

# Capnography

## An Objective Tool for Assessing Respiratory Status



## Maximizing Capnography Monitoring in LIFEPAK® 12, 15 and 20e Defibrillator/Monitors

End-tidal CO<sub>2</sub> (EtCO<sub>2</sub>) is the measurement of carbon dioxide (CO<sub>2</sub>) in the airway at the end of each breath. Capnography provides a numeric reading value and graphic display (waveform) of CO<sub>2</sub> throughout the respiratory cycle.

Capnography is an objective monitoring tool for any patient who might have metabolic, circulatory or ventilatory problems. It is used to confirm, monitor and document ET tube intubation. A nasal-oral cannula is used to assess, monitor and document the respiratory status of the non-intubated patient. EtCO<sub>2</sub> monitoring with LIFEPAK defibrillator/monitors may be used on patients of any age.



## Critical Points of Information

1. A waveform is displayed when any CO<sub>2</sub> is detected, but CO<sub>2</sub> must be > 3 mmHg (for LIFEPAK 12 devices) or > 3.5 mmHg (for LIFEPAK 15 and LIFEPAK 20e devices) for a numerical value to be displayed, and the CO<sub>2</sub> must be at least 8 mmHg for a valid breath and respiratory rate (RR) to be detected and the apnea alarm to function.
2. The CO<sub>2</sub> waveform is compressed (displayed at 12.5/mm/sec sweep speed) to provide more data in the 4 second screen. There is a slight delay between when the breath occurs and when it appears on the screen. Printouts are at 25mm/sec. Continuous print may be changed to 12.5mm/sec, if desired.
3. The monitor shows the maximum CO<sub>2</sub> value over the last 20 seconds. If the EtCO<sub>2</sub> values are increasing, the change can be seen with every breath. However, if the values are continually decreasing, it will take up to 20 seconds for a lower numerical value to be displayed in the CO<sub>2</sub> area. As such, the EtCO<sub>2</sub> value may not always match the CO<sub>2</sub> waveform.
4. The Oridion® capnography module performs self-maintenance within the first hour of monitoring and once an hour during continuous monitoring. This self-maintenance includes “auto-zeroing.” Self-maintenance is also initiated if the surrounding temperature changes 8°C or more or the surrounding pressure changes > 20 mmHg.
5. The CO<sub>2</sub> module is reset after a shock and the CO<sub>2</sub> waveform reappears in less than 20 seconds.
6. The CO<sub>2</sub> function is activated when the gold ring of the FilterLine connector contacts the device CO<sub>2</sub> port. It is possible for the FilterLine to become loose and still have an EtCO<sub>2</sub> value and CO<sub>2</sub> waveform, but they may be invalid. Make sure the FilterLine is firmly seated and tight.

See device Operating Instructions for complete directions for use, indications, contraindications, warnings, precautions and potential adverse events.



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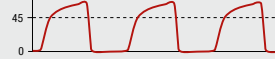
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## Examples of Waveforms

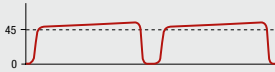
Plateau has curved, “shark-fin” appearance

- Bronchospasm
- asthma
- COPD



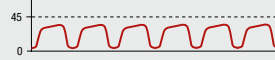
Slow rate with increased EtCO<sub>2</sub>

- Hypoventilation
- Partial airway obstruction



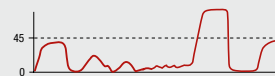
Rapid rate with decreased EtCO<sub>2</sub>

- Hyperventilation
- Hypoperfusion



Decreased EtCO<sub>2</sub>, variable waveform

- Intermittent apnea
- Patient is talking



## CO<sub>2</sub> Detection

When CO<sub>2</sub> is not detected — waveform is either dashes “---” or flat solid line near bottom of scale — several factors must be quickly evaluated as possible causes:

### Equipment issues

- Disconnection of the FilterLine set from the endotracheal tube (ETT)
- System is purging due to fluid in the patient/device connection from ET administration of medications, mucus or blood
- System is auto-zeroing
- Shock was delivered and system is resetting
- Loose FilterLine to device connection

### Loss of airway function

- Improper placement of ETT
- ETT dislodgment
- ETT obstruction

### Physiological factors

- Apnea
- Massive pulmonary embolism
- Exsanguination
- Inadequate CPR
- Loss of perfusion

## Getting Started

1. Turn LIFEPAK 12, 15 and 20e defibrillator/monitor ON. If CO<sub>2</sub> is not already displayed, select channel 2 or 3 to monitor the CO<sub>2</sub> waveform.
2. Attach the FilterLine® to the monitor and turn clockwise until FilterLine is firmly seated.
3. Attach the FilterLine to the patient.

**EtCO<sub>2</sub> Value:** Maximum EtCO<sub>2</sub> value over last 20 seconds.

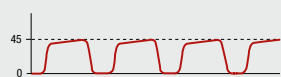
**Waveform:** Real-time monitoring of CO<sub>2</sub> throughout respiratory cycle.

**CO<sub>2</sub> Alarms:** Indicators of possible abnormalities in CO<sub>2</sub> values.

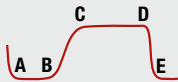
### Normal Ranges:

Arterial PaCO <sub>2</sub>	38–45 mmHg
Airway EtCO <sub>2</sub>	35–45 mmHg (4–6 Vol. %)

### Normal Waveform:



- A–B Respiratory baseline
- B–C Expiratory upslope
- C–D Expiratory plateau
- D End-tidal value—peak CO<sub>2</sub> concentration—at the end of exhalation
- D–E Inspiratory downstroke



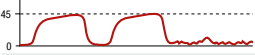
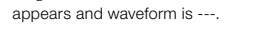
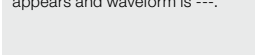
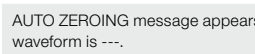
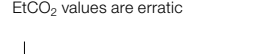
## Applications for Non-intubated Patients

- Ventilatory compromise
  - COPD
  - hyper and hypoventilation
  - apnea or inadequate breathing
  - monitoring during sedation
  - monitoring of EtCO<sub>2</sub> during head injury
- Metabolic compromise
  - diabetic ketoacidosis
  - hypermetabolic states
- Circulatory compromise
  - all types of shock

## Applications for Intubated Patients

- Verification of ET tube placement
- Monitoring ET tube and determination of tube dislodgement
- Determination of effective CPR during cardiac arrest
- Early detection of ROSC

## Troubleshooting Tips

Observation	Possible Cause	Corrective Action
ALARM APNEA message appears and waveform is solid line at or near zero. 	A valid breath was initially detected and then no breath has been detected for 30 seconds. FilterLine connection to device is loose. FilterLine is disconnected from patient or ETT.	<ul style="list-style-type: none"> <li>• Check the patient. See Critical Point 1.</li> <li>• Twist FilterLine connector clockwise until tight and firmly seated.</li> <li>• Check ventilation equipment (if used) for leaks or disconnected tubing.</li> </ul>
CO <sub>2</sub> FILTERLINE OFF message appears and waveform is ---. 	FilterLine set disconnected or not securely connected to device.	<ul style="list-style-type: none"> <li>• Connect FilterLine set to device port.</li> <li>• Twist FilterLine connector clockwise until tight and firmly seated.</li> </ul>
CO <sub>2</sub> FILTERLINE PURGING message appears and waveform is ---. 	FilterLine set is kinked or clogged with fluid or rapid altitude change occurred.	<ul style="list-style-type: none"> <li>• Disconnect and then reconnect the FilterLine set.</li> <li>• Twist FilterLine connector clockwise until tight and firmly seated.</li> </ul>
CO <sub>2</sub> FILTERLINE BLOCKAGE message appears and waveform is ---. 	The message appears after 30 seconds of unsuccessful purging. FilterLine set is kinked or clogged.	<ul style="list-style-type: none"> <li>• Disconnect and then reconnect the FilterLine set.</li> <li>• Change FilterLine set.</li> <li>• Twist FilterLine connector clockwise until tight and firmly seated.</li> </ul>
CO <sub>2</sub> INITIALIZING message appears and waveform is ---. 	FilterLine set just connected to device. Defibrillation shock delivered.	<ul style="list-style-type: none"> <li>• None.</li> <li>• None. System resets automatically within 20 seconds</li> </ul>
AUTO ZEROING message appears and waveform is ---. 	Module is performing self-maintenance. Defibrillation shock was delivered.	<ul style="list-style-type: none"> <li>• None. System resets automatically within 20 seconds. See Critical Points 4 and 5.</li> </ul>
EtCO <sub>2</sub> values are erratic 	FilterLine connection to device is loose. A leak in the FilterLine set. A mechanically ventilated patient breathes spontaneously or patient is talking.	<ul style="list-style-type: none"> <li>• Twist FilterLine connector clockwise until tight and firmly seated.</li> <li>• Check for connection leaks and line leaks to patient, and correct, if necessary.</li> <li>• No action required.</li> <li>• Check the patient.</li> </ul>
EtCO <sub>2</sub> values are consistently higher than expected 	Physiological cause (e.g. COPD). Inadequate ventilation. Patient splinting during breathing. Improper calibration.	<ul style="list-style-type: none"> <li>• None.</li> <li>• Check ventilator, increase ventilatory rate/ bagging.</li> <li>• Supportive measures (e.g. pain relief). Check waveform for elevated baseline.</li> <li>• Contact qualified service personnel.</li> </ul>
EtCO <sub>2</sub> values are consistently lower than expected 	FilterLine connection to device is loose. Physiological cause. Hyperventilation. Improper calibration.	<ul style="list-style-type: none"> <li>• Twist FilterLine connector clockwise until tight and firmly seated.</li> <li>• See CO<sub>2</sub> Detection - Physiological Factors</li> <li>• Check ventilator, decrease ventilatory rate/bagging.</li> <li>• Ventilator malfunction, contact qualified service personnel.</li> </ul>
CO <sub>2</sub> waveform stays elevated for several seconds. 	Expiration is prolonged due to bagging technique.	<ul style="list-style-type: none"> <li>• Release bag reservoir completely with expiration.</li> <li>• Check waveform for elevated baseline.</li> </ul>
Sudden extreme increase in EtCO <sub>2</sub> 	Return of spontaneous circulation.	<ul style="list-style-type: none"> <li>• None.</li> </ul>
xxx appears instead of EtCO <sub>2</sub> value 	CO <sub>2</sub> module failed. CO <sub>2</sub> not successfully calibrated.	<ul style="list-style-type: none"> <li>• Contact qualified service personnel.</li> </ul>

**Note:** To decrease the likelihood of FilterLine connection becoming loose during use, hand-straighten the tubing after removal from the package before connecting to patient or device.