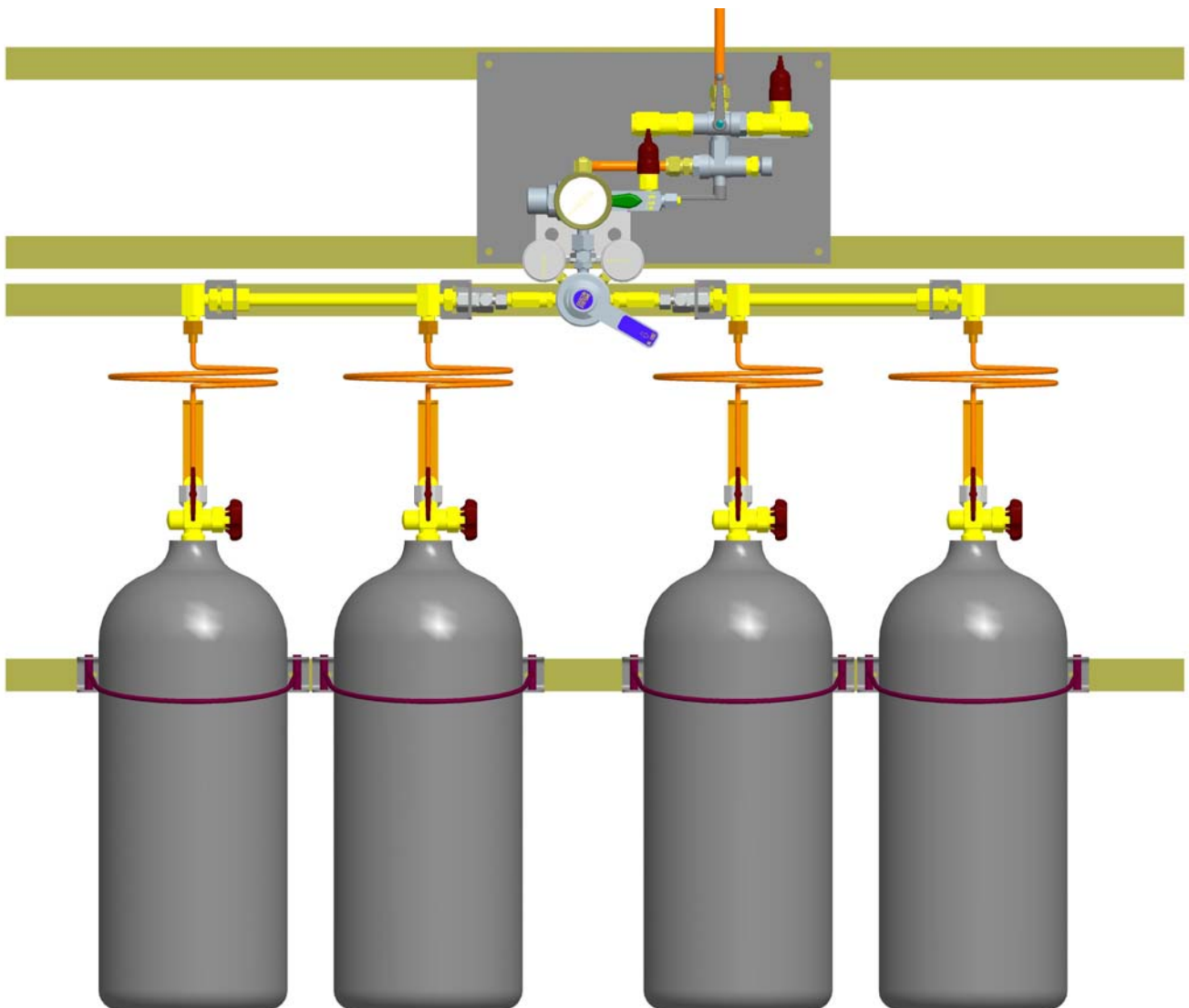


**GASCON SYSTEMS
MEDICAL
AUTO CHANGE-OVER
MANIFOLD INFORMATION
BOOKLET**



Introduction

Gascon Systems designs and manufactures a range of medical auto change-over manifolds and associated equipment. This document is intended to give an overview of the product range as well as the operation of the manifold and associated equipment. There is also general information about medical gas pipeline systems.

Australian Standards – AS2896

There is a dedicated Australian Standard for medical gas pipeline systems, AS2896 – Medical Gas Systems (Installation and testing of non-flammable medical gas pipeline systems). The latest version of this Standard was published in 1998.

This Standard is a detailed document and covers topics including the supply system, piping, terminal units, alarm systems, installation, testing, certification and maintenance. Anyone involved in specifying, designing, installing or testing a medical gas system must have a sound working knowledge of this document.

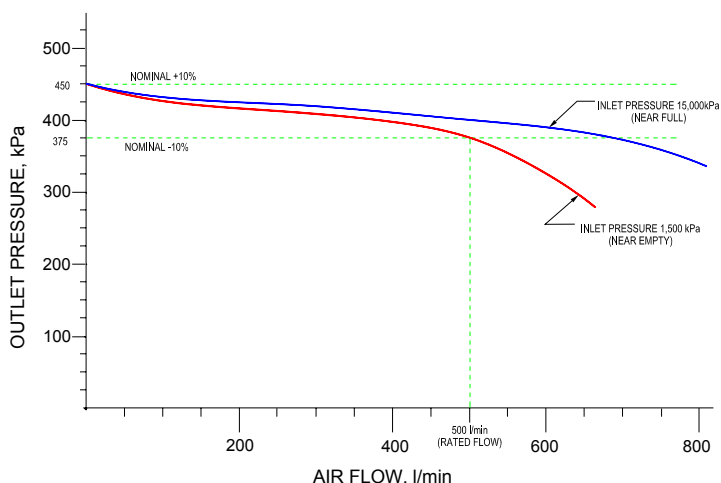
The Gascon Systems range of medical auto manifolds are designed and manufactured to comply with AS2896 provided that they are installed and tested in accordance with the appropriate clauses of the Standard.

Note:

While Standards attempt to clearly define product/system requirements, there is always scope for individuals to have differing interpretations of what is written in a Standard. Any references made to AS2896 requirements in this document are Gascon Systems interpretations of the Standard.

Manifold Flow Capacity Rating

The flow capacities specified for the various model auto manifolds are based on the requirements detailed in AS2896. The flow capacity is that which is achieved when the outlet pressure falls to 90% of the nominal pressure when starting at an initial static (no flow) pressure of 110% of the nominal outlet pressure. The flows are measured at near empty cylinder pressures to ensure that the stated flows can always be achieved regardless of cylinder contents.



Manifold Set Pressures

The recommended nominal outlet pressure of the manifold systems is as specified in section 3.3 of AS2896, ie. 415 kPa for all gases except for surgical tool gas systems which is 1400 kPa. The allowable working pressure range is $\pm 10\%$ of the nominal pressure, eg. for a nominal 415 kPa the allowable range is 455 kPa to 375 kPa.

Note:

Some applications may require an outlet pressure different than that which is specified in the Standard. The most common of these applications are when carbon dioxide, or carbon dioxide and oxygen in nitrogen triple mixtures are used for incubators or culture growth applications. These typically require a lower pressure, in the range of 100 – 200 kPa.

Sizing Manifold

There are two considerations when sizing an auto manifold system, flow capacity and supply storage capacity. The flow capacity required is dependent on the number and local type of terminal units. Appendix B of AS2896 gives detailed guidelines for calculating pipeline design flow capacities. The designed flow capacity and availability of gas deliveries will determine the supply source capacity (ie. number of cylinders on each bank of the manifold). Clause 2.4 of AS2896 gives a general guideline for determining the storage capacity required.

Operating Principle

The auto change-over manifold consists of five key items, pressure control assembly, three way auxiliary service assembly, modular inlet header system, alarm system and a standby regulator.

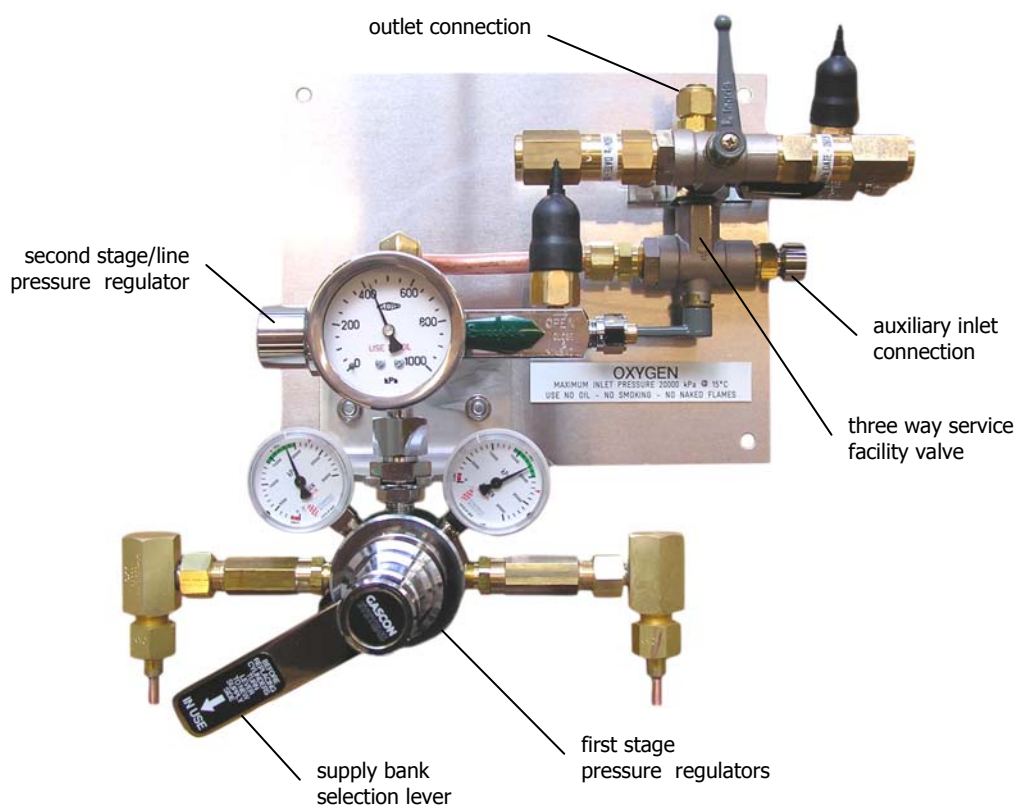
The pressure control assembly consists of three separate pressure regulators, two lower first stage regulators and an upper second stage/line pressure regulator. On the lower first stage regulators the RHS cylinder supply bank is connected rear regulator and the LHS cylinder supply bank is connected to the front regulator. The first stage regulators reduce the cylinder pressure to a lower intermediate pressure. A cylinder bank selection lever simultaneously adjusts pressure setting screws on both the front and rear regulators, (increasing the pressure on one while decreasing the pressure on the other). The direction in which the lever is pointing controls which cylinder supply bank the manifold will start drawing gas from. The cylinder supply bank to which the lever is pointing towards is called the "in-use" bank, and the other bank is called the "reserve" bank. The reserve pressure setting determines the change-over pressure, (this is the pressure left in the empty/near empty cylinders).

When the "in-use" bank empties the pressure differential between the two first stage regulators causes the manifold to automatically, (without any outside intervention), start drawing gas from the "reserve" bank. When this happens an alarm signal is generated at the change-over pressure switch. (Note. the supply bank selection lever does not move). The empty cylinders should be replaced as soon as possible. Inlet non-return valves (NRV) on either side of the first stage regulators prevent gas from decanting from one cylinder bank to the other cylinder bank.

To replace the recently emptied cylinders, first move the lever towards the "reserve" bank that the gas is now being drawn from. After moving the lever the "reserve" bank becomes the new "in-use" bank. Replace the emptied cylinder as detailed in the operating instruction. Moving the lever to full cylinder bank will reset the alarm signal. It is important to alternate the "in-use" and "reserve" banks in this procedure. Simply replacing the emptied and not moving the lever will mean that the gas supply in "reserve" bank will slowly empty to a stage that eventually there will be no "reserve" gas supply.

After the first stage regulators, the gas passes through the second stage/line pressure regulator that reduces the pressure to the final pipeline pressure. The gas then passes through a three way service facility valve, which incorporates an auxiliary supply source inlet, duplex line pressure relief valves and a line failure pressure switch.

A modular inlet header extension is used to allow multiple cylinders or packs of cylinder to be fitted to either side of the auto manifold. They also allow for the storage capacity of the auto manifold to be increase in the future.

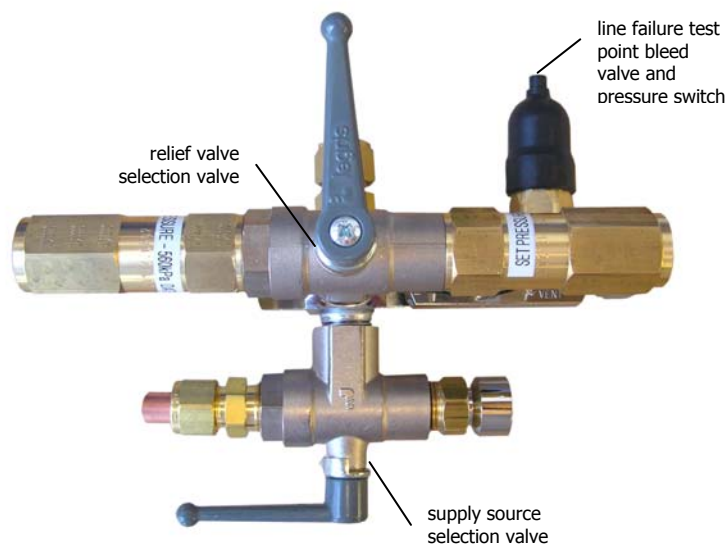


Three Way Service Auxiliary Valve

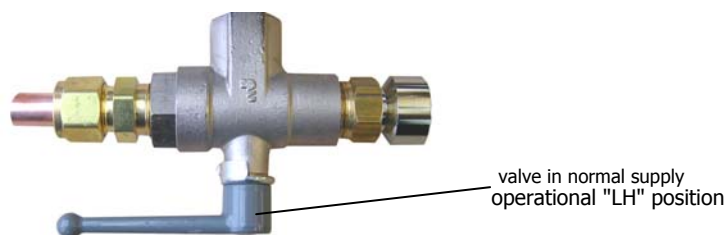
Medical auto manifolds come standard with a three way auxiliary service valve assembly. It consists of two separate three way valves, a lower supply source selection valve and an upper pressure relief valve selection valve.

This service valve assembly has several key functions:

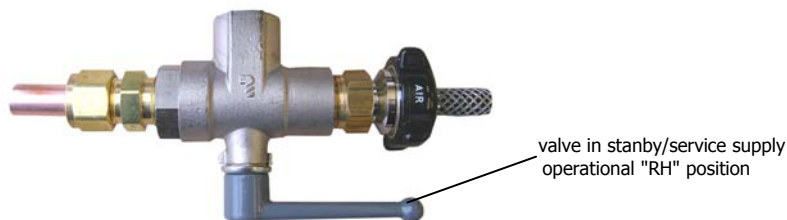
1. Allow an alternative gas source to supply the pipeline system during routine manifold maintenance or during a manifold failure,
2. Allow each of the two pressure relief valves to be isolated from the system for testing, (one at a time), while leaving the other pressure relief valve protecting the pipeline system,
3. Allow connection of a line failure pressure switch/test point bleed valve.



The lower "supply source selection valve" is an "L" ported three way valve, and has two operational positions. With the lever in the far left hand position the auto manifold is selected as the supply source. This is the normal operational position.



With the lever in the far right hand position a standby regulator is selected as the supply source. The standby regulator is connected to the valve via a gas specific SIS (sleeved indexed system) connection. This position used during servicing or in event of a manifold failure.



Note:

When the supply source selection valve is in the middle position both the auto manifold and standby regulator are isolated from the pipeline system. The valve must only be in the middle position during initial pressurization, or re-pressurization of the pipeline system.



The upper pressure relief valve selection valve is a "T" ported three way valve. In the normal operational mode the lever should be in the middle position (as shown in the adjacent picture). In this position both relief valves are connected to the pipeline system.

With the lever pointing to the LHS, the RHS relief valve is dis-connected from the pipeline and can be removed for testing/servicing.

With the lever pointing to the RHS, the LHS relief valve is dis-connected from the pipeline and can be removed for testing/servicing.

Standby Regulator

The standby regulator has two functions;

1. Act as a temporary gas supply source when the auto manifold is shut down for major service.
2. Act as an emergency gas supply source in the unlikely event of a failure of the auto manifold pressure control assembly.

Both the outlet of the standby regulator and inlet to the three way auxiliary valve connections have gas specific SIS connections to avoid accidental connection of an incorrect gas to the pipeline system.



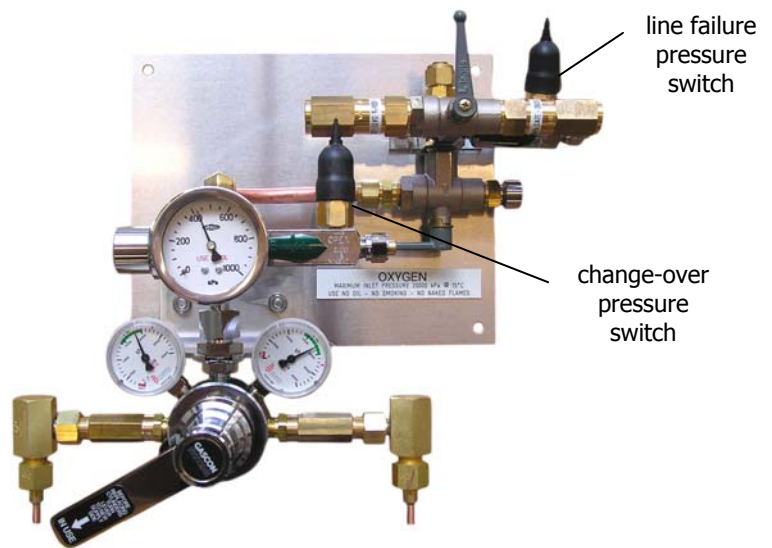
Alarm Systems

Auto manifolds are supplied with two separate pressure switches for connection to an alarm system. The change-over pressure switch generates a signal when the "in-use" cylinder supply bank is empty and the manifold has switched over to the "reserve" cylinder supply bank. The line failure pressure switch generates a signal when the outlet pressure falls below 80% on the nominal working pressure. The change-over alarm corresponds to the amber colour signal, and the line failure alarm corresponds to a red colour signal, as detailed in section 3 of AS2896.

The pressure switches are normally open (N/O) (ie. switch changes to open circuit on a manifold alarm condition). The pressure switches are designed to be fitted with a small printed circuit board that enables the alarm panel to differentiate between an actual alarm condition and a system wiring fault. These circuit boards are specific to each model alarm panel and need to be sourced from the alarm panel manufacturer/supplier.

Note

Some older alarm systems, that were not designed to detect system wiring faults, may not be able to operate with N/O pressure switches. In these cases either the pressure switches need to be changed to the N/C versions, or consideration given to upgrading the alarm system to newer type.



Both pressure switches are fitted to test point bleed valves. These valves have two separate functions.

1. Allow the pressure switches to be easily tested for correct operation without interrupting the operation of the manifold by creating a simulated alarm condition.
2. Allow a test gauge to be fitted to the manifold to check or adjust the pressure settings without interrupting the operation of the manifold.

The small bleed orifice in the valves ensures that the pressure switches cannot be isolated from the manifold system and remain pressurized. The test gauge connection thread is 5/8"-18UN RH.



During normal operation the test point bleed valve must be in the "open" position.

To test the function of the alarm system, or fit a test gauge during servicing, the test point bleed valve needs to be in the "closed/bleed" position

Gas Specific Inlet Header Connections

Auto manifold systems are supplied with modular inlet extensions that have gas specific metric threaded header connections to which the cylinder leads/coils are connected. These gas specific connections are as detailed in section 2.4 of AS2896. A summary of the connections for each gas is listed below.

Working Gas	AS2896 Metric Header Thread
Oxygen	M18x1.5
Air	M20x1.5
Nitrous Oxide	M16x1.5
Carbon Dioxide	M26x1.5
Carbogen™	M28x1.5
Entonox™	M24x1.5

Note
AS2896 required that systems supplied after January 2007 use these gas specific metric threaded header connections. Prior to 2007 Gascon Systems and some other manufacturers used a different set of imperial threaded gas specific header connections. For further details on this older imperial threaded gas specific header system refer to the special section at the end of this document.

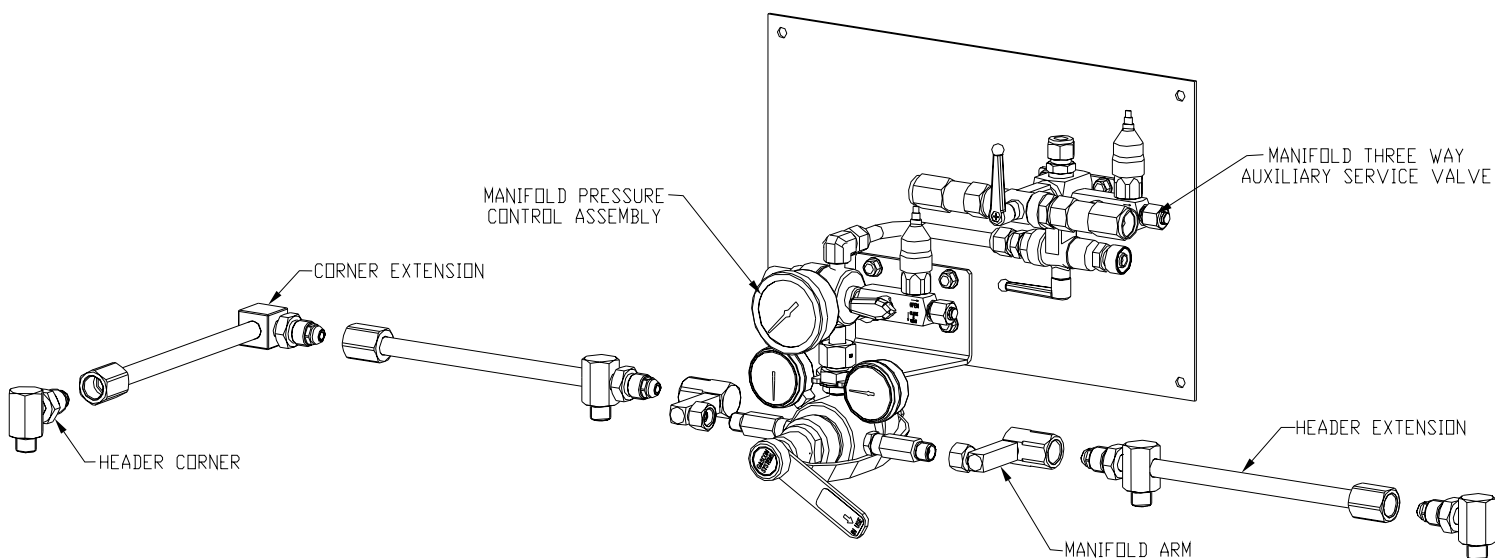
AS2896 does not specify a gas specific header connection for mixtures such as carbon dioxide/oxygen in nitrogen.

Inlet Header Extensions

When an auto manifold requires more than one cylinder on each supply bank, a modular inlet header system is used to extend the gas supply storage capacity.

Each header extension includes a non return valve in cylinder lead/coil connection. The non return valve is designed to stop rapid decanting of cylinders if there is; a cylinder lead failure, an empty cylinder is accidentally connected to a full cylinder bank, or if a cylinder is removed without first turning off the other cylinders in the bank. The non return valves are not designed to create a complete leak tight seal, (they will pass a small flow in the reverse direction). If individual cylinders are to be removed from a working manifold for a prolonged period of time, blanking plugs must be fitted to the headers from which the cylinders have been removed. Inlet corner extensions are available for installations where the supply cylinders need to be located along an adjoining 90° wall.

Note:
In a 1x1 system small inlet elbows are used instead of the modular system pictured. The elbows do not need/have a non-return valve fitted.



INLET HEADER COMPONENTS AS2896 (METRIC)

WORKING GAS	MANIFOLD ARM	HEADER EXTENSION	HEADER CORNER	CORNER EXTENSION
Oxygen	MA10	G0525-OXY	G0526-OXY	519024
Air	MA10	G0525-AIR	G0526-AIR	519024
Nitrous Oxide	MA30	G0525-N2O	G0526-N2O	518847
Carbon Dioxide	MA30	G0525-CO2	G0526-CO2	518847
Carbogen™	MA30	G0525-CARB	G0526-CARB	518847
Entonox™	MA30	G0525-ENT	G0526-ENT	518847

Cylinder Leads and Coils

Cylinder leads are available in two main designs, copper pigtails or stainless steel convoluted flexible leads. Copper pigtail coils are the more commonly used type. Where greater flexibility is required stainless steel convoluted leads can be used. There are versions available for both single cylinders and pack/manpacks of cylinders.

All leads/coils have a gas specific inlet connection as per AS2473.3 and AS2473.2, and gas specific outlet/header connections as per AS2896. All leads/coils are rated for a maximum working pressure of 20,000 kPa @ 15°C.

All leads/coils are stamped/labeled with, working gas, maximum working pressure and date of manufacture code (MMYY, where MM = month YY = year).

Copper "pigtail" Coils

Part No	Gas	Lead Type	Inlet Fitting	Outlet Fitting
553063	Medical Oxygen	Single Cylinder	Type 10 ^{#1}	M18x1.5
553065	Medical Oxygen	Single Cylinder	Pin Indexed Yoke	M18x1.5
G0510	Medical Oxygen	Pack/ Manpack	Type 10 ^{#1}	M18x1.5
G0511	Medical Oxygen	Pack/ Manpack	Pin Indexed Yoke	M18x1.5
G0513	Medical Air	Pack/ Manpack	Pin Indexed Yoke	M20x1.5
553066	Medical Air	Single Cylinder	Pin Indexed Yoke	M20x1.5
553064	Medical Nitrous Oxide	Single Cylinder	Pin Indexed Yoke	M16x1.5
G0512	Medical Nitrous Oxide	Pack/ Manpack	Pin Indexed Yoke	M16x1.5
553068	Medical Carbon Dioxide	Single Cylinder	Pin Indexed Yoke	M26x1.5
553069	Medical Carbogen™	Single Cylinder	Pin Indexed Yoke	M28x1.5
553067	Medical Entonox™	Single Cylinder	Pin Indexed Yoke	M24x1.5



Stainless Steel Convoluted Leads

Part No.	Gas	Lead Length	Inlet Fitting	Outlet Fitting
TBA	Medical Oxygen	800mm	Type 10 ^{#1}	M18x1.5
G8680	Medical Oxygen	800mm	Pin Indexed Yoke	M18x1.5
G8679	Medical Air	800mm	Pin Indexed Yoke	M20x1.5
G8678	Medical Nitrous Oxide	800mm	Pin Indexed Yoke	M16x1.5
G0504	Medical Oxygen	1800mm	Type 10 ^{#1}	M18x1.5
G0505	Medical Oxygen	1800mm	Pin Indexed Yoke	M18x1.5
G0506	Medical Air	1800mm	Pin Indexed Yoke	M20x1.5
G0507	Medical Nitrous Oxide	1800mm	Pin Indexed Yoke	M16x1.5

Notes:

Teflon lined stainless steel braided leads are not recommended for breathable gases such as oxygen, breathing air, nitrous, carbogen™ and entonox™, (refer to special notes in AS2896). However, they are suitable for use with non-breathable gases such as carbon dioxide, carbon dioxide/oxygen in nitrogen mixtures.

Due to an inconsistency in the cylinder valve connections used for gas mixtures by different gas companies, and there being no gas specific threaded connection in the Standard, it is advisable to call and discuss the requirement for leads/coils used on special gas mixtures

In some applications like IVF processes and some culture growth processes copper coils may not be suitable. In these situations stainless steel convoluted lead, or Teflon line stainless steel braided leads (for non-breathable gases) should be used, or special stainless steel coils can be supplied.

#1 – Starting in September 2009 the cylinder valve connection for medical oxygen will be changing to the pin indexed yoke connection for all size cylinders. Before this change larger medical oxygen cylinders used the threaded Type 10 connection. For future information on the progress of this change can be obtained from the gas supplier or ANZIGA (Australian and New Zealand Industrial Gas Association).

Installation

Sections 2.11 and 2.12 of AS2896 give requirements on the location of gas supply sources, and AS4332 give requirements for storage and handling of gas cylinders. There may also be local government authorities that have additional requirements for storage and handling of compressed gas systems.

If located in enclosed rooms, or rooms with limited air flow, consideration should be given to remotely venting the exhausts from the pressure relief valves. Apart from AS2896 there is also a Standard, AS5034 (installation and use of inert gases for beverage dispensing) that has some good information on location and ventilation for gas systems).

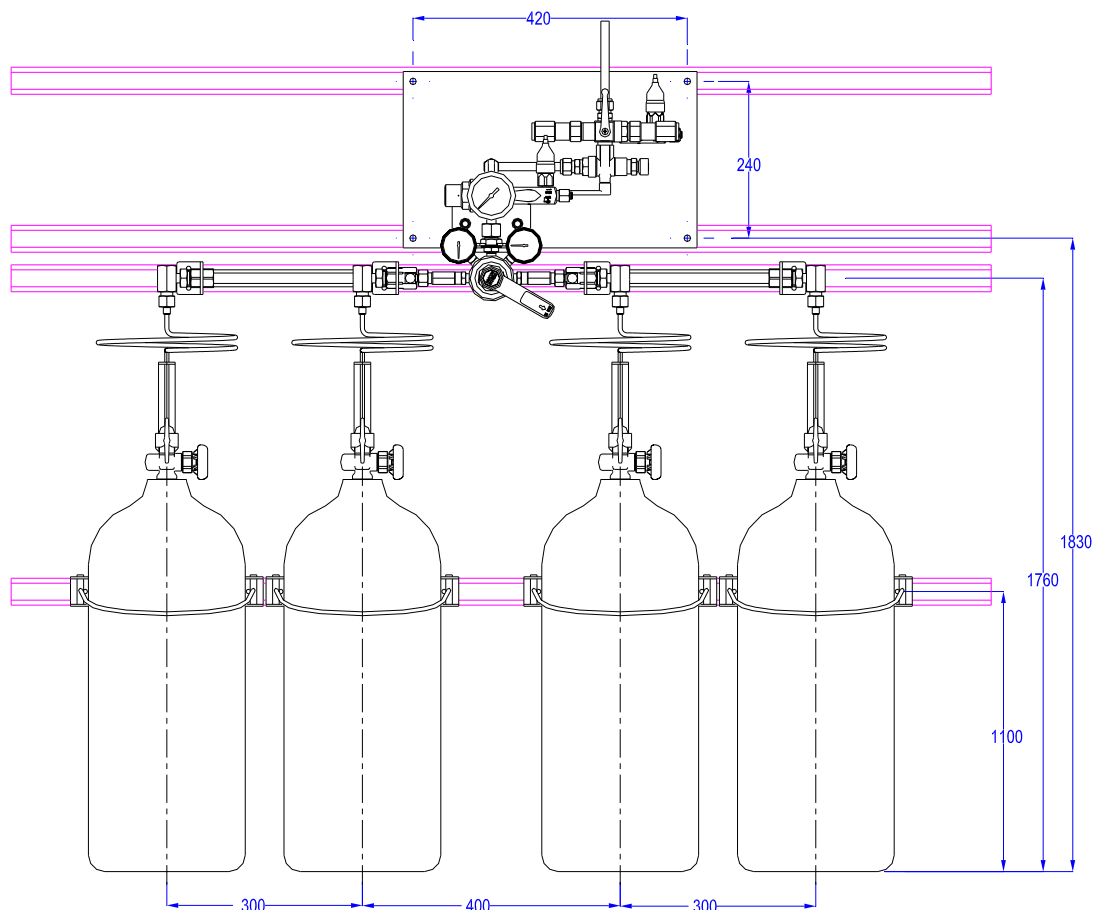
All cylinders, even those not being used, should be fully restrained by appropriate cylinder restraints.

The auto manifold mounting plate has four holes for M10 (or 3/8") securing bolts. The inlet header system is secured using M6 (or 1/4") bolts.

The recommended free wall space required to install an auto manifold is listed below, (allow an extra 350mm for a single standby regulator).

1 cylinder x 1 cylinder	900mm
2 cylinder x 2 cylinder	1500mm
3 cylinder x 3 cylinder	2100mm
4 cylinder x 4 cylinder	2700mm
5 cylinder x 5 cylinder	3300mm
6 cylinder x 6 cylinder	3900mm

For space required for auto manifold using packs of cylinders as the supply source consult the gas supplier for their recommendations. Packs of cylinders come in a variety of sizes and need extra space for safe handling.



Note:
Mounting heights are based on Australian "G" sized cylinders. These cylinders should have a nominal height of 1365mm, although this may vary slightly between different gas suppliers (mounting heights may need to be adjusted accordingly).

When produced manifolds are pressurized for at least 24 hours to allow the components to "bed in". This helps ensure the maximum stability of the pressure settings. The pressure setting may vary slightly between the time the manifold is produced and installed. It is recommended that pressure settings be checked on commissioning, (installers should make an allowance for a little extra time or do this during installation/commissioning).

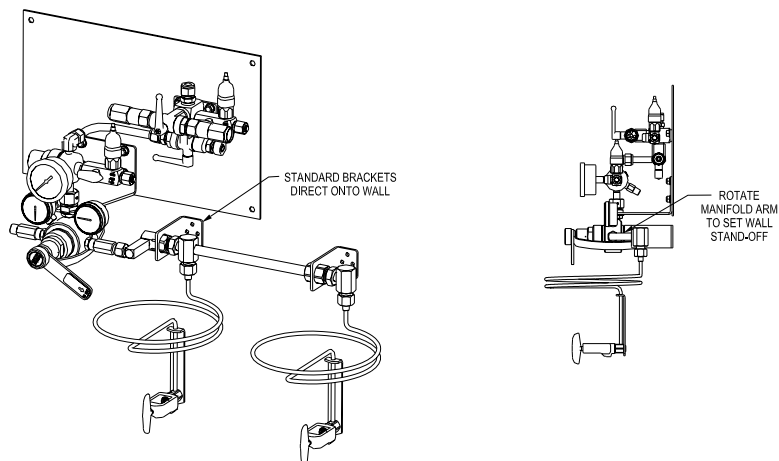
Installing Inlet Header Extensions

For maximum flexibility, there is a range of mounting options for inlet header extensions. All of the different types of extension support brackets locate on the hexagonal ends of the header extensions. For the best support, it is recommended that two brackets be used on the first header extension, and one bracket for each header extension thereafter, (ie a 2x2 system requires 4 brackets, a 3x3 system requires 6 brackets, ... etc). When ordering a manifold system that includes inlet header extensions the mounting brackets are included in the part number.

Each mounting system requires the centre line of the headers components to have a slightly different wall stand-off distance. This is simply done by rotating the manifold arms into the position that achieves that desired stand-off dimension.

1. Standard bracket (G1280) directly onto wall

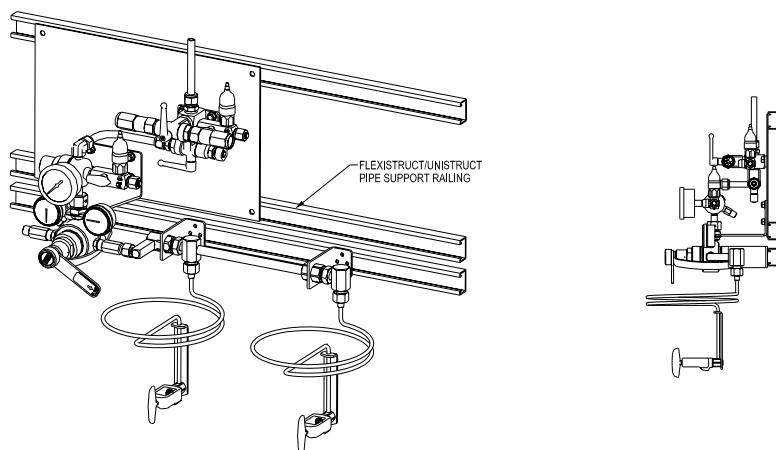
A simple "L" shaped stainless steel bracket with two horizontal and two vertical Ø7mm holes for securing to the wall. This system is best for installations where a single auto manifold with either one or two cylinders per supply bank is required.



2. Standard bracket with Uni-Strut/Flexi-Strut railing

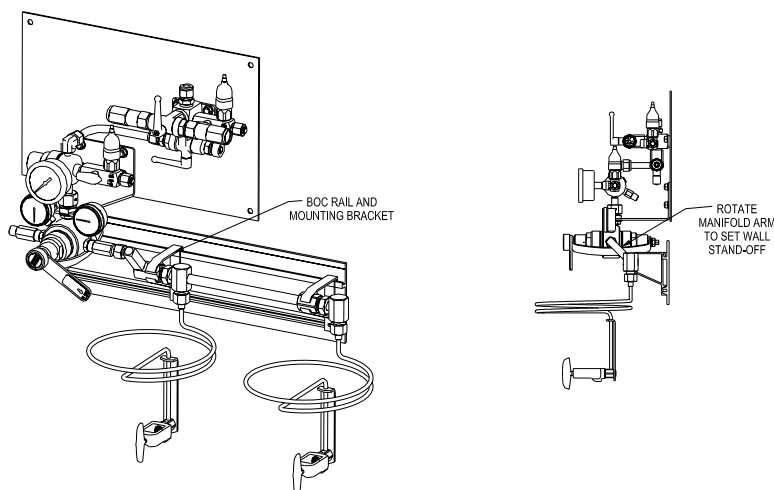
Three rails are secured to the wall. The upper two rails are used to mount the main manifold plate and the low rail is used to mount the inlet extension brackets. A fourth lower rail can be used to secure cylinder restraints. This system is ideal where an auto manifold has multiple cylinders on each supply bank, or where several auto manifolds are required at the same facility

Main plate requires 4 x M10 or 3/8" bolts/nuts, and each support bracket requires 2 x M6 or 1/4" bolts/nuts. The recommend rail section is Uni-strut (P3300/4000), Flexi-strut (FM3000/4000), or equivalent.



3. BOC custom brackets & railing

A special manifold inlet support system has been designed by BOC Gases. It has a similar design to the previous option with slightly less mounting screws.



Maintenance and Servicing

Section 6 of AS2896 gives requirements for maintenance of medical gas system. Each auto manifold system is supplied with a detailed manufacturer recommended maintenance/servicing schedule. An outline of this schedule is detailed below. It is recommended that the owner of the auto manifold keep a service logbook as a permanent record of the system history.

On commissioning

- Check that cylinders have been changed
- Check condition of cylinder leads/coils
- Check for external leaks
- Check first and second stage pressure settings, adjust if necessary
- Check pressure switch settings, adjust if necessary
- Test function of gas alarm system
- Test function of change-over system
- Check for unauthorized modifications since originally installed

Whenever changing cylinders

- Check condition of cylinder leads/coils
- Check for external leaks

Weekly Checks/Tests

- Check that cylinders have been changed

Three Monthly

- Test function of change-over system

Six Monthly

- Test gas alarm system
- Check condition of cylinder leads/coils
- Check for external leaks

Yearly

- Check manifold pressure settings
- Check for unauthorized modifications
- Test pipeline pressure relief valves

Three Yearly

- Service pressure control assembly
- Check inlet header non-return valves

Product Lifespan

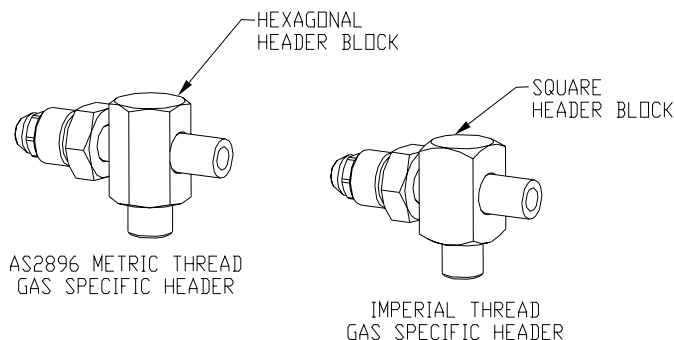
An auto change-over manifold should be able to have a functional service life of 20 years provided that they are maintained and serviced in accordance with the manufacturer recommendations. Copper pigtail coils and stainless steel convoluted leads can work harden over time, and may need to be periodically replaced if cylinders are being changed frequently, (a five year lifespan may be appropriate in such cases).

Imperial Gas Specific Header System

Prior to the introduction of the AS2896 metric threaded gas specific header connection system, Gascon Systems used the same imperial gas specific header connection system as used by CIG/BOC/Cigweld. These components are still available on request as spares parts for existing manifold systems, or to expand the capacity of existing manifold systems.

To assist in identifying both header connections systems, the imperial header connections are manufactured from a square section brass block, while the metric header connections are manufactured from a hexagonal section brass block. Thread details of both types of gas specific connections are listed below.

Working Gas	Imperial Header Thread System
Oxygen	3/8" BSP RH
Air	1/2" BSP RH
Nitrous Oxide	0.86"-14 whit
Carbon Dioxide	5/8"-18UN
Carbogen™	9/16"-18UN
Entonox™	N/A



INLET HEADER COMPONENTS (IMPERIAL)

WORKING GAS	MANIFOLD ARM	HEADER EXTENSION	HEADER CORNER	CORNER EXTENSION
Oxygen	MA10	519023	360200	519024
Air	MA10	360035	360250	519024
Nitrous Oxide	MA30	518844	518841	518847
Carbon Dioxide	MA30	518845	518842	518847
Carbogen™	MA30	518846	518843	518847
Entonox™	MA30	N/A	N/A	518847

Copper "pigtail" Coils

Part No.	Gas	Lead Type	Inlet Fitting	Outlet Fitting
518836	Medical Oxygen	Cylinder Lead	Type 10	3/8" BSP RH
553039	Medical Oxygen	Cylinder Lead	Pin Indexed Yoke	3/8" BSP RH
G0015	Medical Oxygen	Pack Lead	Type 10	3/8" BSP RH
518838	Medical Air	Cylinder Lead	Pin Indexed Yoke	1/2" BSP RH
G0509	Medical Air	Pack Lead	Pin Indexed Yoke	1/2" BSP RH
519259	Medical Nitrous Oxide	Cylinder Lead	Pin Indexed Yoke	0.86"-14 whit
G0508	Medical Nitrous Oxide	Pack Lead	Pin Indexed Yoke	0.86"-14 whit
518839	Medical Carbon Dioxide	Cylinder Lead	Pin Indexed Yoke	5/8"-18UN
518840	Medical Carbogen™	Cylinder Lead	Pin Indexed Yoke	9/16"-18UN

Stainless Steel Convoluted Leads

Part No.	Gas	Lead Length	Inlet Fitting	Outlet Fitting
G0124	Oxygen	800mm	Type 10	3/8" BSP RH
G0123	Oxygen	1800mm	Type 10	3/8" BSP RH
G0126	Medical Air	800mm	Pin Indexed Yoke	1/2" BSP RH
G0125	Medical Air	1800mm	Pin Indexed Yoke	1/2" BSP RH
G0502	Medical Nitrous Oxide	800mm	Pin Indexed Yoke	0.86"-14 whit
G0503	Medical Nitrous Oxide	1800mm	Pin Indexed Yoke	0.86"-14 whit