Practice lecture of anesthetic equipments

Second stage

Medical gas supply

(cylinders)

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Gas supply

Medical gas supply takes the form of either cylinders or a piped gas

system, depending on the requirements of the hospital.

Cylinders

Components:

1. Cylinders are made of thin-walled seamless molybdenum steel in which gases and vapours are stored under pressure. They are designed to withstand considerable internal pressure.

2. The top end of the cylinder is called the neck, and this ends in a tapered screw thread into which the valve is fitted. The thread is sealed with a material that melts if the cylinder is exposed to intense heat. This allows the gas to escape so reducing the risk of an explosion.

3. There is 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.

4. 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 ,while size J cylinders are commonly used for cylinder manifolds. Size E oxygen cylinders contain 680 L, whereas size E nitrous oxide cylinders can release 1800 L.

5. Lightweight cylinders can be made from aluminium alloy with fiberglass,

These can be used to provide oxygen at home, during transport or in magnetic resonance scanners.

Oxygen is stored as a gas at a pressure of 13 700 kPa whereas nitrous oxide is stored in a liquid phase with its vapour on top at a pressure of 4400 kPa.

A full oxygen cylinder at atmospheric pressure can deliver 130 times its capacity of oxygen. A typical size E full oxygen cylinder delivering 4 L per minute will last for 2 hours and 50 minutes but will last only 45 minutes when delivering 15 L/min.

The temperature in such a cylinder can decrease because of the loss of the latent heat of vaporization leading to the formation of ice on the outside of the cylinder.

The marks engraved on the cylinders are:

1. Test pressure.
2. Dates of test performed. inder's content.
3. Chemical formula of the cylinder.
4. Tare weight (weight of nitrous oxide cylinder when empty.

Problems in practice and safety features

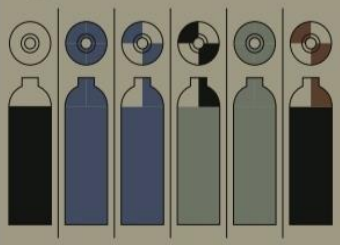
1-The gases and vapours should be free of water vapour when stored in cylinders. Water vapour freezes and blocks the exit port when the temperature of the cylinder decreases on opening.

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

3-Cylinders are colour-coded to reduce accidental use of the wrong gas or vapour.

Table 1.1 Colour coding of medical gas cylinders, their pressure when full and their physical state in the cylinder

	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 ($79\%\ He/21\%\ O_2$)

4- Cylinders should be checked regularly while in use to ensure that they have sufficient content and that leaks do not occur.

5-Cylinders should be stored in a purpose built, dry, wellventilated and fireproof room, preferably inside and not subjected to extremes of heat,

they should not be exposed to continuous dampness, corrosive chemicals or fumes. This can lead to corrosion of cylinders and their valves.

6-To avoid accidents, full cylinders should be stored separately from empty ones.

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

Cylinder valves

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

Other types of valves,

the bull nose, the hand wheel and the star, are used under special circumstances.

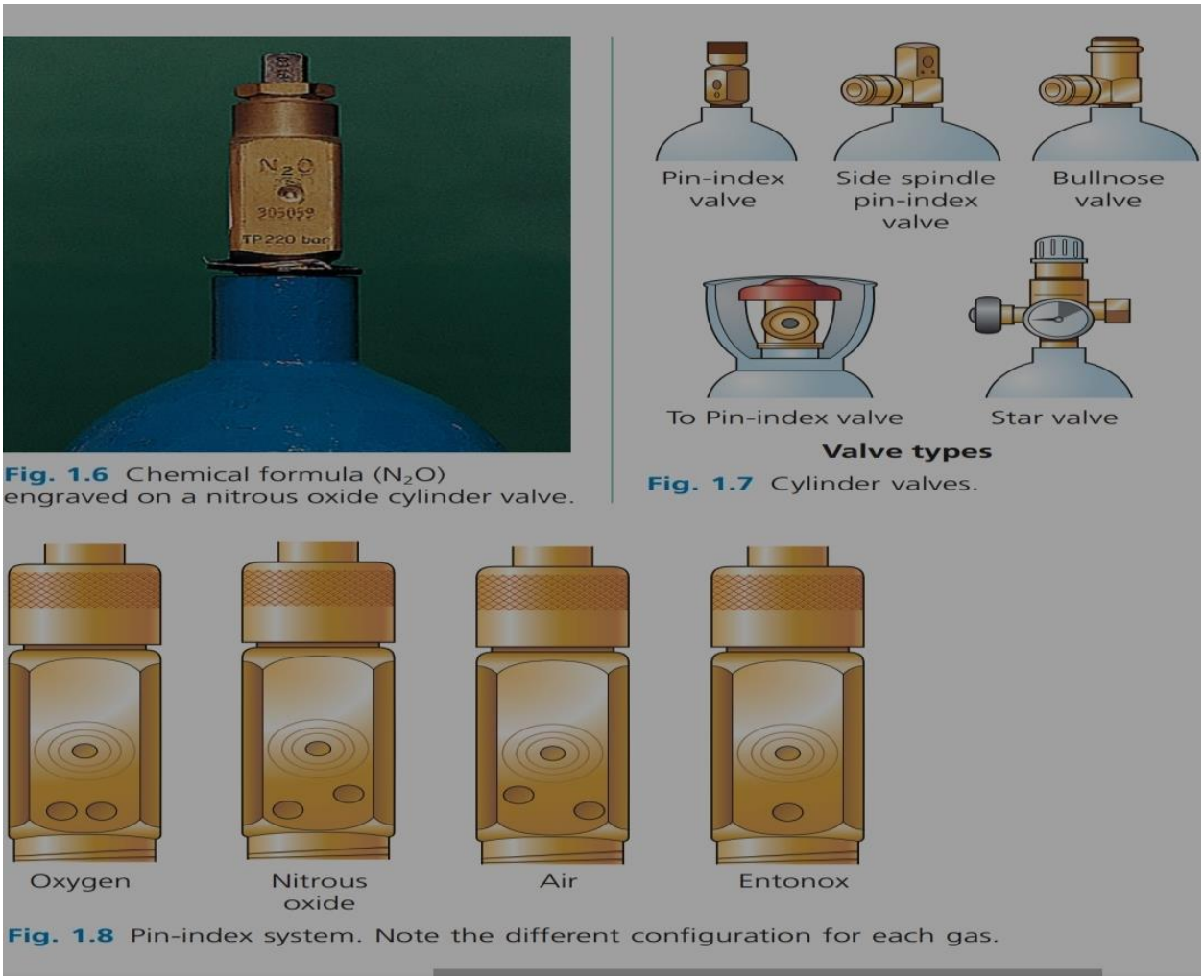


Fig. 1.6 Chemical formula (N_2O) engraved on a nitrous oxide cylinder valve.

Fig. 1.7 Cylinder valves.

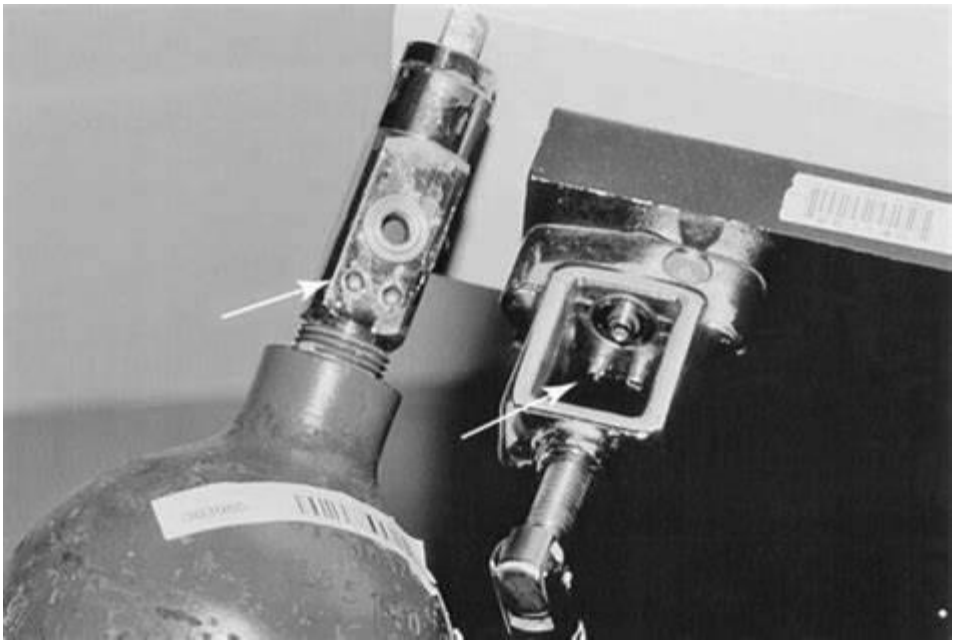
Fig. 1.8 Pin-index system. Note the different configuration for each gas.

Components:

1-The valve is mounted on the top of the cylinder, screwed into the neck via a threaded connection.

2-An on/off spindle is used to open and close the valve

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



4-A safety relief device allows the discharge of cylinder contents to the atmosphere if the cylinder is overpressurized.

5-The non-interchangeable safety system (pin-index system) is used on cylinders of size E or smaller. A specific pin configuration exists for each medical gas on the yoke of the anaesthetic machine.

Mechanism of action:

1-The cylinder valve acts as a mechanism for opening and closing the gaspathway.

2-A compressible yoke-sealing washer (Bodok seal) must be placed between valve outlet and the apparatus to make a gas-tight joint.

Fig. 1.9 A cylinder yoke and pin-index system. Note that a Bodok seal is in position.

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.

2-The valve should be opened slowly when attached to the anaesthetic machine or regulator. This prevents the rapid rise in pressure and the associated rise in temperature of the gas in the machine's pipelines.

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.

Thank you