# NORMAL AND ABNORMAL ETCO$_2$ WAVEFORM PATTERNS

## NORMAL

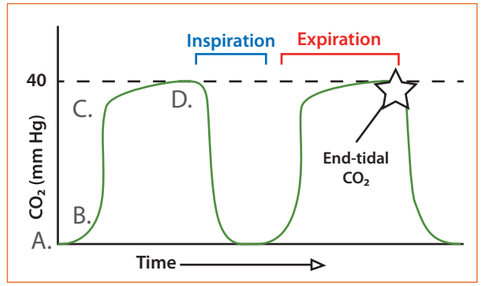
A normal capnogram consists of 4 phases. The baseline represents inspiration as the $CO_2$ levels are normally zero.

A. Phase 1 is the start of exhalation and represents exhaled gas from the upper airways.

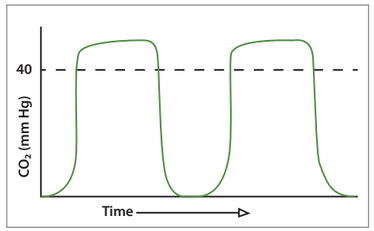
B. Phase 2 is displayed by a rapid rise as alveolar gas replaces anatomical deadspace.

C. Phase 3, the Alveolar Plateau, represents alveolar gas during the end of expiration. This causes the waveform to flatten. The end point of this phase is referred to as $EtCO_2$. This is the numerical value displayed on the capnography. A normal $EtCO_2$ value is between 35 -45 mm Hg.

D. Phase 4. The beginning of inspiration and marked by a rapid downstroke to baseline.

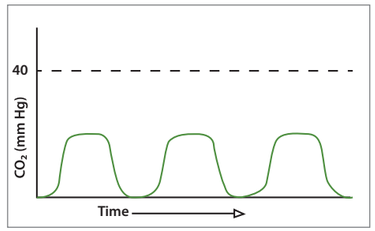



## ABNORMAL



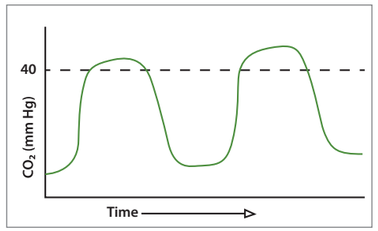

### HYPOVENTILATION

The trademark sign for hypoventilation is an elevated $CO_2$ level above 45 mm Hg in the presence of normal circulationand metabolism.



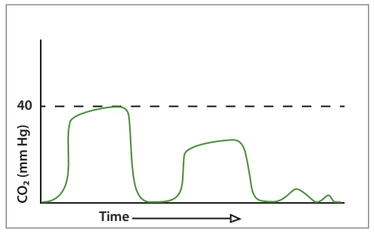

### HYPERVENTILATION

The primary indicator of hyperventilation is a decreased $CO_2$ level below 35 mm Hg in the presence of normal circulation and metabolism.



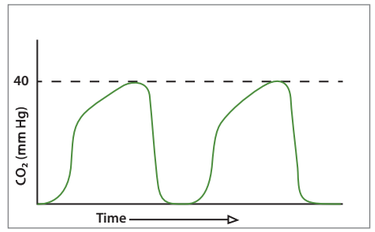

### REBREATHING OF $CO_2$

The pattern for rebreathing $CO_2$ is a gradual rise in the baseline.



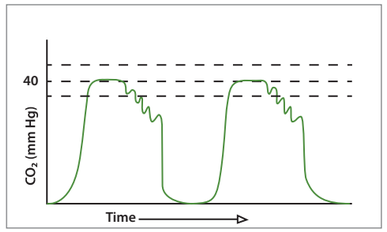

### APNEA

Waveform quickly falls to baseline. No breath for 10 seconds or longer.




### AIRWAY OBSTRUCTION

A common sign of airway obstruction is indicated by a shark fin shaped waveform while occurring normally once every three seconds or less.

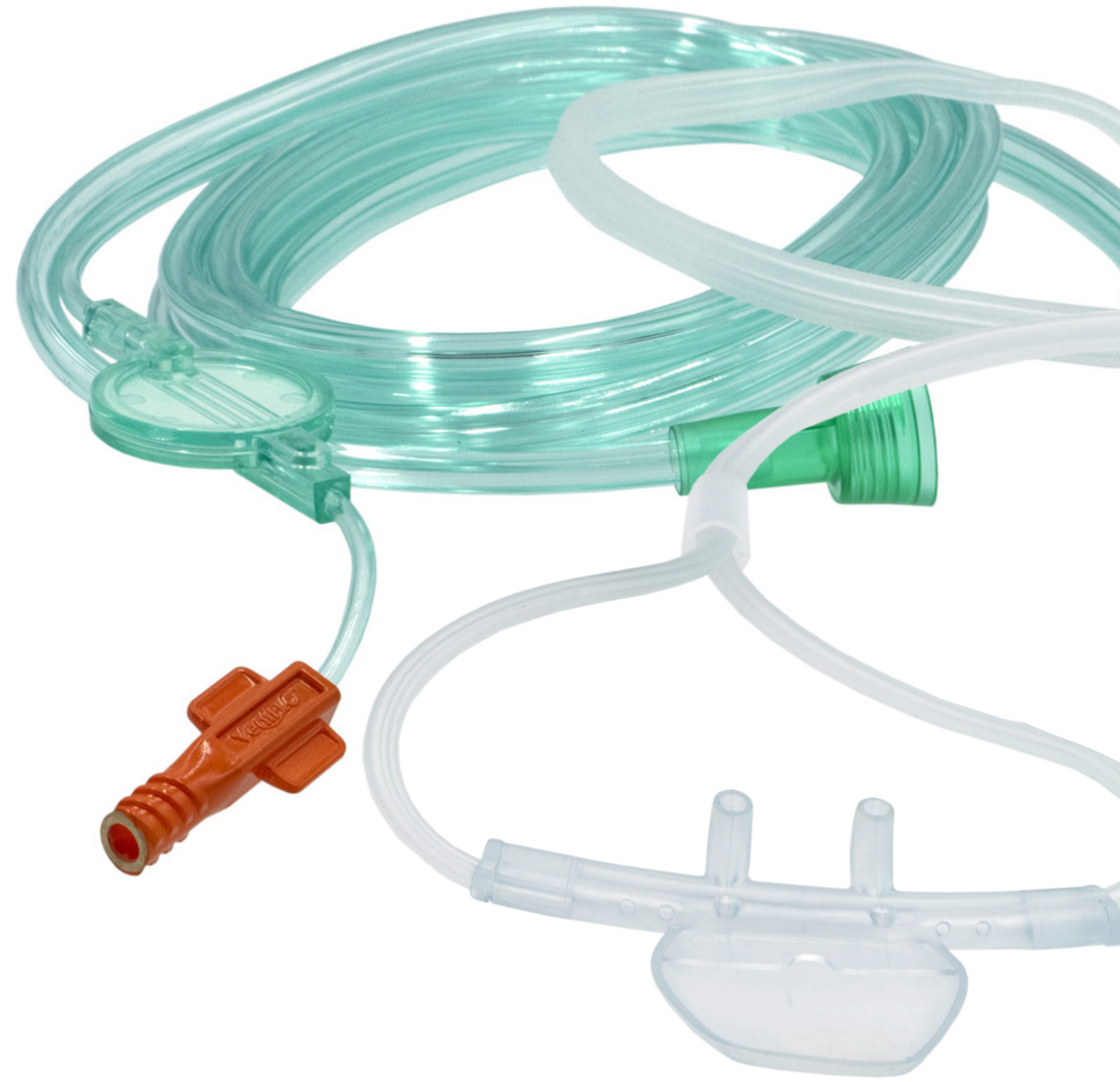



### CARDIOGENIC OSCILLATIONS

Downslope of waveform creates a ripple effect during low frequency ventilation.

BRO-10002 Rev.4

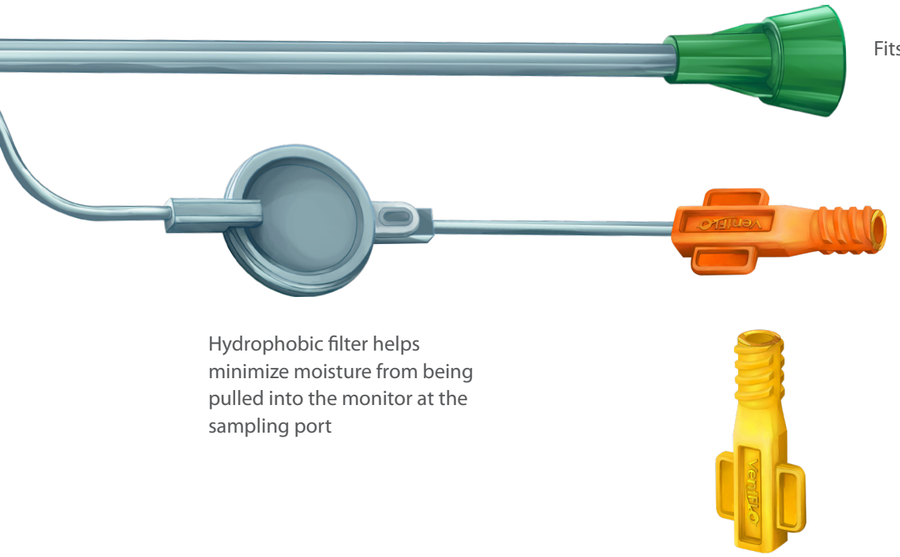
VentFLO™



# VentFLO

# $ETCO_2/O_2$ SAMPLING CANNULAS WITH INLINE FILTER

SunMed's VentFLO™ $EtCO_2/O_2$ sampling cannulas capture the exhaled $CO_2$ while simultaneously delivering oxygen. These $EtCO_2/O_2$ cannulas also feature a bright reflective style connector, compatible with Microstream™, Capnostream™ and Oridion™ capnography monitors.



Fits-All Connector

Reflective connector with ergonomic grip for standard cannulas

Hydrophobic filter helps minimize moisture from being pulled into the monitor at the sampling port



Yellow reflective connector with ergonomic grip indicates the VentFLO extended line with Nafion tubing

## What makes VentFLO™ $EtCO_2/O_2$ sampling cannulas the right choice in capnography sampling?

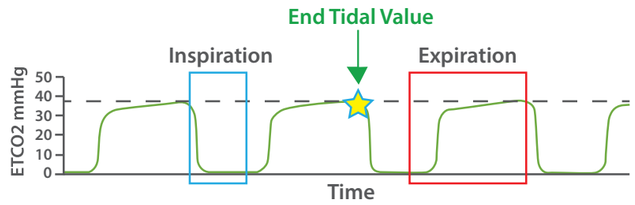
Sidestream capnography sampling with an $O_2/EtCO_2$ nasal cannula can be susceptible to blockage from water vapor or secretions - but risk can be reduced when a filter is introduced.

SunMed's VentFLO™ $EtCO_2/O_2$ cannulas feature a **hydrophobic filter**. The use of this filter helps minimize the potential that water vapor or secretions can have on the capnography waveform output. The result is a waveform that is as close to textbook standard as possible.

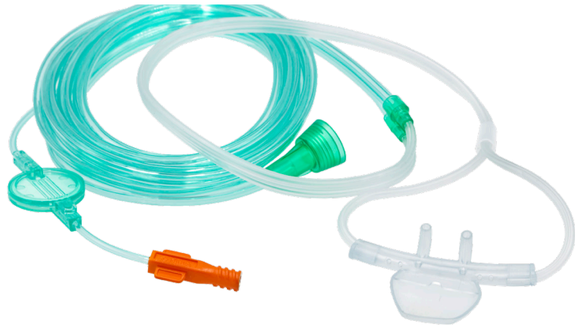
## THE IMPORTANCE OF THE WAVEFORM IN CAPNOGRAPHY

End-tidal carbon dioxide ($EtCO_2$) monitoring provides valuable information about $CO_2$ production and ventilation. Also called capnography, this monitoring provides a breath-by-breath analysis and continuous reading of ventilatory status including early signs of respiratory compromise, cardiac perfusion changes, proper placement of endotracheal tube, and ventilator circuit integrity. Each of these is translated by the capnography waveform.

The normal capnography should be a rectangle with rounded corners. Different waveform shapes can indicate different conditions. When a patient is exhaling $CO_2$, the graph inclines. When a patient inhales, the graph declines. The waveform should return to the baseline, and frequency should match the patient's respiratory rate. The height of the waveform should be between 35 mm Hg and 45 mm Hg, which is a normal $EtCO_2$ reading.

# $ETCO_2$ CANNULAS

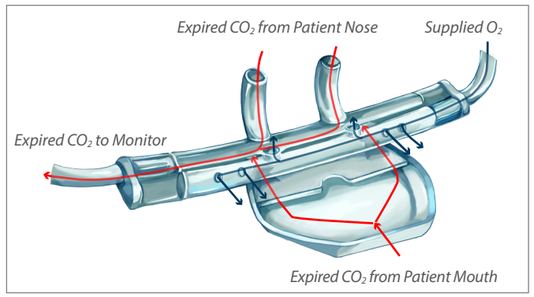


- Hydrophobic filter minimizes moisture ingress into monitor
- Simultaneously delivers oxygen while obtaining $CO_2$ sampling during spontaneous breathing
- Compatible with capnography monitors that utilize Microstream™ technology, e.g. Medtronic Capnostream™ 35
- Soft-Ears™ material helps ensure superior patient comfort
- Designed to prevent mixing of fresh oxygen with $CO_2$
- 3-Channel tubing prevents kinking
- Available in three tubing lengths, each with Fits-All $O_2$ connector

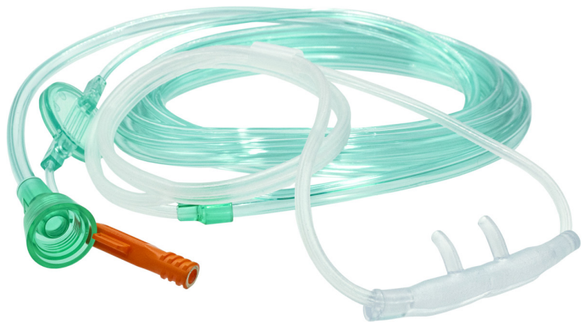
*Microstream, Capnostream and Oridion are trademarks of Medtronic, related to products marketed by Medtronic.*

## $ETCO_2/O_2$ ORAL-NASAL SAMPLING CANNULA

| ITEM | DESCRIPTION | LENGTH | PK |
|---|---|---|---|
| 5707F-SE | Adult $EtCO_2/O_2$ Oral/Nasal Cannula | 7′ | 25 |
| 5710F-SE | Adult $EtCO_2/O_2$ Oral/Nasal Cannula | 10′ | 25 |
| 5714F-SE | Adult $EtCO_2/O_2$ Oral/Nasal Cannula | 14′ | 25 |

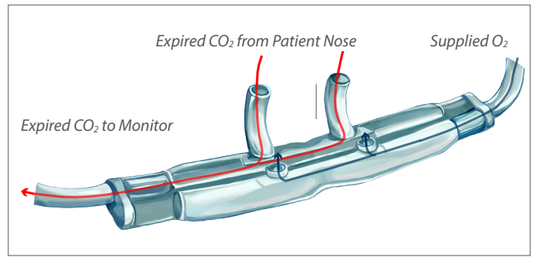



Innovative scoop design enables effective $CO_2$ capture from mouth-breathing patients



## $ETCO_2/O_2$ NASAL SAMPLING CANNULA

| ITEM | DESCRIPTION | LENGTH | PK |
|---|---|---|---|
| 5107F-SE | Adult $EtCO_2/O_2$ Nasal Cannula | 7′ | 25 |
| 5114F-SE | Adult $EtCO_2/O_2$ Nasal Cannula | 14′ | 25 |
| 5207F-SE | Pediatric $EtCO_2/O_2$ Nasal Cannula | 7′ | 25 |
| 5210F-SE | Pediatric $EtCO_2/O_2$ Nasal Cannula | 10′ | 25 |
| 5214F-SE | Pediatric $EtCO_2/O_2$ Nasal Cannula | 14′ | 25 |




Curved nares made of ultra-soft material

# EXTENDED $ETCO_2$ CANNULAS

VentFLO™ $EtCO_2$ Extended devices serve the same purpose as the standard VentFLO $EtCO_2$: to supply $O_2$ to the patient and to collect and sample patient breath exhaled through the nose to monitor and report patient $FiO_2$ & $EtCO_2$ levels, respiratory rate, and more. However, the VentFLO™ Extended devices are fitted with an additional section of Nafion tube that allows the cannula to function longer and in higher-humidity conditions than their standard counterparts.

## EXTENDED $ETCO_2/O_2$ ORAL-NASAL SAMPLING CANNULA

| ITEM | DESCRIPTION | LENGTH | PK |
|---|---|---|---|
| 5107GS-E | Extended $EtCO_2/O_2$ Gas Sampling Line | 7′ | 25 |
| 5107ET-E | Extended $EtCO_2/O_2$ Gas Sampling Line with ET Tube Adapter | 7′ | 25 |
| 5107-SE-E | Adult Extended $EtCO_2/O_2$ Nasal Cannula | 7′ | 25 |
| 5110F-SE-E | Adult Extended $EtCO_2/O_2$ Nasal Cannula | 10′ | 25 |
| 5114F-SE-E | Adult Extended $EtCO_2/O_2$ Nasal Cannula | 14′ | 25 |
| 5207F-SE-E | Pediatric Extended $EtCO_2/O_2$ Nasal Cannula | 7′ | 25 |
| 5210F-SE-E | Pediatric Extended $EtCO_2/O_2$ Nasal Cannula | 10′ | 25 |
| 5214F-SE-E | Pediatric Extended $EtCO_2/O_2$ Nasal Cannula | 14′ | 25 |

## EXTENDED $ETCO_2/O_2$ NASAL SAMPLING CANNULA

| ITEM | DESCRIPTION | LENGTH | PK |
|---|---|---|---|
| 5707F-SE-E | Adult Extended $EtCO_2/O_2$ Oral/Nasal Cannula | 7′ | 25 |
| 5710F-SE-E | Adult Extended $EtCO_2/O_2$ Oral/Nasal Cannula | 10′ | 25 |
| 5714F-SE-E | Adult Extended $EtCO_2/O_2$ Oral/Nasal Cannula | 14′ | 25 |