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Overview of Medical Gas Manifolds

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What is a Medical Gas Manifold?

- Unlike Medical Air Compressors and Vacuum Pumps that generates the gas on-site, many gases used in healthcare settings are delivered to the facility in different type of containers and use manifolds to be distributed into the rooms.
- Gases that can be delivered
  - Oxygen (O_2) delivery pressure of 50psi
  - Nitrous Oxide (N_20) delivery pressure of 50psi
  - Medical Air delivery pressure of 50psi
  - Carbon Dioxide (CO_2) delivery pressure of 50-100psi
  - HeliOX blends delivery pressure of 50psi
  - Nitrogen (N_2) delivery pressure of 180psi
  - Instrument Air (IA) delivery pressure of 180psi

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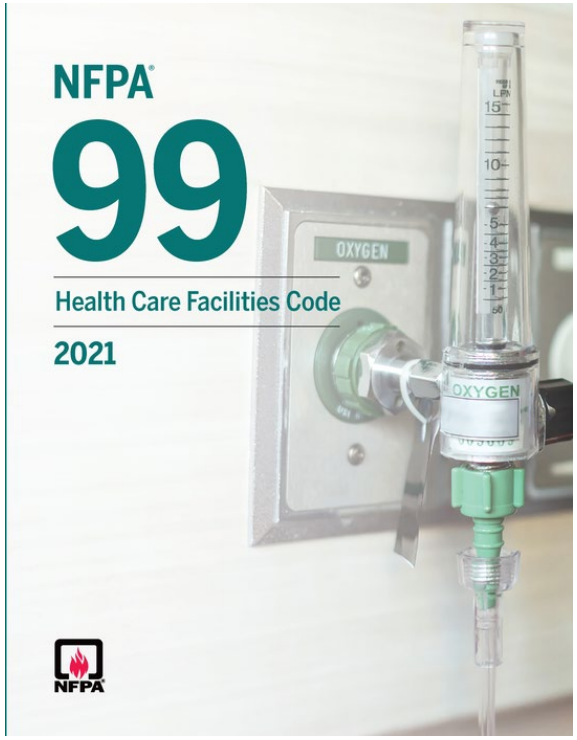

Design Assist & Value Engineering Services

NFPA 99: Health Care Facilities –

Complete rules for the safe application of electrical systems, gas and vacuum systems, and environmental systems, along with materials and emergency management practices.

The 2021 edition has the most recent developments in medical equipment and processes as well as new methods to reduce fire, explosion, and electrical hazards.

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Gas Containers That Get Re-filled On-site

Bulk Tanks

Micro-Bulk Tanks

Used for large applications and requires additional equipment.
This is not covered in the scope of this webinar.

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Gas Containers Delivered & Replaced When Empty

Liquid Dewars

High Pressure Cylinders

Most common for Ambulatory Surgery Centers and Small Outpatient facilities

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High Pressure and Liquid Medical Gas Manifold Installation

Location: Indoors

- Separate secured room with 1 hour fire rating used for no other purpose
- Properly labeled per NFPA 99 5.1.3.1.9

- May contain other Medical Gas manifolds and cylinders
- Electrical devices located at or above 5'-0" AFF
- Relief valves shall be copper piped to the outside with the discharge turned down and screened
- Source valve located in the immediate vicinity of the Source

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High Pressure and Liquid Medical Gas Manifold Installation

- Temperature in room not to exceed 125° F
- Natural ventilation permitted for total gas systems below 3000 cu. ft.
    - Two openings (72 sq in) located within 1 foot of floor and ceiling
- Mechanical ventilation required for total gas systems above 3000 cu. ft.
    - Ventilation intake within 1 foot of floor
    - Makeup air shall be provided
- Indoor rooms heated by indirect means (steam or hot water) if needed

Gas Volumes in "H" or "K" Cylinders	
Medical Air	231 cu. ft.
Nitrogen	226 cu. ft.
Nitrous Oxide	577 cu. ft.
Oxygen	244 cu. ft.

Not allowed to store more than 20,000 ft^3 inside

Reference NFPA 99 5.1.3.3.2 (1-9) for design and construction details for locations of central supply systems and storage of positive pressure gases.

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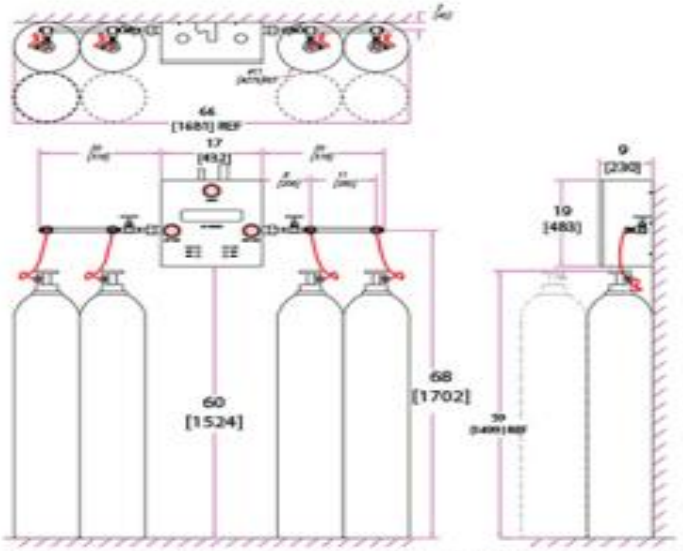
How do Medical Gas Manifolds Work?
High Pressure NFPA 5.1.3.5.13

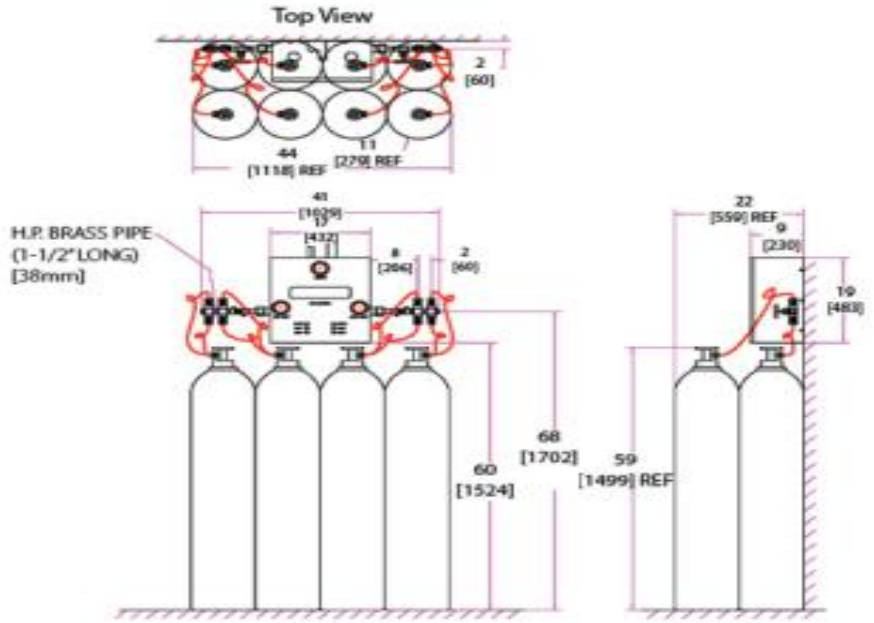
Figure 1: Standard Set



Standard 2x2 Dome Loaded Manifold with Straight Header Bars Layout

Figure 2: Optional Set-up

Inch
[mm]



NOTE: Header bar pipes can be changed from standard 10 1/2" to 8 1/2", 6" or 1-1/2".
For optional set-up, specify the pipe size at the time of ordering.

Equal number of High Pressure H Cylinders are divided into 2 banks that alternate. The primary bank will be the one currently supplying the gas and the secondary bank is ready

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Components of Manifold and Header Bars

NFPA 5.1.3.5.10

• The header bars shall be equipped with high pressure shutoff valves outside the cabinet to allow for emergency isolation of the header bars. The header bar shall incorporate integral check valves for each station.

CGA gas specific header bar with integral check valves and cylinder pigtail assemblies (to be ordered separately)

• The manifold is equipped with pressure transducers, which sends information to the main circuit board for operation of the fail-safe relay which transmits a remote signal to the master alarm or buzzer.

• The Manifold cabinet has a NEMA-1 rating for general purpose use. NEMA-4 available.

• The manifold shall be equipped with a 3/4" outlet shutoff valve. The valve comes complete with a 3/4" type “K” 6-3/4" [172mm] long pipe extensions and 1/8" port for an optional pressure switch.

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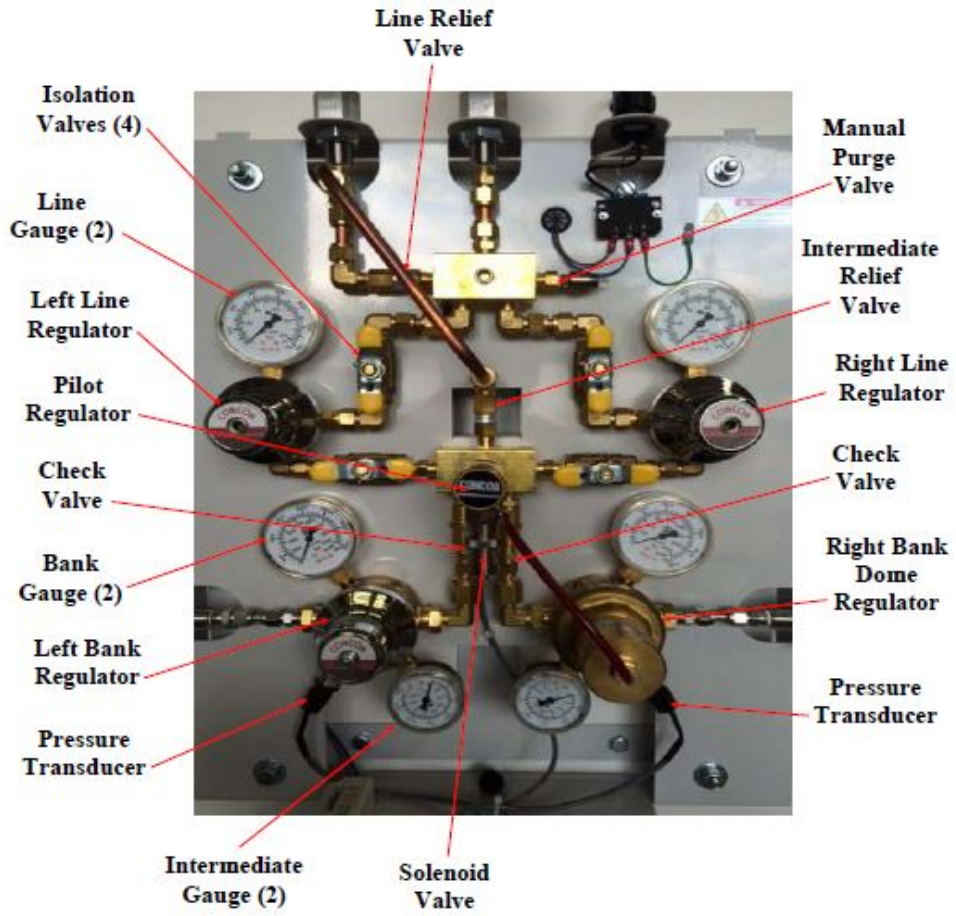
What's Inside a HP Manifold?



The manifold is required to be fully automatic switching banks when gas primary bank is empty

Avoid manifolds that use switching valves

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HEATERS??

CO_2 and N_2O are 2 gases that can potentially freeze up a manifold

What causes the freezing is the pressure drop and flow across the regulators or orifice in manifold

Manifolds with shuttle valves MUST have heaters

Manifolds with smaller flow dome biased regulators MUST have heaters

The heaters will switch on when the temperature drops below 75° F

Heaters add cost and a fail point – better to specify manifolds that do NOT require a heater to function

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Manifold Alarms for Local and Master

NFPA 5.1.3.5.12.6

Local Alarms – green or red lights

- Ready – Reserve bank would be green
- In Use – primary bank would be green
- Replace – when primary bank is exhausted it this light is red

Master Alarm

- High Pressure
- Low Pressure
- Reserve in Use

High/Low Pressure is activated by the Main Line Pressure Switch downstream of the source valve

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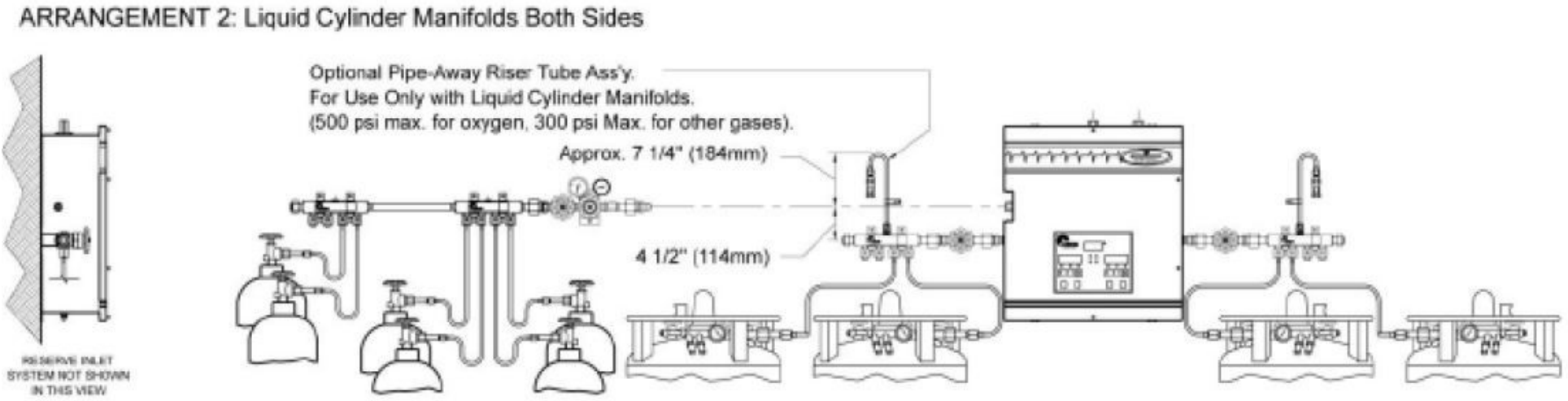
Liquid x Liquid Manifold NFPA 5.1.3.5.13

•In larger facilities the number of high pressure cylinders required to meet the demand can become very high resulting in a huge space requirement and a very labor intensive change out. In those instances cryogenic containers become advantageous.

•If using cryogenic containers, there are options pertaining to the primary and secondary bank.

•If using a Liquid manifold, a HP reserve manifold is required as back-up



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IntelliSwitch Manifold

- Flexibility
- Economizer Function
- Look Back Feature
- I-Link Webserver Technology
- Offers continuous pressure and flow control

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Sizing Manifolds

- Sizing criteria varies base on gas type
- Rule of thumb is to size the banks so that each bank last 1-2 weeks
- Not an exact calculation
    - Can go larger to have less change outs
    - Can go smaller to accommodate space

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Sizing Oxygen Manifolds

Count the number of beds in the facility
Count the number of beds that are anesthetizing

The various beds in a facility added up use a range of Oxygen between 400-1000 ft3/bed/month

If you have a acute care hospital with ICU assume 1000
If you have a Ambulatory Surgery Center or outpatient that is not 24hr – use 600
If you have a freestanding ER or behavioral health use 400

Divide your result by 4 to get a weekly usage or by 2 to get a bi-weekly usage

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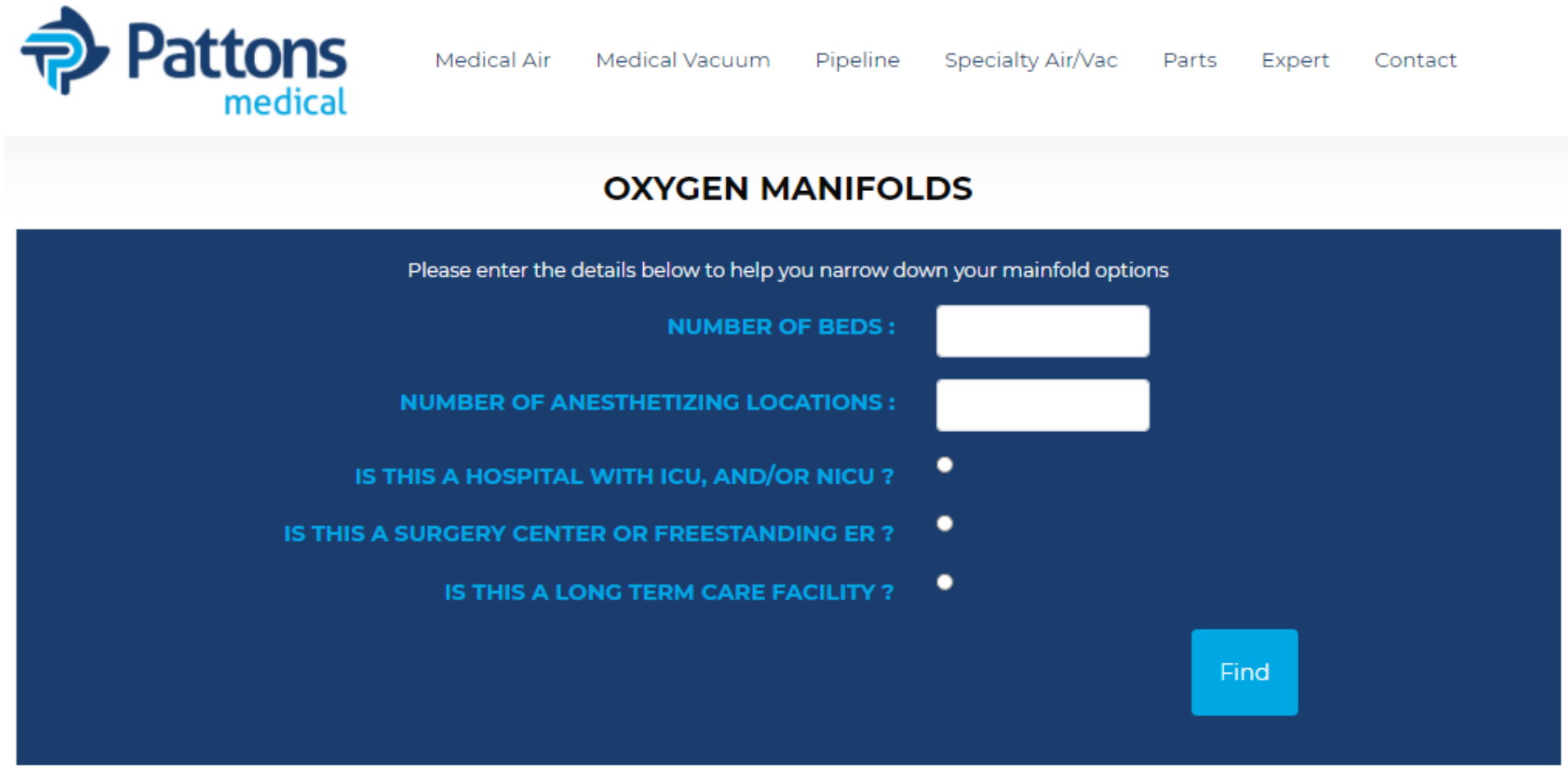
Size O_2 Manifolds on Pattons Medical Website



Sizing Nitrous Oxide Manifolds

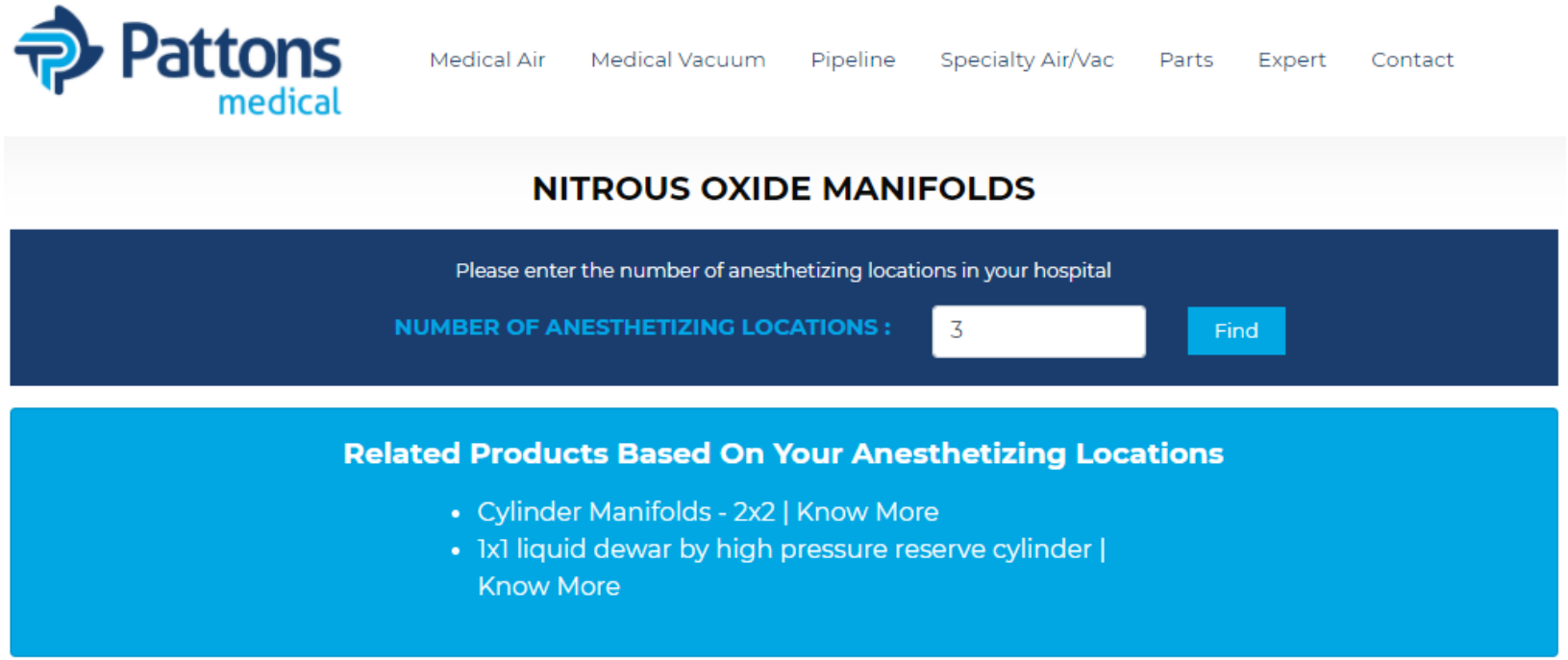
Count up all the anesthetizing locations that are piped with N_2O

Some locations using anesthesia machines will have N_2O on the anesthesia cart and not be hard piped.

The standard sizing method assumes 1 cylinder per OR or anesthetizing location

A 2x2 manifold serves 1-4 ORs

A 4x4 manifold serves 5-8 ORs

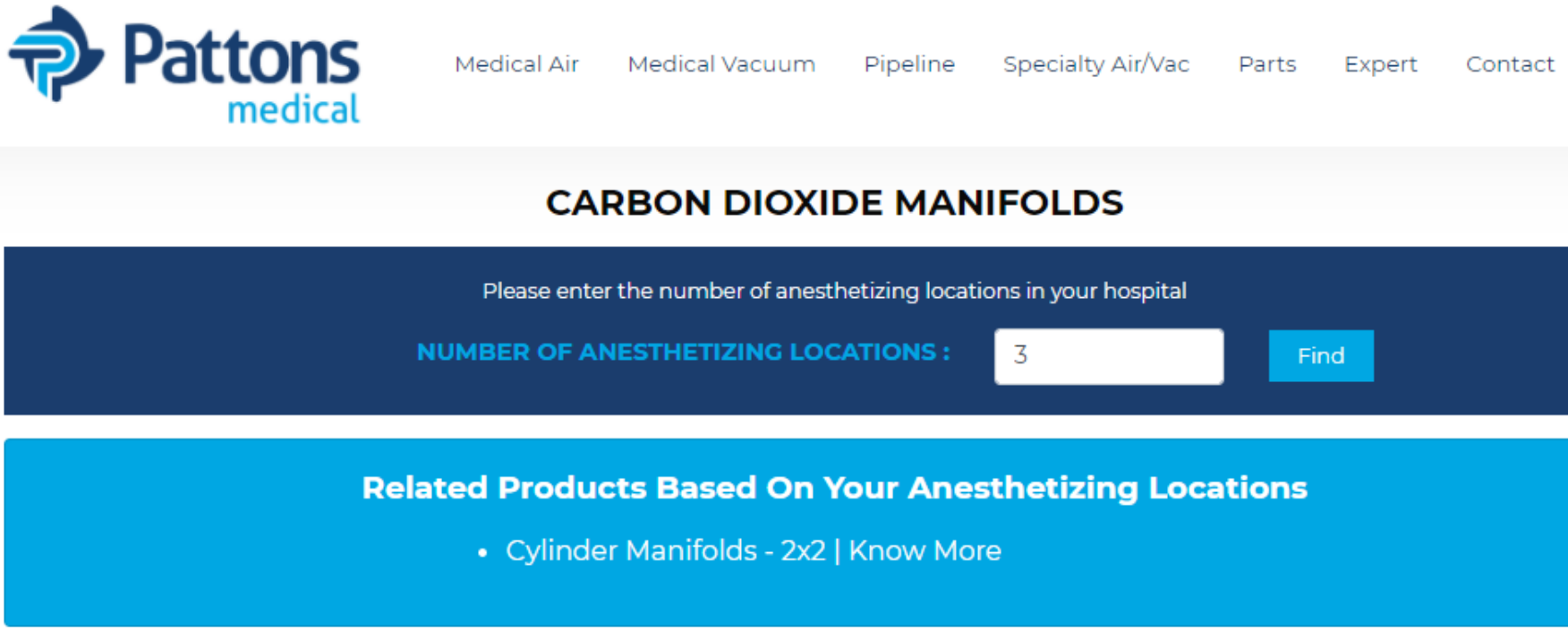


Sizing CO_2 Manifolds

CO_2 is used in some specialty operations.

CO_2 H cylinder holds 500ft3

Number studies have found that approximately ¼ of a cylinder is adequate per OR



Sizing Medical Air Manifolds

In smaller facilities that are not 24 hour locations, it is sometimes more economical to supply a medical air manifold instead of a medical air compressor.

For the calculation use a standard medical air calculation process that you do regardless of source.

The smallest medical air compressor is a 2HP scroll that does 7scfm. If you find your demand is much lower than that then a medical air manifold would be appropriate

Chart for air manifolds

Ft^3 x 24.317 = L

**Not appropriate for ventilators

Size	Ft^3 /L	Liters
2x2	0.3	9
3x3	0.5	14
4x4	0.6	18
5x5	0.8	24
6x6	1	28
7x7	1.2	34
8x8	1.7	37

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Sizing Exotic Manifolds – such as Heliox/Argon/Gases blended with Oxygen

It is very important to obtain information from the clinical staff on the usage required by the equipment delivering the gas.

Example Heliox is primarily used in NICU or maternity ward setting and the usage factor is very low. In the overwhelming majority of the applications a 2x2 is adequate for the 2 week usage and then some.

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Sizing Nitrogen or Instrument Air Manifolds

A standard Ortho OR has shown to use 8scfm
A thoracic OR has shown to use 15scfm

Most regulators flow 70scfm to allow all ORs to operate tools simultaneously.

H cylinder contains 230ft3

Number of Operating Rooms	Number of H Cylinders
1-2	4 (2x2)
3-4	8 (4x4)
5-6	12 (6x6)
7-8	16 (8x8)
8-9	20 (10x10)

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Sizing High Pressure Reserves for Liquid

The High Pressure Reserve must be sized to handle 24 hour demand

Initial calculation gave you the demand for the Month.
Divide that number by 30 to get a daily demand
Divide that number by the contents of the H cylinder for the gas

Gas Volumes in "H" or "K" Cylinders	
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Nitrogen	226 cu. ft.
Nitrous Oxide	577 cu. ft.
Oxygen	244 cu. ft.

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WE CAN HELP!

Our team can help with your specific requirements ,ensure your equipment meets NFPA code, and answer any questions you may have.

Find your rep at https://www.pattonsmedical.com/sales-representative-search/

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Q&A

Please submit questions in the "Questions" field box.

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Thank You

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