Equipment Required for Checking

The following equipment is required for checking the AGM. Part numbers are given in "Chapter 8. Parts List" on page 163.

- Electronic Flowmeter (Instructions are provided with the flowmeter. See also Service Note M1026A-034).
- Span Calibration Equipment.
  - Calibration Gas.
  - Calibration Tubing

Warning **Philips Calibration Gas contains Halocarbon 22. Halocarbon 22 is represented in the Calibration task window by "Substitute", which is the default. If you are using another calibration gas, this must be selected in the task window.**

Checks and Adjustments

The following sections explain the steps needed to carry out the checks and adjustments. A complete check and calibration procedure requires approximately 45 minutes, including waiting time.

Note **Make sure that the watertrap is attached.**

Performance Leakage Check

Complete the following steps to do a performance leakage check:

Note **Do not perform the leakage check while a Zero calibration is running.**

1. Switch on the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module and the ACMS or V24 and V26.
2. Wait until the Anesthetic Gas Module enters the warm up phase.
3. Connect a flowmeter to the exhaust outlet of the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
4. Connect the watertrap to the watertrap manifold.
5. Note the flowrate.
6. Block the gas inlet at the water separation filter (use your fingertip).

   The reading at the flowmeter should decrease to Zero (see table 4-1). If it does not, systematically block the pneumatic path at various points before the pump to isolate the leakage point. (See Figure 1-2, "Pneumatic System" for tubing connections.) When the fault has been corrected, repeat the leakage check.
7. Connect the flowmeter to the inlet.
8. Note the flowrate.
9. Block the Anesthetic Gas Module exhaust (using your finger tip).
10. Check the effect of blocking the exhaust.

    The reading at the flowmeter should decrease to Zero (see Table 4-1). If it does not, systematically block the pneumatic path at various points after the pump to isolate the leakage point. (See Figure 1-2, "Pneumatic System" for tubing connections.) When the fault has been corrected, repeat the leakage check.

Table 4-1 **Leakage Tolerance Limits**

Items	Value / Tolerance
Leakage	Range: 0 → 4 ml/min

Performance Diagnostic Check

Complete the following steps to do a performance diagnostic check:

1. Switch on the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module and the ACMS or V24 and V26.

Note **Make sure that the watertrap is attached.**

2. Wait 8 minutes for the Anesthetic Gas Module to warm up (the warm-up process is finished when the **GAS AN. WARMUP** prompt disappears).
3. Enter the Service Mode at the ACMS (described in the *ACMS Service Guide*).
4. Press **Airway Gases** set-up key from the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
5. Press **AG Diag** and check that no errors are reported for the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.

Performance Flowrate Check

Always perform a leakage check before the flowrate check. Three flowrates need to be checked in the following order:

- Total flow in **Purge** mode.
- Flow in **Measurement Path** in **Normal** mode.
- Total flow in **Normal** mode.

These flowrate checks are described in the following three procedures.

The total flow is measured by connecting the flowmeter to the exhaust, the measurement path flow is measured by connecting the flowmeter to the gas inlet with a special test fixture.

Note **Values for the flowrates displayed in ACMS service mode (normal flow, purge flow) might not match with the actual flowrates required. Use the values given in this manual**

The Flowrate values are summarized in Table 4-2:

Table 4-2 **Total Flowrates**

Total Flowrate	Value
Purge	310 ml/min
Normal	150 ml/min

Note **Do not perform the flowrate check while a Zero calibration is running.**

Procedure 1. Total Flowrate Check and Adjustment in Purge Mode

To make the flowrate measurement and any necessary adjustments:

1. Enter the Service Mode of the ACMS. The Anesthetic Gas Module must have completed the warm up phase.

2. Press **Airway Gases** set-up key from the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
3. Press the **AG Cal** softkey.
4. Select **`Flow Cal`** from the list on the display.
5. Press the **Change CalValue** to adjust the value.
6. Select **`Purge`** flow (310 ml/min).
7. Connect a flowmeter to the exhaust outlet.
8. Note the actual flowrate by following the instructions accompanying the flowmeter. If the actual flowrate is outside the tolerance values (310 ml/min ± 15 ml/min), the flowrate must be adjusted.

Flowrate Adjustment

9. Remove the top cover (see “The Top Cover” on page 113).
10. The flowrate is adjusted by adjusting potentiometer **R125** on the PC board until the required value (310 ml/min ± 15 ml/min) is achieved.

    See Figure 6-8, "Potentiometers, Jumpers, and Test Points" on 106.

Flowrate Calibration

11. If you have made adjustments, you **must** save the settings by pressing **Start Cal** and then **Confirm**. The system does the following:
    a. Runs through various flowrates for 10 seconds each and “Pump off” for 10 seconds.
    b. Saves the value internally.
    c. Switches to the previously selected flowrate.
12. Disconnect the flowmeter from the exhaust.

The Purge mode flowrate tolerance values are summarized in Table 4-3:

Table 4-3 **Purge Mode Flowrate Tolerance**

Total Flowrate in Purge Mode	Tolerance
310 ml/min	± 15 ml/min

Procedure 2. Measurement Path Flowrate Check and Adjustment in Normal Mode

The flowrate of the measurement path is checked using a test fixture in the form of a modified watertrap. In order to perform the flow rate check, the following equipment is required:

- Flow Split Test Tool M1026-60136 containing the Test Fixture Kit
- Electronic Flowmeter M1026-60144

Note

1. Check that the test fixture is still valid for use. It must be less than two years old. The test fixture is labelled with a "Received" date that needs to be filled in when the test fixture is received.

2. The flow value that is labelled on the test fixture is to be used to perform the measurement path flowrate check. It is only valid for this test fixture.

3. Check the test fixture visually for leaks. Regularly perform a leakage check (see page 61, steps 1-6) with the test fixture attached instead of the watertrap. Block both lines (drainage and measurement) at the same time while performing the leakage check. Block the measurement line with a luer cap or a similar device and the drainage line with your fingertip. If a leak exists, replace the test fixture.

This test must be done with ***Normal*** flow.

To make the Measurement Path Flowrate check and any necessary adjustments:

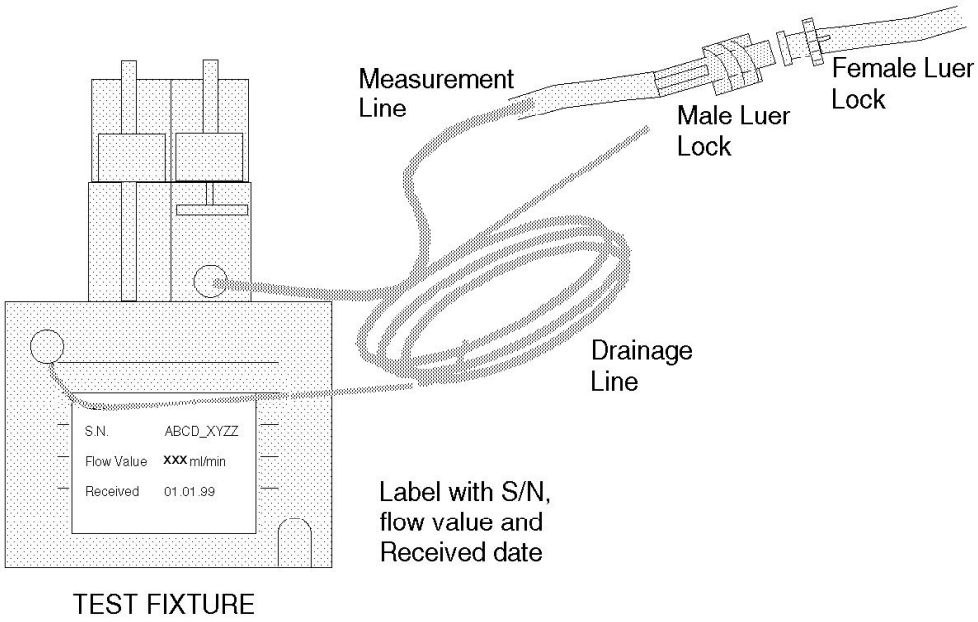
1. Enter the Service Mode of the ACMS. The Anesthetic Gas Module must have completed the warm up phase.
2. Press **Airway Gases** set-up key from the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
3. Press the **AG Cal** softkey.
4. Select **`Flow Cal`** from the list on the display.
5. Press the **Change CalValue** to adjust the value.
6. Select **`Normal`** flow (150 ml/min). The value is displayed in a box on the lower part of the screen.
7. Press the **Select Item** softkey. The box in the lower part of the screen must disappear.
8. Remove the watertrap from its manifold and connect the test fixture to the manifold.

Warning

Always handle the test fixture carefully and avoid contact with dust. Do not change or modify the test line/loops as this can change the flow resistance.

Make sure that there are no sharp bends or kinks in the tubing that leads to the test fixture. If a kink is visible, replace the fixture and use the new one.

9. Connect the measurement line of the test fixture to the flowmeter using the attached male Luer lock.



10. Note the actual flowrate by following the instructions accompanying the flowmeter. If the actual flowrate is outside the tolerance values (labelled flow value ± 3 ml/min), the flowrate must be adjusted.

Flowrate Adjustment

11. If the flowrate must be changed, adjust potentiometer **R126** on the PC board until the required value is reached (labelled flowrate ± 3 ml/min, see Table 4-4).

    See Figure 6-8, "Potentiometers, Jumpers, and Test Points" on 106.

Flowrate Calibration

12. If you have made adjustments, you **must** save the settings by pressing **Start Cal** and then **Confirm**. The system does the following:
    a. Runs through various flowrates for 10 seconds each and "Pump off" for 10 seconds.
    b. Saves the value internally.
    c. Switches to the previously selected flowrate.
13. Remove the test fixture and reattach the watertrap.

The Measurement Path flowrate tolerance values are summarized in Table 4-4:

Table 4-4 Measurement Path Flowrate Tolerance

Measurement Path Flowrate	Tolerance
Labeled value on Test Fixture	± 3 ml/min

Procedure 3. Total Flowrate Check in Normal Mode

To perform the flowrate check:

1. Enter the Service Mode of the ACMS. The Anesthetic Gas Module must have completed the warm up phase.
2. Press **Airway Gases** set-up key from the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
3. Press the **AG Cal** softkey.
4. Select **`Flow Cal`** from the list on the display.
5. Press the **Change CalValue** to adjust the value.
6. Select **`Normal`** flow (150 ml/min).
7. Connect a flowmeter to the exhaust outlet.
8. Check that the actual flowrate is between 132 ml/min and 170 ml/min. If it is not, check all tubing for occlusions (e.g. kinks, dirt) and replace if necessary. Repeat flowrate check. If the flowrate is still not within tolerance, exchange the Nafion tubing, bacterial filters and restrictor in the drainage path (provided in the Tubing Kit M1026-60119 and PM Kit M1026-60132). Then repeat flowrate check.
9. Disconnect the flowmeter from the exhaust.
10. Refit the top cover.

Zero Calibration

Complete the following steps to do a Zero calibration:

Note

Only perform Zero calibration when the top cover is closed. Light and electro-magnetic interference may affect the measurements.

Zero calibration is not possible during Warm-Up.

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1. Enter **`Service`** mode.
2. Press **AG Cal** to access the calibration task window for the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
3. Press the **Select Item** softkey, and select **`Zero Cal`**.
4. Press **Start Cal** and **Confirm** to start Zero calibration.
5. Wait until Zero calibration is complete. A pass/fail indication is displayed against each channel. If a fail indication is displayed against any channel, repeat the Zero calibration. If the failure persists, refer to “Chapter 6. Troubleshooting the Anesthetic Gas Module” on page 77, and correct the fault. Then repeat the Zero calibration procedure.

Barometric Pressure Check and Calibration

Complete the following step to do a Barometric Pressure check and calibration:

Note **Only perform Barometric Check and Calibration when the top cover is closed. Electro-magnetic interference may affect the measurements.**

1. Enter **`Service`** mode.
2. Press **AG Cal** to access the calibration task window for the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module.
3. Check that the Barometric Pressure of the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module corresponds to the absolute atmospheric pressure at your hospital location (see Table 4-5). If it does, proceed to "Span Calibration Check" on page 65.
4. Press **Select Item** and select **`Barometr. Press`**.
5. Press **Change CalValue** to change the calibration value to the current absolute atmospheric pressure at your hospital location.
6. Press **Start Cal** and **Confirm** to start the pressure calibration.
7. Wait for the calibration to complete. Check that a pass indication is displayed against **`Barometr. Press`**. If it is not, perform the calibration again. If you still have a fail indication against Barometric Pressure, refer to "Chapter 6. Troubleshooting the Anesthetic Gas Module" on page 77, and correct the fault.
8. Repeat the Zero calibration. The new barometric pressure value is visible after the Zero calibration.

Tip! **If the hospital cannot provide an accurate value for the absolute Barometric Pressure, call the local weather station or airport.**

Since weather stations or airports sometimes provide barometric pressure values that are corrected to sea level, ensure that the value you are given is valid for the hospital location. Table 4-6 shows you typical atmospheric barometric pressure for various altitudes.

Table 4-5 **Barometric Pressure Tolerance Limits**

Items	Measured Value / Tolerance
Barometric Pressure	Ambient Pressure ± 5mmHg

Table 4-6 **Typical Barometric Pressures at various Altitudes**

Altitude	Typical Barometric Pressure	Altitude	Typical Barometric Pressure	Altitude	Typical Barometric Pressure
0 m	760 mmHg	1100 m	664 mmHg	2200 m	577 mmHg
100 m	751 mmHg	1200 m	656 mmHg	2300 m	570 mmHg
200 m	742 mmHg	1300 m	648 mmHg	2400 m	562 mmHg
300 m	733 mmHg	1400 m	639 mmHg	2500 m	555 mmHg
400 m	724 mmHg	1500 m	631 mmHg	2600 m	548 mmHg
500 m	715 mmHg	1600 m	623 mmHg	2700 m	540 mmHg
600 m	707 mmHg	1700 m	616 mmHg	2800 m	533 mmHg
700 m	698 mmHg	1800 m	608 mmHg	2900 m	526 mmHg
800 m	689 mmHg	1900 m	600 mmHg	3000 m	519 mmHg
900 m	681 mmHg	2000 m	592 mmHg		
1000 m	672 mmHg	2100 m	585 mmHg		

If only a “corrected” (sea-level based or 0 meters) reading is available uncorrect the reading for an altitude by dividing the “TYPICAL BARO. PRESS” value for the selected altitude (as for CMS) by the “TYPICAL BARO. PRESS” value for 0 meters and then multiply the result by the corrected reading.

Example:

$$\text{Hospital Location Altitude} = 600m$$

$$\text{corrected pressure reading from airport} = 745mmHg$$

$$\text{uncorrected pressure} = \frac{\text{TYPICAL BARO. PRESS}}{760mmHg} \times \text{corrected pressure}$$

$$\text{uncorrected pressure} = \frac{707mmHg}{760mmHg} \times 745mmHg = 693mmHg$$

Span Calibration Check

Note

The M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module should run for at least 30 minutes before continuing with the following calibration procedures. This is to allow the module to reach a stable measurement condition.

Only perform Span calibration checks when the top cover is closed. Light and electro-magnetic interference can affect the measurements.

Before performing a Span calibration check, you ***must*** first perform:

- Performance Leakage Check (page 56).
- Performance Diagnostic Check (page 56).
- Performance Flowrate Check (page 57).
- Zero Calibration Check (page 62).
- Barometric Pressure Calibration Check (page 63).
- Ensure that there is enough gas in the calibration gas bottle.
- Check tubing assembly.
- Check that the calibration values displayed in the Calibration task window are the same as the values on the calibration gas bottle. If not, press **Change CalValue** to change the calibration value to that shown on the bottle.

Press **Select Agent** and select the agent that agrees with the calibration gas being used (or "substitute").

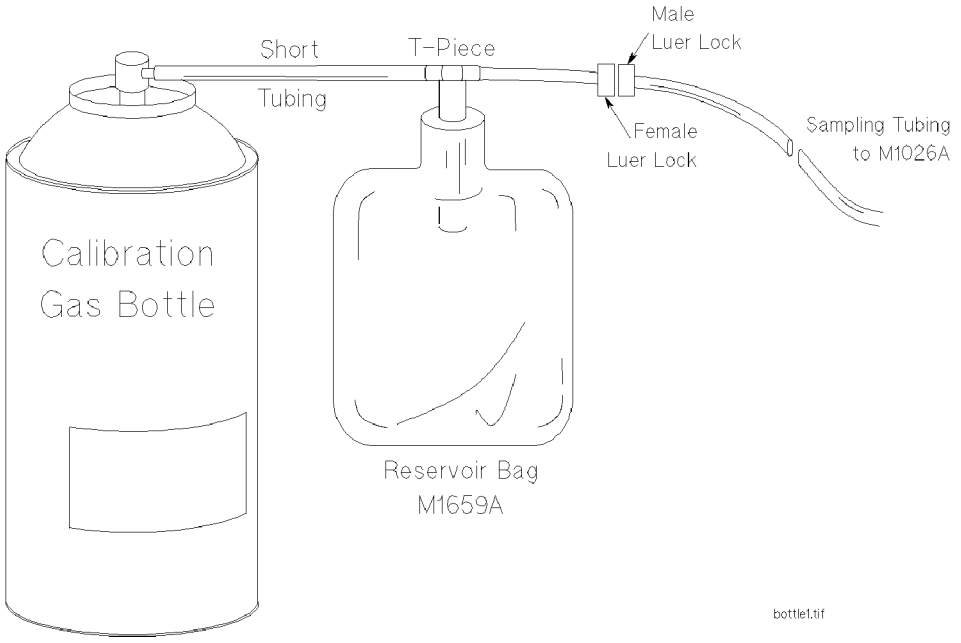

Figure 4-3 **Span Calibration Equipment including Gas Canister and Spray Valve**

Caution **Ensure that the room you are working in is well-ventilated, and that the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module exhaust is properly connected to the gas scavenging system.**

Note **If you are using Halocarbon 22 for anesthetic agent calibration you must select `Subst` (substitute) in the agent selection menu.**

1. Connect the T-piece to the calibration reservoir bag (if not already connected).
2. Connect one end of the short calibration tubing to the spray valve on the gas bottle and the other end to the T-piece.
3. Connect the gas sample tubing to the watertrap and sample inlet on the AGM and to the female luer connector on the tubing connected to the T-piece.
4. Switch to the AG Diagnostic Task window and wait until the pumping action of the AGM has completely emptied the reservoir bag of air. When the reservoir bag is empty, the status of the *Pneumatic System*, *Main PC Board* and *Power Supply* all switch to *Problem*. Make sure this status appears and stay in this mode for approximately 10 seconds. Switch back to the AG calibration window, then open the spray valve of the calibration gas bottle to fill the bag with gas. The bag should

not be pressurized.

Caution **Do not overinflate the reservoir bag. Do not attempt the calibration process if there are any visible leaks in the bag or tubing. If necessary, prevent the bag from emptying before the calibration is complete by adding more gas to the bag.**

5. If you do not have the O_2 option, proceed to step 10.
6. Press **Select Item** and select `O2 (%)`.
7. Check that the measured value for O_2 agrees with the stated content of the calibration gas (tolerance ±1.0%). If it does, do ***not*** perform a calibration and proceed to step 10 or, depending on how many gases you have already completed, step 11 or step 12.
8. Press **Start Cal** and **Confirm** to start the calibration.
9. Wait for the calibration to complete. Check that a pass indication is displayed against the calibration gas. If it is not, perform the Span calibration again. If you still have a fail indication against calibration gas, refer to "Chapter 6. Troubleshooting the Anesthetic Gas Module" on page 77, and correct the fault. Then repeat the Span calibration.
10. Repeat steps 6 to 9, this time for CO_2, using the calibration gas to check the calibration while CO_2 is selected. The tolerance for CO_2 is ± 0.1%.
11. Repeat steps 6 to 9, this time for N_2O, using the calibration gas to check the calibration while N_2O is selected. The tolerance for N_2O is ± 2.0%.
12. Repeat steps 6 to 9, this time for the anesthetic agent, using the calibration gas to check the agent calibration (select appropriate agent first). The tolerance for the anesthetic agent is 0.1%.
13. When you have finished calibrating, disconnect the reservoir bag from the gas sample tube and allow the system to purge with room air.
14. If any recalibration was necessary, repeat the Zero calibration and all concentration checks (because Span and Zero calibrations are inter-related).
15. Check that the displayed values agree with the content of the room air (O_2 at 20.9% ± 0.2%, agent at 0% ± 0.1%, N_2O at 0% ± 0.3% and CO_2 at 0% ± 0.1%). If this is not the case, repeat all calibration checks and procedures.
16. Press **Monitor Setup** to return to the `Service Mode` screen.

Built-in Acceptance Ranges

Each gas has a built-in acceptance range. This means that it is not possible to make the M1026A Opt. #A02 and Opt.#A05 Anesthetic Gas Module accept a value outside the following:

Gas	Range
O_2	47 to 100%
CO_2	5.0 to 10.0%
N_2O	40 to 100%
Agent	1.0 to 20.0%

Table 4-7 **Gas Tolerance Limits**

Items	Value[1]	Calibration Check Tolerance
O_2	52%	± 1.0%
CO_2	5%	± 0.1%
N_2O	40%	± 2.0%
Anesthetic Agent (or substitute Halocarbon 22)	3%	± 0.1%

1. These values are valid for the Philips gas M1660A.
   For other calibration gas mixtures (for example, for Japanese users calibrating with Scott Medical Products DOT29M1060), use the values specified for the mixture, applying the same Calibration Check Tolerance given in this table.

Disposal of Empty Calibration Gas Cylinder

1. Empty cylinder completely by pushing in the pin of the valve.
2. Once the cylinder is empty, drill a hole in the cylinder

Caution **Be careful to assure that the cylinder is completely empty before you try to drill the cylinder.**

3. Write “Empty” on the cylinder and place it with your scrap metal or, if you do not collect scrap metal for recycling, dispose of the cylinder.