



# **Recommendations on Checking Anaesthesia Delivery Systems**

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## **1 INTRODUCTION**

An anaesthesia delivery system includes any machine, equipment or apparatus which supplies gases, vapours, and local anaesthetic and/or intravenous anaesthetic agents in order to safely and reliably induce and maintain anaesthesia.

## **2 PRINCIPLES**

2.1 Anaesthesia delivery systems must be serviced at regular and specified intervals.

2.2 The Hospital, Anaesthesia department or body responsible for the equipment must keep a detailed record of the service requirements for all anaesthesia delivery systems. These requirements should be based on appropriate Hong Kong standards, manufacturers' guidelines, biomedical engineering and Anaesthesia department recommendations. They should describe calibration protocols and the intervals at which these are performed.

2.3 A designated individual should be appointed in each facility for equipment management, whose duty should include servicing and maintaining equipment in accordance to college guidelines, ensuring that relevant personnel are trained in the checking and use of anaesthesia delivery systems and maintaining an up-to-date checking protocol specific to each system.

2.4 A prominent label that is visible to the anaesthesiologist must be attached to all anaesthesia delivery systems to advise of past service(s) and to indicate when the next service is due.

2.5 To ensure early detection of any failure in an anaesthesia delivery system, appropriate alarms must be present, and patient monitoring as specified in HKCA Document [P1] *Guidelines on Monitoring in Anaesthesia* must be provided.

2.6 There must be a secondary facility to maintain oxygenation and ventilation of the patient should failure of the primary systems occur.

2.7 The anaesthesiologist is ultimately responsible for the proper function of all the equipment used to provide anaesthetic care. The anaesthesiologist must not use equipment that they have not been trained to use.



### **3 CHECKING ANAESTHESIA DELIVERY SYSTEMS**

3.1 Every anaesthesia delivery system must be checked before use to ensure that it will function correctly. This document requires three different levels of checks:

3.1.1 **Level One check.** This is very detailed and is required a) on any new system and b) on all systems after servicing. This check is usually performed by the service person - whether from the equipment provider, or from the biomedical engineering department.

3.1.2 **Level Two check.** This should be performed at the start of each anaesthesia session.

3.1.3 **Level Three check.** This should be performed immediately before commencing each anaesthetic.

3.2 The Anaesthesia Department is responsible for:

3.2.1 Defining minimum requirements for each check in accordance with section 4. These must be appropriate for the specific system under test. For anaesthetic delivery systems incorporated with automated self-check features, items that are not being evaluated by the self-check should be identified and supplemented with manual checking as appropriate.

3.2.2 Attaching these checklists to each anaesthesia delivery system where appropriate.

3.2.3 Training and accreditation of the personnel involved with each check as follows:

3.2.3.1 **Level One.** Attendance at a manufacturer's course or a programme developed by the hospital's Anaesthesia Department in consultation with a qualified biomedical engineer.

3.2.3.2 **Level Two and Three.** All Anaesthesia Department personnel must be trained and accredited in correct anaesthesia system checking procedures.



## **4 PROTOCOLS**

4.1 **Level One check.** This must be performed by a suitably qualified person (usually the service provider) on all anaesthesia delivery systems a) before they enter service and b) following servicing. The check shall include:

### **4.1.1 Gas Delivery Devices**

4.1.1.1 Quantifying and minimising leaks.

4.1.1.2 Confirming that pipelines are correctly connected within the anaesthesia delivery system.

4.1.1.3 Ascertaining the correct functioning of non-return valves throughout the system.

4.1.1.4 Ascertaining the integrity of oxygen failure prevention and warning devices.

4.1.1.5 Checking the composition of delivered gases and their flowrate.

4.1.1.6 Checking the batteries performance, if fitted.

4.1.1.7 Ensuring electrical safety.

### **4.1.2 Inhalational Anaesthesia Devices**

4.1.2.1 Ascertaining that no leakage occurs in both “on” and “off” position.

4.1.2.2 Checking any thermostat function.

4.1.2.3 Calibrating output at both high and low flow rates.

4.1.2.4 Checking function of any interlocking or other mechanisms.

4.1.2.5 Checking the batteries performance, if fitted.

4.1.2.6 Ensuring electrical safety.

### **4.1.3 Ventilators**

4.1.3.1 Ensuring mechanical integrity

4.1.3.2 Checking the pressure and volume delivery.



4.1.3.3 Checking of alarm functions

4.1.3.4 Ensuring that the operation meets manufacturer's specifications.

4.1.3.5 Checking performance of batteries, if fitted.

4.1.3.6 Ensuring electrical safety.

#### 4.1.4 **Intravenous and Local Anaesthesia Delivery Devices**

4.1.4.1 Calibrating output rate and accuracy.

4.1.4.2 Calibrating occlusion pressure.

4.1.4.3 Checking alarm function and accuracy.

4.1.4.4 Ensuring operation of all user functions and parameters.

4.1.4.5 Checking that serviced mechanisms operate correctly.

4.1.4.6 Checking battery performance.

4.1.4.7 Ensuring electrical safety.

#### 4.1.5 **Other Equipment**

The check should include the function, safety and accuracy of any other equipment included within the delivery system (such as to provide for suctioning, scavenging and monitoring)

4.1.5.1 The check shall verify that the system as supplied complies with the relevant Hong Kong standards.

#### 4.1.6 **Documentation of level one check**

Documentation of the check is required and should include the date, what had been checked, the results of the check, and who performed the check.

4.2 **Level Two check.** Anaesthesiologist is responsible for this check though this may be undertaken by another suitably qualified person (such as an appropriately trained nurse or technician) in accordance with a protocol specific for the particular system at the beginning of each session. Thus several different protocols may be required in a single hospital. These will



serve to verify the correct functioning of the anaesthesia delivery system before it is used for patient care. Not all the following checks are applicable in some self-checking anaesthesia workstations.

4.2.1 **Service label.** Confirm that the device has been appropriately serviced and has not passed its service date.

4.2.2 **AC Power Supply.** Confirm that the device is connected to a functional AC power supply and both AC power and battery back-up are present.

4.2.3 **High Pressure System.**

4.2.3.1 Check oxygen cylinder supply. Ensure that cylinder content is sufficient for its intended purpose, the cylinder can be turned on and off and the cylinder-yoke fitting does not leak.

4.2.3.2 Perform tug test of pipelines. Check that piped gas supplies (where present) are at the specified pressures and that after completing the high pressure system checks, the cylinders are turned off.

4.2.3.3 Confirm that pipeline gas supplies are not crossed; use a multi-gas analyser to check gas composition at the common gas outlet, the inspiratory limb or the Y-piece.

4.2.4 **Low Pressure System.**

4.2.4.1 Check flow controls. Turn on each gas and observe the appropriate operation of the corresponding flow indicator. Verify the functioning of the anti-hypoxic device and oxygen failure alarm.

4.2.4.2 If **vaporiser(s)** are present:

4.2.4.2.1 Check that adequate anaesthetic liquid is present.

4.2.4.2.2 Ensure that the vaporiser filling ports are closed.

4.2.4.2.3 Check correct seating and locking of a detachable vaporiser.



4.2.4.2.4 Test for circuit leaks for each vaporiser in both on and off positions.

4.2.4.2.5 Ensure that power is available for electrically operated vaporisers.

4.2.4.3 Check for pre-circuit leaks using a protocol appropriate for the specific anaesthesia delivery system.

4.2.4.4 **Breathing systems.** Inspect and check the breathing system to ensure correct assembly and absence of leaks. Particular attention is required to ensure correct outlet is chosen in those machines having an auxiliary common gas outlet. The precise protocol will depend on the anaesthesia circuit to be used.

4.2.4.4.1 Perform leak test on the breathing system by occluding the patient and rebreathing bag connections, setting a fresh gas flow of 300 ml/min and ensure that the pressure rises to >30 cm H<sub>2</sub>O from zero.

4.2.4.4.2 For circle systems, in addition to any automated machine check, inspect the integrity of the system, its connections and check the unidirectional valves. This can be accomplished with a breathing bag on the patient limb of the Y-piece. Ventilate the system manually using an appropriate fresh gas flow. Observe inflation and deflation of the attached breathing bag and check for normal system resistance and compliance. Observe movement of any visible unidirectional valves. Check the function of adjustable pressure limiting (APL) valve by ensuring easy gas spill through APL when the two breathing bags are squeezed.

4.2.4.4.3 Check the compliance for each new breathing system if the ventilator uses automatic compliance compensation.

4.2.4.4.4 If a carbon dioxide absorber is present, check





the colour of the carbon dioxide absorbent. If the absorbent are dried out by prolonged dry gas flow then it should be replaced in order to avoid the potential for production of carbon monoxide.

**4.2.5 Automatic Ventilation System.** This should be checked according to the manufacturer's recommendations. A test lung (such as a suitably compliant bag) may be used to check the function of the ventilator and the delivery of adequate tidal volume. If a test lung is used, the fresh gas flow should be set to zero, or minimal flow, to help detect leaks in the ventilator. Correct function of the disconnection alarm, high pressure alarm and the high pressure relief valve should be checked at this time.

**4.2.6 Scavenging System.** Check that the scavenging system is properly connected and turned on, the scavenging suction flow is adjusted appropriately and that the scavenging outlet is not blocked. This should be checked after connection to the APL valve and appropriate adjustment of the scavenging gas flow. With the patient outlet occluded and the APL valve open, a full breathing system should not normally empty. If emptying does occur, the absence of negative pressure in the circuit system should be confirmed.

**4.2.7 Emergency Ventilation System.** Verify the presence and functioning of an alternative method of providing oxygen and of controlled ventilation (such as a self-inflating bag).

**4.2.8 Intravenous and Local Anaesthesia Delivery Devices.** These should be checked according to the manufacturer's recommendation and should include that:

4.2.8.1 The device is appropriate for the intended function with special attention to its range of flow rate and occlusion pressure.

4.2.8.2 The anaesthetic is correctly loaded and labelled.

4.2.8.3 Any program is correct with special attention to:

4.2.8.3.1 Syringe/container type and volume.

4.2.8.3.2 Drug concentration.



4.2.8.3.3 Flow rate and units.

4.2.8.3.4 Alarm parameters.

4.2.8.4 The device is appropriately powered by mains and/or batteries.

4.2.8.5 All connections to the device and to the patient are secure and appropriate.

4.2.8.6 There is no leakage.

4.2.8.7 The device actually functions and the drug is delivered.

4.2.8.8 An anti-reflux valve is installed if a delivery line is shared.

4.2.9 **Other apparatus to be used.** This should be checked according to specified protocols. Attention should be given to:

4.2.9.1 Equipment used for airway maintenance and intubation of the trachea.

4.2.9.2 Difficult intubation equipment

4.2.9.3 Suction apparatus.

4.2.9.4 Gas analysis devices.

4.2.9.5 Monitoring equipment. Special attention should be paid to alarm limits and any necessary calibration, as well as frequency/ interval of monitoring.

4.2.9.6 Intravenous infusion devices.

4.2.9.7 Devices to minimise hypothermia during anaesthesia.

4.2.9.8 Breathing circuit humidifiers.

4.2.9.9 Breathing circuit filters.

4.2.9.10 Resuscitation equipment

4.2.10 **Final check.** Ensure vaporisers are turned off and that the breathing system is purged with air or oxygen as appropriate. Ensure normal function of oxygen flush.



4.2.11 Documentation of the completion of the check in a logbook kept with the anaesthetic system, containing the date and identity of person performing the check

4.3 **Level Three check.** Immediately before commencement of each anaesthetic, the anaesthesiologist should:

4.3.1 Check a changed vaporiser using the protocol outlined in 4.2.4.2.

4.3.2 Check a changed breathing circuit using the protocol outlined in 4.2.4.4

4.3.3 Check any intravenous or local anaesthesia devices using the protocol outlined in 4.2.8.

4.3.4 Check other apparatus as specified in 4.2.9.

4.3.5 Documentation of the completion of the check in the anaesthetic record is recommended

## **5 References**

ANZCA PS31 (2014) Guidelines on Checking Anaesthesia Delivery Systems

ASA (2008) Recommendations for Pre-Anesthesia Checkout Procedures

AABGI safety guideline –checking anaesthetic equipment 2012

AABGI safety guideline- Safe management of anaesthetic related equipment (Sept 2009)