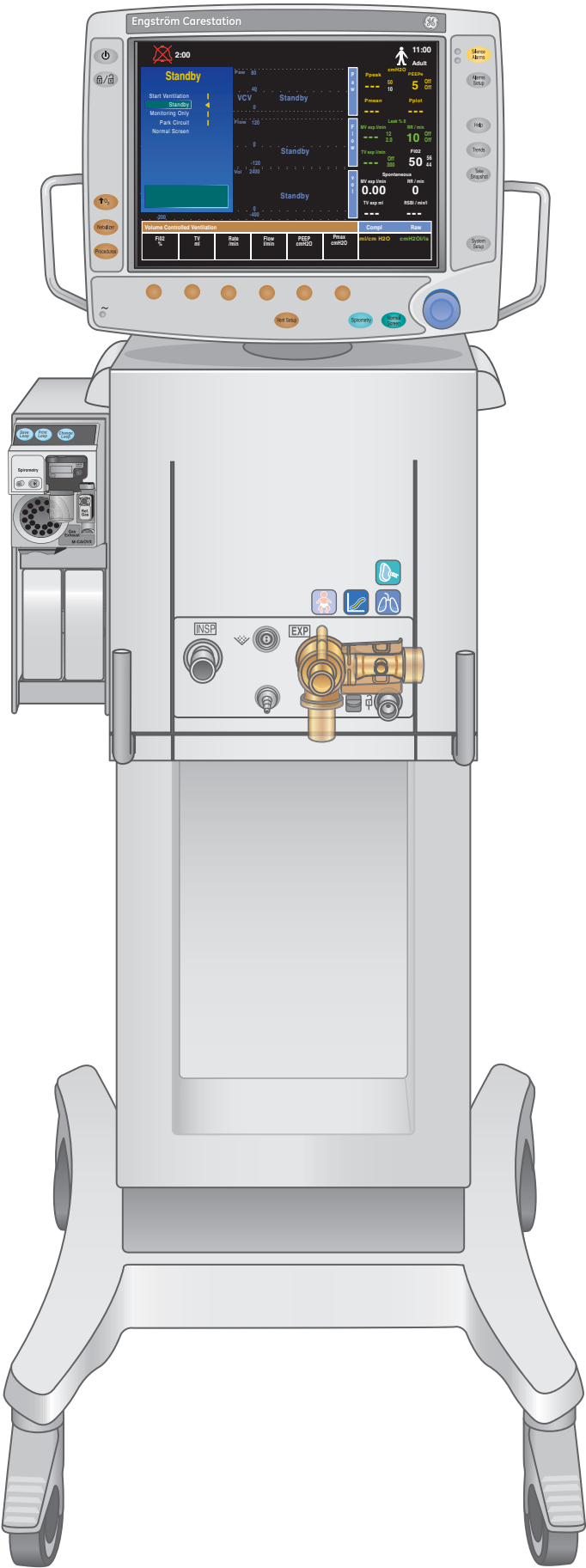


Engström Carestation

Participant Guide

Software Revision 7.X

Version A



Clinical Systems
Clinical Educational Development



Engström Carestation

Participant Guide

Software Revision 7.X

Version A

Clinical Systems

Clinical and Educational Development

Customer Support Center: 800-345-2700

Notice

The materials contained in this document are intended for educational purposes only. This document does not establish specifications, operating procedures or maintenance methods for any of the products referenced. Always refer to the official written materials (labeling) provided with the product for specifications, operating procedures and maintenance requirements.

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All patient names or other protected health information or data contained in any image within this material is fictitious. Any similarity to actual persons is coincidental.



Note! *This Participant's manual is not intended to replace the User's Reference Manual that you received with the machine. Please refer to the disclaimer notice at the end of this manual for more information.*

This course is intended for Engström Carestation software level 7.X. The material contained in this course is intended for educational purposes only. Always refer to the official written materials provided with the Engström carestation for specifications, operating procedures, and maintenance requirements.

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1 Welcome

We would like to take a moment to thank you for choosing GE Healthcare for your carestation needs. Our goal is to provide you with the best training service available while continuing to support you as you use our products in your workplace.

Course Descriptions



All courses will utilize discussion, return demonstration and assessments.

Basic Ventilation Features of the Engström Carestation

This course is required for any caregiver who is required to know detailed information regarding using the Engström Carestation. Approximate time is ninety minutes.

Advanced Ventilation Features of the Engström Carestation

This course is designed to cover the advanced features of the Engstrom Carestation, and is used to supplement the Basic Ventilation course. Approximate time is sixty minutes.

Gas Exchange Features of the Engström Carestation

This course is designed to instruct the user on managing gas exchange measurements with the Engstrom Carestation. Approximate time is sixty minutes.

Neonatal Functionality of the Engström Carestation

This course is designed to cover the functional differences of using the Engstrom Carestation on neonatal patients. The basic and advanced courses should be completed prior to the neonatal functionality course. Approximate time is thirty minutes.

Superuser Details of the Engström Carestation

This course is targeted for individuals who are required to know maintenance, calibration, defaults, purchasing supplies and obtaining technical and clinical support. Approximate time is sixty minutes.



2 Basic Ventilation Features

Overview: Basic Ventilation Features



After completing the **Basic Ventilation Features of the Engström Carestation**, the participant should be able to perform the following tasks:

Overview

- Identify the main components of the Engström Carestation
- Navigate the main display using the ComWheel and the Menu Keys
- Identify and describe the viewable areas on the display
- Utilize the touchscreen to navigate through touch points and the Favorites Bar

Ventilation

- Adjust a ventilator setting using one of the ventilator Quick Keys
- Change a ventilation mode and setting using the Vent Setup menu
- Identify the eight standard modes of ventilation
- Adjust the three ventilator settings common to all modes of ventilation (Trigger, Bias Flow and Rise Time)
- Adjust the two ventilator settings common to pressure support breaths (PSV Rise Time and End Flow)
- Describe the function of Plimit in VCV and SIMV-VC

Alarms

- Pre-silence an alarm using the Silence Alarm key
- Temporarily silence an active alarm using the Silence Alarm key
- Identify the three alarm priorities.
- Identify Resolved Alarms on the display screen
- Adjust an alarm setting using the Alarm Setup menu
- View recent alarms using the **Help** key

Clinical Features

- Access the Trends menu and take a Snapshot
- Perform a Vent Calculation
- Simulate a breathing treatment using a pneumatic nebulizer or the incorporated Aerogen Nebulizer
- Install an Exhalation Valve Heater, if applicable.
- Simulate a closed suctioning using the Increase O₂ key
- Utilize two features of the Standby menu: Standby and Park Circuit
- Power-down the Engström Carestation
- Prepare the Engström Carestation for clinical use by attaching the exhalation valve and breathing circuit, then powering up the system.
- Perform a checkout using the Checkout menu
- Enter a patient weight using the Select Patient menu
- Access the Patient Setup menu

What is an Engström Carestation?

The Engström Carestation is a critical care ventilator that is flexible and physically adaptable to a variety of work environments. It has an intuitive user interface that is common to many GE Healthcare products. A wide selection of performance options gives the user full control of the system configuration. The Engström Carestation is a complete system featuring patient monitoring, patient ventilation, and the capability of interfacing with central monitoring.

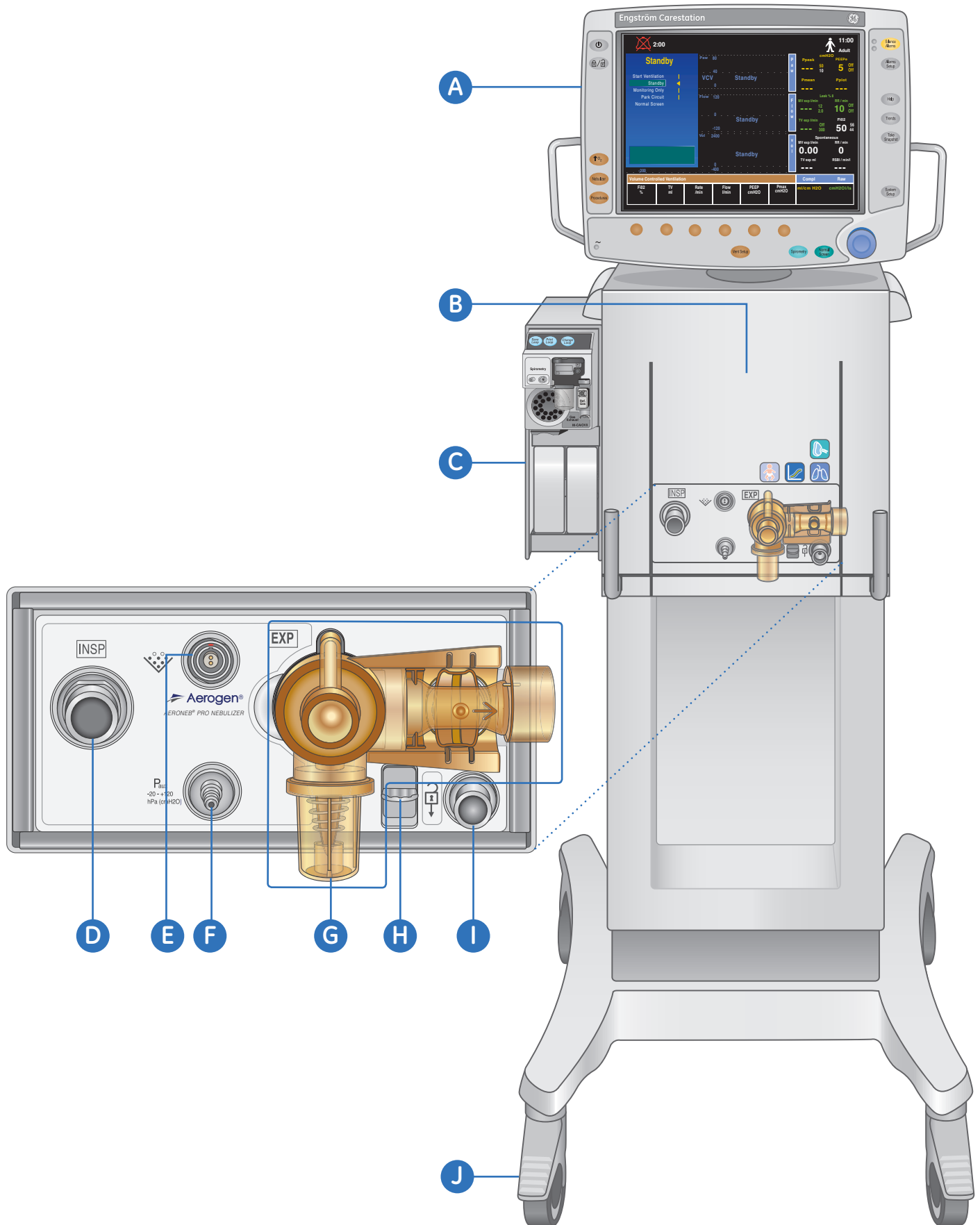
Engström Carestation Component Identification

Front View

- A. Flat Screen Display**
Allows the user to interface with the system and control settings.
- B. Ventilator Unit** (located behind panel)
Controls electrical power, nebulization, and pneumatic gas flow to and from the patient.
- C. Module Bay (Optional)**
Allows the integration of various patient monitoring modules with the ventilator.
- D. Inspiratory Outlet**
Inspiratory gas outlet.
- E. Nebulizer Connection**
Performs patient nebulization based on volume and time settings.
- F. Auxiliary Pressure Port**
Auxiliary pressure is a supplementary pressure measurement that can be displayed with a waveform and numerics.
- G. Exhalation Valve Assembly**
Composed of 4 components, see page 2.4 for details.
- H. Release Latch**
Press down on the latch to release the exhalation valve housing. Pull housing off ventilator to remove it.
- I. Leak Test Plug**
Occludes the patient circuit during a checkout.
- J. Caster Brake**
Press down to lock. Lift up to release.



Note! *Optional accessories include an air compressor, humidifier, water trap and auxiliary electrical outlets.*



2 Basic Ventilation Features

Figure 2.1 Engström Carestation Front View

Exhalation Valve Assembly

- A. Expiratory Gas Inlet**
The expiratory side of the patient circuit connects here.
- B. Expiratory Flow Sensor**
Measures flow and volume.
- C. Diaphragm**
Remove before cleaning or sterilizing the exhalation valve assembly.
- D. Water Trap**
Unscrew to remove and empty contents.

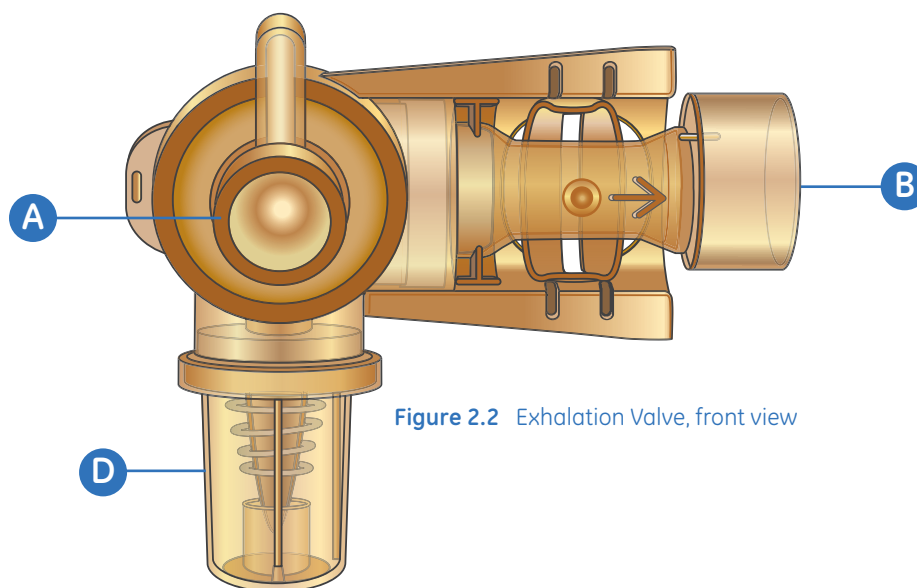


Figure 2.2 Exhalation Valve, front view

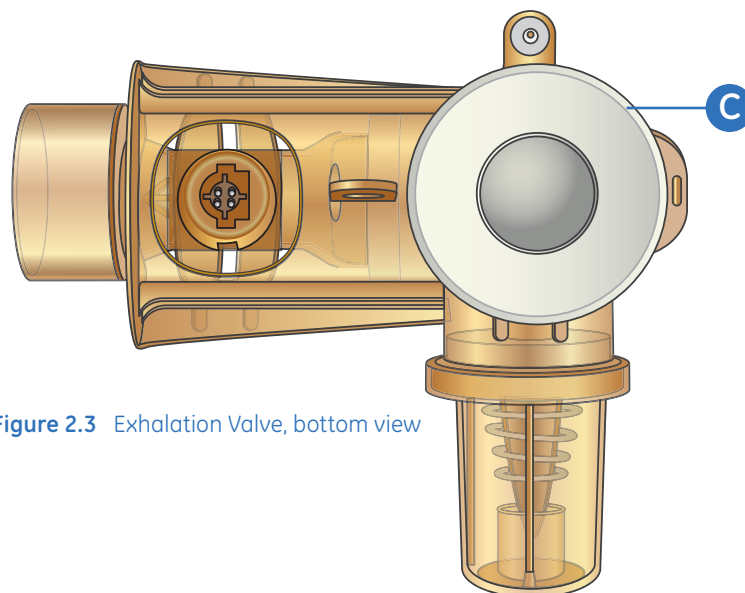


Figure 2.3 Exhalation Valve, bottom view

Back View

- A. System Switch**
Set the switch to the On position to power up the ventilator. The system may only be turned off when in Standby.
- B. Communication Port**
Allows serial input/output of commands and data.
- C. Oxygen and Air Supply Connects**
to the hospital's gas supply.
- D. Power Cord**

Options

- E. Eview**
Allows patient and ventilator data to be downloaded from the Engström system. Data is transferred by using a SD media card or a USB flash drive, then uploaded onto a PC. Data can be examined and stored electronically or can be printed for use in a patient's medical records.
- F. Compressor**
The EVair 03 compressor is intended for use as an optional accessory to Datex-Ohmeda critical care ventilators as a breathable compressed air supply.
- G. Isolated Electrical Outlets**
The configuration of the electrical outlets varies by country.
- H. Compressor Drain Bottle**

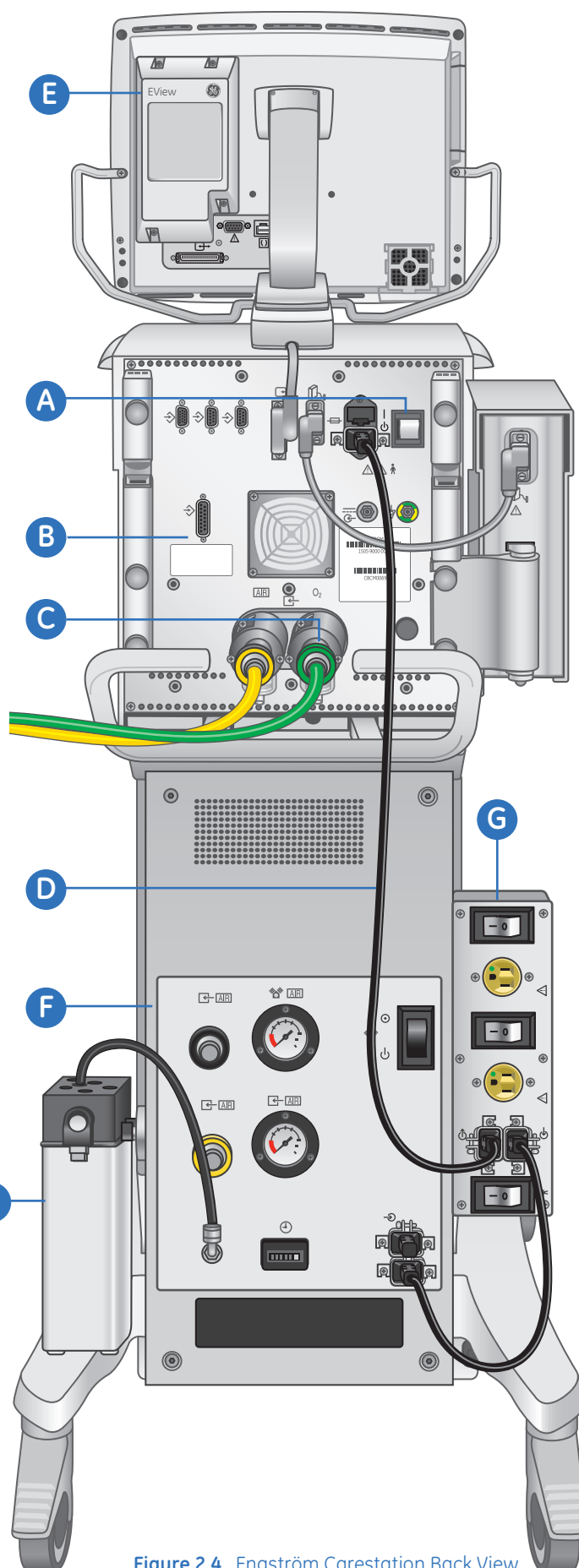


Figure 2.4 Engström Carestation Back View

Monitor and Display Component Identification

Monitor Components

- A. **Alarm LEDs:** The red and yellow LEDs indicate the priority of active alarms.
- B. **Silence Alarms key:** Press to silence any active, silenceable high and medium priority alarms or to suspend any non-active high or medium priority alarms. Alarm audio is silenced or suspended for 120 seconds for Adult and Pediatric patient types, and for 30 seconds for Neonatal patient types. Press to clear resolved alarms.
- C. **Alarms Setup:** Views and adjusts the alarm limits as well as the volume of the audible alarm.
- D. **Help:** View information about alarms.
- E. **Trends:** View historical patient data and ventilator settings either numerically or graphically.
- F. **Take Snapshot:** Record the waveforms, alarms, and measured and set values. A maximum of ten snapshots can be stored in memory.
- G. **System Setup:** Used to view system status and access various setup menus.
- H. **ComWheel:** Press to select a menu item or confirm a setting. Turn clockwise or counterclockwise to scroll menu items or change settings.
- I. **Normal Screen key:** Press to remove all menus from the screen.
- J. **Spirometry:** View patient ventilation data graphically in the form of loops based on pressure, flow, and volume data.
- K. **Vent Setup:** Selects ventilation mode and adjust all ventilation settings for each mode.
- L. **Quick keys:** Press to change corresponding ventilator setting. Turn the ComWheel to make a change. Press the Quick key or ComWheel to activate the change.
- M. **AC mains indicator:** The green LED lights continuously when the system is connected to an AC mains source. The internal batteries are charging when the LED is lit.
- N. **Procedures:** Selects specific procedures such as Intrinsic PEEP and Lung Mechanics.
- O. **Nebulizer:** Used to select patient nebulizer settings.
- P. **Increase O₂ key:** Press to deliver 100% O₂ for two minutes. In neonatal mode, the increase in oxygen will default to a user-set increase over current setting for two minutes.
- Q. **Lock/Unlock:** Press to lock or unlock the touchscreen.
- R. **Standby:** Place the ventilator in Standby mode and to start ventilation when the system is in Standby mode.

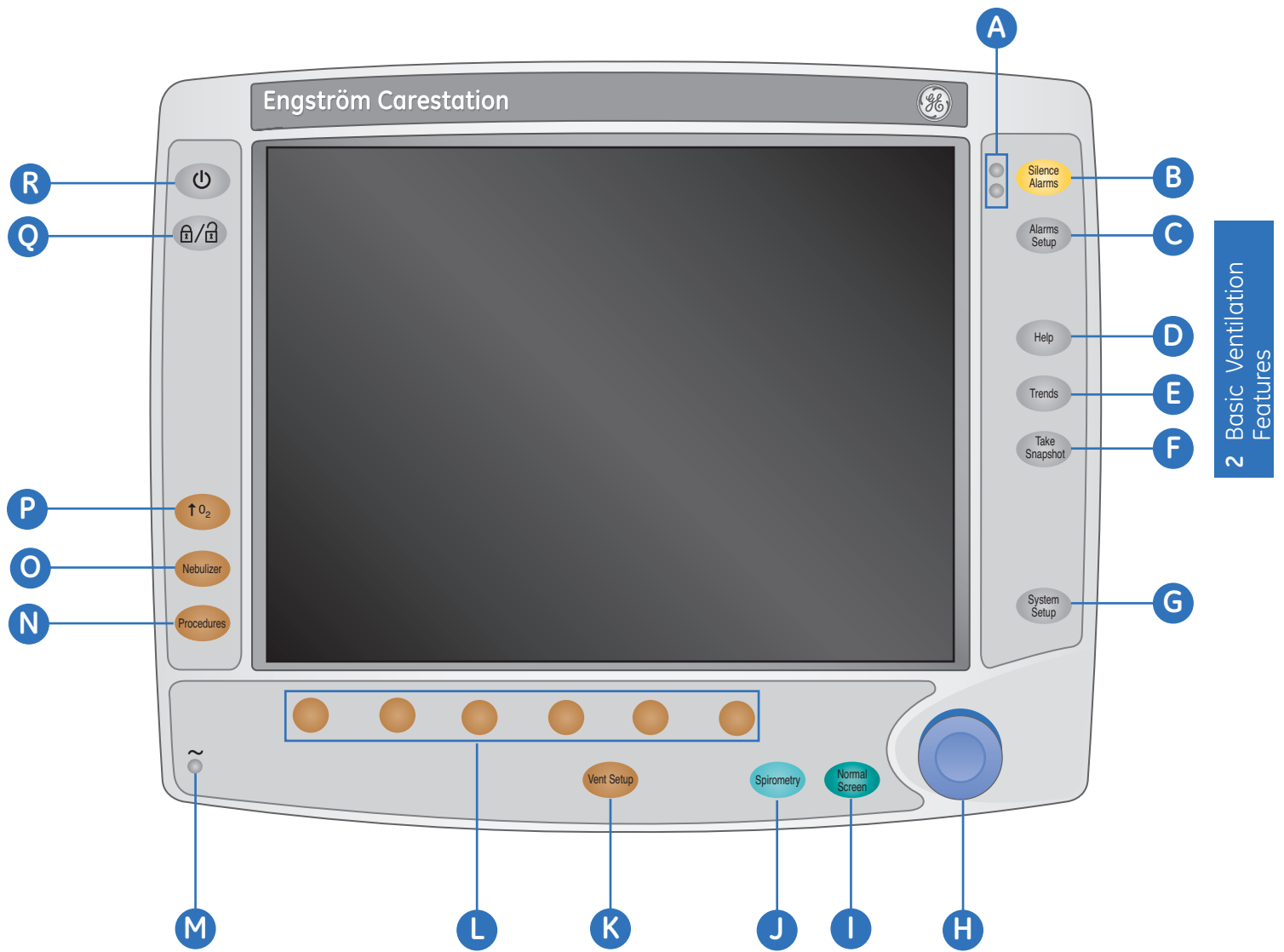


Figure 2.5 Engström Carestation Monitor

Display Components

A. Alarm Messages

Alarms will appear in order of priority. Refer to the Alarm Management section on page 2.27 for more information on alarm behavior.

B. Waveforms

The top two waveforms are permanently set to Paw and Flow. The third waveform may be selected as **CO₂, O₂, Vol, Paux, or Off**.

C. Waveform Numerics

Displays current measured values corresponding to the waveforms.

D. Patient Type Icon: Displays Neonatal, Pediatric or Adult patient type mode.

E. Digit Field

Displays information related to Volume, CO₂, O₂, Compliance, Metabolics, Spirometry, or Volume per Weight.

F. Current Vent Settings

Displays several of the settings for the current mode of ventilation.

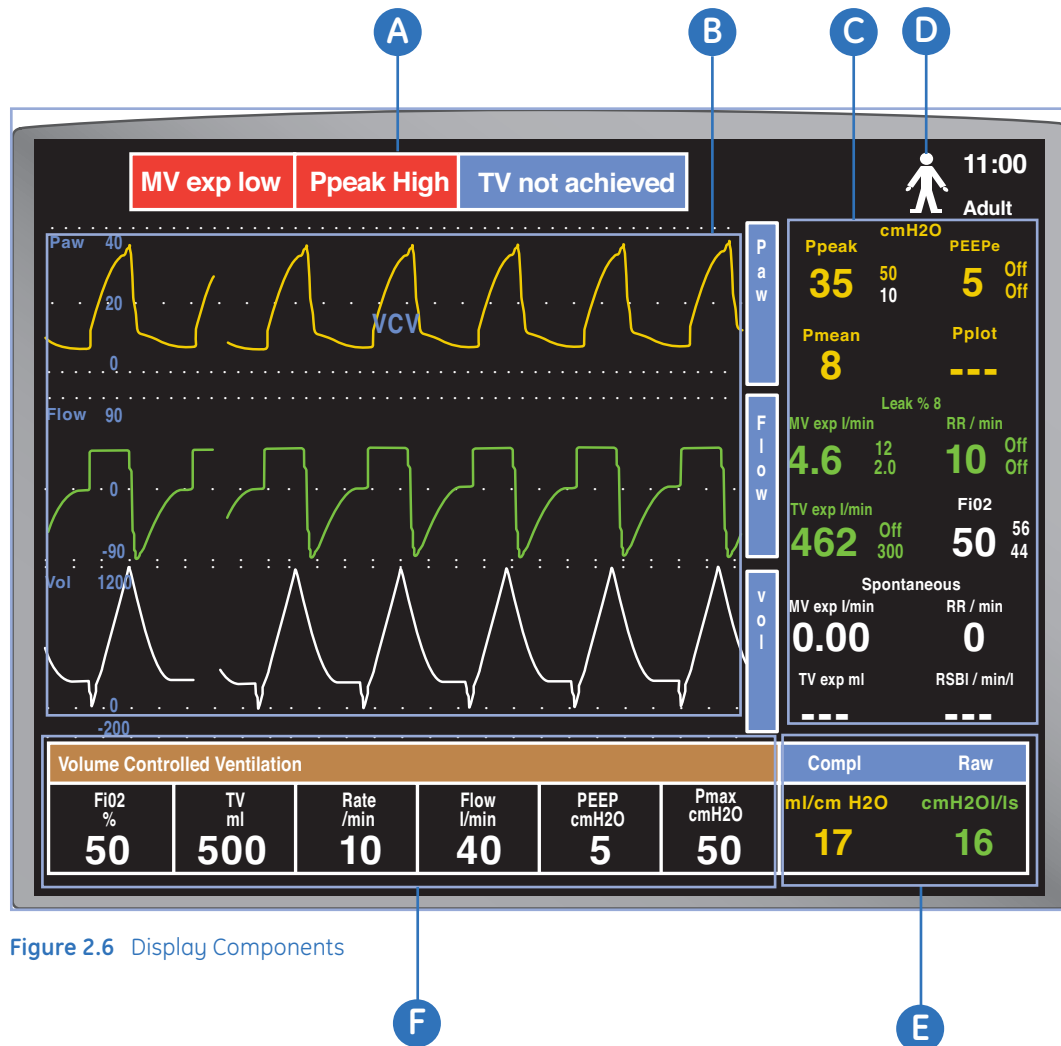


Figure 2.6 Display Components

Touchscreen

The Engström display uses touchscreen technology and a Favorites Bar to easily access system functions, menus, and settings.



Note! To use touchscreen capabilities the Touchscreen setting must be set to **On**, Engström system software 7.X or greater must be installed, and the proper Display Unit hardware must be installed.

The touchscreen has numerous touch point areas that make accessing menus and settings quick and easy. The Favorites Bar provides direct access to seven user selected functions and procedures that shortcut to menus and settings.

Touch only one touch point at a time to ensure the correct selection is made.

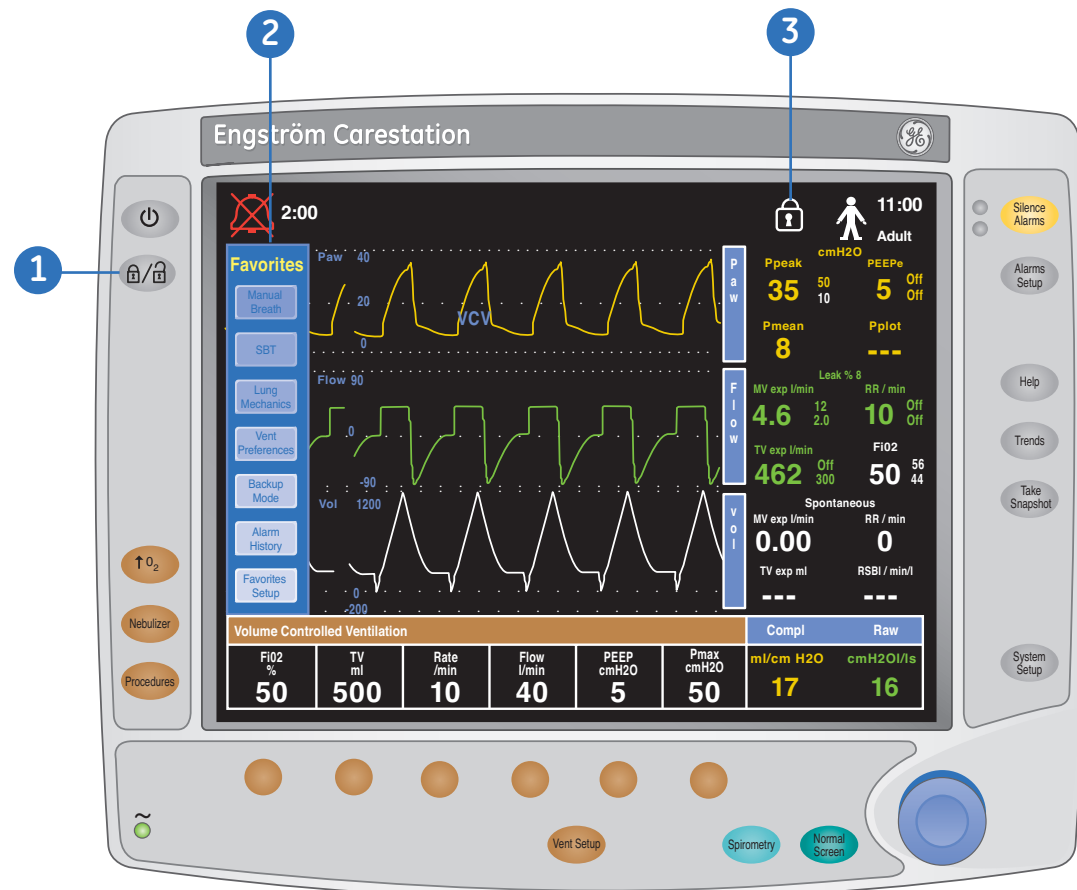


Figure 2.7 Touchscreen Features

1. Lock/Unlock key to lock or unlock the touchscreen.
2. Favorites Bar (shortcut to favorite functions and procedures).
3. Lock icon displays only when touchscreen is locked.

Lock/Unlock Menu Key



The Lock icon displays in the General Message field when the touchscreen is locked. When the touchscreen is locked touch points are inactive.

Press the Lock/Unlock key on the left side of the display to lock or unlock the touchscreen.



Note! The Lock icon only displays when the touchscreen is locked.

Touch Points

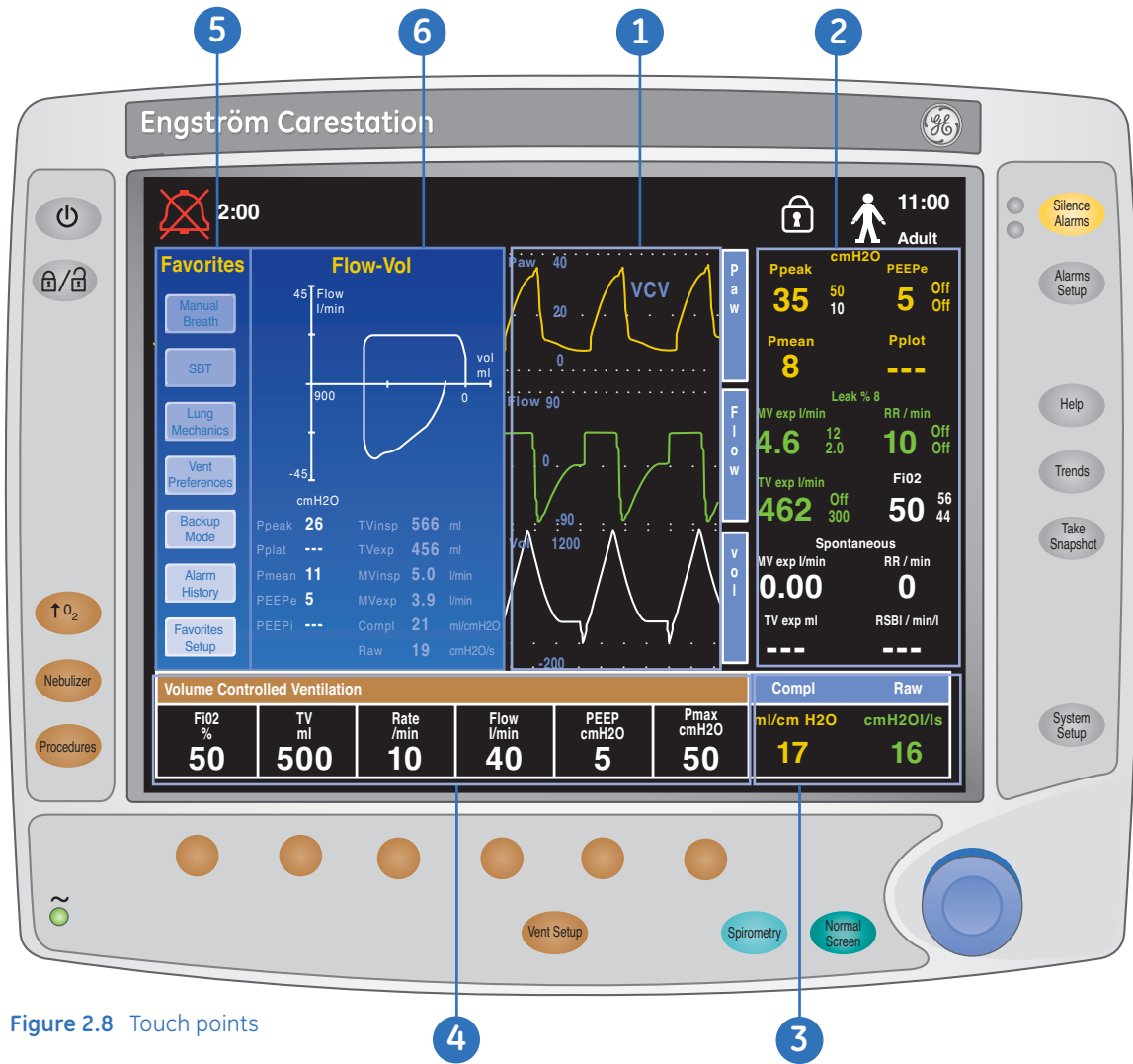


Figure 2.8 Touch points

1. Wave Field 1, 2 and 3.
2. Measured Values
3. Digit Field
4. Quick Keys
5. Favorites Bar
6. Split Screen

Waveform Field Touch Points

1. Touch the waveform field you would like to change.
2. The Screen Setup menu displays with the highlight on the corresponding waveform field that was touched.
3. To set the third waveform field when only waveforms 1 and 2 are shown, touch above or below waveform fields 1 and 2. The Screen Setup menu displays with the highlight on the **Wave Field 3** menu item.
4. Use the ComWheel to select and confirm the desired setting.
5. Select **Previous Menu** or press the **Normal Screen** key to exit.



Note! Waveform fields 1 (Paw) and 2 (Flow) cannot be changed.

Digit Field Touch Points

1. Touch the Digit Field to change the value that is displayed.
2. The Screen Setup menu displays with the highlight on the **Digit Field** menu item.
3. Use the ComWheel to select and confirm the desired setting.
4. Select **Previous Menu** or press the **Normal Screen** key to exit.

Active Alarm Touch Points

When an alarm sounds the alarm message is displayed at the top of the screen and the alarming numeric flashes. The Alarm messages at the top of the screen are message alerts only and not active touch points.

1. Touch the flashing numeric to access the Alarms Setup and alarm limits for the active alarm.
2. The Alarms Setup menu displays with the active alarm limit highlighted. For example: If the Ppeak high alarm activates, the high alarm limit setting for Ppeak displays with the highlight.
3. Use the ComWheel to select and confirm the desired setting.
4. Select **Previous Menu** or press the **Normal Screen** key to exit.

Turning the Favorites Bar On and Off



Figure 2.9 Favorites Menu

1. Press the **System Setup** key.
2. Select **Screen Setup > Favorites Setup**. The Favorites Setup menu displays with the highlight on Select Favorites.
3. Use the ComWheel to scroll to Favorites Bar.
4. Select **On** or **Off** and confirm the selection.
5. Use the ComWheel to select **Previous Menu** or press the **Normal Screen** key to exit.



Note! If the Favorites Bar does not display, the Touchscreen may be turned off. It can only be turned On or Off through the Install/Service menu, which is password protected.

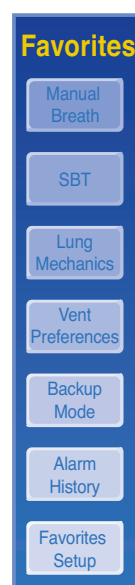
Setting up the Favorites Bar



Figure 2.10 Monitor with Favorites Menu

The Favorites Bar allows quick access to seven user-selectable functions and procedures.

1. Press the **System Setup** key.
2. Select **Screen Setup > Favorites Setup**. The Favorites Setup menu displays with the highlight on **Select Favorites**.
3. Press the ComWheel to enter the Favorites Setup menu and scroll to the desired function or procedure you would like to set as a favorite.
 - Use the ComWheel to select **On** or **Off** and confirm the selection
 - Up to seven functions and procedures may be selected for the Favorites Bar
4. Use the ComWheel to select **Previous Menu** or press the **Normal Screen** key to exit. The Favorites Bar displays on the left side of the screen.



Using the Favorites Bar

1. Touch a Favorite function or procedure.
2. The corresponding menu displays.
3. Use the ComWheel to scroll and select the desired settings.
4. Use the ComWheel to select **Previous Menu** or press the **Normal Screen** key to exit.



Note! *Manual Breath and Suction procedures are immediately started when touched on the Favorites Bar. No menu is displayed and no confirmation is required when Manual Breath or Suction is touched.*

Changing a Ventilator Setting Using the Quick Keys

1. Press the **Quick Key** to change the corresponding ventilator setting. In this case we are adjusting the FiO₂.
2. Turn the ComWheel to change the setting (turning clockwise increases the value, turning counter-clockwise decreases the value).
3. Press the ComWheel or the associated **Quick Key** to confirm the new setting.

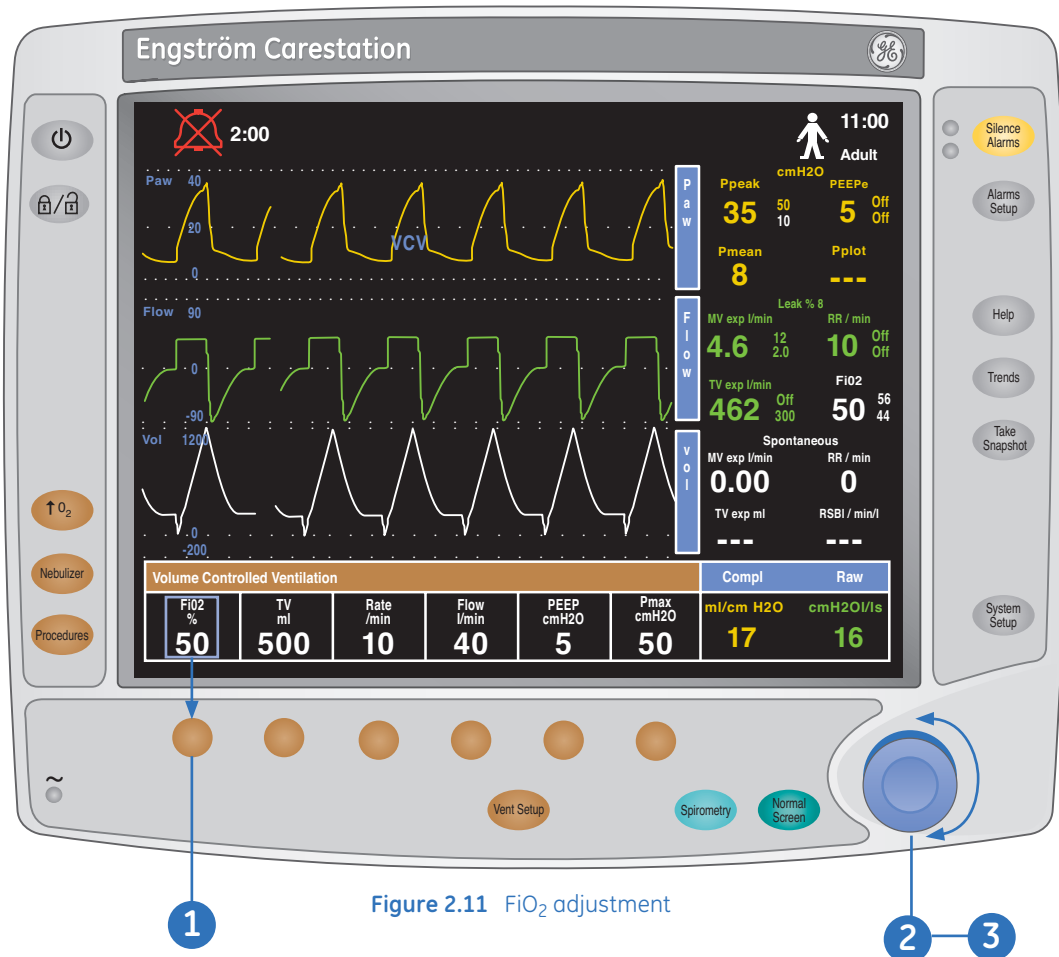


Figure 2.11 FiO₂ adjustment

The Vent Setup Menu

The Vent Setup menu is used to select ventilation modes and adjust all ventilation settings for each mode.

To access the Vent Setup menu:

1. Press the **Vent Setup** Key.
2. Select **Adjust Settings** to adjust settings for the selected ventilation mode.
3. Select **Backup Mode** to adjust settings for the selected Backup mode or to change the Backup ventilation mode.
4. Use the ComWheel to scroll and confirm settings.

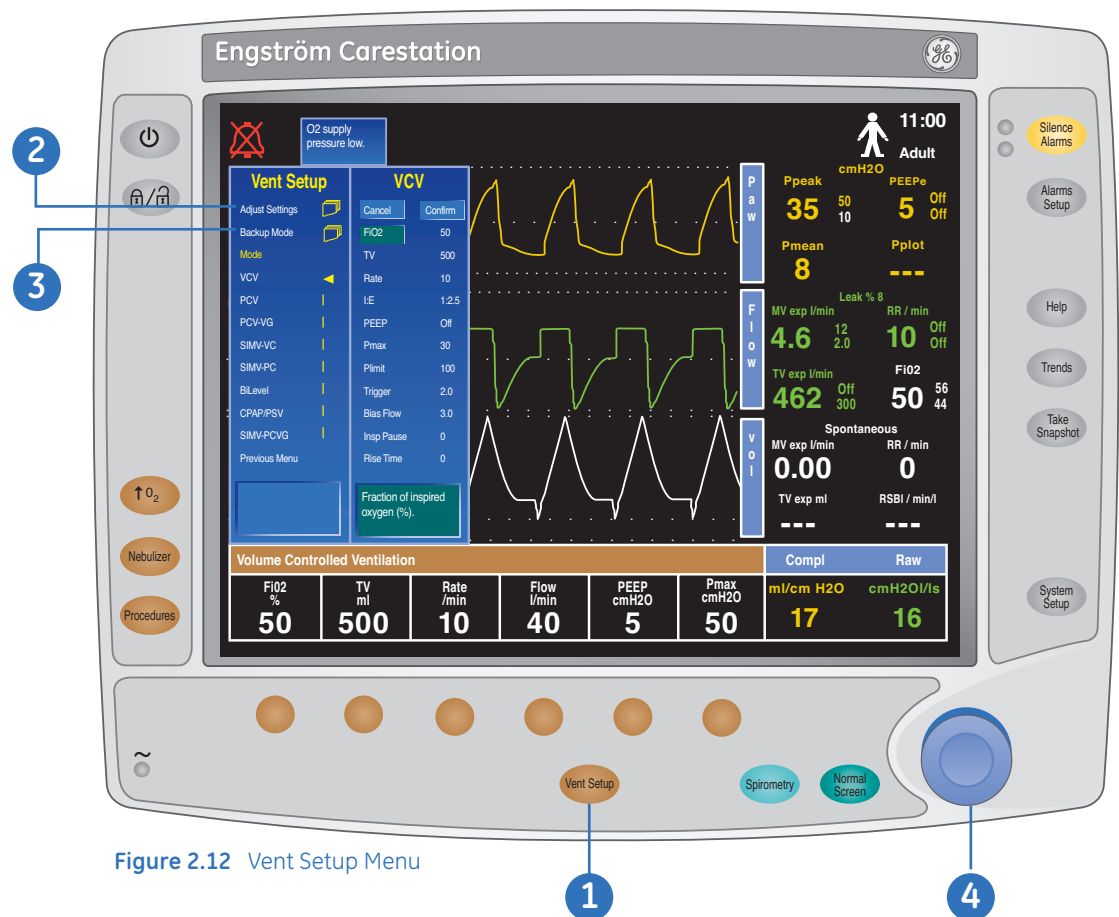


Figure 2.12 Vent Setup Menu

Ventilation Modes

Volume Controlled Ventilation • VCV

In VCV, a set amount of volume is delivered during each mandatory breath. The volume is delivered using a constant flow over a specified amount of time. The amount of pressure required to deliver the tidal volume will vary according to the compliance and resistance of the patient's lungs and thorax.

In VCV, the gas flow to the patient is kept constant during inspiration as long as the airway pressure is below the Plimit setting. Once the Plimit setting has been reached, the flow is reduced to maintain the Plimit level. During the expiratory phase, spontaneous breaths can be drawn from the set PEEP level.

Assist control is available in VCV, PCV, and PCV-VG modes. Activate assist control through the Vent Preferences menu.

- Set to **On** to deliver a controlled breath during the expiratory phase when a patient trigger is detected
- Set to **Off** to support spontaneous patient breathing at the PEEP pressure level during the expiratory phase

Vent Setup		VCV	
Adjust Settings		Cancel	Confirm
Backup Mode		FI02	50
Mode		TV	500
VCV		Rate	10
PCV		I:E	1:2.5
PCV-VG		PEEP	Off
SIMV-VC		Pmax	30
SIMV-PC		Plimit	100
BiLevel		Trigger	2.0
CPAP/PSV		Bias Flow	3.0
SIMV-PCVG		Insp Pause	0
Previous Menu		Rise Time	0
		Fraction of inspired oxygen (%).	

This setting is dependent on the **Timing** and **Flow** selections made in the **Install/Service > Ventilator Settings** menu.

SIMV-PCVG mode will display in this location if it is installed.

Figure 2.13 Vent Setup - VCV

Pressure Controlled Ventilation • PCV

In PCV, a set pressure level is delivered during each mandatory breath. The pressure is delivered using a decelerating flow and the breath is held for a set amount of time. The amount of volume provided will vary according to the compliance of the patient's lungs.

During the inspiratory phase, spontaneous breaths can be drawn from the set inspired pressure level. During the expiratory phase, spontaneous breaths can be drawn from the set PEEP level.

Assist control is available in VCV, PCV, and PCV-VG modes. Activate assist control through the Vent Preferences menu.

- Set to **On** to deliver a controlled breath during the expiratory phase when a patient trigger is detected
- Set to **Off** to support spontaneous patient breathing at the PEEP pressure level during the expiratory phase

Vent Setup		PCV	
Adjust Settings		Cancel	Confirm
Backup Mode		FI02	50
Mode		PInsp	10
VCV		Rate	10
PCV	◀	I:E	1:2.5
PCV-VG		PEEP	Off
SIMV-VC		Pmax	30
SIMV-PC		Trigger	2.0
BiLevel		Bias Flow	3.0
CPAP/PSV		Rise Time	100
SIMV-PCVG			
Previous Menu			
		Fraction of inspired oxygen (%)	

This setting is dependent on the **Timing** and **Flow** selections made in the **Install/Service > Ventilator Settings menu**

SIMV-PCVG mode will display in this location if it is installed.

Figure 2.14 Vent Setup - PCV

Pressure Controlled Ventilation – Volume Guarantee • PCV-VG

In PCV-VG, a tidal volume is set and the ventilator delivers that volume using a decelerating flow and a constant pressure. The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used. The pressure range that the ventilator will use is between the PEEP + 2 cmH₂O level on the low end and 5 cmH₂O below Pmax on the high end. The inspiratory pressure change between breaths is a maximum of ±3 cmH₂O. If a high airway pressure alarm is active due to the current breath, the next breath's pressure target will be 0.5 cmH₂O less than the current breath's pressure target.

This mode will deliver breaths with the efficiency of pressure controlled ventilation, yet still compensate for changes in the patient's lung characteristics. PCV-VG begins by delivering volume controlled breaths for 10 seconds or two breath periods, whichever is longer. The patient's compliance is determined from this period of volume controlled ventilation and the inspiratory pressure level is then established for the next PCV-VG breath. If the patient is disconnected during this period the initial PCV-VG breath will begin at PEEP + 2 cmH₂O.

Assist control is available in VCV, PCV, and PCV-VG modes. Activate assist control through the Vent Preferences menu.

- Set to **On** to deliver a controlled breath during the expiratory phase when a patient trigger is detected
- Set to **Off** to support spontaneous patient breathing at the PEEP pressure level during the expiratory phase

Mode	Cancel	Confirm
FiO2		50
TV		500
Rate		10
I:E		1:2.5
PEEP		Off
Pmax		30
Trigger		2.0
Bias Flow		3.0
Rise Time		100

Annotations:

- This setting is dependent on the **Timing** and **Flow** selections made in the **Install/Service > Ventilator Settings menu** (pointing to I:E).
- SIMV-PCVG mode will display in this location if it is installed. (pointing to SIMV-PCVG in the mode list).

Figure 2.15 Vent Setup - PCV-VG

Synchronized Intermittent Mandatory Ventilation Volume Controlled • SIMV-VC

In SIMV-VC, a set number of volume control breaths are delivered to the patient each minute. The patient can breathe spontaneously between mandatory breaths. Pressure support can be used to support the spontaneous breaths.

A portion of the exhalation phase is defined as the trigger window. If a spontaneous breath is detected in this window, a new volume controlled breath is initiated. If a spontaneous breath is detected outside of this window, support for this breath is provided according to the set pressure support. The remainder of the trigger window is added to the next non-triggered phase.

The inspiratory phase of supported breaths will end if the set End Flow is reached, if the airway pressure exceeds (PEEP + P_{supp} + 2.5 cmH₂O), or if the max T_{insp} is reached. Supported breaths have a maximum inspiratory time of 4 seconds for adults, 1.5 seconds for pediatrics, and 0.8 seconds for neonates.

Ventilation modes to which backup ventilation apply are established by facility defaults. See *Installation Mode*, of the User's Reference Manual, section 10.

If selected to be active in SIMV-VC, backup ventilation will be initiated if the Apnea alarm is triggered or if the patient's minute ventilation decreases to below 50% of the set low MV_{exp} alarm. Backup settings may be changed for each patient.

Vent Setup	SIMV-VC		
Adjust Settings	Cancel	Confirm	
Backup Mode	FiO2	50	Insp Pause 0
Mode:	TV	500	Rise Time 0
VCV	Rate	10	PSV Rise Time 50
PCV	Tinsp	1.7	End Flow 25
PCV-VG	PEEP	Off	< Back
SIMV-VC	Plimit	100	
SIMV-PC	Pmax	30	
BiLevel	Trigger	2.0	
CPAP/PSV	Trig Window	25	
SIMV-PCVG	Bias Flow	3.0	
Previous Menu	Rise Time	100	
	Fraction of inspired oxygen (%)		

This setting is dependent on the **Timing** and **Flow** selections made in the **Install/Service > Ventilator Settings** menu.

SIMV-PCVG mode will display in this location if it is installed.

Figure 2.16 Vent Setup - SIMV-VC

Synchronized Intermittent Mandatory Ventilation Pressure Controlled • SIMV-PC

In SIMV-PC, a set number of pressure control breaths are delivered to the patient each minute. The patient can breathe spontaneously between mandatory breaths. Pressure support can be used to support the spontaneous breaths.

A portion of the exhalation phase is defined as the trigger window. If a spontaneous breath is detected in this window, a new pressure controlled breath is initiated. If a spontaneous breath is detected outside of this window, support for this breath is provided according to the set pressure support. The remainder of the trigger window is added to the next non-triggered phase.

The inspiratory phase of supported breaths will end if the set End Flow is reached, if the airway pressure exceeds (PEEP + P_{supp} + 2.5 cmH₂O), or if the max T_{insp} is reached. Supported breaths have a maximum inspiratory time of 4 seconds for adults, 1.5 seconds for pediatrics, and 0.8 seconds for neonates.

Ventilation modes to which backup ventilation apply are established by facility defaults. See *Installation Mode*, of the User's Reference Manual, section 10.

If selected to be active in SIMV-PC, backup ventilation will be initiated if the Apnea alarm is triggered or if the patient's minute ventilation decreases to below 50% of the set low MV_{exp} alarm. Backup settings may be changed for each patient.

Vent Setup	SIMV-PC		
Adjust Settings	Cancel	Confirm	
Backup Mode	FiO2	50	PSV Rise Time 50
Mode:	P _{insp}	10	End Flow 25
VCV	Rate	10	< Back
PCV	T _{insp}	1.7	This setting is dependent on the Timing and Flow selections made in the Install/Service > Ventilator Settings menu.
PCV-VG	PEEP	Off	
SIMV-VC	P _{supp}	5	
SIMV-PC	P _{max}	30	
BiLevel	Trigger	2.0	
CPAP/PSV	Trig Window	25	
SIMV-PCVG	Bias Flow	3.0	SIMV-PCVG mode will display in this location if it is installed.
Previous Menu	Rise Time	100	
	Fraction of inspired oxygen (%).		

Figure 2.17 Vent Setup - SIMV-PC

BiLevel Airway Pressure Ventilation • BiLevel

In BiLevel, the ventilator switches between two pressure levels at set times. The patient can breathe spontaneously while at either of the pressure levels.

The ventilator synchronizes spontaneous breathing with changes in pressure level. The system has a set trigger window of 80% or 4 seconds whichever is less. If a spontaneous breath is detected within this window, the breath is delivered by an increase to P_{insp} + P_{low}, or P_{high}. If a spontaneous breath is detected outside the window, a PSV breath is delivered.

The level of inspiratory pressure provided during a spontaneous breath taken within the high pressure period (Thigh) will be equal to the pressure difference between P_{supp} and P_{high} if P_{supp} is greater than P_{high}. If P_{high} is greater than P_{supp} then no additional support will be provided.

If the patient triggers a spontaneous breath just before the end of Thigh, the system will continue to deliver at P_{high} (or P_{supp} if P_{supp} is more than P_{high}) until the end flow is detected or PSV times out. Then, the system will transition to P_{low}.

The inspiratory phase of supported breaths will end if the set End Flow is reached, if the airway pressure exceeds (P_{low} + P_{supp} + 2.5 cmH₂O), or if the max T_{insp} is reached. Supported breaths have a maximum inspiratory time of 4 seconds for adults, 1.5 seconds for pediatrics, and 0.8 seconds for neonates.

Ventilation modes to which backup ventilation apply are established by facility defaults. See *Installation Mode*, section 10 of the User's Reference Manual

If selected to be active in BiLevel, backup ventilation will be initiated if the Apnea alarm is triggered or if the patient's minute ventilation decreases to below 50% of the set low MV_{exp} alarm. Backup settings may be changed for each patient.

Vent Setup	BiLevel	
Adjust Settings	Exit	
Backup Mode	FIO2	50
Mode:	Phigh	10
VCV	Plow	Off
PCV	Tinsp	1.7
PCV-VG	Rate	10
SIMV-VC	Psupp	5
SIMV-PC	Pmax	30
BiLevel	Trigger	2.0
CPAP/PSV	Bias Flow	3.0
SIMV-PCVG	Rise Time	100
Previous Menu	PSV Rise Time	50

End Flow 25
< Back

This setting is dependent on the **BiLevel** selections made in the **Install/Service > Ventilator Settings** menu.

SIMV-PCVG mode will display in this location if it is installed.

Adjust controls in right hand menu.

Figure 2.18 Vent Setup - BiLevel

Continuous Positive Airway Pressure / Pressure Support Ventilation • CPAP/PSV

This mode offers the features from both CPAP and PSV modes and is used on spontaneously breathing patients. In CPAP, a pressure above ambient pressure is maintained on the patient’s airway.

In PSV, the ventilator provides a set pressure level on top of the CPAP level during the inspiratory phase of the patient’s breath. The patient determines their own rate, tidal volume, and inspiratory timing.

The inspiratory phase of supported breaths will end if the set End Flow is reached, if the airway pressure exceeds (PEEP + P_{supp} + 2.5 cmH₂O), or if the max T_{insp} is reached. Supported breaths have a maximum inspiratory time of 4 seconds for adults, 1.5 seconds for pediatrics, and 0.8 seconds for neonates.

Ventilation modes to which backup ventilation apply are established by facility defaults. See “Installation Mode,” section 10 in the User’s Reference Manual.

If selected to be active in CPAP/PSV, backup ventilation will be initiated if the Apnea alarm is triggered or if the patient’s minute ventilation decreases to below 50% of the set low MVexp alarm. Backup settings may be changed for each patient.

Rate, P_{insp}, and T_{insp} can be added to the CPAP/PSV menu when CPAP Rate is turned On by the Super User using the Ventilator Settings menu. These settings apply mechanical breaths during CPAP/PSV ventilation.

When Rate is set in CPAP, the ventilator will deliver backup breaths to the patient if the patient fails to breathe spontaneously over two breath periods. Backup breaths will be PCV breaths at the set P_{insp}, T_{insp}, and Rate settings.

See *Installation Mode*, Section 10 in the User’s Reference Manual before making menu changes.

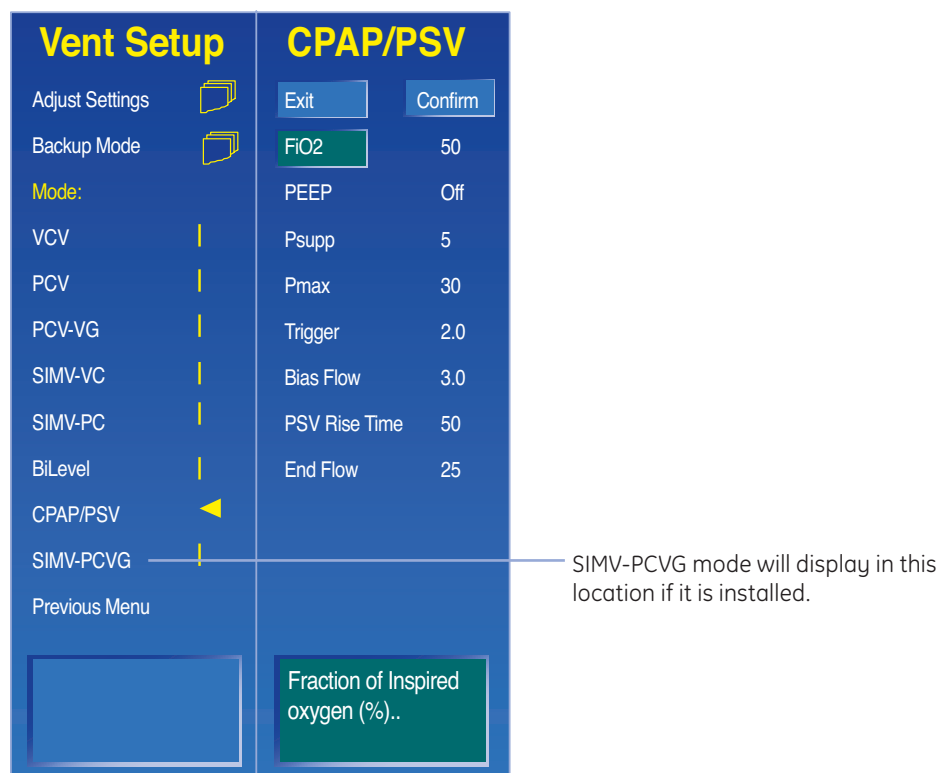


Figure 2.19 Vent Setup - CPAP/PSV

Synchronized Intermittent Mandatory Ventilation – Pressure Controlled Volume Guaranteed • SIMV-PCVG

This is an optional mode on the Engström Carestation.

In SIMV-PCVG, a set number of pressure control breaths with a guaranteed volume are delivered to the patient each minute. The patient can breathe spontaneously between mandatory breaths. Pressure support can be used to support the spontaneous breaths.

The mandatory breaths will deliver the set tidal volume using a decelerating flow and a constant pressure. The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used. The pressure range that the ventilator will use is between the PEEP + 2 cmH₂O level on the low end and 5 cmH₂O below Pmax on the high end. The inspiratory pressure change between breaths is a maximum of +/- 3 cmH₂O. If a high airway pressure alarm is active due to the current breath, the next breath's pressure target will be 0.5 cmH₂O less than the current breath's pressure target.

SIMV-PCVG begins by delivering volume controlled breaths for 10 seconds or two breath periods, whichever is longer. The patient's compliance is determined from this period of volume controlled ventilation and the inspiratory pressure level is then established for the next PCVG breath. If the patient is disconnected during this period the initial PCVG breath will begin at PEEP +2 cmH₂O. The remaining mandatory breaths will be pressure controlled with a guaranteed volume.

A portion of the exhalation phase is defined as the trigger window. If a spontaneous breath is detected in this window, a new mandatory PCVG breath is initiated. If a spontaneous breath is detected outside of this window, support for this breath is provided according to the set pressure support. The remainder of the trigger window is added to the next non-triggering phase.

The inspiratory phase of supported breaths will end if the set End Flow is reached, if the airway pressure exceeds (PEEP + P_{supp} + 2.5 cmH₂O), or if the max T_{insp} is reached.

Supported breaths have a maximum inspiratory time of 4 seconds for adults, 1.5 seconds for pediatrics, and 0.8 seconds for neonates.

If selected to be active in SIMV-PCVG, backup ventilation will be initiated if the apnea alarm is triggered or if the patient's minute ventilation decreases below 50% of the set low MV_{exp} alarm limit. Backup settings may be changed for each patient.

SIMV-PCVG mode will display in this location if it is installed.

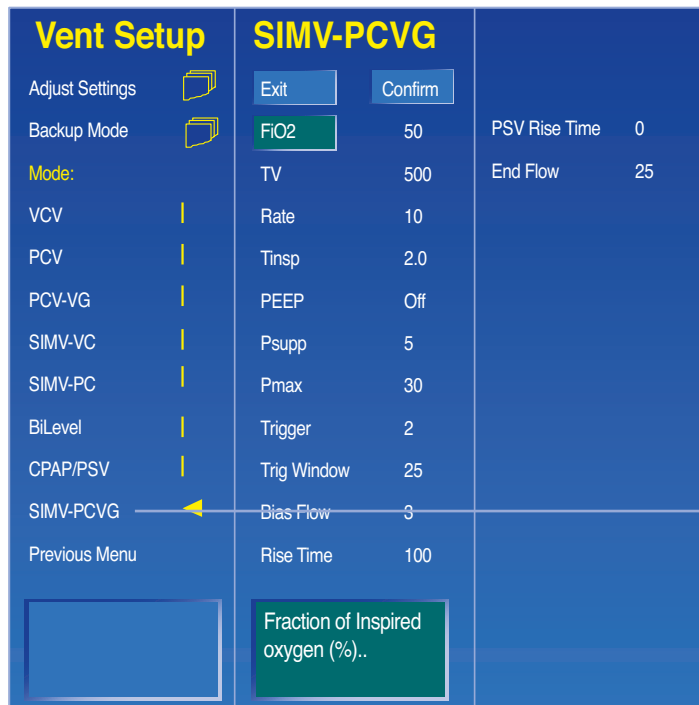


Figure 2.20 Vent Setup - SIMV-PCVG

Ventilator Settings Common to All Modes

Trigger, Bias Flow and Rise Time are three ventilator settings that are common to all modes of ventilation available on the Engstrom Carestation

1. Trigger

The trigger is a signal that causes the ventilator to start the inspiratory phase of a breath. The trigger can use either a negative pressure deflection or a flow signal.

2. Bias Flow

The Bias Flow is the minimum flow that is delivered through the patient circuit during the expiratory phase of the breath cycle. It is used in the flow trigger mechanism and provides a reservoir of fresh gas for the patient. The bias flow may be automatically increased above this setting depending on the FiO₂ setting.

3. Rise Time

The Rise time is time in seconds needed for the profiled pressure to reach 90% of the set P_{insp} or volume-controlled flow.

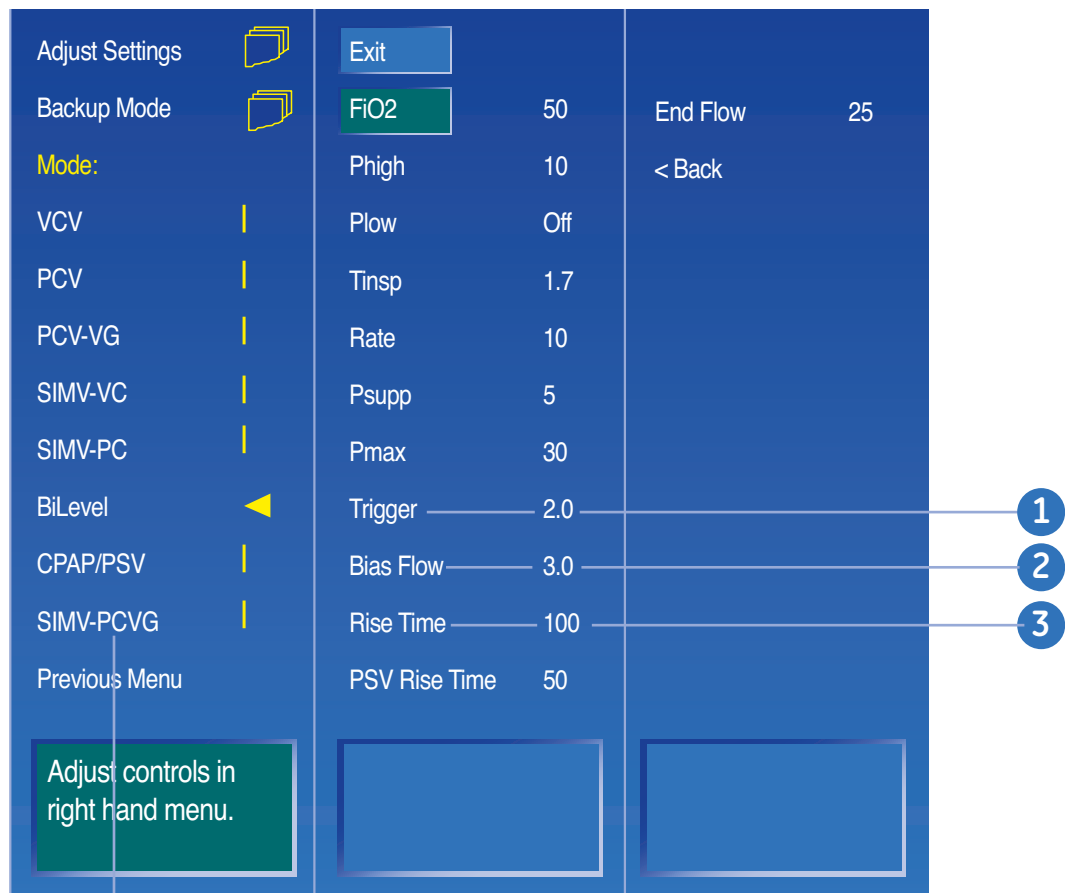


Figure 2.21 Trigger, Bias Flow and Rise Time

SIMV-PCVG mode will display in this location if it is installed.

Ventilator Settings Common to Pressure Support Breaths

PSV Rise Time and End Flow are two ventilator settings that are common to all Pressure Support breaths.

1. PSV Rise Time

The PSV Rise Time is the time in milliseconds needed for the profiled pressure to reach 90% of the set pressure support level.

2. End Flow

The End Flow is the percentage of peak flow at which the pressure supported breath terminates the inspiratory phase and enters the expiratory phase.

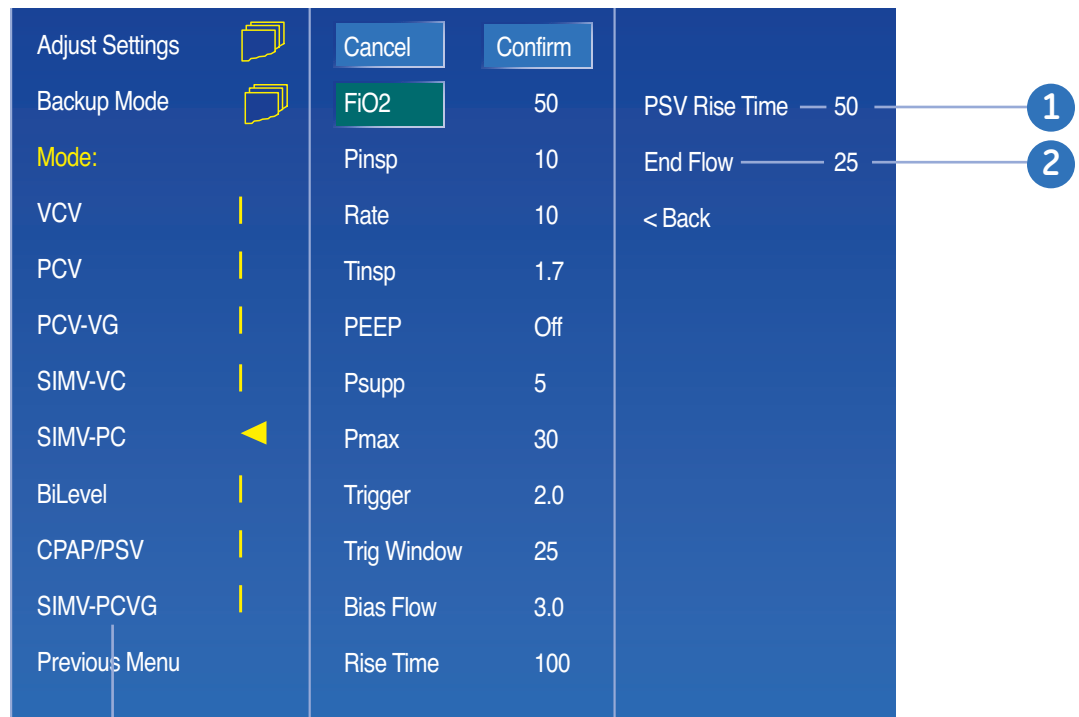


Figure 2.22 Trigger, Bias Flow and Rise Time

SIMV-PCVG mode will display in this location if it is installed.

Plimit in the VCV and SIMV-VC Modes

The Plimit ventilator setting is only available in the VCV and SIMV-VC modes. The Plimit is the pressure at which the breath is limited and held for the set inspiratory time in a volume mode.

1. **Pmax:** When Pmax is reached, the inspiratory phase will be terminated.
2. **Plimit:** Plimit is **NOT** the same as Pmax. When Plimit is reached, inspiration phase continues, but at the set pressure limit. If Plimit is set above Pmax, it will not be active.

Vent Setup	VCV
Adjust Settings	Cancel Confirm
Backup Mode	FiO2 50
Mode	TV 500
VCV	Rate 10
PCV	I:E 1:2.5
PCV-VG	PEEP Off
SIMV-VC	Pmax 30
SIMV-PC	Plimit 100
BiLevel	Trigger 2.0
CPAP/PSV	Bias Flow 3.0
SIMV-PCVG	Insp Pause 0
Previous Menu	Rise Time 0
	Fraction of inspired oxygen (%)

1. Pmax

2. Plimit

SIMV-PCVG mode will display in this location if it is installed.

Figure 2.23 Pmax and Plimit



Note! If the Plimit value has been approached for three consecutive breaths, the **Plimit reached** message will be displayed on the screen.

Alarm Management

Silencing Alarms

If an active alarm is present, press the **Silence Alarms** key to silence the audible parameter alarm tones. Silencing an alarm stops the audible tone for 120 seconds.

Press the key again to reset timer to 120 seconds.

Pressing the **Silence Alarms** key when no medium or high priority alarms are active suspends audible parameter alarm tones for medium and high parameter alarms for 120 seconds. This is typically referred to as “pre silencing alarms”. Press the key again to cancel the alarm suspend timer.



Note! Alarm help is available for any recent or active alarms. Press Help to view the cause and action of the alarms.



Figure 2.24 Silence Alarm Key

Alarm Priorities

Alarm priority is indicated by the color of the alarm message and the alarm LED located next to the Silence Alarms key.

Alarm Levels

1. **High-priority alarm message:** Appears in white text on a red background. During a high-priority alarm, the red LED flashes. A high-priority alarm consists of a series of five tones. If a high-priority alarm is not silenced or resolved within the time set in the **High Alert Audio** menu item in the Alarms Setup menu, the pitch, volume and tone of the alarm will automatically increase to the maximum level.

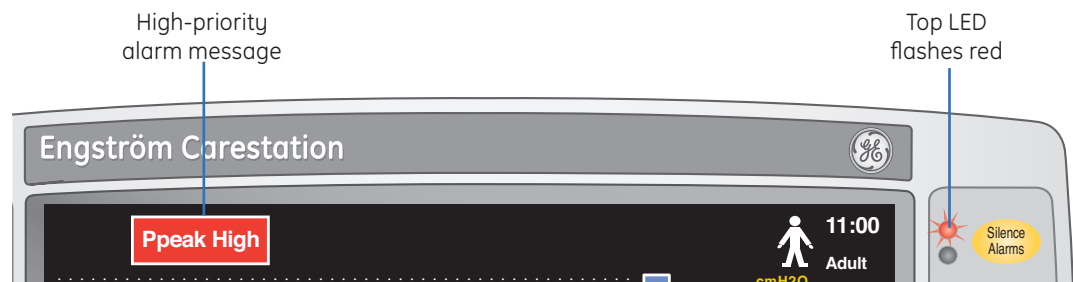


Figure 2.25 High-priority alarm

2. **Medium-priority alarm message:** Appears in yellow text on a gray background. During a medium-priority alarm, the yellow LED flashes. A medium-priority alarm consists of a series of 3 tones.

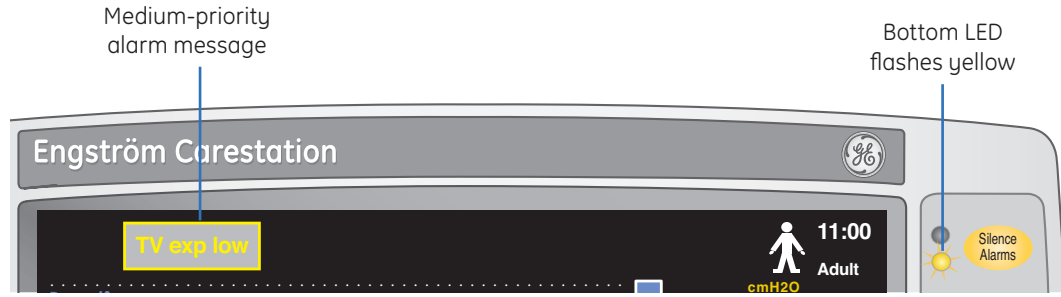


Figure 2.26 Medium-priority alarm

3. **Informational alarm:** Appears in white text on a gray background. During an informational alarm, the yellow LED is on solid. Informational alarms consist of a single tone.

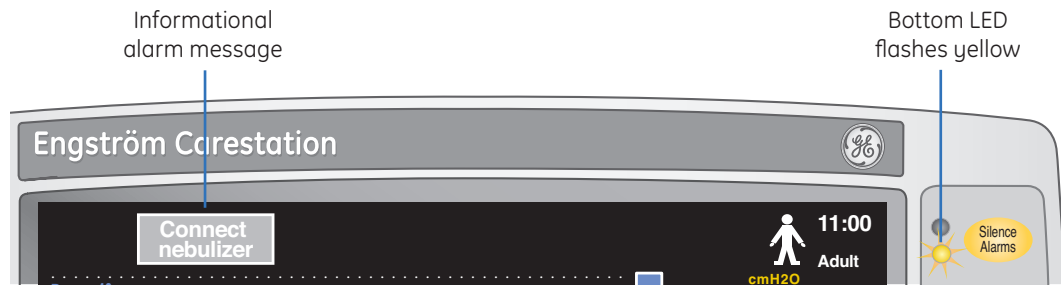


Figure 2.27 Informational alarm

Resolved Alarms

Some alarms continue to display an alarm message after the condition has cleared. These alarms are resolved and may be cleared by pressing **Silence Alarms**. Resolved alarms appear as white messages on a black background.

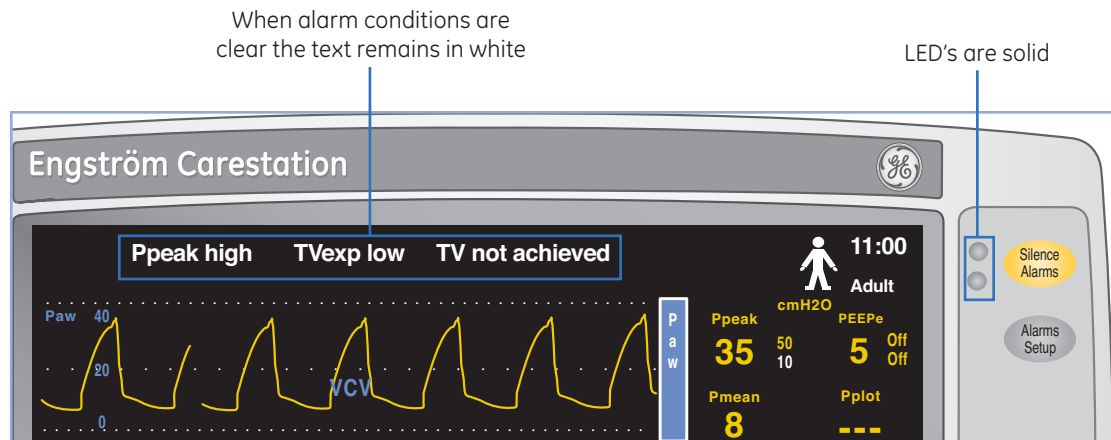


Figure 2.28 Resolved alarm

Adjusting Alarm Settings

1. Press the **Alarms Setup** key to access the Alarms Setup menu.
2. Scroll to **Adjust Limits** and press the ComWheel.
3. Scroll to the desired alarm parameter and press the ComWheel.
4. Use the ComWheel to adjust high and low limits for that parameter.
5. Press **Normal Screen** to exit, or
6. Select **Back** if you would like to access more selections in the Alarm Setup menu.

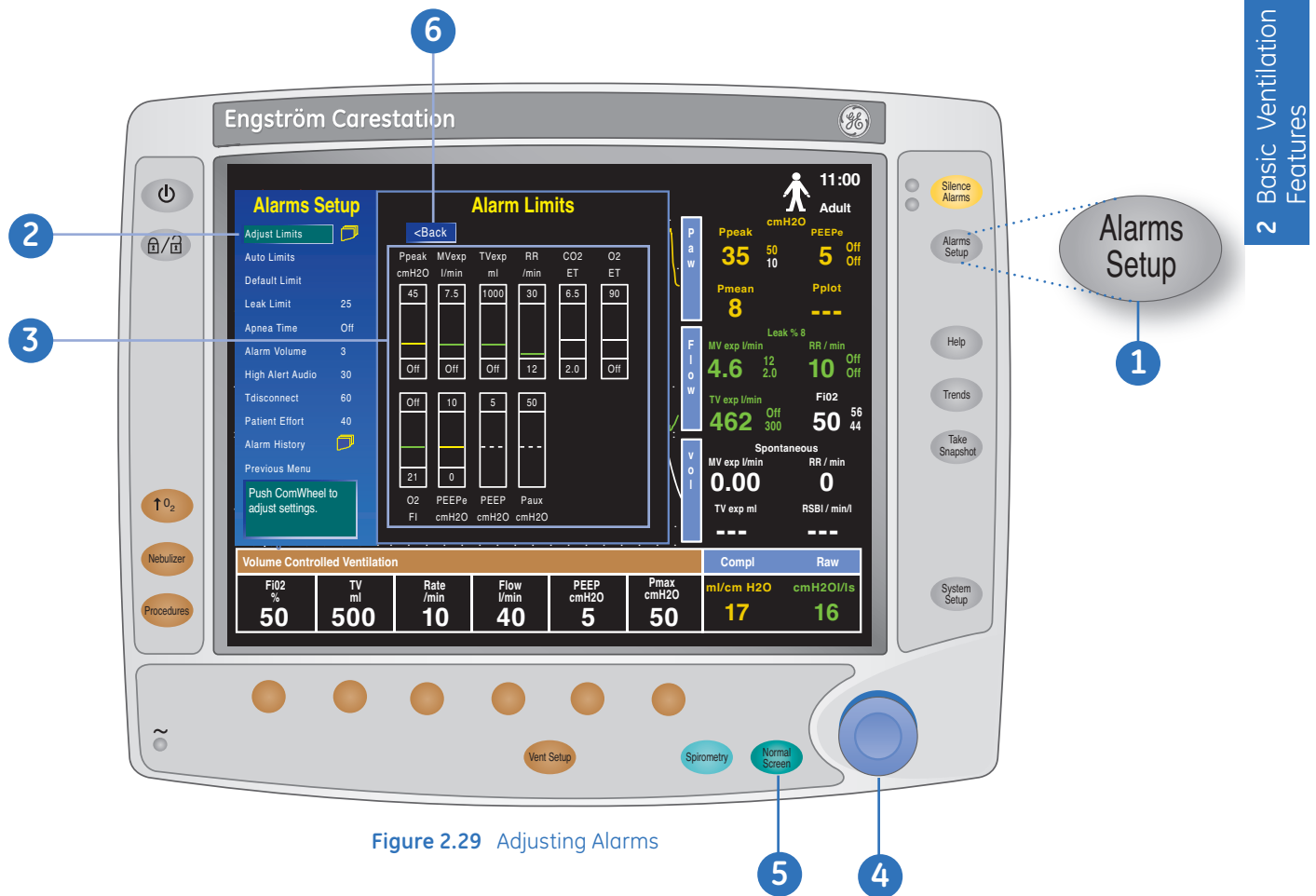


Figure 2.29 Adjusting Alarms



Note! Make sure the alarm limits are set to the desired values before using the ventilator on a patient.

The Alarm Setup Menu

Auto Limits:	Selecting Auto Limits will change the low and high alarm limits based on current measured values for the following parameters: MVexp, TVexp, RR, EtCO2 and PEEPe. Alarm limits that are set to Off will not change if Auto Limits is selected.
Default Limits:	Selecting Default Limits will change the alarm limits to the facility default settings if the default limits do not conflict with the current ventilation settings.
Leak Limit:	The Leak Limit setting determines what size leak is allowed before a leak alarm condition is activated. The setting is a percentage of the total volume delivered to the patient and may be set to Off .
Apnea Time:	The Apnea Time setting determines how much time is allowed between patient breaths before the Apnea alarm is activated.
Alarm Volume:	The Alarm Volume setting adjusts the volume of the alarm. An alarm volume of 1 is the lowest allowable volume allowed on the Engstrom Carestation.
High Alert Audio:	If a high priority alarm has not been resolved the alarm volume can be set to elevate to a higher volume after a specific amount of time. The High Alert Audio can be set to be activated between 0 and 30 seconds of an alarm activating and may also be set to Off .
Tdisconnect:	Tdisconnect is an abbreviation for Disconnect Time. This is the allowable time the patient can be disconnected from the ventilator before the Patient Disconnect alarm is active. Tdisconnect is only active in the non-invasive mode.
Patient Effort:	Patient Effort is the allowable time without a patient triggered breath before an alarm. The alarm message will display No Patient Effort if triggered. Backup breaths may be delivered within this time period. Only a patient triggered breath will reset this timer. Patient Effort is only active in the non-invasive mode.
Alarm History:	The most recent 200 medium and high-priority alarms activated since the last power cycle are displayed with the date and time in the Alarm History menu.

The Help key

Press the Help key to view information about any recent or active alarms. The initial display is the most recent alarm condition, and provides specific reasons and possible troubleshooting suggestions for that alarm.

Alarm Setup Menu



2 Basic Ventilation Features

Figure 2.30 Alarm Setup Menu



Figure 2.31 Alarm Help Menu

Trends and Snapshots

Trends

Press the **Trends** key to view historical patient data and ventilator settings either numerically or graphically.

Trend information will automatically be saved every one minute for the most recent twelve hours of data, every five minutes for data from twelve hours to forty-eight hours and every thirty minutes for data from forty-eight hours to fourteen days.

1. Press **Trends**.
2. Select the desired view. The arrow identifies the current trend view.
3. Select **Cursor** to scroll through the current trend view.
4. Press the ComWheel to return the highlight to **Cursor**.
5. Select **Next Page** to view additional parameters or snapshots.



Note! The ten most recent snapshots are held in the memory. If a an eleventh snapshot is saved the oldest snapshot will be deleted.



Figure 2.32 Trends Menu

Snapshots

Taking a snapshot

Use the Take Snapshot feature to capture the waveform clips, active alarms, measured parameters, and ventilator settings that are currently on the display. Three pages of information are recorded for each snapshot: Page one includes the patient waveforms. Page two consists of the patient numerical data that was recorded when the snapshot was taken. Page three consists of the machine settings that were present when the snapshot was taken.

Press **Take Snapshot** to record a snapshot.

Viewing a snapshot

1. Press **Trends**.
2. Select **Snapshot**.
3. The most recent snapshot will show in the right side menu.
 - Select **Next Page** to scroll through the three pages of snapshot information
 - Continue to scroll to the next page to view additional snapshots that have been saved to the memory
 - Select **Cursor** to view the waveform values

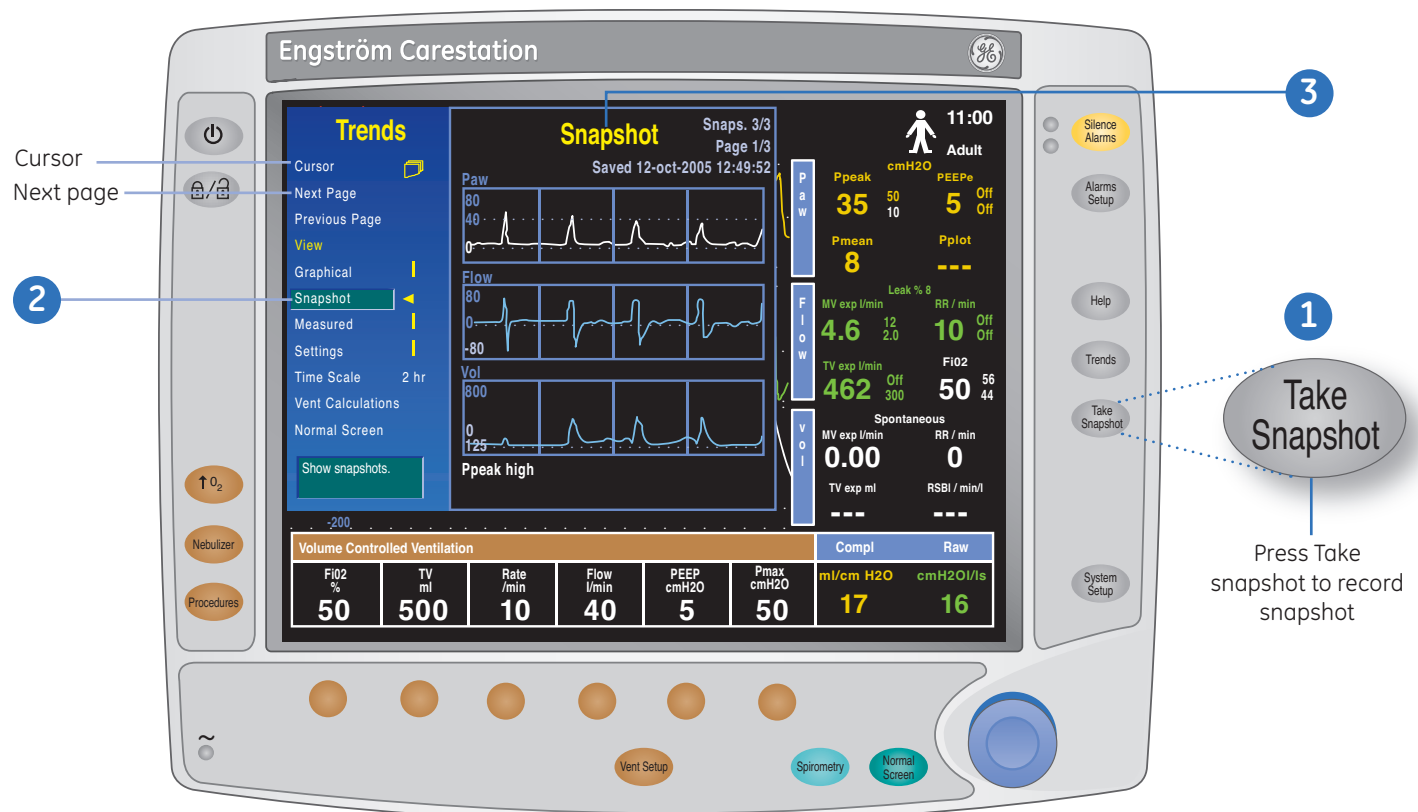


Figure 2.33 Snapshots

Vent Calculations

Vent calculations is used to automate calculations for patient lab data and may only be used for Adult and Pediatric patients.

To calculate patient values:

1. Select **Trends Setup > Vent Calculations**.
 - The Lab Values menu displays.
2. Select **Enter Values**.
3. Select **Sample Time** and enter the correct time the patient sample was collected.
4. Enter the desired patient lab data values and press the ComWheel to confirm lab values.
5. Select **Calculate**.
 - Vent calculations automatically display in the Ventilation Calculations menu.

To view completed lab data calculations:

1. Select **History**.
 - The Vent Calcs History menu displays showing the sample dates and times the calculations were made.
2. Select **Next Page** to view additional history pages or **Previous Page**.
 - When a vent calculation is entered and the Vent Calcs History contains the maximum number of entries (45), the oldest vent calculation is deleted.

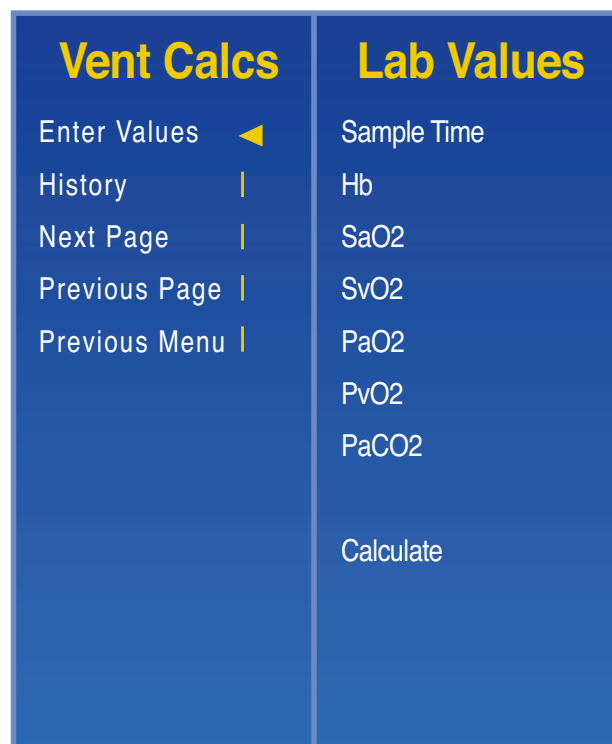


Figure 3.34 Vent Calcs /Lab Values Menu

The Nebulizer Procedure

Electronic Micropump Nebulizer

The Aeroneb Professional Nebulizer System (Aeroneb Pro) by Aerogen, Inc. is integrated into the Engström Carestation.

The Aeroneb Pro is designed to operate in-line with standard ventilator circuits and mechanical ventilators in acute and subacute care environments. It operates without changing the patient ventilator parameters and can be refilled without interrupting ventilation.

The nebulizer may be used with a neonatal, pediatric, or adult breathing circuit. The T-adapter for the nebulizer is specific to the breathing circuit type.



Note! Use of external pneumatic nebulizers in certain modes will result in alteration of volume, triggering, and may produce alarm conditions unless Pneumatic Nebulizer Flow Compensation is used.

Nebulizer Components

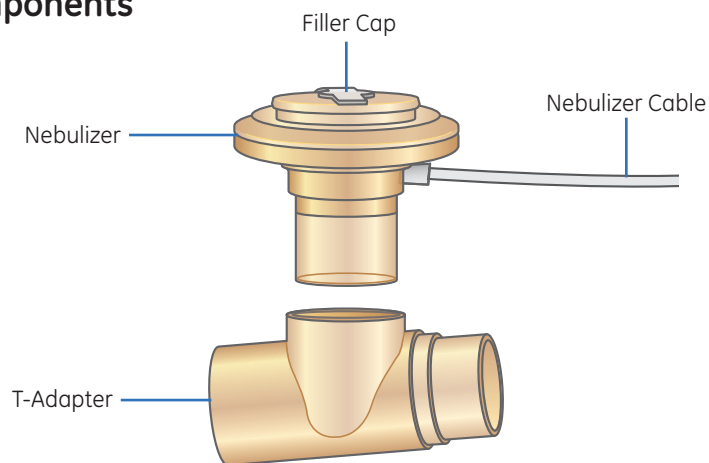


Figure 2.35 Nebulizer



Note! It is strongly recommended to use an expiratory filter when a nebulizer is used to help protect the expiratory flow sensor.

Assembling the Nebulizer

1. Connect the nebulizer to the T-adapter by pushing the nebulizer firmly onto the adapter.

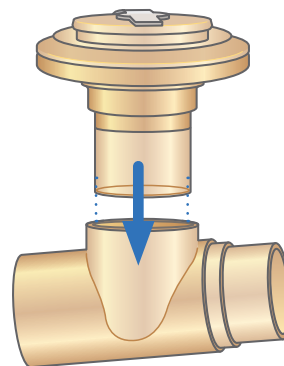
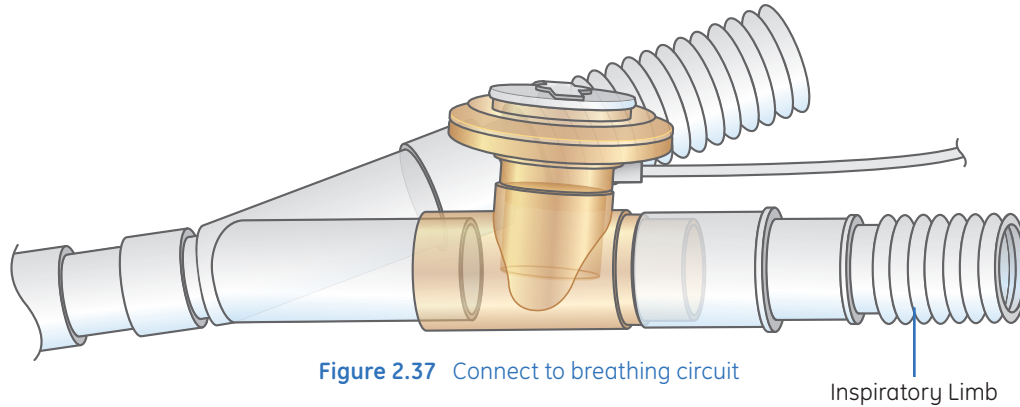


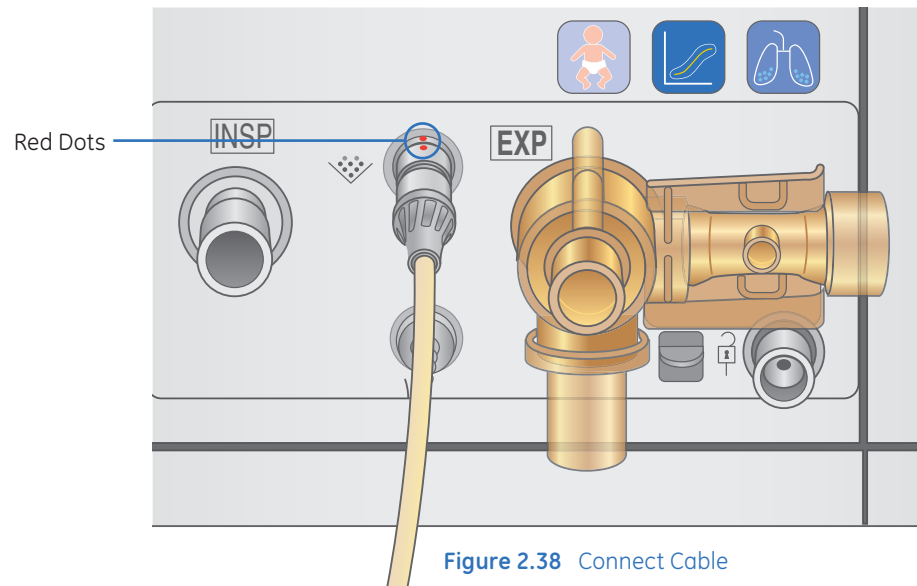
Figure 2.36 Connect to T-adapter

2. Connect the nebulizer and T-adapter into the inspiratory limb of the breathing circuit before the patient wye.



Note! Always maintain the nebulizer in a vertical orientation while in the patient circuit. This orientation helps prevent patient secretions and condensate from contaminating the aerosol generator of the nebulizer and ensures proper nebulization.

3. Attach the cable to the nebulizer connection by aligning the red dots.



4. Activate the nebulizer procedure using the **Nebulizer** menu key.



Note! Use of a heat-moisture exchanger in the breathing circuit can substantially increase flow resistance when a nebulizer is active.

Do not use a heat-moisture exchanger or heat-moisture exchanger filter between the nebulizer and the patient airway.

Filling the Nebulizer

The maximum capacity of the nebulizer is 10 ml. Do not fill the nebulizer beyond the maximum fill indication point. The underside of the filler cap represents maximum fill indication point.

1. Open the filler cap tab on the nebulizer.

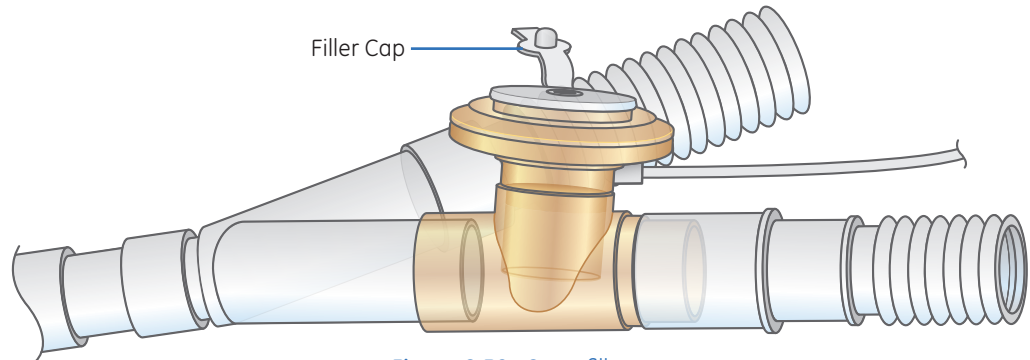


Figure 2.39 Open filler cap

2. Use a prefilled nebulizer or syringe to inject the medication into the nebulizer.

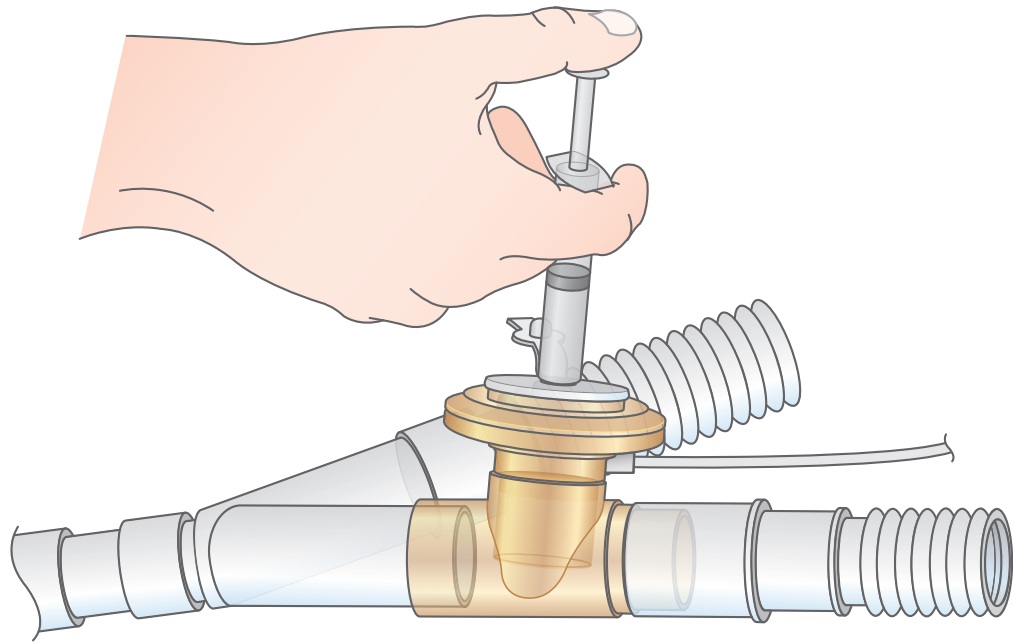


Figure 2.40 Inject medication



Note! To help avoid damage to the nebulizer, do not use a syringe with a needle.

3. Close the filler cap tab.

The Nebulizer Menu

Press the **Nebulizer** key to access the Nebulizer menu.



Note! Do not insert an airway module into the module bay until at least one minute after a nebulizer procedure. Aerosolized medication may damage the D-fend or interfere with the airway module measurements.

Gas sampling and monitoring is suspended while the nebulizer is in use.



Figure 2.41 Nebulizer Menu

Start:	Activates the nebulizer cycle.
Stop:	Terminates the nebulizer cycle.
Volume:	Sets the volume of liquid to be nebulized.
Time:	Sets the duration time for each nebulizer cycle.
Cycles:	Sets the number of nebulizer cycles.
Pause Time:	Sets the pause time between nebulizer cycles.
Next Start:	The Next Start value shows the time of the next nebulizer cycle.
Pneumatic Nebulizer:	Select to compensate for additional flow introduced by a pneumatic nebulizer into the patient circuit.

Flow Compensation

The Engström system can compensate for additional flow introduced by a pneumatic nebulizer into the patient circuit. To set the ventilator for pneumatic nebulizer use:

1. Press **Nebulizer**.
2. Select **Pneumatic Nebulizer**.
3. Select **Flow** and adjust the flow value to match the amount of flow that will be introduced into the circuit, then press the ComWheel to confirm the setting.
4. Select **Flow Compensation > On**.
5. Introduce the pneumatic nebulizer into the patient circuit. For best results, introduce the pneumatic nebulizer into the patient circuit within approximately 15 seconds of selecting Flow Compensation **On**.

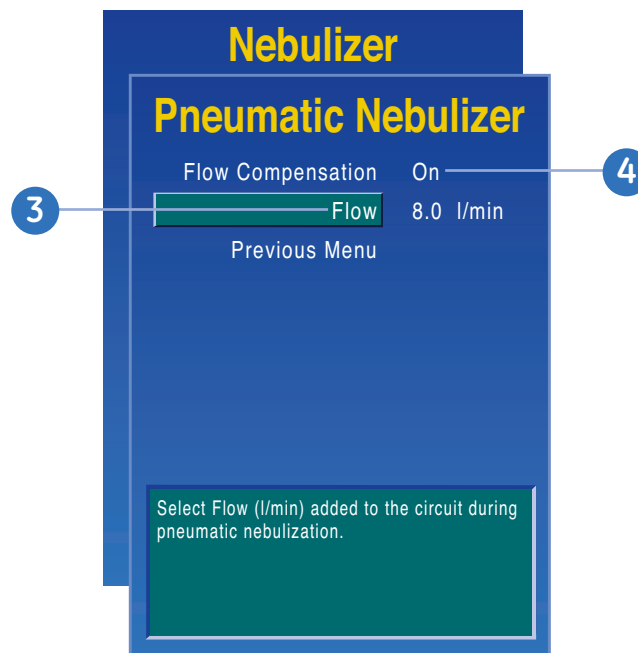


Figure 2.42 Pneumatic Nebulizer Menu

To end pneumatic nebulizer use:

1. Press **Nebulizer**.
2. Select **Pneumatic Nebulizer**.
3. Turn pneumatic nebulizer flow source off.
4. Select **Flow Compensation > Off**.
5. Press **Previous Menu** or **Normal Screen** to exit.



Note! Use of an external pneumatic nebulizer may significantly modify the mixture of gas that is delivered to the patient. When the Pneumatic Nebulizer Flow Compensation is **On**, volume monitoring and delivery accuracy is decreased. Use of an external pneumatic nebulizer may significantly modify the volume of gas that is delivered to the patient if external flow is introduced and Pneumatic Nebulizer Flow Compensation is not used.

Leaks and flow sensor alarms may not be identified by the ventilator when Pneumatic Nebulizer Flow Compensation is **On**.

The addition of nebulizer flow will not be reflected on the FiO₂ reading.

Cleaning the Nebulizer

For detailed information on cleaning and sterilizing the nebulizer, please refer to the *User's Reference Manual*, pages 7-17 through 7-20.



Note! Sterilize the nebulizer prior to the first use on a patient. Clean and sterilize the nebulizer between patients.

Disposable Nebulizer

The Solo Nebulizer (Aeroneb Solo) by Aerogen, Inc. may be integrated into the Engström Carestation.

The Aeroneb Solo is a disposable nebulizer and offers the user a choice of a disposable single patient solution. The Aeroneb Solo can be used with Neonatal, Pediatric, and Adult patients. The Solo nebulizer operates in-line in the same fashion as the Aeroneb Pro, utilizing the Engström Nebulizer menu and nebulizer cable.



Note! The Aeroneb Solo is a disposable and should not be cleaned or reused after single patient use.

External Pneumatic Nebulizers

The Engström Carestation is matched to the Aeroneb Pro for optimum performance. Use of external pneumatic nebulizers in certain modes will result in alteration of volume, percent oxygen delivery, triggering, and may produce alarm conditions.

Exhalation Valve Heater

The exhalation valve heater is used to prevent moisture buildup. To install the exhalation valve heater, perform the following steps.

1. Attach and tighten cable to Port 2 or 3 on the back of the ventilator.
2. Thread the cable through the rear channel to the front of the ventilator.

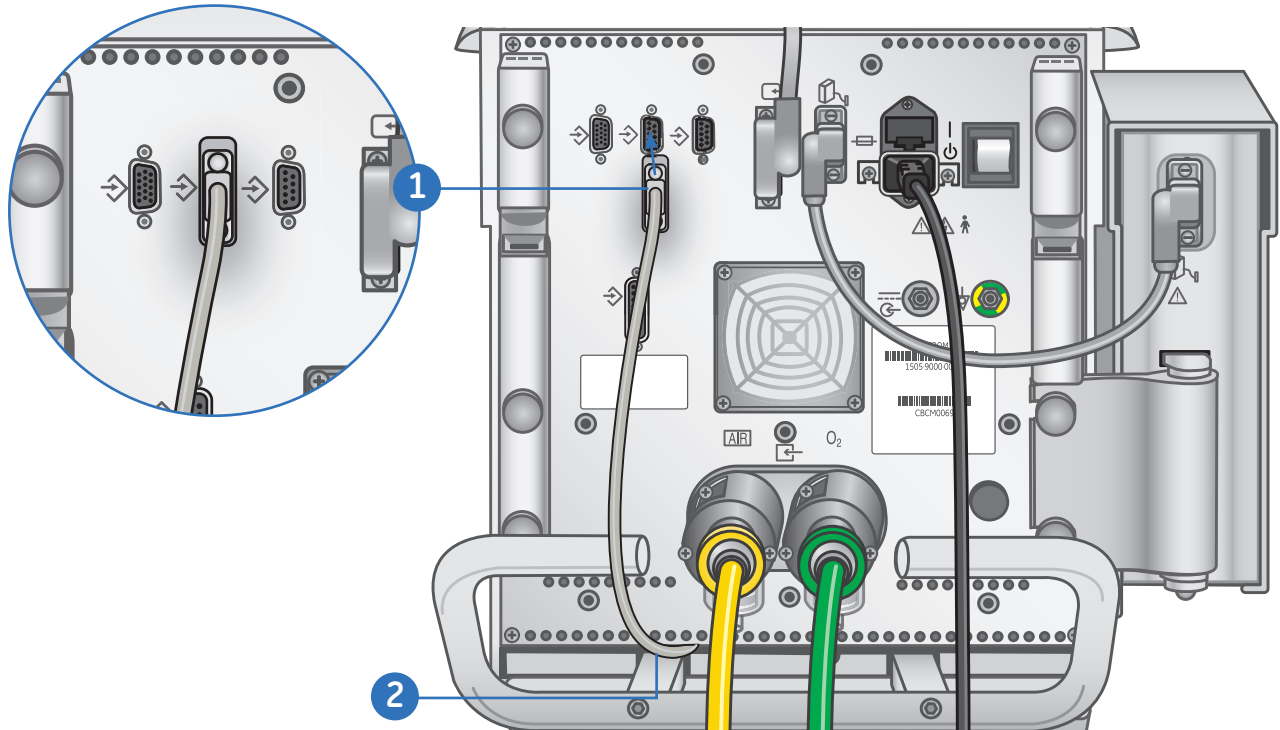


Figure 2.43 Attach cable to the ventilator

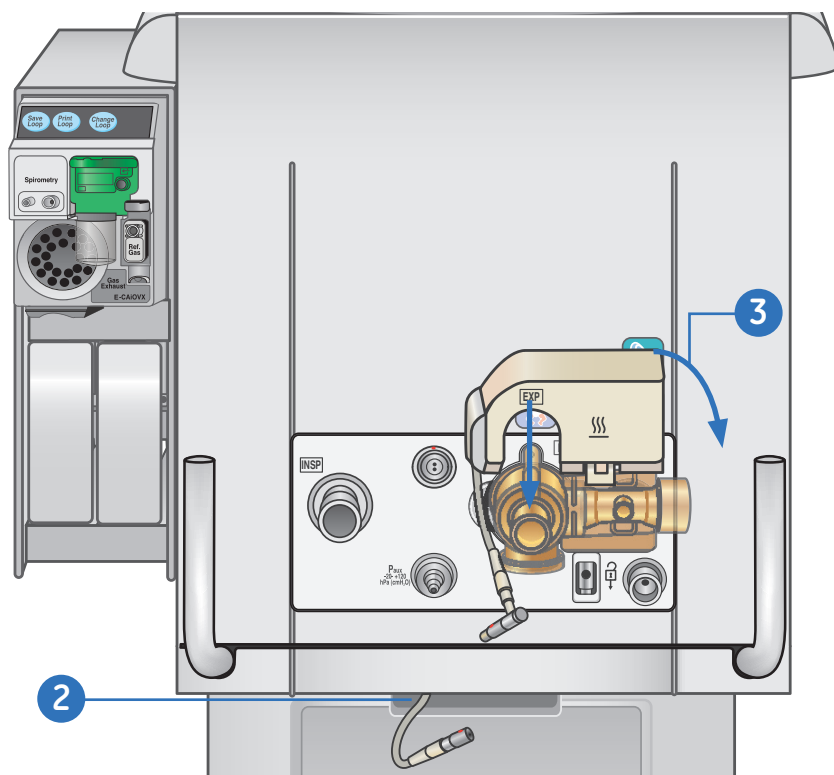


Figure 2.44 Attach the exhalation valve housing

3. Angle the cover over the exhalation valve housing and gently press into place.
4. Align and match the red dots from the exhalation valve heater cable to the power cable and snap together.

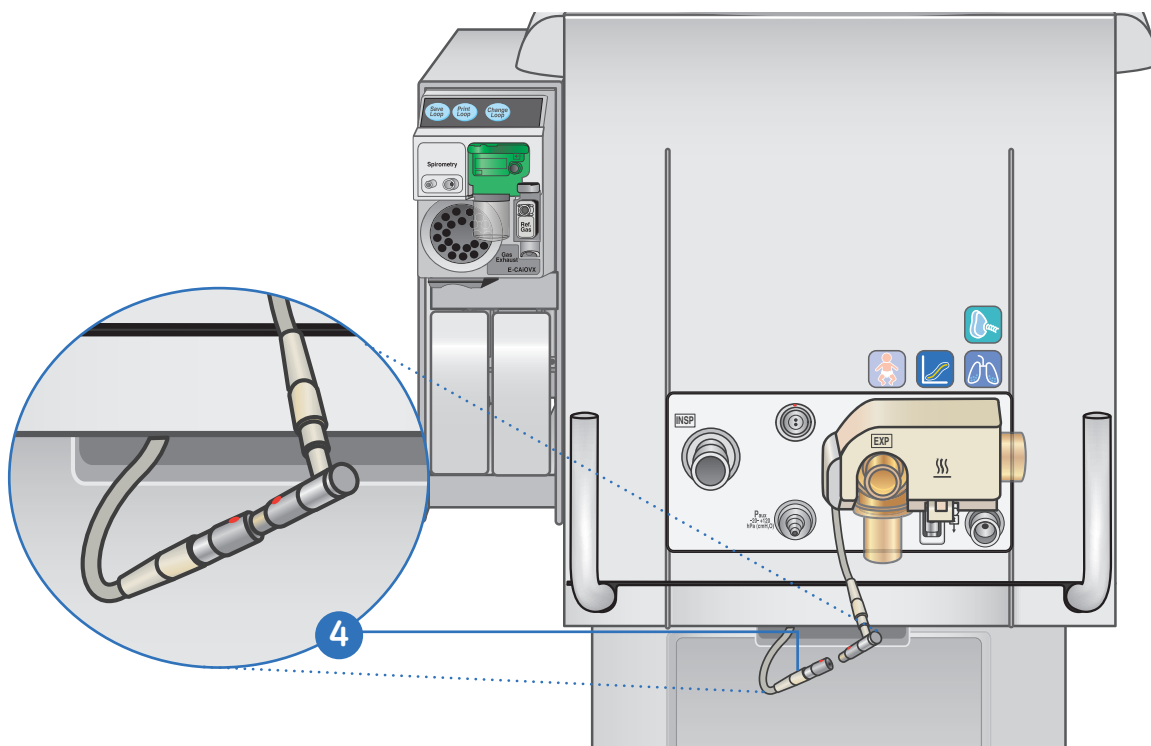


Figure 2.45 Connect the cables

Increasing Oxygen for Closed Suctioning

To Increase Oxygen

The $\uparrow O_2$ key is typically utilized during a closed suction procedure.

1. Press $\uparrow O_2$. The O_2 countdown time is displayed in the general message field.
2. The $\uparrow O_2$ concentration can be adjusted to a level less than 100% by turning the ComWheel and confirming the setting while the FiO_2 setting is highlighted.
3. Press $\uparrow O_2$ to resume the previous setting for O_2 before the two minutes has elapsed.



Note! Increased oxygen may be delivered for two minutes. A general message appears with the time remaining. If delivery is not manually stopped it will automatically end after two minutes.

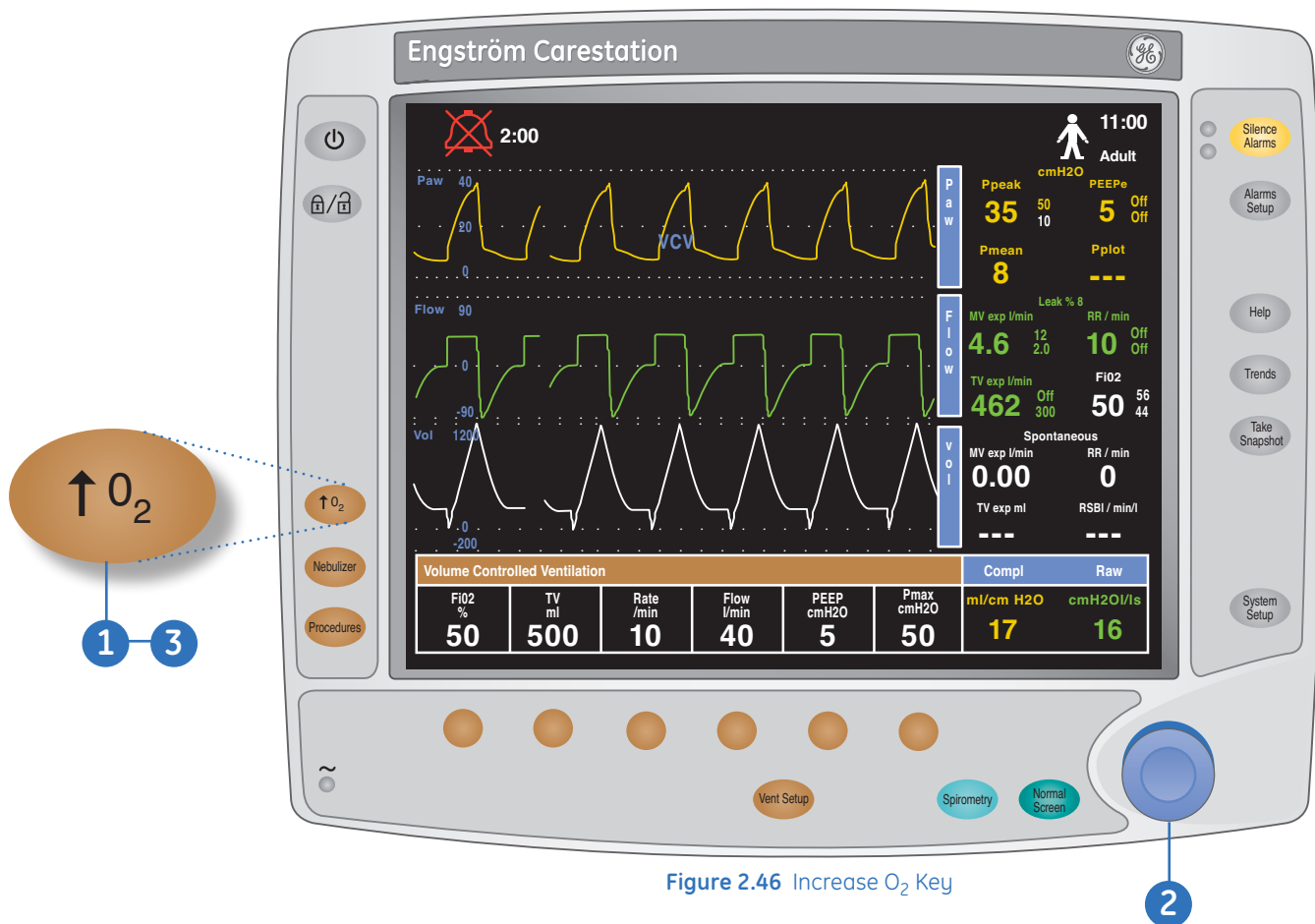


Figure 2.46 Increase O_2 Key



Note! When the Patient Type is set to **Neonatal**, the increase in oxygen will default to a user-set increase over current setting for two minutes.

Standby, Park Circuit and Power Down

Entering Standby

To enter Standby:

1. Disconnect the patient from the circuit.
2. Press the **Standby** key.
3. Select **Standby**.



Note! The patient will not be ventilated when in Standby!

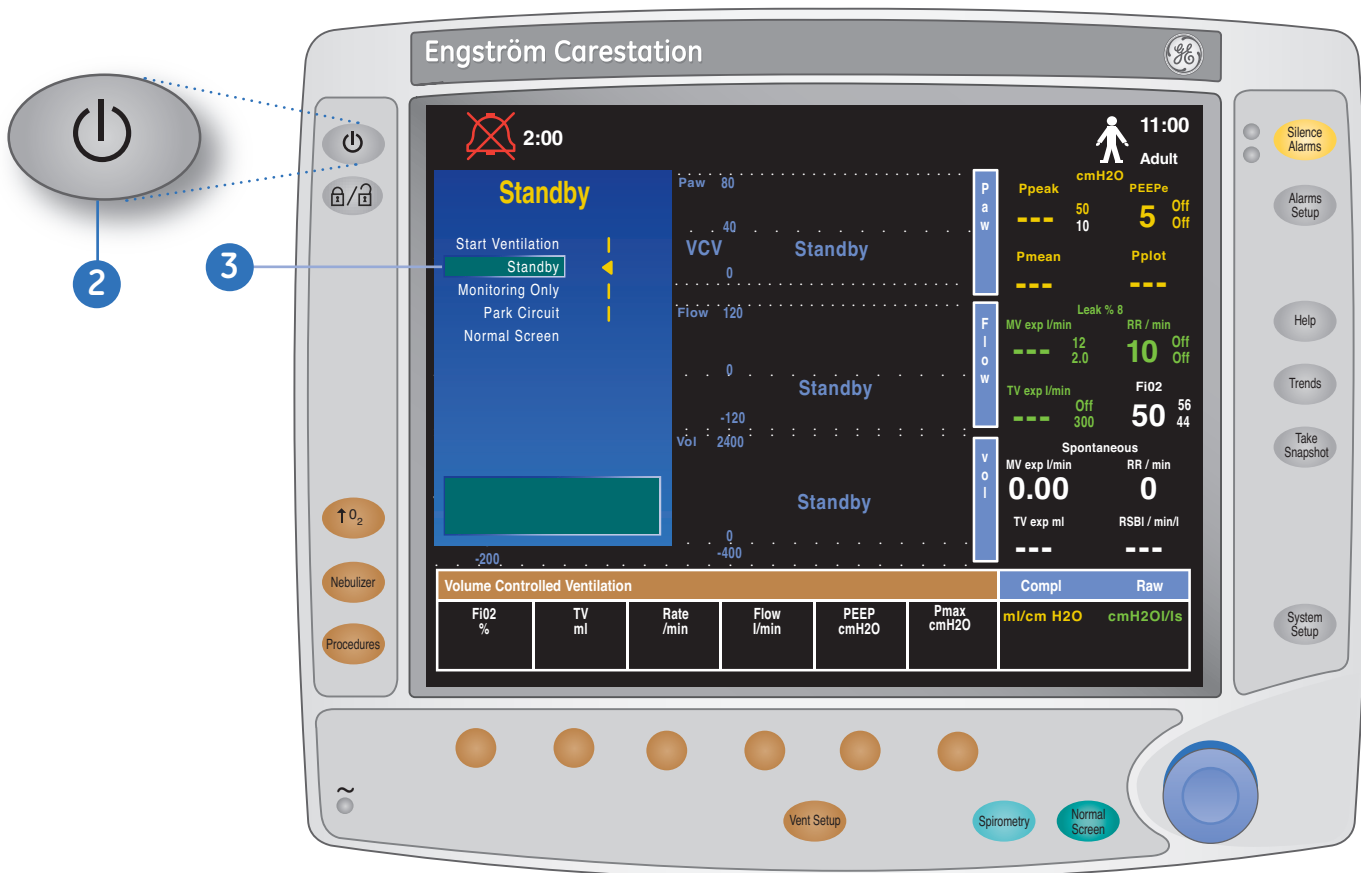


Figure 2.47 Standby Menu



Note! When in Standby, the Patient Setup menu can be accessed by pressing the **Normal Screen** key.

Park Circuit

Use this function to allow the patient circuit to be occluded without the Engström Carestation alarming while in standby. This function allows the patient circuit to be hygienically protected while waiting to connect the patient.

Removing the circuit occlusion will clear the Park Circuit status. The message **Circuit Parked** appears on the screen while in this mode.

Selecting Park Circuit:

1. Press the **Standby** key.
2. Scroll to **Standby** and select.
3. Occlude the patient circuit.
4. Select **Park Circuit**.



Note! The patient will not be ventilated while the circuit is parked!

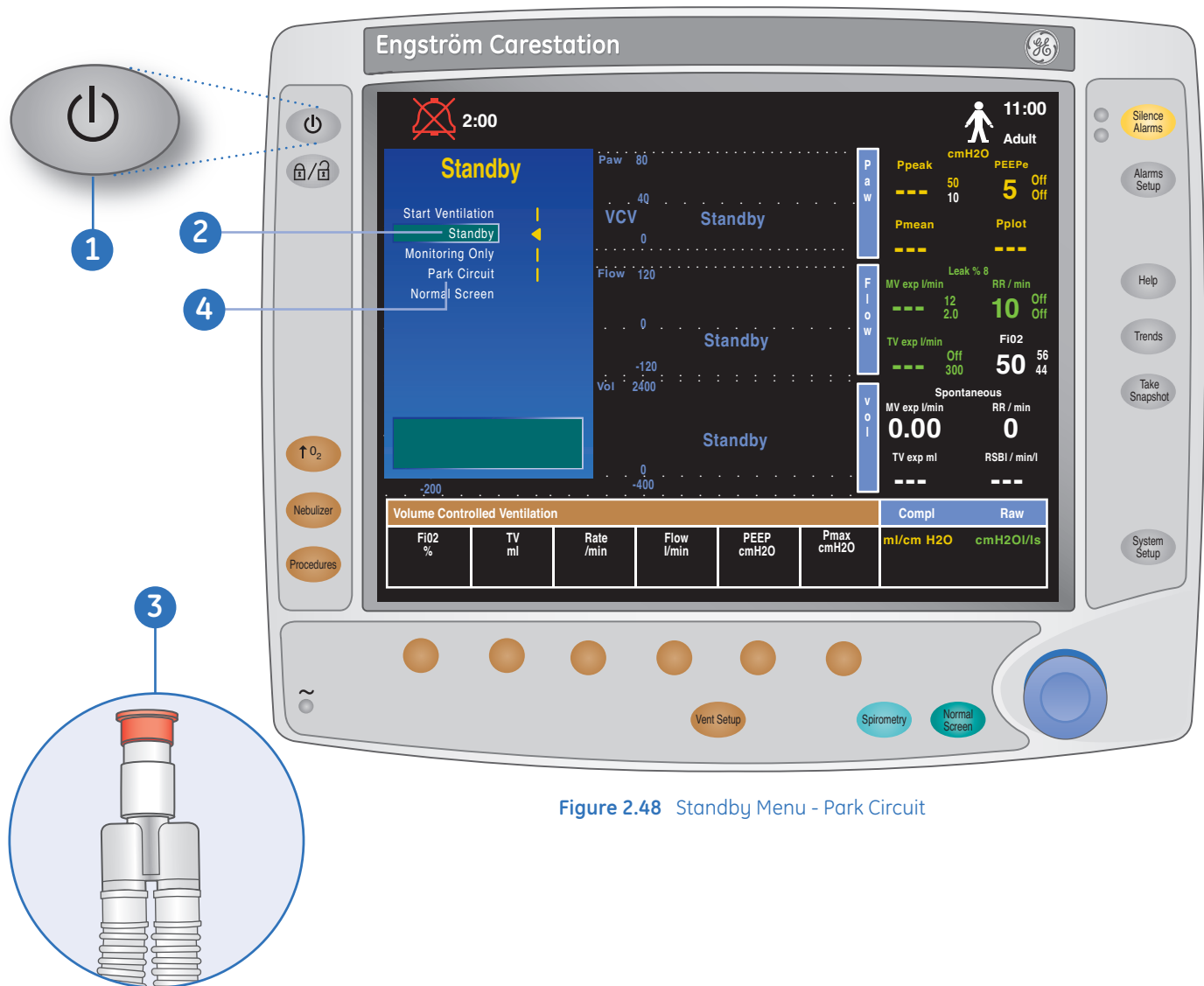


Figure 2.48 Standby Menu - Park Circuit

Starting Ventilation

To start ventilation:

1. Press the **Standby** Key.
2. Scroll to the **Start Ventilation** and select.
3. Connect the circuit to the patient.

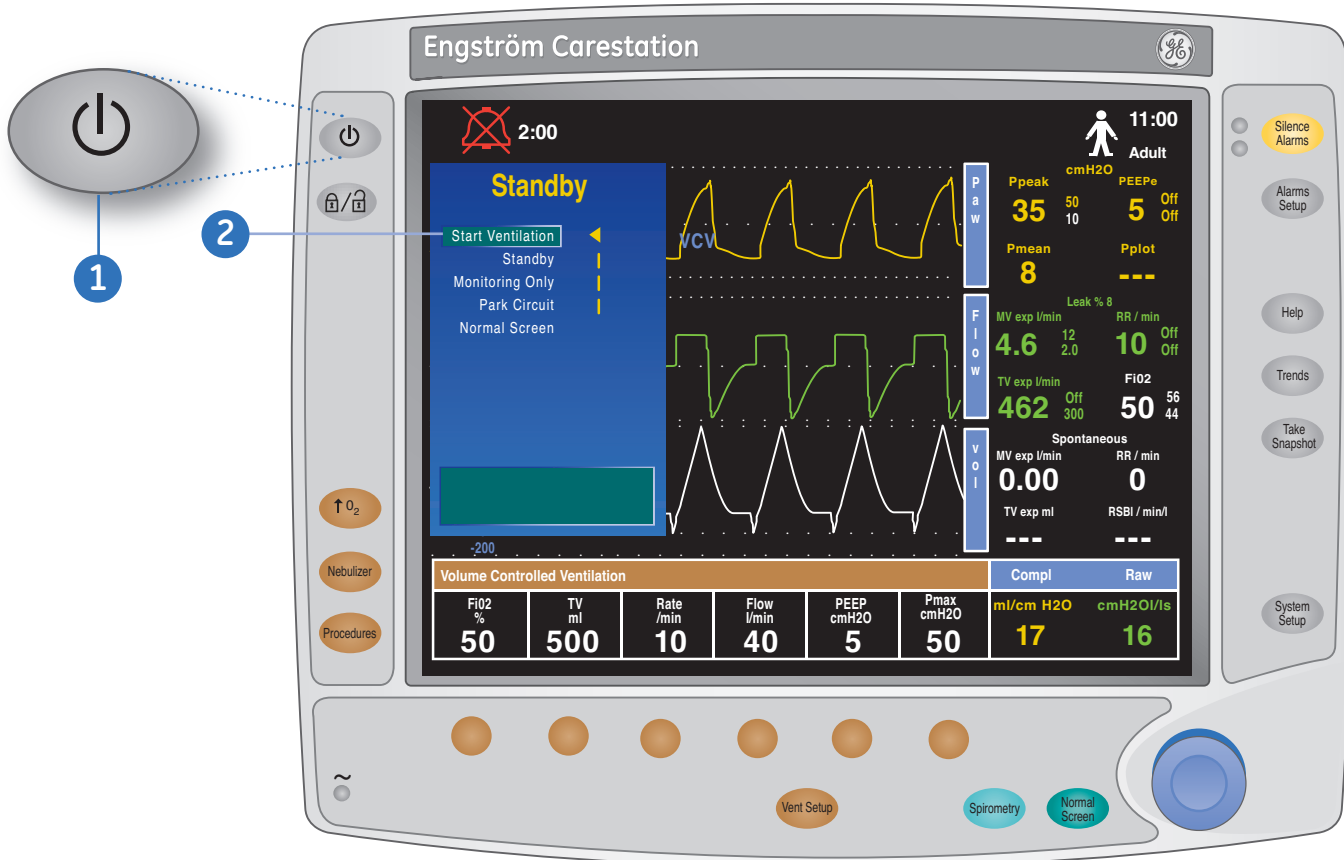


Figure 2.49 Standby Menu - Start Ventilation

Powering Down

To turn the system off:

1. Disconnect the patient from the circuit.
2. Press the **Standby** key.
3. Scroll to **Standby** and select.
4. Set the system switch to the off position.

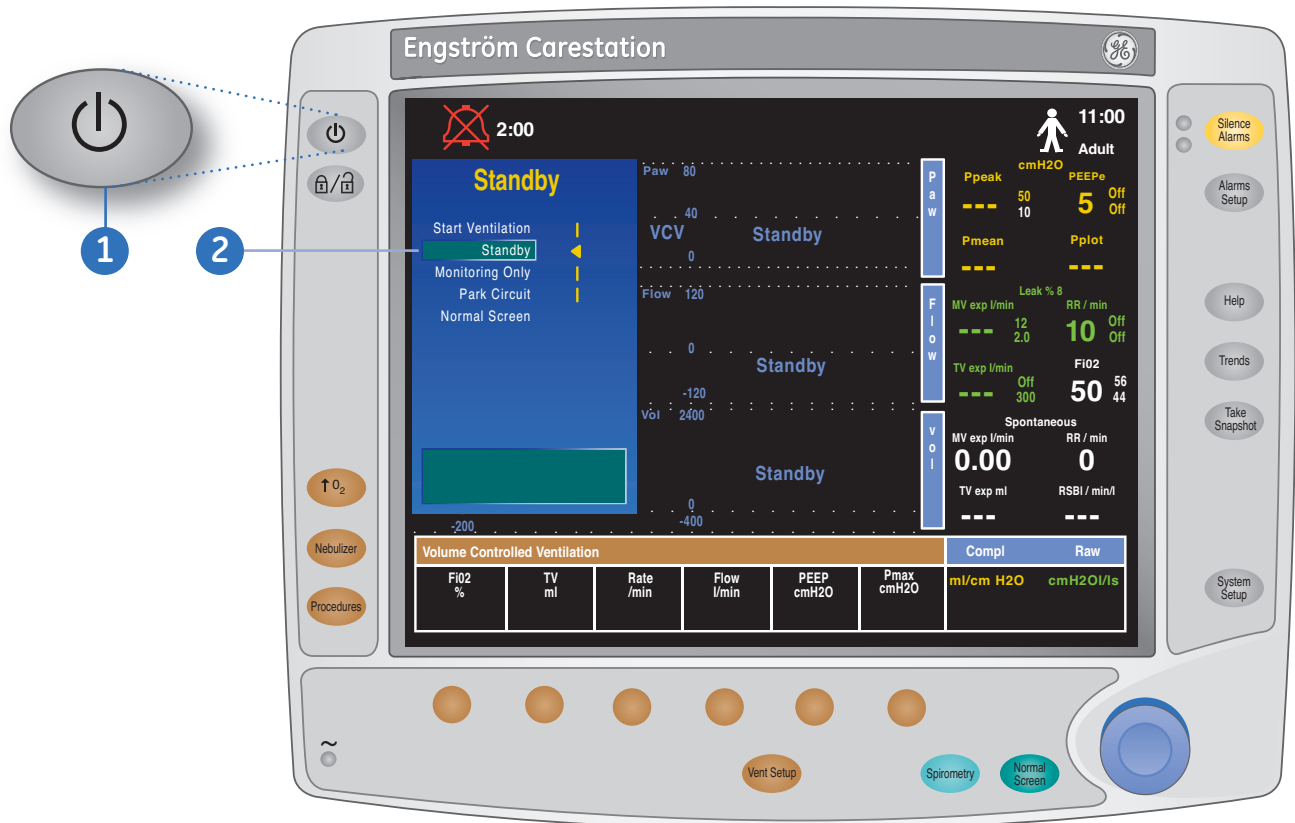


Figure 2.50 Standby Menu

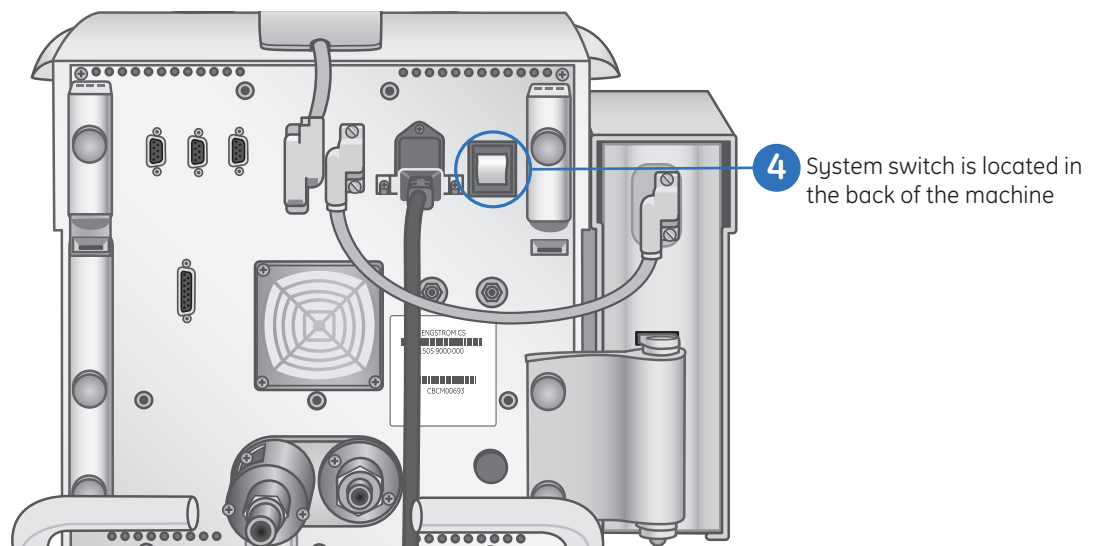


Figure 2.51 System Switch

Cleaning and Sterilization

Datex-Ohmeda recommends cleaning and sterilizing between patients. Cleaning solutions must have a pH of 7.0 - 10.5. Consult your hospital guidelines for specific cleaning and sterilizing guidelines.



Note! *Wear personal protective equipment such as gloves and masks as required by your local guidelines.*

Cleaning

Use a damp cloth with mild detergent to clean all external surfaces. For parts that may be removed and submersed:

1. Wash and soak parts in mild detergent and warm tap water for a minimum of fifteen minutes.
2. Rinse thoroughly in cold water followed by hot water.
3. Dry in room air, allowing cavities to drain.
4. Check for cracks or damage, and replace if any defects are visible.

Sterilization - Autoclave

Only specified parts marked 134° C are autoclavable. Refer to the Cleaning Table on the following page for more information.

1. Wash parts to clean, following the Cleaning procedure.
2. Autoclave at 134° C for a maximum of twenty minutes and cool to room temperature.



Note! *Small imperfections within the plastic are normal after repeated sterilization cycles and do not affect the functionality of the parts.*

Cleaning Table

Components	Process Method						
	Mild detergent and warm water	Ethyl Alcohol	Sporox II	Cidex Plus	Nu-Cidex	Cidex OPA	Autoclave 121° or 134° C
Expiratory flow sensor	Yes	Yes	Yes	Yes	No	Yes	Yes
Exhalation valve housing (Includes diaphragm, o-ring, and water trap)	Yes	Yes	Yes	Yes	No	Yes	Yes
Fan filters	Yes	No	No	No	No	No	No
Aeroneb Pro nebulizer	Yes	No	No	Yes	Yes	Yes	Yes
Water trap (cart mounted)	Yes	Yes	Yes	Yes	No	Yes	Yes
Cables	Yes	Yes	No	No	No	No	No
External Surfaces	Yes	No	No	No	No	No	No
Neo Flow Sensor	Yes	Yes	Yes	Yes	No	Yes	Yes
Display Unit (DU. screen surfaces)	Yes	Yes	No	No	No	No	No
EView (External surfaces)	Yes	No	No	No	No	No	No

Expiratory Flow Sensor

If the expiratory flow sensor is removed during use, the ventilator will alarm, volume and flow measurements will not be displayed, and flow triggering will not be available until the sensor is replaced.

Disassembly:

1. Remove the flow sensor by pulling it away from the ventilator.

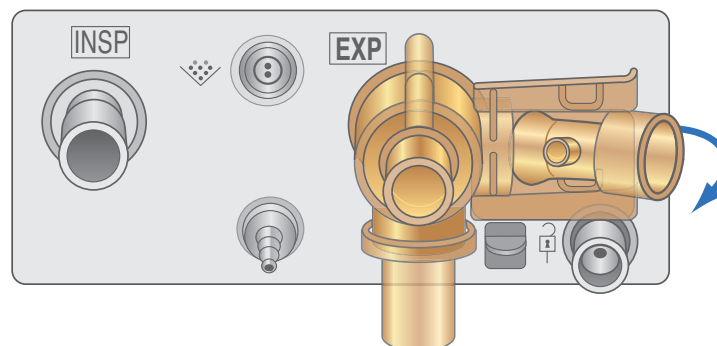


Figure 2.52 Removing the Flow Sensor

Cleaning:

1. Thoroughly rinse component by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of 1 minute. Gently agitate flow sensor if necessary to remove debris.
2. Wash and soak parts in mild detergent and warm tap water for a minimum of fifteen minutes.
3. Thoroughly rinse component in cold water by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute.
4. Thoroughly rinse component in hot water by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute.
5. Dry in room air, allowing cavities to drain.
6. Check for cracks or damage, and replace if any defects are visible.

Sterilization:

1. Place cleaned and disassembled components in a sterilization pouch.
2. Sterilization of components may be performed using any of the following three methods:
 - Gravity autoclave components at 121° C for a minimum of 30 minutes with a 30 minute drying cycle.
 - Gravity autoclave components at 134° C for a minimum of 3 minutes with a 16 minute drying cycle.
 - Prevacuum autoclave components at 134° C for a minimum of 3 minutes with a 16 minute drying cycle.
3. When storing parts do not remove the parts from the sterilization pouch until required for use.

Reassembly:

1. Replace flow sensor when dry. Flow sensor will click when it is properly replaced.
2. Complete a system Checkout prior to use on the next patient.

Exhalation Valve Housing

Disassembly:

1. Remove the exhalation valve assembly from the ventilator by pressing down on the latch and pulling the assembly away from the ventilator.

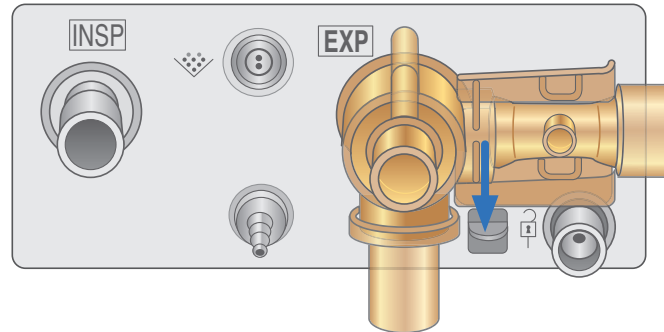


Figure 2.53 Exhalation Valve Assembly Removal

2. Remove the expiratory flow sensor from the exhalation valve assembly and set aside or clean.
3. Unscrew the water trap and empty. Ensure water trap o-ring is not misplaced.
4. Remove the diaphragm from the exhalation valve housing by lifting the edge of the diaphragm away from the housing.

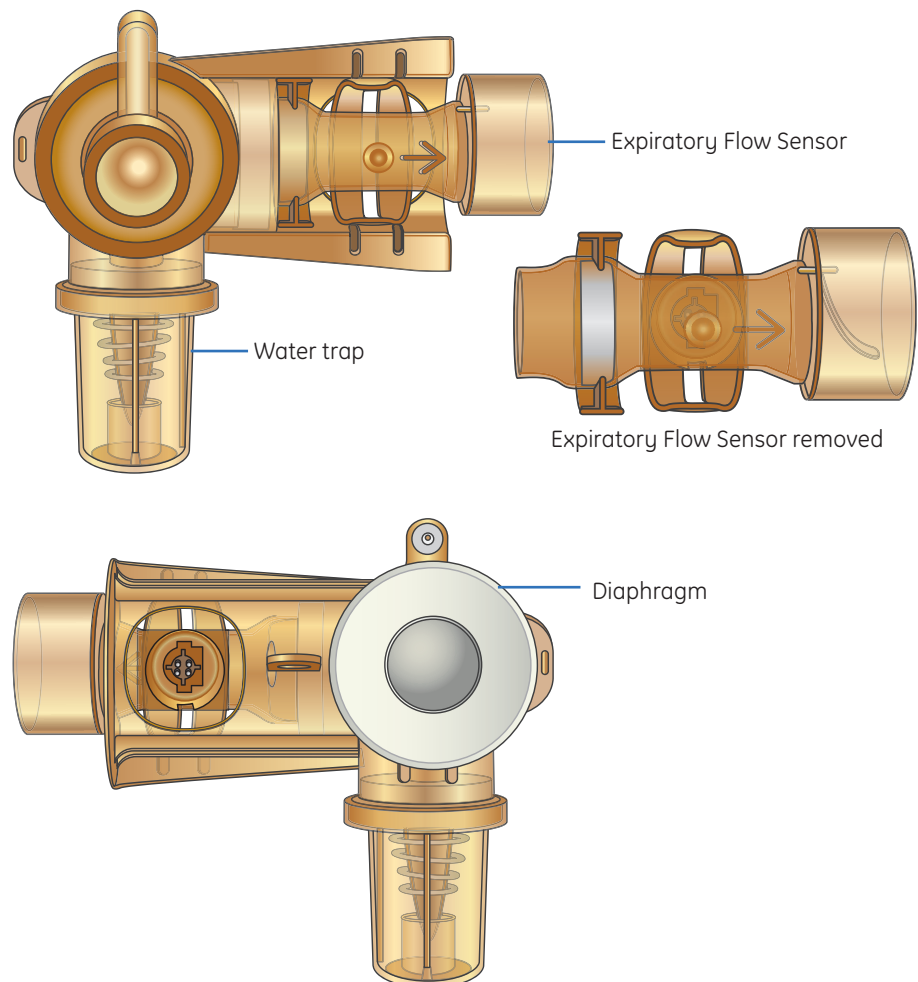


Figure 2.54 Exhalation Valve Components

Cleaning:

1. Thoroughly rinse component by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of 1 minute.
2. Wash and soak parts in mild detergent and warm tap water for a minimum of fifteen minutes.
3. Thoroughly rinse component in cold water by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute.
4. Thoroughly rinse component in hot water by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute.
5. Dry in room air, allowing cavities to drain.
6. Check for cracks or damage, and replace if any defects are visible.

Sterilization:

1. Place cleaned and disassembled components in a sterilization pouch.
2. Sterilization of components may be performed using any of the following three methods.
 - Gravity autoclave components at 121° C for a minimum of thirty minutes with a thirty minute drying cycle.
 - Gravity autoclave components at 134° C for a minimum of three minutes with a sixteen minute drying cycle.
 - Prevacuum autoclave components at 134° C for a minimum of three minutes with a sixteen minute drying cycle.
3. When storing parts do not remove the parts from the sterilization pouch until required for use.

Reassembly:

1. Reassemble the water trap and diaphragm on the exhalation valve housing. Ensure the water trap o-ring is present when reassembling the water trap.
2. Reassemble the dry exhalation valve housing and expiratory flow sensor.
3. Install the exhalation valve assembly onto the ventilator.
4. Complete a system Checkout prior to use on a patient.

Fan Filters

Clean both the display and ventilator fan filters as follows.



Note! Do not autoclave the filters.

1. Remove the display fan filter by sliding the filter holder down from the display housing.
2. Remove the ventilator unit fan filter by inserting a thin blade tool into the groove and prying the filter cover off of the back of the system. Do not remove the screws holding the fan filter in place.

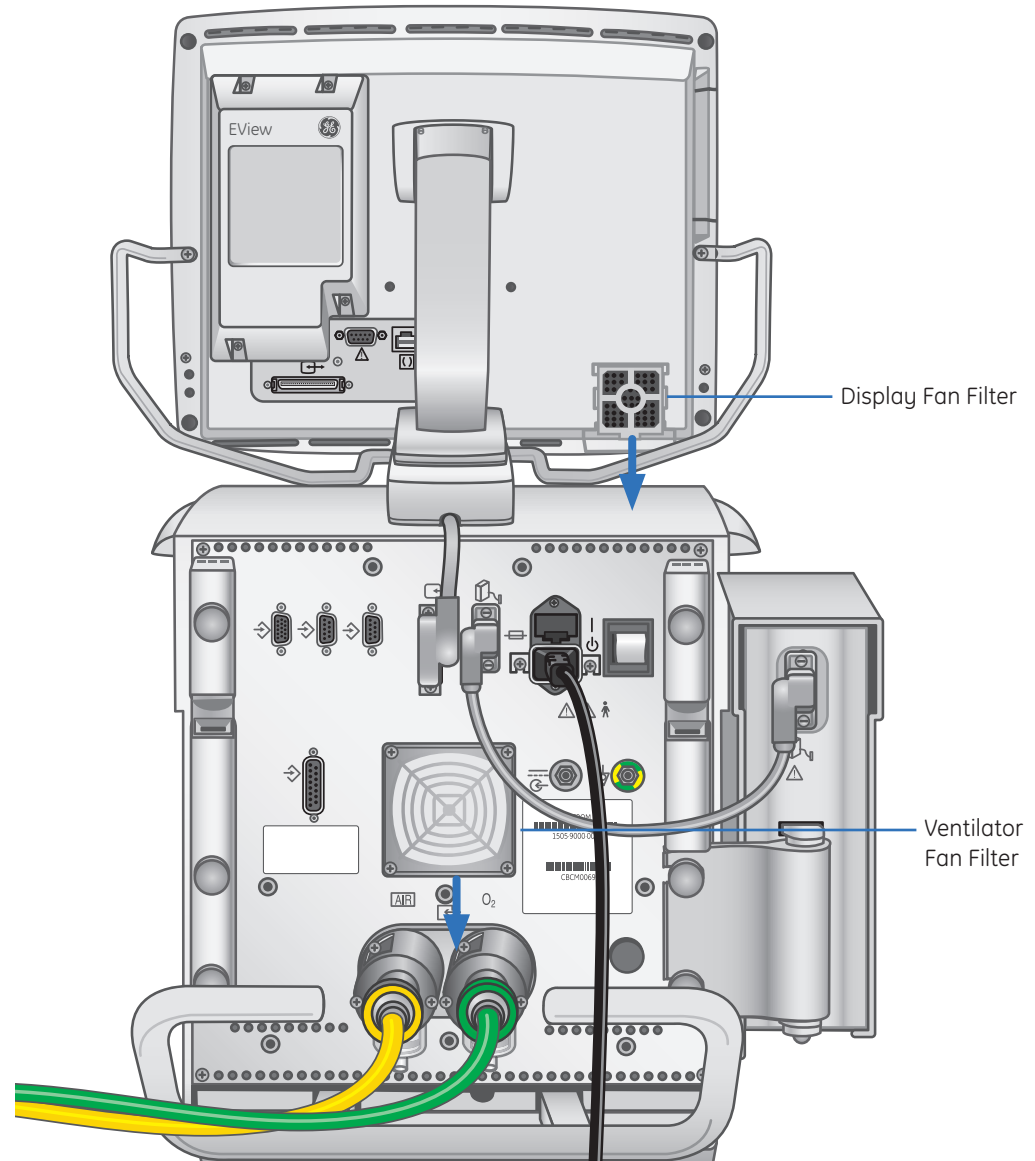


Figure 2.55 Display and Ventilator Fan Removal

3. Rinse the filters with clean water.
4. Allow the filters to dry.
5. Reinsert the filters.



Note! Reinsert the ventilator unit fan filter cover with the smooth side facing out.

Aeroneb Pro Nebulizer

Sterilize the nebulizer prior to the first use on a patient. Clean and sterilize the nebulizer between patients.



Note! Do not use any other cleaning, disinfection, or sterilization methods other than those listed in this section. Do not autoclave or submerge the nebulizer cable.

Cleaning Unit Between Uses for the Same Patient:

1. Remove the nebulizer unit from the T-adapter and firmly insert a plug into the T-adapter.
2. Separate nebulizer and the cable.
3. Remove the filler cap from the nebulizer, and empty any excess liquid.
4. Rinse the parts with sterile water.
5. Shake excess water from the parts, and allow the parts to air dry.

Disinfecting Unit Between Uses for the Same Patient:

1. Remove the nebulizer unit from the T-adapter and firmly insert a plug into the T-adapter.
2. Separate nebulizer and the cable.
3. Remove the filler cap from the nebulizer and empty any excess liquid.
4. Disinfect using the method for CIDEX, NU-CIDEX, CIDEX OPA, or autoclave at 134°C.



Note! Refer to the product labeling for CIDEX, NU-CIDEX, and CIDEX OPA for specific instructions regarding activation, safe use, and disposal of these solutions. Disinfection should not be used as an alternative to sterilization.

Sterilizing Unit Between Patients:



Note! Do not autoclave or submerge the nebulizer cable. Do not reassemble parts prior to autoclaving.

1. Remove the nebulizer and the adapters from the ventilator circuit.
2. Disassemble the nebulizer unit and adapters into individual components.
3. Remove the filler cap from the nebulizer and empty any excess liquid.
4. Clean all of the parts in warm water and a mild liquid detergent.
5. Rinse the parts thoroughly.
6. Shake the excess water from the parts, and allow the parts to air dry.
7. Check for cracks or damage, and replace any parts that show any visible defects.

8. Sterilize the components.

- To steam sterilize, autoclave the wrapped parts using steam sterilization pre-vacuum cycle at 132°C to 135°C for 3 to 4 minutes with a drying cycle.
- To sterilize with hydrogen peroxide gas plasma, place wrapped parts in a STERRAD 100S System and use the long cycle.



Note! Refer to the product labeling for STERRAD 100S System for specific instructions regarding proper operation. When the STERRAD method is used, high-level disinfection with CIDEX, NU-CIDEX or CIDEX OPA should not be carried out.

9. Check for cracks or damage, and replace any parts that show any visible defects.

10. Complete a functional test of the nebulizer.

- Pour 1 to 5 ml of sterile water or normal saline into the nebulizer unit.
- Connect the nebulizer to the ventilator using the nebulizer cable.
- Select **Nebulizer > Start**.
- Verify that aerosol is visible.
- Select **Nebulizer > Stop**.
- Disconnect the nebulizer from the ventilator and store properly.

Expiratory Water Trap

1. Disconnect the water trap from the patient circuit.
2. Disassemble the water trap and discard any liquid.
3. Clean or sterilize expiratory water trap by using one of the recommended procedures.
4. Check for cracks or damage, and replace if any defects are visible.
5. Assemble the water trap and patient circuit.
6. Complete a system Checkout prior to use on a patient.

EVair 03 Compressor

Use a damp cloth with mild detergent to clean external surfaces.

Air Inlet Filter:

1. Pull the air inlet filter out of the compressor housing.
2. Rinse with water to clean. Allow to dry.
3. Slide a new or clean filter into the compressor housing.

Drain Bottle

Empty the drain bottle when needed.

1. Unsnap the drain bottle from the top.
2. Empty the contents.
3. Replace the drain bottle.

Note! *Dispose of contents according to local regulations.*



Airway Module Components

Airway Adapter

Replace the single-use adapter after each patient. A reusable adapter can be disinfected with glutaraldehyde or alcohol. A reusable steel adapter may be autoclaved.

To clean the adapter before use, submerge the adapter in 70% alcohol solution for 30 seconds and rinse carefully with water. Ensure all traces of alcohol or detergent are rinsed away or dried before connecting to the patient.

Sampling Line

Do not reuse the sampling line. Reusing a cleaned sampling line may affect measurement results.

Gas Module Fan Filter

Clean the gas module fan filter as follows.

1. Remove the fan filter cover

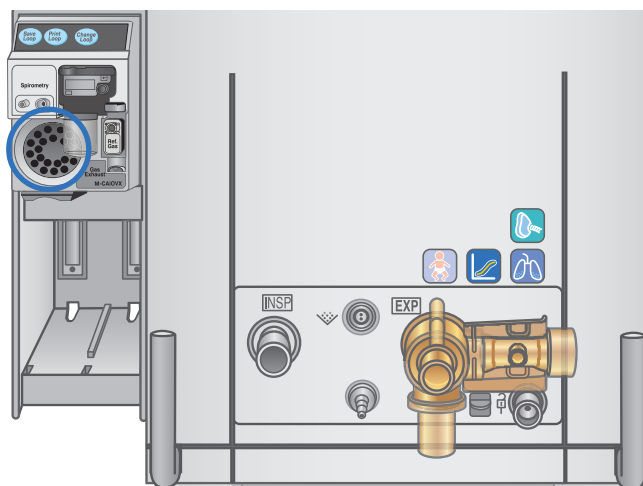


Figure 2.56 Gas Module Fan Filter



Note! *Do not disinfect or open the water trap cartridge. Do not touch the water trap membrane. The hydrophobic membrane is damaged if any cleaning is attempted other than rinsing with water.*

2. Remove the fan filter.
3. Rinse the filter with clean water.
4. Allow the filter to dry.
5. Reinsert the filter and cover.

To lengthen the lifetime of your module and to minimize downtime:

- Empty the water trap container whenever it is more than half full.
- Do not open, wash, or sterilize the water trap cartridge.
- After washing or disinfecting the airway adapter or water trap container, make sure there is no alcohol or detergent left when used again. Traces of alcohol or other organic cleaning solutions may affect measurement.
- Do not force air or oxygen through the water trap.
- Do not allow smoke and dust to enter the water trap.

If a message **Sample line blocked** appears:

- Replace the sampling line.
- Empty the water trap container.

Preparing the Engstrom Carestation for Clinical Use

The four main steps to prepare the Engström Carestation for clinical use are:

1. Install a clean, dry exhalation valve assembly.
2. Attach a clean breathing circuit.
3. Power up the Engström Carestation.
4. Perform a Checkout.

Installing the Exhalation Valve Assembly

1. To insert the exhalation valve assembly, place the tab of the assembly into the groove of the panel, and rotate the housing into position.
2. Gently pull on the housing to make sure it is securely latched.

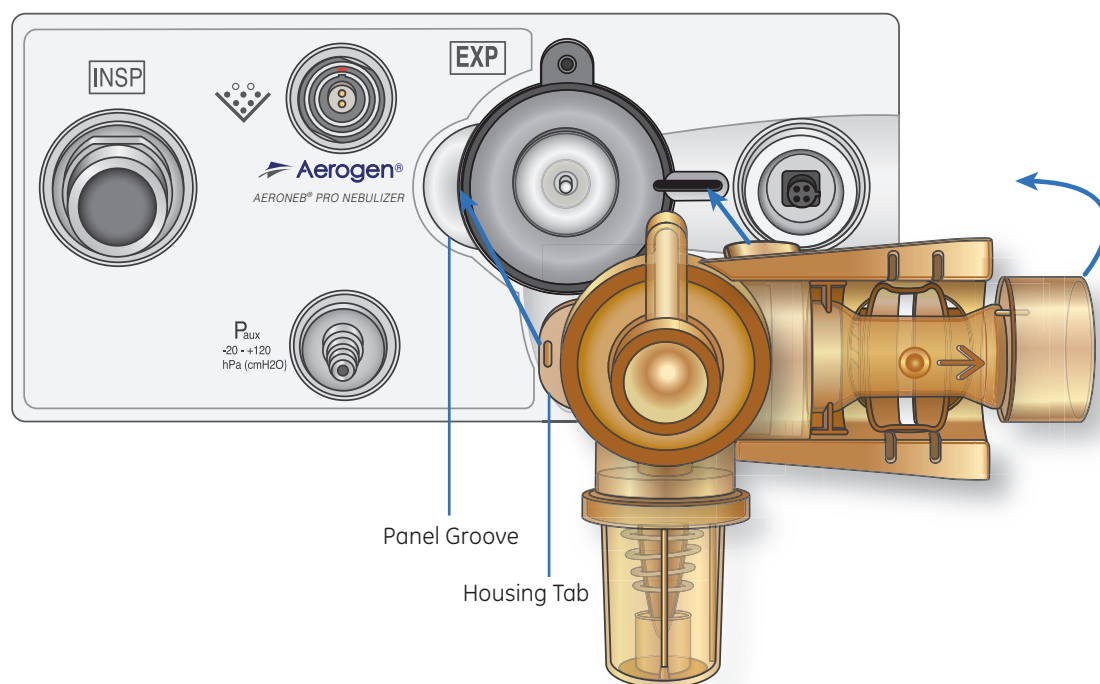


Figure 2.57 Exhalation Valve Assembly

Attaching the Breathing Circuit

Connect the patient circuit, including the humidifier (if used), patient wye (Y-piece), water trap, and filters as shown.

Patient Circuit Components:

1. Expiratory Inlet
2. Expiratory Filter (optional)
3. Expiratory Water Trap (optional)
4. Patient Wye (Y-piece)
5. Humidifier (optional)
6. Inspiratory Filter (recommended)
7. Inspiratory Outlet



Note! Consult your hospital guidelines for proper use of expiratory filters in conjunction with heated humidifiers.

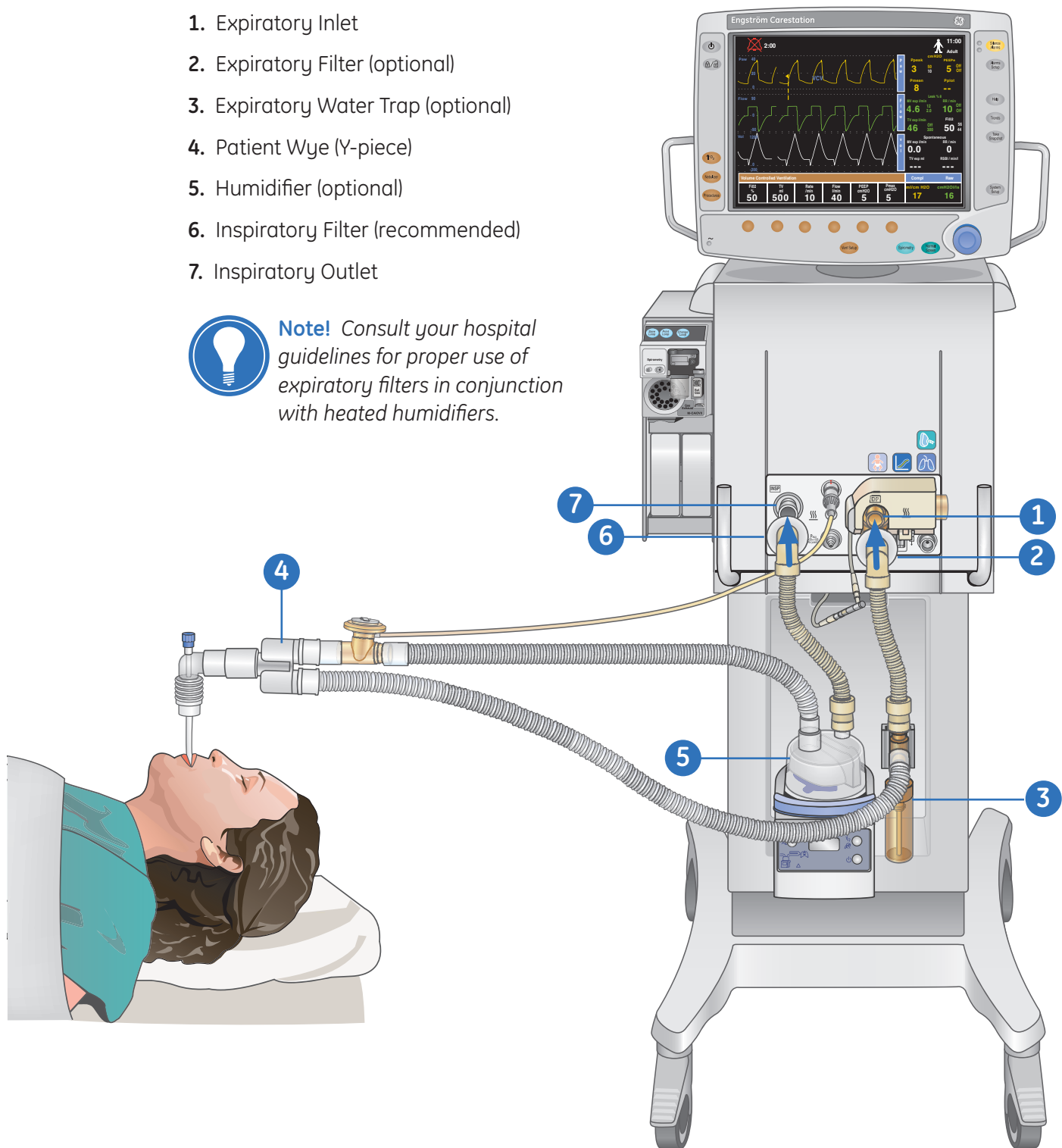


Figure 2.58 Patient Circuit Connections

Powering up the Engström Carestation

Set the System Switch to the On position to power up the Engström Carestation.

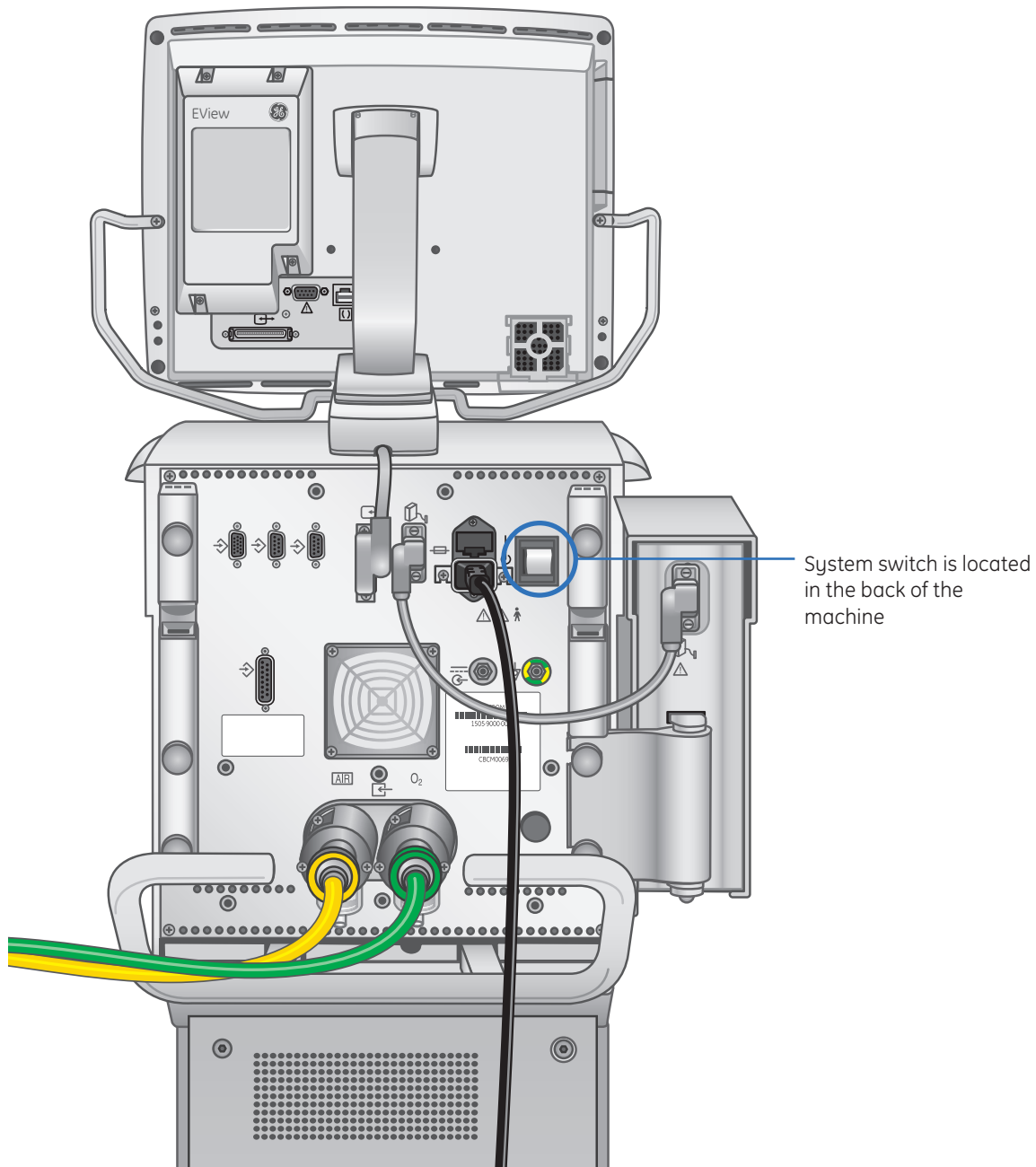


Figure 2.59 System Switch

Performing the Checkout

Accessing the Checkout menu

- **From system startup:** The Select Patient menu appears upon system start up. Select **Patient Type** from the Select Patient menu. You may also enter a patient weight if desired. Scroll to **Checkout** and select by pressing the ComWheel, the Checkout menu will appear.
- **From Standby:** The Patient Setup menu appears when the system is in Standby. Scroll to **Checkout** and select by pressing the ComWheel, the Checkout menu will appear. **To Perform the Checkout:**



Note! If **Bypass Checkout** is selected, the Checkout procedure will not be performed and the system will use the compliance and resistance data from the last completed Checkout procedure.

1. Attach the breathing circuit that will be used for ventilating the current patient. See figure 2.56 on page 2.58. Occlude the patient wye using the occlusion port.
2. Select **Start Check**.
 - The results appear next to each check as they are completed.
 - During the checkout process, the Resistance Check menu appears on the display and a tone sounds. Remove the occlusion from the patient wye. The system will detect the occlusion removal and automatically continue the checkout.
 - When the entire checkout is finished **Checkout complete** will appear and the highlight will move to **Delete Trends**.
3. Select **Yes** to erase trends or **No** to retain the saved trends.
4. If one or more checks failed, select **Check Help** for troubleshooting tips.
5. If all tests passed, select **Normal Screen** to exit or select **Patient Setup** to access the Patient Setup menu.



Note! The circuit leak is measured at 25 cmH₂O, and resistance is resistance of the inspiratory side only.

Checkout includes the following checks:

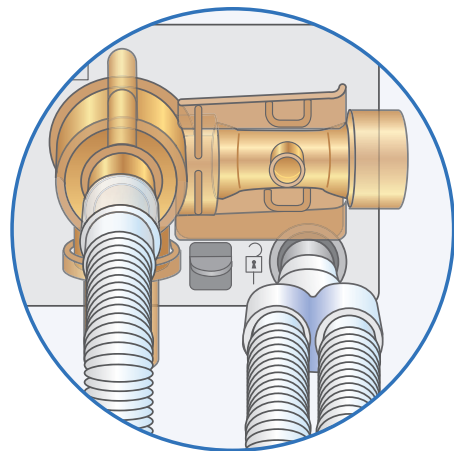
- Paw Transducer Check
- Barometric Pressure Check
- Relief Valve Check
- Exhalation Valve Check
- Expiratory Flow Sensor check
- Air Flow Sensor Check
- O₂ Flow Sensor Check
- O₂ Concentration Sensor Check
- Resistance Check
- Circuit Leak, Compliance, and Resistance



Note! If the circuit leak is greater than 0.5 l/min or if the exhalation flow sensor is changed after Checkout, the expiratory tidal volume measurement may have decreased accuracy.



Figure 2.60 Checkout Menu



Note! Failure to complete Checkout may result in inaccurate delivery and monitoring. Checkout should be completed with the breathing circuit that will be used during ventilation.

The Select Patient Menu

The Select Patient menu appears as the first menu when the system starts up.

Entering a patient weight from the Select Patient Menu:

1. Select **Adult**, **Pediatric**, or **Neonatal**.
2. Enter **Patient Weight**.
3. Select **Checkout** to run pre-use checkout, then select the **Patient Setup** menu. Select **Bypass Checkout** to access the Patient Setup menu without running the pre-use checkout.



Note! Only settings for the selected patient type will be accessible. The system must be turned off and turned on again to select a new patient type and settings. If the Neonatal option is not installed the neonatal menu items will not be selectable.

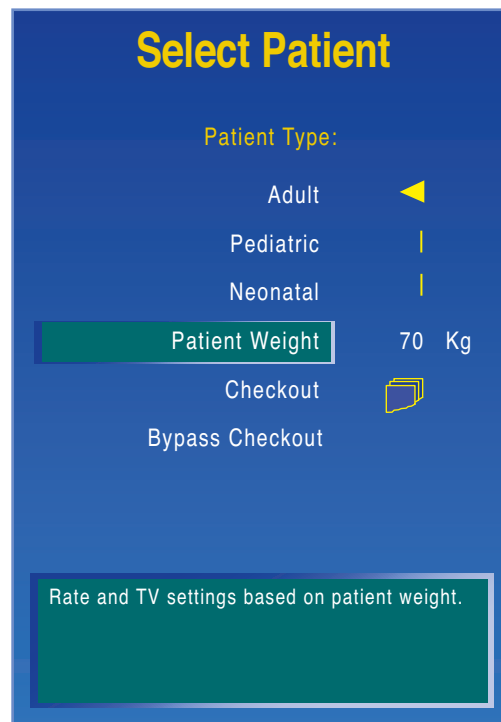


Figure 2.61 Select Patient Menu

Patient Type:	Patient Type may be set to either Adult , Pediatric , or Neonatal . Selecting a value will change the ventilation settings to the facility defaults for that patient type. The Patient Type selection is used internally by the ventilator to match the pneumatic response to a particular patient type.
Patient Weight:	The patient weight entered by the user will determine initial Respiratory Rate and Tidal Volume settings.
Checkout:	Selecting Checkout will perform Checkout.
Bypass Checkout:	Selecting Bypass Checkout will display the Patient Setup menu.

The Patient Setup Menu

1. Press the **System Setup** key and select **Patient Setup**. The Patient Setup menu will appear, use this menu to access the Checkout menu, Vent Setup menu, and Vent Preferences menu.
2. Select the corresponding menu item(s) to access the desired settings.
3. Use the ComWheel to scroll and confirm settings.
4. Select **Previous Menu** or press **Normal Screen** to Exit.



Note! When in Standby, the Patient Setup menu can be accessed by pressing the **Normal Screen** key.



Figure 2.62 Patient Setup Menu

3 Advanced Ventilation Features

Overview: Advanced Ventilation Features



After completing the Advanced Ventilation Features of the Engström Carestation, the participant should be able to perform the following tasks:

- Access the Vent. Preferences menu from the Patient Setup menu and describe the main features
- View and adjust the backup mode settings
- Access the Procedures menu and describe the following procedures:
 - Intrinsic PEEP
 - PEEPi Volume
 - Inspiratory Hold
 - Expiratory Hold
- Access the Lung Mechanics menu and describe the following procedures: P0.1, NIF and Vital Capacity
- Describe the features of the Spirometry menu
- Access the Spirometry menu, save a loop and change a loop type
- Access the System Setup menu and describe the features available
- Access the Patient Setup menu and describe the features available
- Access the Screen Setup menu and Adjust Wave Fields and Digits Fields
- Access the Parameters Setup menu and describe the adjustments that are available
- Access the System Status menu
- Prepare the Engström Carestation for measuring lung mechanics with SpiroDynamics
- Access the Spiro Dynamics menu and describe the main features
- Prepare the Engström Carestation for the non-invasive mode (NIV)
- Access the NIV menu and describe the available settings
- Activate the NIV mode from the invasive mode, and activate the invasive mode from the NIV mode

The Vent Preferences Menu

To access the Vent Preferences menu, press the **System Setup** key, then select **Patient Setup** > **Vent Preferences**.

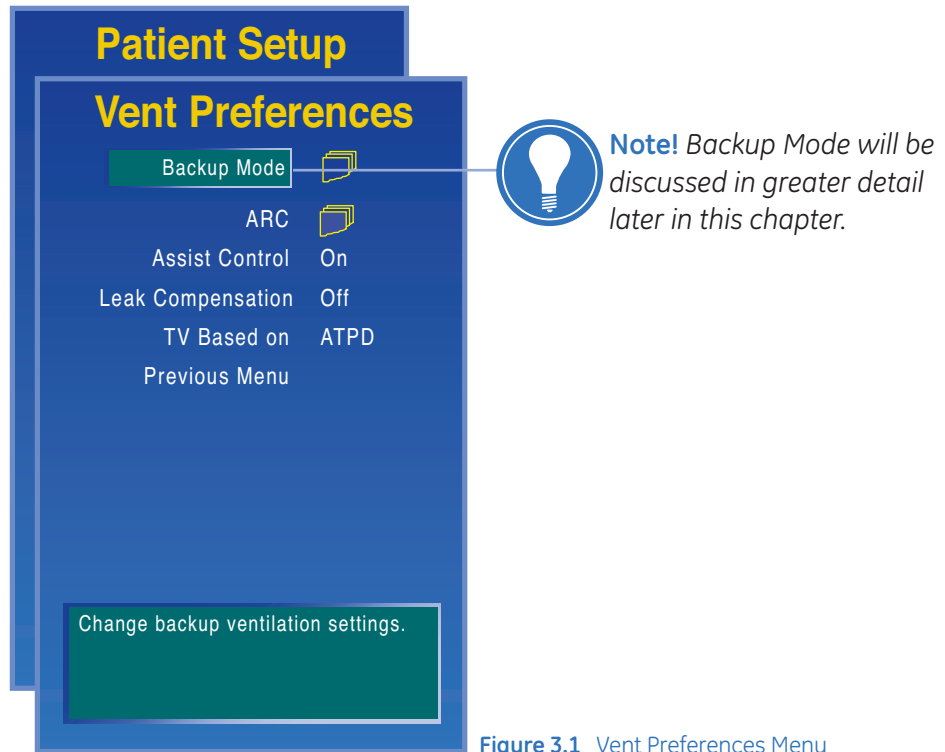


Figure 3.1 Vent Preferences Menu

Vent Preferences Menu Options • Table 3.1

Airway Resistance Compensation (ARC):	Adjusts the target delivery pressure to compensate for the resistance caused by the endotracheal tube or tracheostomy tube used. The compensation is applied to the inspiratory phase of all pressure-controlled, CPAP, and pressure-supported breaths.
Assist Control:	Available in VCV, PCV, and PCV-VG modes. <ul style="list-style-type: none"> Set to On to deliver a controlled breath during the expiratory phase when a patient trigger is detected Set to Off to support spontaneous patient breathing at the PEEP pressure level during the expiratory phase
Leak Compensation:	Automatically adjusts ventilation delivery and monitoring for breathing circuit and patient airway leaks to maintain desired tidal volume delivery in the presence of leaks.
Trigger Compensation:	Adjusts the flow trigger for leaks in the breathing circuit and patient airway, reducing the need to manually adjust the Trigger setting to prevent auto-triggering. Trigger Compensation is available in all modes.
TV Based On:	The flow and volume values are adjusted based on the condition that is selected for TV Based on. <ul style="list-style-type: none"> Use ambient temperature pressure dry (ATPD) when a humidifier is not added to the patient circuit Use body temperature pressure saturated (BTPS) when in active humidifier is added to the inspiratory limb of the circuit

Backup Mode

Backup ventilation will be initiated if the Apnea alarm is triggered or if the patient's minute ventilation decreases to below 50% of the set low MVexp alarm.

Backup ventilation uses the backup settings preset by the user and the settings may be changed for each patient.

Accessing the Backup Mode Menu

There are two ways to access the **Backup Mode** menu:



Figure 3.2
Accessing the Backup Mode Menu

1 Press the **Vent Setup** key and select **Backup Mode**.

2 Press the **System Setup** key and select **Patient Setup > Vent Preferences > Backup Mode**.

Selecting a Backup Mode



Note! Ventilation modes to which backup ventilation apply are established by facility defaults.

Ensure that all users at the facility have been trained and notified of the facility default settings relating to Backup mode.

1. Access the Backup Mode menu as shown in figure 3.2.
2. Select the ventilation mode to be used if the system goes into backup ventilation.
3. Use the ComWheel to navigate through the adjustment window and to change a value. Grayed-out values are carried over from the current ventilation mode.
4. Confirm the settings.



Note! Backup mode can be set to any mode except CPAP/PSV.

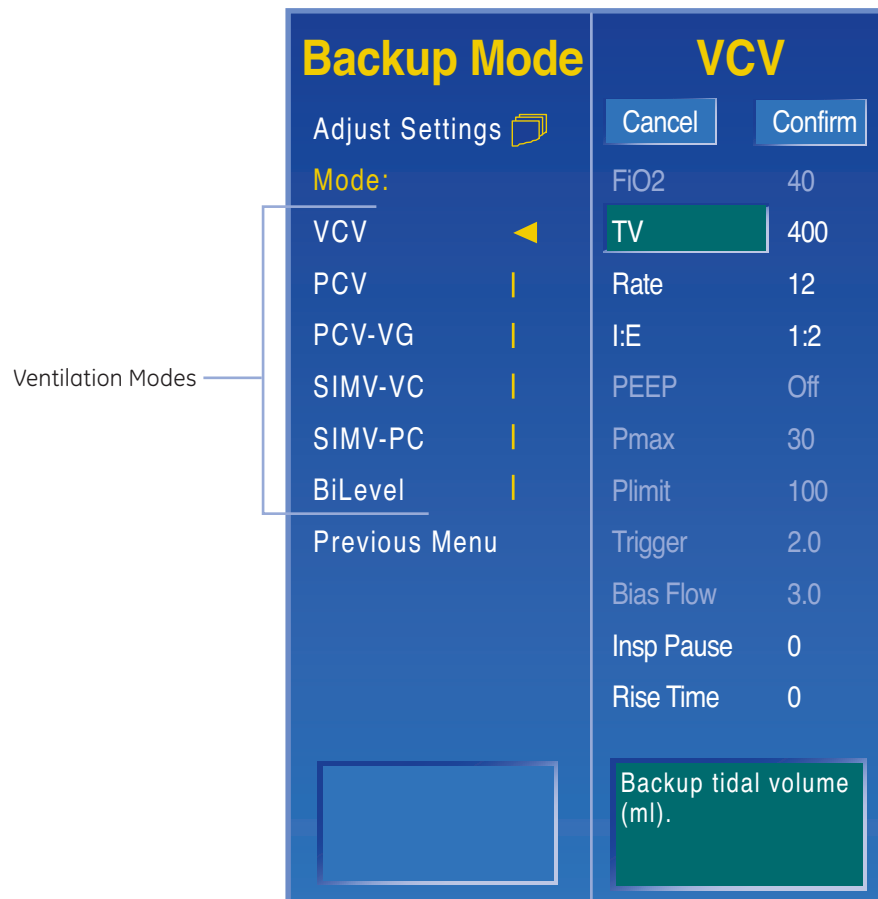


Figure 3.3 Backup Mode Menu

Ventilating in Backup Mode

When the system is operating under backup ventilation, an alarm sounds and a pop-up window message will appear.

1. Select **Reset** to reset the system to the previous mode and exit Backup mode.
2. Select **Adopt**, to exit Backup mode and retain the current Backup mode settings.

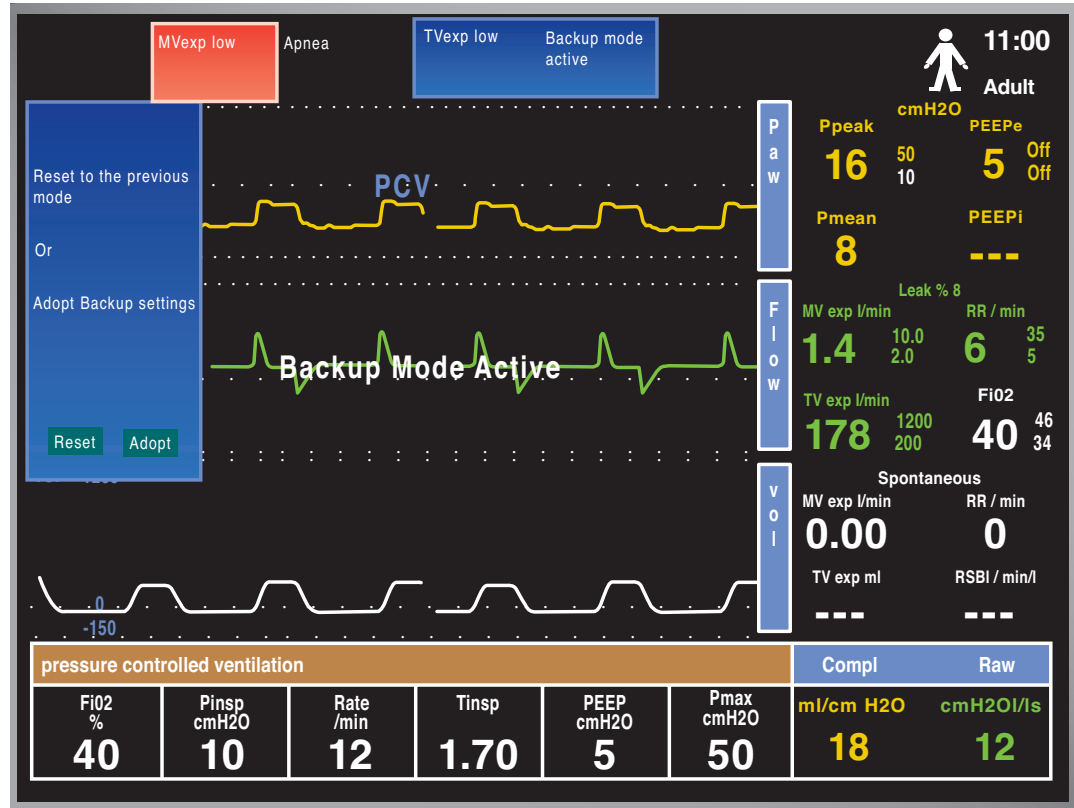


Figure 3.4 Backup Mode Active

Procedures

The Procedures Menu

To access the Procedures Menus, press the **Procedures** key.

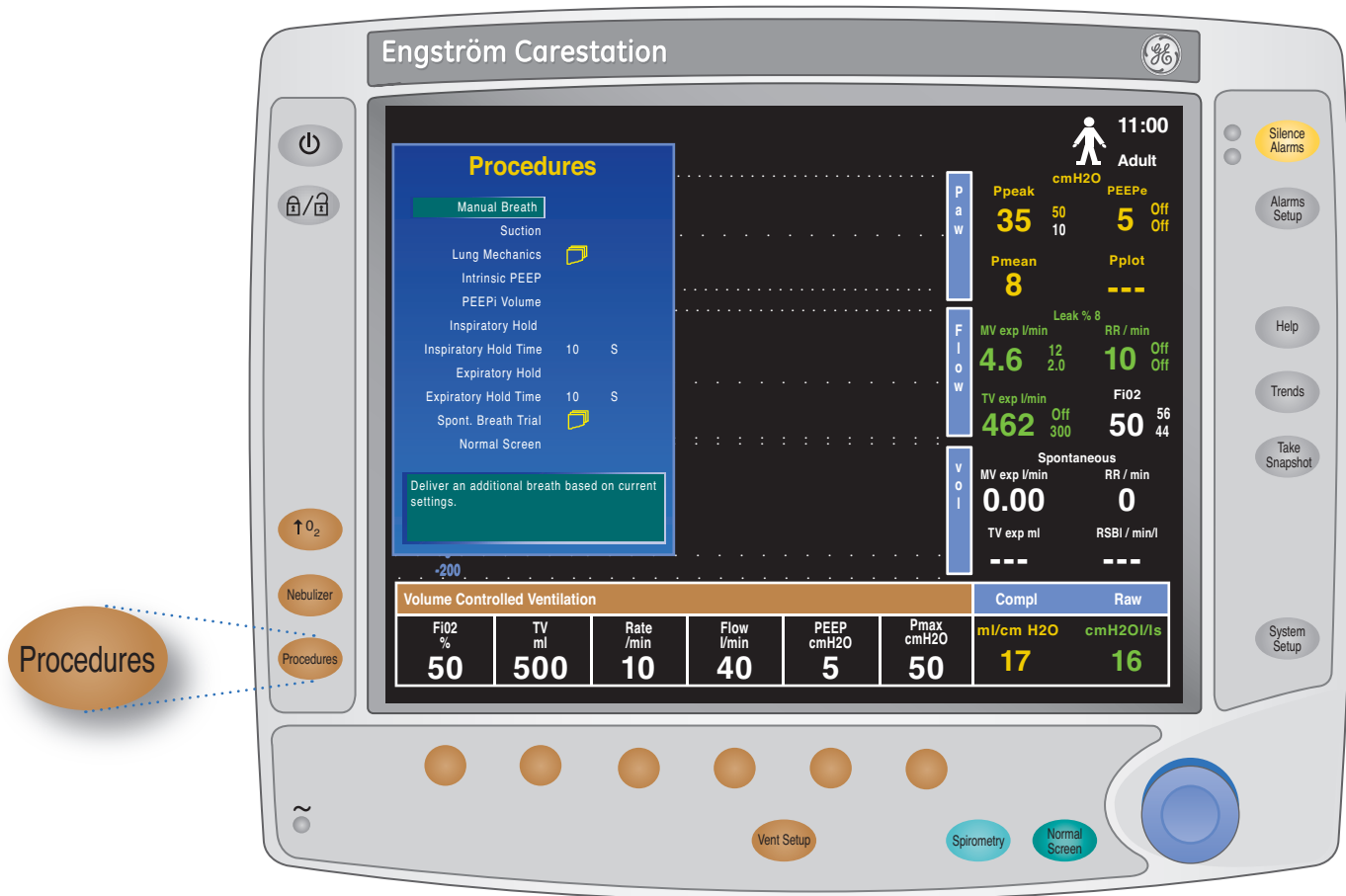


Figure 3.5 Procedures Menu

Procedures Menu Options • Table 3.2

Manual Breath:	An additional breath may be delivered to the patient by selecting Procedures > Manual Breath . The system requires a 0.25 second pause between delivery of manual breaths. This breath will be based on the settings for the current mode. Manual Breath is not available in CPAP/PSV mode.
Suction:	When the Suction procedure is activated: <ul style="list-style-type: none"> • The system delivers 100% O₂ in Adult and Pediatric patients or a user-set increase over current setting for Neonatal patients for two minutes, or until the patient is disconnected. • The system goes into Standby for two minutes or until the patient is reconnected. • The system begins ventilating at the current settings delivering 100% O₂ for two minutes.
Lung Mechanics:	Use this menu to activate a P0.1 procedure, activate the NIF procedure, set NIF time, and activate the Vital Capacity procedure.

Table continues on next page


Intrinsic PEEP:	<p>This procedure will stop the flow of gas at the end of expiration and measure the airway pressure when the lung equilibrates with the circuit pressure. Intrinsic PEEP is the amount of pressure remaining above the PEEP value.</p> <p>The result will appear in the Procedures menu along with a time stamp. It will remain here until the procedure is selected again, or until the ventilator is put into Standby.</p> <p>Follow these steps to obtain an Intrinsic PEEP measurement:</p> <ol style="list-style-type: none"> 1. Press Procedures. 2. Select Intrinsic PEEP. 3. To stop an active Intrinsic PEEP procedure, press the ComWheel. <ul style="list-style-type: none"> • The system will attempt to measure Intrinsic PEEP at the end of each controlled breath during a thirty second time period. If unsuccessful, then the procedure is cancelled • Spontaneous breath triggers or activation of other procedures may cause an unsuccessful measurement • The effects of breathing circuit compliance are accounted for in the Intrinsic PEEP measurement
PEEPi Volume:	<p>Selecting Intrinsic PEEP will also calculate the PEEPi Volume. This is the approximate volume of air trapped in the lungs at the time the Intrinsic PEEP procedure is activated. PEEPi Volume is calculated from the current compliance and PEEPi measurement.</p> <p>If PEEPi Volume cannot be calculated when Intrinsic PEEP is selected, --- will be displayed.</p> <p>PEEPi Volume is abbreviated as P Vol in the trend pages.</p>
Inspiratory Hold and Inspiratory Hold Time:	<p>When Inspiratory Hold is selected, the inspiratory and expiratory valves close at the end of the next inspiratory phase. The duration of the inspiratory hold can be selected. This function can be used during x-ray procedures or to determine plateau pressure and static compliance calculations. The inspiratory hold cannot be repeated until the patient triggers a spontaneous breath or the ventilator delivers a mandatory breath.</p> <p>Follow these steps to start an Inspiratory Hold:</p> <ol style="list-style-type: none"> 1. Press Procedures. 2. Select Inspiratory Hold Time. <ul style="list-style-type: none"> • Use the ComWheel to select an inspiratory hold time between two and fifteen seconds. • The total Tinsp + Hold Time is limited to fifteen seconds. 3. Select Inspiratory Hold. <p> Note! To stop an active inspiratory hold, press the ComWheel.</p>

Table continues on next page

Expiratory Hold and Expiratory Hold Time:

When **Expiratory Hold** is selected, the inspiratory and expiratory valves close at the end of the next expiratory phase. The duration of the expiratory hold can be selected. This function can provide the ability to measure the end expiratory lung pressure and may be used for static compliance measurements. The expiratory hold cannot be repeated until the patient triggers a spontaneous breath or the ventilator delivers a mandatory breath. Follow these steps to start an Expiratory Hold:

1. Press **Procedures**.
2. Select **Expiratory Hold Time**. Use the ComWheel to select an expiratory hold time between two and twenty seconds.
3. Select **Expiratory Hold**.



Note! To stop an active expiratory hold, press the ComWheel.

Spontaneous Breath Trial:

This procedure will place the ventilator in CPAP / PSV mode at the settings defined in the SBT menu. Alarm limits for tidal volume, apnea time, minute volume, respiratory rate can also be set in this menu. If the minute volume or respiratory rate alarm limits are exceeded during the SBT, the trial will immediately end and the ventilator will return to the previous mode and settings. A window will appear with a selection to return to the SBT or to continue ventilation with current settings (previous to SBT).

If the apnea alarm limit is exceeded during the SBT, the trial will immediately end and the ventilator will return to the previous mode and settings. The SBT Split Screen displays the MVexp, RR, and EtCO₂ for the trial. The trial results will remain in the split screen until the next trial is run. A general message appears while the SBT is running indicating the amount of time remaining in the trial. The trial will automatically end at the time set and the ventilator will return to the previous mode and settings. An informational alarm will appear when there are two minutes remaining in the SBT. The Ppeak Low alarm for SBT is not based on the set value in the Alarms Setup menu. The Ppeak Low alarm will occur if the Pexp or P_{insp} is less than 1 cmH₂O for fifteen continuous seconds.



Note! The Ppeak low setting displayed during SBT is based off of the PEEP/ Ppeak low parameters set in the SBT menu, prior to starting the SBT procedure. When the SBT procedure is terminated, the system reverts back to the previous Ppeak low.

Rapid Shallow Breathing Index (RSBI)

The Rapid Shallow Breathing Index (RSBI) is used to assess whether the patient is ready to begin the weaning process. The RSBI can be displayed in the Volume measured value field or in the Volume digit field. RSBI is calculated using spontaneous breath rate/TV (averaged over one minute).

To access RSBI:

1. Press **System Setup**.
2. Select **Screen Setup**.
3. Set the **Wave Field 3** or **Digit Field** to **Vol**.

Procedures Accessed Through the Lung Mechanics Menu

To access the Procedures Menu through the Lung Mechanics menu, press the **Procedures** key, Select **Lung Mechanics**, then select the desired menu option.

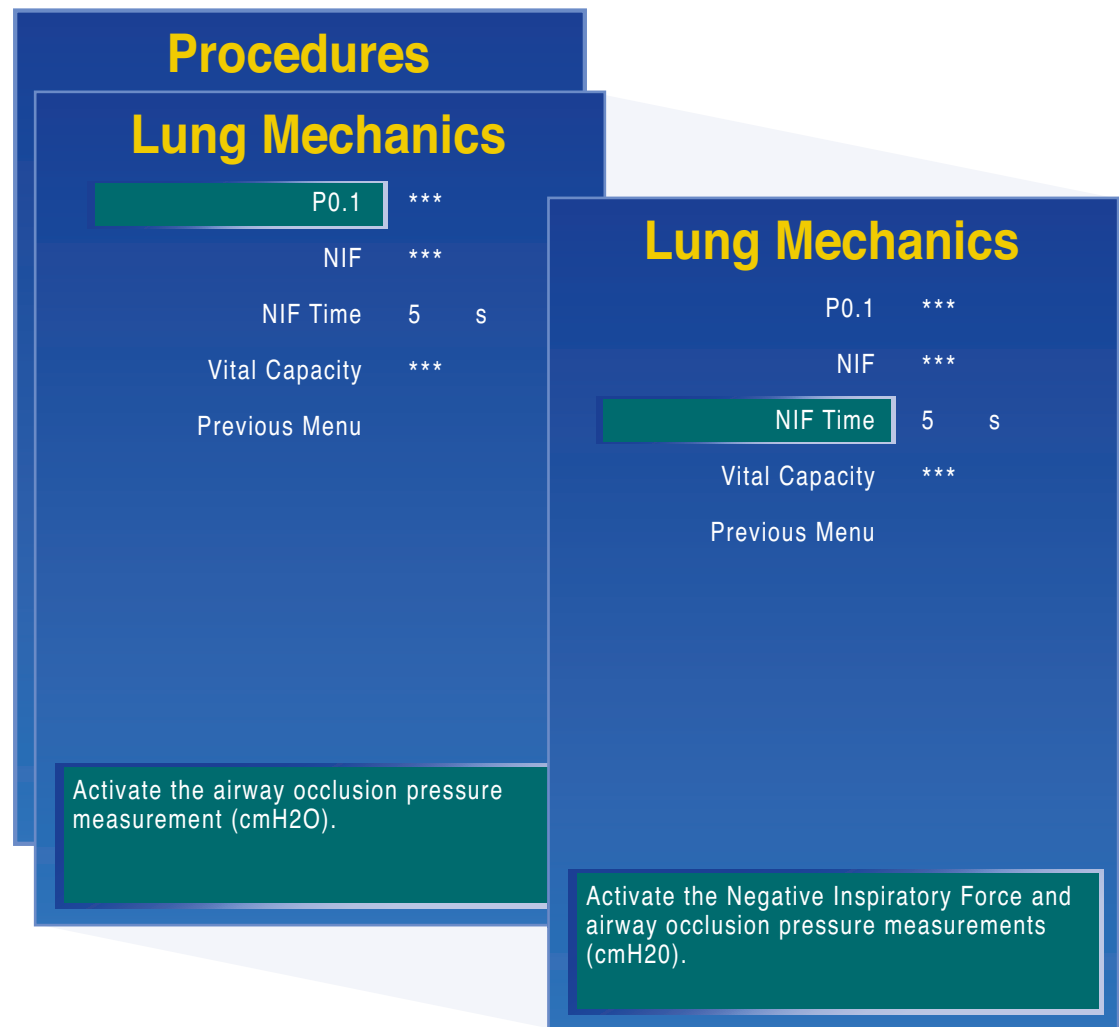


Figure 3.6 Lung Mechanics Menu's



Lung Mechanics Menu Options • Table 3.3

P0.1: This procedure reflects neuromuscular activation of the patient during spontaneous breathing. P0.1 measures the airway occlusion pressure 0.1 second after beginning an inspiratory effort against an occluded airway.

The result will appear in the Lung Mechanics menu along with a time stamp. It will remain here until the procedure is selected again, or until the ventilator is put into Standby.

Follow these steps to obtain a P0.1 measurement:

1. Press **Procedures**.
2. Select **Lung Mechanics**
3. Select **P0.1**.
4. To stop an active P0.1 procedure, press the ComWheel.

<p>Negative Inspiratory Force (NIF):</p>	<p>The Negative Inspiratory Force procedure is used to measure a patient's most negative airway pressure (as measured by the expiratory pressure sensor) during the set NIF time.</p> <p>At the beginning of the NIF procedure, the patient is instructed to fully exhale. The clinician selects NIF in the Lung Mechanics menu. The system waits to detect a breath trigger to begin the procedure. When the NIF procedure is complete, the most negative airway pressure is then recorded. The system displays the NIF and P 0.1 measurements with time stamps in the Lung Mechanics window. If NIF is more negative than -20 cmH₂O, then < -20 cmH₂O will display. To stop a NIF procedure before the set NIF time period press the ComWheel.</p> <p>To begin NIF procedure:</p> <ol style="list-style-type: none"> 1. Press Procedures 2. Select Lung Mechanics > NIF Time. Use the ComWheel to select a NIF time up to thirty seconds. 3. Select NIF. <p> Note! Patient is not ventilated during a NIF procedure!</p>
<p>Vital Capacity (VC):</p>	<p>The Vital Capacity procedure is used to measure a patient's (TVexp) expired Tidal Volume. During a VC procedure, P_{insp} and P_{supp} (PSV) are automatically set to zero. When the VC procedure is complete P_{insp}, or P_{high} and P_{supp} (PSV) automatically return to the previous setting. When VC is activated, the clinician instructs the patient to fully inhale and exhale over a thirty second time period or until the clinician ends the procedure by pressing the ComWheel. The system measures and displays the TV_{insp} and TV_{exp} for each breath in the spirometry window. When the Vital Capacity procedure is complete, the system reports the largest TV_{exp} as the VC measurement in units of mL with a time stamp in the Lung Mechanics window. This information remains until the procedure is selected again, or until the ventilator is put into Standby.</p> <p>To stop a Vital Capacity procedure, press the ComWheel.</p> <p>To begin Vital Capacity measurement:</p> <ol style="list-style-type: none"> 1. Press Procedures. 2. Select Lung Mechanics 3. Select Vital Capacity. <p> Note! Patient is not ventilated during a VC procedure!</p>

Spirometry

The Spirometry Menu

To access the Spirometry menu, press the **Spirometry** key.

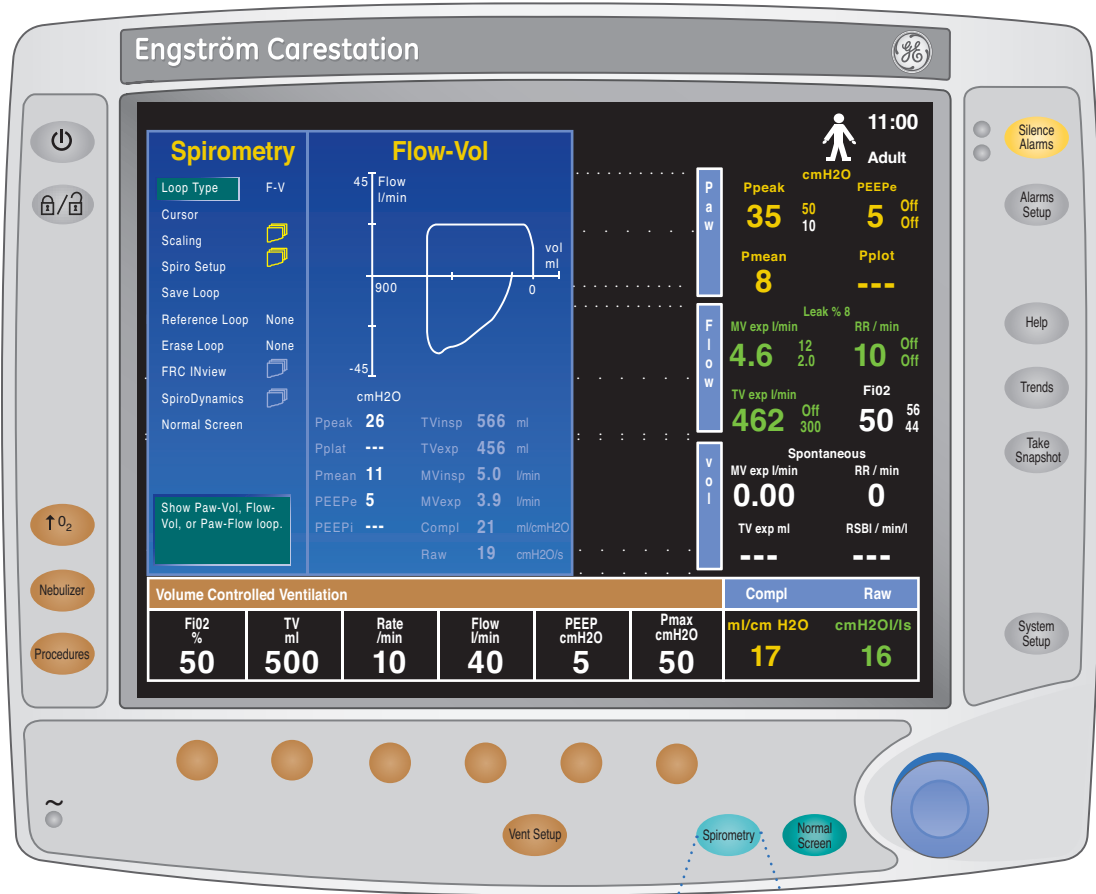


Figure 3.7 Spirometry Menu

3 Advanced Ventilation Features

Spirometry Menu Options • Table 3.4

Loop Type:	To view a specific loop type, select Loop Type and the desired view. There are three types of spirometry loops: <ul style="list-style-type: none"> • Pressure-Volume (P-V) • Flow-Volume (F-V) • Pressure-Flow (P-F)
Cursor:	The cursor is an easy way to quickly read the volume and pressure of the spirometry loop. After selecting Cursor from the spirometry menu, turn the ComWheel to move the cursor across the graph. The volume and pressure values at the points of intersection will be displayed on the graph.
Scaling:	Access the scaling menu to change the loop scaling. For example, Auto will change scales to automatically accommodate the waveform size.
Spiro Setup:	Access the Spiro Setup menu to change the spirometry settings. For example, the sensor type can be changed from Adult to Pediatric .
Save Loop:	Press the ComWheel while Save Loop is selected to store a loop to memory.
Reference Loop:	To view a saved loop, select Reference Loop and the time at which the loop was saved.
Erase Loop:	To erase a saved loop, select Erase Loop and the time at which the loop was saved.
Split Screen:	Spirometry loops may be viewed alongside the waveforms on the normal screen. To set up the split screen, follow these steps: <ol style="list-style-type: none"> 1. Press Spirometry 2. Select Spiro Setup 3. Select Split Screen > Spiro 4. Select Lower spiro split screen. 5. Select Digits, P-V, F-V, or P-F. 6. Press Normal Screen.

The Patient Setup Menu

There are three ways to access the Patient Setup menu:

1. Press the **System Setup** key and then select **Patient Setup**.
2. When the Engström Carestation is in Standby, the Patient Setup menu will be displayed on the screen.
3. When the system starts up, the Select Patient menu appears on the screen. Scroll to **Patient Setup** and select.

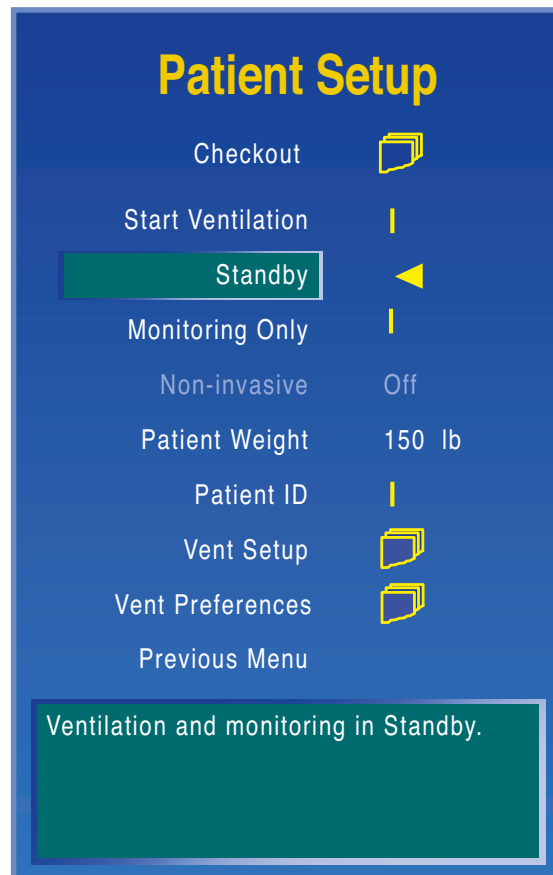


Figure 3.8 Patient Setup Menu

Use the Patient Setup menu to:

- Access the **Checkout** menu
- Start Ventilation
- Place the ventilator in **Standby** mode
- Place the ventilator into **Monitoring Only** mode



Note! Patient is not ventilated during Monitoring Only mode.

- Access the **Non-invasive** Ventilation option
- Enter the **Patient Weight**
- Use the **Patient ID** menu to enter an alphanumeric ID code
- Access the **Vent Setup** menu to adjust settings for ventilation modes and the Backup Mode
- Access the **Vent Preferences** menu for Backup Mode, ARC menus and Vent settings

The Screen Setup Menu

Accessing the Screen Setup Menu

Press the **System Setup** key and then select **Screen Setup** to access the Screen Setup menu. Use the Screen Setup menu to change waveform settings, digit field values, split screen views, sweep speed, brightness, and access the **Select Layout** menu. Use the ComWheel to scroll and confirm settings.

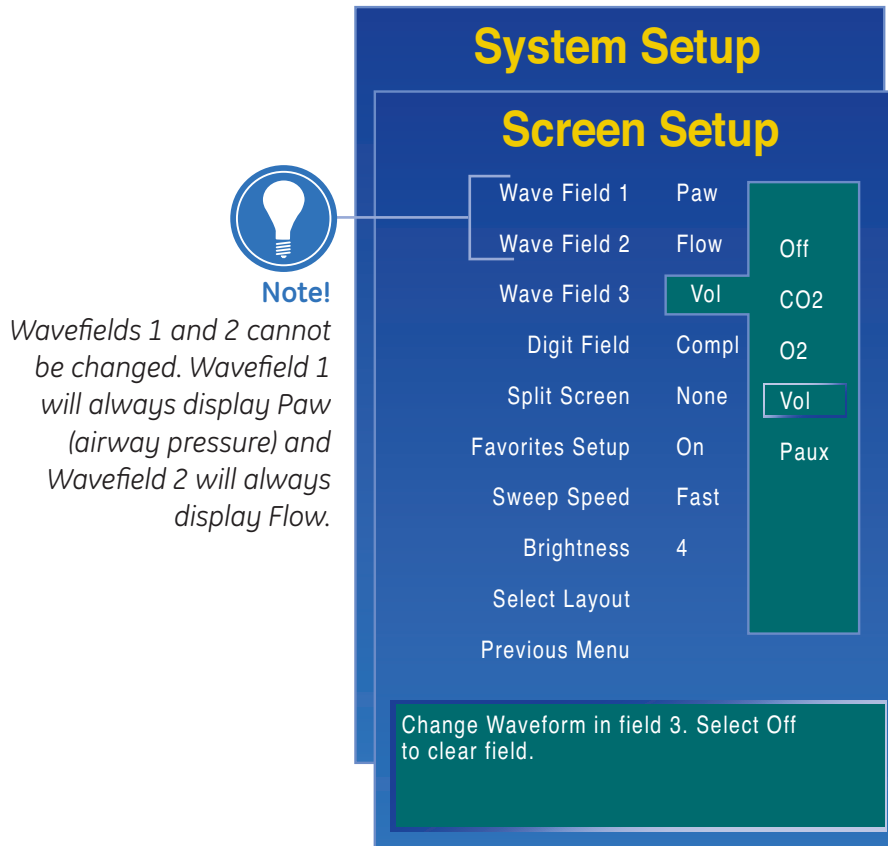


Figure 3.9 Screen Setup Menu

Changing Settings Using the Screen Setup menu • Table 3.5

Wavefield 3:	May be set to: Off, CO₂ , O₂ , Vol , or Paux .
Digit Field:	Select Digit Field to display information in the bottom right corner of the display. May be set to: Vol , CO₂ , O₂ , Compl , Spiro , EE/RQ , VO₂ , Vol/Wt , Mode , or Spont .
Split Screen:	Select Split Screen to display information to the left of the waveforms. May be set to: None , Spiro , SBT , Trend , Paw or SpiroD .
Favorites Setup	Select Favorites Setup to turn the Favorites Bar On or Off and add up to seven favorite functions or procedures to the Favorites Bar.
Sweep Speed:	Sweep Speed is the rate at which the waveform is redrawn across the screen. Select Fast or Slow to set waveform sweep speed.
Brightness:	Select Brightness to adjust the brightness of the screen. Brightness levels may be set from 1 to 5 , level 5 being the brightest.
Select Layout:	Use the Select Layout menu to choose the Full user interface or the Basic user interface.
Previous menu:	Select Previous Menu or press Normal Screen to Exit.

The Parameters Setup Menu

Accessing the Parameters Setup Menu

Press the **System Setup** key and select **Parameters Setup** to access the Parameters Setup menu.

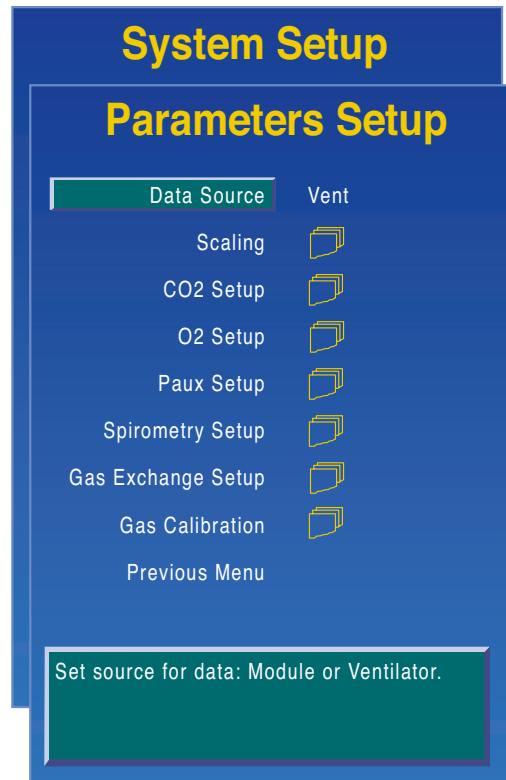


Figure 3.10 Parameters Setup Menu

Parameters Setup Menu Options • Table 3.6

Data Source:	Select Vent or Mod as the primary source for information. If Vent is selected, the internal sensors of the ventilator will be the first source for information. If Mod is selected, the airway module will be the first source for information. If information is not available through the airway module, information will come from the internal ventilator sensors.
Scaling:	Select Scaling to change the spirometry loop and waveform scaling to Auto , Linked , or Independent .
CO₂ Setup:	Select CO₂ Setup to change the scale range for the CO ₂ waveform and to quickly access the CO ₂ alarm limits. Compact airway module required.
O₂ Setup:	Select O₂ Setup to change the scale range for the O ₂ waveform and to quickly access the O ₂ alarm limits. Compact airway module required.
Paux Setup:	Select Paux Setup to change the scale range for the auxiliary pressure waveform and to quickly access the Paux alarm limits.
Spirometry Setup:	Select Spirometry Setup to change the sensor type, change the loop type, select the spirometry split screen and to access the Paw and MVexp alarm limits.
Gas Exchange Setup	Select Gas Exchange Setup to set energy expenditure average time, height, weight and BSA.
Gas Calibration	Select Gas Calibration to calibrate the airway modules gases.

The System Status Menu

To view the System Status menu, press the **System Setup** menu key and select **System Status**.

The System Status menu provides information on:

- O₂ pressure
- Air pressure
- Internal battery status
- System software revision number
- Altitude
- Hours the system has logged
- Last airway module calibration
- Airway module type
- Airway module software revision number



Note! *The last airway module calibration will not appear until the module is warmed up.*

SpiroDynamics Theory

SpiroDynamics is a tracheal pressure measurement obtained through a catheter that provides true tracheal pressure and intrinsic PEEP measurements regardless of the ventilation settings. SpiroDynamics is viewed through the SpiroD menu.

The measurements are captured using an intratracheal pressure catheter that is guided down a standard endotracheal or tracheostomy tubes. The catheter is connected to the auxiliary pressure port of the ventilator and attached to the patient airway. This single-patient-use catheter is easy to insert and is purged using a bias flow to help ensure that it remains open.

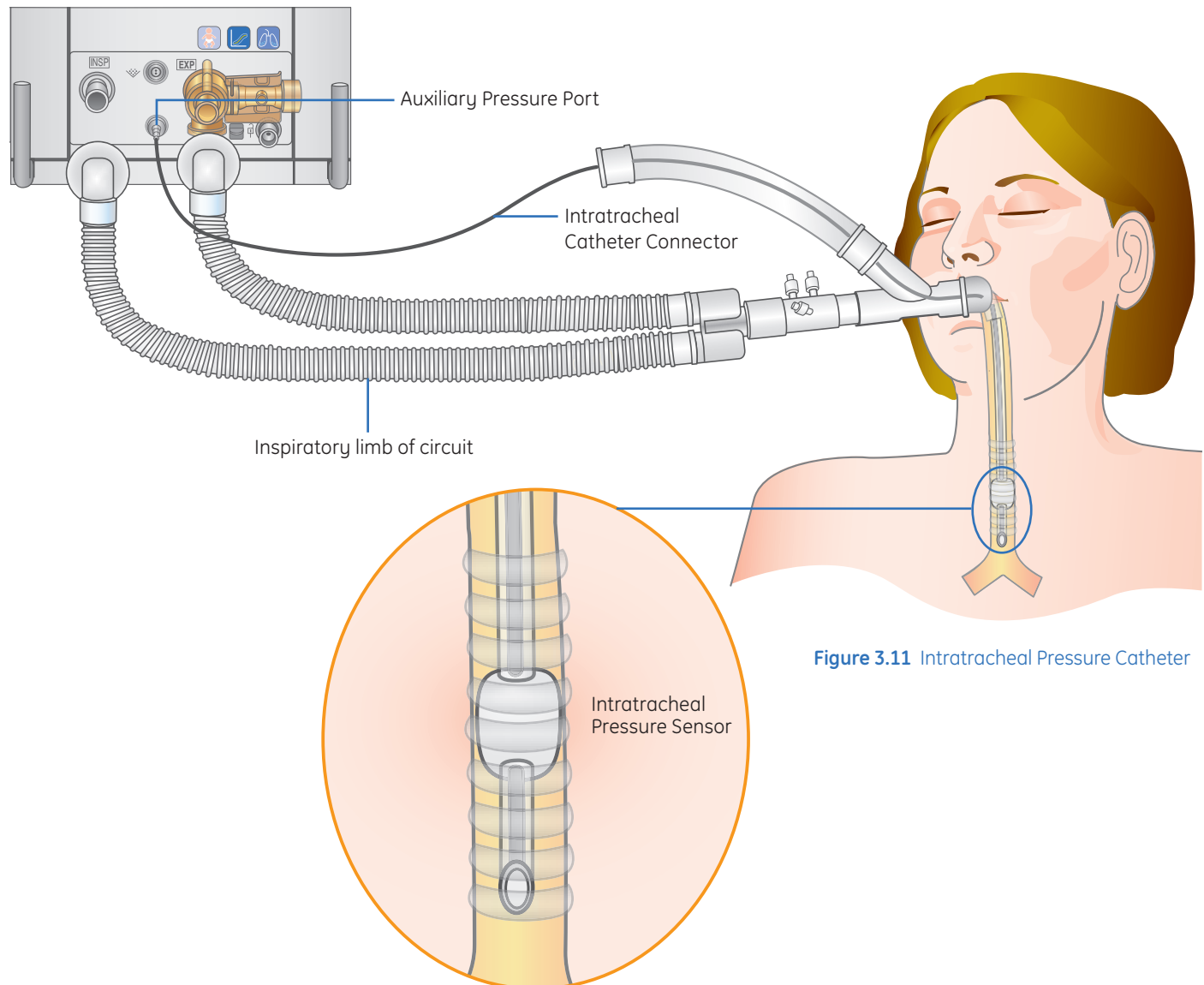


Figure 3.11 Intratracheal Pressure Catheter

This in-line placement of the catheter provides a more accurate measurement of pressure delivery to the lungs by removing the resistance of the endotracheal tube from the spirometry loop. After a breath, a dynostatic curve is calculated from the loop providing an estimate of the alveolar pressure and volume. An algorithm creates the dynostatic curve based on the two pressure and two flow values for a specific volume at several points along the breath loop. This curve is an estimate of the pulmonary compliance during a breath.

Lung mechanics and a graphical tracheal P-V loop are shown on the display. Compliance values are calculated at three points along the dynostatic curve and displayed:

- **Low:** between 5 and 15% of the total curve
- **Mid:** between 45 and 55% of the total curve
- **High:** between 85 and 95% of the total curve



Note! *The intratracheal pressure catheter is only for pressure sensing. It cannot be used for suctioning the patient or for sampling gases. The catheter is for use only with endotracheal or tracheostomy tubes having an internal diameter equal to or larger than 6.5 mm. Refer to the Instructions for Use supplied with the intratracheal pressure catheter for more information on the use and placement of the catheter.*

Setting up SpiroDynamics

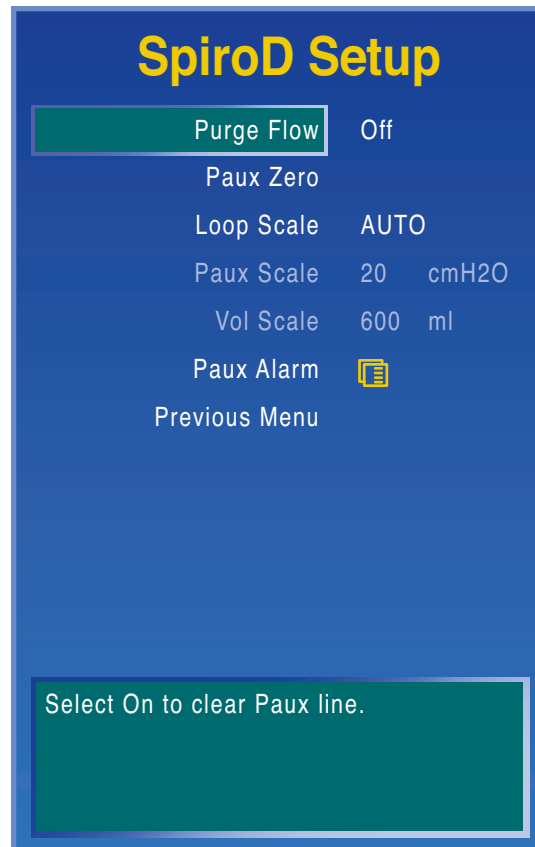


Figure 3.12 SpiroD Setup Menu

1. Attach the intratracheal catheter connector to the auxiliary pressure port on the system. See figure 3.13.
2. Press **Spirometry**.
3. Select **SpiroDynamics > SpiroD Setup**.
4. Set the **Purge Flow** to **On**.



Note! A continuous purge flow of approximately 35 ml/min prevents the buildup of mucous inside of the catheter.

5. Select **Paux Zero** to zero the pressure sensor. When completed, **Done** will appear next to **Paux Zero**.
6. Insert the catheter according to the instructions for use provided with the catheter.
7. Set the **Loop Scale** to the desired scaling method. Changing the loop scale does not affect the Paux waveform scale.
8. Select **Previous Menu** to return to the SpiroD menu to view the SpiroDynamics loops and curves.
9. To display SpiroDynamics to the left of the waveforms on the Normal Screen: Press **System Setup > Screen Setup > Split Screen > SpiroD**.

Viewing SpiroDynamics

The SpiroDynamics loops and curves are viewed, saved, and erased through the SpiroD menu. The loop and curve is displayed on every third breath when the respiratory rate is fifteen or less and on every fifth breath when the respiratory rate is more than fifteen.

Up to six loop and curve sets can be saved in the memory. Once the memory is full, the second oldest saved set is deleted at the next save. After two or more curves are saved, they can be compared to determine if the patient's compliance has changed and if the inflection points have been minimized.

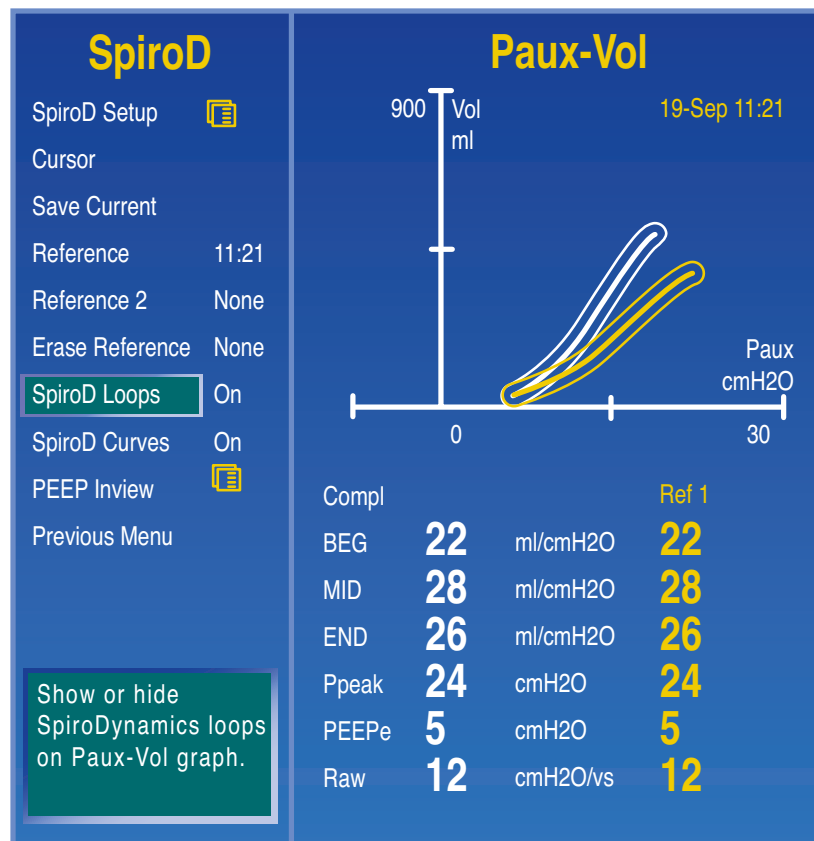


Figure 3.13 SpiroD Menu

1. Press **Spirometry** twice to go to the SpiroD menu. SpiroDynamics can also be selected from the Spirometry menu.
2. The real-time loop and curve show in the graph. Three compliance values, Peak, PEEPe, and Raw show below the graph. The SpiroD curve shows as the thicker line.
3. Select **Save Current** to save the loop and curve of the displayed breath.
 - The first saved loop and curve becomes reference 1
 - If a loop and curve is displayed as reference 1, the next saved loop and curve becomes reference 2
 - After saving six references, the next save overwrites the second oldest reference. If this reference is a displayed reference, it is replaced with **None** until the next save.
4. To show a specific reference, select the reference to be changed and the time of the reference to display. The references display in a different color on the graph and in the data area.
5. The reference can be shown in the graph with both the loop and curve or just the loop or just the curve.
 - To show both the loop and the curve for the reference, set **SpiroD Loops** to **On** and **SpiroD curves** to **On**
 - To show only the loop, set the **SpiroD Curves** to **Off**
 - To show only the curve, set the **SpiroD Loops** to **Off**
6. To erase a saved reference, select **Erase Reference** and the time at which the reference was saved.

Non-invasive Option (NIV)



Note! For additional information on the Non-invasive ventilation option, please consult section 14 of the User's Reference Manual.

The EC NIV (Non-invasive ventilation) option is designed with two modes of non-invasive ventilation: NIV and neonatal nCPAP (nasal continuous positive airway pressure). NIV provides positive-pressure ventilation without the need for an invasive artificial airway.

Noninvasive ventilation should not inhibit the patient from swallowing, talking, and using cough mechanisms. NIV is accomplished by using a nasal or face mask and is delivered through a positive pressure support mode, such as CPAP/PSV.



Note! The NIV mode is designed for use with Adult and Pediatric patient types only.

When using NIV, the patient should demonstrate all of the following characteristics:

- Patient is responsive
- Patient is spontaneously breathing
- Patient has a controlled airway
- Patient may be in need of ventilatory support through PSV

Preparing the Engstrom Carestation For a Patient in Non-invasive Mode



Note! When in NIV mode, the display header and the ventilator settings header is colored teal to signify the mode.

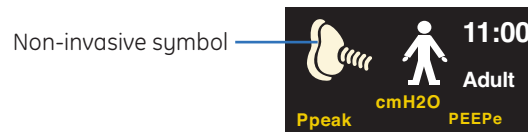
The Select Patient menu appears as the first menu when the system starts up. The default patient type is indicated by an arrow.

1. Select **Adult** or **Pediatric** patient type.
2. Select **Checkout** or **Bypass Checkout**.
 - Select **Checkout** to run pre-use checkout, then select the **Patient Setup** menu.
 - Select **Bypass Checkout** to access the Patient Setup menu without running the pre-use checkout.



Note! If **Bypass Checkout** is selected, the Checkout procedure will not be performed and the system will use the compliance and resistance data from the last completed Checkout procedure.

3. Select **Non-invasive > On**. The NIV symbol appears in the right-hand corner of the display and the Non-invasive message appears above the ventilation settings. The nCPAP mode is only available for Neonatal patient types.



4. Select **Vent Setup** to ensure settings are appropriate for the patient.
5. Press **Alarms Setup** to ensure settings are appropriate for the patient. Press **Normal Screen** to clear menu.
6. Select **Start Ventilation**.

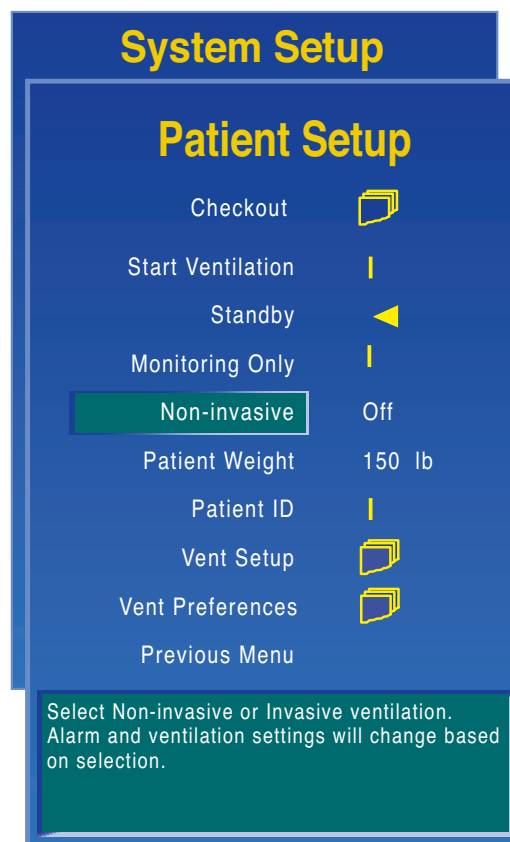


Figure 3.14 Patient Setup Menu

Recommended Non-invasive Ventilation Interfaces

The following interfaces for NIV have been tested and are recommended by GE Healthcare for use with the Engström Carestation NIV.

NIV patient interfaces shall consist of patient masks that do not incorporate an entrainment valve. Patient circuits for both NIV and nCPAP must be dual-limb circuits (i.e. has connections for both the inspiratory and expiratory ports of the EC).

- NIV:**
- Respirationics PerformaTrak SE Full Face Mask (S,M,L)
 - Respirationics Contour Deluxe Nasal Mask (S,M,L)

Changing From Non-Invasive to Invasive Mode

1. Press **System Setup**.
2. Select the **Patient Setup** menu.
3. Disconnect the patient.
4. Select **Standby**.
5. Select **Non-invasive > Off**.
6. Select **Vent Setup** to ensure settings are appropriate for the patient.
7. Press **Alarms Setup** to ensure settings are appropriate for the patient.
8. Press **Normal Screen** to clear menu.
9. Select **Start Ventilation**.

Changing From Invasive Mode to Non-Invasive Mode

1. Press **System Setup**.
2. Select the **Patient Setup** menu.
3. Disconnect the patient.
4. Select **Standby**.
5. Select **Non-invasive > On**.
6. Select **Vent Setup** to ensure settings are appropriate for the patient.
7. Press **Alarms Setup** to ensure settings are appropriate for the patient.
8. Select **Normal Screen** to clear menu.
9. Select **Start Ventilation**.

Changing NIV Mode Settings

NIV mode settings may be changed by using the Quick keys or through the Vent Setup menu. When Non-invasive is set to **On** the NIV Setup menu appears when Vent Setup is selected.

NIV Setup

FiO2	65 %
PEEP	7 cmH2O
Psupp	10 cmH2O
Trigger	5 l/min
Rise Time	70 ms
End Flow	25 %
Tsupp	1.0 s
Bias Flow	10 l/min
Minimum Rate	5 l/min
Backup P _{insp}	10 cmH2O
Backup T _{insp}	12 s

T_{supp}: Used to set the maximum allowable inspired time for a spontaneous breath. During inspiration, the ventilator cycles to expiration if the patient has not started exhalation after the set T_{supp} time.

Minimum Rate: The lowest rate that the patient is required to breathe over a two-breath period before the ventilator will deliver a backup breath.

Backup P_{insp} and Backup T_{insp}: The backup breath is delivered at the Backup P_{insp} and Backup T_{insp} settings.

Fraction of inspired oxygen (%).

Figure 3.15 NIV Setup Menu

Alarms Exclusive to NIV Mode

No Patient Effort:	Patient has not triggered a spontaneous breath within the set Patient Effort time.
Patient Disconnected:	When a patient disconnect condition is detected an informational alarm will activate during the set T _{disconnect} period. The alarm will escalate to high priority after the T _{disconnect} period.



4 Gas Exchange Features

Overview: Gas Exchange Features



After completing the Gas Exchange Features of the Engström Carestation, the participant should be able to perform the following tasks:

- Identify the E-COVX module and insert it into the module bay
- Setup the Engström Carestation and breathing circuit for capnography
- Setup the breathing circuit and the Engström Carestation screen to view energy expenditure data
- Setup the Engström Carestation to view FRC measurement

Compact Airway Modules and the Module Bay

Compact Airway Modules

The optional compact airway modules measure and monitor gases delivered to the patient and exhaled through the breathing circuit.

The modules consist of nondispersive infrared technology for measuring CO₂, N₂O, and anesthetic agents; paramagnetic technology for measuring O₂; differential pressure techniques for measuring spirometry inputs from the D-lite sensor; and a D-fend water separation system.

This Engstrom Carestation is compatible with the E series modules E-miniC, E-CO, E-COV, E-COVX, E-CAiO, E-CAiOV, and E-CAiOVX and the M series modules M-miniC, M-CO, M-COV, M-COVX, M-CAiO, M-CAiOV, and M-CAiOVX. (Modules must be software version 3.2 and above. E-miniC and M-miniC modules must be software version 1.0 and above.) Letters in the compact airway modules stand for:

- E** = plug-in gas module
- M** = plug-in gas module (older version)
- C** = CO₂ (and N₂O in compact gas modules)
- O** = patient O₂
- V** = patient spirometry
- X** = gas exchange
- A** = anesthetic agents
- I** = agent identification
- mini** = single width module



Note! The Engström Carestation is not intended for use with anesthetic agents. It does not currently measure or display anesthetic agents.

The E-COVX Module: Measures CO₂, N₂O, patient spirometry and gas exchange.

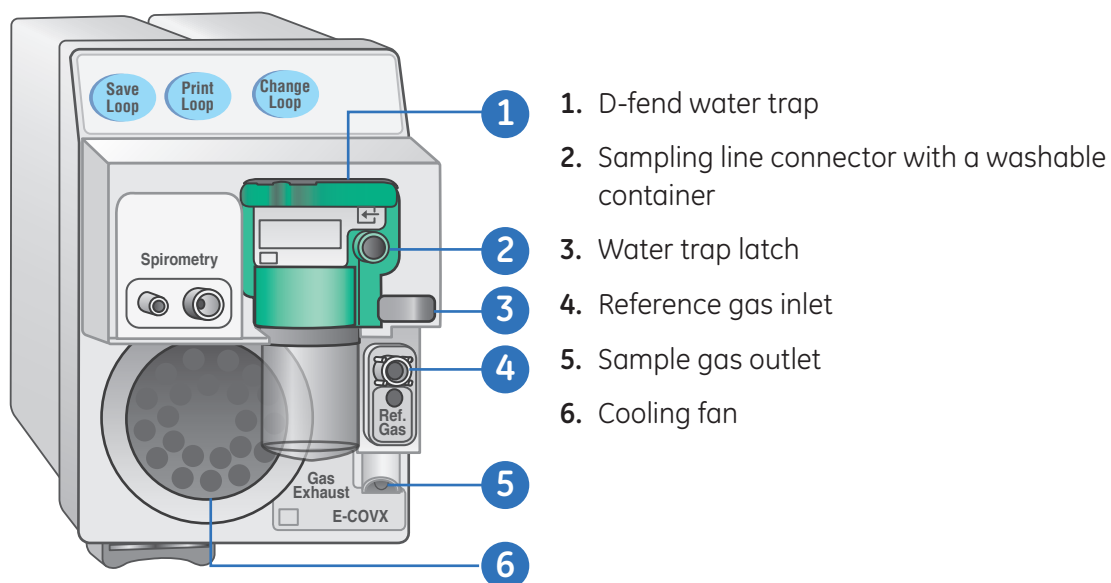


Figure 4.1 E-COVX Module

The Module Bay: The optional module bay allows the integration of various patient monitoring modules with the ventilator.

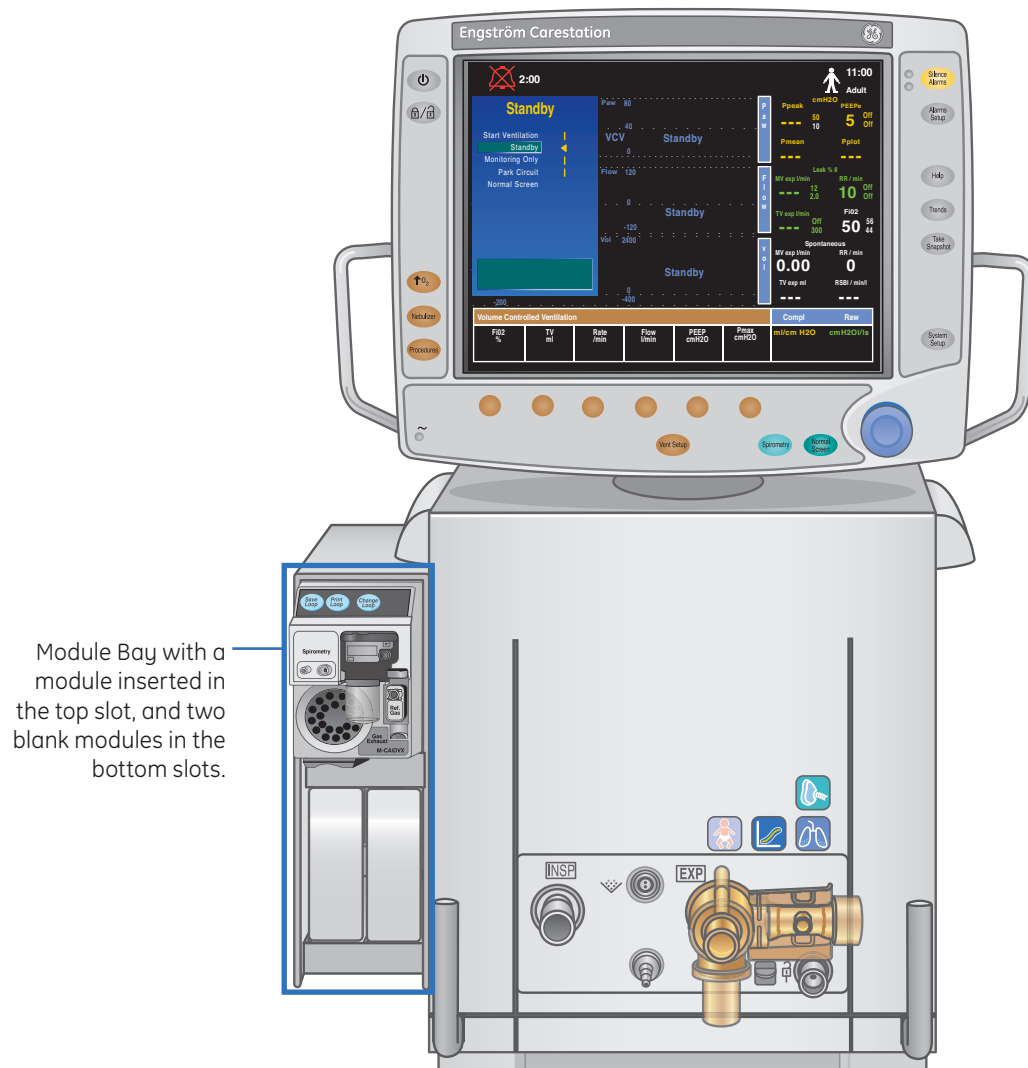


Figure 4.2 Engström Carestation with Module Bay



Note! Do not place the airway module in the lower slot when the airway module bay is on the right side of the system. Exhaust from gas exhaust port will adversely affect the airway gas module accuracy. The CO₂ and O₂ measurements from the module will be inaccurate.

Setting up the Engström Carestation for Capnography

Connection to a Patient

- Check for proper installation of the airway module. The module may be installed at any time, but the measurements will not be available until after the module has warmed up
- Check for tight connections on the airway adapter, and that it is operating properly
- Check the water trap container to be sure it is empty and properly attached
- Attach a new gas sampling line to the water trap
- Ensure the system switch is on. **Zeroing** appears if the CO₂ waveform is displayed
- When **Zeroing** disappears, connect the loose end of the sampling line to the airway adapter. Take the gas sample as close to the patient's airway as possible. Position the adapter's sampling port and spirometry port upwards to prevent condensed water from entering the sampling line

Capnography Connection Components

1. Module
2. Gas sampling line
3. Spirometry line
4. Spirometry airway adapter (D-lite sensor)

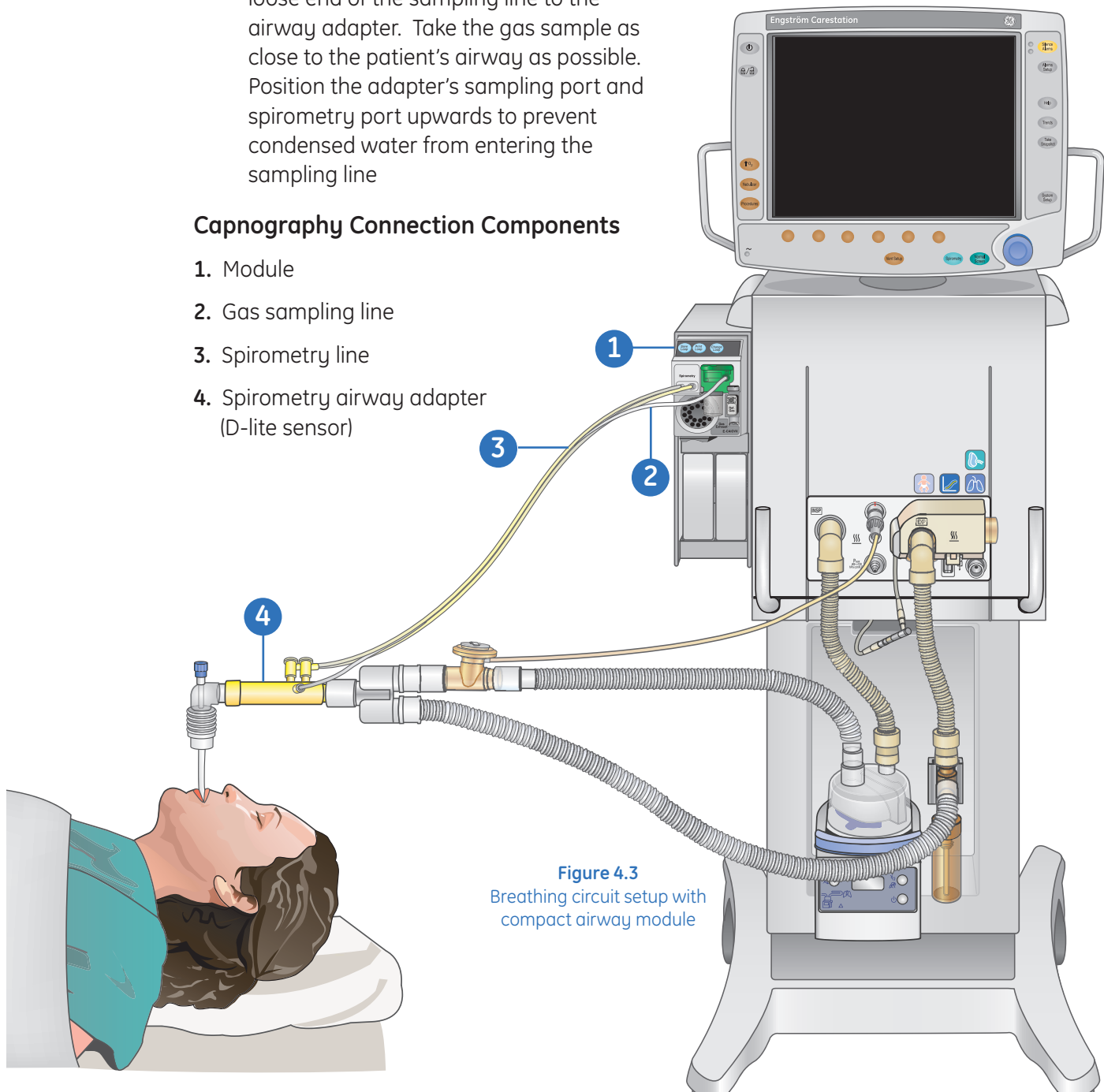


Figure 4.3
Breathing circuit setup with compact airway module

Setting a Wave Field to CO₂

If CO₂ is currently not displayed as a third wave field, change the wave field to CO₂ using the following method:

- Press the **System Setup** key and then select **Screen Setup** to access the Screen Setup menu
- Scroll down to **Wave Field 3** and press the ComWheel
- Scroll to **CO₂** and press the ComWheel
- Press **Normal Screen** on the display

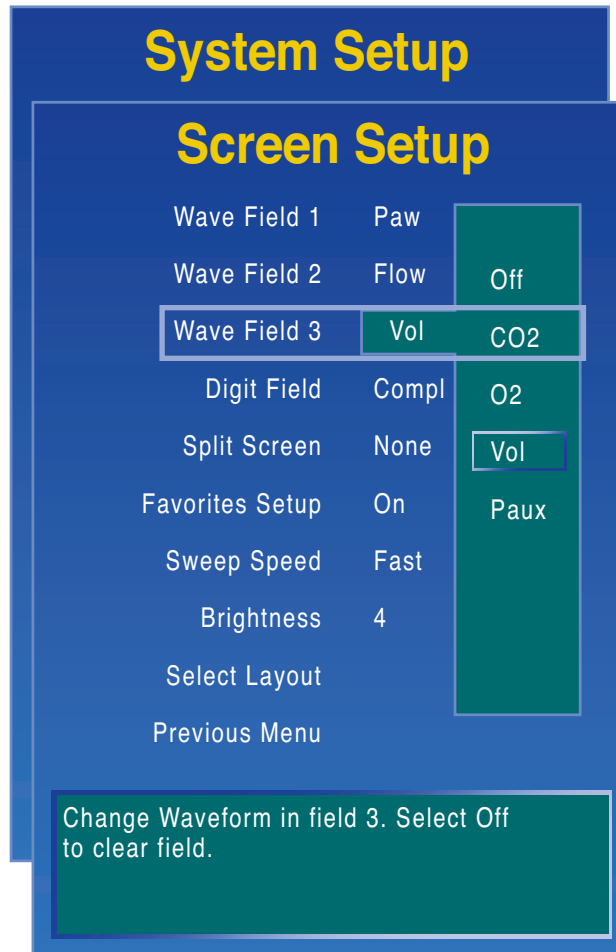


Figure 4.4 Screen Setup Menu for CO₂



Note! If it desirable to continue to monitor volume when CO₂ is assigned to Wave Field 3, assign volume as a Digit Field instead of a Wave Field.

Setting up the Engström Carestation for Viewing Energy Expenditure



Note! The Energy Expenditure (EE) Average Time entered only changes the amount of time displayed in the EE/RQ Digit field. The value does not reflect the length in time the EE value is averaged. EE is calculated breath to breath, regardless of the EE average Time set.

- Attach a spirometry airway adapter, a spirometry line, and a gas sampling line to the breathing circuit and connect the spirometry line and the gas sampling line to the compact gas module, as shown in Figure 4.4.
- Press the **System Setup** key and then select **Screen Setup** to access to access the Screen Setup menu
- Scroll down to **Digit Field** and select **EE/RQ**
- Press **Normal Screen** on the display

FRC INview

FRC Theory

The measurement of Functional Residual Capacity (FRC) represents the volume in the lungs at the end of a normal expiration. An increase in the FRC indicates hyper-inflation due to an increased resistance or a specific disease like emphysema. A decrease in FRC indicates a patient with reduced lung compliance. The FRC value calculation is accessed through the FRC INview menu. The FRC calculation is based on the nitrogen washout method using a step change in the oxygen/air concentration delivered to the patient by the ventilator.

The FRC value is calculated through the use of a spirometry airway adapter (D-lite sensor) and an airway module with energy expenditure capabilities (E-COVX, E-CAiOVX, M-COVX, M-CAiOVX).

An FRC procedure takes two measurements. When an FRC procedure is started, the system captures a baseline of N₂ concentration and then changes the set O₂ to the set FRC O₂. After a few breaths, a curve begins to plot on the graph. A measurement takes approximately 20 breaths. Upon completion of the first measurement the FRC value is displayed, the N₂ concentration is captured, and the O₂ changes back to the original set O₂. The second measurement starts. After a few breaths, the second curve begins to plot on the graph. When the second measurement is completed, the second FRC value is displayed.

Setting up the Engstrom Carestation for FRC INview

Attach a spirometry airway adapter (D-lite sensor), a spirometry line, and a gas sampling line to the breathing circuit and connect the spirometry line and the gas sampling line to the compact gas module, as shown in Figure 4.4.

Performing FRC

The FRC can be performed as a single procedure or as a series of procedures. When FRC is performed in a series, the measurements continue at the set interval until the user stops the series. Measurements are displayed numerically and graphically.



Note! A constant level of delivered O_2 is needed to capture an accurate baseline N_2 concentration for the nitrogen washout process. The first FRC measurement may be inaccurate if the delivered O_2 is changed within 5 minutes of starting an FRC measurement. Consecutive FRC measurements require a 5 minute stabilization period between measurements.

Two volume curves show in the graph and two measurements are listed in the data area below the graph.

When another FRC procedure is performed:

- The two measurements are averaged and move down one row. The values from the most recent five procedures are shown
- The two curves are averaged into one single reference curve. The four remaining curves are saved in the reference curve memory

If the value of the second measurement for the FRC procedure is not within 25% of the first FRC measurement, the curves and values are not averaged.



Note! Ensure that the airway module has warmed up for 30 minutes before performing an FRC procedure. Do not change any ventilation settings, perform any procedures that alter ventilation settings, perform a nebulization procedure, or remove an airway module during this procedure. These actions stop the current measurement, resulting in invalid data shown as dashes. To attain a valid FRC measurement there must be stable metabolic monitoring for at least 10 minutes.

1. Press **Spirometry**.
2. Select **FRC INview**.
3. Set the **FRC O_2** .
 - The FRC O_2 is adjustable to within plus or minus 10% of the set O_2 value. The FRC O_2 setting is the value used for the nitrogen washout calculation.
4. Set the **Series Interval** time if performing a series of procedures.
 - Set to 1 to 12 hours.
5. Select **Start Single** or **Start Series**.
 - The menu item changes to **Stop Single** or **Stop Series**.
 - The delivered O_2 changes to the FRC O_2 setting.
 - **FRC On** shows in the flow waveform field.
 - **Calculating FRC** shows in the general message field.

6. The FRC measurements are taken. The curve shows in the graph. The date, time, FRC, and PEEPe+i values show below the graph.
 - When performing a series of procedures, the FRC measurements continue at the set interval until the user stops the series. The **Next Start** value shows the time of the next automatic FRC procedure.
7. To show a specific reference curve, select **Reference Curve** and the time of the curve to display. The reference curve displays in a different color on the graph and in the data area.
8. To stop an active FRC procedure, select **Stop Single** or **Stop Series**.

FRC INview Scaling

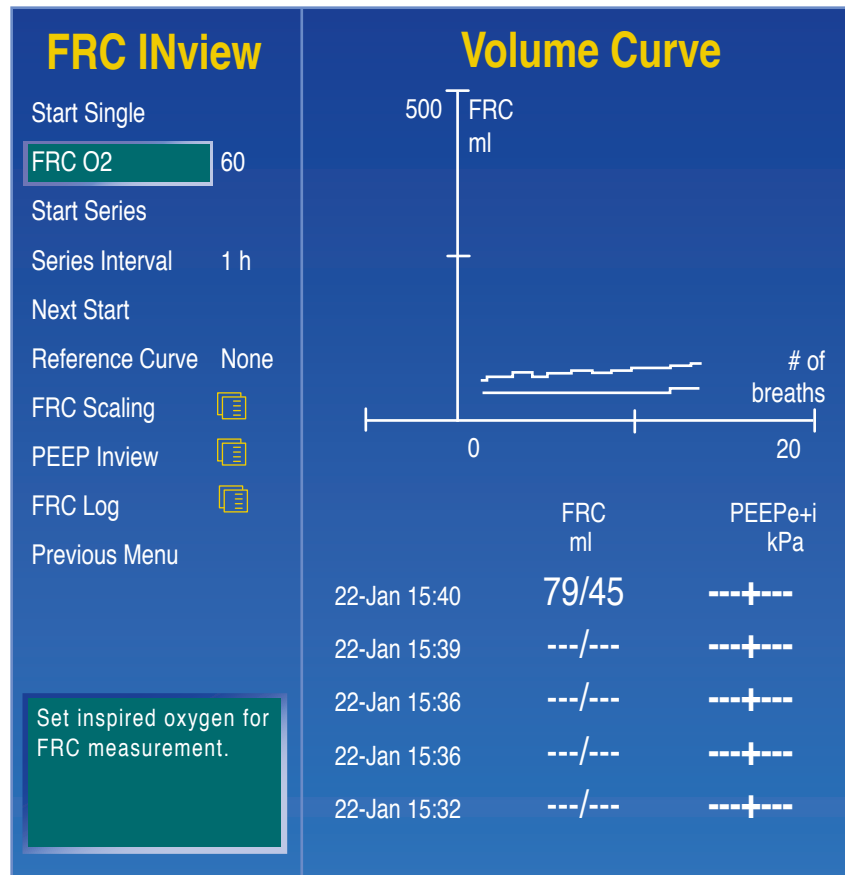


Figure 4.5 Screen Setup Menu for CO₂

The graph scaling is set to AUTO by default. To change the scaling:

1. In the FRC INview menu, select **FRC Scaling**.
2. Set the **FRC Scale** and **Breath Scale** to the desired number.
3. Select **Previous Menu** to return to the FRC INview menu.

5 Neonatal Functionality

Overview: Neonatal Functionality



After completing Neonatal Functionality of the Engström Carestation, the participant should be able to perform the following tasks:

- Set up the Engström Carestation for use on neonatal patients
- Perform a checkout for a neonatal setup
- Access the neonatal flow sensor menu
- Turn the neonatal flow sensor on and off
- Replace and calibrate the neonatal flow sensor during ventilation
- Demonstrate the ability to temporarily increase the O₂ for suctioning
- Prepare the ventilator for a patient in nCPAP mode
- Activate the nCPAP mode and change an nCPAP mode setting

Neonatal Ventilation

The neonatal option on the Engström Carestation provides ventilation for intubated neonatal patients weighing down to 0.25 kg. This is accomplished by using a proximal flow sensor at the patient Y which connects to the ventilator with a cable. This sensor allows the ventilator to deliver flows as low as 0.2 l/min and as high as 30 l/min.

Several features are included with the neonatal option:

- The calculated tidal volume per unit of weight is displayed while adjusting the tidal volume setting
- The volume delivered per unit of weight can be displayed in the digit field for continuous monitoring
- Safety related limits have been imposed on ventilation settings and alarm limits for the intended patient population

Symbols

When the neonatal patient type is active on the Engström Carestation, a symbol will appear in the upper right corner of the display. Neonatal will appear below the clock. This symbol will also appear in specific data areas when the Neo Flow Sensor is turned on.

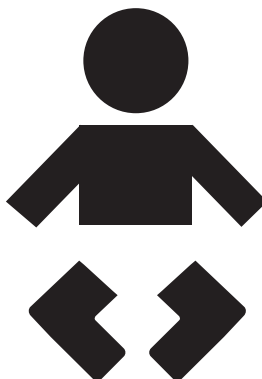


Figure 5.1 Active Neonatal Mode Symbol

Neonatal Flow Sensor

Accessing the Neo Flow Sensor Setup Menu

Press the **System Setup** key, then select **Neo Flow Sensor Setup**. Use the Neo Flow Sensor Setup menu to manually calibrate or turn the neonatal flow sensor off.

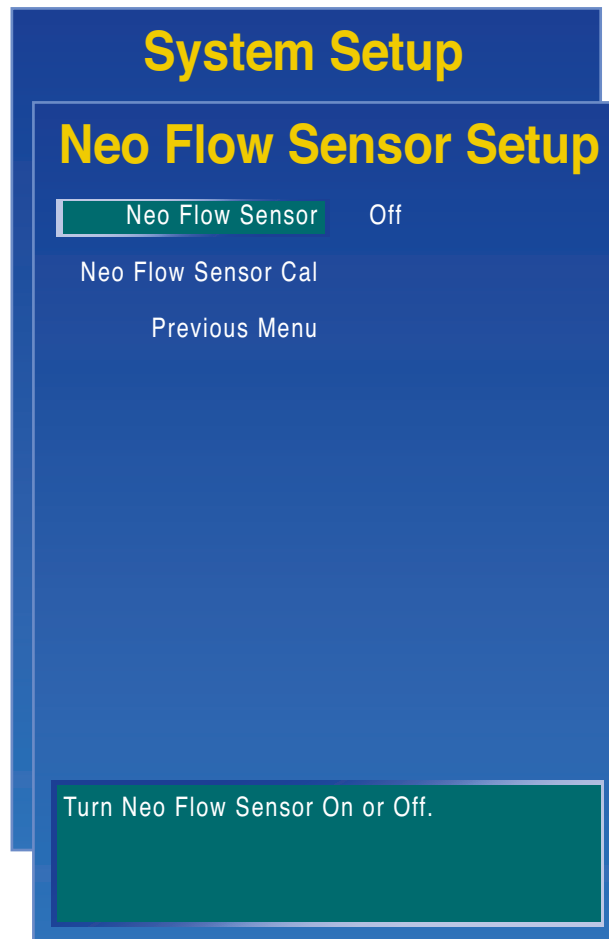


Figure 5.2 Neo Flow Sensor Setup Menu

Volume Guaranteed Pressure Support (VG-PS)

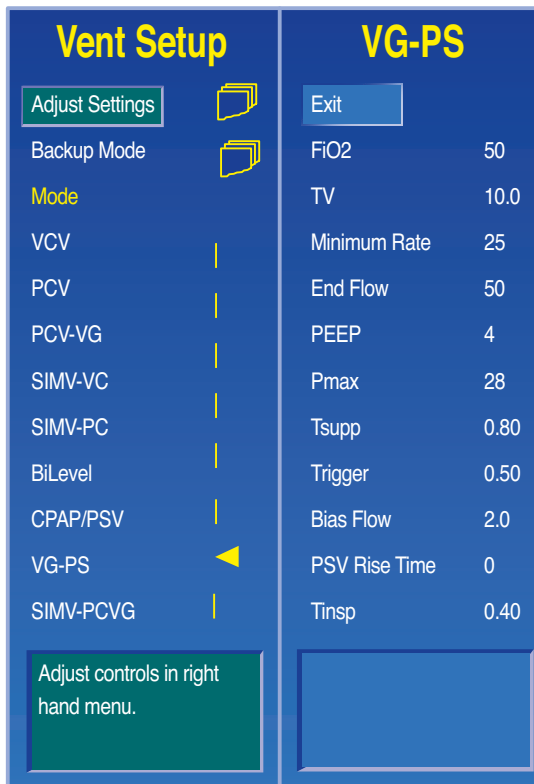


Figure 5.3 Vent Setup/VG-PS Menu

This mode is intended for use on spontaneously breathing neonatal patients.

VG-PS will deliver pressure-supported breaths at the set tidal volume at the patient-determined rate and inspiratory time while compensating for changes in the patient's lung compliance. The ventilator adjusts the pressure support level needed to deliver the set tidal volume breath-by-breath to ensure the lowest pressure is used.

When a patient effort is detected, the ventilator delivers a pressure supported inspiration that ends when (1) the patient's expiratory effort is detected by reaching the set End Flow, (2) the set tidal volume is achieved, (3) the maximum inspiratory time (Tsupp) is reached, or (4) high pressure is detected.

Upon entry into VG-PS, a minimum of two breaths or 10 seconds of volume controlled (constant flow) breaths are delivered in response to patient effort. This period of time allows the ventilator to assess the patient's lung compliance and determine the minimum pressure support level required to deliver the set tidal volume for the next VG-PS breath.

The pressure may vary between PEEP +2 cmH₂O and 5 cmH₂O below Pmax. The maximum inspiratory pressure change between breaths is +/- 3cmH₂O. If a high airway pressure alarm becomes active on the current breath, the next breath's pressure target is 0.5 cmH₂O below the current breath's pressure target.

When the Minimum Rate is set in VG-PS, the ventilator delivers backup breaths to the patient if the patient fails to breathe spontaneously over two Minimum Rate breath periods. These backup breaths are PCV-VG breaths at the set TV, Minimum Rate and Backup Tinsp settings.

The patient will not be able to end these mechanical inspirations early, but if the patient begins to spontaneously breathe again, the ventilator resumes delivering VG-PS breaths in response to each patient effort.

If selected to be active in PG-VS, backup ventilation is initiated if the Apnea alarm is triggered or if the patient's minute ventilation decreases to below fifty percent of the set MVexp low alarm. Backup settings may be changed in the Vent Setup menu.

Connecting the Neonatal Flow Sensor

The neonatal flow sensor is specifically developed for use with neonatal patients and allows proximal volume control, volume monitoring, and flow monitoring.

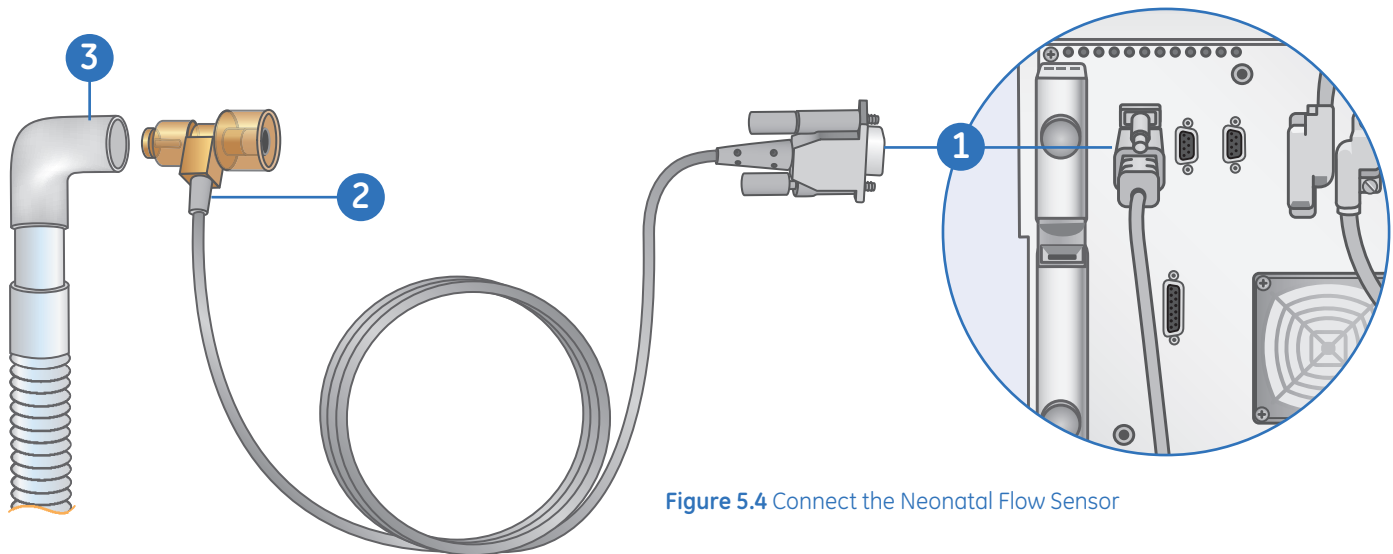


Figure 5.4 Connect the Neonatal Flow Sensor

1. Attach the neonatal flow sensor cable connector to port 1 on the back of the Engström Carestation.
2. Connect the neonatal flow sensor to the cable.
3. Connect the neonatal flow sensor to the patient breathing circuit.
4. Connect the neonatal flow sensor to the patient airway.

Turning the Neonatal Flow Sensor Off

The Engström Carestation will default to show information from the neonatal flow sensor in the neonatal option. The neonatal flow sensor can be removed to perform specific procedures (for example, nebulization). The sensor should be turned off if it is removed from the patient circuit.



Note! When the neonatal flow sensor is Off, ventilation in all modes is allowed and the ventilator uses data from the ventilator sensors.

To turn the flow sensor off:

1. Press **System Setup**.
2. Select **Neo Flow Sensor Setup**.
3. Select **Neo Flow Sensor**.
4. Select **Off**.

Calibrating the Neonatal Flow Sensor

The neonatal flow sensor can be calibrated automatically through the Checkout procedure, or manually through the Neo Flow Sensor Setup menu.



Note! The flow sensor can only be manually calibrated when the Neonatal Flow Sensor is off and when the PCV mode is active.

To calibrate the neonatal flow sensor:

1. Press the **System Setup** key.
2. Select **Neo Flow Sensor Setup**.
3. Select **Neo Flow Sensor > Off**. The sensor must be disconnected from the patient circuit and not used for monitoring during calibration.
4. Hold the flow sensor between thumb and index finger to occlude both ports at the same time.

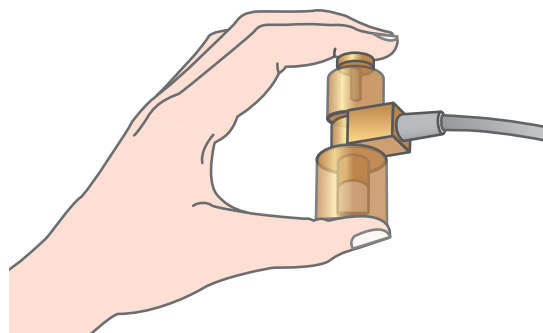


Figure 5.5 Occlude the Neonatal Flow Sensor

5. Select **Neo Flow Sensor Cal**.
6. When complete, **Pass** or **Fail** will appear next to **Neo Flow Sensor Cal**.
7. Select **Neo Flow Sensor > On** and connect the flow sensor to the patient circuit.

Cleaning the Neonatal Flow Sensor

Disassembly:

1. Disconnect the flow sensor from the patient circuit and from the sensor cable.

Cleaning:

1. Thoroughly rinse component by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute. Gently agitate flow sensor if necessary to remove debris.
2. Wash and soak parts in mild detergent and warm tap water for a minimum of fifteen minutes.
3. Thoroughly rinse component in cold water by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute.
4. Thoroughly rinse component in hot water by completely immersing in a large volume (two gallons) of sterile or potable water for a minimum of one minute.
5. Dry in room air, allowing cavities to drain.
6. Check for cracks or damage, and replace if any defects are visible.

Sterilization:

1. Place cleaned and disassembled components in a sterilization pouch.
2. Sterilization of components may be performed using any of the following three methods.
 - Gravity autoclave components at 121° C for a minimum of thirty minutes with a thirty minute drying cycle.
 - Gravity autoclave components at 134° C for a minimum of three minutes with a sixteen minute drying cycle.
 - Prevacuum autoclave components at 134° C for a minimum of three minutes with a sixteen minute drying cycle.
3. When storing parts do not remove the parts from the sterilization pouch until required for use.

Reassembly:

1. Replace flow sensor when dry.
2. Complete a system Checkout prior to use on the next patient.

Preparing the Ventilator for a Neonatal Patient

Select Patient Menu

The Select Patient menu appears as the first menu when the system starts up. The default patient type is indicated by an arrow. Select Neonatal for the neonatal settings. After entering neonatal, the system needs to be powered off and on again to select the **Adult** or **Pediatric** settings. Once the Patient Setup menu item is selected the patient type will be locked.



Note! Remove (or do not install) compact airway modules when **Neonatal** is selected as the Patient Type. If airway modules are installed, the pumps may be active though any data is disregarded by the Engström Carestation.

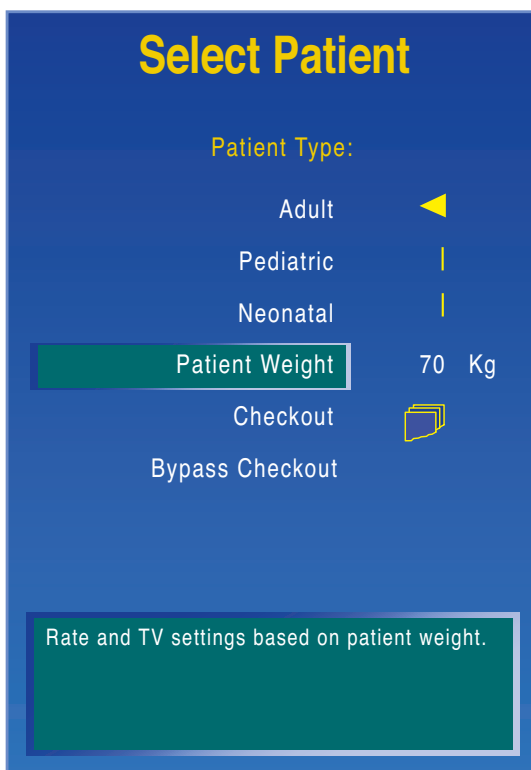


Figure 5.6 Select Patient Menu

Pre-use Checkout

The checkout for neonatal patient types includes a check and calibration of the neonatal flow sensor. Complete the checkout before using the ventilator on a new patient.

The ventilator should be fully cleaned and prepared for a patient prior to performing the checkout. If the current breathing circuit differs significantly from the previous circuit, differences in ventilation parameters due to changes in the compensation process are possible. This may result in risk to the patient. Changing patient breathing circuits to a different compressible volume after the checkout will affect the volume delivery and exhaled volume measurements.



Note! Failure to complete Checkout may result in inaccurate delivery and monitoring. Checkout should be completed with the breathing circuit that will be used during ventilation. If **Bypass Checkout** is selected, the Checkout procedure will not be performed and the system will use the compliance and resistance data from the last completed Checkout procedure.

Checkout Procedure

When in Standby, the Patient Setup menu will be displayed on the normal screen. To begin the Checkout procedure:

1. Select **Checkout**.
2. Attach the neonatal flow sensor to the breathing circuit that will be used for ventilating the current patient.
3. Occlude the neonatal flow sensor with the occlusion port, as shown below

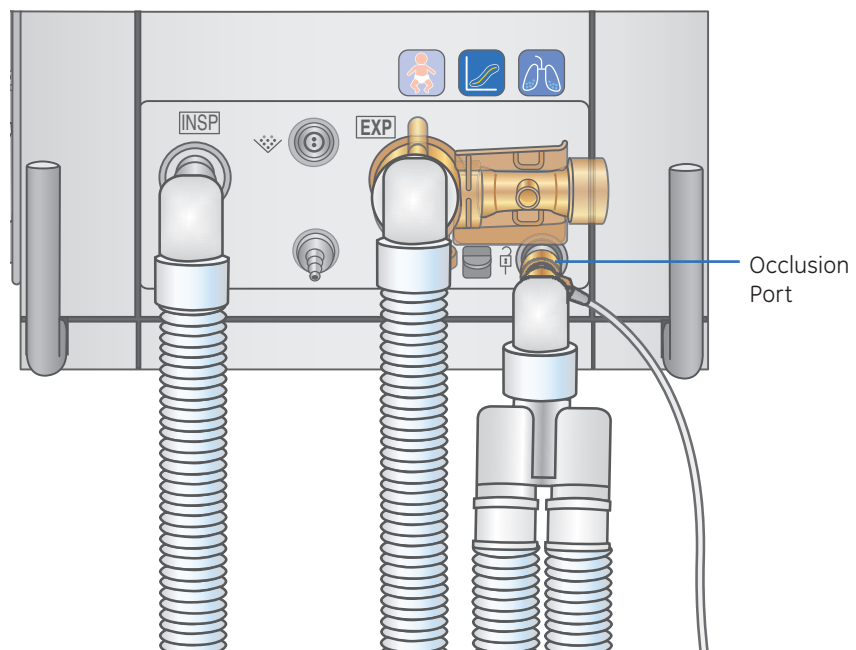


Figure 5.7 Flow Sensor Occlusion

4. Select *Start Check*.

- The results appear next to each check as they are completed.
- During the checkout process, the Neo Flow Check menu appears on the display and a tone sounds.
- Remove the occlusion from the neonatal flow sensor, keeping the flow sensor attached to the patient circuit.
- The system will detect the occlusion removal and automatically continue the checkout.
- If the flow sensor does not pass the first part of this check, **Fail** appears on the Checkout menu and the Neo Flow Check menu does not appear. (The Neonatal Flow sensor has a ninety day warranty.)
- When the entire checkout is finished **Checkout complete** will appear and the highlight will move to **Delete Trends**.

5. Select *Yes* to erase trends or *No* to retain the saved trends.**6. If one or more checks failed, select *Check Help* for troubleshooting tips. Perform Super User calibrations if Check Help is not successful.****7. If all tests passed, select *Normal Screen* to exit or select *Patient Setup* to access the Patient Setup menu.**

Note! *The circuit leak is measured at 25 cmH₂O. The resistance that is displayed is only from the inspiratory side. If the circuit leak is greater than 0.5 l/min or Resistance or Compliance cannot be calculated, the Circuit Check will fail. If the circuit leak is greater than 0.5 l/min or if the exhalation flow sensor is changed after Checkout, the expiratory tidal volume measurement may have decreased accuracy. If the Relief valve failure alarm activates after system check then system will not ventilate.*

Performing Procedures

Increase O₂ and Suction

Both the increase O₂ and the suction procedures involve an increase in oxygen. The increase in oxygen will default to either the current O₂ setting plus the Neonatal Increase O₂ setting, or 100%, whichever is less.

Oxygen may be increased in increments of 5% for neonatal patients during Oxygenation and Suction procedures.



Note! Neonatal Increase O₂ increments must be set prior to the ↑O₂ or suction procedure.

To set increased oxygen increments, follow these steps:

1. Access **Install Service > Ventilator Settings > Neonatal Increase O₂**.
2. Adjust the setting and press the ComWheel to confirm. The increment selected will be added to the current O₂ setting for neonatal patients during the ↑O₂ and suction procedures.
3. Press **Normal Screen** to exit.

Nebulizer

The Aereoneb Pro Nebulizer System can be used with neonatal patient types. An adapter is available for neonatal patient circuits. Refer to the Parts section of the User's Reference Manual for more information.



Note! To prevent damage to the neonatal flow sensor, remove it from the patient circuit during the delivery of nebulized medication and turn the Neo Flow Sensor Off.

Neonatal Nasal CPAP Mode

Theory of Operation

The NIV option includes Neonatal Nasal CPAP (nCPAP) functionality. The Neonatal nCPAP mode is to be used only with neonatal patients and is only available when both Neonatal and Non-invasive options are installed.



Note! *The neonatal flow sensor is not utilized during nCPAP.*

Neonatal nCPAP mode delivers gas into the infant's airway through a nasal cannula, nasal prong, or nasal mask. In nCPAP, a pressure above ambient pressure is maintained on the patient's airway. The patient determines their own rate, tidal volume, and inspiratory timing. The system provides a constant bias flow delivered at the set FiO₂ level. Constant airway pressure is controlled with the exhalation valve.

Backup ventilation is not available while using nCPAP. To account for patient conditions where large leaks may be present, the Apnea Time, Leak Limit, and MVexp low arms may be turned Off while in nCPAP. When any of these alarms are Off, a medium priority alarm activates to notify the user of the alarm status. Pressing the **Silence Alarms** key will de-escalate the alarm priority to an informational alarm. This action serves as user confirmation of the alarm setting. The informational alarm will remain on the screen while the corresponding alarm is Off.



Note! *If the Apnea Time, Leak Limit, or MVexp low alarms are set to **Off**, additional monitoring such as (but not limited to) SpO₂, ECG, CO₂ is recommended to protect the patient from hypoventilation.*

When using nCPAP, the patient should demonstrate all of the following characteristics:

- *Patient is responsive*
- *Patient is spontaneously breathing*
- *Patient has a controlled airway*
- *Patient does not need ventilatory support through PSV*
- *Patient needs oxygen therapy*

Preparing the Ventilator for a Patient in nCPAP mode

The Select Patient menu appears as the first menu when the system starts up. The default patient type is indicated by an arrow.

1. Select the **Neonatal** patient type.
2. Select **Checkout** or **Bypass Checkout**.
 - Select **Checkout** to run pre-use checkout, then select the **Patient Setup** menu.
 - Select **Bypass Checkout** to access the Patient Setup menu without running the pre-use checkout.



Note! If **Bypass Checkout** is selected, the Checkout procedure will not be performed and the system will use the compliance and resistance data from the last completed Checkout procedure.

3. Select **Non-invasive > nCPAP**.
 - The nCPAP mode is only available for Neonatal patient types.
 - The Vent Setup menu is not available for nCPAP mode. All settings will appear in the ventilator settings area.
4. Press **Alarms Setup** to ensure settings are appropriate for the patient.
 - Press **Normal Screen** to clear menu.
5. Select **Start Ventilation**.

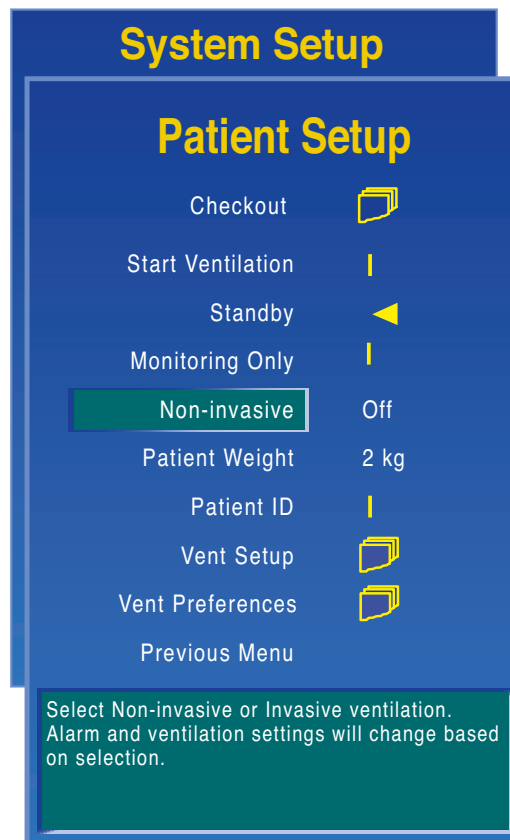


Figure 5.8 Patient Setup Menu

Recommended non-invasive ventilation interfaces

The following interfaces for NIV have been tested and are recommended by GE Healthcare for use with the Engström Carestation nCPAP modes.

NIV patient interfaces shall consist of patient masks that do not incorporate an entrainment valve. Patient circuits for nCPAP must be dual-limb circuits (i.e. has connections for both the inspiratory and expiratory ports of the Engström).

nCPAP interface requires the following recommended and tested components:

- Fisher & Paykel Infant breathing circuit RT131
- Humidification chamber MR225
- Nasal tubing BC180
- Appropriately sized nasal prongs

Changing from nCPAP Mode to Invasive Mode

1. Press **System Setup**.
2. Select the **Patient Setup** menu.
3. Disconnect the patient.
4. Select **Standby**.
5. Select **Non-invasive > Off**.
6. Select **Vent Setup** to ensure settings are appropriate for the patient.
7. Press **Alarms Setup** to ensure settings are appropriate for the patient.
8. Press **Normal Screen** to clear menu.
9. Select **Start Ventilation**.

Changing from Invasive Mode to nCPAP Mode

1. Press **System Setup**.
2. Select the **Patient Setup** menu.
3. Disconnect the patient.
4. Select **Standby**.
5. Select **Non-invasive > nCPAP**.
 - The nCPAP mode is only available for Neonatal patient types.
 - Vent Setup menu is not available for nCPAP mode. All settings will appear in the ventilator settings area.
6. Press **Alarms Setup** to ensure settings are appropriate for the patient.
7. Select **Normal Screen** to clear menu.
8. Select **Start Ventilation**.

Changing nCPAP Mode Settings

The nCPAP mode settings may be changed by using the Quick keys. The only parameters that may be changed in nCPAP mode are:

- FiO₂
- PEEP
- Bias Flow
- Trigger



6 Super User Details

Overview: Super User Details



After completing Super User Details of the Engström Carestation, the participant should be able to perform the following tasks:

- Access the Install/Service menu and describe each setting
- Change the defaults for the Favorites Bar
- Turn the touchscreen on and off
- Set the modes that will have backup ventilation
- Set the modes that will be available in the Vent Setup menu
- Change the default settings for Timing, Flow, BiLevel and CPAP Rate
- Change the default settings for Wave Field 3, Digit Field and Split Screen
- Access the Defaults menu and view the current defaults
- Set the default patient type
- Change the default setting for Patient Types.
- Calibrate the O₂ and Air Flow Control Valves
- Calibrate the Exhalation Valve
- Perform the Backlight Test
- Perform a Gas Calibration
- Access the User Maintenance and Airway Module Preventative Maintenance schedules
- Identify the three possible fan filter locations
- Identify the Engström Carestation serial number
- Access the Tech Support number
- Copy a configuration from system to system
- Access the Data Transfer Settings and Setup menus

Install/Service Menu Overview

Accessing the Install/Service Menu



Note! Do not enter the Install/Service menu when a patient is connected to the ventilator. Ventilation will cease, and the ventilator must be powered down in order to get back into Therapy.

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.



Note! Do not enter the Install/Service menu when a patient is connected to the ventilator. Ventilation will cease, and the ventilator must be powered down in order to resume Therapy.

Changes made in the Installation mode will affect the system configuration. All changes made are permanent and preserved until changed again.

Features of the Install/Service Menu



Note! Changes made in the Installation mode will affect the system configuration. All changes made are permanent and preserved until changed again. These changes should only be made by the person responsible for the configuration of the ventilator.

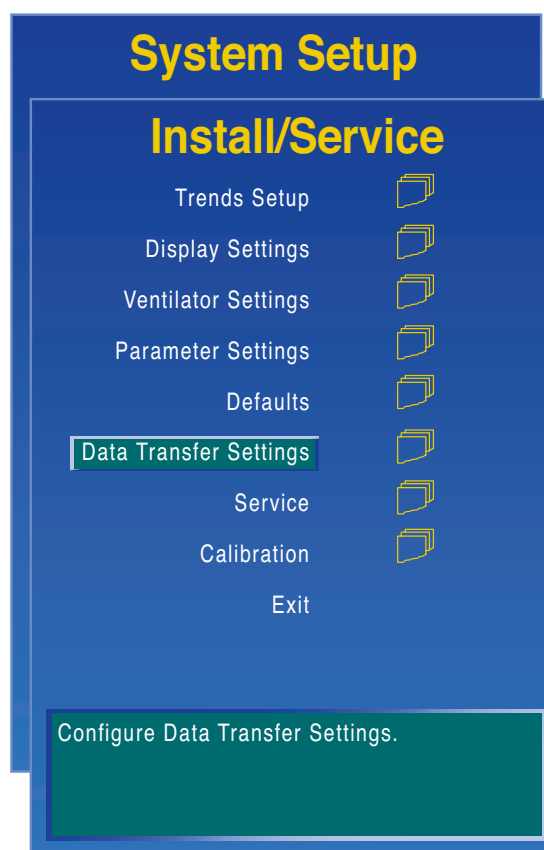


Figure 6.1 Install/Service Menu

Install/Service Menu Options • Table 6.1

Trends Setup:	Sets the default trend and assign graphical trend fields.
Display Settings:	Sets the display settings for Colors, Units, Alarm Limits On/Off, Time and Date, Layout Selection, Favorites and Touchscreen .
Ventilator Settings:	Sets the default ventilator settings for Timing, Flow, BiLevel Timing, BiLevel High Pressure, CPAP Rate, Modes with Backup, Mode Availability, Selected Modes and Neonatal Increase O₂ .
Parameter Settings:	Sets TV Based on to ATPD or BTPS , and sets CO₂ Numbers to Dry or Wet .
Defaults:	Programs the initial settings when the ventilator is first powered on
Data Transfer Settings:	Transfers data from the Engstrom Carestation to a PC using a USB drive or SD card.
Calibrations:	Selects several calibrations and tests.
Service:	Advanced features such as system configuration. Requires additional password.

Changing the Favorites Bar Defaults

The Favorites Bar is preset with seven factory default functions and procedures: Manual Breath, SBT, Lung Mechanics, Vent Preferences, Backup Mode, Alarm History, and Favorites Setup.

These defaults may be changed to configure the Favorites Bar to the user's or facility's preference.

1. To change or view the Favorites defaults the system must be in Standby.
2. Press the **System Setup** key.
3. Select **Install/Service** and enter the password.
4. Select **Display Settings > Favorites**. The Favorites Factory Settings menu displays with the highlight on the Scroll Settings menu item.
 - Select **Scroll Settings** to view either the factory default settings or the facility default and current settings
 - Select **Bar Default On** or **Off** to display the Favorites Bar
 - Select **Facility** to view the facility default and current settings
 - Select **Factory** to view the factory default settings
 - Select **Save Current** to save the current settings
 - Select **Factory Reset > Yes** or **No** to return the Favorites Bar to factory set defaults
5. Select **Previous Menu**.
6. Turn the ventilator off. New settings are displayed after power up.

Turning the Touchscreen On or Off

Touchscreen is enabled when the Touchscreen hardware is detected at startup and the touchscreen is set to **On**.

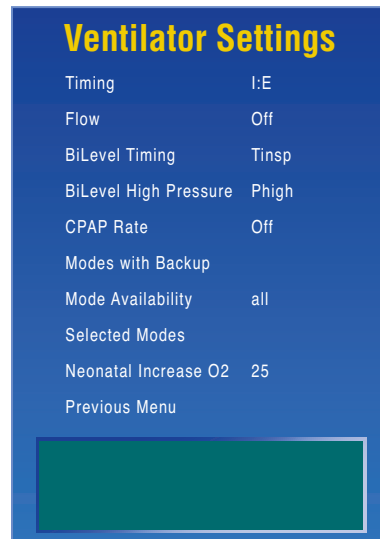
To turn the touchscreen On or Off:

1. Press the **System Setup** key.
2. Select **Install/Service** and enter the password.
3. Select **Display Settings > Touchscreen**.
4. Select **On** or **Off** and confirm the selection.



Note! If the Touchscreen is turned Off, the Favorites Bar will no longer be accessible or displayed.

Ventilator Settings



Ventilator Settings Menu

Use the Ventilator Settings menu to set facility defaults.

Figure 6.2 Ventilator Settings Menu

Ventilator Settings Menu Options • Table 6.2

Timing:	Select I:E , Tinsp , or Tpause . (Tpause is only available when Flow is set to On .) <ul style="list-style-type: none"> Select I:E setting to display in VCV, PCV, PCV-VG ventilation modes and Tinsp setting to display in SIMV-VC and SIMV-PC ventilation modes. Select Tinsp setting to display in all ventilation modes. Select Tpause setting to display in volume modes and Tinsp setting to display in pressure modes.
Flow:	Select On to display Flow as a ventilator setting in VCV and SIMV-VC ventilation modes. (Tpause Timing is available when Flow is set to On .) Select Off to display Insp Pause as a ventilator setting in VCV and SIMV-VC ventilation modes.
BiLevel Timing:	Select I:E to use the I:E and Rate settings, select Tinsp to use the Tinsp and Rate settings, or select Thigh to use the Thigh and Tlow settings for the BiLevel ventilation mode.
BiLevel High Pressure:	Select Phigh or Pinsp to display in BiLevel high pressure. <ul style="list-style-type: none"> If Phigh is selected, the BiLevel ventilation mode will use Phigh as the High Pressure setting and the upper pressure level (Ptot) will display as Phigh. If Pinsp is selected, the BiLevel ventilation mode will use Pinsp as the High Pressure setting and the upper pressure level (Ptot) will display as the sum of Pinsp and Plow.
CPAP Rate:	Select On to display Rate, Pinsp, and Tinsp settings in the Vent Setup and SBT menus for the CPAP/PSV ventilation mode.
Modes with Backup:	Allows user to select modes that will allow backup ventilation such as SIMV-VC, SIMV-PC, BiLevel, CPAP/PSV, SIMV-PCVG, and VGPS. Certain modes may not be available depending on system configuration.
Mode Availability:	Select All to use all ventilation modes or Selected to use a customized list of ventilation modes at power up.
Selected Modes:	The Selected Modes menu can be used to set the customized ventilation mode list that will be available on the Vent Setup menu. When the Select Layout menu is accessed, the user can choose between All or Selected Vent modes.
Neonatal Increase O2:	Select a value to add to the current O ₂ setting for Oxygenation and Suction procedures for neonatal patients.

Mode Availability and Select Modes

Mode Availability can be set to **All** or **Selected**. When set to **Selected**, the Selected Modes menu can be used to set vent modes that will be available on the Vent Setup menu.

To access **Mode Availability** and **Selected Modes**:

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Ventilator Settings**.
5. Select **Mode Availability** or **Selected Modes**.

Modes with Backup Menu



Note! *The settings in the Modes with Backup menu determine which modes will have backup ventilation when insufficient spontaneous breathing is detected. Before deactivating backup ventilation for a specific mode, ensure that all users at the facility have been trained and notified of these settings.*

To set the modes that will have backup ventilation:

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Ventilator Settings**.
5. Select **Modes with Backup**.
6. Scroll to each mode available and select either **Yes** or **No**.

Changing Defaults

Changing Default Settings for Timing, Flow, BiLevel and CPAP Rate

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Ventilator Settings**.
5. Select default settings for **Timing, Flow, BiLevel** and **CPAP Rate**.



Note! Changing the default settings for **Timing, Flow, BiLevel** and **CPAP Rate** will change the defaults for ALL patient types.

Changing the Default Settings for Wave Field 3, Digit Field and Split Screen

1. Assign the desired values for **Wave Field 3, Digit Field** and **Split Screen** through the **System Setup > Screen Setup** menu.
2. Press the **System Setup** Key.
3. Select **Install/Service**.
4. Enter the code provided to you by the clinical trainer.
5. Select **Defaults**.
6. Select **Save Current > Yes**



Note! Changing the default settings for **Wave Field 3, Digit Field** and **Split Screen** will change the defaults for ALL patient types.

Accessing the Defaults Menu

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Default**.



Note! Defaults are the initial settings when the ventilator is first powered on. Many of these may be changed to configure the ventilator to the facility's preference.

Defaults

Scroll Settings

Default Type Neo

View

- Adult
- Pediatric |
- Factory |
- Neonatal |
- Neo Factory |

Save Current No

Factory Reset No

Previous Menu

Push ComWheel to scroll default settings.

Adult Settings

	Saved	Current
Vent Mode	BiLevel	BiLevel
FiO2	50	50
TV	—	—
Pinsp	—	—
Rate	—	—
I:E	—	—
Tinsp	—	—
Tpause	—	—
PEEP	—	—
Psupp	5	5
Pmax	30	30
Plimit	—	—
Insp Pause	—	—
Phigh	10	10
Plow	Off	Off
Thigh	1.7	1.7
Tlow	4.25	4.25
Flow	—	—
Pause Time	100	100
PSV Pause Time	50	50

Figure 6.3 Defaults Menu



Note! If the Neonatal option is not installed the neonatal menu items will not be selectable.

Setting the Default Patient Type

The Default Type indicates the default Patient Type in the Select Patient menu on power up. Selections are **Adult**, **Ped**, and **Neo**.

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Defaults**.
5. Select **Default Type**.
6. Select **Adult**, **Ped** or **Neo**.

Viewing Default Settings

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Defaults**.
5. Select from the following Defaults: **Adult**, **Pediatric**, **Factory**, **Neonatal** or **Neo Factory**.
6. Select **Scroll Settings** to scroll through the current default view.

Changing Default Settings for Patient Types

1. Turn the ventilator on.
2. Select the desired patient type, ventilation mode, ventilation settings and alarm limits.
3. Press the **System Setup** key.
4. Select **Install/Service**.
5. Enter the code provided to you by the clinical trainer.
6. Select **Defaults > Save Current > Yes**.
7. Turn the ventilator off.

Repeat the process for all other patient types.



Note! *Factory defaults are the settings Datex-Ohmeda has installed. These cannot be changed. To return the ventilator to the factory defaults, select **Factory Reset > Yes**.*

Calibration

Recommend Calibration Frequency

Several calibrations and tests may be performed through the Calibration menu. Selecting a menu item will automatically begin the calibration or test. Calibrations can be performed more frequently, as needed, for optimal performance.

Recommended Calibration Frequency • Table 6.3

Calibration	Recommended Frequency
O ₂ FCV	6 months
Air FCV	6 months
Exhalation Valve	6 months
Backlight Test	1 month
Gas Calibration	2 months

Accessing the Calibration Menu

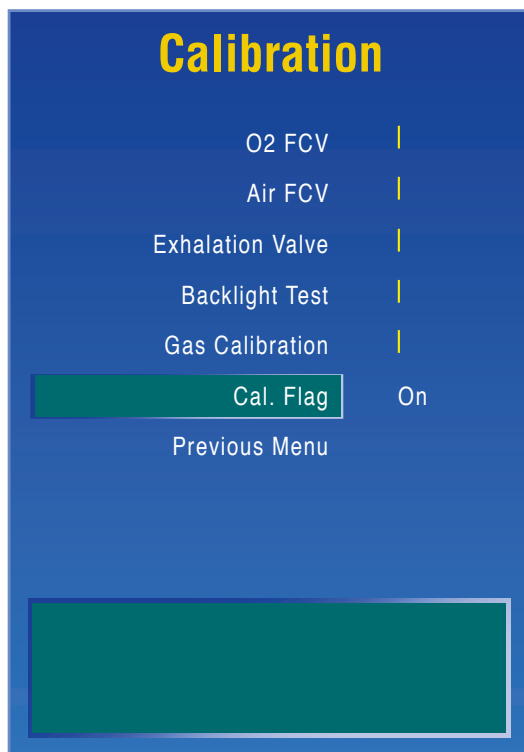


Figure 6.4 Calibration Menu

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Calibration**.

Calibration Procedure for O₂ FCV

On the Calibration menu, select O₂ FCV.

1. On the O₂ FCV menu, select **Start Calibration** and allow the system to perform the calibration procedure.
2. When O₂ FCV calibration is complete (passed), select **Previous Menu**.

Calibration Procedure for Air FCV

On the Calibration menu, select **Air FCV**.

1. On the Air FCV menu, select **Start Calibration** and allow the system to perform the calibration procedure.
2. When Air FCV calibration is complete (passed), select **Previous Menu**.

Calibration Procedure for Exhalation Valve

On the Calibration menu, select **Exhalation Valve**.

1. Connect a patient circuit and block the patient port.
2. On the Exhalation Valve menu, select **Start Calibration** and allow the system to perform the calibration procedure.
3. When Exhalation Valve calibration is complete (passed), select **Previous Menu**.

Calibration Procedure for Backlight Test

On the Calibration menu, select **Backlight Test**.

1. Select **Start Test**.
2. The display will show the test running on light 1 and then on light 2. If the display goes completely blank or flickers during the test, one of the lights has failed.



Note! The screen brightness may change during test.

3. Turn power off to exit the Install/Service menu.

Procedure for Gas Calibration



Note! Calibrate compact airway modules once every two months or whenever there are indications of errors in the gas readings. Only use Datex-Ohmeda calibration gas. Do not use any other calibration gases or the calibration will not succeed.

Specific part numbers for calibration gas and regulators are listed below. Several modules use the same gas and regulator style.

Calibration Gas and Regulator • Table 6.4

E Modules	M Modules	Calibration Gas	Regulator
E-miniC	M-miniC	755587 (US only) 755581	M1006864 (US only) 755534
E-CO	M-CO		
E-COV	M-COV		
E-COVX	M-COVX	755571 (US only) 755583	
E-CAiO	M-CAiO		
E-CAiOV	M-CAiOV		
E-CAiOVX	M-CAiOVX		

To calibrate the gas module:

1. Turn on the ventilator. Let the gas module warm up for 30 minutes before starting calibration.
2. Attach the regulator to the calibration gas cylinder.
3. Attach a new sampling line to the water trap. Connect the loose end of the sampling line to the regulator on the calibration gas cylinder.
4. Press **System Setup**.
5. Select **Parameters Setup > Gas Calibration**. Calibration will begin as soon as the menu item is selected.
6. Wait until **Feed Gas** appears after each gas.
7. Open the regulator and feed calibration gas until the message **OK** or **Adjust** appears.
 - If an error occurs during calibration or if no gas is fed, **Cal. Error** appears after each gas. Press the ComWheel to perform a new calibration.
8. If adjustments are needed:
 - Select the gas to be adjusted and press the ComWheel.
 - Use the ComWheel to change the value until it matches the calibration gas cylinder value.
 - Press the ComWheel to confirm the change.
 - Repeat for each gas requiring adjustment.




Note! During gas calibration % units are used for CO₂ regardless of selected measuring units.

Maintenance Schedule

Calibrations should be completed every 6 months, whenever performance is questioned (such as a failure of checkout), or when associated components are serviced or replaced. Calibrations can be completed more frequently, as needed, for optimal performance.

User Maintenance • Table 6.5

Minimum Frequency	Maintenance
During cleaning and setup	Inspect the parts for damage. Replace or repair as necessary.
As necessary	 IMPORTANT: Batteries will slowly discharge when the system is not plugged in. It is recommended to periodically plug the system in to AC mains to recharge the internal batteries. Empty the water trap on the exhalation valve housing. Empty the water trap on the air pipeline inlet fitting and replace the filter. Remove and clean the fan filters. Clean and replace the expiratory flow sensor. Clean and replace the neonatal flow sensor.
Weekly	Check air inlet filter mat for Evair compressor cabinet and clean with compressed air. Replace if necessary.
Monthly	Complete a Backlight Test.
Every two months	Complete Gas Calibration, if using an airway module.
Every six months	Complete calibrations for the O ₂ Flow Control Valve, Air Flow Control Valve, and the Exhalation Valve.
Annually	Battery Performance Test - Internal batteries must undergo a discharge test annually. Schedule annual service and maintenance check for Engström system, Airway module, and EVair compressor.

Airway Module Preventative Maintenance • Table 6.6

Minimum Frequency	Maintenance
Daily	Replace the D-fend.
Every two months	Complete Gas Calibration
Annually	Schedule annual maintenance check.

Recommended Part Replacement Period • Table 6.7

Item	Interval	Number of Cleaning Cycles
Exhalation Valve Assembly 1505-8568-000	12 months	50
Diaphragm 1505-3224-000	12 months	50
Adult Flow Sensor 1505-3231-000	6 months	50
Neonatal Flow Sensor 1505-3272-000	6 months	25

Fan Filter Location

There are three possible fan filter locations on the Engström Carestation:

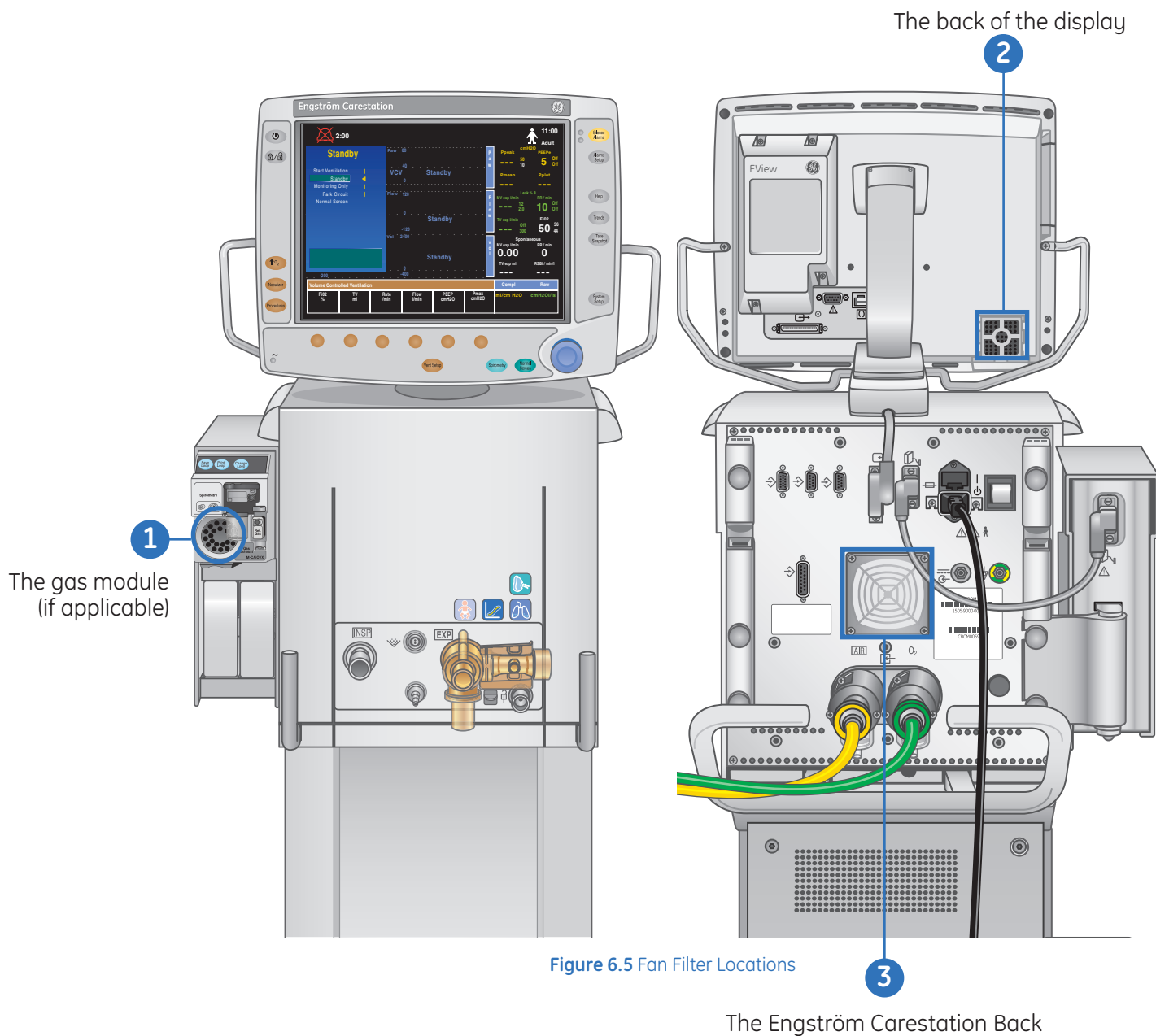


Figure 6.5 Fan Filter Locations

Contacting Technical Support

Serial Number Location

Before contacting Customer Service or Technical Support, be sure to write down the serial number of the unit if you have a question or comment about a specific machine. The serial number can be found on the rear of the unit as shown below. There are two bar codes with associated numbers. The bottom barcode and number is the serial number.

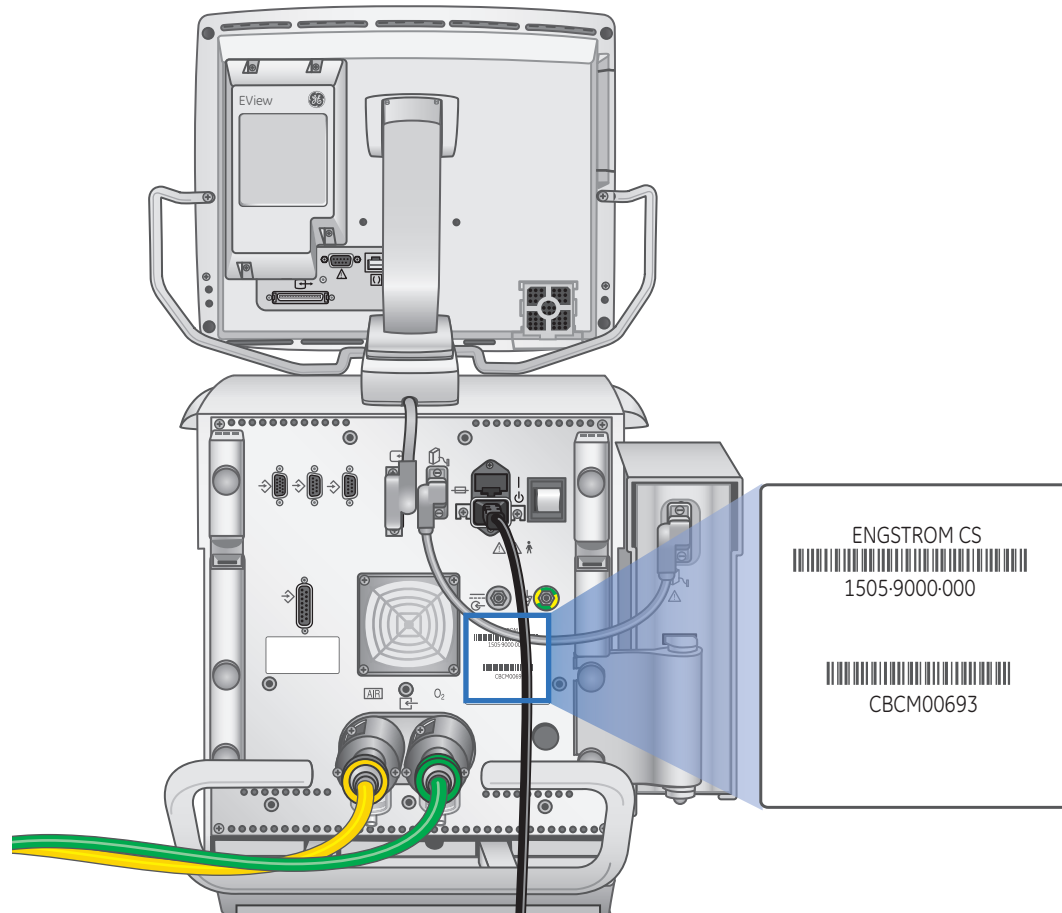


Figure 6.6 Serial Number Location

Technical Support Number



To contact Technical Support in the U.S., call the Customer Service number at: **(800) 345-2700.**

Copying Configurations from System to System

Using the Copy Config Menu

The Copy Config menu is used to save or install configurations and default settings using a memory card. This is useful when configuring multiple machines. To access the Copy Config menu:

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Service**.
5. Enter the Service code provided to you by the clinical trainer.
6. Select **Copy Config**.

Copy Configuration • Table 6.8

Menu Item	Message Text	Values	Comments
Save to Card	Save Configuration and defaults to card.	<blank>, Fail, or OK. The field is blank until the data has either been written to the card (OK) or the system determines it cannot write to the card (Fail).	Saves all settings that are not hardware dependent, including facility defaults, screen configuration, trend settings, colors, units, decimal marker, altitude, patient type, backup settings, and the Show Alarm Limits selection.
Copy from Card	Copy Configuration and defaults from card. When completed: Copy from card complete. Please reboot system.	<blank>, Fail, or OK. The field is blank until the data has either been read from the card (OK) or the system determines it cannot read the card or the card does not have the required data (Fail).	



Note! Systems cannot accept configuration files from a different product model. The software version is stored with the saved configuration. A system will reject any configurations from other than the current version of software. Selecting Save to Card overwrites any configuration on the card.

Data Transfer with EView

The EView electronic data logging device is an optional accessory which allows patient and ventilator data to be downloaded from the Engström system. Data is transferred by using a SD media card or a USB flash drive, then uploaded onto a PC. Data can be examined and stored electronically or can be printed for use in a patient's medical records. The data from the EView is comprised of procedure data, ventilator settings, measured data and numerics, waveforms, alarms, checkout data, and snapshots. Desired data can be user-configured to meet facility needs.



Note! *The Enhanced Serial Port and Engström System 5.05 software or greater are required to operate EView. To upgrade from the Standard Serial Port to the Enhanced Serial Port, order Enhanced Serial Port M1057953.*

Data Transfer Settings Menu

To access the Data Transfer Settings menu:

1. Press the **System Setup** key.
2. Select **Install/Service**.
3. Enter the code provided to you by the clinical trainer.
4. Select **Data Transfer Settings > Transfer Media**.
5. Select **USB, SD, or Both**.
 - If USB is selected, SD will be disabled.
 - If SD is selected, USB will be disabled.
 - If Both is selected, USB and SD will be enabled.

Data Transfer Setup Menu

To access the Data Transfer Setup menu:

1. Press the **System Setup** key.
2. Select **Data Transfer Setup**.



Note! Use the Data Transfer Setup menu to select settings for desired patient data transfer.

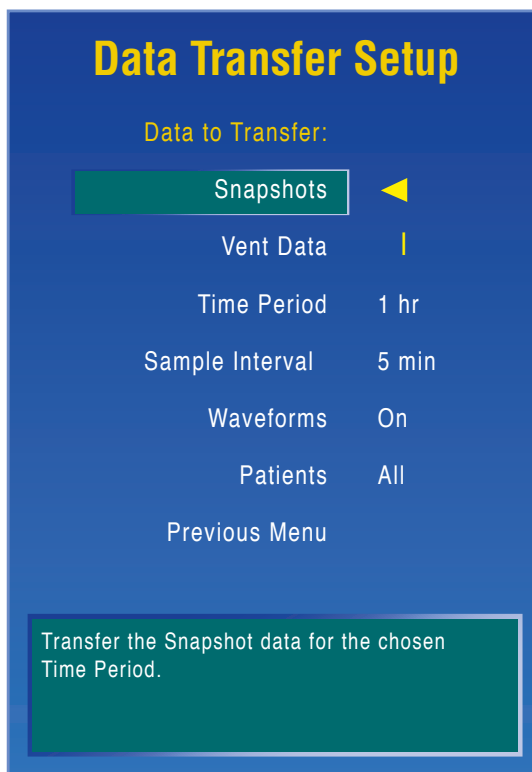


Figure 6.7 Data Transfer Setup Menu

Data Transfer Setup Menu Options • Table 6.9

Snapshots:	Collects only the snapshots data for the chosen Time Period. Snapshots is similar to a Vent Check option. If Snapshots is selected, a Time Interval value is not needed.
Vent Data:	Collects all available data at the Sample Interval for the chosen Time Period.
Time Period:	Sets time period for which the data transfer will span. Time period may be from 15 minutes to 7 day increments.
Sample Interval:	Available only if Vent Data is selected. Set the sample interval for: Every Breath, 1, 5, 10, 15, 30 and 60 minute intervals.
Waveforms:	Setting to On will capture waveform data, setting to Off will exclude waveform data.
Patients:	Select All to transfer patient data for all patients during the selected Time Period. Select Current to transfer only the patient data for the current patient.

Transferring EView data to USB or SD

1. Insert the designated media type (SD card or USB flash drive).
 - Insert the SD card with card label facing away from the display.
 - Do not force media into corresponding port/slot connections as damage could occur.
2. The blue data transfer LED turns on to signify that the requested data is being downloaded.
 - The time of transfer is dependent upon the amount of data being transferred and the speed and size of the transfer media used.
 - For example, if **Breath** is selected for the sample interval and **Waveforms** is turned **On** in the Data Transfer settings, data transfer could possibly take up to one hour per day of data transferred.
3. Remove media when the blue LED turns off.



Note! Use only the blue LED on EView for download status. The LED on the USB flash drive does not pertain to downloading through EView. Do not remove media or shutdown the Engström ventilator before the blue LED has illuminated or during download as this could corrupt data on the SD card or USB flash drive.

Transferring EView Data to the PC

1. Remove the transfer media from EView and insert it into the USB port or SD card slot on the PC. The Vent Data folder displays containing the Patient ID folder and Error Log(s).

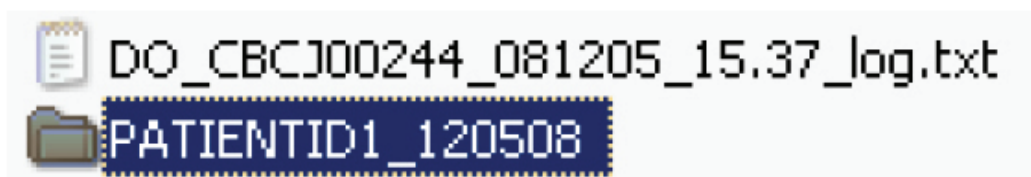


Figure 6.8 Patient ID Folder

2. Double-click the Vent Data folder and then the Patient ID folder to access the data text and waveform files.

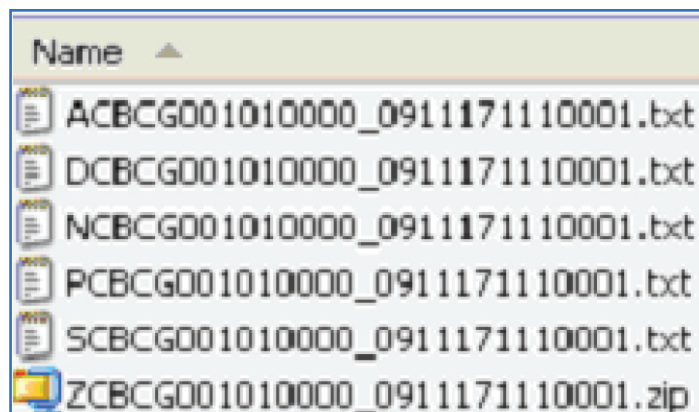


Figure 6.9 Patient ID folder naming structure

3. Ensure the text files for Settings, Measured, Waveforms, Procedures, and Alarms data exist. Data text file naming structure:
 - **A** = Alarms
 - **C** = Checkout Information
 - **D** = Dynostatic Curves or Spirometry Data (Zip file)
 - **L** = SpiroDynamics data from Paux
 - **N** = Measured Data (Numeric)
 - **P** = Procedure Data
 - **S** = Setting
 - **Z** = Waveform (Zip file) The Zip file contains the W-Waveform files and the L-Spirodynamics data files only if that option is enabled.
4. Right-click on the **Settings** text file and select **Open With**, then select a spreadsheet application to view the file. When the file opens, look under the **Settings** heading to verify the following:
 - **Set Rate** = 20
 - **Set TV** = 300
5. Close the **Settings** text file and remove the media from the PC.

7 Assessments

Hands on Activity: Basic Ventilation Features



The instructor will verify that you can perform the following functions on Engström Carestation:

Place a check mark next to each task that is verified.

- Identify the following components on the Engström Carestation: The flat screen display. The ventilator unit. The exhalation valve assembly. The inspiratory outlet. The expiratory gas inlet. The system switch. The oxygen and air supply connections.
- Identify the following touch points areas on the display: Wave Fields, Measure Values, Digit Field, Quick Keys, Favorites Bar and Split Screen.
- If applicable, demonstrate the ability to install the Exhalation Valve Heater.
- Increase the FiO₂ utilizing the FiO₂ quick key.
- Change the ventilation mode utilizing the Vent Setup key and then adjust the Rise Time.
- Use the ComWheel to highlight the three ventilator settings common to all modes of ventilation (Trigger, Bias Flow and Rise Time).
- Use the ComWheel to highlight the two ventilator settings common to pressure support breaths (PSV Rise Time and End Flow).
- Adjust the Plimit setting in VCV and explain the difference between Plimit and Pmax.
- Pre Silence an alarm utilizing the Silence Alarm key.
- Temporarily silence an active alarm utilizing the Silence Alarm key.
- Describe to the instructor what is meant by Resolved Alarm.
- Describe to the instructor the difference between the informational, medium, and high priority alarms, and the color associated with each.
- Adjust an alarm setting utilizing the Alarm Setup key.
- View recent alarms utilizing the Help key.
- Access the Trends menu and view the recent trends.
- Take a snapshot using the Trends menu.
- Simulate a breathing treatment using the incorporated Aerogen Nebulizer
- Simulate a closed suctioning utilizing the Increase O₂ key.
- Place the Engström Carestation into Standby.
- While in Standby, occlude the patient circuit and utilize the Park Circuit function.

- Power down the Engström Carestation.
- Prepare the Engström Carestation for clinical use by attaching the exhalation valve assembly and a patient circuit, then power up the system.
- Perform a checkout using the Checkout menu.
- Enter a patient weight using the Select Patient menu.
- Access the Patient Setup menu.

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____

Check Your Knowledge: Basic Ventilation Features



After completion of the assessment, compare your answers to the answer key. Ask the instructor to explain any answers you do not understand.

Circle the correct answer.

1. The main system switch is located on the front of the machine.
 - a. True
 - b. False
2. The parameter displayed above each of the ventilator quick keys will always remain the same.
 - a. True
 - b. False
3. Which menu key would you press to change a ventilation mode?
 - a. Spirometry
 - b. System Setup
 - c. Vent Setup
4. The Engström Carestation has a total of five modes of ventilation available.
 - a. True
 - b. False
5. Which of the following ventilator settings are common to all modes of ventilation?
 - a. Trigger and Bias Flow.
 - b. Inspiratory Pause and Trigger Window
 - c. Rise Time and End Flow
6. Which ventilator settings is described as “The percentage of peak flow at which the pressure supported breath terminates the inspiratory phase and enters the expiratory phase?”
 - a. P_{supp}
 - b. End Flow
 - c. PSV Rise Time
7. With an adult patient type, how long would the alarm be suspended if the Silence Alarm key is pressed when an active alarm is present?
 - a. 10 seconds
 - b. 5 minutes
 - c. 120 seconds
8. What color text is associated with medium priority alarms?
 - a. White
 - b. Yellow
 - c. Red
9. It is strongly recommended to use an expiratory filter when a nebulizer is used to help protect the expiratory sensor.
 - a. True
 - b. False

10. How would you increase the oxygen for closed suctioning?
- a. Through the Procedures Key.
 - b. By pressing the Increase O₂ key.
 - c. Through the Procedures key.
11. From the Standby menu, you can activate other functions such as Start Ventilation and Park Circuit.
- a. True
 - b. False
12. A Checkout should be performed before using the ventilator on a new patient.
- a. True
 - b. False
13. This menu appears when the system starts up, and allows you to select patient type, enter a patient weight and access the Patient Setup menu.
- a. Vent Preferences
 - b. Procedures
 - c. Select Patient

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____

Hands on Activity: Advanced Ventilation Features



The instructor will verify that you can perform the following functions on Engström Carestation:

Place a check mark next to each task that is verified.

- Adjust the Backup Mode settings for any mode of ventilation.
- Access the Procedures menu and describe the following procedures: Intrinsic PEEP, PEEPi Volume, Inspiratory Hold and Expiratory Hold.
- Access the Lung Mechanics menu and describe the following procedures: P0.1, NIF and Vital Capacity.
- Access the Spirometry menu, save a loop and change a loop type.
- Access the System Setup menu and view the System Status menu
- Access the Patient Setup menu and enter a patient weight
- Access the Screen Setup menu and change a Wave Field and a Digit Field.
- Access the Neo Flow Sensor Setup menu and demonstrate the ability to turn the Neo Flow Sensor on and off.
- Access the Parameters Setup menu and change the CO2 scale.
- If applicable, access the SpiroDynamics menu and save a loop.
- If applicable, activate the NIV mode from the invasive mode, and activate the invasive mode from the NIV mode.

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Check Your Knowledge: Advanced Ventilation Features



After completion of the assessment, compare your answers to the answer key. Ask the instructor to explain any answers you do not understand.

Circle the correct answer.

1. The Vent Preferences Menu can be accessed from the:
 - a. Procedures Menu Key
 - b. Spirometry Menu Key
 - c. Nebulizer Menu Key
 - d. Trends Menu Key
 - e. Patient Setup Menu Key

2. Backup mode can be accessed only from the Vent Preferences menu.
 - a. True
 - b. False

3. Backup ventilation is initiated if:
 - a. The apnea alarm is triggered
 - b. The ventilator is in Standby
 - c. The patient's minute ventilation decreases to below 50% of the set low minute volume alarm.
 - d. A and C
 - e. None of the above.

4. Which of the following selections are NOT included in the Procedures menu:
 - a. Manual Breath
 - b. Backup Mode
 - c. Suction
 - d. Intrinsic PEEP

5. The Lung Mechanics menu can be used to measure:
 - a. P 0.1
 - b. NIF
 - c. Vital Capacity
 - d. All the above
 - e. None of the above

6. To access the Spirometry Menu, press the:
 - a. Trends Menu Key
 - b. Procedures Menu Key
 - c. Spirometry Menu Key
 - d. Vent Setup Menu Key
 - e. Take Snapshot Key

7. The Screen Setup Menu can be accessed from the:
 - a. System Setup Key
 - b. Procedures Key
 - c. Help Key
 - d. Spirometry Key
 - e. Trends Key

8. Wave Fields 1 and 2 can be adjusted by the user.
 - a. True
 - b. False

9. Which of the following statements is true regarding the SpiroDynamics option on the Engstrom Carestation?
 - a. Requires the use of an intratracheal catheter
 - b. Requires the use of the auxiliary pressure port
 - c. Requires the user set the purge flow to On
 - d. All statements are true

10. The Non-invasive ventilation option can be activated through the:
 - a. Patient Setup Menu
 - b. Vent Setup Menu
 - c. Procedures Menu
 - d. Trends Menu
 - e. Spirometry Menu

11. Regarding the NIV option on the Engstrom Carestation, which of the following statements best describes the Tsupp setting?
 - a. It is used to set the maximum allowable inspired time for a spontaneous breath.
 - b. Time that the patient can be disconnected in the NIV ventilation mode without a high priority alarm sounding
 - c. The patient has not triggered a spontaneous breath within the set patient effort time in the NIV ventilation mode.
 - d. The lowest rate that the patient is required to breathe over a two-second period in the NIV ventilation mode before the ventilator will deliver a backup breath.

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____

Hands-on Activity: Gas Exchange Features



The instructor will verify that you can perform the following functions on Engström Carestation:

Place a check mark next to each task that is verified.

- Remove and insert a compact airway module into the module bay.
- Attach a spirometry airway adapter (D-Lite adapter), a spirometry line and a gas sampling line to the patient circuit.
- Attach a spirometry line and a gas sampling line to a compact airway module.
- Assign CO₂ to Wave Field 3.
- Assign Volume to a Digit Field.
- Assign EE/RQ to a Digit Field.
- Access the FRC INview menu and adjust the series interval time.

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Check Your Knowledge: Gas Exchange Features



After completion of the assessment, compare your answers to the answer key. Ask the instructor to explain any answers you do not understand.

Circle the correct answer.

1. The E-COVX module is capable of measuring CO₂, O₂, Patient Spirometry and Gas Exchange.
 - a. True
 - b. False

2. What is needed to measure CO₂ on the Engström Carestation?
 - a. An airway adapter
 - b. A gas sampling line
 - c. An airway gas module
 - d. All of the above

3. What would be the first key selected in order to assign CO₂ to a wave field or a digit field?
 - a. Vent Setup key
 - b. System Setup key
 - c. Spirometry key
 - d. Procedures key

4. How is EE/RQ assigned as a digit field?
 - a. Vent Setup > EE/RQ Setup > Digit Field > On
 - b. Spirometry > EE/RQ View > EE/RQ > Digit Field
 - c. System Setup > Screen Setup > Digit Field > EE/RQ

5. O₂ and ventilator settings may be adjusted during an FRC procedure.
 - a. True
 - b. False

6. What would be the first key selected in order to access the FRC INview menu?
 - a. Vent Setup key
 - b. System Setup key
 - c. Spirometry Setup key
 - d. Procedures key

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Hands-on Activity: Neonatal Functionality



The instructor will verify that you can perform the following functions on Engström Carestation:

Place a check mark next to each task that is verified.

- Connect the neonatal sensor cable to the neonatal flow sensor and to the Engström Carestation.
- Connect the neonatal flow sensor to a patient circuit.
- Access the neonatal flow sensor setup menu and turn the flow sensor on.
- Calibrate the neonatal flow sensor.
- Select Neonatal as a patient type from the Patient Setup menu.
- Perform a checkout with a neonatal flow sensor.
- Temporarily increase the O₂ for suctioning

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Check Your Knowledge: Neonatal Functionality



After completion of the assessment, compare your answers to the answer key. Ask the instructor to explain any answers you do not understand.

Circle the correct answer.

1. What would be the first key selected in order to access the Neo Flow Sensor Setup menu?
 - a. Vent Setup key
 - b. System Setup key
 - c. Spirometry key
 - d. Procedures key
2. Where does the neonatal flow sensor cable connect to on the Engström Carestation?
 - a. On the front of the machine near the occlusion port
 - b. On the rear of the machine to port 1
 - c. Next to the inspiratory port
3. The flow sensor can only be manually calibrated when the Neonatal Flow Sensor is off.
 - a. True
 - b. False
4. After selecting Neonatal from the Select Patient menu and starting ventilation, what needs to be done in order to access the Adult and Pediatric patient types?
 - a. Nothing
 - b. Enter a patient weight
 - c. Power the system off and on again

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Hands-on Activity: Super User Details



The instructor will verify that you can perform the following functions on Engström Carestation:

Place a check mark next to each task that is verified.

- Access the Install/Service menu.
- Access the Modes with Backup menu.
- Access the Mode Availability menu selection.
- Change a default setting for Timing, Flow, BiLevel or CPAP rate.
- Change a default setting for Wave Field 3, Digit Field or Split Screen.
- Set a default Patient Type.
- View default settings.
- Change a default setting for a Patient Type.
- Calibrate the O₂ and Air FCV, the Exhalation Valve and perform a Backlight Test.
- Perform a gas calibration.
- Access the maintenance schedule.
- Point out the three possible fan filter locations.
- Access the serial number.
- Access the customer service number.
- Access the Copy Config menu.
- Access the Data Transfer Settings menu and the Data Transfer Setup menu (if applicable).

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Check Your Knowledge: Super User Details



After completion of the assessment, compare your answers to the answer key. Ask the instructor to explain any answers you do not understand.

Circle the correct answer.

1. You do not need to enter a code to access the Install/Service menu.
 - a. True
 - b. False

2. The Modes with Backup and Mode Availability menus are accessed through which menu selection?
 - a. Display Settings
 - b. Ventilator Settings
 - c. Parameter Settings
 - d. Trends Setup

3. Changing a default setting for Timing, Flow, BiLevel, CPAP Rate, Wave Field 3, Digit Field and Split Screen will change the defaults for ALL patient types.
 - a. True
 - b. False

4. Setting the default Patient Type, viewing default settings and changing default settings for Patient Types are all accomplished through which menu?
 - a. Display Settings
 - b. Ventilator Settings
 - c. Parameter Settings
 - d. Defaults

5. How often should the O₂ FCV valve be calibrated?
 - a. Every 6 months
 - b. Every month
 - c. Once a year
 - d. Every 2 months

6. How often should a gas calibration be performed?
 - a. Every 6 months
 - b. Every month
 - c. Once a year
 - d. Every 2 months

7. What is needed to save or install configurations and default settings using the Copy Config menu?
 - a. A memory card
 - b. An external hard drive
 - c. A USB hub

Name: _____ Date: _____

Clinical Educators Name: _____ Date: _____



Check Your Knowledge Answers: Basic Ventilation Features



1. The main system switch is located on the front of the machine.
b. False.
2. The parameter displayed above each of the ventilator quick keys will always remain the same.
b. False.
3. Which menu key would you press to change a ventilation mode?
c. Vent Setup
4. The Engström Carestation has a total of five modes of ventilation available.
b. False.
5. Which of the following ventilator settings are common to all modes of ventilation?
a. Trigger and Bias Flow
6. Which ventilator settings is described as “The percentage of peak flow at which the pressure supported breath terminates the inspiratory phase and enters the expiratory phase?”
b. End Flow
7. With an adult patient type, how long would the alarm be suspended if the Silence Alarm key is pressed when an active alarm is present?
c. 120 seconds
8. What color text is associated with medium priority alarms?
b. Yellow
9. It is strongly recommended to use an expiratory filter when a nebulizer is used to help protect the expiratory sensor.
b. True
10. How would you increase the oxygen for closed suctioning?
b. By pressing the Increase O₂ key.
11. From the Standby menu, you can activate other functions such as Start Ventilation and Park Circuit.
a. True
12. A Checkout should be performed before using the ventilator on a new patient.
a. True
13. This menu appears when the system starts up, and allows you to select patient type, enter a patient weight and access the Patient Setup menu.
c. Select Patient.

Check Your Knowledge Answers: Advanced Ventilation Features



1. The Vent Preferences Menu can be accessed from the:
e. Patient Setup Menu Key
2. Backup mode can be accessed only from the Vent Preferences menu.
b. False
3. Backup ventilation is initiated if:
d. A and C
4. Which of the following selections are NOT included in the Procedures menu:
b. Backup Mode
5. The Lung Mechanics Procedure can be used to measure:
d. All the above
6. To access the Spirometry Menu, press the:
c. Spirometry Menu Key
7. The Screen Setup Menu can be accessed from the:
a. System Setup Key
8. Wave Fields 1 and 2 can be adjusted by the user.
b. False
9. Which statement(s) are true regarding the SpiroDynamics option on the Engstrom Carestation:
d. All statements are true
10. The Non-invasive ventilation option can be activated through the:
a. Patient Setup Menu
11. Regarding the NIV option on the Engstrom Carestation. Which of the following statement best describes the Tsupp setting.
a. Used to set the maximum allowable inspired time for a spontaneous breath.

Check Your Knowledge Answers: Gas Exchange Features



1. The E-COVX module is capable of measuring CO₂, O₂, Patient Spirometry and Gas
a. True
2. What is needed to measure CO₂ on the Engström Carestation?
d. All of the above
3. What would be the first key selected in order to assign CO₂ to a wave field or a digit field?
b. System Setup key
4. How is EE/RQ assigned as a digit field?
c. System Setup > Screen Setup > Digit Field > EE/RQ
5. O₂ and ventilator settings may be adjusted during an FRC procedure.
b. False. Do not change any O₂ or ventilator settings during an FRC procedure.
6. What would be the first key selected in order to access the FRC INview menu?
c. Spirometry key

Check Your Knowledge Answers: Neonatal Functionality



1. What would be the first key selected in order to access the Neo Flow Sensor Setup menu?
b. System Setup key
2. Where does the neonatal flow sensor cable connect to on the Engström Carestation?
b. Rear of the machine, port 1
3. The flow sensor can only be manually calibrated when the Neonatal Flow Sensor is off.
a. True
4. After selecting Neonatal from the Select Patient menu and starting ventilation, what needs to be done in order to access the Adult and Pediatric patient types?
c. Power the system off and on again

Check Your Knowledge Answers: Super User Details



1. You do not need to enter a code to access the Install/Service menu.
b. False
2. The Modes with Backup and Mode Availability menus are accessed through which menu selection?
b. Ventilator Settings
3. Changing a default setting for Timing, Flow, BiLevel, CPAP Rate, Wave Field 3, Digit Field and Split Screen will change the defaults for ALL patient types.
a. True
4. Setting the default Patient Type, viewing default settings and changing default settings for Patient Types are all accomplished through which menu?
d. Defaults
5. How often should the O₂ FCV valve be calibrated?
a. Every 6 months
6. How often should a gas calibration be performed?
d. Every 2 months
7. What is needed to save or install configurations and default settings using the Copy Config menu?
a. A memory card



8 Resources

Contacting Technical Support

Serial Number Location

Before contacting Customer Service or Technical Support, be sure to write down the serial number of the unit if you have a question or comment about a specific machine. The serial number can be found on the rear of the unit as shown below. There are two bar codes with associated numbers. The bottom barcode and number is the serial number.

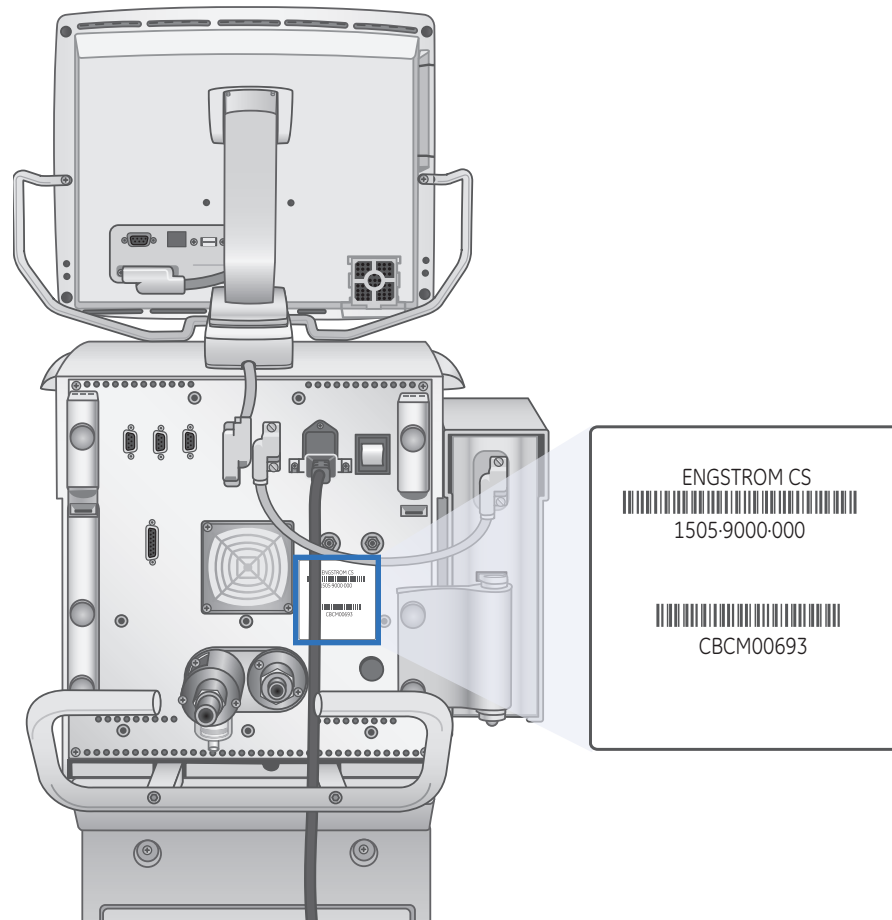


Figure 8.1 Serial Number Location

Technical Support Number



To contact Technical Support in the U.S., call the Customer Service number at:
(800) 345-2700.

Maintenance Schedule

User Maintenance • **Table 8.1**

Minimum Frequency	Maintenance
During cleaning and setup	Inspect the parts for damage. Replace or repair as necessary.
As necessary	<p>! IMPORTANT: Batteries will slowly discharge when the system is not plugged in. It is recommended to periodically plug the system in to AC mains to recharge the internal batteries.</p> <p>Empty the water trap on the exhalation valve housing. Empty the water trap on the air pipeline inlet fitting and replace the filter. Remove and clean the fan filters.</p> <p>Clean and replace the expiratory flow sensor. Clean and replace the neonatal flow sensor.</p>
Weekly	Check air inlet filter mat for Evair compressor cabinet and clean with compressed air. Replace if necessary.
Monthly	Complete a Backlight Test.
Every two months	Complete Gas Calibration, if using an airway module.
Every six months	Complete calibrations for the O ₂ Flow Control Valve, Air Flow Control Valve, and the Exhalation Valve.
Annually	<p>Battery Performance Test - Internal batteries must undergo a discharge test annually.</p> <p>Schedule annual service and maintenance check for Engström system, Airway module, and EVair compressor.</p>

Airway Module Preventative Maintenance • **Table 8.2**

Minimum Frequency	Maintenance
Daily	Replace the D-fend.
Every two months	Complete Gas Calibration
Annually	Schedule annual maintenance check.

Recommended Part Replacement Period • **Table 8.3**

Item	Interval	Number of Cleaning Cycles
Exhalation Valve Assembly 1505-8568-000	Twelve months	50
Diaphragm 1505-3224-000	Twelve months	50
Adult Flow Sensor 1505-3231-000	Six months	50
Neonatal Flow Sensor 1505-3272-000	Six months	25

Disposable Parts

Table 8.4

Description	Stock Number
Adult patient spirometry kit for humid conditions	8004381
Disposable CO ₂ sampling line	733162
Straight T adapter	73385
Disposable spirometry tube	890031
D-fend+ water trap, green	881319
Pediatric spirometry kit	8002718
Mini D-fend water trap	8002174
Intratracheal pressure catheters	M1045564
D-lite+ sensor, adult, disposable	896952
Pedi-lite+ sensor, disposable	8001948

Technical Support Number



To contact Technical Support in the U.S., call the Customer Service number at:
(800) 345-2700.

Additional Contacts: _____



9 Evaluation

Engström Carestation Software Revision 7.X

Course:

Instructor:

Date:

Please rate the program and the manual using a scale of 1-7

Program Evaluation		1 = Poor 4 = Average 7 = Excellent						
1.	Program met the stated objectives.	1	2	3	4	5	6	7
2.	Content covered the topics adequately.	1	2	3	4	5	6	7
3.	Overall quality of this program.	1	2	3	4	5	6	7
4.	How well did this presentation meet your personal objectives?	1	2	3	4	5	6	7
5.	I can incorporate program content into my practice.	1	2	3	4	5	6	7
Speaker Evaluation		1 = Poor 4 = Average 7 = Excellent						
1.	Trainer was prepared for the training session.	1	2	3	4	5	6	7
2.	Presenter was knowledgeable about the product.	1	2	3	4	5	6	7
3.	Trainer was able to effectively present the program materials.	1	2	3	4	5	6	7
4.	Trainer was able to effectively respond to student questions.	1	2	3	4	5	6	7
5.	Rate the overall effectiveness of the Trainer.	1	2	3	4	5	6	7

I found the following most helpful in my learning:

The following was least useful in my learning:

Additional comments/suggestions for other learning opportunities related to this training program:





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Healthcare Re-imagined

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