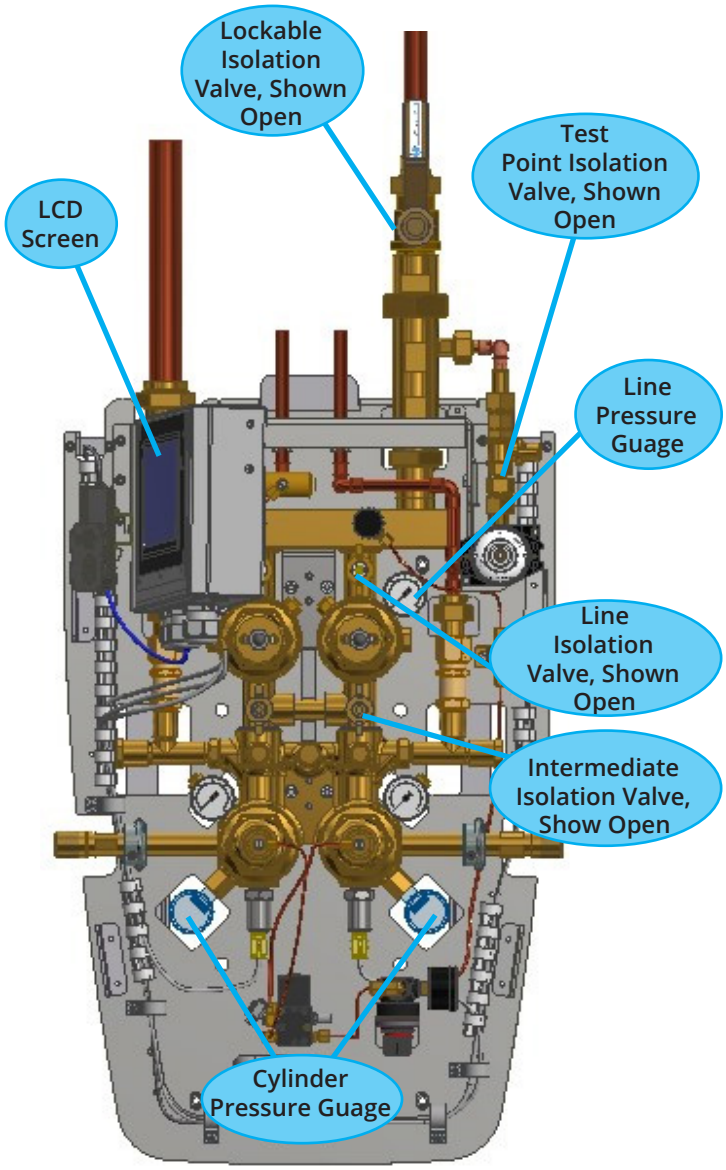
6.18.2 Ensure both intermediate and line isolation valves are open.

6.18.3 Ensure that full gas cylinder pressure is shown on the operating screen and backup cylinder gauge, the cylinder graphics are shown as full and the appropriate icons are lit up (see Section 3, figure 16). See figure 9 to 12 in section 2.5 if setup changes are required.

6.18.4 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.

6.18.5 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 52 - Returning the Manifold Back in Use.



6.19 Replace Controller.

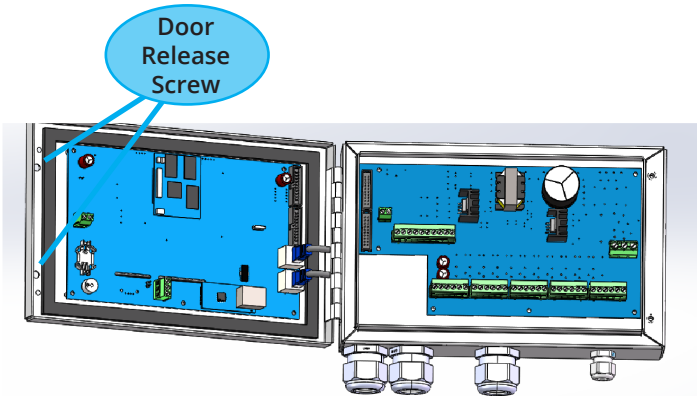
Controller kit number, see table 13, chapter 7.

NOTE - See **section 4.8 for full details on manually controlling the manifold during electrical isolation.**

NOTE - Contact the Beaconmedaes engineer to get the touch screen controllers which have the factory settings.

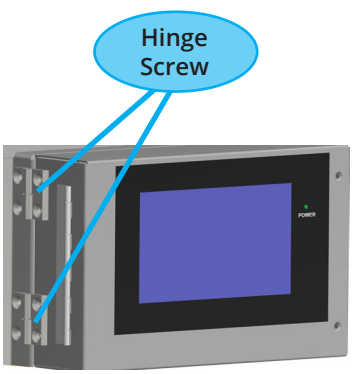
6.19.1 Isolate the power supply to the manifold controls. Left bank will supply the gas automatically. Connect the optional normal condition resisters to the alarm (BeaconMedaes alarm only, see above note) if required.

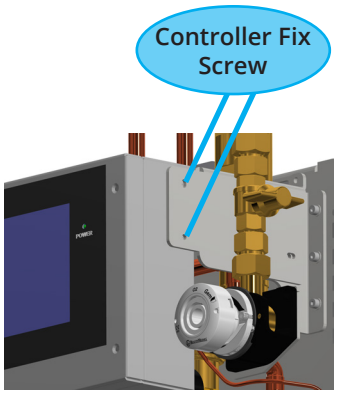
6.19.2 Loosen the screws on the side of the controller to open the door.



6.19.3 Disconnect the sensor cables, solenoid valve cable and power cable from power PCB which is shown as item 30 in figure 1.

6.19.4 Release the upper four hinge screws and the two controller fix screws.





6.19.5 Replace the new controller, connect the cable to the controller refer to figure 2b.

6.19.6 Fix the hinge screws and controller fix screws.

6.19.7 Finish the settings refer to section 2.5.

6.19.8 Recover the manifold to normal status.

7. Recommended Spares and Accessories.

7.1 Spare Part Kit as Required

7.1.1 Apart from the regular maintained parts (See section 5), all other items are to be replaced as required.

See table 13 for available spare part kit numbers

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

Table 13: Service and Spare Part Kits.

Kit number	Description
4109150498	Intermediate Relief Valve Kit
4109150509	Line Pressure Relief Valve Kit-5.2 bar
4109150510	Line Pressure Relief Valve Kit-11 bar
4109150511	Line Pressure Relief Valve Kit-13 bar
4109150499	1st Stage Regulator Kit
4109150500	2nd Stage Regulator Kit
4109150501	Header Non-Return Valve Kit-O2
4109150502	Header Non-Return Valve Kit-N2O
4109150503	Header Non-Return Valve Kit-O2/N2O
4109150504	Header Non-Return Valve Kit-MA
4109150505	Header Non-Return Valve Kit-N2
4109150506	Header Non-Return Valve Kit-CO2
4109150507	Terminal Unit Capsule Kit
4109150508	Screen Inlet Filter Kit
4109150490	Controller Kit
4109150441	Line Pressure Gauge Kit
4109150440	Intermediate Pressure Gauge Kit
4109150439	Dome Regulator Assembly Kit
4109150438	Control Solenoid Valve Kit

7.1.2 Other parts which are not included in the existing spare part kits (in section 5 and section 7) can be referred to the part list book 4109992245.

Appendix: Symbols			
	Date of manufacture		Manufacturer
	Authorized representative in the European Community/ European Union		Serial number
	CE mark and NB number		Medical device
	Caution		Consult instructions for use or consult electronic instructions for use
	Temperature limitation		Unique device identifier
	Atmospheric pressure limitation		Humidity limitation

BeaconMedæs®

www.beaconmedaes.com

EC REP

European Authorized Representative
Atlas Copco Airpower N.V.
Boomsesteenweg 957, 2610 Wilrijk

Atlas Copco (Wuxi) Compressor Co., Ltd.
No.45 XiMei Road, Xinwu District, Wuxi City, Jiangsu Province, 214111, China