7. BOTTLED MEDICAL OXYGEN AND OXYGEN CONCENTRATORS

a. BOTTLED MEDICAL OXYGEN

1. Purpose of Equipment

To provide patients with a reliable supply of oxygen.

2. How the Equipment Works

Bottled oxygen supplies comprise the following components:

- metal cylinder
- gas under pressure
- cylinder valve
- cylinder connector (bullnose, pin-index or other)
- regulator to reduce high, variable pressure to constant low pressure
- connector to fit the cylinder connector
- pressure gauge
- gas outlet
- pressure relief valve
- regulator pressure adjustment

Bottled oxygen is supplied under pressure in specially designed steel cylinders of varying sizes. British Standard oxygen bottles range in capacity from 170 litres to 6800 litres:

Capacity (litres)	Cylinder reference	Valve type
170	C	Pin-index
340	D	Pin-index
680	E	Pin-index
1360	F	Bullnose
1360	AF	Bullnose
3400	G	Bullnose
6800	J	Bullnose

Because the types of valves used on cylinders vary, always check that the regulator will fit the cylinder valve before use (Figure 12).

Valves and regulators should be carefully checked when cylinders are changed: ensure that mating surfaces are free of debris. Remember that pin-index valves are different for different gases.

British Standard oxygen cylinders are black with white tops (Figure 12) but colours may vary in other countries. Check each cylinder very carefully for content before use by reading the pressure gauge.

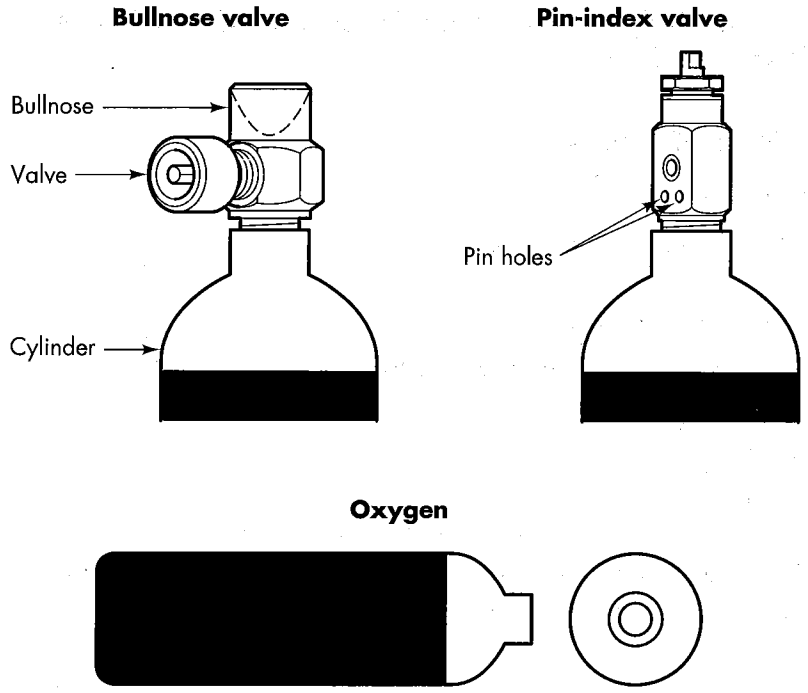

Figure 12: Valve types used for medical oxygen and cylinder colour code to British Standards

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The pressure and rate at which a patient receives an oxygen supply is determined by the person overseeing his or her medical treatment. The rate is indicated on a flowmeter. The maximum flow rate normally supplied to a patient is about 4 litres/minute.

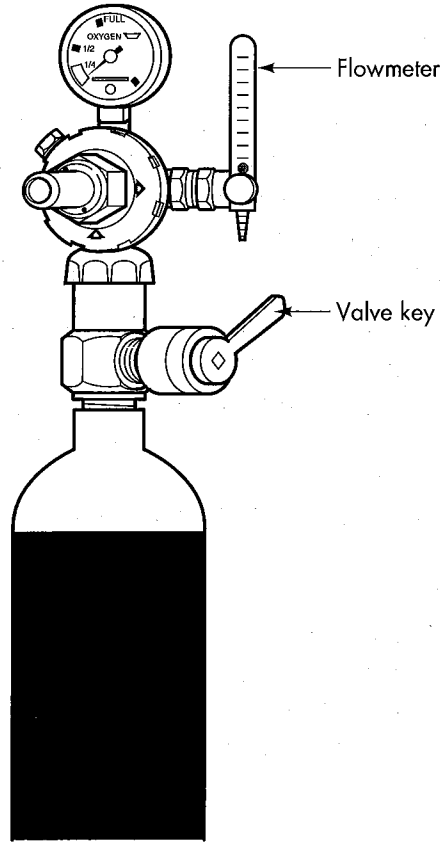
3. Routines and Safety

i. Routines

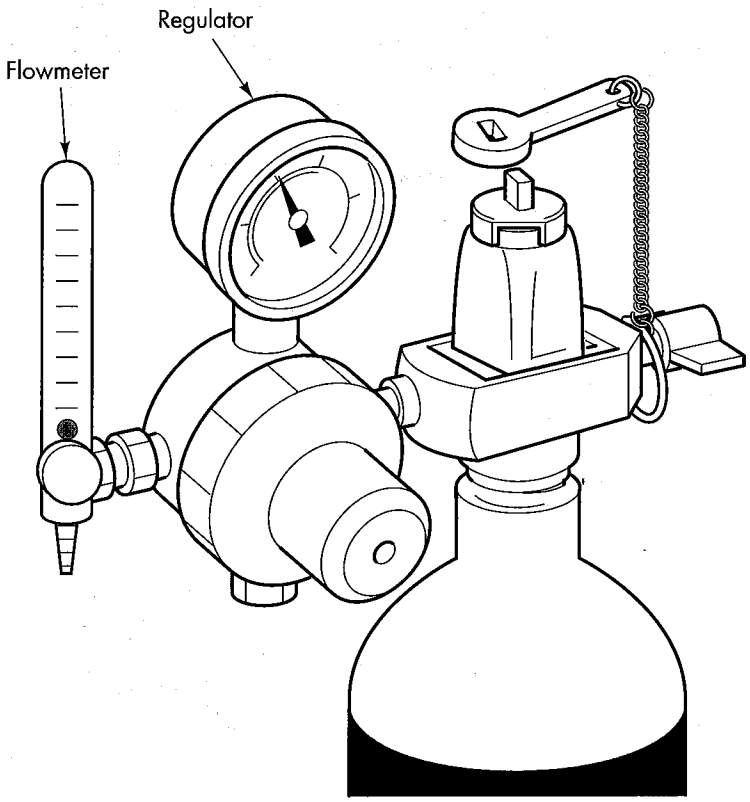
All cylinders should be carefully examined upon receipt from the suppliers and again when taken out of store and put into operational use.

Before putting a cylinder into service, the user should ensure that:

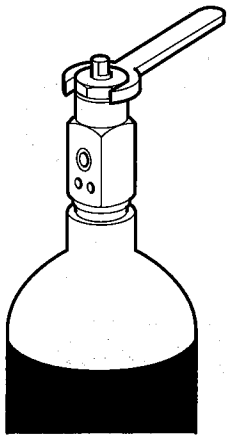
- the cylinder is not damaged or rusted
- the cylinder valves have their protective caps or seals in place and that their threads and pin-indexes are in good order
- the correct cylinder valves are fitted
- the cylinders are colour-coded and stamped correctly according to the standard laid down by the governing authority
- the valves are free from oil, grease, moisture and dust
- the correct key or spanner of similar length (not more than 150mm) is available for opening valves (Figure 13). Severe damage can be caused if the wrong tool is used



13 a. Bull-nose regulator and cylinder combination



13 b. Pin-index regulator and cylinder combination: always keep cylinder valve key physically strapped to regulator



13 c. Tightening the gland nut on a pin-index valve cylinder

Figure 13: Use of correct spanner/key on cylinder valves

ii. Safety

a. Personnel safety

Do take great care when handling oxygen cylinders, making sure that there are at least two people to lift and carry large cylinders
Do wear good foot protection when moving a cylinder in case it is inadvertently dropped
Do use a wheeled cylinder trolley to move cylinders

Do NOT allow flames or smoking anywhere near the cylinders as oxygen promotes combustion
Do NOT carry a cylinder by its valve
Do NOT use grease or oil anywhere on the equipment as this can create an explosion risk
Do NOT allow pressurised oxygen to come into contact with the skin

b. Storage safety

Do keep cylinders in a dry, clean and well ventilated area
Do keep cylinders away from flames, lighted cigarettes, inflammable liquids and combustible material
Do use clear signs as warnings of potential dangers (Figure 14)

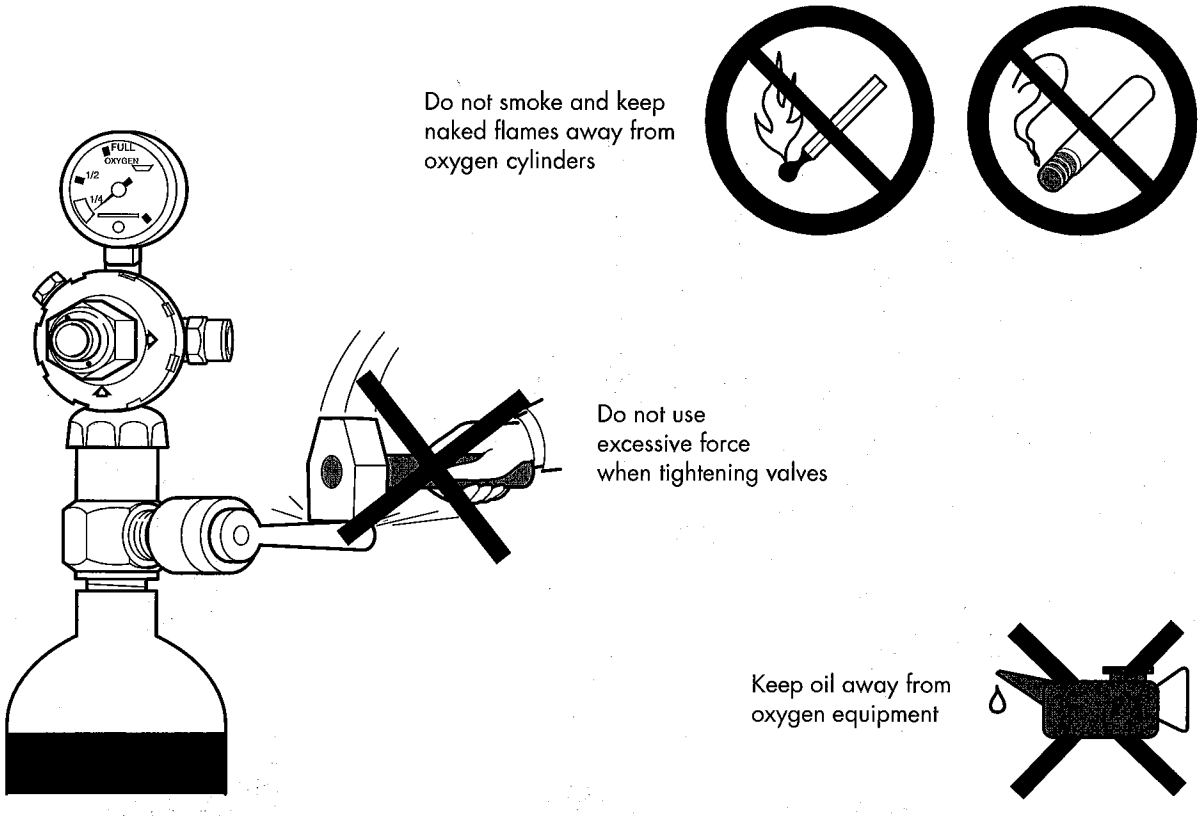


Figure 14: Use of clear warning signs

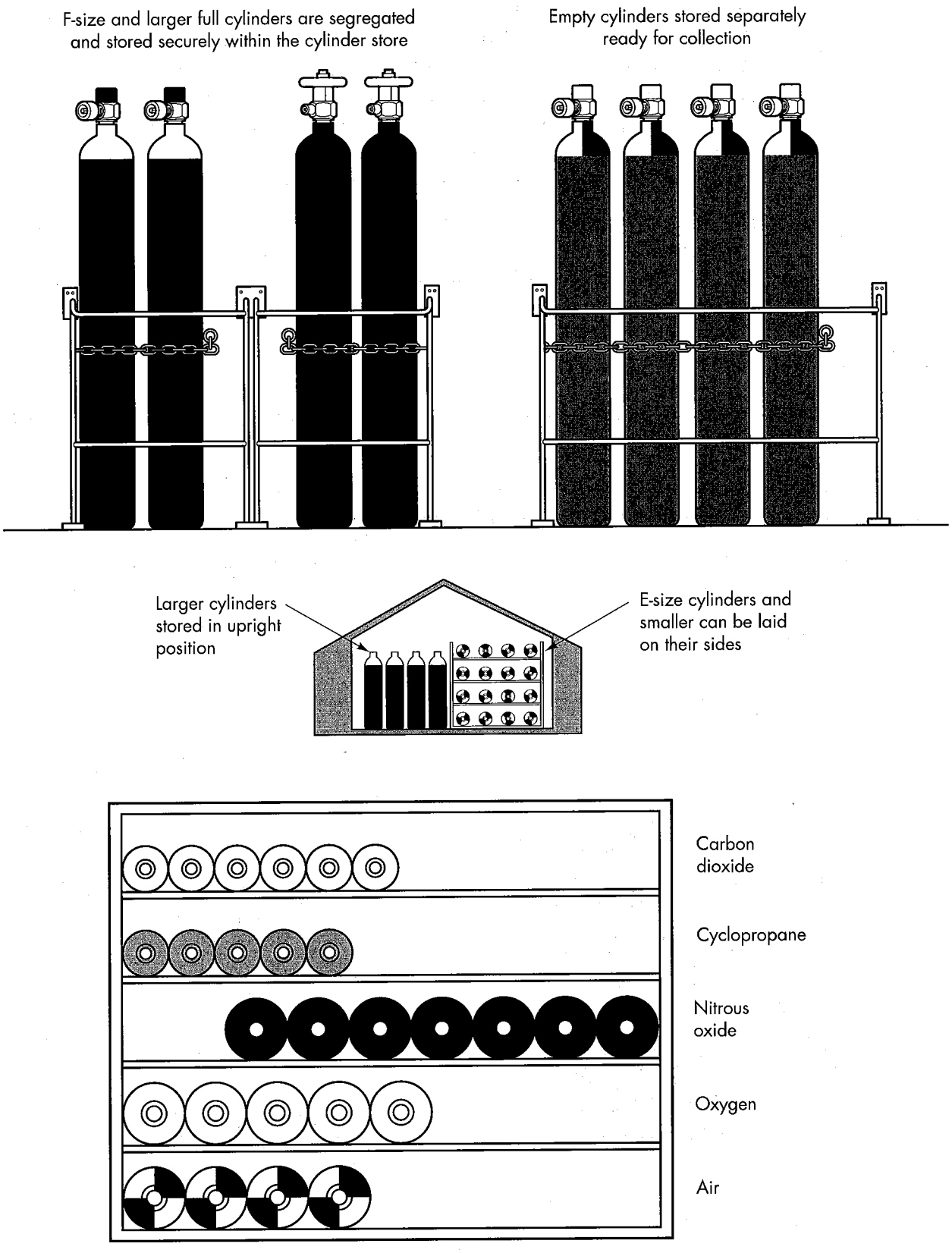


Figure 15: Safe storage of cylinders

Do sort and store different gases separately
Do store E-sized and smaller cylinders on their sides and larger cylinders in an upright position (Figure 15)
Do use chains or other methods to prevent the cylinders falling over
Do ensure that cylinders are used in strict rotation by date
Do keep empty cylinders separate from full ones
Do replace the protective covers or caps from the valves of empty cylinders (Figure 16)
Do ensure that empty cylinders are returned to the suppliers

Do NOT store cylinders in direct sunlight as this can cause the gas to expand and the cylinder pressure to increase excessively
Do NOT use excessive force to shut cylinder valves; tighten by hand tool only

iii. Fire

In the event of fire, raise the alarm and, unless life is endangered, attempt to move the cylinders away from the area.

If personnel are not trained to use fire fighting equipment leave cylinders in the fire zone and carry out statutory fire drill procedures.

Only trained personnel should handle cylinders which have been affected by fire or excessive heat.

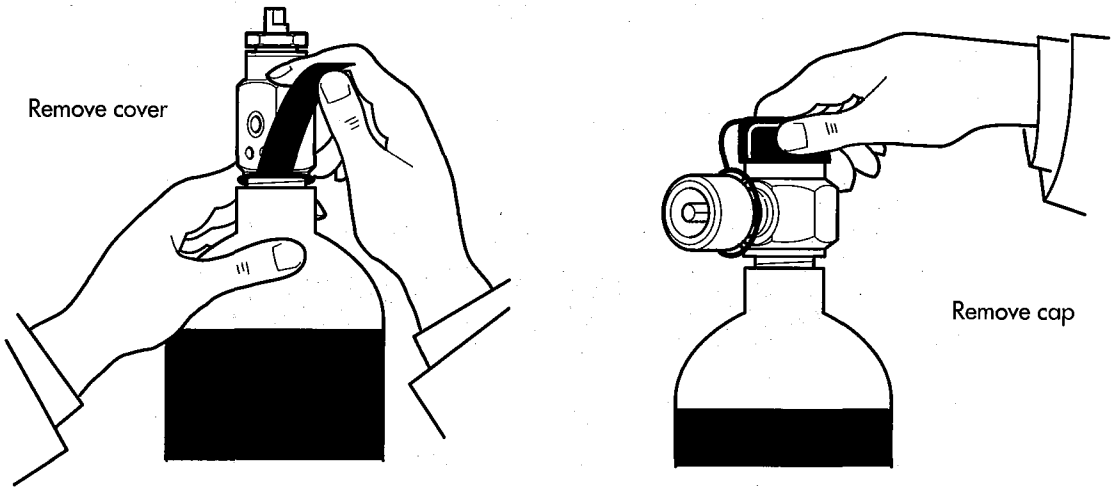


Figure 16: Protective caps and seals

4. How to Use the Equipment

Always refer to the manufacturer's instructions for specific advice on the equipment you are using. The following are general guidelines only.

A. Equipment with a bullnose regulator

Opening the system:

i. remove protective cover or seal from the valve and retain this in a safe place (around the cylinder collar)
ii. with the appropriate key or spanner (Figure 13) open the valve slightly and momentarily in order to blow out any foreign matter which may have accumulated around the valve mouth. Make certain that the oxygen is directed away from personnel when you do this
iii. check that the regulator is the correct type and is also free from foreign matter
iv. check that the 'O' ring is in place where there is a groove for it and in good condition (Figure 17)
v. fit the regulator into the cylinder valve
vi. if an 'O' ring is fitted, tighten by hand. If an 'O' ring is not fitted, tighten by using the appropriate spanner. Do not use excessive force as that can damage the valve
vii. open the cylinder valve by turning SLOWLY once only with the correct key or spanner of similar length. If neither key nor spanner is available, do NOT attempt to turn the valve
viii. check for leakage at the cylinder connection
ix. check that the gauge is registering and that the pointer has steadied before giving the valve another complete turn
x. open the flowmeter
xi. administer the oxygen by selecting the prescribed flow

Using the system:

i. use no oil or grease
ii. blow out valves to remove dust
iii. open cylinder valves slowly
iv. secure cylinders so that they cannot fall over

Closing the system:

i. close cylinder valve
ii. open equipment or machine valves to release any gas held in the system
iii. when cylinder gauge reading has reached zero and hissing has stopped, close flowmeter valve

Do close the cylinder valve when the equipment is not in use otherwise the life of the regulator will be shortened.

Do NOT attempt to remove the regulator with the cylinder valve open as this excessive pressure will damage the thread.

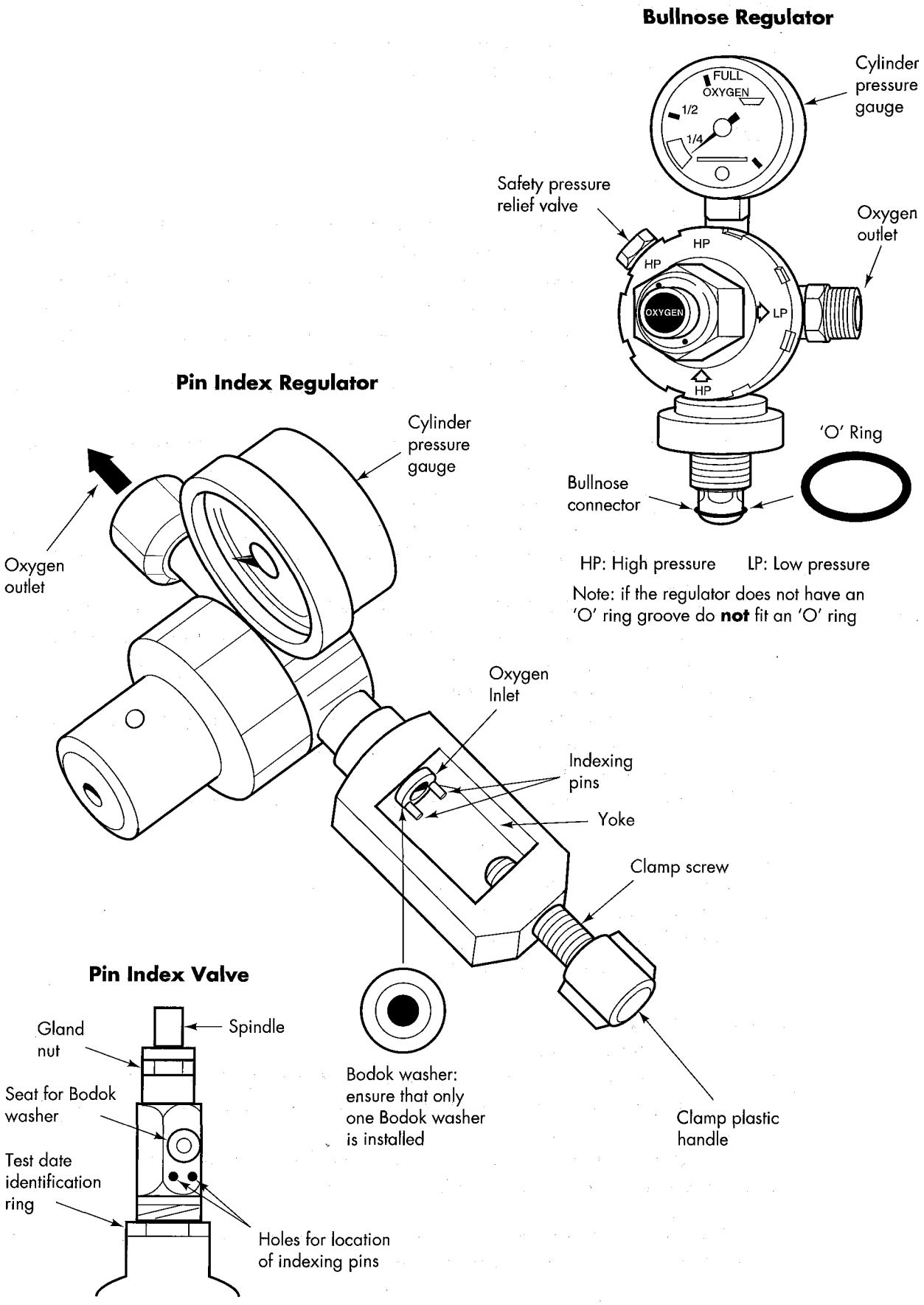


Figure 17: Pin index and bullnose regulators, "O" ring and Bodok washer locations

B. Equipment with pin-index regulators

Opening the system:

i. remove protective cover or seal from the valve and retain this in a safe place (around the cylinder collar) (Figure 16)
ii. with the appropriate key or spanner (Figure 13) open the valve momentarily in order to blow out any foreign matter which may have accumulated around the valve mouth. Make certain that the oxygen is directed away from personnel when you do this.
iii. check that the regulator is the correct type and is also free from foreign matter
iv. check that the Bodok washer is in place and in good condition
v. locate the clamp over the pin-index valve
vi. clamp the regulator to the cylinder, using a Bodok washer as a seal (Figure 17)
vii. when the Bodok washer is in place, use the handle to tighten the clamp (Figure 17)
viii. if there is no leakage, open the cylinder valve by turning once only with the correct key or spanner of similar length. If neither key nor spanner is available, do not attempt to turn the valve
ix. check that the gauge is registering and that the pointer has steadied before giving the valve another complete turn
x. open equipment or machine valves (flowmeters)
xi. administer the oxygen as prescribed

Do NOT overtighten the clamp
Do NOT use a spanner
Do NOT use more than one Bodok washer

Using and closing the system:

As for equipment with a bullnose regulator (See A. above)

C. Equipment with pin-index cylinders fitted direct

Some equipment, such as anaesthetic machines, include an oxygen cylinder with a pin-index system. It is important to make sure that all valves on the machine are closed before proceeding as described above.

5. Simple Fault-finding and Maintenance

The Maintenance Staff Member should carry out the following maintenance procedures.

Weekly:

i. check all associated equipment for signs of mechanical damage or loose connections
ii. gently tap the regulator dial to make sure that the indicating needle is not jammed
iii. check all pipes for cracks
iv. open and close all valves to make sure they are working correctly

Monthly:

i. check that washers, caps and seals are in place on cylinders and regulators
ii. examine regulators and flowmeters for damage
iii. check that all statutory labels and warning notices are in place and are visible
iv. check that the 'O' rings on bullnose regulators are fitted and in good condition
v. check that the Bodok washers are fitted to the pin-index regulators and are in good condition
vi. examine equipment for oxygen leakages (see below)

Yearly:

Have the equipment inspected for leaks and accuracy by a qualified technician

Oxygen leaks

If an oxygen leak is suspected:

i. with the system open and under pressure listen for the usual hissing noise which gas makes as it escapes under pressure

If difficult to locate:

ii. with a toothbrush, apply detergent solution (e.g. 0.5%) over the suspect area. NEVER use oily soap as this can create an explosive mixture. Small bubbles will appear at the leakage point

When the leak has been located:

iii. close down the system (as described in Section 4 above)
iv. tighten pipeline joints

If the leak is from the connection between the regulator and the cylinder, take great care not to over-tighten by using excessive force. These joints are machine manufactured to a high degree of accuracy and are easily damaged. Examine seals and sealing faces for damage. Replace damaged seals

If the pressure relief valve does not shut off automatically, close the valve and send the equipment away for expert repair

Do NOT use jointing compounds or tape to mend a leak
Do NOT dismantle a cylinder valve
Do NOT readjust a pre-set pressure regulator
If either of these develops a leak, replace it.

6. Spares

For local maintenance service, the following should be kept in store:

- a full cylinder
- regulator
- 'O' rings
- Bodok washers

} available from the oxygen supplier

- detergent solution and toothbrush
- clean cloths
- cylinder valve keys

7. User Checklist (to be displayed near the equipment)

Always refer to the manufacturer's instructions

Always keep a spare full cylinder in reserve for emergency use

To keep this equipment in good working order for as long as possible:

Before using:

i. check that you have the correct cylinder
ii. check that the cylinder is not damaged or rusted
iii. check that the cylinder contains enough oxygen for your patient
iv. use the correct valve key
v. make sure the cylinders are not leaking oxygen
vi. check that the equipment is free from oil, grease and water

Opening the system:

For a bullnose regulator:

i. remove the protective cap or cover from the valve and retain this in a safe place to replace on the empty cylinder
ii. with the appropriate key or spanner open the valve momentarily to blow out any foreign matter which may have accumulated around the valve mouth. Make certain the oxygen is directed away from personnel when you do this
iii. check that the regulator is the correct type and is free from foreign matter
iv. check that the 'O' ring is in place and in good condition. The machined groove on the bullnose will indicate the need for this: some makes do not require the 'O' ring
v. fit the regulator into the cylinder valve
vi. if an 'O' ring is fitted, tighten it by hand. If an 'O' ring is not fitted, tighten by using the appropriate spanner. Do not use excessive force as that can damage the valve
vii. if there is no leakage, open the cylinder valve by turning once only with the correct key or spanner of similar length. If neither key nor spanner is available, do not attempt to turn the valve
viii. check that the gauge is registering and that the pointer has steadied before giving the valve another complete turn
ix. open equipment or machine valves (flowmeters)
x. administer the oxygen as prescribed

For a pin index regulator:

i. remove the protective cap or cover from the valve and retain this in a safe place to replace on the empty cylinder
ii. with the appropriate key or spanner open the valve momentarily to blow out any foreign matter which may have accumulated around the valve mouth. Make certain the oxygen is directed away from personnel when you do this

iii. check that the regulator is the correct type and is free from foreign matter
iv. check the Bodok washer is in place and in good condition
v. locate the clamp over the pin index valve
vi. clamp the regulator to the cylinder using the Bodok washer as a seal and use the handle to tighten the clamp
vii. if there is no leakage, open the cylinder valve by turning once only with the correct key or spanner of similar length. If neither key nor spanner is available, do not attempt to turn the valve
viii. check that the gauge is registering and that the pointer has steadied before giving the valve another complete turn
ix. open equipment or machine valves (flowmeters)
x. administer the oxygen as prescribed

Closing the system (for both bullnose and pin index regulators):

i. close cylinder valve
ii. open equipment or machine valves (flowmeters) to release any gas held in the system
iii. when the cylinder gauge reading has reached zero and hissing has stopped, close flowmeter valve
vi. close cylinder valve when the equipment is not in use

Report to Maintenance Officer:

Any apparent damage
Any leakage of oxygen
Any other fault

Follow these SAFETY points (for both bullnose and pin index regulators):

Do keep cylinders well away from flames and smokers
Do make sure equipment is free from oil, grease and water
Do follow the 'opening the system' and 'closing the system' procedures carefully
Do close the cylinder valve when the equipment is not in use
Do return the empty cylinder back to the store

Do NOT move cylinders alone
Do NOT lift cylinders by their valves
Do NOT point pressurised oxygen towards anyone
Do NOT leave the cylinder valve open when the equipment is not in use
Do NOT allow oil or grease to come into contact with the equipment
Do NOT use more than one Bodok washer on a pin index valve connection
Do NOT use jointing components or tape to mend a leak
Do NOT dismantle or readjust a regulator or cylinder valve
Do NOT attempt to remove the regulator with the cylinder valve open as the excessive pressure will severely damage the thread