Lecture of anesthesia equipment practical

MEDICAL GAS SUPPLY

Prepared by ...

ANMAR HASAN HADI

MSc. of anesthesia and intensive care medicine

MEDICAL GAS SUPPLY

Gas supply: medical gas supply takes the form of either cylinders or a piped gas system, depending on the requirements of the hospital.

Cylinders

PARTS OF CYLINDER

- Body
- Valve
- Port
- Stem
- Pressure relief device

1. **Cylinders** are made of molybdenum steel in which gases and vapours are stored under pressure.

2. A plastic disc around the neck of the cylinder. The year when the cylinder was last examined can be identified from the shape and colour of the disc.

3. Cylinders are manufactured in different sizes (A to J). Sizes A and H are not used for medical gases. Cylinders attached to the anaesthetic machine are usually size E.


Oxygen is stored as a gas at a pressure of 13700 kPa where as nitrous oxide is stored in a liquid phase with its vapour on top at a pressure of 4400 kPa. As the liquid is less compressible than the gas, this means that the cylinder should be only partially filled. The amount of filling is called the filling ratio.

The filling ratio is the weight of the fluid in the cylinder divided by the weight of water required to fill the cylinder. In the UK, the filling ratio for nitrous oxide is 0.75.



Problems in practice and safety features:

1. The gases and vapours should be free of water vapour when stored in cylinders. Water vapour freezes and blocks the exit port when the temperature of the cylinder decreases on opening.

2. The cylinder valve uses the pin-index system to make it almost impossible to connect a cylinder to the wrong yoke

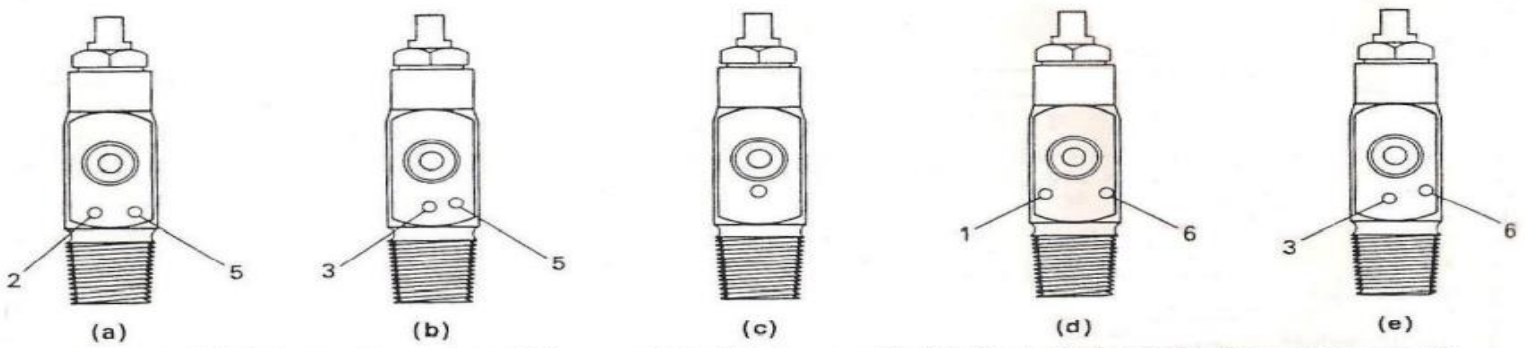


FIG. 32. Pin index configuration. (a) Oxygen (O_2); (b) nitrous oxide (N_2O); (c) Entonox (N_2O 50 per cent + O_2 50 per cent); (d) carbon dioxide (CO_2); (e) cyclopropane (C_3H_6).

3. Cylinders are colour coded to reduce accidental use of the wrong gas or vapour. In UK, the colour coding is a two-part colour.

4. Cylinders should be stored in a dry, well-ventilated and fireproof room. They should not be stored near flammable material such as oil or grease or near any source of heat. They should not be exposed to continuous dampness, corrosive chemicals or fumes. This can lead to corrosion of cylinders and their valves.

5. To avoid accidents, full cylinders should be stored separately from empty ones. Cylinders are stored upright to avoid damage to the valves.

6. Overpressurized cylinders are hazardous and should be reported to the manufacturer.

The 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 empty).

Labelling

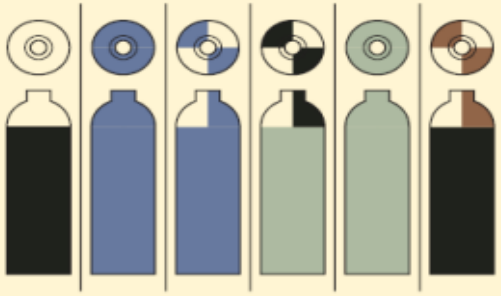
The cylinder label includes the following details:

- Name, chemical symbol, pharmaceutical form, specification of the product, its licence 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, shelf life and expiry date.
- Directions for use.
- Storage and handling precautions.

Cylinders in use are checked and tested by manufacturers at regular intervals, usually 5 years. Test details are recorded on the plastic disc between the valve and the neck of the cylinder. They are also engraved on the cylinder:

1. Internal endoscopic examination.
2. Flattening, bend and impact tests are carried out on at least one cylinder in every 100.
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 one cylinder in every 100.

	Body colour	Shoulder colour	Pressure, kPa (at room temperature)	Physical state in cylinder
Oxygen	Black (green in USA)	White	13 700	Gas
Nitrous oxide	Blue	Blue	4400	Liquid/vapour
Carbon dioxide	Grey	Grey	5000	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



Oxygen

Nitrous oxide

Entonox
(50% N_2O/50%O_2)

Air

Carbon dioxide

Helium/oxygen mixture
(79% He/21% O_2)

Cylinder valves:

These valves seal the cylinder contents. The chemical formula of the particular gas is engraved on the valve

(Fig. 1.6). Other types of valves, the bull nose, the hand wheel and the star, are used under special circumstances (Fig. 1.7).

Components:

1. The valve is mounted on the top of the cylinder, screwed into the neck via a threaded connection. It is made of brass and sometimes chromium plated.

2. An on/off spindle is used to open and close the valve by opposing a plastic facing against the valve seating.

3. The exit port for supplying gas to the apparatus (e.g. anesthetic machine).

4. A safety relief device allows the discharge of cylinder contents to the atmosphere if the cylinder is over pressurized.
5. The non-interchangeable safety system (pin-index system) is used on cylinders of size E or smaller as well as on F- and G-size Entonox cylinders (Figs 1.8).

6. A more recent modification is where the external part of the valve is designed to allow manual turning on and off of the cylinder without the need for a key.

Fig. 1.6 Chemical formula (N_2O) engraved on a nitrous oxide cylinder valve.

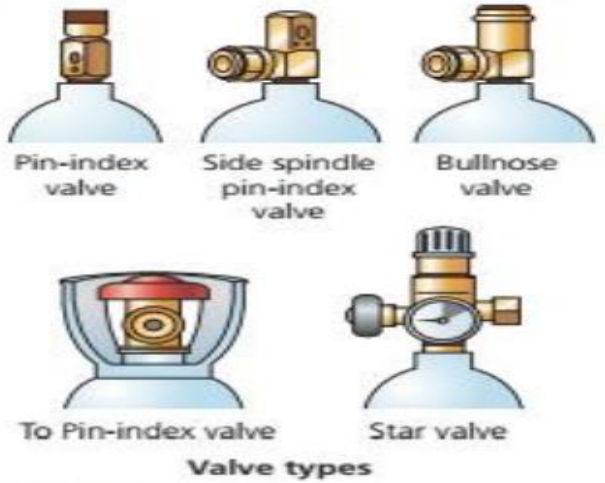


Fig. 1.7 Cylinder valves.

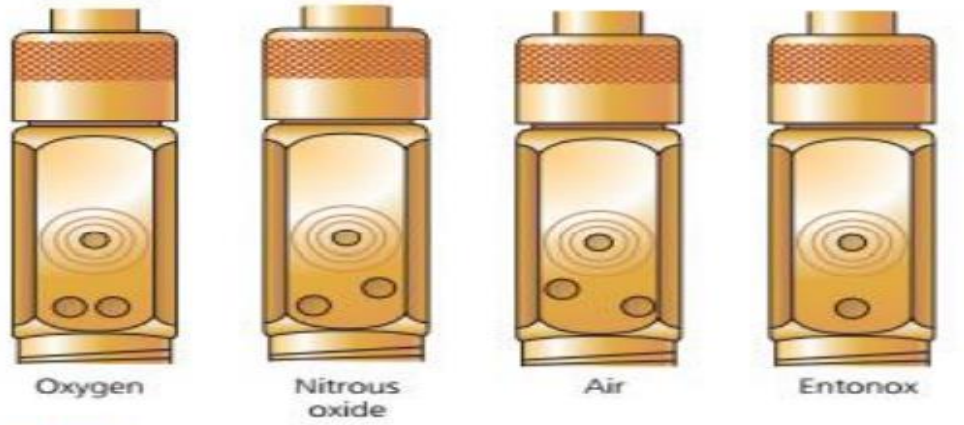


Fig. 1.8 Pin-index system. Note the different configuration for each gas.

Mechanism of action

1. The cylinder valve acts as a mechanism for opening and closing the gas pathway.

2. A compressible yoke-sealing washer (Bodok seal) must be placed between valve outlet and the apparatus to make a gas-tight joint. It is a gasket made of non-combustible material with a metal rim.

Problems in practice and safety features: -

1. The plastic wrapping of the valve should be removed just before use. The valve should be slightly opened and closed (cracked) before connecting the cylinder to the anaesthetic machine. This clears particles of dust, oil and grease from the exit port, which would otherwise enter the anaesthetic machine.
2. The valve should be opened slowly when attached to the anaesthetic machine or regulator. This prevents a rapid rise in pressure and an associated rise in temperature of the gas in the machine's pipelines. The cylinder valve should be fully open when in use (the valve must be turned two full revolutions).
3. During closure, overtightening of the valve should be avoided. This might lead to damage to the seal between the valve and the cylinder neck.
4. The Bodok seal should be inspected for damage prior to use. Having a spare seal readily available is advisable. This bonded non-combustible seal must be kept clean and should never become contaminated with oil or grease. If a gas-tight seal cannot be achieved by moderate tightening of the screw clamp, it is recommended that the seal be renewed. Excessive force should never be used