

## VM-2500 - Frequently Asked Questions

### VM-2500 General Questions

**Q) Does the VM-2500 require calibration?**

A) No. This is due to the internal reference components + software compensation, and very stable light sourcing. A basic maintenance plan conducted by qualified service personnel is recommended.

**Q) How do you monitor CO<sub>2</sub> on a non-intubated patient?**

A) Monitoring non-intubated patients using the sidestream unit is typically performed with a nasal or oral sampling configuration. This sampling assembly is connected directly to the nose or mouth via a cannula.

Monitoring non-intubated patients using the mainstream unit can be performed with a mask. The airway adapter is connected directly onto the mask.

**Q) What is the warm-up time of the VM-2500?**

A) < 10 seconds to full specification.

**Q) What is classed as 'full specification'?**

A) A steady stated of accuracy is reached and all parameters will be monitored as per the technical specification.

**Q) What is 'Rise Time'?**

A) The time required to achieve an increase from 10% to 90% of final value when a step function change in concentration occurs at the sampling site (i.e. the time taken to respond to a step change in CO<sub>2</sub>; longer rise times create abnormal waveforms; this can be seen by a reduced slope in Phase II of the waveform).

Mainstream: ≤ 90ms (at 10 l/min)

Sidestream: ≤ 200ms (at 50 l/min sample flow)

**Q) What is 'Delay Time'?**

A) The time from a step function change in gas level at the sampling site to the achievement of 10% of the final gas reading of the Capnograph (i.e. the time taken to move from the point of sampling to the point of measurement; longer delay times cause an underestimation of CO<sub>2</sub> due to the dispersion of gases).

NB. The mainstream unit does not have a delay time as the reading is taken at the patient site.

**Q) What is the 'Total System Response Time'?**

A) The time from a step function change in gas level at the sampling site to the achievement of 90% of the final gas reading of the Capnograph.

Total System Response Time = Delay Time + Rise Time

*Total System Response Time*

**Mainstream:** < 1 second

**Sidestream:** < 3 second (with 50 ml/min sample flow and 2 m sampling line)

**Q) What is 'Dead Space' in Capnography?**

A) Dead space is air that is inhaled, but does not take part in gas exchange. In adults it is usually in the range of 150 ml. Not all the air is able to be used for the exchange of oxygen and carbon dioxide. Roughly a third of every resting breath is exhaled exactly as it came into the body.

Because of dead space, taking deep breaths more slowly (e.g. 10 x 500 ml breaths per minute) is more effective than taking shallow breaths quickly (e.g. 20 x 250 ml breaths per minute). Although the amount of gas per minute is the same (5 l/min), a large proportion of the shallow breaths is dead space, and does not allow oxygen to enter the blood.

**Q) What is 'Zeroing' and when does it need to be conducted?**

A) Zeroing is an ambient gas reference measurement used to establish a zero concentration level of CO<sub>2</sub>.

Zeroing needs to be performed only when an offset in gas values is observed, or when an unspecified accuracy message is displayed, i.e. when the unit is first switched on, should there be a reading displayed for either the EtCO<sub>2</sub> or the FiCO<sub>2</sub> zeroing needs to be conducted.

A successful zeroing requires the presence of ambient air (21% O<sub>2</sub> and 0% CO<sub>2</sub>) in the airway adapter. Incorrect zeroing will result in false CO<sub>2</sub> gas readings.

**Q) How long does the zeroing process take to complete?**

A) 3 seconds

**Q) Why does the sidestream unit automatically zero whereas the mainstream unit does not?**

A) Automatic zeroing in sidestream is possible because the air for zeroing is taken through an additional pipe from within the device. Therefore, even if a patient is already connected to the Nomo Adapter there will be no negative influence on the zeroing process. However, if zeroing is performed whilst the mainstream unit is connected to a patient breathing into the airway adapter rather than in ambient air, incorrect zeroing will result in false gas readings.

**Q) Can the VM-2500 be used during surgery?**

A) Only the mainstream VM-2500 may be used to analyse gasses which contain nitrous oxide. Ensure that the patient circuit is connected correctly to an appropriate scavenging system.

Do not use the sidestream unit to analyse gasses that need to be returned to the patient or a scavenging system (e.g. anaesthetics such as nitrous oxide). The gas outlet of the sidestream device is not designed to return exhaust gases to the patient circuit or a scavenging system.

The mainstream unit can be used during surgery as this does not aspirate a sample of the exhaust gas, unlike the sidestream unit.

**Q) Does the VM-2500 have gas compensation?**

A) Yes. The presence of oxygen and nitrous oxide can cause some interference in the CO<sub>2</sub> measurement. These interferences are compensated by setting the range of O<sub>2</sub> and N<sub>2</sub>O concentration under the menu “Gas Compensation” accordingly.

When the O<sub>2</sub>/N<sub>2</sub>O concentrations are set correctly, the measurement is within the accuracy range stated in the “Technical Specification” section of the user manual.

Note – Only the mainstream unit may be used to analyse gasses which contain nitrous oxide. Ensure that the IRMA Airway Adapter is correctly connected to the patient circuit.

**Q) What does the ‘Neonatal Mode’ do?**

A) When the neonatal mode is activated the default alarm settings are adjusted accordingly (please refer to the “Default Alarm Limits” section in the VM-2500 User Manual). The “*neonatal symbol*” will be displayed.

**Q) What is “Auto Scaling”?**

A) The default setting of the amplitude scale is “Auto Scaling”. Here the reading is automatically adjusted to the signal strength; therefore, a waveform with strong amplitude should be visible at all times. The scale maximum of the capnogram and CO<sub>2</sub> trend can be fixed to 6%, 10% or 15%. Select the “Auto Scaling” for optimal amplitude scaling of the data.

**Q) Will the CO<sub>2</sub> reading be affected by humidity or condensation?**

A) The partial pressure and the volume percentage of CO<sub>2</sub> will depend on the amount of water vapour in the measured gas.

Both the mainstream and sidestream devices will always show the actual CO<sub>2</sub> partial pressure at the current humidity level.

The following has to be considered when using the sidestream unit; in the alveoli of the patient, the breathing gas is saturated with water vapour at body temperature (BTPS). When the breathing gas is sampled, and passing through the sampling line, the gas temperature will almost reach the ambient temperature, before reaching the sidestream monitor. As the Nomo Adapter removes all condensed water, no water will reach the measurement unit. The relative humidity of the sampled gas will be approximately 95%.

**Q) How long does the Li-ion battery take to charge fully?**

A) The charging time and working time with full functionality is 5 – 6 hours.

**Q) How long does the Li-ion battery last when fully charged?**

A) Up to 6 hours of continuous operation.

**Q) In the ‘Real-Time Mode’ how often is the measurement taken?**

A) Activation of the ‘Real-Time Mode’ enables visualization and storage of measurement data on a PC.

In this mode the ongoing measurement values of EtCO<sub>2</sub>, FiCO<sub>2</sub>, SpO<sub>2</sub>, respiration rate and pulse rate are available every 4 seconds at the USB port for download to the PC.

**Q) Can the monitor remain connected to a PC during monitoring?**

A) Yes, the software provided can be used to display and save measurement values and alarm messages on a PC, parallel to ongoing measurement. To enable this function the Real-Time Mode has to be selected on the monitor. During this mode the device sends the current EtCO<sub>2</sub>, FiCO<sub>2</sub>, SpO<sub>2</sub>, respiration rate and pulse rate measurement values every four seconds via USB to the PC.

**Q) Can the Adult/Paediatric Airway Adapters be used with Infants?**

A) No. The Adult/Paediatric Airway Adapters have a larger diameter than the Infant Airway Adapters. Therefore, if you use an airway adapter with a large diameter for infants the tidal volume (the lung volume representing the normal volume of air displaced between normal inhalation and exhalation when extra effort is not applied) applied to the infant is much smaller than in the case of an adult (adults typically get around 500ml of air with each breath and infants around 50ml).

This may lead to dead space in the patient circuit as the air going to the patient is still in the circuit and not delivered to the patient. Therefore, it is important to use an adapter with little dead volume so that with each breath, the concentration recorded is in correlation with the inspired and expired air.

**Q) Can the Infant Airway Adapters be used with Adults/Paediatrics?**

A) No. The Infant Airway Adapter has a smaller diameter than the Adult/Paediatric airway adapter. When the patient breathes out if the diameter of the adapter is small, e.g. 5mm, then the resistance to breath into it is large. This may result in excessive flow resistance.

**VM-2500-M Questions**

**Q) How much dead space does the IRMA Adult/Paediatric and Infant Airway Adapters add to the patient circuit?**

A) Adult/Paediatric: < 6ml of dead space  
Infant: < 1ml of dead space

**Q) Is it necessary to recalibrate the mainstream unit if the IRMA CO<sub>2</sub> Analyser is replaced?**

A) No. As all necessary calibration constants are stored within each IRMA CO<sub>2</sub> Analyser, the analyser can be replaced without the need to recalibration.

**Q) Why is the IRMA CO<sub>2</sub> Analyser heated?**

A) The IRMA CO<sub>2</sub> Analyser is heated in order to prevent condensation of water vapour in the expired breath, which can cause falsely high CO<sub>2</sub> readings.

**Q) What temperature does the IRMA CO<sub>2</sub> Analyser heat up to?**

A) At an ambient temperature of 23 °C, the surface temperature of the mainstream optical window will be a maximum of 41 °C.

**Q) What is the length of the mainstream sensor cable?**

A) 2.55 mm

**Q) What does the XTP™ light transmission window do?**

A) The XTP™ windows of the IRMA™ airway adapters prevent a decrease in performance when water vapour is present. The airway adapters are designed to minimize the impact of water vapour on the percentage of light passing through the window and therefore give an accurate reading.

### **VM-2500-S Questions**

**Q) Where is the sidestream CO<sub>2</sub> analyser positioned?**

A) The sidestream monitor uses the ISA CO<sub>2</sub> Analyser incorporated inside the unit.

**Q) What is the flow rate of the sidestream sampling line?**

A) 50 ml/min +/- 10 ml/min

This is a low flow sampling rate and so is suitable for use on young patients. The Nomo adapter has a very low dead space that results in an ultra-fast rise time, making CO<sub>2</sub> measurement possible, even in very high respiratory rates.

**Q) What is Nomo technology?**

A) Nomo stands for “no moisture”. The Nomo Adapter contains a unique water separation section and hydrophobic bacterial filter to protect the ISA analyser against water intrusion and cross contamination.

Because of condensing water within the connected sampling line, droplets can potentially result in occlusion of the sampling system and interfere with the CO<sub>2</sub> measurement. To prevent this situation the Nomo Adapter incorporates an unique water separation section, the “Nomo” section.

This section is made of a special polymer and a hydrophobic bacteria filter that removes water vapour and aspired or condensed water. Water and water vapour passes through the membrane-like surface of the sampling line and evaporates into the surrounding air, while leaving CO<sub>2</sub> unaffected.

**Q) Is the Nomo Adapter reusable?**

A) The Nomo Adapter is reusable and will last for approximately 2 weeks. It only needs to be replaced if occluded, at which point the warning ‘*Sampling system occlusion!*’ will be displayed.

This is calculated by the degree of particles/humidity etc in the air and bacteria within the filter. If the internal pump requires additional power this indicates that the Nomo Adapter is occluded and therefore the warning will be displayed.

**Q) Is the sidestream CO<sub>2</sub> analyser protected against cross contamination?**

A) Yes. To protect the sidestream ISA CO<sub>2</sub> Analyser the Nomo Adapter includes a filter with a bacterial filter efficiency of >99.9980%.

**Q) What is the length of the sidestream sampling line?**

A) 2 m