VetSpecs® Capno-5

Bluetooth Capnograph

User's Manual

All VetSpecs® products are for veterinary use only.

www.vetspecs.com

I. Introduction

The Capno-5 features state-of-the-art microflow side-stream capnography, which is developed for monitoring in a wide range of veterinary patients, intubated and non-intubated, in surgery, dentistry, procedural sedation, preoperative preparation, anesthesia recovery, emergency and critical care, and transport, and provides:

- Real-time CO2 Waveforms
- End-tidal CO2 Reading (EtCO2)
- Respiratory Rate (RR)
- Fractional Inspired CO2 (FiCO2)
- EtCO2 and RR Trends
- EtCO2 and Apnea Alarms

II. Set Up

The Capno-5 comes standard with a power adapter / battery charger, a rubber cover, a stand holder, an airway adapter, and multiple moisture filters and sample lines.

The Capno-5 is designed for portable independent use at points of care, and connection to VetSpecs® multiparameter

monitors via Bluetooth for integrated performance in surgery and dentistry. For customers who own VetSpecs® monitor(s), a Bluetooth receiver, which is to be plugged to their monitor, is provided with the Capno-5.

1. Turn on or off

To turn on the Capno-5, push down and hold the power button at the left side until the screen displays “VetSpecs® Capno-5 Bluetooth Capnograph”. To turn it off, push down and hold the power button until the Capno-5 is shutting down.

2. Connect filter, sample line, and airway adaptor

Connect a filter to one end of the sample line and the airway adaptor to the other end of the sample line. Connect the filter to the port at the top of the Capno-5 by pushing in and turning clockwise. The port flashes a blue light with no filter inserted. After the filter is inserted and locked in place, the port lights up in solid blue. After the patient is intubated, insert the airway adaptor on the sample line between the endotracheal tube and the breathing circuit.

3. Placement

For monitoring in dentistry, place the Capno-5 away from the patient mouth area to prevent it from getting wet.

Store the Capno-5 in a secure and dry place when it is not in use. Avoid direct sunshine, heat, and corrosive materials.

4. Charge the battery

Connect the power adaptor / battery charger to the mini-USB port on the right side and then to a power outlet. The battery allows multiple hours of continuous operation after a full charge. For a longer battery life, charge the battery frequently and do not drain it completely. Never use a power adaptor which was not provided by VetSpecs for use exclusively with the Capno-5.

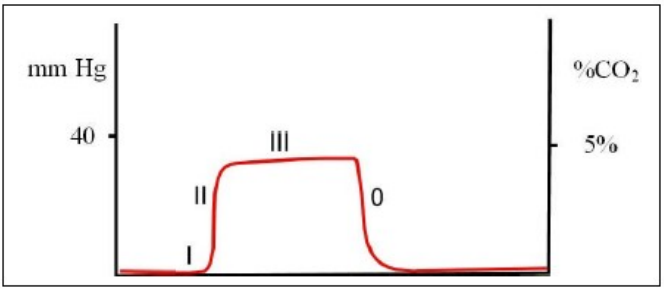
III. Clinical Instructions

1. Capnography

Capnography is measurement and waveform display of CO2 concentration at the patient's airway. It provides information about CO2 production, pulmonary perfusion, alveolar ventilation, respiratory patterns, and elimination of CO2 from the anesthesia circuit and ventilator, and therefore, is very effective for early detection of adverse respiratory events.

A capnogram is the graphical waveform depicting CO2 concentration throughout respiration. In a single breath, air sampled during inspiration should contain virtually no carbon dioxide. As exhalation begins, the air passing the sampling site initially represents dead space that has not been in contact with alveolar air, therefore containing virtually no carbon dioxide. As exhalation continues, alveolar air mixes with the dead space, with a resultant gradual increase in the amount of carbon dioxide measured (upstroke of the capnogram curve). Eventually, the air passing the sampling site is alveolar air, and the partial pressure of CO2 reaches a plateau, which is reported as the end-tidal CO2.

The diagram below shows a normal capnogram.



Phase I: A near zero baseline — Exhalation of CO2-free gas contained in dead space.

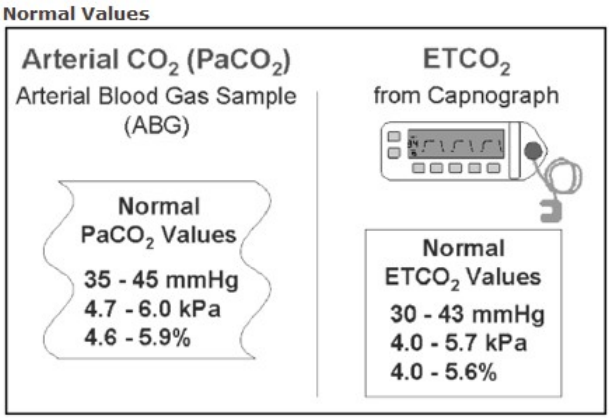
Phase II: Rapid, sharp rise — Exhalation of mixed dead space and alveolar gas.

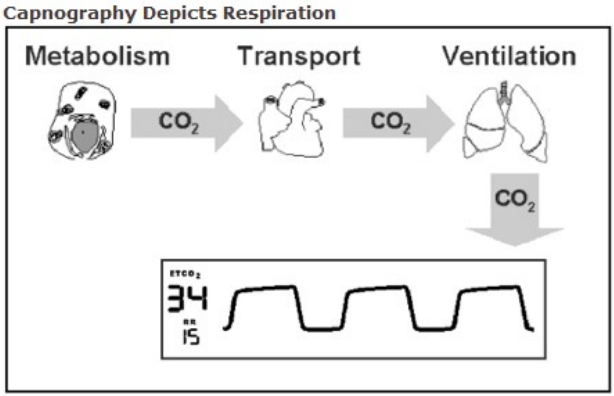
Phase III: Alveolar plateau — Exhalation of mostly alveolar gas. At the end of exhalation, CO2 concentration reaches the peak - end-tidal CO2 value.

Phase 0: Rapid, sharp down-stroke — Inhalation.

The end-tidal CO2 (EtCO2), which can be expressed as mmHg or percentage, refers to the measurement of CO2 concentration at the end of exhalation. EtCO2 is a product of three major determinants: the rate of CO2 production by the tissues, the rate of exchange of CO2 from the blood to the alveoli, and the rate of CO2 removal by alveolar ventilation. Because CO2 is a highly soluble gas, diffusing from air to liquid and back again occurs very quickly. Because of this solubility, the relationship between CO2 and minute

ventilation is a straight line, the higher the ventilation, the lower the CO2. Conversely, hypoventilation leads to high CO2 levels as the gas is retained. Therefore, EtCO2 provides a close clinical estimate of the alveolar and thus the arteriolar CO2. The normal range of ETCO2 for most mammals is 30 – 43 mmHg or 4.0 – 5.6%.



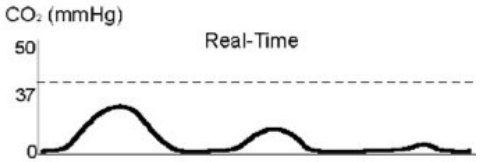


2. Clinical Implications

Normal EtCO2 readings, together with a normal capnogram, indicate normal function of the patient’s metabolism, circulation, and ventilation, and of the anesthesia machine.

Increases in EtCO2 may be due to anesthetic induced respiratory depression, increased metabolism, or the addition of CO2 to the circulatory system as a result of re-breathing CO2. Re-breathing CO2 can be due to soda lime exhaustion or incompetent expiratory valve on the anesthesia machine allowing exhaled CO2 to be re-inhaled. Decreased or abolished EtCO2 may be due to hyperventilation, low cardiac output, respiratory arrest, or cardiac arrest. Capnogram also provides vital information regarding the patient's airway potency. A depressed or absent capnogram may be due to a dislodged, misplaced, or obstructed endotracheal tube or airway, a leak around endotracheal tube cuff, or disconnection of the endotracheal tube from the anesthetic machine. The following are some examples of abnormal capnograms.

(1) No EtCO2 recorded

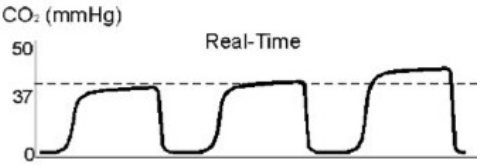


Possible causes:

- Apnea
- Accidental endotracheal tube disconnect
- Esophageal intubation
- Airway obstruction
- Cardiac arrest
- Respiratory arrest

A sudden drop of the EtCO2 to near zero followed by the absence of capnogram is potentially life-threatening, which could indicate malposition of the endotracheal tube, disruption of airway integrity, disruption of sampling lines, or a sudden cardiac arrest.

(2) Increasing EtCO2 (hypoventilation)

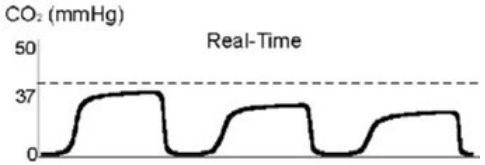


Possible causes:

- Decreased respiratory rate
- Decreased tidal volume
- Deep anesthesia
- Interference with chest expansion
- Increased metabolic rate

In anesthetized patients, EtCO2 higher than 50mmHg indicates hypoventilation.

(3) Decreasing EtCO2

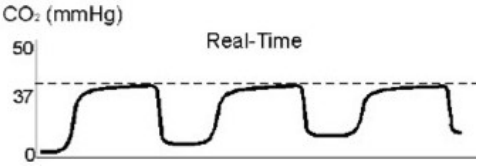


Possible causes:

- Increased respiratory rate
- Increased tidal volume
- Reduced cardiac output
- Leaks around the tube (dilution)
- Decreased metabolic rate – e.g. hypothermia

Gradual reductions in EtCO2 often reflect decreases in $PaCO_2$ that occur following increases in minute ventilation or a reduction of the metabolic rate.

(4) Baseline does not return to zero

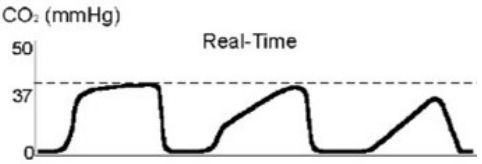


At the same time the EtCO2 value will also start to rise.

Possible causes:

- Incompetent or absent unidirectional dome valves
- Insufficient fresh gas in non-rebreathing circuit
- Exhausted soda-lime in rebreathing circuit
- Absorber canister bypassed
- Leak in Bain circuit inner hose
- Excessive dead space in anesthetic circuit

(5) Abnormal Upstroke (Shark Fins)

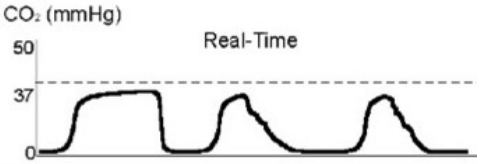


Possible causes:

- Kinked or occluded endotracheal tube.
- Upper airway obstruction

- Obstruction on expiratory side of anesthesia machine
- Bronchospasm

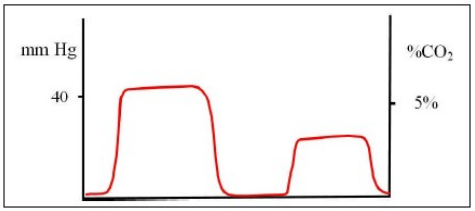
(6) Abnormal Down Stroke



Possible causes:

- Leak around endotracheal tube cuff
- Artificial airway is too small for the patient

(7) Abrupt fall in EtCO2 level



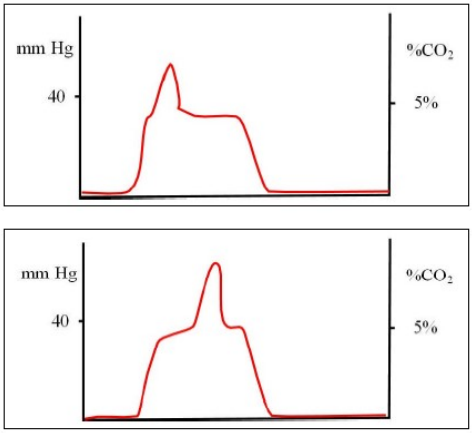
Possible causes:

- Pulmonary artery compression
- Pulmonary artery embolism
- Sudden hemorrhage

- Acute cardiac tamponade
- Cardiac compression

Abrupt decreases in the EtCO2 are often associated with an altered cardiopulmonary status (embolism or hypoperfusion).

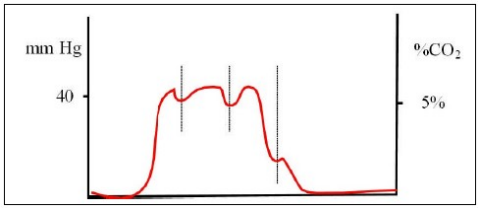
(8) Differential emptying



The above capnograms can result from the following:

- Positioning of the endotracheal tube at or beyond the carina, so that one side of the lung has impaired emptying. This makes the retained gas higher in CO2 and later to empty than from the normal lung. The “spike” can occur anywhere in the plateau phase.
- Any functional blockage of a major airway, below the carina – foreign body, mucous, compressed airway, etc.

(9) Cardiogenic oscillations



Cardiogenic oscillations are ripples superimposed on the expiratory plateau and the descending limb of the capnogram, which are caused by small gas movements inside the airway. Although cardiogenic oscillations can occur in any animal where the pulsations of the aorta and heart cause areas of lungs to be compressed and thereby emptied and filled, they are typically seen in large dogs with a slow RR. The guide to the fact that this is happening is that the oscillations are in synch with the heartbeats. The displayed respiratory rate can be much higher than the actual respiratory rate when cardiogenic oscillations occur.

IV. Operational Instructions

1. Menus

Push ∏ key to display MAIN MENU.

MAIN MENU

CO2 SET
TREND
TIME SET
SOUND SET
NEW PATIENT
EXIT

Push ▲ or ▼ keys to select and push ENTER key to enter a selected sub-menu.

CO2 SET

EtCO2	ALARM H 50.0mmHg
	ALARM L 19.0
RESP	ALARM H 30RPM
	ALARM L 08
FLOW RATE	100mL/m
APNEA TIME	30S

CO2 UNIT	mmHg
CO2 PUMP	ON
AUTO OFF TIME	10min
SWEEP SPEED	NORMAL
WAVE SCALE	54mmHg
EtCO2 AVERAGING	10SEC

Push ▲ or ▼ keys to select items, push ◄ or ► keys to change settings, and the push ENTER key to confirm.

FLOW RATE – the sample flow rate (volume of the gas withdrawn in a minute), adjustable from 50 to 250 ml/m.

APNEA TIME – the time set to trigger an alarm after the patient stopped breathing, adjustable from 15S to 39S.

CO2 UNIT – EtCO2 can be expressed as mmHg, % or KPA

CO2 PUMP – after the Capno-5 has been idle for a preset time, the pump will automatically be turned off to save battery energy. PUMP OFF will be displayed. To turn on the pump, push the ENTER key.

AUTO OFF TIME – after the Capno-5 has been idle for the set time, it will be turned off automatically to save battery energy, adjustable from 10 to 30 minutes.

SWEEP SPEED – the speed of the displayed waveforms: SLOW, NORMAL, FAST

WAVE SCALE – the magnitude of the displayed waveforms.

EtCO2 AVERAGING – the displayed EtCO2 is an averaged reading of 10, 20, or 30S breaths, or reading of each breath.

LOAD DEFAULTS – to restore all default settings.

TREND

To display EtCO2 trend and recorded data spreadsheet, select TREND in the main menu and push ENTER key. Push ▲ or ▼ keys to switch between EtCO2 trend and data spreadsheet. Push ◄ or ► keys to see trend graphics of previous hours.

SOUND SET

To change alarm volume, select SOUND SET in the main menu, and then push ◄ or ► keys to increase or decrease.

NEW PATIENT

To clear the memory, select NEW PATIENT in the main menu, and then select YES.

2. Filters and Sample Lines

Use a different moisture filter and sample line in each monitoring and rotate the filters and sample lines between procedures to give time for the moisture inside to dissipate.

The moisture filters and sample lines are disposable items. To ensure a proper performance and prevent potential damage to the Capno-5, the filters and sample lines must be replaced frequently.

3. Calibration

The Capno-5 automatically calibrates itself whenever necessary. A calibration process usually takes only about a couple of seconds in which the measurement is suspended (waveforms go flat for 1 - 2 seconds).

4. The exhaust port

For the Capno-5 to perform properly, do not block the exhaust port at the bottom. It is recommended to connect the exhaust port to the hospital scavenging system.

V. Technical Support

For customer support, please call

1-800-705-0113

To order accessories, please call

1-800-599-2566

To return the Capno-5 for testing and service, please ship to

VetSpecs, Inc.
200 Oakside Lane, Canton, GA 30114, USA

Limited Warranty

VetSpecs, Inc. (“VetSpecs”) warrants the VetSpecs® Capno-5 (“the Monitor”) to be free from defects in materials and workmanship, when stored under appropriate conditions and given normal, proper and intended usage, for TWO (2) YEAR from the date of delivery of the Monitor to the original end user purchaser (“Buyer”). VetSpecs agrees during the applicable warranty period to repair or replace defective unit without cost to Buyer. VetSpecs shall not have any obligation under this Limited Warranty to make replacements which result, in whole or in part, from catastrophe, fault or negligence of Buyer, or anyone claiming through or on behalf of Buyer, or from improper use of the Monitor, or use of the Monitor in a manner for which it was not designed, or by cause external to the Monitor. The power adaptor (battery charger) is covered by a one (1) year limited warranty. The sample lines, moisture filters, and airway adaptors are disposable items with no warranty.

Buyer shall notify VetSpecs of any product which it believes to be defective during the warranty period. Such product shall be returned by Buyer, transportation and insurance prepaid, to VetSpecs for examination and testing. VetSpecs shall repair or replace any such product found to be so defective and return such product to Buyer, transportation and insurance prepaid. The provisions of the foregoing Limited Warranty are exclusive and are expressly in lieu of any other warranty, whether express or implied, written or oral. VetSpecs’ liability arising out of the manufacture, sale or supplying of the Monitor shall not exceed the actual purchase price paid by Buyer for the Monitor. In no event shall VetSpecs be liable to Buyer or any other person or entity for special, incidental or consequential damages (including, but not limited to, loss of profits, damages to properties, and injuries to the patient and/or the user) arising out of the manufacture, sale, supplying or use of the Monitor. The foregoing Limited Warranty extends to Buyer only and shall not be applicable to any other person or entity including, without limitation, customers of Buyer.