
Oxygen

Oxygen is a colourless, odourless, gas. It is found as approximately 21% of the atmosphere, and is essential for life.

The administration of Oxygen to a casualty, (above that normally found in the atmosphere) may well prove beneficial in the vast majority of cases.

Oxygen used in CPR gives a considerable increase in the effectiveness of the procedure.

Oxygen equipment

Cylinder

Oxygen for medical use is stored in steel, Aluminium alloy, or Carbon fibre cylinders.

Some cylinders are colour-coded black with white shoulders, others are identified using "Oxygen" as a label.

Common sizes in use for first aid and ambulance work are:

- D size - steel or alloy cylinder with a double pin index yoke connection - containing 340 litres.
- E size - steel cylinder with a double pin index yoke connection - containing 680 litres.
- F size - steel cylinder with a 'bullnose' screw connection - containing 1360 litres.
- CD size - Carbon fibre cylinder with a Schrader valve and a 6mm 'firtree' attachment - containing 460 litres.
- HX size - Carbon fibre cylinder with a Schrader valve and a 6mm 'firtree' attachment - containing 2300 litres.

Cylinders incorporate valves, either direct hand operated, or 'key' operated. The cylinder valve should not be turned on until the Oxygen is required, and should be turned off after use, to prevent leakage.

Excessive force is not required (and should not be used) when turning cylinder valves on and off.

Regulator

A regulator is connected to an Oxygen cylinder to reduce the gas pressure to a working pressure (around 60 psi), from the high cylinder pressure.

A regulator often includes a cylinder pressure gauge which acts as a contents gauge.

Therapy head or flow-meter

A therapy head or flow-meter is connected to the output of the regulator. This controls the flow of Oxygen to the casualty, maintaining a constant flow rate.

Several types of flow-meters are available:

- Those with an adjustment knob and a 'pipe and ball' meter to indicate flow rate.
- Those with an adjustment knob and a traditional indicator to show flow rate.
- Those with preset flow rates, usually selectable with a control knob.

The regulator and flow-meter may be combined into one item.

Cylinder types CD and HX have integral regulators and flow-meters.

Therapy mask

A therapy mask or facemask is usually a clear plastic moulding which is fitted over the casualty's mouth and nose. The therapy mask connects to the flow-meter output via a flexible tube.

Therapy masks are available in many different styles, and in types which mix Oxygen with outside air in different concentrations.

For the mask to deliver the correct concentration of Oxygen to the casualty, the correct flow rate must be set on the flow-meter. The required rate is indicated on the mask packaging, or the mask itself.

A nasal cannula has small tubes which fit into the patient's nostrils. It is used for long-term delivery of low flow rates of Oxygen.

Masks and cannulae are disposable, and should be used for one casualty only. They should not be removed from their packaging until actually required.

Connecting Oxygen equipment

1. Verify that all items of equipment are compatible.
2. Remove the manufacturer's seal from the cylinder.
3. Check that the cylinder outlet is not damaged.
4. Ensure that the cylinder outlet is pointed away from any persons, and turn on the cylinder valve momentarily to blow away dust from the outlet.
5. Check that the bodok seal (if part of the assembly) is in good condition, and attach the regulator to the cylinder, ensuring that there are no gas leaks, but without overtightening the fitting.
6. Attach the flow-meter to the regulator, ensuring that there are no gas leaks, but without overtightening the fitting.
7. Ensure that the flowmeter is off, and turn on the cylinder key. Check the cylinder contents gauge.
8. Check that the flow-meter operates.
9. Turn off.

CD and HX cylinders may be connected directly to the therapy mask or cannula, or to internal ambulance piping.

Oxygen therapy

Oxygen is almost always beneficial to casualties, especially those suffering from shock or who are hypoxic.

Concentration

Current protocols for Red Cross personnel are that Oxygen should be given using non-rebreathing '100%' masks, at a flow rate of 10 - 15 l/min for the majority of trauma casualties and those suffering from medical emergencies. The flow rate should be sufficient to prevent the reservoir bag on the mask emptying completely.

For those suffering from chronic obstructive pulmonary disease, Oxygen may be given at a concentration of 28% using 3 l/min. 100% will be required in cases of hypoxia or acute breathing difficulty.

Where a patient is already receiving oxygen therapy, the instructions of the responsible medical staff should be followed. This may involve the use of masks designed to give lower concentrations of Oxygen, with lower flow rates.

When using Oxygen in CPR, a flow rate of 10 - 15 l/min should be used, with a reservoir bag attached to a bag-valve-mask apparatus.

Procedure

1. Assess the casualty.
2. Deal with any airway problems.
3. Determine the need for Oxygen administration, and what concentration is required. Consider the alternative of Entonox in cases where pain relief is needed.
4. Explain to the casualty what is to be done, and that the benefit of the Oxygen will take some time to become apparent.
5. Remove a mask or cannula from its wrapping, and connect it to the flow-meter outlet.
6. Turn on the Oxygen and select the appropriate flow rate. Ensure that the Oxygen actually flows correctly into the mask. Ensure that the valves on a non-rebreathing mask operate clearly, and that the reservoir bag fills and empties.
7. Place the mask over the casualty's mouth and nose, and then place the elastic strap over the head.
8. Monitor the casualty's condition carefully, including frequent Oxygen saturation level checks.
9. After use, dispose of the mask and tubing (unless designed for multiple use) safely. Ensure that the cylinder valve is turned off, then turn on the flow-meter valve to empty the flow-meter and regulator.

It is advisable to monitor a casualty's blood Oxygen saturation using a pulse oximeter during Oxygen therapy.

If the casualty's respiration becomes depressed through the administration of Oxygen (as might occur in cases of COPD), discontinue the administration. Recommence Oxygen therapy if the casualty's condition does not immediately improve, or if signs of hypoxia return or worsen.

Also discontinue Oxygen therapy if the casualty shows signs of over-Oxygenation - a stable and constant 100% Oxygen saturation reading on a pulse oximeter, no signs of hypoxia, rosy cheeks and very 'healthy' looking face. Recommence Oxygen therapy on observing any returning signs of hypoxia.

The use of Oxygen must be recorded, and must be made known to ambulance crews or Accident and Emergency department staff when handing over the casualty.

Possible problems and contra-indications

Some casualties will not accept a mask. The mask may be held near their face in such cases.

Breathing unhumidified Oxygen can dry the mouth and airway over a period of 10 - 20 minutes. A few sips of water may be given to overcome this problem.

Caution must be used if giving Oxygen to premature neonates, as long-term over administration may cause blindness. (This risk is open to debate). A mask held near the face is a suggested method of administration.

Oxygen must *not* be given to those who have been poisoned by Paraquat, as it increases the toxicity of the poison.

A non-rebreathing mask must be used at a flow rate sufficient to keep the reservoir bag at least partially inflated (probably no less than 10 l/min) to prevent Carbon Dioxide build-up in the mask.

Safety

Oxygen supports combustion; it must be used with care to avoid increasing the dangers of fire.

Cylinders store considerable pressure; they must be handled with care to avoid damage, which could lead to an explosion.

Do not apply any oil, grease, or other lubricant to any part of Oxygen equipment.

Do not smoke, or allow others in the vicinity to smoke, when using Oxygen.

Do not use Oxygen where there is a fire, or obvious risk of fire.

Do not use Oxygen in the immediate vicinity of electrical equipment, or equipment which may produce large charges of static electricity.

Turn off oxygen equipment, or move it away, when using a defibrillator.

Do not roll cylinders when moving them.

Store cylinders in a safe, protected manner, away from direct heat or sunlight.

Do not store empty cylinders together with full cylinders.

Ideally size D, E, and F cylinders should not be allowed to run to completely empty.

Cylinder running times

The table below gives the times in minutes for a full cylinder to empty, when Oxygen is supplied at a continuous flow rate.

Cylinder Size	Capacity	Time at 15 l/min	Time at 12 l/min	Time at 3 l/min
D	340 l	22 min	28 min	113 min
E	680 l	45 min	56 min	226 min
F	1360 l	90 min	113 min	453 min
CD	460 l	30 min	38 min	153 min
HX	2300 l	153 min	191 min	766 min

Note: as D, E, and F cylinders should not be emptied completely, the actual time in use will be slightly less than that listed.