User manual

International English
Revision D

Respironics V680 Ventilator

PHILIPS

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NOTE

You can find the most current version of this user manual here:
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Contents

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1 General Warnings, Cautions, and Notes

Before using the Respironics V680 ventilator on a patient, familiarize yourself with this user manual, particularly the safety considerations listed. Be aware, however, that this manual is a reference only. It is not intended to supersede your institution's protocol regarding the safe use of assisted ventilation devices.

Warnings and cautions that apply to the use of the ventilator under all circumstances are included in this section. Additional warnings and cautions are also inserted within the manual where they are most meaningful.

Notes are also located throughout the manual to provide additional information related to specific features.

Definitions

WARNING
Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or equipment damage.

NOTE
Emphasizes information of particular importance.

General

WARNING

- **An alternative means of ventilation should be available whenever the ventilator is in use. In case of ventilator failure, lack of immediate access to appropriate alternative means of ventilation could harm the patient, ranging from CO_2 rebreathing to death.**
- **If a fault is detected in the ventilator, disconnect the patient from it and immediately start ventilation with an alternative device. The ventilator must be removed from clinical use and serviced by authorized service personnel.**
- **Be aware that a ventilator shutdown for any reason increases the patient's risk of CO_2 rebreathing.**
- **Modification of the V680 ventilator and associated equipment is not permitted and may compromise ventilator operation and patient safety. Servicing should only be done by qualified service personnel.**

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- **To reduce the risk of electric shock from liquid entering the device, do not put a container filled with a liquid on the ventilator.**
- **To reduce the risk of fire, use the ventilator in well-ventilated areas away from flammable anesthetics. Do not use in a hyperbaric chamber or other similarly oxygen-enriched environments. Do not use near an open flame.**
- **Do not leave the ventilator unattended when stationed on an incline.**
- **The V680 ventilator is intended for use by healthcare professionals only.**

CAUTION

- **Federal law (USA) restricts this device to sale by or on the order of a physician.**
- **To ensure the correct performance of the ventilator and the accuracy of patient data, use only Philips Respironics-approved accessories with the ventilator. See Appendix C, "Parts and Accessories".**

NOTE

- The displays shown in this manual may not exactly match what you see on your own ventilator.
- This Respironics V680 ventilator and its recommended accessories that have patient contact are not made with natural rubber latex.
- If an alarm persists for no apparent reason, discontinue ventilator use and contact Philips.
- If you detect any unexplained changes in the performance or visual displays of the ventilator, discontinue ventilator use and contact Philips.
- Avoid operating the ventilator at barometric pressure below 600 mmHg or above 765 mmHg. A Check Vent message occurs when the ventilator is operated in barometric pressures that are out-of range.
- Automatic record-keeping is not supported.
- All ventilator mode and alarm settings, alarm messages and significant events are retained and automatically logged, even when power is lost.
- The V680 ventilator and all accessories listed in Appendix C are suitable for use in the patient environment. The patient environment is defined as the immediate area surrounding the patient's bedside, to a distance of 1.5m, in an institutional health care environment (e.g. hospitals) or during intra-hospital transport.

Single-Limb Modes

WARNING

- **When the ventilator is used with a single-limb circuit, make sure EPAP pressures and exhalation times are sufficient to clear all exhaled gas through the exhalation port. In noninvasive ventilation continuous air flow through the port flushes exhaled gases from the circuit. The ability to completely exhaust exhaled gas from the circuit depends on the EPAP setting and I:E ratio. Higher tidal volumes further increase the volume of CO_2 rebreathed by the patient.**

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- **The patient's exhaled volume can differ from the measured exhaled volume due to leaks around the mask during noninvasive ventilation. We recommend that you set the leak alarm to detect and notify when a clinically significant leak occurs.**
- **To prevent possible asphyxia and to reduce the risk of CO_2 rebreathing, take these precautions with respect to mask and exhalation port use:**
  - **Use only an oro-nasal mask with an anti-asphyxia valve or a nasal mask for noninvasive ventilation.**
  - **Do not occlude the exhalation port.**

Preparing for Ventilation

WARNING

- **The Respironics V680 Ventilator is designed to use ambient air and high pressure 100% oxygen. No other gases should be used.**
- **Do not use the ventilator with helium or mixtures with helium.**
- **Do not use the ventilator with nitric oxide.**
- **Avoid adding resistive circuit components on the patient side of the proximal pressure line. Such components may defeat the disconnect alarm. When in doubt, test that the disconnect alarm functions properly.**
- **Speaking valves, Heat Moisture Exchangers (HMEs), and filters create additional circuit resistance and may affect the performance of the patient circuit disconnect alarm.**
- **To reduce the risk of strangulation from patient tubing, use a tubing support arm and secure the proximal pressure line with clips to position the sensor cables and tubing appropriately.**
- **Provide independent patient monitoring during transport to minimize patient risk from impaired ventilator performance due to improper orientation of the ventilator.**
- **Manufacturer default settings are not appropriate for all patients. Prior to using the ventilator, verify that the current alarm settings or defaults are appropriate for each particular patient.**
- **To reduce the risk of fire, use only patient circuits intended for use in oxygen-enriched environments. Do not use antistatic or electrically conductive tubing.**

CAUTION

The eSYS exhalation cartridge must be installed during use for both single-limb and dual-limb circuit configurations. During single-limb ventilation, it helps prevent liquid ingress hazards.

Oxygen hose configurations using SIS connectors generate higher resistance to flow. Therefore, a minimum supply pressure of 53 psig is recommended when adding supplemental O_2 accessories with SIS adapters such as the O_2 transport manifold.

NOTE

- We recommend you run EST and SST, as required, before placing the ventilator on a patient. See Chapter 5, "Preparing for Ventilation".

- Any dual-limb circuit that meets the specifications in Table 11-14 *and* passes the ventilator's SST (Short Self-Test) on page 76 is approved for use with the V680 Ventilator.
- During single-limb ventilation, patient exhalate is released into room air. Use of a patient circuit with a filter on its exhalation port is recommended.
- During single-limb ventilation the eSYS exhalation cartridge is not in use. It is recommended that a filter be used to cover the inlet port of the eSYS cartridge to protect it from airborne cross-contamination.

Operation

WARNING

- **Be sure to set the high inspiratory pressure (HIP) alarm appropriately to minimize patient risk from overpressurization or early breath termination.**
- **When attachments or other components or subassemblies are added to the ventilator breathing system, the pressure gradient across the ventilator breathing system can change, which may adversely affect ventilator performance. Always rerun the SST, at a minimum, when the dual-limb circuit configuration is altered.**
- **To minimize patient risk from aspiration of condensate, use either a circuit with water traps or a heated wire circuit.**
- **Verify displayed measurements and other patient data to minimize patient risk from the user acting upon inaccurate measured data and waveforms.**

NOTE

- All V680 ventilation modes and settings are appropriate and safe for use with a closed-suction catheter.
- Volume-controlled ventilation is not recommended for patients with bronchopleural fistula. Pressure-regulated volume control or pressure-controlled PCV are recommended modes in this patient care scenario.

Power and Battery

WARNING

- **The backup battery must be installed in the ventilator. Periodically check and replace the battery as needed. Refer servicing to qualified service personnel.**
- **A ventilator shutdown due to a total loss of power during ventilation poses serious risks to the patient. Always have a backup battery installed and fully charged.**
- **To prevent unintentional disconnection of the power cord, always use the correct, Philips-supplied power cord and lock it into place with the power cord retainer before use.**
- **The V680 ventilator should not be positioned in a way that makes it difficult to disconnect from mains power if necessary. Disconnect from supply mains by removing the power cord from the wall outlet.**

- **To reduce the risk of electric shock use only a Respironics-supplied (hospital-grade) power cord and connect the ventilator only to supply mains with protective earth ground.**
- **If the integrity of the protective earth conductor (grounding) of the AC supply mains is in doubt, the ventilator should be operated on battery power while an alternate means of ventilation is obtained or a repair is made.**
- **To reduce the risk of electric shock, regularly inspect the AC power cord and verify that it is not frayed or cracked.**
- **The battery is intended for backup or transport use only. Battery operation time can be affected by discharge and recharge cycles, time, and ambient temperature. Using the battery as primary power source increases patient risk resulting from a ventilator shutdown due to total power loss.**
- **To reduce the risk of fire, explosion, leakage, or other hazard, take these precautions with respect to the battery:**
  - **Do not attempt to disassemble, open, drop, crush, bend or deform, insert foreign objects into, puncture, or shred the battery pack; modify or remanufacture it; immerse or expose it to water or other liquids; expose it to fire, excessive heat (including soldering irons); or put it in a microwave oven.**
  - **Replace the battery only with another battery specified by the manufacturer.**
  - **Follow all instructions for proper use of the battery.**
  - **Do not short-circuit the battery or allow metallic or conductive objects to contact the battery connector housing.**

NOTE

- All ventilator mode and alarm settings, alarm messages and significant events are retained and automatically logged, even when power is lost.
- Instructions for first-time device installation, including the information necessary to ensure that the ventilator is installed correctly and is in safe and correct working order, can be found in Appendix A, “First-Time Installation”.

Care and Maintenance

NOTE

- To prevent possible damage to the ventilator, always ship it with the original packing material. If the original material is not available, contact Philips to order replacements.
- The ventilator should be periodically removed from clinical use and serviced by authorized service personnel. For necessary service intervals, “Preventive Maintenance” on page 163.

Communications Interface

WARNING

- **It is the responsibility of the end user to validate the compatibility and use of information transmitted from the ventilator to the device to be connected to the ventilator.**
- **The USB port is currently approved for use with only one device: the Aerogen USB-powered controller. NEVER connect or attempt to power any other equipment from the USB port.**
- **Connect to the ventilator only items that are specified as part of or compatible with the ventilator system. Additional equipment connected to medical electrical equipment must comply with the respective IEC or ISO standards. Furthermore, all configurations shall comply with the requirements for medical electrical systems (see IEC 60601-1-1 or clause 16 of edition 3 of IEC 60601-1, respectively). Anybody connecting additional equipment to medical electrical equipment configures a medical system and is therefore responsible for ensuring that the system complies with the requirements for medical electrical systems. Also be aware that local laws may take priority over the above mentioned requirements. If in doubt, consult Philips.**

2 Symbols

Refer to these tables to interpret symbols used on the ventilator and battery labels, and on the ventilator screen. To interpret symbols pertaining to accessories, refer to their instructions for use.

Symbol	Description
	Caution, consult accompanying documents
	Warning: Corrosive substance
	Consult operating instructions
	(Blue) It is mandatory for the operator to consult the accompanying documents.
	Protective earth (ground)
	Type B applied part, which is equipment that provides a particular degree of protection against electric shock, particularly in regard to allowable leakage current and of the protective earth connection
	Requires alternating current (AC)
IPX1	Degree of fluid ingress protection provided by the enclosure (drip-proof)
Rx ONLY	Prescription only (U.S.)
	Alarm and remote alarm
	Two states of control: **ON/Shutdown** and **Standby.**
	Battery
CE 0086	European Conformity. Symbol is on rear panel of ventilator. If included, number below symbol represents certifying agency.

Symbol	Description
	Brazilian Conformity. Certification by INMETRO (National Institute of Metrology, Standardization and Industrial Quality)/SGS (Societe Generalle de Surveillance).
	EurAsian Conformity mark - EAC
	Date of manufacture
	Manufacturer
	Serial number
	Order number
	Lot or batch number
	Model number
	Use by date[
	RS-232 serial input/output
	USB port
	Oxygen
	Directional arrows
	(Yellow) Warning
	Ethernet connection (Reserved for future use)

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Symbol	Description
	Accept button on the navigation ring
	Adjustment direction on the navigation ring
	ETL Listed Mark - product safety compliance certified. Conforms to UL STD 60601-1, ANSI/AAMI STD ES60601-1, ISO STD 80601-2-12, IEC STDS 60601-1, 60601-1-1, 60601-1-4, 60601-1-6, 60601-1-8, 60601-2-12, 62366 & 62304. Certified to CSA STD C22.2 No. 60601-1-6.
	Do not disassemble. Refer to authorized service personnel.
	Electronic or electrical product must be disposed of in accordance with the WEEE directive in the European Community
	Noninvasive ventilation (patient with mask), single-limb
	Invasive ventilation (intubated patient), single-limb
	Invasive ventilation (intubated patient), dual-limb
	Do not block the cooling fan Inlet (at the rear of the ventilator).
	No pushing. Do not push on the ventilator screen. Tipping hazard.

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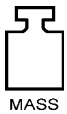
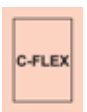
Symbol	Description
	Total mass (weight) of the ventilator, ventilator stand, and standard setup. See page 183 for more information.
 (On power cord)	(Green dot) Hospital-grade power cord
	Recycle. Battery must be recycled or disposed of properly.
	Recycle (Taiwan)
	RoHS (China). Administrative Measure on the Control of Pollution Caused by Electronic Information Products. Contains RoHS substances with 50 years environmentally friendly use period (EFUP).
	uR UL recognition symbol
	European Community Representative
	Direct current (DC). Symbol is on backup battery.
	Rechargeable battery. Symbol is on backup battery.
	Lithium-ion battery. Battery must be recycled or disposed of properly. Symbol is on backup battery.
	C-Flex software option label
	AVAPS+ software option label
	PPV software option label

Symbol	Description
	Alarm (audible)

Symbol	Description
	Alarm is silenced
	Alarm
	Alarm reset
	Informational message
	Alarm message is displayed. Touch to hide alarm messages.
	Alarm message is hidden. Touch to display alarm messages.
	Single Limb, invasive ventilation is selected.
	Single Limb, noninvasive ventilation is selected.
	Dual Limb, invasive ventilation is selected.
	Increase and decrease (adjustment arrow) buttons. Adjusts a setting or selects a value.
	Accept button. Accepts set values.
	Cancel button. Cancels set values.
	Ventilator is powered by AC power *and* the battery is installed.
	Ventilator is powered by AC power *and* the battery is not installed.
	Ventilator is powered by the battery. This symbol shows the approximate battery time remaining in hours and minutes, and it shows the capacity graphically.

Symbol	Description
	Help button. Touch to display onscreen help information.
	Vertical Autoscale button. Autoscales the Y axis of the graphs to fit the data currently displayed.
	Time Scale adjust button. Rescales the X axis of the graph display data at 3, 6, 12, and 24 second increments.
	Loops Autoscale button. Rescales the X and Y axes of the Loops display window to fit the data currently displayed.
	Pause Graph button. Freezes graphs in the Graphs window or loops in the Loops window.
	Pause in progress
	Resume Graph button. Resumes all graphs from a paused state.
 	Adjust Cursor Position. Moves the cursor around stored flow-volume and pressure-volume loops for viewing data points at specific points of the loop.
	No valid data to display
	Data is under range
	Data is over range
	Pressure, centimeters of water or hPa
	Flow, liters per minute. BTPS compensated.
	Volume, milliliters

Symbol	Description
	User-set Ramp Time. Ramp graphic fills in as Ramp Time progresses.
	Ramp Time is Off (no ramp time set).
	Intentional leak. The number corresponds to the leak symbol printed on Philips Respironics masks.

3 General Information

Intended Use

The V680 Ventilator is a mechanical ventilator designed to provide invasive and non-invasive, continuous or intermittent, respiratory support in a hospital or other institutional healthcare environment. The V680 ventilator is intended for pediatric and adult patients weighing at least 5 kg (11 lb).

The V680 Ventilator is intended for use by qualified, trained personnel under the direction of a physician and also intended for intra-hospital transport.

Noninvasive Ventilation Clinical Contraindications

- Lack of spontaneous respiratory drive
- Inability to maintain a patent airway or adequately clear secretions
- At risk for aspiration of gastric contents
- Acute sinusitis or otitis media
- Epistaxis (nosebleed), causing pulmonary aspiration of blood
- Hypotension
- Untreated pertussis

Potential Side Effects during Noninvasive Ventilation

Advise the patient to immediately report any unusual chest discomfort, shortness of breath, or severe headache. Other potential side effects of noninvasive positive pressure ventilation include: ear discomfort, conjunctivitis, skin abrasions due to mask/patient interface, and gastric distention (aerophagia). If skin irritation or breakdown develops from the use of the mask, refer to the accompanying mask instructions for appropriate action.

Patient Interface and Accessories

Use the V680 Ventilator only with various combinations of Respironics-approved patient circuits, interfaces, humidifiers, nebulizers and other accessories.

The V680 ventilator is connected to a patient by means of a patient circuit which is connected to a mask, endotracheal tube (ETT), or tracheostomy tube.

About CO_2 Rebreathing (Single-Limb)

As with mask ventilation in general, patient CO_2 rebreathing may occur under some circumstances. Follow these guidelines to minimize the potential for CO_2 rebreathing. If rebreathing is a significant concern for a particular patient and these guidelines are not sufficient to acceptably reduce the potential for CO_2 rebreathing, consider an alternative means of ventilation.

- Increase EPAP to decrease the potential for CO_2 rebreathing. Higher pressures produce more flow through the exhalation port, which helps to purge all CO_2 from the circuit to prevent rebreathing.
- When increasing EPAP is not possible, creating a small leak around the mask or between the mask and exhalation port will also help purge CO_2.
- Be aware that the potential for CO_2 rebreathing increases as inspiratory time or respiratory rate increases. A longer inspiratory time or high respiratory rate decreases exhalation time, allowing less CO_2 to be purged from the circuit before the next cycle. In such circumstances, higher tidal volumes further increase the volume of CO_2 rebreathed by the patient.

General Description

The V680 ventilator is a microprocessor-controlled mechanical ventilator for providing continuous or intermittent ventilator support for pediatric and adult patients. It functions as a pressure/volume support ventilator by providing pressure- or volume-targeted breaths delivered via endotracheal or tracheostomy tube, as well as approved nasal, oro-nasal, and full face masks.

Ventilation types and modes. The ventilator offers three ventilation configurations: single-limb invasive (INV), single-limb noninvasive (NIV) and dual-limb invasive (INV). Each offers a range of modes.

For single-limb INV or NIV:

- CPAP (continuous positive airway pressure) with Apnea Backup
- PCV (pressure-controlled ventilation)
- S/T (spontaneous/timed)

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- AVAPS+ (average volume-assured pressure support). The volume-targeted AVAPS+ mode combines the attributes of pressure-controlled and volume-targeted ventilation.
- PPV (proportional pressure ventilation). The optional PPV mode provides pressure-targeted ventilation in proportion to the patient's efforts.

For dual-limb INV:

- A/C-PCV (assist/control, pressure-controlled ventilation)
- A/C-VCV (assist/control, volume-controlled ventilation)
- SIMV-PCV (synchronized intermittent mandatory ventilation, pressure-controlled ventilation) with apnea backup
- SIMV-VCV (synchronized intermittent mandatory ventilation, volume-controlled ventilation) with apnea backup
- PRVC (pressure-regulated, volume-controlled)
- PSV (spontaneous pressure support ventilation) with apnea backup

Apnea backup mode is a specific set of ventilator settings to be used in case of apnea. It is available during single-limb ventilation in CPAP mode, and during dual-limb ventilation in SIMV-PCV, SIMV-VCV, and PSV modes. Choose between volume- or pressure-targeted breath types within Apnea Mode setup.

Auto-Trak+ algorithm. Available in single-limb modes. Automatically compensates for intentional and dynamically fluctuating unintentional leaks to help maintain optimum patient-ventilator synchrony. Trigger and cycle sensitivity settings allow tailoring to various patient types.

User interface. The ventilator's ergonomic design, including a 12.1-inch (31-cm) color touchscreen, a navigation ring, and key panel, lets you easily access ventilator settings and monitored parameters.

eSYS exhalation cartridge. The eSYS cartridge is a reusable exhalation system. Gas flow through the eSYS cartridge is controlled by a valve diaphragm and seat that are electromagnetically actuated. A flow sensor, pressure port, and heater element to mitigate condensation are housed inside the cartridge. The exhalation valve actively controls flow/pressure through the exhaust path by actuating a diaphragm within the eSYS cartridge.

Oxygen monitoring. An integrated sensor measures oxygen in the delivered gas mixture. The V680 ventilator will not operate without an oxygen sensor installed. This sensor is user-replaceable and accessible from the eSYS enclosure. A tool may be required to loosen the oxygen sensor during replacement.

Monitoring. The ventilator displays monitored parameters as numbers and as real-time waveforms (graphs and loops). Graph pause and cursor measurement functions are available.

Alarms. The ventilator's operator-adjustable and nonadjustable alarms help ensure the patient's safety.

Power and gas supplies. The ventilator uses as its primary power source AC mains. An internal backup battery powers the ventilator for at least 4 hours using nominal settings.

The ventilator uses high-pressure oxygen. An integral blower pressurizes gas for delivery to the patient.

NOTE
Oxygen delivered through the compressed gas hose and blower is used as fresh gas.

Mounting. The ventilator can be mounted via a quick-release mechanism to the V680 ventilator stand. When equipped with the optional cylinder holder, the stand can accommodate two oxygen cylinders up to 160 mm in diameter. An oxygen manifold kit is available, which allows two oxygen cylinders and one wall oxygen supply line to be used as inputs to the ventilator.

Communications interface. The ventilator can output data through the RS-232 serial port upon receiving a command from a host computer or bedside monitoring system. The ventilator is equipped with a remote alarm/nurse call connection to activate alarms remotely.

Upgradability via Respi-Link remote diagnostic system. The Respi-Link interface permits software upgrade and remote troubleshooting of the ventilator through the RS-232 port. (Not available in all countries.)

Physical Description

Patient Circuits, Mask/Patient Interfaces, and Accessories

Figure 3-1 shows the Respironics V680 ventilator with its patient circuit and accessories. Table 3-1 on page 28 lists recommended patient circuits, masks/patient interfaces, and other accessories for use with the ventilator. Appendix C provides ordering information for parts and accessories.

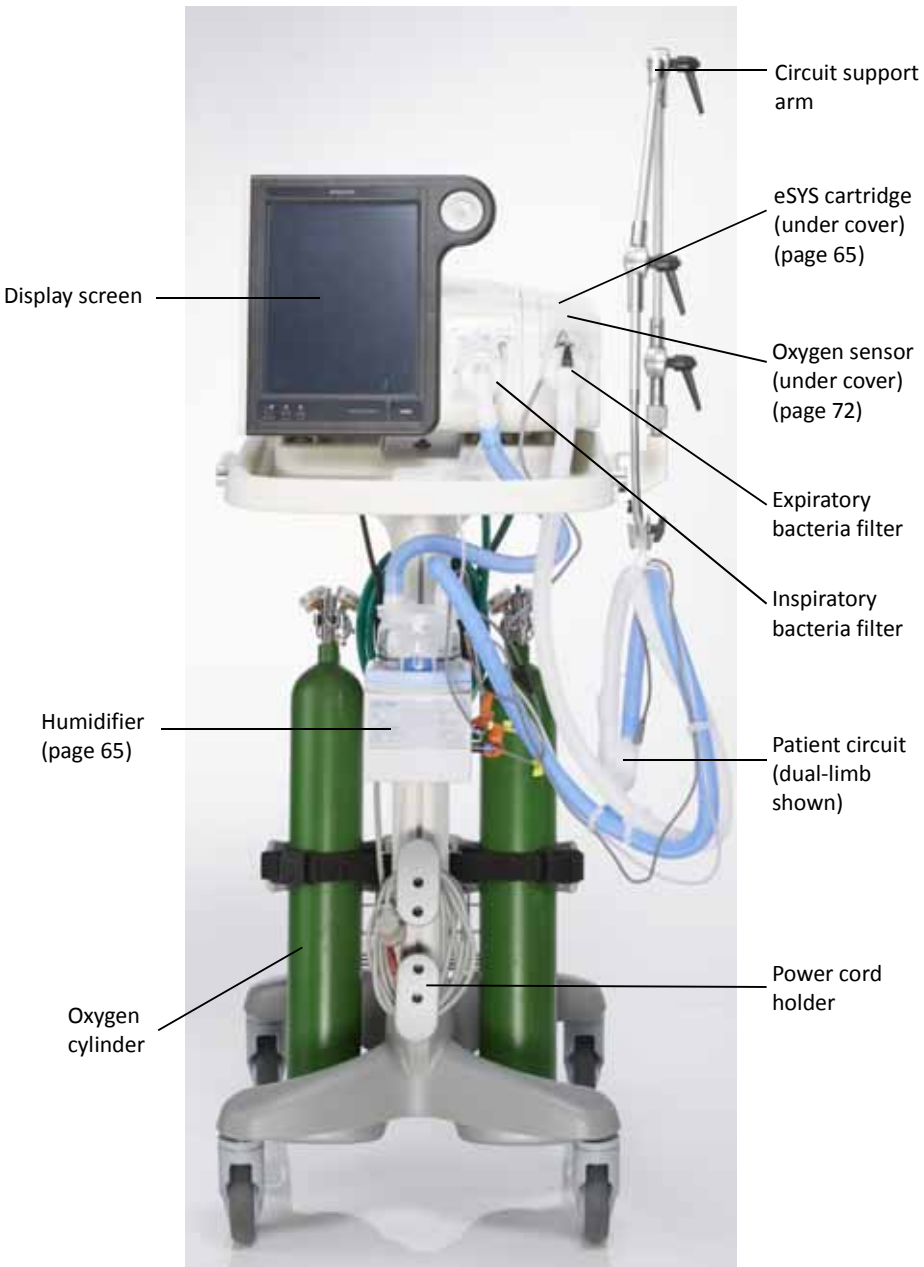

Figure 3-1: Respironics V680 ventilator with accessories

Table 3-1: Recommended parts and accessories

Part	Use...
Patient circuit, single-limb	Intended for noninvasive or invasive ventilation. To minimize turbulence, we recommend that you use smooth-inner wall tubing. Use a circuit listed in Appendix C or equivalent. NOTE: • During single-limb ventilation, patient exhalate is released into room air. Use of a patient circuit with a filter on its exhalation port is recommended. • During single-limb ventilation the eSYS exhalation cartridge is not in use. It is recommended that a filter be used to cover the inlet port of the eSYS cartridge to protect it from airborne cross-contamination.
Patient circuit, dual-limb	Intended for invasive ventilation. To minimize turbulence, we recommend that you use smooth-inner wall tubing. Use a circuit listed in Appendix C or equivalent.
Patient interface (noninvasive or invasive)	Respironics masks listed in Appendix C Invasive interface (tracheostomy or endotracheal (ET) tube)
Exhalation port (passive)	Philips Respironics exhalation ports listed in Appendix C
Inspiratory filter	Main flow (inspiratory) bacteria filter listed in Appendix C
Expiratory filter	Expiratory bacteria filter listed in Appendix C
Exhalation system cartridge	eSYS cartridge listed in Appendix C
Humidifier	Fisher & Paykel MR850, Fisher & Paykel MR810
Heat and Moisture Exchangers (HME)	HMEs listed in Appendix C or equivalent.
Oxygen sensor	Oxygen sensor listed in Appendix C
Nebulizer	• Aerogen Pro-X system • NIVO/Pro-X system (for single-limb use with AF531 Leak 1 mask) • Aerogen Solo system • Aerogen USB-powered systems

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Ventilator Unit

Figure 3-2 through Figure 3-4 show the controls, indicators, and other important parts of the ventilator unit.

Figure 3-2: Front view

Number	Description
1	**Graphical user interface.** Color LCD (liquid crystal display) with touchscreen.
2	**Navigation ring.** Lets you adjust values and navigate the graphical user interface by rotating the finger on its touchpad.
3	**Accept button.** Activates selections.
4	**Proximal pressure port.** Connection for tubing that monitors patient pressure in the patient circuit.
5	**eSYS cartridge (From patient).** Exhalation system cartridge assembly with return gas port and heated flow sensor. See page 65 for more information.
6	**Ventilator outlet port (To patient).** Main connection for the patient circuit. Delivers air and oxygen in prescribed pressure or flow to the patient.
7	**Alarm speakers.** Located beneath ventilator. Two speakers to provide redundant safety backup.
8	**Alarm LED.** Flashes during a high-priority alarm. On continuously during a ventilator inoperative condition.

Number	Description
9	**Battery (charged) LED.** Flashes when battery is charging. On continuously when battery is charged. Off when ventilator is running on battery or when the ventilator is off and AC power is not connected.
10	**ON/Shutdown key with LED.** Turns on AC power and initiates ventilator shutdown. LED is continuously on when AC power is connected. See page 73 and page 84 for more information.

Figure 3-3: Side view with cover removed

Number	Description
1	**Oxygen sensor** (under upper right side panel). Measures delivered oxygen. See page 191 for more information.
2	**Air intake filter cover.** Allows intake of air for delivery to the patient and easy access to the inlet air filter. See page 164 for more information.

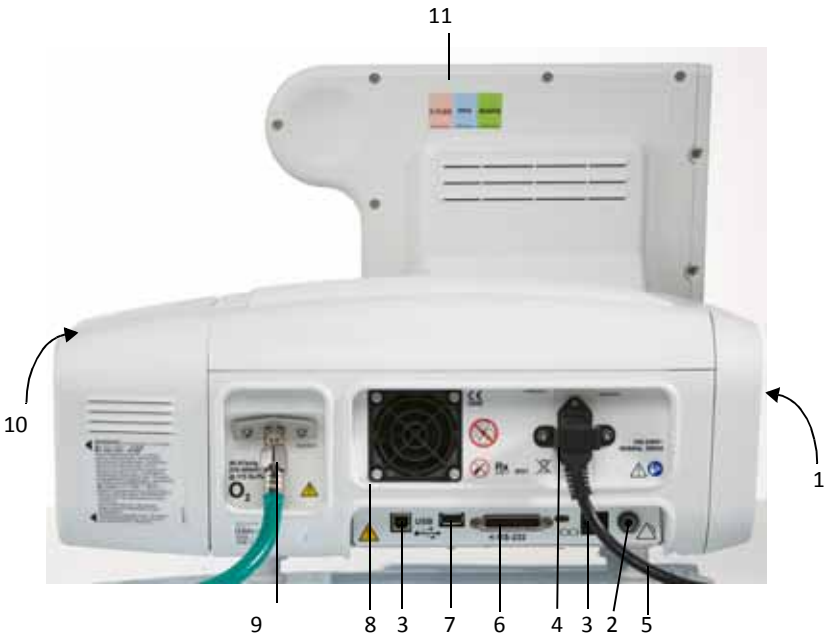

Figure 3-4: Rear view

Number	Description
1	**Backup battery** (compartment under side panel). 4 hour minimum, backup battery. See page 32 and page 188 for more information.
2	R**emote alarm/nurse call connector.** See page 204 for more information.
3	**Reserved for future use**
4	**Power cord retainer**
5	**Power cord**
6	**RS-232 serial and analog I/O connector (female DB-25).** Connects to hospital information systems and other serial devices, and functions as an interface for analog signals. Connects Respi-Link remote diagnostic system gateway for software updates. See page 197 for more information.
7	**USB port.** Connect ONLY to an approved accessory listed in Appendix C, “Parts and Accessories”.
8	**Cooling fan filter.** See page 166 for more information.
9	**High-pressure oxygen inlet connector.** See page 72 for more information.
10	**eSYS cartridge housing and oxygen sensor** (under upper side panel). See page 65 for more information about the eSYS cartridge and page 72 for more information about the oxygen sensor.
11	**Option labels**

About the Backup Battery

WARNING

- **A ventilator shutdown due to a total loss of power during ventilation poses serious risks to the patient. Always have a backup battery installed and fully charged.**
- **The backup battery must be installed in the ventilator. Periodically check and replace the battery as needed. Refer servicing to qualified service personnel.**
- **To reduce the risk of power failure, pay close attention to the battery's charge level. The battery's operation time is approximate and is affected by ventilator settings, discharge and recharge cycles, battery age, and ambient temperature. Battery charge is reduced at low ambient temperatures or in situations where the alarm is continuously sounding.**

NOTE

- A new backup battery should be installed and charged within one year of the date of manufacture identified on the battery and on the shipping box.

The internal backup battery protects the ventilator from AC (mains) power interruptions. If AC power fails, the ventilator automatically switches to operation on backup battery with no interruption in ventilation. The battery powers the ventilator until AC power is restored or until the battery is depleted. The battery powers the ventilator typically for at least 4 hours.

As a safeguard, the ventilator provides a low battery alarm. It also has a capacitor-driven backup alarm that sounds for at least 2 minutes when AC and backup battery power is completely lost.

The ventilator charges the battery whenever the ventilator is connected to AC, with or without the ventilator switched on. The battery (charged) LED flashes to show that the battery is being charged.

Check the battery charge level before putting a patient on the ventilator and before unplugging the ventilator for transport or other purposes. The power source symbol at the bottom right-hand corner of the screen shows the power source in use. If the ventilator is running on battery, the level of battery charge is shown (Figure 3-5). If the battery is not fully charged, recharge it by connecting the ventilator to AC power for a minimum of 5 hours. Pressing the Help button shows you the time remaining until the battery is fully charged. If the battery is not fully charged after this time, have the ventilator serviced.

For battery installation instructions, see page 188.

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ON/Shutdown LED

On continuously: AC power is connected

Battery (charged) LED

Flashes: Battery is charging
On continuously: Battery is charged (90 to 100%)
Off: Ventilator is running on battery, or the ventilator is off and AC power is not connected

Power source symbol (when powered)

The ventilator is powered by AC and the battery is installed.

The ventilator is powered by AC and the battery is not installed.

The ventilator is powered by the battery. This symbol shows the approximate battery time remaining in hours and minutes, and it shows the capacity graphically.

Figure 3-5: Power indicators

Graphical User Interface

Through the graphical user interface (Figure 3-6 and Figure 3-7) you make ventilator settings and view ventilator and patient data. During ventilation, the upper screen displays alarms and patient data. The middle screen displays real-time graphs and loops, and alarm and informational messages. The lower screen lets you access modes and other ventilator settings, display help information, and see the power status.

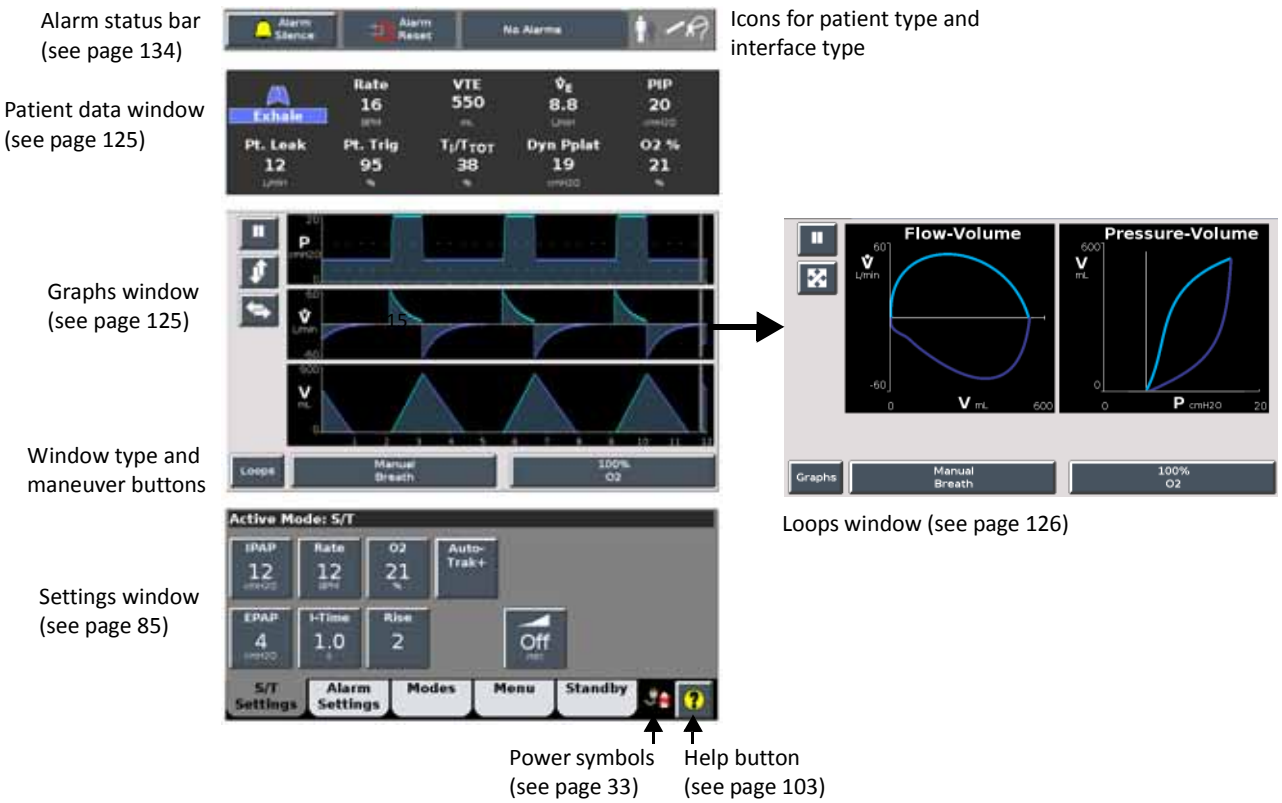
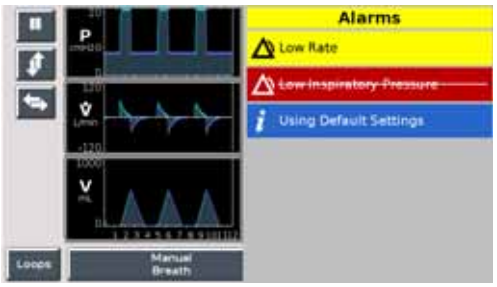
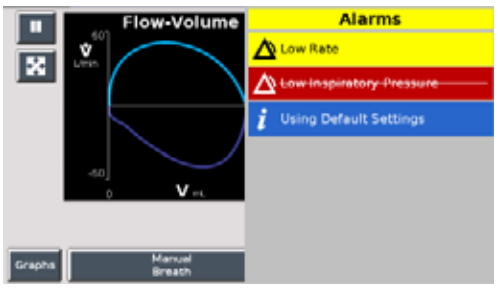


Figure 3-6: Parts of graphical user interface



Compressed graphs window with **Alarms**/**Messages** list (see page 125)



Loops window with **Alarms**/**Messages** list (see page 126)

Figure 3-7: Graphs and Loops windows with alarms displayed

Navigating the Graphical User Interface

Select a function by touching the desired tab or button on the touchscreen. Use this as the primary method to control the ventilator.

You can use the navigation ring as an alternative to the following touchscreen functions:

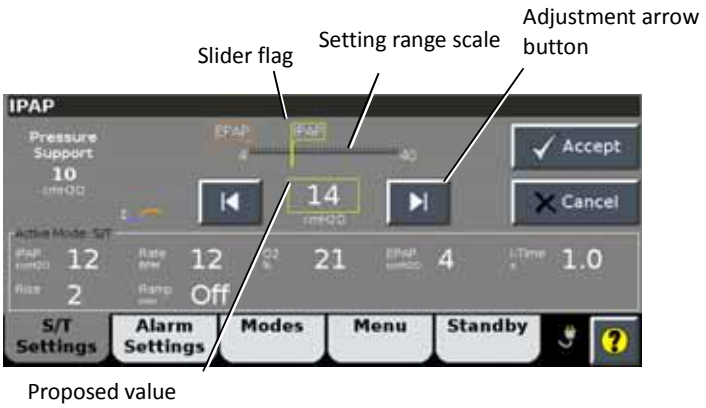
Touchscreen equivalent	Navigation ring equivalent
Touch increase button (adjustment arrow)	Touch and rotate finger clockwise to increase value or move cursor forward
Touch decrease button (adjustment arrow)	Touch and rotate finger counterclockwise to decrease value or move cursor backward
Touch **Accept** button (applies selection)	Press Accept (checkmark) button (applies selection)

After making selections and adjusting values, accept selections by pressing the circular Accept button (the checkmark) in the middle of the navigation ring to accept and apply the change.

To open a window, touch the window tab.

To cancel a function and close the window, either select Cancel or touch another window tab.

To adjust a parameter, touch the arrow buttons repeatedly or select the value with the navigation ring. The slider flag moves along the setting range scale. Select **Accept** to apply.



The navigation ring also lets you adjust the position of the cursor in the graphs window while the screen is frozen. See “Freezing and Unfreezing Graphs” on page 130 for more information.

Training

Product training is available. Contact your local Philips sales representative or Philips Customer Support for assistance. Call 1-800-225-0230 for ordering and 1-800-722-9377 for service.

4 Principles of Operation

System Operational Overview

The Respironics V680 ventilator is a microprocessor-controlled pneumatic system. It is powered by AC with a battery backup to protect against power failure or unstable power and to facilitate intrahospital transport. The ventilator's pneumatics deliver gas and its electrical systems control pneumatics, monitor the patient, and distribute power.

The user provides inputs to the ventilator through a touchscreen, keys, and a navigation ring. These inputs become instructions for the pneumatics to deliver a precisely controlled gas mixture to the patient. Pressure and flow sensors provide feedback, which is used to adjust gas delivery to the patient. Monitored data based on sensor inputs is also displayed by the graphical user interface. The ventilator's microprocessor system controls gas delivery and monitors the patient. The gas delivery and monitoring functions are cross-checked by an alarm controller. This cross-checking helps prevent simultaneous failure of these two main functions and minimizes the possible hazards of software failure.

A comprehensive system of visual and audible alarms helps ensure the patient's safety. Clinical alarms can indicate an abnormal physiological condition. Technical alarms, triggered by the ventilator's self-tests, can indicate a hardware or software failure. In the case of some technical alarms, an emergency ventilation mode is provided that may give the user additional time for corrective actions, which may include disconnecting the ventilator and providing alternative ventilation. When a condition is critical enough to possibly compromise safe, prolonged ventilation, the ventilator is placed into the ventilator inoperative state, in which oxygen flow and blower operation are disabled.

The ventilator has several means to ensure that safe patient or respiratory pressures are maintained. The maximum airway pressure is ensured by the high inspiratory pressure (HIP) alarm limit. If the set high pressure limit is reached, the ventilator cycles into exhalation.

Pneumatic System Operation

Gas delivered to the patient is a combination of room air and compressed oxygen (Figure 4-1). Room air enters through an intake filter. Oxygen enters though an inlet connector, and a proportional valve regulates the oxygen flow to the operator set concentration. The air and oxygen are mixed, then the blower regulates the gas to the appropriate flow and pressure using feedback from the ventilator outlet (machine) pressure sensor and flow sensors. Target flows and pressures are adjusted to compensate for the resistance and compliance of the inspiratory and expiratory filters, patient circuit, and humidifier measured during SST. This helps ensure accurate and responsive pressure and flow delivery. The proximal pressure sensor provides a direct pressure measurement at the patient connector for monitoring and circuit compensation. The proximal pressure line is purged periodically by the positive pressure of the inspiratory gas.

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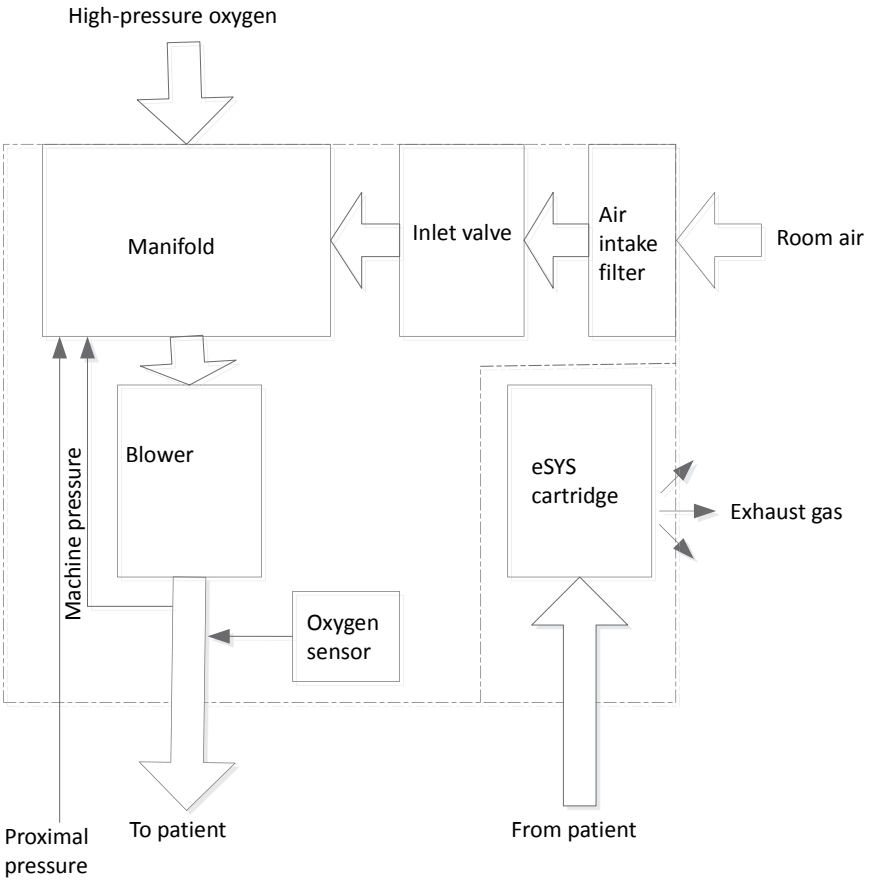

Figure 4-1: Respironics V680 ventilator pneumatic system

During inspiration, the ventilator delivers gas to the patient through an inspiratory bacteria filter, a single- or dual-limb patient breathing circuit, a humidification device (optional) and a patient interface such as a mask or ET tube. An oxygen sensor monitors the oxygen concentration of the delivered gas. An inspiratory hold valve provides a means to close the inspiratory path for certain respiratory mechanics maneuvers.

In dual-limb modes, during exhalation the exhalation valve opens, and the patient's exhalate is returned to the ventilator through the expiratory limb of the patient circuit, through the expiratory bacteria filter, and expelled through the eSYS cartridge. The eSYS cartridge includes a valve diaphragm, an exhalation flow sensor, an exhalation pressure measurement port, and a heater. The exhalation valve is used in conjunction with the blower and machine pressure sensor to control PEEP. Flow and pressure sensor measurements are used for spirometry data and alarm detections such as Occlusion and High Inspiratory Pressure.

In single-limb modes, exhalation proceeds passively through the exhalation port that is part of the patient circuit. This exhalation port also continually exhausts gas from the circuit during inspiration, to minimize rebreathing and ensure CO_2 removal.

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Breath Delivery Characteristics

Control Variable

Breaths delivered by the Respironics V680 ventilator are either pressure or volume controlled depending on the mode and breath type. In the AVAPS+ (single-limb) and PRVC (dual-limb) modes, the ventilator's applied pressure is automatically adjusted over the course of one or more breaths to maintain a user-set target tidal volume. In A/C-VCV and SIMV-VCV (dual-limb) modes the ventilator may adjust volume output breath-to-breath, compensating for leaks to ensure the set tidal volume is delivered to the patient, which is measured by the expiratory flow sensor within the eSYS cartridge. Volume delivery and patient data displays are circuit compliance and BTPS compensated.

Trigger Variable

Breaths may be triggered by the ventilator (time), the user (manual breath), or the patient. In single-limb modes, patient-triggered breaths are triggered using the Auto-Trak sensitivity algorithm (see “Auto-Trak Sensitivity (Single-Limb Modes Only)” on page 40). In dual-limb modes, patient-triggered breaths are triggered using the operator-set I-Trig flow setting, which uses a non-adjustable pressure trigger as a backup.

Cycle Variable

In single-limb modes, spontaneous breaths are cycled using the Auto-Trak sensitivity algorithm (see “Auto-Trak Sensitivity (Single-Limb Modes Only)” on page 40). In dual-limb modes, spontaneous breaths are cycled using the operator-set E-Cycle flow setting. As a backup, they may be cycled by the HIP or Max V safety settings or the I-Time Too Long alarm condition. Mandatory breaths, including assist breaths, are time cycled.

Bias Flow

Dual-limb modes provide a non-adjustable bias flow of 10 L/min for flow triggering.

Baseline Pressure

A positive baseline pressure (PEEP**,** EPAP, or CPAP) may be set for all breaths in all modes.

Pressure Rise Time

The operator-set Rise Time defines the time required for inspiratory pressure to rise to the set (target) pressure.

Oxygen Enrichment and Monitoring

The Respironics V680 ventilator incorporates an air/oxygen mixer. You can set oxygen concentration in all modes and monitor its concentration in the delivered gas.

Auto-Trak Sensitivity (Single-Limb Modes Only)

An important characteristic of the Respironics V680 ventilator is its ability to recognize and compensate for intentional and unintentional leaks in the system, and to automatically adjust its triggering and cycling algorithms to maintain optimum performance in the presence of leaks. This is called Auto-Trak sensitivity. It is active in single-limb ventilation modes. The following subsections describe this function in detail.

Triggering

Breaths may be patient triggered in all modes, typically when patient effort causes a certain volume of gas to accumulate above baseline flow (volume method). An inspiration is also triggered when the patient inspiratory effort causes an increase in the flow demand (shape signal method; see page 40).

Cycling

Cycling to exhalation occurs in these cases:

- Patient expiratory effort distorts the inspiratory flow waveform sufficiently (shape signal method). See “Shape signal method of cycling and triggering” on page 40.
- Patient flow reaches the spontaneous exhalation threshold (SET). See “SET method of cycling” on page 41.
- After 3 seconds at the IPAP level (timed backup safety mechanism)
- When a flow reversal occurs, typically due to an acute change in mask or mouth leak

Shape signal method of cycling and triggering

The shape signal or “shadow trigger” method uses a mathematical model derived from the flow signal. A new flow signal (shape signal) is generated by offsetting the signal from the actual flow and delaying it (Figure 4-2). This intentional delay causes the flow shape signal to be slightly behind the patient’s flow signal. If there is a sudden change in patient flow, the patient’s flow signal crosses the shape signal; this results in a trigger or a cycle. As a result, a sudden decrease in expiratory flow from an inspiratory effort will cross the shape signal and create a signal for ventilator triggering.

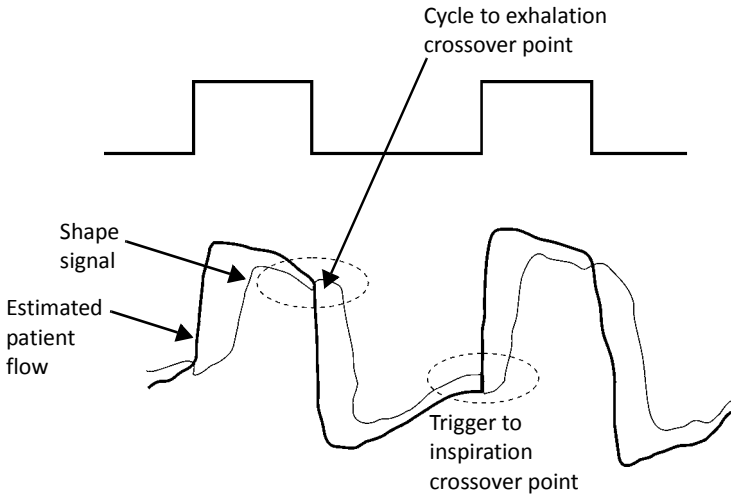

Figure 4-2: Shape signal

SET method of cycling

Patient flow reaches the spontaneous exhalation threshold (SET); see Figure 4-3. The SET represents the intersection of the flow waveform and a line of a given slope (related to peak flow). SET is updated each breath.

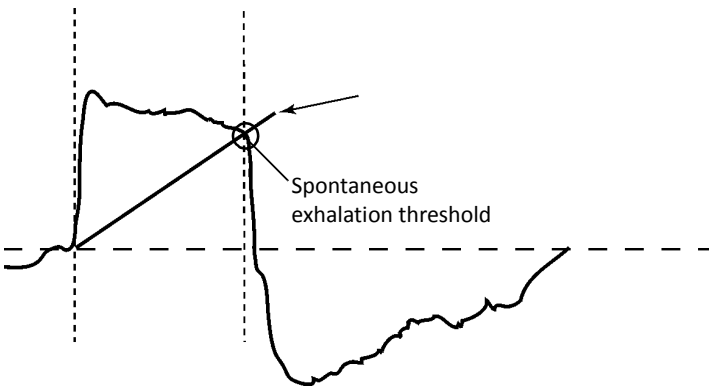

Figure 4-3: Spontaneous exhalation threshold (SET)

Leak Adaptation

Noninvasive ventilation in particular may involve considerable leakage around the mask or through the mouth. Some leakage is known or *intentional*: it is a characteristic of the mask/patient interface design. So that it can accurately adjust its baseline flow, the ventilator has you enter the intentional leakage value specific to the mask/patient interface (“Selecting the Mask and Exhalation Port” on page 79). Other leakage is unpredictable or *unintentional*, often changing dynamically around the mask seal or escaping through the mouth (nasal masks).

To maintain prescribed pressures and reliable triggering and cycling synchrony in the presence of leakage, the ventilator adjusts its baseline flow. Because the unintentional part of the leakage may constantly change, the ventilator recalculates the baseline flow each breath at the end of exhalation. The ventilator uses two main mechanisms to update its baseline flow: expiratory flow adjustment and tidal volume adjustment.

Expiratory flow adjustment

Every breath, at end-exhalation, the ventilator updates its flow baseline. At end-exhalation patient flow is assumed to be zero, so any difference between actual patient flow and the original baseline flow indicates a change in leakage. Figure 4-4 shows how the ventilator adjusts the baseline.

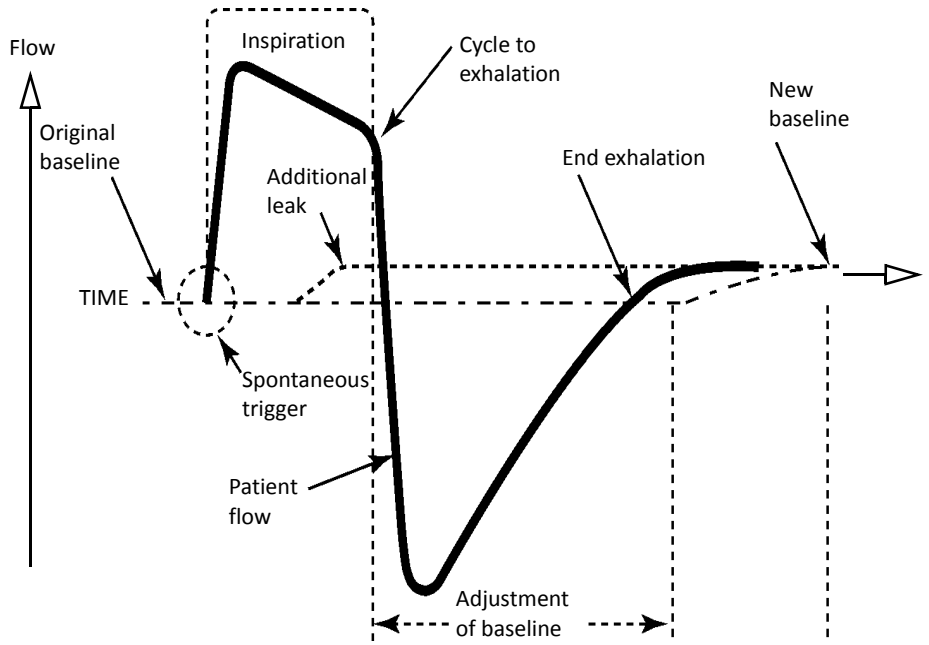

Figure 4-4: Expiratory flow adjustment

Tidal volume adjustment

Every breath, the ventilator compares the inspiratory and expiratory tidal volumes. Any difference is assumed to be due to an unintentional circuit leak. The ventilator adjusts the baseline to reduce this tidal volume difference for the next breath. Figure 4-5 shows how the ventilator adjusts the baseline.

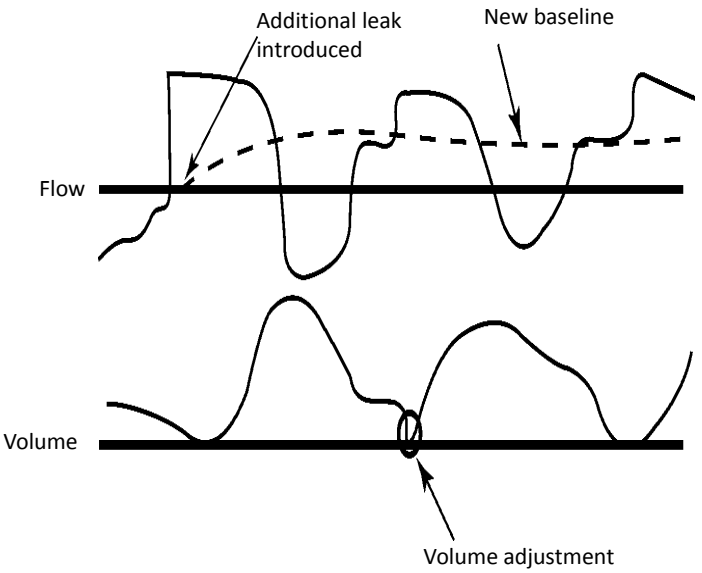

Figure 4-5: Tidal volume adjustment

Auto-Trak+

Auto-Trak+ lets you further adjust the level of Auto-Trak Sensitivity. This algorithm has multiple breath trigger and cycle thresholds. When you adjust Auto-Trak+ settings (**I-Trig** and **E-Cycle**), you adjust these multiple trigger or cycle thresholds simultaneously, retaining all the auto-adaptive features of Auto-Trak Sensitivity.

The Normal Auto-Trak settings work well for most patients. Pediatric patients, however, may benefit from more sensitive trigger settings, while some adult patients may benefit from more or less sensitive cycle settings. A more sensitive default **I-Trig** setting is automatically selected when the pediatric patient type is selected.

Ventilation Modes

The V680 ventilator has a range of ventilation modes that provide full and partial ventilatory support. Table 4-1 summarizes the characteristics of these modes. Chapter 11, “Technical Specifications”, lists the controls active in all modes.

See Chapter 6, “Operation - Single-Limb” and Chapter 7, “Operation - Dual-Limb” for mode and controls settings.

NOTE
The following discussion uses the same terminology displayed by the ventilator breath type indicator. A mandatory breath (**Mand** indicator) is triggered and cycled by the ventilator or user. An assist breath (**Assist** indicator) is triggered by the patient and cycled by the ventilator. A spontaneous breath (**Spont** indicator) is not pressure supported, and is triggered and cycled by the patient. A pressure-supported breath (**Support** indicator) is pressure supported, and is triggered and cycled by the patient.

Table 4-1: Characteristics of Respironics V680 ventilation modes

Ventilation type	Mode	Mandatory/assist breaths				Spontaneous/supported breaths		
		Control*	Trigger†	Limit‡	Cycle**	Trigger	Limit	Cycle
Dual-limb	A/C-VCV	Volume	Flow, Time, (Pressure backup)	Volume	Time	N/A	N/A	N/A
	A/C-PCV	Pressure	Flow, Time, (Pressure backup)	Pressure	Time	N/A	N/A	N/A
	PRVC	Pressure	Flow, Time, (Pressure backup)	Volume, Pressure	Time	N/A	N/A	N/A
	PSV	N/A	N/A	N/A	N/A	Flow (Pressure backup)	Pressure, Time	Flow (Pressure backup)
	SIMV-VCV	Volume	Flow, Time, Pressure	Volume	Time	Flow (Pressure backup)	Pressure, Time	Flow (Pressure backup)
	SIMV-PCV	Pressure	Flow, Time, Pressure	Pressure	Time	Flow (Pressure backup)	Pressure, Time	Flow (Pressure backup)
Single-limb	CPAP	N/A	N/A	N/A	N/A	Auto-Trak+	Pressure	Auto-Trak+
	PCV	Pressure	Time	Pressure	Time	N/A	N/A	N/A
	S/T	Pressure	Time	Pressure	Time	Auto-Trak+	Pressure	Auto-Trak+
	AVAPS+	Pressure	Time	Pressure	Time	Auto-Trak+	Pressure	Auto-Trak+
	PPV	Pressure	Time	Pressure	Time	Auto-Trak+	Pressure, Volume	Auto-Trak+

*. A control variable is the primary variable the ventilator adjusts to achieve inspiration.
†. A trigger variable starts inspiration.
‡. A limit variable can reach and maintain a preset level before inspiration ends but it does not end inspiration.
**. A cycle variable is a measured parameter used to end inspiration.

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Invasive Dual-Limb Modes

Assist/Control (A/C) modes

The assist/control (A/C) ventilation modes deliver mandatory and assist breaths only, either volume- or pressure-controlled. These breaths may be initiated by the patient, the ventilator (time-triggered), or the user (manual breath).

When the patient triggers or the user initiates a breath, the respiratory rate increases, while both the inspiratory time and the tidal volume (for A/C-VCV) or the inspiratory pressure (for A/C-PCV) remains constant. The minute volume increases as a result.

A/C-VCV mode. The A/C-VCV mode provides volume-controlled mandatory and assist breaths, triggered by the ventilator or patient, or manual breaths triggered by the user.

Figure 4-6 shows A/C-VCV waveforms. Figure 4-7 shows the control settings active in the A/C-VCV mode. The **V_T** setting defines the delivered volume. **Rate** defines the minimum number of breaths delivered per minute, while **I-Time** (inspiratory time) defines the length of the inspiratory phase. To deliver the set volume in the set, time, the ventilator alters the flow rate. The flow pattern setting defines the shape of the flow delivery pattern.

As in other dual-limb modes, you also set **PEEP**, **I-Trig** (inspiratory trigger), and **O_2**.

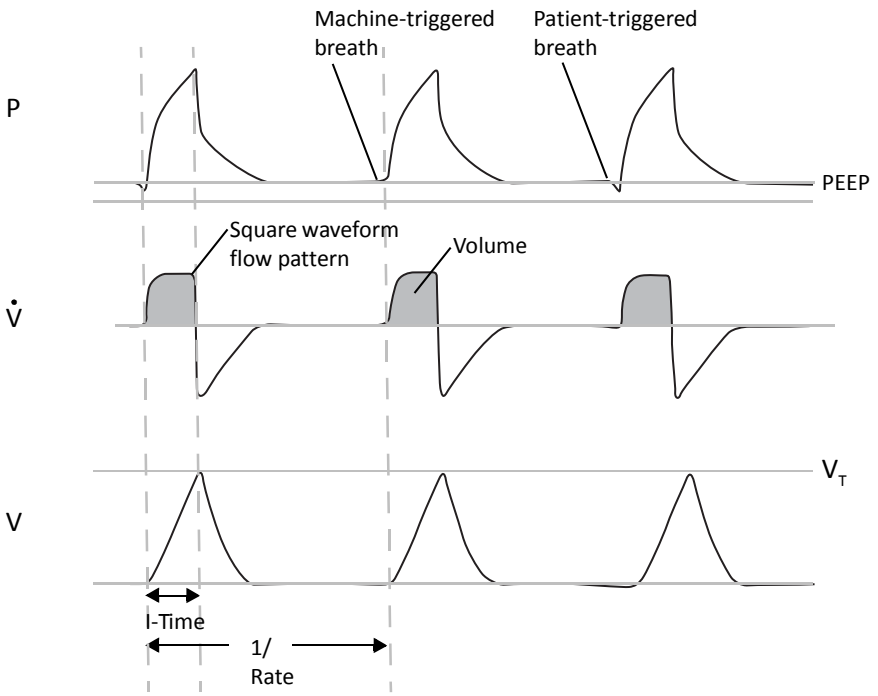

Figure 4-6: A/C-VCV breath

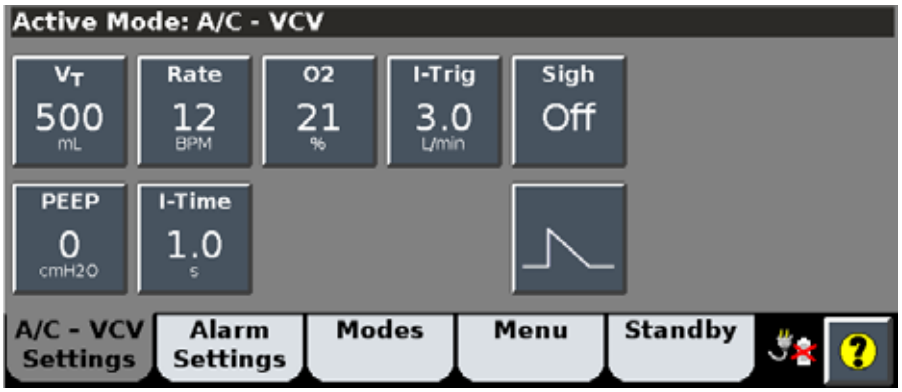

Figure 4-7: A/C-VCV controls

A/C-PCV mode. The A/C-PCV mode provides pressure-controlled mandatory and assist breaths, triggered by the ventilator or patient, or manual breaths triggered by the user.

Figure 4-8 shows A/C-PCV waveforms. Table 4-9 shows the control settings active in the A/C-PCV mode. The **PC** setting defines the applied pressure for all breaths. **Rate** defines the minimum number of breaths delivered per minute, while **I-Time** (inspiratory time) defines the length of the inspiratory phase. The **Rise** setting defines the pressure rise time.

As in other dual-limb modes, you also set **PEEP**, **I-Trig** (inspiratory trigger), and **O_2**.

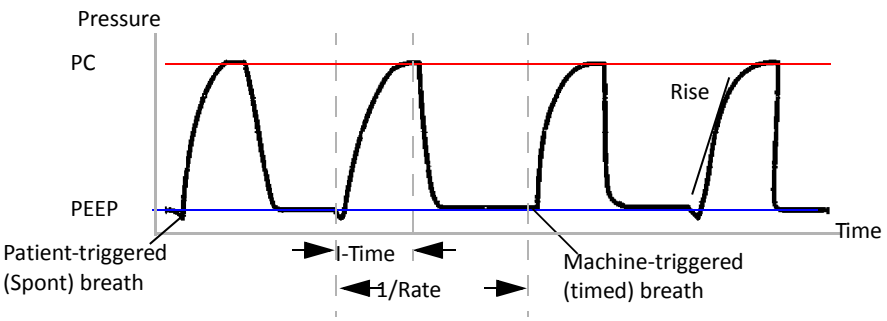

Figure 4-8: A/C-PCV pressure waveform

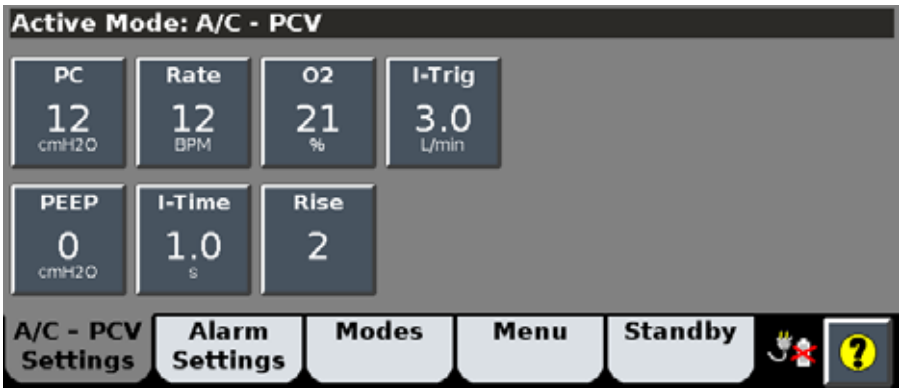

Figure 4-9: A/C-PCV controls

The A/C-PCV mode, while delivering a preset pressure, does not guarantee delivery of a fixed tidal volume, especially during changes in respiratory system compliance, airway resistance, AutoPEEP, or the patient's respiratory activity.

PRVC (pressure-regulated volume control) mode.

NOTE
The PRVC dual-limb mode is similar to the AVAPS+ single-limb mode. In PRVC, the applied pressure may change from breath to breath. In the AVAPS+ mode, the applied pressure change is slower, being limited to between 1.0 and 5.0 cmH_2O per minute after the initial startup phase.

The PRVC mode functions much like A/C-PCV except that PRVC targets a tidal volume. To do this, PRVC automatically adjusts the target pressure at the beginning of each inspiration to achieve the operator-set target $\mathbf{V_T}$. Pressure changes are limited to between the **Min P** and **Max P** settings. The mode aims to deliver $\mathbf{V_T}$ with the lowest pressure possible, depending on the lung dynamics.

Figure 4-10 shows a PRVC waveform. Figure 4-11 shows the control settings active in the PRVC mode.

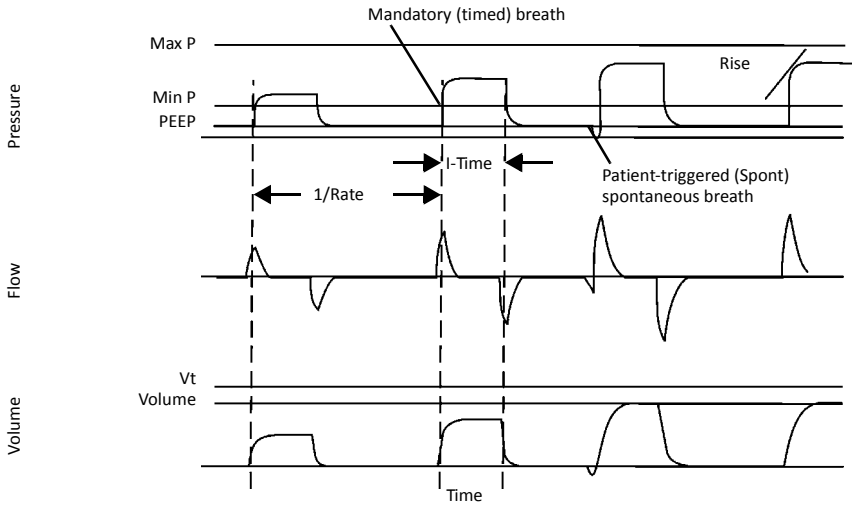

Figure 4-10: PRVC waveforms

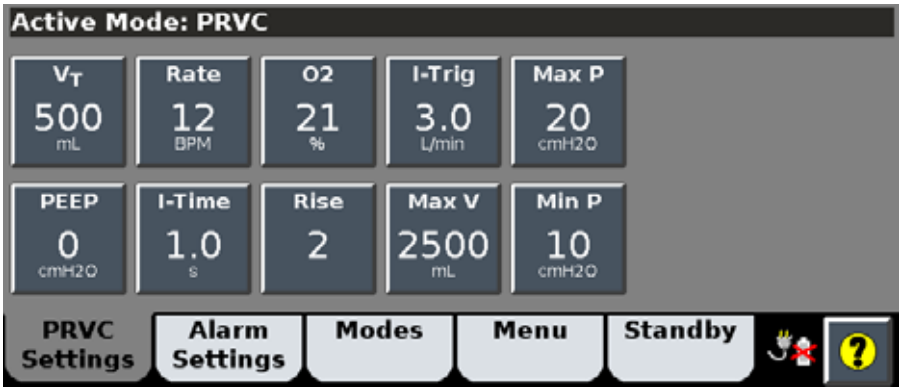

Figure 4-11: PRVC controls

When starting PRVC mode, the following rules apply:

- Pressure target: If PRVC is entered from a PCV or VCV breath delivery mode, the previous target pressure is used for the first breath. If PRVC mode is entered from any breath delivery mode other than PCV or VCV or from standby, the previous target pressure is set to the minimum pressure setting (**Min P**).
- Compliance: If PRVC is entered from a PCV or VCV breath delivery mode and the dynamic compliance is valid, the compliance value is set to the last estimated dynamic compliance (**Dyn C**). Otherwise, a starting compliance value of 60 ml/cmH_2O is used until the dynamic compliance is valid.

NOTE
If the VTI/VTE difference is greater than 30%, meaning an acute change in leak has occurred during the previous breath, a pressure change is not permitted. This prevents inappropriate ventilation changes based on invalid data.

Each breath is compared to the target volume, and adjustments are made to quickly achieve and maintain the target volume. The following table shows the pressure change limits during the initial three PRVC breaths. From the fourth breath on, pressure changes are limited to ±3 cmH_2O

Breath #	1	2	3	4+
Max ΔP	±3 cmH_2O	±9 cmH_2O	±6 cmH_2O	±3 cmH_2O

NOTE
If PRVC is entered from a PCV or VCV mode and the dynamic compliance is valid, the initial breath sequence begins at number 2 above.

PSV (pressure support ventilation) mode. In the PSV mode, the ventilator delivers spontaneous, pressure-supported, breaths and user-initiated mandatory breaths. The ventilator functions as a demand flow system, with the patient triggering breaths and determining their timing and volume. The ventilator can support the breaths with the set pressure support. When the pressure support is set to Off, the ventilator functions like a conventional CPAP system. Figure 4-12 shows PSV waveforms. Figure 4-13 shows the control settings active in the PSV mode.

The **PSV** (pressure support) setting defines the applied pressure above PEEP. The patient determines the breath timing. The **Rise** setting defines the pressure rise time. The **E-Cycle** setting defines the expiratory cycling sensitivity in percentage of peak flow. As in other dual-limb modes, you also set **PEEP**, **I-Trig** (inspiratory trigger), and **O_2**. It is recommended that apnea backup ventilation be set in the PSV mode.

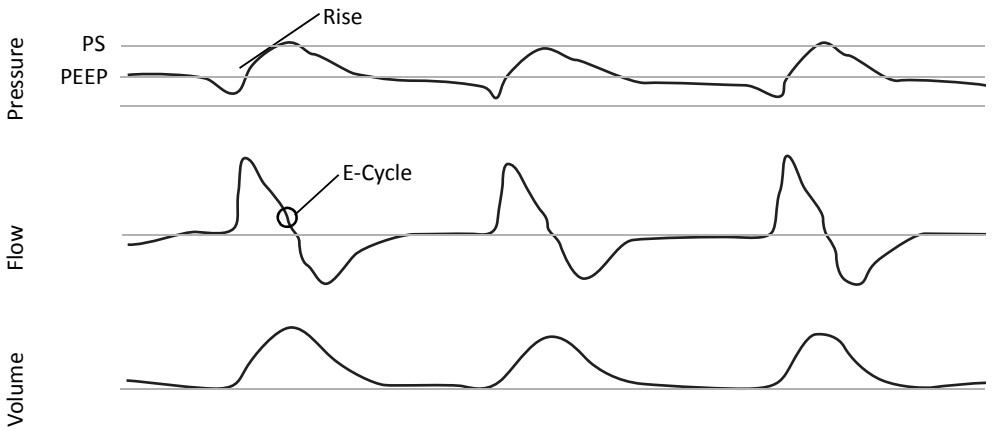

Figure 4-12: PSV waveforms

Figure 4-13: PSV controls

SIMV (synchronized intermittent mandatory ventilation) modes

The SIMV modes guarantee that one or more breaths will be delivered within an interval determined by the user-set **Rate**. Within this interval, at least one mandatory or assist breath is delivered, along with any number of spontaneous breaths, with or without pressure support. These modes help the patient gain full control of their breathing pattern by synchronizing the patient's spontaneous breaths with mandatory/assist breaths.

Each SIMV breath interval can be thought of as having a trigger window, during which the ventilator waits for a patient trigger (Figure 4-14). If the patient triggers a breath during this time, the ventilator immediately delivers an assisted breath with the target volume or pressure. If the patient does not trigger a breath, then the ventilator automatically delivers a mandatory breath at the end of the trigger window. After the mandatory breath is delivered, the patient is free to take any number of spontaneous or pressure-supported breaths for the remainder of the breath interval.

When the patient triggers a breaths before the trigger window closes, thereby starting a new breath cycle, the preceding breath cycle becomes shorter than the operator-set cycle time, 1/**Rate**. As you can see below, the patient triggers the third breath shown during the trigger window. The triggering of this third breath starts a new SIMV cycle. As a result, the second SIMV cycle time shown is shorter than 1/**Rate**. The cycle timer is now reset. The fourth breath shown is a machine-triggered mandatory breath that starts at the end of the trigger window. Thus, here again, the SIMV cycle time is equal to 1/**Rate**.

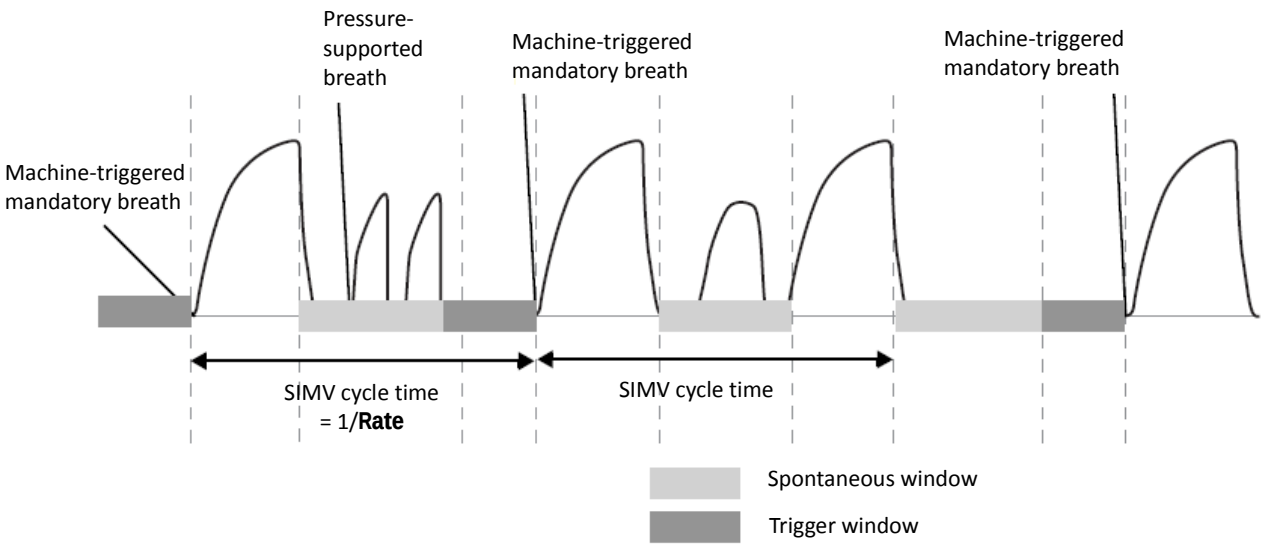

Figure 4-14: Breathing timing in SIMV modes

Because the SIMV modes are mixed modes, with attributes of both a mandatory and a spontaneous pressure support mode, you set the parameters specific to the applicable mandatory mode and to the PSV mode. For example, when the SIMV-PCV mode is selected, you set the parameters used in the A/C-PCV mode plus the parameters used in the PSV mode. As in other dual-limb modes, you also set **PEEP**, **I-Trig** (inspiratory trigger), and $\mathbf{O_2}$. Apnea backup ventilation is available in the SIMV modes.

Volume-controlled SIMV (SIMV-VCV) mode. In the SIMV-VCV mode, the mandatory/assist breaths are A/C-VCV breaths (see “A/C-VCV mode” on page 45). These mandatory breaths can be alternated with PSV breaths. Figure 4-15 shows the control settings active in the SIMV-VCV mode.

Figure 4-15: SIMV-VCV controls

Pressure-controlled SIMV (SIMV-PCV) mode. In the SIMV-PCV mode, the mandatory breaths are A/C-PCV breaths (see “A/C-PCV mode” on page 46). These can be alternated with PSV breaths. Figure 4-16 shows the control settings active in the SIMV-PCV mode.

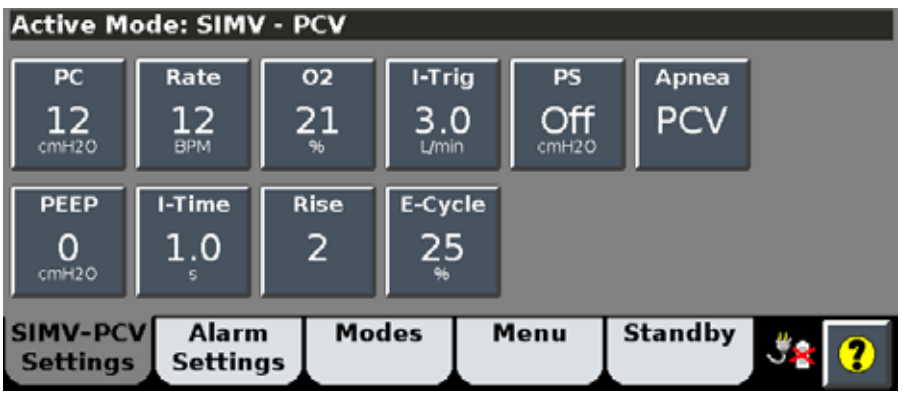

Figure 4-16: SIMV-PCV controls

Invasive and Noninvasive, Single-Limb Modes

NOTE

As is always the case for single-limb configuration modes, inspiratory pressure settings (IPAP) are not baseline (EPAP) pressure-compensated. Alternatively, inspiratory pressure settings in a dual-limb configuration mode are always PEEP-compensated.

CPAP mode

In the CPAP (continuous positive airway pressure) mode, the ventilator functions as a demand flow system, with the patient triggering all breaths and determining their timing and volume. The patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms and settings. The control settings active in the CPAP mode are shown in Figure 4-17. Figure 4-18 shows CPAP mode waveforms.

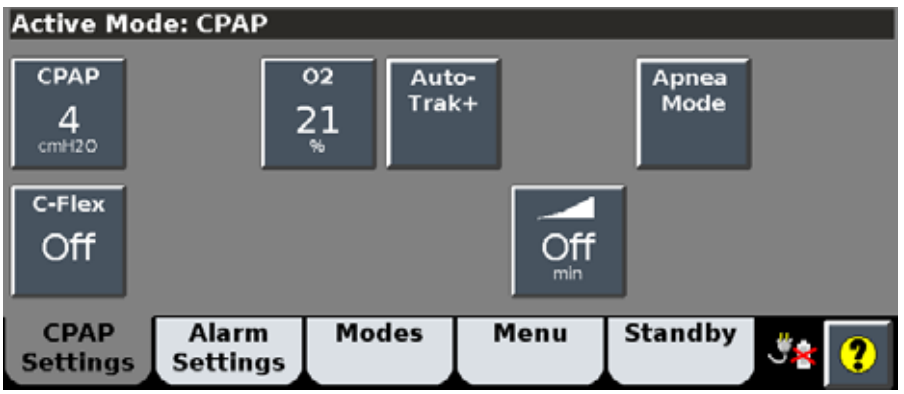

Figure 4-17: CPAP controls

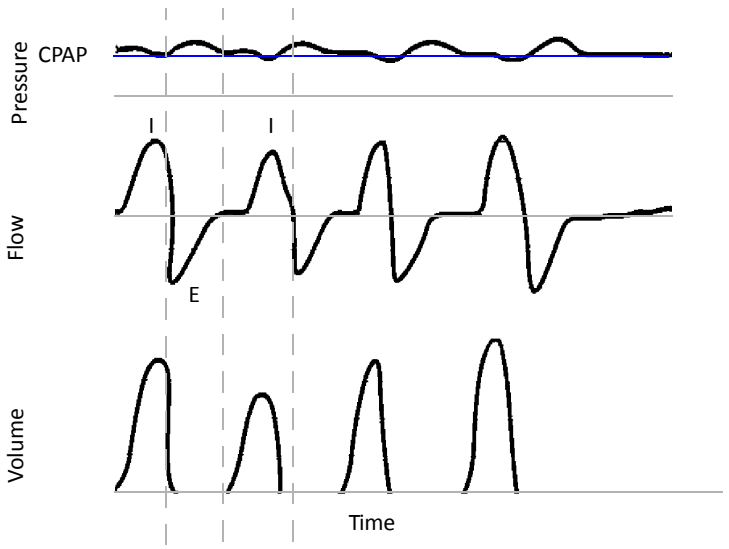

Figure 4-18: CPAP waveforms

The optional C-Flex setting enhances traditional CPAP by reducing the pressure at the beginning of exhalation – a time when patients may be uncomfortable with exhaling against high CPAP levels – and returning it to the set CPAP level before the end of exhalation. C-Flex has no effect when the CPAP setting is below 6 cmH_2O. Figure 4-19 shows C-Flex settings.

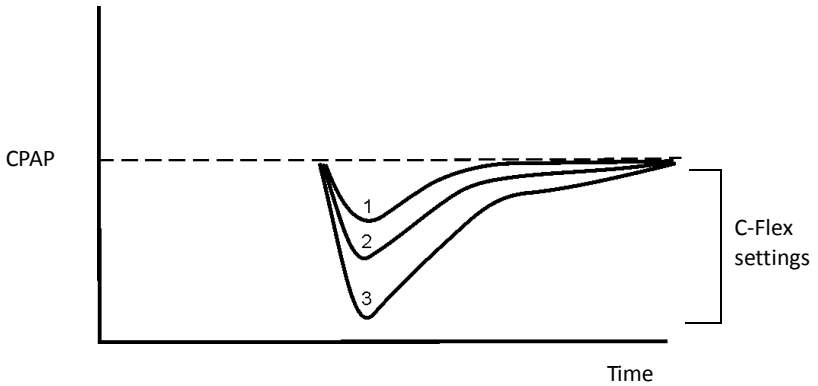

Figure 4-19: C-Flex in comparison to traditional CPAP therapy

PCV mode

The PCV (pressure-controlled ventilation) mode delivers pressure-controlled mandatory and assist breaths, either time-triggered by the ventilator (Mand) or triggered by the patient (Assist). The patient trigger is based on the ventilator's Auto-Trak Sensitivity algorithms and settings. The control settings active in the PCV mode are shown in Figure 4-20. The **IPAP** setting defines the applied pressure for all breaths. **Rate** and **I-Time** define the breath timing for all breaths. In most cases, you do not need to alter triggering and cycling settings; the ventilator's Auto-Trak Sensitivity algorithms automatically determine when to trigger and cycle based on patient efforts and the default settings are already appropriate for most patients. Figure 4-21 shows a PCV mode pressure waveform.

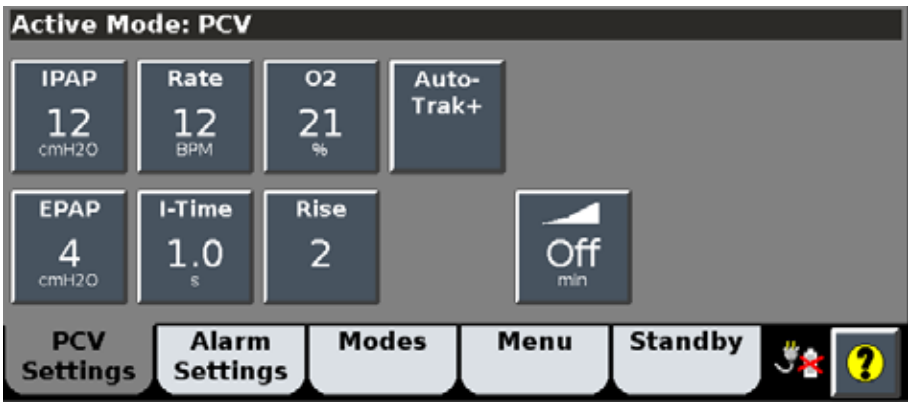

Figure 4-20: PCV controls

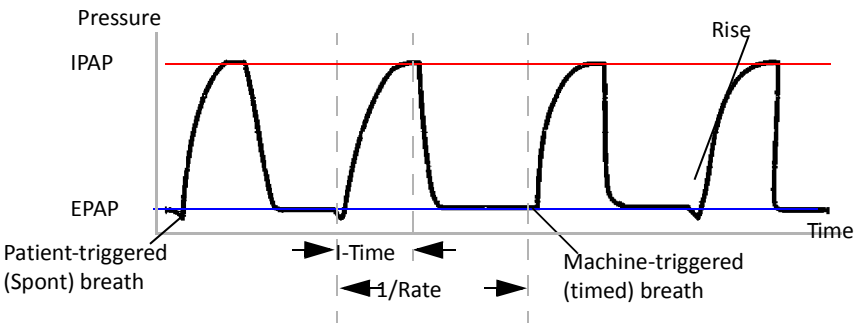

Figure 4-21: PCV pressure waveform

S/T mode

The S/T (spontaneous/timed) mode guarantees breath delivery at the user-set rate. It delivers pressure-controlled, time-cycled mandatory and pressure-supported spontaneous breaths, all at the IPAP pressure level. If the patient fails to trigger a breath within the interval determined by the **Rate** setting, the ventilator triggers a mandatory breath with the set **I-Time**. In most cases, you do not need to alter triggering and cycling settings; the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms and the default settings are already appropriate for most patients. The control settings active in the S/T mode are shown in Figure 4-22. Figure 4-23 shows an S/T mode pressure waveform.

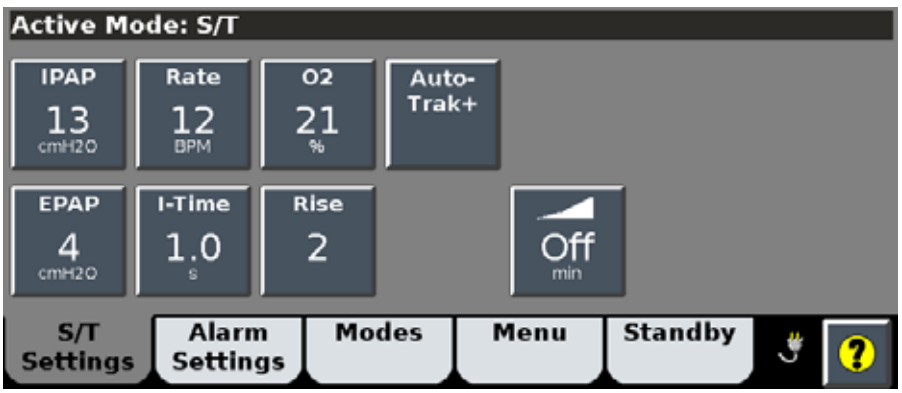

Figure 4-22: S/T controls

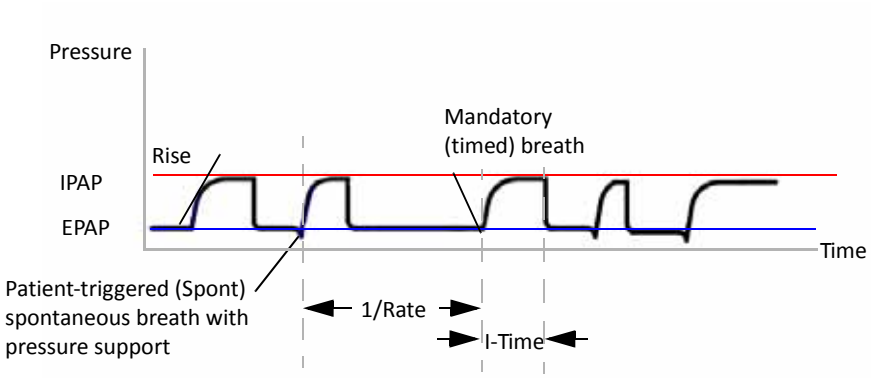

Figure 4-23: S/T pressure waveform

AVAPS+ mode (optional)

NOTE
When you adjust AVAPS+ minimum and maximum pressures, remember that IPAP is automatically adjusted to meet the target volume. If the calculated target pressure is outside of the minimum and maximum pressure settings, the target volume will not be achieved.

Unlike most pressure modes, the AVAPS+ (average volume-assured pressure support) mode delivers a target tidal volume. It achieves the target volume by regulating the pressure applied following an initial pressure ramp-up. The AVAPS+ mode delivers time-cycled mandatory breaths and pressure-supported spontaneous breaths.

If the patient fails to trigger a breath within the interval determined by the **Rate** control, the ventilator triggers a mandatory breath with the set **I-Time**. Mandatory and spontaneous breaths are delivered at a pressure that is continually adjusted over a period of time to achieve the volume target, **V_T**. **Min P**, and **Max P** define the minimum and maximum pressures that can be applied. In most cases, you do not need to alter triggering and cycling settings. The patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms, and the default settings are appropriate for most patients.

At start-up, AVAPS+ applies an inspiratory pressure equal to the **Min P** setting. The measured volume is then compared to the target volume, and breath-to-breath adjustments are made to achieve the target volume within 40 breaths. To speed up the time and number of breaths to reach target **V_T**, first start in the S/T mode to determine the pressure required to achieve the desired tidal volume. Then set the initial **AVAPS+ Min P** setting a few cmH_2O below this pressure. After this initial start-up period, pressure adjustments are limited by the **Max ΔP** setting.

Patients often alternate between active and resting breathing patterns. The resulting volume delivered at the same inspiratory pressure can be different depending on the breath type.

- A spontaneous "assisted" breath—when the patient triggers and participates in the breath the volume—is greater.
- A timed breath—when the patient is resting and not triggering or participating in the breath delivery the volume—is less.

This fact makes it harder to maintain a consistent tidal volume target, especially with a relatively slow-adjusting algorithm. The solution is to learn the tidal volume of both breath types and apply a pressure boost to the timed breaths to make volume for both breath types more consistent.

The control settings active in the AVAPS+ mode are shown in Figure 4-24. Figure 4-25 shows AVAPS+ mode waveforms.

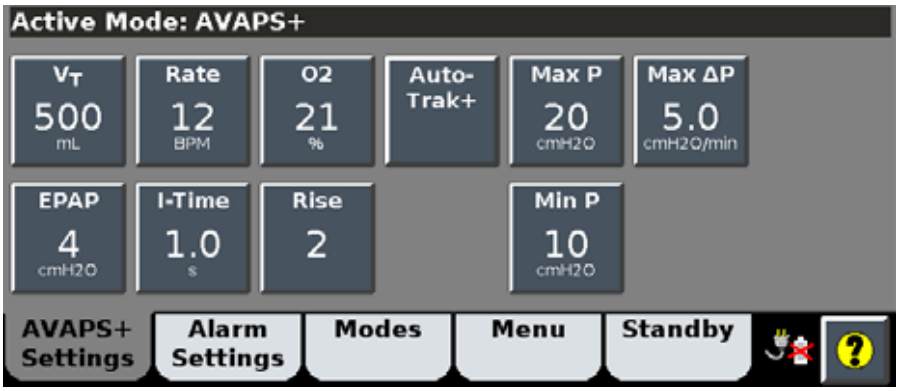

Figure 4-24: AVAPS+ controls

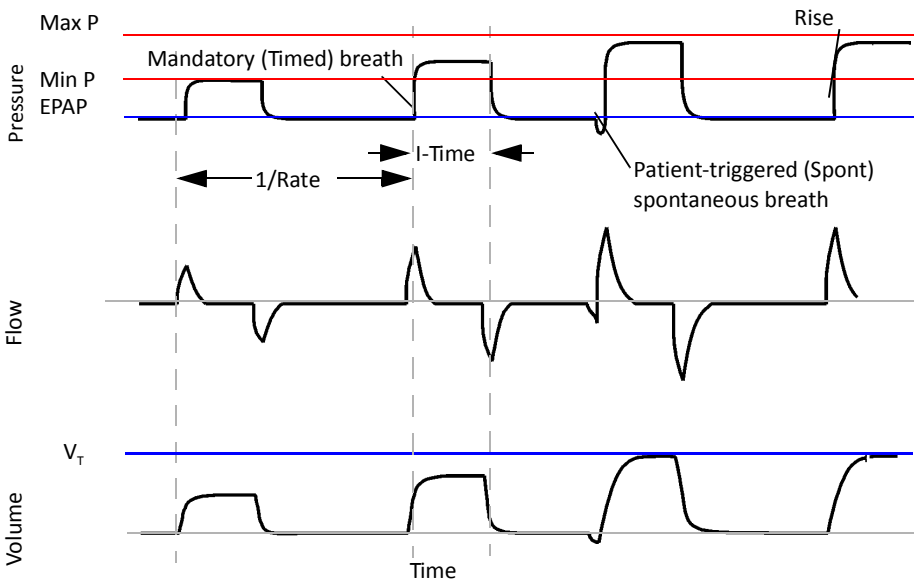

Figure 4-25: AVAPS+ waveforms

PPV mode (optional)

The PPV (proportional pressure ventilation) mode provides patient-triggered breaths that deliver pressure in proportion to patient effort. Additionally a user-settable backup rate activates machine time-triggered, pressure-limited, and time-cycled breaths in the case of apnea. In the PPV mode (excluding machine, time-triggered breaths), patient effort determines the pressure, flow, and tidal volume delivered by the ventilator. The ventilator responds to patient effort, allowing the patient to determine when to start and end a breath. Additionally, flow and pressure change based on the patient's efforts throughout inspiration. PPV mode is available only for adult and pediatric patients weighing more than 20 kg.

The physics behind PPV. Two forces oppose ventilation, *resistance* and *elastance*.

Resistance is the impedance to air movement in the airways:

Pressure/Flow = Resistance

Airway resistance in healthy adults ranges from approximately 0.5 to 2.5 $cmH_2O/L/s$.

Elastance is the elastic opposition to ventilation or the tendency of the lungs to resist inflation (elastance is the reciprocal of compliance):

Pressure/Volume = 1/Compliance = Elastance

The compliance of lungs and chest wall for a healthy adult is approximately 0.1 L/cmH_2O, resulting in an elastance value of 10 cmH_2O/L.

The inspiratory muscles, therefore, must generate force to overcome the resistance and elastance of the respiratory system. The proximal airway pressure is the net result of this contraction of these muscles: it is the force of the inspiratory muscle contraction minus both the pressure needed to generate air flow (overcome respiratory system resistance) and the pressure generated to inflate the lungs (overcome respiratory system elastance).

PPV is based on the equation of motion:

Pressure = Volume x Elastance + Flow x Resistance

where Pressure is the sum of patient effort (P_{muscle}) and the ventilator-generated pressure.

How PPV works. The delivery of a PPV breath is controlled by the maximum elastance (volume) assist (**Max E**), maximum resistance (flow) assist (**Max R**), and **PPV %** settings. The actual delivered assistance to overcome elastance is the product of **PPV %** and **Max E**. The actual delivered assistance to overcome resistance is the product of **PPV %** and **Max R**. In general, **Max E** should be set relative to the respiratory elastance and **Max R** should be set relative to the respiratory resistance. You adjust assist levels to optimize patient comfort. The resultant pressure support delivered in the PPV mode is the resistance assist times patient flow plus the elastance assist times the patient volume. The end result is that the level of pressure support is controlled by the inspiratory effort of the patient. Because the patient completely controls ventilatory output,[1] PPV may significantly improve patient-ventilator synchrony and ultimately, patient comfort.

The PPV backup rate ensures that the patient receives a minimum number of breaths per minute if the spontaneous breathing rate falls below the **Rate** setting. If the patient fails to trigger a breath within the interval determined by the **Rate** control, the ventilator triggers a timed (backup) breath with the set **I-Time**, **Rise**, and **IPAP** settings.

The control settings active in the PPV mode are shown in Figure 4-26.

Figure 4-26: PPV controls

Figure 4-27 shows PPV mode waveforms. Note how volume and pressure increase as does the ventilatory demand of the patient. **Max V** (PPV maximum volume limit) and **Max P** (PPV maximum pressure limit) are used to prevent the delivery of excessive pressure or volume. More information about these limits is provided in “About Max V and Max P Alarms and Alarm Limits” on page 96.

1. Marantz, S., Patrick, W., Webster, K., et al. “Response of ventilator-dependent patients to different levels of proportional assist.” *Journal of Applied Physiology,* Vol. 80: 397-403, 1996.

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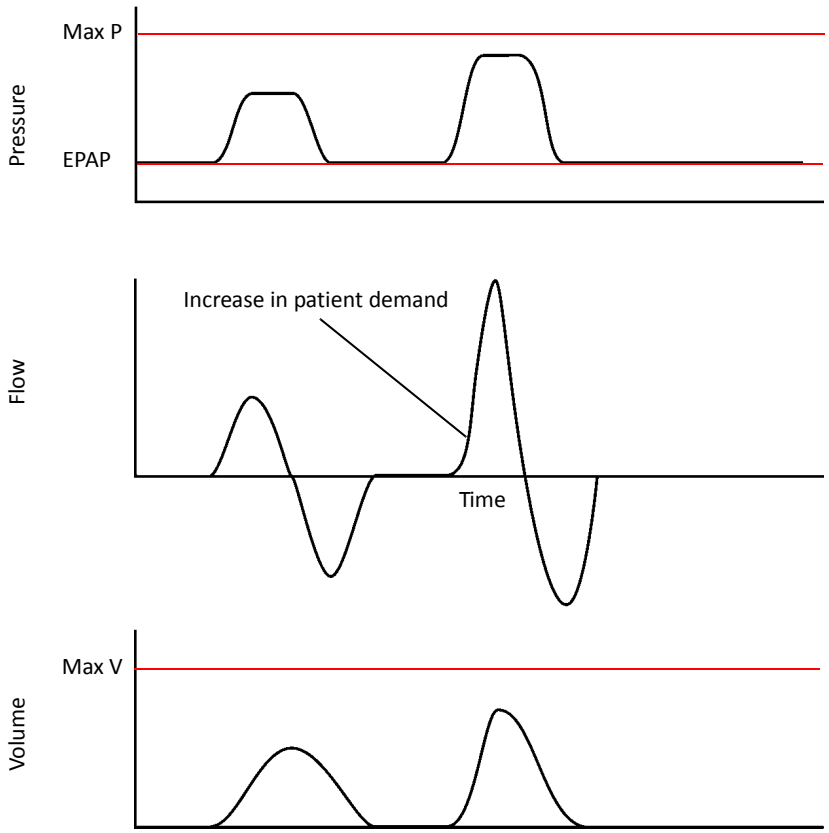


Figure 4-27: PPV waveforms

Apnea Backup Ventilation

NOTE
We recommend that apnea backup ventilation be appropriately set whenever a mode that relies mainly on spontaneous breathing is selected. For safety reasons, apnea backup is enabled by default.

The V680 ventilator provides apnea backup ventilation, a mechanism that minimizes possible patient injury due to apnea or cessation of respiration. Apnea can occur in any spontaneous mode, that is, one that relies solely on the patient to trigger. When the ventilator detects no inspiratory efforts or delivers no control breaths during the operator-set Apnea interval, it annunciates an Apnea alarm and starts apnea backup ventilation. It provides ventilation at the operator-selected apnea settings.

If the patient triggers two consecutive breaths, or the alarm is reset, the ventilator reverts to ventilation in the original support mode and at the original settings.

Emergency Ventilation

The ventilator switches to emergency ventilation under the following alarm conditions: patient circuit occluded, exhalation valve stuck closed, and exhalation flow sensor failure alarm. The Patient Circuit Occlusion alarm is an auto-resettable audible and visual alarm. The audible and visual alarms for Exhalation Valve Stuck Closed and Exhalation Flow Sensor Failure are non-resettable.

In response to these alarms, the ventilator switches to single-limb ventilation using the inspiratory limb to deliver gas and allow exhalation to happen through the inspiratory limb. The exhalation valve is opened for Patient Circuit Occlusion (to allow spontaneous emergency breathing for the case of inspiratory limb occlusion) and Exhalation Valve Stuck Closed alarms. The exhalation valve is closed for the Exhalation Flow Sensor Failure alarm. An internal leak valve is also opened during exhalation.

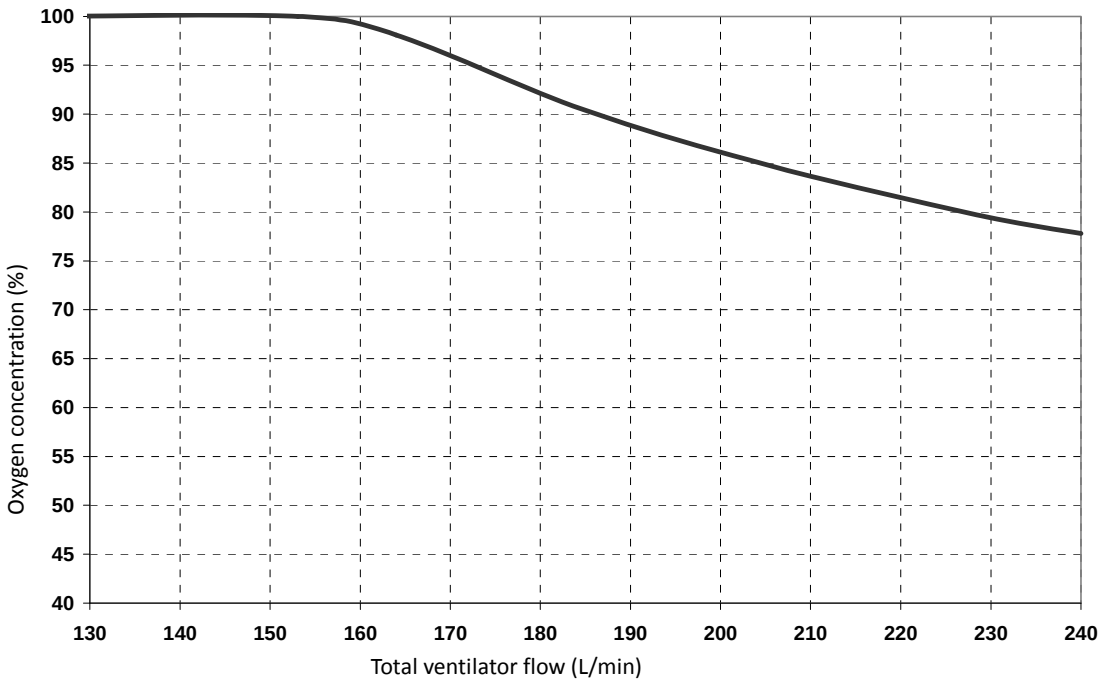
When the patient circuit occlusion is corrected, the audible and visual alarms will auto-reset and normal dual-limb ventilation resumes at the prescribed settings.

Oxygen Mixing

The ventilator's oxygen mixer regulates and proportions oxygen into the air from the blower according to the O_2 setting. The delivered oxygen accuracy is ±5% of the set value up to the maximum oxygen flow available. The ventilator can deliver up to 240 L/min of air/oxygen mix to assist in managing uncontrolled leaks during single-limb, noninvasive ventilation.

Many hospital oxygen supply systems, however, cannot meet such high flow demands. Under extraordinary conditions (high O_2 setting plus high leak, and/or high patient demand) where demand exceeds available oxygen system flow, the ventilator provides additional air flow from the blower to ensure the target pressure is met. Under such conditions, the accuracy of delivered oxygen may be affected. Figure 4-28 shows the effect on the delivered oxygen concentration as the maximum oxygen system flow is exceeded. This graph assumes a continuous flow demand. Normally the higher "peak" flow is only needed during the start of inspiration, therefore this is a worst case scenario.

In cases where the delivered O_2 concentration is affected by this phenomenon, you may or may not see the effect on measured O_2%. This is because the change may only be transient and therefore not long enough for the oxygen sensor to detect and reflect the short duration change.



Assumptions: At an **O_2** setting of 100% and an oxygen supply with a 50 psig inlet pressure capable of delivering up to160 L/min.

Figure 4-28: O_2 concentration as a function of total ventilator flow

5 Preparing for Ventilation

Set up the ventilator for each patient use as described in this chapter. For first-time installation, refer to Appendix A.

WARNING

- **Do not cover or position the ventilator so as to adversely affect its operation or performance.**
- **To reduce the risk of the device overheating and possible burn injury, do not block the fan intake at the rear of the ventilator.**
- **To ensure normal air circulation and exchange, do not cover or block the ports on the ventilator. Do not block the air intake panel on the right side of the ventilator or the vent on the right rear of the ventilator.**
- **To reduce the risk that an alarm will go unnoticed or be disregarded, do not block the speakers. They are located on bottom of the ventilator enclosure, covered by a perforated screen.**
- **To reduce the risk of electric shock from liquid entering the device, do not put a container filled with a liquid on the ventilator.**

Installing eSYS Exhalation Cartridge

The eSYS cartridge must always be installed and covered to prevent damage to the ventilator as a result of liquid spillage into the ventilator electronics.

WARNING

- **NEVER replace the eSYS cover without an eSYS cartridge installed. You will damage the cover detection switch.**
- **Do not operate the V680 Ventilator without filters. A bacteria filter should be used on the patient gas outlet port and on the inlet port of the eSYS cartridge.**

CAUTION

The eSYS exhalation cartridge must be installed during use for *both* single-limb and dual-limb circuit configurations. During single-limb ventilation, it helps prevent liquid ingress hazards. Always install a bacteria filter to cover the eSYS port and keep it clean.

For installation and maintenance instructions, see “Replacing the eSYS Exhalation Cartridge” on page 167.

Installing a Humidifier

WARNING

- **To prevent possible patient injury and equipment damage, do not turn the humidifier on until the gas flow has started and is regulated. Starting the heater or leaving it on without**

gas flow for prolonged periods may result in heat build-up, causing a bolus of hot air to be delivered to the patient. Circuit tubing may melt under these conditions. Turn the heater power switch off before stopping gas flow. Note: Standby mode provides a continuous gas flow therefore it is not necessary to turn off the humidifier during Standby mode.

- **To prevent possible patient injury and possible water damage to the ventilator, make sure the humidifier is set appropriately.**
- **To reduce the risk that the patient will aspirate condensed water from the breathing circuit, position any humidifier lower than both the ventilator and the patient.**
- **When using a humidifier, always use either a circuit with a water trap or a heated wire circuit to minimize patient risk from condensate in the circuit.**
- **Nebulization or humidification can increase the resistance of breathing system filters. When using a nebulizer or humidifier, monitor the breathing system filter frequently for increased resistance and blockage.**

NOTE
Set the appropriate compensation for the type of humidification in use whenever a patient circuit is changed. These settings are available in the Ventilator Configuration screen.

Install a humidifier to the V680 using the slide bracket on the ventilator stand column (Figure 5-1). The bracket is adjustable and can slide up and down the column to accommodate water chamber clearance. Prepare the humidifier as described in the manufacturer's operation manual.

Figure 5-1: Humidifier mounted on ventilator stand

You may need to purchase an adapter to mount some humidifier brands on the V680 ventilator stand.

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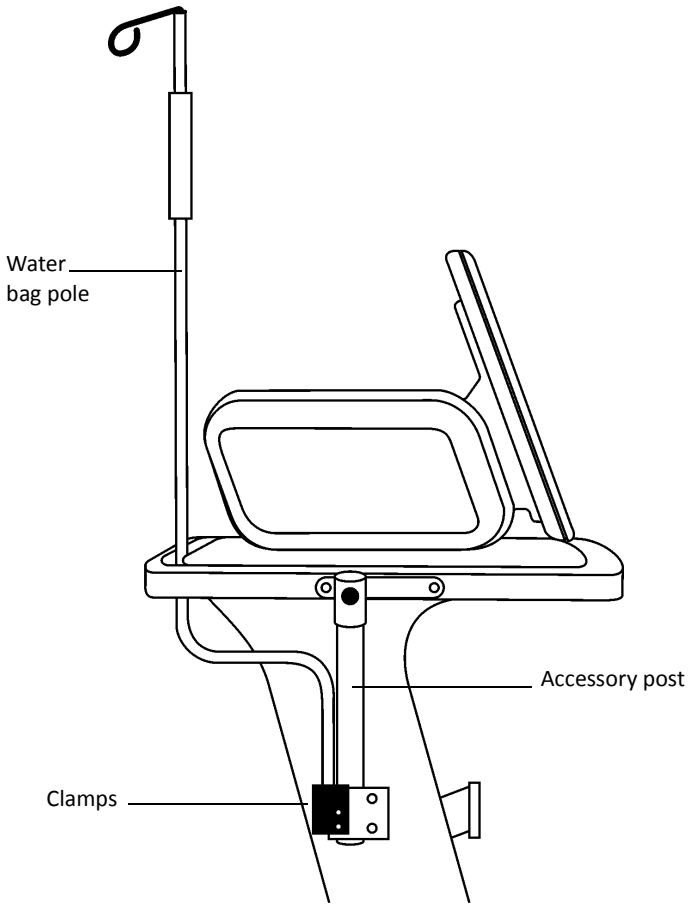
Mounting a Water Bag Pole

An optional water bag mounting kit is available for use with a humidifier. (See Appendix C, Parts and Accessories). Use a pole kit along with an accessory mounting post. You will need a 4 mm hex wrench, which is included in the kit.

Three sets of screws are included with the pole kit; use the medium length 36 mm screws. Assemble the accessory post and pole kit as shown below, with the pole clamp low on the accessory post. Mount the water bag pole *inside* the ventilator stand handle as shown.



Installing the Patient Circuit

WARNING

- **Do not operate the V680 Ventilator without filters. A bacteria filter should be used on the patient gas outlet port and on the inlet port of the eSYS cartridge.**
- **Any additional accessories in the patient circuit may substantially increase flow resistance and deadspace and impair ventilation.**
- **Speaking valves, Heat Moisture Exchangers (HMEs), and filters create additional circuit resistance and may affect the performance of the patient circuit disconnect alarm.**
- **To reduce the risk of CO_2 rebreathing during noninvasive ventilation, avoid introducing extra dead space to the patient circuit.**

Install the patient circuit exactly as it will be used on the patient. For a list of compatible parts and accessories offered by Philips, see Appendix C.

1 Determine the correct patient type. Press the **Adult >20 kg** button or the **Pediatric 5-20 kg** button.

2 Assemble the patient circuit, including the main flow (inspiratory) bacteria filter, proximal pressure line, and HME (if desired).

NOTE

In single-limb modes, the eSYS exhalation cartridge must be installed and covered with a bacteria filter even though it is not used as the exhalation port. The V680 should never be run without an eSYS cartridge installed and the eSYS cover properly closed.

Figure 5-2 through Figure 5-5 show circuit configurations for single-limb and dual-limb ventilation. Follow the manufacturers' instructions for use for the individual parts, including the humidifier.

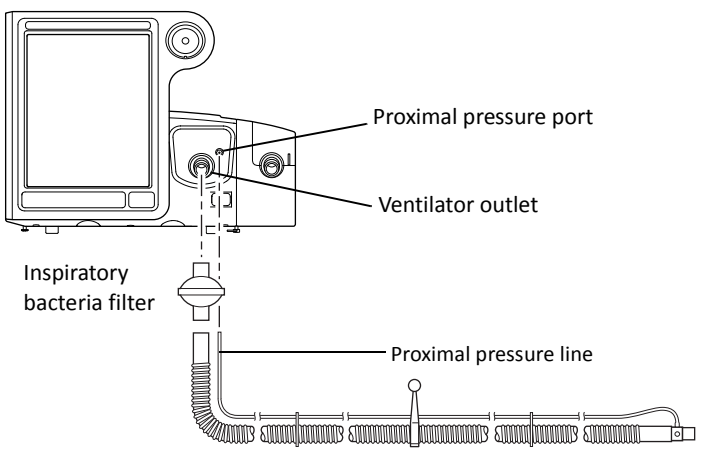


Figure 5-2: Single-limb, noninvasive circuit, without humidification

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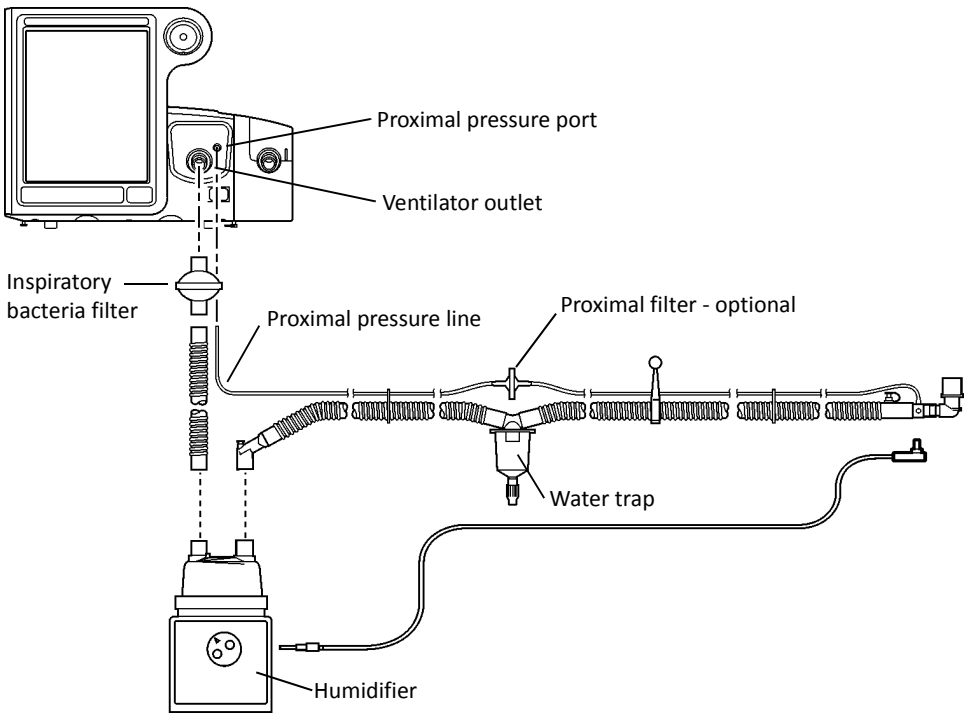

Figure 5-3: Single-limb, invasive circuit, with humidification

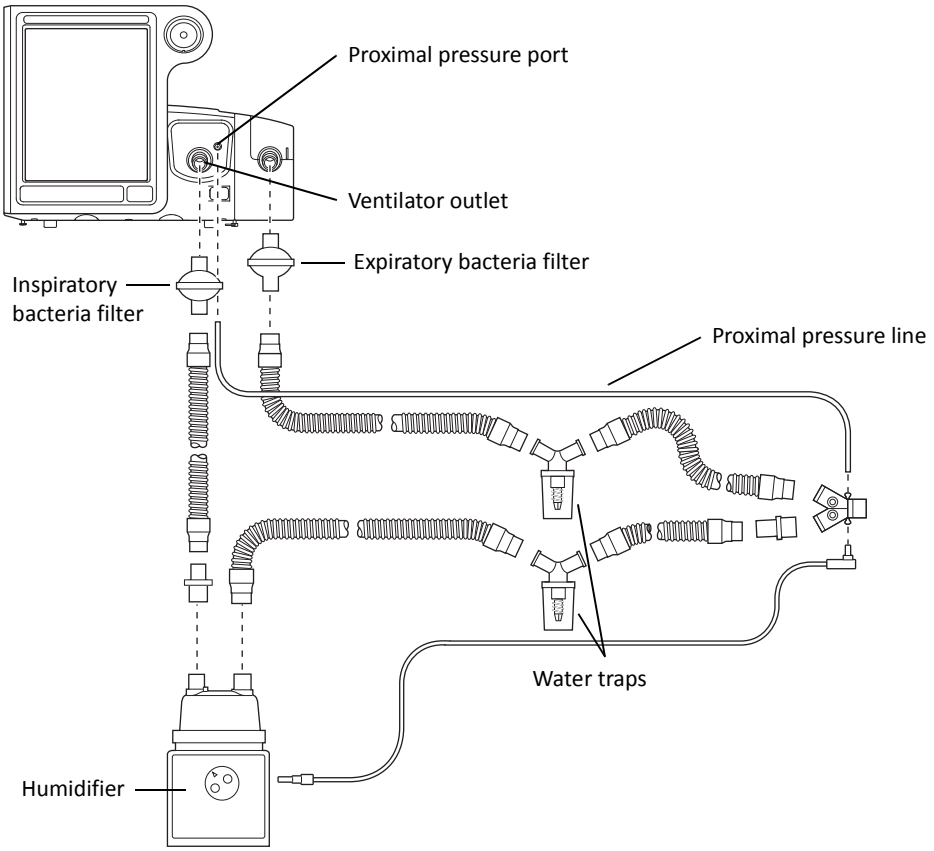

Figure 5-4: Dual-limb adult circuit with non heated-wire humidification

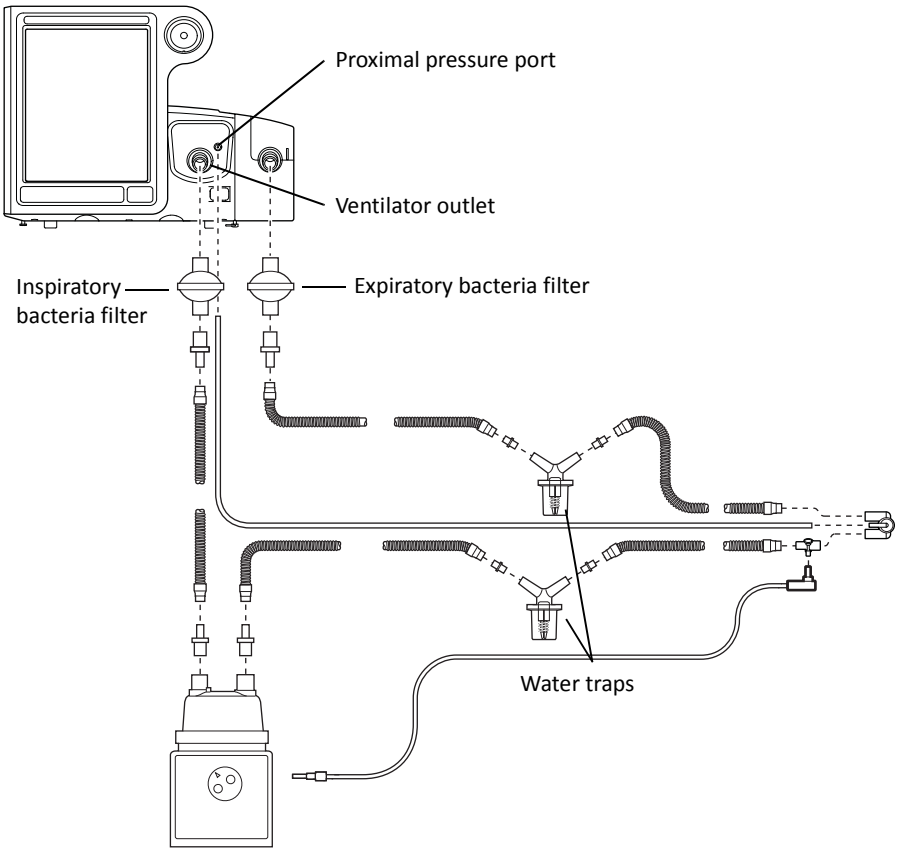

Figure 5-5: Dual-limb pediatric circuit with non heated-wire humidification

1 Properly position the patient circuit before use on a patient. Make sure the tubing will not be pushed, pulled, or kinked during patient movement or other procedures.

NOTE

Run SST (page 76) after installing a new or reprocessed patient circuit.

Connecting Oxygen

WARNING

Connect the ventilator to an appropriate medical-grade oxygen source only. The source must be able to deliver 100% oxygen regulated to 276 to 600 kPa (40 to 87 psig) and sustained flow of 140 L/min. Always use medical-grade hoses and supply systems to minimize the risks of:

- **impaired ventilator performance**
- **inhalation injury**
- **explosion from contaminants in the gas path**

To reduce the risk of hypoxia, connect only oxygen to the high-pressure connector at the rear of the ventilator.

Be aware that 21% O_2 is used in case of an oxygen supply failure, increasing the risk of hypoxemia due to continued ventilation with air.

CAUTION

- **To prevent possible damage to the ventilator, ensure that the connection to the oxygen supply is clean and unlubricated, and that there is no water in the oxygen supply gas.**

Connect the oxygen hose to the ventilator's oxygen inlet connector (Figure 5-6) or to the optional oxygen manifold, if applicable.

Use of SIS connectors and supplemental oxygen accessories such as the O_2 manifold requires higher oxygen supply pressures. Consult Table 11-12 on page 184 for appropriate oxygen pressure ranges.

Figure 5-6: Oxygen inlet connector

Calibrating the Internal Oxygen Sensor

The V680 includes an integrated oxygen sensor that is automatically calibrated during EST (Extended Self Test). The oxygen sensor must be calibrated before first use. It is also recommended that you calibrate the sensor between patients to avoid oxygen measurement issues over time. Calibrate the oxygen sensor using the EST on page 76.

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Connecting to AC Power

WARNING

- **To reduce the risk of electric shock use only a Respironics-supplied (hospital-grade) power cord and connect the ventilator only to supply mains with protective earth ground.**
- **To prevent unintentional disconnection of the power cord, always use the correct, Philips-supplied power cord and lock it into place with the power cord retainer before use.**
- **To reduce the risk of strangulation, route the power cord to avoid entanglement.**

CAUTION

Grounding reliability can only be achieved when equipment is connected to an appropriate voltage receptacle marked "hospital only" or "hospital grade."

Plug the power cord into a grounded outlet that supplies AC power between 100 and 240 V, 50/60 Hz.

Always check the reliability of the AC outlet. If you are using a 120 V outlet, make sure that it is hospital-grade.

Connecting External Devices

You can connect the ventilator to a remote alarm (nurse call) device and a patient monitor or other external device. The ventilator supports the connection of a Philips monitor through the VueLink and IntelliBridge EC5/EC10 Open Interface modules. See Appendix B for details.

Turning on the Ventilator

NOTE

Upon power-on the ventilator automatically runs a test of the backup audible alarm followed by the primary audible alarm. You should hear a high-pitched tone, followed by several alarm tones at increasing volumes. If you do not hear all of these sounds, discontinue use of the ventilator and have it serviced.

Power on the ventilator with the **ON/Shutdown** key.

Startup Window

After power-on, the startup window is displayed.

Resume

Select **Resume** to start up in the same mode and with the settings that were active before last power down. The **Ventilator Configuration** screen opens. Confirm these settings and adjust as needed.

New Patient

Select **New Patient** to configure a new patient. The **Ventilator Configuration** screen opens. Select and adjust settings as needed.

NOTE
Selecting **New Patient** resets all settings to default and clears all stored data.

Ventilator Configuration Overview

The **Ventilator Configuration** screen is used to set up the patient type, patient circuit, and components of the breathing system for new and resuming patients. The screen is dynamic, meaning the choices change based on the patient type and circuit type selected.

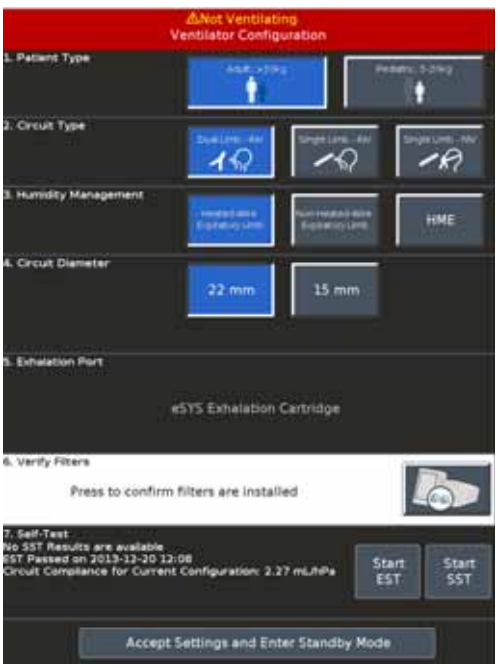
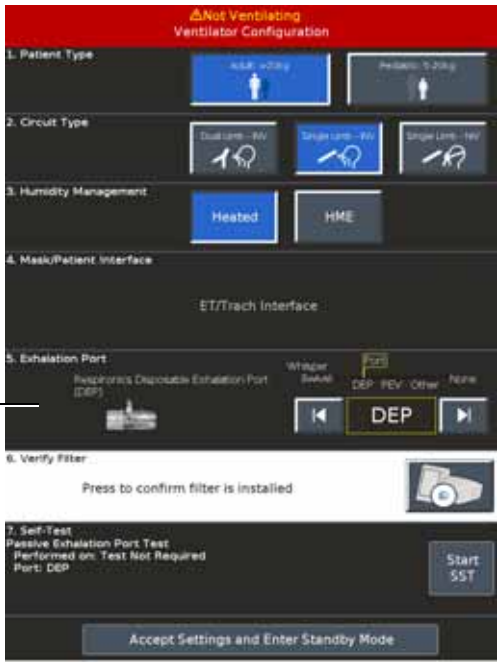


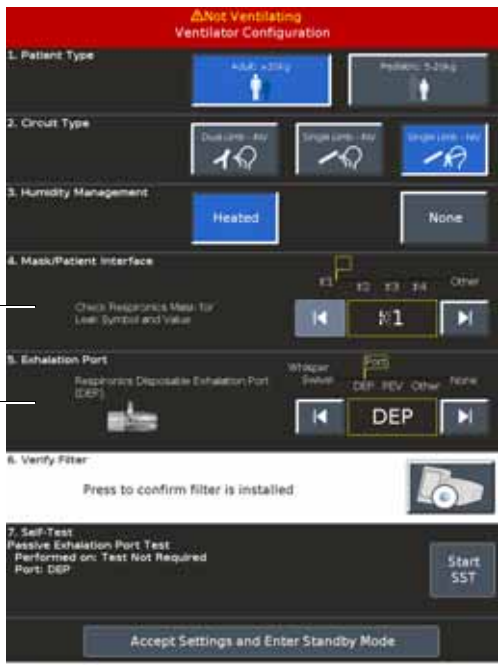
Figure 5-7: Dual-limb - configuration screen (adult)

Philips



See page 80 for exhalation ports

Figure 5-8: Single-limb invasive - configuration screen (adult)



See page 79 for masks

See page 80 for exhalation ports

Figure 5-9: Single-limb noninvasive - configuration screen (adult)

Philips

Running EST and SST

NOTE

- Any dual-limb circuit that meets the specifications in Table 11-14 *and* passes the ventilator's SST (Short Self-Test) on page 76 is approved for use with the V680 Ventilator.
- Filters must be installed and confirmed before the ventilator can begin EST (Extended Self Test) and SST (Short Self Test) **or before starting ventilation.** When filters are confirmed, the EST and SST buttons become active.
- The V680 was designed to operate with inspiratory and expiratory filters in place. Failure to use filters may affect performance and/or result in nuisance alarms.

Always perform EST and SST with any circuit accessories such as swivel adapters and HMEs installed. EST and SST are performed by following the on-screen steps, instructions, and messages. Run the following tests as applicable:

Extended Self-Test (EST)

We recommend that you run EST:

- Between patients
- When the oxygen sensor is replaced
- When the eSYS cartridge is removed and replaced regardless of whether it was sterilized

A dual-limb circuit must be connected to run the test. The EST takes approximately 3 minutes if no optional tests are skipped.

NOTE

The V680 ventilator must be connected to a hospital-grade oxygen supply to run the O_2 calibration test during EST. EST should always be performed with oxygen connected. However, it is allowable to skip oxygen sensor calibration if the sensor is already calibrated.

Short Self-Test (SST)

Run SST:

- When the ventilator circuit is changed on the same patient
- Between patients during setup
- To verify the remote alarm function
- Also:
  - If a dual-limb circuit is used, you should run SST between patients and whenever the circuit is changed.
  - If a single-limb circuit is used and PEV or OTHER is the exhalation valve setting, run SST between patients and when the circuit is changed.

The SST takes approximately 30 seconds.

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Configuring a New Patient

1 Select **New Patient** from the Startup screen. The **Ventilator Configuration** window opens.

2 Select **Dual Limb - INV**. Every new patient must be initially set up in dual limb to run the system tests included in **EST**, and the tests included in **SST**.

3 Select settings for patient type, circuit type, humidifier and patient interface, depending on which type of circuit you chose.

4 Select and confirm filters.

5 Select **Start EST** or **Start SST**. We recommend running SST first, in case there are leaks that would cause failures of EST tests.

6 An automatic pre-operational test sequence is performed. Follow the on-screen prompts.

7 After configuring the ventilator and running the EST and/or SST, press **Accept Settings and Enter Standby Mode** to open the Standby screen.

8 From the **Standby** screen you can:

- Start ventilation by pressing the **Start Mode** button or,
- Return to the **Ventilator Configuration** screen or,
- Adjust ventilator settings using the tabs at the bottom of the screen and then start ventilation.

9 If you will be using a single-limb circuit on the patient, place it on the ventilator now and re-run the SST.

NOTE
For more information on mask and exhalation port characteristics, see “Selecting the Mask and Exhalation Port” on page 79.

For more information on adjusting ventilator and patient settings, see “Operation - Single-Limb” on page 85 or “Operation - Dual-Limb” on page 109.

Backup Battery Check

Recommended between patients.

WARNING
Do not perform this check while attached to a patient.

NOTE
The battery must be adequately charged to run this test. Recharge as necessary before running the test.

1 Disconnect the ventilator from AC power while the ventilator is running.

When the backup battery is in use:

- The ventilator switches over to battery power (battery symbol in right-hand corner of screen is displayed).

- The green LED above the ON/Shutdown key remains lit.
- The audible alarm sounds intermittently.
- **Running on Internal Battery** is shown.
- The Battery LED is off.

2 Reconnect the ventilator to AC power. The alarm resets.

3 Verify the ventilator is again running on AC (symbol displayed in right-hand corner of screen), and the battery LED flashes to indicate the battery is charging.

Troubleshooting

If any configuration step fails, discontinue ventilator use and contact Philips.

NOTE
A procedure to run battery or alarm tests separately from Ventilator Configuration, when needed, is available in Appendix A, “First-Time Installation”.

Selecting the Mask and Exhalation Port

Mask Types and Leak Settings

Philips Respironics masks are leak-calibrated to match V680 ventilator settings. Mask examples are shown below for each Leak type. For a comprehensive list of compatible masks as well as new products, contact your Philips Respironics representative.

Other mask brands can also be used with the V680 but, because they are not leak-calibrated, you need to select **Other** for mask type. When the mask type is set to **Other**, the ventilator displays total leak (**Tot. Leak**) rather than patient leak (**Pt. Leak**), which is available only for the calibrated masks.

Mask/patient interface type*		Description
	Leak 1	Mask with minimal intentional leak characteristics. Enter **Leak 1** for any of these Philips Respironics masks: • Contour Deluxe nasal mask • PerformaTrak mask • Image3 full face mask • AF811 oro-nasal mask • AF531 full face mask with Leak 1 elbow • AF421 oro-nasal mask with Leak 1 elbow
	Leak 2	Mask with medium intentional leak characteristics. Enter L**eak 2** for these masks: • Philips Respironics PerforMax oro-nasal mask [EE] • AF421 oro-nasal mask with Leak 2 elbow
	Leak 3	Reserved for future Philips Respironics mask releases
	Leak 4	Philips Respironics Total full face mask
	Other	Mask not manufactured by Philips Respironics NOTE: If you select **Other**, the ventilator displays **Tot.Leak** rather than **Pt. Leak**.

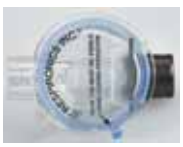
*.A leak symbol is printed on Respironics masks.

Exhalation Ports

WARNING
To prevent possible patient injury, inspect and verify the proper operation of the single-limb passive exhalation port regularly during use.

NOTE
- If you selected **PEV** or **Other** as an exhalation port, you must run an exhalation port test. The test is included in SST or may be performed from the Mask/Port menu.
- If the exhalation port test is not run or if it fails, the intentional leak is unknown. **Tot.Leak** rather than **Pt. Leak** is displayed in the patient data window.

Run the exhalation port test when indicated (see “Running the Exhalation Port Test” on page 90 for instructions).

Port type		Exhalation port test recommended?
	**DEP** Philips Respironics Disposable Exhalation Port	No
	**Whisper Swivel** Philips Respironics Whisper Swivel	No
	**PEV** Philips Respironics Plateau Exhalation Valve	Yes
	**Other** Exhalation port not supplied by Philips Respironics.	Yes
	**None** No inline circuit exhalation port	No
NOTE If you select **None**, refer to the manufacturer’s instructions to make sure the mask selected contains an exhalation port.		

For more information concerning mask/port leak characteristics, see the instructions provided with each mask/port. See Appendix C for a list of masks, circuits, and related components used with the ventilator.

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Installing a Nebulizer

WARNING

- **To minimize patient risk from increased volume delivery, altered ventilator performance, inadvertent alarms, and altered FiO_2, do not use a pneumatic nebulizer or otherwise inject flow into the circuit. Use only vibrating mesh or non-flow driven type nebulizers.**
- **Nebulization or humidification can increase the resistance of breathing system filters. When using a nebulizer or humidifier, monitor the breathing system filter frequently for increased resistance and blockage.**
- **Do not use a filter or heat-moisture exchanger (HME) between the nebulizer and patient airway.**

NOTE

Connect only approved nebulizers to the V680 ventilator. See Appendix C, “Parts and Accessories” for compatible nebulizers.

Attach the nebulizer to the mounting bracket on the ventilator stand (Figure 5-10). Consult the operating instructions supplied with the nebulizer for further installation and operating information.

Figure 5-10: Installing the Aerogen Pro nebulizer

Using the Ventilator for Transport

WARNING

- **Ventilator performance may be impaired due to improper orientation.**
  - **Do not tilt more than 12 degrees in any direction. Take particular care when crossing thresholds during intra-hospital transport.**
  - **The ventilator should only be used on a flat, level surface capable of safely holding 12.3 kg (27 lb) or more, or properly mounted to the V680 stand supplied by Philips.**
  - **To avoid blocking the exhalation port during dual-limb ventilation, do not set the ventilator directly on bedding. The ventilator should only be placed on a hard surface to allow for exhaled gases to escape unimpeded.**
- **To reduce patient risk from an insufficient oxygen supply, always check the status of the oxygen cylinders before using the ventilator during transport. For single-limb use, the oxygen consumption may be several times that of dual-limb configuration.**
- **The battery is intended for backup or transport use only. Battery operation time can be affected by discharge and recharge cycles, time, and ambient temperature. Using the battery as primary power source increases patient risk resulting from a ventilator shutdown due to total power loss.**
- **Do not leave the ventilator unattended when stationed on an incline.**

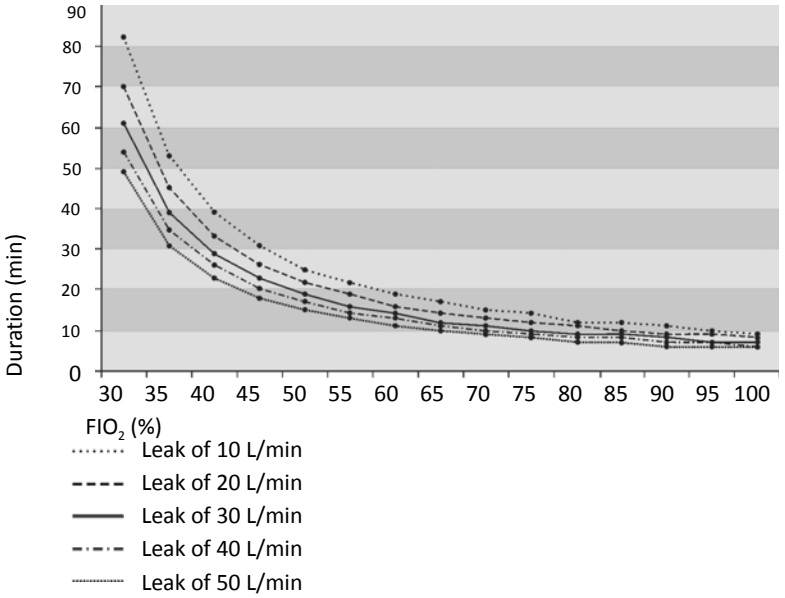
CAUTION

- **Oxygen hose configurations using SIS connectors generate higher resistance to flow. Therefore, a minimum supply pressure of 53 psig is recommended when adding supplemental O_2 accessories with SIS adapters such as the O_2 transport manifold.**
- **The V680 Ventilator requires a pressurized oxygen supply that provides a minimum flow of 175 SLPM. Because single-limb ventilation requires high flow due to patient leak, do not use any devices such as valves, hoses, Grab n' Go regulators or other brands of combined cylinder/regulators that limit supply of oxygen flow below 175 SLPM.**

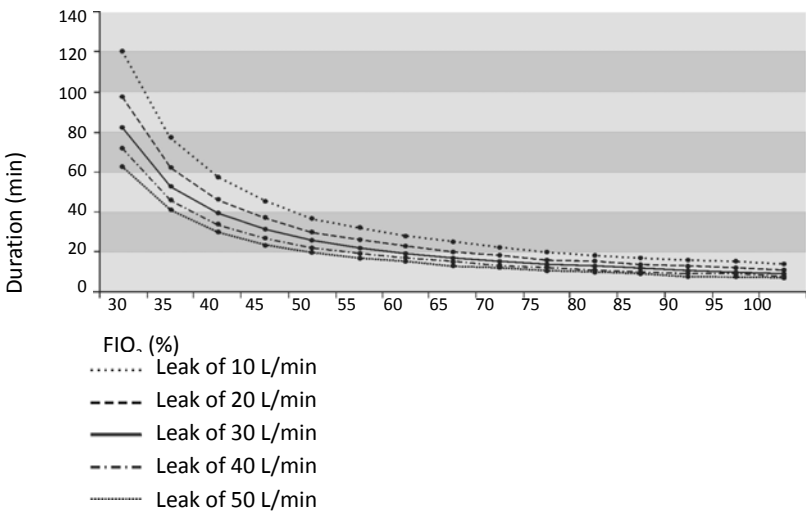
Due to the higher gas consumption when using single-limb circuits, do the following to conserve oxygen during transport with the ventilator.

- Make sure all cylinders are full (13,790 kPa/2000 psig or more).
- Make sure the cylinder regulators are turned off while the ventilator is connected to wall oxygen.
- Never turn the cylinder regulator on until you are ready to begin transport.
- Only turn one cylinder regulator on at a time. If you turn on both cylinders, they may become depleted simultaneously, leaving you with no backup oxygen.
- Whenever possible, reduce the O_2 setting before transport.
- Minimize all inadvertent leaks. Tighten masks prior to transport, and loosen up when patient is back on wall oxygen.
- Avoid using masks that have an exhalation port built into the mask when there is already an exhalation port in the circuit.

- Be aware that oxygen is more rapidly depleted at higher leak rates (see Figure 5-11).



a. Single-limb circuit, V_T = 500 mL, Rate = 40 BPM, EPAP = 6 cmH_2O, IPAP = 18 cmH_2O



b. Single-limb circuit, V_T = 500 mL, Rate = 20 BPM, EPAP = 6 cmH_2O, IPAP = 18 cmH_2O

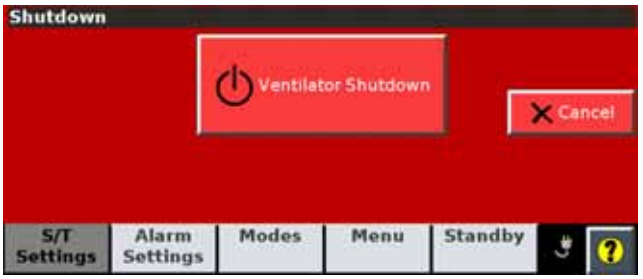
Figure 5-11: Duration of U.S. "E" size oxygen cylinder (13,790 kPa/2000 psig) at various leak rates during single-limb circuit use

Shutting Down the Ventilator

Shut down the ventilator as follows:

1 Press and release the **ON/Shutdown** key. The **Shutdown** window opens.

2 Select **Ventilator Shutdown**. The ventilator shuts down.



NOTE

- Improper shutdown may cause a **Power has been restored** message the next time the ventilator is turned on.
- If the screen is blank and the dialogue box cannot be displayed, shut down the ventilator by pressing the **ON/Shutdown** key, then the Accept button on the navigation ring.

6 Operation - Single-Limb

WARNING

- **For first-time installation, we recommend preparing and testing the ventilator according to the instructions in Appendix A, “First-time installation” and as described Chapter 5, “Preparing for ventilation” before using the ventilator on a patient. If the ventilator fails any tests, remove it from clinical use immediately. Do not use the ventilator until necessary repairs are completed and all tests have passed.**
- **When the ventilator is used with a single-limb circuit, make sure EPAP pressures and exhalation times are sufficient to clear all exhaled gas through the exhalation port. In noninvasive ventilation continuous air flow through the port flushes exhaled gases from the circuit. The ability to completely exhaust exhaled gas from the circuit depends on the EPAP setting and I:E ratio. Higher tidal volumes further increase the volume of CO_2 rebreathed by the patient.**

You must be familiar with using the touchscreen and navigation ring to select, adjust, activate, and confirm parameters. For details, see “Navigating the Graphical User Interface” on page 35.

Changing Ventilator Settings

Access the ventilator setting windows from the tabs at the bottom of the screen.

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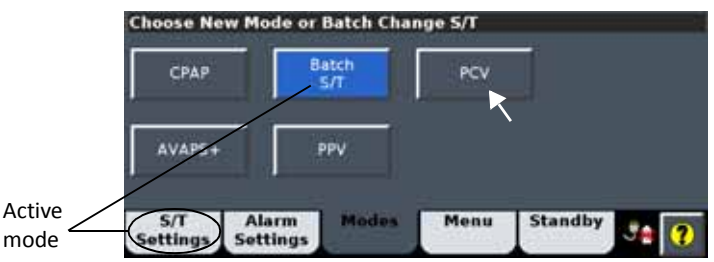
Changing the Mode

The active ventilation mode is displayed in the bottom, left-hand corner of the screen. Change the mode as follows. For details on modes, see “Ventilation Modes” on page 44.

1 Open the **Modes** window.

2 Select the desired mode.



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3 Adjust settings as desired (see “Changing Individual Ventilator Settings” on page 87). Newly adjusted setting values are shown in yellow.

4 Select **Activate Mode** to apply.

Changing Control Settings

Table 6-2 is an alphabetical list of the control settings with their ranges. Table 11-2 and Table 11-5 show the control settings applicable to the different modes. For more information on control settings as they apply in the different ventilation modes, see “Ventilation Modes” on page 44.

Making Batch Setting Changes

NOTE
During a batch setting change, you cannot change the Ramp Time setting when a ramp is active.

This process applies to ventilation settings only, not to alarm settings.

1 Open the **Modes** window.
2 Select the active mode.

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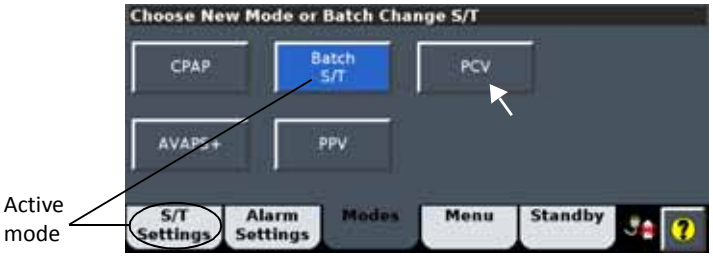


3 Adjust settings as desired (see “Changing Individual Ventilator Settings” on page 87). Newly adjusted setting values are shown in yellow.

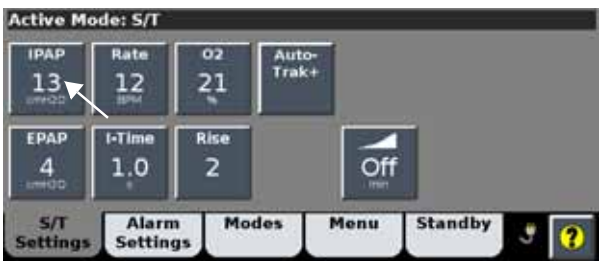
4 Select **Activate Batch Change** to apply.

Changing Individual Ventilator Settings

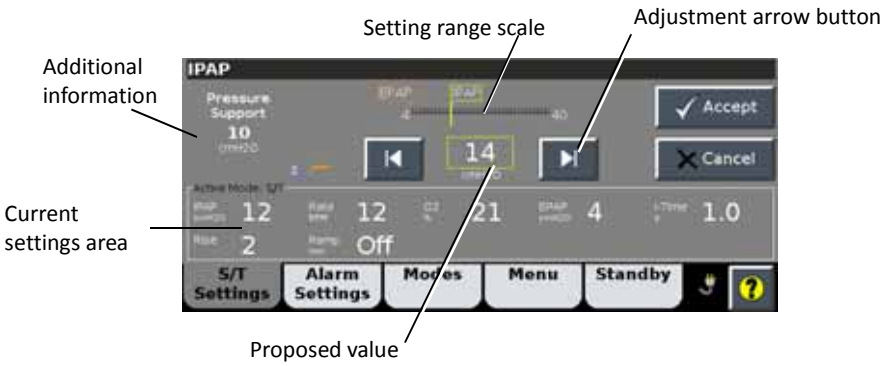
You can make ventilator settings from the **Settings** window.

1 Open the **Settings** window.

2 Select the desired setting. As an example we will show the IPAP adjustment.



3 The setting window opens. Adjust the setting. Select **Accept** to apply.



Changing Alarm Settings

WARNING

- **To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.**
- **To reduce patient risk from inappropriate ventilatory support, avoid turning off the alarms.**

Some ventilator alarm settings are operator adjustable. You can adjust these at any time. Table 6-3 on page 107 lists the alarm settings and their ranges.

Review and adjust the alarm settings as follows:

1 Open the **Alarm Settings** window.

Some alarm settings windows open to a **Hi** and **Lo** setting window, while in others you can adjust a single setting.

2 Press the Hi and Lo buttons inside the Alarm window and adjust each setting separately.

Or, select the desired setting and adjust.

3 Select **Accept** to apply.

The ventilator alarms when a monitored value goes out of the range bounded by the alarm limits.

Changing the Mask/Port Settings

Mask and port settings can be viewed and adjusted primarily in the Ventilator Configuration screen during startup or by opening the **Menu** screen and pressing the **Mask/Port** button (noninvasive) or the **Port** button (invasive).

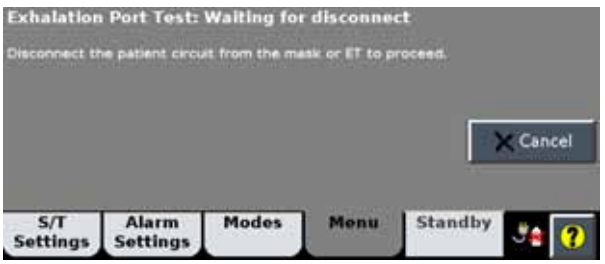
When **PEV** or **Other** is selected, an exhalation port test is required and the window is automatically displayed if you are in the **Mask/Port** menu. In the Ventilator Configuration screen the exhalation port is tested as part of SST.

Running the Exhalation Port Test

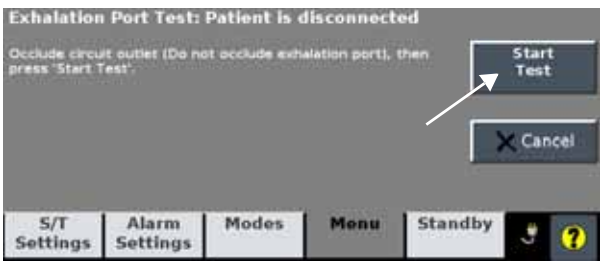
NOTE
The exhalation port test is included as part of the preoperational **SST** (Short Self Test).

Run the test as follows:

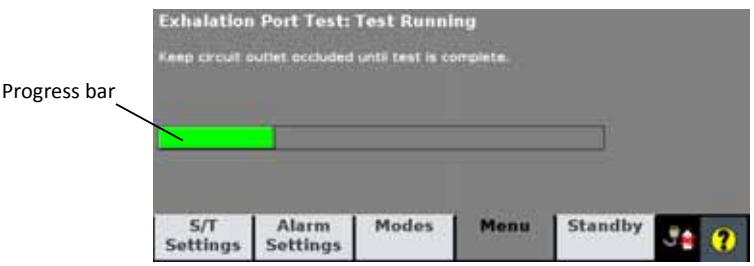
1 Disconnect the patient circuit from the mask/patient interface.



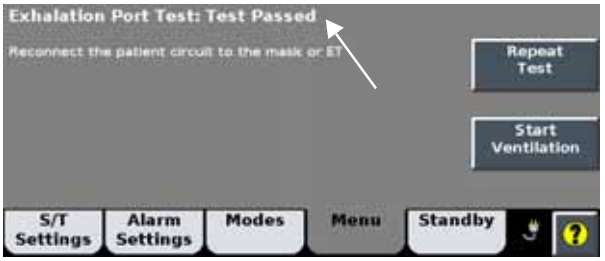
2 Occlude the circuit outlet. Select **Start Test**.



3 Wait while the test runs.



4 Verify that **Test Passed** is displayed.



5 Reconnect the patient circuit to the mask/interface.

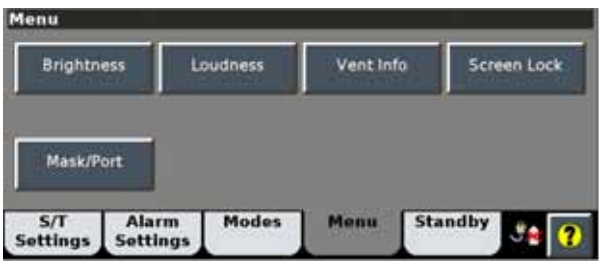
6 Select **Start Ventilation** to initiate ventilation.

Troubleshooting

If **Test Failed** is displayed, check for leaks in the patient circuit, and install an exhalation device with lower leak characteristics. Repeat test. If the exhalation port test fails again and PEV is selected, the intentional leak is unknown and **Tot.Leak** rather than **Pt. Leak** is displayed in the patient data window.

Other Functions: the Menu Window

From the **Menu** window you can adjust user preferences. Available buttons vary based on the ventilation mode.

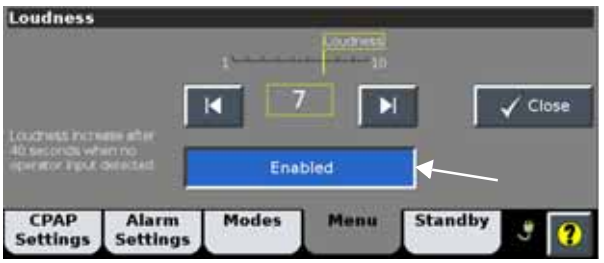


Brightness

Use **Brightness** to adjust the screen for optimum daytime or nighttime viewing.

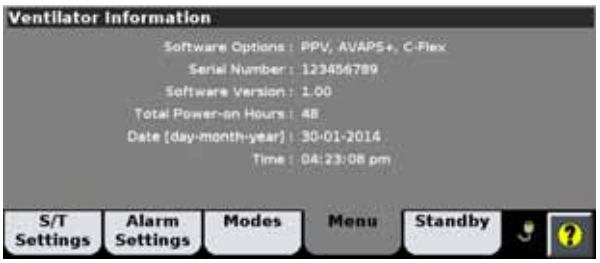
Loudness

Use **Loudness** to adjust the volume of the alarm and touchscreen audible feedback. You will hear audible feedback as you go through the selections. Turn volume escalation on or off using the **Enabled/Disabled** button. See “Escalating Alarm Volume” on page 136 for more information.



Vent Info (Ventilator Information)

The **Ventilator Information** window displays software version and other information specific to your ventilator.



Screen Lock

Screen Lock deactivates all buttons and tabs on the touchscreen except **Alarm Silence**, **Alarm Reset**, **Manual Breath, 100% O_2**, the Alarm/Message button, and Help. Tabs are grayed out as in this example.

This message bar is displayed at the top of the screen:

To unlock the screen, press the **Accept** button in the center of the navigation ring.

NOTE
If Screen Lock is active, the touchscreen remains locked even if an alarm becomes active.

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Mask/Port

This menu allows you to select the mask and port in single-limb noninvasive ventilation without re-entering the Ventilator Configuration mode.

Port

This menu allows you to select the port in single-limb invasive ventilation without re-entering the Ventilator Configuration mode.

Therapeutic Maneuvers

Manual Breath

When the **Manual Breath** button is pressed, the V680 delivers a manual breath during the next unrestricted expiratory phase.

NOTE
The expiratory phase is considered unrestricted if the expiratory phase has been active for at least 300 ms AND the measured exhaled volume is greater than or equal to $V_{TI}/2$.

The **Manual Breath** button responds while the Screen Lock is active.

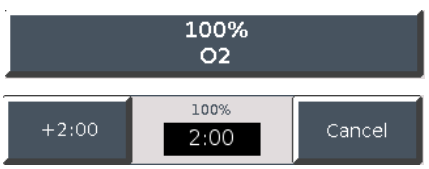
The breath is delivered using the settings in Table 6-1.

Table 6-1: Manual breath settings

Active Mode	Settings
CPAP	Apnea Backup
S/T	S/T
PCV	PCV
AVAPS+	AVAPS+
PPV	PPV Backup

100% O_2

A **100% O_2** button is available in all ventilation modes. When pressed, the **100% O_2** button is temporarily replaced by a **2:00** button, countdown timer, and a **Cancel** button.



100% O_2 is delivered for 2 minutes each time the button is pressed. If the **2:00** button is pressed, the V680 will add another 2-minute period to the time remaining on the first 2-minute counter. The **2:00** button will be disabled after pressing until less than 2 minutes remain, at which time it will be re-enabled. Press the **Cancel** button to end 100% O_2 delivery.

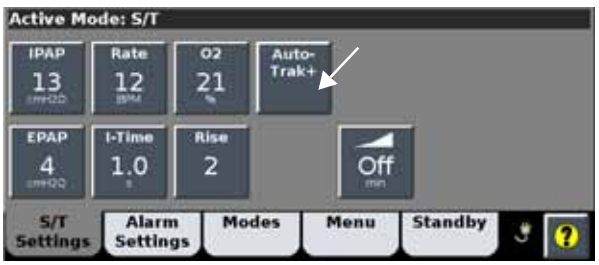
The **100% O_2** button is available while Screen Lock is active. Whenever the 100% O_2 feature is used the ventilator will perform a single-point O_2 sensor calibration at 100%.

Using the Auto-Trak+ Feature

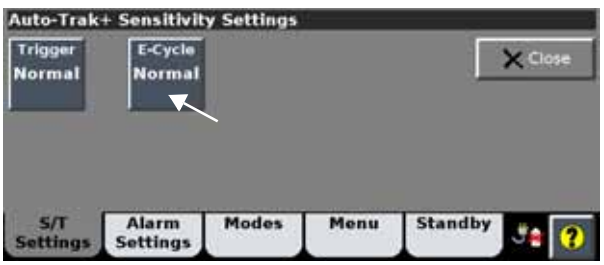
The **Normal** Auto-Trak settings work well for most patients. Pediatric patients, however, may benefit from more sensitive trigger settings, while some adult patients may benefit from more or less sensitive cycle settings. When the 5-20 kg patient type is selected, a more sensitive Trigger Sensitivity setting is selected as a default but it may be appropriate to adjust further as needed.

Changing Auto-Trak+ settings:

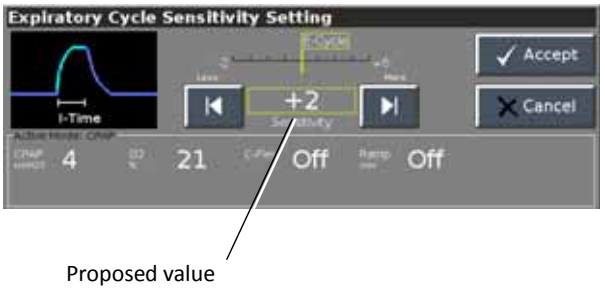
1 Select **Auto-Trak+** from the mode **Settings** window.



2 Select the desired adjustment. As an example, the **E-Cycle** adjustment is shown below.



3 The setting window opens. Adjust the setting, referring to the pressure-time graphic which represents the effect on I-Time. Select **Accept** to apply.



4 Select **Accept** to return to the **Settings** screen.

Using the Ramp Time Function

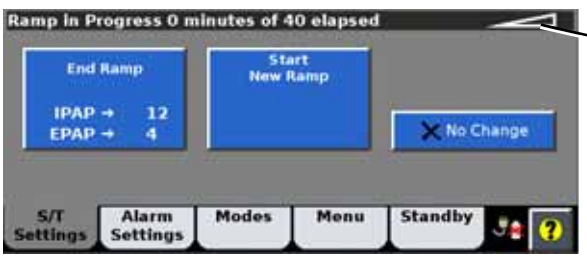
The Ramp Time function helps your patient adapt to ventilation by gradually increasing inspiratory and expiratory pressure (IPAP and EPAP/CPAP) from sub-therapeutic to user-set pressures over a user-set interval. Table 6-2 on page 104 describes this function's principles of operation.

Follow these instructions to use the Ramp Time function:

1 Select the **Ramp Time** button in the **Settings** window.

2 The ramp starts. As the ramp progresses, the **Ramp Time** button graphic fills in.

3 To change the ramp interval or to end the ramp, select the **Ramp Time** button again. The **Ramp in Progress** window opens.



4 To end the ramp and apply the full IPAP and EPAP/CPAP immediately, select **End Ramp**.

5 To end the ramp and start a new one, select **Start New Ramp**. The **Ramp Time** setting window opens again so that you can set up a new ramp.

Using PPV

Follow these instructions to set up the ventilator in the PPV mode, referring to Figure 6-3. For principles of operation, see “PPV mode (optional)” on page 59.

1 Open the **PPV Settings** window.

2 Set **EPAP**, **O_2**, alarm limits, and backup settings to appropriate values. See “Principles of Operation” on page 37 for a detailed explanation of these settings.

3 Set the **Max V** and **Max P** limits.

4 Set alarm limits to appropriate values. The **HIP** alarm limit should be greater than the **Max P**.

About Max V and Max P Alarms and Alarm Limits

Max V (PPV maximum volume limit) and **Max P** (PPV maximum pressure limit) are used to prevent the delivery of excessive pressure or volume.

WARNING
To prevent the delivery of excessive pressure or volume, set the PPV limits appropriately. Delivery of excessive pressure or volume can occur from a sudden increase in mask leak, inappropriate settings, or a plugged or kinked proximal pressure line. Conversely, insufficient treatment may result if limits are set too low.

When the **Max V** (PPV maximum volume limit) is reached, the breath is terminated and a message is displayed. After the limit is reached in three consecutive breaths, the audible alarm sounds. A PPV waveform with **Max V** is shown in Figure 6-1.

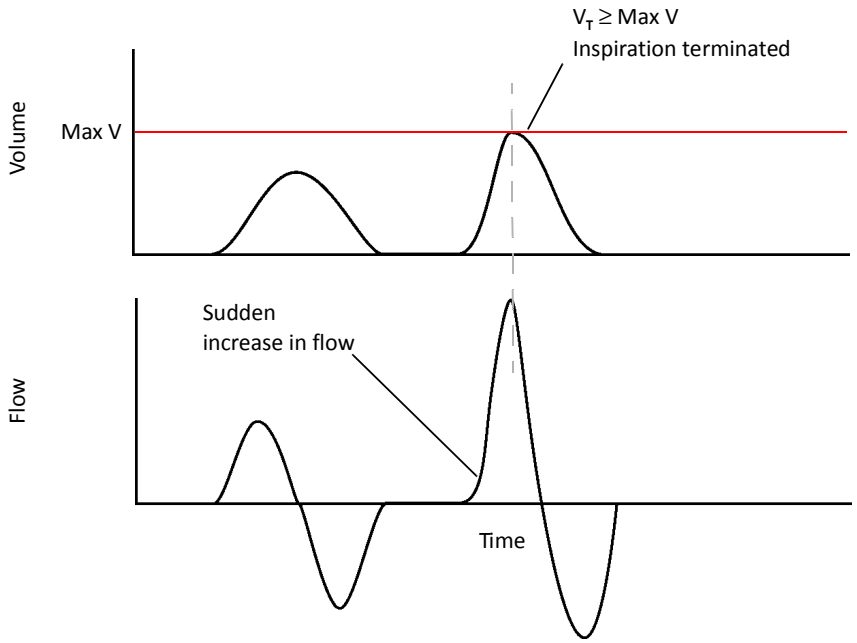


Figure 6-1: PPV waveform – Max V limit

When the **Max P** (PPV maximum pressure limit) is reached, pressure is limited but the breath is not terminated, and a message is displayed. After the limit is reached in three consecutive breaths, the audible alarm sounds. A PPV waveform with **Max P** is shown in Figure 6-2.

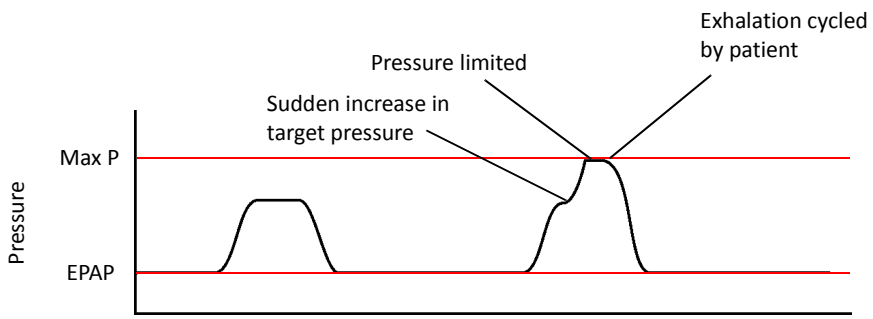


Figure 6-2: PPV waveform – Max P limit

Frequent annunciation of one or both alarms typically indicates improved patient status. It may, however, indicate that the patient is more actively breathing, possibly due to agitation or a change in the patient's level of sedation. It may also indicate an increase in leakage.

The $\mathbf{V_T}$ (estimated exhaled tidal volume) measurement may remain below the set **Max V** limit even though the inspired volume exceeds **Max V**. This results from variable leakage, which reduces the exhaled volume in relation to the inspired volume.

Guidelines for Using PPV

NOTE
The guidelines below are based on recommendations by clinicians. They do not replace the clinical judgment of a physician and should not, on their own, be used for clinical decision making.

Determining Max R and Max E settings

The V680 measures and displays dynamic elastance and both inspiratory and expiratory resistance. These breath-to-breath measurements are very helpful in the initial set up of the PPV mode. It is recommended to first ventilate the patient in the S/T mode using a backup respiratory rate that is just above the patient's normal rate. This will provide for more time-triggered breaths, which are necessary in order to estimate and display **Dyn Ri** (dynamic inspiratory resistance) for the benefit of PPV set up.

Dynamic mechanics measurements are averaged over 10 breaths, so we recommend that you allow at least 10 breaths before using these measurements for PPV set up.

Suggested titration procedure

Follow this procedure to titrate settings to optimize patient comfort while avoiding overassisting. See also the flow chart in Figure 6-3.

NOTE
You may also need to adjust **PPV %** according to patient response, as you do for the other PPV settings described below. Mask leakage, especially a sudden increase, is interpreted as patient effort by the ventilator and assisted accordingly; this may necessitate lowering the **PPV %** setting. However, the best solution is to maintain a minimal leak.

1 Set **EPAP**, **O_2**, alarm limits, and backup settings to appropriate values. The **HIP** alarm limit should be greater than **Max P**.

Suggested starting settings:	
EPAP	4 cmH_2O*
O_2	Current setting or per prescription
Max P	25 cmH_2O
Max V	1000 to 1500 mL
PPV %	80 to 90%
Max E	Match Dyn E display in S/T mode
Max R	Match Dyn Ri display in S/T mode
All other backup settings and alarms	Per usual protocol

*.Consider higher EPAP settings for COPD patients to treat autoPEEP as evidenced by missed triggers

Philips

2 Adjusting **Max E** after initial setting using **Dyn E**:
   a Evaluate the patient. Check whether any of these conditions is true:
   - The patient says they are getting too much air, pressure, or volume
   - The patient is using accessory muscles to actively stop inspiration
   - The **Max V** or **Max P** limit is reached
   - The mask leak has suddenly increased

   b If any is true, decrease **Max E** by 2 cmH_2O/L, and re-evaluate. Repeat to optimize patient comfort.
3 Repeat the process above adjusting **Max R**, decreasing in increments of 1 $cmH_2O/L/s$ to optimize patient comfort.
4 Repeat adjustment for **Max E** and **Max R** as needed.
5 Adjust **PPV %** downward as tolerated.

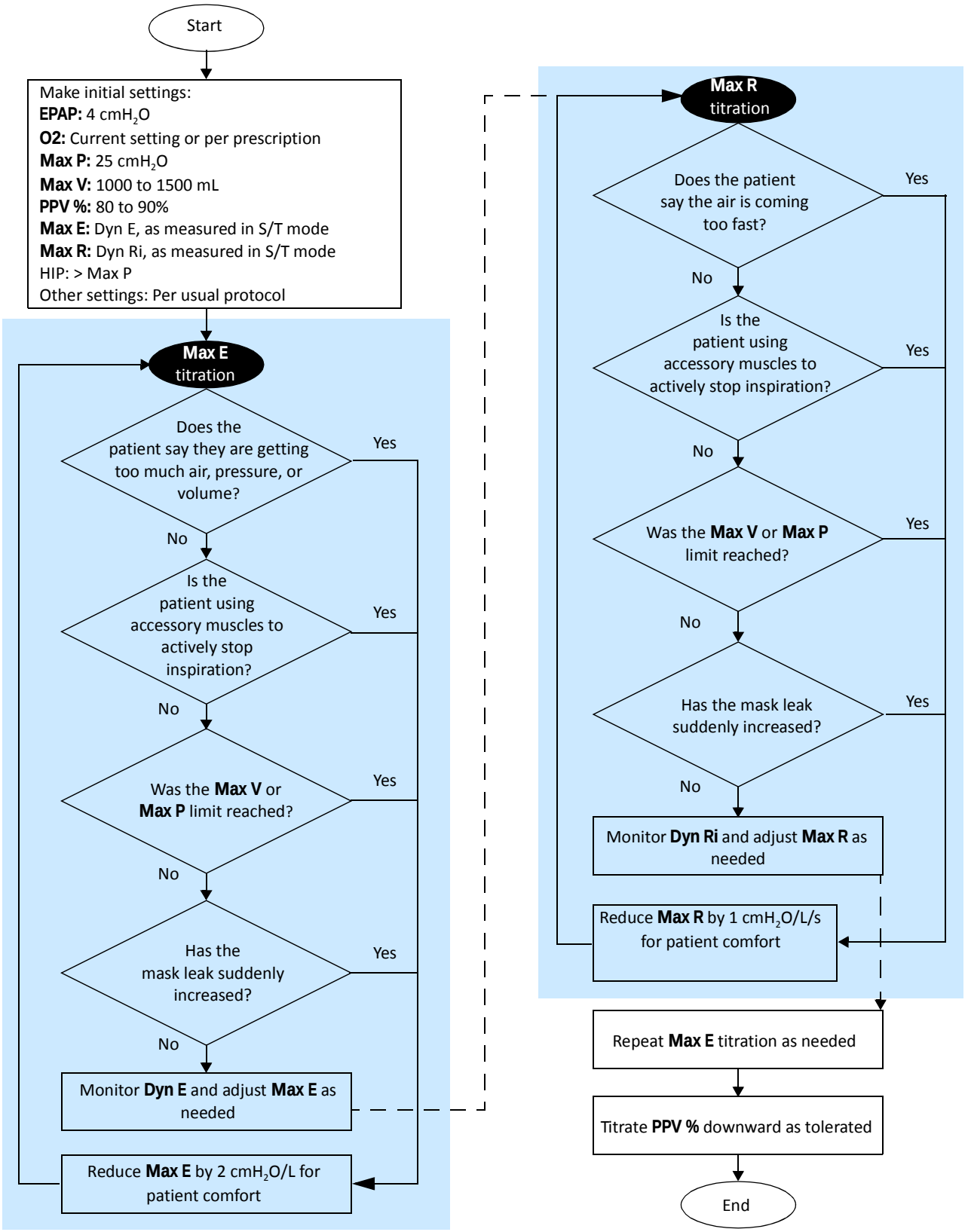


Figure 6-3: PPV initial setup

Philips

Using Standby

Standby lets you safely suspend ventilation to temporarily disconnect the patient from the ventilator or to set up the ventilator before connecting the patient. Alarms are disabled and oxygen is turned off during standby.

You can also change ventilator settings and most menu functions during standby. The settings changes are effective when you exit standby. Enter standby as follows:

1 Select the **Standby** tab. The **Entering Standby** window opens.

NOTE

- The ventilator will not enter or remain in standby with a patient connected. If the patient is not disconnected, the ventilator continues breath delivery while waiting for the patient to be disconnected. The standby mode request cancels in 60 seconds if the patient remains connected.
- You may also manually enter standby mode in cases where the patient is disconnected but the ventilator is unable to detect disconnection due to a highly resistive circuit/interface.
- Standby mode disables alarms and oxygen delivery and should be used only when the patient is disconnected.

2 Disconnect the patient from the ventilator now and press the **Standby** button.

3 The ventilator enters standby and displays the **Standby** screen.

4 To resume ventilation, reconnect the patient. When the ventilator senses a patient breathing effort, ventilation automatically resumes in the previous mode.

NOTE

You can also manually resume ventilation with the **Start Mode** button.

Help Function

Select the Help button to display additional information.

Help messages are displayed:

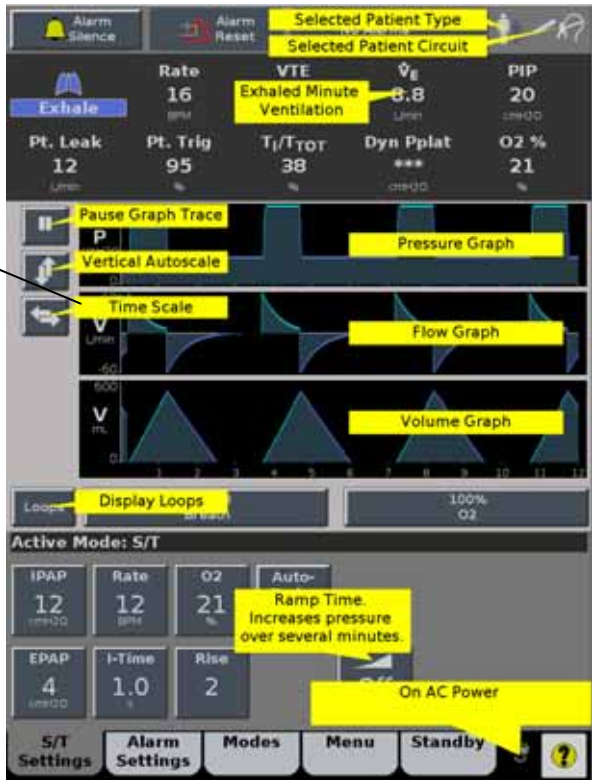


Table of Modes and Control Settings

Table 6-2: Single-limb modes and control settings with ranges

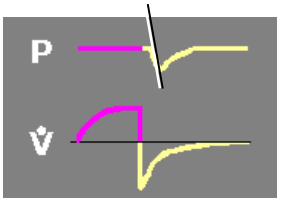
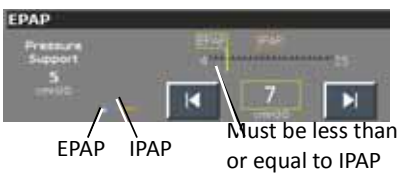
Setting	Description	Range
Modes		
Modes	Ventilation mode	CPAP, S/T, PCV Optional: AVAPS+, PPV
Control settings		
Auto-Trak+ (Auto-Trak+ Sensitivity Settings)	Accesses Auto-Trak+ settings for Trigger and E-Cycle. See applicable control settings in this table for ranges.	N/A
Apnea Mode	Accesses apnea mode settings. Apnea ventilation provides ventilation after the adjustable Apnea Time passes without a breath trigger. Set control settings for Pressure Control, Rate, I-Time and Rise to be used during apnea ventilation. See applicable control settings in this table for ranges.	N/A
C-Flex (optional)	Enhances traditional CPAP by reducing the pressure at the beginning of exhalation—a time when patients may be uncomfortable with CPAP—and returning it to the set CPAP pressure before the end of exhalation. The amount of pressure relief is determined by the C-Flex setting and the expiratory flow. The higher the setting number (1, 2 or 3) and the greater the expiratory flow, the greater the pressure relief (during the active part of exhalation only). Applies in CPAP mode only. Pressure relief 	Off, 1 to 3
CPAP	Continuous positive airway pressure. The average pressure applied continuously. Applies in CPAP mode only.	4 to 25 cmH_2O
E-Cycle (Expiratory Cycle Sensitivity Setting)	Expiratory Cycle Sensitivity Setting. Auto-Trak+ employs several algorithms to determine the point at which the ventilator cycles into exhalation. This setting adjusts all algorithms simultaneously. At the lowest setting (-2), inspiration terminates later, resulting in the longest inspiratory time. At the highest setting (+6), inspiration terminates earlier, resulting in the shortest inspiratory time. **Normal** is the default setting.	-2, -1, Normal, +1 to +6
EPAP	Expiratory positive airway pressure. The application and maintenance of pressure above atmospheric at the airway throughout the expiratory phase of positive-pressure mechanical ventilation. 	4 to 25 cmH_2O

Table 6-2: Single-limb modes and control settings with ranges

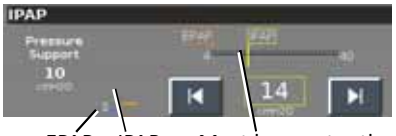
Setting	Description	Range
IPAP	Inspiratory positive airway pressure. The application and maintenance of pressure above atmospheric at the airway throughout the inspiratory phase of positive-pressure mechanical ventilation.  EPAP IPAP Must be greater than or equal to EPAP	4 to 40 cmH_2O
I-Time (Inspiratory Time)	Time to deliver the required gas. Inverse ratio ventilation is not allowed.  Resulting I:E ratio Shows where I:E ratio becomes inverse	0.30 to 3.00 s
Max ΔP (Max ΔP/min)	Change in pressure per minute. Limits the speed at which pressure may increase or decrease to maintain the target tidal volume. Applies in AVAPS+ mode only.	1.0 to 5.0 cmH_2O/min
Max E	The maximum elastance (volume assist) value used by the PPV mode to overcome the elastance of the patient's lungs. See also **PPV %** setting. Applies in PPV mode only.	0 to 100 cmH_2O/L
Max P (AVAPS+ Maximum IPAP Pressure)	The maximum pressure to be applied. **NOTE** When you adjust the AVAPS+ minimum and maximum pressures, remember that IPAP is adjusted to meet the target value. If the calculated target pressure is outside of the minimum and maximum pressure range, the target volume will not be achieved. Applies in AVAPS+ mode only.	6 to 40 cmH_2O
Max P (PPV Maximum Pressure Limit)	The maximum pressure to be applied. When the limit is reached, the ventilator limits the pressure and displays a **PPV Max P** alarm message. If the condition persists for three consecutive PPV inspirations, an audible alarm also sounds. Applies in PPV mode only. **WARNING** • **Be sure to set the high inspiratory pressure (HIP) alarm appropriately to minimize patient risk from overpressurization or early breath termination.** • **To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.**	5 to 40 cmH_2O
Max R	The maximum resistance (flow assist) value used by the PPV mode to overcome pulmonary resistance. See also **PPV %** setting. Applies in PPV mode only.	0 to 50 cmH_2O/L/s

Table 6-2: Single-limb modes and control settings with ranges

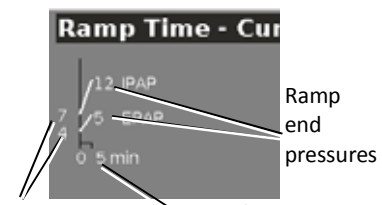
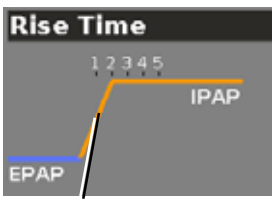
Setting	Description	Range
Max V (PPV Maximum Volume Limit)	The maximum volume to be delivered. When the limit is reached, the ventilator terminates the breath and displays a **PPV Max V** alarm message. If the condition persists for three consecutive PPV inspirations, an audible alarm also sounds. Applies in PPV mode only. **WARNING** • **Be sure to set the high inspiratory pressure (HIP) alarm appropriately to minimize patient risk from overpressurization or early breath termination.** • **To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.**	200 to 3500 mL
Min P (AVAPS Minimum IPAP Pressure)	The minimum pressure to be applied. AVAPS+ uses this settings as a starting point (first breath). Subsequent adjusts are made to arrive at the target tidal volume. **NOTE** When you adjust the AVAPS+ minimum and maximum pressures, remember that IPAP is adjusted to meet the target value. If the calculated target pressure is outside of the minimum and maximum pressure range, the target volume will not be achieved. Applies in AVAPS+ mode only.	5 to 30 cmH_2O
O2 (Oxygen)	Oxygen concentration to be delivered.	21 to 100%
PPV %	Percentage of PPV assist or gain. This gain is applied to the **Max E** and **Max R** settings, yielding the applied **Elastance** and **Resistance** assist values. Applies in PPV mode only.  PPV % **Max E** and **Max R** are multiplied by **PPV %** to obtain the applied **Elastance** assist and **Resistance** assist values. Here a **Max R** setting of 4 $cmH_2O/L/s$ and a **PPV %** setting of 30% yield a **Resistance** assist value of 1.2 $cmH_2O/L/s$.	0 to 100%
Ramp Time	An interval during which time the ventilator linearly increases pressure, helping to reduce patient anxiety. $\text{Initial CPAP/EPAP} = \frac{\text{CPAP/EPAP} + 4\ \text{cmH2O}}{2}$ $\text{Initial IPAP} = \text{Initial EPAP} + \frac{(\text{IPAP} - \text{EPAP})}{2}$  Ramp end pressures Ramp start pressure Ramp duration	Off, 5 to 45 min

Table 6-2: Single-limb modes and control settings with ranges

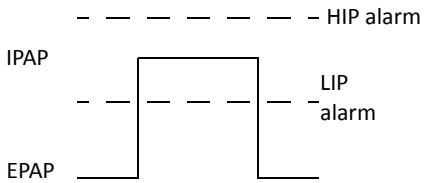
Setting	Description	Range
Rate (Respiratory Rate)	Respiratory frequency or number of breaths per minute. Inverse ratio ventilation is not allowed in single-limb modes.  Resulting I:E ratio Shows where I:E ratio becomes inverse	1 to 80 BPM
Rise (Rise Time)	Speed with which inspiratory pressure rises to the set (target) pressure. If the Rise Time is insufficient to reach the target IPAP pressure, adjust the Rise Time or I-Time setting.  Proposed rise slope in relation to EPAP and IPAP	1 to 5 (1 is fastest)
Trigger (Trigger Sensitivity Setting)	Trigger Sensitivity. Auto-Trak+ employs several algorithms to determine the point at which the inspiration begins. The larger the value, the more sensitive the trigger (that is, the patient can trigger inspiration with less effort). **Normal** is the default setting when the patient type is Adult (> 20 kg), and **+3** when the Pediatric (5-20 kg) patient type is selected.	Normal, +1 to +7
V_T (AVAPS+ Target Tidal Volume)	Target tidal volume to be delivered during inspiration. The ventilator meets this target by adjusting the inspiratory pressure with each breath. Applies in AVAPS+ mode only.	50 to 2000 mL

Alarm Settings Tables

Table 6-3: Single-limb alarm settings

Setting	Description	Range
Apnea T	Apnea interval time	10 to 60 s, Off
Hi Leak (High Leak Alarm)	High leak rate	0 to 99 L/min, Off
Hi Rate (High Rate Alarm)	High total breath rate.	5 to 90 BPM
Lo Rate (Low Rate Alarm)	Low total breath rate. NOTE: In non-CPAP modes, the Low Rate Alarm is essentially off if set below the Respiratory Rate setting.	1 to 89 BPM
Hi $\dot{V}_E$ (High Minute Ventilation Alarm)	High expiratory minute volume.	Off, 0.2 to 99.0 L/min
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	Low expiratory minute volume.	Off, 0.1 to 98.9 L/min

Table 6-3: Single-limb alarm settings

Setting	Description	Range
Hi V_T (High Tidal Volume Alarm)	High exhaled tidal volume.	50 to 3500 mL
Lo V_T (Low Tidal Volume Alarm)	Low exhaled tidal volume.	Off, 5 to 1500 mL
HIP (High Inspiratory Pressure Alarm)	High pressure at the patient airway.	5 to 70 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	Low pressure at the patient airway. **NOTE** In the S/T and PCV modes, the LIP alarm should be set 3-5 cmH_2O below the IPAP level. When set in this manner, the alarm works in conjunction with the LIP Delay alarm to indicate if there is a failure to trigger between the two pressure levels. It will also alert the clinician to pressure degradation due to excessive leaks. See figure below.  	Off, 1 to 60 cmH_2O
LIP T (Low Inspiratory Pressure Delay Time)	The interval from the detection of low inspiratory pressure until the alarm becomes active.	5 to 60 s
O_2 (Oxygen Alarm)	Oxygen Alarm. Enable or disable measured oxygen alarm	On, Off

7 Operation - Dual-Limb

WARNING
For first-time installation, we recommend preparing and testing the ventilator according to the instructions in Appendix A, “First-Time Installation” and as described in Chapter 5, “Preparing for Ventilation” before using the ventilator on a patient. If the ventilator fails any tests, remove it from clinical use immediately. Do not use the ventilator until necessary repairs are completed and all tests have passed.

You must be familiar with using the touchscreen and navigation ring to select, adjust, activate, and confirm parameters. For details, see “Navigating the Graphical User Interface” on page 35.

Changing Ventilator Settings

Access the ventilator setting windows from the tabs at the bottom of the screen.

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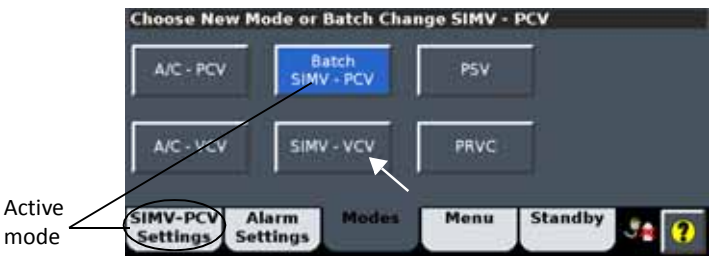
Changing the Mode

The active ventilation mode is displayed in the bottom, left-hand corner of the screen. Change the mode as follows. For details on modes, see “Ventilation Modes” on page 44.

1 Open the **Modes** window.

2 Select the desired mode.



3 Adjust settings as desired (see “Changing Individual Ventilator Settings” on page 112). Newly adjusted setting values are shown in yellow.

4 Select **Activate Mode** to apply.

Changing Control Settings

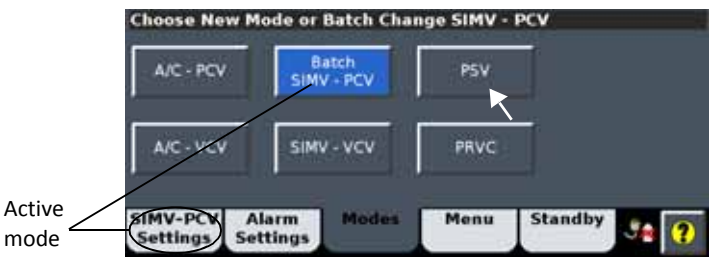
Table 7-2 is an alphabetical list of the control settings with their ranges. Table 11-3 and Table 11-5 show the control settings applicable to the different modes. For more information on control settings as they apply in the different ventilation modes, see “Ventilation Modes” on page 44.

Making Batch Setting Changes

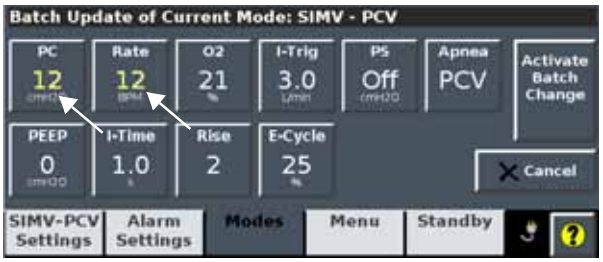
NOTE
During a batch setting change, you cannot change the Ramp Time setting when a ramp is active.

This process applies to ventilation settings only, not to alarm settings.

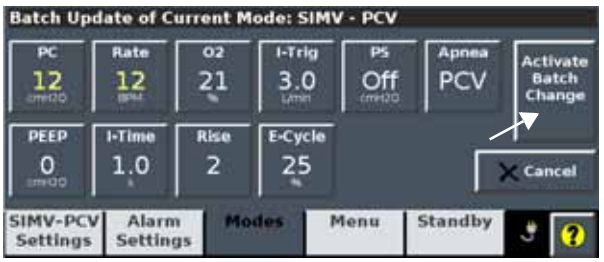
1 Open the **Modes** window.
2 Select the active mode.



3 Adjust settings as desired (see “Changing Individual Ventilator Settings” on page 112). Newly adjusted setting values are shown in yellow.



4 Select **Activate Batch Change** to apply.

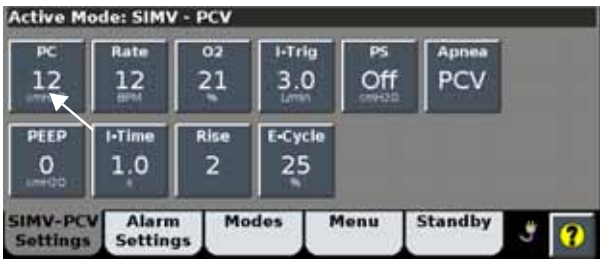


Changing Individual Ventilator Settings

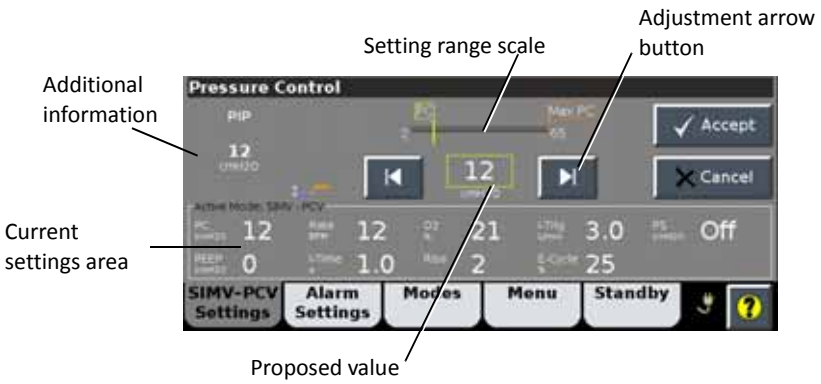
You can make ventilator settings from the **Settings** window.

1 Open the **Settings** window.

2 Select the desired setting. As an example we will show the PC (pressure control) adjustment.



3 The setting window opens. Adjust the setting. Select **Accept** to apply.



Changing Alarm Settings

WARNING

- **To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.**
- **To reduce patient risk from inappropriate ventilatory support, avoid turning off the alarms.**

Some ventilator alarm settings are operator adjustable. You can adjust these at any time. Table 7-3 on page 123 lists the alarm settings and their ranges.

Review and adjust the alarm settings as follows:

1 Open the **Alarm Settings** window.

Some alarm settings windows open to a Hi and Lo setting window, while in others you can adjust a single setting.

2 Press the **Hi** and **Lo** buttons inside the Alarm window and adjust each setting separately.

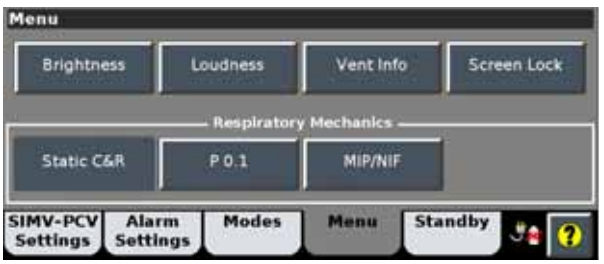
Or, select the desired setting and adjust.

3 Select **Accept** to apply.

The ventilator alarms when a monitored value goes out of the range bounded by the alarm limits.

Other Functions: the Menu Window

From the **Menu** window you can adjust user preferences. Available buttons vary based on the ventilation mode.

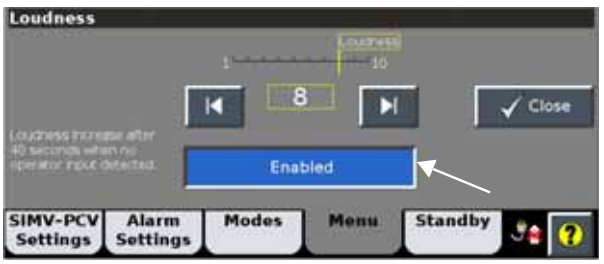


Brightness

Use **Brightness** to adjust the screen for optimum daytime or nighttime viewing.

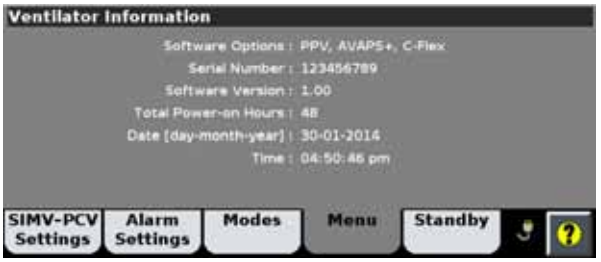
Loudness

Use **Loudness** to adjust the volume of the alarm and touchscreen audible feedback. You will hear audible feedback as you go through the selections. Turn volume escalation on or off using the **Enabled/Disabled** button. See “Escalating Alarm Volume” on page 136 for more information.



Vent Info (Ventilator Information)

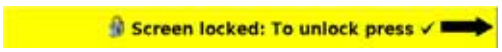
The **Ventilator Information** window displays software version and other information specific to your ventilator.



Screen Lock

Screen Lock deactivates all buttons and tabs on the touchscreen except **Alarm Silence, Alarm Reset, Manual Breath, 100% O2,** the Alarm/Message button, and Help. Tabs are grayed out as in this example.

This message bar is displayed at the top of the screen:

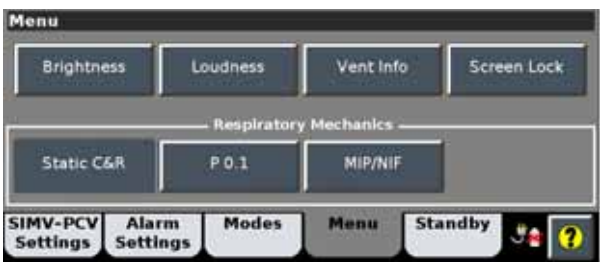


To unlock the screen, press the **Accept** button in the center of the navigation ring.

NOTE
If Screen Lock is active, the touchscreen remains locked even if an alarm becomes active.

Respiratory Mechanics Maneuvers

Respiratory maneuvers are performed from the Respiratory Mechanics section of the Menu screen. Select the **Menu** tab from any window.



Static C&R

Static (fixed, no air flow) compliance and resistance maneuvers are available in A/C-VCV and SIMV-VCV modes. You can perform a static measurement maneuver to display total resistance, lung elastance, lung compliance and plateau pressure. Elastance is the inverse of compliance and therefore calculated from compliance measurements.

Up to four Static C&R test results are stored. When more maneuvers are performed and accepted for the same patient, the oldest test results are overwritten.

P0.1

The airway occlusion pressure, P0.1, is the negative airway pressure generated during the first 100 ms of an occluded inspiration. The P0.1 results are based on a four-breath average. This maneuver cannot be attempted while any alarm is active.

Up to four P0.1 test results are stored. When more maneuvers are performed and accepted for the same patient, the oldest test results are overwritten.

MIP

WARNING

- **Close supervision of the patient by a clinician is recommended during MIP maneuver to minimize patient risk from possible delayed breath delivery, delayed lung recruitment, and delayed alarms.**
- **Be aware that PEEP is set to zero during a MIP maneuver, possibly increasing patient risk from delayed lung recruitment.**

The MIP (Maximum Inspiratory Pressure) maneuver measures the maximum negative pressure resulting from the patient's inspiratory effort. When the Press & Hold button is released, the V680 updates time, date, and MIP measurement with the lowest pressure sampled during the maneuver. During the breath hold, the patient is allowed to exhale; the exhalation and inspiratory valves close to allow negative pressure measurements.

Up to four MIP test results are stored. When more maneuvers are performed and accepted for the same patient, the oldest test results are overwritten.

Therapeutic Maneuvers

Manual Breath

When the **Manual Breath** button is pressed, the V680 delivers a manual breath during the next unrestricted expiratory phase.

NOTE
Expiratory phase is considered unrestricted if the expiratory phase has been active for at least 300 ms AND the measured exhaled volume is greater than or equal to $V_{TI}/2$.

The **Manual Breath** button responds while the Screen Lock is active.

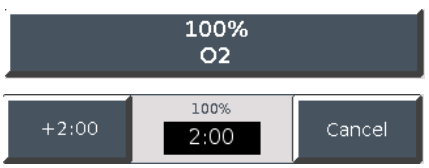
The breath is delivered using the settings Table 7-1:

Table 7-1: Manual breath settings

Active Mode	Settings
A/C – PCV	A/C – PCV, PC, I-Time, Rise settings
A/C – VCV	A/C – VCV, V_T, I-Time, flow pattern settings
SIMV – PCV	SIMV mandatory PCV breath delivery settings
SIMV – VCV	SIMV mandatory VCV breath delivery settings
PSV	Apnea Backup, PCV or VCV breath delivery settings

100% O_2

A **100% O2** button is available in all ventilation modes. When pressed, the **100% O2** button is temporarily replaced by a **+2:00** button, countdown timer, and **Cancel** button.



100% O_2 is delivered for 2 minutes each time the button is pressed. If the **+2:00** button is pressed, the V680 adds another 2-minute period to the time remaining on the first 2-minute counter. The **+2:00** button will be disabled after pressing until less than 2 minutes remain, at which time it will be re-enabled. Press the **Cancel** button to end 100% O_2 delivery.

The **100% O2** button is available while **Screen Lock** is active. Whenever the 100% O_2 feature is used the ventilator will perform a single-point O_2 sensor calibration at 100%.

Using the Flow Pattern Function

Use the flow pattern button in A/C-VCV and SIMV-VCV modes to select a descending ramp flow pattern or a square ramp flow pattern.

- For a square flow pattern, a constant peak flow is held for the duration of the inspiratory phase, based on the set tidal volume (V_T) and inspiratory time (**I-Time**).

- For a descending ramp flow pattern, peak inspiratory flow is based on the set tidal volume (V_T) and inspiratory time (**I-Time**) at the start of a breath, then decreases linearly over the inhalation period to 50% of the peak inspiratory flow.

Using Standby

Standby lets you safely suspend ventilation to temporarily disconnect the patient from the ventilator or to set up the ventilator before connecting the patient. Alarms are disabled and oxygen is turned off during standby.

You can also change ventilator settings and most menu functions during standby. The settings changes are effective when you exit standby. Enter standby as follows:

1 Select the **Standby** tab. The **Entering Standby** window opens.

NOTE

- The ventilator will not enter or remain in standby with a patient connected. If the patient is not disconnected, the ventilator continues breath delivery while waiting for the patient to be disconnected. The standby mode request cancels in 60 seconds if the patient remains connected.
- You may also manually enter standby mode in cases where the patient is disconnected but the ventilator is unable to detect disconnection due to a highly resistive circuit/interface.
- Standby mode disables alarms and should be used when the patient is disconnected.

1 Disconnect the patient from the ventilator now and press the **Standby** button.

2 The ventilator enters standby and displays the **Standby** screen.

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3 To resume ventilation, reconnect the patient. When the ventilator senses a patient breathing effort, ventilation automatically resumes in the previous mode.

NOTE

You can also manually resume ventilation with the **Start Mode** button.

Help Function

Select the help button to display additional information.

Help messages are displayed:

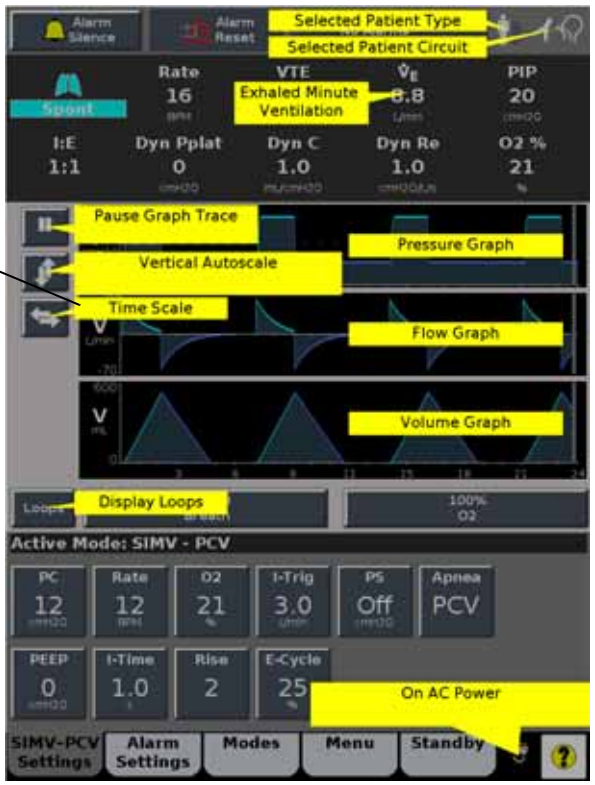


Table of Modes and Control Settings

Table 7-2: Dual-limb modes and control settings with ranges

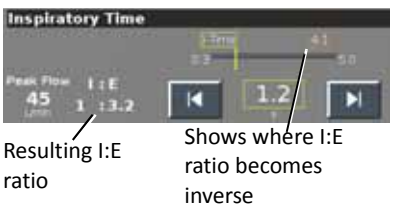
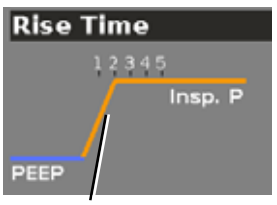
Setting	Description	Range
Modes		
Modes	Ventilation mode	A/C-PCV, A/C-VCV, SIMV-PCV, SIMV-VCV, PSV, PRVC
Control settings		
Apnea	Accesses apnea mode settings. Apnea ventilation provides ventilation after the adjustable Apnea T (Apnea Delay Time) passes without a breath trigger. Select breath type used during apnea ventilation, PCV or VCV. See applicable control settings in this table for ranges.	N/A
E-Cycle (Expiratory Flow Cycle)	Expiratory flow cycle sensitivity. E-Cycle determines the patient flow at which the ventilator cycles to exhalation. The setting is a percentage of the peak flow measured during the breath. The ventilator cycles into exhalation when the patient flow equals the selected percentage of peak flow.	10% to 80%
Flow Pattern	The shape of inspiratory flow pattern, either square or descending ramp. 	Square, Ramp
I-Time (Inspiratory Time)	Time (seconds) spent in the inspiratory phase. Also determines the flow used for A/C-VCV and SIMV-VCV control breaths. 	0.3 to 5.0 s
I-Trig (Inspiratory Flow Trigger)	The patient flow setting at which inspiration is triggered. When I-Trig is set to a smaller value, the inspiratory trigger is more sensitive. Higher settings require a larger patient effort to trigger inspiration. A back-up pressure trigger is activated at PEEP - 2 cmH_2O. Not user settable.	0.5 to 20.0 L/min, Off
Max P (Maximum Pressure)	The maximum pressure to be applied. Active in PRVC mode only.	3 to 65 cmH_2O
Max V (Maximum Volume Limit)	The maximum volume to be delivered. Active in PRVC mode only.	Adult: 55 to 2500 mL Pediatric: 55 to 500 mL
Min P (Minimum Pressure)	The minimum pressure to be applied. Active in PRVC mode only.	2 to 64 cmH_2O
O2	Oxygen concentration to be delivered.	21% to 100%
PC (Pressure Control)	Inspiratory pressure control target	2 to 65 cmH_2O
PEEP	Positive end expiratory pressure.	0 to 40 cmH_2O*

Table 7-2: Dual-limb modes and control settings with ranges

Setting	Description	Range
PS (Pressure Support)	Target pressure during the inspiratory phase of a spontaneous breath. The actual pressure applied is either this setting or 2 cmH_2O, whichever is greater, + PEEP.	Off, 2 to 65 cmH_2O
Rate (Respiratory Rate)	Respiratory frequency or number of breaths per minute. Inverse ratio ventilation up to 4:1 is permitted only in PCV modes. Not available in PSV mode.  Resulting I:E ratio Shows where I:E ratio becomes inverse	1 to 80 BPM
Rise (Rise Time)	Speed with which inspiratory pressure rises to the set (target) pressure. If the Rise Time is insufficient to reach the target pressure, adjust the Rise Time or I-Time setting.  Proposed rise slope in relation to PEEP and Insp. P	1 to 5 (1 is fastest)
Sigh	Enables/disables Sigh breath delivery. When Sigh is enabled, a sigh breath is delivered every 100th mandatory or assist breath, using a volume equal to 150% of V_T, up to 2000 mL and with a maximum flow of 140 L/min. The High Pressure Limit is automatically increased to 150% of set value during Sigh breath delivery. Active in A/C-VCV mode only.	On, Off
V_T	Tidal Volume. Target tidal volume to be delivered during inspiration. In PRVC mode the ventilator meets this target by adjusting the inspiratory pressure as needed.	Adult: 50 to 2000 mL Pediatric: 50 to 500 mL

* It may not be possible to achieve PEEP as low as 0 cmH_2O under all conditions when using a 10 mm circuit.

Alarm Settings Table

Table 7-3: Dual-limb alarm settings

Setting	Description	Range
Apnea T (Apnea Delay Time)	Apnea delay time	10 to 60 s
Hi Leak (High Leak Alarm)	High leak rate	0 to 99 L/min, Off
Hi Mand V_T (High Mandatory Tidal Volume Alarm)	High exhaled mandatory tidal volume.	Adult: 50 to 3500 mL Pediatric: 50 to 800 mL
Lo Mand V_T (Low Mandatory Tidal Volume Alarm)	Low exhaled mandatory tidal volume.	Adult: Off, 5 to 1500 mL Pediatric: Off, 5 to 600 mL
Hi PEEP (High PEEP Alarm)	High positive end expiratory pressure alarm **NOTE** The Hi PEEP alarm setting is *in addition to* the current PEEP setting. For example, if PEEP is set to 25 cmH_2O and Hi PEEP alarm is set to 15 cmH_2O, the effective pressure limit is 40 cmH_2O.	1 to 15 cmH_2O
Hi Rate (High Rate Alarm)	High total breath rate.	5 to 90 BPM
Lo Rate (Low Rate Alarm)	Low total breath rate.	Off, 1 to 89 BPM
Hi Spont V_T (High Spontaneous Tidal Volume Alarm)	High spontaneous exhaled tidal volume.	Adult: 50 to 3500 mL Pediatric: 50 to 800 mL
Lo Spont V_T (Low Spontaneous Tidal Volume Alarm)	Low spontaneous exhaled tidal volume.	Adult: Off, 5 to 1500 mL Pediatric: Off, 5 to 600 mL
Hi $\dot{V}_E$ (High Minute Ventilation Alarm)	High expiratory minute volume.	Adult: 0.2 to 99.0 L/min, Off Pediatric: 0.2 to 30.0 L/min, Off
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	Low expiratory minute volume.	Adult: Off, 0.1 to 98.9 L/min Pediatric: Off, 0.1 to 29.9 L/min
Hi V_T (High Tidal Volume Alarm)	High exhaled tidal volume.	Adult: 50 to 3500 mL Pediatric: 50 to 800 mL
Lo V_T (Low Tidal Volume Alarm)	Low exhaled tidal volume.	Adult: Off, 5 to 1500 mL Pediatric: Off, 50 to 600 mL
HIP (High Inspiratory Pressure Alarm)	High pressure at the patient airway.	5 to 70 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	Low pressure at the patient airway.	Off, 1 to 60 cmH_2O
O_2 (Oxygen Alarm)	Enable or disable measured oxygen alarm	Off, On

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8 Patient Monitoring

Graphs Window

The ventilator displays numeric patient data in the patient data window and real-time graphics in the graphs window (Figure 8-1). Numeric patient data is updated every breath. Table 8-1 on page 127 lists the ventilator's monitored parameters.

NOTE: The patient data window can be custom-configured with a variety of parameters. For instructions on selecting the displayed parameters, see "Configuring the Numeric Patient Data Window" on page 129.

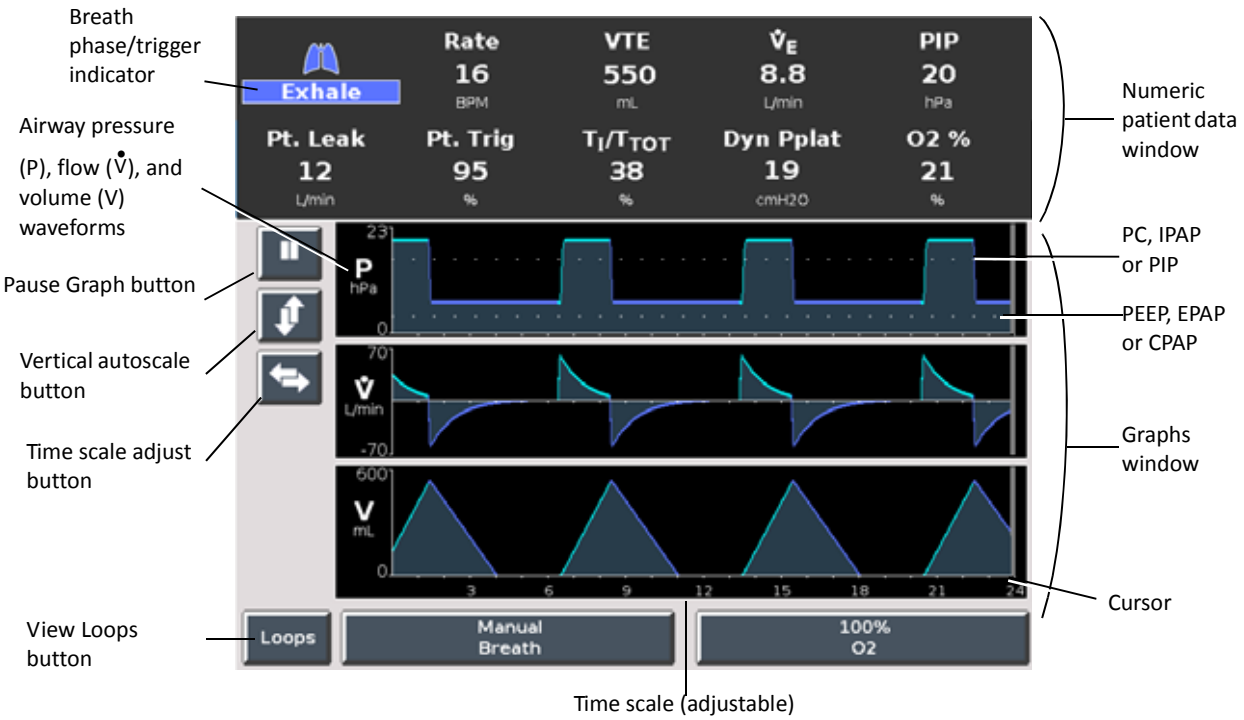

Figure 8-1: Patient data and graphs window

Loops Window

The ventilator displays numeric patient data in the patient data window and real-time flow-volume and pressure-volume loops in the loops window (Figure 8-2). Numeric patient data and loops are updated every breath. Table 8-1 on page 127 lists the ventilator's monitored parameters.

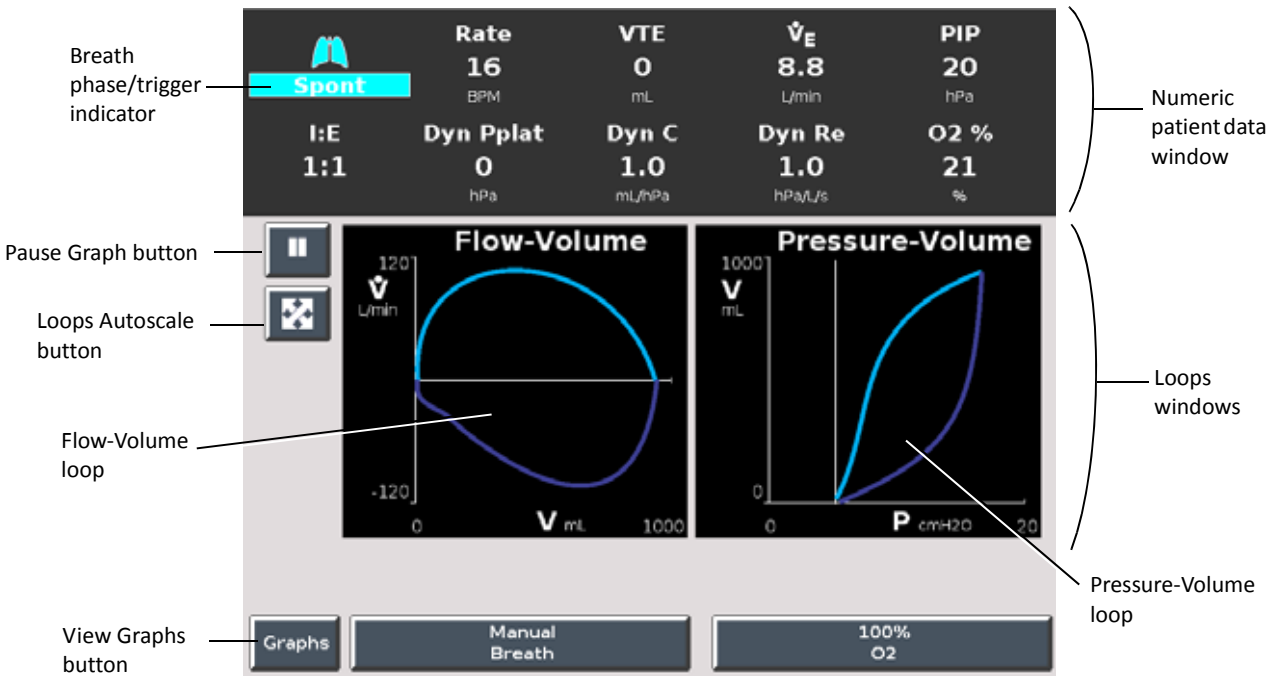

Figure 8-2: Patient data and loops window

Display Conventions

The following symbols may be displayed in place of numeric values:

***Data is not valid, and/or ventilator is in standby mode or disconnected

+++Data is over range

- - -Data is under range

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Table of Monitored Parameters

Table 8-1: Monitored parameters

Patient data window	
Parameter	**Definition**
Breath phase/trigger indicator	**Spont** (spontaneous): Inspiratory phase, patient-triggered, non-supported breath (color: turquoise) **Support**: Inspiratory phase, patient-triggered, pressure-supported breath (color: turquoise) **Mand** (mandatory): Inspiratory phase, ventilator-triggered and cycled breath (color: orange) **Assist**: Inspiratory phase, patient-triggered, ventilator-cycled breath (color: orange) **Exhale**: Expiratory phase (color: blue)
Dyn C	Dynamic compliance
Dyn E	Dynamic elastance
Dyn Pplat	Dynamic plateau pressure
Dyn Re	Dynamic expiratory resistance
Dyn Ri	Dynamic inspiratory resistance
NOTE: Dynamic mechanics values are not accurate if the inspiratory to expiratory pressure differential is less than 5 cmH_2O.	
EPAP	Expiratory positive airway pressure
I:E	Inspiratory: expiratory ratio. Ratio of inspiratory to expiratory time.
Mand VTE	Mandatory exhaled tidal volume
MAP	Mean airway pressure
O_2	Inspired oxygen percent
PEEP	Positive end expiratory pressure
PIP	Peak inspiratory pressure. The highest patient pressure during the previous breath cycle.
Pt. Leak	Patient leak
Pt. Trig	Patient-triggered breaths, as a percentage of total breaths over the last 15 minutes. Single-limb - INV, Single-limb - NIV only.
Rate	Respiratory rate or total breathing frequency. Moving average over the last 6 breaths (or 15 s).
RSBI (f/Vt)	Rapid shallow breathing index. Also called frequency/tidal volume. Only available in PSV and CPAP modes.
Spont R	Spontaneous rate
Spont Ve	Spontaneous minute volume
Spont VTE	Spontaneous exhaled tidal volume
Te	Expiratory time
T_I/T_{TOT}	Inspiratory duty cycle or inspiration time divided by total breath period. Moving average over the last 8 breaths.
Tot.Leak	Estimated total leak. Average during the previous breath cycle.
Ve	Minute volume. Total ventilation during 1 minute.
VTE	Dual-limb: Exhaled tidal volume. Single-limb: Estimated exhaled tidal volume. Moving average over the last 6 breaths.

Table 8-1: Monitored parameters

Patient data window	
Parameter	**Definition**
VTI	Dual-limb: Inhaled tidal volume. Single-limb: Estimated inhaled tidal volume.
Graphs window	
P *graph*	Airway pressure. In single-limb modes, dotted lines represent target IPAP and EPAP. In dual-limb, they represent **PEEP** and **PC**.
• V *graph*	**Single-limb**: Estimated patient flow. The total delivered flow minus the leak flow (**Tot.Leak**), where **Tot.Leak** includes known (intentional) leakage through the exhalation port plus any unintentional leakage in the circuit or at the mask/patient interface. **Dual-limb**: Measured patient flow. Patient flow is compensated for unintentional circuit leaks and circuit compliance.
V *graph*	Estimated patient volume. In AVAPS+, A/C-VCV, SIMV-VCV and PRVC modes, the dotted line represents target volume.
Loops window	
Flow-Volume loop	The flow-volume loop is plotted in a clockwise direction, comparing flow versus volume for a single patient breath and providing information regarding the condition of the airways.
Pressure-volume loop	The pressure-volume loop is plotted in a counter-clockwise direction; the slope from the beginning of inspiration to the end of inspiration depicts compliance while the width of the loop provides an indication of resistance.

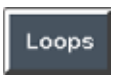
Configuring the Numeric Patient Data Window

Touch any numeric parameter in the display window for 2 seconds to open the **Select new parameter** screen. The parameter you are replacing in the numerics screen is surrounded by a box, and the corresponding parameter button below is highlighted in blue. Touch any button to replace the parameter inside the box with a new parameter.

Since all the values in the **Select new parameter** screen are live and real-time, you can also use this screen as an expanded monitoring screen for parameters that do not need to be displayed continuously. If you do not want the viewed parameter to remain on the screen, re-select the original button. Press the **Restore Defaults** button to return the numeric patient data window to the default parameter set.

Press **Close** to return to the main GUI screen.

Selecting Window Type



Use the **Graphs** button and the **Loops** button to toggle back and forth between graphs and loops windows.

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Scaling the Graphs and Loops Axes

Scale the vertical and horizontal pressure, flow, and volume graph axes with the scale buttons.

The vertical scale button autoscales the Y axes to best fit the current data.

The horizontal (time adjust) button rescales the X axis to show 3, 6, 12, or 24 seconds.

Auto-scale both loops axes with the auto-scale loops button.

The auto-scale loops button rescales both the vertical (X) and horizontal (Y) axes simultaneously to best fit the current data.

Freezing and Unfreezing Graphs

Freeze graphs for extended viewing by selecting the pause button to the left of the graphs window.

The pause in progress symbol displays while the cursor makes one complete sweep across the graphs. The graphic display is then frozen, and the cursor is visible in the middle of the display (Figure 8-3). Reposition the cursor with the navigation ring or by touching the cursor directly in the graphs window. Data values at cursor location for pressure, flow, and volume are displayed in the white boxes to the right of the graphs window.

Unfreeze the graphs with the resume button.

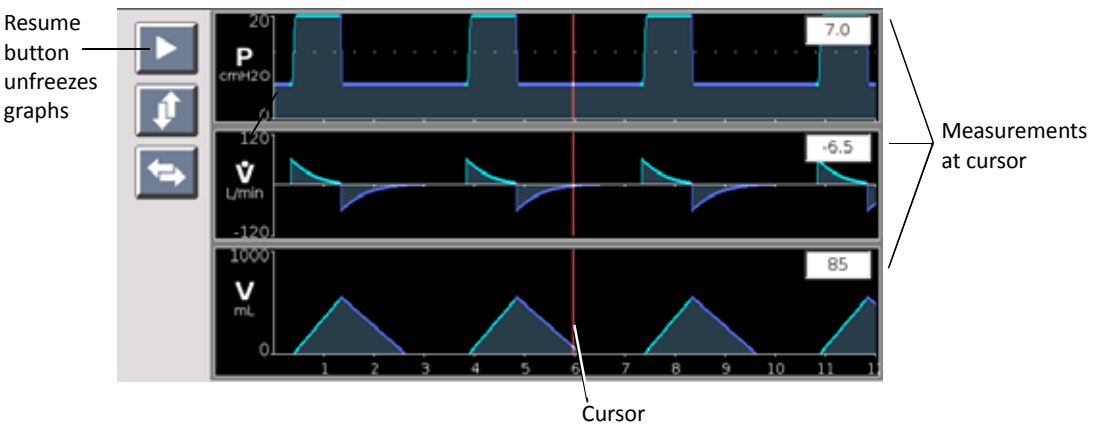


Figure 8-3: Graphs window with frozen screen

Freezing and Unfreezing Loops

Freeze loops for extended viewing by selecting the pause button to the left of the loops window.

The loop completes and the graphic display is then frozen. The cursor is visible on the left side of the display.

Move the cursor around the paused flow-volume and pressure-volume loops with the navigation ring or by pressing the positioning arrows (Figure 8-4). Data values at cursor location for pressure, flow, and volume are displayed in the white boxes.

Unfreeze the loops with the resume button.

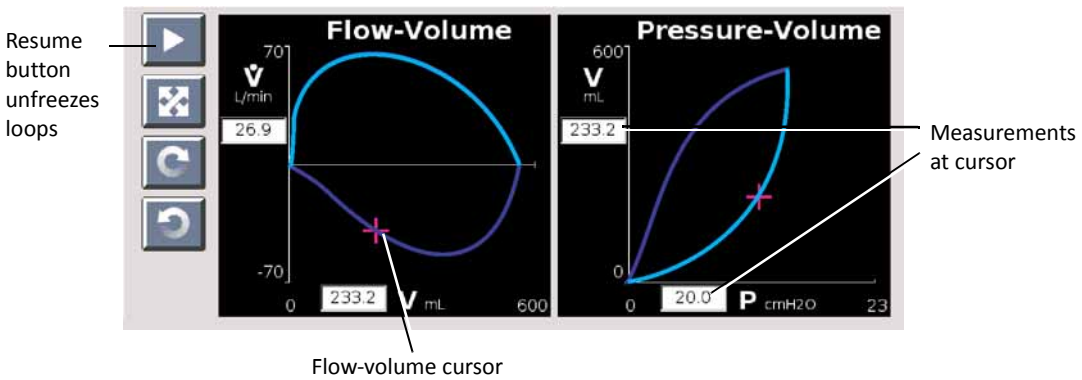


Figure 8-4: Loops window with frozen screen

9 Alarms and Messages

Visual alarm indicators are located on the front panel of the ventilator and are best seen from directly in front of the unit. Alarm speakers are located underneath the front of the ventilator. They can be heard from any direction and should never be blocked in any way. See page 29 for more information.

Alarms and messages on the ventilator alert you to situations that require your attention. The ventilator can also activate remote alarms when connected. Figure 9-1 on page 134 shows the visual alarm characteristics. Table 9-2 on page 138 summarizes the different types of alarm and tells you how to respond to each.

NOTE
The delay time from the onset of an alarm condition to the point that the alarm signal leaves the ventilator input/output port is typically 500 ms. The time it takes the message to appear on an external device such as a remote alarm depends on the characteristics of the device.

Responding to Alarms

WARNING

- **If AC power fails and the backup battery is depleted, an audible and visual alarm annunciates for at least 2 minutes. Immediately discontinue ventilator use and secure an alternative means of ventilation. As with most ventilators, when power is lost, exhaled air may be rebreathed.**
- **To ensure the alarm will be heard, make sure the alarm loudness is adequate and avoid blocking the alarm speakers beneath the ventilator. Avoid blocking the LED indicators on the front panel of the ventilator.**

NOTE
If an alarm persists for no apparent reason, discontinue ventilator use and contact Philips.

Respond to an alarm as follows:

1 Approach the patient immediately. Secure sufficient and effective ventilation for the patient if required. You may silence the alarm if possible.

2 Correct the alarm condition, referring to the alarm messages in Table 9-2.

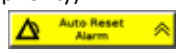
You can modify alarm settings at any time through the **Alarm Settings** tab.

Alarm status bar (nonalarm status)

No active alarms

Figure 9-1: Visual alarm indications

Table 9-1: Alarm summary

Status	Alarm LED on front panel	Alarm status bar	Alarm message in Alarms list	Audio*	Action required	Remote alarm
No alarms	Off		None	Off	None	Off
Autoreset alarm	Off	Red (high-priority) or yellow (low-priority) 	Background color same as that of active alarm. Message with strikeout text. Alarm icon.			
Informational message	Off	Blue 	Blue background color. Informational icon.		Important information or instructions.	
Low-priority alarm	Off	Yellow 	Yellow background color. Alarm icon.	Intermittent tone at an interval of approximately 20 s	Respond promptly. Troubleshoot as per Table 9-2.	
High-priority alarm	Flashes	Alternates black and red 	Red background color. Alarm icon.	Repeating sequence of 5 tones	Respond immediately to ensure patient safety. Troubleshoot as per Table 9-2.	On
High-priority alarm – Check Vent					Respond immediately to ensure patient safety. Do not use equipment that is malfunctioning or that indicates a potential problem until the problem is corrected. Troubleshoot as per Table 9-3.	
High-priority alarm – Vent Inoperative	On continuously	Vent Inoperative screen, including code (Figure 9-2)		Primary alarm (Repeating sequence of 5 tones) or backup alarm (alternating tone for a minimum of 2 min)	Continued safe ventilator operation may be in jeopardy. Oxygen flow and blower operation are disabled. Immediately secure alternative ventilation for the patient. Troubleshoot as per Table 9-4.	
Loss of power	Off	Blank	Blank		Immediately secure alternative ventilation for the patient.	

*.The volume of the primary alarm is the same for low- and high-priority alarms.

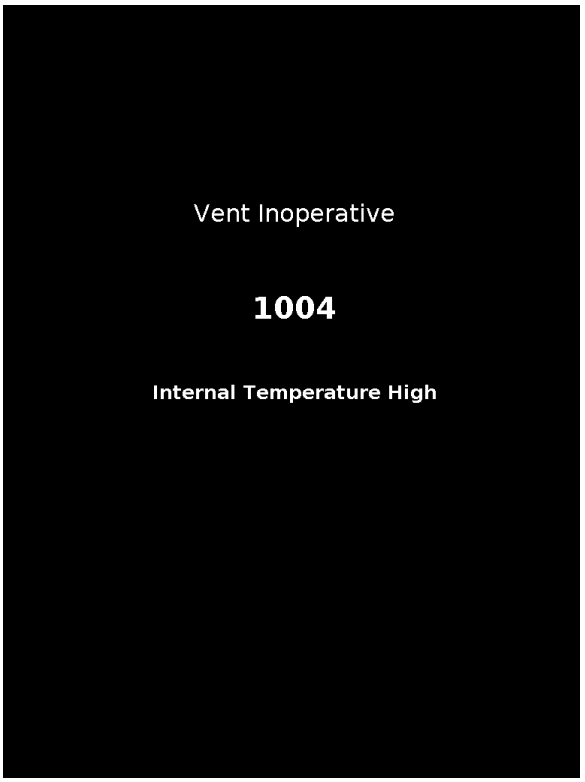


Figure 9-2: Vent Inoperative screen

Setting Alarm Loudness

You can set the alarm loudness from the **Menu** window (see “Loudness” on page 91 or page 114).

Escalating Alarm Volume

You can enable or disable volume escalation from the **Menu** window (see “Vent Info (Ventilator Information)” on page 92 or page 114). Volume escalation is enabled by default.

When volume escalation is enabled and a high priority alarm occurs, if a touchscreen or button press is not detected within 40 seconds, the V680 ventilator will progressively increase the alarm volume to the maximum setting over a 20-second period. When a touchscreen or button press is detected, the alarm volume returns to the original setting.

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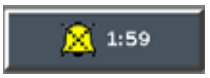
Silencing Alarms

Silence an alarm for 2 minutes by selecting the **Alarm Silence** button.

The button icon is replaced by this one. A timer shows time remaining in the 2-minute alarm silence period.



Select **Alarm Silence** again at any time to reset the counter to 2:00 minutes. During patient maneuvers, you can pre-silence audible alarms as desired.

Some alarms cannot be silenced; these are listed in Table 9-2. When a non-silenceable alarm is annunciated, the following is shown.

Resetting Alarms

Most alarms reset themselves (autoreset) when the alarm triggering condition is no longer present, but you must manually reset others. Table 9-2 specifies whether an alarm is autoreset.

Manually Resetting Alarms

Manually reset an alarm by selecting **Alarm Reset**.

When an alarm is manually reset, the message is cleared from the **Alarms** list, any other alarm indications are removed, and the alarm silence is terminated.

If the alarm cannot be manually reset, you see the following:

Clearing Autoreset Alarms from the Alarms List

Autoreset alarms are shown with text crossed out in the **Alarms** list.

Clear the message from the **Alarms** list by selecting **Alarm Reset**.

Hiding/Displaying Alarm Messages

To hide an alarm or informational message in the **Alarms** or **Messages** list, touch the flashing alarm indicator button or informational message button when up arrows are present. To display messages, touch the flashing alarm indicator or **Informational Message** button when down arrows are present. Both active and autoreset alarms and informational messages are displayed and hidden.

Alarms and Other Messages

Table 9-2 is a list of alarms and other messages displayed by the ventilator, along with descriptions, suggested corrective actions, and other information. All are considered either physiological or hardware alarms. The ID (identifier) listed with the priority type is the priority number of the alarm. This priority number determines the order of alarm message display. Unless otherwise indicated, alarms listed as autoresettable are reset when the alarm condition is removed.

Table 9-2: Alarm and other messages: summary and troubleshooting

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Apnea	Neither the ventilator nor the patient has triggered a breath for the operator-selected apnea time. In some modes where apnea mode is enabled, the ventilator enters apnea ventilation.	Check the patient. Consider switching to a mandatory mode or increasing the mandatory rate. Check Apnea time setting for appropriateness.	High (72)	Yes	Yes	Yes
Barometric Pressure High	The barometric pressure reading is greater than 850 mmHg for more than 10 s, the Barometric Pressure High alarm sounds. 850 mmHg is used in the ventilator's BTPS compensation routines.	Confirm your current altitude is consistent with 850 mmHg (altitude below sea level), which would most likely indicate a true barometric pressure change. If yes, check the patient, the ventilator, and presence of other alarms to assure appropriate ventilation. If your altitude is not below sea level, replace the ventilator and have it serviced.	Infor-mation/ Low (103)	Yes	Yes	Yes

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Barometric Pressure Low	When the barometric pressure reading is less than 525 mmHg for more than 10 s, the Barometric Pressure Low alarm sounds. 525 mmHg is used in the ventilator's BTPS compensation routines.	Confirm your current altitude is consistent with 525 mmHg (high altitude approximately 10,000 ±2000 feet above sea level), which would most likely indicate a true barometric pressure change. If yes, check the patient, the ventilator and presence of other alarms to assure appropriate ventilation. If you are not at high altitude above sea level, replace the ventilator and have it serviced.	Infor-mation/ Low (102)	Yes	Yes	Yes
Check Vent: *description of failure*	See Table 9-3 on page 146					
High Inspiratory Pressure	Measured inspiratory pressure is greater than the HIP setting, and the ventilator cycles into exhalation. Autoresets after a complete inspiration without the alarm condition. At first, an information message. If condition persists for two consecutive inspirations, this escalates to a high-priority alarm.	Check the patient. Check patient circuit for kinks or occlusions. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Infor-mation/ High (63)	Yes	Yes	Yes
High Leak	Measured leak is greater than the Leak setting.	Check the patient for evidence of leaks. Confirm ventilator and alarm settings are appropriate. If problem persists while using dual-limb circuit, run SST to leak test the circuit.	Low (87)	Yes	Yes	Yes
High Mandatory Tidal Volume	Measured mandatory tidal volume is greater than the Hi Mand V_T setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	Low/ High (83)	Yes	Yes	Yes
High Minute Ventilation	Measured minute ventilation is greater than the Hi V_E setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	Low/ High (81)	Yes	Yes	Yes

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
High O_2	Measured oxygen is greater than the O_2% setting by ≥ 6% for 60 s. High O_2 is automatically set based on the O_2 % setting selected by the user.	Check the patient. Check oxygen supply. Run EST to calibrate the oxygen sensor. If calibration fails install a new oxygen sensor. If problem persists have ventilator serviced.	High (70)	Yes	Yes	Yes
High O_2 Supply Pressure	O_2 inlet pressure is greater than 92 psig, O_2 is turned off. Autoresets when O_2 supply pressure falls below 87 psig.	Check the patient. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (68)	No	Yes	Yes
Hi PEEP	Measured positive end expiratory pressure is greater than the PEEP plus Hi PEEP setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	High (64)	Yes	Yes	Yes
High Rate	Measured respiratory rate is greater than the Hi Rate setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 s.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (85)	Yes	Yes	Yes
High Spontaneous Tidal Volume	Measured spontaneous tidal volume is greater than the Hi Spont V_T setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	Low/ High (84)	Yes	Yes	Yes
High Tidal Volume	Measured estimated tidal volume is greater than the Hi V_T setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 s.	Check the patient. Check for large leaks. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (82)	Yes	Yes	Yes
I-Time Too Long	Displays when the ventilator detects a maximum inhalation time condition and automatically cycles to exhalation.	Check the patient for leaks. Confirm ventilator and alarm settings are appropriate (E-Cycle setting). If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (86)	Yes	Yes	Yes

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Low Inspiratory Pressure	Dual-limb: Measured inspiratory pressure is less than the LIP setting for 3 consecutive mandatory breaths. Single-limb: Measured inspiratory pressure is less than the LIP setting for longer than the LIP T setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (65)	Yes	Yes	Yes
Low Internal Battery	Battery can provide operating power for only an additional 15 min under nominal conditions. Autoresets when ventilator is connected to AC power.	Connect ventilator to AC power. Provide alternative ventilation.	High (61)	No	Yes	No
Low Leak–CO_2 Rebreathing Risk	Estimated volume of exhaled gas returned to the patient is high in single-limb configuration only. External flow added to patient circuit to drive a jet nebulizer > 10 L/min.	Check the patient, as possibility of CO_2 rebreathing could pose a potential problem. Check the exhalation port for occlusions. Check for appropriate patient interface and exhalation port settings. If the approved exhalation port is unobstructed, mask and port settings are appropriate, and problem persists, increase the ventilator baseline flow by adding leak or increasing EPAP, if possible.	High (60)	Yes	Yes	Yes
Low Mandatory Tidal Volume	Measured mandatory tidal volume is greater than the Lo Mand V_T setting.	Check the patient. Check for leaks. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	Low/ High (79)	Yes	Yes	Yes
Low Minute Ventilation	Estimated minute ventilation is less than the Lo $\dot{V}_E$ setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 s.	Check the patient. Check for leaks. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (77)	Yes	Yes	Yes
Low O_2	Measured oxygen is less than the O_2 setting by ≥ 6% for 60 s. Low O_2 is automatically set based on the O_2 % setting selected by the user.	Check the patient. Check oxygen supply. Run EST to calibrate the oxygen sensor. If calibration fails, install a new oxygen sensor. If problem persists, have ventilator serviced.	High (69)	Yes	Yes	Yes

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Low O_2 Supply Pressure	Oxygen supply pressure is less than 30 psig and delivered oxygen is at least 5% lower than O_2 setting for 30 s. The ventilator continues to deliver as much oxygen as possible, but ends oxygen support when oxygen inlet pressure drops to less than 18 psig. Autoresets when oxygen supply pressure exceeds 23 psig.	Check the patient. Attach to oxygen source with sufficient pressure and flow. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (67)	No	Yes	Yes
Low Rate	A low-priority alarm if the measured respiratory rate is less than the Lo Rate setting, escalating to a high-priority alarm in 60 s. A high-priority alarm from the start if: The Lo Rate setting is ≤ 4 BPM and there are no breaths for > 60/Lo Rate setting. The Lo Rate setting is > 4 BPM and there are no breaths for > 15 s.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (76)	Yes	Yes	Yes
Low Spontaneous Tidal Volume	Measured spontaneous tidal volume is less than the Lo Spont V_T setting.	Check the patient. Check for leaks. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	Low/ High (80)	Yes	Yes	Yes
Low Tidal Volume	Tidal volume is less than the Lo V_T setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 s.	Check the patient. Check for leaks. Confirm ventilator and alarm settings are appropriate. If problem persists using dual-limb circuit, run EST.	Low/ High (78)	Yes	Yes	Yes

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Maximum Pressure Exceeded	Computed target pressure is greater than the PPV or PRVC maximum pressure alarm limit. The pressure is limited. PPV: Possible causes are excessive patient inspiratory effort; a significant change in the leak around the patient interface; or high PPV %, Max E, or Max R setting. PRVC: Possible causes are Max P threshold set too low to achieve target volume, change in compliance or resistance. Target pressure is limited. At first, an information message. If condition persists for three consecutive PPV or PRVC inspirations, this escalates to a high-priority alarm.	Check the patient. Confirm ventilator and alarm settings are appropriate. Check for circuit or mask leaks (single-limb). If problem persists, provide alternative ventilation. Have ventilator serviced.	Information/ High (75)	Yes	Yes	Yes
Modify HIP Alarm Limit	Treatment pressure increased. The sum of the inspiratory pressure and PEEP exceeds the HIP alarm setting.	Increase the HIP alarm limit.	Information (97)	No	Yes	N/A
O_2 alarms disabled. Use external O_2 monitor.	Displays when the Oxygen Alarm is set to Off.	Install an external monitor until the alarm is set to On. Run EST to recalibrate internal oxygen sensor. Replace internal oxygen sensor if calibration fails and re-run EST.	Information (99)	Yes	Yes	N/A
O_2 sensor missing	There is no signal from the oxygen sensor.	Check the oxygen sensor cable jack is fully inserted. If the message does not clear, replace the oxygen sensor. If problem persists, provide alternative ventilation. Have ventilator serviced.	Information (98)	Yes	N/A	N/A
Oxygen Not Available	Oxygen supply pressure out of range, oxygen device failed, air flow sensor and/or oxygen flow sensor calibration failed, or oxygen inlet pressure sensor calibration failed. The ventilator discontinues oxygen support.	Check the patient. Check if O_2 source is the problem and correct. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (66)	No	Yes	Yes

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Patient Circuit Occluded	Patient circuit occlusion detected. Dual-limb: Detection occurs within 5 breaths. Single-limb: Detection occurs within 5 s.	Check the patient. Single-limb: check inspiratory limb and filter for bulk liquid, crimps etc. Replace filter and drain water as necessary. Dual limb: check inspiratory and expiratory limbs and filters for bulk liquid, crimps, etc. Replace filter(s) and drain water as necessary. If problem persists, check or replace eSYS cartridge and run EST. If still unresolved provide alternative ventilation and have the ventilator serviced.	High (55)	No	Yes	Yes
Patient Circuit Partially Occluded	A partial occlusion of the patient circuit is detected. Detection occurs within 5 breaths. At first, a low-priority message. If condition persists for 3 consecutive breaths, this escalates to a high-priority alarm.	Check the patient. Check the patient circuit expiratory limb for bulk liquid, crimps, or blocked expiratory filter. Replace filter and drain water as needed. Run EST. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (73)	Yes	Yes	Yes
Patient Disconnect	Excessive flow to the patient circuit for a few seconds. Patient is no longer connected to the ventilator, either through circuit, mask, or ET tube; or the patient circuit is disconnected from the ventilator and the patient is no longer receiving ventilatory support. Detection occurs within 5 breaths.	Check the patient. Reconnect patient circuit. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (54)	Yes	Yes	Yes
Power has been restored	Power is restored following a total loss of power. The ventilator restarts and continues ventilation using all breath delivery and alarm settings before power was lost.	Check the patient. Confirm ventilator and alarm settings are appropriate. NOTE: it will take several hours to fully recharge the backup battery. Consider replacing the ventilator with a fully charged backup battery.	Infor-mation (100)	Yes	N/A	N/A

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Pressure Regulation High	Pressures exceed ventilator-defined thresholds. Ventilation continues. Autoresets when alarm condition removed; otherwise, transitions to the ventilator inoperative state if pressure continues to rise.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (62)	Yes	Yes	Yes
Proximal Pressure Line Disconnected or Occluded	An occlusion or disconnection of the proximal pressure line is detected. Detection occurs within 3 s. Air flow to the patient continues.	Check the patient. Reconnect proximal pressure line. Check the inspiratory limb for occlusion. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (57)	Yes	Yes	Yes
Replace eSYS cover and verify that eSYS is installed	Displays when either of the following conditions are present: No data from exhalation flow sensor or eSYS cover is not detected.	The alarm will auto reset when the data is received from the flow sensor AND the eSYS cover is detected. Note: the eSYS cartridge and cover must be in place during single and dual-limb circuit configuration.	High (71)	No	Yes	Yes
Running on Internal Battery	System is powered by the internal battery. Autoresets when ventilator is connected to AC power. Begins as a low-priority alarm and remains as an informational message after reset.	Connect ventilator to AC power when available.	Low/ Infor-mation (88)	Yes	Yes	Yes
Target V_T exceeded. Min Pressure Too High	Target pressure is less than Min P setting. The ventilator limits its applied pressure to Min P.	Check the patient. Confirm pressure settings are compatible with target. Evaluate pressure and volume settings.	Infor-mation (93)	No	Yes	N/A
Target V_T not achieved. Insufficient Max Pressure	Target pressure exceeds Max P setting. The ventilator limits applied pressure to Max P.	Check the patient. Confirm pressure settings are compatible with target. Evaluate pressure and volume settings.	Infor-mation (92)	No	Yes	N/A
Using Default Settings	Displayed after power on if setting values are corrupted or not set, or if default values were restored by the user.	Check the patient. Check and adjust settings as required.	Infor-mation (101)	Yes	N/A	N/A
Vent Inoperative *X* description of failure	See Table 9-4 on page 150					

Table 9-2: Alarm and other messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Volume Limit Exceeded	Estimated delivered patient tidal volume is greater than the PPV maximum volume alarm limit. The breath is immediately terminated. Possible causes are excessive patient inspiratory effort; a significant change in the leak around the patient interface; or high **P**PV %, Max E, or Max R setting. Ventilator cycles to exhalation. At first, an information message. If condition persists for three consecutive PPV breaths, this escalates to a high-priority alarm.	Check the patient. Confirm ventilator and alarm settings are appropriate. Check for circuit or mask leaks. If problem persists, provide alternative ventilation. Have ventilator serviced.	Infor-mation/ High (74)	Yes	Yes	Yes

Check Vent and Vent Inop alarms in Table 9-3 and Table 9-4 are considered technical alarms.

Table 9-3: Check Vent alarm messages: summary and troubleshooting

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Check Vent: 1.8 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (24)	Yes	No	No
Check Vent: 3.3 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (25)	Yes	No	No
Check Vent: 5 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (26)	Yes	No	No
Check Vent: 12 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (27)	Yes	No	No
Check Vent: 24 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (28)	Yes	No	No
Check Vent: 35 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (29)	Yes	No	No
Check Vent: Alarm LED Failed	Technical failure.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	Yes	No	No

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Table 9-3: Check Vent alarm messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Check Vent: Aux Supply Failed	Backup alarm problem	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (23)	Yes	No	No
Check Vent: Backup Alarm Failed	Backup alarm problem	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (4)	Yes	No	No
Check Vent: Barometer Calibration Data Error	Default barometric pressure of 686.0 mmHg (approximately 900 m/ 2953 ft above sea level) used in calculations	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (21)	Yes	No	No
Check Vent: Battery Failed	Battery problem	Check the patient. Connect the ventilator to AC. Provide alternative ventilation. Have the ventilator serviced.	High (40)	Yes	No	No
Check Vent: Battery Temperature High	Battery problem	Check the patient. Connect the ventilator to AC. Check for causes of overheating, such as high room temperature, blocked vents, clogged air intake filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (39)	Yes	No	No
Check Vent: Blower Temperature High	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air intake filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (38)	Yes	No	No
Check Vent: Cooling Fan Speed Error	Overheating of ventilator possible	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (41)	Yes	No	No
Check Vent: CPU PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (33)	Yes	No	No
Check Vent: Data Acquisition PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (31)	Yes	No	No
Check Vent: eSYS Fan Speed Error	eSYS enclosure fan speed is out of range	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (42)	No	Yes	No

Table 9-3: Check Vent alarm messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Check Vent: eSYS Heater Failure	eSYS heater failure detected.	Check the patient. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (52)	No	Yes	No
Check Vent: Exh. Pressure Sensor Zero Failed	POST autozero resulted in offset outside of expected range	Check the patient. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (46)	Yes	No	No
Check Vent: Exhalation Flow Sensor Failed	Communication lost or message corruption	Check the patient. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (20)	Yes	No	No
Check Vent: Exhalation Pressure Sensor disconnected	Communication lost or message corrupt	Check the patient. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (48)	Yes	No	No
Check Vent: Exhalation Pressure Sensor Range Error	Exhalation pressure sensor reporting measurements outside of expected range	Check the patient. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (47)	Yes	No	No
Check Vent: Exhalation Valve Stuck Closed	Exhalation flow less than expected during ventilation	Check the patient. Check exhalation valve diaphragm. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (18)	No	No	N/A
Check Vent: Exhalation Valve Stuck Open	Exhalation flow greater than expected during ventilation	Check the patient. Check exhalation valve diaphragm. Replace eSYS cartridge and re-run EST. If condition persists, provide alternative ventilation. Have the ventilator serviced.	High (17)	Yes	No	No
Check Vent: Flash File System Error	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (43)	Yes	No	No
Check Vent: Internal Temperature High CPU	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air intake filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (35)	Yes	No	No

Table 9-3: Check Vent alarm messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Check Vent: Internal Temperature High Daq	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air intake filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (36)	Yes	No	No
Check Vent: Internal Temperature High Mtr	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air intake filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (37)	Yes	No	No
Check Vent: Machine Pressure Sensor Auto Zero Failed	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (8)	Yes	No	No
Check Vent: Machine Pressure Sensor Calibration Data Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (6)	Yes	No	No
Check Vent: Machine Pressure Sensor Range Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (10)	Yes	No	No
Check Vent: Motor Control PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (32)	Yes	No	No
Check Vent: O_2 Flow Sensor Calibration Data Error	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (13)	Yes	No	No
Check Vent: O_2 Pressure Sensor Calibration Data Error	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (14)	Yes	No	No
Check Vent: O_2 Supply Pressure Sensor Range Error	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (16)	Yes	No	No
Check Vent: OVP Circuit Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (44)	Yes	No	No
Check Vent: Oxygen Device Failed	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (15)	Yes	No	No
Check Vent: Primary Alarm Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (3)	Yes	No	No

Table 9-3: Check Vent alarm messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Check Vent: Program CRC Test Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (1)	Yes	No	No
Check Vent: Proximal Pressure Sensor Auto Zero Failed	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (9)	Yes	No	No
Check Vent: Proximal Pressure Sensor Calibration Data Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (7)	Yes	No	No
Check Vent: Proximal Pressure Sensor Range Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (11)	Yes	No	No
Check Vent: Sensor/ Driver CPU Failure	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (19)	Yes	No	No
Check Vent: Sensor/ Driver PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (34)	Yes	No	No
Check Vent: Sensor/ Driver PCBA Power Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (30)	Yes	No	No
Check Vent: Sensor/ Driver Watchdog Failure	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (51)	Yes	No	No
Check Vent: Ventilator Restarted	Ventilator Restarted Event	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (2)	Yes	No	No

Table 9-4: Vent Inoperative alarm messages: summary and troubleshooting

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Vent Inoperative 1000 3.3 V Supply Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (2)	Yes	No	No
Vent Inoperative 1001 12 V Supply Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (3)	Yes	No	No
Vent Inoperative 1002 Blower Temperature Too High	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (4)	Yes	No	No

Table 9-4: Vent Inoperative alarm messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Vent Inoperative 1003 Internal Temperature High	Technical failure of the CPU PCBA. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	Yes	No	No
Vent Inoperative 1004 Internal Temperature High	Technical failure of the DAQ PCBA. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	Yes	No	No
Vent Inoperative 1005 Internal Temperature High	Technical failure of the motor PCBA. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	Yes	No	No
Vent Inoperative 1006 Data Acquisition PCBA ADC Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (6)	Yes	No	No
Vent Inoperative 1007 Machine and Proximal Pressure Sensors Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (7)	Yes	No	No
Vent Inoperative 1008 Machine and Proximal Pressure Sensors Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (7)	Yes	No	No
Vent Inoperative 1009 Pressure Regulation High	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (8)	Yes	No	No
Vent Inoperative 100A Data Acquisition PCBA ADC Reference Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (9)	Yes	No	No
Vent Inoperative 100B Watchdog Test Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced	High (10)	Yes	No	No
Vent Inoperative 100C Air Valve Stuck Closed	Displays when an Inspiratory Valve Occlusion is detected. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced	High (11)	Yes	No	No

Table 9-4: Vent Inoperative alarm messages: summary and troubleshooting (Continued)

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Auto-resettable	Silence-able
Vent Inoperative 100D Air Flow Sensor Calibration Data Error	Air Flow sensor calibration is corrupt or not present. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced	High (12)	Yes	No	No

10 Care and Maintenance

WARNING
To reduce the risk of electric shock, power down the ventilator and disconnect it from AC power before cleaning, disinfecting, or servicing it.

NOTE
- It is the user's responsibility to comply with the information provided in this chapter.
- Cleaning, disinfection and sterilization are most effective if soiling is not allowed to dry on a medical device.[1]
- Disinfection and sterilization are most effective on medical devices that were previously cleaned. [1]

To ensure the safety and reliability of your ventilator, follow these maintenance procedures along with your own institutional policies for cleaning, disinfecting, and maintaining equipment. All the procedures in this manual are intended to be performed by the operator. For further maintenance, contact your service representative.

Exterior and Touchscreen Cleaning

CAUTION
- **To prevent possible damage to the ventilator, do not drip or spray any liquids directly onto any surface including the front panel, touchscreen, and navigation ring.**
- **Never clean or disinfect the touchscreen with an abrasive brush or device, since this will cause irreparable damage.**
- **To prevent possible damage to the ventilator, use only those cleaning and disinfecting agents listed in this manual.**

NOTE
- Do not attempt to sterilize or autoclave the ventilator.
- Use of unapproved cleaning and disinfecting agents may cause damage to the enclosure, touchscreen, or parts of the ventilator.

1. Reprocessing Medical Devices in Health Care Settings: Validation Methods and Labeling Guidance for Industry and Food and Drug Administration Staff, 2015. Food and Drug Administration (FDA)

Approved Cleaning Agents

The following cleaning agents are acceptable for use on the touchscreen and exterior surfaces of the ventilator:

- Clean water
- Soapy water with Medivators Intercept Detergent* or equivalent, per manufacturer's recommendation at 1⁄3 oz (10 mL) per gallon of warm tap water.
  *(Benzalkonium chloride 4.8%, diethylene glycol monoethyl ether 4.8%, lactic acid 1.4%, alkyl polyglycoside 1.4%)

Cleaning Instructions

1 Apply cleaning agent to a soft lint-free cloth or use a disposable wipe. The cloth or wipe should be saturated but not dripping.

2 Wipe cleaning agent over the entire exterior surface and touchscreen of the ventilator.

3 Continue wiping until all visible contaminants and soiling are removed.

4 Rinse with a clean, water-dampened cloth and allow to dry completely before reuse.

Exterior and Touchscreen Disinfection

CAUTION

- **To prevent possible damage to the ventilator, do not drip or spray any liquids directly onto any surface including the front panel, touchscreen, and navigation ring.**
- **To prevent possible damage to the ventilator, use only those cleaning and disinfecting agents listed in this manual.**
- **Never clean or disinfect the touchscreen with an abrasive brush or device, since this will cause irreparable damage.**

NOTE

- Do not attempt to sterilize or autoclave the ventilator.
- Use of unapproved cleaning and disinfecting agents may cause damage to the enclosure, touchscreen, or parts of the ventilator.

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Approved Disinfecting Agents

The following disinfecting agents are acceptable for use on the touchscreen and exterior surfaces of the ventilator:

Table 10-1: Exterior disinfection

Disinfectant
Clorox Healthcare® Bleach Germicidal Wipes Sodium hypochlorite 0.55% **Note**: Use only this brand and type. Other brands and types may have both active and inactive ingredients that can damage the ventilator.
Solution of 1 part 5% sodium hypochlorite (bleach) diluted in 9 parts deionized water.
70% isopropyl alcohol
70% ethyl alcohol
3% hydrogen peroxide
PDI Super Sani-Cloth® Germicidal Disposable Wipes (n-Alkyl (68% C12, 32% C14) dimethyl ethylbenzyl ammonium chlorides (0.25%); n-Alkyl (60% C14, 30% C16, 5% C12, 5% C18) dimethyl benzyl ammonium chlorides (0.25%); Isopropyl Alcohol (55%)) **Note**: Use only this brand and type. Other brands and types may have both active and inactive ingredients that can damage the ventilator.

Disinfection Instructions

1 Apply disinfecting agent to a soft lint-free cloth or use a disposable wipe. The cloth or wipe should be saturated but not dripping.

2 Wipe disinfecting agent over the entire exterior surface of the ventilator.

3 Allow disinfectant to remain on the surface for the contact times indicated in the specifications for the disinfecting agent.

4 Rinse with a clean cloth dampened with water and allow to dry completely before reuse.

eSYS Exhalation Cartridge Cleaning, Disinfection and Sterilization

For information on how to remove and replace the eSYS, see “Replacing the eSYS Exhalation Cartridge” on page 167 or the label located inside the eSYS cover.

WARNING

- **To protect the eSYS exhalation cartridge from contamination, always use an expiratory filter for both dual- and single-limb ventilation.**
- **The eSYS exhalation cartridge may become contaminated during use. It can be removed and then either cleaned and disinfected, or cleaned and sterilized.**
- **To prevent possible damage to the eSYS cartridge, use only those cleaning, disinfecting and sterilization methods listed in this manual.**

eSYS Disassembly Instructions

Prior to internal cleaning, disinfection, and sterilization, the diaphragm and retaining ring must be removed.

1 Remove the diaphragm retaining ring by pushing across one side of the retaining ring or by lifting up on one of the large tabs. This will free one of the two alignment tabs from its notch in the eSYS cartridge housing, allowing you to lift the ring up and out of the opening. Do NOT use a screwdriver or other tool to pry off the retaining ring. (Continued on next page.)

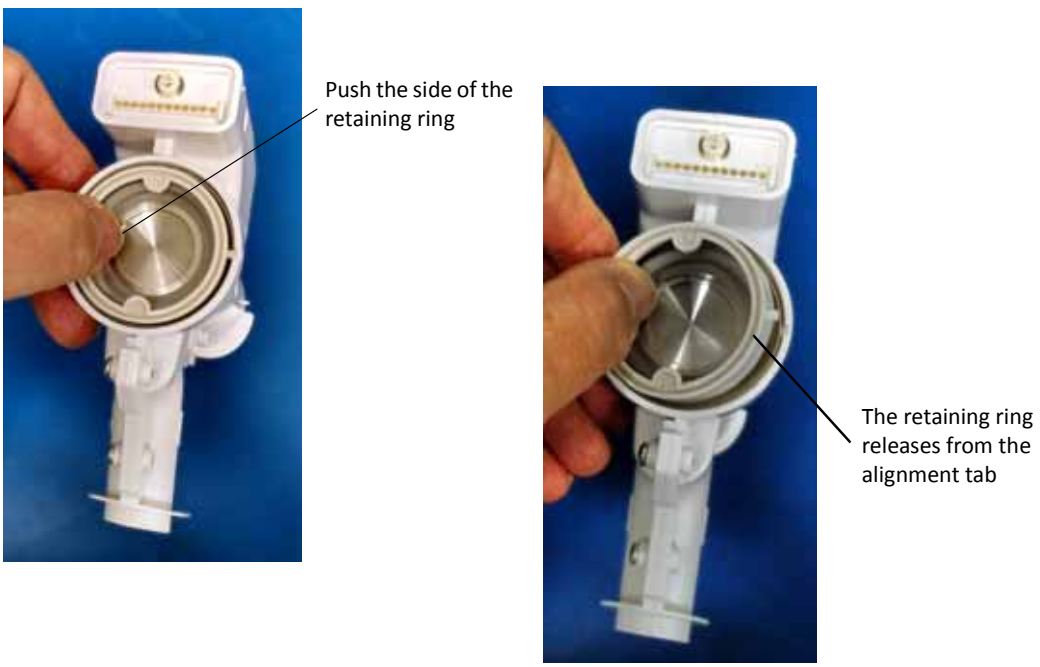


Figure 10-1: Remove retaining ring

2 Remove the diaphragm from the eSYS cartridge. Do not remove the metal disk from the diaphragm. The diaphragm and disk remain assembled during cleaning, disinfection and sterilization. See Figure 10-2 below.

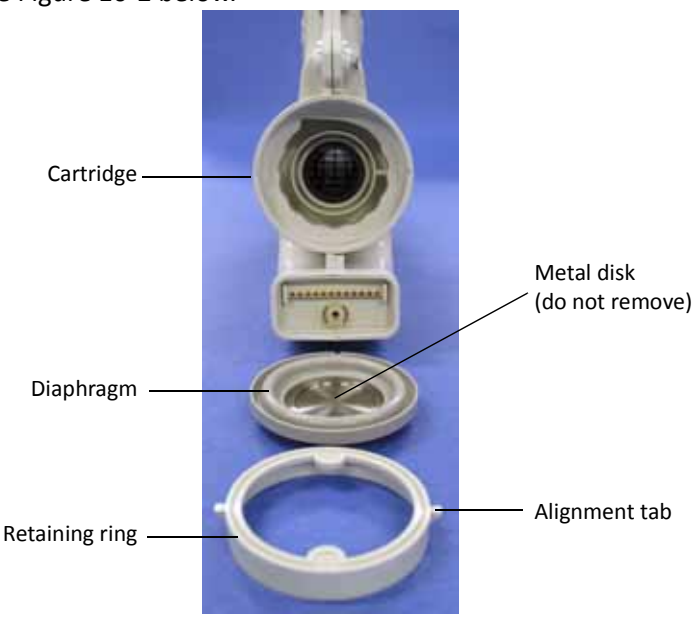


Figure 10-2: eSYS cartridge disassembly

After the eSYS cartridge is disassembled, internal cleaning, disinfection and sterilization can be performed by following the instructions below.

eSYS Cleaning by Detergent Soak

NOTE

- Clean all parts of the eSYS cartridge.
- Use *only* the approved cleaning agents shown below. Enzyme-based cleaners can damage the diaphragm and retaining ring.

Approved Detergent

The following detergent agent is approved for use with the eSYS cartridge:

- Soapy water with Medivators Intercept Detergent or equivalent*, per manufacturer's recommendation at 1⁄3 oz (10 mL) per gallon of warm tap water.
  *(Benzalkonium chloride 4.8%, diethylene glycol monoethyl ether 4.8%, lactic acid 1.4%, alkyl polyglycoside 1.4%)

1 Submerge all eSYS parts--**the cartridge, diaphragm with disc, and retaining ring**--in approved detergent solution for one (1) minute.

2 Agitate by hand in the detergent solution for one (1) minute.

3 Fully drain.

4 Submerge in clean deionized water and agitate by hand for one (1) minute.

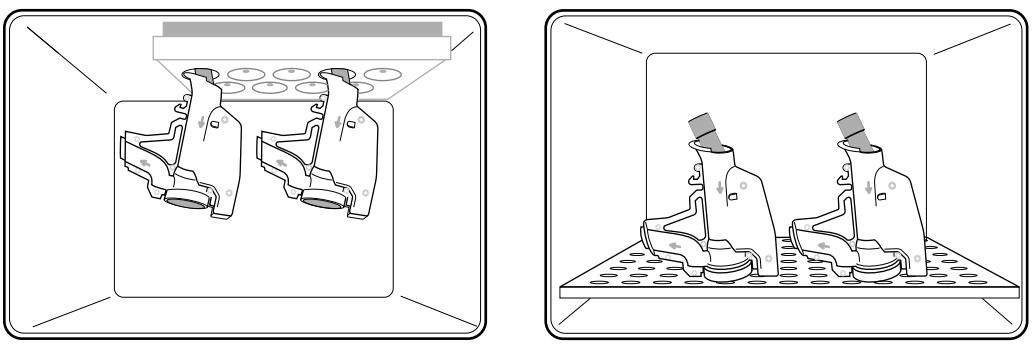
5 Fully drain.

6 Submerge in 70% isopropyl alcohol and agitate by hand for one (1) minute.

7 Fully drain.

8 Inspect all eSYS parts to ensure that visible contaminants have been removed.

9 Dry all eSYS parts at a minimum of 45°C for a minimum of eight (8) hours, or dry at a minimum of 60°C for two (2) hours on a tube holder in a sterile dryer. See Figure 10-3l below.



Drying position 1 (preferred) Drying position 2

Figure 10-3: Drying position on tube holder

eSYS Sterilization Procedure

CAUTION
Repeated autoclaving, autoclaving at higher than recommended temperatures, and autoclaving for longer cycle times than recommended, will greatly reduce the life of the eSYS cartridge.

NOTE
- Before sterilization, follow the cartridge disassembly and internal cleaning procedures above.
- The eSYS cartridge has been tested to withstand 50 autoclave cycles.
- **Sterilize all parts of the eSYS cartridge.**

Steam Autoclave Instructions
- Pre-vacuum
- Three pre-conditioning pulses
- Temperature = 132 °C
- Full cycle exposure time = 4 minutes
- Dry time = 30 minutes
- Room temperature cooling time = 30 minutes

Cleaning and Disinfecting by Medical Washer/Pasteurizer

The eSYS cartridge can be disinfected using a medical washer.

NOTE
- Before disinfection, follow the cartridge disassembly and internal cleaning procedures above.
- Repeated disinfection can reduce the life of the cartridge.
- **Disinfect all parts of the eSYS Cartridge**.

Approved Cleaning and Disinfecting Agent

The following detergent agent is approved for use with the eSYS cartridge:

- Soapy water with Medivators Intercept Detergent* or equivalent, per manufacturer's recommendation at 1⁄3 oz (10 mL) per gallon of warm tap water.
  *(Benzalkonium chloride 4.8%, diethylene glycol monoethyl ether 4.8%, lactic acid 1.4%, alkyl polyglycoside 1.4%)

1 Set the medical washer to the settings noted below in Table 10-2:

Table 10-2: Medical washer

Process	Setting
Pre-Wash	Cold tap water for 2 minutes
Wash 1	Heated tap water at 66°C for 2 minutes, using mild detergent per manufacturer's recommendation
Neutralization	Heated tap water at 66°C for 2 minutes
Rinse 1	Hot tap water for 15 seconds
Thermal Rinse	Hot tap water at 93°C for 2.5 minutes
Deionized water rinse	Heated to 66°C
Drying	Heated air 115.5°C for 7 minutes (Not maintained)

2 Insert all eSYS parts--**cartridge, diaphragm with disc, and retaining ring**--into the automatic washer and start the cycle.

3 When the cycle is completed, remove all eSYS parts from the automatic washer.

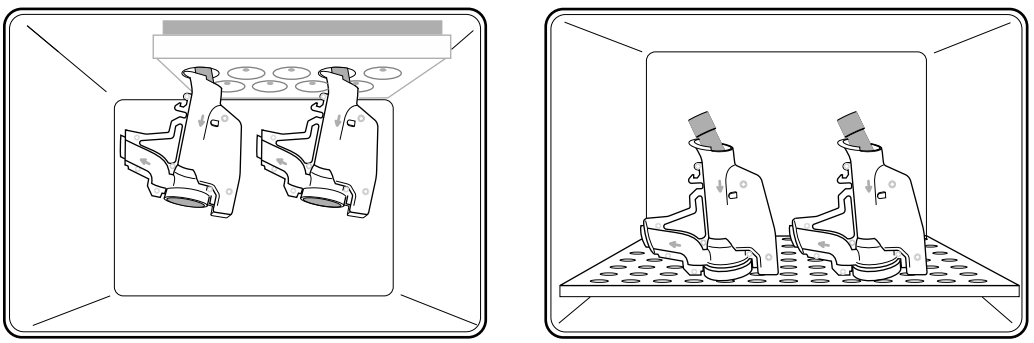
4 Fully drain.

5 Submerge in 70% isopropyl alcohol and agitate by hand for one (1) minute.

6 Fully drain.

7 Inspect all eSYS parts to ensure that visible contaminants have been removed.

8 Dry at a minimum of 45°C for a minimum of eight (8) hours, or dry at a minimum of 60°C for two (2) hours on a tube holder in a sterile dryer. See Figure 10-4 below.



Drying position 1 (preferred) Drying position 2

Figure 10-4: Drying position on tube holder

After processing, care should be taken to reassemble the diaphragm and retaining ring in the correct orientation. Refer to the reassembly instructions and Figure 10-5 through Figure 10-8 below.

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Reassembling the eSYS Cartridge Diaphragm and Retaining Ring

1 Insert the diaphragm into the eSYS cartridge body, with outer diaphragm edge and metal disk facing out.

Figure 10-5: Diaphragm orientation

2 The retaining ring is keyed. Be sure to line up the alignment tabs with the notches in the eSYS cartridge body. The large tabs should be facing out. Press the retaining ring down evenly (not tilted) until the retaining ring snaps into place. See Figure 10-6 and Figure 10-7 below.

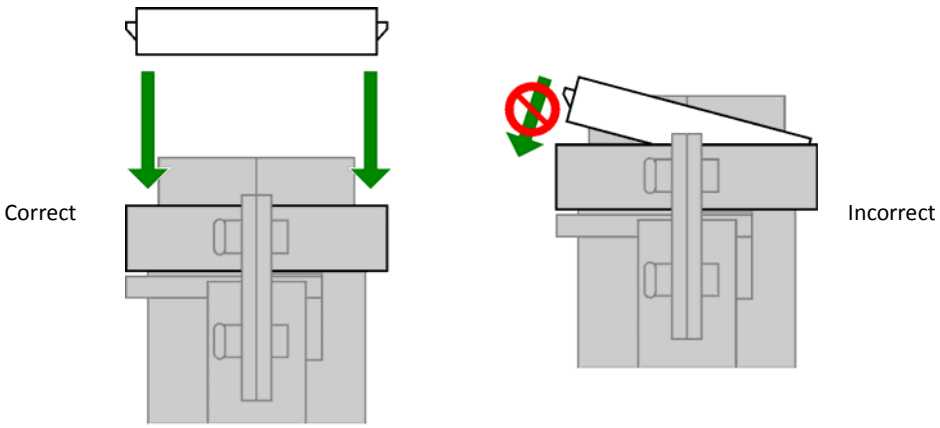

Figure 10-6: eSYS retaining ring assembly

NOTE

When assembled, the large tabs should be positioned at the top of the opening, not down inside the opening next to the diaphragm. Incorrect assembly of the retaining ring will push the tabs against the diaphragm, preventing proper eSYS cartridge operation.

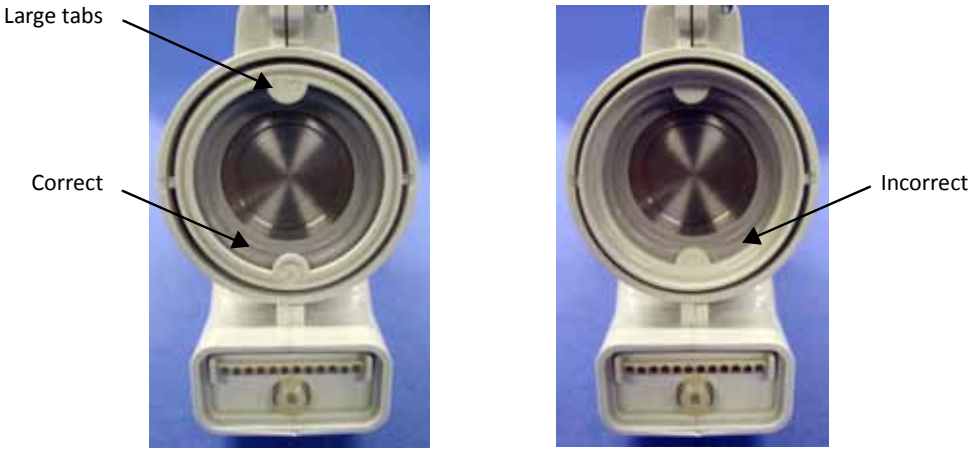

Figure 10-7: eSYS retaining ring tabs

3 Visually check the diaphragm for pinching. Using improper technique when seating the retaining ring can sometimes pinch one side of the diaphragm. If needed, disassemble and reassemble the eSYS cartridge to correct the pinched area. See Figure 10-6 above for how to correctly seat the ring.

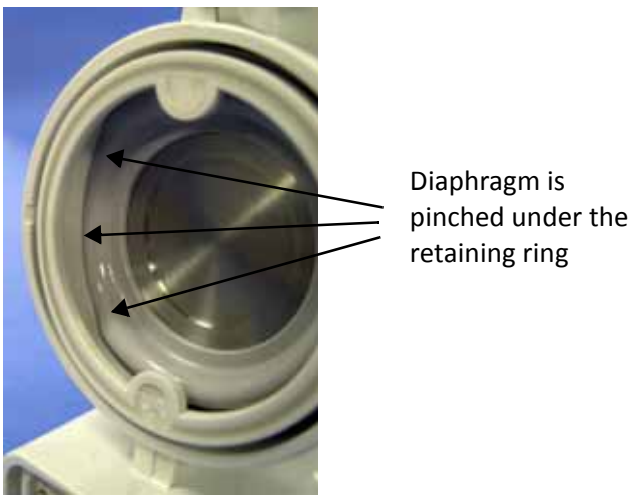

Figure 10-8: Pinched eSYS diaphragm

4 Replace the eSYS cartridge into the ventilator. Refer to “Replacing the eSYS Exhalation Cartridge” on page 167 for instructions.

Calibration

Before placing the eSYS cartridge back into service, follow the eSYS return-to-use procedure on page 168. If calibration fails and you are certain the cartridge is assembled correctly, try installing another eSYS cartridge. If calibration still fails, return the ventilator to qualified service personnel.

The eSYS cartridge has been tested to withstand at least 50 steam autoclave sterilization cycles. A sterilization log is provided on page 172 to assist in tracking the number of cycles for each eSYS cartridge. Dispose of a cartridge that appears damaged or fails repeated EST exhalation valve calibration according to institutional protocols.

Reusable Patient Circuits, Filters and Masks

Follow the manufacturer's instructions that accompany the accessory.

Preventive Maintenance

WARNING
To reduce the risk of electric shock, power down the ventilator and disconnect it from AC power before cleaning, disinfecting, or servicing it.

Perform preventive maintenance on your Respironics V680 ventilator according to the schedule in Table 10-3. You can view the hours of ventilator operation in the **Vent Info** window (see "Vent Info (Ventilator Information)" on page 92 or page 114). The following subsections provide details for some of these preventive maintenance procedures.

Table 10-3: Schedule of preventive maintenance

Frequency	Component	Maintenance
Between patients and per institutional guidelines	Patient circuit	Per manufacturer recommendations.
	Main flow bacteria filter and expiratory filter	Replace per institutional guidelines.
Every month or more frequently in dusty conditions	Cooling fan filter	Inspect for occlusions, dust, lint, etc. If discolored or dirty, remove and wash or rinse thoroughly, and let dry completely before reinstalling.
	Air intake filter	Inspect and replaced if needed
Every year	Backup battery	Inspect, test, and replace if needed *
	Oxygen sensor	Replace every 12 months or when the sensor cannot be calibrated.
	Ventilator	Preventive maintenance: * Install annual preventive maintenance kit. Clean ventilator interior and exterior. Complete performance verification procedure.

Table 10-3: Schedule of preventive maintenance (Continued)

Frequency	Component	Maintenance
Every 35,000 hours	Blower	Preventive maintenance: * Install 35,000 hour preventive maintenance kit. Clean ventilator interior and exterior. Complete performance verification procedure.
As required	eSYS cartridge	Sterilize with approved methods. Inspect for cracking and correctly installed diaphragm and retaining ring. Inspect diaphragm for signs of wear or visible holes. Run **EST** and **SST**.
	Backup battery	A new backup battery should be installed and charged within one year of the date of manufacture identified on the battery and on the shipping box.
Every 5 years	Backup battery	Replace.* Battery replacement is based on the date of manufacture recorded on the battery label. Also viewable in Diagnostic Mode on the system information screen.

*.Must be done by authorized service personnel according to the instructions in the service manual.

Replacing the Air Intake Filter

CAUTION

- **To avoid introducing foreign matter into the ventilator and to ensure proper system performance, inspect and change a visibly dirty air intake filter at regular intervals (or as stipulated by your institution).**
- **To ensure proper system performance, use only a Philips Respironics-approved air intake filter.**
- **Because some environments cause a quicker collection of lint and dust than others, inspect the filters more often when needed. The air intake filter should be replaced; the cooling fan filter should be cleaned.**

Replace the air intake filter as follows, referring to Figure 10-9 and Figure 10-10.

1 Power down the ventilator and disconnect it from AC power.

2 Remove the filter cover by grasping the small tab below the ventilation fins then pulling the cover out and up to remove. The filter cover is held on by tabs at the top and a magnet at the bottom. Tools are not required for removal.

NOTE

Pull cover out by the bottom. Do not bend or break the plastic tabs at the top. Never use a screwdriver or any other object to pry the filter cover off.

Figure 10-9: Removing filter cover

3 Remove the inlet filter by pinching it out of the recess in the bracket.

4 Install a new air filter by tucking it into the recessed area.

Figure 10-10: Replacing the air intake filter

5 Hook the cover onto the tabs at the top, check alignment, and push gently until the magnet at the bottom engages.

6 Reconnect the ventilator to AC power. Turn on the ventilator by pressing the **ON/ Shutdown** key on front panel.

Cleaning or Replacing the Cooling Fan Filter

Clean or replace the cooling fan filter as follows, referring to Figure 10-11:

1 Insert a small, flat blade driver tip between the foam filter and the filter retaining cover (Figure 10-11).

2 Gently pry the filter cover from the back of the ventilator. Do not remove the fan retaining pins.

3 Wash or rinse the filter. Let it dry completely before reinstalling.

4 Replace the filter, then snap the filter cover into place.

Figure 10-11: Replacing the cooling fan filter

Replacing the eSYS Exhalation Cartridge

CAUTION

- **Do not replace the eSYS cover without an eSYS cartridge installed. You will damage the cover detection switch.**
- **The eSYS exhalation cartridge must be installed during use for both single-limb and dual-limb circuit configurations. During single-limb ventilation, it helps prevent liquid ingress hazards.**

1 Power down the ventilator and disconnect it from AC power.

2 Grasp the eSYS cover by the tab and pull forward towards you. It is attached to the ventilator by a tether. Do not attempt to remove the tether or the cover from the ventilator.

3 Flip the cover over and let it hang beside the ventilator. Avoid excess tension on the tether, cover, or attachment point inside the ventilator.

Figure 10-12: Removing the eSYS cover

4 Remove the eSYS cartridge by grasping the breathing circuit connector on the front of the cartridge, then pulling the small release latch on the right towards you to release the cartridge. Lift the cartridge up and out and place it aside.

Figure 10-13: Removing the eSYS cartridge

5 Replace the eSYS cartridge with a new or sterilized cartridge only. Before use, inspect for cracking and for a correctly installed diaphragm and retaining ring.

6 Carefully place the cartridge inside the ventilator housing. The connection is keyed. Align the mating connector on the back of the exhalation cartridge with the pins inside the ventilator housing, and push. **There will be moderate resistance because the eSYS actuator is spring-loaded.** It will take some force but not excessive.

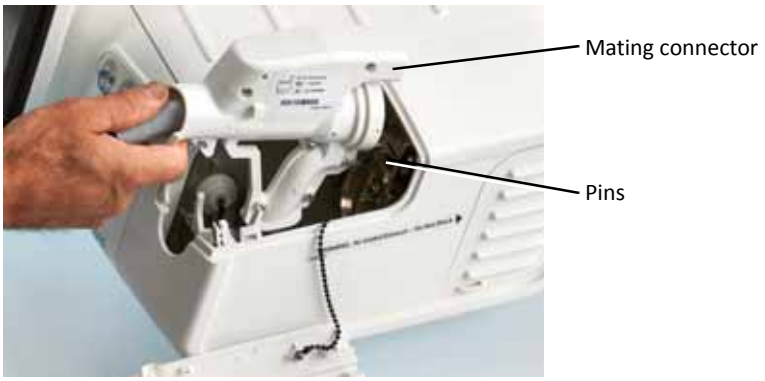

Figure 10-14: Replacing the eSYS cartridge

7 When the *back* of the module is correctly seated on the pins, press the front of the module back and down into the "collar" on the housing edge. **There will be moderate resistance because the eSYS actuator is spring-loaded.** It will take some force but not excessive.

You will hear a positive snap when the module drops into place. Do not force it.

Figure 10-15: Aligning the eSYS cartridge

8 Replace cover and slide back, towards the rear of the ventilator. There is a slight click when it is correctly seated (magnetically latched).

9 Reconnect the ventilator to AC power. Turn on the ventilator by pressing the **ON/ Shutdown** key on front panel.

eSYS Return to Use Procedure

A reprocessed eSYS cartridge must be tested during EST to verify performance and recalibrate it prior to use on a new patient.

1 Power down the ventilator and disconnect it from AC power.

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2 Remove the ventilator eSYS cover and install the eSYS cartridge. Replace the cover.

3 Reconnect the ventilator to AC power. Turn on the ventilator by pressing the **ON/ Shutdown** key on front panel.

4 Select **New Patien**t, then select the patient type, dual-limb patient circuit, and humidification type.

5 Install filters on the inspiratory port and on the eSYS, then confirm on the touchscreen that filters are installed.

6 Install a dual-limb patient circuit.

7 Press the **Start EST** button to execute the Extended Self-Test, including the Exhalation Valve Calibration Test. DO NOT skip this test.

8 Follow the on-screen prompts to execute the tests.

9 If all tests pass, the reprocessed eSYS cartridge and ventilator are ready for use on the next patient.

If repeated EST Exhalation Valve Calibration tests fail, try installing another eSYS cartridge. If calibration still fails, return the ventilator to qualified service personnel.

Removing and Replacing the Oxygen Sensor

WARNING

The oxygen sensor is a sealed device containing a mild acid electrolyte, lead (Pb), and lead acetate. Follow these precautions when handling the oxygen sensor:

- **Always visually inspect both a new sensor or a used, reinstalled, sensor for damage or electrolyte leakage before use. DO NOT USE if damaged or leaking.**
- **If a removed sensor shows any signs of electrolyte leakage such as visible liquid or dried crystalline residue past the sensor membrane, have the ventilator inspected and serviced by a qualified service technician.**

CAUTION

- **DO NOT attempt to open or repair the oxygen sensor.**
- **Do not immerse the sensor in any cleaning solution, autoclave or expose the sensor to high temperatures.**
- **Dropping sensor can adversely affect its performance.**

NOTE

- The V680 ventilator cannot be operated without an oxygen sensor installed. The oxygen sensor is located inside the right side of the ventilator enclosure, under the cover for the eSYS cartridge.
- It may take a new oxygen sensor several minutes to stabilize to room air and temperature after removal from a sealed package. If a newly installed sensor fails EST calibration, wait 15-20 minutes then repeat the calibration.
- Dispose of damaged, defective, or depleted oxygen sensors properly in accordance with local regulations.

1 Follow the eSYS replacement procedure on page 167 to remove the eSYS cover and cartridge. The oxygen sensor is located on the inside wall of the expiratory enclosure.

2 Carefully unplug the sensor stereo jack connector. Next, unscrew the oxygen sensor head. A 1/2-inch wrench may be needed if the sensor is more than hand tight. When the sensor is loosened it can be removed by hand. Carefully place aside.

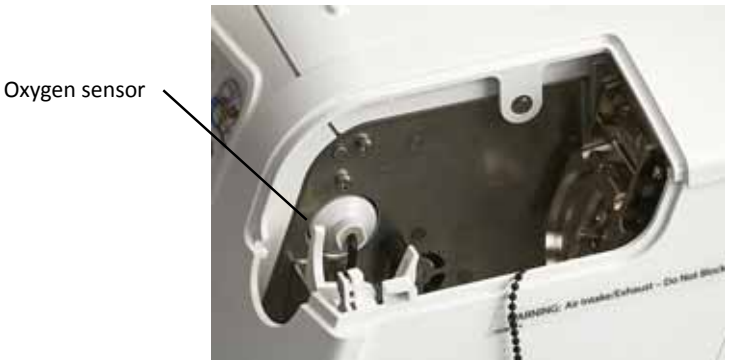

Figure 10-16: Oxygen sensor inside enclosure

3 Hand-tighten the new sensor into the threaded connection and reinsert the sensor stereo jack into the adjacent connector.

4 Follow the eSYS replacement procedure on page 167 to replace the eSYS cartridge and cover.

5 Run the O_2 calibration procedure as part of the EST tests before using the ventilator on a patient. DO NOT skip the O_2 calibration step. Refer to “Extended Self-Test (EST)” on page 76

NOTE
If the Extended Self-Test fails, do not use the ventilator. Refer the device to qualified service personnel.

Removing and Replacing the Battery

See “Installing the Battery” on page 188.

Disposal

Dispose of all parts removed from the device according to your institution’s protocol. Follow all local, state, and federal regulations with respect to environmental protection, especially when disposing of the electronic device or parts of it (for example, oxygen cell, batteries).

Storage

See page 184 for ventilator storage requirements.

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Service and Repairs

For technical service or repair information not included in this chapter, contact Philips.

A *Respironics V680 Ventilator Service Manual* is available, PN 1099929. The Service Manual includes removal and installation procedures, parts lists, and testing and troubleshooting information.

Repacking and Shipping

CAUTION
To prevent possible damage to the ventilator, always ship it with the original packing material. If the original material is not available, contact Philips to order replacements.

NOTE
Transport of lithium ion batteries is strictly controlled by international regulations and laws. Do not ship the battery either in the ventilator or separately by sea or air.

Remove the battery from the ventilator before shipping the ventilator. See “Installing the Battery” on page 188 for more information. Ship the battery and ventilator separately in appropriate packaging in conformance with federal, state, and local regulations.

eSYS Cartridge Sterilization Log

ESYS CARTRIDGE STERILIZATION LOG			
Device: eSYS Exhalation Cartridge			
Serial number:			
Cycle #	Sterilization Information	Date	Initials
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2			
3			
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ESYS CARTRIDGE STERILIZATION LOG			
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11 Technical Specifications

NOTE
Volume delivery and patient data displays are both circuit compliance and BTPS compensated. Flow delivery data displays are BTPS compensated.

Control Settings: Single-Limb Modes

Table 11-1 lists the ventilator control setting ranges and resolutions for single-limb modes. Table 11-2 lists the controls active in the different single-limb ventilation modes.

Table 11-1: Control setting ranges and resolutions - single-limb modes

Parameter	Range	Resolution	Factory default
Mode settings			
Modes	CPAP, S/T, PCV, AVAPS+ (optional), PPV (optional)	N/A	S/T
Control settings			
Auto-Trak+ Trigger (Trigger Sensitivity Setting)	Normal (0), +1 to +7	1	Adult: Normal (0) Pediatric: +3
Auto-Trak+ E-Cycle (Expiratory Cycle Sensitivity Setting)	Normal (0), -2 to +6	1	Normal
C-Flex	Off, 1 to 3	1	Off
CPAP	4 to 25 cmH_2O	1 cmH_2O	4 cmH_2O
EPAP	4 to 25 cmH_2O	1 cmH_2O	4 cmH_2O
IPAP	4 to 40 cmH_2O	1 cmH_2O	12 cmH_2O
I-Time (Inspiratory Time)	0.30 to 3.00 s	0.1 s	Adult: 1.00 s Pediatric: 0.7 s
Max ΔP/min (AVAPS+ Maximum Change in Pressure per Minute)	1.0 to 5.0 cmH_2O/min	0.5 cmH_2O/min	5 cmH_2O
Max E	0 to 100 cmH_2O/L	1 cmH_2O/L	5 cmH_2O/L
Max P (PPV Maximum Pressure Limit)	5 to 40 cmH_2O	1 cmH_2O	20 cmH_2O
Max P (AVAPS+ Maximum IPAP Pressure)	6 to 40 cmH_2O	1 cmH_2O	20 cmH_2O
Max R	0 to 50 cmH_2O/L/s	1 cmH_2O/L/s	2 cmH_2O/L/s
Max V (PPV Maximum Volume Limit)	200 to 3500 mL	5 mL	Adult: 1500 mL

Table 11-1: Control setting ranges and resolutions - single-limb modes (Continued)

Parameter	Range	Resolution	Factory default
Min P (AVAPS+ Minimum IPAP Pressure)	5 to 30 cmH_2O	1 cmH_2O	10 cmH_2O
O_2 (Oxygen)	21% to 100%	1%	21%
PPV %	0% to 100%	1%	80%
Ramp Time (single-limb NIV only)	Off, 5 to 45 min	5 min	Off
Rate (Respiratory Rate)	1 to 80 BPM	1 BPM	Adult: 12 BPM Pediatric: 20 BPM
Rise (Rise Time)	1 to 5	1	2
V_T (AVAPS+ Target Tidal Volume)	Adult: 50 to 2000 mL Pediatric: 50 to 500 mL	5 mL	Adult: 500 mL Pediatric: 200 mL

Table 11-2: Controls active in single-limb ventilation modes

	CPAP	S/T	PCV	AVAPS	PPV
Timing		Rate			Rate*
		I-Time			I-Time*
Baseline pressure	CPAP	EPAP			
Inspiratory pressure		IPAP		Max P	Max P
				Min P	IPAP*
Rise Time		Rise			Rise*
O_2	O_2				
Volume				V_T	Max V
Ramp feature	Ramp Time				
Mode-specific	C-Flex				PPV %
					Max E
					Max R

*Used in backup only

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Control Settings: Dual-Limb Modes

Table 11-3 lists the ventilator control setting ranges and resolutions for dual-limb modes. Table 11-4 lists the controls active in the different dual-limb ventilation modes.

Table 11-3: Control setting ranges resolutions - dual-limb modes

Parameter	Range	Resolution	Factory default
Mode settings			
Modes	A/C-PCV, SIMV-PCV, PSV, A/C-VCV, SIMV-VCV, PRVC	N/A	A/C-PCV
Control settings			
Pressure trigger backup (not user-adjustable)	Triggers at -2 cmH_2O	1 cmH_2O	N/A
E-Cycle	10 to 80%	1%	25%
I-Time (Inspiratory Time)	0.30 to 5.00 s	0.1 s	Adult: 1.00 s Pediatric: 0.7 s
I-Trig (Flow Trigger)*	0.5 to 20.0 L/min	0.5 L/min	3.0 L/min
Max P (PRVC Maximum Pressure Limit)	3 to 65 cmH_2O	1 cmH_2O	20 cmH_2O
Max V (PRVC Maximum Volume Limit)	Adult: 55 to 2500 mL Pediatric: 55 to 500 mL	1 mL	Adult: 2500 mL Pediatric: 300 mL
Min P (PRVC Minimum Pressure)	2 to 64 cmH_2O	1 cmH_2O	10 cmH_2O
O_2 (Oxygen)	21 to 100%	1%	21%
PC (Pressure Control above PEEP)	2 to 65 cmH_2O	1 cmH_2O	12 cmH_2O
PEEP	0 to 40 cmH_2O†	1 cmH_2O	0 cmH_2O
PS (Pressure Support above PEEP)	Off, 2 to 65 cmH_2O	1 cmH_2O	Off
Rate (Respiratory Rate)	1 to 80 BPM	1 BPM	Adult: 12 BPM Pediatric: 20 BPM
Rise (Rise Time)	1 to 5	1	2
Sigh	On, Off	N/A	Off
(Flow Pattern)	Square, Ramp (descending)	N/A	Ramp
V_T (Target Tidal Volume)	Adult: 50 to 2000 mL Pediatric: 50 to 500 mL	5 mL	Adult: 500 mL Pediatric: 200 mL

* A backup pressure trigger is activated at PEEP - 2 cmH_2O. Not user-settable.

† It may not be possible to achieve PEEP as low as 0 cmH_2O under all conditions when using a 10 mm circuit.

Table 11-4: Controls active in dual-limb modes

	A/C-PCV	AC-VCV	SIMV-PCV	SIMV-VCV	PSV	PRVC
Timing	Rate					Rate
	I-Time					I-Time
Mandatory breath control	PC	V_T	PC	V_T		V_T
Spontaneous breaths			PS			
			E-Cycle			
Baseline	PEEP					
Pressure-specific	Rise		Rise			
Volume-specific		Flow Pattern		Flow Pattern		
		Sigh				
General	I-Trig					
			Apnea Mode			
	O_2					
Mode-specific						Max P
						Max V
						Min P

Patient Data

Table 11-5: Patient data ranges, resolutions, and accuracies

Parameter	Range	Resolution	Accuracy
Patient data window			
Breath phase/trigger indicator	Spont, Support, Mand, Assist, Exhale	Color-coded display: Spont - turquoise Support - turquoise Mand - orange Assist - orange Exhale - blue	N/A
Mechanics			
Dyn C	1 to 200 mL/cmH_2O	0.1 mL/cmH_2O	Dual-limb: ± 3 mL/cmH_2O + 25% actual Single-limb: ± 3 mL/cmH_2O + 30% actual
Dyn Re	1 to 200 cmH_2O/L/s	0.1 cmH_2O/L/s	Dual-limb: ± 5 cmH_2O/L/s + 25% actual Single-limb: ± 5 cmH_2O/L/s + 30% actual
Dyn Ri	1 to 200 cmH_2O/L/s	0.1 cmH_2O/L/s	Dual-limb: ± 5 cmH_2O/L/s + 25% actual Single-limb: ± 5 cmH_2O/L/s + 30% actual
Dyn Pplat	0 to 70 cmH_2O	1 cmH_2O	Dual-limb: ± 2 cmH_2O + 25% actual Single-limb: ± 2 cmH_2O + 25% actual
Dyn E	5 to 1000 cmH_2O/L	0.1 cmH_2O/L	N/A

NOTE: The accuracy of dynamic mechanics estimates may be less than stated in cases of high airway resistance or when tidal volume is less than 300 mL. However, the estimates remain very useful for trending purposes. If the Static Pplat and Dyn Pplat are closely matched, then all other dynamic mechanics estimates will also be accurate.

NOTE: Dynamic mechanics values are not accurate if the inspiratory to expiratory pressure differential is less than 5 cmH_2O.

Rate			
Rate	0 to 99 BPM	1 BPM	± 1 BPM
I:E	1 to 99	N/A	± 10% or 0.1
Spont R	0 to 99 BPM	1 BPM	± 1 BPM
Te	0.3 to 100 s	0.1 s	± 0.1 s
Oxygen			
O_2	18 to 100%	1%	± 3%
Volume			
VTE	0 to 3500 mL	1 mL	± 4 mL + 15% actual

Table 11-5: Patient data ranges, resolutions, and accuracies (Continued)

Parameter	Range	Resolution	Accuracy
Spont VTE	0 to 3500 mL	1 mL	± 4 mL + 15% actual
Mand VTE	0 to 3500 mL	1 mL	± 4 mL + 15% actual
Pt. Leak	0 to 200 L/min	1 L/min	N/A
Tot.Leak	0 to 200 L/min	1 L/min	N/A
VTI	0 to 3500 mL	1 mL	± 4 mL + 15% actual
Spont Ve	0 to 99 L/min	0.1 L/min	± 4 mL + 15% or 0.1 L/min (whichever is greater)
$\dot{V}_E$	0 to 99.0 L/min	0.1 L/min	± 4 mL + 15% or 0.1 L/min (whichever is greater)
Pressure			
PIP	0 to 74 cmH_2O	1 cmH_2O	± 2 cmH_2O + 4% actual
PEEP	0 to 50 cmH_2O	1 cmH_2O	± 2 cmH_2O + 4% actual
EPAP	0 to 50 cmH_2O	1 cmH_2O	± 2 cmH_2O + 4% actual
MAP	0 to 65 cmH_2O	1 cmH_2O	± 2 cmH_2O + 4% actual
Weaning			
Pt. Trig	0 to 100%	1%	N/A
T_I/T_{TOT}	0 to 99%	1%	N/A
RSBI	0 to 999	1	N/A
Waveform window			
P *waveform*	0 to 70 cmH_2O	Time axis: 1 s	N/A
$\dot{V}$ *waveform*	-240 to 240 L/min	Time axis: 1 s	N/A
V *waveform*	0 to 3500 mL	Time axis: 1 s	N/A
Loops window			
$\dot{V}$ *- V (Flow-Volume) loop*	Flow: -10 to -240 L/min negative 10 to 240 L/min positive	Flow: Adult 60 mL Pediatric, 30 mL	Flow: ± 2 L/min + 4% actual
	Volume: 50 to 3500 mL	Volume: Upper limit: Adult 600 mL, Pediatric, 350 mL Lower Limit: 0 mL	Volume: ±4 mL + 15% actual
P - V (Pressure-Volume) loop	Pressure: Upper limit: 10 to 80 cmH_2O Lower limit: 0 to -15 cmH_2O	Pressure: Upper limit: 20 cmH_2O Lower limit: 0 cmH_2O	Pressure: ± 2cmH_2O + 4% actual
	Volume: 50 to 3500 mL	Volume: Upper limit: Adult 600 mL, Pediatric, 350 mL Lower Limit: 0 mL	Volume: ±4 mL + 15% actual

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Alarms

Table 11-6 lists the adjustable alarm ranges and resolutions. Table 9-2 on page 138 describes other, nonadjustable alarms.

Table 11-6: Adjustable alarm ranges and resolutions

Parameter	Range	Resolution	Factory default
Hi Rate (High Rate Alarm)	5 to 90 BPM	1 BPM	Adult: 20 BPM Pediatric: 30 BPM
Lo Rate (Low Rate Alarm)	Off, 1 to 89 BPM	1 BPM	Off
O_2 (Oxygen Alarm)	On, Off	N/A	On
Hi V_T (High Tidal Volume Alarm)	Adult: 50 to 3500 mL Pediatric: 50 to 800 mL	5 mL	Adult: 1500 mL Pediatric: 500 mL
Lo V_T (Low Tidal Volume Alarm)	Adult: Off, 5 to 1500 mL Pediatric: Off, 5 to 600 mL	5 mL	Off
HIP (High Inspiratory Pressure Alarm)	5 to 70 cmH_2O	1 cmH_2O	35 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	Off, 1 to 60 cmH_2O	1 cmH_2O	Off
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	Adult: Off, 0.1 to 98.9 L/min Pediatric: Off, 0.1 to 29.9 L/min	0.1 L/min	Adult: 5 L/min Pediatric: 1 L/min
Hi $\dot{V}_E$ High Minute Ventilation Alarm)	Adult: 0.2 to 99 L/min, Off Pediatric: 0.2 to 30 L/min, Off	0.1 L/min	Off
Hi Mand V_T (High Mandatory Tidal Volume Alarm)	Adult: 50 to 3500 mL Pediatric: 50 to 800 mL	5 mL	Adult: 1500 mL Pediatric: 500 mL
Lip T (Low Inspiratory Pressure Delay Time)	5 to 60 s	1 s	20 s
Lo Mand V_T (Low Mandatory Tidal Volume Alarm)	Adult: Off, 5 to 1500 mL Pediatric: Off, 5 to 600 mL	5 mL	Off
Hi Leak (High Leak Alarm)	0 to 99 L/min, Off	1 L/min	Off
Apnea T (Apnea Delay Time Alarm)	10 to 60 s	1 s	20 s

Table 11-6: Adjustable alarm ranges and resolutions (Continued)

Parameter	Range	Resolution	Factory default
Hi PEEP (High PEEP Alarm)	1 to 15 cmH_2O	1 cmH_2O	6 cmH_2O
Hi Spont V_T (High Spontaneous Tidal Volume alarm)	Adult: 50 to 3500 mL Pediatric: 50 to 800 mL	5 mL	Adult: 1500 mL Pediatric: 500 mL
Lo Spont V_T (Low Spontaneous Tidal Volume alarm)	Adult: Off, 5 to 1500 mL Pediatric: Off, 5 to 600 mL	5 mL	Off

Menu Window Settings

Table 11-7: Menu window settings and ranges

Parameter	Range
Brightness	1 to 5
Loudness	1 to 10, Volume Escalation On/Off
Vent Info	Ventilator Information
Screen Lock	On, Off
Port (single-limb INV)	Whisper Swivel (Philips Respironics Whisper Swivel), DEP (Philips Respironics Disposable Exhalation Port, PEV (Philips Respironics Plateau Exhalation Valve, Other (Other Exhalation Port), None (No inline circuit exhalation port)
Mask/Port (single-limb NIV)	Mask: 1, 2, 3, 4, Other Port: Whisper Swivel (Philips Respironics Whisper Swivel), DEP (Philips Respironics Disposable Exhalation Port, PEV (Philips Respironics Plateau Exhalation Valve, Other (Other Exhalation Port), None (No inline circuit exhalation port)

Table 11-8: Respiratory Mechanics maneuvers

Parameter	Range	Resolution	Accuracy
Dual-limb modes only - available from Menu window			
Static C&R	Static C: 1 to 200 mL/cmH_2O	0.01 mL/cmH_2O	± 1 mL/cmH_2O + 20% actual
	Static E: 5 to 1000 cmH_2O/L	0.1 cmH_2O/L	N/A
	Static R: 1 to 200 $cmH_2O/L/s$	0.01 cmH_2O /L/s	± 3 $cmH_2O/L/s$ + 20% actual
	Static Pplat: 0 to 70 cmH_2O	0.01 cmH_2O	± 2 cmH_2O + 10% actual
P0.1	0 to -50 cmH_2O	0.1 cmH_2O	± 0.5 cmH_2O + 10% actual
MIP	0 to -50 cmH_2O	0.1 cmH_2O	± 0.5 cmH_2O + 10% actual

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Diagnostic Mode Functions

Table 11-9: Diagnostic mode functions

Function	Range/Description
Language	Français (French), Deutsch (German), Italiano (Italian), Magyar (Hungarian), Polski (Polish), Português (Brazilian Portuguese), Español (Spanish)
Date/Time	Customizable formats for type of time and date display. Set current time and date. NOTE: Ventilator does not compensate for daylight savings time.
Pressure Units	cmH_2O, hPa
Restore Default Settings	--
Software Options	--
Baud Rate	9,600; 19,200; 115,200
Significant Event Log	Displays most recent 2000 entries
Touch Screen Calibration	--

Physical Characteristics

Table 11-10: Physical characteristics

Parameter	Specification
Weight	12.3 kg (27 lb) with battery 11.3 kg (25 lb) without battery
Dimensions	
V680 ventilator stand	Maximum load 32 kg (70.5 lb) Note: Maximum load *in addition to* the ventilator is 19.7 kg (43.5 lb).
Installed weight and height (V680 ventilator on stand, including accessories as listed)	V680 Ventilator with eSYS, backup battery, ventilator stand, O_2 tank holder, circuit arm with mount, patient circuit, O_2 manifold with hoses Weight: 36.7 kg (80.8 lb) Width: 64 cm (25 in) Height: 136* cm (53.5* in) to top of ventilator *Does NOT include height of flexible circuit arm

Environmental Specifications

Table 11-11: Environmental specifications

Parameter	Specification
Temperature	Operating: 5 to 40°C (41 to 104°F) Storage: -20 to 50°C (-4 to 122°F) Transport: -20 to 60°C (-4 to 140°F)
Relative humidity	Operating: 15 to 95% (noncondensing) Storage: 10 to 95% (noncondensing) Transport: 10 to 95% (noncondensing)
Barometric pressure	Operating: 600 to 765 mmHg (80 to 102 kPa) +/- 15 mmHg **NOTE**: You may experience reduction in peak flow and pressure at high altitudes. See the flow delivery specification in Table 11-15. Storage: 450 to 765 mmHg (60 to 102 kPa) Transport: 450 to 765 mmHg (60 to 102 kPa)
Orientation	During operation, not to exceed an angle of 12° from horizontal on any of the four sides

Pneumatic Specifications

Table 11-12: Pneumatic specifications

Parameter	Specification
High-pressure oxygen supply	Composition, cleanliness, and dryness: Must meet all requirements for USP (U.S. Pharmacopeial Convention) medical-grade oxygen Connector: DISS male, DISS female, NIST Pressure: 2.76 to 6.00 bar / 276 to 600 kPa / 40 to 87 psig Flow: 175 SLPM Connector: SIS Pressure: 3.31 to 6.00 bar / 331 to 600 kPa / 48 to 87 psig Flow: 175 SLPM
High-pressure oxygen supply (using V680 manifold)	Connector: DISS male, DISS female, NIST Pressure: 3.10 to 6.00 bar / 310 to 600 kPa / 45 to 87 psig Flow: 175 SLPM Connector: SIS Pressure: 3.66 to 6.00 bar / 366 to 600 kPa / 53 to 87 psig Flow: 175 SLPM
Air supply	Blower
Inspiratory outlet (To patient port)	Connector: ISO 15 mm female/22 mm male conical
eSYS Exhalation Cartridge	Exhaled gas flow accuracy: ± (0.1 SLPM +5% of reading) after calibration. Total leak: ≤ 50 mL/min (STPD) at 40 cmH_2O Gas port connector: 22 mm conical
O_2 sensor	Accuracy: ± 3% after calibration T90 response time: 50 s for V_T = 50 mL, 21 s for V_T = 1000 mL

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Electrical Specifications

Table 11-13: Electrical specifications

Parameter	Specification
AC voltage	100 to 240 VAC
AC frequency	50/60 Hz
AC power	300 VA
Battery	PN 1076374: 14.4 V, 11.0 Ah, 163 Wh Maximum system current draw: 11 A Charge voltage: +16.9 V maximum Minimum operating time: 240 min (4 hours) under nominal conditions

Accessory Requirements

To meet performance specifications, the ventilator requires a patient circuit and filters that meet the requirements in Table 11-14 and Table 11-15.

NOTE
Any dual-limb circuit that meets the specifications in Table 11-14 *and* passes the ventilator's SST (Short Self-Test) on page 76 is approved for use with the V680 Ventilator.

Table 11-14: Accessory Requirements

Parameter	Specification
Compliance	Maximum compliance of the gas pathway including the breathing circuit: 3 mL/cmH_2O
Resistance	Maximum resistance of the breathing circuit and attachments: 22 mm circuit: 5 cmH_2O at 30 L/min 15 mm circuit: 5 cmH_2O at 15 L/min 10 mm circuit: 5 cmH_2O at 2.5 L/min

Other Specifications

Table 11-15: Other specifications

Parameter	Specification
Flow delivery	150 L/min with 40 cmH_2O airway pressure and 608 mmHg barometric pressure
Flow range	-240 to 240 L/min BTPS
Dynamic pressure regulation	± (2 cmH_2O + 4% of target) Negative (subatmospheric) pressure settings are not available.

Table 11-15: Other specifications (Continued)

Parameter	Specification
Start-up time	Ready to ventilate 9 s after power on
Inspiratory and expiratory pressure drop following equipment failure	≤ 6.0 cmH_2O at 2.5 L/min, using a 10 mm circuit ≤ 6.0 cmH_2O at 15 L/min, using a 15 mm circuit ≤ 6.0 cmH_2O at 30 L/min, using a 22 mm circuit
Inspiratory filter/expiratory filter (PN 1014047)	Particle size: Captures particles of 0.3 µm (micron) with > 99.99% efficiency Resistance: < 0.7 cmH_2O at 0.5 L/s Dead space: ≤ 68 mL Connectors: 15 mm ID/22 mm OD, 22 mm ID
Time required for the oxygen concentration to change from 21% to 90%	The ventilator adjusts O_2 within one breath. FiO_2 within the gas delivery system and entire breathing circuit adjusts at the following rate: up to 14 s (for delivered volume of 500 mL, dual-limb 22 mm OD patient circuit with water traps) up to 14 s (for delivered volume of 150 mL, dual-limb 15 mm OD patient circuit with water traps)
Audio alarm loudness	Highest volume setting: Average sound pressure level is approx. 76 dB(A) Lowest volume setting: Average sound pressure level is approx. 62 dB(A)
Operational acoustics	Sound power level is approx. 51 dB(A) and is the total sound energy emitted by the ventilator. Average sound pressure level is approx. 43 dB(A) measured 1 meter from the ventilator

A First-Time Installation

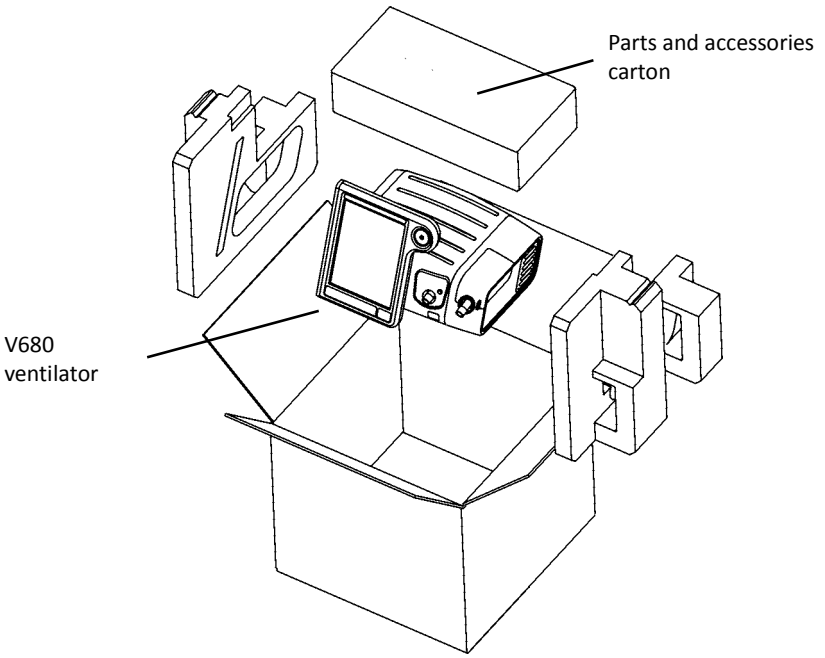
Before putting the ventilator into service for the first time, install it as described in this chapter.

NOTE
Training by Philips is recommended prior to initial use. See “Training” on page 36. for more information.

Unpacking and Inspection

Unpack the ventilator and inspect it for damage. Inspect the exterior cabinet of the ventilator for cracks, scratches, or blemishes. Inspect the front panel for scratches or abrasions. Correct and/or report any problems found to Philips before using the ventilator.

Before using the ventilator the first time, we recommend wiping the exterior clean and disinfecting components according to the instructions in Chapter 10, “Care and Maintenance”.



Included with the V680 ventilator are the following parts and accessories:

1 Installed
   a Power cord
   b O_2 fitting with retention plate
   c eSYS exhalation cartridge
2 Included
   a User manual (shipped in a separate box)

b Oxygen hose
c Test lung
d Disposable inspiratory filter
e Disposable expiratory filter
f Reusable adult dual-limb breathing circuit

Backup Battery (shipped in a separate box)

The ventilator battery cannot be shipped inside the ventilator carton; it must be shipped separately due to shipping regulations. The battery is supplied in a specially labeled “hazardous material” box.

Mounting the Ventilator

The ventilator may be placed on a flat, stable, clean surface or mounted to the optional V680 ventilator stand.

WARNING
Ventilator performance may be impaired due to improper orientation.

- **Do not tilt more than 12 degrees in any direction. Take particular care when crossing thresholds during intra-hospital transport.**
- **The ventilator should only be used on a flat, level surface capable of safely holding 12.3 kg (27 lb) or more, or properly mounted to the V680 stand supplied by Philips.**

Ventilator Stand Assembly

Follow the accompanying instructions to assemble the ventilator stand. An optional O_2 cylinder mounting kit is also available.

Installing the Battery

The battery is shipped with the product, but not installed. It should be installed prior to using the ventilator.

WARNING

- **Never attempt to disconnect or connect the battery during operation.**
- **To reduce the risk of fire, explosion, leakage, or other hazard, take these precautions with respect to the battery:**
  - **Do not attempt to disassemble, open, drop, crush, bend or deform, insert foreign objects into, puncture, or shred the battery pack; modify or remanufacture it; immerse or expose it to water or other liquids; expose it to fire, excessive heat (including soldering irons); or put it in a microwave oven.**
  - **Replace the battery only with another battery specified by the manufacturer.**

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– **Follow all instructions for proper use of the battery.**
– **Do not short-circuit the battery or allow metallic or conductive objects to contact the battery connector housing.**

CAUTION
Following battery installation, if a Check Vent or Vent Inoperative alarm occurs during the power-on self-test, discontinue use of the ventilator immediately and contact Philips. The Vent Inoperative alarm occurs if AC power is disconnected and a battery is not installed, or if the battery is fully discharged.

NOTE
- Refer battery replacement to qualified service personnel. Replace the battery only with another battery specified by the manufacturer.
- A new battery must be charged for at least 5 hours before being placed into service.
- Failure to properly shut down the ventilator before battery installation may result in erroneous alarms after power-on.

Install the battery as follows (Figure A-3). You will need a 3mm hex wrench.

1 If the ventilator is on, shut down and then unplug the ventilator.

2 Remove the side panel by turning the captive fastener a ¼ turn and releasing.

Figure A-1: Removing the side panel

3 Using a 3-mm hex wrench, remove the battery bracket by removing two screws.

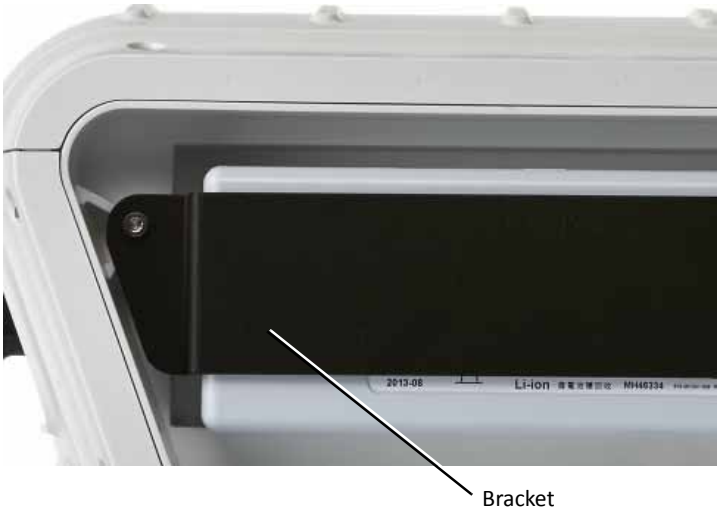

Figure A-2: Removing the battery

4 Holding the battery so that the vent hole faces up and the Philips logo faces out, thread the battery cable through the battery bracket. Position and place the battery inside the battery compartment. Pinching the end of the battery connector, plug it in so that it locks in place.

5 Reinstall the battery bracket by replacing the two screws. Reinstall the side panel and secure the fastener with a ¼ turn clockwise.

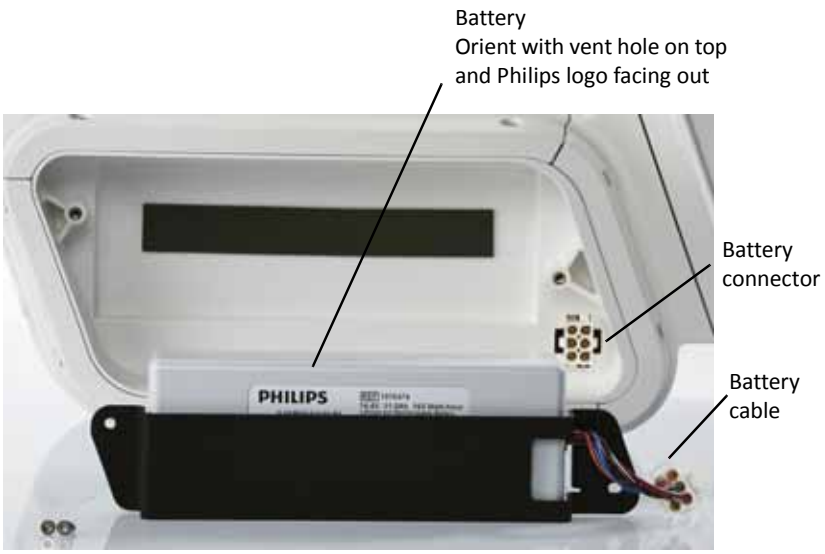

Figure A-3: Installing the battery

6 Make sure the battery is properly installed by plugging the ventilator into an AC power receptacle and verifying that the yellow Battery (charged) LED on the front panel flashes. The flashing LED indicates the battery is being charged.

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Installing the Oxygen Manifold Kit

The oxygen manifold allows two oxygen cylinders and one wall oxygen supply line to be used as inputs to the ventilator. Each of the three inlets has a check-valve that prevents pressure loss when the hose is disconnected from the wall or cylinders. This allows quick, easy transfer between oxygen supplies without interruption of flow. Easy transfer of oxygen supply facilitates patient transport within the facility and allows replacement of one cylinder while operating from the other.

If desired, install the oxygen manifold kit as described in the accompanying instructions.

Installing the Oxygen Sensor

The oxygen sensor is installed in the ventilator before shipping. To replace the sensor, see installation instructions on page 169.

A new or replaced oxygen sensor must be calibrated before the ventilator can be used. For this reason, an O_2 supply must be available for the EST (Extended Self Test) that is run during the initial ventilator setup. When the V680 ventilator is used in the future, oxygen sensor calibration may be skipped during EST, but only after the test is performed at least once for that particular oxygen sensor. However, to avoid oxygen measurement issues over time, it is recommended that you also perform an O_2 sensor calibration between patients. Use the EST on page 76.

NOTE
Whenever the 100% O_2 feature is used the ventilator performs a single-point oxygen sensor calibration at 100%.

Configuration and Screen Calibration

After completing the setup activities described in Chapter 5, set or check the ventilator settings for language, units of measure, date format, and time format in the diagnostic mode (see Appendix E). Calibrate the screen as required, referring to Appendix E.

Operational Test Procedure

The following are operational tests to verify the ventilator's operation, including battery, alarm functionality and remote alarm functionality. They should be run for first-time installation and whenever required by your institutional guidelines.

Required Materials

- Breathing circuit, dual-limb, PN 1104598 or the equivalent.
- 1-L test lung, PN 1021671 or the equivalent

Pre-use Check

Recommended between patients.

1 Connect the ventilator to AC power and the oxygen supply.

2 Install inspiratory and expiratory filters.

3 Assemble the dual-limb patient breathing circuit. Verify breathing circuit is assembled correctly. See Figure 5-4 and Figure 5-5 for possible circuit configurations.

4 Switch on power. Verify you hear tones from the backup alarm.

5 Follow the steps in the Ventilator Configuration screen. Verify all pre-use steps are followed and reflect the actual system configuration. (See page 74 for an overview of Ventilator Configuration.)

6 Run the SST (Short Self Test) following the on-screen prompts.

7 Run the EST (Extended Self Test) following the on-screen prompts.

8 If applicable, replace the dual-limb circuit with the actual circuit you will be putting on the patient.

WARNING
To prevent possible patient injury due to nonannunciating alarms, verify the operation of any remote alarm device before use.

9 Accept settings to enter ventilation mode. Press Start. Verify you are in the expected ventilation mode.

Backup Battery Check

Recommended between patients.

WARNING
Do not perform this check while attached to a patient.

NOTE
The battery must be adequately charged to run this test. Recharge as necessary before running the test.

1 Disconnect the ventilator from AC power while the ventilator is running.

When the backup battery is in use:

- The ventilator switches over to battery power (battery symbol in right-hand corner of screen is displayed).
- The green LED above the ON/Shutdown key remains lit.
- The audible alarm sounds intermittently.
- **Running on Internal Battery** is shown.
- The Battery LED is off.

2 Reconnect the ventilator to AC power. The alarm resets.

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3 Verify the ventilator is again running on AC (symbol displayed in right-hand corner of screen), and the battery LED flashes to indicate the battery is charging.

Troubleshooting

If any test step fails, discontinue ventilator use and contact Philips.

Alarm Tests

The ventilator performs a self-check during start-up and continuously during operation. Alarm functionality is verified by this self-check. You may also want to run alarm tests, which demonstrate the alarms' operation.

WARNING

- **To reduce patient risk from inappropriate ventilatory support, avoid turning off the alarms.**
- **Manufacturer default settings are not appropriate for all patients. Prior to using the ventilator, verify that the current alarm settings or defaults are appropriate for each particular patient.**

Preparation

1 Set the ventilator up as for normal operation: > 20 kg patient type, dual-limb configuration; adult 22 mm dual-limb breathing circuit, and a test lung assembly (PN 1021671).

2 Set the mode, control, and alarm settings as shown the table below:

	Using a dual-limb, adult circuit	
Mode	A/C-PCV	
Control Settings	PC: 12 cmH_2O	PEEP: 4 cmH_2O
	Rate: 10 BPM	I-Time: 1 s
	O_2: 21%	Rise: 3
	I-Trig: 3.0 L/min	
Alarm settings	Hi Rate: 20 BPM	Hi V_T: 1500 mL
	Lo Rate: Off	Lo V_T: Off
	O_2: On	Hi Leak: Off
	HIP: 35 cmH_2O	Apnea T: 20 s
	Hi V_E: Off	LIP: Off
	Lo V_E: Off	Hi PEEP: 6 cmH_2O

High Inspiratory Pressure

1 Lower the HIP alarm limit to 14 cmH_2O.

2 VERIFY that the **High Inspiratory Pressure** alarm is activated, the ventilator immediately cycles into exhalation, and pressure falls to 4 cmH_2O (the PEEP level).

3 Raise the HIP alarm limit to 20 cmH_2O.

Low Tidal Volume

1 Raise the Lo V_T alarm setting above the displayed, measured V_T.
2 VERIFY that the **Low Tidal Volume** alarm is activated.
3 Turn the Lo V_T alarm setting Off.
4 VERIFY that the alarm resets.

High Tidal Volume

1 Lower the Hi V_T alarm setting below the displayed, measured V_T.
2 VERIFY that the **High Tidal Volume** alarm is activated.
3 Reset the Hi V_T alarm setting to above the displayed, measured V_T.
4 VERIFY that the alarm resets.

High PEEP Alarm

1 Add a T-fitting and syringe in line with the proximal pressure line.
2 Set PEEP to 1 cmH_2O.
3 Set the Hi PEEP alarm to 2 cmH_2O.
4 Inject a small amount of volume from the syringe to artificially raise the sensed pressure and trigger the alarm.

Patient Disconnect

1 Disconnect the test lung.
2 VERIFY that the **Patient Disconnect** alarm is activated.
3 Reconnect the test lung.
4 VERIFY that the alarm resets and that the ventilator automatically resumes ventilation.

Patient Circuit Occluded

1 Disconnect the patient circuit at the eSYS inlet and block the end of the circuit.
2 VERIFY that the **Patient Circuit Occluded** alarm is activated.
3 Unblock the end of the circuit and reconnect it to the eSYS inlet.
4 VERIFY that the alarm resets.

Patient Circuit Partially Occluded

1 Disconnect the patient circuit at the eSYS inlet.
2 Add a gas or water flow control valve to the end of the circuit.
3 Close the valve almost completely until you see the partial occlusion alarm.
4 VERIFY that the **Patient Circuit Partially Occluded** alarm is activated. NOTE: this alarm can be difficult to trigger, but is possible.
5 Remove the valve and reconnect the circuit to the eSYS inlet.
6 VERIFY that the alarm resets.

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Oxygen Supply Failure

1 Set O_2 to above 21%.
2 Disconnect the ventilator from the gas supply at the wall or source connector.
3 VERIFY that the **Oxygen Not Available** alarm is activated.
4 Reconnect the gas supply.
5 VERIFY that the alarm resets and that the ventilator automatically resumes ventilation.

Apnea

1 Set the mode to PSV.
2 Wait for 20 seconds.
3 V680 should begin ventilating at a rate of 12 BPM while activating the Apnea alarm.
4 Simulate two consecutive spontaneous breaths by expanding or compressing and releasing the test lung.
5 VERIFY that the alarm resets and that the ventilator automatically resumes ventilation.
6 Return to A/C-PCV mode.

B Communications Interface

WARNING

- **Connect to the ventilator only items that are specified as part of or compatible with the ventilator system. Additional equipment connected to medical electrical equipment must comply with the respective IEC or ISO standards. Furthermore, all configurations shall comply with the requirements for medical electrical systems (see IEC 60601-1-1 or clause 16 of edition 3 of IEC 60601-1, respectively). Anybody connecting additional equipment to medical electrical equipment configures a medical system and is therefore responsible for ensuring that the system complies with the requirements for medical electrical systems. Also be aware that local laws may take priority over the above mentioned requirements. If in doubt, consult Philips.**
- **The USB port is currently approved for use with only one device: the Aerogen USB-powered controller. NEVER connect or attempt to power any other equipment from the USB port.**
- **It is the responsibility of the end user to validate the compatibility and use of information transmitted from the ventilator to the device to be connected to the ventilator.**

The ventilator provides the following communications interface ports (Figure B-1):

- **RS-232 serial and analog I/O port. T**hrough this port the ventilator receives commands from a host computer or bedside monitoring system and responds with fixed-format records. The port is also used for ventilator servicing and software downloading.
- **Remote alarm/nurse call port.** This port is used to activate alarms remotely.

Figure B-1: Location of communications interface ports

RS-232 Serial and Analog I/O Port

The ventilator can exchange both analog and RS-232 digital data through a 25-pin D-sub connector on the rear panel. The ventilator assumes the "slave" role and responds to commands from the external "master." The digital port uses a standard RS-232, null modem pin configuration with the auxiliary pins supporting analog data I/O.

This port permits the ventilator to send data to a patient monitor.or a hospital information system. The ventilator is compatible with Philips monitors (see "Communicating with Philips monitors using the VueLink/IntelliBridge Open Interface" on page 199). For complete compatibility information, contact your Philips representative.

Pinout of Connector

Table B-1 shows the pinout of the 25-pin D-sub connector used for the RS-232 serial and analog I/O port.

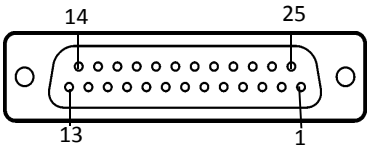

Table B-1: RS-232 serial and analog I/O connector pinout

Pin	Signal	I/O	Description
1	HIS_RS232_ SHLD	Power	HIS RS232 cable shield
2	HIS_RS232_TxD	Output	HIS RS232 transmit data output
3	HIS_RS232_RxD	Input	HIS RS232 receive data input
4	HIS_RS232_RTS	Output	HIS RS232 Ready To Send
5	HIS_RS232_CTS	Input	HIS RS232 Clear To Send
6	HIS_RS232_ DSR	Input	HIS RS232 Data Set Ready
7	HIS_SIG_RTN	Power	HIS RS232/Signal common
8	Unused	N/A	N/A
9	HIS_DIG_IN0	Input	HIS digital Input #0
10	HIS_DIG_IN1	Input	HIS digital Input #1
11	HIS_ANALOG_ IN00	Input	HIS analog input #0 (0 to 5 V)
14	HIS_DIG_IN2	Input	HIS digital Input #2
15	HIS_DIG_IN3	Input	HIS digital Input #3
16	HIS_DIG_OUT0	Output	HIS digital output #0 (0 to 3.3V)
17	HIS_DIG_OUT1	Output	HIS digital output #1 (0 to 3.3V)
18	HIS_DIG_OUT2	Output	HIS digital output #2 (0 to 3.3V)
19	HIS_DIG_OUT3	Output	HIS digital output #3 (0 to 3.3V)
20	HIS_RS232_ DTR	Output	HIS RS232 Data Terminal Ready
21	HIS_SIG_RTN	Power	HIS RS232/Signal common
22	HIS_BOOT_SEL	Input	Boot Select Signal, 0 – Download, 1 – Flash
23	HIS_ANALOG_ OUT0	Output	HIS analog output #0 (0 to 5 V)
24	HIS_ANALOG_ OUT1	Output	HIS analog output #1 (0 to 5 V)

Philips

Table B-1: RS-232 serial and analog I/O connector pinout

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
12	HIS_ANALOG_IN01	Input	HIS analog input #1 (0 to 5 V)	25	HIS_ANALOG_OUT2	Output	HIS analog output #2 (0 to 5 V)
13	HIS_SIG_RTN	Power	HIS RS232/Signal common	SHLD	Chassis	Power	Cable shield

Communications Protocol

The RS-232 serial protocol is configured as follows for all communications functions:

- Baud rate: Configurable in diagnostic mode
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

VueLink/IntelliBridge Interface

Communicating with Philips monitors using the VueLink/IntelliBridge Open Interface

NOTE

- The VueLink and IntelliBridge interfaces are currently available only in English.
- Data displayed on the VueLink and IntelliBridge systems is for reference purposes only. Decisions for patient care should not be based solely on the data obtained through the VueLink or IntelliBridge system.

The Respironics V680 ventilator can communicate with a Philips patient monitor using the VueLink or IntelliBridge Open Interface. Figure B-2 shows the required hardware setup for VueLink. Figure B-3 shows the required hardware setup for IntelliBridge. The interface requires a ventilator baud rate 19,200. Check for the correct baud rate in the ventilator diagnostic mode (see “Baud Rate” on page 230).

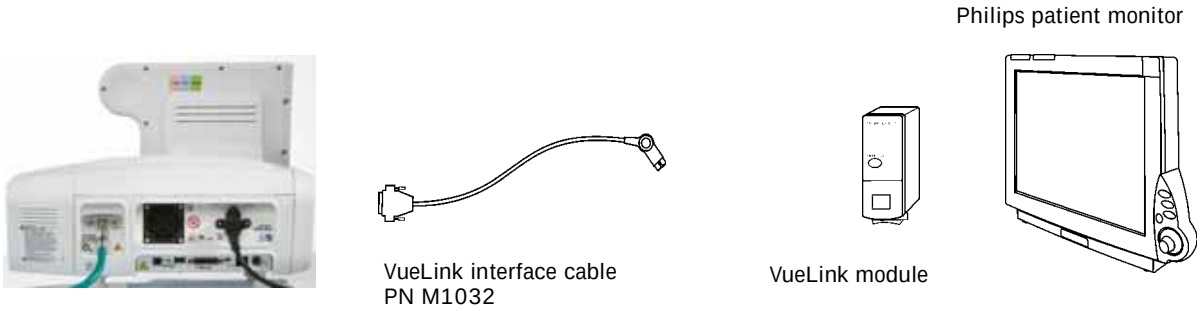

Figure B-2: Connection to a Philips monitor using VueLink

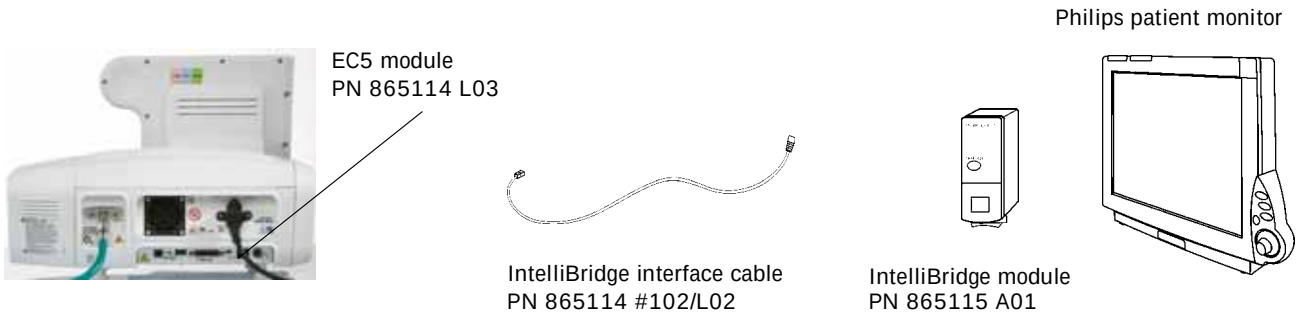

Figure B-3: Connection to a Philips monitor using IntelliBridge

The data from your Respironics V680 ventilator is displayed in several windows on your Philips monitor. This data may be labeled differently on the monitor than on the ventilator. Refer to Table B-2 to interpret these labels.

For more information, consult the documentation for your IntelliBridge or VueLink module and patient monitor..

Table B-2: Ventilator data displayed on Philips monitor

Monitor label	Ventilator label
Waveform data	
AWF	Flow
AWP	Pressure
AWV	Volume
Monitored parameters	
awRR	Rate
Cdyn	Dyn C
E	Dyn E
EPAP	PEEP

Philips

Table B-2: Ventilator data displayed on Philips monitor

Monitor label	Ventilator label
ExpTi	Te
FIO_2	O_2%
I:E 1:	I:E
MnAwP	MAP
MTV	Mand VTE
MV (MINVOL)	$\dot{V}_E$
PEEP	PEEP
PIP or Ppeak	PIP
Pplat	Dyn Pplat
Pt. Leak	Leak
PtTrig	Pt. Trig
Rexp	Dyn Re
Rinsp	Dyn Ri
RSBI	RSBI
SpAWRR	Spont R
SpMV	Spont VE
SpTVex	Spont VTE
Tin/Tt	T_I/T_{TOT}
Tot. Leak	Leak
TVex	VTE
TVin	VTI
Modes	
Same as ventilator mode name	All modes except standby
STNDBY	Standby
Control settings	
Epav	PPV Elastance
Rpav	PPV Resistance
PAVsup	PPV %
sAADel	Apnea Delay Time
sAFWav	Apnea Flow Pattern
sAInTi	Apnea Inspiratory Time
sAMVnt	Apnea Breath Type
sAPVcP	Apnea Pressure Control
sARR	Apnea Respiratory Rate

Philips

Table B-2: Ventilator data displayed on Philips monitor

Monitor label	Ventilator label
sARsTi	Apnea Rise Time
sATV	Apnea Tidal Volume
sAWRR	Respiratory Rate
sCPAP	CPAP
sdPmax	Max ΔP/min
sEnSgh	Sigh Enabled
sEPAP	EPAP
sFIO2	O_2%
sFWave	Flow Pattern
sInsTi	Inspiratory Time
sIPAP	IPAP
sLIPTi	Low Inspiratory Pressure Delay Time
sPEEP	PEEP
sPin	Pressure Control
sPmax	Max Pressure
sPmin	Min Pressure
sPSV	Pressure Support
sPtCat	Patient Type
sRampT	Ramp Time
RisTi	Rise Time
sSenEx	AutoTrak+ E-Cycle
sSenEx	E-Cycle
sTrig	AutoTrak+ Trigger
sTrig	Flow Sensitivity
sTV	Tidal Volume (V_T)
sVent	Ventilation Type (variable
sVmax	Max Volume
sVMode	Ventilation Mode (variable)
Not shown	C-Flex
Alarm messages	
APNEA	Apnea
CHECK O2 SUPPLY	High O_2 Supply Pressure
CHECK O2 SUPPLY	Low O_2 Supply Pressure
CHECK O2 SUPPLY	Oxygen Not Available
HIGH EXH MV	High Minute Ventilation

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Table B-2: Ventilator data displayed on Philips monitor

Monitor label	Ventilator label
HIGH EXH TV	High Mandatory Tidal Volume
HIGH EXH TV	High Spontaneous Tidal Volume
HIGH EXH TV	High Tidal Volume
HIGH FIO2	High O_2
HIGH INSP PRESS	High Inspiratory Pressure
HIGH LEAK	High Leak
HIGH PEEP	High PEEP
HIGH RESP RATE	High Rate
I-TIME TOO LONG	I-Time Too Long
LOW BATTERY	Low Internal Battery
LOW EXH MV	Low Minute Ventilation
LOW EXH TV	Low Mandatory Tidal Volume
LOW EXH TV	Low Spontaneous Tidal Volume
LOW EXH TV	Low Tidal Volume
LOW FIO2	Low O_2
LOW INSP PRESS	Low Inspiratory Pressure
LOW LEAK	Low Leak – CO_2 Rebreathing Risk
LOW RESP RATE	Low Rate
MAX P	Maximum Pressure Exceeded
MAX V	Volume Limit Exceeded
OCCLUSION	Patient Circuit Occluded
OCCLUSION	Patient Circuit Partially Occluded
PT. DISCONNECT	Patient Disconnect
PRESS REG HIGH	Pressure Regulation High
PROX DISC/OCCL	Proximal Pressure Line Disconnected or Occluded
Vent CHK DEVICE	Check Vent:
VENT ON BATTERY	Running on Internal Battery
Ventilation parameters blanked	Vent Inoperative *xxxx*

Philips

Remote Alarm Port

WARNING

- **To prevent possible patient injury due to nonannunciating alarms, verify the operation of any remote alarm device before use.**
- **To ensure the functionality of the remote alarm, connect only Philips Respironics-approved cables to the remote alarm port.**
- **Validate the compatibility and use of information transmitted to any device connected to the ventilator, to minimize patient risk from unreliable data transmission.**
- **The data provided through the communications interface is for reference only. Decisions for patient care should be based on the clinician's observations of the patient.**

NOTE

- The remote alarm delay time is < 10 ms from onset of the alarm condition to the point where the alarm signal leaves the ventilator output port. The time it takes the message to appear on the remote alarm depends on the characteristics of the device.
- The remote alarm port is intended to connect only to an SELV (safety extra-low voltage and ungrounded system with basic insulation to ground), in accordance with IEC 60601-1. To prevent damage to the remote alarm, make sure the signal input does not exceed the maximum rating of 24 VAC or 36 VDC at 500 mA with a minimum current of 1 mA.
- Selecting **Alarm Silence** deactivates the remote alarm.

The remote alarm (nurse call) port allows ventilator alarm conditions to be annunciated at locations away from the ventilator (for example, when the ventilator is in an isolation room). The ventilator sends alarm signals to a remote alarm through the connector at the rear of the ventilator (Figure B-1 on page 197). Figure B-4 shows the pin assignments for this connector. The connector is a standard ¼-inch, female, audio (ring, tip, sleeve) connector.

The ventilator signals an alarm using either a normally open (NO) or normally closed (NC) relay contact. The de-energized state of the relay represents an alarm state (any high-priority alarm) and the energized state represents a non-alarm state. This application requires one of the cables listed in Table B-3.

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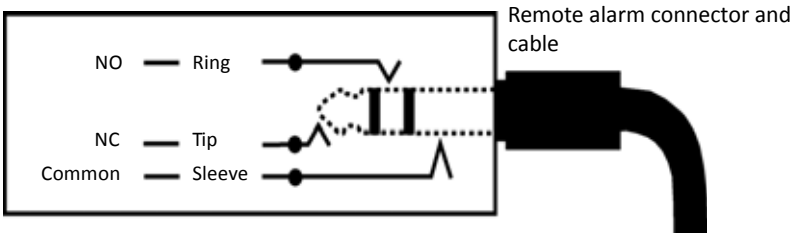

Figure B-4: Remote alarm port

Table B-3: Remote alarm cable kits

Description	System	Part Number
Remote alarm cable kit, alarm state=open	Use on Normally Closed nurse call systems (system expects to see open contacts when ventilator alarms). For ¼" jack.	1003741
Remote alarm cable kit, alarm state=closed	Use on Normally Opened nurse call systems (system expects to see closed contacts when ventilator alarms). For ¼" jack.	1003742
Remote alarm cable kit	Philips Respironics (LifeCare)	1003743

C Parts and Accessories

WARNING

- **To minimize the risk of CO_2 rebreathing in noninvasive ventilation modes, use only masks, patient circuits, and exhalation ports specified as compatible with the ventilator.**

CAUTION

To ensure the correct performance of the ventilator and the accuracy of patient data, we recommend you use only Respironics-approved accessories with the ventilator.

NOTE

The ventilator breathing system (ventilator gas path, patient interfaces, exhalation ports and valves, filters, breathing circuits, and proximal pressure line) is a Type B applied part as defined by IEC 60601-1.

This appendix lists parts and accessories supplied by Philips that are compatible with the Respironics V680 ventilator. Contact your Philips representative to order these parts.

Masks

Contact your Philips representative for mask ordering information and for updates to the product list. Compatible masks include:

Description	Type
Respironics Contour Deluxe	Nasal
Respironics PerformaTrak	
Respironics AP111	
Respironics PN831	
Respironics Performa Trak	Oro-nasal
Respironics AF531	
Respironics AF811	
Respironics AF421	
Respironics Total	Total
Respironics PerforMax	
Respironics Pediatric Mask	

Exhalation Ports

You must use an exhalation device with a single-limb circuit.

Description	Quantity	Part number	Order number
Plateau exhalation valve (PEV) - reusable	1	302312	989805617941
Replacement diaphragm for PEV	5	302310	989805609221
Whisper Swivel II exhalation port	1	332113	989805617951
Disposable exhalation port (DEP) designed for noninvasive use - with exhalation port filter	10	1065775	453561517211

Patient Breathing Circuits

NOTE

In addition to the circuits listed below, any dual-limb circuit that meets the specifications in Table 11-14 *and* passes the ventilator's SST (Short Self-Test) on page 76 is approved for use with the V680 Ventilator.

Description	Quantity	Part number	Order number
Single-limb Patient Circuits - SINGLE PATIENT USE			
Respironics circuit, with exhalation port, water trap, temperature probe ports, proximal pressure line, proximal airway filter, humidifier coupling tube, tube hanger, and hose clips	10	652002	989805609681
	20	652001	989805609671
Bilevel/CPAP single-limb heated circuit, with extension and Philips Respironics disposable exhalation port (DEP) (Fisher & Paykel)	10	1020524	989805610851
Respironics circuit, for use without humidifier Includes 1.8 m (6 ft) tubing, exhalation port, 2.1 m (7 ft) proximal pressure line, tube hanger, and 2 hose clips.	10	582073	989805609611
Respironics noninvasive circuit with main flow bacteria filter Includes 1.83 m (6 ft) smooth-lumen tubing, 2.13 (7 ft) proximal pressure line, disposable exhalation port (DEP) designed for use with exhalation port filter, tube hanger, 2 hose clips, and, optionally, an exhalation port bacteria filter.	10	1065830 (with exhalation port filter)	989805621311
	10	1065832 (without exhalation port filter)	989805621321
	10	1069210 (without main flow filter and exhalation filter))	989805634871

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Description	Quantity	Part number	Order number
Dual-limb Patient Circuits - REUSABLE			
Reusable 22 mm adult breathing circuit Includes wye with temperature and pressure ports, dual water-traps, 3.6 m (12 feet) of tubing, 1.5 m (5 ft) proximal pressure line and 4 hose clips.	1	1104598	989805646601
Reusable 10 mm pediatric breathing circuit Includes T-connecter with temperature port, dual water-traps, 3.6 m (12 feet) of tubing, 1.5 m (5 ft) proximal pressure line and 4 hose clips.	1	1104600	989805646621
Dual-limb Patient Circuits - SINGLE PATIENT USE			
Adult dual-limb circuit with proximal pressure line and two water traps (CE), F&P RT134	10	1120220	989805652811
Adult dual-limb circuit with proximal pressure line and dual heated wires (CE)	10	F&P RT104	Order from manufacturer or local distributor
Adult dual-limb circuit kit with proximal pressure line and dual heated wires, disposable chamber (CE)	10	F&P RT204	
Adult dual-limb circuit kit with proximal pressure line, single heated wire and one water trap (CE)	10	F&P RT106	
Adult dual-limb circuit kit with proximal pressure line, single heated wire and one water trap, disposable chamber (CE)	10	F&P RT206	
Adult dual-limb circuit with proximal pressure line (CE)	10	F&P RT116	
Adult dual-limb circuit with proximal pressure line, dual heated wires, Evaqua 2 (CE)	10	F&P RT385	
Circuit Accessories			
Proximal pressure line, single-use, 2.13 m (7 ft), with a total of 2 hose clips	10	312121	989805609331
Proximal pressure bacteria filter, single-use	1	1002362	453561517101

Bacteria Filters

Description	Quantity	Part number	Order number
Inspiratory/expiratory, single-use, bacteria/viral filter with 22-mm M x F connectors	1	1014047	989805618161
	10	342077	989805609521
Expiratory bacteria/viral filter, single-use, double-wall insulated with 22-mm M x F connectors	20	F&P RT020	Order from manufacturer or local distributor

Nebulizers

Description	Quantity	Part number	Order number
Aerogen NIVO Pro-X Controller kit Includes Pro-X controller, power adapter, mounting bracket, mounting clamp, and cable	1	1076301*	989805634291*
Aerogen NIVO Nebulizer (use with AF531 mask) Includes NIVO and Leak 1 entrainment elbow	5	1084320	989805635031 (US)
	5	1076304	989805634321 (Intl)
NIVO Nebulizer	5	1076302	989805634301
Aerogen Solo USB* USB-powered controller kit	1	1115359	989805651671
Aerogen Pro USB* USB-powered controller kit	1	1115448	989805651781
Aerogen Solo Nebulizer		AG-AS3100 plus T-piece	N/A

* Part number and plug differ by country. Contact Philips Respironics for ordering information.

Operator Maintenance Parts

Description	Quantity	Part number	Order number
eSYS exhalation system cartridge	1	1109849	989805648551
V680 replacement O_2 sensor	1	1109850	989805648561
Cooling fan filter	5	1054280	453561507301
Air intake filter	5	1109851	989805648571

External Communications

Description	Part number	Order number
VueLink module	M1032A A02*	Contact your Philips representative
VueLink cable	M1032A K6B*	
IntelliBridge EC10 module	865115 /A01	
IntelliBridge EC5 cable (10 m)	865114/ L03	
IntelliBridge EC5 cable (10 m)	865114-105	
25-to-9-pin adapter, RS-232	1058403	453561509661
HIS (hospital information system)/EMR (electronic medical record) null modem cable assembly	1080588	989805629921
HIS/EMR modem cable assembly	1080782	989805630111

*Discontinued

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Other Parts

Description	Part number	Order number
V680 stand - partially assembled	1084491	989805648731
Cylinder holder for ventilator stand	1109869	989805648721
Oxygen manifold kits -		
O_2 Inlet Connector - DISS male	1109602	989805648241
O_2 Inlet Connector - DISS female (Canada)	1113392	989805650191
O_2 Inlet Connector - NIST	1109881	989805648741
O_2 Inlet Connector - SIS	1113371	989805650181
Circuit support arm - three-part flex arm	332497	989805617961
Circuit support arm - two part flex arm	1003781	989805612571
Support arm bracket	1002497	989805611511
Humidifier water bag support -		
Pole kit (pole, bracket, and clamp)	1002226	989805612071
Accessory mounting post (required)	1048899	453561506591
Water bag Pole - bent	1002506	989805613541
Pole mounting bracket - Fisher & Paykel	1002229	989805613131
Fixed pole clamp - Fisher & Paykel	1002230	989805612071
Replacement backup battery	1076374	989805626941
Power cord	Contact your Philips representative	
O_2 hose	Contact your Philips representative	
Bracket - Teleflex/Hudson humidifiers	1002231	989805613491

D Regulatory and Environmental Compliance

WARNING

- **Do not use in presence of magnetic resonance imaging (MRI). There is a risk of reciprocal interference posed by the presence of the ventilator during MRI treatments.**
- **Observe precautions for electrostatic discharge (ESD) and electromagnetic interference (EMI) to and from other equipment. Be aware that EMI devices may interrupt ventilator operation and put the patient at risk.**
- **The V680 ventilator should not be used adjacent to or stacked with other equipment; if adjacent or stacked use is necessary, the equipment should be observed to verify normal operation in the configuration in which it will be used.**
- **The V680 ventilator may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the ventilator or shielding the location.**
- **Use of non-approved accessories, transducers or cables may increase EMC emissions or decrease the EMC immunity performance of the equipment.**

NOTE

- The use of portable and mobile radio frequency (RF) communications equipment can affect this and other pieces of medical equipment.
- Accessory equipment connected to the analog and digital interfaces must be certified to the respective IEC standards (i.e. IEC 60950 for data processing equipment and IEC 60601-1 for medical equipment).
- The V680 ventilator complies with IEC 60601-1-2:2007, providing reasonable protection against electromagnetic interference in a typical medical installation. The equipment generates, uses and can radiate electromagnetic interference (EMI), and if not installed and used in accordance with the instructions, may cause interference with other devices in the vicinity.

  If interference does occur, correct it using one or more of the following measures:
  - Move the receiving device or increase separation between the equipment.
  - Consult Philips or members of the hospital's engineering department for more information.
- Medical electrical equipment requires special precautions regarding EMC and must be installed and placed into service per the EMC information provided in this document.

Electromagnetic Compatibility (EMC)

2nd Edition Standards

EN 60601-1-2	Electromagnetic Compatibility Requirements and Tests
EN 55011	Radiated and Conducted RF Disturbance Characteristics--Limits and Methods of Measurement (Level A)
EN 55014-1	Electromagnetic Compatibility Requirements. Part 1: Emissions
EN 61000-3-2	Limits for Harmonic Current Emissions
EN 61000-3-3	Limitation of Voltage Changes, Fluctuations, and Flicker Emissions
EN 61000-4-2	Electrostatic Discharge Immunity Test (8/15KV)
EN 61000-4-3	Radiated Electromagnetic Field Immunity Test (10V/M)
EN 61000-4-4	Electrical Fast Transient/Burst Immunity Test
EN 61000-4-5	Surge Immunity Test
EN 61000-4-6	Immunity to Conducted RF Disturbances (10V)
EN 61000-4-8	Power Frequency Magnetic Field Immunity Test
EN 61000-4-11	Voltage Dips, Short Interruptions, and Voltage Variations Immunity Tests
MIL-STD 461E RE101	Electromagnetic Field Generation (Army Level)

3rd Edition Standards

IEC 60601-1; Ed. 3.1	Medical electrical equipment – Part 1: General requirements for basic safety and essential performance
IEC 60601-1-2; Ed. 3.0	Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances
IEC 60601-1-6; 2013	Medical electrical equipment – Part 1-6: General requirements for safety
IEC 60601-1-8; Ed. 2.1	Medical electrical equipment – Part 1-8: General requirements for safety
IEC 62366; 2007 + A1: 2004	Medical devices - Application of usability engineering to medical devices
ISO 14971; 2007	Medical devices – Application of risk management to medical devices
EN ISO 14971; 2012	Medical devices – Application of risk management to medical devices
ISO 80601-2-12; 2011	Medical electrical equipment – Particular requirements for basic safety and essential performance of critical care ventilators
ISO 60529; Ed. 2.1	Degrees of protection provided by enclosures (IP Code)
IEC 62304; Ed. 1.0	Medical device software - Software life cycle processes

Electromagnetic Compatibility Declaration

Medical equipment needs special precautions regarding electromagnetic compatibility (EMC) and needs to be installed and put into service according to the EMC information provided in this document.

Electromagnetic Emissions

Guidance and manufacturer's declaration - electromagnetic emissions

The V680 ventilator is intended for use in the electromagnetic environment specified below. The user of the V680 ventilator should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic enforcement - guidance
RF Emissions CISPR 11	Group 1	The V680 ventilator uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause interference in nearby electronic equipment.
RF Emissions CISPR 11	Class A	The V680 ventilator is suitable for use in all establishments other than domestic, and may be used in domestic establishments and those directly connected to the public low voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Electromagnetic Immunity

Guidance and manufacturer's declaration - electromagnetic immunity

The V680 ventilator is intended for use in the electromagnetic environment specified below. The user of the V680 ventilator should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines. ±1 kV for input / output lines	±2 kV for power supply lines. ±1 kV for input / output lines	Mains power quality should be that of a typical hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles 5% U_T (>95% dip in U_T) for 5 s	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles 5% U_T (>95% dip in U_T) for 5 s	Mains power quality should be that of a typical hospital environment. If the user of the V680 ventilator requires continued operation during power mains interruptions, it is recommended that the V680 ventilator be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical hospital environment.

NOTE: U_T is the AC mains voltage prior to application of the test level.

Philips

Guidance and manufacturer's declaration - electromagnetic immunity

The V680 ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the V680 ventilator should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the V680 ventilator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance:
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands[a]	3 Vrms	$d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$ where V_1 = 3 Vrms
Radiated RF IEC 61000-4-3	10 Vrms 150 kHz to 80 MHz in ISM bands[a]	10 Vrms	$d = \left[\frac{12}{V_2}\right]\sqrt{P}$ where V_2 = 10 Vrms
	10 V/m 80 MHz to 2.5 GHz	10 V/m	$d = \left[\frac{12}{E_1}\right]\sqrt{P}$ 80 MHz to 800 MHz, where E_1 = 10 V/m
			$d = \left[\frac{23}{E_1}\right]\sqrt{P}$ 800 MHz to 2.5 GHz, where E_1 = 10 V/m
			where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).[b] Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[c] should be less than the compliance level in each frequency range.[d] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.
NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

a. The ISM (industrial, scientific and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.
b. The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/ portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 has been incorporated into the formulae used in calculating the recommended separation distance for transmitters in these frequency ranges.
c. Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the V680 ventilator is used exceeds the applicable RF compliance level above, the V680 ventilator should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the V680 ventilator.
d. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Philips

Recommended separation distances between portable and mobile RF communications equipment and the V680 ventilator

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter (m)			
	150 kHz to 80 MHz outside ISM bands	150 kHz to 80 MHz in ISM bands	80 MHz to 800 MHz	800 MHz to 2.5 GHz
	$d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$	$d = \left[\frac{12}{V_2}\right]\sqrt{P}$	$d = \left[\frac{12}{E_1}\right]\sqrt{P}$	$d = \left[\frac{23}{E_1}\right]\sqrt{P}$
0.01	0.12	0.12	0.12	0.23
0.1	0.37	0.38	0.38	0.73
1	1.17	1.20	1.20	2.30
10	3.69	3.79	3.79	7.27
100	11.67	12.00	12.00	23.00

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: The ISM (industrial, scientific and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz;13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

NOTE 3: An additional factor of 10/3 has been incorporated into the formulae used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.

NOTE 4: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

WEEE Recycling Directive

Waste electrical and electronic equipment (WEEE) recycling directive.

Compliant with the WEEE recycling directive.

If you are subject to the WEEE directive, refer to http://www.healthcare.philips.com/main/about/Sustainability/Recycling/ for the passport for recycling this product.

Safety

Protection Against Electric Shock	Class 1
Degree of Protection Against Electric Shock	Type B applied part
Degree of Protection Against Harmful Ingress of Fluids	IPX1
Rating	Continuous Operation
2nd edition	
CSA C22.2 No. 601.1	Medical Electrical Equipment, Part 1: General Requirements for Safety
EN 60529	Degrees of Ingress Protection Provided by Enclosures (IPX1@zero degrees tilt)
EN 60601-1	Medical Electrical Equipment, Part 1: General Requirements for Safety
EN 60601-1-1	Medical Electrical Equipment, Part 1-1: General Requirements for Safety - Collateral Standard
EN 60601-1-2	Medical Electrical Equipment, Part 1-2: General Requirements for Safety - Collateral Standard
EN 60601-1-4	Medical Electrical Equipment, Part 1-4: General Requirements for Safety - Collateral Standard
EN 60601-1-6	Medical Electrical Equipment, Part 1-6: General Requirements for Safety - Collateral Standard
EN 60601-1-8	Medical Electrical Equipment, Part 1-8: General Requirements for Safety - Collateral Standard
IEC 60601-2-12	Medical Electrical Equipment – Part 2-12: Particular Requirements for the Safety of Lung Ventilators – Critical Care Ventilators
UL 60601-1	Medical Electrical Equipment, Part 1: General Requirements for Safety
3rd edition	
IEC 60601-1	Medical Electrical Equipment, Part 1: General Requirements for Safety
IEC 60601-1-2	Medical Electrical Equipment, Part 1-2: General Requirements for Safety
IEC 60601-1-6	Medical Electrical Equipment, Part 1-6: General Requirements for Safety
IEC 60601-1-8	Medical Electrical Equipment, Part 1-8: General Requirements for Safety
ISO 80601-2-12	Medical Electrical Equipment – Part 2-12: Particular requirements for basic safety and essential performance of critical care ventilators

Philips

E Diagnostic Mode

In the diagnostic mode you select the language of software display, set the date and time, select pressure units, enable software options, and calibrate the touchscreen.

NOTE
The diagnostic mode is primarily for use by authorized service personnel to download software and perform other diagnostic procedures.

Entering the Diagnostic Mode

WARNING
To prevent possible patient injury, do not enter the diagnostic mode while a patient is connected to the ventilator. Verify that the patient is disconnected before proceeding.

Enter the diagnostic mode as follows:

1 Make sure the patient is disconnected and the ventilator is powered off.

2 Press and hold the Accept button on the navigation ring and turn on the ventilator by pressing the **ON/Shutdown** key. The screen displays **Press**  **again for Diagnostics or wait for Ventilation**.

3 Within less than 5 seconds, release and press the Accept button again. The **Diagnostics Menu** (Figure E-1) is displayed.

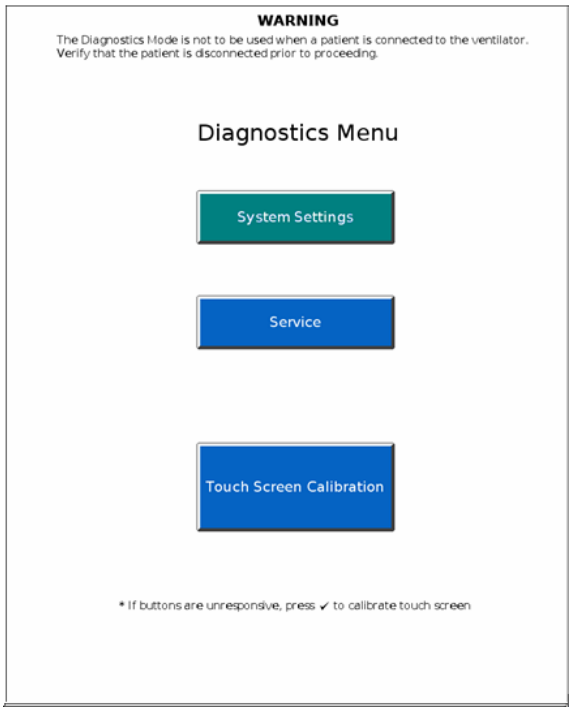


Figure E-1: Diagnostics Menu

4 Select the desired function.

System Settings

From the **System Settings** screen (Figure E-2) you can perform the functions below.

Figure E-2: System Settings screen

Language

The **Language** function lets you set the language of software display.

NOTE
The ventilator is set to the locally required language based on the shipping destination. The following instructions may be used to change the language setting.

1 From the **System Settings** screen, select **Language** to display the **Set Language** screen (Figure E-3).

Figure E-3: Set Language screen 1

2 The active language is shown in white type. Select the new language.

3 A second **Set Language** screen is displayed (Figure E-4). Select **Ventilator Shutdown** to apply the change. The change is effective after you restart the ventilator.

Figure E-4: Set Language screen 2

Date/Time

The **Date/Time** function lets you verify date and time settings.

1 From the **System Settings** screen, select **Date/Time** to display the **Set Date and Time** screen (Figure E-5).

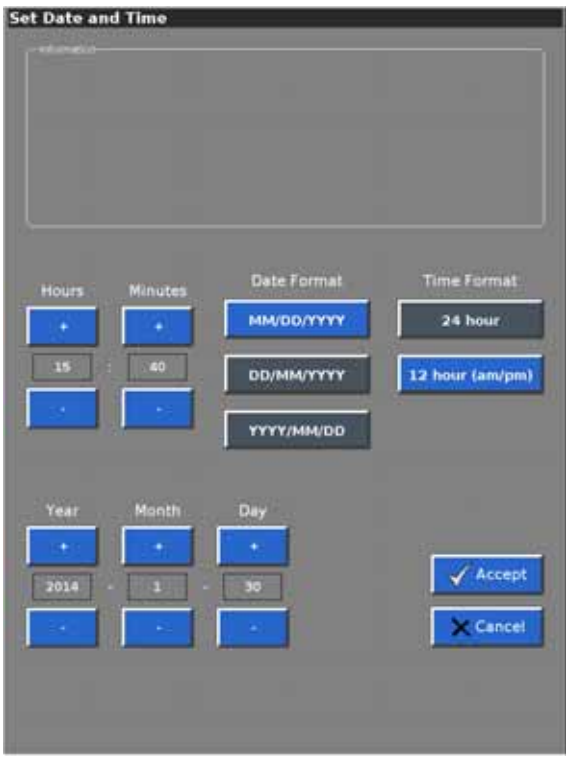


Figure E-5: Set Date and Time screen

2 Adjust the date and time with the + and - buttons.

3 Choose a date and time format; then **Accept.**

Pressure Units

The **Pressure Units** function lets you select the unit of measure for pressure display.

1 From the **System Settings** screen, select **Pressure Units** to display the **Set Pressure Units** screen (Figure E-6).

Figure E-6: Set Pressure Units screen

2 The active pressure unit is shown in white type. Select the desired pressure unit. The change is effective after you restart the ventilator.

Restore Default Settings

The **Restore Default Settings** function lets you return ventilator settings to factory defaults. The factory defaults are listed in Chapter 11. Factory defaults cannot be changed.

1 From the **System Settings** screen, select **Restore Default Settings** to display the **Restore Default Settings** screen (Figure E-7).

Figure E-7: Restore Default Settings screen

2 Select **Restore Defaults**.

Software Options

With the **Software Options** function, you enable a software option using a unique code specific to the option and the ventilator serial number. Options can also be enabled through the Respi-Link remote service program.

NOTE

- Respi-Link is not available in all countries or locations.
- Before installing an option, verify that the ventilator serial number matches the serial number shown in the **Vent Info** window (see page 92 or page 114. If the serial numbers do not match, contact Philips.

1 From the **System Settings** screen, select **Software Options** to display the **Enable Software Options** screen (Figure E-8).

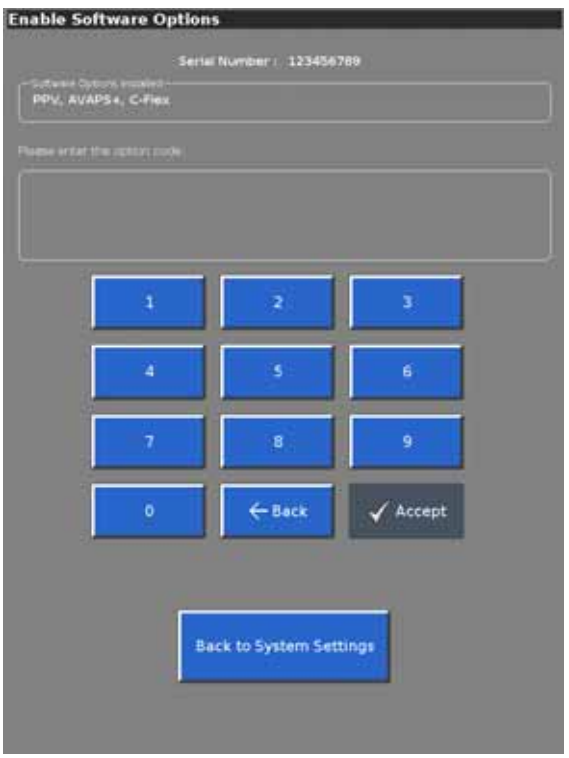


Figure E-8: Enable Software Options screen

2 Use the onscreen keypad to enter the code; then select **Accept**. The screen displays **Enabled:** followed by the name of the software option.

3 Repeat as needed to enable additional options.

4 Verify that the options are enabled by selecting **Back to System Settings**, then **Back to Diagnostics Menu**, then **Service**. The **Vent Info** window should show the new options.

5 Attach the option label as shown in Figure 3-4 on page 31.

Baud Rate

The **Baud Rate** function lets you set the baud rate for serial communications.

1 From the **System Settings** screen, select **Baud Rate** to display the **Set Baud Rate for Serial Communications** screen (Figure E-9).

Figure E-9: Set Baud Rate for Serial Communications screen

2 The active baud rate is shown in white type. Select the desired baud rate.

Service

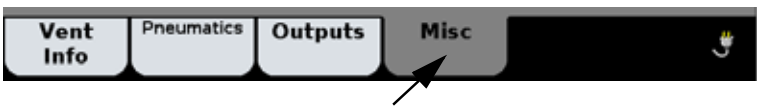
The **Service** screen lets you view the event log. Other service functions are for use by authorized service personnel.

Significant Event Log

NOTE
The **Significant Event Log** is stored indefinitely. Up to 2000 events are stored; the oldest records are overwritten first. Event records are retained when the ventilator is powered down or if the ventilator experiences a loss of power.

The **Significant Event Log** contains data about clinically relevant ventilator occurrences, including alarms and setting changes. The time, date, and an identifier for event classification are included.

1 From the **Service** screen, select the **Misc** tab.



2 The **Miscellaneous** screen opens (Figure E-10). Select **Significant Event Log**.

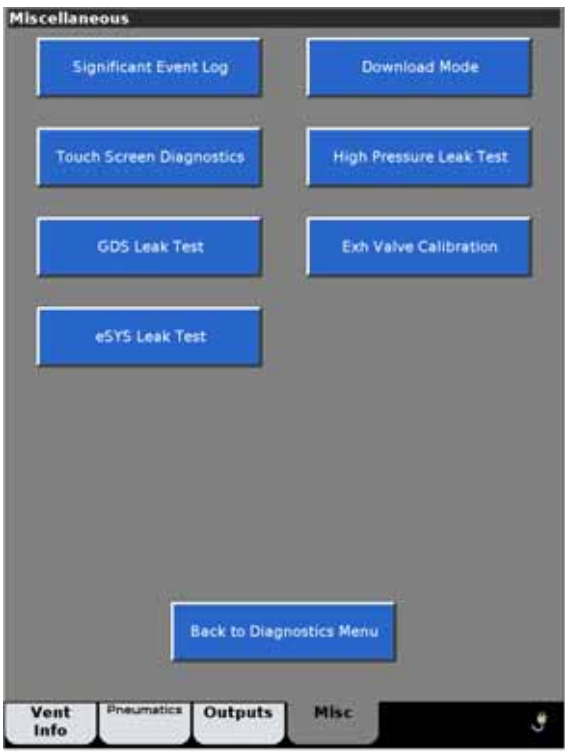


Figure E-10: Miscellaneous screen

3 The **Significant Event Log** opens (Figure E-11). Use the buttons on right side to navigate through the log.

Figure E-11: Significant Event Log screen

Touchscreen Calibration

NOTE
Do not confuse **Touch Screen Calibration** with **Touch Screen Diagnostics**. Calibration is available from the **Diagnostics Menu** as a user function, while **Touch Screen Diagnostics** is for use by service personnel only.

Calibrate the touchscreen X and Y coordinates as follows:

1 From the **Diagnostics Menu**, select **Touch Screen Calibration**. The **Touch Screen Calibration** screen is displayed (Figure E-12).

NOTE
If the **Touch Screen Calibration** button does not respond, press the Accept button on the navigation ring to begin.

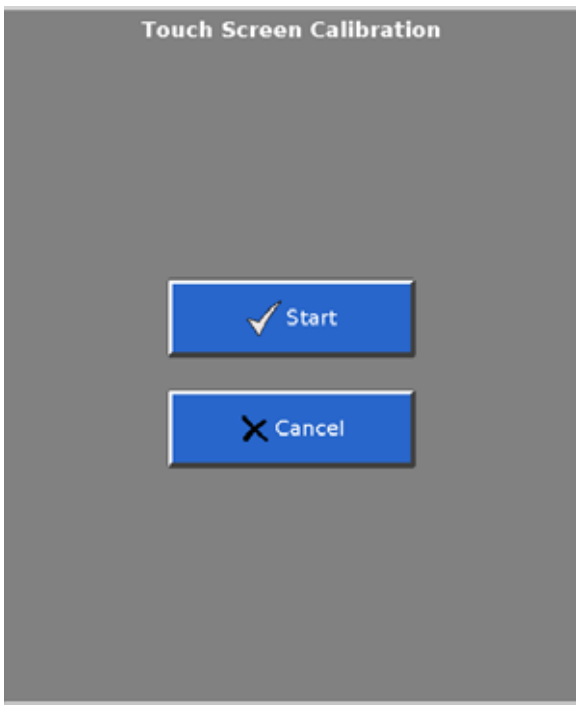


Figure E-12: Calibrate Touch Screen screen

2 Follow the steps shown. Press on the middle of each target with a blunt, narrow object.

If the calibration is not successful, have the ventilator serviced.

Exiting the Diagnostic Mode

Exit the diagnostic mode by turning off ventilator power with the **ON/Shutdown** key.

Glossary

A

Ampere, a unit of current.

AC

Alternating current.

A/C-PCV mode

A dual-limb ventilation mode. Assist/Control - Pressure Control Ventilation

A/C-VCV mode

A dual-limb ventilation mode. Assist/Control - Volume Control Ventilation

Alarm Silence button

Silences alarm sound for 2 minutes.

Apnea Ventilation

Available only in spontaneous breathing modes. Apnea ventilation can be set to either VCV or PCV, and will tell the ventilator which modes to adopt in case an apnea condition occurs.

Assist indicator

Denotes patient-triggered (assisted) breathing.

Auto-Trak Sensitivity

A Respironics innovation in triggering and cycling that utilizes several different methods to provide enhanced sensitivity in the presence of leaks and changing breathing patterns.

AVAPS+

Average volume-assured pressure support. A ventilation mode in which pressure support is automatically adjusted to maintain the user-defined target tidal volume.

AVAPS+ Maximum IPAP Pressure

See Max P.

AVAPS+ Minimum IPAP Pressure

See Min P.

AVAPS+ Target Tidal Volume

See V_T.

Average volume-assured pressure support

See AVAPS+.

Baseline

As in *baseline pressure*. The pressure at end exhalation.

BPM

Breaths per minute.

BTPS

Body temperature (98 °F, ambient pressure), 100% saturated (with water vapor).

C&R

Compliance and resistance

C-Flex

A setting in CPAP mode, which enhances traditional CPAP by reducing the pressure at the start of exhalation.

cmH_2O

Centimeters of water, a unit of pressure measurement.

Compliance

A measure of the ease of expansion of the lungs determined by volume and elasticity. High compliance indicates a loss of elasticity of the lungs.

Continuous positive airway pressure

See CPAP.

CPAP

Continuous positive airway pressure. A ventilation mode that provides a single, continuous level of positive pressure to the patient and a control setting in that mode.

Cycle

To end inspiration.

dB(A)

Decibel, a unit of acoustic power.

DISS

Diameter index safety standard, a standard for high-pressure gas inlet fittings.

Dyn C

Dynamic compliance

Dyn R

Dynamic resistance

Dyn Re

Dynamic expiratory resistance

Dyn Ri

Dynamic inspiratory resistance

Dyn Pplat

Dynamic pressure plateau

E-Cycle (Expiratory Cycle Sensitivity)

A control setting in Auto-Trak+. It determines the threshold at which the ventilator will transition from inspiration to exhalation.

Elast.

See Elastance.

Elastance

The elastic opposition to ventilation or the tendency of the lungs to resist inflation (elastance is the reciprocal of compliance).

EPAP

Expiratory positive airway pressure. A control setting. The application and maintenance of pressure above atmospheric at the airway throughout the expiratory phase of positive-pressure mechanical ventilation.

Estimated exhaled tidal volume

See V_T.

Estimated minute ventilation

See $\dot{V}_E$.

Estimated patient leak

See Pt. Leak

Estimated total leak

See Tot.Leak.

eSYS cartridge

Expiratory system cartridge. A replaceable assembly installed inside the ventilator housing. Includes the gas return port and flow sensor.

ET

Endotracheal.

Exhalation Port test

Performed to assess the leak flow rate through the exhalation port.

Expiratory Cycle

See E-Cycle.

Expiratory positive airway pressure
See EPAP.

HIP
High Inspiratory Pressure Alarm, an alarm setting.

Hi Rate
High Rate Alarm, an alarm setting.

Hi V_T
High Tidal Volume Alarm, an alarm setting.

HME
Heat moisture exchanger

hPa
Hectopascal, a unit of pressure measurement. 1 hPa is equal to 1 mbar, which is approximately equal to 1 cmH_2O.

Hz
Hertz. Rear panel of ventilator.

ID
Inner diameter.

IEC
International Electrotechnical Commission.

I:E ratio
Ratio of inspiratory to expiratory time.

Inop
Inoperative.

Inspiration:exhalation ratio
See I:E ratio.

Inspiratory positive airway pressure
See IPAP.

Inspiratory time
See I-Time.

Inspiratory duty cycle
See T_I/T_{TOT}.

Philips

Intentional leakage

"Known," quantifiable leakage that is a function of the mask.

IPAP

Inspiratory positive airway pressure. A control setting. The application and maintenance of pressure above atmospheric at the airway throughout the inspiration phase of positive-pressure mechanical ventilation.

IPX1

classification of water protection. Rear panel of ventilator.

ISO

International Organization for Standardization, a worldwide federation of national standards bodies.

I-Time

Inspiratory time. The duration of inspiration during mechanical ventilation.

kPa

Kilo-pascals. A unit of measurement. Rear panel of ventilator, O_2 port label.

L

Liter.

LCD

Liquid crystal display.

LED

Light-emitting diode.

Limit

To prevent from exceeding a specified maximum value during a breath.

LIP

Low Inspiratory Pressure Alarm, an alarm setting.

Lo Rate

Low Rate Alarm, an alarm setting.

Lo $\dot{V}_E$

Low Minute Ventilation Alarm, an alarm setting.

Lo V_T

Low Tidal Volume Alarm, an alarm setting.

Mand indicator

Denotes machine, time-triggered (mandatory) breathing.

Mandatory breath

A breath for which either the timing or volume is controlled by the ventilator. That is, the machine triggers and/or cycles the breath.

Max E

Maximum elastance (volume assist). A control setting in PPV.

Max P

AVAPS+ Maximum IPAP Pressure. A control setting in AVAPS+.

Max P

Maximum Pressure. See PPV Maximum Pressure Limit.

Max R

Maximum resistance (flow assist). A control setting in PPV.

Max V

Maximum Volume. See PPV Maximum Volume Limit.

Min P

AVAPS+ Minimum IPAP Pressure. A control setting in AVAPS+.

MIP

Maximum inspiratory pressure

mL

Milliliter.

mm

Millimeter.

Noninvasive

Pertaining to a diagnostic or therapeutic technique that does not require the skin to be broken or a cavity or organ of the body to be entered. Mechanical ventilation via mask, nasal prongs, or mouthpiece.

O_2

Oxygen (concentration). A control setting.

OD

Outer diameter.

PC

Pressure control

PCV

Pressure-controlled ventilation. A ventilation mode that provides mandatory and spontaneous breaths with a set frequency, pressure, and inspiratory time.

Peak inspiratory pressure

See PIP.

Percentage of patient-triggered breaths

See Pt. Trig.

PIP

Peak inspiratory pressure. The peak pressure for the previous inspiration.

Pplat

See pressure plateau.

PPV %

A control setting in PPV. The percent of proportional pressure ventilation supplied by the ventilator.

PPV

Proportional pressure ventilation. A ventilation mode that delivers a pressure-controlled breath in proportion to the patient's effort. The ventilator responds to patient instantaneous efforts, allowing the patient to determine when to start and end a breath, and how flow and pressure change as the patient breathes spontaneously.

PPV Maximum Pressure Limit (Max P)

A control setting in PPV.

PPV Maximum Volume Limit (Max V)

A control setting in PPV.

Pressure-controlled ventilation

See PCV.

Pressure plateau

The pressure applied during positive pressure ventilation to the small airways and alveoli.

Pressure-supported breath

A patient-triggered, pressure-targeted breath.

PRVC

Pressure-regulated volume control. A mode in which pressure-targeted breaths are delivered based on the set V_T.

PS

Pressure support

psi

Pounds per square inch.

psig

Pounds per square inch gauge (above atmospheric pressure).

Proportional pressure ventilation

See PPV.

PSV

Pressure supported ventilation using CPAP (continuous positive airway pressure).

Pt. Leak

The leak resulting from leaks around the mask or from unintentional leaks in the circuit. A monitored parameter shown when the intentional leak is known.

Pt. Trig

Percentage of patient-triggered breaths. Patient-initiated breaths as a percentage of total breaths during the last 15 minutes.

Ramp

Can be used to allow the patient to become accustomed to respiratory ventilatory therapy over time. Ramp will allow the pressure to linearly increase over a user-set period.

Rate (Respiratory Rate)

Respiratory frequency, a control setting and monitored parameter.

Resist.

See Resistance

Resistance

The pressure drop across a pneumatic device (i.e., bacteria filter, patient circuit tubing) for a unit of flow when the volume of the device remains constant, i.e., $cmH_2O/mL/s$.

Respiratory Rate (Rate)

Respiratory frequency, a control setting.

Rise Time (Rise)

The time required for a pressure-supported or pressure-controlled breath to reach its target pressure, a control setting.

Philips

RS-232
Serial data communications protocol.

RSBI
Rapid shallow breathing index. Also known as f/Vt.

SIMV-PCV
Synchronous intermittent mandatory ventilation - pressure control ventilation.

SIMV-VCV
Synchronous intermittent mandatory ventilation - volume control ventilation.

SLPM
Standard liters per minute. Rear panel of ventilator, O_2 port label.

Spont indicator
Denotes patient-initiated breathing.

Spontaneous breath
A breath for which both the timing and volume are controlled by the patient. That is, the patient both triggers and cycles the breath.

Spontaneous/timed mode
See S/T mode.

S/T mode
Spontaneous/timed mode. A pressure support ventilation mode that ensures patients receive a minimum number of breaths per minute if their spontaneous breathing rate drops below the respiratory rate setting.

Standby
Suspends ventilation and retains current settings when the clinician wants to temporarily disconnect the patient from the ventilator.

Support indicator
Denotes patient-triggered (pressure-supported) breathing.

Te
Expiratory time

Time Trigger
Initiation of inspiration by the ventilator according to the **Respiratory Rate** setting.

T_I/T_{TOT}
Inspiratory duty cycle. Inspiratory time divided by total cycle time, averaged over 8 breaths, a monitored parameter.

Tot.Leak

Estimated total leak, both intentional and unintentional. A monitored parameter shown when the mask leak and type of exhalation port are not known.

Trigger

To begin inspiration.

Trigger

Trigger Sensitivity, a control setting in Auto-Trak+.

Trigger Sensitivity

See Trigger.

Unintentional leakage

Unpredictable leakage that cannot be quantified.

USB

Universal serial bus. Rear panel of ventilator.

V

Volt, a unit of electrical potential *or* volume.

$\dot{V}$

Flow.

VA

Volts AC (alternating current). Rear panel of ventilator.

$\dot{V}_E$

Estimated minute ventilation. The product of tidal volume (spontaneous and timed) and rate (spontaneous and timed), a monitored parameter.

V_T

Estimated exhaled tidal volume, a monitored parameter and AVAPS+ Target Tidal Volume, a control setting in AVAPS+ mode.

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