



Critical Care Therapy and Respiratory Care Section

Category:	Clinical
Section:	Clinical Monitoring
Title:	Hewlett Packard Viridia Mainstream EtCO ₂ Monitor Procedure
Policy #:	06
Revised:	03/00

1.0 DESCRIPTION

1.1 Definition: The HP Viridia End Tidal Carbon Dioxide Module, Model M1016A, in conjunction with the M1460A transducer, provide two method of measuring the partial pressure of carbon dioxide in the patient's airway. From this, the end tidal carbon dioxide (ETCO₂) is derived. ETCO₂ is the peak CO₂ value measured at the end of expiration. The ETCO₂ measurement uses a technique based on the absorption of infrared radiation by some gases. It indicates changes in the elimination of CO₂. The CO₂ module provides the system with an ETCO₂ value, a CO₂ waveform, and the following additional values:

- 1.1.1 Inspired Minimum CO₂ (IMCO₂) - The smallest value sensed during inspiration (displayed as a number).
- 1.1.2 Airway Respiration Rate (AWRR) - The number of breaths per minute (displayed as a number).
- 1.1.3 The uncorrected instantaneous CO₂ value (displayed in Calibration Mode).

1.2 Indications: A capnograph is indicated for all intensive care unit patients in whom constant surveillance of ventilation is crucial. Examples include: patients undergoing mechanical ventilation, patients being transported, difficult to wean patients, patients with central nervous system problems who require therapeutic hyperventilation, patients with depressed respiratory drive or decreased ability to ventilate, and patients who might benefit from a less invasive measure of carbon dioxide than an arterial blood gas.

1.3 Contraindications: The capnograph should never be used in the presence of flammable anesthetics because it may present an explosion hazard.

1.4 Complications: Erroneous measurement of ETCO₂ could lead to potentially less than effective ventilator adjustments. Always correlate acute, dramatic

changes in capnograph readings with an arterial blood gas (See Precautions below).

1.5 Precautions

- 1.5.1 In ventilation and perfusion abnormalities (V/Q) which cause V/mismatch, a divergence of ETCO₂ from PaCO₂ can occur. The monitor should only be used to trend changes in patient status.
- 1.5.2 The following factors can influence the ETCO₂ measurement:
 - 1.5.2.1 nitrous oxide
 - 1.5.2.2 elevated oxygen levels
 - 1.5.2.3 barometric pressure
 - 1.5.2.4 water vapor or patient secretions
 - 1.5.2.5 halogenated agents
 - 1.5.2.6 aerosolized pharmaceuticals
 - 1.5.2.7 nitric oxide
- 1.5.3 Do not use the module if it does not respond as it is intended, is wet or damp, or if it appears to have been dropped or damaged.
- 1.5.4 Never sterilize or immerse the module in liquids.
- 1.5.5 Do not store the module or transducer at temperatures less than 14 degrees F. or greater than 131 degrees F. Do not operate the sensors at temperatures less than 50 degrees F. or greater the 104 degrees F.
- 1.5.6 Do not apply tension to the sensor cable.

1.6 Adverse Reactions and Interventions

- 1.6.1 When an acute, dramatic change in ETCO₂ occurs, verify that the monitor is functioning appropriately, and obtain an arterial blood gas for correlation purposes.
- 1.6.2 Loss of the ETCO₂ reading, an acute change in the reading, or a diminished reading may be the result of excessive moisture or secretions on the infrared light path. Remove the airway adapter from the monitoring circuit, and clean and dry excess moisture and secretions. Always keep the infrared "windows" in a vertically superior position during monitoring.

2.0 EQUIPMENT AND MATERIALS

2.1 Hewlett Packard CO₂ Module M1016A and Transducer M1460A

2.2 Appropriate airway adapter

2.2.1 For intubated patients:

2.2.1.1 Adult airway adapter for endotracheal tubes larger than 4.0 mm, M1465A

2.2.1.2 Pediatric airway adapter for endotracheal tubes smaller than 4.0 mm, M14363A

Use TcCO₂ or Novamatrix monitors for spontaneously breathing patients, without artificial airways.

3.0 PROCEDURE

3.1 Calibration

3.1.1 Plug the Module in the rack

3.1.2 The Message "**CO₂ SENSOR WARMUP**" is shown on the Standard Display to indicate that the sensor is warming up. If the sensor is cold, a waiting period of 20 minutes may be needed to ensure subsequent measurements have the maximum possible accuracy. When the message disappears from the Standard Display, a calibration can be performed.

3.1.3 Begin Calibration process by pressing the CAL key on the front of the module.

3.1.4 When you enter the CAL Task Window, you are prompted:

Place sensor on calstick

Press Start Calibr

At this point, place the transducer on either calstick cell, and then press the softkey **Start Calibr**. This process is indicated by the message **CO₂ CAL1 running**.

3.1.5 If an error occurs during the calibration procedure, the system displays the message **CO₂ CAL1 error**, and you are prompted to:

Check whether sensor is securely in position on calstick

Start calibration again

3.1.6 When the first part of the calibration has been successfully completed (this takes up to 5 minutes), the message **CO₂ CAL1 done** is displayed and you are prompted to:

Place sensor on other cell

Press Start Calibr

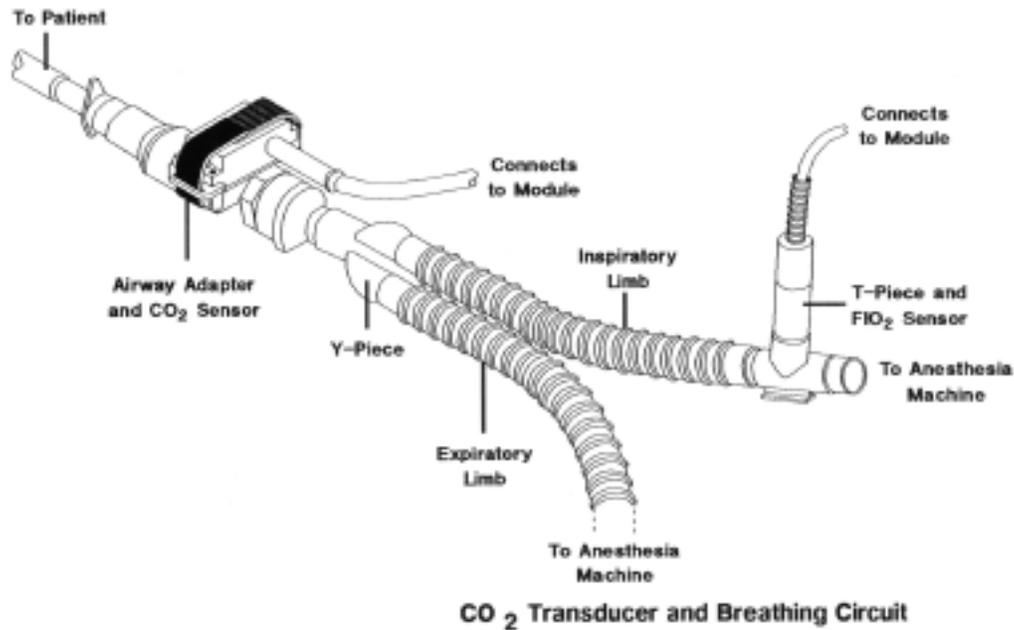
Place the transducer on the other calstick cell, then press the softkey **Start Calibr**. This process is indicated by the message **CO₂ CAL2 running**.

- 3.1.7 When the second calibration has been successfully completed (this takes up to 5 minutes), the message **CO₂ CAL2 done** and the date and time of this successful calibration are displayed.
- 3.1.8 With the transducer on the high cell, check that the CO₂ value you get matches the calstick value to within +/- 1.0 mmHg within 1 minute.
- 3.1.9 When to calibrate:
 - 3.1.9.1 If a new (or different) sensor is attached to the module.
 - 3.1.9.2 When the *Accuracy Check* values displayed do not coincide with the calstick value.
 - 3.1.9.3 Once every 1-2 weeks.

3.2 Assembly

- 3.2.1 Snap the transducer onto the appropriate Airway Adapter and place it in the patient's breathing circuit between the ETT and the Y-piece.
- 3.2.2 The accuracy of the transducer depends on the operating temperature. The INOP message **CO₂ SENSOR WARMUP** is displayed until the transducer is at operating temperature.

Mainstream Setup Diagram:



3.3 Accuracy Check

- 3.3.1 Check that the calstick value displayed in the box on the screen is the same as that indicated on our calstick.
- 3.3.2 If the calstick value displayed is the same as the value indicated on your calstick, do the following:
 - 3.3.2.1 Place the transducer on the low cell (labeled 0.0 mmHg). The reading on the display should be within +/- 0.3 mmHg within 1 minute.
 - 3.3.2.2 Place the transducer on the high cell. The reading should be within +/- 1 mmHg of the calstick value within 1 minute.

If either of the readings is out of range, press **Start Calibr.** to recalibrate the transducer. Follow the Calibration procedure above.

If both readings are inside the given ranges, calibration is not required. Press the **Setup CO₂** to return to the CO₂ Task Window, or press **Main Screen** to return to the Main Screen.
- 3.3.3 If the calstick value displayed does **not** match the values indicated on your calstick, do the following:

- 3.3.3.1 Use the softkey **Change Cal Value** to set the correct value. (Each time you press the key, the value is adjusted by 0.1 mmHg).
- 3.3.3.2 Press **Confirm**. You will then enter the CAL Task Window. Follow the calibration procedure outlined above. The calstick value is only stored after a successful calibration. Hence, if you have changed the Cal Value, you must do a calibration.
- 3.3.4 When to perform an Accuracy Check:
 - 3.3.4.1 Once a day
 - 3.3.4.2 If a module is moved with the sensor plugged in to another monitor or used with another patient.

3.4 Oxygen Compensation

- 3.4.1 The CO₂ absorption is influenced by the temperature and by water vapor in the patient's breath. These influences are corrected automatically.
- 3.4.2 The CO₂ absorption is further influenced by barometric pressure and by other gases in the mixture. You can make corrections to compensate for these influences in the following ways:
 - 3.4.2.1 An adjustment for barometric pressure was made during the installation of the HP Viridia CMS by entering the altitude of operation.
 - 3.4.2.2 When a FiO₂ module is not used, the default values the system uses are 45% O₂ and 55% N₂.
 - 3.4.2.3 or other inspired O₂ concentrations use the information below to correct for CO₂:
 - If the gas contains N₂, O₂, and CO₂ only, you must select **N₂O OFF (ICU)**.
 - If the gas contains N₂O, O₂ and CO₂, you must select **N₂O ON (OR)**.

Refer to the Following Table:

CO ₂ Reading in mmHg	Correction Values			
	N ₂ O ON		N ₂ O OFF	
	21% O ₂	75% O ₂	21% O ₂	75% O ₂
30	-1.1	+1.3	-0.4	+0.7
40	-1.6	+1.9	-0.5	+0.9
60	-2.6	+3.1	-0.8	+1.5
80	-3.8	+4.6	-1.1	+2.1
100	-5.1	+6.3	-1.5	+2.6

O₂ Correction Values (in mmHg)

For our use of this monitor, we should always have the N₂O OFF.

4.0 ALARMS

4.1 The alarm limit ranges are as follows:

ALARM PARAMETER	RANGE
ETCO ₂ High Alarm	20-100 mmHg (2-14 kPa)
ETCO ₂ Low Alarm	10-95 mmHg (1-13 kPa)
IMCO ₂	2-20 mmHg (0.3-3 kPa)
AWRR High Limit Ranges:	
Adult & Ped.	10-100 rpm
Neonatal	30-150 rpm
AWRR Low Limit Ranges:	
Adult & Ped.	0-95 rpm
Neonatal	0-145 rpm
Apnea Delay Value (all patients)	10-40 seconds

4.2 Set alarms to within reasonable parameters as defined by the patient's physiologic condition.

5.0 POST PROCEDURE

5.1 Cleaning of the transducer and cable is to be done after each patient use, with warm soapy water, and air-dried. Do not immerse.
(For occasional sterilization of the transducer, refer to HP Viridia Manual 17-28 for specific instructions.)

5.2 Cleaning of the reusable airway adapter is to be performed after each patient use.

5.2.1 Immerse in warm, soapy water.

5.2.2 Carefully brush the inside and between the window using a small bristle brush.

5.2.3 When all debris is removed inside and out, rinse with clean water, and air dry.

5.2.4 Sterilize with Ethylene oxide.

6.0 MONITORING AND CHARTING:

The HP capnograph should be checked every two hours for proper functioning by the Critical Care Therapist, and values for ETCO_2 and respiratory rate should be recorded on the “Continuous Ventilation Record” for intubated patients. All pertinent data should be reported to the physician.

7.0 REFERENCES

- 7.1 HP VIRIDIA Component Monitoring System User’s Reference Manual, Vol. 2 of 2 (Chapter 17), Thirteenth Ed. M1046-9001H.

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