



CHECKING ANAESTHETIC EQUIPMENT

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Section 1

INTRODUCTION

To check the correct functioning of anaesthetic equipment before use is a mandatory procedure. In 1997 the Association of Anaesthetists of Great Britain and Ireland published the second edition of its 'Checklist for Anaesthetic Machines' which gained widespread acceptance in the profession. This document recognised that changes in anaesthetic equipment and the introduction of microprocessor-controlled technology would necessitate continued revision of the document in the future. This new edition further updates the procedures recommended in 1997.

The principles set out in previous booklets have governed amendments to this new edition. It must be emphasised that a major contributory cause of anaesthetic misadventures, resulting at worst in hypoxic brain damage or death, has been the use of anaesthetic machines and/or breathing systems which had not been adequately checked beforehand by an anaesthetist. It is the responsibility of all Trusts and other Hospitals to ensure that all personnel are trained in the use and checking of relevant equipment. This is usually devolved to the Department of Anaesthesia, but where such a department does not exist other arrangements must be made. The use of checklists and associated procedures is an integral part of training in Anaesthesia, and as such is part of the Royal College of Anaesthetists' Competency Based Training.

This checking procedure is applicable to all anaesthetic machines, should take only a few minutes to perform, and represents an important aspect of patient safety. It is not intended to replace any pre-anaesthetic checking procedures issued by manufacturers, and should be used in conjunction with them. For example, some modern anaesthetic "workstations" will enter an integral self-testing cycle when the machine is switched on, in which case those functions tested by the machine need not be re-tested by the user. The intention is to strike the

right level of checking so that it is not so superficial that its value is doubtful, nor so detailed that the procedure is impracticable.

The checking procedure covers all aspects of the anaesthetic delivery system from the gas supply pipelines, the machine and breathing systems, including filters, connectors and airway devices. It includes an outline check for ventilators, suction, monitoring and ancillary equipment.

There must be a system of implementing the routine checking of anaesthetic machines by trained staff according to the checklist, together with the manufacturer's instructions in every environment where an anaesthetic is given. **A record should be kept, with the anaesthetic machine, that this has been done.**

In addition, Trusts, Independent Hospitals, Service Hospitals and other organisations must ensure that all machines are fully serviced at the regular intervals designated by the manufacturer and that a service record is maintained. Since it is possible for errors to occur in the reassembly of machines, it is essential to confirm that it is correctly configured for use after servicing. **The 'first user' check after servicing is therefore especially important and must be recorded.**

Faults may develop during anaesthesia which were either not present or not apparent on the preoperative equipment check. This may include pipeline failure, electrical failure, circuit disconnections etc. In the event of any mishap it should not be presumed that the equipment is in the same state as when checked before the start of the case.

The checking procedure described in this publication is reproduced in an abbreviated form as a laminated sheet entitled "Checklist for Anaesthetic Equipment 2004". This laminated sheet should be attached to each anaesthetic machine and used to assist in the routine checking of anaesthetic equipment.

Section 2

PROCEDURES

The following checks should be carried out at the beginning of each operating theatre session. In addition, specific checks should be carried out for each new patient during a session on any alteration or addition to the breathing system, monitoring or ancillary equipment. **Implementation of these checks is the responsibility of the anaesthetist, who must be satisfied that they have been carried out correctly.** In the event of a change of anaesthetist during an operating session the checked status of the anaesthetic equipment must be agreed.

Before using any anaesthetic equipment, ventilator, breathing system or monitor, it is essential to be fully familiar with it. Many of the new anaesthetic 'workstations' are complex pieces of machinery. It is essential that anaesthetists have a full and formal induction on any machines they may use. A short 'run-through' prior to an operating session is not acceptable.

The anaesthetic machine should be connected directly to the mains electrical supply (where appropriate), and only correctly rated equipment connected to its electrical outlets. Multi-socket extension leads must not be plugged into the anaesthetic machine outlets or used to connect the anaesthetic machine to the mains supply.

To check the correct function of the oxygen failure alarm involves disconnecting the oxygen pipeline on some machines, whilst on machines with a gas supply master switch, the alarm may be operated by turning the master switch off. Because repeated disconnection of gas hoses may lead to premature failure of the Schrader socket and probe, the following guidelines recommend that the regular pre-session check of equipment includes a "tug" test to confirm correct insertion of each pipeline into the appropriate socket.

It is therefore recommended that, in addition to these checks, the oxygen failure alarm must be checked on a weekly basis by disconnecting the oxygen hose whilst the oxygen flowmeter is turned on, and a written record kept. In addition to sounding an alarm which must sound for at least 7 seconds, oxygen failure warning devices are also linked to a gas shut off device. Anaesthetists must be aware both of the tone of the alarm and also what gases will continue to flow with the make of anaesthetic machine in use.

A. ANAESTHETIC MACHINE

Check that the anaesthetic machine and relevant ancillary equipment are connected to the mains electrical supply (where appropriate) and switched on. Switch on the gas supply master switch (if one is fitted). Check that the system clock (if fitted) is set correctly. Careful note should be taken of any information or labelling on the anaesthetic machine which might refer to its current status.

B. MONITORING EQUIPMENT

Check that all monitoring devices, especially those referred to in the AAGBI Monitoring Standards document, are functioning and that appropriate parameters have been set before using the anaesthetic machine. This includes the cycling times, or frequency of recordings, of automatic non-invasive blood pressure monitors. Check that gas sampling lines are properly attached and free from obstruction or kinks. In particular check that the oxygen analyser, pulse oximeter and capnograph are functioning correctly and that appropriate alarm limits for all monitors are set.

C. MEDICAL GAS SUPPLIES

1. Identify and take note of the gases which are being supplied by pipeline, confirming with a 'tug test' that each pipeline is correctly inserted into the appropriate gas supply terminal.
2. Check that the anaesthetic apparatus is connected to a supply of oxygen and that an adequate reserve supply of oxygen is available from a spare cylinder.
3. Check that adequate supplies of any other gases intended for use are available and connected as appropriate. All cylinders should be securely seated and turned **off** after checking their contents.
4. Carbon dioxide cylinders should not normally be present on the anaesthetic machine. A blanking plug should be fitted to any empty cylinder yoke.
5. Check that all pressure gauges for pipelines connected to the anaesthetic machine indicate 400 - 500kPa.
6. Check the operation of flowmeters, where these are present, ensuring that each control valve operates smoothly and that the bobbin moves freely throughout its range without sticking. If nitrous oxide is to be used the anti-hypoxia device should be tested by first turning on the nitrous oxide flow and ensuring that at least 25% oxygen also flows. Then turn the oxygen flow off and check that the nitrous oxide flow also stops. Turn on the oxygen flow and check that the oxygen analyser display approaches 100%. **Turn off all flow control valves.** (Machines fitted with a gas supply master switch will continue to deliver a basal flow of oxygen.)

7. Operate the emergency oxygen bypass control and ensure that flow occurs without significant decrease in the pipeline supply pressure. Ensure that the emergency oxygen bypass control ceases to operate when released.

D. VAPORIZERS

1. Check that the vaporizer(s) for the required volatile agent(s) are fitted correctly to the anaesthetic machine, that any back bar locking mechanism is fully engaged and that the control knobs rotate fully through the full range(s). Ensure that the vaporizer is not tilted. **Turn off the vaporizers.**
2. Check that the vaporizer(s) are adequately, but not over, filled and that the filling port is tightly closed.
3.
 - (i) Set a flow of oxygen of 5 litres/min and, with the vaporizer turned off, temporarily occlude the common gas outlet. There should be no leak from any of the vaporizer fittings and the flowmeter bobbin (if present) should dip.
 - (ii) Turn each vaporizer on in turn and repeat this test. There should be no leak of liquid from the filling port. **After this test, ensure that the vaporizers and flowmeters are turned off.**
 - (iii) Should it be necessary to change a vaporizer at any stage, it is essential to repeat the leak test. Failure to do so is a common cause of critical incidents.
 - (iv) Removal of a vaporizer from a machine in order to refill it is not considered necessary.
 - (v) Vaporizers must always be kept upright since tilting can result in the subsequent delivery of dangerously high concentrations of vapour.

E. BREATHING SYSTEM

1. Check all breathing systems which are to be employed. They should be visually and manually inspected for correct configuration and assembly. Check that all connections within the system and to the anaesthetic machine are secured by 'push and twist'. Ensure that there are no leaks or obstructions in the reservoir bags or breathing system and that they are not obstructed by foreign material. Perform a pressure leak test on the breathing system by occluding the patient-end and compressing the reservoir bag. Breathing systems should be protected at the patient-end when not in use to prevent the intrusion of foreign bodies.
2. Bain-type and circle co-axial systems - Perform an occlusion test on the inner tube and check that the adjustable exhaust valve, where fitted, can be fully opened and closed.
3. Check the correct operation of the unidirectional valves in a circle system.
4. If it is intended to use very low fresh gas flows in a circle breathing system, there must be a means to analyse the oxygen and vapour concentration in the inspiratory limb. (Under other circumstances these may be monitored at the anaesthetic machine fresh gas outlet.)
5. A new, single-use bacterial/viral filter and angle piece/catheter mount must be used for each patient. It is important that these are checked for patency and flow, both visually and by ensuring gas flow through the whole assembly when connected to the breathing system.

F. VENTILATOR

1. Check that the ventilator is configured correctly for its intended use. Ensure that the ventilator tubing is securely attached. Set the controls for use and ensure that adequate pressure is generated during the inspiratory phase.
2. Check that disconnect alarms are present and function correctly.
3. Check that the pressure relief valve functions correctly at the set pressure.

G. SCAVENGING

Check that the anaesthetic gas scavenging system is switched on and functioning. Ensure that the tubing is attached to the appropriate exhaust port of the breathing system, ventilator or anaesthetic workstation.

H. ANCILLARY EQUIPMENT

1. Check that all ancillary equipment (such as laryngoscopes, intubation aids eg intubation forceps, bougies, etc.) which may be needed is present and in working order. Ensure that all appropriate sizes of face masks, laryngeal masks, airways, tracheal tubes and connectors are available, and checked for patency at the point of use.
2. Check that the appropriate laryngoscopes function reliably.

3. Check that the suction apparatus is functioning and all connections are secure; test for the rapid development of an adequate negative pressure.
4. Check that the patient trolley, bed or operating table can be rapidly tilted head-down.

I. SINGLE USE DEVICES

Any part of the breathing system, ancillary equipment or other apparatus that is designated “single-use” must be used for one patient only, and not re-used. Packaging should not be removed until the point of use for infection control, identification and safety. (For details of decontamination of re-usable equipment, see the AAGBI Infection Control document.)

J. MACHINE FAILURE

In the event of failure some modern anaesthetic workstations may default to little or no flow. It is essential that an alternative oxygen supply and means of ventilation (e.g. self-inflating bag, circuit and oxygen cylinder, which must be checked as functioning correctly with an adequate supply of oxygen) are always readily available. Consideration should be given to alternative methods of maintaining anaesthesia in this situation.

K. RECORDING AND AUDIT

A clear note must be made in the patient's anaesthetic record, that the anaesthetic machine check has been performed, that appropriate monitoring is in place and functional, and that the integrity, patency and safety of the whole breathing system has been assured. There must also be a logbook kept with each anaesthetic machine to record the daily pre-session check and weekly check of the oxygen failure alarm. Documentation of the routine checking and regular servicing of anaesthetic machines and patient breathing systems should be sufficient to permit audit on a regular basis.

The Association of Anaesthetists of Great Britain and Ireland cannot be held responsible for failure of any anaesthetic equipment as a result of a defect not revealed by these procedures.

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