Oxygen Regulator

Oxygen for use in anaesthetic machines is supplied in cylinders which hold the gas under high pressure (2200psi/15000kpa). As the oxygen is used, the pressure in the cylinder correspondingly reduces. Operation of anaesthetic equipment requires a constant accurate supply of oxygen which would not be possible because of the fluctuating pressure if the gas was drawn directly from the cylinder. A regulator is fitted to the cylinder which reduces the pressure of the oxygen coming out down to approx 60psi/350kpa. The regulator is fitted with a pressure gauge which indicates how full the cylinder is.

Flowmeter

The flowmeter controls the rate of oxygen supply to the anaesthetic machine.

Vapourisers

The purpose of a vapouriser is to convert a liquid anaesthetic agent (commonly halothane) to a vapour or gas. There are two common types of vapouriser in use.

i) Calibrated Vapourisers

These are fitted out of the breathing circuit and are designed to deliver a precise gas concentration when used within a temperature range of 20ºC to 32ºC and with a flow rate over 500 ml per minute. Common brands are Fluotec and Penlon. Calibrated vapourisers have the advantage of an accurate output subject to correct operating temperatures.

ii) In circuit vapourisers

These are identified by their glass bowl or jar which contains the anaesthetic agent. They are positioned within the breathing circuit. i.e. after passing through the absorber cannister the exhaled gases re-enter the vapouriser along with the fresh oxygen. These are affected by temperature and flow rate. Common brands are Stephens, Komesaroff and Medvet. In-circuit vapourisers have a low initial cost and minimal service expenses. They are suitable for use with several anaesthetic agents and are more economical to operate than out-of-circuit vapourisers.
Absorber cannisters
Absorber cannisters contain either soda lime or baralyme which is used to remove the CO₂ from the patients exhaled gases allowing recycling of the remaining gases. Use of an absorber cannister also helps retain warmth and humidity within the breathing circuit.

Scavenge Valve
Situated in close proximity to the absorber cannister is the scavenge or pop off valve. This is used to vent excess gases out of the machine and should be connected to tubing to direct the gases either into a wall cavity or out of the clinic. If this is not possible, filters are available which connect to the scavenge hose. It is essential they are replaced at the manufacturer’s specification.

Anaesthetic Hose Circuits
The Y hose system is the standard method of anaesthetic gas delivery but may not be suitable for smaller patients on out-of-circuit machines. The F circuit is an alternative to the Y hose. It consists of one hose inside another which makes it tidier to use, the exhaled gases warm the fresh gas preserving heat and moisture within the circuit. The Ayres T piece is the most common circuit for smaller patients on out-of-circuit machines. Use of a T piece bypasses the machine’s absorber system and vents the exhaled gasses directly out the scavenge hose.

F Circuit Quality
Coaxial rebreathing circuit. Allows fresh gas to be warmed by expired gas. Also simplifies clutter of hoses during anaesthesia. Use for dogs 4.5-90kg. Hose set is higher quality with fully transparent couplings, 1.5m long with 22mm cuffs.

Ayres T-piece
Open-circuit breathing system with scavenge valve and 0.5 litre bag. Hose length 1.73m. Note: Replacement scavenger valve only.

Bains T-piece
Open-circuit coaxial system with scavenge valve and 2 litre bag. This non-rebreathing system is great for smaller patients. Hose length 1.9m o.a. N.B. Parts not available.

Washington T-piece
Open-circuit system for small patients. 0.5 litre bag. Hose length 1.54m. Note: Scavenge system not incorporated.

Hose Set
Standard latex-free plastic hose set 22mm i.d. with 22mm cuffs. Hose length 1.1m o.a. Y hose.
Scavenging Systems

Scavenging systems remove waste anaesthetic gases from the circuit to the atmosphere. The three types available are active scavengers, passive scavengers and charcoal filters. The scavenging systems should have a 19mm or 30mm connection to prevent accidental connection to the anaesthetic breathing circuit.

i) Passive scavenging systems

These are a cheap and simple system which consist of a piece of tubing or pipe which runs from the machine to a point outside the building. It is considered unacceptable to have the scavenging tubing outlet placed within the building (e.g. dog kennels).

Passive systems can be affected by wind movement, either blowing the gas back into the system or sucking the gas out at a high flow rate can affect passive systems. These systems should be designed to prevent dust, wind, water and pests entering the system.

ii) Active scavenging systems

Active gas scavenging systems remove the waste gases via continual suction. This is the preferred method of gas evacuation, but is also the most expensive. The suction should not be greater than -2cmH²O so as to prevent the development of a negative pressure in the patient’s lungs.

The active scavenging should be a purpose build device, placed centrally, with outlets where anaesthetic machines are commonly used.

ii) Activated charcoal filters

An activated charcoal cannister which removes waste anaesthetic gas. Attaches to a standard scavenge hose and lasts for approx 12-15 hours of anaesthesia or up to 50gM of gas. Ideal for surgeries where it is undesirable to vent into a wall cavity. Do not use with nitrous-oxide.
Potential health hazards associated with occupational exposure to inhalational anaesthetic agents

A link between chronic exposure to trace anaesthetic gases and the following, has been suggested.

Exposure to trace anaesthetic agents

- Increased spontaneous abortion rate
- Increased congenital abnormalities
- Increased incidence of infertility
- Decreased mental agility
- Fatigue and irritability
- Increased hepatic and renal disease

It has been shown that personal exposed to waste anaesthetic gases continue to exhale halothane for 7 to 64 hours, and nitrous oxide for 3 to 7 hours following exposure.

Recommended acceptable levels for waste anaesthetic gases set by Occupational Safety and Health Institutes vary between countries, but generally are in the order of less than 2 parts per million (ppm) for volatile agents alone, or less than 0.5ppm volatile agent plus less than 25 ppm nitrous oxide.

Recent studies have found that the presence of scavenging had little effect in reducing environmental contamination when there leaks present within the anaesthetic circuit. The most common sites for leaks were at connections, especially the connections around vaporisers, tubing, seals and the rebreathing bags. Spillage of halothane as well as un-inflated or leaking endotracheal tubes increased contamination of halothane by 100%.

Faulty anaesthetic machines will not only increase environmental contamination of trace anaesthetic gases, but will also compromise patient safety. Machine malfunction can result in patient hypoxia, hypercapnia, anaesthetic overdose, volume and pressure excess and anaesthetic under-dose. All of these problems can be rectified by regular checking of the machine and circuit as well as an annual machine service by qualified service personnel.

Basic Rules of Controlling Waste Anaesthetic Gases:

- All staff should be aware of the possible hazards of waste anaesthetic gases.
- Maintenance of equipment should be performed regularly.
- Machine and breathing circuit checked should be regularly for leaks and correct function.
- Minimise spilling of agents and mop up accidental spills immediately.
- Use of keyed filling devices.
- Use of cuffed endotracheal tubes.
- Turn vaporiser on only after inflating endotracheal tube cuff.
- Flush system as long as possible at the conclusion of the case with 100% oxygen (at least 5 minutes).
- Ensure recovery area is well ventilated.
- Minimise the use of mask and chamber induction techniques.
- Use adequate scavenging systems.
Cleaning and Sterilisation of Anaesthesia Circuits

The patient circuits are a potential source for contamination and cross infection. Fortunately, there is a low incidence of cross infection in Veterinary patients. On a weekly basis, it is a good practice to wash and sterilise anaesthetic equipment. Drain and dry all equipment which should first be washed in hot soapy water (this removes 90% of all bacteria). Steam autoclaving is generally effective against most infectious bacteria. If an autoclave is not available, or the equipment is plastic or unable to be autoclaved, chemical sterilisation (e.g. Gigasept, isopropyl alcohol or 5% chlorhexidine) is generally effective, but the equipment needs to be thoroughly rinsed to prevent any residual effect of the chemicals. Residual traces of these chemicals can damage the endotracheal tubes and this can result in tracheal irritation. When autoclaving silicone or rubber tubing or endotracheal tubes, remove any plastic connections first. Routine autoclaving will shorten the life of the equipment. Black rubber rebreathing bags are autoclavable. Plastic rebreathing bags can only be sterilised by chemical means. Ethylene oxide sterilisation (E.T.O) or gamma irradiation are very effective means of sterilisation, but these items maybe away from the hospital for a period of up to two weeks. To sterilise the carbon dioxide absorber, check the manufacturers instructions. Some absorbers can only be sterilised by using a very specific technique (e.g. radiation) thus changing the soda lime, and washing as many parts as possible after an infectious case is all that can be achieved. The alkalinity of the carbon dioxide absorbent acts as a barrier against infection.

Laryngoscope blades should be washed in hot soapy water between cases. All metal laryngoscope blades are autoclavable.

It is important that the patient circuit is sterilised after any suspected infectious respiratory case is anaesthetised. Infectious cases include aspergillosis, tuberculosis (T.B) and pneumonia. Always treat the case as infectious until proved otherwise. Gloves should be worn when handling any infectious tubing, particularly if these are contaminated with mucous or blood. Autoclave as much equipment as possible. If sterilisation is impractical, consider destroying the tubing, rebreathing bag and endotracheal tube. Carbon dioxide absorber cannisters, uni-directional valves and pop off valves should be sterilised according to the manufacture’s recommendations.

Most of those products are disposable and cheap to replace. If sending the infectious equipment away for sterilisation, place in two plastic bags and mark in red writing infectious goods. Wash the oustide of the anaesthetic machine in soapy water and wipe with alcohol. Once the infectious equipment has been cleaned and sterilised, it is important to wash your hands.

Resource Acknowledgement

Articles Pages 4 & 5
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Palmerston North
Anaesthetic machine check list - Easy steps for your clinic

Why routinely check for leaks in your anaesthetic machine?

- patient safety
- personal safety
- ensuring patient receives correct concentrations and volumes of gases
- preventing environmental pollution
- economy - chronic oxygen leakage can cost a fortune over time!

Follow these simple checks to ensure your anaesthetic machine is functioning at its optimum standard and to ensure your patients safety is not compromised:

A. High Pressure check - at the beginning of each surgical day
1. turn on the oxygen cylinder at the pressure regulator
2. note the reading on the pressure gauge
3. check that the flow meter is turned off
4. leave the machine for approx. 20 minutes, then re-check reading
5. if the needle on the gauge has dropped, this indicates a leak in the high pressure system
6. check the pressure regulator yoke on the neck of the oxygen cylinder. If this is secure, there may be a problem with the valves on the cylinder or at the various connections within the regulator. Request assistance from your oxygen supplier to assess the problem

B. Flow meter check - at the beginning of each surgical day
1. is the bobbin rotating freely within the chamber? Gently turn off
2. turn vapouriser(s) on and off. They should dial freely and securely lock
3. check the agent in the vapouriser. As a general rule, never let the agent drop below 1/3 full.
4. check soda lime - change if looking dusty or has changed colour
5. check the level of oxygen
6. check that the vapouriser filling parts are closed
7. connect appropriate breathing circuit

C. Medium pressure check - prior to each case
1. disconnect the breathing circuit from the fresh gas outlets
2. occlude the outlet with your thumb or the palm of your hand
3. turn the oxygen flowmeter on to 1 litre
4. the bobbin will gradually drop to 500mls over 10 - 20 seconds. If this fails to happen, you may have a leak across one or more components of the machine - flowmeter, vapouriser, fresh gas outlet
5. check fittings that you can easily access
6. if the problem persists, resist the temptation to pull out the spanners and dismantle the machine! this is a job for a professional medical service person

D. Low pressure check - prior to each case
1. reconnect the breathing circuit to fresh gas outlet.
2. close pop-off valve and occlude patient end of circuit with your thumb or a cork.
3. turn the oxygen flowmeter on to approximately 2 litres to fill the circuit with oxygen
4. turn off when the rebreathing bag becomes full (no wrinkles)
5. gently squeeze the bag
6. there should be no pressure loss for 10 - 20 seconds. A collapse in the bag indicates a leak in the low pressure system which is usually easily identified (holes or cracks in bags or tubing, pop-off valve closed, connections firmly in place)

TIP: Soapy water is a useful aid to identifying sites of leaks. Brush a small amount on to fittings, tubing, rebreathing bags, etc and watch for any bubbling of the detergent

Once you have completed your checking procedure, you can go ahead with your surgery knowing your equipment is sound and safe. The whole routine takes only a few minutes each day - but ensures peace of mind which is priceless!
Anaesthetics

Waste Gas Filter
200 191
An activated charcoal cannister which removes waste anaesthetic gas. Attaches to a standard scavenge hose and lasts for approx 12-15 hours of anaesthesia or up to 50gM of gas. Ideal for surgeries where it is undesirable to vent into a wall cavity. Do not use with nitrous-oxide.

Scavenge Tube Wall Plate
200 162
Made of stainless steel and used to vent anaesthetic waste gas into the wall cavity. Drill 22mm clearance hole into wall cavity.

Scavenge Tube
per metre 200 161

Hose Swivel Y-piece
200 095
Swivel feature allows freedom of movement and connection of anaesthetic lines, without tangles.

Absorber Cannister Circular
excl. mount 200 071
mount only 200 072
scavenge tube connector 203 761
Ideal replacement for older absorber systems. The cannister incorporates a scavenge valve.

Absorber Cannister Funnel
200 073
Filter funnel for soda lime container. Ideal for use with circular cannister.

Vapouriser Tec 3
200 188
Overhauled and re-conditioned vapouriser available for use with either halothane or isoflurane (specify).

Vapouriser Isoflurane Isotec 5
200 184
Isotec 5 vapouriser, new and unused.

Key-Fill Adaptor
halothane 200 096
isoflurane 200 097
Designed to fit all vapourisers using the key-fill system.

Soda Lime Medisorb
4.5kg bottle 205 751
Great value in 4.5kg bottle at great price. Quality soda lime granules change from white to violet as carbon dioxide is absorbed.

Soda Lime Spherasorb
1kg bag 205 752
5kg bottle 205 753
Spherasorb is made of 3-4mm spheres to minimise dusting. Its uniform shape allows better packing in the absorber resulting in a more even flow of anaesthetic gases. As the carbon dioxide is absorbed the granules change from white to violet.

Handy Hint
Split scavenge tubing and use to cover external fixator nut and bolts instead of bandaging.

Handy Hints

We service, and supply parts for Stephens anaesthetic machines.

Stephens Anaesthetic Machines
Parts List
(a) scavenger valve disc
(b) scavenger valve and kit
(c) scavenger valve spring
(d) uni valve perspex cover
(e) uni valve body ‘o’ ring
(f) uni valve claw
(g) uni valve disc
(h) vapouriser glass bowl
(i) vapouriser bowl gasket
(j) absorber cannister gasket
(k) absorber cannister ‘o’ ring

Anaesthetic Regulator Oxygen
complete 200 160
Bodok seal only 200 159
Chrome plated brass with a self cleaning high-pressure cartridge. Accurately maintains correct oxygen pressure at all cylinder pressures.

Private Bag 522, Cambridge. Call free on 0800-800-801, Fax free 0800-264-625. Prices listed do not include GST. Prices and specifications subject to change without notice. A $5.00 administration fee will be charged on orders under $50 value.
The Space Chamber is a spacer device which is designed to make it easier and more efficient to administer medication such as asthma medications. Separate inspiratory and expiratory valves enable unrestricted and continuous inhalation and exhalation. The low-resistance valves allow the spacer to remain in position for multiple breaths. All components are latex-free. Constructed from high impact medical grade polycarbonate. Simply attach the Space Chamber spacer to an anaesthetic mask and oxygen tubing. The low-resistance valves allow the enable unrestricted and continuous inhalation and administration of medication such as asthma medications.

**Resusitator Rodney Small Animal**

resusculator 205 361

Every clinic should have one! Constructed from long life P.V.C, this resusculator features two non-return valves, an oxygen or anaesthetic gas entry inlet, and a lock-down valve which allows positive pressure ventilation. A standard anaesthetic bag mount can be used for administering asthma drugs for small animals such as cats. Incorporation of an endotracheal tube mount as well as an anaesthetic mask mount, guarantees the flexibility of this essential piece of equipment. Reach for a Rodney when an emergency occurs!

**Oxy Hood**

small 204 972

medium 204 971

large 204 970

The Oxy Hood uses the cone shape of the Elizabethan collars and adds a clear plastic lid over the end. Excess gas is vented through numerous holes throughout the cone. Oxygen is provided via a nasal cannula attached to the hood. The Oxygen source uses a bubble humidifier to prevent drying of the respiratory tract. Oxy Hood comes with a sewn-on collar with drawstring and velcro attachment for proper neck sizing. The lid is attached with a zipper and clear plastic is used throughout for better observation. Very small animals can be placed totally inside the larger Oxy Hood. Comes complete with nebuliser, oxygen nasal cannula and oxygen tubing.

**Space Chamber™**

Not Incl. Mask 205 765

The Space Chamber is a spacer device which is designed to make it easier and more efficient to administer medication such as asthma medications. Incorporation of an endotracheal tube mount as well as an anaesthetic mask mount, guarantees the flexibility of this essential piece of equipment. Reach for a Rodney when an emergency occurs!

**Rebreathing Bag (Black)**

0.5 litre 200 130

1 litre 200 141

1.5 litre 200 143

2 litre 200 147

3 litre 200 151

4 litre 200 156

15 litre 200 144

30 litre 200 153

These rebreathing bags are supplied by Knau of Denmark. High quality and long lasting. They are made of black anti-static natural rubber.

**Anaesthetic Mask Plastic**

Complete

5cm dia (27mm) 200 125

6cm dia (40mm) 200 126

9cm dia (38mm) 200 128

11cm dia (44mm) 200 121

13cm dia (70mm) 200 123

Replacement diaphragm only

6cm dia mask 200 127

9cm dia mask 200 129

11cm dia mask 200 122

13cm dia mask 200 124

Clear plexiglass body of these masks enables visibility of patient. Correct sizing of mask to patient is useful to minimise mask void space. Dimension of mask is the overall diaphragm diameter. Dimension in brackets is the diaphragm opening.

**Anaesthetic Mask Flexi**

Complete

6cm dia (25mm) bird 200 110

6cm dia (35mm) cat 200 112

9cm dia (35mm) small dog 200 114

10cm dia (58mm) long nose 200 106

13cm dia (80mm) large dog 200 108

Replacement Diaphragm only

6cm dia mask (bird) 200 111

6cm dia mask (cat) 200 113

8cm dia mask (small dog) 200 115

10cm dia mask (long nose) 200 107

13cm dia mask (large dog) 200 109

These masks are produced from very flexible PVC which can allow better fit on the patient than rigid materials. Transparent for visibility of the patient. Unbreakable. The ‘long nose’ model AMF10 is also very suitable for calves, foals or similar animals as well as dogs. Replacement rubber diaphragms available. Dimension of mask is the overall diameter. Dimension in brackets is the diaphragm opening.

**Mask Rubber**

9cm long x 6cm dia 200 131

9cm long x 11cm dia 200 132

16cm long x 11cm dia 200 130

Made from soft and comfortable black rubber. This mask will conform to the animal’s muzzle shape better than a plastic mask, allowing a custom fit. High quality for extra long life.

**Bubble Tubing**

per metre 200 908

Universal tubing which is ideal for delivering oxygen to patients. Tubing incorporates a ‘bubble’ every one metre that, when cut, allows for attachment to various size fittings. Useful for connections of anaesthetic machines, humidifiers, nebulisers and nasal cannulas.
Anaesthetic Machine Parts
Anaesthetic Machine Parts
Anaesthetic Accessories