

Checking and Calibrating the Gas Analyzer

This chapter explains how to check the gas analyzer to ensure that it is operating within its specified limits. A list of the equipment required to carry out the checks is included, as well as step-by-step instructions for the calibrations.

If you receive fail indications while testing, refer to the troubleshooting section of this document for guidance.

Access Service Functions of the Gas Analyzer

Service functions of the IntelliVue G1 and IntelliVue G5 are accessed with the M1013A/M1019A Service Software (VISIA tool) which is available on the Service CD shipped with the product.

When and how to check the Gas Analyzer

To ensure that the gas analyzer operates within the specified limits, it must be checked every 12 months. If you find values outside the tolerance limits while checking, please refer to the troubleshooting section in order to determine whether the instrument can be calibrated again or needs to be repaired.

Whenever the readings are in doubt, a gas calibration check should be performed.

Equipment required for checking

The following equipment is required for checking the gas analyzer. If applicable, part numbers are given in the parts list section of this manual.

Equipment	Philips part # or other recommendation	Accuracy
IntelliVue G1/G5 PC cable	M1013-61005 / 451261005001	n/a
Digital Flowmeter	M1026-60144 / 453563230731	±3 ml/min or better
Flow Split Tool	M1026-60136 / 453563230711	n/a
Digital Barometer/ Pressure Indicator	Recommended: DRUCK DPI 705, 2bar, absolute	±2 mbar or better
Watertrap	M1657B / 989803110871	n/a

Equipment	Philips part # or other recommendation	Accuracy
Sample Tubing	M1658A / 989803104671	n/a
Calibration Gas Reservoir Bag	M1659A / 989803104681	n/a
Calibration Gas	M1662A / 451261001391	n/a
Gas Exhaust Return Line or Exhaust Tubing	M1655A/B / 989803145671 or M1015-40001 / 453563227921	n/a
Leakage Test Kit	M1013-64002 / 451261014851	n/A

Annual Checks

Perform the following procedure once a year

- 1 Connect a PC/Laptop running the Service Software (VISIA tool) to the instrument and wait for the first zero calibration after the start up period. (Make sure that zero mode is switched to **Auto** - see "Zero Calibration" on page 29)
- 2 Check that there are no reported errors.
- 3 Perform the pneumatic tests:
 - a. Leak check
 - b. Flow rate check
 - c. Pump test
 - d. Pressure sensor test.
- 4 Gas calibration tests

Connecting the Gas Analyzer to a PC/Laptop

To set up a computer as a service host for the gas analyzer, a serial connection must be established with the IntelliVue G1/G5 PC cable (for part number see "Equipment Required for Checking"). Connect the RJ45 connector of the cable to the appropriate receptacle on the back of the gas analyzer (see Figure 4), and then connect the D-SUB9 connector of the cable to the serial port of your computer.

Switch on the gas analyzer and then start the VISIA software on your computer.



Figure 4 RJ45 connection on the back of the gas analyzer

Getting started with the VISIA software

When the VISIA tool starts up, it is switched to *Standby*, Breath Detection is *Enabled*, and the Pump Flow Level is *Off*. Check the COM port for correct settings (Baud Rate: 19200) and push the “Connect” button if the connection was not established automatically after starting the VISIA tool.

In order to keep the gas analyzer running, always do the following first:

- 1 Switch the tool to *Operate*,
- 2 Switch Breath Detection to *Disabled* (as shown in Figure 5) and
- 3 switch Pump Flow Level to *High* (as shown in Figure 6).

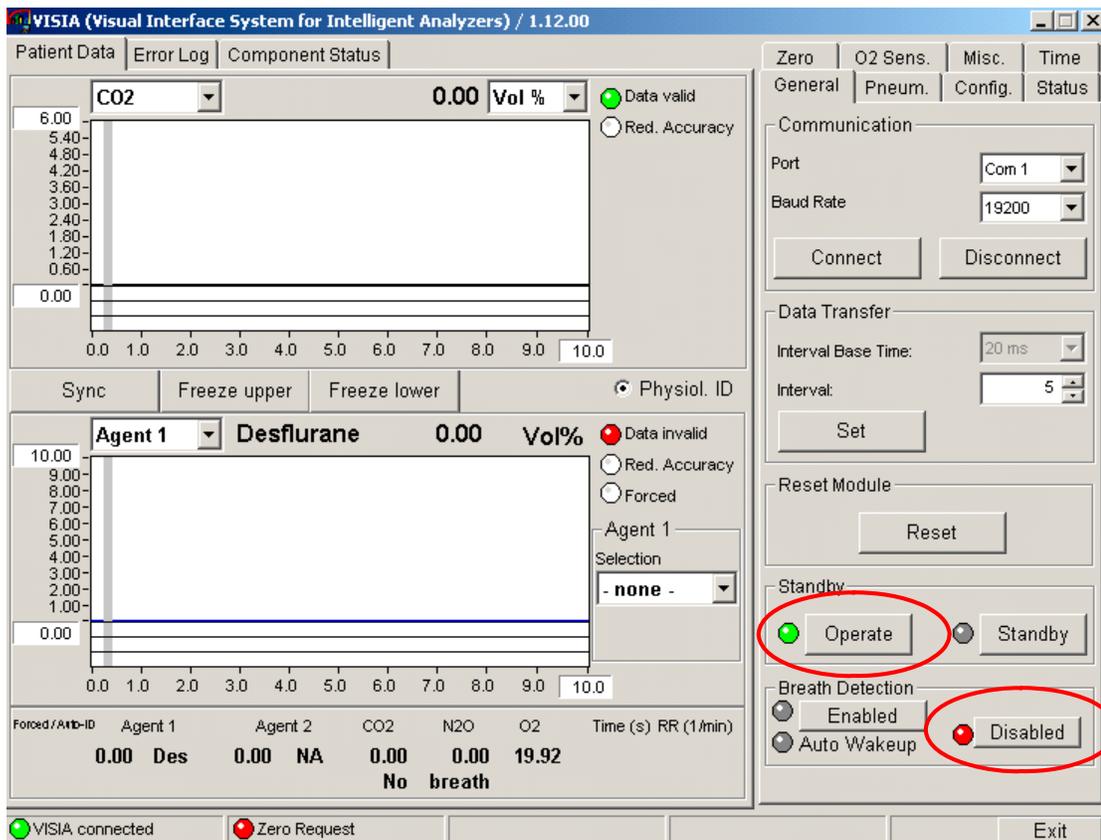


Figure 5 General Tab in VISIA tool

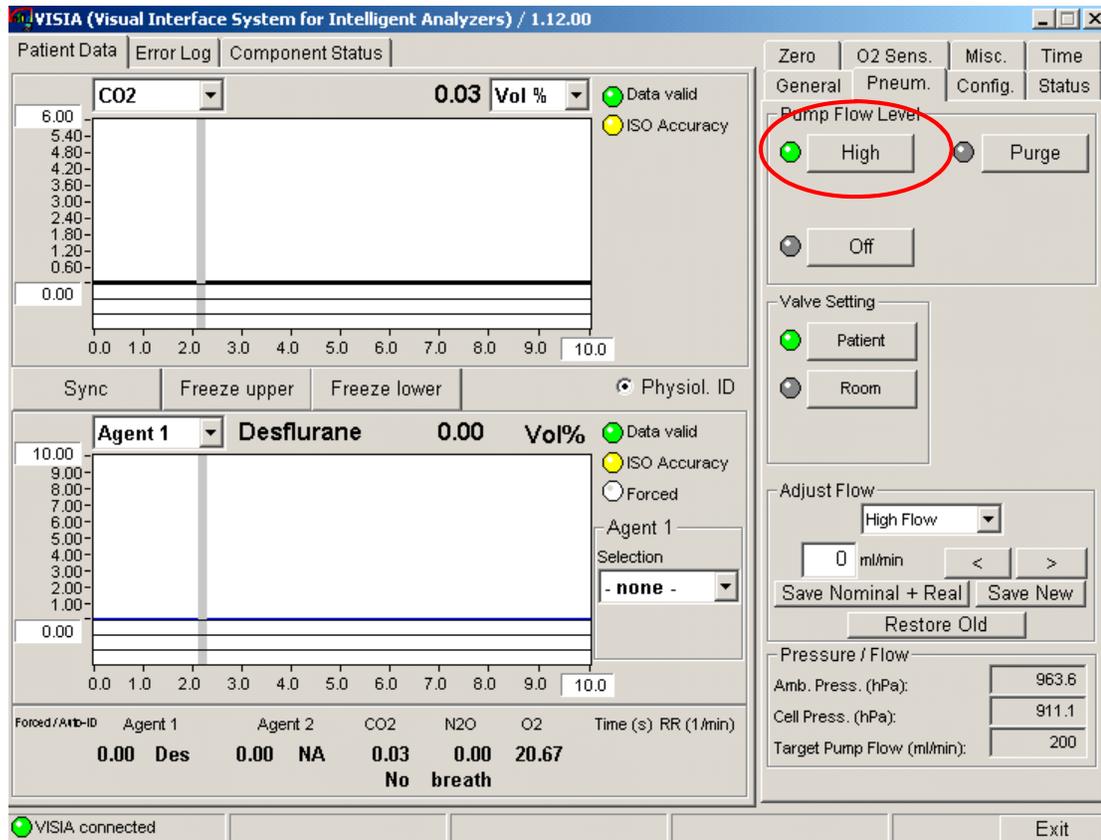


Figure 6 Pneumatic Tab in VISIA tool

Zero Calibration

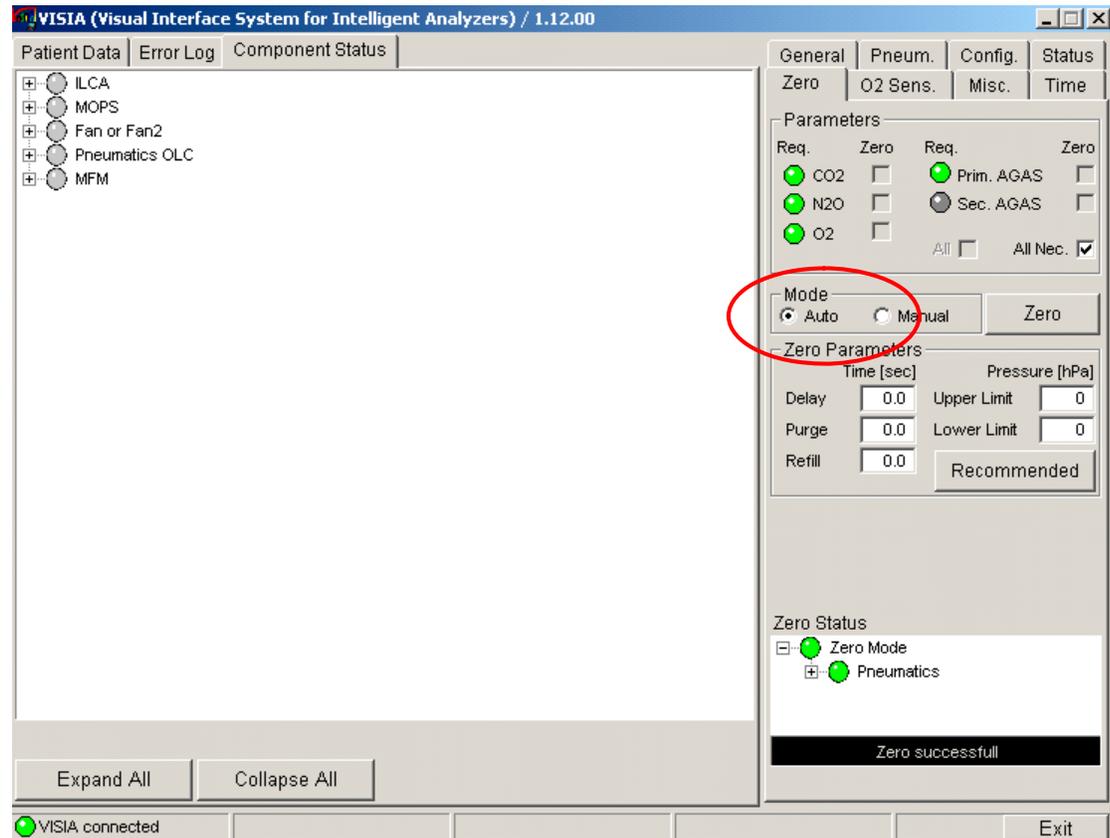


Figure 7 Zero Calibration

The IntelliVue G1 and G5 require a periodic zero calibration. Whenever this is due, the instrument sends a zero request command to the host monitor. The Philips patient monitor automatically initiates a zero calibration whenever it receives such a request from the gas analyzer - if you want the VISIA tool to do the same, you have to switch the zero mode from Manual to Auto (see Figure 7).

Zero requests occur 5 and 10 minutes after power on and then every two hours.

You can also initiate a zero calibration manually by pressing the Zero button.

A zero calibration can either be run on selected gas channels only or on all necessary channels. The latter is recommended and therefore the *All Nec.* check box should always be checked in the Zero tab.

Zero Calibration Test

Test Procedure:

- Make sure that the *All Nec.* check box is checked in the Zero tab
- Press the *Zero* button. Note that the Mode in the Zero tab must be switched to *Manual* for this test. Do not forget to switch it back to *Auto* upon completion of the test.

Expected Result: a “Zero successful” message in the lower right hand side of the Zero tab and only green soft-LEDs in the Zero Status area.

If this test fails, perform a Pump Test and a Flowrate Check and rerun the Zero Calibration Test. If it fails again, the gas analyzer needs to be replaced.

Component Status Check

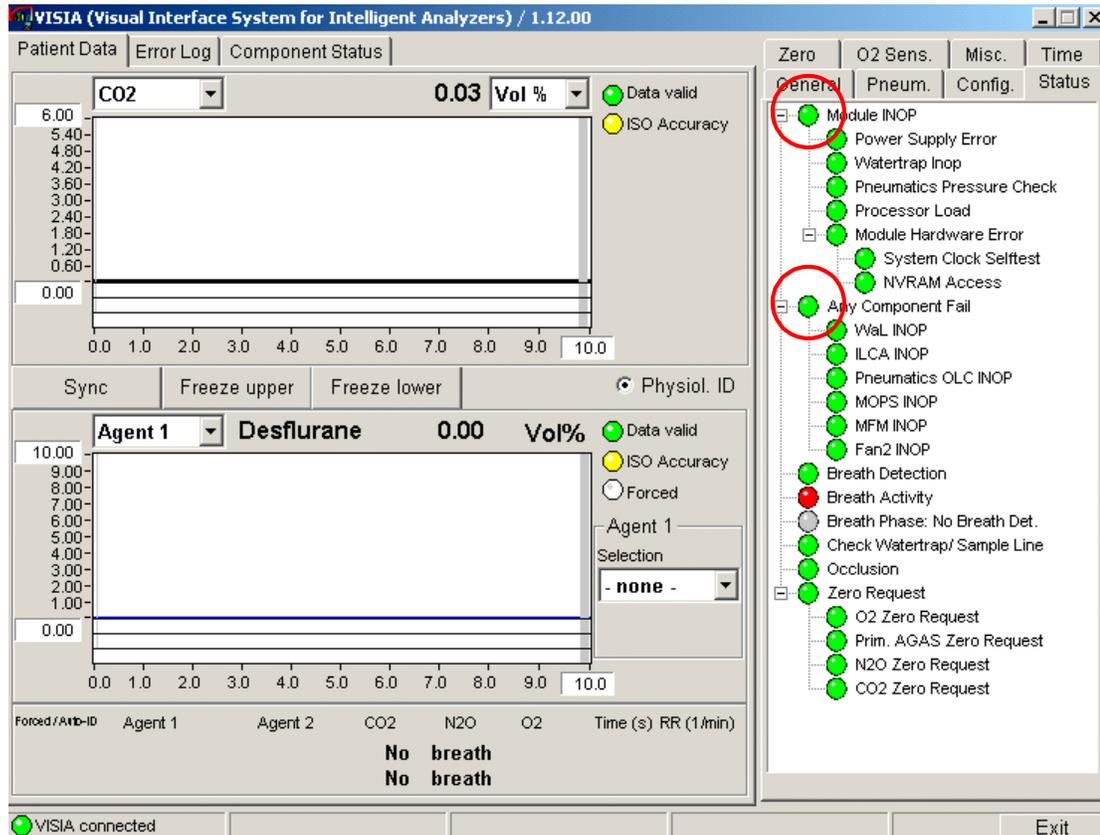


Figure 8 Component Status Check with the Status Tab in VISIA Tool

Wait for the first automatic zero calibration to complete (for details on automatic zero calibrations refer to “Zero Calibration” on page 29)

To check the status of the gas analyzer's components, open the Status tab on the right hand side of the VISIA tool as shown in Figure 8.

Expected result: The two top-level entries in this view, *Module INOP* and *Any Component Fail*, show green soft-LEDs.

If this test fails, perform a pump test and a flowrate calibration. Then rerun the test. If the test fails again, the gas analyzer needs to be replaced.

Pneumatic Tests

These tests ensure the integrity of the pneumatics system, which has a big impact on the quality of the measured values. Make sure that all the pneumatics tests are passed before checking the measurement accuracy.

Leak Check

Equipment needed:

- M1655A/B Gas Exhaust Return Line or
- M1015-40001 Exhaust Tubing to measure the flow at the gas analyzer outlet
- M1026-60144 Electronic Mass Flowmeter
- M1657B Watertrap
- M1658A Sample Tubing
- M1013-64002 Leakage Test Kit
- Digital Pressure Indicator

WARNING When measuring the flow at the gas analyzer's outlet you have to connect an M1655A/B Gas Exhaust Return Line or the M1015-40001 Exhaust Tubing between the gas analyzer and the flowmeter as a dampener in order to reduce the pneumatic noise resulting from the pump. Not using a complete Exhaust Return Line may result in significantly wrong flow readings when you measure at the gas analyzer's outlet.

Checking for leaks between inlet and pump

Test Procedure:

- 1 Trigger a zero procedure (all necessary parameters) via the service host, watch it progress and wait until it is finished (zero successful).
- 2 Switch to the *Pneum.* tab on the VISIA tool.
- 3 Set pump flow to *off*
- 4 Switch valve setting to *patient* (default setting after startup of IntelliVue G1/G5)
- 5 Connect digital pressure indicator and the leakage test kit. See Instructions for Use supplied with the leakage test kit for details (M1013-9302A).
- 6 Follow the leakage test kit IfU to apply negative pressure and wait until you have a pressure of 200 mbar below ambient.
- 7 Wait until the negative pressure has stabilized.

Expected result:

After 1 minute, check the pressure. The pressure should not increase more than 80 mbar in 1 minute for the test to pass.

If this test fails, make sure that there are no leaks in the setup and rerun the test. If it still fails, the gas analyzer has an internal leakage and needs to be replaced.

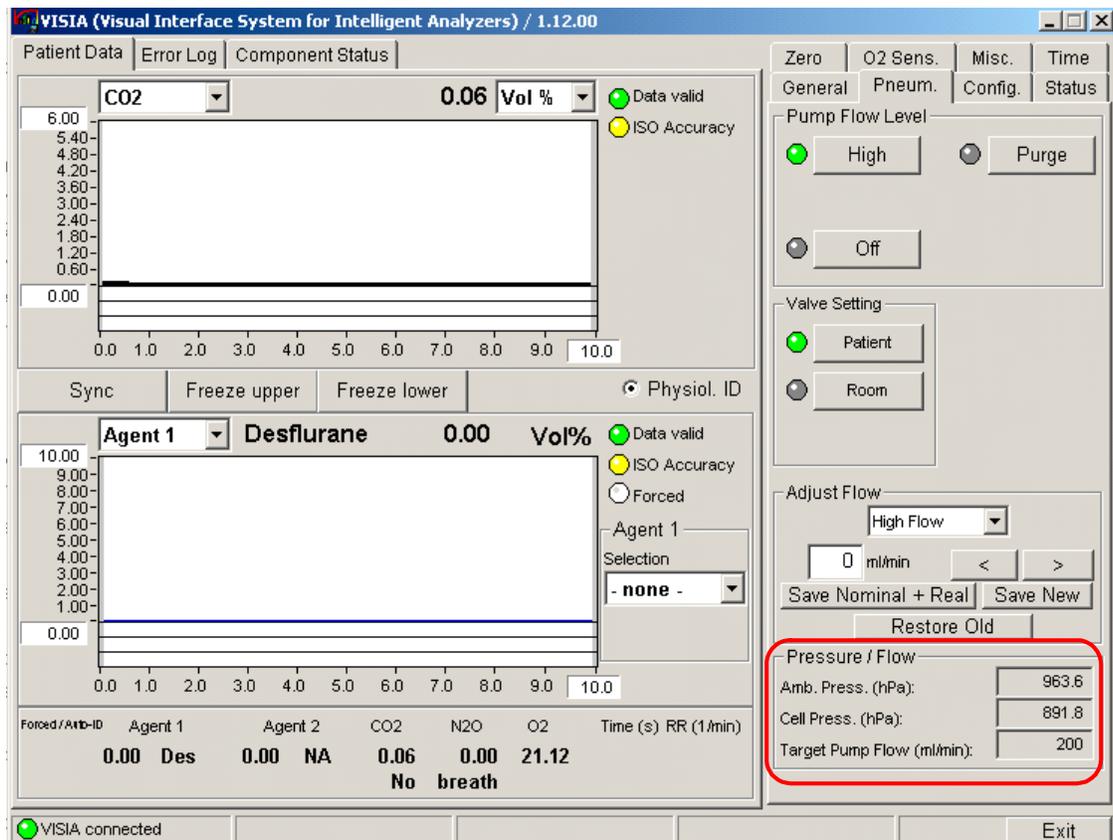


Figure 9 Leak Check

Flow Rate Check

CAUTION For this check, always measure the gas analyzer flow rate at the sample gas inlet. Measuring at the outlet may lead to incorrect flow readings due to ripple on the gas flow.

Test Procedure:

- Connect sample line to the watertrap
- Connect a flowmeter to Luer-Lock connector of the sample line

Expected Result: Sampling rate is 200±20 ml/min

NOTE After warm up or zero the flow rate may be higher than 200 ml/min for about 30 minutes. Please wait until the flow stabilizes.

In case the pump flow is out of the specified limits, it needs to be adjusted following the procedure described in the section "Flow Rate Adjustment".

Pressure Sensor Test

Zero Pressure Test Procedure:

- Trigger a zero procedure (all necessary parameters) via the service host, watch it progress and wait until it is finished (zero successful).
- Measure ambient pressure with independent digital barometer.
- Compare the ambient pressure measured with the digital barometer with the ambient pressure measured by IntelliVue G1/G5 as shown by the VISIA tool.

Expected result: The deviation between the two measured values is < 10 mbar.

Amplification Pressure Test Procedure:

- Switch to the *Pneum.* tab on the VISIA tool.
- Set pump flow to *off*
- Switch valve setting to *patient* (default setting after startup of IntelliVue G1/G5)
- Connect digital pressure indicator and the leakage test kit. See Instructions for Use supplied with the leakage test kit for details (M1013-9302A).
- Follow the leakage test kit IfU to apply negative pressure and wait until you have a pressure of 200 mbar below ambient.
- Wait until the negative pressure has stabilized.
- Compare the pressure measured with the digital pressure indicator with the sample cell pressure measured by the IntelliVue G1/G5 as shown by the VISIA tool

Expected result: The deviation between the two measured values is < 10 mbar.

If any of the two pressure sensor tests fails, the unit needs to be exchanged.

Flow Rate Adjustment

CAUTION For this adjustment, always measure the gas analyzer flow rate at the gas sample inlet. Measuring at the outlet may lead to incorrect flow readings due to ripple on the gas flow.

In case the gas analyzer flow rate is outside the tolerance limits, it can be adjusted according to the following procedure:

- 1 Make sure you measure the flow at the gas analyzer's inlet.
- 2 Select High Flow in the Adjust Flow pull down menu (See Figure 10).
- 3 Connect the sample line to the watertrap and check the difference between the sample cell pressure and the ambient pressure. It should read between 80 and 100 mbar in the VISIA tool.
- 4 Connect the flowmeter to the sample line. The pressure difference may now be slightly higher than before. A decrease of up to 150 mbar is acceptable.
- 5 Now use the < and > buttons to decrease or increase the flow until it is inside the tolerance limits.
- 6 Press the Save New button to store the new flow rate setting.
- 7 Switch the pump to *off* and then *high* again and check the flow in the flowmeter and in the Target Pump Flow field in the VISIA tool.

If the flow rate cannot be brought inside the tolerance limits, the gas analyzer needs to be replaced.

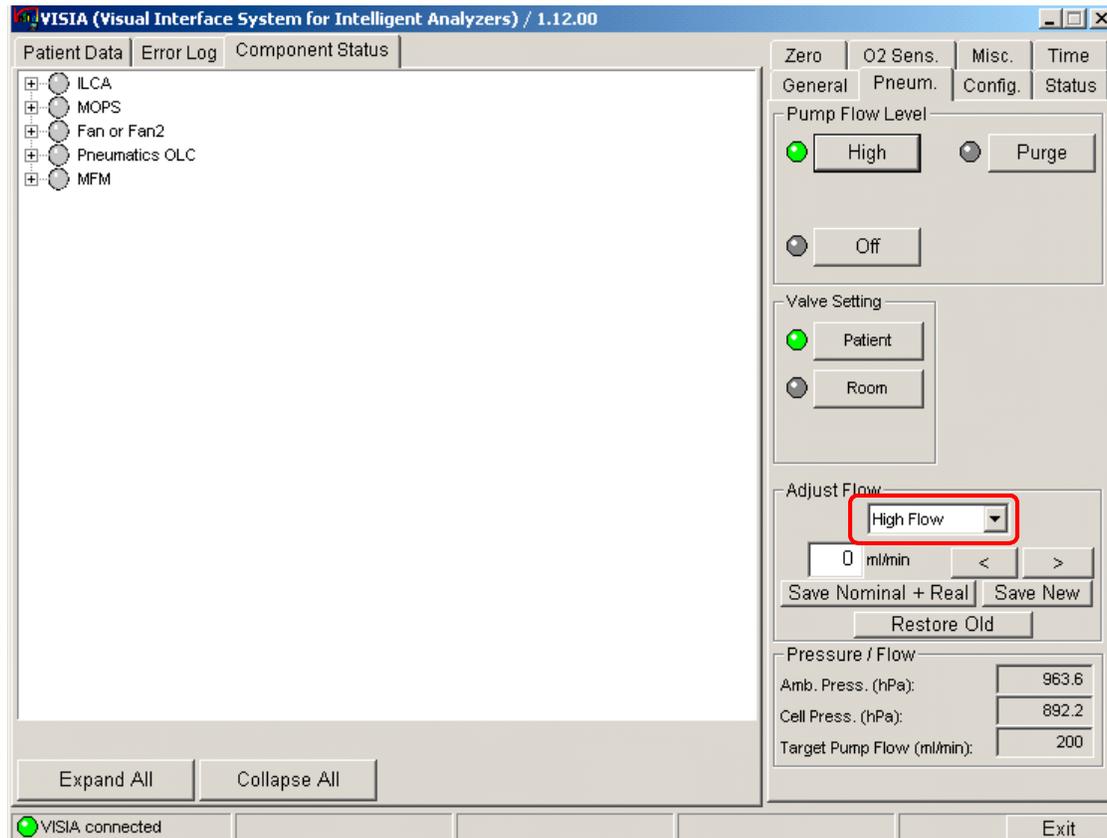


Figure 10 Flow Rate Adjustment

The Restore Old button brings back the last saved flow rate. Once a new flow rate has been saved, only this flow rate can be recalled when attempting to restore an old one.

Gas Calibration Test

The gas analyzer should run for at least 6 minutes until the Data soft-LED in the Patient Data reads *Data Valid* before continuing with the following calibration procedures. This is to allow the module to reach ISO accuracy (see Figure 12). Use the M2211A Flow Regulator when performing the gas calibration test. Refer to the instruction sheet provided with the flow regulator for detailed instructions for use.

Before performing Gas Calibration Test, you must first:

- pass all Pneumatic Tests (Leak Test, Pump Test, Flowrate Test, Pressure Sensor Test),
- pass a Zero Calibration,
- ensure that there is enough gas in the check gas bottle,
- check tubing assembly and reservoir bags for leaks or damage.

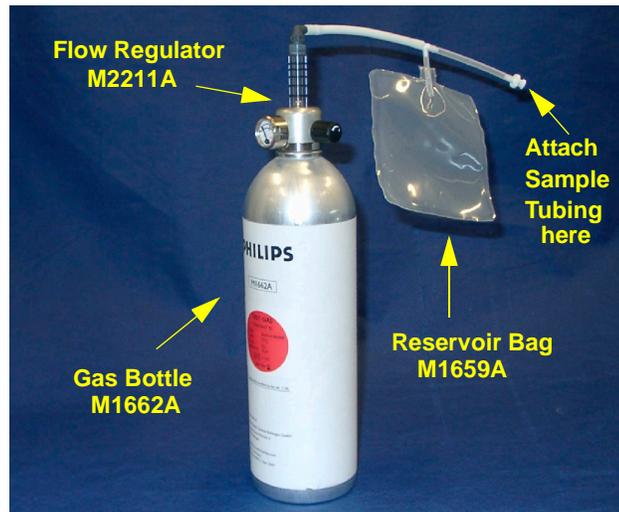


Figure 11 Span Checking Equipment including Gas Canister and Spray Valve

The procedure to check the gas accuracy is as follows:

- 1 Set *Breath Detection* to *Disabled* in the General Tab.
- 2 Select the Patient Data Tab in the VISIA tool so that you can see the waveforms (see Figure 12).
- 3 Set the upper Gas section to CO_2 (make sure the unit is set to Vol%) and the lower Gas section to *Agent 1* (see Figure 12).
- 4 On the M1013A, set *Agent 1* to *DES* for measuring Desflurane. On the M1019A, set *Agent 1* to *Auto ID* and make sure Desflurane is detected.
- 5 Make sure the pump is off, then connect the calibration gas bottle, the reservoir bag and the sample line as shown in Figure 11.
- 6 Wait until the reservoir bag is empty. Wait for another 10 seconds to let the IntelliVue G1/G5 completely evacuate the reservoir bag.
- 7 Now fill the reservoir bag with gas.

CAUTION Do not pressurize the reservoir bag.
Do not attempt the span check process if there are any visible leaks in the bag or tubing.
Prevent the bag from emptying before the gas calibration test is complete.

- 8 Set the pump flow level to *high*.
- 9 Wait until the two gas concentration curves are completely flat as shown in Figure 12.

NOTE With the M1019A, the “Agent 1 Selection” field shown below, should read “Auto ID”

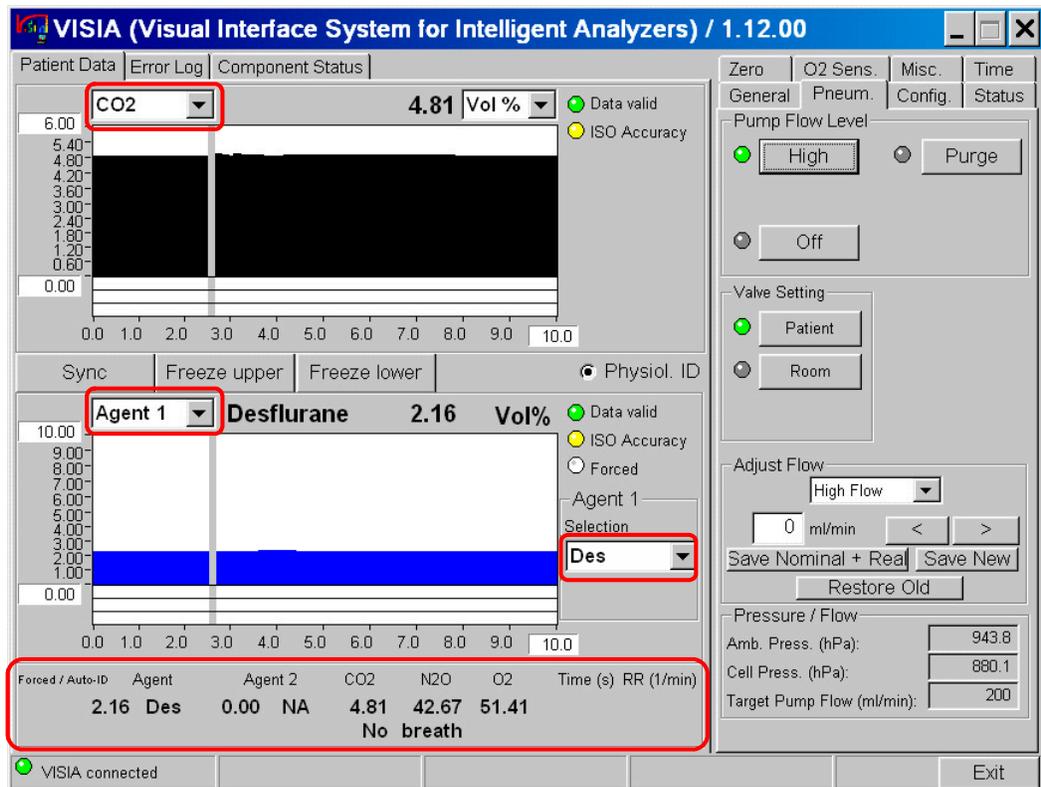


Figure 12 Patient Data Window during Gas Calibration Test

- 10 Now compare the numeric values shown in the lower section of the Patient Data Window with the concentrations as printed on the calibration gas canister. (You can press the *Freeze Upper* button to make the values stay in the view for comparison.)
- 11 Verify that the values measured by the gas analyzer are within the specified limits

Gas Type	Allowed Tolerance
Anesthetic Agent	±0.5 vol%
CO ₂	± 0.7 vol%
N ₂ O	±6.2 vol%
O ₂	± 3vol%

Disposal of Empty 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.