pneumatech
medical gas solutions

HTM2022 Manual Changeover and Emergency Supply Manifold

Installation, Operation and Maintenance Manual

CE
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Published by Pneumatech Medical Gas Solutions

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Product Part Number
Lot/ Batch Number
Approximate date of purchase
Apparent fault.

Issue Record

Issue No.	Reason for Change	Pages affected	Date
Rev. 01	Rebranding	All	October 2015

Introduction

This manual contains information needed to install, operate and maintain the Pneumatech Medical Gas Solutions (Pneumatech MGS) Manual Changeover and Emergency Supply Manifold.

The contents of this manual are intended to be read and used by suitably qualified personnel.

WARNINGS, CAUTIONS and NOTES

The following Warnings, Cautions, and Notes must be read and understood before using the Manual Changeover and Emergency Supply Manifold.

Warnings!

Warnings tell you about dangerous conditions that could lead to death or serious injury to the user that can occur if you do not obey all of the instructions in this manual.

1. **WARNING! Read through this entire instruction manual before using or showing others how to use this equipment. As with all medical equipment, attempting to use this device without a thorough understanding of its operation may result in patient or user injury.**
2. **WARNING! Do not attempt to modify this device in any way not strictly described within this manual.**
3. **WARNING! Manual Changeover and Emergency Supply Manifold must be protected from access by unauthorized personnel.**
4. **WARNING! No attempt should be made to use this product with a gas service or at a pressure other than as identified.**
5. **WARNING! Do not use this product if it appears damaged in any way.**
6. **WARNING! Do not use this product if there is evidence of contamination internally or on any of gas wetted connections (e.g. debris, particles, oil, lubricants or grease). This equipment should only be installed, commissioned, operated and maintained by technicians who are suitably trained with medical gas systems, such as Competent or Authorised Persons as defined in UK Department of Health Technical Memorandum No. 02-01 (HTM 02-01).**
7. **WARNING! Before loosening any pneumatic connection, ensure that the pressure has been isolated.**
8. **WARNING! Inspect the manifold regularly to confirm the correct pressure is being delivered and that the pressure regulator set points have not drifted. These checks must be performed after each cylinder change and/or at regular intervals where the manifold is an emergency reserve/standby supply source.**
9. **WARNING! Before carrying out maintenance work on the HTM02-01 Manual Changeover Manifold the reserve manifold, when fitted, should be brought on line: refer to the Maintenance section of this manual.**
10. **WARNING! Risk of fire or explosion: Do not lubricate this product with oil or grease. Safe and compatible lubricants can be obtained from Pneumatech Medical Gas Solutions if required.**
11. **WARNING! Do not, under any circumstances, attempt to prove the safety relief valve in-situ by adjusting the regulators.**
12. **WARNING! Always open gas cylinder valves *VERY SLOWLY* to prevent damage to pressure regulators, pressure sensors and valves.**
13. **WARNING! Never apply external sources of heat directly to cylinders to increase the vapour withdrawal rate. Cylinders must never be exposed to temperatures greater**

than 52°C or lower if specified by the cylinder manufacturer. Consult the cylinder manufacturer's instructions for use. If in doubt seek professional advice.

Cautions!

Cautions tell you about dangerous conditions that can occur and cause damage to the equipment if you do not obey all of the instructions in this manual.

1. **CAUTION! Use of sub-standard or inappropriate parts and materials may damage the Manifold System and invalidate the warranty. Only use genuine Pneumatech Medical Gas Solutions spare parts.**
2. **CAUTION! Any work involving alteration, extension or maintenance work to an existing system should be subject to the 'Permit to Work' procedure detailed in HTM 02-01.**
3. **CAUTION! System Capacity: HTM 02-01 recommends that each bank of the manifold should contain enough gas to supply the system for two days. Additional cylinders should be held in the gas store to facilitate one complete bank change. For O2/ N2O mixture, retain sufficient cylinders to change two banks.**
4. **CAUTION! Liquefied Gas: When the cylinders contain liquefied gas, such as nitrous oxide, extra care should be taken. Full pressure is not an indication of cylinder contents.**
5. **CAUTION! Do not assume that a cylinder of liquefied gas is full when the gauge shows full pressure.**
6. **CAUTION! Always open valves slowly.**
7. **CAUTION! Be careful not to over-torque face seal fittings.**
8. **CAUTION! Only use leak detection fluids that are compatible with the materials being tested.**
9. **CAUTION! Always wash leak detection fluids off with clean water immediately after use.**

Notes:

All information, specifications and illustrations within this manual are those in effect at the time of printing.

The manufacturer reserves the right to change or make improvements without notice and without incurring any obligation to make changes or add improvements to products previously provided.

If a bank of cylinders is left for a period of time without any flow being drawn through the pressure regulator, gas permeation or minor seat leak may cause the downstream pressure to rise or fall.

Regularly check the pressure downstream of each regulator, and vent a small amount of gas downstream of the pressure regulator to bring the outlet pressure back to the normal level if required.

Abbreviations used

The following abbreviations are used in this manual:

Abbreviation	Full name
MGS	Medical Gas Solutions
ESM	Emergency Supply Manifold
kPA	Kilopascal
NRV	Non return Valve
IPX0	Not protected against water ingress
HTM	Health Technical Memorandum
RH	Relative Humidity
BSP	British Standard Pipe

Scope of this manual

This manual describes the Operation Service, Repair and Testing of the Pneumatech MGS Manual Changeover and HTM 2022 Emergency Supply Manifold (ESM).

Pneumatech Medical Gas Solutions service contact

In the event of any queries or problems that cannot be resolved using information in this manual, please call:

+44 (0) 1235 463051

Quote if possible, the:

- Product part number
- Lot/ Batch number
- Approximate date of purchase
- Apparent fault

Contents

Storage and Handling

All products are separately packaged and stored in under controlled conditions.

Identification

The Pneumatech MGS Manual Changeover and HTM 2022 Emergency Supply Manifold (ESM) are identified by the machine number, printed onto a label fixed to the mounting panel/ bracket respectively.

Environmental Conditions

Manual Changeover and Emergency Supply Manifold can be safely handled and stored under normal working and environmental conditions. Adverse environmental conditions and harsh abrasives or chemicals may cause damage to the unit.

1 Description

1.1 Features

- Available to suit 400 kPa or 700 kPa systems.
- Non-return valves are located in the manifold headers at each cylinder location.
- Particle filter on the inlet to the regulator.
- Includes gauges to monitor cylinder contents and outgoing pressure.
- Manual changeover components mounted on one common back-plate for ease and speed of installation.
- Heavy duty steel headers and back-plates offer protection against damage from the cylinders.

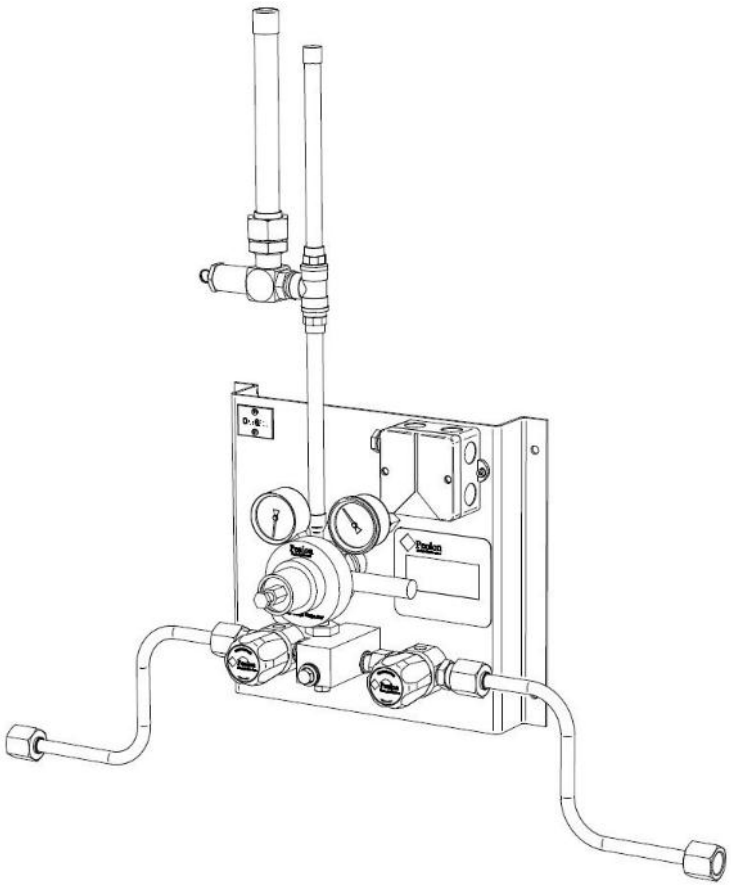


Figure 1-1 Manual Changeover Manifold

1.2 Manual Changeover Manifold

1. The Pneumatech MGS Manual Changeover Manifold consists of a central regulator panel flanked by two cylinder headers complete with cylinder tailpipes. Gas cylinders are attached to each side. The Duty bank is manually selected by opening a valve on the central panel. This manifold arrangement can be used as a reserve or backup gas supply, usually to a high demand system i.e. an automatic changeover manifold.

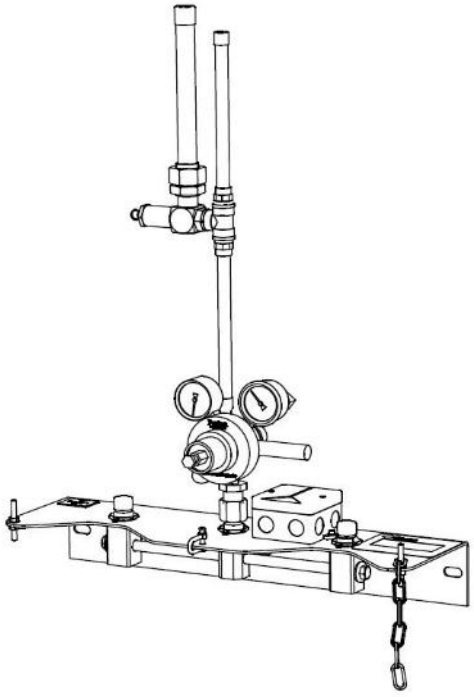


Figure 1-2 Emergency Supply Manifold

1.3 Emergency Supply Manifold

The Pneumatech MGS Emergency Supply Manifold is a two cylinder header and regulator, typically used as an emergency backup to an automatic manifold.
Emergency standby manifolds are supplied with gas specific tailpipes to suit bottle requirements and stub and relief valve assembly.

1.4 Control/ Regulator Assembly

1. The Control panel/ Regulator assembly is located between two gas-specific header racks, equipped with gas specific tailpipes to suit gas bottle requirements.
2. The system includes a mano switch pressure gauge to monitor cylinder pressure, and a line pressure gauge to monitor outgoing pressure.
3. Flow from the cylinder banks on the manual changeover manifold is controlled by the high pressure isolation valves located before the regulator inlet block.
4. This manifold arrangement can be used as a reserve or backup gas supply, usually to an automatic changeover manifold.

1.5 Cylinder Manifold

The cylinder manifold consists of two banks of cylinders supported by steel fabrications with cylinder retaining chains. Each cylinder is connected to a header assembly via a tailpipe. The tailpipes have gas specific connectors at each end to prevent the inadvertent connection of the wrong gas type to the manifold. There is a non-return valve at the point where each tailpipe connects to the header assembly. This prevents loss of gas from the manifold when a gas cylinder is disconnected.

1.6 System Capacity

The size of the manifold (number of gas cylinders) is dependent on gas usage and the frequency of cylinder deliveries.

1.7 Liquefied Gases

Nitrous oxide and carbon dioxide are stored in cylinders as liquid under pressure. In these cases the latent heat of vaporisation limits the flow of gas from a cylinder, which is in turn limited by the convective heat transfer into the liquid from the cylinder wall. Where frosting on the outside of cylinders is apparent, it may be necessary to install additional cylinder capacity or add heaters within the manifold room to raise the ambient temperature and increase heat transfer through the cylinder wall.
Flow rates obtained from cylinders containing liquefied gases will be significantly lower than flow rates from cylinders of similar size containing compressed gases. Any ice formation will insulate the equipment, lowering the heat transfer to the liquid in the cylinder and the downstream gas. As a rule of thumb each cylinder should supply not more than 10% of its contents per hour.

Continued withdrawal of high flow rates from liquefied gas cylinders will lead to a loss of vapour pressure within the cylinder, initiating a changeover of the manifold to the Standby bank. In this case, the original duty bank pressure eventually recover after changeover as the liquid warms and the vapour pressure increases - the cylinders will not be full. The only way to determine the remaining contents in a partly used cylinder is to weigh it and subtract the empty cylinder weight to give the net mass of liquid remaining.

To increase the sustainable flow that the system can deliver the following methods can be used. Non-heated flow-enhancing options should be evaluated as a first preference:
Increase the cylinder size e.g. exchange G size cylinders for J size, which provides a greater surface area for heat transfer.
Increase the number of cylinders. This also provides a greater surface area for heat transfer.
Provide indirect heating to the cylinders e.g. by installing thermostatically controlled heaters within the manifold room. This increases the rate of convective heat transfer into the liquid from the atmosphere surrounding the cylinder.

WARNING! Never apply external sources of heat directly to cylinders to increase the vapour withdrawal rate. Cylinders must never be exposed to temperatures greater than 52°C or lower if specified by the cylinder manufacturer. Consult the cylinder manufacturer's instructions for use. If in doubt seek professional advice.

1.8 Manifolds for O2/N2O 50%/50% Service

Pre-mixed analgesic gas contains 50% nitrous oxide by volume. Nitrous oxide has a high Joules-Thomson coefficient, meaning that when the gas is expanded i.e. reduced in pressure, there is a large increase in enthalpy to maintain a constant temperature. High flows of gas require a large amount of heat input – much higher than can be easily transferred to the gas from the ambient air through the manifold components. Upon expansion of the gas through a pressure regulator the gas will absorb a lot of heat, cooling the pressure regulator significantly. It is common practice to install heaters adjacent to pressure regulators in order to increase the gas temperature and prevent freezing. Whilst ice formation externally is no cause for concern, ice formation inside the bonnet of a pressure regulator may prevent free movement of the bias spring and prevent correct operation of the system.

2 Technical Specification

Table 4-1 Technical Specifications

HTM 2022 Emergency Reserve Manifold 2x1 / 2x2		
Physical Characteristics:		
Height	720 mm / 720 mm	
Width	540 mm / 1500 mm	
Depth	180 mm / 180 mm	
Weight	10 kg / 20kg	
Environmental Transport, Storage and Operating Conditions:		
Temperature	10 to 40 °C	
Humidity	10 to 95 % R.H. Non-condensing	
Air Pressure	70 to 110 kPa	
Performance:	4 bar System	7 bar System
Volumetric Flow Rate*	350 l/min	500 l/min
Maximum Inlet Pressure	230 bar	
Regulatory Classification:		
GMDN Code (Term)	36271 (Medical gas and vacuum supply systems)	
EC MDD Classification	Class IIb	
GHTF Classification	Class C	

Manual Manifold 500l/min & 1500l/min		
Physical Characteristics:		
Height	780 mm	
Width	800 mm	
Depth	225 mm	
Weight	22 kg	
Performance:	4 bar System	7 bar System
Volumetric Flow Rate*	350 / 500 l/min	500 / 750 l/min
Full Cylinder Flow Rate**	500 / 1250 l/min	500 / 1500 l/min
Maximum Inlet Pressure	230 bar	
Regulatory Classification:		
GMDN Code (Term)	36271 (Medical gas and vacuum supply systems)	
EC MDD Classification	Class IIb	
GHTF Classification	Class C	

*Based on dry air with a 10% droop from static set pressure as per EN ISO 10524-2. For other gases a correction factor should be applied as shown in the table below.
**Based on Pneumatech MGS Factory Test.

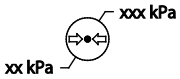
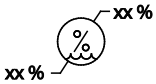
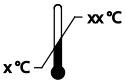
Gas Correction Factors

Gas/Gas Mixture	O_2	N_2O	O_2/N_2O 50%/50%	Air	N_2	CO_2
Correction Factor	0.95	0.81	0.88	1	1.02	0.81

3 User Responsibility

This device has been built to conform to the specification and operating procedures stated in this manual and/ or accompanying labels and notices when checked, operated, maintained and serviced in accordance with these instructions.
To ensure the safety of this device, it must be checked and serviced to at least the minimum standards laid out in this manual. A defective or suspected defective product must **not** be used under any circumstances.
The user must accept responsibility for any malfunction which results from non-compliance with the servicing requirements detailed in this manual. Additionally, the user must accept responsibility for any malfunction which may result from misuse of any kind, or non-compliance with other requirements detailed in this manual.
Worn, broken, distorted, contaminated or missing components must be replaced immediately. Should such a repair be necessary, it is recommended that a request for service advice be made to the nearest Pneumatech Medical Gas Solutions Service Centre.
This device and any of its constituent parts must be repaired only in accordance with written instructions issued by Pneumatech Medical Gas Solutions and must not be altered or modified in any way without the written approval or Pneumatech Medical Gas Solutions.
The user of this equipment shall have the sole responsibility for any malfunction which results from improper use, maintenance, repair, damage or alteration by anyone other than Pneumatech Medical Gas Solutions or their appointed agents.

4 Description of Symbols

WARNING!	Indicates a potentially hazardous situation which, if not avoided, could result in personal injury to the user or others
CAUTION!	Indicates a potentially hazardous situation which, if not avoided, could result in damage to the device or property
Note:	Emphasises points to achieve more convenient or efficient use of the device
	Ambient pressure range
	Ambient humidity range
	Ambient temperature range
	Consult accompanying documents

5 Technical Information

5.1 Performance

All Pneumatech MGS Manual Changeover and Emergency Supply Manifolds are designed to operate at a maximum pressure of 230 bar (23000 kPa).

High pressure medical gas from the cylinders passes along the headers and is reduced to the gas specific working pressure of 400 or 700 kPa by regulators mounted on the central panel.
For added safety, all manifold systems are provided with a pressure relief valve.

5.2 Capacity

The size of the manifold, and number of gas cylinders, will be dependent on gas usage and the frequency of cylinder deliveries. HTM 02-01 recommends that each half of the manifold system, bank of cylinders, should contain enough gas to supply the system for two days and those additional cylinders should be stored in a spare rack.

5.3 External Services

A 220-240 v a.c., 50/ 60 Hz, 3.0 A electrical supply is required if a monitoring system is specified.

6 Installation

WARNING! Keep all control panel and manifold unit components dry and clean during installation.

6.1 Components

Unpack and inspect all components, ensuring that the all the following have been supplied:

Manual Manifold:

- Manual Control Panel – Includes First Fix Plate
- Duplex Header Assemblies
- L/H and R/H header to control panel connection pipes
- 15 mm Isolation/ Line Valve kit
- 15 mm Stub Pipe and 22 mm Relief Valve Kit

2x1 / 2x2 ESM:

- ESM Header Assembly – Includes First Fix Plate
- 15 mm Isolation/ Line Valve kit
- 15 mm Stub Pipe and 22 mm Relief Valve Kit

6.2 Manual Control Panel Installation

Using 8 mm anchor bolts, or equivalent, secure the first fix plate to the wall (see *Figure 6-1*).
The first fix plate should be mounted centrally between the racks. Once the control panel is secure connect the pre-assembled 15 mm Stub Pipe and 22 mm Relief Valve Kit to the regulator.

6.3 ESM Header Installation

Using 10 mm anchor bolts, or equivalent, secure the ESM to the wall (see *Figure 6-2*). Once the ESM Header is secure connect the pre-assembled 15 mm Stub Pipe and 22 mm Relief Valve Kit to the regulator.

6.4 Header Rack Installation

Using 10 mm anchor bolts, or equivalent, secure the header assemblies to the wall (see *Figure 6-4*). Ensure that the end block with the male adaptor is facing towards the control panel/ ESM. Install the header to control panel interconnecting pipes/ ESM.

When the header racks are securely fastened to the wall, fit the tailpipes to the bosses on the headers making sure to brace the nipple to prevent the pipe from being twisted.

6.5 Pipework Connections

Solder the service and the relief valve pipework to the service and relief valve stubs.

WARNING! Line pressure relief valve connections for gases other than air should be safely piped to atmosphere outside the manifold room.

6.6 Alarm Connections

The Junction Box houses the pre-wired terminal block configuration, mounted on the Manual Manifold Control Panel / ESM Header, and is used for connection to the automatic manifold.
See *Figure 7-1 for* connection details.

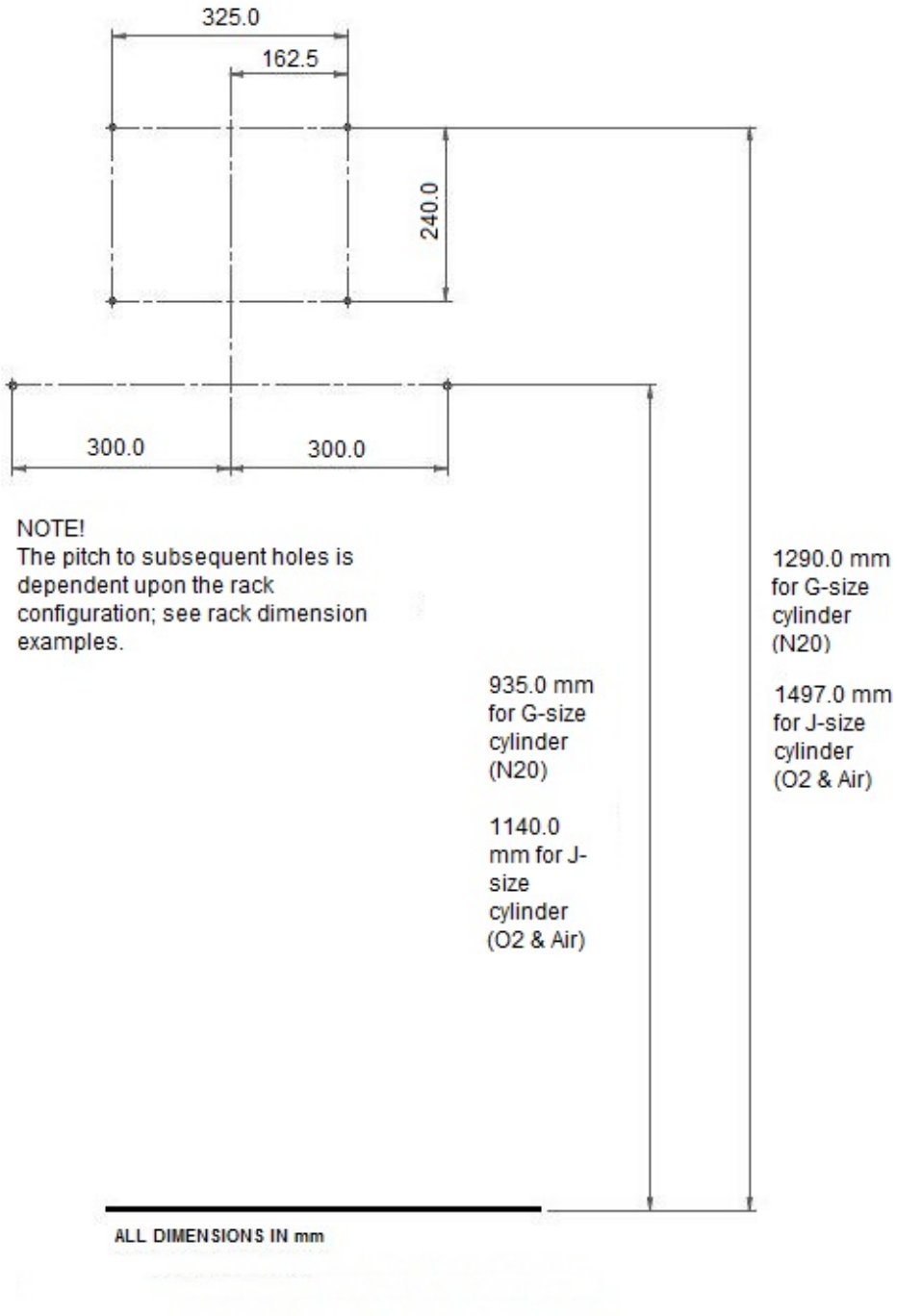


Figure 6-1 Manual Installation Details

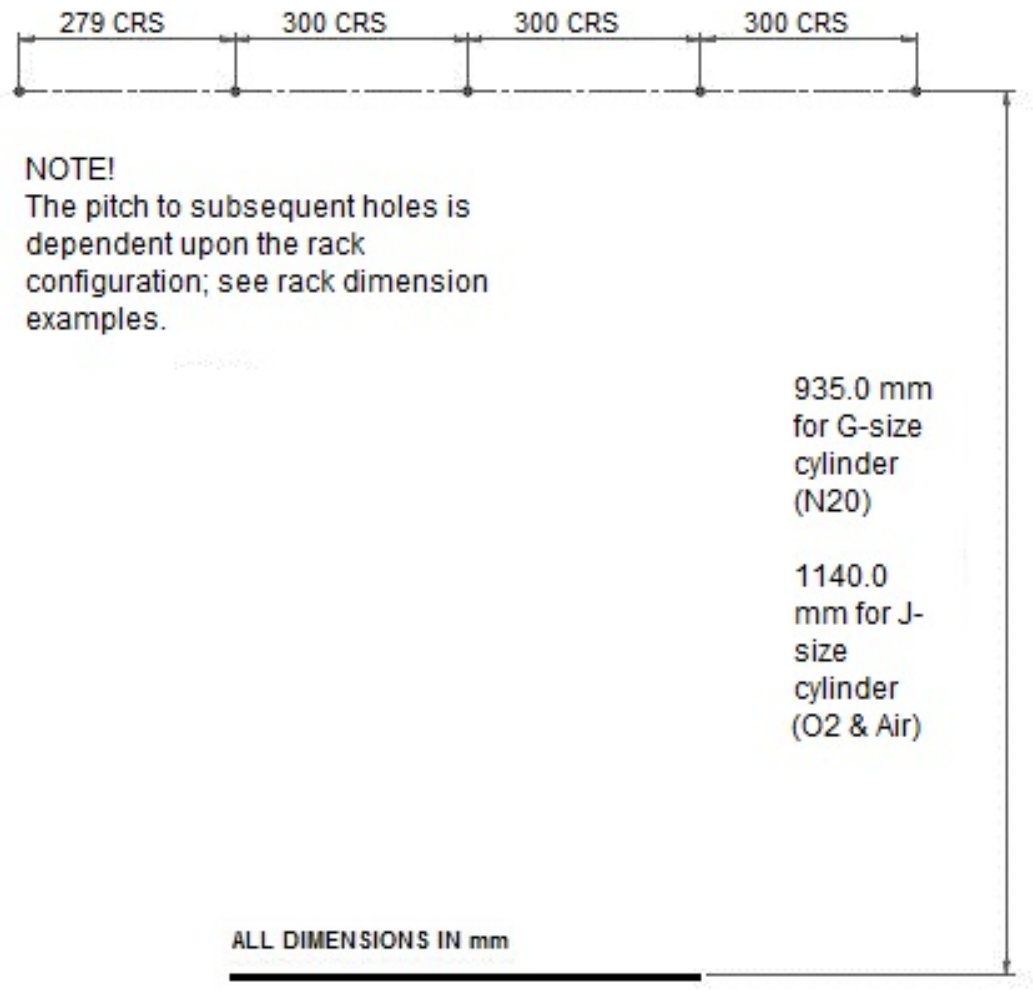


Figure 6-2 Emergency Supply Manifold Installation Details 2 x 2

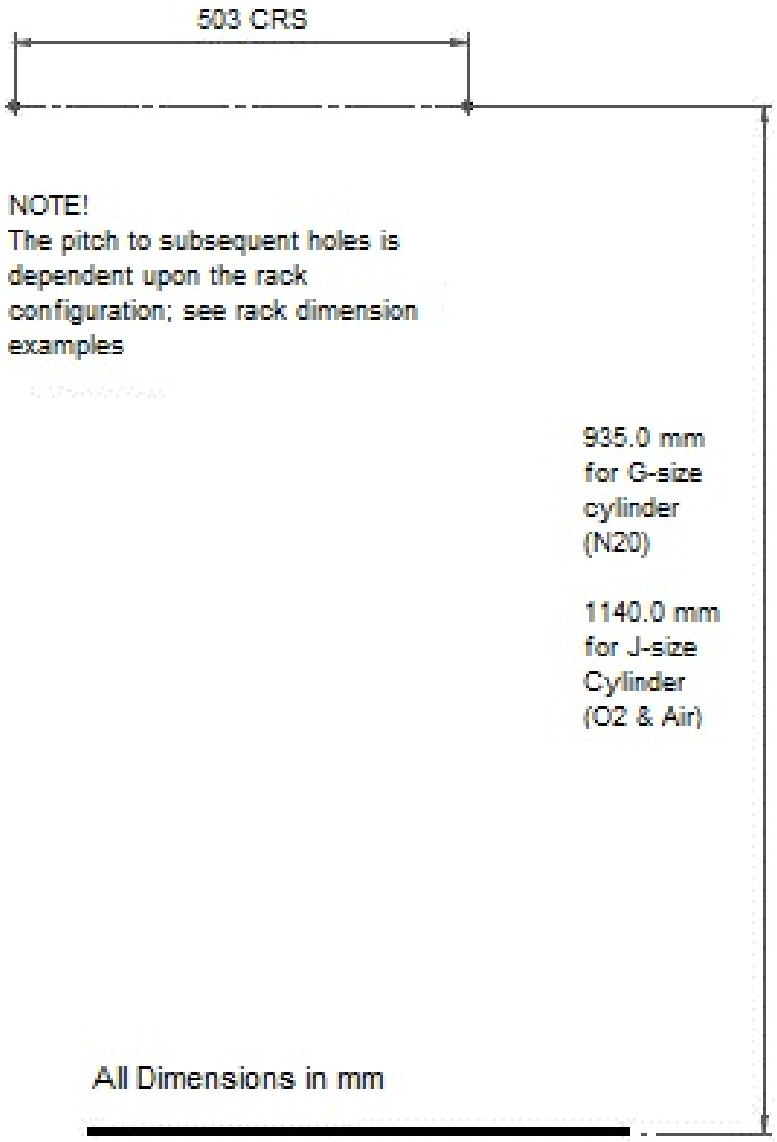


Figure 6-3 Emergency Supply Manifold Installation Details 2 x 1

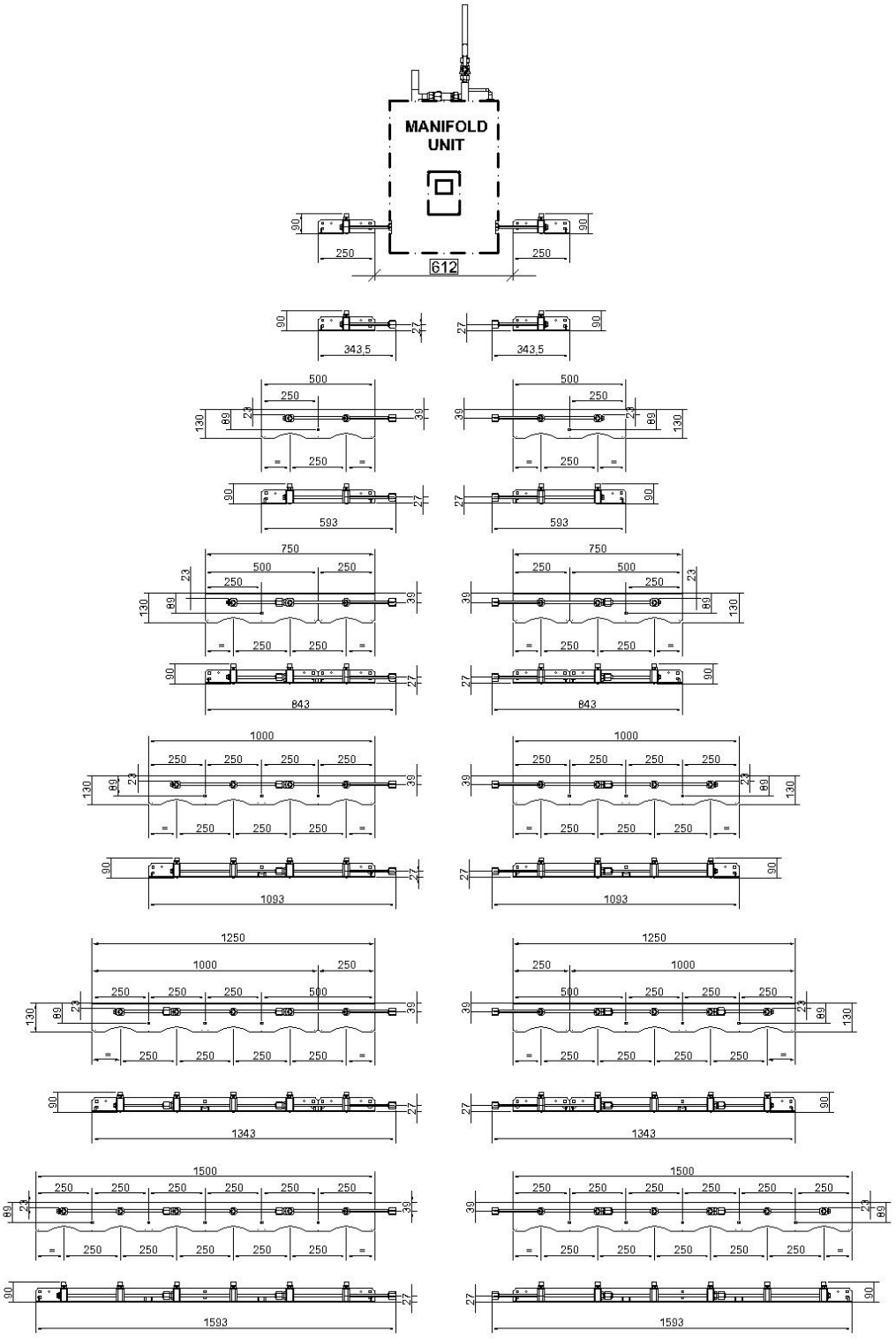


Figure 6-4 Header Rack Interconnection Dimensions

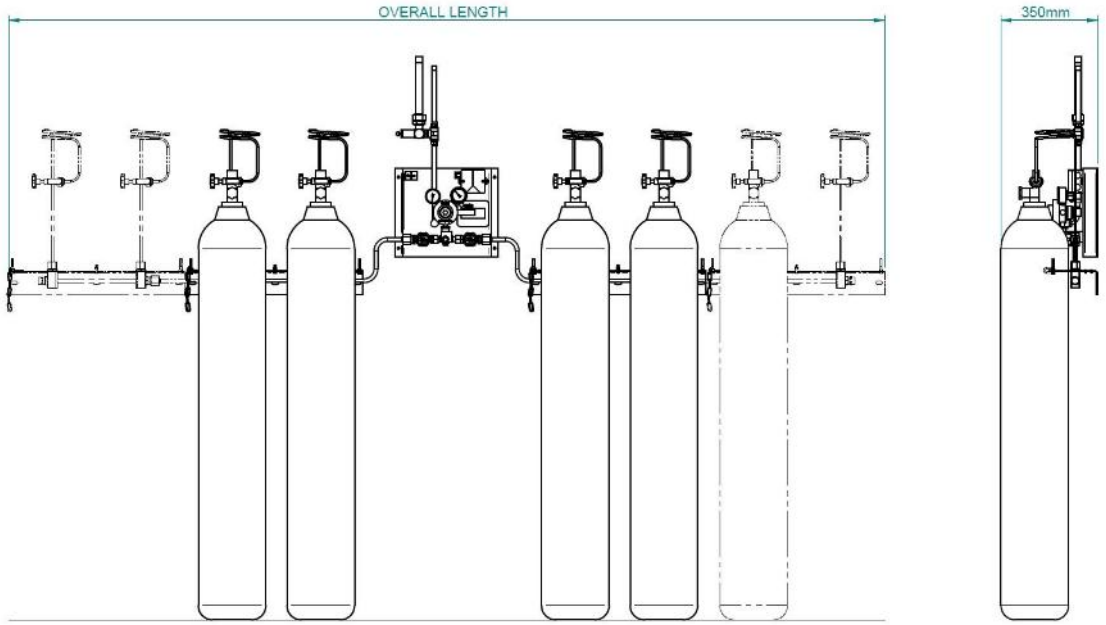


Figure 6-5 Manual Changeover Manifold Installation Details

Table 6-2 Manual Changeover Manifold Cylinder Lengths

Number of Cylinders	Overall Length
2 x 1	1156 mm
2 x 2	1756 mm
2 x 3	2356 mm
2 x 4	2964 mm
2 x 5	3564 mm
2 x 6	4164 mm

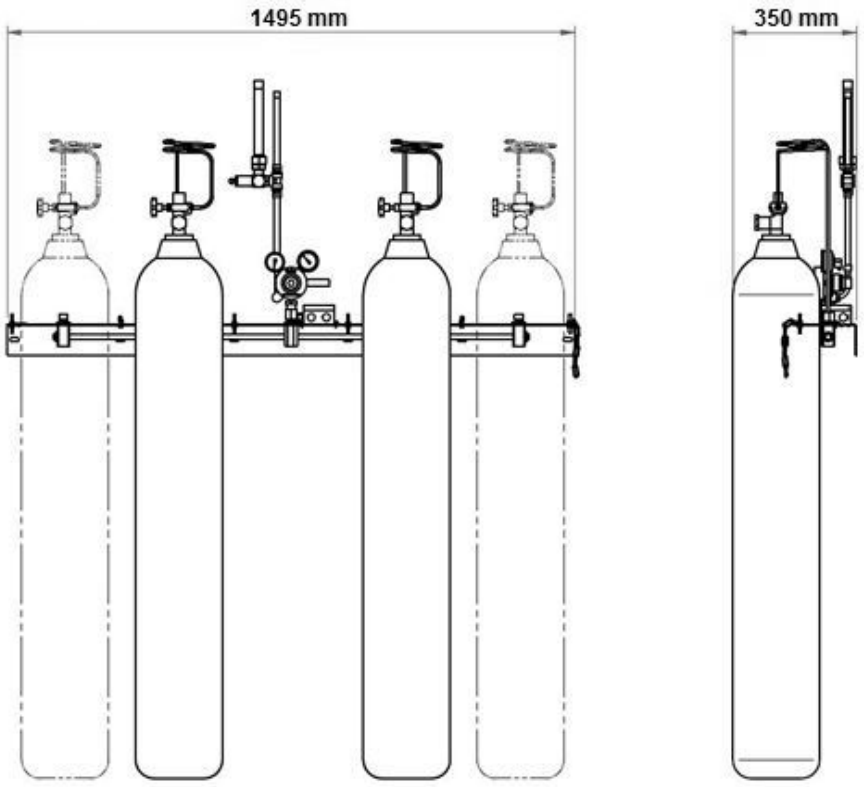


Figure 6-6 Emergency Supply Manifold Installation Details 2 x 2

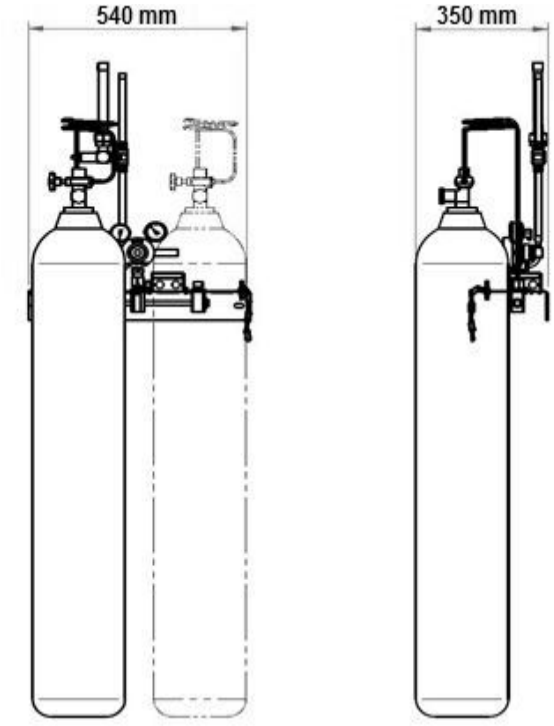


Figure 6-7 Emergency Standby Manifold Installation Details 2 x 1

7 Schematics

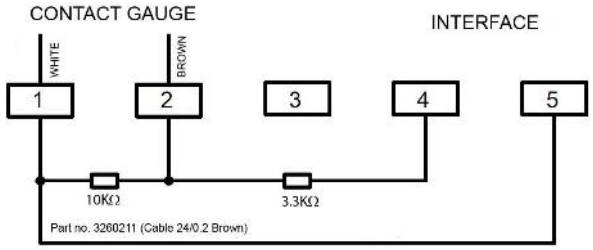


Figure 7-1 Terminal Block – Alarm Schematic

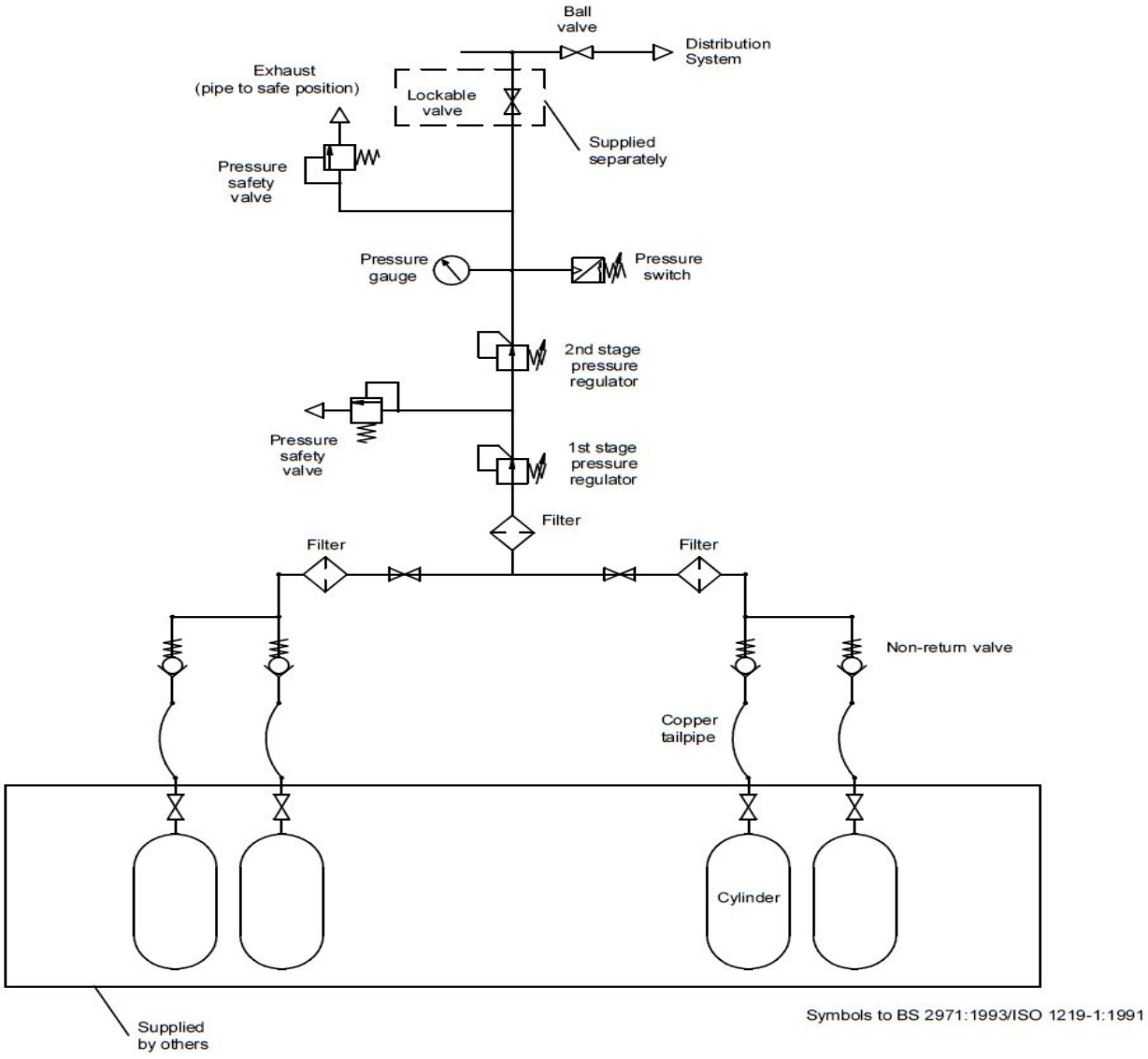


Figure 7-2 Manual Manifold Piping and Instrumentation Diagram

8 Commissioning

8.1 Introduction

Commissioning of the manifold must be carried out in full:

- after initial installation
- after a major component change, and
- as part of a planned preventative maintenance programme.

The objective of commissioning is to ensure that all components are serviceable, pressure switches operate at the correct settings and that all alarm functions operate satisfactorily. Personnel carrying out the following commissioning procedure must be qualified and fully conversant with the information contained in this manual.

WARNING! Before commencing the commissioning procedure, ensure that:

- **The manifold and control panel components are securely mounted.**
- **All tailpipes are connected to the cylinders and headers on both banks.**
- **The control panel is isolated from the distribution pipeline with the downstream valve.**

8.2 Proving the Control Panel

WARNING! Always open gas cylinder valves *VERY SLOWLY* to prevent damage to pressure regulators, pressure sensors and valves.

1. Normally, one bank of cylinders should be 'On stream' with the second bank as 'Standby'.
2. The pressure switches monitor both banks of cylinders when the manifold system is unmanned.
3. The pressure switches are set to 68 bar (14 bar for Nitrous Oxide), to allow remote indication of 50% plus capacity.
4. Pressure switches must be wired in series. An open circuit will occur if either indicates low pressure.

8.3 Testing the Manifold System

8.3.1 Testing - General

Pneumatech MGS Manual Changeover and Emergency Supply Manifolds are subjected to a series of tests in accordance with British Standards and CE regulations, including visual inspections and pressure tests on the assemblies, which include the following:

8.3.2 Manifold Header Racks

1. Apply pressure to the header and observe that all headers incorporate a renewable non-return valve.
2. Check all the joints and unions; ensure there are no leaks.
3. Check that the gas specific thread sizes are correct:

Nitrous Oxide	M18 x 2
Oxygen	M20 x 2
Medical Air	M24 x 2
Oxygen 50%/ Nitrous Oxide 50%	M22 x 2
Carbon Dioxide	3/8 in. BSP RH
Nitrogen	M14 x 2

4. The Identification labels correspond with the gas index.

8.3.3 Manual Changeover Manifold System

1. Apply test pressure to the manifold, ensure there are no leaks.
2. Release the pressure slowly and check the contact gauge signals are at the correct pressure:
   68 bar for Oxygen and Air

14 bar for Nitrous Oxide.

3. Increase the outlet, line pressure and check the relief valve relieves at the correct pressure:
   5.5 bar for Oxygen, Nitrous Oxide, Oxygen/Nitrous Oxide 50%/50%, Air 4 bar and Carbon Dioxide
   11 bar for Air 7 bar
4. Inspect the unit for general finish, labels, and gas specificy.

8.3.4 Emergency Standby Manifold System

Perform the test procedure as per *paragraph. 8.3.3*.

9 Operating Instructions

9.1 Manual Manifold

The manual manifold control panel is not automatic and when required, is operated manually.
Whilst not in use (i.e. on Standby) the manual manifold should be kept in the following mode:

1. Both cylinders should be full of gas and connected to the manifold.
2. The isolation valve to the distribution pipeline should be closed.
3. One bank of cylinders should be closed and the other supplying pressure to the regulator.

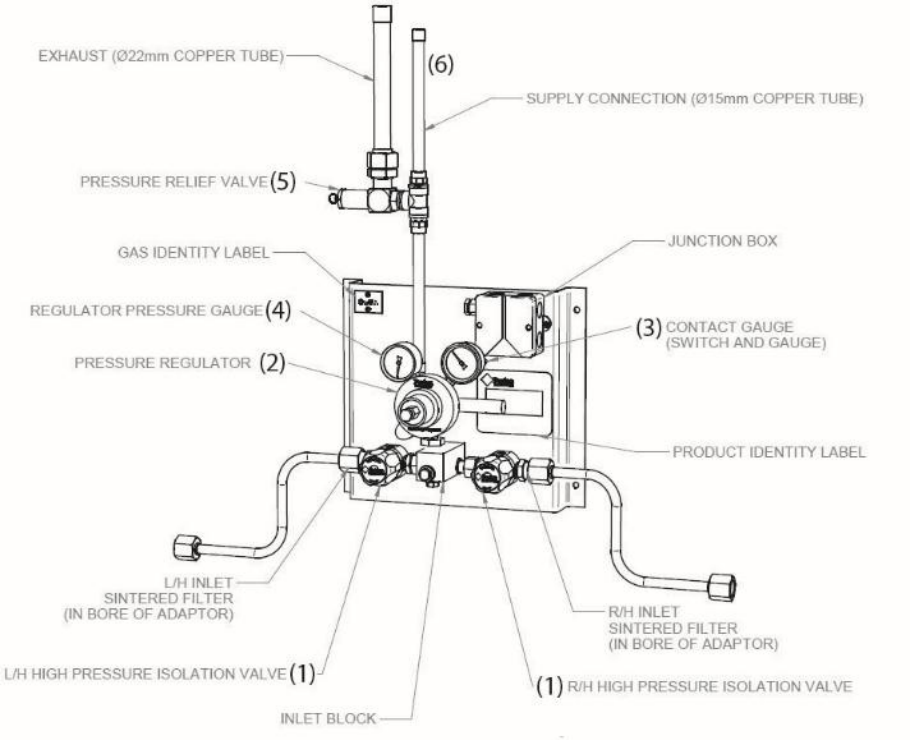


Figure 9-1 Manual Changeover Manifold

9.1.1 Gas Flow

Ref. *Figure 9-1.*
Gas is supplied at full pressure from the left hand or right hand banks of cylinders [selected by operation of the high pressure isolation valves, (**1**)] to the pressure regulator (**2**) which reduces the pressure to the correct level for distribution into the hospital pipeline.
The contact gauge (**3**) indicates the pressure in the cylinder banks.
The regulator pressure gauge (**4**) indicates the reduced pressure delivered from the regulator.
The gas exits into the distribution pipeline (**6**) which is fitted with a pressure relief valve (exhaust) (**5**).
An isolation valve (not shown) is supplied in kit form.

9.1.2 Liquefied Gas

When the cylinders contain liquefied gas, such as Nitrous Oxide, extra care should be taken. Full pressure is not an indication of cylinder contents. Do not assume that a cylinder of liquefied gas is full when the gauge shows full pressure.

9.1.3 Pneumatic Operation

When the situation arises (i.e. in an emergency or for maintenance purposes) and a gas supply is required from the manual manifold, the isolation valve should be opened and then the isolation valve in the supply line from the automatic manifold should be closed so that an uninterrupted gas supply is maintained to the distribution pipeline.

Example: Manifold operating with gas supplied from left hand bank.
The gas from the left-hand bank of cylinders passes through the regulator (**2**) and outlet supply connection tube (**6**)/ isolation valve (supplied in kit form). During normal operation the control panel remains in this condition until the pressure in the left hand bank is depleted.
When the left-hand bank becomes empty, the supply must be manually switched to the right-hand bank of cylinders. The empty cylinders on the left-hand bank must then be replaced with full ones, and the sequence starts again.
When the fault in the main supply has been rectified, the gas supply from the automatic manifold should be reinstated by opening the isolation valve in the main supply line and by closing the isolation valve connected to the reserve manifold. The manual manifold should then be returned to the Standby mode.

9.2 Emergency Supply Manifold

The ESM is not automatic and when required, is operated manually.
Whilst not in use (i.e. on Standby) the ESM should be kept in the following mode:

1. Both cylinders should be full of gas and connected to the manifold.
2. The isolation valve to the distribution pipeline should be closed.
3. One bank of cylinders should be closed and the other supplying pressure to the regulator.

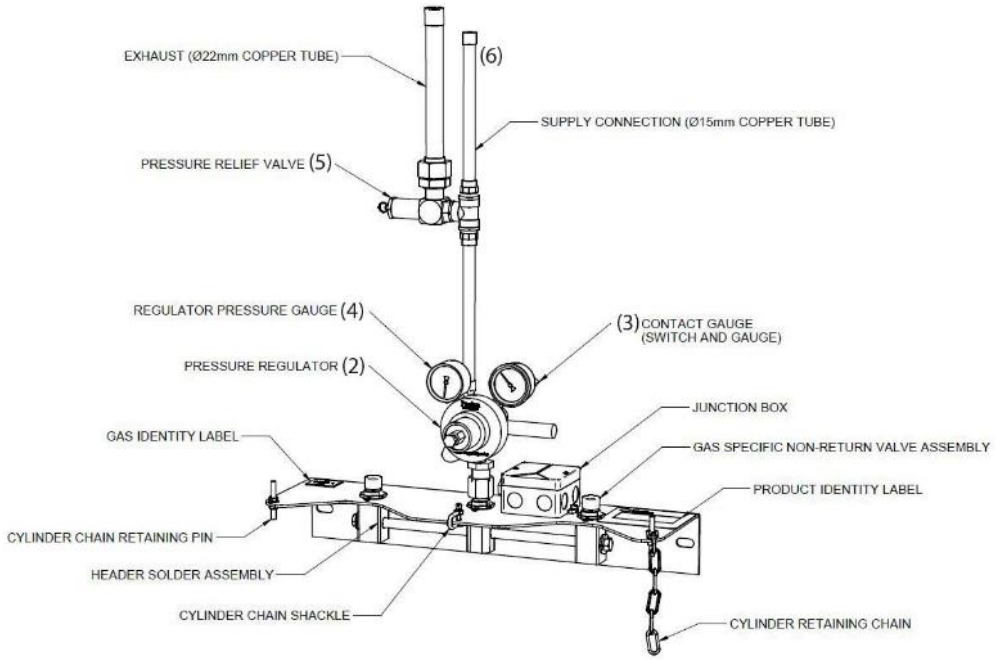


Figure 9-2 Emergency Supply Manifold Layout

9.2.1 Gas Flow

Ref. *Figure 9-2.*
Gas is supplied at full pressure from the left hand or right hand banks of cylinders (selected by opening one bank of cylinders), to the pressure regulator (**2**) which reduces the pressure to the correct level for distribution into the hospital pipeline.
The contact gauge (**3**) indicates the pressure in the cylinder banks.
The regulator pressure gauge (**4**) indicates the reduced pressure delivered from the regulator.
The gas exits into the distribution pipeline (**6**) which is fitted with a pressure relief valve (exhaust) (**5**).
An isolation valve (not shown) is supplied in kit form.

9.2.2 Liquefied Gas

When the cylinders contain liquefied gas such as Nitrous Oxide, extra care should be taken. Full pressure is not an indication of cylinder contents. Do not assume that a cylinder of liquefied gas is full when the gauge shows full pressure.

9.2.3 Pneumatic Operation

When the situation arises (i.e. in an emergency or for maintenance purposes) and a gas supply is required from the ESM, the isolation valve should be opened and then the isolation valve in the supply line from the automatic manifold should be closed so that an uninterrupted gas supply is maintained to the distribution pipeline.

Example: Manifold operating with gas supplied from left hand bank.
The gas from the left-hand bank of cylinders passes through the regulator (**2**) and outlet supply connection tube (**6**)/ isolation valve (supplied in kit form). During normal operation the control panel will remain in this condition until the pressure in the left hand bank is depleted.

When the left-hand bank becomes empty, the cylinder valve on the full cylinder (right hand bank) must be opened and the empty cylinder valve must be closed. The empty cylinders on the left-hand bank must then be replaced with full ones, and the sequence starts again.

When the fault in the main supply has been rectified, the gas supply from the automatic manifold should be reinstated by opening the isolation valve in the main supply line and by closing the isolation valve connected to the reserve manifold. The ESM should then be returned to the Standby mode.

10 Maintenance

Pneumatech MGS manifolds are designed to operate with the minimum of maintenance, however regular routine minor maintenance operations are recommended to prove the system integrity.
Maintenance operations are carried out in accordance with the planned preventative maintenance contract purchased by the customer.
Maintenance engineers must fully understand the manifold control system and must be conversant with the information contained in this manual.

Service and Maintenance of the manifold is limited to periodic checking and adjustment, or replacement if necessary, of components that develop a fault.

WARNINGS!

1. **Use of sub-standard or inappropriate parts and materials may damage the Manifold System and invalidate the warranty. Only use genuine Pneumatech MGS spare parts.**
2. **Isolate the electrical supply before commencing work on any electrical components.**
3. **Oil, grease or jointing compound must not be used on the automatic control panel or manifolds.**
4. **Do not attempt to prove the safety relief valve in-situ by adjusting the regulators.**
5. **Obtain a work permit before commencing any work on medical gas equipment.**

10.1 Tools and equipment

No special tools are required, however all common hand tools used must be clean, completely free of oil and grease and checked for serviceability before commencing maintenance procedures.
All necessary spare parts must be obtained before commencing work.

10.2 Cleaning

The use of abrasive or solvent based cleaning solutions is not recommended.
Cleaning external surfaces - use a damp cloth only. Mild soap solution may be used but detergent/ surfactant solutions are not recommended.

10.3 Routine Inspection, Checks and Maintenance

Minimum requirements for routine inspections, checks and maintenance are given in *Table 10-1* and must be observed in full to ensure continued safe operation of the system.

10.4 Annual inspection

The commissioning procedure detailed in *Section 8.2* should be completed after renewing any functional component and at least annually to prove the system is operating as normal and there are no faults present.

10.5 Maintenance schedule

Manifolds require regular checks to ensure they are not leaking or have become damaged during use. It should be noted that routine maintenance of the units is recommended and should be part of a maintenance programme carried out by a competent person, in accordance with the manufacturer's instructions.

Monthly

1. Visually inspect the manifold.
2. Check the high pressure, cylinder contents gauge.

Annually

1. Arrange to run the system from the manifold to prove the regulators function correctly.
2. Change over the ‘Duty’ and ‘Standby’ bank of cylinders, using the isolating valves adjacent to the regulator.
3. Repeat step **1** for the bank that is now the ‘Duty’ bank.

NOTE: This test should be as brief as possible to avoid unnecessary usage of gas.

Table 10-1 Inspection and Maintenance Schedule

Actions	Commissioning	After Each Cylinder Change	Daily	Weekly	Quarterly	Annually	5 Yearly
Inspection, Checks and Tests:							
Ambient temperature	■				■		
Suitability of location	■						
Adequate room ventilation	■						
Adequate access for maintenance	■				■	■	■
Electrical connection and supply integrity	■					■	■
Delivered Line Pressure	■	■	■	■	■	■	■
Changeover Operation	■				■	■	■
Line Pressure Alarm Settings	■					■	■
Planned Preventative Maintenance:							
Complete Commissioning Procedure						■	■
Test Line Pressure Relief Valve						■	■
Component Replacement							
Inlet sintered Filters (manual only)						■	■
Line pressure Relief Valve							■
Pressure regulator Assembly (including PRV)							■
Tailpipes							■

10.6 Component Replacement and Adjustment

WARNING! If access to mains electrical parts is necessary, ensure that the mains electrical power supply is off and remains isolated during work on the manifold panel.

17. **WARNING! Do not use oil, grease or jointing compound on any components on the control panel or manifolds. Ensure that the mains supply to the control panel is disconnected before commencing work.**

10.7 Regulator Replacement

WARNING! Pressure regulators must not be used in service beyond their indicated replacement date. Pressure regulators are marked with a replacement date. Ensure that regulators are replaced in a timely manner.

10.8 Manifold Maintenance

Regular flexing of tailpipes during replacement of cylinders will cause the tailpipes to harden and eventually fail due to fatigue. The condition of the tailpipes must be checked regularly and they must be replaced if damaged or work hardened and in all cases after 5 years of service.

Check all joints for leaks and replace seals as necessary. Check header non-return valves

1. Close the valve on one cylinder.
2. Slacken the tailpipe connection to the cylinder.
18. There should be an initial discharge of the gas trapped in the tailpipe.
19. After this initial discharge the flow of gas should reduce dramatically. There may not be a complete seal as the NRV has a hard seat and is intended to prevent gross gas release in the event of tailpipe rupture only. If there is a large leak, the non-return valve assembly should be replaced; it cannot be maintained.
3. Tighten the tailpipe connection and slowly open the cylinder valve.
4. Check connection for leaks.
5. Repeat steps **1** to **4** for each cylinder location on both manifolds.

10.8.1 Header Non Return Valve (NRV) Replacement

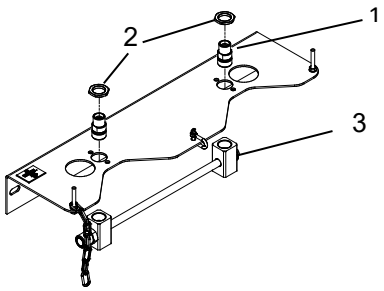


Figure 10-1 Header NRV Replacement

1. If the faulty NRV (**1**) is in the duty bank, switch the control panel so gas is being supplied from the other bank.
2. Close the valves on all the cylinders in the affected bank.
3. Remove the retaining nut from the faulty NRV (**2**).
4. Slacken faulty NRV bracing against the square block (**3**) under the header and allow the residual gas to escape.
5. Fit a new NRV assembly and tighten fully home.
6. Slowly open the valves on all the cylinders.
7. Check disturbed joints for leaks.
8. Switch the control panel to return to the original duty bank if required.

10.8.2 Tailpipe Replacement

1. Close the valve on the cylinder connected to the tailpipe which is to be replaced.
2. Slacken the tailpipe connection to the cylinder and allow residual gas pressure to escape.
3. Undo the union nut securing the tailpipe to the manifold block making sure to brace with the NRV assembly spanner flats and remove the tailpipe.

4. Fit the new tailpipe using a new seal.
5. Slowly open the cylinder valve and check disturbed joints for leaks.

11 Fault Diagnosis

11.1 Introduction

Pneumatech MGS Manual Changeover and Emergency Supply Manifolds and Emergency Supply Manifolds are of sturdy construction with few parts, reducing the possibility of complex faults occurring. Gas leakage from poorly maintained systems, perished or damaged O-ring seals should be the only faults that occur.
Tables 11-1 to *11-3* detail possible defects/ symptoms which may occur with the manifold control panel with the necessary rectification actions.

Table 11-1 Creeping Standby Pressure Regulator

Possible cause	Remarks/ rectification action
No flow being delivered (see note below)	No action required
Regulator seat damage	If the leak is significant then it is likely that the seat of the regulator is damaged. Renew the pressure regulator.

Note: All valves leak to some degree. With a very small volume downstream of the regulator and the solenoid valve, over a period of time in the standby condition, the pressure may rise to the relief valve set point. This is to be expected and does not require attention unless the leak is large.

Table 11-2 Creeping Duty Pressure Regulator

Possible cause	Remarks/ rectification
No flow being delivered	Vent gas until system reaches normal pressure and evaluate the size of the leak; if the leak is significant, renew the pressure regulator.
Regulator Seat damage or contamination	Renew the pressure regulator.

Table 11-3 Low Line Pressure

Possible cause	Remarks/ rectification
Supply pressure effect	As the pressure in a cylinder falls the line pressure can be subject to a small reduction due to the supply pressure effect acting on the regulators in series i.e. as the cylinder pressure falls, the outlet pressure of the 1st. stage regulator rises, which in turn causes the line pressure to fall slightly. Unless it is significant, do not adjust or renew the pressure regulators
Too high a flow being delivered	If too a high flow of nitrous oxide or carbon dioxide is being withdrawn for a sustained period, the vapour pressure may collapse (see *Section 1.7).*
Blocked inlet filters (Manual Manifolds Only)	Check the filters in the header connections are not blocked or contaminated; renew as required.

Demand too high	Add more cylinders, install a 1500 manifold or split the medical gas system to have multiple supply sources.

12 Recommended Spares

The recommended holding of spares depends upon the number of manifolds installed and is detailed in *Tables 12-1* to *12-3*. The number recommended for overseas customers is expressed in brackets and takes into account expected transport delays.
Refer to *Figures 9-1* and *9-2* to identify each part.

Table 12-1 Minimum Recommended Spares Scheduling – Oxygen, O2/N2O 50%/50% Manifolds and Medical Air Manifolds

Item	Description	Part Number	Number of Panels Installed		
			1-3	4-6	7+
2	Manual Manifold Regulator, Pressure Gauge and Fittings	5005037	1 (1)	2 (2)	2 (3)
2	ESM Regulator, Pressure Gauge and Fittings	5003226	1 (0)	2 (2)	2 (3)
3	Contact Gauge	3262680	0 (1)	1 (2)	1 (2)
4	Line Pressure Gauge	6000026	0 (0)	1 (1)	1 (2)
5	Line Pressure Relief Valve	3261480	1 (1)	1 (2)	1 (2)
1	Inlet Sintered Filter (Manual Manifold Only)	0762	2(4)	2(6)	4(8)

Table 12-2 Minimum Recommended Spares Scheduling – Nitrous Oxide Manifolds

Item	Description	Part Number	Number of Panels Installed		
			1-3	4-6	7+
2	Manual Manifold Regulator, Pressure Ga Fittings	5003148	1 (1)	2 (2)	2 (3)
2	ESM Regulator, Pressure Gauge and Fittings	5003227	1 (1)	2 (2)	2 (3)
3	Contact Gauge	3262720	0 (1)	1 (2)	1 (2)
4	Line Pressure Gauge	6000026	0 (0)	1 (1)	1 (2)
5	Line Pressure Relief Valve	3261480	1 (1)	1 (2)	1 (2)
1	Inlet Sintered Filter (Manual Manifold Only)	0762	2(4)	2(6)	4(8)

Table 12-3 Minimum Recommended Spares Scheduling – Surgical Air (7 bar) Manifolds

Item	Description	Part Number	Number of Panels Installe		
			5-10	10-15	15-25
2	Manual Manifold Regulator, Pressure Gauge and Fittings	5005039	1 (1)	2 (2)	2 (3)
2	ESM Regulator, Pressure Gauge and Fittings	5005125	1 (1)	2 (2)	2 (3)
3	Contact Gauge	3262680	0 (1)	1 (2)	1 (2)
4	Line Pressure Gauge	6000026	0 (0)	1 (1)	1 (2)

5	Line Pressure Relief Valve	3261549	1 (1)	1 (2)	1 (2)
1	Inlet Sintered Filter (Manual Manifold Only)	0762	2(4)	2(6)	4(8)

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