

Medical Gas Supply

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Intended Learning Outcomes

By the end of this lecture , the student will be able to:

1.know different available forms of medical gas supply.
2.understand the performance of each form.
3.interpret their applications in anesthetic practice.

Gases found on anesthesia machines

- **Oxygen**
- **Nitrous oxide**
- **Helium** used :

-to reduce work of breathing in patients with an upper or lower airway obstruction as it has a lower density than oxygen, nitrogen and air.
-in laser surgery around the airway to reduce the flammability of the breathing mixture.
-in the measurement of lung volumes because of its very low solubility.

- **Air** used to dilute oxygen when other gases are not desired.

Medical Gas Supply

- cylinders
- a piped gas system

Cylinders

- made of thin-walled **molybdenum steel** to withstand high pressures. Lightweight O_2 cylinders can be made from **aluminum** alloy used during transport.

- are made in different sizes (A to J).; size **E** is used on anaesthetic machine; size **J** is used in cylinder banks.

- O_2 cylinders contain gas , while N_2O cylinders contain a mixture of liquid and vapour.

filling ratio = weight of fluid in cylinder / weight of water required to fill the cylinder

filling ratio of N_2O is 0.75. In hotter climates, it is reduced to 0.67

- are colour-coded.

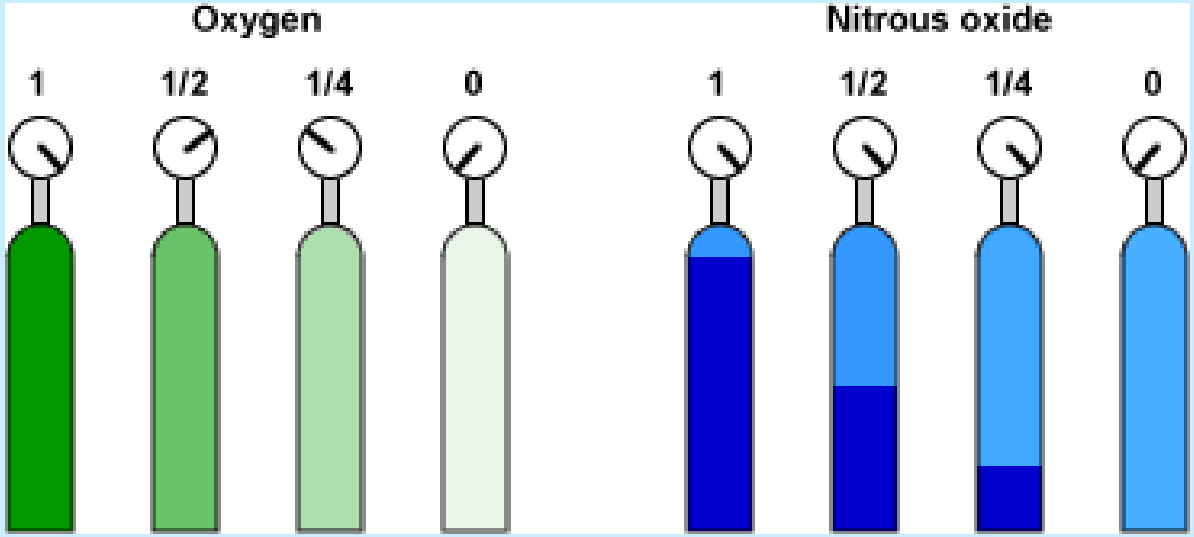
	Body colour (UK)	Shoulder colour (UK)	Pressure, kPa (at room temperature)	Physical state in cylinder
Oxygen	Black (Green in USA)	White	13 700	Gas
Nitrous oxide	Blue	Blue	4 400	liquid / vapour
Carbon dioxide	Grey	Grey	5 000	liquid / vapour
Air	Grey (Yellow in USA)	White/black quarters	13 700	Gas
Entonox	Blue	White/blue quarters	13 700	Gas
Oxygen/ helium (Heliox)	Black	White/brown quarters	13 700	Gas

Standard colour

Oxygen	White
Nitrous oxide	Light blue
Medical air	Black and white
Suction	Yellow
Nitrogen	Black
Carbon dioxide	Grey
Helium	Brown

Size	Capacity (liters)	
	Oxygen	Nitrous oxide
E	680	1800
J	6800	18000

absolute pressure = **gauge** pressure + **atmospheric** pressure



"At a constant temperature, the pressure in a **GAS** cylinder decreases linearly and proportionally as it empties. "

This is not true in cylinder containing **liquid / vapour**.

Cylinders are tested regular intervals, usually 5 years.

1. *Internal endoscopic examination*

2. *Flattening , bend and impact tests ;* are carried out on at least 1/100 cylinders.

3. *Pressure test* ; the cylinder is subjected to high pressures of about 22 000 kPa, which is more than 50% above their normal working pressure.

4. *Tensile test ;* where strips of the cylinder are cut and stretched. This test is carried out on at least 1/100 cylinders.

Marks engraved on the cylinders are:
1. Test pressure.
2. Dates of test performed.
3. Chemical formula of the cylinder's content.
4. Tare weight (weight of nitrous oxide cylinder when en



Labeling. The cylinder label includes the following details:

- name, chemical symbol, pharmaceutical form, specification of the product, its license number and the proportion of the constituent gases in a gas mixture
- substance identification number and batch number
- hazard warnings and safety instructions
- cylinder size code
- nominal cylinder contents (litres)
- maximum cylinder pressure (bars)
- filling date and expiry date
- directions for use
- storage and handling precautions.

Cylinder valves

- They are mounted on the neck of the cylinder.
- Act as an on/off device for the discharge of cylinder contents.
- Pin index system to make it almost impossible to connect a cylinder to the wrong yoke (**O_2** 2&5 , **N_2O** 3&5 , **CO_2** 1&6 , **Air** 1&5)



Index positions of a cylinder valve











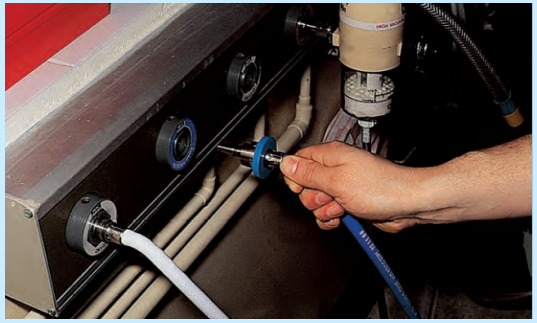
● Bodock sealing washer must be placed between the valve and the yoke of the anaesthetic machine.



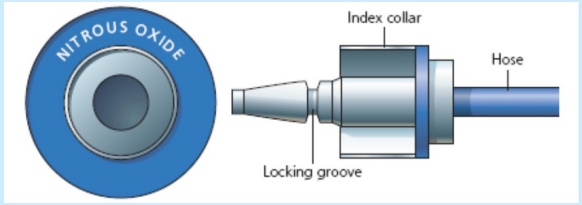
Piped Gas Supply

- a network of copper alloy pipelines from central supply points.

- The outlets are colour- and shape-coded to accept matching ‘Schrader’ probes.



wall-mounted outlet socket



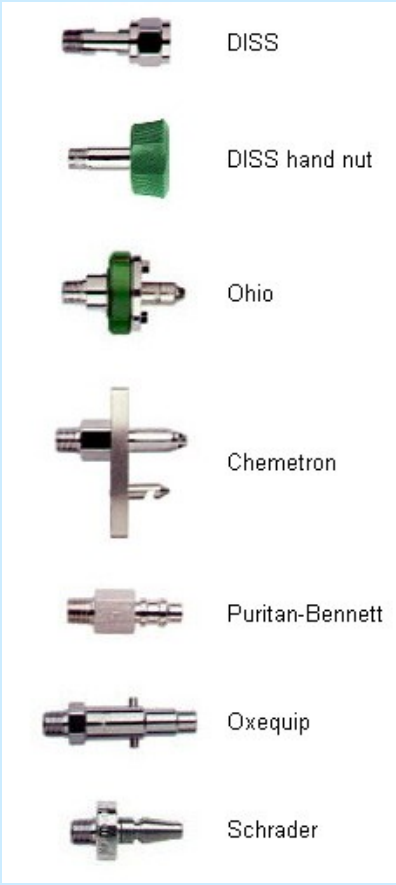


ceiling unit

- Flexible and colour-coded pipelines run from the anaesthetic machine to the outlets.

- There is risk of fire from worn and damaged hoses.





Source of Gas supply

- **Cylinder manifold**: banks of large cylinders(usually size J), usually divided into two groups, primary and secondary (alternating supplying the pipelines automatically)

- **Liquid oxygen**: a thermally insulated vessel at a temperature of -150°C to -170°C and a pressure of 5 –10 atmospheres is used.

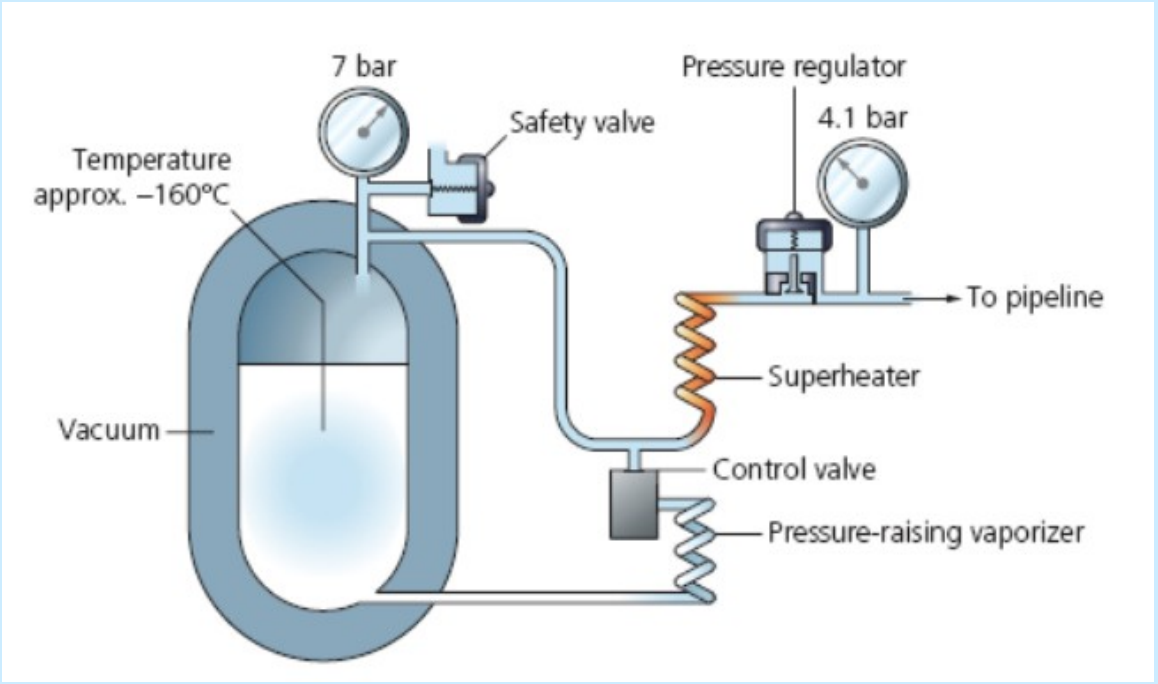
- **Oxygen concentrator**: extracts oxygen from air by differential absorption, a zeolite molecular sieve is used.

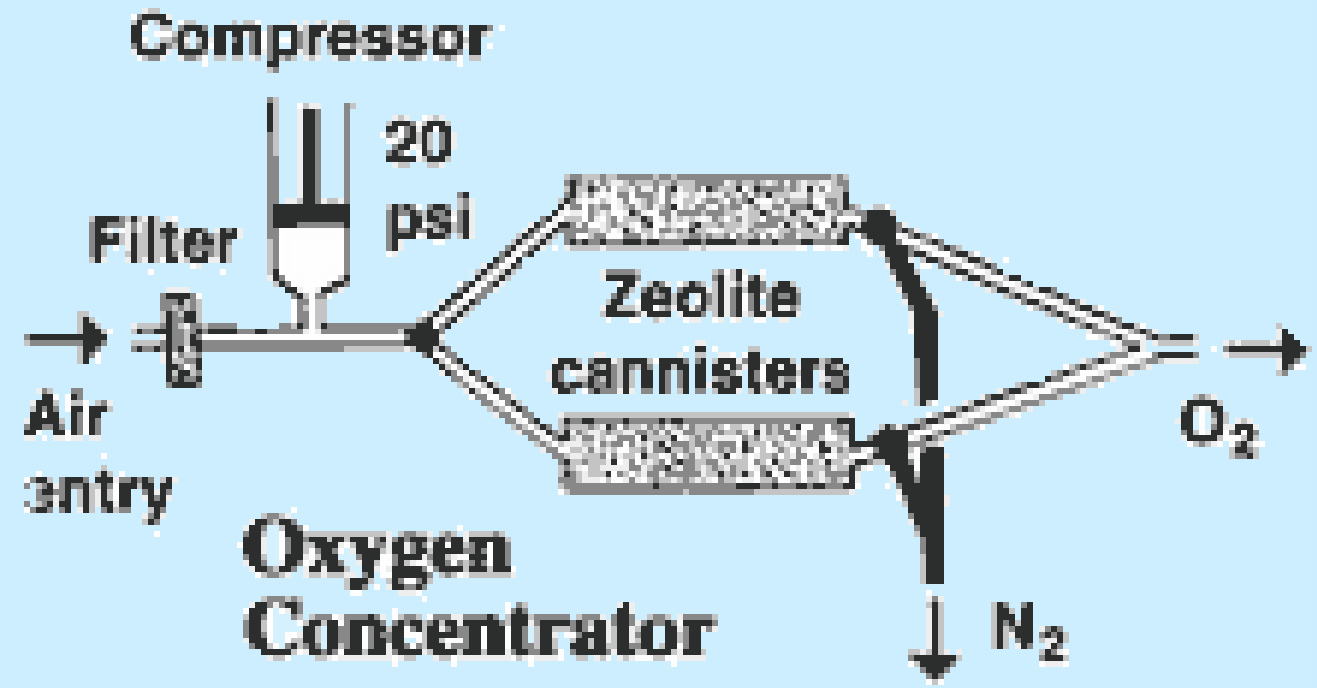
Cylinder Manifold



Liquid Oxygen







atmospheric air is entrained by the concentrator, filtered and raised to a pressure of 20 psi by a compressor

Questions

- **A filling ratio is used when filling cylinders of:**

  1) CO_2.

  2) O_2

  3) N_2O.

  4) Entonox.

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- **With respect to gas cylinders:**

1)Oxygen cylinders contain liquid and vapor.

2)They are made of pure steel.

3)The critical pressure in a nitrous oxide cylinder is 137 Bar.

4)Nitrous oxide cylinders contain liquid and vapor.

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- **Concerning the vacuum-insulated evaporator “VIE” (liquid oxygen tank):**

1)Has a temperature inside of -118 degrees Celsius.

2)Liquid oxygen is evaporated by passing it through copper super heaters in times of increased demand.

3)The amount of oxygen remaining within the VIE is measured by the magnitude of vapor pressure .

4)Has a safety valve that opens at approximately 1700 kPa.

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- **Oxygen :**

1)is stored in cylinders at 137 kPa when full.

2)is stored in black cylinders.

3)for medical use, is usually formed from fractional distillation of air.

4)has a critical temperature of 118 degrees Celsius.

5)is in the liquid form in the cylinder.

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5th *ed*. Paul Davis, Gavin Kenny

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- Physics & Monitoring For Anesthesia & Intensive Care. Hesham M El-Azzazi

THANK YOU