Respironics V60/V60 Plus Ventilator

User Manual

PHILIPS

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You can find the most current version of this user manual here:
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Chapter 1. Warnings, cautions, and notes

Before using the Respironics V60/V60 Plus 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.

Definitions

WARNING: **Alerts the user to the possibility of injury, death, or other serious adverse reactions associated with the use or misuse of the device.**

CAUTION: Alerts the user to the possibility of a problem with the device associated with its use or misuse, such as device malfunction, device failure, damage to the device, or damage to other property.

NOTE: Emphasizes information of particular importance.

General

WARNING: **An alternative means of ventilation shall be available whenever the ventilator is in use. If a fault is detected in the ventilator, disconnect the patient from it and immediately start ventilation with such a device. The ventilator must be removed from clinical use and serviced by authorized service personnel.**

WARNING: **Use the Respironics V60/V60 Plus Ventilator on spontaneously breathing patients only. It is an assist ventilator and is intended to augment the ventilation of a spontaneously breathing patient. It is not intended to provide the total ventilatory requirements of the patient.**

WARNING: **We do not recommend you use the Respironics V60/V60 Plus Ventilator on patients who require ventilation at predetermined tidal volumes. The ventilator provides continuous positive airway pressure (CPAP) and positive pressure ventilation (S/T, PCV, and AVAPS, and PPV) and is indicated for assisted ventilation only. These modes do not provide ventilation with guaranteed tidal volume delivery.**

Warnings, cautions, and notes

WARNING: **We do not recommend you use AVAPS on patients who require rapid and frequent IPAP adjustments to maintain a consistent tidal volume. AVAPS, a volume targeted mode, changes the IPAP setting in order to achieve the target tidal volume. During AVAPS setup, there may be a period of time before the target tidal volume is achieved. AVAPS is ideal for more stabilized patients.**

WARNING: **To reduce the risk of CO_2 rebreathing, 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.**

WARNING: **To reduce the risk of CO_2 rebreathing, monitor the patient for changes in respiratory status at the start of ventilation and with each change in ventilator settings, circuit configuration, or patient condition. Pay attention to ventilator alarms that warn of increased CO_2 rebreathing risk.**

WARNING: **To ensure accuracy of oxygen administration and to monitor for the presence of contamination (incorrect gas connected), use an external oxygen monitor to verify the oxygen concentration in the delivered gas.**

WARNING: **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.**

WARNING: **To reduce the risk of electric shock from liquid entering the device, do not put a container filled with a liquid on the ventilator.**

WARNING: **To reduce patient risk of oxygen toxicity, keep free-flowing oxygen away from air inlet of ventilator.**

WARNING: **The nurse call/remote alarm should be considered a backup to the ventilator's primary alarm system.**

WARNING: **To ensure that the alarm will be heard, make sure the alarm loudness is adequate and avoid blocking the alarm speakers beneath the ventilator.**

WARNING: **Do not leave the ventilator unattended when stationed on an incline.**

WARNING: **The V60/V60 Plus 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.**

WARNING: **Use of non-approved accessories, transducers or cables may increase EMC emissions or decrease the EMC immunity performance of the equipment.**

CAUTION: Federal law (USA) restricts this device to sale by or on the order of a physician.

CAUTION: The Respironics V60/V60 Plus Ventilator is designed to operate in the temperature range of 5 to 40 °C (41 to 104 °F). To minimize the risk of overheating the device, do not operate adjacent to heaters or other heat sources.

NOTE: The displays shown in this manual may not exactly match what you see on your own ventilator.

NOTE: Pressures are indicated on the ventilator in cmH_2O. Millibars and hectopascals (hPa) are used by some institutions instead. Since 1 millibar equals 1 hPa, which equals 1.016 cmH_2O, the units may be used interchangeably.

NOTE: The ventilator is *not* intended for use as an ambulance transport ventilator or as an Automatic Transport Ventilator as described by the American Hospital Association and referenced by the FDA. It *is* intended to allow the patient to be transported within the hospital setting using a cart to move the ventilator.

NOTE: When attachments or other components or subassemblies are added to the ventilator breathing system, the pressure gradient across the ventilator breathing system, measured with respect to the ventilator outlet, may increase.

NOTE: To ensure the correct performance of the ventilator and the accuracy of patient data, use only Respironics-approved accessories with the ventilator. See Appendix C, “Parts and accessories”.

NOTE: This Respironics V60/V60 Plus Ventilator and its recommended accessories that have patient contact are not made with natural rubber latex.

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

NOTE: If you detect any unexplained changes in the performance or visual displays of the ventilator, discontinue ventilator use and contact Philips.

NOTE: The Respironics V60/V60 Plus Ventilator does not support automatic record keeping.

NOTE: All ventilator mode and alarm settings, alarm messages and significant events are retained and automatically logged, even when power is lost.

Preparing for ventilation

WARNING: Connect the ventilator only to an appropriate medical-grade oxygen source.

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

WARNING: To reduce the risk of fire, do not use a high-pressure oxygen hose that is worn or contaminated with combustible materials like grease or oil.

WARNING: The Respironics V60/V60 Plus Ventilator is designed to use ambient air and high pressure 100% oxygen. No other gases should be used.

WARNING: Do not use the ventilator with helium or mixtures with helium.

WARNING: Do not use the ventilator with nitric oxide.

WARNING: 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.
- Turn on the ventilator and verify that the port is operational before application. Pressurized gas from the ventilator should cause a continuous flow of air to exhaust from the leak port, flushing exhaled gas from the circuit.
- Never leave the mask on the patient while the ventilator is not operating. When the ventilator is not operating, the exhalation port does not allow sufficient exhaust to eliminate CO_2 from the circuit. Substantial CO_2 rebreathing may occur.

WARNING: The patient's exhaled volume can differ from the measured exhaled volume due to leaks around the mask during noninvasive ventilation.

WARNING: To ensure normal air circulation and exchange, do not cover or block the ports on the ventilator. Do not block the air inlet panel on the right side of the ventilator.

WARNING: Do not cover or position the ventilator so as to adversely affect its operation or performance. Use the V60/V60 Plus in an upright position that does not block the air inlet.

WARNING: To reduce the risk of the device overheating and possible burn injury, do not block the fan intake at the rear of the ventilator.

WARNING: To prevent possible patient injury and possible water damage to the ventilator, make sure the humidifier is set appropriately.

WARNING: 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.

WARNING: To prevent the possibility of inadequate humidification, pay close attention to the humidifier's functioning when operating the ventilator at an ambient temperature > 30 ºC (86 ºF). The ventilator warms the air delivered to the patient above ambient temperature, which may impair the humidifier's performance.

WARNING: 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.

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.

WARNING: 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.

WARNING: To prevent patient or ventilator contamination, always use a main flow bacteria filter on the patient gas outlet port. Filters not approved by Respironics may degrade system performance.

WARNING: During ventilation, patient exhalate is released into room air. Use of a patient circuit with a filter on its exhalation port is recommended.

WARNING: To reduce the risk of bacterial contamination or damage, handle bacteria filters with care.

WARNING: **Any additional accessories in the patient circuit may substantially increase flow resistance and impair ventilation.**

WARNING: **Avoid adding resistive circuit components on the patient side of the proximal pressure line. Such components may defeat the disconnect alarm.**

WARNING: **To reduce the risk of strangulation from patient tubing, use a tubing support arm and secure the proximal pressure line with clips.**

WARNING: **To reduce the risk of electric shock, connect the ventilator to an AC supply mains with protective earth only.**

WARNING: **Do not use extension cords, adapters, or power cords with the ventilator that are not approved by Respironics.**

WARNING: **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 you switch the ventilator on. The retainer is designed to hold the connector end of the Philips-supplied cord securely in place.**

WARNING: **The V60/V60 Plus 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.**

WARNING: **To reduce the risk of electric shock, regularly inspect the AC power cord and verify that it is not frayed or cracked.**

WARNING: **To reduce the risk of strangulation, route the power cord to avoid entanglement.**

WARNING: **To reduce the risk of power failure to the ventilator, 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.**

WARNING: **Always check the status of the oxygen cylinders before using the ventilator during transport.**

WARNING: **Provide external oxygen monitoring to minimize patient risk in case of O_2 supply loss or ventilator failure.**

WARNING: **To ensure the ventilator's safe operation, always verify ventilator operation as described in "Verify ventilator operation" on page 5-7 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.**

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

WARNING: **To prevent possible patient injury, always return alarm settings to hospital-standard values after verifying ventilator operation.**

WARNING: **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.**

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.

CAUTION: For 120 V equipment, grounding reliability can only be achieved when it is connected to an equivalent receptacle marked “hospital only” or “hospital grade.”

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.

Operation

WARNING: To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.

WARNING: PPV limits are not intended to be the primary ventilator alarms and should not be substituted for the alarms found in the Alarm Settings window.

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.

WARNING: 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.

WARNING: Using a jet nebulizer can cause inadvertent alarms and affect the accuracy of delivered FiO_2. To reduce patient risk, limit the flow of pneumatic nebulizers to 10 L/min or use a vibrating mesh nebulizer.

Operation in high flow therapy (HFT)

WARNING: When transitioning from a high flow therapy interface to an NIV mask, ensure that an exhalation port is placed in the circuit and is unobstructed to reduce the risk of CO_2 rebreathing.

WARNING: When transitioning from ventilation to high flow therapy, remove the NIV mask and use only a Philips-approved high flow patient interface to minimize pressure build-up and patient discomfort.

WARNING: When transitioning from high flow therapy to ventilation, remove the nasal cannula as these are restrictive and may defeat alarms such as patient disconnect. Using a nasal cannula in an NIV mode may lead to hypercarbia due to the inability to provide pressure support.

WARNING: Patient alarms are not available during high flow therapy (HFT) as the therapy uses an open system. A nasal cannula occupies only a portion of the nares and patients can breathe through their mouth, which prevents estimation of patient parameters such as tidal volume, respiratory rate, pressure, and minute ventilation. Provide external monitoring, including oximetry, to inform the clinician of a change in the patient's condition.

WARNING: **During high flow therapy (HFT), verify that an occlusive patient interface is not being used. Occlusive patient interfaces include a cannula fully sealed within the nares, an NIV mask, or a direct connection to a tracheostomy tube or endotracheal tube. Remove any occlusive interface immediately as this may expose the patient to unintended high pressures.**

Alarms and messages

WARNING: **If AC power fails and the backup battery is not installed or 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 in most ventilators with passive exhalation ports, when power is lost, sufficient air is not provided through the circuit and exhaled air may be rebreathed.**

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.**

WARNING: **To prevent patient or ventilator contamination, inspect and replace the main flow bacteria filter between patients and at regular intervals (or as stated by the manufacturer).**

WARNING: **To prevent possible patient injury, inspect and verify the proper operation of the exhalation port regularly during use.**

WARNING: **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.**
- **Use the battery with the Respironics V60/V60 Plus Ventilator only.**

WARNING: **Modification of the V60/V60 Plus Ventilator and associated equipment is not permitted and may compromise ventilator operation and patient safety. Service should only be performed by qualified service personnel.**

WARNING: **This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or federal laws. (Within this system, the backlight lamps in the monitor display contain mercury.)**

CAUTION: Do not attempt to sterilize or autoclave the ventilator.

CAUTION: To prevent possible damage to the ventilator, use only those cleaning and disinfecting agents listed in this manual.

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.

CAUTION: Never clean or disinfect the touchscreen with an abrasive brush or device, since this will cause irreparable damage.

CAUTION: To avoid introducing foreign matter into the ventilator and to ensure proper system performance, change the air inlet filter at regular intervals (or as stipulated by your institution).

CAUTION: To ensure proper system performance, use a Respironics-approved air inlet filter.

CAUTION: Because some environments cause a quicker collection of lint and dust than others, inspect the filters more often when needed. The air inlet filter should be replaced; the cooling fan filter should be cleaned.

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.

First-time installation

WARNING: Never attempt to disconnect or connect the battery during operation.

CAUTION: To prevent possible damage to the ventilator, always secure it to its stand or securely place it on a flat, stable surface that is free of dirt and debris. Do not use the ventilator adjacent to, or stack it with, other equipment.

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.

WARNING: The USB port is not currently available for use. DO NOT connect or attempt to power any equipment from the USB port.

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.

WARNING: 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.

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

WARNING: To ensure the functionality of the remote alarm, connect only Respironics-approved cables to the remote alarm port.

CAUTION: 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.

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.

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Chapter 2. Symbols

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

Table 2-1: Symbols used on ventilator labels and packaging

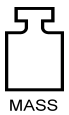
Symbol	Description
	Warning: Risk of explosion. Do not use in the presence of flammable anesthetics.
	Attention, consult the accompanying documents.
	Read the user manual before using the ventilator.
	(Blue) It is mandatory for the operator to consult the accompanying documents.
	Protective earth (ground)
	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	Caution: Federal law restricts this device to sale by or on the order of a physician
	Alarm and remote alarm
	Two states of control: ON and Shutdown
	Battery
CE 2797	European Conformity. Symbol is on rear panel of ventilator.

Symbols

Table 2-1: Symbols used on ventilator labels and packaging (continued)

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

Table 2-1: Symbols used on ventilator labels and packaging (continued)

Symbol	Description
	Accept button on the navigation ring
	Adjustment direction on the navigation ring
	Canadian Standards Association approval
	Do not disassemble. Refer to authorized service personnel.
	Product must be disposed of in accordance with the WEEE directive.
	Noninvasive ventilation (patient with mask)
	Invasive ventilation (intubated patient)
	Do not block the cooling fan Inlet (at the rear of the ventilator).
	No pushing. Do not push on the ventilator screen. Tipping hazard.
	Total mass (weight) of the ventilator, ventilator stand, and standard setup. See page 11-5 for more information.
 (On power cord)	Hospital-grade

Symbols

Table 2-1: Symbols used on ventilator labels and packaging (continued)

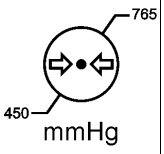
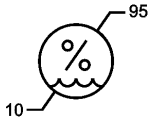
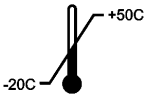
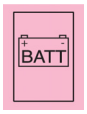
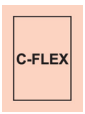
Symbol	Description
	Recycle
	Recycle (Taiwan)
	RoHS (China). Administrative Measure on the Control of Pollution Caused by Electronic Information Products. Contains RoHS substances with 50 years environmentally friendly use period (EFUP).
	uR UL recognition symbol
	Direct current (DC). Symbol is on backup battery.
	Rechargeable battery. Symbol is on backup battery.
	Lithium-ion battery. Battery must be recycled or disposed of properly. Symbol is on backup battery.
	Atmospheric pressure limitation. Indicates the acceptable upper and lower limits of atmospheric pressure for transport and storage.
	Humidity limitation. Indicates the acceptable upper and lower limits of relative humidity for transport and storage.
	Temperature limit. Indicates the maximum and minimum temperature limits at which the item shall be stored or transported.
	Battery option
	C-Flex feature
	AVAPS mode (included)

Table 2-1: Symbols used on ventilator labels and packaging (continued)

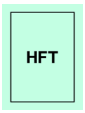
Symbol	Description
	PPV software option
	Auto-Trak+ software option
	High flow therapy **Note**: 3.00 software and above. HFT is optional for model V60 and included with model V60 Plus.

Table 2-2: Symbols used on graphical user interface

Symbol	Description
	Alarm (audible)
	Alarm is silenced
	High priority alarm
	Low priority alarm
	Alarm reset
	Informational message
	Alarm message is displayed. Touch to hide alarm messages.
	Alarm message is hidden. Touch to display alarm messages.
	Do not use an NIV mask during high flow therapy (3.00 software and above, and V60 Plus).

Symbols

Table 2-2: Symbols used on graphical user interface (continued)

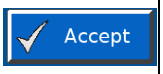
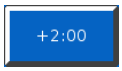
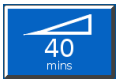
Symbol	Description
	Increase and decrease (adjustment arrow) buttons. Adjusts a setting or selects a value.
	Accept button. Accepts set values.
	Cancel button. Cancels set values.
	+2:00 minutes button. Adds two minutes to 100% O_2 delivery.
	Ventilator is powered by AC power *and* the optional battery is installed.
	Ventilator is powered by AC power *and* the optional 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.
	Help button. Touch to display onscreen help information.
	Vertical autoscale button. Autoscales the Y axis of the graphs to fit the data currently displayed.
	Pause button. Freezes waveforms in the Waveform window.
	Pause in progress
	Resume button. Resumes all waveform graphs from a paused state.

Table 2-2: Symbols used on graphical user interface (continued)

Symbol	Description
	Time base adjust button. Rescales the X axis of the graph display data at 3, 6, 12, and 24 second increments.
$\dot{V}_E$	Estimated minute ventilation
V_T	Estimated exhaled tidal volume
T_I/T_{TOT}	Duty cycle. Inspiratory time divided by total cycle time.
	No valid data to display
	Data is under range
	Data is over range
	Pressure, centimeters of water
	Flow, liters per minute. BTPS compensated.
	Volume, milliliters
	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.

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Chapter 3. General information

This manual covers the Respironics V60 and V60 Plus Ventilator configurations. Both share the same platform. The V60 Plus Ventilator comes standard with High Flow Therapy (HFT). The V60 Ventilator can be field-upgraded with HFT, subject to local regulations. For a full list of features, modes, and options, see "General description" on page 3-2.

NOTE: The 3.00 software upgrade, which permits the activation of HFT, and the V60 Plus Ventilator are not available in all countries

NOTE: .

Intended use

The Respironics V60/V60 Plus Ventilator is an assist ventilator and is intended to augment patient breathing. It is intended for spontaneously breathing individuals who require mechanical ventilation: patients with respiratory failure, chronic respiratory insufficiency, or obstructive sleep apnea in a hospital or other institutional settings under the direction of a physician.

The ventilator is intended to support pediatric patients weighing 20 kg (44 lb) or greater to adult patients. It is also intended for intubated patients meeting the same selection criteria as the noninvasive applications. The ventilator is intended to be used by qualified medical professionals, such as physicians, nurses, and respiratory therapists. The ventilator is intended to be used only with various combinations of Respironics-recommended patient circuits, interfaces (masks), humidifiers, and other accessories.

Contraindications

The Respironics V60/V60 Plus Ventilator is contraindicated for patients with any of the following conditions:

- 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
- Hypotension
- Untreated pertussis
- Epistaxis (nosebleed)

About CO_2 rebreathing

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.
- Be aware that the potential for CO_2 rebreathing increases as inspiratory time increases. A longer inspiratory time 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.

Potential side effects

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.

General description

The Respironics V60/V60 Plus Ventilator (Figure 3-1) is a microprocessor-controlled, bilevel positive airway pressure (BiPAP) ventilatory assist system that provides noninvasive positive pressure ventilation (NPPV) and invasive ventilatory support for spontaneously breathing adult and pediatric patients.

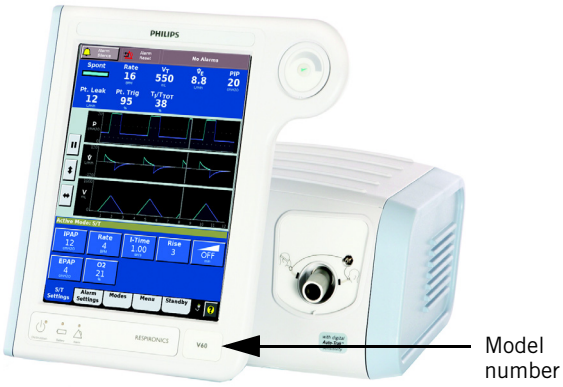


Figure 3-1: Respironics V60 Ventilator shown

Ventilation modes. The ventilator offers a range of conventional pressure modes, CPAP (continuous positive airway pressure), PCV (pressure-controlled ventilation), and S/T (spontaneous/timed). The volume-targeted AVAPS (average volume-assured pressure support) mode combines the attributes of pressure-controlled and volume-targeted ventilation. The optional PPV mode provides pressure ventilation in proportion to the patient's efforts.

Modes, therapies and features. Table 3-1 shows which modes, therapies and features are included or optional for the V60 and V60 Plus models.

Table 3-1: V60 and V60 Plus comparison

Ventilator Model	Modes		Therapy	Features	
	AVAPS	PPV	HFT	Auto-Trak+	C-Flex
V60	Included	Optional	Optional	Optional	Included
V60 Plus	Included	Optional	Included	Optional	Included

High flow therapy (HFT). High flow therapy provides a set flow of mixed air and oxygen. Flow and O_2 percentage settings are selected by the clinician. HFT is available for 3.00 software and above, as well as for the V60 Plus.

Auto-Trak Sensitivity allows the ventilator to automatically compensate for intentional and unintentional leaks by maintaining a stable baseline and adjusting trigger and cycle thresholds for optimum patient-to-ventilator synchrony. The optional Auto-Trak+ feature lets you further adjust the level of Auto-Trak Sensitivity.

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.

Monitoring. The ventilator displays monitored parameters as numbers and as real-time waveforms (curves or scalars).

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 optional internal backup battery powers the ventilator typically for 6 hours.

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 to a stand. When equipped with the optional cylinder holder, the stand can accommodate two E-size oxygen cylinders. 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.

Physical description

Patient circuits, masks/patient interfaces, and accessories

Figure 3-2 shows the Respironics V60/V60 Plus Ventilator with its patient circuit and accessories. Table 3-2 on page 3-5 lists recommended patient circuits, masks/patient interfaces, and other accessories for use with the ventilator. Appendix C provides ordering information for parts and accessories.

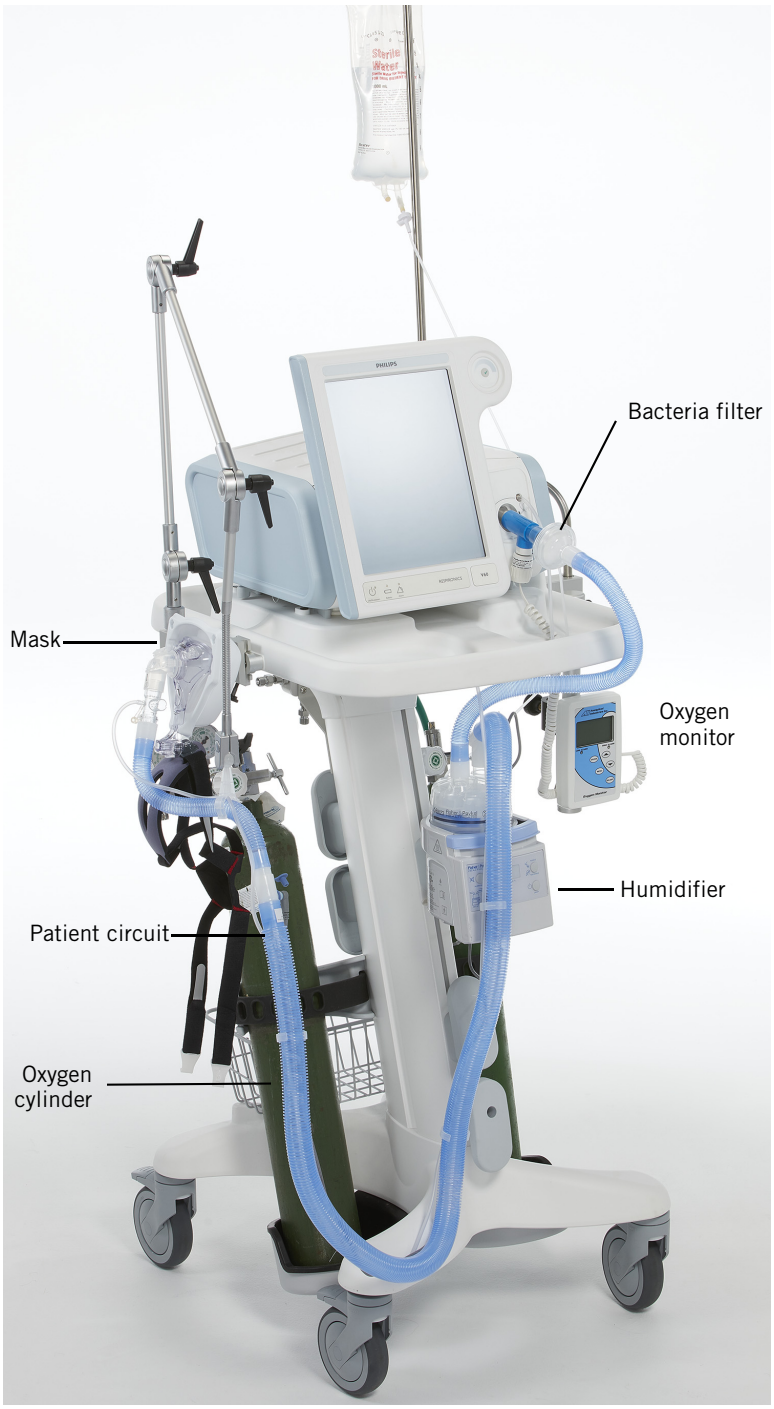


Figure 3-2: Respironics V60/V60 Plus Ventilator with accessories

Table 3-2: Recommended parts and accessories

Part	Use...
Patient circuit	Single-limb patient circuit intended for noninvasive ventilation, invasive ventilation, or high flow therapy (if applicable). Use a circuit listed in Appendix C. WARNING: During ventilation, patient exhalate is released into room air. Use of a patient circuit with a filter on its exhalation port is recommended.
Patient interface (noninvasive or invasive)	• Respironics masks listed in Appendix C • Invasive interface (tracheostomy or ET tube)
Patient interface (HFT)	Nasal high flow cannula and tracheostomy interface listed in Appendix C. (For use with 3.00 software and above, as well as V60 Plus.)
Exhalation port	Philips Respironics exhalation port listed in Appendix C. Contact your Philips representative.
Inspiratory filter	Main flow (inspiratory) bacteria filter listed in Appendix C
Humidifier	• Fisher & Paykel MR850 • Fisher & Paykel MR290 chamber
Oxygen analyzer/monitor	• Analytical Industries AII-2000M oxygen analyzer/monitor* *NOTE: Contact Philips representative for availability outside the U.S.
Nebulizer	• Vibrating mesh nebulizer, such as the Aerogen • Jet nebulizer with low drive flow requirements (< 10 L/min)

Ventilator unit

Figure 3-3 through Figure 3-5 show the controls, indicators, and other important parts of the ventilator unit.

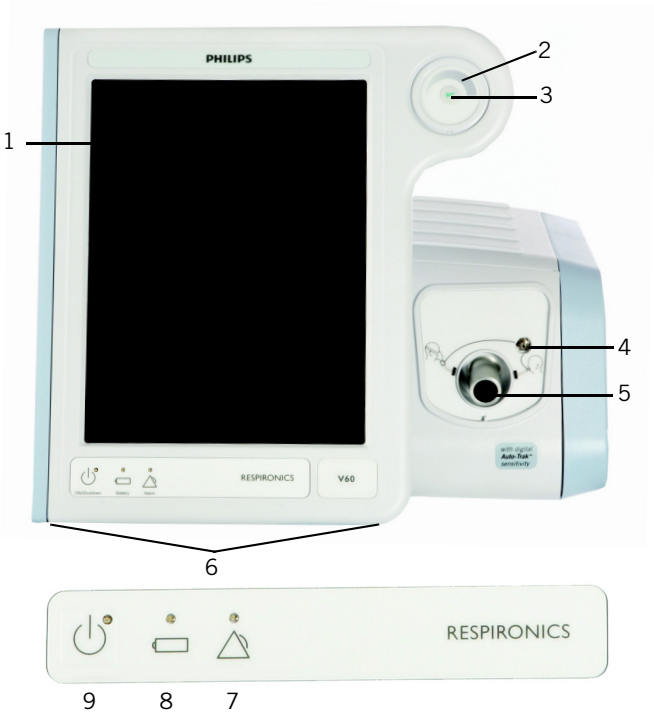


Figure 3-3: Front view

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	**Ventilator outlet (To patient) port.** Main connection for the patient circuit. Delivers air and oxygen in prescribed pressures to the patient.
6	**Alarm speakers** (beneath ventilator)
7	**Alarm LED.** Flashes during a high-priority alarm. On continuously during a ventilator inoperative condition.
8	**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.
9	**ON/Shutdown key with LED.** Turns on AC power and initiates ventilator shutdown. LED is continuously on when AC power is connected.

Figure 3-4: Side view

Number	Description
1	**Ventilation vents.** Allow intake of air for delivery to the patient.
2	**Air inlet filter** (under side panel). Filters the air for delivery to the patient.

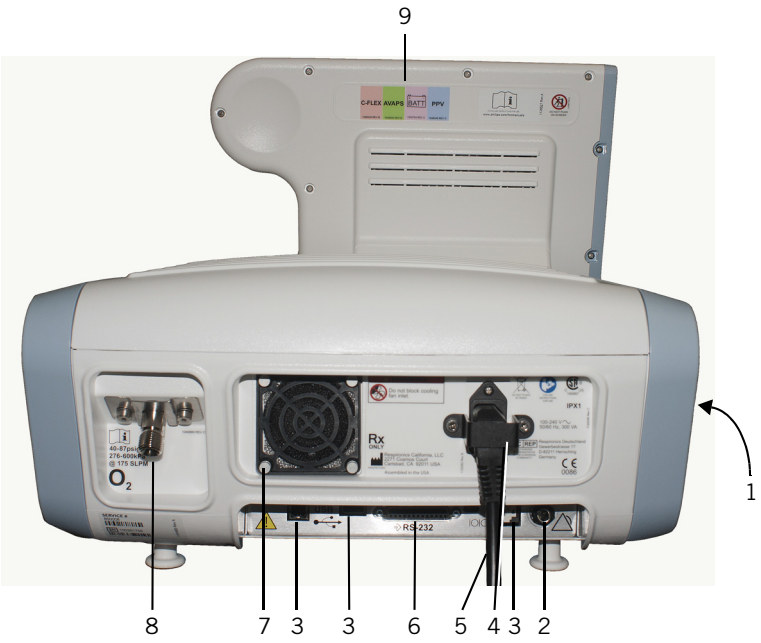


Figure 3-5: Rear view

Number	Description
1	**Backup battery (compartment under side panel).** Optional, 6-hour backup battery.
2	**Remote alarm/nurse call connector**
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.
7	**Cooling fan filter**
8	**High-pressure oxygen inlet connector**
9	**Option labels**

About the optional backup battery

WARNING: To reduce the risk of power failure to the ventilator, 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: The backup batteries are intended for short-term use only. They are not intended to be a primary power source.

NOTE: We recommend that the ventilator's batteries be fully charged before you ventilate a patient. If the batteries are not fully charged and AC power fails, always pay close attention to the level of battery charge.

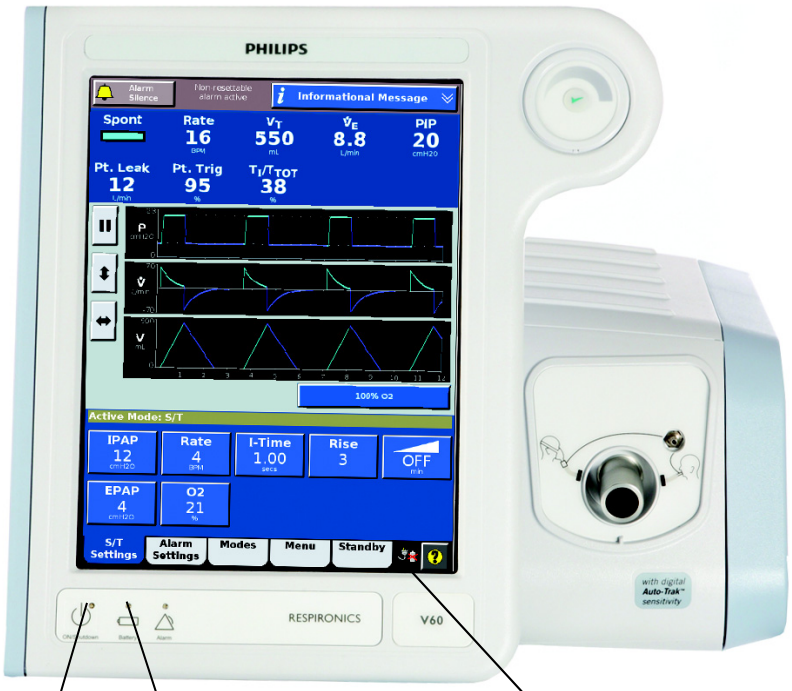
NOTE: A new backup battery should be installed and charged within one year of the date of manufacture identified on the battery and on the shipping box.

The optional internal backup battery protects the ventilator from low, or failure of, AC (mains) power. 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 again adequate or until the battery is depleted. The battery powers the ventilator typically for 6 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 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 and, if the ventilator is running on battery, the level of battery charge (Figure 3-6). 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 full. If the battery is not fully charged after this time, have the ventilator serviced.



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

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 3-6: Power indicators

About the graphical user interface

Through the graphical user interface (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 waveforms and alarm and informational messages. The lower screen lets you access modes and other ventilator settings, display help information, and see the power status.

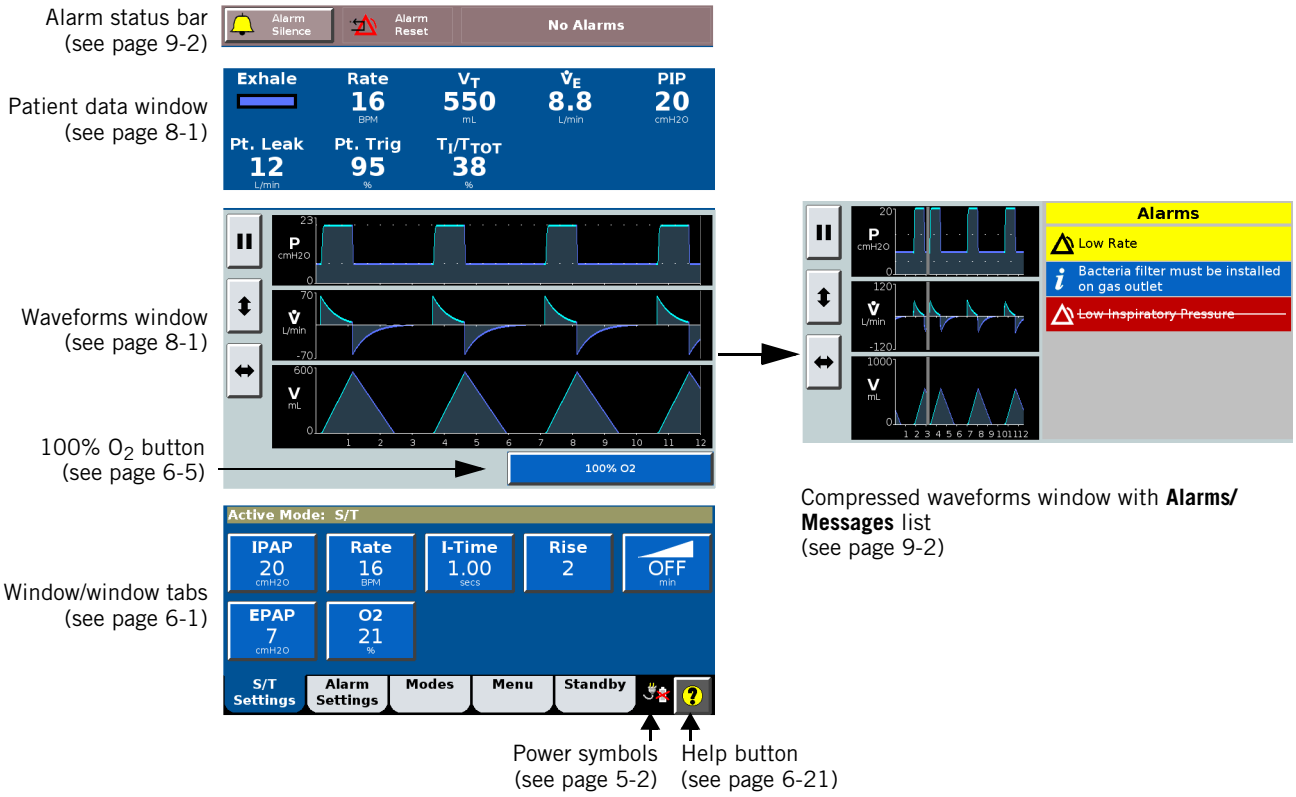


Figure 3-7: Parts of graphical user interface

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). Press and hold for faster adjustments.*	Touch and rotate finger clockwise to increase value or move cursor forward
Touch decrease button (adjustment arrow). Press and hold for faster adjustments.*	Touch and rotate finger counterclockwise to decrease value or move cursor backward
Accept Touch **Accept** button (applies selection)	Press Accept (checkmark) button (applies selection)

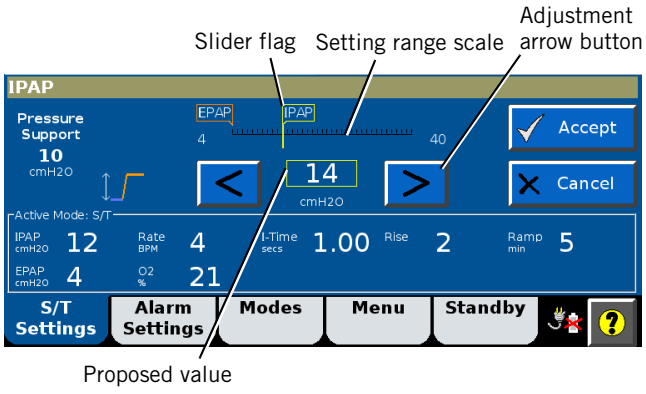
* Available in Revision 2.30 software and above.

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, select the value with the navigation ring or touch the arrow button. Each touch changes the value in single increments or, for parameters with wide ranges, press and hold the arrow key to make faster changes. 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 waveforms window while the screen is frozen. See Freezing and unfreezing waveforms on page 8-3 for more information.

Starting up the ventilator

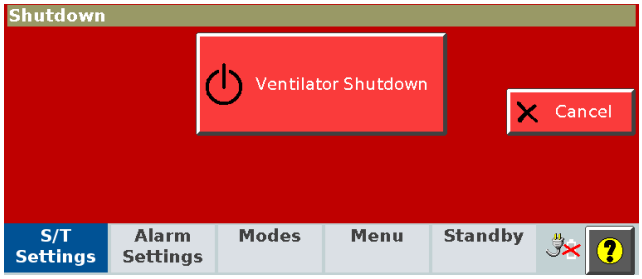
NOTE: Upon power-on the ventilator automatically runs a test of the backup audible alarm followed by the primary audible alarm. You should hear a high-pitched tone, followed by a beep. If you do not hear all of these sounds, discontinue use of the ventilator and have it serviced.

1. Power on the ventilator with the **ON/Shutdown** key.
2. Verify the ventilator operation, as described on page 5-7.

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.

NOTE: 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.

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.

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Chapter 4. Principles of operation

System operational overview

The Respironics V60/V60 Plus Ventilator is a microprocessor-controlled pneumatic system that delivers a mixture of air and oxygen. It is powered by AC with optional 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 gas delivery and monitoring functions are cross-checked. This cross-checking helps prevent simultaneous failure of these two main functions and minimizes the possible hazards of system 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, limited ventilation is provided to give the user time for corrective actions. When a condition is critical enough to possibly compromise safe 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 working 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

The ventilator uses ambient air and high-pressure oxygen (Figure 4-1). Air enters through an inlet filter. Oxygen enters though a high-pressure inlet, and a proportioning valve provides the operator-set concentration. The system mixes the air and oxygen, pressurizes it in the blower, and then regulates it to the user-set pressure. To do this, the ventilator compares the proximal (patient) pressure measurement with the ventilator outlet (machine) pressure, and adjusts the machine pressure to compensate for the pressure drop across the inspiratory filter, patient circuit, and humidifier. This helps ensure accurate and responsive pressure delivery and leak compensation.

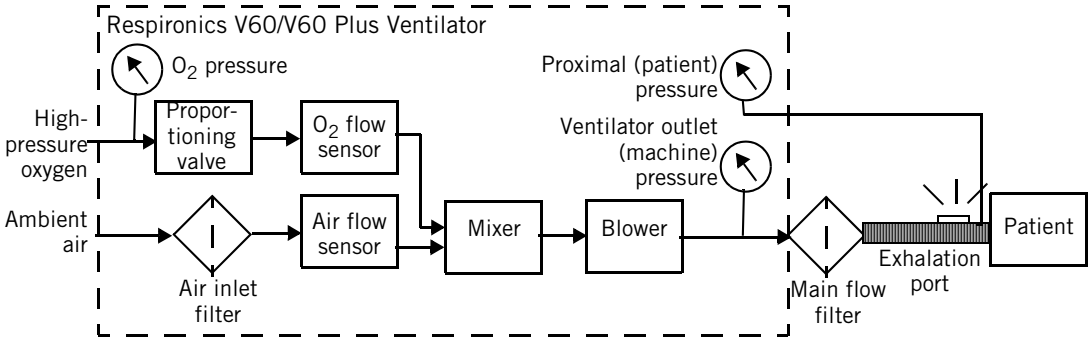


Figure 4-1: Respironics V60/V60 Plus Ventilator gas delivery system

The ventilator delivers gas to the patient through a main flow (inspiratory) bacteria filter, a single-limb patient breathing circuit, a humidification device (optional) and a patient interface such as a mask or ET tube. A pressure tap proximal to the patient is used to monitor patient pressure. The exhalation port continually exhausts gas from the circuit during inspiration and exhalation to minimize rebreathing and ensure CO_2 removal.

Breath delivery characteristics

Control variable

Breaths delivered by the Respironics V60/V60 Plus Ventilator are pressure controlled. In the AVAPS mode, the ventilator's applied pressure is automatically adjusted over a period of time to maintain a target tidal volume.

Triggering, cycling, and leak adaptation

Unlike other ventilators, the Respironics V60/V60 Plus Ventilator does not require you to set triggering and cycling sensitivity or to adjust baseline flow.The ventilator's unique Auto-Trak Sensitivity algorithm adjusts these automatically; see "Auto-Trak Sensitivity" on page 4-3.

Baseline pressure

A positive baseline pressure (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.

Negative pressures

There are no negative pressures generated during exhalation.

Oxygen concentration

The Respironics V60/V60 Plus Ventilator incorporates an oxygen mixer. Oxygen concentration can be set in all modes.

Auto-Trak Sensitivity

An important characteristic of the Respironics V60/V60 Plus 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. The following subsections describe this function in detail.

Triggering

Breaths are patient (flow) 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 distorts the expiratory flow waveform sufficiently (shape signal method; see page 4-4).

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 4-4.
- Patient flow reaches the spontaneous exhalation threshold (SET). See “SET method of cycling.” on page 4-4.
- After 3 seconds at the IPAP level (timed backup safety mechanism)
- When a flow reversal occurs, typically due to a 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.

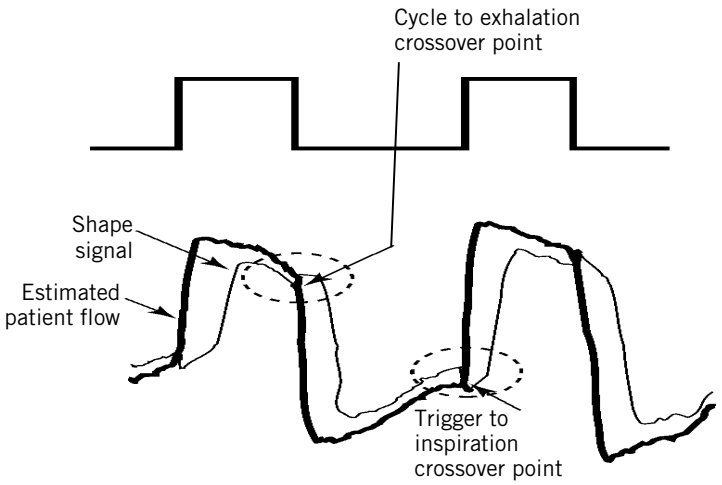


Figure 4-2: Shape signal

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. SET is updated each breath.

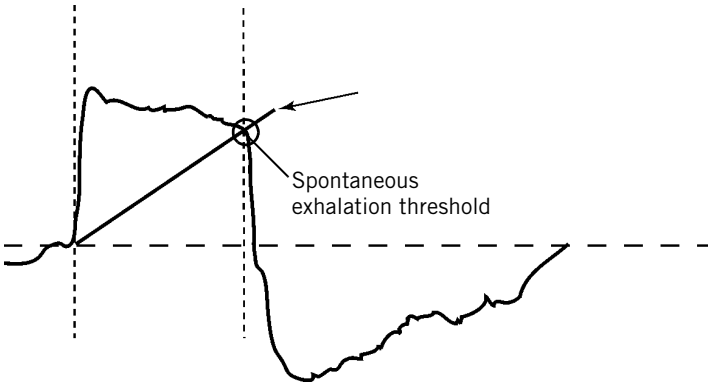


Figure 4-3: Spontaneous exhalation threshold (SET)

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 6-12). Other leakage is unpredictable or *unintentional*, and it changes as the patient's breathing pattern changes.

To maintain prescribed pressures 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.

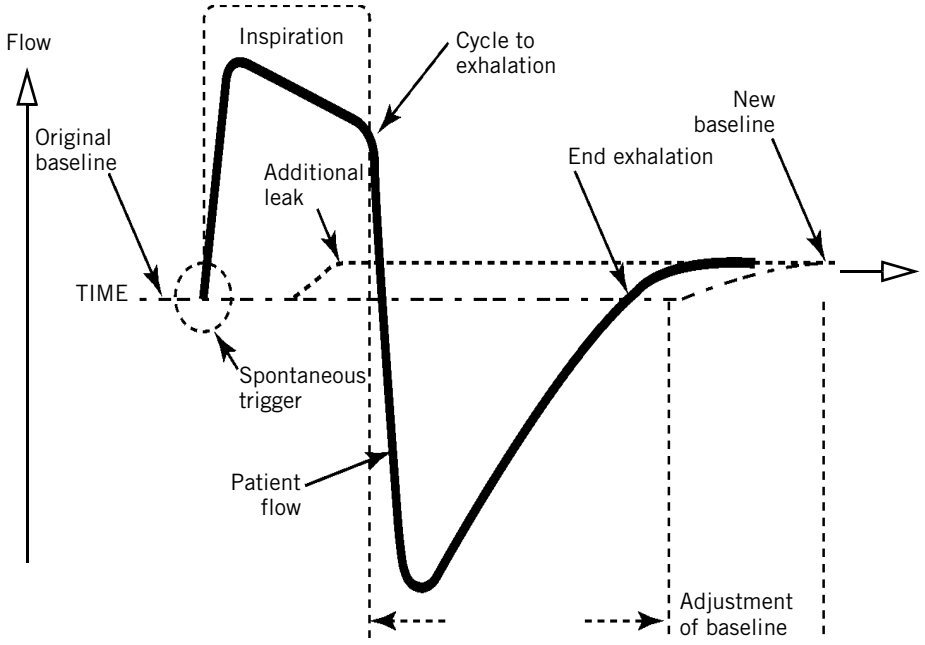


Figure 4-4: Expiratory flow adjustment

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.

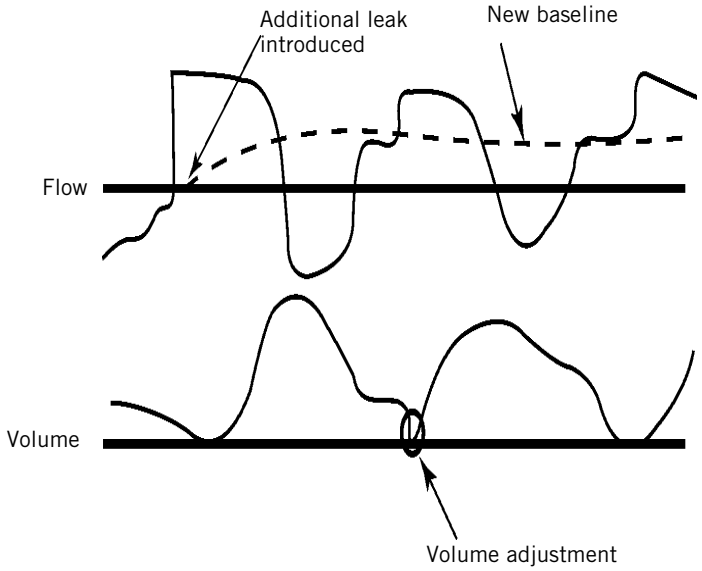


Figure 4-5: Tidal volume adjustment

Auto-Trak+ (optional)

The Auto-Trak+ option for the Respironics V60/V60 Plus Ventilator lets you further adjust the level of Auto-Trak Sensitivity, a feature that recognizes and compensates for intentional and unintentional leaks. This algorithm has multiple breath trigger and cycle thresholds. When you adjust Auto-Trak+ settings, you adjust these multiple trigger and/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.

High flow therapy

High flow therapy (HFT) enables delivery of a humidified gas mixture at an operator-set flow rate via a nasal cannula interface or tracheal adapter. The principle mechanism of action for high flow therapy is delivering a known FiO_2 at a flow rate equal to or greater than the patient's peak flow, thus minimizing dilution of the gas.

HFT provides blended gas to the patient at a targeted flow. Both O_2 concentration and flow are set by the clinician. Heated humidification is recommended during high flow therapy.

High flow therapy (HFT) controls flow instead of pressure and is accessed only while in Standby mode. Patient alarms are not available during high flow therapy. This therapy is not considered a breath delivery mode.

Available for 3.00 software and above, as well as the V60 Plus.

Ventilation modes

The Respironics V60/V60 Plus Ventilator operates in the following ventilation modes:

- CPAP (continuous positive airway pressure) mode
- S/T (spontaneous/timed) mode
- PCV (pressure-controlled ventilation) mode
- AVAPS (average volume-assured pressure support) mode
- PPV (proportional pressure ventilation) mode (optional)

Table 4-1 summarizes the characteristics of these modes. Note that on the ventilator, the **Timed** breath indicator means the breath is ventilator triggered, while the **Spont** breath indicator means the breath is patient triggered.

Table 4-1: Characteristics of Respironics V60/V60 Plus ventilation modes

	Timed breaths			Spont breaths		
Mode	**Trigger***	**Limit†**	**Cycle‡**	**Trigger**	**Limit**	**Cycle**
CPAP	N/A	N/A	N/A	Auto-Trak	Pressure	Auto-Trak
PCV	Time	Pressure	Time	Auto-Trak	Pressure	Time
S/T	Time	Pressure	Time	Auto-Trak	Pressure	Auto-Trak
AVAPS	Time	Pressure	Time	Auto-Trak	Pressure	Auto-Trak
PPV	Time	Pressure	Time	Auto-Trak	Pressure	Auto-Trak

* 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.

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, pressure, and size. You set no triggering or cycling sensitivities: the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms. The control settings active in the CPAP mode are shown in Figure 4-6. Figure 4-7 shows CPAP mode waveforms.

The C-Flex feature setting 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 level before the end of exhalation.

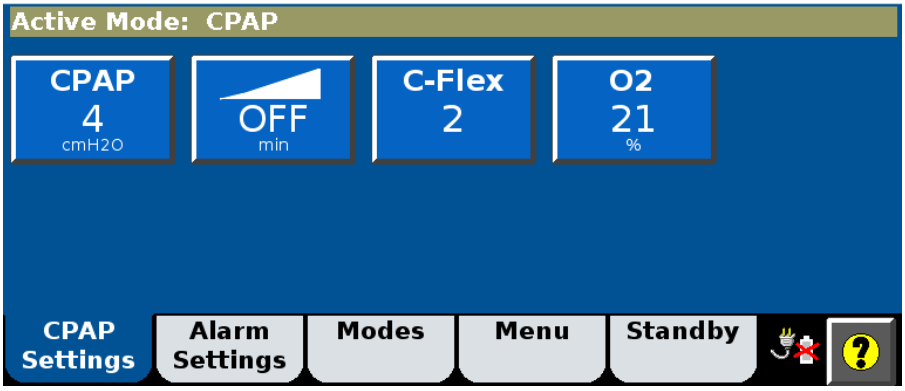


Figure 4-6: CPAP controls

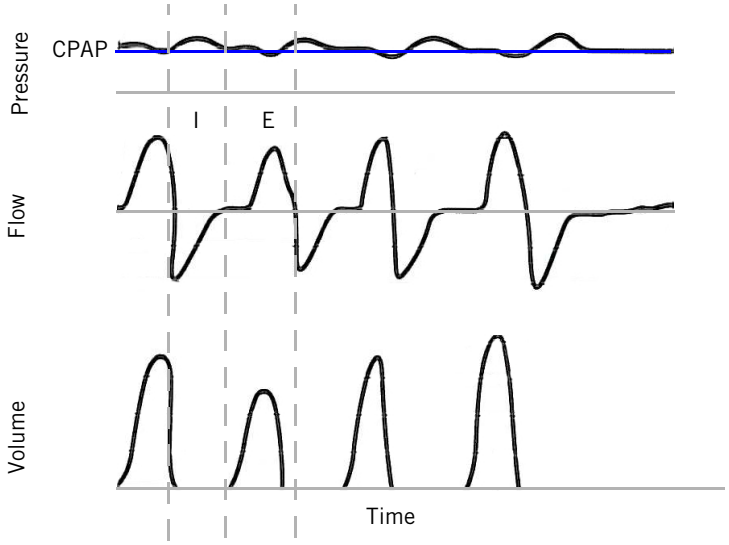


Figure 4-7: CPAP waveforms

PCV mode

The PCV (pressure-controlled ventilation) mode delivers pressure-controlled breaths, either triggered by the ventilator (Timed) or the patient (Spont). The control settings active in the PCV mode are shown in Figure 4-8. The IPAP setting defines the applied inspiratory pressure for all breaths. If the patient fails to trigger a breath through Auto-Trak within the interval determined by the rate setting, the ventilator triggers a mandatory breath. The I-Time setting is the cycle criterion for all breaths. Figure 4-9 shows a PCV mode pressure waveform.

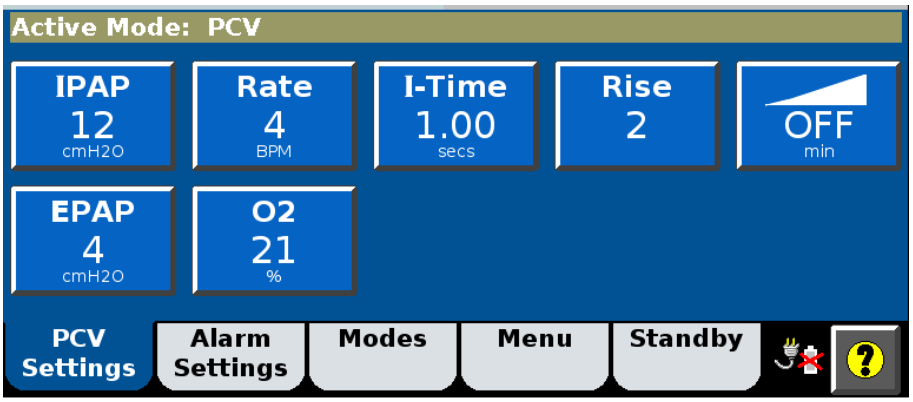


Figure 4-8: PCV controls

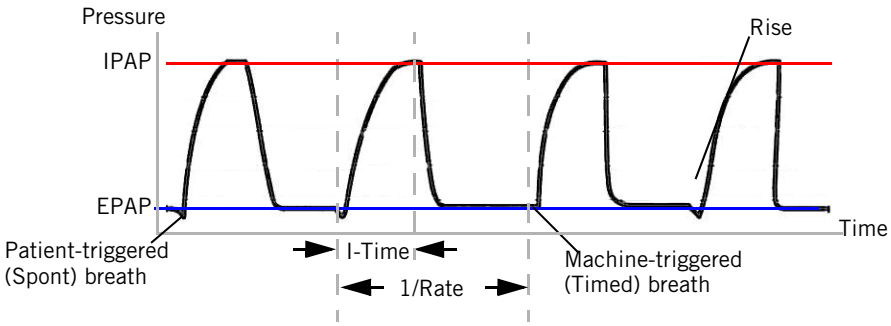


Figure 4-9: PCV pressure waveform

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. You set no patient triggering or cycling sensitivities: the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms. The control settings active in the S/T mode are shown in Figure 4-10. Figure 4-11 shows an S/T mode pressure waveform.

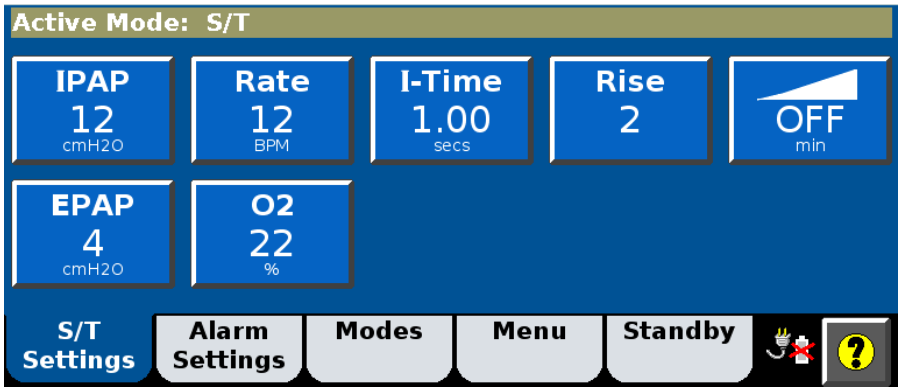


Figure 4-10: S/T controls

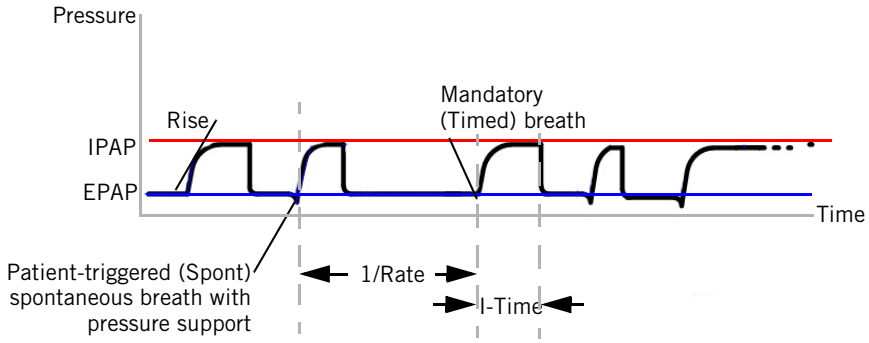


Figure 4-11: S/T pressure waveform

AVAPS mode

NOTE: When you adjust 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.

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. You set no patient triggering or cycling sensitivities: the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms.

At start-up, AVAPS applies an inspiratory pressure equal to one of the following, whichever is greater:

- EPAP + (target volume / 60 ml/cmH_2O)
- EPAP + 8 cmH_2O
- Pmin

The control settings active in the AVAPS mode are shown in Figure 4-12. Figure 4-13 shows AVAPS mode waveforms.

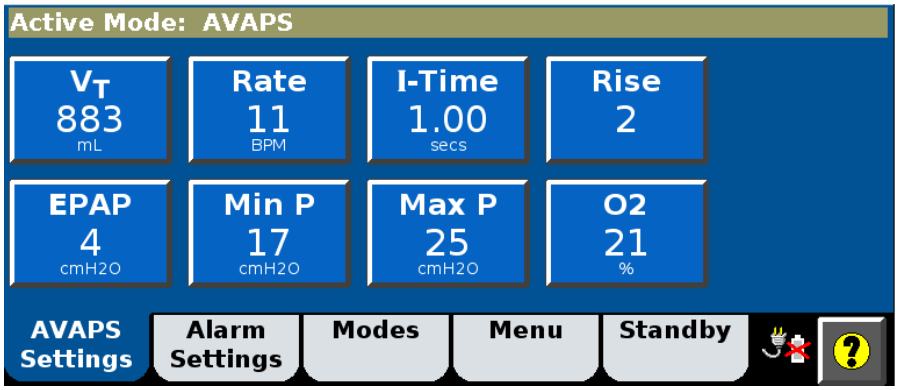


Figure 4-12: AVAPS controls

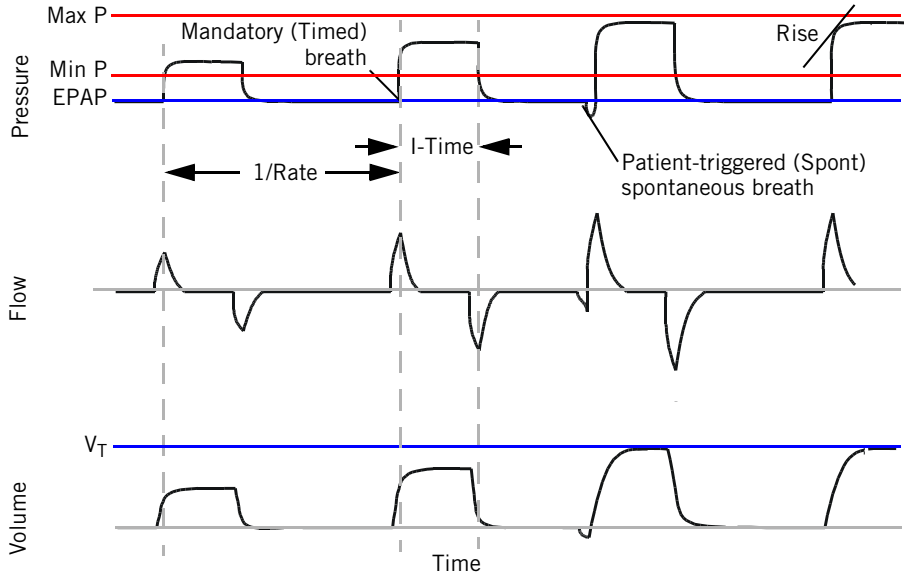


Figure 4-13: AVAPS waveforms

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-triggered, pressure-limited, and time-cycled breaths in the case of apnea. In the PPV mode, 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.

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, although you do not need to know the actual value of either to apply PPV. 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 4-14.

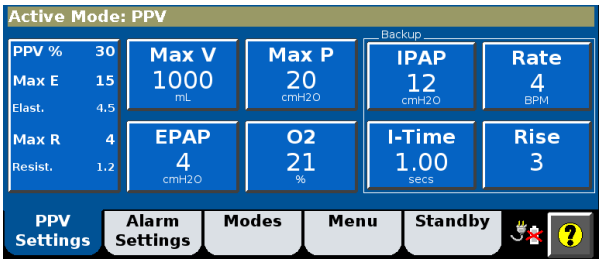


Figure 4-14: PPV controls

Figure 4-15 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 6-7.

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.

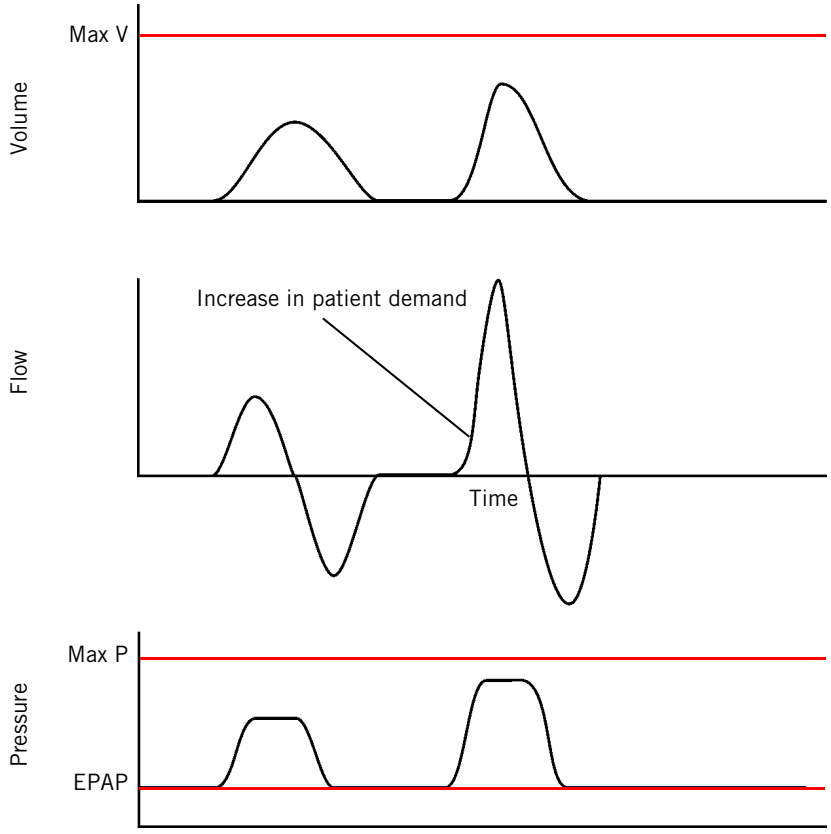
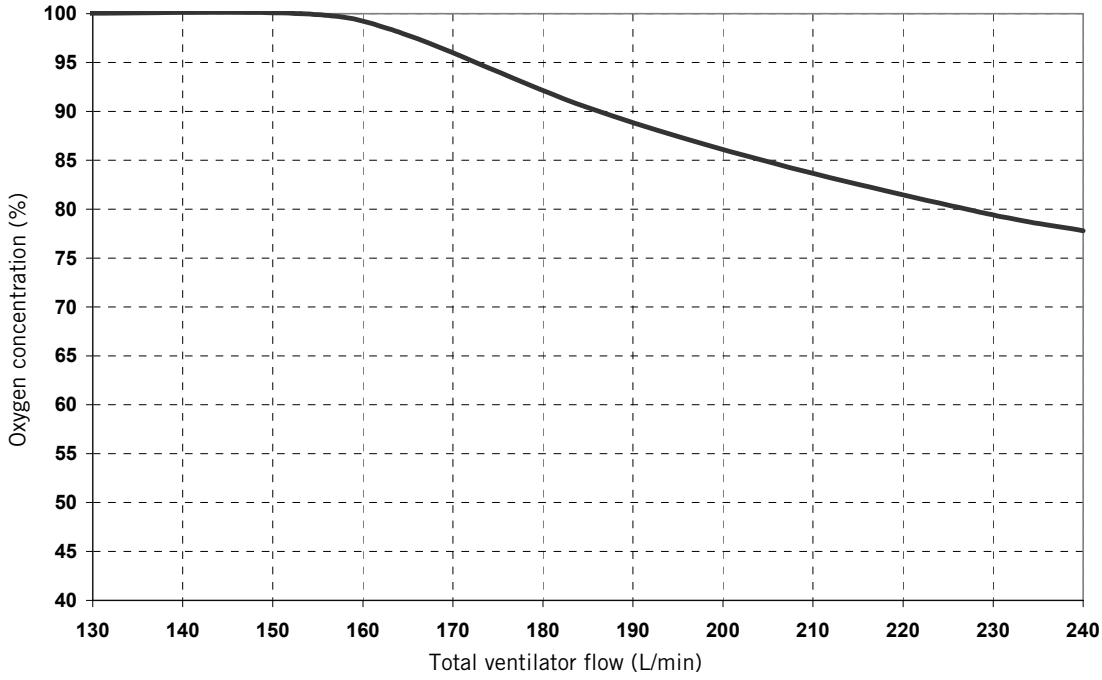


Figure 4-15: PPV waveforms

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 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 4-16 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 inspiration, so this is a worst case scenario.



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 4-16: O_2 concentration as a function of total ventilator flow

Chapter 5. Setting up the ventilator for use

Set up the ventilator for each patient use as described in this chapter. For first-time installation, refer to Appendix A. For use with high flow therapy (HFT), set up the ventilator as described in this chapter, then refer to Chapter 7, High flow therapy.

Connecting oxygen

WARNING: Connect the ventilator only to an appropriate medical-grade oxygen source.

WARNING: To ensure accuracy of oxygen administration and to monitor for the presence of contamination (incorrect gas connected), use an external oxygen monitor to verify the oxygen concentration in the delivered gas.

WARNING: To reduce the risk of fire, do not use a high-pressure oxygen hose that is worn or contaminated with combustible materials like grease or oil.

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

WARNING: To reduce patient risk of oxygen toxicity, keep free-flowing oxygen away from air inlet of ventilator.

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 an appropriate high-pressure oxygen source.

Use of SIS connectors and supplemental oxygen accessories such as the O_2 manifold requires higher oxygen supply pressures. Consult Table 11-9 on page 11-6 for appropriate oxygen pressure ranges.

Installing an oxygen analyzer/monitor

Install an Analytical 2000M oxygen analyzer/monitor, or the equivalent, and follow the manufacturer's instructions for setup and calibration.

Connecting to AC power

WARNING: To reduce the risk of electric shock, connect the ventilator to an AC supply mains with protective earth only.

WARNING: Do not use extension cords, adapters, or power cords with the ventilator that are not approved by Respironics.

WARNING: 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 you switch the ventilator on. The retainer is designed to hold the connector end of the Philips-supplied cord securely in place.

WARNING: To reduce the risk of electric shock, regularly inspect the AC power cord and verify that it is not frayed or cracked.

WARNING: To reduce the risk of strangulation, route the power cord to avoid entanglement.

CAUTION: For 120 V equipment, grounding reliability can only be achieved when it is connected to an equivalent 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.

Installing the patient circuit

WARNING: To reduce the risk of strangulation from patient tubing, use a tubing support arm and secure the proximal pressure line with clips.

WARNING: To prevent possible patient injury and possible water damage to the ventilator, make sure the humidifier is set appropriately.

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.

WARNING: 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.

WARNING: 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.

WARNING: To prevent patient or ventilator contamination, always use a main flow bacteria filter on the patient gas outlet port. Filters not approved by Respironics may degrade system performance.

WARNING: During ventilation, patient exhalate is released into room air. Use of a patient circuit with a filter on its exhalation port is recommended.

WARNING: To reduce the risk of bacterial contamination or damage, handle bacteria filters with care.

WARNING: Any additional accessories in the patient circuit may substantially increase flow resistance and impair ventilation.

WARNING: Avoid adding resistive circuit components on the patient side of the proximal pressure line. Such components may defeat the disconnect alarm.

NOTE: Bacteria filter must be installed onto gas outlet.

NOTE: Under extreme conditions and a missing, ruptured, or defective bacteria filter, the entire gas pathway can become contaminated with bodily fluids or exhaled gas.

Install the patient circuit as shown in this section. For a list of compatible parts and accessories offered by Philips, see “Parts and accessories” on page C-1.

Assemble the patient circuit, including the main flow (inspiratory) bacteria filter, proximal pressure line, oxygen sensor tee, and if desired, humidifier and nebulizer. Figure 5-2 and Figure 5-3 show circuit configurations for noninvasive and invasive ventilation. Follow the manufacturers’ instructions for use for the individual parts.

NOTE: If you are using a jet nebulizer, use the lowest possible flow rate recommended by the manufacturer. The flow rate must not exceed 10 L/min.

NOTE: This circuit setup is recommended for noninvasive ventilation. It is also recommended for high flow therapy when using the AC611 FEP Connect to block the exhalation port.

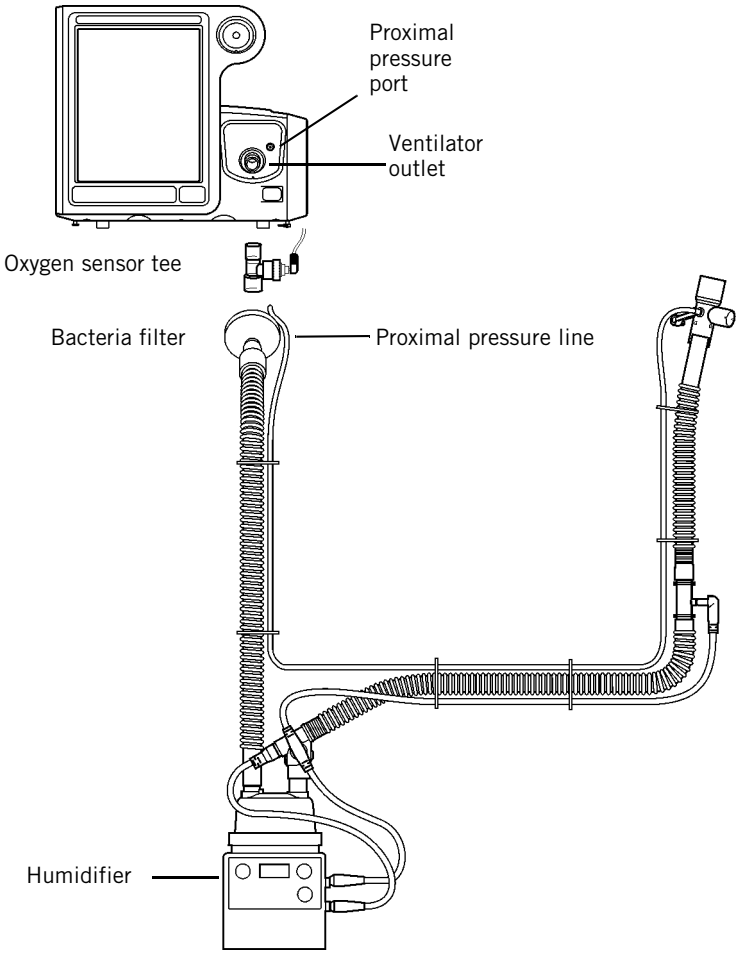


Figure 5-1: Noninvasive patient circuit, with heated-wire and humidification

NOTE: This circuit setup is recommended for noninvasive ventilation.

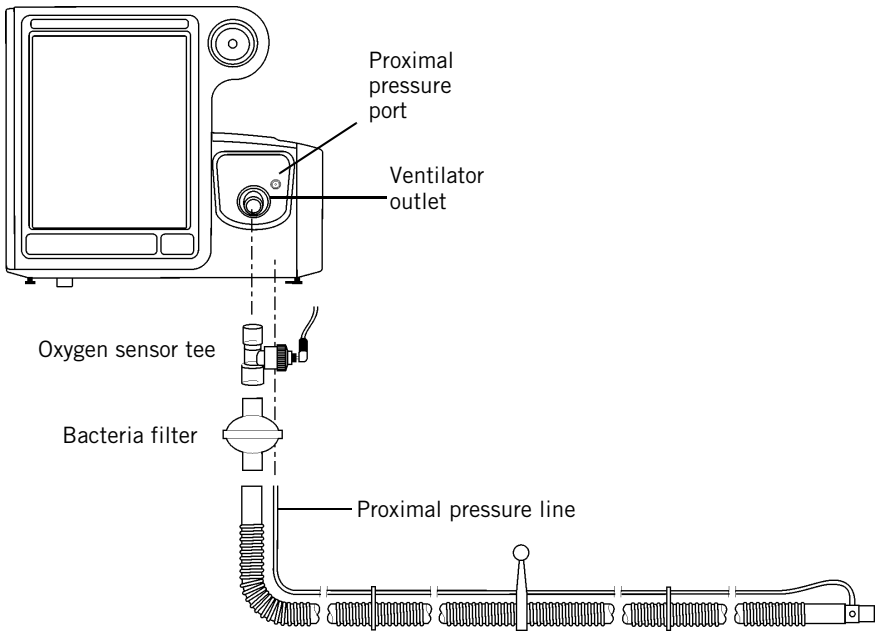


Figure 5-2: Noninvasive patient circuit, without humidification

NOTE: This circuit setup is recommended for both noninvasive and invasive ventilation.

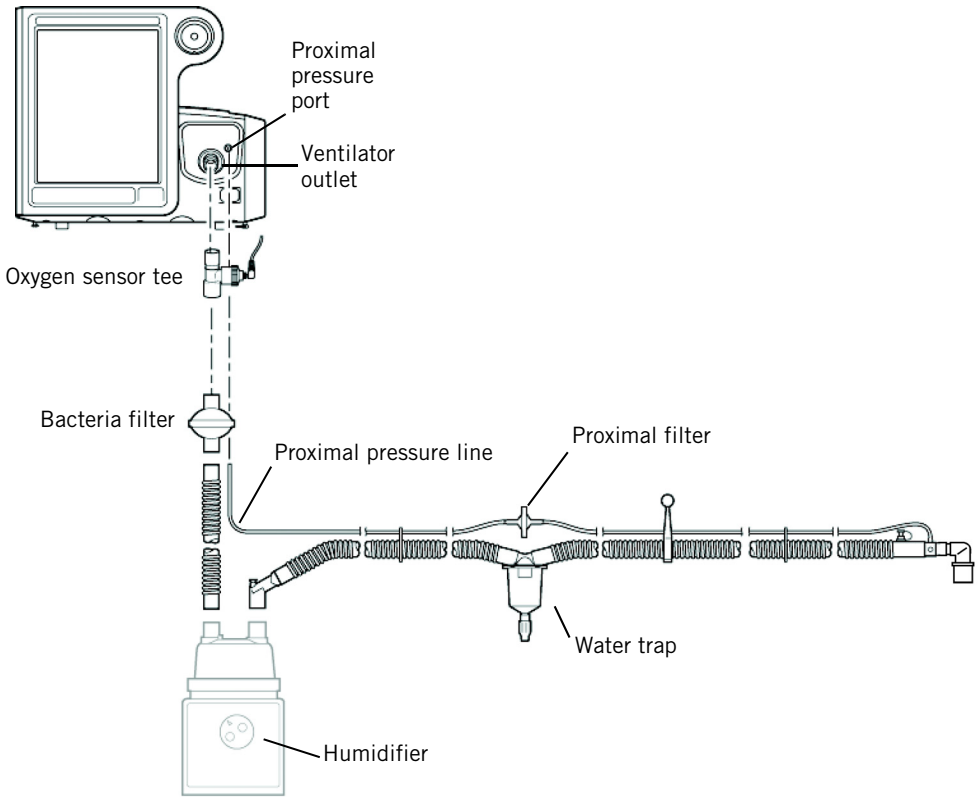


Figure 5-3: Invasive patient circuit, with humidification

Connecting external devices

Connect the ventilator to a remote alarm (nurse call) device and a patient monitor or other external device, if applicable.

The Respironics V60/V60 Plus Ventilator can communicate with a Philips patient monitor using the IntelliBridge Open Interface. See “Using Philips monitors and the IntelliBridge Open Interface” on page B-15. The ventilator also supports the VueLink Open Interface. VueLink has been replaced by IntelliBridge, but information is included in this manual for backwards compatibility. See “Using Philips monitors and the VueLink Open Interface*” on page B-15.

For more information about connecting with non-Philips systems, contact your Philips representative.

Before placing a patient on the ventilator

WARNING: Always verify ventilator operation before placing the patient on a ventilator. If the ventilator fails any verification steps, remove it from clinical use immediately. Do not use the ventilator until necessary repairs are completed and the ventilator passes verification.

WARNING: To reduce the risk of power failure to the ventilator, 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: If the ventilator has a backup battery, the battery must be adequately charged to verify operation. Recharge as necessary before verifying operation.

NOTE: The backup batteries are intended for short-term use only. They are not intended to be a primary power source.

NOTE: We recommend that the ventilator's batteries be fully charged before you ventilate a patient. If the batteries are not fully charged and AC power fails, always pay close attention to the level of battery charge.

Verify ventilator operation

1. Power on the ventilator. The ventilator automatically runs a test of the backup audible alarm followed by the primary audible alarm. Verify that you hear a high-pitched tone, followed by a beep.
2. Create a patient alarm, such as a disconnect alarm.
   a. VERIFY that the proper alarm is annunciated (audio, visual, flashing, and alarm LED).
   b. VERIFY that the volume setting is adequate for the environment in which it will be used.
   c. VERIFY remote alarm setup, if applicable.
3. Resolve the alarm condition and manually reset the alarm.
4. If the backup battery is installed, disconnect the ventilator from AC power while the ventilator is running. If the backup battery is not installed, go to step 5.
   a. VERIFY that the ventilator switches over to battery power (battery symbol in right-hand corner of screen is displayed).
   b. VERIFY that the audible alarm sounds intermittently.
5. Reconnect the ventilator to AC power.

Running 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 prevent possible patient injury, always return alarm settings to hospital-standard values after verifying ventilator operation.

Preparation

1. Set the ventilator up as for normal ventilation, complete with breathing circuit (PN 582073 or the equivalent) and a 1-liter test lung assembly (PN 1021671).
2. Set the mode to S/T and make the following control settings: Rate: 4 BPM, IPAP: 10 cmH_2O, EPAP: 6 cmH_2O, I-Time: 1 sec, Rise: 1, Ramp: Off, O_2: 21%.
3. Make the following alarm settings: Hi Rate: 90 BPM, Lo Rate: 1 BPM, Hi V_T: 2000 mL, Lo V_T: OFF, HIP: 50 cmH_2O, LIP: OFF, Lo $\dot{V}_E$: OFF, LIP T: 5 secs.

High Inspiratory Pressure

1. Lower the HIP alarm limit to 8 cmH_2O.
2. VERIFY that the **High Inspiratory Pressure** alarm is activated, the ventilator cycles into exhalation, and pressure falls to 6 cmH_2O (the EPAP level).
3. Raise the HIP alarm limit to 15 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.

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 (including bacteria filter) from the ventilator outlet, and block the ventilator outlet.
2. VERIFY that the **Patient Circuit Occluded** alarm is activated.
3. Unblock the outlet, and reconnect the circuit.
4. VERIFY that the alarm resets.

Using the ventilator for intra-hospital transport

WARNING: Always check the status of the oxygen cylinders before using the ventilator during transport.

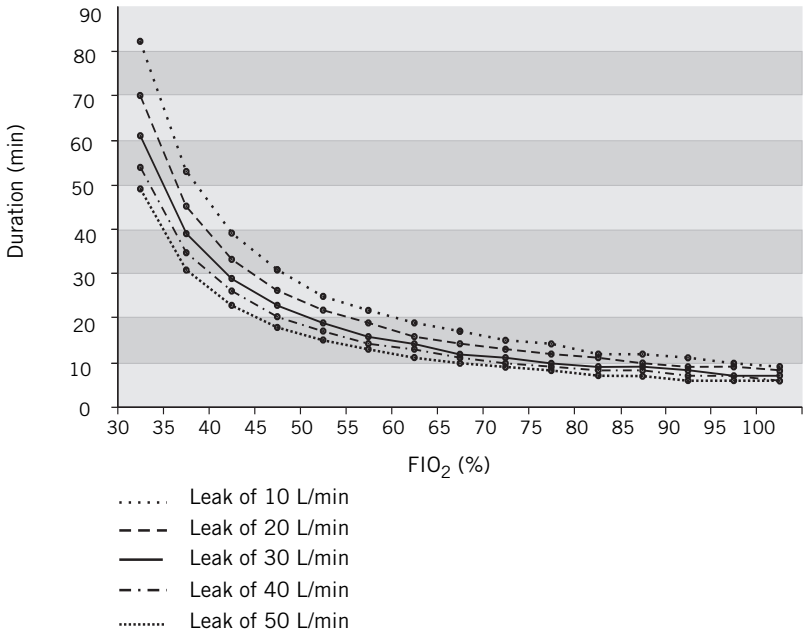
WARNING: To reduce the risk of power failure to the ventilator, pay close attention to the battery's charge level. The battery's operation time is approximate and is affected by ventilator settings, discharge and recharge cycles, battery age, and ambient temperature. Battery charge is reduced at low ambient temperatures or in situations where the alarm is continuously sounding.

WARNING: The V60/V60 Plus Ventilator requires a pressurized oxygen supply that provides a minimum flow of 175 SLPM. 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.

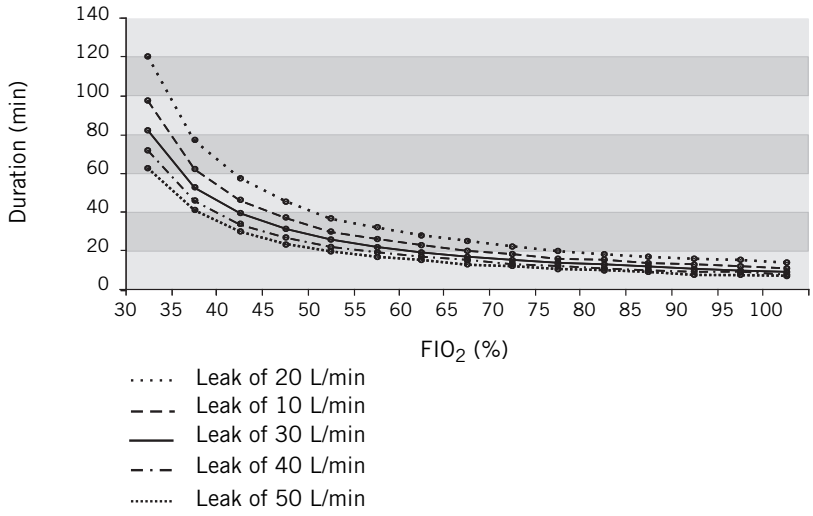
WARNING: Do not leave the ventilator unattended when stationed on an incline.

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 $\mathbf{O_2}$ 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 5-4).



a. V_T = 500 mL, Rate = 40 BPM, EPAP = 6 cm$H_2$0, IPAP = 18 cm$H_2$0



b. V_T = 500 mL, Rate = 20 BPM, EPAP = 6 cm$H_2$0, IPAP = 18 cm$H_2$0

Figure 5-4: Duration of cylinder oxygen (13,790 kPa/2000 psig) at various leak rates

Storing the ventilator between patient use

See "Storage between patient use" on page 10-7 for information about storing the ventilator.

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Chapter 6. Operation

WARNING: **To ensure the ventilator's safe operation, always verify ventilator operation as described in "Verify ventilator operation" on page 5-7 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.**

NOTE: Before operation, prepare the ventilator as instructed in Chapter 5.

After power-on, the ventilator starts up in the mode and with the settings that were active before last power down. Check these settings and adjust as required. You must be familiar with using the touchscreen and navigation ring to select, adjust, activate, and confirm parameters. For details, see "Before placing a patient on the ventilator" on page 5-7.

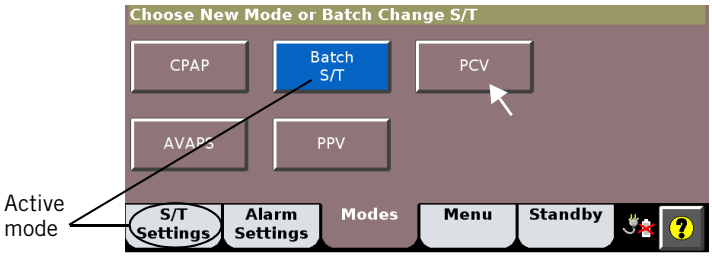
Access the ventilator setting windows from the tabs at the bottom of the screen.

page 6-3 page 6-12 page 6-2 page 6-17 page 6-19 page 6-21

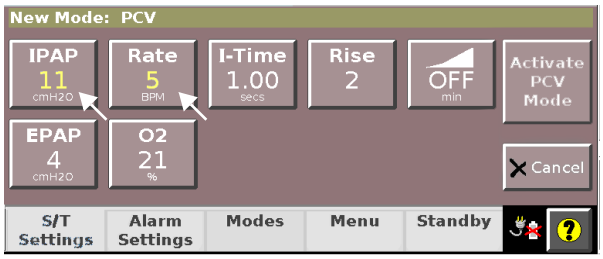
Changing the mode

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 4-7.

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



3. Adjust settings as desired (see “Changing individual ventilator settings” on page 6-4). Newly adjusted setting values are shown in yellow.



4. Select **Activate Mode** to apply.

Changing control settings

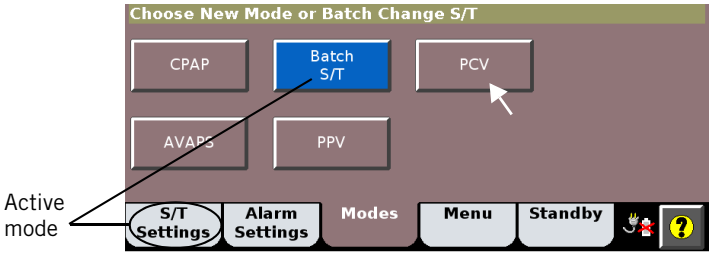
Table 6-3 on page 6-22 is an alphabetical list of the control settings with their ranges. Table 11-2 on page 11-2 shows the control settings applicable to the different modes. For more information on control settings as they apply in the different ventilation modes, see “Ventilation modes” on page 4-7.

Making batch setting changes

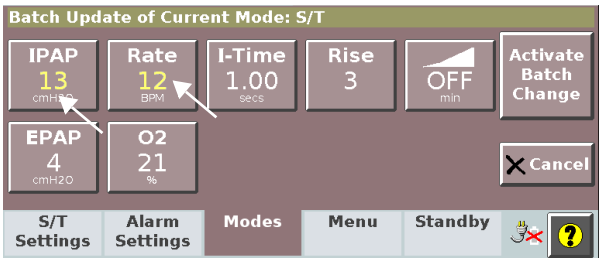
NOTE: During a batch setting change, you cannot change the Ramp Time setting when a ramp is active.

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

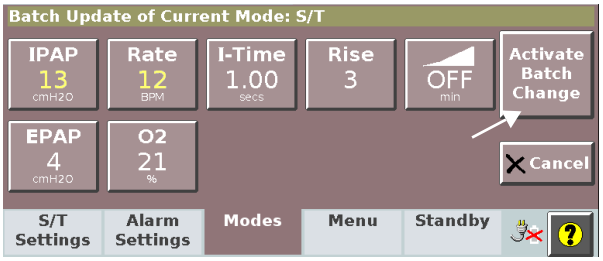
1. Open the **Modes** window.
2. Select the active mode.



3. Adjust settings as desired (see “Changing individual ventilator settings” on page 6-4). Newly adjusted setting values are shown in yellow.



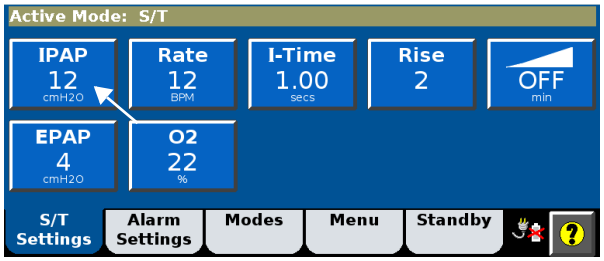
4. Select **Activate Batch Change** to apply.



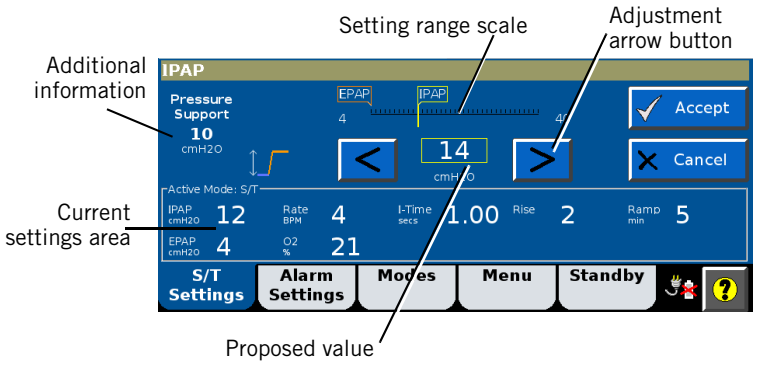
Changing individual ventilator settings

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.



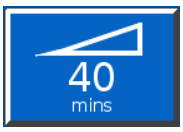
Using the Ramp Time function

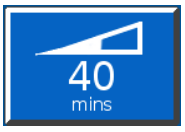
The Ramp Time function helps your patient adapt to ventilation by gradually increasing inspiratory and expiratory pressure (IPAP and EPAP/CPAP) from subtherapeutic to user-set pressures over a user-set interval. Table 6-3 on page 6-22 describes this function's principles of operation.

Follow these instructions to use the Ramp Time function:

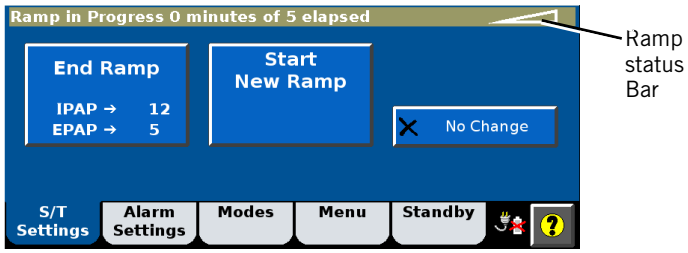
1. Select the **Ramp Time** button in the **Settings** window.

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





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



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

4. 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 the 100% O_2 function

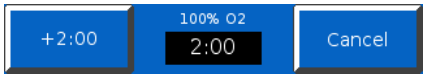
NOTE: The 100% O_2 feature is available in Revision 2.30 software and above.

The 100% O_2 function delivers 100% oxygen to the patient. It is available during **Screen Lock** status.

Follow these instructions to use the 100% O_2 function:

1. Select the **100% 02** button in the main GUI window.

2. The ventilator delivers 100% oxygen for two minutes. A countdown timer displays.

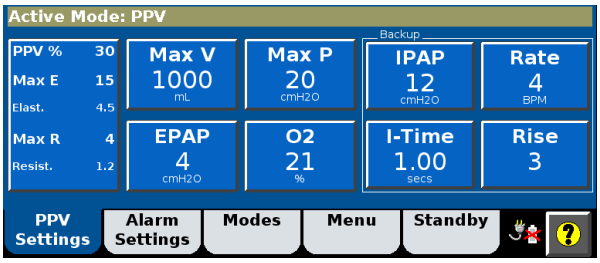


While 100% oxygen delivery is active, you can press the +2:00 button to add two minutes more. Press **Cancel** to stop.

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 4-13.

1. Open the **PPV Settings** window.
2. Set **EPAP**, **O_2**, alarm limits, and backup settings to appropriate values. The **HIP** alarm limit should be greater than **Max P**. See “Principles of operation” on page 4-1 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: **PPV limits are not intended to be the primary ventilator alarms and should not be substituted for the alarms found in the Alarm Settings window.**

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.

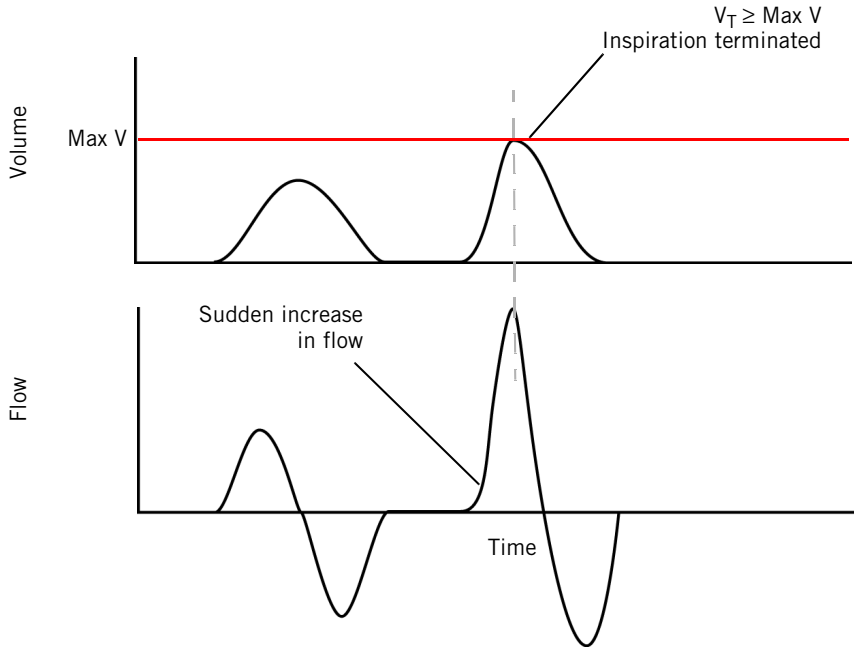


Figure 6-1: PPV waveform – Max V limit

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.

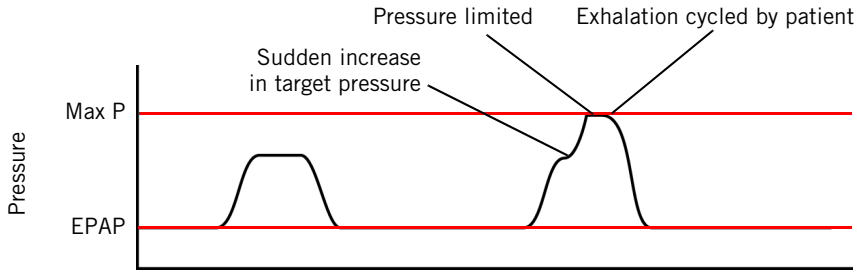


Figure 6-2: PPV waveform – Max P limit

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 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

It is recommended you set **Max R** (flow assist) and **Max E** (volume assist) to initial values and then titrate them based on the patient's disease process:

- **Obstructive disease (COPD, asthma):** Focus on **Max R**. Overcoming increased resistance is typically the emphasis, not volume delivery.
- **Restrictive disease (neuromuscular, chest-wall deformities, obesity hypoventilation):** Focus on **Max E**. Maintaining sufficient volume is typically the emphasis, not overcoming increased resistance.
- **Mixed disease processes affecting both resistance and elastance:** Titrate both **Max R** and **Max E** settings.

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 100%
Max E	5 cmH_2O/L
Max R	2 cmH_2O/L/s
All other backup settings and alarms	Per usual protocol

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

2. Adjust **Max 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 none is true, increase **Max E** in increments of 2 cmH_2O/L while continuing to evaluate the patient's response.
   c. 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**, increasing and decreasing in increments of 1 cmH_2O/L/s to optimize patient comfort.
4. Repeat adjustment for **Max E** as needed.
5. Adjust **PPV %** downward as tolerated.

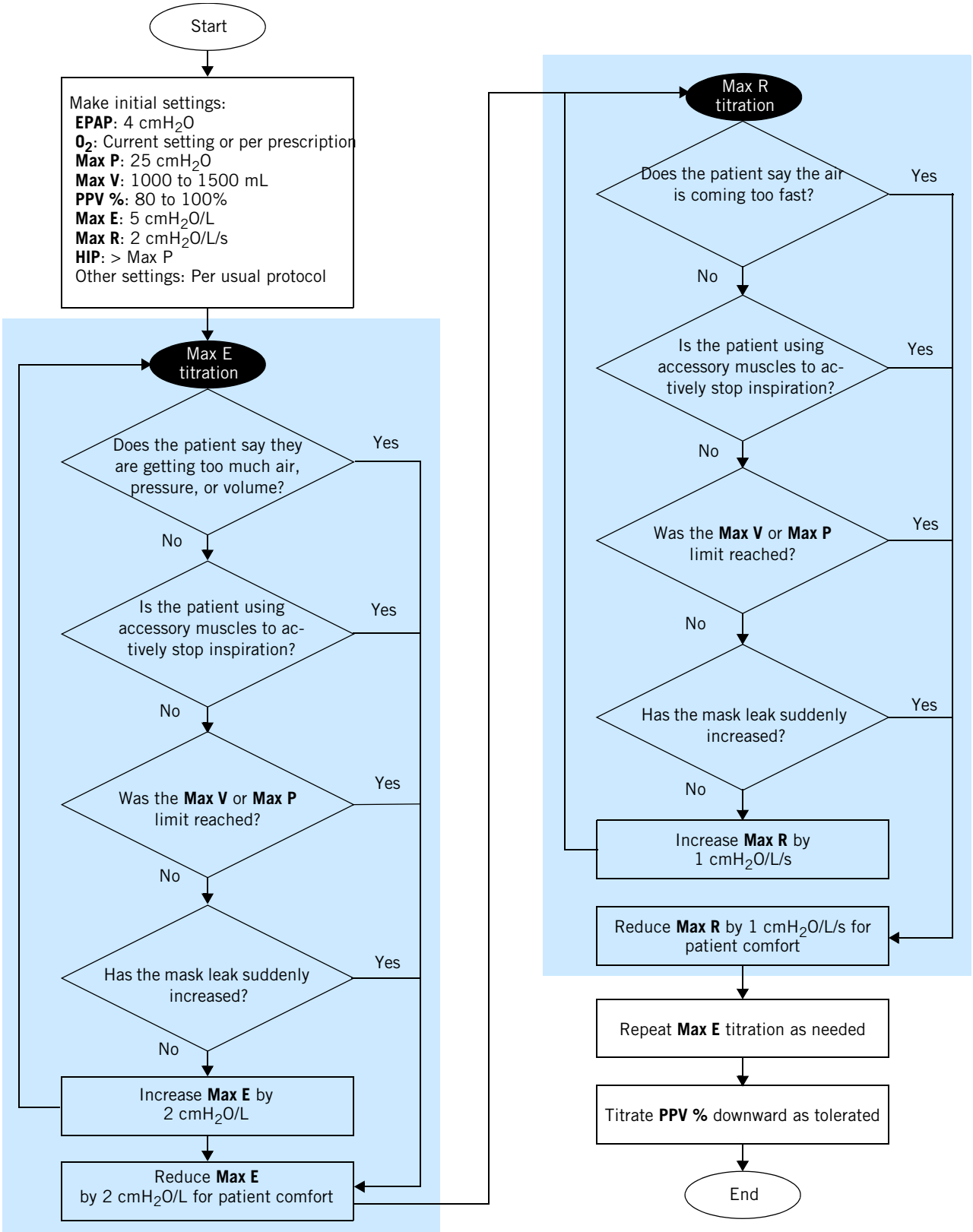


Figure 6-3: PPV initial setup

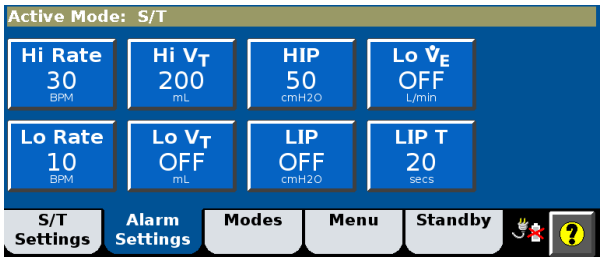
Changing alarm settings

WARNING: To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.

Some ventilator alarm settings are operator adjustable. You can adjust these at any time. Table 6-4 on page 6-25 lists the alarm settings and their ranges.

Review and adjust the alarm settings as follows:

1. Open the **Alarm Settings** window.



2. Select the desired setting, adjust it, and select **Accept** to apply.

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

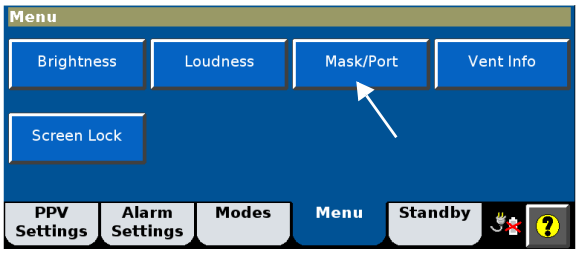
Selecting the mask and exhalation port

To be able to display full leakage data plus accurate tidal and minute volumes, the ventilator must know the intentional leak characteristics of the specific mask/patient interface and exhalation port.

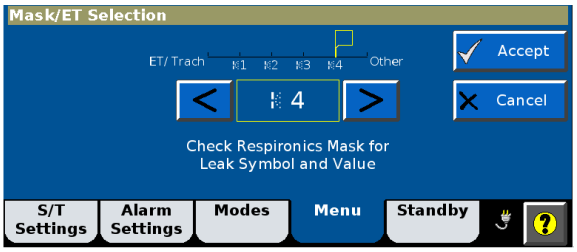
After power-on, the **Messages** list displays the current mask and port settings for 5 minutes.

Change these settings as follows:

1. Open the **Menu** window.
2. Select **Mask/Port**.



3. Select the desired mask/patient interface type (Table 6-1). Select **Accept** to apply.



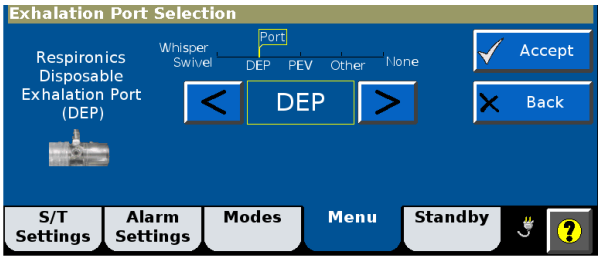
For information concerning mask/port leak characteristics, see the instructions provided with each mask/port. See Appendix C for a list of masks, circuits, and related components used with the ventilator.

Table 6-1: Mask/patient interface selections

Mask/patient interface type*	Description
ET/ Trach ET/Trach	ET or tracheostomy tube
1 Leak 1	Mask with minimal intentional leak characteristics. Enter **Leak 1** for any of these Philips Respironics masks: • Contour Deluxe nasal mask • PerformaTrak mask • AF421, AF531, AF541, AF811 (EE)
2 Leak 2	Mask with medium intentional leak characteristics. Enter **Leak 2** for this mask: • Philips Respironics PerforMax oro-nasal mask [EE] • AF421, AF531, AF541 (EE)
3 Leak 3	AP111
4 Leak 4	Reserved for future use
Other 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.

4. Select the desired exhalation port type (Table 6-2). Select **Accept** to apply.



If you select an exhalation port that is not compatible with the selected mask, **Not allowed with current mask** is displayed.

NOTE: In ventilation modes, ET/tracheostomy tubes and most Philips Respironics masks require the use of an exhalation port. If you selected **ET/Trach** or **Leak 1** as a mask/patient interface, you may not select **None** as an exhalation port.

Table 6-2: Exhalation port selections

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 NOTE: If you select **None**, refer to the manufacturer's instructions to make sure the mask selected contains an exhalation port.	No

5. Run the exhalation port test if indicated in the table (see "Running the exhalation port test" on page 6-16 for instructions).

CAUTION: If you selected **PEV** or **Other** as an exhalation port, you must run an exhalation port test.

NOTE: 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.

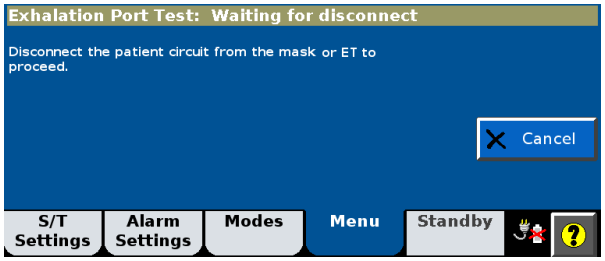
Running the exhalation port test

The exhalation port test is required and its window is automatically displayed when **PEV** or **Other** is selected.

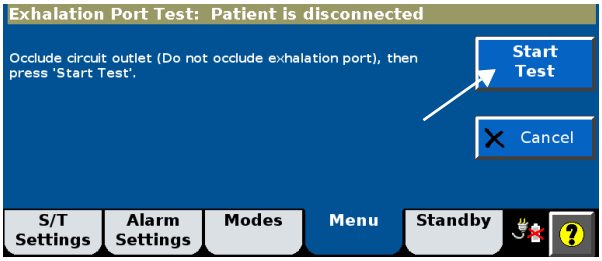
Procedure

Run the test as follows:

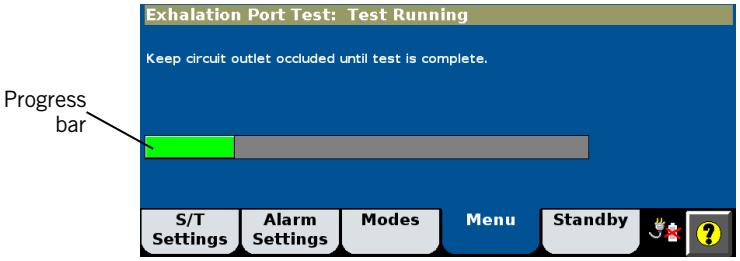
1. Disconnect the patient circuit from the mask/patient interface.



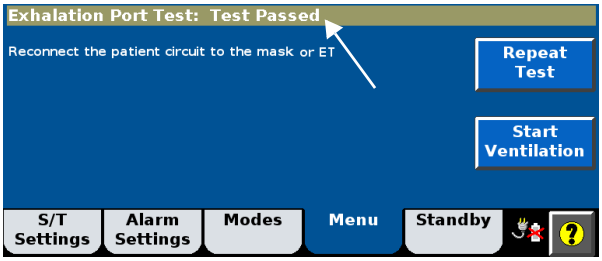
2. Occlude the circuit outlet. Select **Start Test**.



3. Wait while the test runs.



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



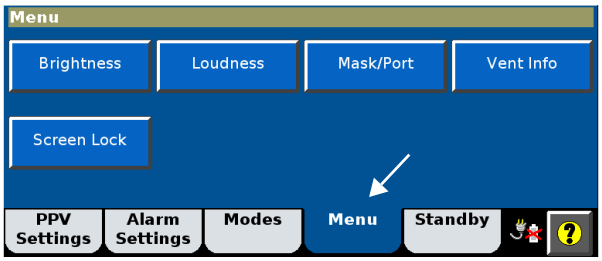
5. Reconnect the patient circuit to the mask/interface.
6. Select **Start Ventilation** to initiate ventilation.

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, 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.



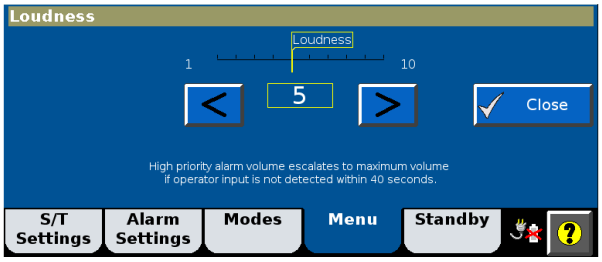
Brightness

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.

The **Alarm Volume Escalation** status is also displayed on this screen. See “Alarm Volume Escalation” on page E-11 for more information.

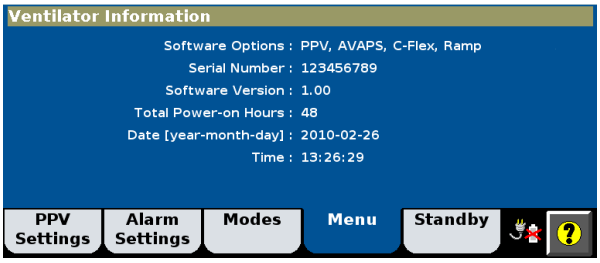


Mask/Port

See “Selecting the mask and exhalation port” on page 6-12.

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**, 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.

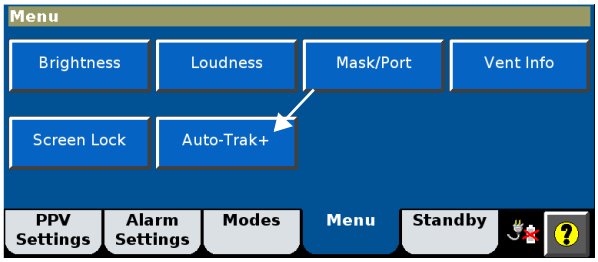
NOTE: If Screen Lock is active, the touchscreen remains locked even if an alarm becomes active.

Auto-Trak+

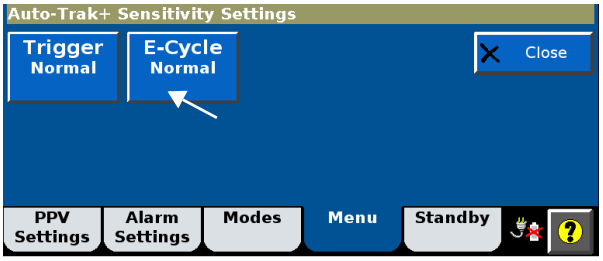
The **Normal** Auto-Trak settings work well for most patients. Pediatric patients, however, may benefit from more sensitive trigger settings, while some adult patients may benefit from more or less sensitive cycle settings.

Changing Auto-Trak+ settings

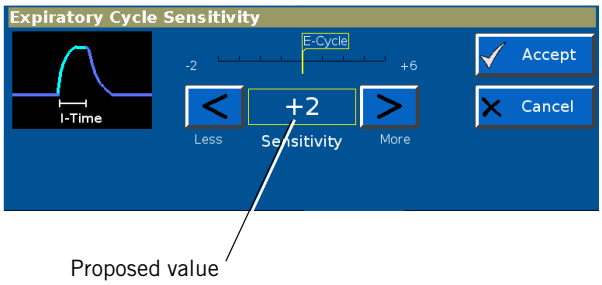
1. Select **Auto-Trak+** from the **Menu** window.



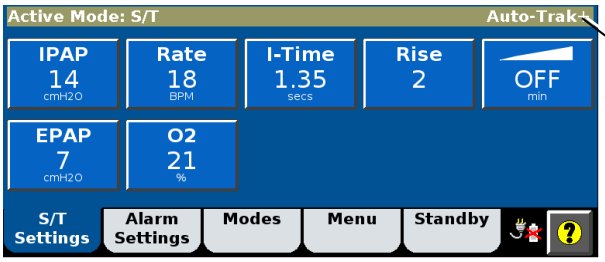
2. Select the desired adjustment. As an example, the **E-Cycle** adjustment is shown below.



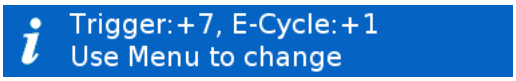
3. The setting window opens. Adjust the setting, referring to the pressure-time graphic which represents the effect on I-Time. Select **Accept** to apply.



When Auto-Trak+ is active (when either **Trigger** or **E-Cycle** is set to a value other than **Normal**), the ventilator setting window displays **Auto-Trak+**.



Additionally, after power-on the **Messages** list displays the Auto-Trak+ settings for 5 minutes.

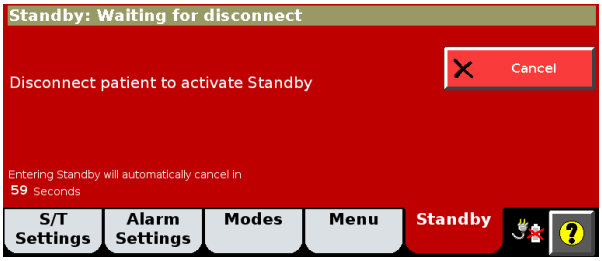


Standby

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 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:

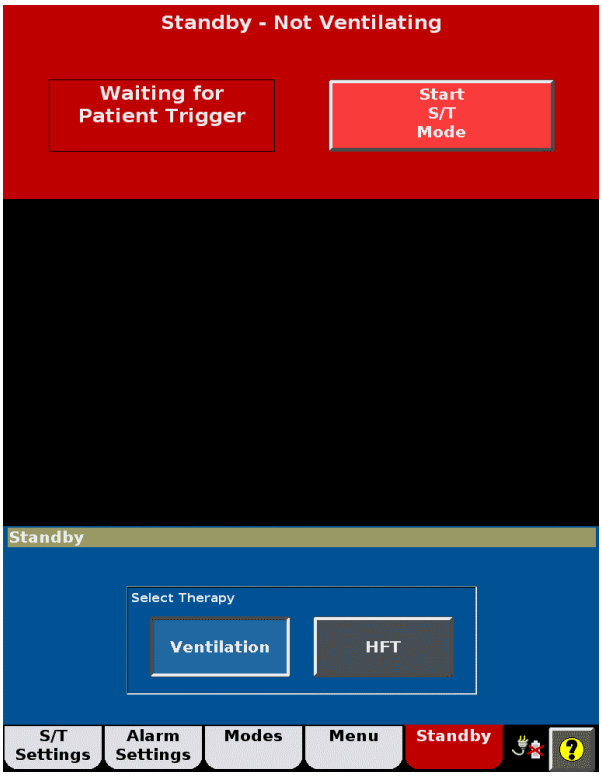
1. Select **Standby**. The **Entering Standby** window opens.



NOTE: Remove the mask/patient interface in order to enter standby. The ventilator will not enter 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.

NOTE: Standby mode disables alarms and should be used when the patient is disconnected.

2. Disconnect the patient from the ventilator now. The ventilator enters standby and displays the **Standby** screen.



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 **Restart Mode** button.

Help function

Select the help button to display additional information.

Help messages are displayed:

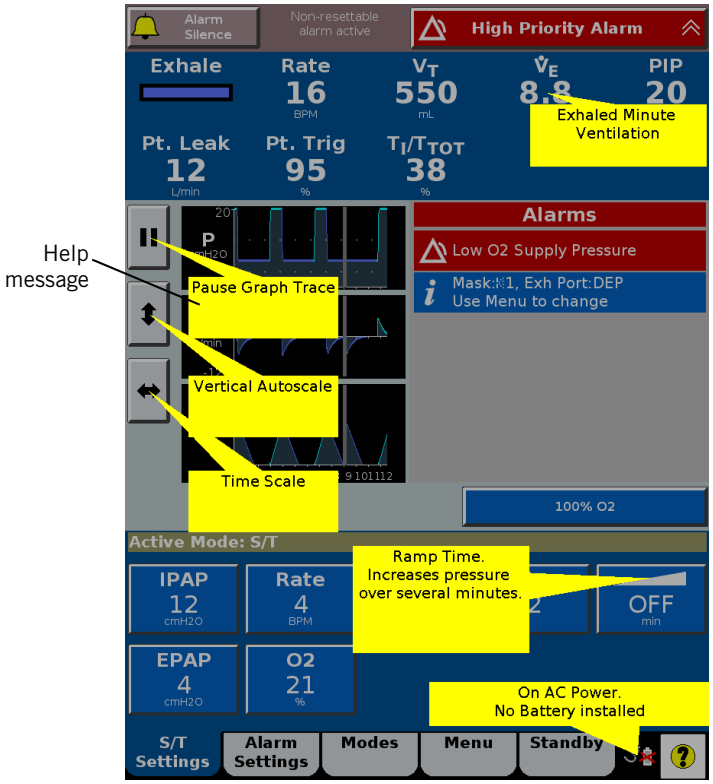


Table of modes and control settings

Table 6-3: Modes and control settings with ranges

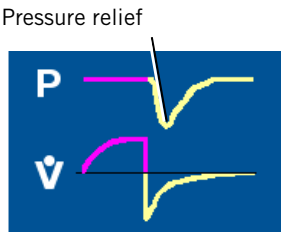
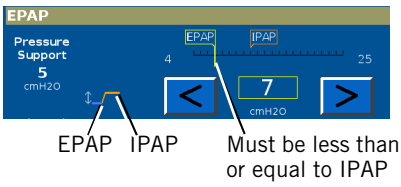
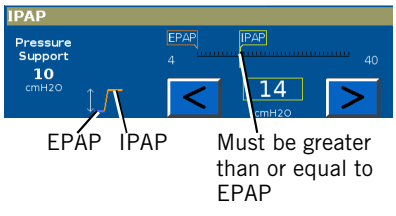
Setting	Description		Range
Modes			
Modes	Ventilation mode		AVAPS, CPAP, S/T, PCV Optional: PPV
Control settings			
C-Flex	Enhances traditional CPAP by reducing the pressure at the beginning of exhalation—a time when patients may be uncomfortable with CPAP—and returning it to the set CPAP pressure before 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.		OFF, 1 to 3
CPAP	Continuous positive airway pressure. The baseline pressure applied during the expiratory phase. Applies in CPAP mode only.		4 to 25 cmH_2O
E-Cycle (optional)	Expiratory Cycle Sensitivity. 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 Auto-Trak setting used when Auto-Trak+ is not enabled. Applies only when the optional Auto-Trak+ feature is installed.		-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
IPAP	Inspiratory positive airway pressure. The application and maintenance of pressure above atmospheric at the airway throughout the inspiration phase of positive-pressure mechanical ventilation.		4 to 40 cmH_2O

Table 6-3: Modes and control settings with ranges (continued)

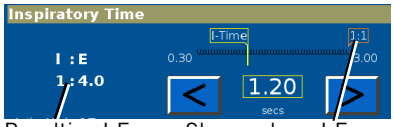
Setting	Description		Range
I-Time (Inspiratory Time)	Time to deliver the required gas. Inverse ratio ventilation is not allowed.	 Resulting I:E ratio. Shows where I:E ratio becomes inverse	0.30 to 3.00 secs
Max E	The maximum elastance (volume assist) value used by the PPV mode to overcome the elastance 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: PPV limits are not intended to be the primary ventilator alarms and should not be substituted for the alarms found in the Alarm Settings window.** **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.**		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 $cmH_2O/L/s$
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: PPV limits are not intended to be the primary ventilator alarms and should not be substituted for the alarms found in the Alarm Settings window.** **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.**		200 to 3500 mL

Table 6-3: Modes and control settings with ranges (continued)

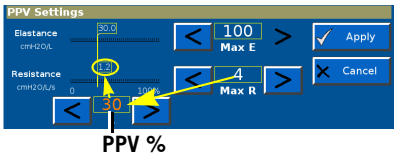
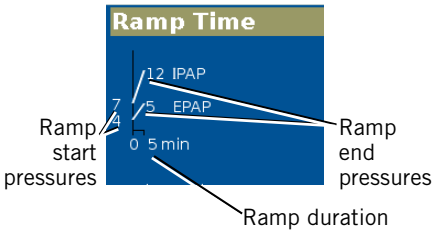
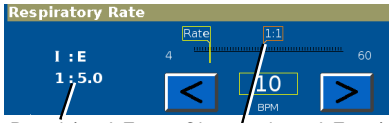
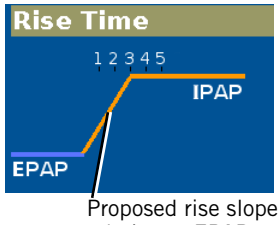
Setting	Description		Range
Min P (AVAPS Minimum IPAP Pressure)	The minimum pressure to be applied. NOTE: When you adjust the AVAPS minimum and maximum pressures, remember that IPAP is adjusted to meet the target value. If the calculated target pressure is outside of the minimum and maximum pressure range, the target volume will not be achieved. Applies in AVAPS mode only.		5 to 30 cmH_2O
O_2	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. $\text{Initial CPAP/EPAP} = \frac{\text{CPAP/EPAP} + 4\ \text{cmH2O}}{2}$ $\text{Initial IPAP} = \text{Initial EPAP} + \frac{(\text{IPAP} - \text{EPAP})}{2}$		OFF, 5 to 45 min
Rate (Respiratory Rate)	Respiratory frequency or number of breaths per minute. Inverse ratio ventilation is not allowed.		4 to 60 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.		1 to 5 (1 is fastest)

Table 6-3: Modes and control settings with ranges (continued)

Setting	Description	Range
Trigger (optional)	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 Auto-Trak setting used when Auto-Trak+ is not enabled. Applies only when the optional Auto-Trak+ feature is installed.	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.	200 to 2000 mL

Table 6-4: Alarm settings

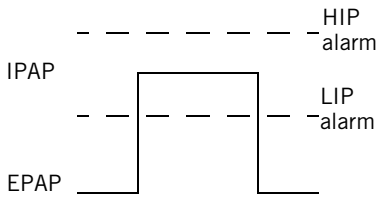
Setting	Description	Range
Hi Rate (High Rate Alarm)	High total breath rate.	5 to 90 BPM
Lo Rate (Low Rate Alarm)	Low total breath rate.	1 to 89 BPM
	NOTE: In non-CPAP modes, the Low Rate Alarm is essentially off if set below the Respiratory Rate setting.	
Hi V_T (High Tidal Volume Alarm)	High exhaled tidal volume.	200 to 3500 mL
Lo V_T (Low Tidal Volume Alarm)	Low exhaled tidal volume.	OFF to 1500 mL
HIP (High Inspiratory Pressure Alarm)	High pressure at the patient airway.	5 to 50 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	Low pressure at the patient airway.	OFF to 40 cmH_2O
	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 T 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.	
		

Table 6-4: Alarm settings (continued)

Setting	Description	Range
LIP T (Low Inspiratory Pressure Delay Time)	The interval from the detection of low inspiratory pressure until the alarm becomes active.	5 to 60 secs
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	Low expiratory minute volume.	OFF to 99.0 L/min

Chapter 7. High flow therapy

The high flow therapy (HFT) feature is available for 3.00 software and above, as well as V60 Plus. HFT is accessed from the **Standby** mode. For more information, see “Standby” on page 6-19.

For principles of operation, see “High flow therapy” on page 4-6.

WARNING: **When transitioning from a high flow therapy interface to an NIV mask, ensure that an exhalation port is placed in the circuit and is unobstructed to reduce the risk of CO2 rebreathing.**

WARNING: **When transitioning from ventilation to high flow therapy, remove the NIV mask and use only a Philips-approved high flow patient interface to minimize pressure build-up and patient discomfort.**

WARNING: **When transitioning from high flow therapy to ventilation, remove the nasal cannula as these are restrictive and may defeat alarms such as patient disconnect. Using a nasal cannula in an NIV mode may lead to hypercarbia due to the inability to provide pressure support.**

WARNING: **Patient alarms are not available during high flow therapy (HFT) as the therapy uses an open system. A nasal cannula occupies only a portion of the nares and patients can breathe through their mouth, which prevents estimation of patient parameters such as tidal volume, respiratory rate, pressure, and minute ventilation. Provide external monitoring, including oximetry, to inform the clinician of a change in the patient's condition.**

WARNING: **During high flow therapy (HFT), verify that an occlusive patient interface is not being used. Occlusive patient interfaces include a cannula fully sealed within the nares, an NIV mask, or a direct connection to a tracheostomy tube or endotracheal tube. Remove any occlusive interface immediately as this may expose the patient to unintended high pressures.**

NOTE: High flow therapy (HFT) is accessed only from the Standby window. Standby mode cannot be entered if a nasal cannula is connected to the circuit.

Circuit setup

See “Installing the patient circuit” on page 5-3 for circuit configuration.

High flow nasal cannula setup

Use either the AC611 with FEP Connector (Figure 7-1) or the AC611 22 mm (Figure 7-2), which connects directly to the patient circuit.

Connecting to a circuit with an FEP (filter exhalation port) installed

Insert the AC611 FEP Connect into the FEP, making sure the perforations in the port are completely blocked.

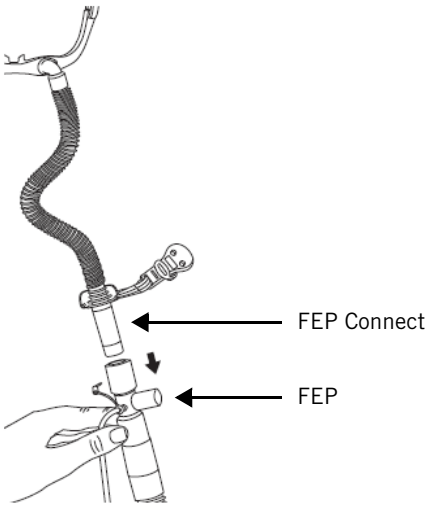


Figure 7-1: High flow nasal cannula using the FEP Connect

Connecting directly to a 22 mm circuit

Remove the DEP/FEP. Connect the high flow nasal cannula with 22 mm connector directly to the circuit.

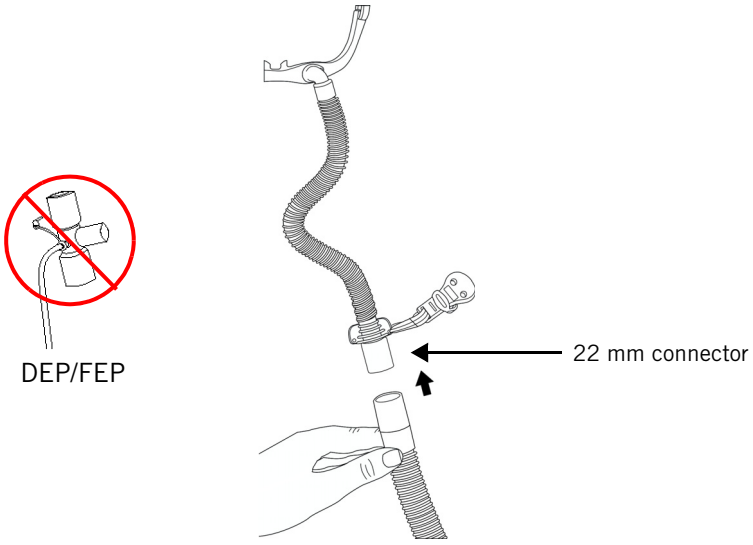
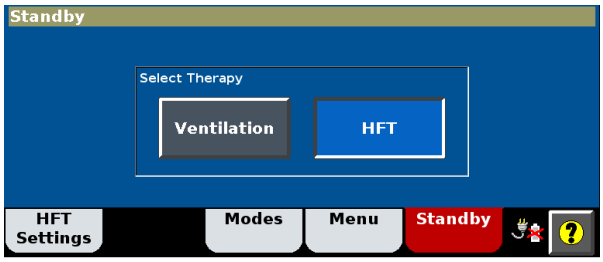


Figure 7-2: High flow nasal cannula, 22 mm connection

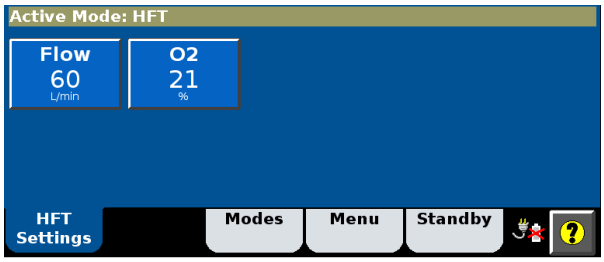
Changing from an NIV mode to high flow therapy

Follow these instructions to use the V60/V60 Plus Ventilator for high flow therapy (HFT).

1. Select **Standby**. The **Entering Standby** window opens.
2. Remove the patient mask or ET interface to enter **Standby**.
3. Install a Philips-approved nasal cannula (Figure 7-1 and Figure 7-2 above) or a high flow tracheostomy interface on the patient circuit.
4. Select **HFT**.



5. From the **Active Mode** window, you can adjust **Flow** and **O_2%**.



6. Press **Start HFT**.

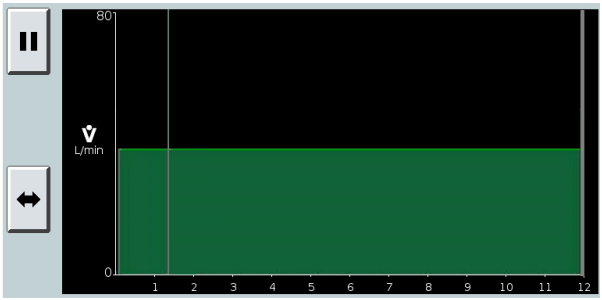
7. The **High Flow Therapy Active** message is displayed during **HFT**.

8. Apply the HFT interface to the patient.

9. Note the low priority alarm stating that patient alarms are disabled during HFT. Press alarm reset to confirm this message.

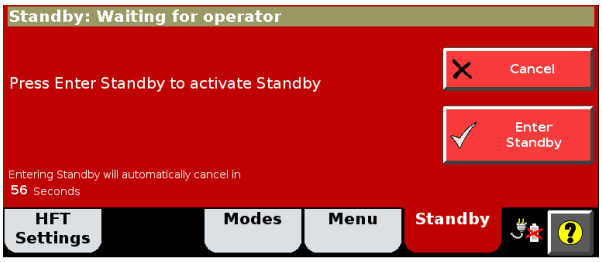
Viewing and pausing the HFT graph

A flow graph is displayed during high flow therapy. Press the Pause button to view an event.

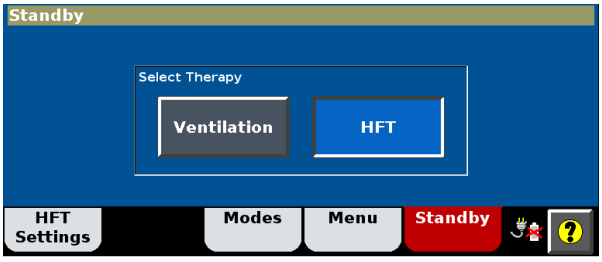


Changing from high flow therapy to an NIV mode

1. Verify that the nasal cannula is removed from the patient and disconnected from patient circuit.
2. Select **Standby** to open the Standby window.
3. Press the **Enter Standby** button.

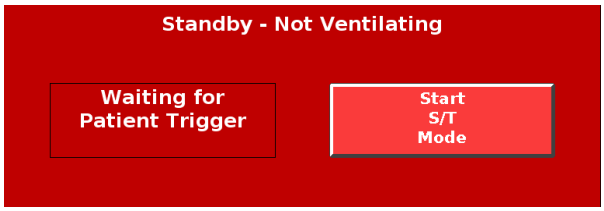


4. In the **Select Therapy** window, press **Ventilat**ion.



5. Replace the high flow patient interface with a Philips-approved NIV mask.

6. Review patient settings and alarms.
7. Install the appropriate interface on the patient.
8. Verify that the ventilator detects the patient's breath to activate ventilation, or press the **Start Mode** button.



HFT alarms and messages

Table 7-1 is a list of alarms and other messages displayed by the ventilator, along with descriptions, suggested corrective actions, and other information. 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 7-1: HFT Alarm and other messages: summary and troubleshooting

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Cannot Reach Target Flow	Displays when HFT (high flow therapy) is active. Indicates that flow target is not achieved.	Check the patient. Check that the nasal cannula size is appropriate for the flow setting. Check that an occlusive interface is NOT in use (a cannula fully sealed within the nares, an NIV mask or direct connection to an ETT/trach). Check for an occlusion, kink or liquid in the patient circuit.	Low (66)	No	Yes	Yes
Patient alarms are disabled during HFT	Displays when HFT (high flow therapy) is active. Patient alarms are not available in this therapy.	Manually reset to confirm and clear the audible alarm.	Low/ Infor-mation (68)	Yes	No	Yes
Patient Circuit Occluded	Displays when HFT (high flow therapy) is active. Gas flow to the patient is obstructed.	Check the patient. Check that an occlusive interface is NOT in use (a cannula fully sealed within the nares, an NIV mask or direct connect to an ETT/trach). Check for an occlusion, kink or liquid in the patient circuit. If problem persists, provide alternative ventilation.	High (67)	No	Yes	Yes

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Chapter 8. Patient monitoring

The ventilator displays numeric patient data in the patient data window and real-time graphics in the waveform window (Figure 8-1). Numeric patient data is updated every breath.Table 8-1 on page 8-2 lists the ventilator's monitored parameters.

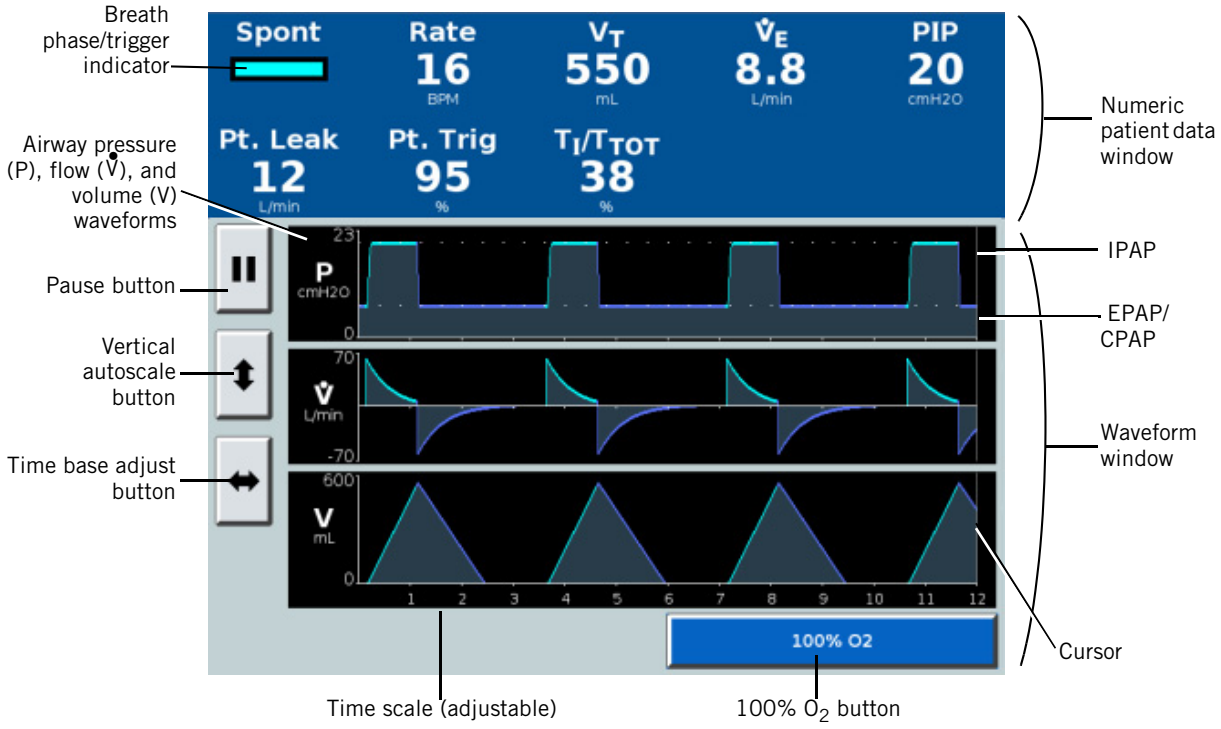


Figure 8-1: Patient data and waveform window

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

Table of monitored parameters

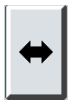
Table 8-1: Monitored parameters

Parameter	Definition
Patient data window	
Breath phase/trigger indicator	**Spont** (spontaneous): Inspiratory phase, patient-triggered breath (color: turquoise) **Timed:** Inspiratory phase, ventilator-triggered breath (color: orange) **Exhale:** Expiratory phase (color: blue)
PIP	Peak inspiratory pressure. The highest patient pressure during the previous breath cycle.
Pt. Leak	Estimated patient leak or unintentional leak. Average during the previous breath cycle. Displayed only after a suitable exhalation port and mask/patient interface are selected.
Pt. Trig	Patient-triggered breaths, as a percentage of total breaths over the last 15 minutes.
Rate	Respiratory rate or total breathing frequency. Moving average over the last 6 breaths (or 15 seconds).
T_I/T_{TOT}	Inspiratory duty cycle or inspiration time divided by total cycle time. Moving average over the last 8 breaths.
Tot.Leak	Estimated total leak. Average during the previous breath cycle. Displayed before a suitable exhalation port and mask/patient interface are selected.
$\dot{V}_E$	Estimated minute ventilation. The product of tidal volume (spontaneous and timed) and rate (spontaneous and timed). Moving average over the last 6 breaths.
V_T	Estimated exhaled tidal volume. Moving average over the last 6 breaths. It is body temperature pressure saturated (BTPS) compensated.
Waveform window	
P *waveform*	Airway pressure. Where applicable, dotted lines represent target IPAP and EPAP.
$\dot{V}$ *waveform*	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.
V *waveform*	Estimated patient volume. In AVAPS mode, the dotted line represents target volume.

Scaling the waveform axes

Scale the vertical and horizontal waveform 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.

Freezing and unfreezing waveforms

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

The cursor makes one complete sweep across the waveform and then displays the pause in progress symbol. The graphic display is then frozen, and the cursor is visible in the middle of the display (Figure 8-2). Reposition the cursor with the navigation ring or by touching the waveform screen. Data values at cursor location for pressure, flow, and volume are displayed in the white boxes.

Unfreeze the waveforms with the resume button.

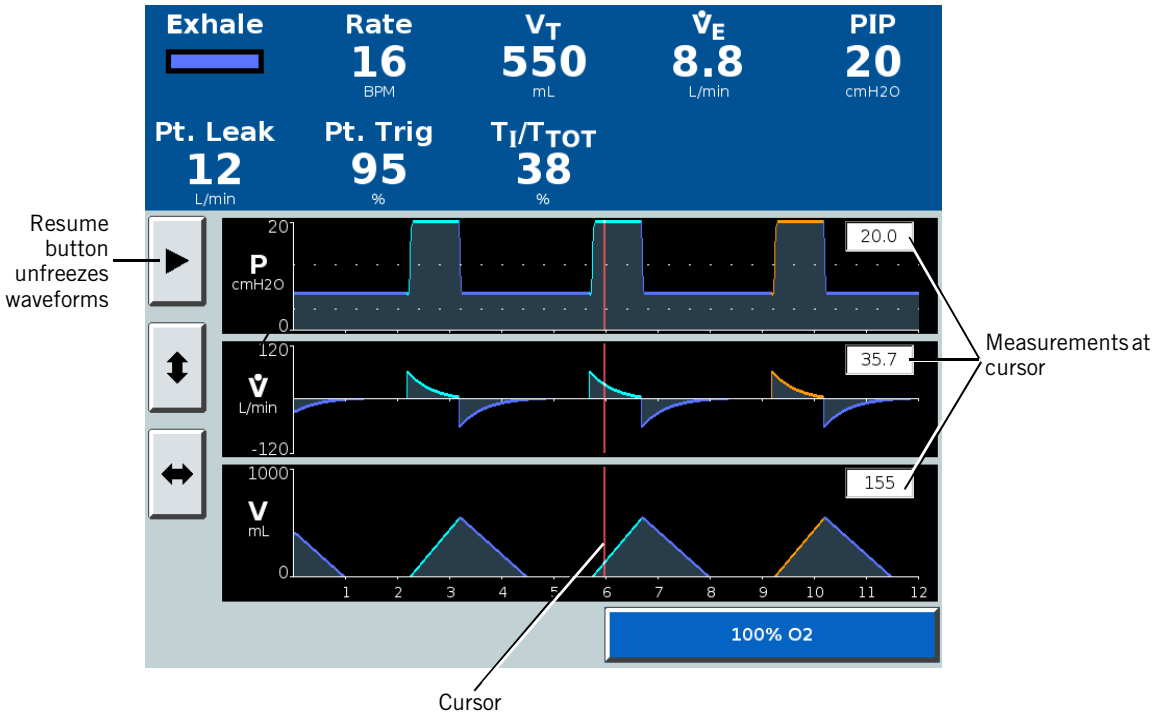


Figure 8-2: Waveform window with frozen screen

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Chapter 9. Alarms and messages

Alarms and messages on the ventilator alert you to situations that require your attention. The ventilator can also actuate remote alarms. Figure 9-1 on page 2 shows the visual alarm characteristics. Table 9-2 on page 9-6 summarizes the different types of alarm and tells you how to respond to each.

Responding to alarms

WARNING: **If AC power fails and the backup battery is not installed or 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 in most ventilators with passive exhalation ports, when power is lost, sufficient air is not provided through the circuit and exhaled air may be rebreathed.**

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. 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.

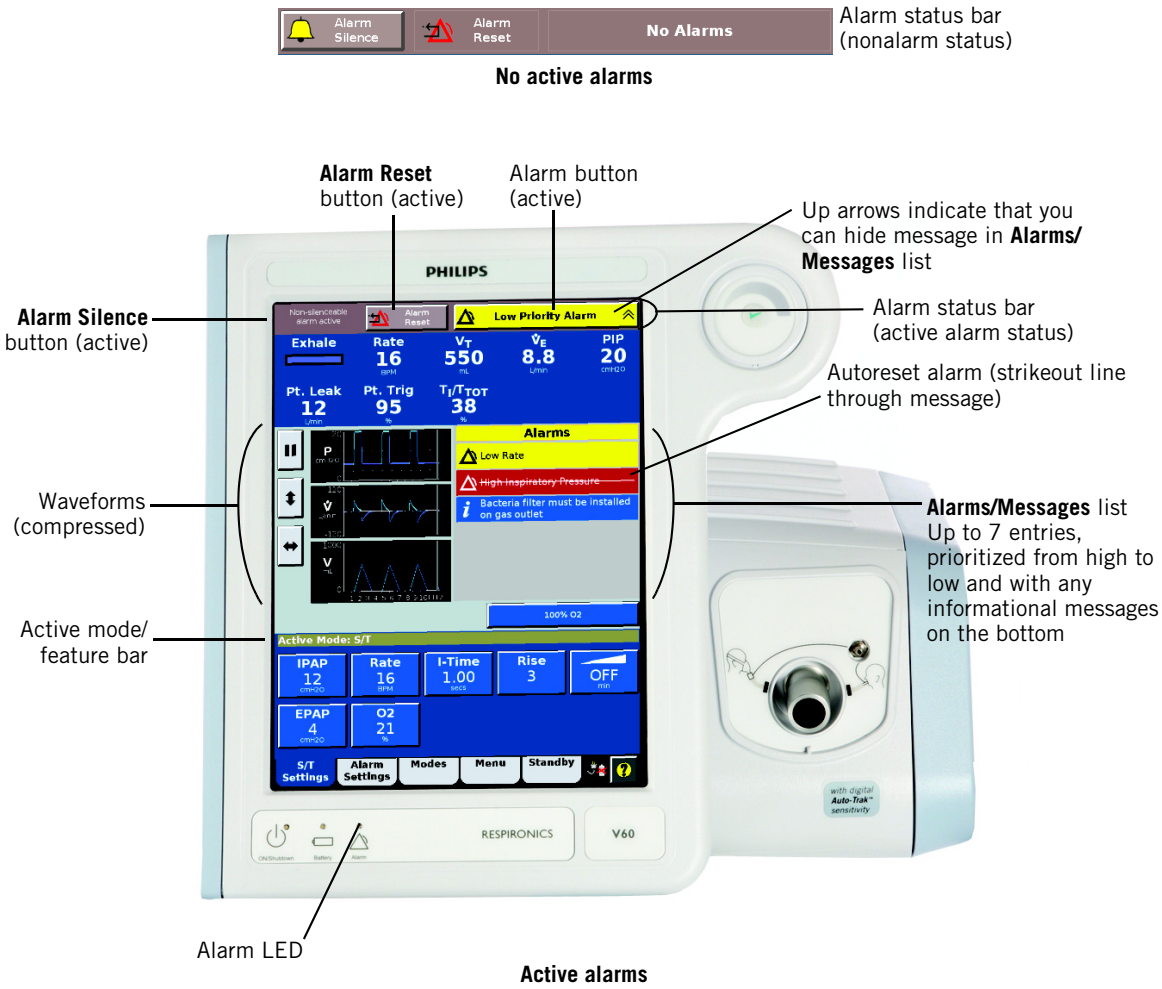


Figure 9-1: Visual alarm indications

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 strike-out 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 seconds	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 minutes)	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.

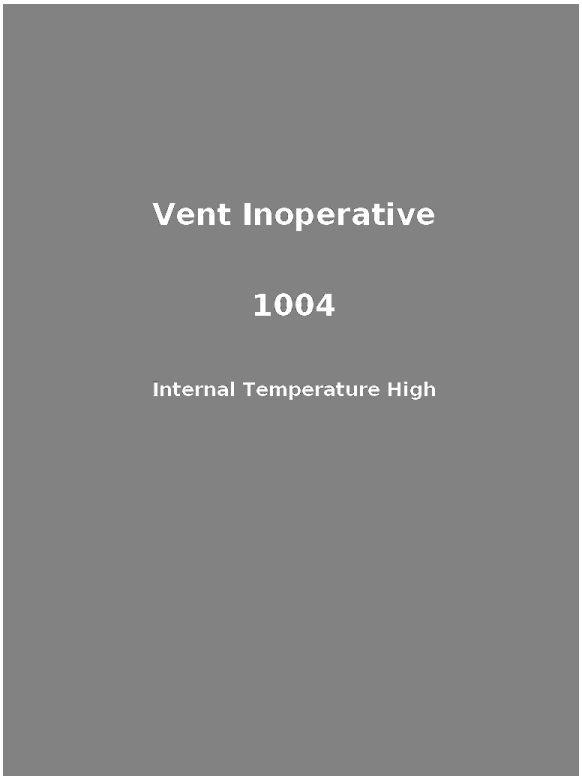


Figure 9-2: Vent Inoperative screen

Setting alarm loudness

You can set the alarm loudness from the **Menu** window (see “Loudness” on page 6-17).

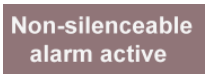
Silencing alarms

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 removed, 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. 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	Autoresettable	Silenceable
AVAPS: Target V_T Exceeded. Min Pressure Too High	AVAPS 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.	Information (60)	No	Yes	N/A
AVAPS: Target V_T Not Achieved. Insufficient Max Pressure	AVAPS 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.	Information (59)	No	Yes	N/A
Bacteria filter must be installed onto gas outlet	An inspiratory bacteria filter must be installed on the patient gas outlet port.	Confirm that a bacteria filter is installed. Install a bacteria filter if one is not present.	Information (63)	Yes	N/A	N/A
Cannot Reach Target Flow	Displays when HFT (high flow therapy) is active. Indicates that flow target is not achieved.	Check the patient. Check that the nasal cannula size is appropriate for the flow setting. Check that an occlusive interface is NOT in use (a cannula fully sealed within the nares, an NIV mask or direct connection to an ETT/trach). Check for an occlusion, kink or liquid in the patient circuit.	Low (66)	No	Yes	Yes
Check Vent: *description of failure*	See Table 9-3 on page 9-11					

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
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.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (45)	Yes	Yes	Yes
High O_2 Supply Pressure	O_2 inlet pressure is greater than 92 psig, so O_2 enrichment ends. Autoresets when O_2 supply pressure falls below 87 psig.	Check the patient. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (49)	No	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 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (56)	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 secs.	Check the patient. Check for large leaks. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (55)	Yes	Yes	Yes
Low Inspiratory Pressure	Measured inspiratory pressure is less than the LIP setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (46)	Yes	Yes	Yes
Low Internal Battery	Battery can provide operating power for only an additional 15 minutes under nominal conditions. Autoresets when ventilator is connected to AC power.	Connect ventilator to AC power. Provide alternative ventilation.	High (43)	No	Yes	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autoresettable	Silenceable
Low Leak–CO_2 Rebreathing Risk	Estimated volume of exhaled gas returned to the patient is high. 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 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. Reduce nebulizer flow or switch to a vibrating mesh nebulizer.	High (42)	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 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (53)	Yes	Yes	Yes
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. 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. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (48)	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 sec. 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 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (52)	Yes	Yes	Yes

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Low Tidal Volume	Estimated 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 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (54)	Yes	Yes	Yes
Mask:*x*, Exh Port:*y* Use Menu to change	Displays when ventilator is turned on. Displays selected mask type and exhalation port.	Select mask and port from Menu tab. Message is removed when user confirms selections, or after 5 minutes.	Information (61)	No	Yes	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 high/low O_2 source is the problem and correct. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (47)	No	Yes	Yes
Patient alarms are disabled during HFT	Displays when HFT (high flow therapy) is active. Patient alarms are not available in this therapy.	Manually reset to confirm and clear the audible alarm.	Low/ Information (68)	Yes	No	Yes
Patient Circuit Occluded	Proximal pressure and patient flow are low. Patient circuit occluded.	Check the patient. Check the patient circuit for bulk liquid, crimps, or blocked filter. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (40)	Yes	Yes	Yes
Patient Circuit Occluded	Displays when HFT (high flow therapy) is active. Gas flow to the patient is obstructed.	Check the patient. Check that an occlusive interface is NOT in use (a cannula fully sealed within the nares, an NIV mask or direct connect to an ETT/trach). Check for an occlusion, kink or liquid in the patient circuit. If problem persists, provide alternative ventilation.	High (67)	No	Yes	Yes

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Patient Disconnect	Patient is no longer connected to the ventilator, either through circuit or mask, or the patient circuit is disconnected from the ventilator and the patient is no longer receiving ventilatory support. Ventilation continues. NOTE: The Patient Disconnect alarm is triggered when 11 seconds have elapsed.	Check the patient. Reconnect patient circuit. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (39)	Yes	Yes	Yes
Power has been restored	Power is restored following loss of power. The ventilator restarts and continues ventilation in the set mode before power was lost.	Check the patient. Confirm ventilator and alarm settings are appropriate.	Information (62)	Yes	Yes	N/A
PPV Max P	Computed target pressure is greater than the PPV maximum pressure alarm limit. 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. Target pressure is limited. At first, an information message. If condition persists for three consecutive PPV inspirations, 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.	Information/ High (51)	Yes	Yes	Yes
PPV Max V	Estimated delivered patient tidal volume is greater than the PPV maximum volume alarm limit. 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. Ventilator cycles to exhalation. At first, an information message. If condition persists for three consecutive PPV inspirations, 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.	Information/ High (50)	Yes	Yes	Yes

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	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 (44)	Yes	Yes	Yes
Proximal Pressure Line Disconnect	Proximal pressure low for a few seconds. Proximal pressure line is disconnected. Air flow to the patient continues.	Check the patient. Reconnect proximal pressure line. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (41)	Yes	Yes	Yes
Running on Internal Battery	System is powered by the internal battery. Autoresets when ventilator is connected to AC power.	Connect ventilator to AC power.	Low (57)	Yes	Yes	Yes
Trigger:+*x*, E-Cycle: +*x* Use Menu to change	Auto-Trak+ is active and using the displayed settings. This messages is displayed for 5 min after start-up.	Confirm that Auto-Trak+ settings are appropriate.	Information (61)	Yes	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.	Information (58)	Yes	Yes	N/A
Vent Inoperative *x* description of failure	See Table 9-4 on page 9-15					

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Check Vent: 1.8 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (21)	Yes	No	No
Check Vent: 3.3 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (22)	Yes	No	No
Check Vent: 5 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (23)	Yes	No	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Check Vent: 12 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (24)	Yes	No	No
Check Vent: 24 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (24)	Yes	No	No
Check Vent: 35 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (26)	Yes	No	No
Check Vent: Air Flow Sensor Calibration Data Error	Flow-related patient data is disabled. Oxygen concentration switches to 21% (ventilates with air only). Default volume used in AVAPS mode. Standby disabled. Volume, leak, disconnect, and occlusion alarms compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (13)	Yes	No	No
Check Vent: Alarm LED Failed	Technical failure.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (6)	Yes	No	No
Check Vent: Auxiliary Alarm Supply Failed	Backup alarm problem	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (20)	Yes	No	No
Check Vent: Backup Alarm Failed	Backup alarm problem	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	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 (18)	Yes	No	No
Check Vent: Barometer Sensor Range 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 (19)	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 (35)	Yes	No	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
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 inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (34)	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 inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (33)	Yes	No	No
Check Vent: Blower Stalled	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (2)	No	No	No
Check Vent: Cooling Fan Speed Error	Overheating of ventilator possible	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (36)	Yes	No	No
Check Vent: CPU PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (29)	Yes	No	No
Check Vent: Data Acquisition PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (27)	Yes	No	No
Check Vent: Flash File System Error	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (37)	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 inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (30)	Yes	No	No
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 inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (31)	Yes	No	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Check Vent: Internal Temperature High Mtr	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (32)	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 (9)	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 (7)	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 (11)	Yes	No	No
Check Vent: Motor Control PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (28)	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 (16)	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 (14)	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 (15)	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 (17)	Yes	No	No
Check Vent: OVP Circuit Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (38)	Yes	No	No
Check Vent: Primary Alarm Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (4)	Yes	No	No
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 (10)	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 (8)	Yes	No	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
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 (12)	Yes	No	No
Check Vent: Ventilator Restarted	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (3)	Yes	No	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	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
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 (6)	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 (7)	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 (8)	Yes	No	No

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

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
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 (9)	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 (10)	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 (11)	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 (12)	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 (13)	Yes	No	No

Chapter 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.This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or federal laws. (Within this system, the backlight lamps in the monitor display contain mercury.)**

NOTE: It is the user's responsibility to comply with the information provided in this chapter.

NOTE: Cleaning and disinfection are most effective if soiling is not allowed to dry on a medical device.[1]

NOTE: Disinfection is most effective on medical devices that were previously cleaned.[1]

NOTE: For all V60/V0 Plus hardware accessories recommended by Philips, follow the cleaning and disinfection guidelines in this chapter. For multi-patient interface and circuit accessories, consult the product instructions for use. For single patient use accessories, no cleaning and disinfection is needed.

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, use only those cleaning and disinfecting agents listed in this manual.

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.

CAUTION: Never clean or disinfect the touchscreen with an abrasive brush or device, since this will cause irreparable damage.

CAUTION: Do not attempt to sterilize or autoclave the ventilator.

NOTE: 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)

Exterior and touchscreen disinfection

Approved cleaning agents

The following cleaning agent is acceptable for use on the touchscreen and exterior surfaces of the ventilator:

- Soapy water with Medivators Intercept Detergent*, per manufacturer's recommendation at 1/3 oz (10 mL) per gallon of warm tap water. Or equivalent.
  *(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.

CAUTION:	To prevent possible damage to the ventilator, use only those cleaning and disinfecting agents listed in this manual.
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.
CAUTION:	Never clean or disinfect the touchscreen with an abrasive brush or device, since this will cause irreparable damage.
CAUTION:	Do not attempt to sterilize or autoclave the ventilator.
NOTE:	Use of unapproved cleaning and disinfecting agents may cause damage to the enclosure, touchscreen, or parts of the ventilator.

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
Solution of 1 part 5% sodium hypochlorite (bleach) diluted in 9 parts deionized water.
3% hydrogen peroxide

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.

Bacteria filter, patient circuit, and other accessories

Follow the manufacturer's instructions that accompany the accessory.

WARNING: To prevent patient or ventilator contamination, inspect and replace the main flow bacteria filter between patients and at regular intervals (or as stated by the manufacturer).

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

CAUTION: Because some environments cause a quicker collection of lint and dust than others, inspect the filters more often when needed. The air inlet filter should be replaced; the cooling fan filter should be cleaned.

CAUTION: To ensure proper system performance, use a Respironics-approved air inlet filter.

Preventive maintenance

Perform preventive maintenance on your Respironics V60/V60 Plus Ventilator according to the schedule in Table 10-2. You can view the hours of ventilator operation in the **Vent Info** window ("Vent Info (ventilator information)" on page 6-18). The following subsections provide details for some of these preventive maintenance procedures.

Table 10-2: Schedule of preventive maintenance

Frequency	Component	Maintenance
Between patients and per institutional guidelines	Patient circuit	Per manufacturer recommendations.
	Main flow bacteria filter	Replace per institutional guidelines.
Every month	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 inlet filter	Inspect and replaced if needed
Every year	Backup battery	Inspect, test, and replace if needed*
	Ventilator	Preventive maintenance*
As required	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 inlet filter

Replace the air inlet filter as follows, referring to Figure 10-1.

1. Power down the ventilator and disconnect it from AC power. Remove ventilator from cart, if applicable.
2. Turn the captive D-ring fastener counter-clockwise one-quarter turn and release. Remove the side panel.
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. Replace the side panel, and push in and turn the D-ring fastener one-quarter turn until it locks.

Figure 10-1: Replacing the air inlet filter

Cleaning or replacing the cooling fan filter

Clean or replace the cooling fan filter as follows, referring to Figure 10-2:

1. Insert a small, flat blade driver tip between the foam filter and the filter retaining cover (Figure 10-2).
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.

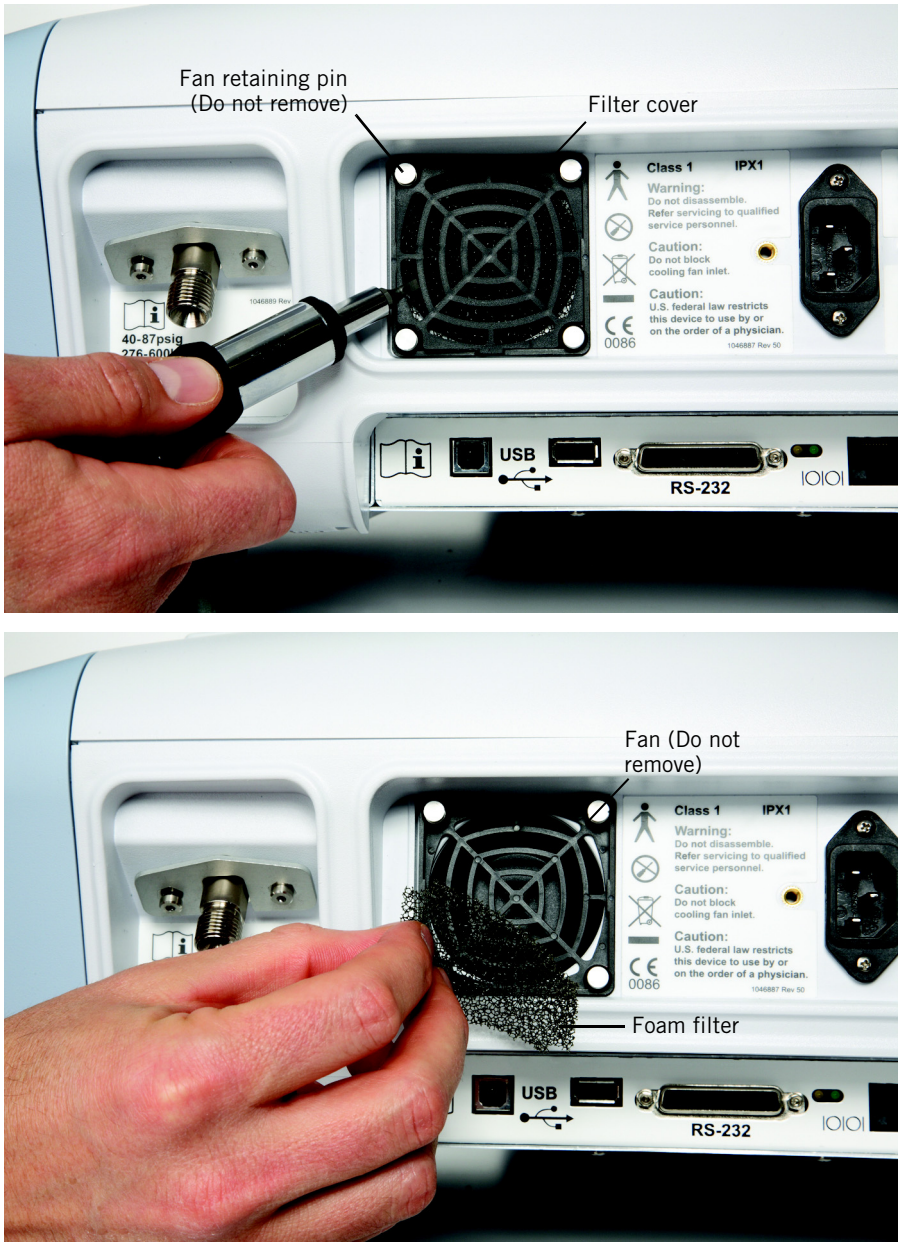


Figure 10-2: Replacing the cooling fan filter

Removing and replacing the battery

See “Installing the optional battery” on page A-3.

Disposal

WARNING: This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or federal laws. (Within this system, the backlight lamps in the monitor display contain mercury.)

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 between patient use

Follow the steps below when storing the ventilator between patient use:

1. Ensure that the patient circuit is assembled and installed properly as described in “Installing the patient circuit” on page 5-3.
2. Plug the ventilator into an AC outlet and verify that the power source symbol is displayed.
3. Adjust settings to hospital defaults.
4. Check oxygen cylinder fill status (if applicable).
5. Ensure oxygen cylinders are turned off.
6. Ensure the environmental specifications are met. Refer to Table 11-8: “Environmental specifications” on page 11-6.

Service and repairs

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

A Respironics V60/V60 Plus Ventilator Service Manual is available, PN 1049766. 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 optional battery” on page A-3 for more information. Ship the battery and ventilator separately in appropriate packaging in conformance with federal, state, and local regulations.

Chapter 11. Technical specifications

Control settings

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

Table 11-1: Control setting ranges, resolutions, and accuracies

Parameter	Range	Resolution	Performance Accuracy	Factory default
Mode settings				
Modes	AVAPS, CPAP, S/T, PCV, PPV (optional)	N/A	N/A	S/T
Control settings				
C-Flex	OFF, 1 to 3	1	N/A	2
CPAP	4 to 25 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	4 cmH_2O
EPAP	4 to 25 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	4 cmH_2O
Flow (High flow therapy, 3.00 software and above, and V60 Plus)	10 to 80 L/min	5 L/min	N/A	35 L/min
IPAP	4 to 40 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	12 cmH_2O
I-Time (Inspiratory Time)	0.30 to 3.00 sec	0.05 sec	± 0.03 sec	1.00 sec
Max E	0 to 100 cmH_2O/L	1 cmH_2O/L	N/A	15 cmH_2O/L
Max P (PPV Maximum Pressure Limit)	5 to 40 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	20 cmH_2O
Max P (AVAPS Maximum IPAP Pressure)	6 to 40 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	25 cmH_2O
Max R	0 to 50 cmH_2O/L/sec	1 cmH_2O/L/s	N/A	4 cmH_2O/L/s
Max V (PPV Maximum Volume Limit)	200 to 3500 mL	5 mL	± 15%	1000 mL
Min P (AVAPS Minimum IPAP Pressure)	5 to 30 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	10 cmH_2O
O_2 (Oxygen)	21 to 100%	1%	± 5%	21%
PPV %	0 to 100%	1%	N/A	30%

Table 11-1: Control setting ranges, resolutions, and accuracies (continued)

Parameter	Range	Resolution	Performance Accuracy	Factory default
Ramp Time	OFF, 5 to 45 min	5 min	± 1 sec	OFF
Rate (Respiratory Rate)	4 to 60 BPM	1 BPM	± 1 BPM	4 BPM
Rise (Rise Time)	1 to 5	1	N/A	3
V_T (AVAPS Target Tidal Volume)	200 to 2000 mL BTPS	5 mL	± 15%	500 mL

Table 11-2: Controls active in Respironics V60/V60 Plus 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

Patient data

Table 11-3: Patient data ranges, resolutions, and accuracies during ventilation

Parameter	Range	Resolution	Accuracy
Patient data window			
Breath phase/trigger indicator	Spont, Timed, Exhale	Color-coded display: Spont - turquoise, Timed - orange, Exhale - blue	N/A
PIP	0 to 50 cmH_2O	1 cmH_2O	± 2 cmH_2O
Pt. Leak	0 to 200 L/min BTPS	1 L/min	N/A
Pt. Trig	0 to 100%	1%	± 10%
Rate	0 to 90 BPM	1 BPM	± 1 BPM
T_I/T_{TOT}	0% to 91%	1%	± 5%
Tot.Leak	0 to 200 L/min BTPS	1 L/min	N/A
$\dot{V}_E$	0 to 99.0 L/min BTPS	0.1 L/min	± 15% or 0.3 L/min (whichever is greater)
V_T	0 to 3500 mL BTPS	1 mL	± 15% for volumes above 200 mL
Waveform window			
P *waveform*	0 to 50 cmH_2O	Time axis: 1 second	N/A
$\dot{V}$ *waveform*	-240 to 240 L/min BTPS	Time axis: 1 second	N/A
V *waveform*	0 to 3500 mL BTPS	Time axis: 1 second	N/A

Alarms

Table 11-4 lists the adjustable alarm ranges and resolutions. Table 9-2 on page 9-6 describes other, nonadjustable alarms.

Table 11-4: Adjustable alarm ranges and resolutions

Parameter	Range	Resolution	Factory default
Hi Rate (High Rate Alarm)	5 to 90 BPM	1 BPM	30 BPM
Lo Rate (Low Rate Alarm)	1 to 89 BPM	1 BPM	10 BPM
Hi V_T (High Tidal Volume Alarm)	200 to 3500 mL BTPS	5 mL	2500 mL
Lo V_T (Low Tidal Volume Alarm)	OFF, 5 to 1500 mL BTPS	5 mL	OFF
HIP (High Inspiratory Pressure Alarm)	5 to 50 cmH_2O	1 cmH_2O	50 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	OFF, 1 to 40 cmH_2O	1 cmH_2O	OFF
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	OFF, 0.1 to 99.0 L/min BTPS	0.1 L/min	OFF
LIP T (Low Inspiratory Pressure Delay Time Alarm)	5 to 60 sec	1 sec	20 secs

Menu window settings

Table 11-5: Menu window settings and ranges

Parameter	Range
Brightness	1 to 5
Loudness	1 to 10
Mask/ET Selection	ET/Trach, 1, 2, 3, 4, Other
Exhalation Port Selection	• DEP (Philips Respironics Disposable Exhalation Port • Whisper Swivel (Philips Respironics Whisper Swivel), • PEV (Philips Respironics Plateau Exhalation Valve), • Other (Other Exhalation Port), • None (No circuit exhalation port)
Screen Lock	Off, On
Auto-Trak+ (optional)	Trigger: Normal, +1 to +7. E-Cycle: -2 to -1, Normal, +1 to +6

Diagnostic mode functions

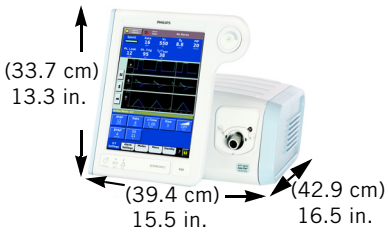
Table 11-6: Diagnostic mode functions

Function	Range
Language	English, Nederlands, Français, Deutsch, Italiano, Português, Español, Dansk, Suomi, Norsk, Svenska, Chinese, Japanese, Türkçe
Date/Time	--
Pressure Units	cmH_2O, hPa
Restore Default Settings	--
Software Options	--
Baud Rate	9,600, 19,200, 115,200
Alarm Volume Escalation*	Enable, Disable (default)
Significant Event Log	
Touch Screen Calibration	

* Available in Revision 2.30 software and above.

Physical characteristics

Table 11-7: Physical characteristics

Parameter	Specification
Weight	11.7 kg (25.7 lb) with optional battery 10.6 kg (23.3 lb) without battery
Dimensions	
V60 Ventilator stand	Maximum load: 32 kg (70.5 lb) Note: Maximum load in addition to the ventilator with battery is 20.3 kg (44.8 lb).
Installed weight and height (V60/V60 Plus Ventilator on stand, including accessories as listed)	V60/V60 Plus Ventilator with backup battery, ventilator stand, O_2 tank holder, circuit arm with mount, patient circuit, O_2 manifold with hoses Weight: 36.1 kg (79.5 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 11-8: Environmental specifications

Parameter	Specification
Temperature	Operating: 5 to 40 °C (41 to 104 °F) Storage/transport: -20 to 50 °C (-4 to 122 °F)
Relative humidity	Operating: 15 to 95% (noncondensing) Storage/transport: 10 to 95% relative (noncondensing)
Barometric pressure	Operating: 600 to 765 mmHg (approximately -61 to 1951 m (-200 to 6400 ft) relative to sea level) Storage/transport: 450 to 765 mmHg (approximately -61 to 4434 m (-200 to 14550 ft) relative to sea level)

Pneumatic specifications

Table 11-9: Pneumatic specifications

Parameter	Specification
High-pressure oxygen supply	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 V60/V60 Plus 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	Integrated blower
Inspiratory outlet (to patient port)	Connector: ISO 15 mm female/22 mm male conical

Electrical specifications

Table 11-10: Electrical specifications

Parameter	Specification
AC voltage	100 to 240 VAC
AC frequency	50/60 Hz
AC power	300 VA
Battery (optional)	PN 1076374: 14.4 V, 11.0 Ah, 163 Wh Maximum system current draw: 11 A Charge voltage: +16.9 V maximum Operating time: 360 minutes under normal conditions

Accessory requirements

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

Table 11-11: Accessory Requirements

Parameter	Specification
Compliance	For volume accuracy requirements, the patient circuit compliance should be 0.98 mL/cmH_2O. For all other performance requirements except volume accuracy, the maximum compliance of the circuit can be up to 2.8 mL/cmH_2O.
Resistance	Maximum resistance of the breathing circuit and attachments: 2.9 cmH_2O at 60 L/min.

Other specifications

Table 11-12: Other specifications

Parameter	Specification
Flow delivery	150 L/min at 40 cmH_2O at 1951 m (6400 ft) altitude (10% degradation in flow at 2286 m (7500 ft))
Flow range	-240 to 240 L/min BTPS
High flow therapy (3.00 software and above, and V60 Plus)	10 to 80 L/min BTPS NOTE: The maximum deliverable flow rate varies based on the orifice size of the nasal cannula and on the patient's nasal passage resistance.

Table 11-12: Other specifications (continued)

Parameter	Specification
Pressure range	4 to 40 cmH_2O
Dynamic pressure regulation	± (2 cmH_2O + 4% of target) NOTE: Negative (subatmospheric) pressure settings are not available.
Start-up time	Ready to ventilate 9 seconds after power on
Triggering, cycling, and leak tolerance	As per the Digital Auto-Trak Sensitivity algorithms (see "Auto-Trak Sensitivity" on page 4-3)
Inspiratory and expiratory pressure drop following equipment failure: measured at patient connection, when the recommended breathing system is in use.	< 4 cmH_2O (at 60 LPM) < 1.5 cmH_2O (at 30 LPM)
Time required for the oxygen concentration to change from 21% to 90% (during ventilation)	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 3 seconds for delivered volume of 500 mL, single limb 22 mm ID patient circuit.
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*	Average sound power level is approx. 54 dB(A) measured at the ventilator Average sound pressure level is approx. 46 dB(A) measured 1 meter from the ventilator

* In accordance with 3rd Edition testing methods

Appendix A. First-time installation

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

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.

Mounting the ventilator

CAUTION: To prevent possible damage to the ventilator, always secure it to its stand or securely place it on a flat, stable surface that is free of dirt and debris. Do not use the ventilator adjacent to, or stack it with, other equipment.

NOTE: If you mount the ventilator to a stand, make sure the stand is approved by Respironics.

The ventilator may be mounted to the optional stand or placed on a flat, stable, clean surface. Figure A-1 shows the installed ventilator.

Use the brakes to lock and unlock the wheels as needed. Make sure the wheels are unlocked before moving the ventilator.

Figure A-1: Respironics V60/V60 Plus Ventilator on stand

Installing the optional battery

WARNING: 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.**
- **Use the battery with the Respironics V60/V60 Plus Ventilator only.**

Install the battery as follows (Figure A-2).

1. Shut down and then unplug the ventilator.

NOTE: Failure to properly shut down the ventilator before battery installation may result in erroneous alarms after power-on.

2. Remove the side panel by turning the captive fastener a ¼ turn and releasing.
3. Using a 3-mm hex wrench, remove the battery bracket by removing two screws.
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.
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.

7. Attach the option label as shown in Figure 3-5 on page 3-8.

WARNING:	**Never attempt to disconnect or connect the battery during operation.**
CAUTION:	Following battery installation, if a **Check Vent** or **Vent Inoperative** alarm occurs when verifying ventilator operation, 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:	A new battery must be charged for at least 5 hours before being placed into service.

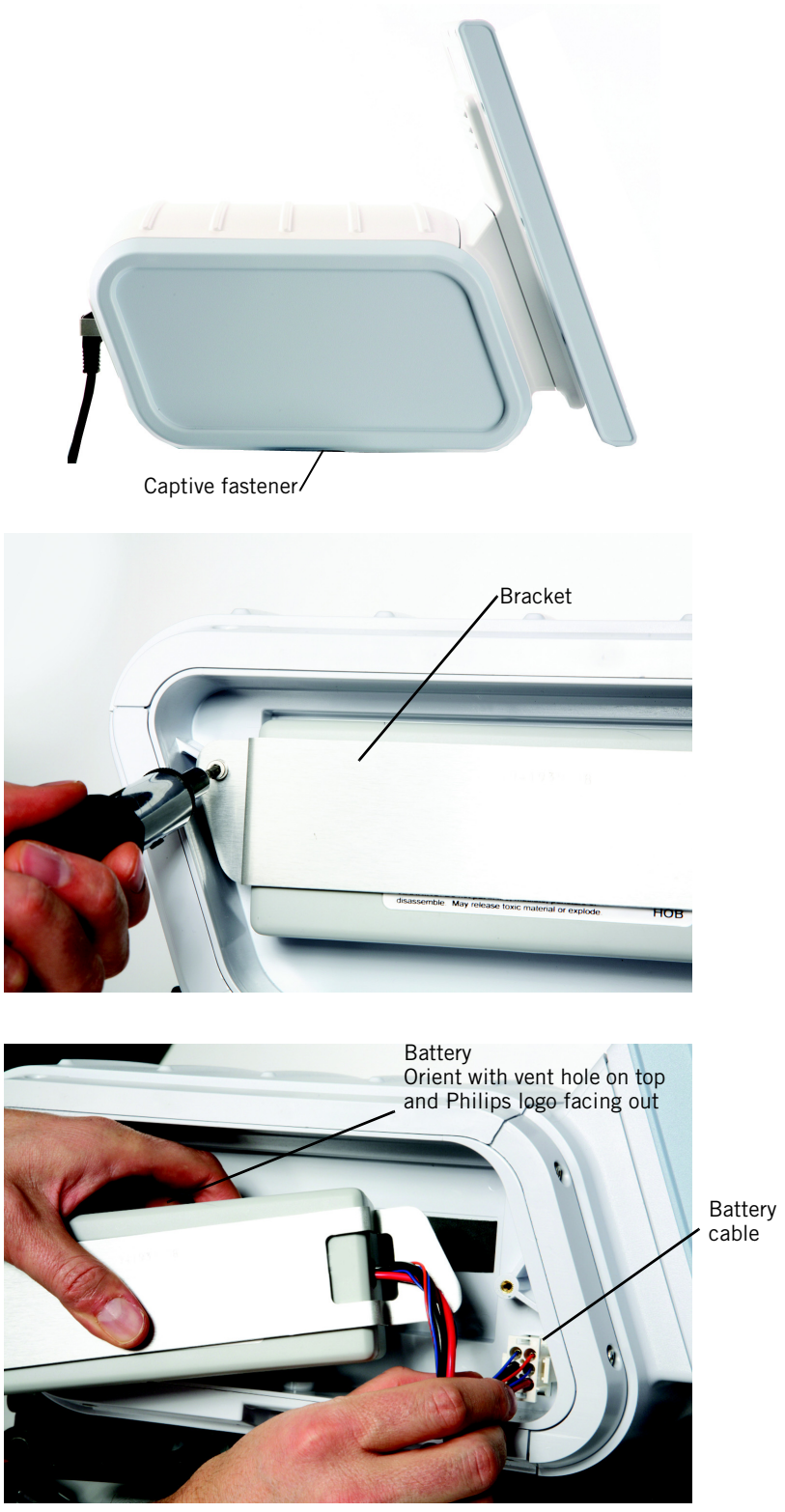


Figure A-2: Installing the battery

Installing oxygen inlet connector and AC power cord

The Respironics V60/V60 Plus Ventilator destined for Japan, China, and the U.S. are pre-configured. V60/V60 Plus Ventilators shipped to other countries may require installation of the power cord and oxygen inlet connector.

1. Install the oxygen inlet connector as follows (Figure A-3):
   a. Gently fit connector into the hole provided with flat sides to the left and right.
   b. Install the oxygen inlet connector retaining plate. Tighten the two screws with a 2.5-mm hex wrench.

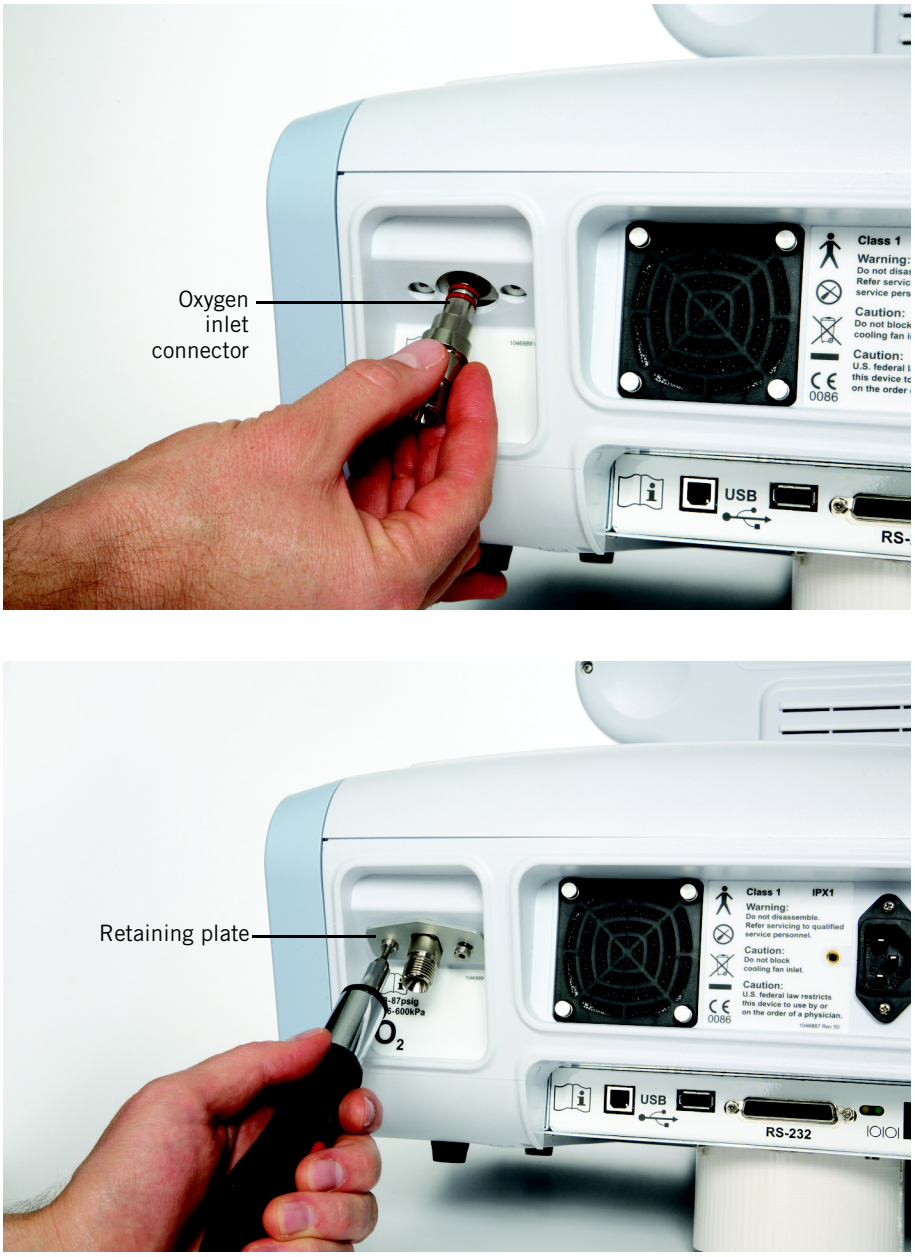


Figure A-3: Installing the oxygen inlet connector

WARNING: **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 you switch the ventilator on. The retainer is designed to hold the connector end of the Philips-supplied cord securely in place.**

WARNING: **The V60/V60 Plus 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.**

2. Secure the power cord with the power cord retainer (Figure A-4):
   a. Remove the power cord retainer by removing two screws.
   b. Connect the power cord that is appropriate to your region into the AC power connector.
   c. Reinstall the power cord retainer over the power cord, and tighten the screws with a 3.0-mm hex wrench.

Figure A-4: Installing the power cord retainer

Installing the oxygen manifold kit

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

Verifying ventilator operation and audible alarm

Perform the following steps to verify ventilator and audible alarm operation:

1. Assemble and install a patient circuit. (See Chapter 5 for instructions on installing a patient circuit.)
2. Power on the ventilator and verify that it completes the power-on self-test.
3. Disconnect the proximal pressure airway pressure line from the ventilator connector, and verify that the **Proximal Pressure Line Disconnect** alarm is annunciated (audio, visual, and flashing alarm LED).
4. Reconnect the proximal pressure line, and manually reset the alarm.
5. Turn the ventilator off.
6. Remove the patient circuit.

The ventilator is ready to be set up for use as described in Chapter 5.

Configuration and screen calibration

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

Appendix 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.**

WARNING: **The USB port is not currently available for use. DO NOT connect or attempt to power any equipment from the USB port.**

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.**

WARNING: **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.**

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

- **RS-232 serial and analog I/O port.** Through 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.

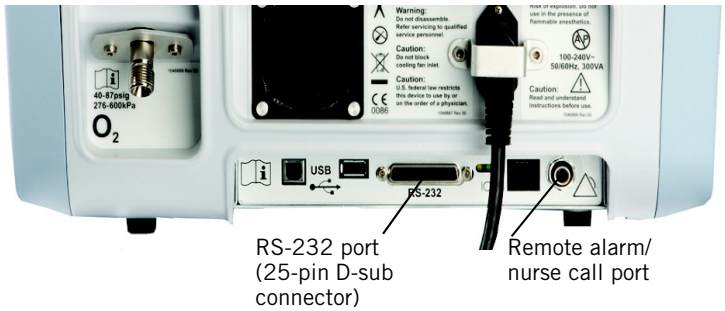


Figure B-1: Location of communications interface ports

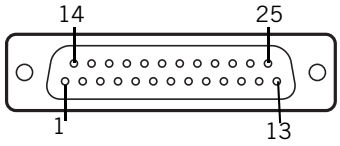
RS-232 serial and analog I/O port

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 "Using Philips IntelliBridge or VueLink" on page B-15), It is compatible with Cardiopulmonary Corporation's Bernoulli Ventilator Management System. For complete compatibility information, contact your Philips representative.

Pinout of connector

Figure B-2 shows the pinout of the 25-pin D-sub connector used for the RS-232 serial and analog I/O port.



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)
12	HIS_ANALOG_IN01	Input	HIS analog input #1 (0 to 5 V)
13	HIS_SIG_RTN	Power	HIS RS232/Signal common

Pin	Signal	I/O	Description
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)
25	HIS_ANALOG_OUT2	Output	HIS analog output #2 (0 to 5 V)
SHLD	Chassis	Power	Cable shield

Figure B-2: RS-232 serial and analog I/O connector pinout

Communications interface

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

Commands and transmission conventions

The ventilator supports the following commands that are of interest to the user:

- VRPT (Send Ventilator Report) (Table B-1)
- SNDA (Send Variable-Length Ventilator Report) (Table B-2 on page B-11)
- PVOI (Philips Ventilation Open Interface)

These commands, which are available during ventilation, return raw data that can be used for monitoring the patient and ventilator.

After receiving a command, followed by a carriage return, the ventilator responds by transmitting the information in the tables. The fields that comprise these tables are separated by commas. The ventilator stores and responds to valid commands in the order received. It returns invalid commands in an error message.

The ventilator also supports service-oriented commands. Contact Philips for details.

In the tables shown, a space is designated as "◆". When a field is unused, the output field contains all spaces.

Table B-1: VRPT record format

Field	Description	Example	Resolution	Range	Units	Comments
H1	Command name	VRPT	N/A	N/A	N/A	
H2	Number of characters between the start and stop codes	990	N/A	N/A	N/A	3-character field
H3	Number of fields between the start and stop codes	134	N/A	N/A	N/A	3-character field
H4	Start code	0x02	N/A	N/A	N/A	ASCII Start Transmission character (STX)
1	Time of request	13:45◆	N/A	N/A	N/A	24-hour clock, hh:mm◆

Table B-1: VRPT record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
2	Date	FEB◆23◆2008◆	N/A	N/A	N/A	12-character field, MMM◆DD◆YYYY◆
3	Current ventilation type	NPPV◆◆	N/A	NPPV◆◆	N/A	
4 to 8	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
9	Flow Setting	35◆◆◆◆	1	10 to 80	L/min	Air flow setting in HFT. "◆◆◆◆◆◆" in other modes
10 to 52	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
53	NPPV mode setting NPPV (Noninvasive Positive Pressure Ventilation)	S/T◆◆◆	N/A	S/T◆◆◆ PCV◆◆◆ CPAP◆◆ AVAPS◆ PPV◆◆◆ HFT◆◆◆ STDBY◆	N/A	6-character field representing available modes in NPPV, including STDBY (during leak test)
54	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
55	NPPV respiratory rate setting	12◆◆◆◆	1	4 to 60	BPM	Breaths per min in modes with setting. "◆◆◆◆◆◆" in CPAP mode. "◆◆◆◆◆◆" in HFT
56	NPPV EPAP setting (or CPAP setting).	5◆◆◆◆◆	1	4 to 25	cmH_2O	CPAP or EPAP setting "◆◆◆◆◆◆" in HFT. In CPAP mode: EPAP = IPAP = CPAP
57	NPPV IPAP setting (or CPAP setting).	5◆◆◆◆◆	1	4 to 40	cmH_2O	IPAP setting in S/T and PCV CPAP setting in CPAP mode In CPAP mode: EPAP = IPAP = CPAP. "◆◆◆◆◆◆" in other modes
58	NPPV inspiratory time setting	1.00◆◆	0.05	0.30 to 3.00	sec	"◆◆◆◆◆◆" in HFT
59	NPPV rise time	0.1◆◆◆	0.1	0.1 to 0.5	N/A	"◆◆◆◆◆◆" in HFT (Display range 1-5).
60	NPPV I-trigger type	AUTO◆◆	N/A	N/A	N/A	"◆◆◆◆◆◆" in HFT

Table B-1: VRPT record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
61	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
62	NPPV E-cycle type	AUTO◆◆	N/A	N/A	N/A	"◆◆◆◆◆◆" in HFT
63	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
64	NPPV oxygen concentration setting	21◆◆◆◆	1	21 to 100	%	
65	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
66	NPPV low inspiratory pressure alarm limit setting	3◆◆◆◆◆	1	0 to 40	cmH_2O	Off = 0 "◆◆◆◆◆◆" in HFT
67	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
68	NPPV low tidal volume alarm limit setting	0◆◆◆◆◆	5	0 to 1500	mL	Off = 0 "◆◆◆◆◆◆" in HFT
69	NPPV high respiratory rate alarm limit setting	60◆◆◆◆	1	5 to 90	BPM	"◆◆◆◆◆◆" in HFT
70	NPPV low minute volume alarm limit setting	1.00◆◆	0.01 for 0.00 to 9.99 0.1 for 10.0 to 99.0	0 to 99	L/min	"◆◆◆◆◆◆" in HFT
71 to 72	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
73	Measured peak inspiratory pressure	24◆◆◆◆	1	0 to 50	cmH_2O	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
74 to 76	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
77	Measured (exhaled) tidal volume	460◆◆◆	5	0 to 3500	mL	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
78	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"

Table B-1: VRPT record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
79	Measured minute volume	5.8◆◆◆	0.1	0 to 99	L/min	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
80	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
81	Measured total breath rate	12◆◆◆◆	1	0 to 90	BPM	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
82 to 83	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
84	Measured patient leak or Total Leak	20◆◆◆◆	1	0 to 200	L/min	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
85	Measured percent of breaths triggered by the patient	20◆◆◆◆	1	0 to 100	%	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
86	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
87	Ti/Ttot	0.23◆◆	0.01	0.00 to 1.00	N/A	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
88 to 91	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
92	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
93	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
94	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
95	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"

Table B-1: VRPT record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
96	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
97 to 98	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
99	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
100	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
101	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
102	Occlusion alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	In HFT, equivalent to these alarms: "Patient Circuit Occluded" and "Cannot Reach Target Flow."
103	Safety valve status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
104	Low internal battery alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
105	Nonvolatile memory failure—Using default settings	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
106	Primary alarm failure	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
107	High inspiratory pressure alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
108	Apnea alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Low Rate alarm status
109	Low inspiratory pressure alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	

Table B-1: VRPT record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
110	Air source fault alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
111	O_2 valve stuck closed alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
112	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
113	Low O_2 supply alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	High and low supply pressure
114	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
115	Low minute volume alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
116 to 117	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
118	Low tidal volume alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
119	Low spontaneous tidal volume alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Low Tidal Volume Alarm status
120	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
121	High respiratory rate alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
122	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
123	High enclosure temperature alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
124	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
125	Low PEEP alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Patient Disconnect alarm status

Table B-1: VRPT record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
126	Low EPAP alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Patient Disconnect alarm status
127	High leak alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Patient Disconnect alarm status
128	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
129	Alarm silence status	OFF◆◆◆	N/A	ON◆◆◆◆ OFF◆◆◆	N/A	
130	Screen lock status	OFF◆◆◆	N/A	ON◆◆◆◆ OFF◆◆◆	N/A	
131 to 134	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
135	Stop code	0x03	N/A	N/A	N/A	ASCII End Transmission character (ETX)

Table B-2: SNDA record format

Field	Description	Example	Resolution	Range	Units	Comments
H1	Command name	MISCA	N/A	N/A	N/A	5-character field
H2	Number of characters between the start and stop codes	706	N/A	N/A	N/A	3-character field
H3	Number of fields between the start and stop codes	97	N/A	N/A	N/A	2-character field
H4	Start code	0x02	N/A	N/A	N/A	ASCII Start Transmission character (STX)
1	Time of request	13:45◆	N/A	N/A	N/A	24-hour clock, hh:mm◆
2	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
3	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
4	Date (ventilator system clock)	FEB◆23◆2008◆	N/A	N/A	N/A	12-character field, MMM◆DD◆YYYY◆
5	Mode setting	PCV◆◆◆	N/A	S/T◆◆◆ PCV◆◆◆ CPAP◆◆ AVAPS◆ PPV◆◆◆ HFT◆◆◆ STDBY◆	N/A	"STDBY◆" in standby mode or during exhalation port leak test
6	Active respiratory rate setting	12◆◆◆◆	0.1 for 4.0 to 9.9 1 for 10 to 60	4.0 to 9.9 10 to 60	BPM	"◆◆◆◆◆◆" in CPAP mode Rate setting in other modes. "◆◆◆◆◆◆" in HFT
7	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
8	Peak Flow setting	35◆◆◆◆	1	10 to 80	L/Min	Air flow setting in HFT. "◆◆◆◆◆◆" in other modes
9	Oxygen concentration setting	21◆◆◆◆	1	21 to 100	%	
10	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"

Table B-2: SNDA record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
11	PEEP or EPAP setting	0.0◆◆◆	0.1	4.0 to 25.0	cmH_2O	CPAP or EPAP setting. "◆◆◆◆◆◆" in HFT. In CPAP mode: EPAP = IPAP = CPAP
12 to 21	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
22	Pressure support setting	0◆◆◆◆◆	1	0 to 36	cmH_2O	IPAP - EPAP in S/T and PCV modes. 0 in CPAP mode. "◆◆◆◆◆◆" in AVAPS and PPV modes, and HFT.
23 to 29	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
30	Measured total respiratory rate	0.0◆◆◆	0.1 for 1.0 to 9.9 1 for 10 to 90	0.0 to 9.9 10 to 90	BPM	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
31	Measured tidal volume	0.00◆◆	0.01	0.00 to 3.50	L	"◆◆◆◆◆◆" in standby mode, during exhalation port leak test, or for values out of range. "◆◆◆◆◆◆" in HFT
32	Measured total minute volume	0.00◆◆	0.01 for 0.00 to 9.99 0.1 for 10.0 to 99.9	0.00 to 9.99 10.0 to 99.9	L	For values out of range set output to 99.9◆◆ "◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
33	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
34	Measured peak inhalation pressure	50.0◆◆	0.1	0.0 to 50.0	cmH_2O	"◆◆◆◆◆◆" in standby mode or during exhalation port leak test. "◆◆◆◆◆◆" in HFT
35 to 37	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
38	High inhalation pressure alarm setting	20◆◆◆◆	1	5 to 50	cmH_2O	"◆◆◆◆◆◆" in HFT

Table B-2: SNDA record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
39	Low inhalation pressure alarm setting	3◆◆◆◆◆	1	0 to 40	cmH_2O	"◆◆◆◆◆◆" in HFT
40	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
41	Low exhaled mandatory tidal volume alarm setting	0.00◆◆	0.01	0.00 to 1.50	L	Lo V_T alarm setting. "◆◆◆◆◆◆" in HFT
42	Low exhaled minute volume alarm setting	0.0◆◆◆	0.1	0.0 to 99.0	L	"◆◆◆◆◆◆" in HFT
43	High respiratory rate alarm setting	0◆◆◆◆◆	1	5 to 90	BPM	"◆◆◆◆◆◆" in HFT
44	High inhalation pressure alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
45	Low inhalation pressure alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
46	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
47	Low exhaled mandatory/ spontaneous tidal volume alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
48	Low exhaled minute volume alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
49	High respiratory rate alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
50	Low oxygen supply pressure alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
51	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
52	Low battery alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
53 to 57	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"

Table B-2: SNDA record format (continued)

Field	Description	Example	Resolution	Range	Units	Comments
58	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
59 to 80	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
81	Inhalation pressure setting	12.00◆	0.01	4.00 to 40.00	cmH_2O	IPAP in PCV mode IPAP in S/T mode CPAP in CPAP mode "◆◆◆◆◆◆" in other modes
82	Inhalation time setting	0.10◆◆◆	0.01	0.10 to 3.00	sec	I-Time in PCV mode "◆◆◆◆◆◆" in other modes
83 to 88	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
89	Alarm silence status	ON◆◆◆◆	N/A	ON◆◆◆◆ OFF◆◆◆	N/A	
90	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
91	Occlusion alarm status or I-time too long alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	Report highest urgency of these alarms: Patient Circuit Occluded and Patient Disconnect. In HFT, these alarms: "Patient Circuit Occluded" and "Cannot Reach Target Flow."
92 to 95	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
96	Parameter control setting	I-TIME◆◆◆	N/A	N/A	N/A	"I-TIME◆◆◆" in Ventilation modes. "◆◆◆◆◆◆◆◆◆◆" in HFT.
97	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
98	Stop code	0x03	N/A	N/A	N/A	ASCII End Transmission character (ETX)

Using Philips IntelliBridge or VueLink

Using Philips monitors and the IntelliBridge Open Interface

NOTE: Data displayed on the IntelliBridge system is for reference purposes only. Decisions for patient care should not be based solely on the data obtained through the IntelliBridge system.

The Respironics V60/V60 Plus Ventilator can communicate with a Philips patient monitor using the IntelliBridge Open Interface. Figure B-3 shows the required hardware setup. The IntelliBridge Open Interface requires a ventilator baud rate 19,200. Check for the correct baud rate in the ventilator diagnostic mode (see “Baud Rate” on page E-10).

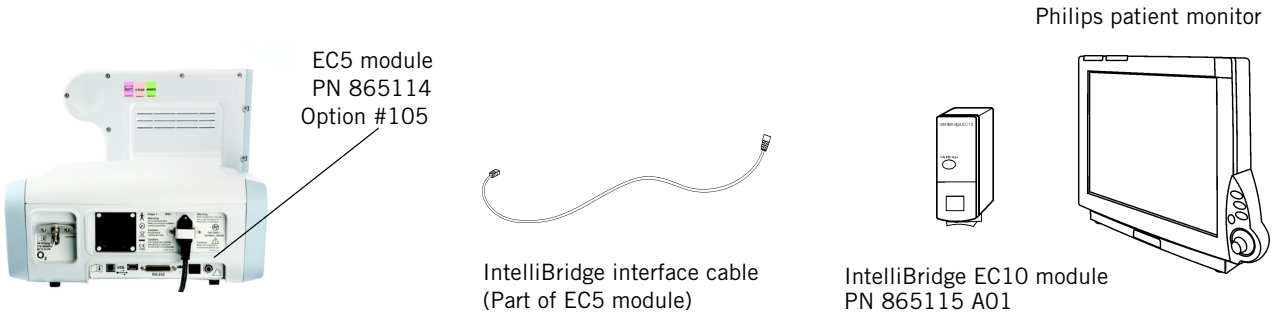


Figure B-3: Connect via IntelliBridge to a Philips patient monitor

Using Philips monitors and the VueLink Open Interface*

NOTE: Data displayed on the VueLink system is for reference purposes only. Decisions for patient care should not be based solely on the data obtained through the VueLink system.

The Respironics V60/V60 Plus Ventilator can communicate with a Philips patient monitor using the VueLink Open Interface. Figure B-4 shows the required hardware setup. The VueLink Open Interface requires a ventilator baud rate 19,200. Check for the correct baud rate in the ventilator diagnostic mode (see “Baud Rate” on page E-10).

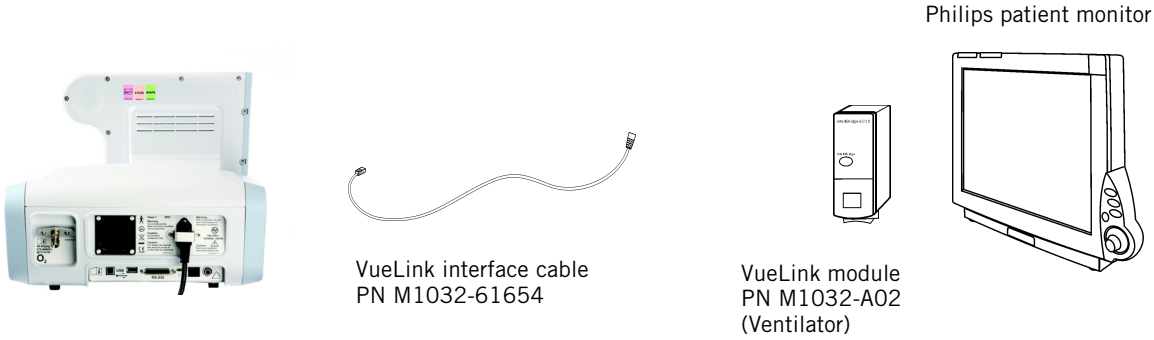


Figure B-4: Connect via VueLink to a Philips patient monitor

*NOTE: VueLink is discontinued. Information is included for backwards compatibility only.

Data display

The data from your Respironics V60/V60 Plus 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-3 to interpret these labels.

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

Table B-3: Ventilator data displayed on Philips monitor

Monitor label	Ventilator label
Waveform	
AWP	P (airway pressure)
AWF	$\dot{V}_E$ (flow)
AWV	V (volume)
Monitored parameters	
%Bsp:t	Pt. Trigger
Leak	Pt. Leak or Tot.Leak
MINVOL	$\dot{V}_E$
PIP	PIP
RRaw	Rate
Tin/Tt	T_I/T_{TOT}
TVexp	V_T

Table B-3: Ventilator data displayed on Philips monitor (continued)

Monitor label	Ventilator label
Modes	
Same as ventilator mode name	All modes except standby
STNDBY	Standby
Control settings	
sEppv	Max E
Not shown	C-Flex
PAVsup	PPV %
sCPAP	CPAP
sEPAP	EPAP
sfgFl	Flow (in HFT)
$sFIO_2$	O_2
sInsTi	I-Time (Inspiratory Time)
sIPAP	IPAP
sPmax	Max P (AVAPS Maximum IPAP Pressure) Max P (PPV Maximum IPAP Pressure)
sPmin	Min P (AVAPS Minimum IPAP Pressure)
sRisTi	Rise (Rise Time)
sRmpTi	Ramp Time
sRppv	Max R
sRRaw	Rate (Respiratory Rate)
sTV	V_T (AVAPS Target Tidal Volume)
sVmax	Max V (PPV Maximum Volume Limit)
sVMode	Ventilation mode
Alarm messages	
HIGH INSP PRESS	High Inspiratory Pressure
HIGH O2 SUPPLY	High O_2 Supply Pressure
HIGH RESP RATE	High Rate
HIGH EXH TV	High Tidal Volume
LOW INSP PRESS	Low Inspiratory Pressure
LOW BATTERY	Low Internal Battery
LOW FLOW	Cannot Reach Target Flow
LOW LEAK	Low Leak – CO_2 Rebreathing Risk

Table B-3: Ventilator data displayed on Philips monitor (continued)

Monitor label	Ventilator label
LOW EXH MV	Low Minute Ventilation
LOW O2 SUPPLY	Low O_2 Supply Pressure
LOW RESP RATE	Low Rate
LOW EXH TV	Low Tidal Volume
NO O2 SUPPLY	Oxygen Not Available
OCCLUSION	Patient Circuit Occluded
PT. DISCONNECT	Patient Disconnect
PPV MAX P	PPV Max P
PPV MAX V	PPV Max V
PRESS REG HIGH	Pressure Regulation High
PROX DISCONNECT	Proximal Pressure Line Disconnect
Vent CHK DEVICE	Check Vent:
VENT ON BATTERY	Running on Internal Battery
Ventilation parameters blanked	Vent Inoperative *xxxx*

Remote alarm port

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

WARNING: **To ensure the functionality of the remote alarm, connect only Respironics-approved cables to the remote alarm port.**

CAUTION: 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.

NOTE: 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 B-1). Figure B-5 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-4.

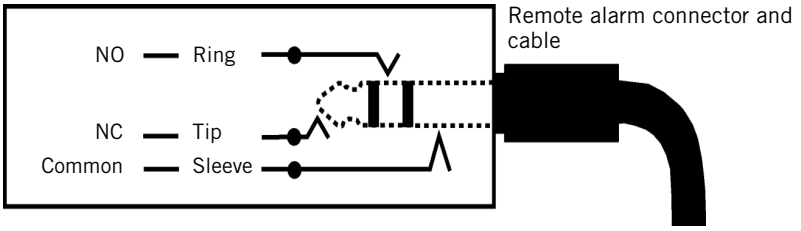


Figure B-5: Remote alarm port

Table B-4: 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

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Appendix C. Parts and accessories

All parts and accessories are not available in all markets. Contact your Philips representative for more information.

WARNING: **Avoid adding resistive circuit components on the patient side of the proximal pressure line. Such components may defeat the disconnect alarm.**

NOTE: 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.

This appendix lists parts and accessories supplied by Philips that are compatible with the Respironics V60/V60 Plus Ventilator. Contact your Philips representative to order these parts.

Please refer to Philips.com/hrc for a complete list of accessories and part numbers for your ventilator and region.

Masks

NOTE: Pediatric masks intended for patients weighing less than 20 kg (44 lb) are not approved for use with the V60/V60 Plus Ventilator.

Contact your Philips representative or refer to the *Respironics V60 Ventilator ordering and accessories guide* for mask ordering information and for updates to the product list.

Compatible masks include entrainment elbow (EE) versions from these product lines:

Description	Type
Respironics Contour Deluxe	Nasal
Respironics AP111	
Respironics PerformaTrak	Oro-nasal
Respironics AF811	
Respironics AF541, over-the-nose	
Respironics AF541, under-the-nose	
Respironics AF531	
Respironics AF421	
Respironics PerforMax, adult only	Total

HFT interfaces

For use with 3.00 software and above, and V60 Plus.

Description
Respironics AC611 high flow nasal cannula, 22 mm
Respironics AC611 high flow nasal cannula, FEP Connect
Fisher & Paykel OptiFlow OPT970, high flow tracheostomy interface

Exhalation ports

Description	Quantity	Part number	Order number
Plateau exhalation valve (PEV)	1	302312	989805617941
Replacement diaphragm for PEV	5	302310	989805609221
Whisper Swivel II exhalation port	1	332113	989805617951
Disposable exhalation port (DEP)	10	312149	989805609391
Disposable exhalation port (DEP) with an exhalation filter connection (FEP) and cap	10	1065775	453561517211
Filter exhalation port (FEP) with proximal pressure line	10	1116891	989805652291
FEP Connect adapter, 22 mm (F) x FEP (M)	20	1134310	989805656981

O_2 analyzer/monitor

Description	Part number	Order number
Analytical Industries AII-2000M oxygen analyzer/monitor	1128903	989805654621
Analytical tee adapter for O_2 sensor	1129064	989805654731
O_2 analyzer tee adapter, threaded, amber	1020380	453561509031

Patient breathing circuits

Description	Quantity	Part number	Order number
Noninvasive single-use patient circuit with main flow bacteria filter. Each includes 1.83 m (6 ft) smooth-lumen tubing, 2.13 (7 ft) proximal pressure line, filter exhalation port (FEP) 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) 1065832 (without exhalation port filter)	989805621311 989805621321
BiPAP Vision single-use circuit, for use without humidifier. Each 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
BiPAP Vision invasive single-use circuit, with filter exhalation port (FEP), 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 disposable exhalation port (DEP), Fisher & Paykel RT139	10	1020523	989805610851
Respironics noninvasive circuit with filter exhalation port (FEP), proximal pressure line, hanger, and hose clips (main flow and exhalation filters not included)	10	1069210	989805634871
Heated-wire circuit, 22 mm with filter exhalation port (FEP), proximal pressure line, and chamber, WILAmed (Not approved in the U.S. May not be available in all markets)	10	1122059	989805653191
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

Humidification

Description	Quantity	Part number	Order number
Humidifiers			
Respiratory humidifier, Fisher & Paykel MR850	---	---	Contact your Philips representative
Respiratory humidifier, WILAmed AIRcon Gen2, 230V (Not approved in the U.S. May not be available in all markets)	---	---	
Chambers			
Humidifier chamber, adult, Fisher & Paykel MR290	---	22105	989805609091
Humidifier chamber, autofill, WILAmed (Not approved in the U.S. May not be available in all markets)	30	1121825	989805653111

Bacteria filter

Description	Quantity	Part number	Order number
Single-use bacteria/viral filter, with 22-mm M x F connectors	10	342077	989805609521

Operator maintenance parts

Description	Quantity	Part number	Order number
Cooling fan filter	5	1054280	453561507301
Air inlet filter	5	1054279	453561505991

Other parts

The accessories shown below apply to:

- V60 Ventilator serial numbers beginning with "1," all serial numbers *less than* 100111553
- V60 Ventilator serial numbers beginning with a "2," all serial numbers *less than* 201007805

Description	Part number	Order number
Universal stand	1041139	989805611501
E-cylinder holder for universal stand	1048903	989805611741
Oxygen manifold kit	1082823	989805633431
Oxygen manifold kit, Canada	1078693	989805628381

The accessories shown below apply to:

- V60 Ventilator serial numbers beginning with "1," all serial numbers *greater than and including* 100111553
- V60 Ventilator serial numbers beginning with a "2," all serial numbers *greater than and including* 201007805

Description	Part number	Order number
Respironics V60 Ventilator stand, partially assembled	1109866	989805648691
Respironics V60 Ventilator stand, fully assembled (Available only in the U.S.)	1109865	989805648681
Cylinder holder for ventilator stand	1109869	989805648721

Compatible with all V60/V60 Plus Ventilators:

Description	Part number	Order number
Oxygen manifold kit, for DISS male oxygen inlet connector	1109602	989805648241
Oxygen manifold kit, for DISS female oxygen inlet connector, (Canada)	1113392	989805650191
Oxygen manifold kit, NIST	1109881	989805648741
Oxygen manifold kit, SIS	1113371	989805650181
Support arm	332497	989805617961
Support arm bracket	1002497	989805611511
Backup battery	1076374	989805626941
25-to-9-pin adapter	1058403	453561509661
HIS (hospital information system)/EMR (electronic medical record) null modem cable assembly	1080588	989805629921

Parts and accessories

Description	Part number	Order number
HIS/EMR modem cable assembly	1080782	989805630111
IntelliBridge EC10 module	865115 / A01	Contact your Philips representative
IntelliBridge EC5 cable (10 m)	865114 / L03	
IntelliBridge EC5 cable (10 m)	865114-105	

NOTE: When using non-Respironics cables, follow the special setup procedure in Chapter 6 of the *Respironics V60 Ventilator Service Manual*, PN 1049766. Otherwise, the ventilator may not power up correctly.

Appendix D. Regulatory compliance

Electromagnetic compatibility (EMC)

IEC 60601-1-2; 2014, Ed. 4.0	Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances

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.

WARNING: The V60/V60 Plus 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.

Electromagnetic emissions

Guidance and manufacturer's declaration - electromagnetic emissions		
The V60/V60 Plus Ventilator is intended for use in the electromagnetic environment specified below. The user of the V60/V60 Plus Ventilator should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic enforcement - guidance**
RF Emissions CISPR 11	Group 1	The V60/V60 Plus 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 V60/V60 Plus 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 V60/V60 Plus Ventilator is intended for use in the electromagnetic environment specified below. The user of the V60/V60 Plus Ventilator should assure that it is used in such an environment.			
Immunity test	**IEC 60601-1-2 test level**	**Compliance level**	**Electromagnetic environment guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15 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	0% U_T for 0.5 cycles* 0% U_T for 1.0 cycle* 70% U_T for 25 cycles (50 Hz)/ 30 cycles (60 Hz) 0% U_T for 250 cycles (50 Hz)/ 300 cycles (60 Hz)	0% U_T for 0.5 cycles 0% U_T for 1.0 cycle 70% U_T for 25 cycles (50 Hz)/ 30 cycles (60 Hz) 0% U_T for 250 cycles (50 Hz)/ 300 cycles (60 Hz)	Mains power quality should be that of a typical hospital environment. If the user of the V60/V60 Plus Ventilator requires continued operation during power mains interruptions, it is recommended that the V60/V60 Plus Ventilator be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	30 A/m	30 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.			

* According to IEC 60601-1-2: 2014

Guidance and manufacturer's declaration - electromagnetic immunity

The V60/V60 Plus Ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the V60/V60 Plus Ventilator should assure that it is used in such an environment.

Immunity test	IEC 60601-1-2 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	**3 Vrms** **150 kHz to 80 MHz outside ISM bands[a]**	**3 Vrms**	Portable and mobile RF communications equipment should be used no closer to any part of the V60/V60 Plus Ventilator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: $d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$ where V_1 = 3 Vrms $d = \left[\frac{12}{V_2}\right]\sqrt{P}$ where V_2 = 6 Vrms
	6 Vrms **150 kHz to 80 MHz in ISM bands[a]**	**6 Vrms**	
Radiated RF IEC 61000-4-3	**3 V/m[e]** **80 MHz to 2.7 GHz**	**3 V/m**	$d = \left[\frac{12}{E_1}\right]\sqrt{P}$ 80 MHz to 800 MHz, where E_1 = 3 V/m $d = \left[\frac{23}{E_1}\right]\sqrt{P}$ 800 MHz to 2.7 GHz, where E_1 = 3 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 2.7 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 V60/V60 Plus Ventilator is used exceeds the applicable RF compliance level above, the V60/V60 Plus 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 V60/V60 Plus Ventilator.

d. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

e. According to IEC 60601-1-2: 2014

Regulatory compliance

Recommended separation distances between portable and mobile RF communications equipment and the V60/V60 Plus Ventilator				
Rated maximum output power of transmitter (W)	**Separation distance according to frequency of transmitter (m)**			
	150 kHz to 80 MHz outside ISM bands $d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$	**150 kHz to 80 MHz in ISM bands** $d = \left[\frac{12}{V_2}\right]\sqrt{P}$	**80 MHz to 800 MHz** $d = \left[\frac{12}{E_1}\right]\sqrt{P}$	**800 MHz to 2.5 GHz** $d = \left[\frac{23}{E_1}\right]\sqrt{P}$
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 2.7 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.

NOTE 5: **The minimum separation distance for RF communication equipment operating within the following frequency bands is 0.3 m:**

- 380 –390 MHz (TETRA 400)
- 430 – 470 MHz (GMRS 460, FRS 460)
- 704 – 787 MHz (LTE Band 13, 17)
- 800 – 960 MHz (GSM 800/900, TETRA 800, iDEN 820, CDMA 850, LTE Band 5)
- 1 700 –1 990 MHz (GSM 1800; CDMA 1900; GSM 1900; DECT; LTE Band 1, 3, 4, 25; UMTS)
- 2 400 – 2 570 MHz (Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7)
- 5 100 – 5 800 MHz (WLAN 802.11 a/n)

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 https://www.usa.philips.com/healthcare/resources/recycling-passports/respiratory_care for the passport for recycling this product.

Safety

Protection Against Electric Shock	Class 1
Degree of Protection Against Electric Shock	Type B
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 60601-1-4	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
3rd edition	
IEC 60601-1; 2012, Ed. 3.1	Medical electrical equipment – Part 1: General requirements for basic safety and essential performance
IEC 60601-1-6; 2013, Ed. 3.1	Medical electrical equipment – Part 1-6: General requirements for basic safety and essential performance; collateral standard: usability

IEC 60601-1-8; 2012, Ed. 2.1	Medical electrical equipment – Part 1-8: General requirements for basic safety and essential requirements; collateral standard - alarm systems
IEC 62366-1, 2015, Ed. 1.1	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
IEC 60529; 2013, Ed. 2.2	Degrees of protection provided by enclosures (IP Code)
IEC 62304; 2015, Ed. 1.1	Medical device software - Software life cycle processes

Appendix 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.

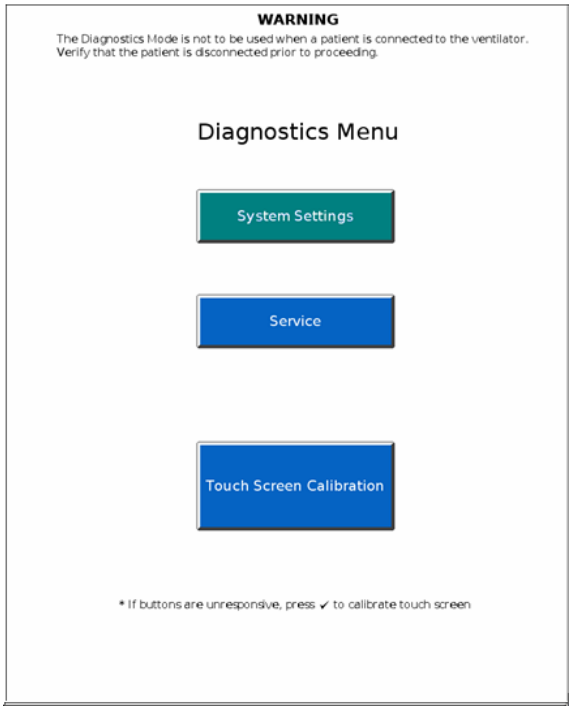

Figure E-1: Diagnostics Menu

4. Select the desired function.

System settings

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

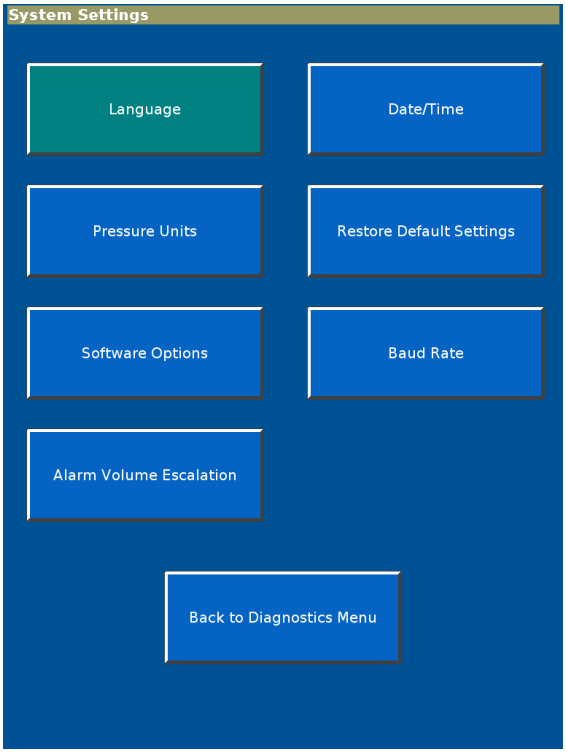

Figure E-2: System Settings screen

Language

The **Language** function lets you set the language of software display.

1. From the **System Settings** screen, select **Language** to display the **Set Language** screen (Figure E-3).

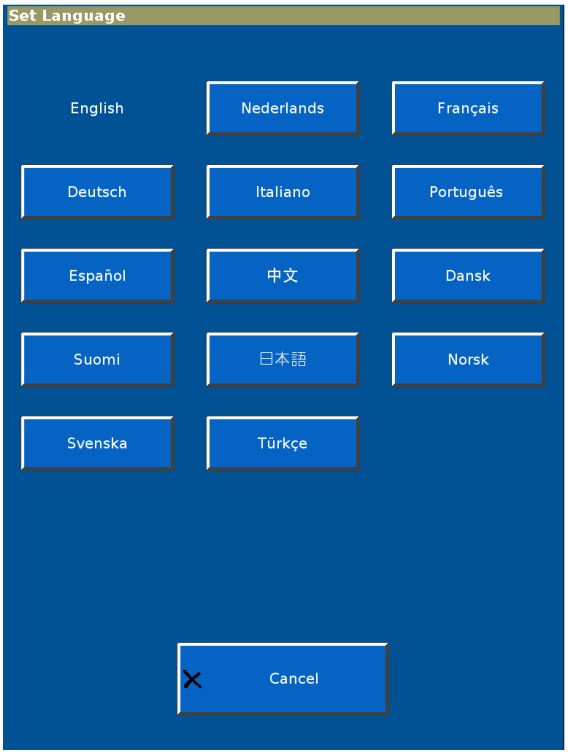

Figure E-3: Set Language screen 1

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.

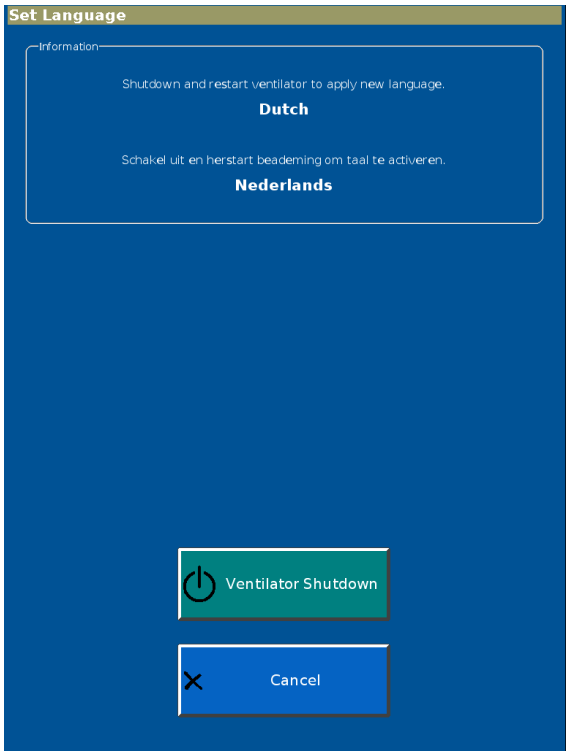

Figure E-4: Set Language screen 2

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).

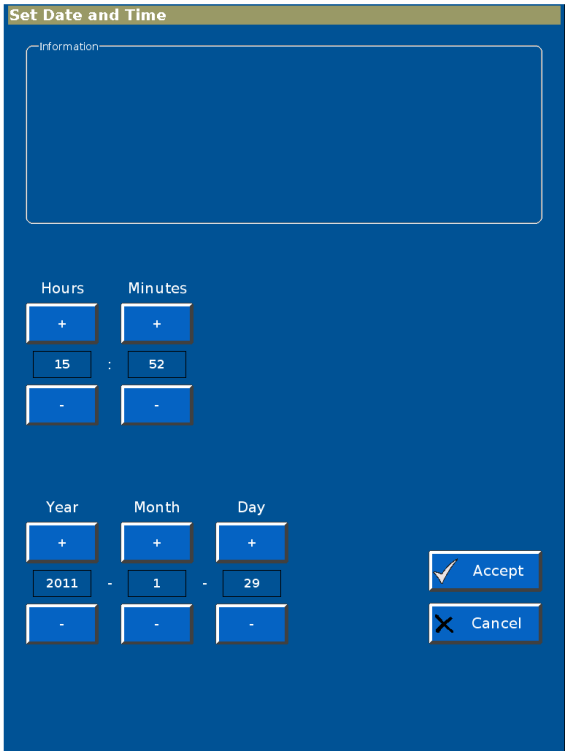

Figure E-5: Set Date and Time screen

2. Adjust the date and time with the + and - buttons; then **Apply**.

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).

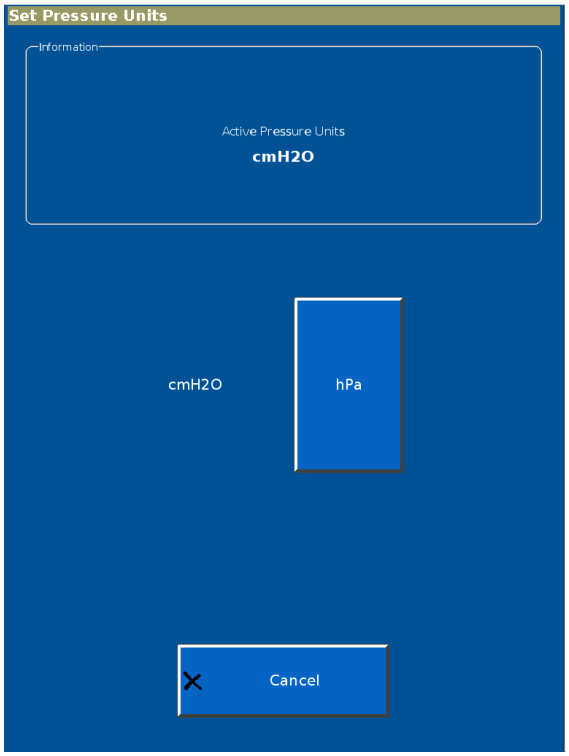

Figure E-6: Set Pressure Units screen

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.

1. From the **System Settings** screen, select **Restore Default Settings** to display the **Restore Default Settings** screen (Figure E-7).

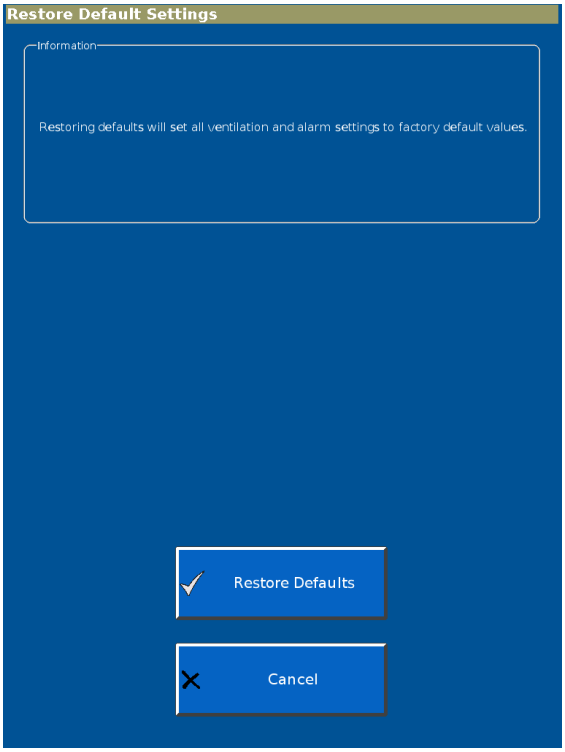

Figure E-7: Restore Default Settings screen

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: Before installing an option, verify that the ventilator serial number matches the serial number shown in the **Vent Info** window (“Vent Info (ventilator information)” on page 6-18. 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).

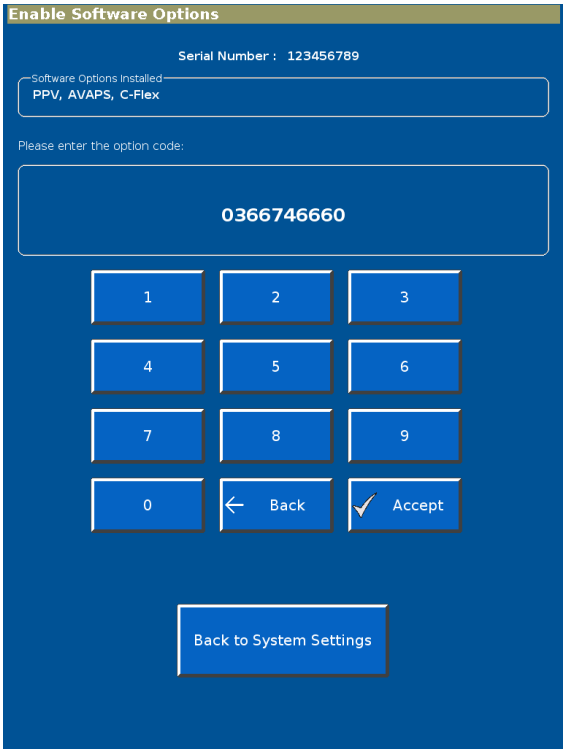

Figure E-8: Enable Software Options screen

2. Use the onscreen keypad to enter the code; then select **Enter**. 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 3-5 on page 3-8.

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).

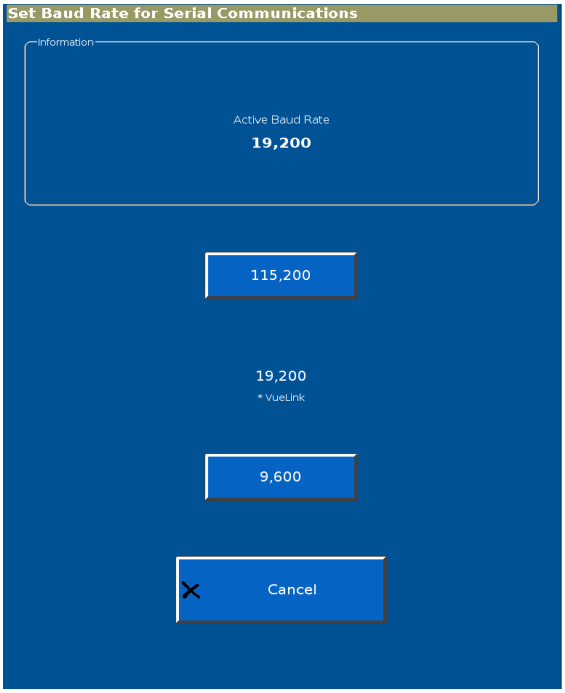

Figure E-9: Set Baud Rate for Serial Communications screen

2. The active baud rate is shown in white type. Select the desired baud rate.

Alarm Volume Escalation

The **Alarm Volume Escalation** function lets you enable or disable volume escalation[1]. When alarm volume escalation is **Enabled** and a high priority alarm is not responded to within 40 seconds, the ventilator alarm volume increases to maximum over an 20-second period.

When the **Alarm Volume Escalation** function is active and a touchscreen or button press is detected, the ventilator automatically returns the alarm volume to the user setting.

1. From the **System Settings** screen, select **Alarm Volume Escalation** to display the **Set Alarm Volume Escalation** screen (Figure E-10).

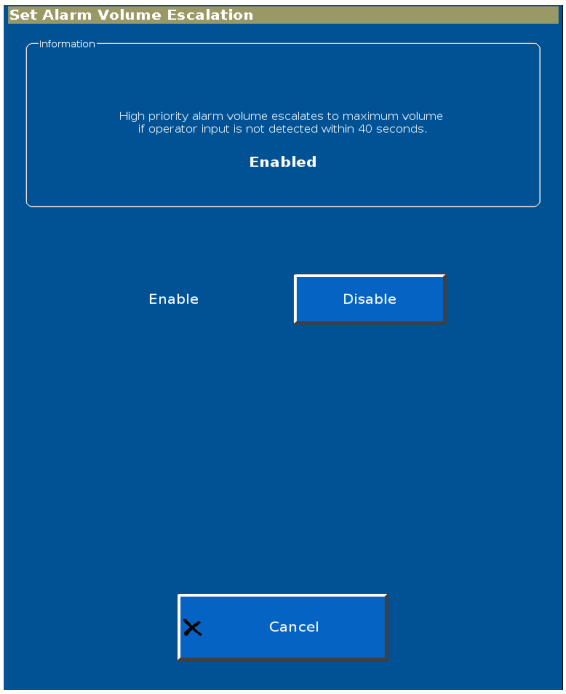

Figure E-10: Set Alarm Volume Escalation

2. The current setting is shown in the Information box at the top of the screen. If Alarm Volume Escalation is currently **Disabled**, you will see a selectable **Enable** button. If Alarm Volume Escalation is currently **Enabled**, you will see a selectable **Disable** button. Press the button to change the setting.

3. The new setting is applied after the V60/V60 Plus Ventilator is shut down and powered on again.

1. Available in Revision 2.30 software and above.

Service

The **Service** screen lets you view the event log. Other service functions are for use by authorized service personnel.

Significant Event Log

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-11). Select **Significant Event Log**.

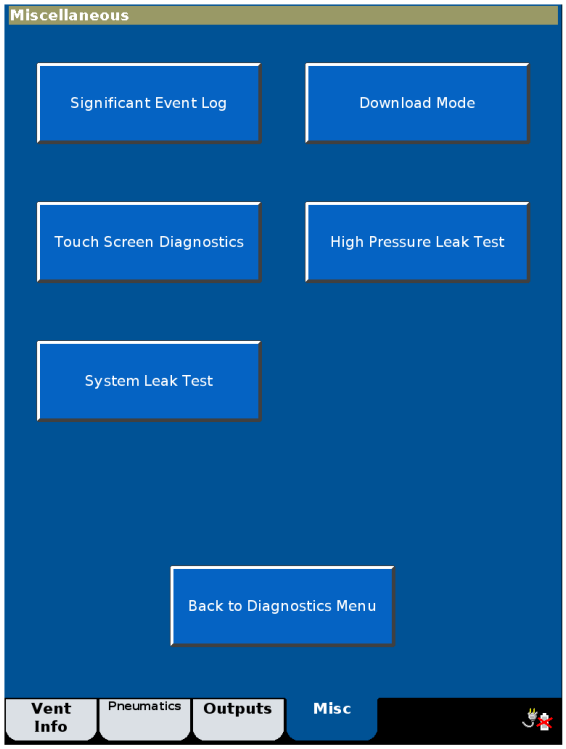

Figure E-11: Miscellaneous screen

3. The **Significant Event Log** opens (Figure E-12). Use the buttons on right side to navigate through the log.

Figure E-12: Significant Event Log screen

Touchscreen calibration

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-13).

NOTE: If the **Touch Screen Calibration** button does not respond, press the Accept button on the navigation ring to begin.

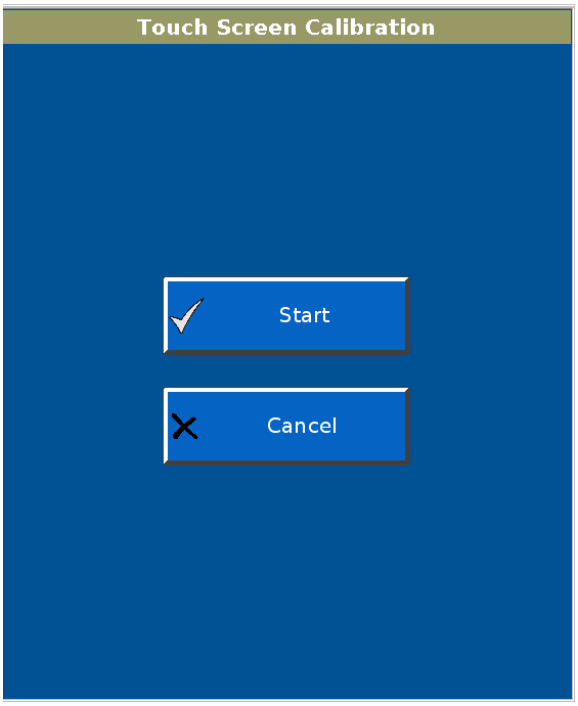

Figure E-13: Calibrate Touch Screen screen

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.

Alarm Silence button Silences alarm sound for 2 minutes.

Alarm Volume escalation When enabled, this function becomes active if there is no response to a high priority alarm within 40 seconds. Ventilator alarm volume then increases to its maximum over a 20-second period.

Auto-Trak+ An optional feature that allows adjustments to trigger and cycle thresholds beyond Auto-Trak Sensitivity settings.

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-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.

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.

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 exhalation 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.

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.

Flow Flow rate, a setting in high flow therapy

HFT High flow therapy, a feature that provides a constant flow of mixed air and oxygen.

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.

hPa Hectopascal, a unit of pressure measurement. 1 hPa is equal to 1 mbar, which is approximately equal to 1 cmH_2O.

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 $\mathbf{T_I/T_{TOT}}$.

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.

ISO International Organization for Standardization, a worldwide federation of national standards bodies.

I-Time Inspiratory time. The duration of inspiration during mechanical ventilation.

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 $\mathbf{V_T}$ Low Tidal Volume Alarm, an alarm setting.

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.

mL Milliliter.

mm Millimeter.

NIST Non-Interchangeable Screw-Threaded. A connector for high-pressure gas inlet fittings.

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.

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.

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-supported breath A patient-triggered, pressure-targeted breath.

psi Pounds per square inch.

psig Pounds per square inch gauge (above atmospheric pressure).

Proportional pressure ventilation see PPV.

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., $cmH_2O/mL/sec$.

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.

RS-232 Serial data communications protocol.

SIS Sleeve Indexed System (Australia). A connector for high-pressure gas inlet fittings.

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.

Time Trigger Initiation of inspiration by the ventilator according to the **Respiratory Rate** setting.

Timed indicator Denotes machine-triggered (mandatory) breathing.

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.

V Volt, a unit of electrical potential *or* volume.

$\dot{V}$ Flow.

$\dot{V}_E$ 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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