

Short title: Anaesthesia machine safety

1. Purpose and scope

- 1.1 The anaesthesia machine is designed to deliver anaesthetic gases, anaesthetic vapours, oxygen and/or air via a breathing circuit to patients. Safe anaesthesia machines are essential to the provision of safe patient care.
- 1.2 This document specifies minimum safety requirements for anaesthesia machines in clinical use in Australia and New Zealand.
- 1.3 The document also provides guidance regarding whether an anaesthesia machine should be replaced.
- 1.4 The general intent of this document is that all anaesthesia machines in clinical use in Australia and New Zealand should comply with Australian/New Zealand standards *AS/NZS 3200.2.13:2005 Medical electrical equipment - Particular requirements for safety - Anaesthetic systems*¹ and *AS/NZS 4059:1996 Anaesthetic machines - Non-electrical - For use with humans*², and other relevant national standards by January 1, 2014.
- 1.5 This document does not apply to:
 - 1.5.1 Anaesthesia ventilators, anaesthesia gas scavenging systems or medical suction systems.
 - 1.5.2 Equipment used for the delivery of intravenous anaesthetic agents.
 - 1.5.3 Monitoring equipment, whether integral to or separate from the machine, except as required by *AS/NZS 3200.2.13:2005*.¹ ANZCA's monitoring recommendations are outlined in college professional document *PG18(A) Guideline on monitoring during anaesthesia*.
 - 1.5.4 Basic draw-over systems and draw-over capable field anaesthesia machines.
 - 1.5.4.1 The use of field equipment for teaching or continuing professional development in anaesthetising locations in Australia and New Zealand is acceptable when directly supervised by anaesthetists experienced in the principles and use of such equipment and when approved by the head of department or his or her equivalent. Monitoring must comply with college professional document *PG18(A) Guideline on monitoring during anaesthesia*.

2. Anaesthesia machine safety assessment

- 2.1 Anaesthesia machines must be assessed for safety, reliability and functionality at least once a year by a specialist anaesthetist, or other person, with the required skill and technical knowledge.

- 2.2 This assessment will result in a classification of each machine into one or more of the following categories, each of which defines a specific course of action for that machine:
- 2.2.1 Anaesthesia machines that fail to comply with one or more of the safety requirements specified in items 3.1 to 3.15 inclusive and the maintenance requirements specified in 4.1.
- Action:* Anaesthesia machines in this category must be removed from clinical use. If they can be upgraded to meet the requirements of items 3.1 to 3.15 inclusive and 4.1, they may be returned to clinical practice only after re-assessment confirms full compliance with all mandatory safety requirements.
- 2.2.2 Anaesthesia machines that meet the safety requirements of items 3.1 to 3.15 inclusive and the maintenance requirements of item 4.1, but fail to comply with one or more of the safety requirements of items 3.16 to 3.20 inclusive.
- Action:* Anaesthesia machines in this category must enter an update or replacement process for which planning should start immediately. By January 1, 2014, all anaesthesia machines in this category must either have been upgraded to comply with all the requirements of this document or have been removed from clinical use.
- 2.2.3 Anaesthesia machines that fail to comply with the maintenance requirements of items 4.2 and 4.3.
- Action:* Anaesthesia machines in this category must be withdrawn from clinical use no later than six months from the date on which their lack of compliance with items 4.2 and 4.3 was documented. Items 2.2.1 and 2.2.2 apply to machines that in addition fail to comply with the requirements of items 3.1 to 3.20 inclusive.
- 2.2.4 Anaesthesia machines that comply with all the safety and maintenance requirements of this document.
- Action:* Anaesthesia machines in this category are acceptable for clinical use.
- 2.3 Anaesthesia machines may be unsafe for clinical use for reasons other than those addressed in this document, including failure to meet electrical safety requirements, or lack of appropriate monitoring equipment.
- 2.4 All anaesthesia machines in clinical use need to comply with safety standards/checks/tests beyond those addressed in this document (see item 2.3). Unsafe anaesthesia machines must not be used.

3. Safety requirements

- 3.1 Connections for medical gas cylinders, yokes or regulators must be pin indexed.³
- 3.2 A reserve supply of oxygen must be attached to the anaesthesia machine in a manner that ensures easy activation should the oxygen supply failure warning system (see item 3.5) indicate impending failure of the external oxygen supply.
- 3.3 Non-interchangeable gas hose connectors must be present on all gas inlet and outlet sockets to prevent incorrect gas supply connections.

- 3.4 A display of gas supply line and cylinder pressures must be provided. The pressure displays must be visible from the front of the machine either continuously or on demand^{1,4}.
- 3.5 When high pressure gas supply systems are in use, an oxygen supply failure warning device must be present on the anaesthesia machine. This must:
 - 3.5.1 Activate automatically when the oxygen supply pressure falls below a predetermined critical level.
 - 3.5.2 Generate an alarm to warn the operator.
 - 3.5.3 Cut off the supply of gases other than air or oxygen to the common fresh gas outlet.
 - 3.5.4 Cancel the alarm only when the oxygen supply pressure has been restored to a level above that at which the device was activated.
- 3.6 If the anaesthesia machine incorporates a gas flowmeter bank, oxygen must be the last gas to enter the common gas manifold at the top of the flowmeter tubes. The oxygen flow knob must be the first from the left on the rotameter, relative to other flow knobs.
- 3.7 If mechanical means are provided to mix the anaesthetic gases on the anaesthesia machine, there must be only one gas flow control knob for each gas.
- 3.8 If a mechanical oxygen flow knob is provided, it must differ from the other flow control knobs so that tactile identification of the oxygen control knob is possible (for example, fluted).
- 3.9 If the anaesthesia machine is capable of delivering nitrous oxide, the machine must not deliver a hypoxic mixture. When oxygen and nitrous oxide are the only gases used, the machine must prevent delivery of a gas mixture with an oxygen concentration below that of ambient air.
- 3.10 If two or more vapourisers can be simultaneously mounted on the anaesthesia machine, a vapouriser interlock system must allow only one vapouriser to be used at a time.
- 3.11 Vapourisers with mechanical adjustment dials, when used in high pressure circuits, must increase the delivered anaesthetic vapour concentration when the dial is rotated in an anti-clockwise direction.
- 3.12 A fresh gas outlet, if provided, must be 22 mm outer diameter and 15 mm inner diameter, visible to the operator and should be capable of being connected to the breathing system in such a way as to prevent accidental disconnection.
- 3.13 A high pressure relief valve or other means of automatically preventing dangerously high pressures in the breathing system must be present in the breathing circuit but it is not necessary for such a device to be integral to the anaesthesia machine.
- 3.14 Anaesthesia gas scavenging system connections must be of a diameter that is different from the other connections used for the breathing system.
- 3.15 When each feature of the anaesthesia machine is enabled, any associated monitor and alarm functions must be automatically activated.

¹ ISO Standard 80601-2-13:2011 states that a display of gas supply line and cylinder pressures must be provided. The pressure displays must be visible from the front of the machine either continuously or on demand. ANZCA supports this.

- 3.16 A high priority alarm must be activated when high airway pressure is present.
- 3.17 A high priority alarm must be activated when the airway pressure falls 10 cm H₂O below atmospheric pressure for more than one second.⁵
- 3.18 The emergency oxygen flush control must be protected from accidental activation.
- 3.19 An “on/off” switch, if present, must be protected from unintended activation or deactivation.
 - 3.19.1 Switching “off” an electronic anaesthesia machine during normal operation should require a confirmatory step and/or the machine should display a warning of imminent shut-down.
- 3.20 If the anaesthesia machine requires electrical power for normal operation, a backup power supply must be a part of the machine and permit normal operation for at least 30 minutes after a mains power supply failure. An alarm must be activated at the time of the mains failure and the state of the reserve power supply must be indicated while it is in use.

4. Maintenance requirements

- 4.1 Adequate maintenance of the anaesthesia machine must be ongoing for the life of the unit. Any replacement parts must be of suitable quality and the work undertaken by appropriately qualified service personnel. Repair or maintenance must involve testing of key safety and performance parameters prior to patient use (see *AS/NZS 3551:2012 Management programs for medical equipment*⁶).
- 4.2 A maintenance record and problem log must be kept for all anaesthesia machines in clinical use (see college professional document *PG31(A) Guideline on checking anaesthesia delivery systems*).
- 4.3 An anaesthesia machine must be considered for replacement if its maintenance history indicates that problems with the machine are adversely affecting clinical service to an extent that is unacceptable to the institution or which threatens patient safety, or if it cannot meet the reasonable needs of current anaesthesia practice in the facility.

Related ANZCA documents

PG18(A) Guideline on monitoring during anaesthesia

PG31(A) Guideline on checking anaesthesia delivery systems

PS55(A) Position statement on minimum facilities for safe administration of anaesthesia in operating suites and other anaesthetising locations

This document is accompanied by a background paper (PS54(A)BP) which provides more detailed information regarding the rationale and interpretation of the Position Statement.

References

1. Standards Australia. AS/NZS 3200.2.13:2005 Medical electrical equipment - Particular requirements for safety - Anaesthetic systems. 2005. Note: this reference has been withdrawn by Standards Australia.
2. Standards Australia. AS/NZS 4059:1996 Anaesthetic machines - Non-electrical - For use with humans. 1996. Note: this reference has been withdrawn by Standards Australia.
3. International Organization for Standardization. ISO 407:2004 Small medical gas cylinders - Pin-index yoke-type valve connections. 2004. *This reference has been superseded by: Standards Australia. ISO 407:2023[Current] Small medical gas cylinders — Pin-index yoke-type valve connections. Note: this updated reference has not yet been reviewed by ANZCA. Please contact your hospital library if access is required.
4. International Organization for Standardization. ISO 80601-2-13:2011 Pressure or content MONITORING EQUIPMENT (201.101.4.3). Note this reference has been withdrawn by Standards Australia.
5. International Organization for Standardization. ISO 80601-2-13:2011 Medical electrical equipment - Part 2-13: Particular requirements for basic safety and essential performance of an anaesthetic workstation. 2011. *This reference has been superseded by: Standards Australia. ISO 80601-2-13:2022[Current] Medical electrical equipment — Part 2-13: Particular requirements for basic safety and essential performance of an anaesthetic workstation. Note: this updated reference has not yet been reviewed by ANZCA. Please contact your hospital library if access is required.
6. Standards Australia. AS/NZS 3551:2012 Management programs for medical equipment. 2012. Note: this reference is pending revision by Standards Australia.

Further reading

American Society of Anesthesiologists. Guidelines for determining anesthesia machine obsolescence. American Society of Anesthesiologists; 2004. Available from: <https://pubs.asahq.org/monitor/article-abstract/68/9/27/1204/Anesthesia-Machine-Obsolescence-Guidelines?redirectedFrom=PDF> Accessed 13 May 2024.

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