

Short title: Checking anaesthesia delivery systems BP

1. Purpose of review

Anaesthesia delivery systems continue to advance as a result of technology accompanied by increasing complexity of systems and their componentry. Delivery systems were originally confined to the administration of gases and volatile anaesthetic agents. Systems are also available for the administration of intravenous anaesthetic and analgesic agents. The inherent risks of anaesthesia delivery systems demand that measures are implemented to detect and prevent faults prior to equipment use.

The document seeks to assist all personnel, whose roles involve interaction with anaesthesia delivery systems, to achieve the highest standards of safety for these systems and thereby contributing to patient safety and best possible outcomes. Although the scope specifies those systems when used by anaesthetists, the principles would apply wherever deep sedation or anaesthesia, typically intravenous delivery systems, is provided in other contexts such as in intensive care or patient transport.

2. Background

This document is intended to apply to all contemporary anaesthesia delivery systems, including their individual functional components. It deals with the principles of checking delivery systems and protocols. This document is not intended to provide checklists for the array of specific equipment available from all manufacturers. It is the responsibility of each facility to ensure that specific checklists are available in accordance with manufacturers' guidelines, for each item of equipment relevant to anaesthesia delivery systems.

For gas supply, the Australian standard, AS 2896:2021 Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems, is frequently referred to. Previously In New Zealand, this standard was co badged as AS/NZS and it is often still applied.

The delivery system is considered to be the components delivering anaesthetic agents up to the devices directly connected to the patient. For intravenous systems this represents the infusion pump, drug reservoir (syringe or other container) and associated tubing up until, but not including, the cannula inserted into the patient. For anaesthetic gases this includes the anaesthesia machine itself, the gas pathway of the anaesthesia machine, and the anaesthetic gas delivery circuit up until, but not including, the airway device directly connecting to the patient (eg face mask, supraglottic airway, endotracheal tube and any short flexible connector).

The principal problems of equipment malfunction are either delivery of inadequate quantities of medications, excessive quantities of medication, incorrect medication or inappropriate airway pressures.

In general terms, equipment failure may result in one or more of the following:

1. Failure of power supply, including battery power in battery operated devices.
2. Failure to supply selected anaesthetic or analgesic medications.

3. Failure of monitoring and alarm devices.
4. Failure to maintain breathing circuit pressures within acceptable limits.

It is essential that each facility designates one or more suitable individuals whose responsibilities include anaesthesia delivery system commissioning and maintenance, and that this individual be highly accountable for fulfilling this role to the highest level. The principles of *AS/NZS 3551:2026 Management programs for medical equipment* must be applied where relevant.

Checking processes for anaesthesia delivery systems outside the operating or procedure room environment may need to be considered in the context of available resources (eg critical transport, remote locations), however the principles of PG31 should be applied to that equipment being used to ensure patient safety.

Anaesthesia delivery systems may be complex and prone to disconnections, misconnections, leaks, pressurisation or depressurisation, and these may arise at any time before or even during use. Consequently, frequent checks are required.

The level 1 check must be implemented to ensure that equipment performs according to standards as well as manufacturers' specifications. This is a detailed check requiring the expertise of a suitably qualified person (typically a biomedical engineer) to certify that all new equipment, or all equipment following service and repair, achieve the standards and specified levels of performance.

Equally important are the level 2 and level 3 checks. For each level of check, protocols are provided and documentation of these is essential. Suitably trained personnel for these tasks include anaesthetists, anaesthetic nurses, anaesthetic technicians and those with specific responsibility for anaesthetic machines including biomedical technicians. It is the responsibility of the anaesthetist to ensure the checks have occurred. The most commonly reported errors include failure to check circuit for leaks between cases, especially when circuit or components are changed, incorrect ventilator mode (eg not on T-piece), inadequate vaporiser filling levels and suction equipment has been replaced.

The manual "two bag" test in the level 2 check is to be applied to all machines as it exceeds the capabilities of any equipment featuring automated checks. In particular, it is designed to detect obstruction of the expiratory limb of the circle breathing system, a condition not reliably identified by other commonly used tests which focus on eliminating leaks. This is important, as expiratory limb obstruction typically manifests as hypotension and air trapping shortly after induction of anaesthesia, a condition easily mistaken for anaphylaxis. The "two bag" test also can detect obstruction or leaks past the junction of the inspiratory and expiratory limbs but must be conducted at the final point of connection to the patient airway access device – this point should include the 'Y-piece' for dual tubing circuits, the patient-end connector for co-axial circuits, and be on the patient side of a circuit filter if used at this point.

Errors have occurred where the bag used to undertake the 'two-bag' test was left in situ and the breathing bag was removed with that part of the circuit connected to the patient. A clearly marked or coloured bag ("test lung") should be used for the patient-end "two bag" test so that its removal at the end of the test is unambiguous. This should be able to be reused.

It is noted that carbon dioxide absorbants do not have identical chemical composition or characteristics (eg CaOH, NaOH/KOH), however the principle of discarding absorbants that have been exposed to long periods of dry gas flow (to avoid CO release from soda-lime) is applied in order to keep processes simple and generally applicable as the type of absorbent supplied may change from time to time.

A protocol for checking electric driven powered devices used for infusion of anaesthetic or analgesic medications has been included, in recognition of the increasing use of infusion pumps for anaesthetic delivery. Components of the infusion line have been specified, including an anti-reflux valve to prevent intravenous anaesthetic drugs back flowing up a shared line where the infusion line is shared. An anti-

siphon valve is recommended on the anaesthetic drug infusion line to prevent unintended passive siphoning of anaesthesia medication from an unsecured syringe.

It is understood that in an emergency a full Level 2 and Level 3 check may not be practical due to time constraints. It is recommended that delivery systems that may be required in an acute emergency have a Level 2 check undertaken on a daily basis.

Checklists are necessary to ensure steps are not omitted. Some components of checklists may be displayed electronically by the anaesthesia delivery system enabling confirmation of their completion.

Process of document review

The 2025-2026 document development group comprised:

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