

## **b. OXYGEN CONCENTRATORS**

### **1. Purpose of Equipment**

To provide patients with a reliable supply of oxygen. It is usually used where oxygen cylinders are difficult to obtain and/or are expensive.

### **2. How the Equipment Works**

Air is drawn into the machine by a compressor. After passing through a series of filters to cleanse it of bacteria and solid matter, the air is pumped into the concentrator where all nitrogen is extracted. The resulting oxygen is then fed into the oxygen reservoir from where it is administered to the patient at the prescribed rate.

### **3. Routines and Safety**

#### **i. Routines**

Before using an oxygen concentrator check that:

- the concentrator is standing in a place which is as dust-free as possible. This will reduce the load on the filters and thus cut operational costs
- the machine is standing at least 30cm away from any obstruction
- the inlet filter is clean
- the exterior of the machine is not damaged
- gauges and switches are not damaged
- the mains lead is not frayed or damaged
- the plug is not damaged
- the machine is clean and the inlets are free of debris
- outlets are clean

Report any damage to the Maintenance Officer

Weekly (or more frequently if the environment is dusty):

if the air intake filter (Figure 18) is washable:

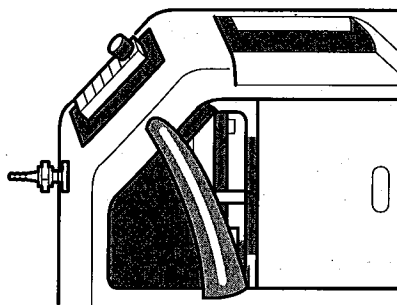
- disconnect machine from mains supply
- remove and wash filter in detergent solution. Do NOT use soap
- dry the filter thoroughly but do not use heat as this may damage the filter
- replace the filter. Never run the machine without this in place. (Some machines have a safety device which prevents the machine from being used without the filter)

If applicable, remove and empty condensation tray. (Not all oxygen concentrators have a condensation tray)

### Intake filter

Check the intake filter daily and clean it whenever it is dirty. Dirt or lint can easily be seen on the filter and must be removed.

To clean the filter, take it off the side of the concentrator; wash it in mild detergent solution, rinse in clean water, and squeeze out excess water. Never use soap.



### Caution

Do not use heat to dry the filter - heat might damage it.

Do not use the filter until dry.



**Figure 18:** Typical air intake filter, also known as the coarse filter

After 5000 running hours (indicated on the counter at the back of the equipment):

- return equipment to maintenance workshop for general overhaul and a change of secondary filters (Figure 19)

If there is no workshop available:

- change filters according to manufacturer's instructions

## ii. Safety

Oxygen concentrators must not be used near flammable anaesthetics such as ether. A concentrator should only be used in an operating room if it is mounted 1.5 metres high on a wall so that it is beyond the zone of risk for flammable anaesthetics.

Do use the equipment in an environment which is clean, cool and well ventilated

Do keep the machine clean by washing with detergent solution and drying thoroughly

Do ensure that all tubing is non-toxic and free of odour

Do switch off and unplug the machine when it is not in use

Do keep a spare cylinder of oxygen to hand, in case the concentrator breaks down unexpectedly

Do NOT use the machine where there are odours or volatile gases or liquids

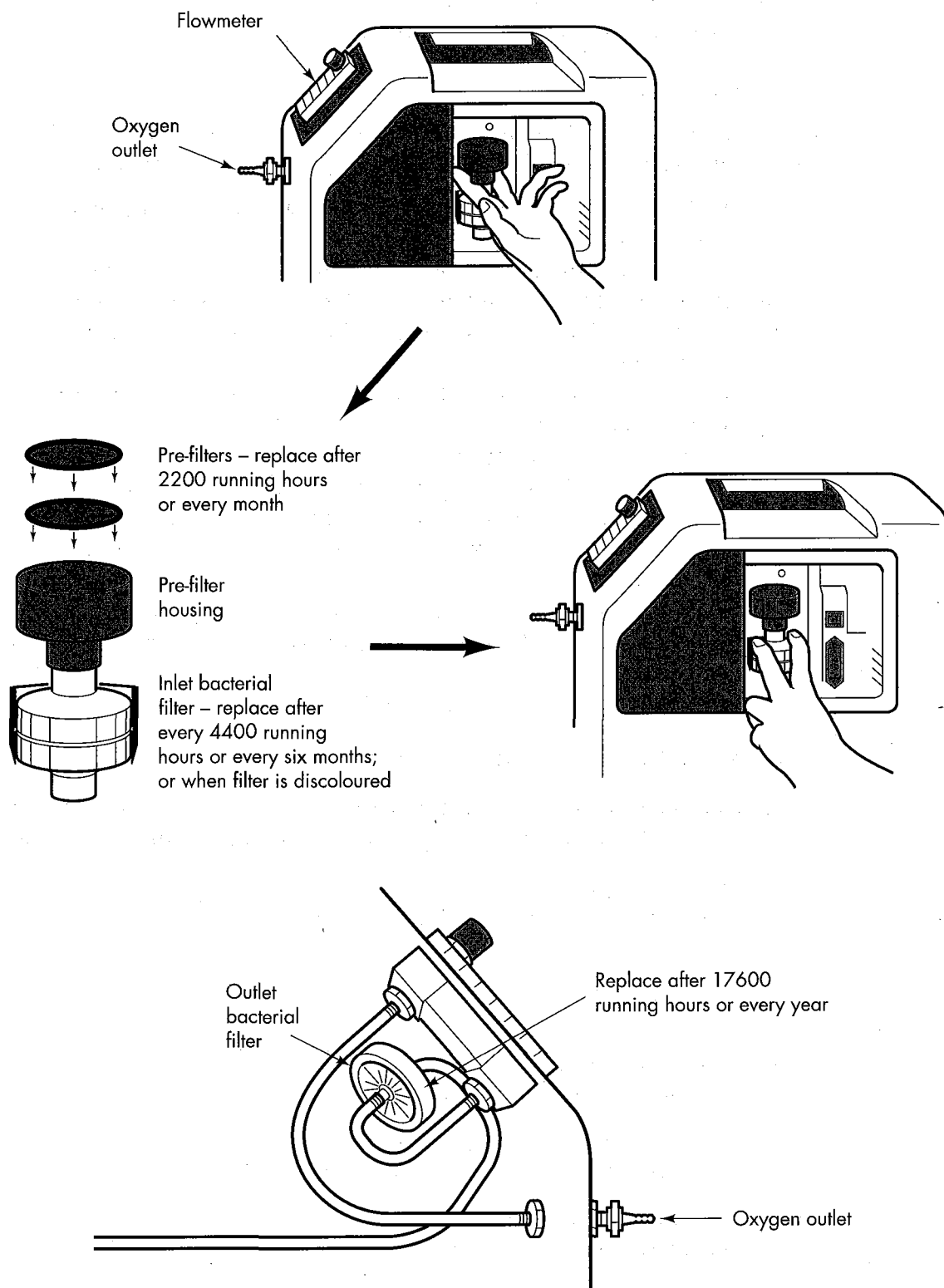
Do NOT allow any liquid to run into the machine

Do NOT use soap or grease on the machine

Do NOT place anything on top of the machine

Do NOT allow smoking or flames near the machine and the oxygen outlets

Do NOT allow children near the machine



**Figure 19:** Typical appearance and layout of secondary filters

If humidifying equipment is being used:

- Do make sure water cannot be fed back into the machine; use only dry filters
- Do use only boiled water in the humidifier
- Do wash and dry the humidifier frequently

#### **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.

- i. make sure that the equipment is in an upright position and is standing on a level surface
- ii. confirm that the mains voltage is suitable for the machine
- iii. if the model is not insulated, check that there is an earth pin
- iv. make sure that the power source has a capacity which matches the load (400 watts)
- v. carry out a visual check of all external connections to make sure that there is no leakage of oxygen
- vi. check that all hand-operated valves are open
- vii. make sure that the air-inlets are clear (Figure 20)
- viii. plug concentrator into mains socket and switch on
  - if either a portable generator or a truck battery with an AC inverter is being used:
    - start generator or inverter and close control switch
    - when satisfied that the generator/inverter is working, plug in concentrator and switch on
- ix. adjust oxygen flow to the prescribed rate

#### **5. Simple Fault-finding and Maintenance**

**Example a:** The oxygen concentrator is 'dead' with no sound or lights on:

- check that all the filters are in place and that the inlet filter is clean

If these are satisfactory:

- check that the socket outlet is working

If that is satisfactory:

- check the mains lead

If that is satisfactory:

- check the fuse(s) on the machine

If that is satisfactory:

- send equipment away for expert repair

**Example b:** The flowmeter gauge is not indicating the oxygen flow:

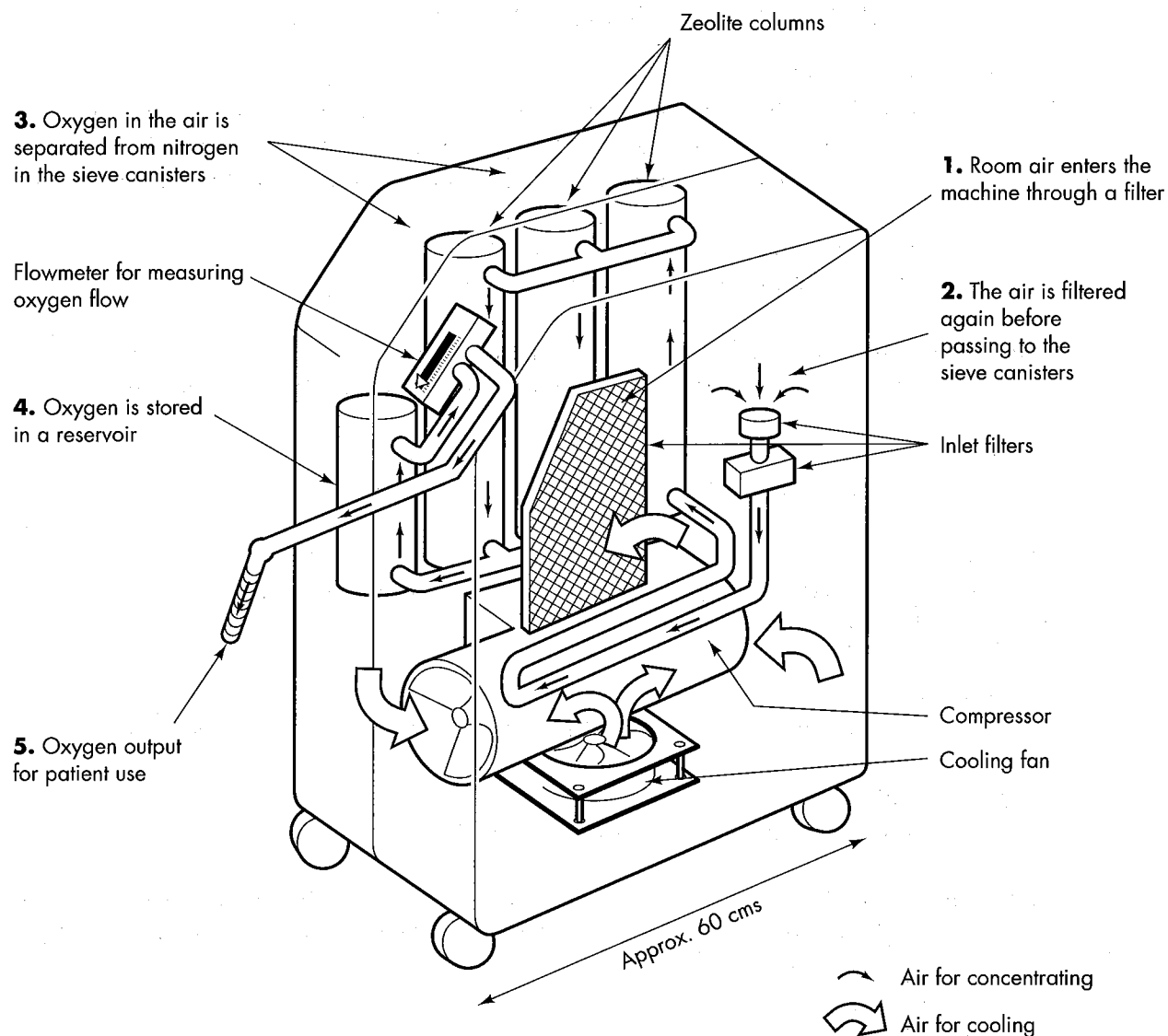
- check tubing for kinks and blockages

If these are satisfactory:

- check that all downstream valves are open

If these are satisfactory:

- send equipment away for expert repair



**Figure 20:** Oxygen concentrator in operation

**Example c:** Oxygen is not reaching the patient:

- check that the machine is running and the flowmeter gauge is indicating flow of oxygen

If these are satisfactory:

- check downstream tubing and ancillary equipment for leaks, kinks and blockages

If machine is running and the flowmeter is not indicating the flow of oxygen:

- send equipment away for expert repair

**Example d:** Machine stops:

- check the socket outlet is working

If that is satisfactory:

- check the mains lead

If that is satisfactory:

- check that inlets and filters are clean and not blocked

If these are satisfactory:

- machine may have cut out automatically due to over-heating, over-loading or low voltage, so cool room if possible and switch off machine for 30 minutes. Check the voltage supply and use a voltage stabiliser if needed.

If machine fails to start again after 30 minutes:

- send equipment away for expert repair

**Example e:** Machine outlet flow rate drops or is erratic:

- check that the ancillary equipment is not making too high a demand

If it is not:

- check that the machine is standing on a level surface

If it is:

- check that the filters are correctly fitted and the intake filter is clean (Figures 18 and 19)

If they are:

- call the medical officer in charge for advice on adjusting the flow rate

If still not satisfactory:

- send equipment away for expert repair

Some machines have an Oxygen Sensing Device (OSD). This is an alarm which is activated if the oxygen concentration falls below a given level, usually about 80%.

#### *Oxygen monitor*

If there is no Oxygen Sensing Device, the concentration of oxygen should be tested using an oxygen monitor.

An oxygen monitor contains a sensor called a fuel-cell, which is like a battery and must be replaced when it is worn out. Because its level of charge varies throughout its life, it must be checked regularly.

#### **Daily check:**

Breathe onto the sensor several times. The reading should drop slightly (approximately 3%).

Set up a flow of, say, 4 litres per minute of *cylinder* oxygen into a small (A4 size) plastic bag. Place the sensor in the middle of the open bag (not a corner) for one minute. Then adjust the calibration knob to read 100%. If cylinder oxygen is not available, then an alternative technique is to leave the sensor in normal room air. After a minute or so, adjust the calibration knob on the monitor so that a reading of 21% is obtained.

Any problems are likely to be due to the fuel-cell. The life of a cell (typically seven months) may sometimes be extended by refitting the shorting clip and putting the cell in a small, sealable container when not in use. Dispose of the fuel-cell thoughtfully - they contain some toxic chemicals.

#### *Oxygen leaks*

See above under Bottled Medical Oxygen

### **6. Spares**

Oxygen concentrators are sophisticated pieces of equipment and all regular overhauls and major repairs to them should be carried out only by a qualified technician.

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

- a second oxygen cylinder
- air filters
- bacterial filters
- main circuit fuses
- plug fuses (if applicable)
- plug
- toothbrush and 0.5% detergent solution
- oxygen monitor (fuel-cell type)

## **7. User Checklist (to be displayed on or near the equipment)**

Always refer to the manufacturer's instructions.

Always keep a spare full cylinder for emergency use.

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

- i. keep the working area as dust free as possible
- ii. make sure that the machine is standing in an upright position and on a level surface
- iii. use only specified tubing and fittings
- iv. keep air inlets clean
- v. keep outlets clean
- vi. never use soap, grease or oil on the machine
- vii. never place anything on top of the machine
- viii. always switch off and unplug the machine when it is not in use
- ix. never run the machine without the filters being correctly fitted
- x. once a week:
  - remove and empty condensation tray (not all machines have one)
  - clean air inlets and filters
  - check tubing and ancillary equipment for leaks

Report to Maintenance Officer:

- any visible damage to mains lead, plug or body of machine
- any leakage of oxygen
- any other fault or breakdown

Follow these SAFETY points:

- Do keep equipment away from flames and cigarettes
- Do keep equipment away from odours, volatile gases and liquids
- Do keep children away from equipment
- Do keep the machine dry
- Do disconnect the machine from the main electricity supply when it is not in use
- Do switch off the machine immediately if fire breaks out
- Do install the machine outside the risk zone if it is being used in an operating theatre
- Do fit the humidifier below the level of the patient's head to prevent condensation flowing to the patient
- Do run the concentrator for five to ten minutes every week, even if it is not in use