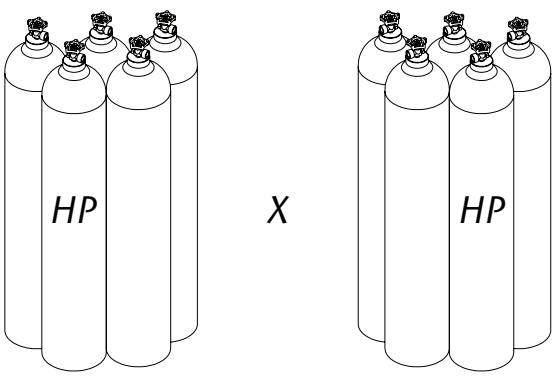
Installation, Operation and Maintenance Instructions



Medical Gas Supply System

Cylinder Manifold System and Manifold Changeover System

MAT-S (NFPA)

Part number 4109992459
Revision 00
May 8, 2023

BeaconMedæs®

Installation, Operation and Maintenance Manual

NOTICE: Any serious incident that has occurred in relation to the device should be reported to the manufacturer and the competent authority of the Member State in which the user and/or patient is established.

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**
C	Common	**ID**	Identification
CGA	Compressed Gas Association	**"**	Inch
FNPT	Female National Pipe Thread	**ISO**	International Standard Organisation
MNPT	Male National Pipe Thread	**Kg**	Kilograms
N/C	Normally Closed	**kPa**	Kilo pascals
N/O	Normally Open	**Max**	Maximum
PSIG	Pounds Per Square Inch-Guage	**Med**	Medical
SCFM	Standard Cubic Feet Per Minute	**m**	Meter
VAC	Voltage, Alternating Current	**mm**	Millimetres
VDC	Voltage, Direct Current	**Min**	Minimum
BS	British Standard	**N2**	Nitrogen
CO2	Carbon Dioxide	**N2O**	Nitrous Oxide
°C	Degree Celsius	**NRV**	Non-Return Valve
ø	Diameter	**OD**	Outside Diameter
ERM	Emergency Reserve Manifold	**O2**	Oxygen
EN	European Standards	**%**	Percentage
1st	First	**2nd**	Second
NFPA	National Fire Protection Association		

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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.

Minimum environment temperature: -20 ^{0}C

Maximum environment temperature: 50 ^{0}C

Minimum relative humidity (non-condensing): 10%

Maximum relative humidity (non-condensing): 95%

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.

Minimum environment temperature: 0 ^{0}C

Maximum environment temperature: 40 ^{0}C

Minimum relative humidity (non-condensing): 10%

Maximum relative humidity (non-condensing): 95%

Atmospheric pressure range: 700-1100 hpa

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

Relative humidity - 95%

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.

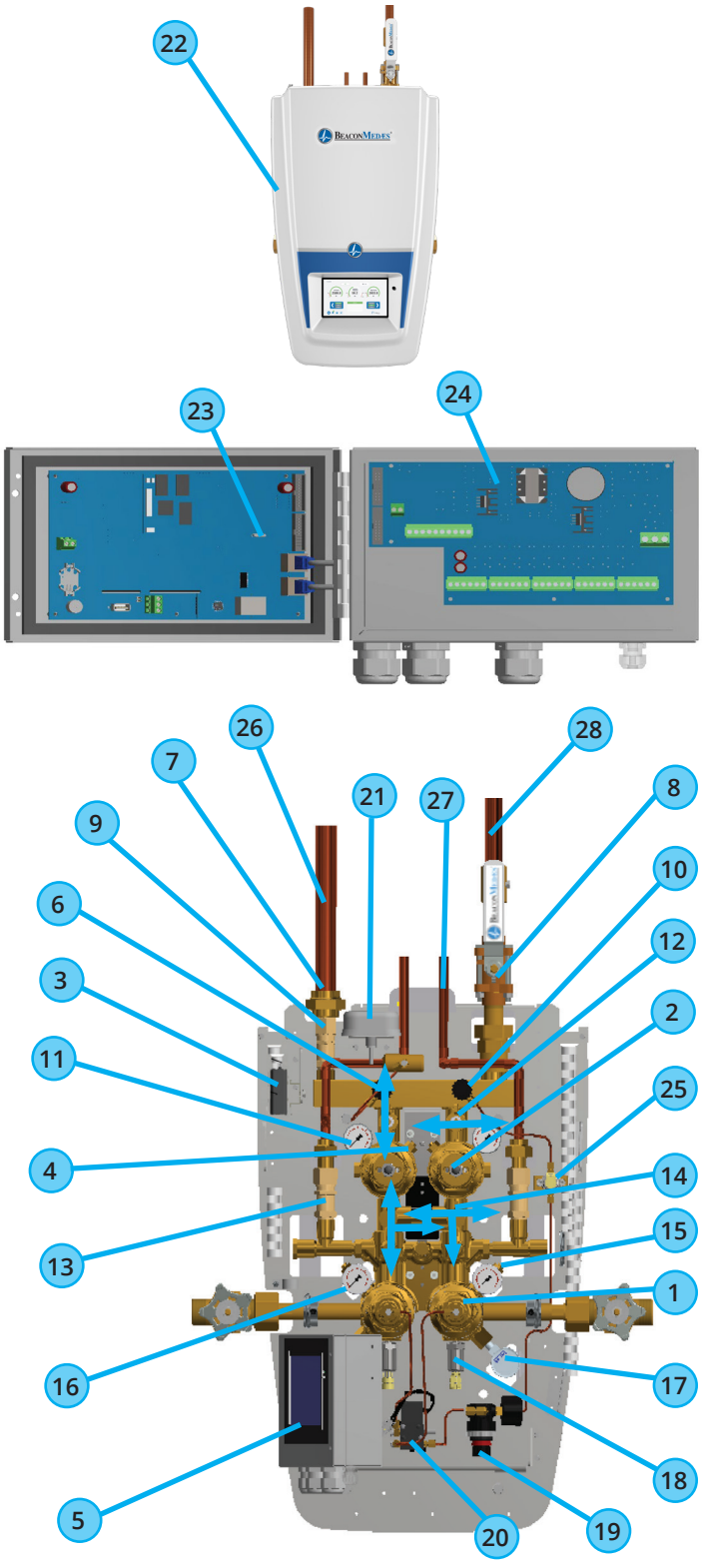
Lifeline manifold is designed in accordance with National Fire Protection Association (NFPA) 99 and International Organization for Standardization (ISO) 7396-1.

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.

1. General Information.

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



NOTE - Isolation valves item 8, 12 and 14 are shown in their open position, this is typically the normal operating condition for the manual valves.

1.1 Introduction.

Intended Use

The BeaconMedaes Medical Gas Supply System, mainly consists of cylinder manifold system, manifold changeover system, header & pigtails 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, O2, He, CO2O2, O2CO2, HeO2, O2He, ISO N2O, ISO Inst. Air, and ISO Med.

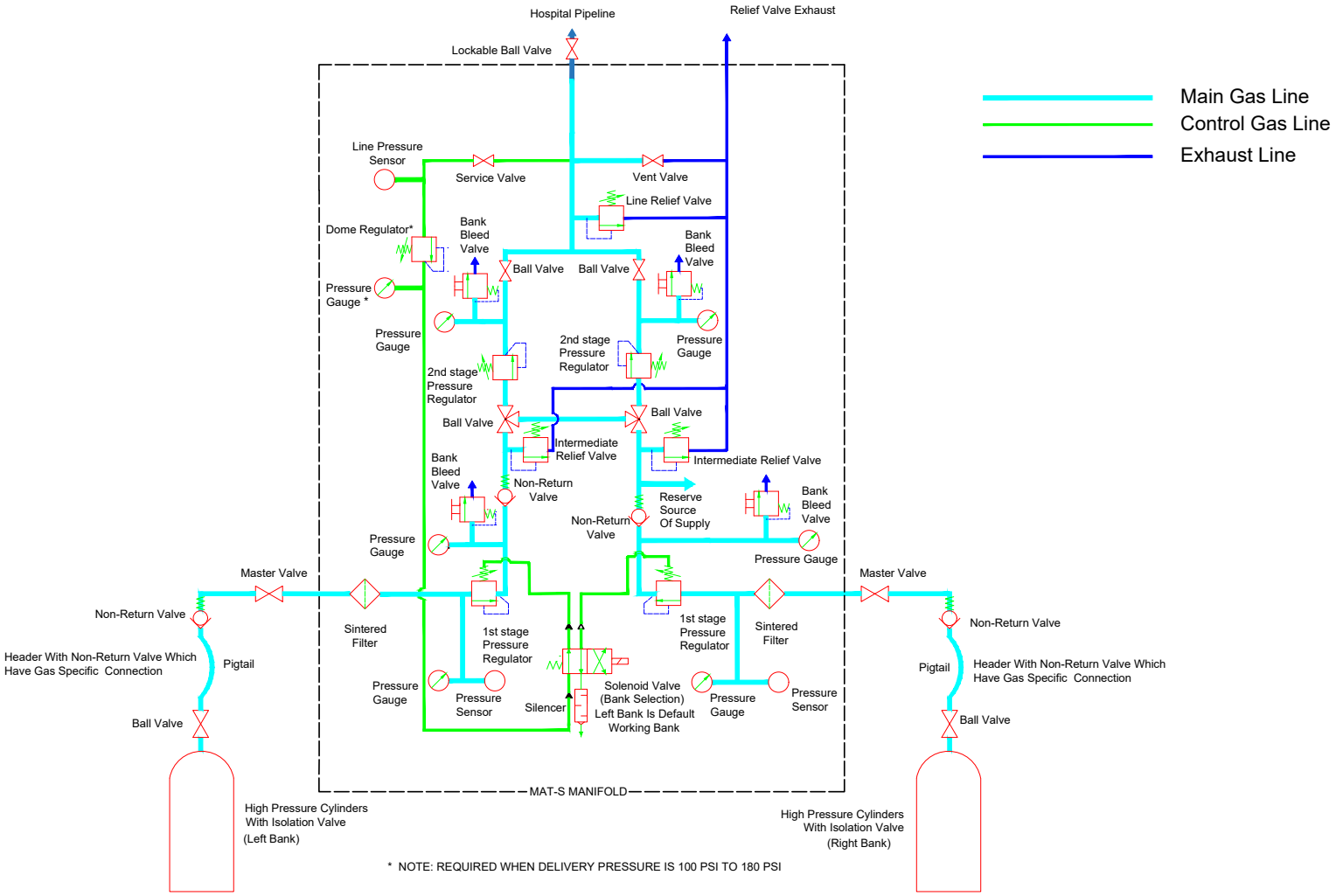
See Figure 1 for general arrangement and Figure 2 for the schematic diagram.

The Manifold Changeover System consists of:

No.	Description
1	1st Stage Pressure Regulator
2	2nd Stage Pressure Regulator
3	Smart Box
4	Line Bleed Valve
5	Touch Screen Controller
6	Vent Valve
7	Line Relief Valve Vent Pipe Connector
8	Line Source Isolation Valve
9	Line Relief Valve
10	Service Valve
11	Line Pressure Gauge
12	Line Isolation Valve
13	Intermediate Relief Valve
14	Intermediate Isolation Valve (Three Way)
15	Bank Bleed Valve
16	Intermediate Pressure Gauge
17	Cylinder Gauge
18	Changeover Pressure Sensor
19	Dome Regulator (100-180 psi Delivery Pressure Manifold Only)

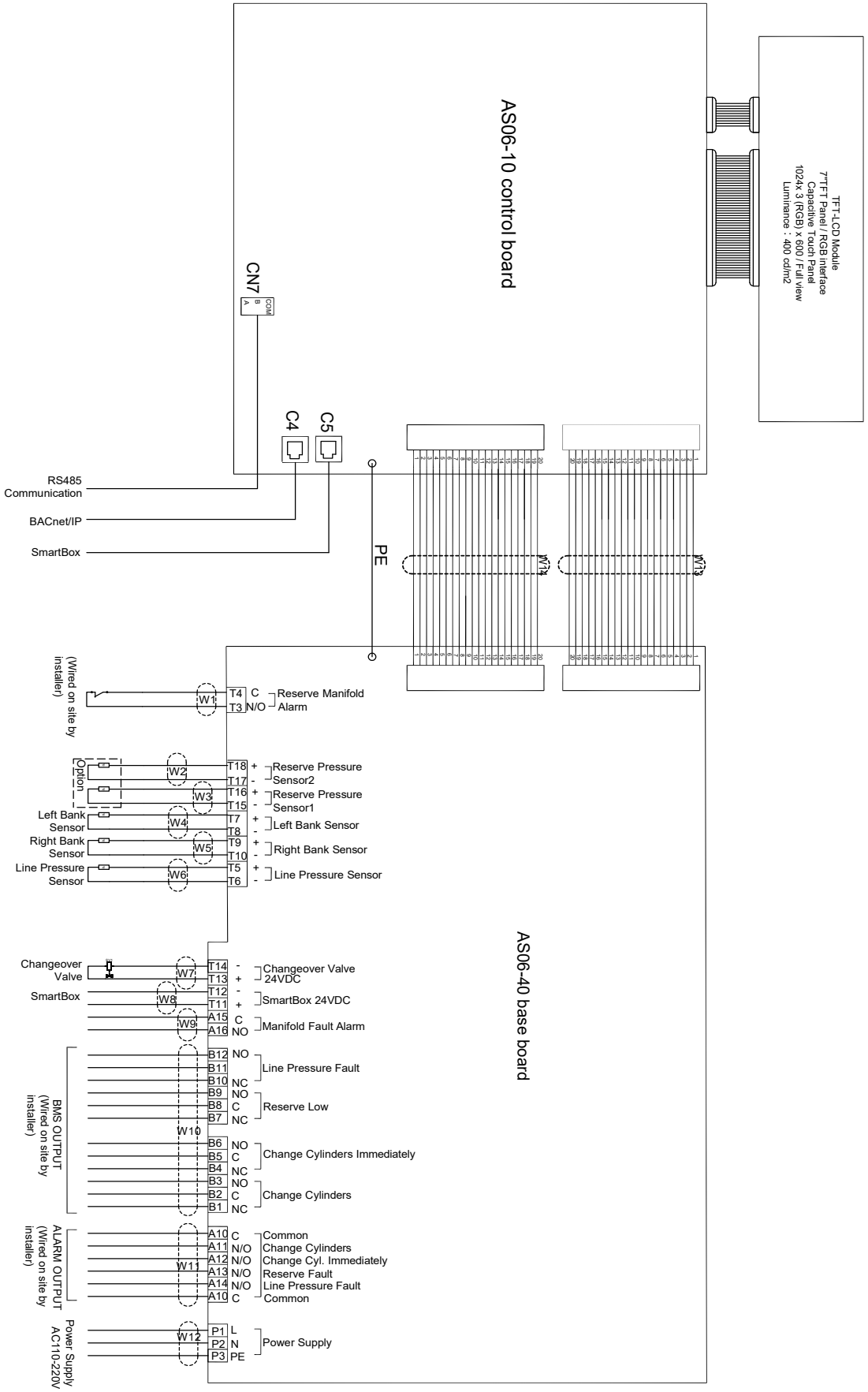
No.	Description
20	Solenoid Valve
21	Smart Box Antenna
22	Manifold Cover
23	Manifold Screen PCB
24	Manifold Power PCB
25	Line Pressure Sensor
26	Line Pressure Relief Exhaust Connection Point (28 mm OD Copper Tube)
27	Intermediate Pressure Relief Exhaust Connection Point (12 mm OD Copper Tube)
28	Pipeline Connection Point (22 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 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 ISO 10524-2. A pressure relief valve connected to the regulator protects the downstream pressure and is set a 2.4 MPa (350 psi).

1.3 2nd Stage Pressure Regulator.

For safe operation regarding performance, mechanical strength and cleanness the device fully conforms to 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 55 psi, 100 psi and 180 psi 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
0.52 MPa (75 psi)	0.38 MPa (55 psi)
1.03 MPa (150 psi)	0.69 MPa (100 psi)
1.72 MPa (250 psi)	1.24 MPa (180 psi)

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 2x15 cylinder connections.

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 3 MPa in normal operation or single fault condition, as recommended for safe practise of the medical gas pipeline system.

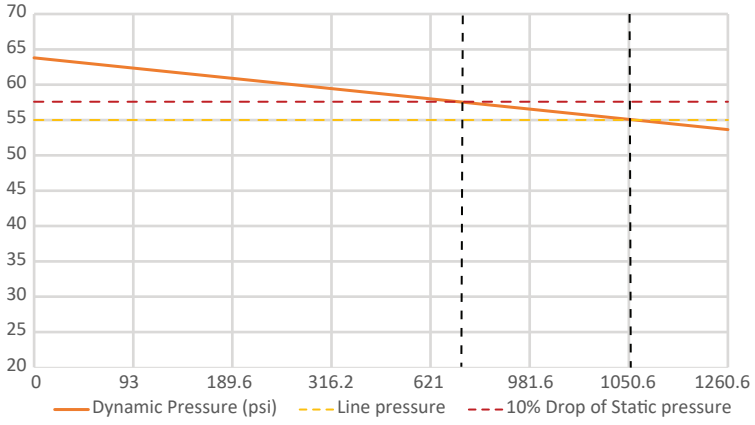
1.7 Technical Specification.

1.7.1 Technical parameter.

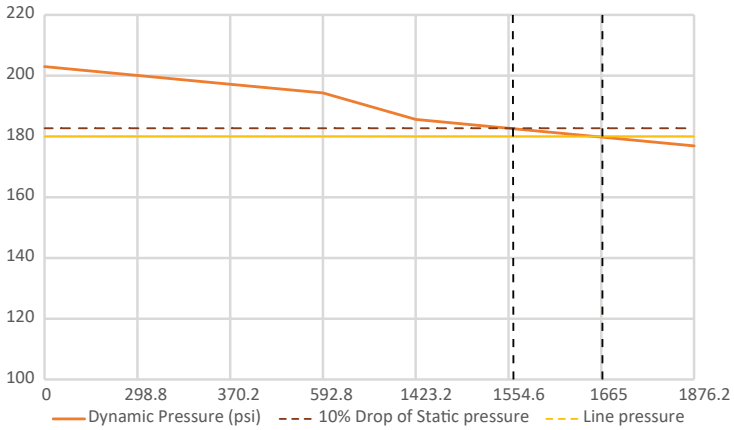
NFPA Technical Parameter	Values		
Nominal Delivery / Line Output Pressure (psi)	55	100	180
Nominal Delivery / Line Output Flow (scfh)	2250	3200	3600
2nd Stage Regulator Test Pressure as per 10524-2 at 10% Pressure Drop (psi)	57	101	183
2nd Stage Regulator Output Flow (Single) as per 10524-2 at 10% Pressure Drop (scfh)	2000	3100	3300
Input Pressure Range (psi)	150-2900	300-2900	
1st Stage Regulator Pressure (Intermediate) (psi)	125	220	220
2nd Stage Regulator Pressure Output (Line) (psi)	55	100	180
High-Pressure Regulator Relief Valve Setting (psi)	350		
Line Pressure Relief Valve Setting (psi)	75	150	250
Changeover Pressure (psi)	145	290	290

1.7.2 Flow performance.

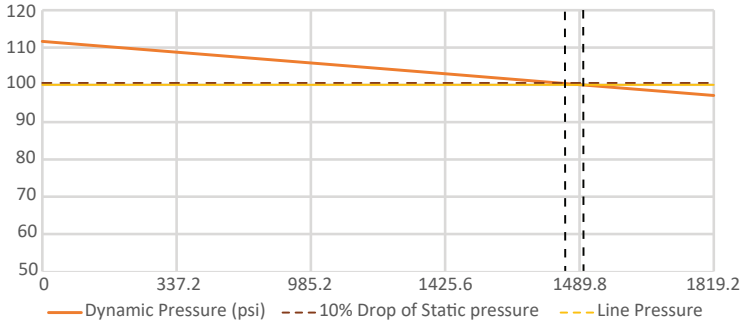
Single, Line 55 psi, Intermediate 127 psi, Inlet 145 psi



Single, Line 180 psi, Intermediate 217.5 psi, Inlet 290 psi



Single, Line 100 psi, Intermediate 217.5 psi, Inlet 290 psi



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.

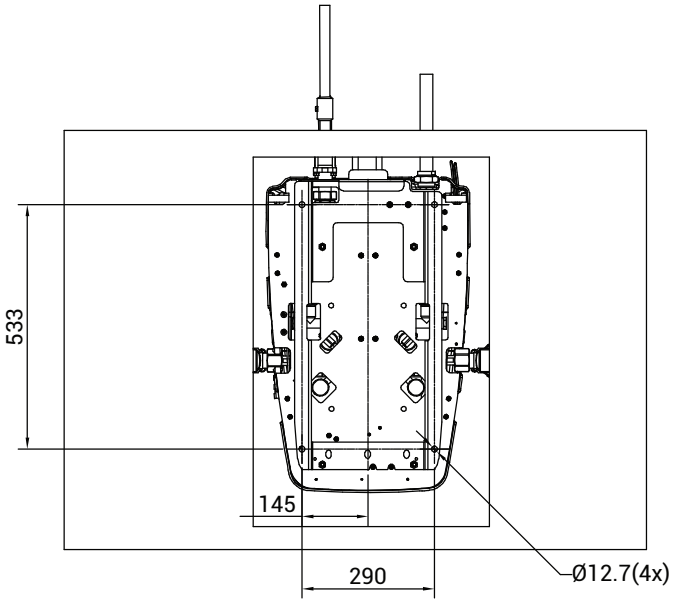
2.1.1 Unpack and inspect all items for damage.

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 4109992439) for more details.

Figure 3 - Mounting Plate Installation Details.

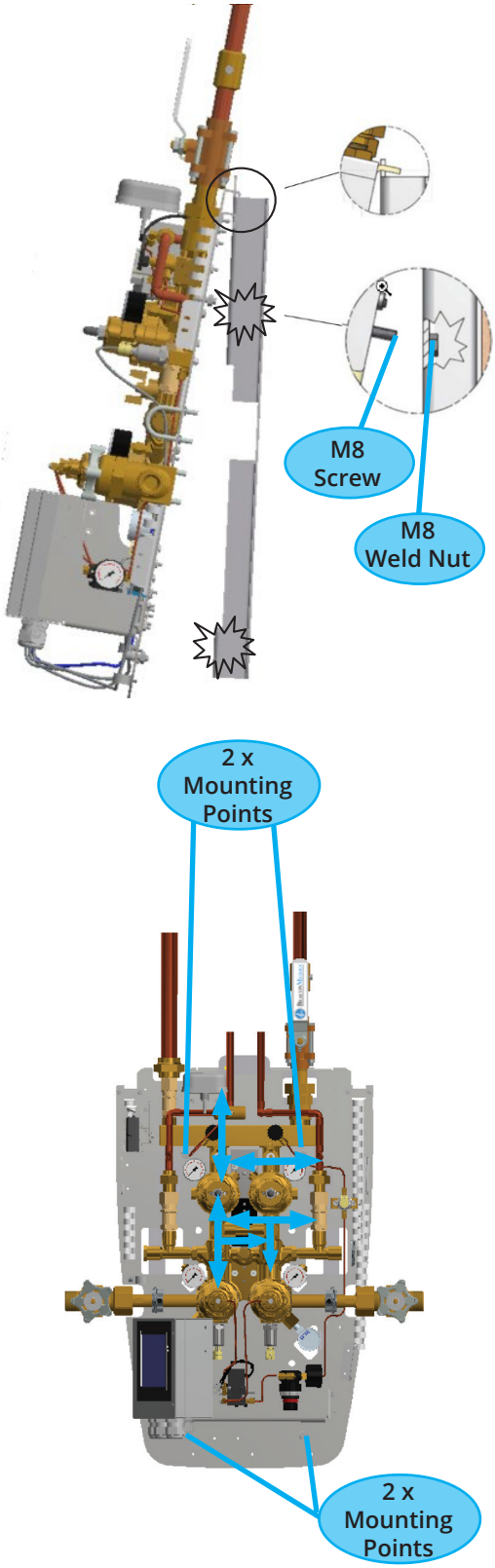


NOTE - Herder to ground height is 1670 mm.

2.1.4 Drill the 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 28, Figure 1) to the main pipeline isolation valve (Item 8, 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 28, 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 26, Figure 1) shall be brazed using fluxless brazing technique with nitrogen purge.

2.1.11 The ø12 mm exhaust line (Item 27, Figure 1) shall be brazed using fluxless brazing technique with nitrogen purge.

⚠ CAUTION! The ø28 mm exhaust line (Item 26, Figure 1) and ø12 mm exhaust line (Item 27, 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 Figures 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 Each header kit greater than 5 inlets is shipped with an appropriate number of header brackets. Position brackets against wall and on bottom side of header as shown in Figure 5. Attach bracket to wall using appropriate anchors (by others). 3/8" diameter anchors are recommended.

2.2.7 Assemble the U-bolt and bracket hardware as shown in Figure 5. Tighten the U-bolt nuts.

2.2.8 Additional header extensions may be attached end to end, if required.

2.2.9 Install the large nut and plug on end of last header extension. Tighten the large nut.

Figure 5 - Manifold Header Installation.

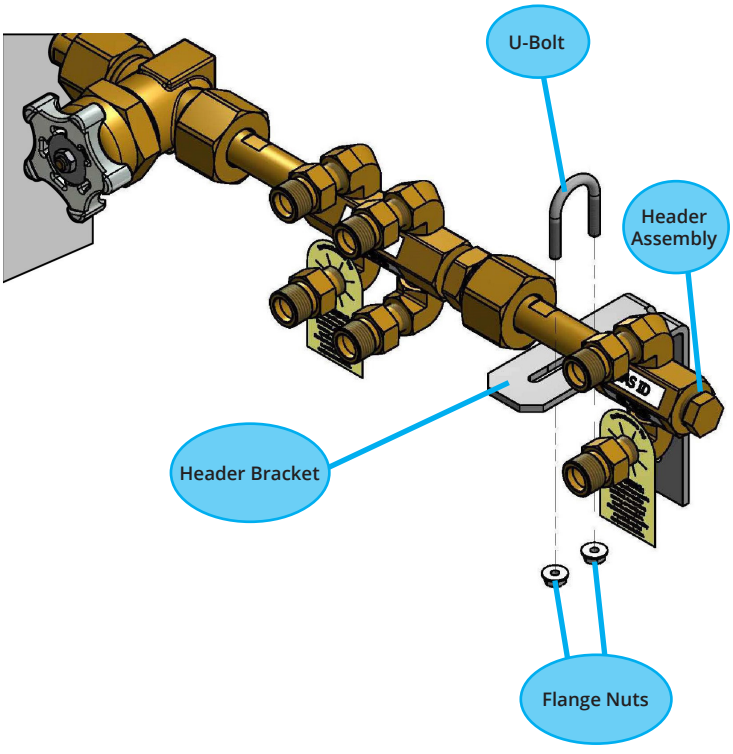
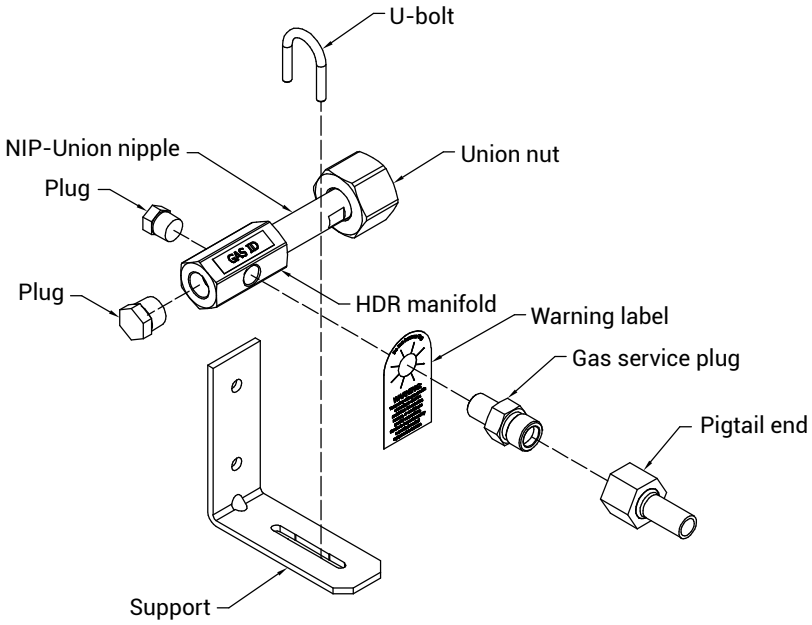
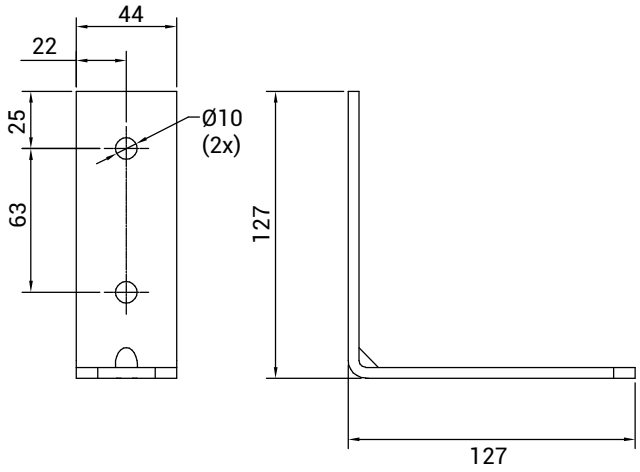


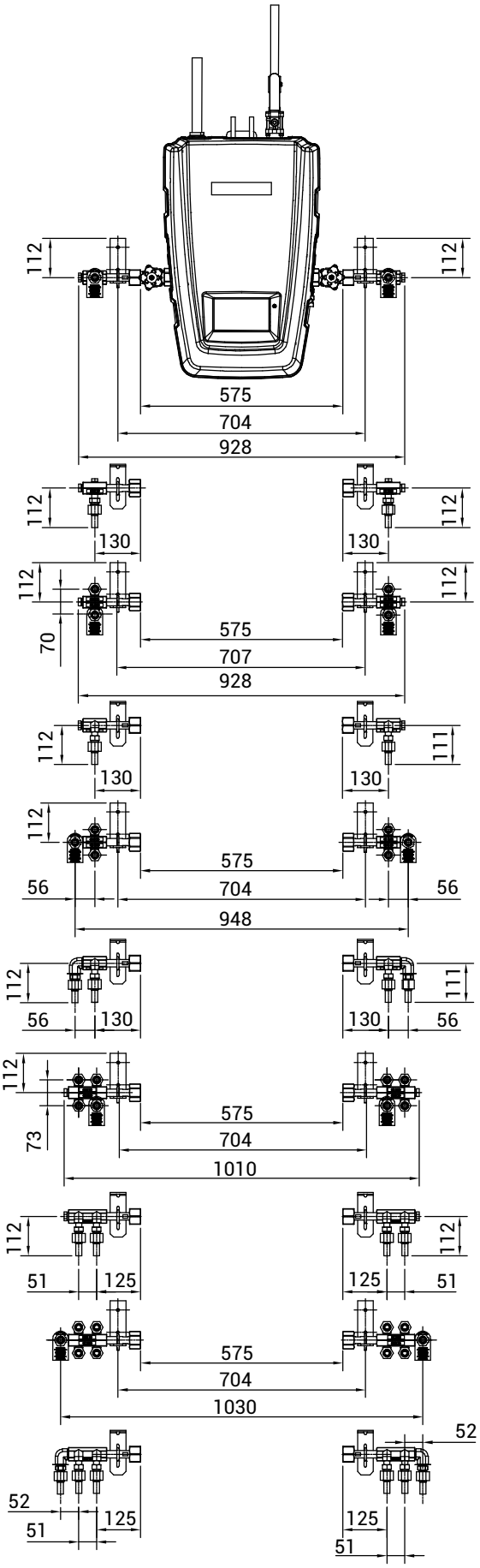
Figure 6 - Manifold Changeover System Header Arrangement Details.



Note: Header assembly shall be leak free at minimum of 4000 PSI

DETAIL OF SUPPORT





2.3 Cylinder Connection.

All manifolds other than O2, He, CO2O2, O2CO2, HeO2, O2He, ISO N2O, ISO Inst. Air, and ISO Med. Air utilize 24" length flexible stainless-steel braided pigtails. All cylinders on the right bank of the manifold, even those placed directly beneath should be positioned, so that the cylinder outlets face right. All cylinders on the left bank of the manifold, even those placed directly beneath should be positioned so that the cylinder outlets face left.

Figure 7a illustrates a typical 4 x 4 manifold system utilizing 24" length flexible pigtails. O2, He, CO2O2, O2CO2, HeO2, O2He, ISO N2O, ISO Inst. Air, and ISO Med. Air manifolds are supplied with pre-formed rigid copper pigtails. All cylinders on the right bank of the manifold, even those placed directly beneath should be positioned so that the cylinder outlets face right. All cylinders on the left bank of the manifold, even those placed directly beneath should be positioned, so that the cylinder outlets face left.

Figure 7b illustrates a typical 4 x 4 O2, He, CO2O2, O2CO2, HeO2, O2He, ISO N2O, ISO Inst. Air, and ISO Med. Air manifold utilizing pre-formed rigid copper pigtails.

2.3.1 Remove the plastic shipping caps from the manifold header pigtail connections.

2.3.2 Connect one end of pigtail assembly to header connection. Coiled end of rigid copper pigtails attaches to header connection.

⚠ 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 Position the gas cylinders as shown in Figure 7. Secure each cylinder to wall or floor stand with chains or straps.

2.3.4 Connect the pigtails to each cylinder. Rigid copper pigtails used on O2, He, CO2O2, O2CO2, HeO2, O2He, ISO N2O, ISO Inst. Air, and ISO Med. Air manifolds are preformed to approximate required shape. Lower end of rigid copper pigtails must be bent 90° toward cylinder outlets.

2.3.5 Tighten all pigtail connections firmly. Do not over-tighten.

⚠ WARNING! All pigtail assemblies are shipped in sealed bags and are cleaned as if for oxygen use. Manifold header connections are clean and capped. Do not unpackage or remove any cap until ready to install. During installation use care to maintain cleanliness.

⚠ WARNING!

- Do not repeatedly bend, sharply bend, or twist copper pigtails as damage to tubing may occur.
- Do not bend flexible pigtails into a radius smaller than 3".
- Always secure cylinders with racks, straps, or chains. Unrestrained cylinders may fall over and damage or break off cylinder valve.

⚠ CAUTION! Do not use thread sealant on header or pigtail connections.

⚠ CAUTION! Prior to connecting pigtail to cylinder, slightly open and close each cylinder valve to blow out dirt and debris.

NOTE - Both ends of flexible pigtails are the same. Either end may be connected to manifold header. Rigid copper pigtails are preformed and must be connected as shown in Figure 11. Tighten all pigtail connections firmly. Do not over-tighten.

Figure 7a - Typical Flexible Pigtails & Cylinder Connection.

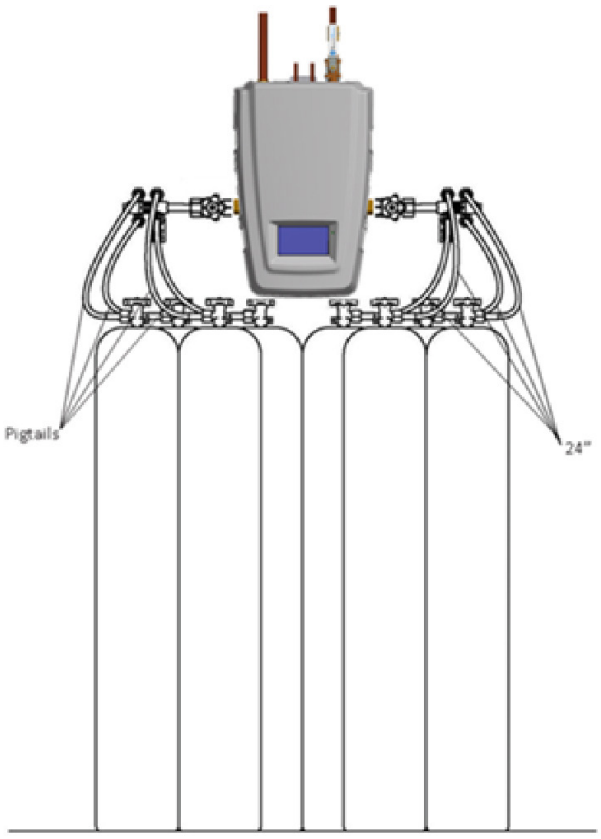
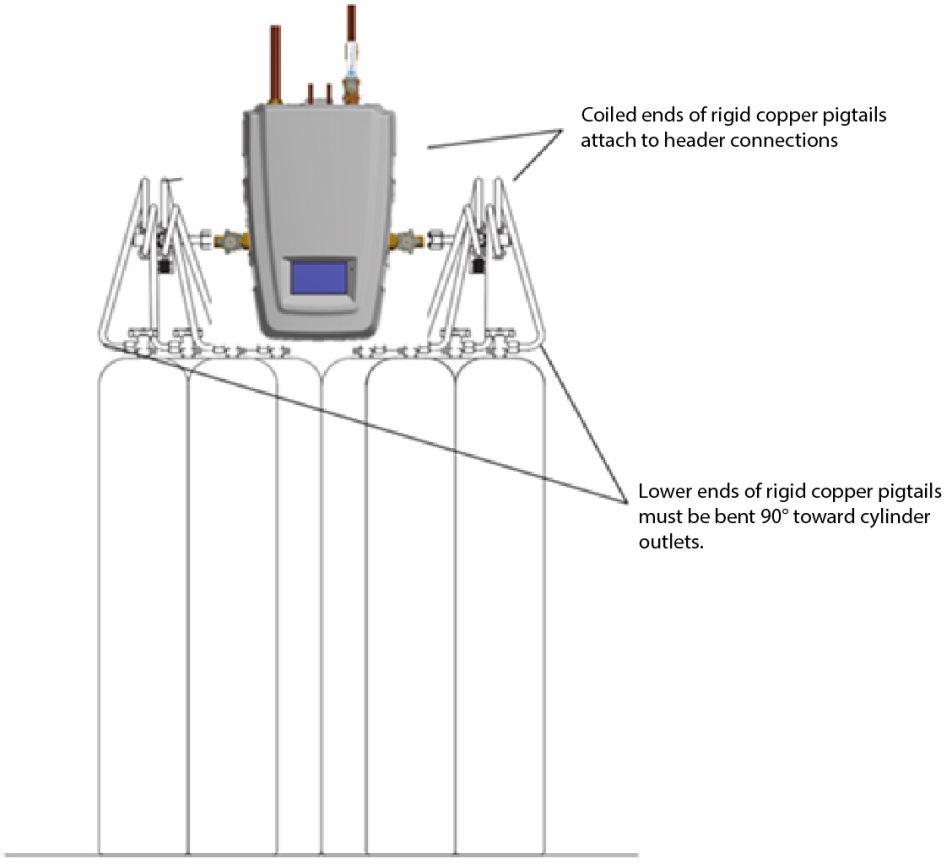


Figure 7b - Typical Rigid Pigtails & Cylinder Connection.



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.

2.4.1.2 The power PCB should be permanently connected to an essential single-phase supply of 100-250V 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 24, 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.

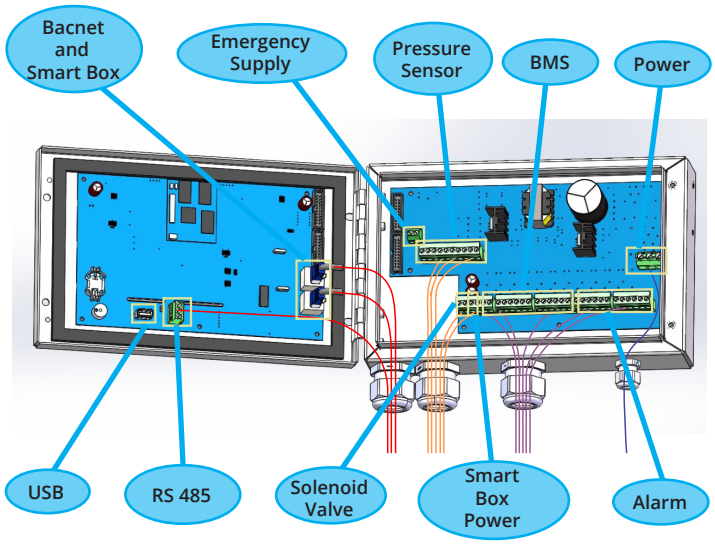
2.4.2.3 Connect the alarm cable to the terminals shown in Figure 8.

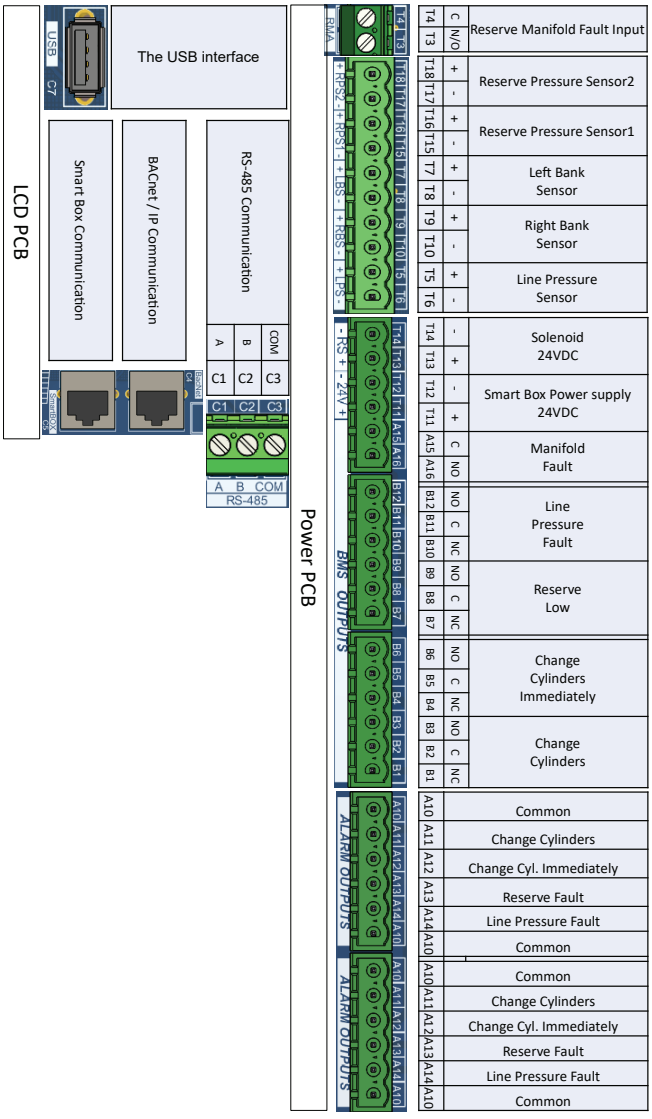
2.4.2.4 If a non BeaconMedaes remote alarm is to be used, the output signal from the manifold can be changed from the standard line contact resistors to a closed in normal condition by following the set-up menu detailed in Section 2.5.

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 2 for the descriptions on the icons in the menu.

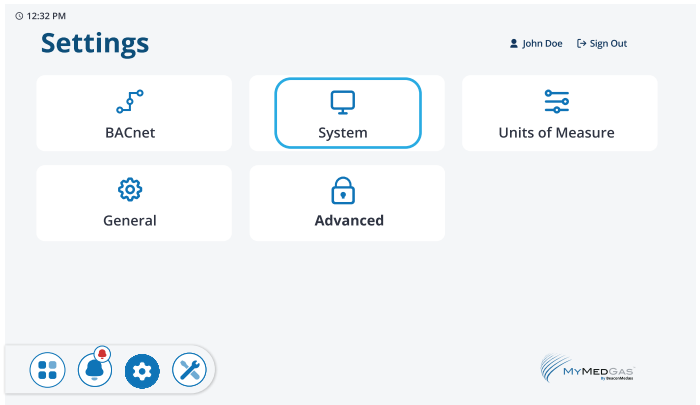
Table 2: Icon Description.

Icon	Description
	General icon. Move to the general setting screen.
	Advanced icon. Takes you to the advanced setting screen, need password.
Save	Save icon. Press-confirm the input setting
Cancel	Cancel icon. Press-cancel the input setting .
Set Up System Information	Set up system information. Press-set up system information.
Enable / Disable	Enable/Disable icon. Press-enable/disable the relative function.
	Switch icon. Press-switch different parameter.
	Events history icon. Takes you to the events history screen.
	Maintenance 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.
Setting ›	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.
O2	Gas ID Show the gas type on home page
55 L/min	Flow value Show real-time flow on home page.

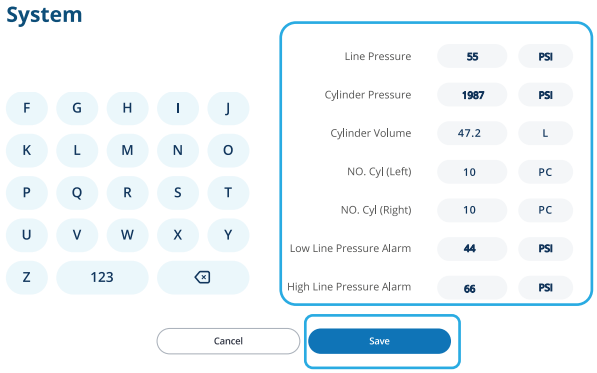
Figure 9 - Accessing the Set-Up Menu.

1. Press the setting icon in the home page.

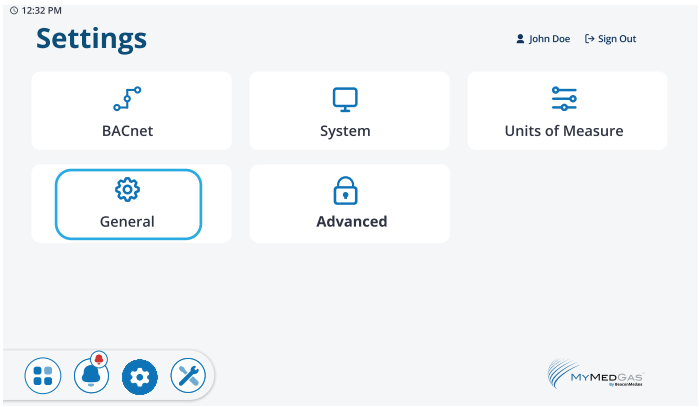
2. Press the system icon in the setting page.



3. Press the value which need update, and use the keyboard to modify. Press the save icon Save to save the changes made.



4. Press the General icon General in the setting page.



5. Press the value which need to change language type, date and time. Use the keyboard to modify. Press the save icon Save to save the changes made.

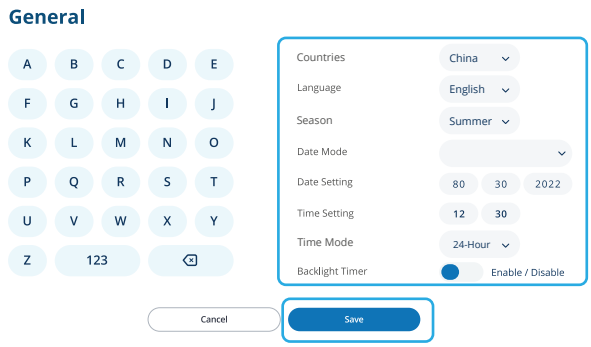


Figure 10 - Set Line Pressure.

NOTE - Line pressure will normally be pre-set from the factory. Options are for nominal 55, 100 & 180 psi 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. Press the save icon Save to save the changes made.

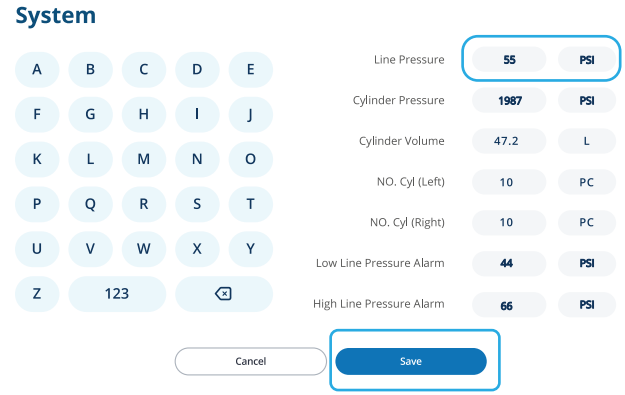
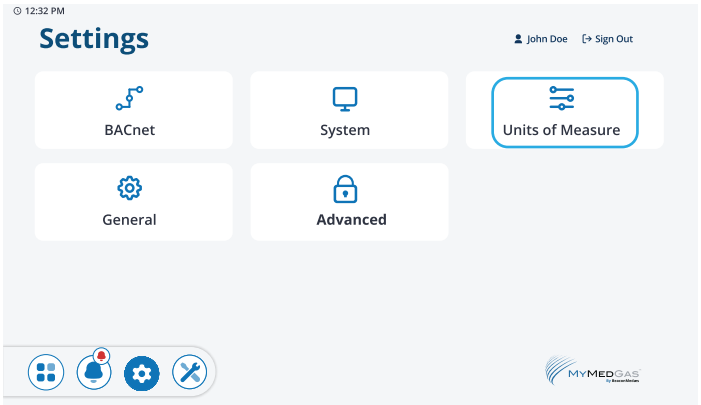


Figure 11 - Set Pressure Units.

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

1. Press the icon unit of measure.



2. Press the downward arrow to change the unit. Press the save icon Save to save the changes made.

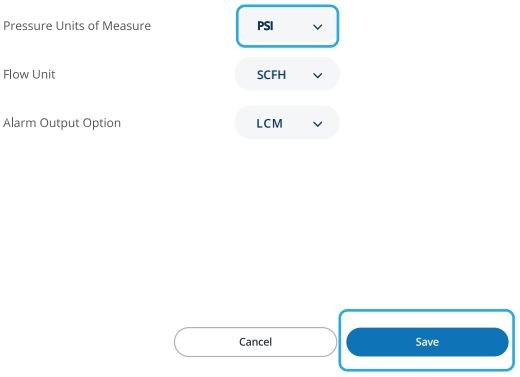
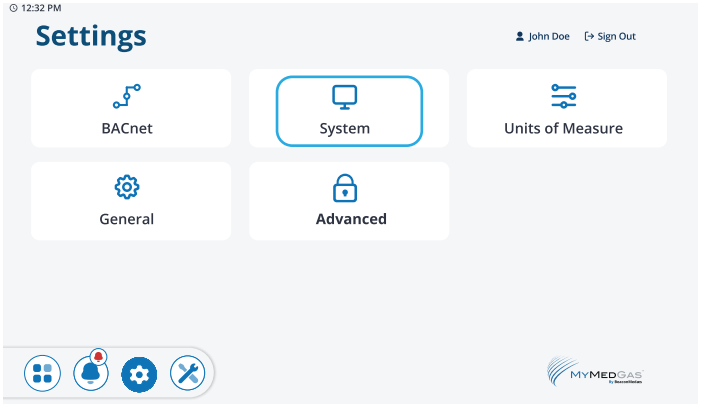


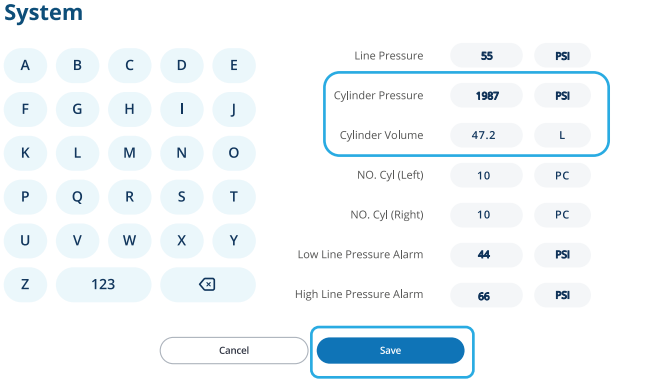
Figure 12 - Cylinder Set-Up.

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.

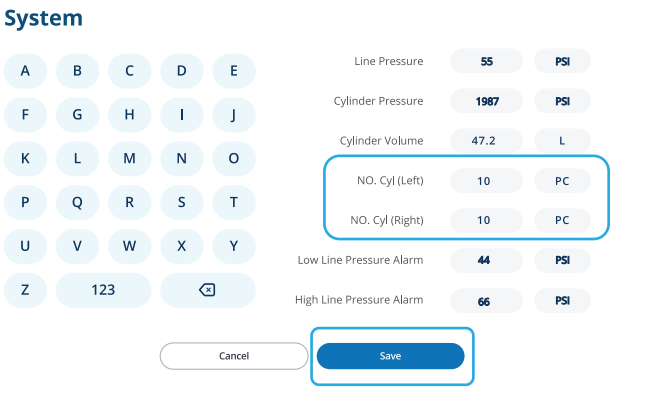
1. Press the system icon in the setting page.



2. Press the Cylinder Pressure and Cylinder Volume to modify the value by the keyboard. Press the save icon Save to save the changes made.



3. Press the NO. Cyl (Left) and NO. Cyl (Right) to modify the quantity by keyboard. Press the save icon Save to save the changes made.

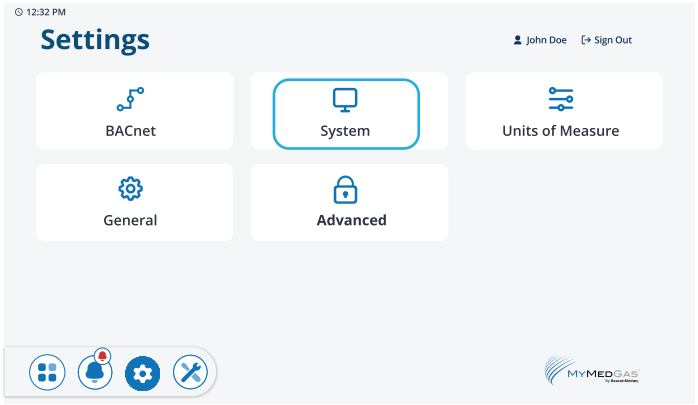


NOTE - The typical average gas usage is only for gas phase in the cylinders. This calculated value will not convert correctly for liquid phase in the cylinders.

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 3 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. Press the save icon Save and return to main setting page.

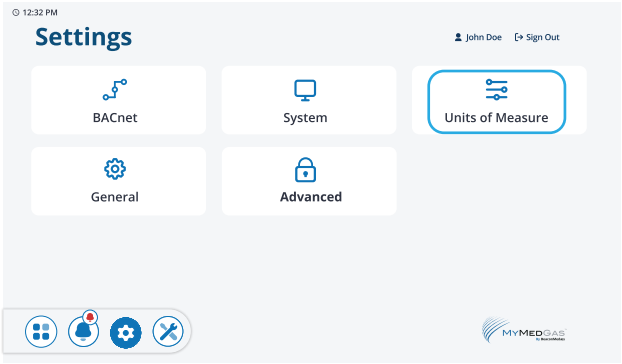
Table 3: Default Line Pressure Alarm Settings and Adjustment Range.

Nominal Line Pressure	Default Values	
	Low Pressure Alarm	High Pressure Alarm
55 psi	44	66
100 psi	80	120
180 psi	144	216

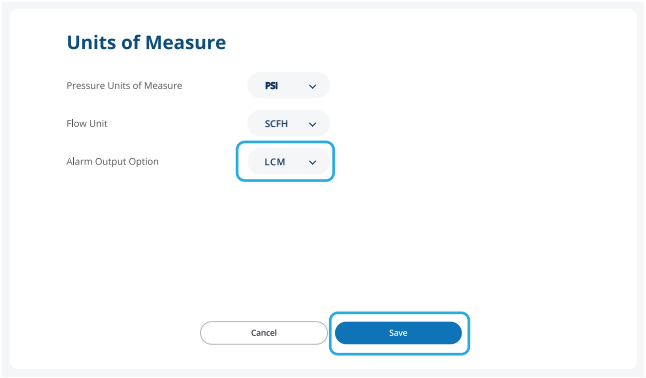
NOTE - Low line pressure set-point may need to be reduced if the device is used as a backup manifold. See Table 5 in Section 4 for reference.

Figure 14 - Alarm Output Option.

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

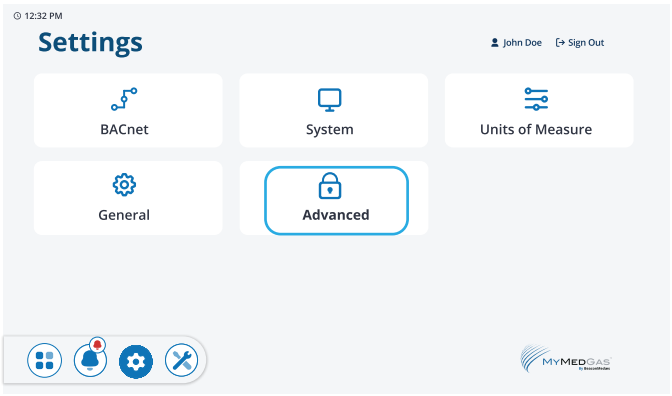


2. Press the downward arrow to change the alarm output option. Press the save icon Save and return to main setting page.

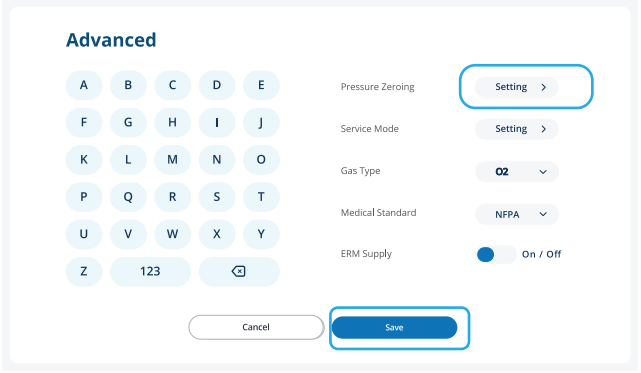


Advanced Set-Up.

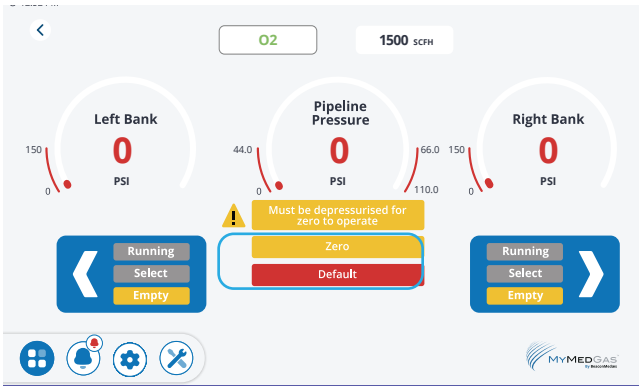
1. Press the Advanced icon in the setting page, this action needs password, only authorized service persons can do that.



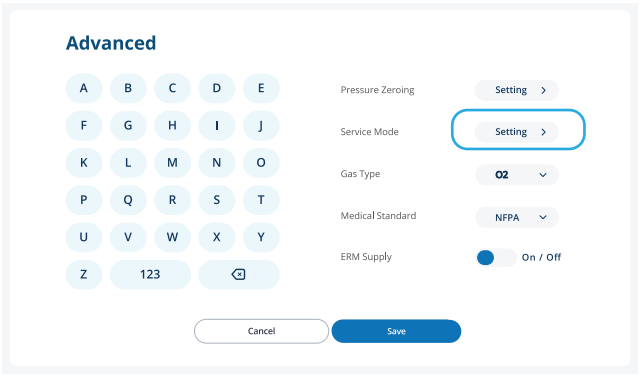
2. Press the Setting › of the pressure zeroing to zero the pressure.



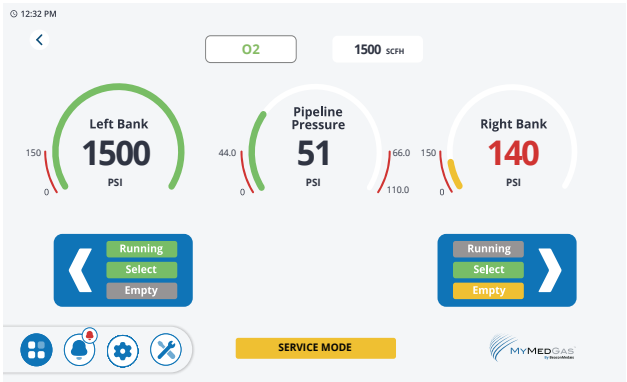
3. Press the Zero to correct current pressure to value 0. Pressure the Default to make current pressure follow the default algorithm in the controller software.



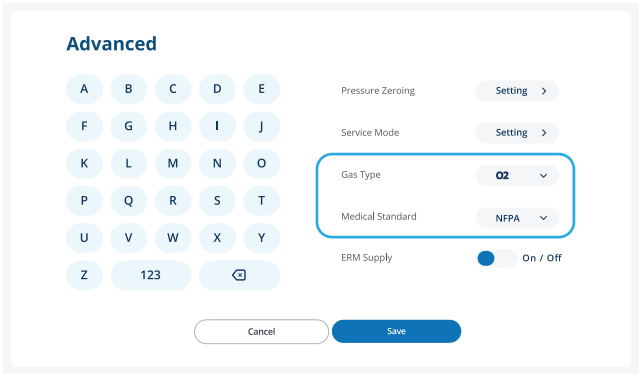
4. Press the Setting › of the service mode.



In the service mode, one can press the ❮ and ❯ change-over button, no matter which alarm sounds.



5. In the advanced page, the gas type and medical standard also can be selected.



2.6 Installation Check.

2.6.1 Ensure that all pigtails 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 Item 3, Figure 15).

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

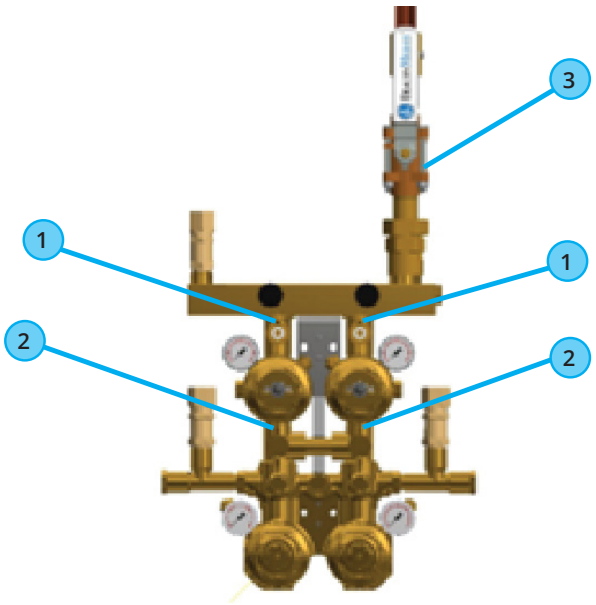
2.6.4 Use 1 cylinder per bank, slowly pressurise the manifold (see Section 4.10 - Cylinder operation). Both cylinder gauges (Item 17, Figure 1) should indicate full cylinder pressure. The line pressure gauge (Item 11 Figure 1) should read typically as per Table 5, Section 4, adjust as necessary (see Section 4.5).

⚠ CAUTION! If used as a backup manifold it would be recommended to set the line pressure at least 0.02 MPa below the main supply source pressure at full design flow, to ensure the manifold does not supply the pipeline during normal primary source operation.

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

2.6.6 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	Line source Isolation Valve

Pressure drop leak test validation notes:

- The Manifold Changeover System uses medical regulators approved to EN ISO 10524-2 standard. 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 0.00016 MPa/min, or 0.0096 MPa/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
MPa/Hr	1.78	1.09	0.78	0.61	0.5
No. Cyl.	60	70	80	90	100
MPa/Hr	4.2	3.7	3.3	2.9	2.6

- 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 0.1 MPa.

2.6.7 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.

3. Commissioning.

3.1 General.

Commissioning of the Manifold Changeover System must be carried out in full after initial installation. The objective 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 pigtails 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 shutoff valve (shown in Item 8, Figure 1) 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, pigtails, 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 (Item 17, Figure 1) check the intermediate pressure according to Table 6, the cylinder graphics are shown as full and the appropriate LED and icons are lit up (see Figure 16). See Figures 9 to 14 in Section 2.5, if setup changes are required.

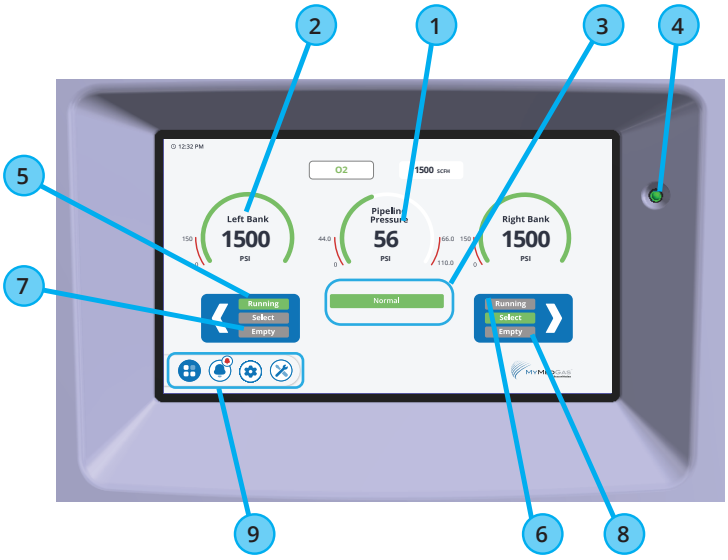
3.3.2 Check that the pipeline distribution pressure displayed on the screen and back up gauge (Item 11, Figure 1) is typically as per Table 5 in Section 4, Principles of Operation. Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

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 vent valve (shown in Figure 1, Item 6) until the cylinder contents pressure is below the bank changeover point (typically 150 psi for 55 psi supply, 300 psi for 100 and 180 psi 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
		Change Cylinder Immediately	Change Cylinder Immediately
		Change Cylinder	Change Cylinder
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
Standby Running	On
Standby Low	Off
Reserve Low	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
Standby Running	Off
Standby Low	Off
Reserve Low	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 vent valve (shown in Figure 1, Item 6) until the cylinder contents pressure is below the bank changeover point (typically 150 psi for 55 psi supply, 300 psi for 100 and 180 psi 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
Standby Running	On
Standby Low	Off
Reserve Low	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 vent valve (shown in Figure 1, Item 6) until the cylinder contents pressure is below the bank changeover point (typically 150 psi for 55 psi supply, 300 psi for 100 and 180 psi 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
Standby Running	On
Standby Low	On
Reserve Low	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). Apply a slow bleed to the vent valve, as shown in (Item 6, Figure 1). This will apply a small flow across the 2nd stage regulator. Typically 5-15 l/min will be adequate.

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 4.

Table 4: Default Line Pressure Alarm Settings.

Nominal Line Pressure	Default Values	
	Low Pressure Alarm	High Pressure Alarm
55 psi	44	66
100 psi	80	120
180 psi	144	216

3.4.13 The controller screen output alarm conditions will show as per Figure 23.

Figure 23 - Low Line Pressure Fault.

3.4.14 Adjust the line pressure back to nominal (see Table 5 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 vent valve.

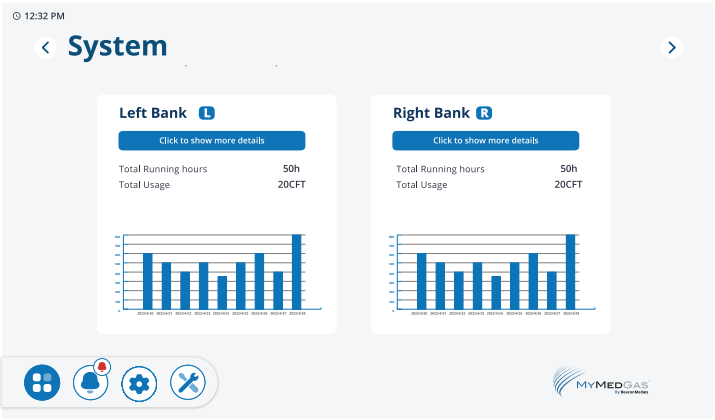
3.4.16 Close all bank cylinder valves.

3.5 Prime the Manifold Changeover System.

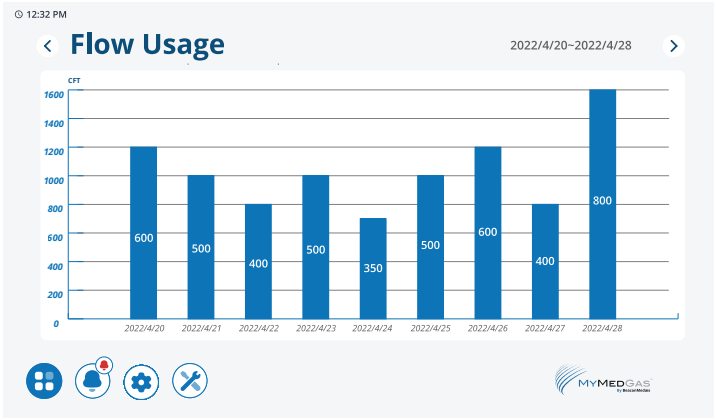
3.5.1 Complete the steps in Section 4.2 - Procedure to prime Manifold Changeover System, to bring it online.

3.6 System Flow and System Pressure Statistics.

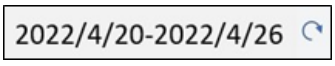
3.6.1 Click home button on the home page, showing the information of total running hours and total usage of left bank and right bank.



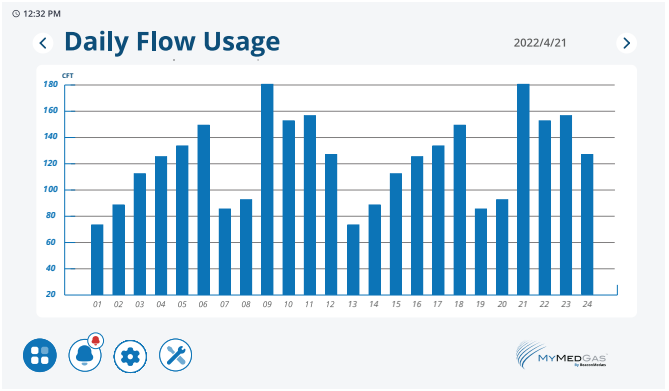
3.6.2 Click Click to show more details on either bank side, showing the flow usage of 7 days.



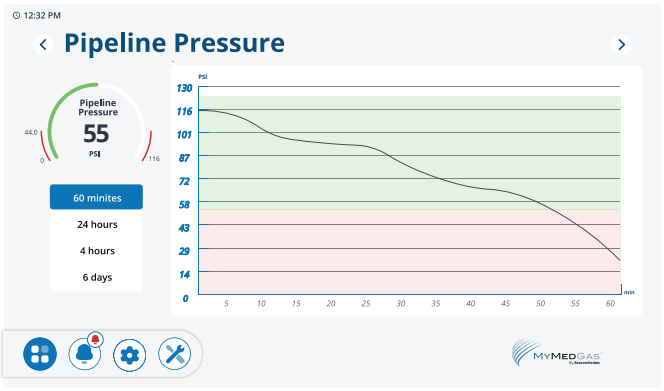
3.6.3 Click the date on the top right corner of the screen, slide up or down on the number which need modify, after that click the circle arrow to confirm.



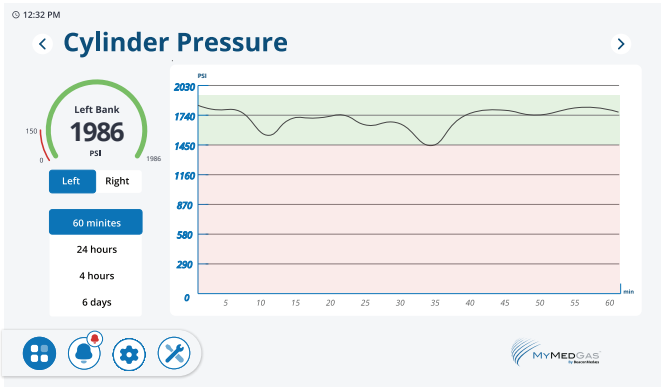
3.6.4 Click on the corner, which shows the flow usage every hour of the day, the date also can be modified as 3.6.3 shows.



3.6.5 Click on the corner, enter the pipeline pressure statistics page, showing the pressure trend of last 60 minutes, 4 hours, 24 hours and 6 days.



3.6.6 Click home button on the corner, enter the cylinder pressure statistics page, showing the pressure trend of last 60 minutes, 4 hours, 24 hours and 6 days.

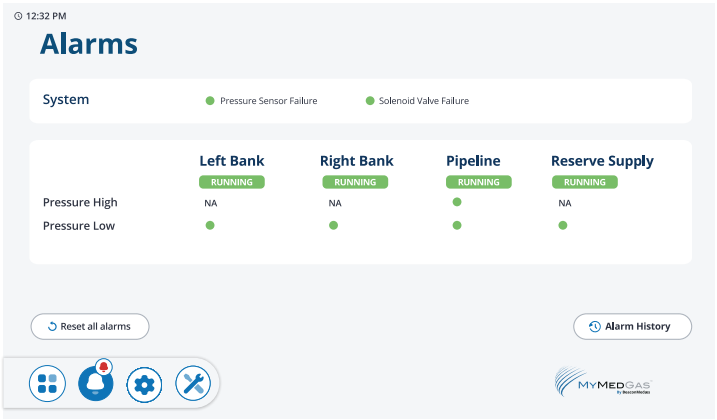


3.6.7 Click home button to go to the home page.

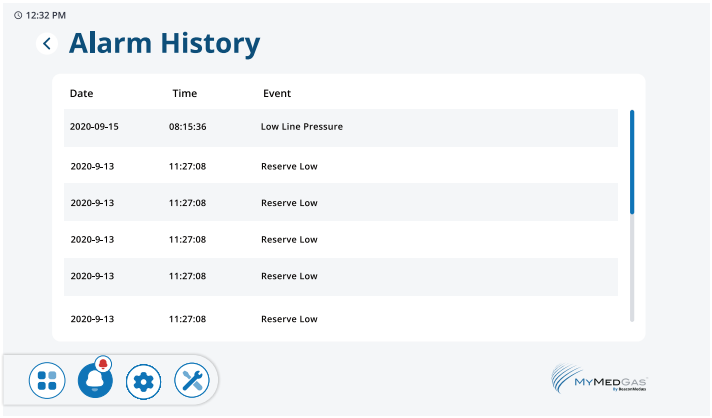
⚠ CAUTION! Flow calculation should be based on correct cylinder set-up, refer to 2.5.2. Extra flowmeter connected to controller can provide more accurate flow usage display.

3.7 Alarm Page.

3.7.1 Click alarm button to enter the alarm page, which shows the pressure status of pipeline and cylinder, and failure status of solenoid valve and pressure sensor.

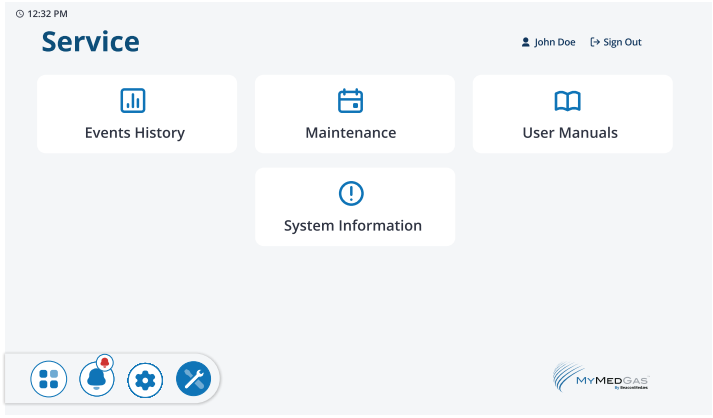


3.7.2 Click the alarm history button Alarm History on the alarm page to enter the alarm history page.

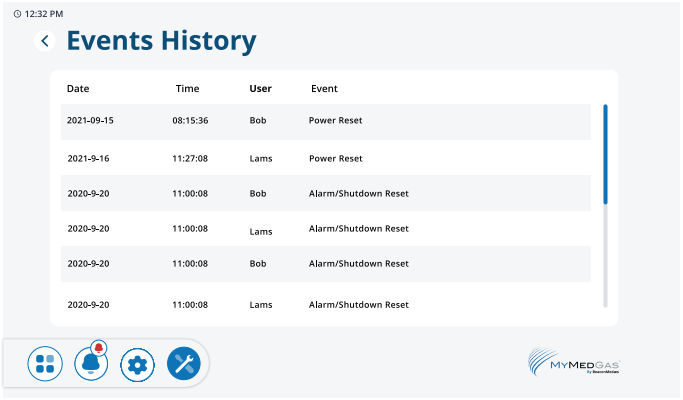


3.8 Service Page.

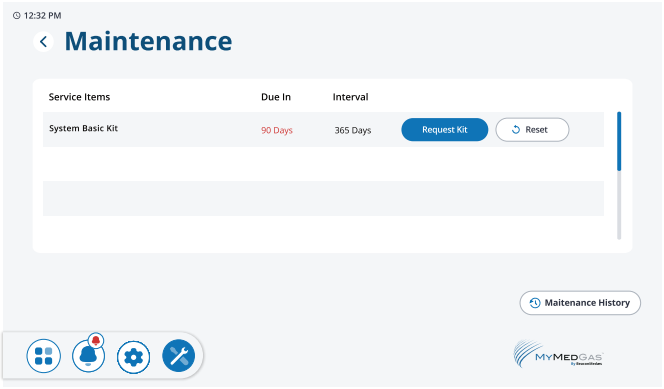
3.8.1 Click the service button to enter the service page.



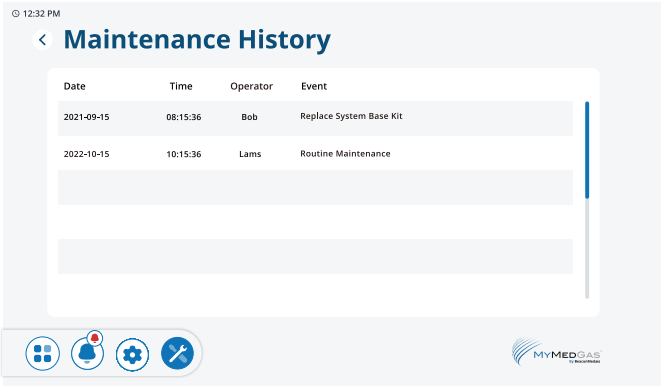
3.8.2 Click the Events History Events History to enter the events page.



3.8.3 Click the Maintenance button Maintenance to enter the maintenance page.



3.8.4 Click the maintenance history button Maitenance History on the maintenance page to enter the maintenance history page.



4. Principles of Operation.

4.1 General.

The Manifold Changeover System pressure is set typically as per Table 5 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.

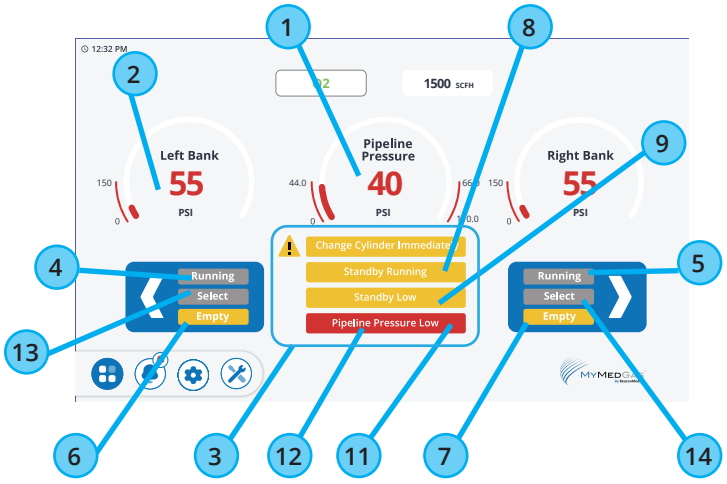
See Figure 24 for full manifold visual indicators and meanings.

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
		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
		Change Cylinders	Change empty cylinders
		Change Cylinders Immediately	Change empty cylinders immediately
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.

Figure 24 - Visual Indicators.



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

No.	Description	Condition	Action
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 5: Typical pressure settings for NFPA primary and emergency manifold changeover system, during normal pipeline system operation.

	Pressure (Psi)		
Nominal System Design	**55**	**100**	**180**
Max. Static Pressure Primary Supply	63	117	213
Min. Dynamic Pressure Primary Supply	47	83	147
Max. Static Pressure Backup Supply	63	117	213
Min. Dynamic Pressure Backup Supply	47	83	147

NOTE - Table 5 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 0.02 Mpa 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 8, Figure 1).

NOTE - Sections 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 Figures 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 isolation valve (Item 12, 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 25). Then turn anti-clockwise until the intermediate pressure reading is typically set as per Table 6.

Figure 25 Pressure Regulator Adjustment.

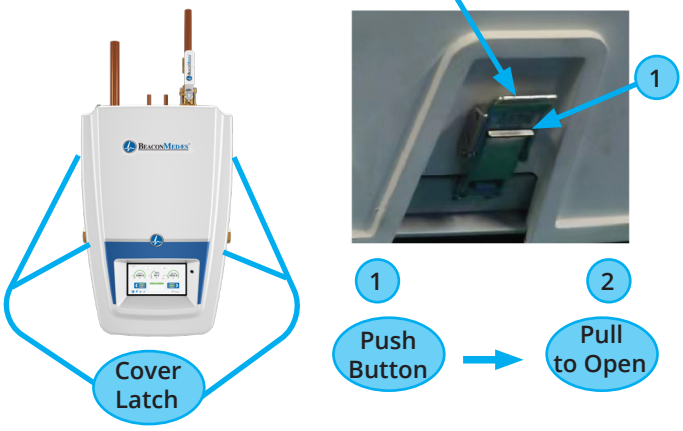
Rotate anti-clockwise to reduce set point

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 (Refer to Section 3.4) 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 6 (Intermediate Pressure - Standby Bank). After base pressure has been set, pressure will be increased by amount of dome bias pressure. Refer to Table 6 (Intermediate Pressure - Running Bank).

4.5.1.1 Remove the front cover of manifold system (Item 22, Figure 1).

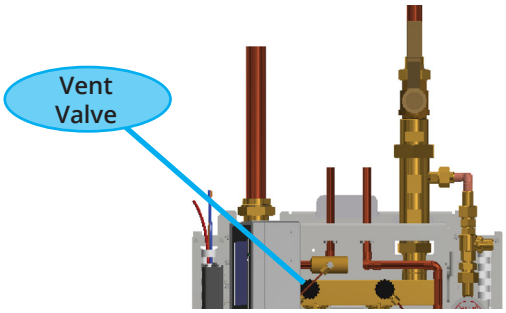


4.5.1.2 Close service valve for the control pressure line (Item 10, Figure 1).

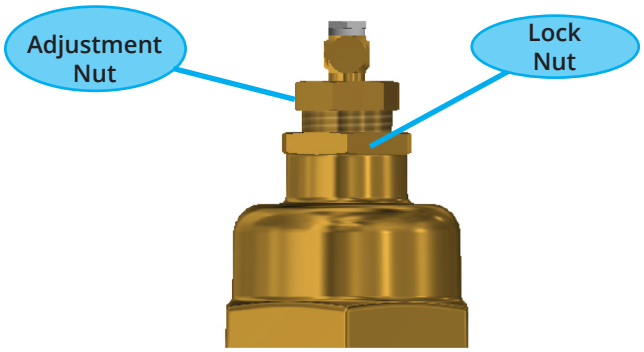
4.5.1.3 Press manual changeover icon ❯ and ❮ on the screen. Cycle manifold from bank to bank to vent residual dome bias pressure.

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 6 (Intermediate Pressure – Standby Bank). Turn anti-clockwise to reduce the set point and turn clockwise to increase the set point.

4.5.1.8 Check the setting point of the intermediate pressure by the intermediate pressure gauge (Item 16, Figure 1).

Table 6: Regulator Pressure Setting.

Nominal System Design	55 psi	100 psi	180 psi
Intermediate Pressure (Standby Bank)	70 psi	210 psi	210 psi
Dome Bias Pressure	55 psi	40 psi	40 psi
Intermediate Pressure (Running Bank)	125 psi	250 psi	250 psi

4.5.1.9 Tighten the 1st stage pressure regulator locknut.

4.5.1.10 Close the vent valve (Item 6, Figure 1).

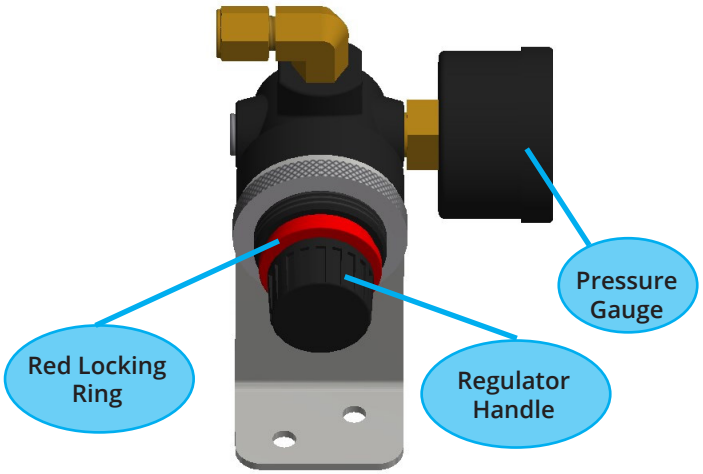
4.5.1.11 If the other 1st stage pressure regulator also needs to be adjusted, repeat steps 4 through 9.

4.5.1.12 Slowly open all cylinders on both manifold banks.

4.5.1.13 Open the service valve (Item 10, Figure 1) and reset dome regulator (Item 19, Figure 1) to 40 psi (if dome regulator included).

NOTE - By closing service valve, manifold's line pressure sensor (Item 25, 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 30 psi. Then increase pressure to between 40-45 psi. Rotate the regulator handle to adjust the pressure and pressure value can refer to the pressure gauge.



4.5.2 2nd stage pressure regulator adjustment

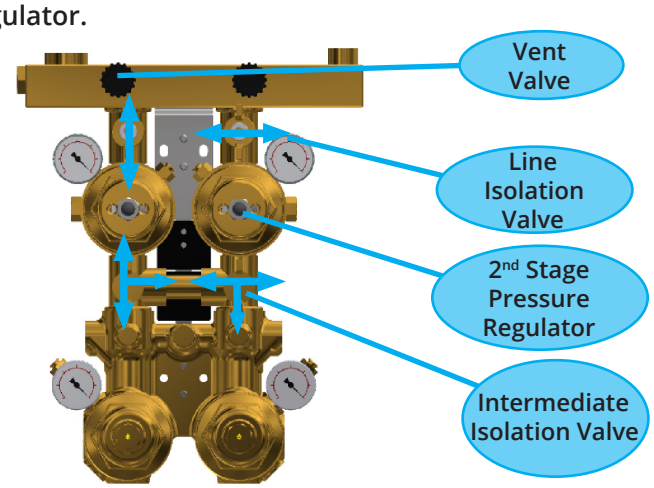
Following procedure describes process of setting 2nd stage pressure regulator pressure. This procedure should only need to be performed if 2nd stage pressure regulator pressures are not within acceptable limits during performance verification procedure or after servicing the 2nd stage pressure regulator 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 26.

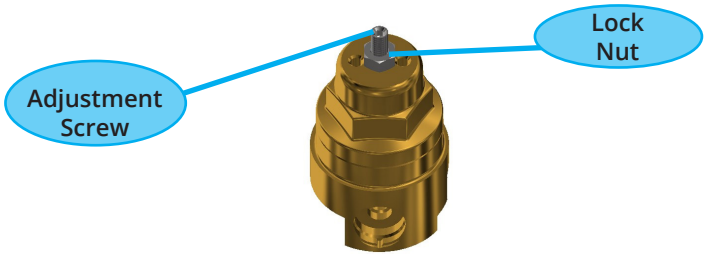
Figure 26 - Isolating the Right 2nd Stage Pressure Regulator.



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

4.5.2.5 Using a 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.

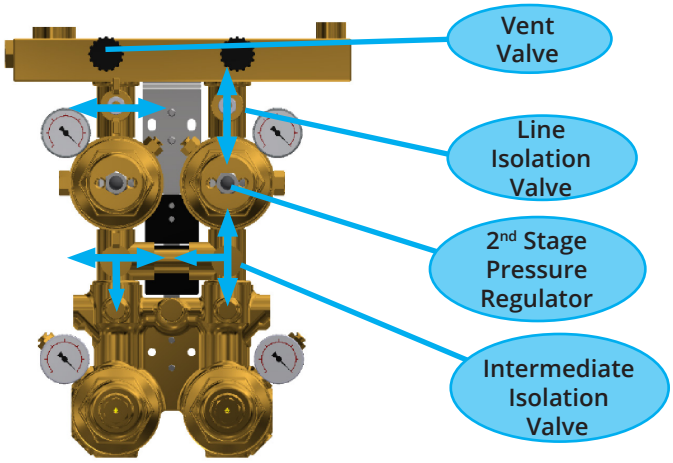


4.5.2.6 Adjust Screw to achieve an appropriate line pressure gauge reading. Note reading for later use. Refer to Table 5 for typical pressure settings.

⚠ CAUTION! If used as a backup manifold it would be recommended to set the line pressure at least 0.02 MPa 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.

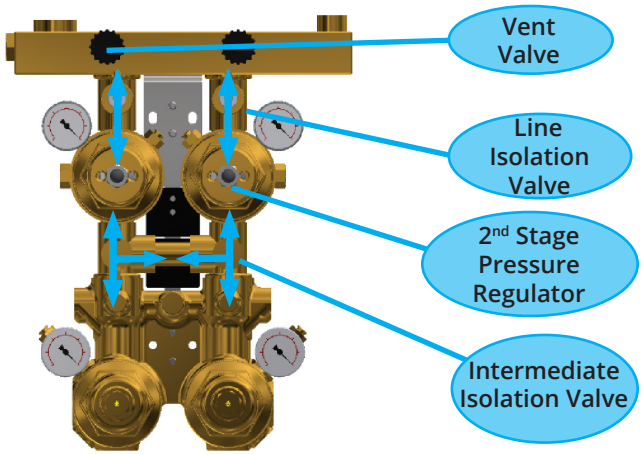
4.5.2.8 Rotate both the left and right isolation ball valves handle to below position, and set the right 2nd stage pressure regulator to the same pressure with the left one.



4.5.2.9 Tighten the right 2nd stage pressure regulator locknut.

4.5.2.10 Close the vent valve (Item 6, Figure1).

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



4.5.2.12 Verify the manifold operation. Refer to Section 3.4

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 and Section 5.2 for typical cylinder handling safety check list) when moving the cylinders into place ready for connection to the pigtails.

4.6.2 When the running cylinder bank pressure falls to the changeover set point (for typical changeover pressures see Table 8). The running cylinder bank will automatically switch to the standby cylinder bank and provide the following alarm outputs shown in Table 7. Figure 27 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 3 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 7: Change Cylinder Alarm Conditions.

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

Figure 27 - Left Bank Running, Right Bank Empty.

NOTE - This is providing the standby cylinders are full, when the cylinders are replaced by filled cylinders, no changeover happened,and the “Change Cylinders ” alarm output will become inactive.

Table 8: Typical Cylinder Bank Changeover Pressure.

Nominal Supply Pressure	Typical Cylinder Changeover
55 psi	150 psi
100 psi	300 psi
180 psi	300 psi

4.6.3 For each empty cylinder, disconnect the pitails from the cylinder by either undoing the hand wheel or unscrewing the nut at the cylinder end, depending on the cylinder connection type.

4.6.4 Replace the empty cylinder and reconnect the pigtails.

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

NOTE - 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. The empty cylinder status on the screen and status icon will automatically return to normal.

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

4.7 Procedure for Manual Cylinder Bank Changeover.

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

4.7.2 Change empty cylinders as per Section 4.6.

Figure 28 - Manual Cylinder Bank Selection.

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

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.

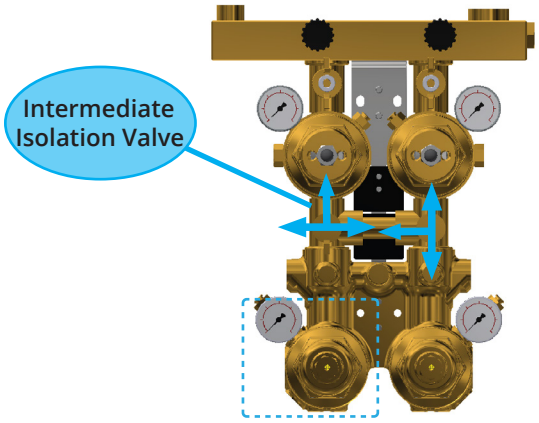
4.8.2 During power failure the electronic controls will not be in operation, but cylinder banks can changeover due to the balanced mechanical design.

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 70 psi. 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, until power is restored.

4.8.5 When the running bank cylinder pressure reaches the changeover pressure open the standby bank valve, then close the empty bank. Below picture shows the left bank empty and right bank valve open.

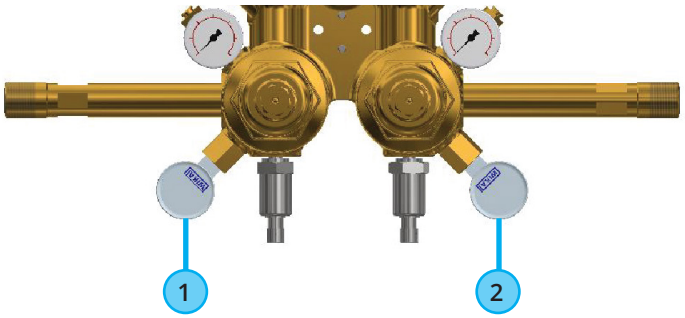


⚠ CAUTION! To ensure continuous supply of the medical gas when manually controlling cylinder bank changeover from the isolation valves shown, NEVER have both valves closed at the same time. Always open the next running bank first, before closing the empty bank ready for changing cylinders.

4.8.6 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 29 to determine the cylinder pressure status.

Figure 29 - Cylinder Pressure Gauges.



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

4.8.8 Changing empty cylinders as per Section 4.6.

⚠ CAUTION! To ensure continuous supply of the medical gas, NEVER have both line isolation valves (Item 12, Figure 1) closed at the same time. NEVER close both side of the intermediate three way isolation valve (Item 14, 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 30 - Full Menu Map.

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

5. Maintenance Procedures.

A qualified 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 pigtails as damage to tubing may occur.

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

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

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

5.2 During Cylinder Replacement.

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

5.2.2 Check leaks at the connections of cylinder to pigtails 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 24 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 24 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. Refer to Section 3.4.

5.4.2 Perform pressure and function inspection. Refer to Section 3.4.

5.4.3 Check the line pressure on the running cylinder bank is normal, typically as per Section 4.1 Table 5. 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 28), 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 31). 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 pigtails at the cylinder end (see Figure 34). Listen for a

leak from the pigtails. 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 pigtails but instead retighten it and test other pigtails 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 pigtails for cleanliness and pipe damage. Don't use and immediately replace dirty or damaged pigtails.

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

5.5.3 Verify the operation of manifold changeover system using Performance Verification Procedure. Refer to Section 3.4.

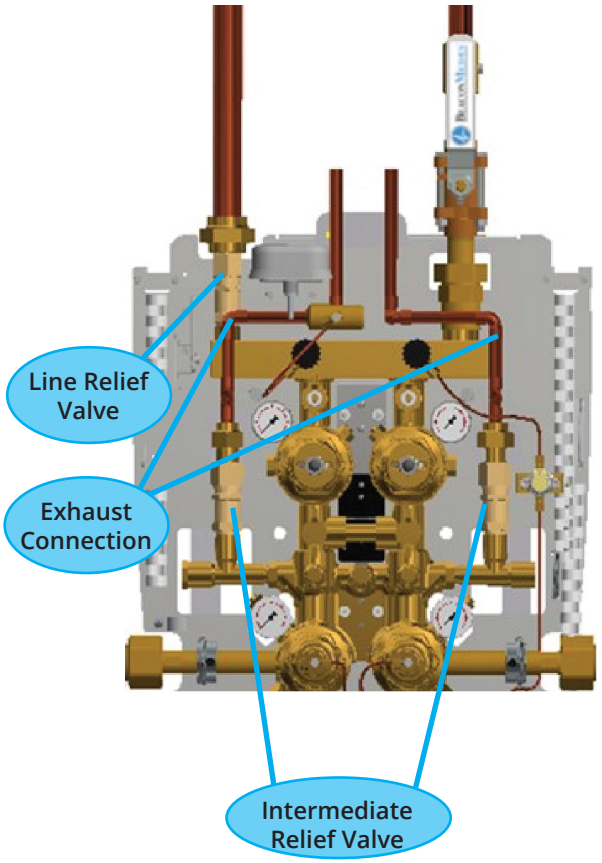
5.5.4 Calibrate the gauge and relief valve refer to the local law.

5.5.5 Check the power supply. Refer Electrical Details on Page 4.

5.5.6 Replace the pigtails, see Table 10.

⚠ 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 31 - Relief Valve Inspection



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

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

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 pigtails.

5.6.4 Replace inlet sintered filter.

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

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

Table 9: 5-Year Service Kits.

Kit Number	Description
4109150491	Intermediate Relief Valve Kit
4109150492	Line Pressure Relief Valve Kit-75 psi
4109150493	Line Pressure Relief Valve Kit-150 psi
4109150494	Line Pressure Relief Valve Kit-250 psi
4109150499	1st Stage Regulator Kit
4109150500	2nd Stage Regulator Kit
4109150508	Screen Inlet Filter Kit

⚠ CAUTION! It is mandatory to replace intermediate relief valves and line pressure relief 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 10: Pigtails Kit Numbers.

Kit Number	Description
4109150625	PIGTAIL RIGID N2O 24” SOFT TIP
4109150626	PIGTAIL, RIGID, O2, 24” W/ O-RING
4109150627	PIGTAIL, FLEX, N2O, 24” W/ O-RING
4109150628	PIGTAIL, FLEX, AIR, 24” W/ O-RING
4109150629	PIGTAIL, FLEX, N2 & ARGON, 24” W/ O-RING
4109150630	PIGTAIL, FLEX, CO2, 24” W/ CYLIND
4109150631	PIGTAIL, RIGID, CO2-O2 & HE-O2 W/ O-RING
4109150632	PIGTAIL, RIGID, O2-CO2 & O2-HE
4109150633	PIGTAIL, RIGID, HE, 24” W/ O-RING

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.

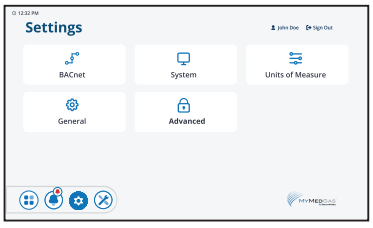
6.1 Optional Service Mode Setting.

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.

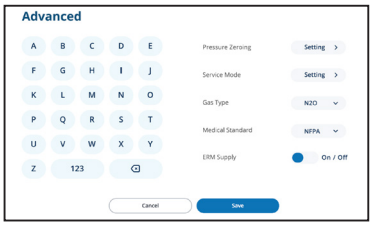
Figure 32 - Service Mode Option.

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

2. In setting page, push the Advanced button . This step needs password and only trained service persons can operate.



3. Click the Setting of service Mode.



4. Enter the service mode page.

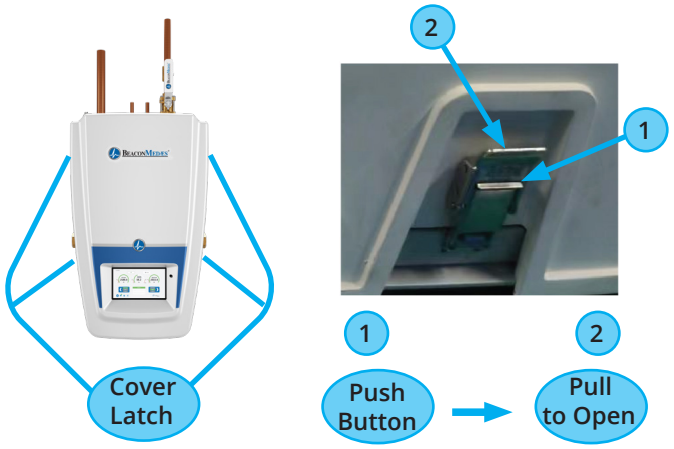
5. Press the home button or previous icon to quit the service mode.

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 33 and lift away.

Figure 33 - Main Cover Removal.

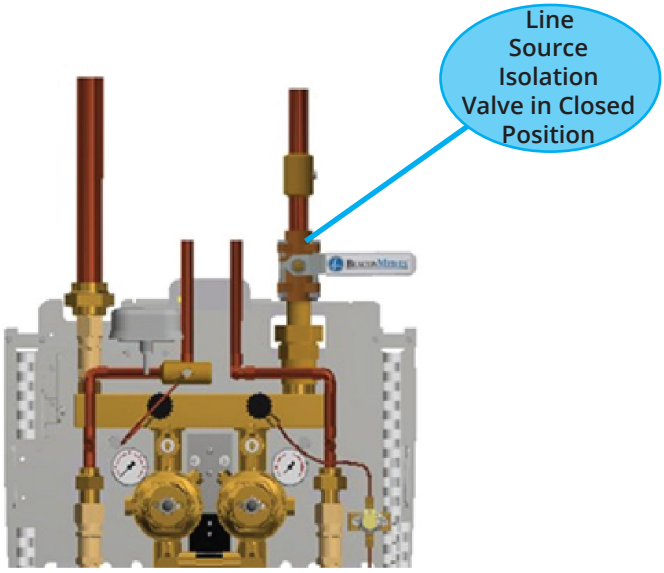


6.2.3 Close the line source isolation valve as shown in Figure 34 and close all the cylinder valves.

⚠ 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 34 - Line Source Isolation Valve.



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 in case 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 33, and lift away.

6.3.3 Close the isolation valves as shown in Figure 35 and Figure 36 for the relevant side to be serviced and close all the cylinder valves on the same bank.

Figure 35 - Isolating the Left 1st Stage Regulator.

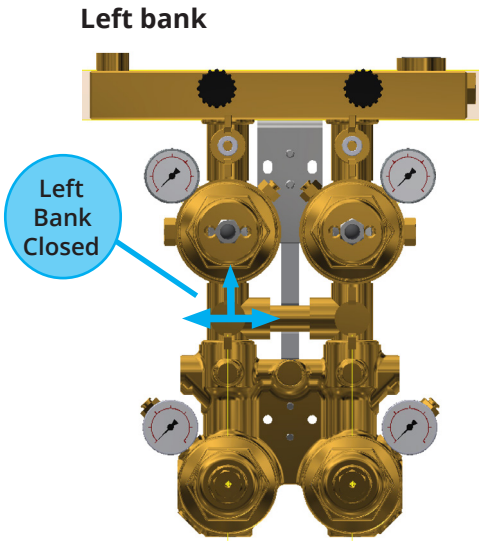
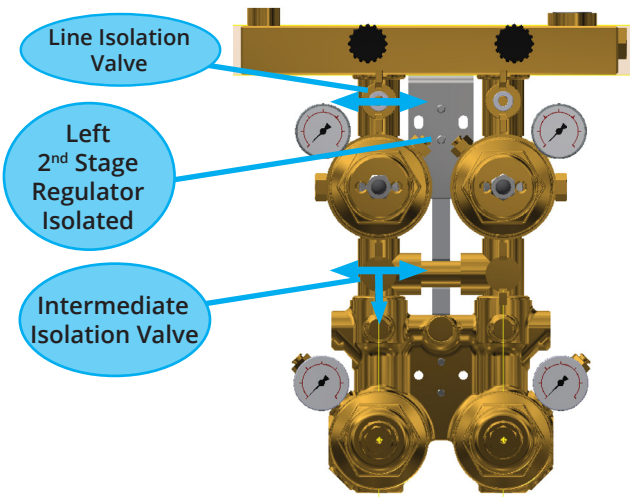


Figure 36 - Isolating the Left 2nd Stage Regulator.



6.4 1st Stage Pressure Regulator Maintenance.

⚠ WARNING! Vent all inlet pressure and outlet pressure to 0 psi 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.

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

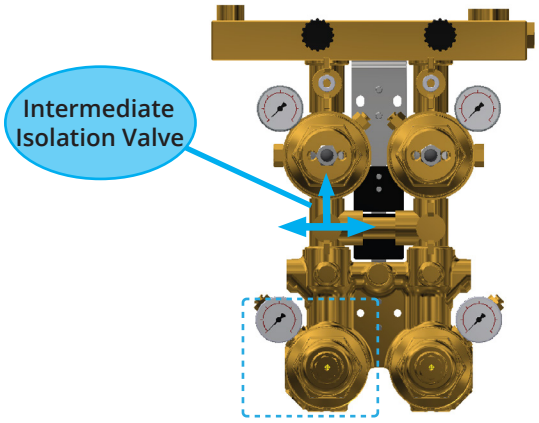
6.4.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred, follow steps in 6.2.

NOTE - Figure 37 shows example of left 1st stage regulator maintenance, mirror to opposite side for working on the right bank.

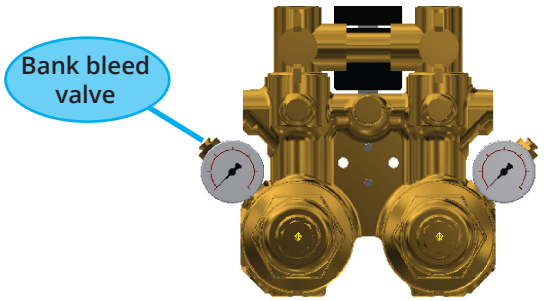
6.4.3 Close all cylinders on side of manifold where 1st stage pressure regulator will be repaired.

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.

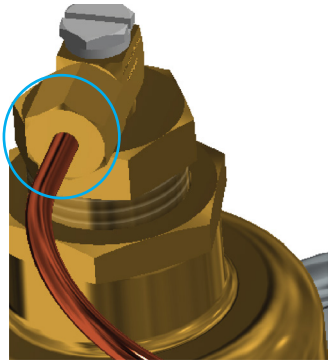
Figure 37 - Isolating the Left 1st Stage Regulator.



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

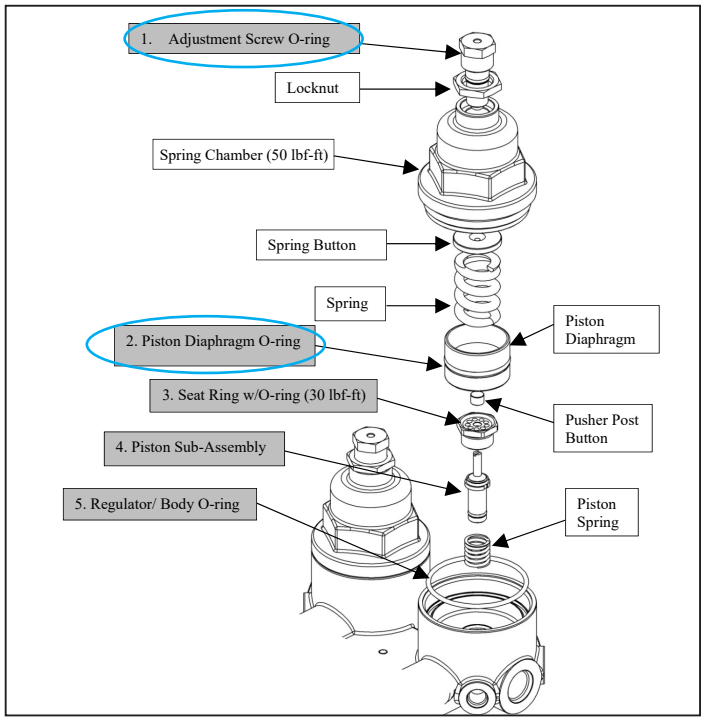


6.4.6 Disconnect tubing from 1st stage pressure regulator by loosening the connector.



6.4.7 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.

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



6.4.9 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.

6.4.10 Remove Pusher Post Button and set aside.

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

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

6.4.13 Discard Seat Ring w/O-ring.

6.4.14 Remove Piston Sub-Assembly and discard.

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

6.4.16 Insert new Piston Sub-Assembly.

6.4.17 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 30 lbf-ft.

6.4.18 Assemble Pusher Post Button.

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

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

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

6.4.22 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.

6.4.23 Assemble Spring Chamber to the Regulator Body. Tighten to 50 lbf-ft.

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

6.4.25 Assemble new Adjustment Screw O-ring.

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

6.4.27 Turn the Adjustment Screw until desired set pressure.

6.4.28 Tighten the locknut.

6.4.29 Verify the manifold operation. Refer to Section 3.4

6.5 2nd Stage Pressure Regulator Maintenance.

⚠ WARNING! Vent all inlet pressure and outlet pressure to 0 psi 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.

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

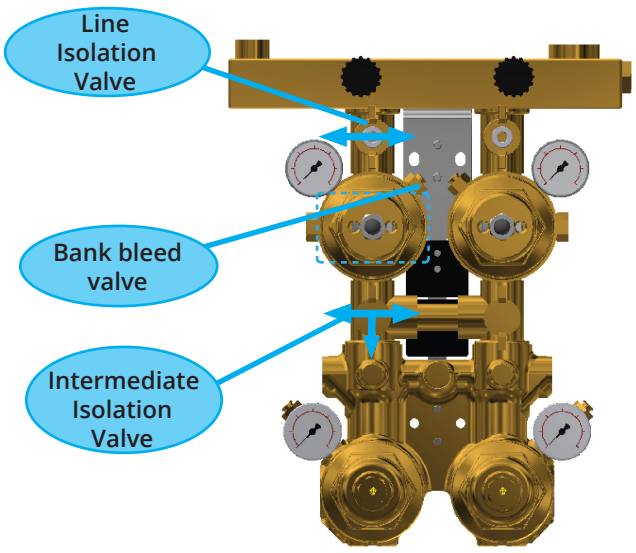
6.5.2 Complete the steps in 6.3 to perform this maintenance with one bank running. If total isolation is preferred, follow steps in 6.2.

NOTE - Figure 38 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 psi by pressing the bank bleed valve.

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

Figure 38 - 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.

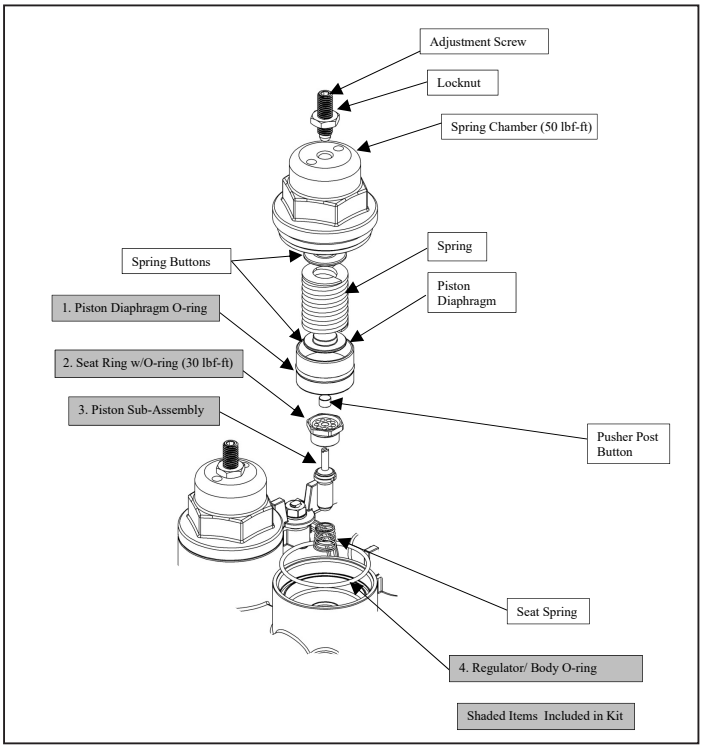
6.5.13 Assemble Pusher Post Button.

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 30 lbf-ft.

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 50 lbf-ft.

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. Refer to Section 3.4.

6.6 Replace the Line Pressure Relief Valve.

Line pressure relief valve kit numbers, see Table 11, 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 39. Loosen the relief valve nut at the below position see Figure 39. 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.

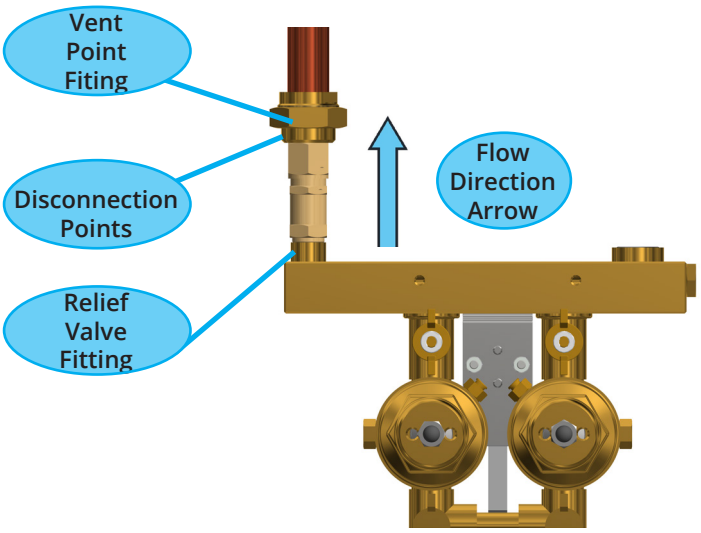
6.6.4 Fit the new relief valve, ensure the direction arrow is as per Figure 39.

6.6.5 Fit the vent point fitting.

6.6.6 Follow Section 6.21 to bring the manifold back online.

6.6.7 Verify the manifold operation. Refer to Section 3.4.

Figure 39 - Line Pressure Relief Valve Replacement.



6.7 Replace the Intermediate Pressure Relief Valve.

Intermediate pressure relief valve kit number, see Table 11, 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 40 shows example of left intermediate pressure relief valve replacement, mirror to opposite side for working on the right bank.

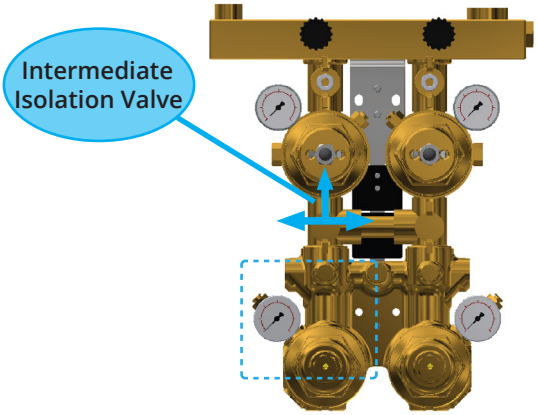
⚠ CAUTION! When exhausting anaesthetic and oxygen manifolds ensure that the manifold room is well ventilated and no potential ignition sources are present.

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

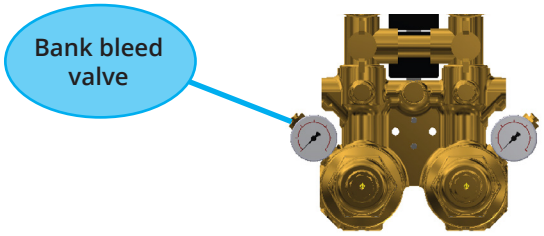
6.7.3 Switch the duty bank to the side where the intermediate relief valve will not be replaced. Then close all the cylinders on one bank of manifold where the intermediate relief valve will be replaced.

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 37 for isolating the 1st stage regulator on the left side.

Figure 37 - 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 bank bleed valve as shown in figure below.



6.7.6 Once all the gas has been vented, fully disconnect the exhaust pipe from the fittings marked in Figure 40.

6.7.7 Remove the relief valve and old connector.

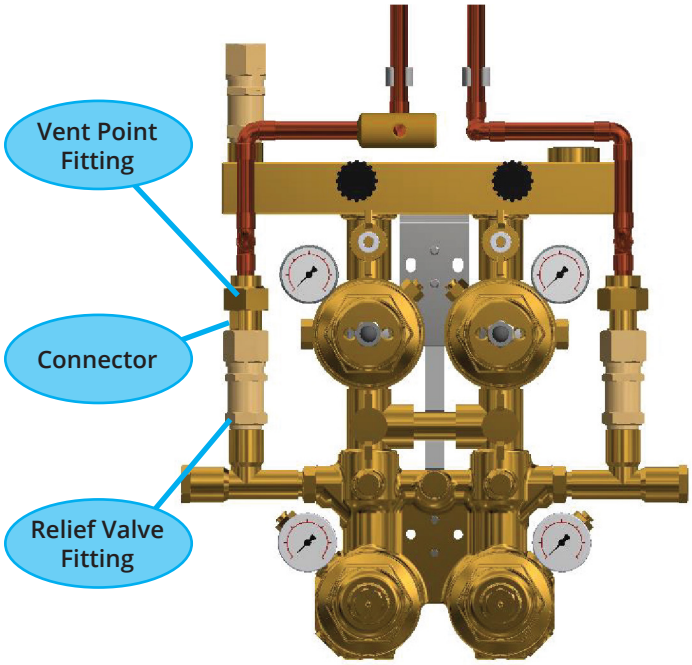
6.7.8 Connect the new relief valve with the new connector and re-connect the exhaust pipework. Tighten the vent point fitting.

6.7.9 Follow Section 6.19 or 6.20 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. Refer to Section 3.4.

Figure 40 - Intermediate Relief Valve Replacement.

NOTE - Figure 40 shows example of left bank replacement unit, mirror to opposite side for working on the right bank.



6.8 Replace the Solenoid Valve.

Solenoid valve kit number, see Table 11, Chapter 7.

NOTE - Solenoid replacement can be performed with the service valve closed (Item 10, Figure 1), while running on both banks of the manifold.

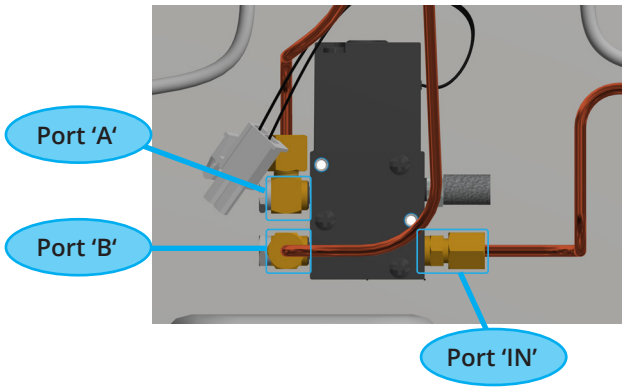
6.8.1 If the optional service mode is selected during maintenance, complete steps in 6.1.

6.8.2 Close the service valve (Item 10, Figure 1).

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

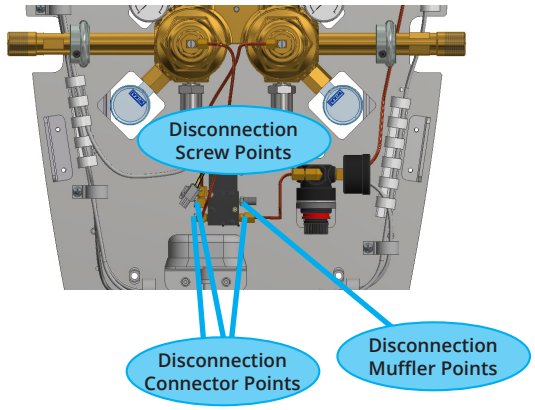
6.8.3 Disconnect the cables for the solenoid valve. Refer to Figure 8.

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



6.8.5 Remove the 3 connectors, 2 screws and 1 muffler from the old solenoid valve as shown in Figure 41.

Figure 41 - Solenoid Valve Replacement.



6.8.6 Connect the 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.

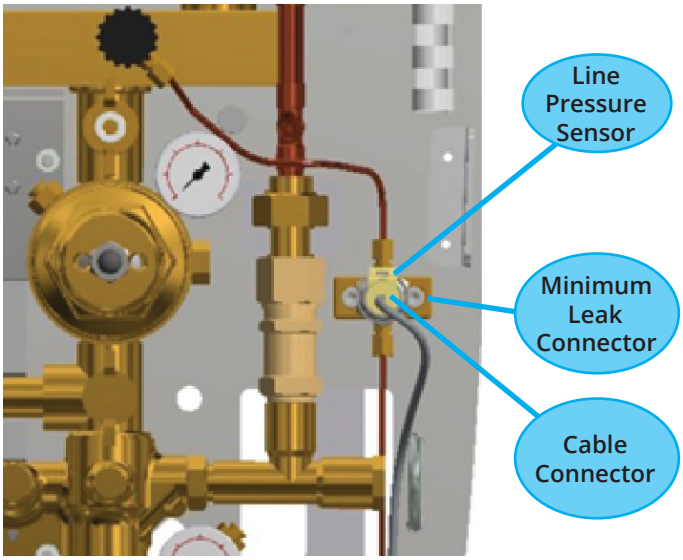
6.8.7 Wire the new solenoid valve cable to the controller cables. Refer to Figure 8.

6.8.8 Open the service valve (Item 10, Figure 1).

6.9 Replace the Sensor for Distribution System Pressure.

NOTE - Line pressure sensor replacement can be performed with the service valve closed (Item 10, Figure 1), can read the line pressure by line pressure gauge (Item 11, Figure 1) at that time, in condition of running on any bank of the manifold.

Figure 42 - Line Pressure Sensor Replacement.



6.9.1 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.

6.9.2 Close the service valve (Item 10, Figure 1).

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

6.9.3 Disconnect the sensor cable connector with old sensor. Refer to Figure 8.

6.9.4 Replace the old sensor with the new one, and fit sensors to the minimum leak fitting. Connect the cable connector with new sensor. Refer to Figure 8.

6.9.5 Open the service valve (Item 10, Figure 1).

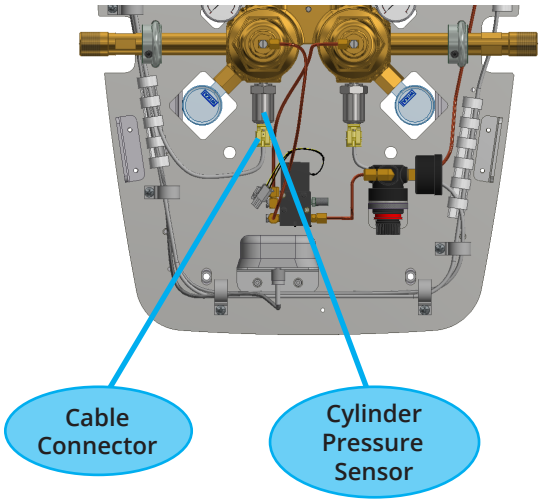
6.9.6 Press the home icon or the previous icon to quit the service mode.

6.10 Replace the Sensor for Cylinder Pressure.

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

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

Figure 43 - 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.

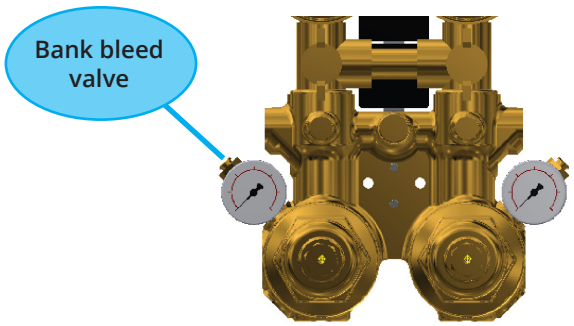
Following procedure describes process to service cylinder pressure sensor. If necessary, sensor service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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

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

6.10.3 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 37.

6.10.4 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the bank bleed valve as shown in figure below.



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

6.10.5 Disconnect the sensor connector.

6.10.6 Replace the new sensor which is shown in figure 43, and tighten the sensor screw fitting.

6.10.7 Connect the cable connector with the new sensor.

6.10.8 Follow Section 6.19 or 6.20 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.10.9 Verify the manifold operation. Refer to Section 3.4.

6.11 Replace the Gauge for Distribution System Pressure.

Line pressure gauge kit number, see Table 11, 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, gauge service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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

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

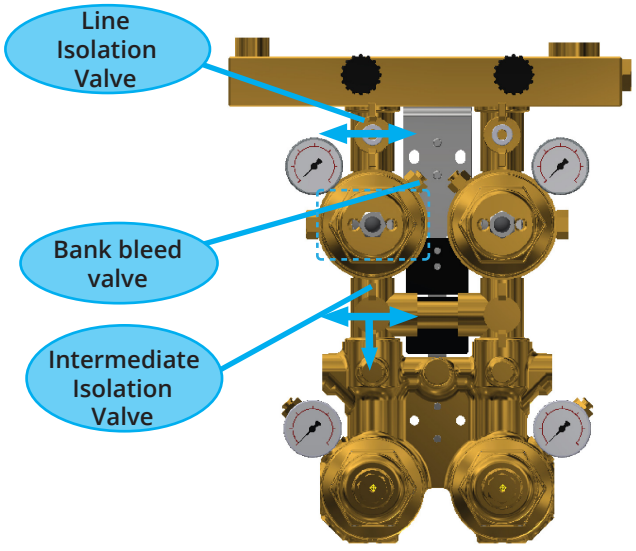
NOTE - Figure 44 shows example of left line pressure gauge maintenance, mirror to opposite side for working on the right bank.

6.11.3 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 38.

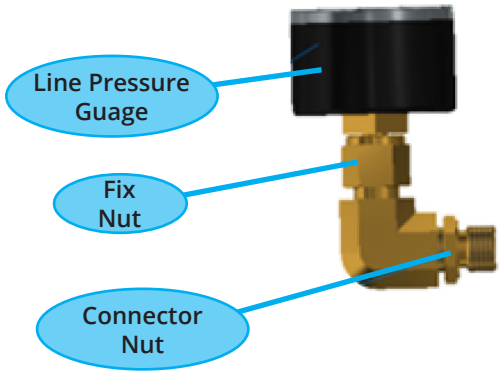
6.11.4 Vent the pressure in the 2nd stage regulator which is isolated from last step to 0 psi by pressing the bank bleed valve on the regulator.

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

Figure 38 - Isolating the Left 2nd Stage Regulator.



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

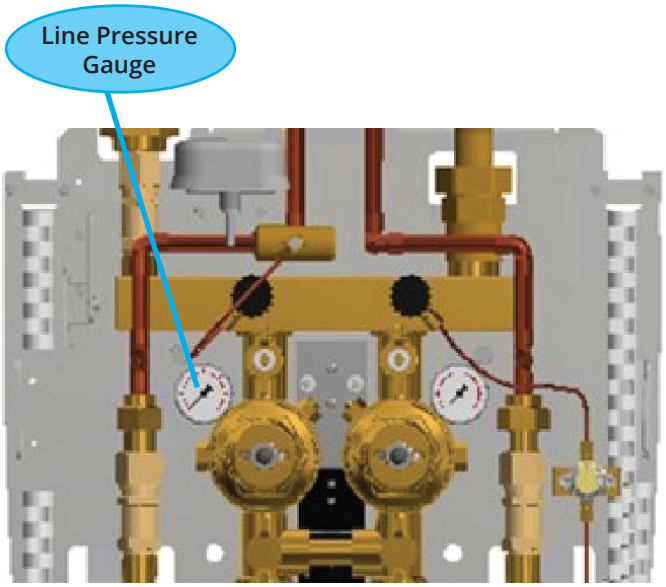


6.11.6 Replace the new gauge and new connector.

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

6.11.8 Verify the manifold operation. Refer to Section 3.4.

Figure 44 - Line Pressure Gauge Replacement.



6.12 Replace the Gauge for Cylinder Pressure.

Cylinder pressure gauge kit number, see Table 11, 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.

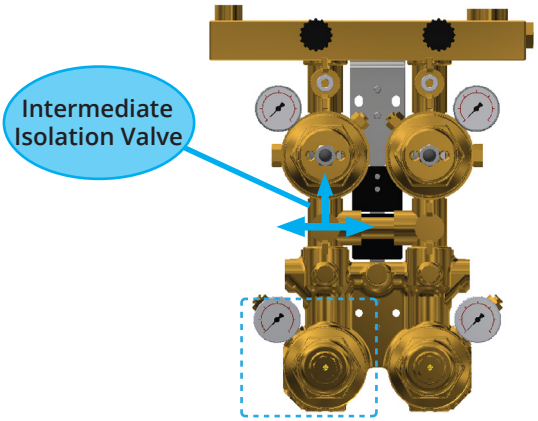
6.12.1 If the optional service mode is selected during maintenance, complete steps in 6.1.

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.

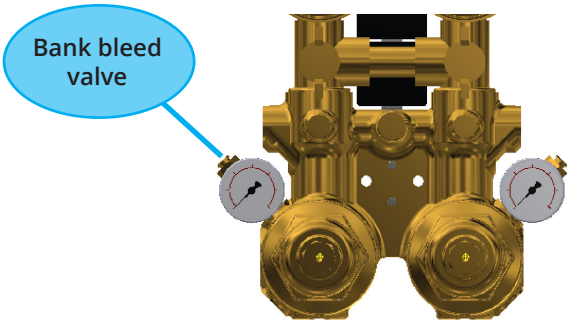
6.12.3 Close all cylinders on the side of manifold where the cylinder pressure gauge will be replaced.

6.12.4 Rotate the intermediate isolation valve on the same side downstream the 1st stage regulator to isolate the 1st stage regulator. Refer to Figure 37.

Figure 37 - Isolating the Left 1st Stage Regulator.



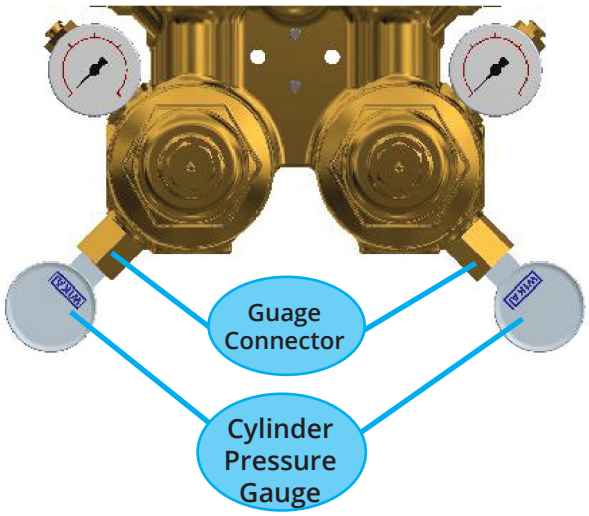
6.12.5 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the bank bleed valve as shown in figure below.



6.12.6 Loosen the old pressure gauge from the connector referring to Figure 45 and remove the old washer.

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

Figure 45 - Cylinder Pressure Gauge Replacement.



6.12.8 Follow Section 6.21 or 6.22 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. Refer to Section 3.4.

6.13 Replace the Intermediate Pressure Gauge.

Intermediate pressure gauge kit number, see Table 11, 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.

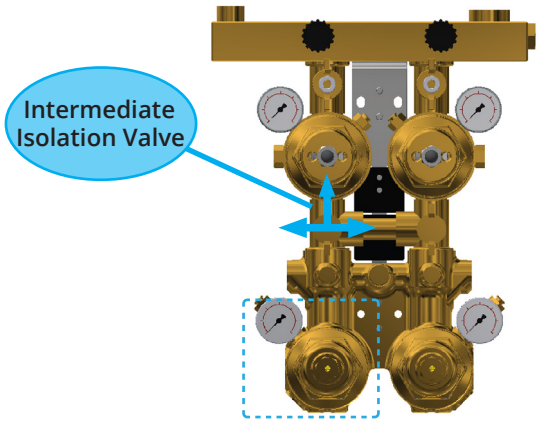
6.13.1 If the optional service mode is selected during maintenance complete steps in 6.1.

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.

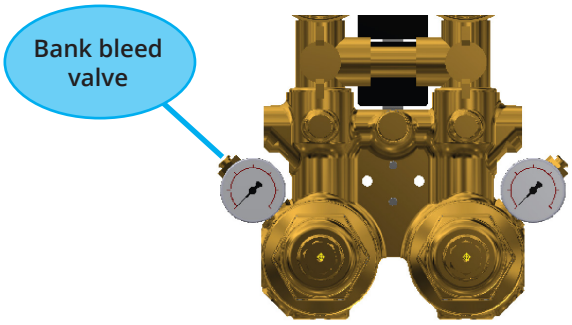
6.13.3 Close all cylinders on the side of manifold where intermediate pressure guage will be repaired.

6.13.4 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 37 - Isolating the Left 1st Stage Regulator.

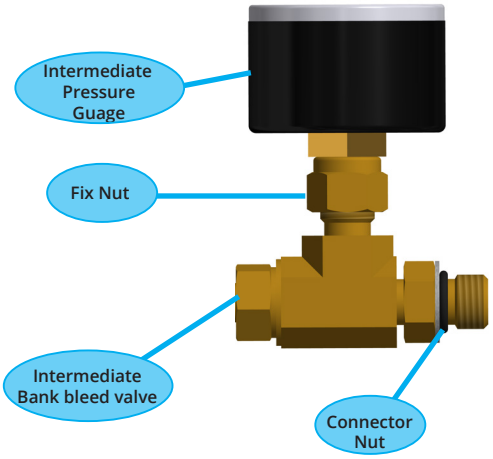


6.13.5 Vent pressure in the 1st stage regulator that is isolated from last step by pressing the bank bleed valve as shown in figure below.



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

Figure 46 - Intermediate Pressure Gauge Replacement.



6.13.6 Disconnect the intermediate pressure gauge, fix nut, bank bleed valve and connector nut, referring to Figure 46.

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

6.13.8 Follow Section 6.19 or 6.20 depending on whether the maintenance was performed with total or 1 bank isolation to bring the manifold back online.

6.13.9 Verify the manifold operation. Refer to Section 3.4.

6.14 Replace the Manifold Dome Regulator.

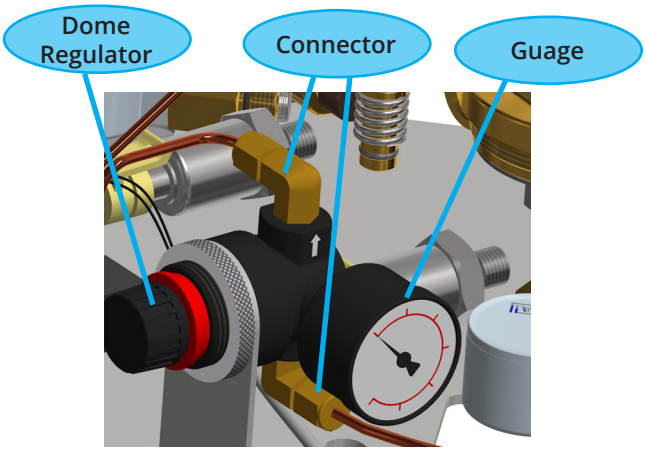
Dome regulator kit number, see Table 11, Chapter 7.

NOTE - Dome regulator replacement can be performed with the service valve closed (Item 10, Figure 1), while running on both banks of the manifold.

6.14.1 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.

6.14.2 Close the service valve (Item 10, Figure 1).

6.14.3 Disconnect the dome regulator fixture and connector, as shown in figure below.



6.14.4 Replace the old dome regulator with new one, gauge and connectors.

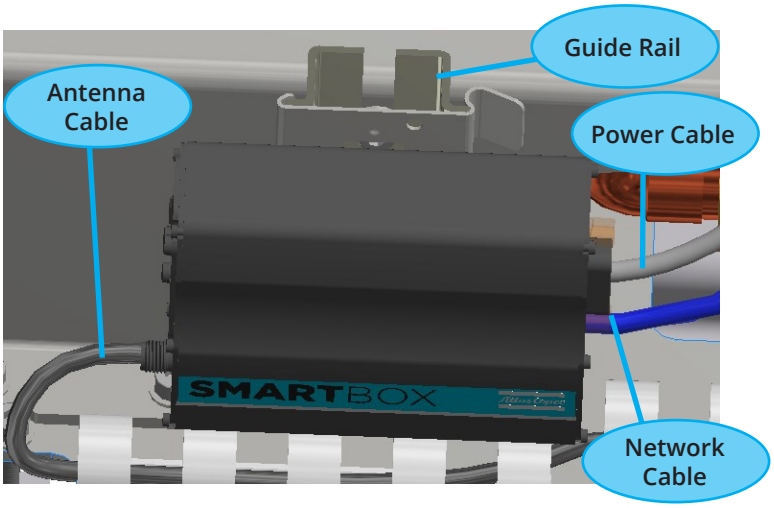
6.14.5 Check the regulator set point according to Section 4.5.

6.14.6 Open the service valve.

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

6.15 Replace the Smart Box.

6.15.1 Loosen the smart box power cable, antenna cable and network cable from smart box.



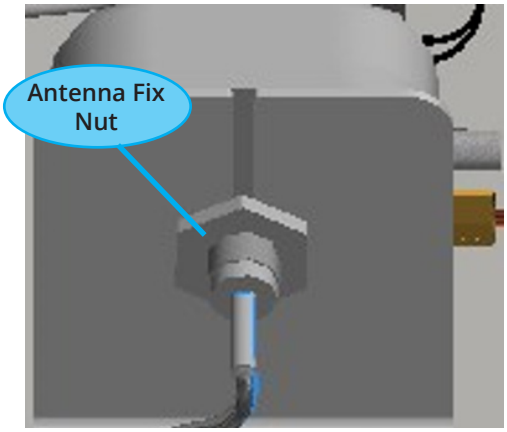
6.15.2 Push the smart box upward to remove the old smart box.

6.15.3 Install the new smart box on the guide rail and connect the smart box power cable, antenna cable and network cable.

6.16 Replace the Smart Box Antenna.

6.16.1 Loosen the antenna cable from the smart box.

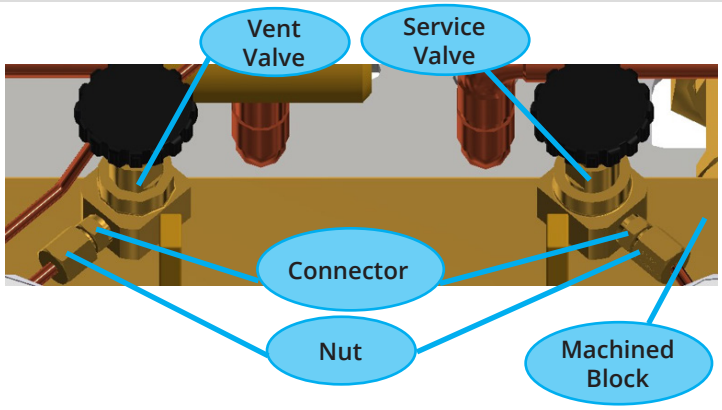
6.16.2 Using a 35 mm wrench, loosen the antenna fix nut.



6.16.3 Replace the old antenna with new one , connect the antenna cable on the smart box.

6.17 Replace the Service Valve and Vent Valve.

⚠ CAUTION! Service valve and vent valve replacement requires total isolation of the manifold. Refer to Section 6.2.



6.17.1 Loosen the nut.

6.17.2 Loosen the connector from the vent valve or service valve.

6.17.3 Using a 21 mm wrench, loosen the vent valve or service valve from the machined block.

6.17.4 Install the new vent valve or service valve, fix the connector and nut.

6.17.5 Rotate the handle of vent valve anti-clockwise to close position, rotate the handle of service valve clockwise to open position.

6.18 Replace the Bank Bleed Valve.

⚠ WARNING! Vent all inlet pressure and outlet pressure to 0 bar prior to replace the bank bleed valve.

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

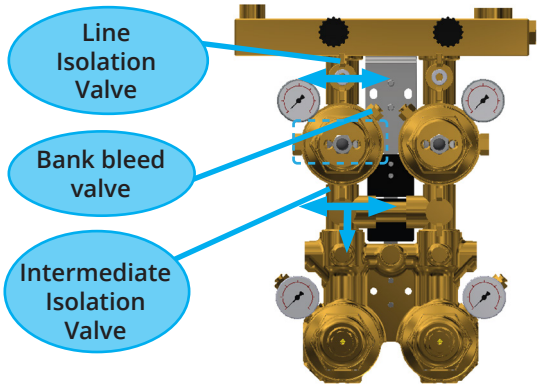
Following procedure describes process to service 2nd stage pressure regulator. If necessary, bank bleed valve service can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

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

6.18.2 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 38 shows example of bank bleed valve on the left 2nd stage regulator maintenance, mirror to opposite side for working on the right bank.

Figure 38 - Isolating the Left 2nd Stage Regulator.

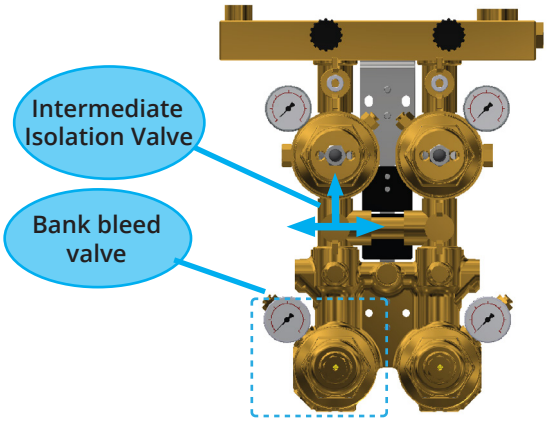


6.18.3 Depressurized the gas pressure inside the 2nd stage regulator by pressing the bank bleed valve, if the bank bleed valve can not work, then slowly loosen the valve screw, when there is gas vented, stop rotate the wrench, after all gas vented, then totally loose the screw.

6.18.4 Replace the bank bleed valve on 2nd stage regulator.

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

NOTE - Below figure shows example of bank bleed valve on the left 1st stage regulator maintenance, mirror to opposite side for working on the right bank.



6.18.6 Rotate the ball valve handle on side after the 1st stage pressure regulator to isolate the 1st stage pressure regulator as shown in Figure 37.

6.18.7 Depressurized the gas pressure inside the 1st stage regulator by pressing the bank bleed valve, if the bank bleed valve can not work, then slowly loose the valve screw, when there is gas vented, stop rotate the wrench, after all gas vented, then totally loosen the screw.

6.18.8 Replace the bank bleed valve on 1st stage regulator.

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

6.19.1 Ensure all cylinder valves are open.

6.19.2 Ensure both line isolation valves and intermediate isolation valves are open. Refer to Figure 47.

6.19.3 If required, purge the manifold from the vent valve point by completing the following steps:

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

6.19.3.2 Open the vent valve, apply a flow to the vent valve to purge the left side of the manifold. Close the vent valve (Item 6, Figure 1).

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

6.19.3.4 Open the vent valve, apply a flow to the vent valve to purge the right side of the manifold. Close the vent valve (Item 6, Figure 1).

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

6.19.4 Ensure that full gas cylinder pressure is shown on the operating screen and backup 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 14 in Section 2.5, if setup changes are required.

6.19.5 Check that the pipeline distribution pressure displayed on the screen and back up gauge is typically as per Table 5 in Section 4, Principle of Operation . Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

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.

6.19.6 Open the lockable isolation ball valve (Item 8, Figure 1) to return the gas supply back to the medical gas distribution system. Refer to Figure 47.

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

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

6.20.1 Ensure all cylinder valves are open. Refer to Figure 47.

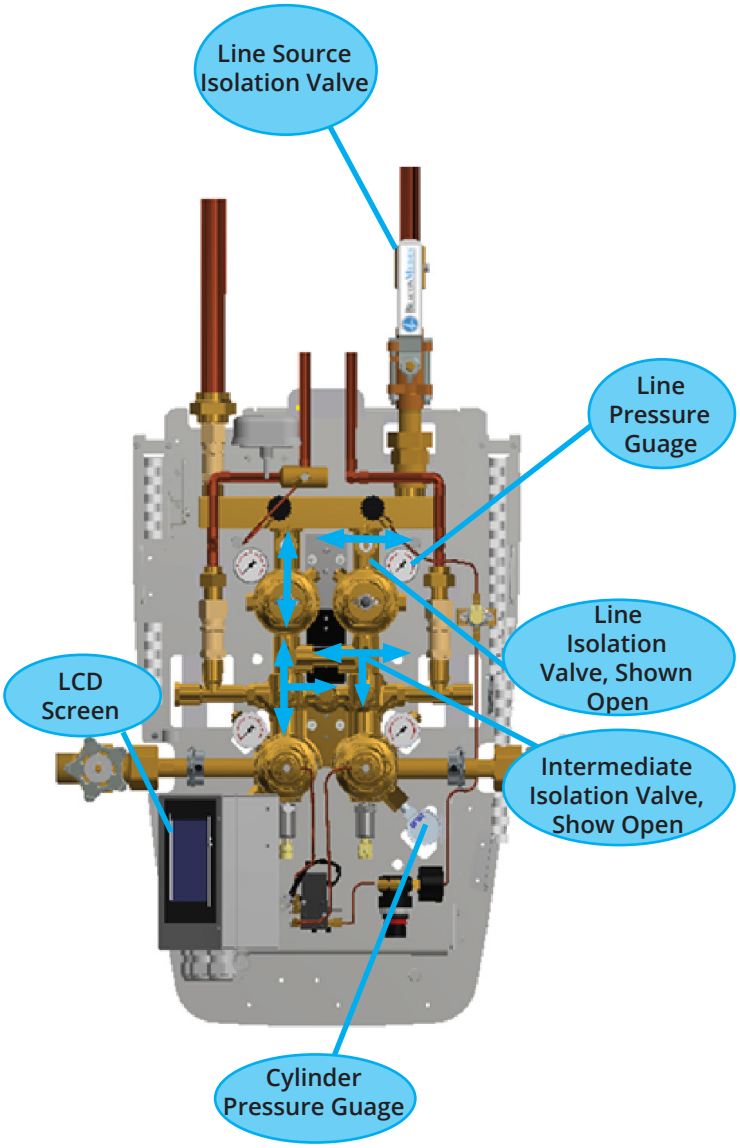
6.20.2 Ensure both intermediate and line isolation valves are open. Refer to Figure 47.

6.20.3 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 14 in Section 2.5 if setup changes are required. Refer to Figure 47.

6.20.4 Check that the pipeline distribution pressure displayed on the screen and back up gauge is typically as per Table 5 in Section 4, Principle of operation . Adjust as necessary. See procedure for line pressure adjustment in Section 4.5.

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

Figure 47 - Returning the Manifold Back in Use.



6.21 Replace the Controller.

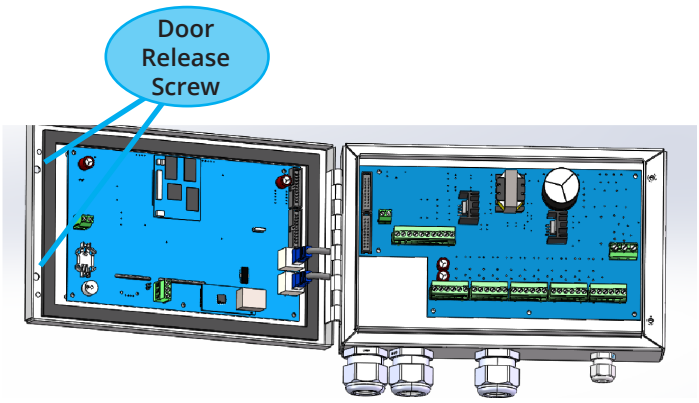
Controller kit number, see Table 11, Chapter 7.

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

NOTE - The new controller is delivered with the factory settings.

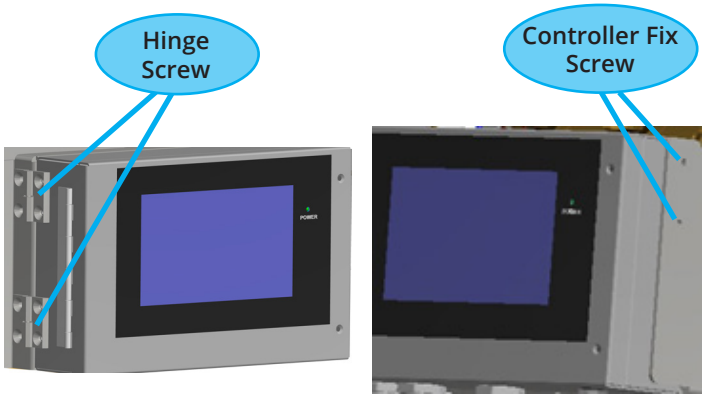
6.21.1 Isolate the power supply to the manifold controls. Left bank will supply the gas.

6.21.2 Loosen the screws on the side of the controller to open the door, as shown in figure below.



6.21.3 Disconnect the sensor cables, solenoid valve cable and power cable from power PCB (Item 24, Figure 1). Refer to Figure 8.

6.21.4 Release the upper four hinge screws and the two controller fix screws, as shown in figure below.



6.21.5 Replace the new controller, connect the cable to the controller. Refer to Figure 2b.

6.21.6 Fix the hinge screws and controller fix screws.

6.21.7 Finish the settings. Refer to Sections 2.5 and 3.4.

6.21.8 Recover the manifold to normal status. Refer to Sections 6.19 and 6.20.

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 11 for available spare part kit numbers

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

Table 11: Service and Spare Part Kits.

Kit number	Description
4109150491	Intermediate Relief Valve Kit
4109150492	Line Pressure Relief Valve Kit-75 psi
4109150493	Line Pressure Relief Valve Kit-150 psi
4109150494	Line Pressure Relief Valve Kit-250 psi
4109150499	1st Stage Regulator Kit
4109150500	2nd Stage Regulator Kit
4109150508	Screen Inlet Filter Kit
4109150490	Controller Kit
4109150495	Line Pressure Gauge Kit
4109150496	Intermediate Pressure Gauge Kit
4109150497	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 4109992248.

Appendix: Symbols			
	Date of manufacture		Manufacturer
	Caution		Serial number
	Temperature limitation		Consult instructions for use or consult electronic instructions for use
	Atmospheric pressure limitation		Humidity limitation

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