



# PS66 Guideline on the role of the anaesthetist in commissioning medical gas pipelines

## 1. Purpose

This guideline is intended to assist anaesthetists and other clinical practitioners tasked with commissioning medical gas pipelines to comply with AS 2896:2011-*Medical gas systems – Installation and testing of non-flammable medical gas pipeline systems*. It specifies the personnel, equipment, procedures and documentation required to perform the tests for determining the identity of the gas at the gas terminal outlet (terminal unit) as part of the commissioning procedure and certification of the Medical Gas Pipeline System (MGPS).

It also specifies the documentation necessary for recording and storage of the results of the testing.

## 2. Scope

Some specific details of this Guideline are applicable to Australia only as New Zealand practice may vary from that detailed in AS 2896:2011.

This document is intended to apply to anaesthetists but is also applicable to other clinical practitioners involved in the testing and certification of the results of operational testing of the gas identity at the terminal units during the commissioning of the MGPS.

This guideline is not intended to apply to any additional testing beyond the minimum required by AS 2896:2011. Aspects of pipeline commissioning which do not necessarily involve the anaesthetist such as checking for pipeline contaminants resulting from welding & pressure drop during use following commissioning of new outlets are excluded from this guideline.

## 3. Introduction

MGPS as conduits for medical gases are a life support system. Integrity of MGPS is essential for delivery of the correct gas at the correct pressure and flow rate to terminal unit in a medical facility.

Australian Standard: AS 2896:2011 "*Medical gas systems—Installation and testing of non-flammable medical gas pipeline systems*" requires that:

- During the commissioning of a MGPS, a member of the health care facility experienced in administration of medical gases to patients ('Clinical Practitioner') must be present and witness

the tests determining that the identification of the medical gas at the terminal unit is correct as designated.

- Where asphyxiating medical gases such as nitrous oxide and carbon dioxide are piped and/or when piping exists for non-medical gases such as for air conditioning in the same area as medical gases, the Clinical Practitioner involved in the tests must be the facility anaesthetist-in-charge or a delegated anaesthetist.

Anaesthetists are specialist practitioners whose training specifically includes delivery of gas mixtures for patient care. As such, their involvement during testing of MGPS is a critical step where hypoxic mixtures are possible, to ensure that the correct gas is delivered from the correct terminal unit prior to MGPS use for patient care, facilitating patient safety.

#### **4. Background**

Undetected cross connections between pipelines of MGPS can result in serious patient harm including death. Cross connection can occur at the time of installation of the MGPS or when modifications or repairs are made to the MGPS.

Testing as per AS 2896 includes a specific 'Cross connection test' of MGPS performed before the supply of the correct gas is connected. Anaesthetists and other Clinical Practitioners are not required to be involved in this 'Cross connection test'.

Once the medical gas supply to the MGPS is connected, identification of the gas at the terminal unit is another opportunity to identify correct connection of gas pipelines.

#### **5. Personnel**

The health care facility must designate a person or persons, competent in medical gas testing and verification of piping systems, to carry out the tests specified in AS 2896:2011. This is often a biomedical engineer for most of these tests.

Final operational testing is performed on terminal units and requires a Clinical Practitioner to verify the tests.

- a) Anaesthetists are not required where only oxygen, medical air and suction are supplied by the MGPS.
- b) Where asphyxiating medical gases such as nitrous oxide and carbon dioxide and/or non-medical gases are piped, tests to identify the gas at the terminal unit must be performed by a delegated anaesthetist.

Consultation with the relevant biomedical engineering department and anaesthesia colleagues with prior experience in this area should be sought prior to the gas identity tests being undertaken.

## 6. Equipment

Testing equipment will be provided, managed and maintained (including calibration) by the testing engineer and consists of:

- Oxygen concentration analyser and
- Gas analyser(s) if more than one asphyxiating gas is piped

All instruments must have been calibrated within the previous 12 months, or lesser period if recommended by the instrument manufacturer.

Accuracy ratings for pressure gauges must be  $\pm 2\%$  of full scale deflection or better. Flow meters must be  $\pm 5\%$  of full scale or better.



**Figure 1. Example of gas analyser for testing gas identity at the terminal unit**

## 7. Procedure

At the completion of construction and initial testing of the MGPS by the contractor, the pipelines are purged with the designated working gases.

The form TERMINAL UNIT TESTING for GAS IDENTIFICATION & CONCENTRATION (Form 1 which is equivalent to AS 2896:2011 Appendix I) should be used to record the testing. It is noted an alternative form of equivalence may be used.

- Each area/ward should have the room number and bed number/s allocated and marked before any testing is carried out.
- Details at the top of Form 1 are to be entered before commencement of testing in each area.
- Results must be entered on the form at the time of testing.

### 7.1 Identification of gas at the terminal unit

The gas delivered at each terminal unit must be the correct gas designated for that terminal unit.

*Test by verifying the nominal concentration of the gas at each terminal unit. For the test to pass, only the correct gas should be detected and at the concentrations in Table 1.*

Re/commissioning should take in all downstream gas units. Anaesthesia input may not be required if no gas pipeline has been cut into or gas-specific connector changed.

Where only one asphyxiating gas is piped, such as nitrous oxide or carbon dioxide, or one non-medical gas, an oxygen analyser is used. If more than one asphyxiating gas is piped an oxygen analyser cannot differentiate between the two gases and another method of positive identification must be used such as a gas analyser.

Using various gas analysers the following readings for the specific gas should be as given in Table 1.

**Table 1**

Reticulated gas	Oxygen analyser	Nitrous oxide analyser	Carbon dioxide analyser	Helium analyser
Oxygen	≥ 97 %	N/A	N/A	±2 % of nominal oxygen concentration
Medical air	19-23 %	N/A	N/A	< 1 %
Surgical tool air	19-23 %	N/A	N/A	< 1 %
Nitrous oxide	< 1 %	≥ 97 %	< 1 %	N/A
Carbon dioxide	< 1 %	< 1 %	≥ 97 %	N/A
CO <sub>2</sub> in oxygen (CO <sub>2</sub> ≤ 7 %) <sup>a</sup>	±2 % of nominal oxygen concentration	< 1 %	±2 % of nominal carbon dioxide concentration	N/A
N <sub>2</sub> O/O <sub>2</sub> 50/50	43-57 %	43-57 %	N/A	N/A
Helium and oxygen mixtures (He > 20 %) <sup>b</sup>	N/A	N/A	N/A	±2 % of nominal helium concentration

<sup>a</sup> The most commonly used mixture concentration is 5 % CO<sub>2</sub> in oxygen.  
<sup>b</sup> The most commonly used mixture concentration is 28 % helium and oxygen.

If gas from any terminal unit fails to pass the identity test as described in point 7.1, the cause of the failure must be determined and the MPGS recommissioned. Recommissioning tests must be carried out on the part affected as if it were an addition to an existing system. However, if more than 10% of units of a system are affected, all the units must be retested.

## **7.2 Results**

The results of testing for incorrect connection of gas supply will be detection of the correct gas at the terminal unit.

The gas designated by the terminal unit and no other gas must be detected at the terminal unit.

When the designated gas is detected at the terminal unit the terminal unit will be deemed to have passed.

## **8. Documentation**

The results entered in Form 1 are part of the permanent test record.

The delegated anaesthetist must be noted on Form 1.

A copy of the completed Form 1 must be given to the anaesthetist and held on file by the anaesthetist-in-charge or health care facility responsible person.

Anaesthetists involved in certifying the results of operational testing at the terminal units must not sign off testing that was not personally witnessed.

## **9. Additional testing**

### **9.1 Gas-specific connection**

Although not required by AS 2896:2011, it is recommended that each terminal unit is confirmed by the anaesthetist to be labelled correctly and has the correct gas-specific sleeve index. The thread used on all high pressure gas pipes is the same. It is the addition of the gas-specific sleeve index (see AS 2902) to the high pressure gas pipe that makes it gas-specific and identifies the gas being piped as well as preventing connection of low pressure piping not specific for that gas.

The results of this testing can be added manually to Form 1 by the anaesthetist. Note that this test is outside the scope of AS 2896:2011.

Each terminal unit must permit only the correct gas-specific probe to connect.

*Test the terminal unit by confirming that it is correctly labelled with the designated gas, that the appropriate colour is used and that only the correct probe is able to be connected to it. The terminal unit will be passed only if it meets all three of these criteria.*

Testing equipment will be provided by the testing engineer.

The following gas-specific probes should be used, depending on which medical gases are piped.

- Oxygen
- Medical air
- Nitrous oxide
- Surgical tool air
- Carbon dioxide
- <7% CO<sub>2</sub> in oxygen
- Nitrous oxide/oxygen 50/50
- Variable air/oxygen mixtures (rarely reticulated)
- Oxygen/helium mixtures (oxygen ≥20%) (rarely reticulated)
- Carbon monoxide in air (n.b. this is a NIST fitting)
- Anaesthetic gas scavenging
- Suction



**Figure 2. Example of tool for testing gas-specific connection at the terminal unit**

#### **10. Use of terminal units following works involving pipelines and terminal units**

Anaesthetists should be aware that terminal units in areas with nitrous oxide, carbon dioxide and other asphyxiating gases should not be used following work involving pipeline cut-ins or replacement of terminal units on the MGPS, until a formal recommissioning process has been completed. Confirmation of recommissioning may be sought from the delegated health care facility responsible person.

**This document is accompanied by a background paper (PS66BP) which provides more detailed information regarding the rationale and interpretation of the Guideline.**



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