COVIDIEN

Clinician's Manual

Puritan Bennett™
520 Ventilator

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Preface

Purpose of this Manual

This manual contains important information regarding the safe operation of your Puritan Bennett™ 520 Ventilator. Your ventilator is an electrical device that can provide years of useful service with the proper care, as described in this manual.

Ensure that you read and understand the instructions contained in this manual before operating the ventilator.

WARNING:
Before operating the ventilator, read, understand, and strictly follow the information contained in Chapter *1*, "*Safety Information*. "

Qualification of Personnel

Installation and maintenance of the device must be made by authorized and trained personnel. In particular, training for the handling of products sensitive to electrostatic discharges must include the use of electrostatic discharge (ESD) protection devices and knowledge of the following symbol's meaning: , as well as using original spare parts and respecting quality assurance and traceability rules approved by Covidien.

Warranty

Information regarding your product warranty is available from your sales representative or Covidien.

Extended Service

The Puritan Bennett 520 Ventilator offers extended service contracts/warranties for purchase when the ventilator is purchased. Please contact your local Covidien sales or service representative for additional information.

For online technical support, visit the SolvIT[SM] Center Knowledge Base by clicking the link at: www.medtronic.com/covidien/support/solvit-center-knowledge-base/.

Here, you will find answers to frequently asked questions about the product and other Covidien products 24 hours a day, 7 days a week. If you require further assistance, contact your local Covidien representative.

Technical Support

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1 Safety Information

1.1 Definitions

This manual uses three indicators to highlight critical information: warning, caution, and note. They are defined as follows:

⚠️	**WARNING** **Indicates a condition that can endanger the patient or the ventilator operator.**
◆	**Caution** **Indicates a condition that can damage the equipment.**
📖	**Note** Indicates points of particular emphasis, that make operation of the ventilator more efficient or convenient.

It is essential to read, understand and follow these instructions before using the Puritan Bennett™ 520 Ventilator.

In order to use the ventilator correctly and efficiently and to help prevent incidents, please pay particular attention to section *1.2*, "*Warnings*," as well as all warnings and cautions contained throughout this manual.

1.2 Warnings

1.2.1 Fire Hazard Warnings

⚠️ **WARNING:**
The ventilator must not be used with flammable anesthetic substances.

⚠️ **WARNING:**
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

⚠️ **WARNING:**
Never expose any batteries to direct flame.

⚠️ **WARNING:**
In the event of an oxygen leak, shut down the supply of oxygen at its source. In addition, remove and/or keep any incandescent source away from the device, which may be enriched with oxygen. Circulate fresh air into the room to reduce the oxygen concentration level.

1.2.2 Warnings About Reducing Infection

⚠️ **WARNING:**
To reduce the risk of infection, wash your hands thoroughly before and after handling the ventilator or its accessories.

⚠️ **WARNING:**
A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection.

⚠️ **WARNING:**
Single Use accessories ②️ should not be reused.

⚠️ **WARNING:**
The air inlet filter is for use on a single patient and is not reusable; do not attempt to wash, clean, or reuse it.

1.2.3 Warnings Before Using Equipment

⚠️ **WARNING:**
The ventilator must be used only under the responsibility and on the prescription of a doctor.

⚠️ **WARNING:**
The ventilator is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

⚠️ **WARNING:**
The ventilator must be used according to its intended use. Refer to *2.1*, "*Indications for Use*."

WARNING:

Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.

WARNING:

Before dispensing the ventilator to caregivers or the patient for home use, ensure the Locking Key is activated so that critical ventilator settings are not modified.

WARNING:

Do not perform ventilator alarm tests while the patient is connected to the ventilator. Provide the patient with an alternate means of ventilation before conducting these tests.

WARNING:

Verify the functionality of the alarm conditions before connecting the patient to the ventilator. Refer to Appendix *F*, "*Alarms Tests*."

WARNING:

If the ventilator fails the alarm tests or if you cannot complete the tests, refer to section *5.8*, "*Troubleshooting*" or call your equipment supplier or Covidien.

WARNING:

The default setting for altitude compensation is YES. Altitude compensation should always be set to YES for accurate volume delivery calculations at all elevations.

WARNING:

Before starting ventilation, ensure that the device is properly assembled and that the air inlet, cooling vents, and alarm sound diffusion holes are not obstructed. Ensure also that the patient circuit is of the proper configuration, properly connected to the ventilator, and that the circuit hoses are neither damaged nor compressed and contain no obstructions or foreign bodies.

WARNING:

This ventilator offers a choice of breath delivery modes and types. Throughout the patient's treatment, the clinician should carefully select the ventilation mode and/or breath type to use for that patient. This selection should be based on the clinician's clinical judgment, considering the condition and needs of the individual patient, as such condition and needs change from time to time, and considering the benefits, limitations and operating characteristics of each mode and/or breath type.

WARNING:

Patients on home care ventilation equipment should be appropriately monitored by clinicians, caregivers and suitable monitoring equipment, as advised by the patient's clinician.   The Puritan

Bennett™ 520 Ventilator is not intended to be a comprehensive monitoring device and does not activate alarms for all types of dangerous conditions for patients.

1.2.4 Warnings Regarding Environment of Use

WARNING:
Do not operate the ventilator in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.

WARNING:
Avoid using the ventilator, if possible, in dusty environments. Dusty environments may require more vigilant monitoring, cleaning, and/or replacement of air intake and other filters.

WARNING:
Ensure that the ventilator's immediate surroundings allow for the proper operational connection of the device without folding, pinching, or damaging any of the required cables or tubes, and that the connection of the patient circuit to the patient provides for a secure, comfortable fit.

WARNING:
Place the ventilator in a safe place when ventilating and according to the recommendations in this manual.

WARNING:
Do not place the ventilator in a position where a child can reach it or in any position that might cause it to fall on the patient or someone else.

WARNING:
To ensure correct and lasting operation of the ventilator, ensure that its air circulation holes (main inlet or cooling) are never obstructed. Place the device in an area where air can freely circulate around the ventilator and avoid installing it near floating fabrics, such as curtains.

WARNING:
If the ventilator has been transported or stored at a temperature that differs more than $\pm20°C$ ($\pm68°F$) from the temperature in which it will be operating, the ventilator should be allowed to stabilize in its operating environment for at least two (2) hours prior to use.

WARNING:
If the ambient temperature where the device is operated is greater than 35°C (95°F), the flow supplied at the device outlet may exceed 41°C (106°F). This may lead to undesirable side effects for the patient. To avoid injury to the patient move the patient and the ventilator to a cooler location.

WARNING:
The default setting for altitude compensation is YES. Altitude compensation should always be set to YES for accurate volume delivery calculations at all elevations.

WARNING:
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

WARNING:
Before starting ventilation, ensure that the device is properly assembled and that the air inlet, cooling vents, and alarm sound diffusion holes are not obstructed. Ensure also that the patient circuit is of the proper configuration, properly connected to the ventilator, and that the circuit hoses are neither damaged nor compressed and contain no obstructions or foreign bodies.

WARNING:
Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see Chapter *10*, "*Routine Maintenance*"). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.

WARNING:
Due to typical voltage fluctuations that occur during normal power wheelchair use, the wheelchair mains battery should never be used to power the Puritan Bennett™ 520 Ventilator. The ventilator should always be connected to an independent power source (e.g., AC power, extra batteries, or DC power source).

WARNING:
Handle the ventilator with care during and after use, particularly when ambient temperatures are high. Some ventilator surfaces may become hot, even if safety specifications are not exceeded.

WARNING:
Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. See *7.3.4*, "*Alarm Volume*." The audible alarm vents located at the front of the device should never be obstructed.

1.2.5 Warnings Regarding Electromagnetic Interference

WARNING:
The Puritan Bennett™ 520 ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in Appendix *B*, "*Specifications*." In particular, the use of nearby mobile and portable communications

equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC 60601-1-2 standard, may affect its operation. Refer to section *B.10*, "*Manufacturer's Declaration*."

WARNING:

The use of any accessory other than those specified, with the exception of the power supplies or cables sold by Covidien, may lead to an increase in electromagnetic emissions or a decrease in the equipment protection against electromagnetic emissions. If the ventilator is used adjacent to such accessories or stacked with such devices, the ventilator's performance should be monitored to verify normal operation.

1.2.6 Warnings Regarding Settings

WARNING:

Before starting ventilation, always verify that all settings are properly set in accordance with the required prescription.

WARNING:

The Puritan Bennett™ 520 Ventilator offers a variety of breath delivery modes. Throughout the patient's treatment, the clinician should carefully select the ventilation mode or modes to use for that patient. This selection should be based on the clinician's clinical judgment, considering the condition and needs of the individual patient, as such condition and needs change from time to time, and considering the benefits, limitations and operating characteristics of each mode.

WARNING:

The CPAP mode does not provide a set respiratory rate. Do not use this mode if it is not appropriate for the patient's condition.

WARNING:

Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. See *7.3.4*, "*Alarm Volume*."

WARNING:

Ensure that the I Sens setting is not set to OFF when ventilating patients capable of triggering spontaneous breaths.

WARNING:

Monitor the patient's state of health in order to ensure that the ventilator's settings are always suited to the patient's current physiological requirements.

WARNING:
In adult or pediatric use ensure that the adjusted tidal volume is compatible with the needs of the patient.

WARNING:
When changing the mode during ventilation, significant transitions of pressure, flow or cycling rate might occur, depending on the difference between the modes. Before setting the new mode, first ensure that the settings between the different modes are compatible. This reduces the risk of discomfort and harm to the patient.

WARNING:
The setting of the Min PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the Low Pressure Test (refer to section *F.1*, "*Low Pressure Test*") to ensure the Min PIP alarm is properly set.

WARNING:
If APNEA TIME is set to a value higher than 60/Control R then the APNEA alarm will not activate.

WARNING:
The Apnea Alarm should be set to YES if an audible alarm sound is desired when apnea events occur.

WARNING:
Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.

WARNING:
Ensure the I Time setting is compatible with the physiological requirements of the patient.

WARNING:
Adjustable alarms should not be systematically canceled; instead, they should be adjusted according to the needs and condition of the patient.

WARNING:
The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or "autotriggering" of the ventilator. For example, Level 0P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.

1.2.7 Warnings Applicable During Use of Equipment

⚠️ **WARNING:**
The ventilator must be used only under the responsibility and on the prescription of a doctor.

⚠️ **WARNING:**
The ventilator must be used according to its intended use. Refer to section *2.1*, "*Indications for Use*."

⚠️ **WARNING:**
The ventilator is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

⚠️ **WARNING:**
Be aware this manual describes how to respond to the ventilator, but it does NOT tell you how to respond to the patient.

⚠️ **WARNING:**
While the ventilator is in use, an alternative means of ventilation should always be available in the event of a ventilator problem. Supplementary observation, appropriate for the patient's condition, is also recommended.

⚠️ **WARNING:**
Patients should always be monitored by trained and competent medical personnel. Ensure that the patient's caregiver is able and prepared to take suitable action in the event the ventilator identifies an alarm condition or experiences a problem.

⚠️ **WARNING:**
When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.

⚠️ **WARNING:**
A continuous alarm condition will be activated if the ventilator power switch is turned off while ventilation is in progress. When the power switch is turned back on again, ventilation will resume without having to press the VENTILATION ON/OFF button.

⚠️ **WARNING:**
If the device is damaged, its external housing is not correctly closed, or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.

WARNING:
Handle the ventilator with care during and after use, particularly when ambient temperatures are high. Some ventilator surfaces may become hot, even if safety specifications are not exceeded.

WARNING:
Even though the Puritan Bennett™ 520 Ventilator meets current safety standards, and although the internal Lithium-ion battery of the device is considered to be Dangerous Goods for transport in commerce, this devices lithium battery is below the 100Wh threshold and is therefore excepted from being a Class 9 – Miscellaneous - Dangerous Goods (DG). As such, the Puritan Bennett™ 520 Ventilator and/or the associated Lithium-ion battery are subject to some transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport; the Puritan Bennett™ 520 Ventilator is permitted as checked-in or carry-on baggage. Spare batteries may be taken on board as carry-on luggage only. This classification and regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.

WARNING:
To minimize the risk of damage, you must use the ventilator's Dual Bag to transport the ventilator. See *Table H-1. List of Consumables and Accessories*.

WARNING:
To ensure that ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use.

WARNING:
The ventilator must not be used with flammable anesthetic substances.

WARNING:
The ventilator should never be immersed in any liquid, and any liquid on the surface of the device should be wiped away immediately.

WARNING:
To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

⚠️ **WARNING:**

To ensure correct and lasting operation of the device, ensure that the ventilator is installed and operated in the environmental conditions recommended in Appendix *B*, "*Specifications*."

⚠️ **WARNING:**

Do not leave power cables lying on the ground where they may pose a hazard.

⚠️ **WARNING:**

Do not allow a patient to remain connected to the ventilator when ventilation is stopped, because a substantial quantity of exhalation gas, primarily carbon dioxide, may be inhaled by the patient. In some circumstances, inhaling carbon dioxide may lead to under ventilation, suffocation, and serious injury or death.

⚠️ **WARNING:**

Do not conduct the ventilator alarm test while the patient is connected to the ventilator. Switch the patient to an alternate means of ventilation before testing.

1.2.8 Warnings Regarding Electrical Power

⚠️ **WARNING:**

To ensure that ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use.

⚠️ **WARNING:**

Never connect your ventilator to an electrical outlet controlled by a wall switch because the power may be inadvertently turned off.

⚠️ **WARNING:**

To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

⚠️ **WARNING:**

Do not leave power cables lying on the ground where they may pose a hazard.

⚠️ **WARNING:**

Due to typical voltage fluctuations that occur during normal power wheelchair use, the wheelchair mains battery should never be used to power the Puritan Bennett™ 520 Ventilator. The ventilator should always be connected to an independent power source (e.g., AC power, extra batteries, or DC power source).

⚠️ **WARNING:**
The operator should connect the ventilator to an AC power source whenever available, for safer operation.

⚠️ **WARNING:**
The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years, or more, prior to its first use.

⚠️ **WARNING:**
Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.

⚠️ **WARNING:**
For the AC ("mains") power cable to be properly secured, the attachment located on the power cable must be fitted into the power cable holder incorporated in the battery access cover and located under the AC (mains) power socket. Refer to section *6.2*, "*Connecting to External AC Power*."

⚠️ **WARNING:**
The power supply to which the ventilator is connected (both AC and DC) must comply with all applicable standards and provide electrical power corresponding to the voltage characteristics inscribed on the rear of the ventilator to ensure correct operation. Refer also to the electrical specifications found in Appendix *B*, "*Specifications*."

⚠️ **WARNING:**
Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12– 30 VDC power source (via the DC power cable) does not enable its internal battery to recharge.

⚠️ **WARNING:**
Due to its limited internal battery's reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.

⚠️ **WARNING:**
When using a car auxiliary adapter (cigarette lighter) ensure the car has been started prior to plugging in the ventilator's DC adapter. Refer to section *6.3*, "*Connecting to an External DC Power Source*."

⚠️ **WARNING:**
Even if the "INTERNAL BATTERY" charging indicator is off, charging of the battery may sometimes be incomplete if the ambient temperature is above 40 °C (104 °F) because of the battery's internal heat safety device.

WARNING:
When the "LOW BATTERY" alarm is triggered, immediately connect the ventilator to an AC power supply to maintain ventilation and recharge the internal battery.

WARNING:
Batteries should be disposed of according to environmental legislation in your country and locality.

WARNING:
Ensure that the AC power cable is in perfect condition and not compressed. The device should not be turned on if the AC power cable is damaged.

WARNING:
A continuous alarm condition will be activated if the ventilator power switch is turned off while ventilation is in progress. When the power switch is turned back on again, the ventilation will resume without having to press the VENTILATION ON/OFF button.

WARNING:
Before using the ventilator's internal battery, ensure that the battery is fully charged and that the charge holds. Back up ventilators or those in storage should be connected to an AC power source to protect the integrity of the battery.

WARNING:
To connect the ventilator to an external power source, first connect the desired power cable to the ventilator. Then connect the power cable to the external power source.

WARNING:
To disconnect the ventilator from an external power source, first disconnect the power cable from the external power source and then, the ventilator.

WARNING:
Connect the external DC power source by first connecting the power cable to the ventilator and then to the external DC source. Follow the reverse procedure to disconnect the device from the external DC power source.

1.2.9 Warnings Regarding Oxygen

WARNING:
Oxygen therapy for patients with respiratory failure is a common and effective medical prescription. However, be aware that inappropriate oxygen use may potentially lead to serious complications, including, but not limited to, patient injury.

⚠ **WARNING:**
Strictly follow the instructions provided in section *6.7.2*, "*Connecting the Oxygen Supply*," which include the use of a special oxygen connector.

⚠ **WARNING:**
To avoid injury to the patient and/or possible damage to the ventilator: before connecting the ventilator to the oxygen supply, ensure a flow meter (flow regulator) is connected to the ventilator to regulate the oxygen supply to the required specification.

⚠ **WARNING:**
If using oxygen with the Puritan Bennett™ 520 Ventilator, Covidien recommends using an oxygen analyzer with minimum and maximum concentration alarms. Always measure the delivered oxygen with a calibrated oxygen analyzer that features a minimum and maximum concentration alarm in order to ensure that the prescribed oxygen concentration is delivered to the patient.

⚠ **WARNING:**
The Puritan Bennett™ 520 Ventilator is designed to deliver a percentage of oxygen equal to or lower than 50%. Do not exceed this value as this may cause the ventilator to malfunction and put the patient at risk.

⚠ **WARNING:**
Ensure that the oxygen supply pressure to the machine never exceeds 7 psi (50 kPa) or a flow of 15 lpm. Refer to *Table B-8.* on page *B-3* for sensitivity tolerances.

⚠ **WARNING:**
In the event of an oxygen leak, shut down the supply of oxygen at its source. In addition, remove and/or keep any incandescent source away from the device, which may be enriched with oxygen. Circulate fresh air into the room to bring the oxygen level down to normal.

⚠ **WARNING:**
The hose connecting the ventilator to the oxygen source must be designed exclusively for use with medical-grade oxygen. Under no circumstances should the oxygen hose be modified by the user. In addition, the hose must be installed without the use of lubricants.

⚠ **WARNING:**
Ensure that the only gas supplied to the ventilator through the dedicated oxygen supply connector is medical-grade oxygen.

⚠ **WARNING:**
The coupler must not remain connected to the oxygen connector unless it also connected to a leak-proof, external oxygen gas source. When an oxygen supply is not being used with the ventilator, disconnect the oxygen source completely from the ventilator.

⚠️ **WARNING:**

To ensure stability, when the Puritan Bennett™ 520 Ventilator is mounted on a cart, the weight of the oxygen bottle should not exceed 14 kg (30 lbs).

⚠️ **WARNING:**

The oxygen supply hose ages even when it is not in use and should be replaced periodically. Follow the expiration date, if any.

⚠️ **WARNING:**

The oxygen supply must be regulated using a flow meter connected to the source gas outlet.

⚠️ **WARNING:**

The oxygen supply must be shut off when ventilation is interrupted. Before disconnecting the oxygen hose, allow the ventilator to continue for a few cycles without oxygen to flush the patient circuit of excess oxygen.

⚠️ **WARNING:**

Before connecting the oxygen supply, ensure that the stud on the oxygen connector is protruding outwards.

⚠️ **WARNING:**

Inspect the oxygen coupler before use to ensure it has its black o-ring attached and in good condition. Do not use an oxygen coupler with a missing, damaged, or worn o-ring.

1.2.10 Warnings Regarding Hoses and Accessories

⚠️ **WARNING:**

The ventilator must not use, nor be connected to, any anti-static or electrically conductive hoses, tubing, or conduits.

⚠️ **WARNING:**

Before opening the packaging for the Patient Circuit, ensure that no damage is evident to the packaging or its contents. Do not use if evidence of damage exists.

⚠️ **WARNING:**

The patient circuit should not be changed during ventilation.

⚠️ **WARNING:**

On a DAILY basis, inspect the patient circuit to ensure that it shows no signs of damage, is properly connected, and is operating correctly without leakage.

WARNING:

Single Use ② accessories should not be reused.

WARNING:

During invasive ventilation (when an artificial airway bypasses the patient's upper respiratory system), the patient's upper respiratory system cannot humidify the incoming gas. For this reason, the use of a humidifier, to minimize drying of the patient's airway and subsequent irritation and discomfort, is required.

WARNING:

The air inlet filter is for use on a single patient. It is not reusable; do not attempt to wash, clean, or reuse it.

WARNING:

Failing to replace a dirty air inlet filter, or operating the ventilator without a filter, may cause serious damage to the ventilator.

WARNING:

The patient circuit should always be positioned to avoid hindering the patient's movements, to prevent accidental disconnection or leakage, and to minimize the risk of patient strangulation.

WARNING:

For pediatric use, ensure that the patient circuit type fits, and, in all respects, is suitable for use with a child. Use a pediatric circuit for patients that weigh under 53 lb. (23 kg). To ensure proper performance of the ventilator, see *Table H-2.* , *List of Circuits*, on page *H-2*, for a list of recommended patient circuits.

WARNING:

The exhalation valve must allow rapid discharge of the circuit pressure. Ensure that the exhalation valve is always clean and its evacuation aperture (exhaust port) is never obstructed.

WARNING:

Users must always possess an additional breathing circuit and exhalation valve while using the ventilator.

WARNING:

Always ensure that the humidification device is positioned lower than both the ventilator and the patient. Use water traps, if necessary, to limit water in the patient circuit and periodically empty these water traps.

⚠ **WARNING:**
If a heated humidifier is used, you should always monitor the temperature of the gas delivered to the patient. Gas delivered from the ventilator that becomes too hot may burn the patient's airway.

⚠ **WARNING:**
Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.

⚠ **WARNING:**
The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier, HMEs, etc.) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, maximum inspired volume (Max VTI), and minimum inspired volume (Min VTI) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced. Adding attachments to the ventilator breathing system can cause the pressure during exhalation at the patient connection port to increase.

⚠ **WARNING:**
To ensure proper performance of the ventilator, use a patient circuit recommended by Covidien in this manual; refer to Chapter *6*, "*Installation and Assembly*" and Appendix *H*, "*Parts and Accessories*." The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 meters (3.6 feet) to 2.0 meters (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.

⚠ **WARNING:**
To ensure proper performance of the ventilator, use only accessories (including oxygen accessories) approved and recommended by Covidien. See Appendix *H*, "*Parts and Accessories*" or contact your local Covidien Sales or Service Representative.

⚠ **WARNING:**
The oxygen supply hose ages even when it is not in use and should be replaced periodically. The expiration date may be located on the back of the hose end-piece.

⚠ **WARNING:**
When using non-invasive ventilation (NIV) without an exhalation valve, use a vented nose or face mask or a non vented mask combined with a leak accessory. When using non-invasive ventilation (NIV) with an exhalation valve, use a non-vented mask.

WARNING:
Before using the Nurse Call system, ensure that its connections are secure and it operates properly.

WARNING:
To connect the ventilator to a Nurse Call device, check the ventilator's compatibility with the Nurse Call device and order a suitable connection cable.

WARNING:
Do not use Nurse Call devices that operate based on the closure of an electrical circuit, because the devices often do not take into account possible cable disconnection or a total loss of power. Ensure that the Nurse Call device is always connected to the ventilator.

WARNING:
To prevent any interference with the internal sensors of the ventilator, do not install a humidifier upstream of the ventilator.

WARNING:
The use of any accessory other than those specified, with the exception of the power supplies or cables sold by Covidien, may lead to an increase in electromagnetic emissions or a decrease in the equipment protection against electromagnetic emissions. If the ventilator is used adjacent to such accessories or stacked with such devices, the ventilator's performance should be monitored to verify normal operation.

1.2.11 Warnings Regarding Maintenance

WARNING:
If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternative means of ventilation.

WARNING:
Never use a ventilator or any components or accessories that appear to be damaged. If any signs of damage are evident, contact your equipment supplier or Covidien.

WARNING:
If the ventilator is damaged or its external housing is not correctly closed or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.

⚠ **WARNING:**

If the ventilator fails the alarm tests or if you cannot complete the tests, refer to section *5.8*, "*Troubleshooting*" or call your equipment supplier or Covidien.

⚠ **WARNING:**

Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only personnel authorized and qualified by Covidien should repair, open or service the ventilator.

⚠ **WARNING:**

Regularly clean the ventilator's Dual Bag according to manufacturer's recommendations.

⚠ **WARNING:**

Before cleaning the ventilator, first disconnect the ventilator and the patient circuit.

⚠ **WARNING:**

The ventilator should never be immersed in any liquid, and any liquid on the surface of the device should be wiped away immediately.

⚠ **WARNING:**

To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

⚠ **WARNING:**

The air inlet filter is for use on a single patient and is not reusable; do not attempt to wash, clean, or reuse it.

⚠ **WARNING:**

Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over; see Chapter *10*, "*Routine Maintenance*." This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.

⚠ **WARNING:**

Before cleaning the ventilator, first disconnect the ventilator and the patient circuit. If the ventilator is used indoors, the condition of the air inlet filter should be checked monthly. If the ventilator is used outdoors or in a dusty environment, the filter should be checked weekly and replaced as necessary.

WARNING:
To ensure proper servicing and avoid the possibility of physical injury to personnel or damage to the ventilator, only personnel authorized and qualified by Covidien should attempt to service or make authorized modifications to the Puritan Bennett™ 520 Ventilator.

WARNING:
If you cannot determine the cause of a problem with your ventilator, contact your equipment supplier. Do not use the ventilator until the problem has been corrected.

WARNING:
To ensure proper performance of the ventilator, the preventative maintenance schedule should be followed. For further information contact Covidien.

WARNING:
On a daily basis, ensure the proper connection and operation of the patient circuit.

WARNING:
After assembling, cleaning, or reassembling the patient circuit, and on a daily basis, inspect the hoses and other components to ensure that there are no cracks or leaks and that all connections are secure.

WARNING:
Use all cleaning solutions and products with caution. Read and follow the instructions associated with the cleaning solutions you use to clean your ventilator. Use only those solutions listed in *Table 9-1.*

WARNING:
Never use a liquid cleaner inside the patient circuit, or on any component of a gas pathway. Clean the patient circuit only as specified by the manufacturer's instructions.

WARNING:
The patient circuit is intended for single use by a single patient ⨂ and should be changed according to the manufacturer's recommendations and according to the patient circuit lifetime. Refer to the instructions for use supplied by the manufacturer of the patient circuit (included with the ventilator) and to Chapter *6*, "*Installation and Assembly*."

WARNING:
A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection.

> ⚠️ **WARNING:**
> Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see Chapter *10*, "*Routine Maintenance*"). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.

> ⚠️ **WARNING:**
> If the ventilator is damaged or its external housing is not correctly closed or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.

1.2.12 Warnings to Protect the Environment

> ⚠️ **WARNING:**
> Batteries should be disposed of according to environmental legislation in your country and locality.

> ⚠️ **WARNING:**
> For environmental protection, the ventilator and its components, whatever their respective conditions of operation, cannot be disposed of with household waste and must be submitted for suitable selective collection and possible recycling of the materials. Observe all applicable regulations when disposing of the ventilator and any of its components.

1.2.13 Warnings Regarding USB Memory Device

> ⚠️ **WARNING:**
> Always verify the file ID before using a USB memory device to transfer data between the ventilator and a PC.

1.3 Symbols and Markings

Table 1-1. Ventilator Symbols

Symbols	Descriptions
⚠	It is essential to read, understand, and follow these instructions before using the Puritan Bennett 520 Ventilator (ISO 7000-0434A). This symbol appears on the ventilator's back panel, see *Table 1-2.* , item 2.
(Type BF applied part symbol)	Type BF applied part (IEC 60417-5333). A regulatory standard classification for protection against electrical shock for the part of the device that contacts the patient. This symbol appears on the ventilator's back panel; see *Table 1-2.* , item 4.
⎓	Direct current, DC (IEC 60417-5031). This symbol appears on the ventilator's back panel and keyboard; see *Figure 1-2.* , item 7, and *Figure 2-3.* , item 10.
∼	Alternating current, AC (IEC 60417-5032). This symbol appears on the ventilator's back panel and keyboard; see *Figure 1-2.* , item 6, and *Figure 2-3.* on page *2-7*, item 10.
(battery symbol)	Internal battery. This symbol appears on the ventilator's keyboard; see *Figure 2-3.* on page *2-7*, item 10.
▣	Insulation class II equipment (IEC 60417-5172). A regulatory standard classification for protection against electric shock. Class II equipment relies on double insulation rather than protective earthing. This symbol appears on the ventilator's back panel; see *Table 1-2.* , item 4.
IP31	Index of Protection rating for the ventilator's enclosure, defined in IEC 60529 (BSEN60529:1991). The first digit, 3, indicates protection against the intrusion of small foreign bodies (including fingers, tools, wires, etc. with a diameter greater than 2.5 mm) into the ventilator. The second digit, 1, indicates protection against water dripping or falling vertically, as well as an environment featuring water vapor condensation and/or light rain. This rating appears on the ventilator's back panel; see *Table 1-2.* , item 4.
(CSA) ® LR 58941 NRTL /C	CSA—Canadian Standards Association. This symbol appears on the ventilator's back panel; see *Table 1-2.* , item 4.
CE 0123	CE—Conformity European Signifies compliance with the medical device directive 2007/47/EC. This symbol appears on the ventilator's back panel; see *Table 1-2.* , item 4.
(UP key symbol)	This symbol appears on the ventilator's front panel UP key; see *Figure 2-3.* on page *2-7*, item 4. This key is used to: move the LCD display's cursor upwards, line-by-line; increase the value of displayed and selected parameter setting.
(DOWN key symbol)	This symbol appears on the ventilator's front panel DOWN key; see *Figure 2-3.* on page *2-7*, item 6. This key is used to: move the LCD display's cursor downwards, line-by-line; decrease the value of displayed and selected parameter settings.
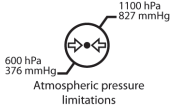
Table 1-1. Ventilator Symbols (Continued)

Symbols	Descriptions
⊘	This symbol appears on the ventilator's front panel ENTER key; see *Figure 2-3.* on page *2-7*, item 5. This key is used to confirm command actions.
⟳	This symbol appears on the ventilator's front panel ALARM CONTROL key; see *Figure 2-3.* on page *2-7*, item 2. This key is used to: cancel the audible portion of alarms for 60 seconds at a time; cancel an alarm. For more information, see Appendix *F*, *Alarms Tests*.
📖	This symbol appears on the ventilator's front panel MENU key; see *Figure 2-3.* on page *2-7*, item 7. This key is used to access the ventilator's menus via the ventilator's front panel LCD display.
⏻	This symbol (IEC 60417– 5009) appears on the ventilator's front panel VENTILATION ON/OFF button; see *Figure 2-3.* on page *2-7*, item 8. This key is used to start and stop ventilation.
↷	To patient port. This symbol appears on the front right of the ventilator, adjacent to the To patient port; see *Figure 1-1.* , item 1.
	Patient proximal pressure port. This symbol appears on the front right of the ventilator, adjacent to the To patient port; see *Figure 1-1.* on page *1-27*, item 3 and *Figure 1-3.* on page *1-28*.
	Exhalation valve pilot port. This symbol appears on the front right of the ventilator, adjacent to the To patient port indicating the connection of the tubing between the patient circuit exhalation valve; see *Figure 1-1.* on page *1-27*, and *Figure 1-3.* on page *1-28*, item 3.
O2 INLET	Oxygen inlet. This marking appears on the back panel of the ventilator, adjacent to the oxygen inlet port; see *Figure 1-2.* on page *1-27*, item 2.
🔔	Nurse call connector. This symbol appears on the back panel of the ventilator, adjacent to the nurse call connector; see *Figure 1-2.* on page *1-27*, item 10.
O	Switch in "Off" position (IEC 60417-5008). This symbol appears on the I/O (power on/off) switch on the back panel of the ventilator to indicate the switch's "Off" position. See *Figure 2-2.* on page *2-6*, item 2.
I	Switch in "On" position (IEC 60417-5007). This symbol appears on the I/O (power on/off) switch on the back panel of the ventilator to indicate the switch's "On" position. See *Figure 2-2.* on page *2-6*, item 2.
🔑	Software lock enabled. This symbol appears on the upper-left of the ventilator's LCD display when the keyboard Locking key is enabled; see section *7.8*, "*Locking the Control Panel*."

Table 1-1. Ventilator Symbols (Continued)

Symbols	Descriptions
	Internal battery.
	This symbol appears on the top-center of ventilator's LCD display to indicate that the ventilator is being powered by its internal battery. See *Figure 2-4.* on page *2-10*, item 1 and Chapter *8*, "*Internal Battery*," for more information.
1 / 2 / 3 / 4	Pressure rise time (inspiratory phase) parameter.
	These symbols appear on the ventilation mode menu screens. For more information, see Chapter *3*, "*Operating Parameters*." In pressure ventilation modes, you can select one of four rise times with setting 1 representing the fastest rise time and setting 4 representing the slowest.
	Selected line (filled square).
	When making menu choices, this graphic indicates the line on which the cursor is currently positioned. *Figure 7-15.* , *Selecting the Preferences Menu*, on page *7-15*.
	Non-selected line (empty square).
	When making menu choices, this graphic indicates a line on which the cursor is currently not positioned.
	Locked parameter line.
	When making menu choices, this graphic indicates a line that cannot be selected (the Locking key is enabled).
	Active parameter line.
	When making menu choices, this graphic indicates that the current parameter is selected and can be changed. See Chapter *7*, "*Operating Procedures*."
	Inspiratory effort detected.
	This symbol appears in the front panel display's Status window when the patient triggers a breath.
− ▬ +	Parameter adjustment bar.
	This graphic shows the current setting for parameters such as display contrast and alarm volume in the Preferences menu. See section *7.3*, *Preferences Menu Parameters*.
	WEEE (Waste Electrical and Electronic Equipment).
	This symbol means that this product must not be disposed of with household waste. Observe local ordinances for proper disposal. See *Table 1-2.* , item 4.
	Year of manufacture.
	Manufacturer.
	Audio Paused (alarm key once).
	This symbol means the sounding of audible alarms is currently disabled. This period lasts for 60 seconds. For more information, see section *5.4*, "*Pausing the Audible Portion of Alarms*."

Table 1-1. Ventilator Symbols (Continued)

Symbols	Descriptions
	Alarm Paused (alarm key twice). This symbol means one or more alarms have been paused or reset/canceled. The alarm is paused until the alarm condition is corrected and the condition reoccurs. For more information, see section *5.5*, "*Pausing/Resetting Alarms*."
	Alarm off (Apnea off). This symbol means that the Apnea alarm has been set to OFF in the Preferences menu. For more information, see section *5.5*, "*Pausing/Resetting Alarms*."
	Exhalation valve detected. This symbol means that an exhalation valve has been detected during ventilation.
	No exhalation valve detected. This symbol means that no exhalation valve has been detected during ventilation.
	Follow instructions for use (ISO 7000-1641). This symbol directs the user to observe and adhere to the instructions contained in the product's user manuals.
	USB port. This symbol indicates a communications port for interfacing with a USB connector. See *Figure 1-2.* , item 9.
	PC connector. This symbol indicates a port that can be used by authorized Puritan Bennett product service personnel or Covidien service personnel for software maintenance. See *Figure 1-2.* , item 8.
1100 hPa 827 mmHg 600 hPa 376 mmHg Atmospheric pressure limitations	Atmospheric pressure limitation.
95% 10% Humidity limitations	Humidity limitations.
70°C -40°C Temperature limitations	Temperature limitations.
Fragile	Fragile.
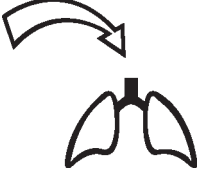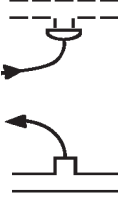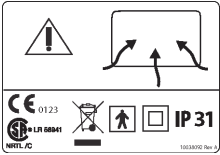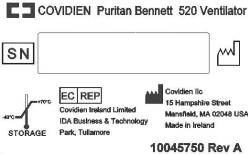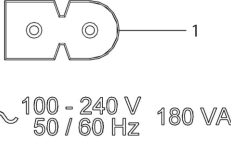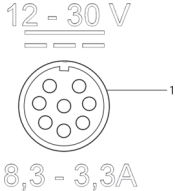
Table 1-1. Ventilator Symbols (Continued)

Symbols	Descriptions
Keep dry	Keep dry.
Keep away from sunlight	Keep away from direct sunlight.
This side up	This side up.

1.4 Labels / Identification and Instruction Information

Various labels or specific markings are affixed to the ventilator that describe precautions to be taken for the correct use of the ventilator and contribute to the traceability of the product. See *Table 1-2.* and the figures on the following pages for illustrations of these labels and markings and their locations on the ventilator. Use the item numbers in *Table 1-2.* to locate the labels in *Figure 1-1.* to *Figure 1-3.*

Table 1-2. Ventilator Labels and Markings

1. Patient gas inlet label (*Figure 1-1.* , *Figure 1-3.*)	2. Oxygen inlet marking and label (*Figure 1-2.*)	3. Exhalation valve and patient pressure connection label (*Figure 1-1.* , *Figure 1-3.*)
4. Air inlet label (*Figure 1-2.*)	5. Identification label (*Figure 1-3.*)	*1 Location of AC power cable connector* 6. AC power (mains) cable connector marking (*Figure 1-2.*)
1 Location of DC power cable connector 7. External cable connector marking (*Figure 1-2.*)	8. PC connection marking (*Figure 1-2.*)	9. USB port marking (*Figure 1-2.*)
10. Nurse call cable connector Marking (*Figure 1-2.*)	N/A	N/A

Note:

The item number callouts in the following figures refer to those listed in *Table 1-2.*

Figure 1-1. Locations of Labels—Top-Front View

Figure 1-2. Location of Labels and Markings—Rear View
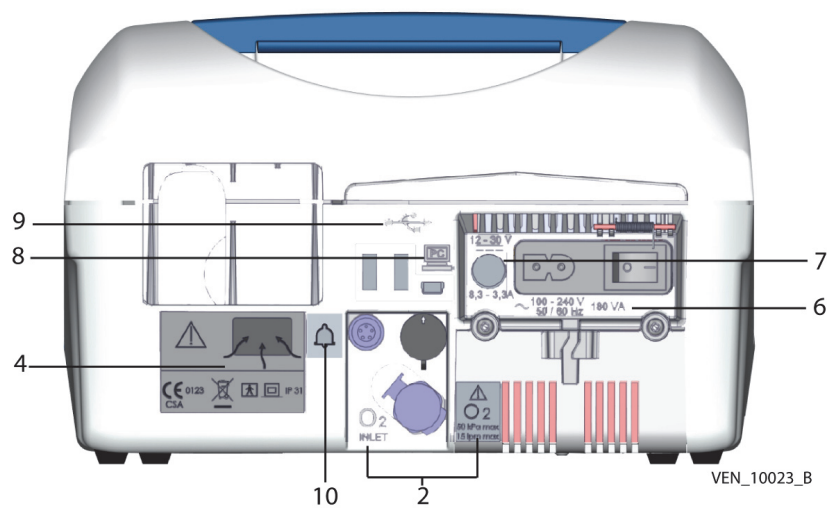
Figure 1-3. Location of Labels—Bottom View

VEN_12012_A
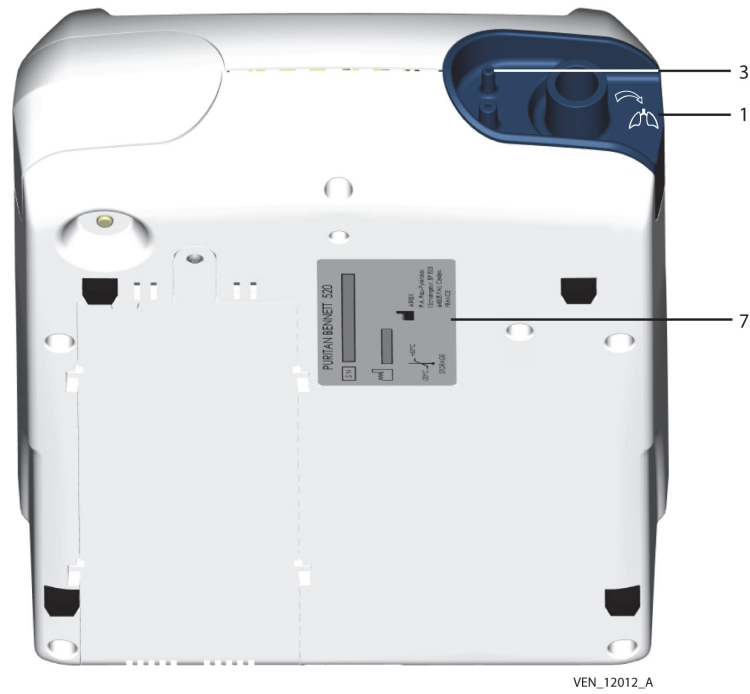
2 Ventilator Overview

2.1 Indications for Use

The Puritan Bennett™ 520 Ventilator is indicated for the continuous or intermittent mechanical ventilatory support of patients weighing at least 11 lb (5 kg) who require mechanical ventilation. The ventilator is a restricted medical device intended for use by qualified, trained personnel under the direction of a doctor. It is essential to read, understand, and follow these instructions before using the Puritan Bennett™ 520 Ventilator.

Target Patients

Specifically, the ventilator is applicable for adult and pediatric patients who require the following general types of invasive or non-invasive ventilatory support, as prescribed by an attending doctor:

- Positive Pressure ventilation

- Assist/Control, PSV, or CPAP modes of ventilation

- Breath types, including Pressure Control and Pressure Support

Target Environments

The ventilator is suitable for use in institutional, home, and portable settings. It is not intended for use as an emergency transport ventilator.

The Puritan Bennett 520 Ventilator is suitable for use on commercial aircraft, per FAA requirements. See section *B.11*, "*Standards Compliance and IEC Classification.*" Patients traveling with the Puritan Bennett 520 Ventilator may be required by their airline to demonstrate evidence of compliance with the RTCA/DO-160F standard, as well as other requirements. Contact your airline prior to travel to determine airline-specific requirements and documentation.

WARNING:
Even though the Puritan Bennett™ 520 Ventilator meets current safety standards, and although the internal Lithium-ion battery of the device is considered to be Dangerous Goods for transport in commerce, this devices lithium battery is below the 100Wh threshold and is therefore excepted from being a Class 9 – Miscellaneous - Dangerous Goods (DG). As such, the Puritan Bennett™ 520 Ventilator and/or the associated Lithium-ion battery are subject to some transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for

Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport; the Puritan Bennett™ 520 Ventilator is permitted as checked-in or carry-on baggage. Spare batteries may be taken on board as carry-on luggage only. This classification and regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.

Target Operators

The ventilator may be operated by the following caregivers:

- Respiratory therapists

- Doctors

- Nurses

- Homecare providers

- Patient and patient's families

For more details on the knowledge and skill requirements for operating the Puritan Bennett 520 Ventilator, see Appendix *A*, "*Patient/Caregiver Checklist*."

WARNING:
This ventilator must be used only under the responsibility and on the prescription of a doctor.

WARNING:
The ventilator is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

2.2 Contraindications

This ventilator is not for use with anesthetic gases, and is not intended for use as an emergency transport ventilator. It is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

2.3 Operational Use

The Puritan Bennett 520 Ventilator uses a micro-turbine to provide ventilatory support to patients. Clinicians may use a variety of interfaces to connect patients to the ventilator for continuous or intermittent ventilatory support. Some examples include mouthpieces; nasal masks or full face masks; endotracheal tubes or tracheotomy tubes. User-selectable ventilation modes include the following types:

- Assisted Controlled Pressure (P A/C)

- Continuous Positive Airway Pressure (CPAP)

- Pressure Support Ventilation with apnea ventilation (PSV/ST)

Safety Net

Incorporated in the ventilator design is an alarm system that continuously monitors both patient and machine for signs of specific errors or faults that could lead to an unsafe condition. Should any of these errors or faults be detected, the alarm system announces the specific alarm condition both audibly and visually. The machine-related alarm conditions are factory set, whereas the patient-related alarm conditions are defined by alarm-threshold values selected by an operator (a clinician or a caregiver). For more information, see Chapter *5*, "*Alarms and Troubleshooting*."

WARNING:
Patients on home care ventilation equipment should be appropriately monitored by clinicians, caregivers and suitable monitoring equipment, as advised by the patient's clinician. The Puritan Bennett™ 520 Ventilator is not intended to be a comprehensive monitoring device and does not activate alarms for all types of dangerous conditions for patients.

Settings

A software key, known as the Locking key, restricts access to ventilation parameter settings and ventilation mode changes in order to distinguish between clinician usage and patient usage (see section *7.8*, "*Locking the Control Panel*" on page *7-36*).

Oxygen Enrichment

Oxygen may be supplied from an external, low pressure source, but the oxygen flow must be limited to 15 lpm (50 kPa, 7 PSI). The ventilator automatically compensates for the extra flow created by the external oxygen supply (see Chapter *6*, "*Installation and Assembly*."

WARNING:
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

WARNING:
Oxygen therapy for patients with respiratory failure is a common and effective medical prescription. However, be aware that inappropriate oxygen use may potentially lead to serious complications, including, but not limited to, patient injury.

WARNING:
Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 520 Ventilator.

Breathing Circuit

The ventilator is used with a single-limb patient circuit. For more information, see section *6.4*, "*Patient Circuit*" on page *6-8*.

2.4 Device Classification

The ventilator's IEC/EN 60601-1 classification is as follows:

- Protection/insulation class (electric shock): Class II

- Protection index of enclosure: IP31

- Medical device directive classification: II B

- Degree of protection against risk of electric shock: BF

- Power: external (AC—mains, or DC—cigarette lighter) or internal (DC—battery)

- Operation mode: continuous operation

For additional information, see Appendix *B*, "*Specifications*."

2.5 Front Panel

Figure 2-1. Front Panel

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1	**LCD display**—Shows information about the ventilator, including patient hours and software version, ventilation modes and settings, and monitored and calculated patient data. The display also allows the user to view and, using the control panel, adjust the ventilator's operating and alarm configuration settings.	4	**Patient pressure monitoring port**—Nipple for monitoring proximal patient pressure.
2	**Control panel**—Features the controls for setting up and operating the ventilator, and LEDs to indicate the ventilator's power source, ventilation on/off status, and alarm priority level. Control functions include turning on and off the ventilation, configuring ventilation modes, pausing audible alarms, canceling alarms, and setting device and alarm parameters.	5	**Exhalation valve port**—Nipple for providing piloting pressure to the exhalation valve. Controls the open-closed position of the exhalation valve.
3	**Patient connection port**—Provides an outlet for the gas to be delivered to the patient via the patient circuit.	6	**Lateral and front openings** – Vents that allow for air circulation to cool the ventilator's internal components. In addition, these openings function as sound ports for audible alarms. ⚠ **WARNING:** **Do not cover or obstruct these openings.**

2.6 Back Panel

Figure 2-2. Back Panel

VEN_11947_A

1	Ergonomic carrying handle.	7	PC cable connector:
			USB mini-B connector used for Puritan Bennett Ventilator test software.
2	On/off (I/O) switch with protective cover:	8	O_2 inlet port:
	Device powered on in position I; device switched off in position 0.		Connects the ventilator to a low pressure oxygen source via an adapter connected to the O_2 Inlet (see section *6.7.1*, "*Administering Oxygen*" on page *6-16*).
3	AC power ("mains") cable connector.	9	Nurse call output connector:
			Used to connect the ventilator to the nurse call system.
4	AC power ("mains") cable holding system:	10	USB memory device connection:
	Secures AC power cable to avoid accidental disconnection.		USB connection to be used with Puritan Bennett Respiratory Insight Software. There are two USB type A ports.
5	Access cover for the internal battery.	11	Air inlet filter:
6	DC power cable connector with key.		Filters air as it enters the ventilator.
			⚠ WARNING:
			Do not cover or obstruct these openings.

2.7 Control Panel

Figure 2-3. Control Panel

VEN_10839_A

1	Alarm indicators (two LEDs): Red indicator: • Continuous: very high priority (VHP) alarm activated • High priority (HP) alarm activated. Yellow indicator: • Medium priority (MP) alarm activated.	6	DOWN key: • Moves the cursor down and decreases parameter values.
2	ALARM CONTROL key: • Press once to pause an audible alarm for 60 seconds. • Press twice to halt visual and audible alarms. If alarm is remedied, the alarm is canceled (other than the high pressure alarm).	7	MENU key: Changes the menu shown. From the Ventilation menu screen, press this key to show the Alarm menu screen. When a USB memory device is inserted into the ventilator, press this key to show the USB memory device screen.
3	Display screen: Shows modes, ventilation settings, patient data, configuration of the ventilator, and alarm management.	8	VENTILATION ON/OFF button: • ON: Press briefly and release to start ventilation. • OFF: Press and hold for 3 seconds, then press again to stop ventilation.
4	UP key: •Moves the cursor up and increases parameter values.	9	Ventilation status indicator: Blue indicator illuminated: Device is turned on and ventilation is off (on standby). Blue indicator off: Ventilation is on.
5	ENTER key: • Access to a setting value and validation of the modification of this setting. • Access to a sub-menu.	10	Electrical power source indicators: • AC POWER indicator lit: AC power source connected. • DC POWER indicator lit: DC power source connected. • INTERNAL BATTERY indicator lit continuously: internal battery in use (no external power source connected.) • INTERNAL BATTERY indicator flashing: battery charging.

2.8 Ventilation Menu

Figure 2-4. Ventilation Menu Display
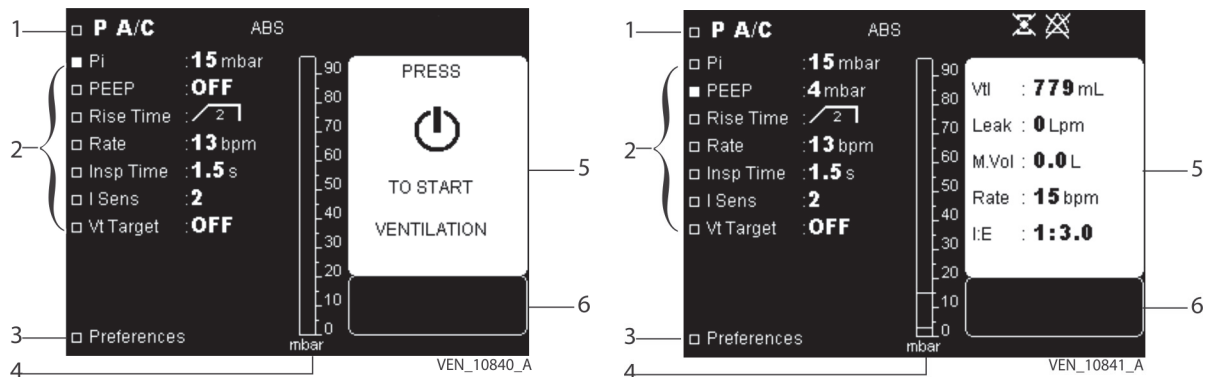
Ventilation menu with ventilation on standby.

Ventilation menu during ventilation.

1	General information line:	2	Ventilation settings:	3	Preferences menu access line:
	Shows the current ventilation mode, along with the following:		Shows the specific ventilation parameter values for the currently selected ventilation mode. See Chapter *3*, "*Operating Parameters*" for more information.		Highlight this line and press the ENTER ⟨✓⟩ key to show the Preferences menu.
	• Battery ▯ symbol if the device is powered by the internal battery.				See manual section *7.3*, "*Preferences Menu Parameters*" on page *7-14* for more information.
	• Audio paused ⟋⟍ symbol if an alarm is currently inhibited.				
	• Alarm paused ⟋⟍ symbol if an alarm has been canceled manually and the cause of the alarm remains.				
	• Apnea alarm deactivation ⟋⟍.				
	• Exhalation valve ✛ symbol.				
	• No exhalation valve ⟆ symbol.				
	• Absolute ABS symbol.				
	• Relative REL symbol.				
4	Bargraph:	5	Status/monitored data window:	6	Alarm conditions window:
	Shows pressure generation during ventilation.		• Ventilation stopped (standby): shows the message, "PRESS ⏻ TO START VENTILATION."		• For active alarms, scrolls through active alarm messages in flashing reverse video.
			• Ventilation on: parameters are monitored and shown.		•For inactive alarms, shows the last alarm along with its trigger date and end-of-event time.
			• The Inspiratory effort detected symbol ● appears adjacent to the monitored I:E ratio when the patient actively triggers a breath.		See Chapter *5*, "*Alarms and Troubleshooting*" for details.

2.9 Alarm Menu

Figure 2-5. Alarm Menu
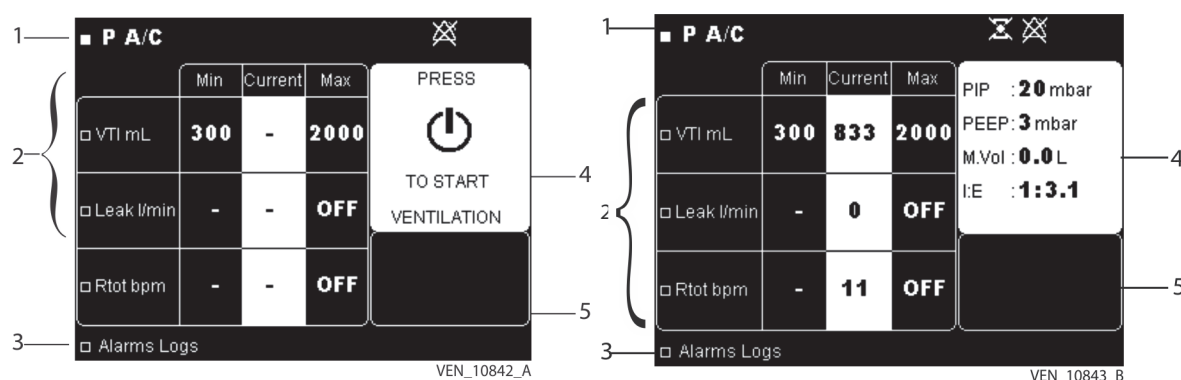
Alarm menu with ventilation on standby.   Alarm menu when not in standby.

1	Title line:	2	Alarm settings:	3	Access line to Alarm Logs menu.
	Shows ventilation mode and the following symbols:		Shows the specific alarm parameter values for the currently selected ventilation mode, which are the following:		Highlight this line and press the ENTER ⊘ key to show the Alarm Logs menu.
	• Battery symbol if the ventilator is powered by the internal battery.		• Min and max alarm threshold settings, and		See manual section *5.3*, "*Alarm Log Menu*" on page *5-1*.
	• Audio paused if an alarm is currently inhibited.		• Current monitored patient readings, or hyphen (-) when ventilation is in standby.		
	• Alarm paused if an alarm has been canceled manually and the cause of the alarm remains.				
	• Apnea alarm deactivation.				
	• Exhalation valve symbol.				
	• No exhalation valve symbol.				
4	Status/monitored data window:	5	Alarm message window:		
	• Ventilation stopped (standby): shows the message, "PRESS ⏻ TO START VENTILATION."		• For active alarms, scrolls through active alarm messages in flashing reverse video.		
	• Ventilation on: parameters are monitored and shown.		• For inactive alarms, shows the last alarm along with its trigger date and end-of-event time.		
	• The Inspiratory effort detected symbol ● appears adjacent to the monitored I:E ratio when the patient actively triggers a breath.		See Chapter *5*, "*Alarms and Troubleshooting*" for details.		

2.10 USB Memory Device Menu

Figure 2-6. USB Memory Device Menu

VEN_10844_A

1	Title line	**3**	USB Memory Device menu
2	Ventilator serial number	**4**	Dialog box
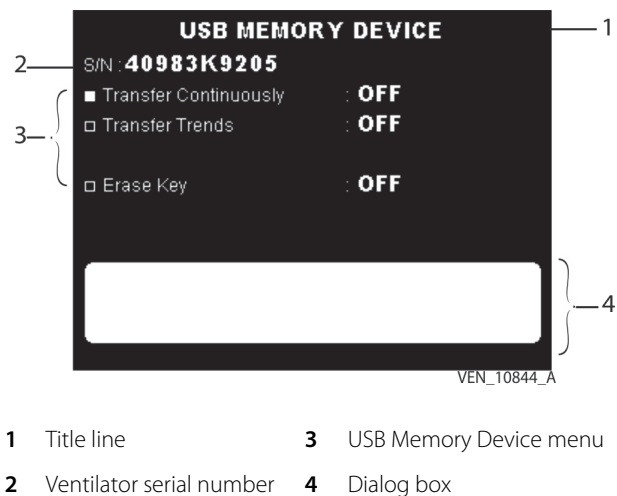
2.11 If Ventilator Failure Occurs

If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternate means of ventilation.

Keep in mind that troubleshooting information is available in this manual to assist you in the event of a problem. See Chapter *5*, "*Alarms and Troubleshooting*."

If you cannot determine the cause of a problem, contact your equipment supplier or Covidien. See section *10.3*, "*Service Assistance*."

3 Operating Parameters

This chapter describes ventilation and alarm parameters and their setting ranges for each ventilation mode. For a listing of operating parameters and monitored patient data, see *Table B-8.* on page *B-3*. For further information about the different ventilation modes and breath types provided by the Puritan Bennett™ 520 Ventilator, see Appendix *D*, "*Modes and Breath Types*."

⚠ **WARNING:**
The ventilator is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

⚠ **WARNING:**
If APNEA TIME is set to a value higher than 60/Rate then the APNEA alarm will not activate.

📖 **Note:**
Before choosing settings for operating parameters and alarms, be sure to carefully review the warnings regarding settings. See section *1.2*, "*Warnings*" on page *1-1*.

3.1 PSV Mode Parameters and Setting Ranges

The menus for PSV—Pressure Support Ventilation mode are shown in *Figure 3-1.* and *Figure 3-2.* :

Figure 3-1. Menus in PSV Mode with Exhalation Valve Configuration

VEN_11981_A
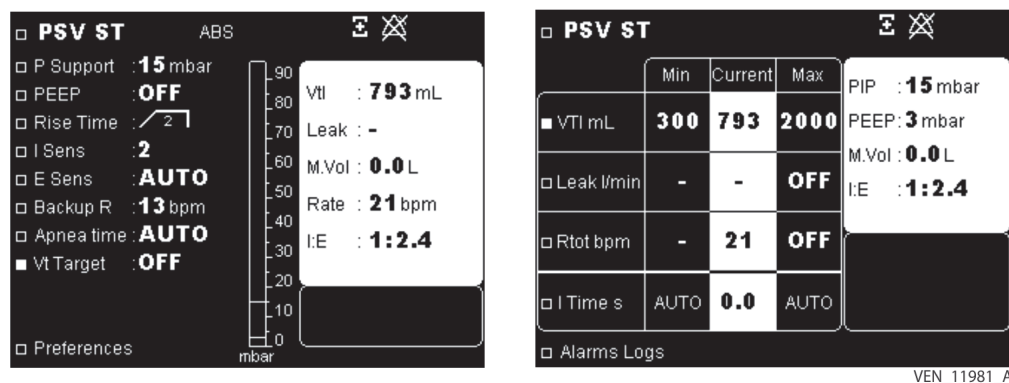
Figure 3-2. Menus in PSV Mode with Leakage Configuration

VEN_11982_A
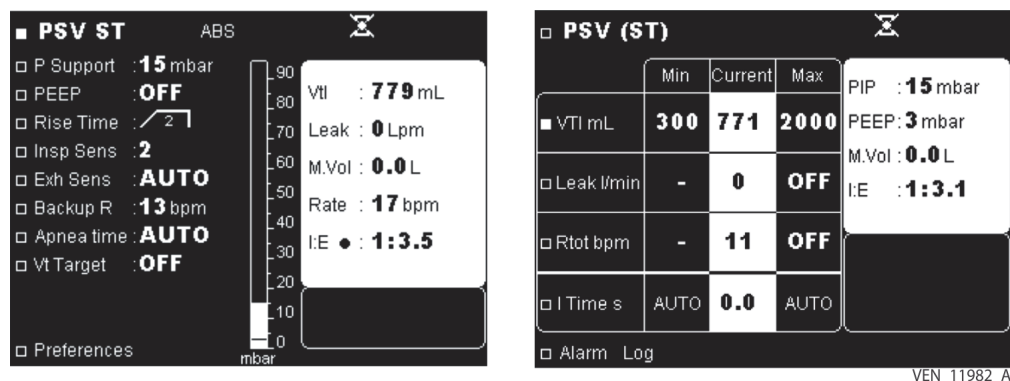
The ventilation parameters and setting ranges available in PSV mode are listed in *Table 3-1.*

Table 3-1. Ventilation Parameters in PSV Menu

Name	Units	Min. value	Max. value	Adjustment resolution	Default value	Linked parameters
P Support	cmH$_2$O, mbar, or hPa	Standby: 2 Valve configuration: 5 Leak configuration: 6	Standby: 55 Valve configuration: 55 Leak configuration: 30	1	15	PEEP
PEEP	cmH$_2$O, mbar, or hPa	Standby: OFF Valve configuration: OFF Leak configuration: 4	20	1	OFF	P Support Max P
Rise Time	–	1	4	1	2	I Time
I Sens	–	0P	5	1	2	–
E Sens[1]	%	5 (-95)	95 (-5)	5	Auto	–
Backup R	bpm	4	40	1	13	Min I Time
Apnea Time	s	1	60	1	Auto	Backup R
Vt Target	ml	50	2000	10	OFF = 100	–
Min I Time	s	0.1	2.8	0.1	Auto	Max I Time
Max P	mbar	8	55	1	Pi + 3	-
Max I Time	s	0.8	3	0.1	Auto	Min I Time

1   See Chapter *7*, "*Operating Procedures*" for information on positive and negative E Sens settings.

Table 3-2. lists the available alarm settings in PSV mode.

Table 3-2. Alarm Parameters in PSV Mode

Name	Units	Min. value	Max. value	Adjustment resolution	Default value	Linked parameters
Min VTI	ml	30	2000	10	300	Max VTI
Max VTI	ml	80	3000	10	2,000	Min VTI
Max Leak (with leak configuration)	lpm	5	200	5	OFF	-
Max Rtot	bpm	10	70	1	OFF	Backup R

P Support—Pressure Support

When Relative pressure is set to YES in the Setup menu, P Support allows you to determine inspiratory pressure added to PEEP during the inspiratory phase.

In this configuration, the sum of P Support and PEEP must not exceed 55 mbar.

When Relative pressure is set to OFF in the Setup menu, P Support allows you to determine inspiratory absolute pressure.

In this configuration, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

PEEP—Positive End Expiratory Pressure

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

When Relative pressure is set to YES in the Setup menu, the sum of P Support and PEEP must not exceed 55 mbar.

When Relative pressure is set to OFF, P Support and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to OFF) in valve configuration.

In leak configuration, the minimum PEEP setting is 4 mbar.

Rise Time

This parameter is used during the inspiration phase to determine how the target pressure will be reached. This setting indirectly defines the minimum inspiratory time.

The different levels available are as follows:

Rise time $\boxed{1}$ = 200 ms

Rise time $\boxed{2}$ = 400 ms

Rise time $\boxed{3}$ = 600 ms

Rise time $\diagup\!\!4$ = 800 ms

These time ranges are determined by the pressure setting required, the breath rate, and the physiological condition of the patient.

I Sens—Inspiratory Trigger Sensitivity

I Sens allows you to set the level of inspiratory effort the patient has to provide during the initiation of a machine breath.

The sensitivity levels are 0P, 1P, 2, 3, 4, and 5 (P denotes pediatric use); the lower the number, the more sensitive the trigger sensitivity.

I Sens can be set to OFF.

⚠ **WARNING:**
Ensure that the I Sens setting is not set to OFF when ventilating patients capable of triggering spontaneous breaths.

⚠ **WARNING:**
Carefully modify the trigger threshold setting to reduce the risk of ventilator autotriggering. Level 0P, the most sensitive inspiratory trigger, is recommended for pediatric use. For an adult, this setting may result in ventilator autotriggering.

E Sens—EXHALATION SENSITIVITY

E Sens is available in PSV mode.

E Sens allows you to determine sensitivity of switching to exhalation and thus indirectly determines the inspiratory time of a breath.

The end of inspiration will occur when inspiratory flow has decreased to the preset E Sens setting.

The exhalation trigger is only taken into account after the Rise Time (which constitutes a default minimum inspiratory time) has elapsed.

If the flow drop is insufficient, exhalation is automatically triggered independently of the E Sens, which is defined as a percentage of peak inspiratory flow. Exhalation may be triggered if the maximum inspiratory time setting has elapsed. For more information about maximum inspiratory time, see Min and Max I Time—Minimum/Maximum Inspiration Time.

Figure 3-3. Exhalation Trigger Sensitivity

VEN_10188_A

| x | Seconds | y2 | Exhalation |
| y1 | Inspiration | | |
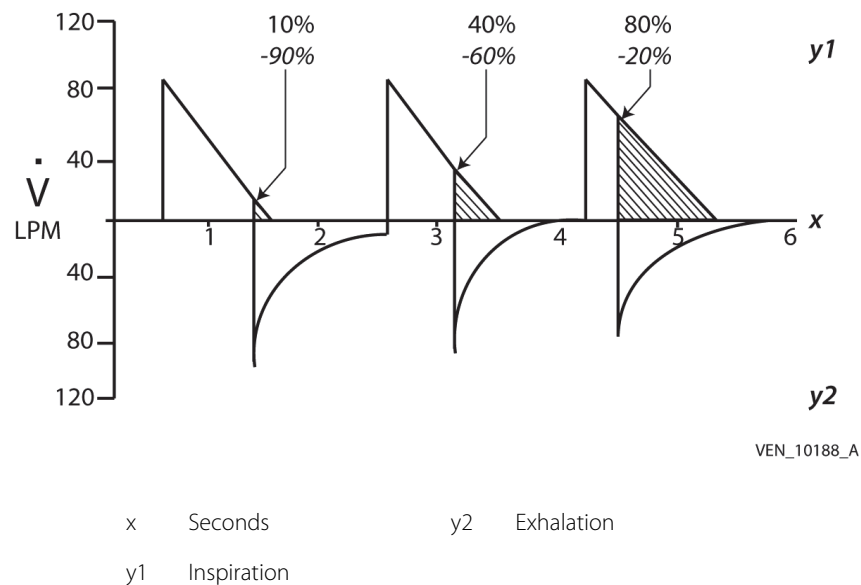
Note:

See section *7.2.2*, "*Changing the Setup Menu Parameters*" for positive and negative E Sens settings.

Backup R

Backup R allows you to determine the frequency of ventilation breaths to be applied in the event of prolonged apnea—as long as no inspiratory trigger is detected.

The inspiratory time of the backup breaths applied in the event of apnea still depends on the detection of exhalation trigger (E Sens) and the safety maximum inspiratory time (see above comment on E Sens). The rise time of these cycles is identical to the ventilation cycle previously set.

The controlled cycles following apnea are interrupted as soon as a new spontaneous inspiration of the patient is detected.

The Backup R is linked to the Min I Time so that the Min I Time setting cannot be greater than half the inspiratory phase of a ventilator-controlled breath.

Backup R breath is delivered at the Pressure Support settings.

Setting a backup rate is not optional; it is always set.

3.1.1 Apnea Time

Apnea time allows the user to monitor and detect interruptions to the patient's spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.

The APNEA TIME adjustment range shall be 1 to 60 seconds. The ventilator shall enable the operator to set an auto-setting. The Apnea time AUTO setting (in seconds) is calculated using the formula (Auto = maximum value between 3 seconds and 60/Backup R or AUTO = 30 in CPAP mode).

Note:
During apnea ventilation, the ventilator delivers machine-controlled breaths according to a backup rate (Backup R)—as long as no inspiratory trigger has been detected.

Note:
The Backup R value applied depends on the Rate setting.

Note:
If the Apnea alarm is set to OFF in the Preferences menu, the Apnea time setting will still be active.

Vt Target—TARGET TIDAL VOLUME

Vt Target allows the ventilator to deliver a target volume of gas to the patient.

When a Vt Target is set, the ventilator constantly adjusts the target inspiratory pressure between Pi and Max P to ensure the inspired tidal volume remains as close as possible to the Vt target.

Vt Target should be more than 10 ml lower than Max VTI to avoid triggering a VTI alarm. The minimum increase or decrease of target inspiratory pressure is 0.5 mbar and the maximum is 2 mbar.

Setting the Vt Target is not mandatory (it can be set to OFF).

Max P—MAXIMUM INSPIRATION PRESSURE

Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the target tidal volume (Vt Target).

P Support and Max P are related and the difference between them must be less than 20 mbar.

Max P is not shown when Vt Target is set to OFF.

Min and Max I Time—MINIMUM / MAXIMUM INSPIRATION TIME

Min I Time and Max I Time are ventilation parameters that can be adjusted in the alarm menu.

Min I Time defines the minimum duration of time the inspiratory phase is maintained. It takes priority over activation of the exhalation trigger, which can only be triggered after the Min I Time has expired.

The Backup R is linked to the Min I Time so that the Min I Time setting cannot be greater than half the inspiratory phase of a cycle triggered by the ventilator.

If Backup R is changed, Min I Time is, if necessary, automatically readjusted so that the difference between them is always maintained.

The minimum time by default if no parameter is set (Min I Time = AUTO) corresponds to the Rise Time to which an operating margin of 0.3 seconds is added. See "*Rise Time*" on page *3-3* for details about Rise Time.

Max I Time defines the maximum duration of time during which the inspiratory phase is maintained. The switch-over to exhalation occurs, at the latest, after this time has expired.

By default, if no parameter is set, the maximum time (Max I Time = AUTO) is the shortest time between a fixed time of 3 seconds and half the duration of the patient's inspiratory breaths expressed in seconds. (AUTO equals the lesser of 3 seconds or 30/Rate). This default value will be applied if it is lower than the Max I Time setting.

Min I Time and Max I Time are related so that the Max I Time cannot be set to a value lower than the Min I Time.

VTI (Min and/or Max Alarm Settings)—INSPIRATORY TIDAL VOLUME

It is possible to set a minimum, maximum, or both Tidal Volume alarm threshold for the patient's inspired tidal volume during a cycle.

This setting is used to trigger an alarm if the tidal volume inspired by the patient is lower than the minimum threshold set (LOW VTI alarm) or greater than the maximum threshold set (HIGH VTI alarm). See Chapter *5*, "*Alarms and Troubleshooting*."

Min VTI and Max VTI are related, and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read OFF for these settings.

Max Leak (Max Alarm Settings)

The setting of a high leakage threshold enables a HIGH LEAKAGE alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasite leakage flow observed during the exhalation phase.

Max Leak is shown when ventilating without an exhalation valve.

Setting the Max Leak is not mandatory (it can be set to OFF), but the measured value is always shown.

Max Rtot (Max Alarm Setting)—TOTAL BREATH RATE

The maximum rate threshold set is used to warn of hyperventilation or ventilator autotriggering.

The alarm setting is used to trigger the HIGH RATE alarm. See Chapter *5*, "*Alarms and Troubleshooting*."

When set, the Max Rtot threshold must always exceed the backup rate by 5 bpm. If the backup rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to OFF), but the measured value is always shown.

3.2 CPAP Mode Parameters and Setting Ranges

The menus in CPAP (Continuous Positive Airway Pressure) ventilation mode are shown in *Figure 3-4.* :

Figure 3-4. Menus in CPAP Mode in Leakage Configuration

VEN_11983_A
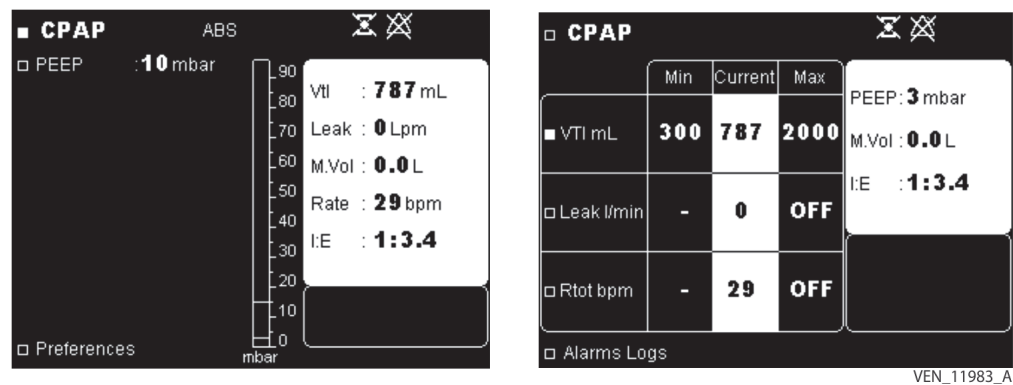
The ventilation parameters and setting ranges available in CPAP mode are listed in *Table 3-3*.

Table 3-3. Ventilation Parameters in CPAP Menu

Name	Units	Min. value	Max. value	Adjustment resolution	Default value	Linked parameters
PEEP	cmH_2O, mbar or hPa	4	20	1	10	Pi
Apnea Time[1]	s	1	60	1	Auto	Backup R

1. Not available if Apnea alarm is set to OFF in Preferences menu.

Table 3-4. lists the available alarm settings in CPAP mode.

Table 3-4. Alarm Parameters in CPAP Mode

Name	Units	Min. value	Max. value	Adjustment resolution	Default value	Linked parameters
Min VTI	ml	30	2000	10	300	Max VTI
Max VTI	ml	80	3000	10	2000	Min VTI
Max Leak	lpm	5	200	5	OFF	-
Max Rtot	bpm	10	70	1	OFF	Backup R

⚠ **WARNING:**
The CPAP mode does not provide a set respiratory rate. Do not use this mode if it is not appropriate for the patient's condition.

Note:

Only leak configuration is available in CPAP mode.

PEEP—Positive End Expiratory Pressure

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to OFF).

A PEEP value can be set to determine the level of pressure maintained during the inspiratory phase and the exhalation phase.

Apnea Time

Apnea time allows the user to monitor and detect interruptions to the patient's spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.

The Apnea time AUTO setting is 30 seconds.

Apnea time is not available if Apnea alarm is set to OFF in the Preferences menu.

VTI (Min and/or Max Alarm Settings)—INSPIRATORY TIDAL VOLUME

It is possible to set a Min, Max, or both Tidal Volume alarm threshold for the patient's inspired tidal volume during a cycle.

This setting is used to trigger an alarm if the tidal volume inspired by the patient is lower than the minimum threshold set (LOW VTI alarm) or greater than the maximum threshold set (HIGH VTI alarm). See Chapter *5*, "*Alarms and Troubleshooting*."

Min VTI and Max VTI are related, and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read OFF for these settings.

Max Leak (Max Alarm Settings)

The setting of a high leakage threshold enables a HIGH LEAKAGE alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasite leakage flow observed during the exhalation phase.

It is not mandatory to set the maximum Leak alarm limit. When the maximum Leak alarm limit is not set, the display will read OFF for these settings.

Max Rtot (Max Alarm Setting)—TOTAL BREATH RATE

The maximum rate threshold set is used to warn of hyperventilation or ventilator autotriggering.

The alarm setting is used to trigger the HIGH RATE alarm. See Chapter *5*, "*Alarms and Troubleshooting*."

When set, the Max Rtot threshold must always exceed the backup rate by 5 bpm. If the backup rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to OFF), but the measured value is always shown.

I Sens—INSPIRATORY TRIGGER SENSITIVITY

The trigger threshold for switching to inhalation cannot be set in CPAP mode. The device is configured with a default I Sens of 2.

E Sens—EXHALATION TRIGGER SENSITIVITY

The trigger threshold for switching to exhalation cannot be set in CPAP mode. The device is configured with a default E Sens of 25%.

3.3 P A/C Mode Parameters and Setting Ranges

The menus in P A/C (Pressure Assisted/Controlled) ventilation mode are shown in *Figure 3-5.* and *Figure 3-6.*

Figure 3-5. Menus in P A/C Mode with Exhalation Valve Configuration

VEN_11985_A
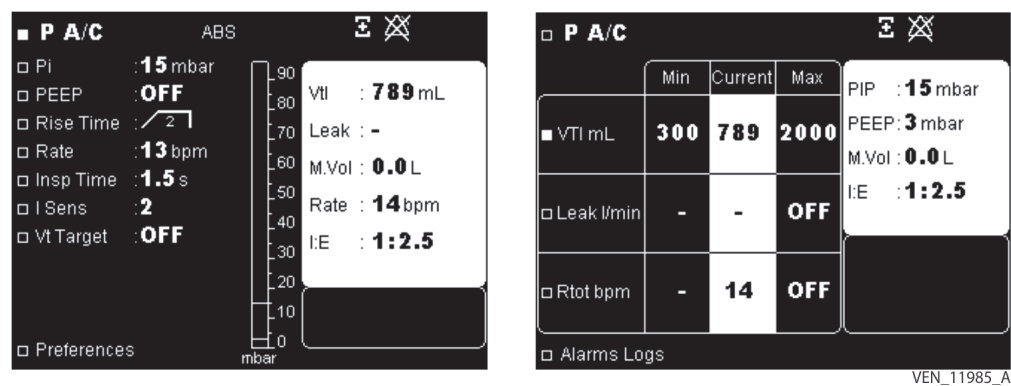
Figure 3-6. Menus in P A/C Mode with Leakage Configuration

VEN_11986_A
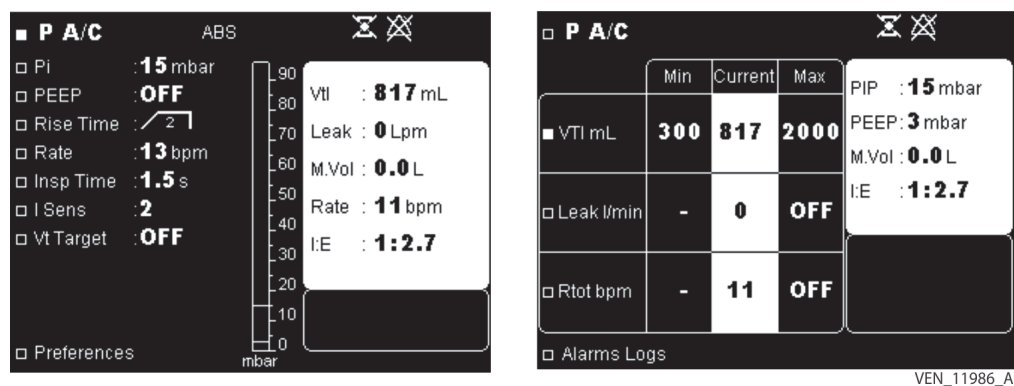
The ventilation parameters adjustable in P A/C mode are listed in *Table 3-5.*

Table 3-5. Ventilation Parameters in PA/C Mode menu

Name	Units	Min. value	Max. value	Adjustment resolution	Default value	Linked parameters
Pi	cmH$_2$O, mbar, or hPa	Standby: 2 Valve configuration: 5 Leak configuration: 6	Standby: 55 Valve configuration: 55 Leak configuration: 30	1	15	PEEP
PEEP	cmH$_2$O, mbar, or hPa	Standby: OFF Valve configuration: OFF Leak configuration: 4	20	1	OFF	Pi
Rise Time	–	1	4	1	2	Rate I/T
Rate	bpm	1	60	1	13	Max Rtot
Insp Time	s	0.3	6.0	0.1	1.5	Rate Apnea Time
I Sens	–	OFF	5	1	2	–
Vt Target	ml	50	2000	10	OFF	Min VTI Max VTI
Max P	cmH$_2$O, mbar, or hPa	8	55	1	Pi + 3	Pi PEEP

Table 3-6. lists the adjustable alarm parameters in P A/C mode.

Table 3-6. Alarm Parameters in PA/C Mode

Name	Units	Min. value	Max. value	Adjustment resolution	Default value	Linked parameters
Min VTI	ml	30	2000	10	300	Max VTI
Max VTI	ml	80	3000	10	2000	Min VTI
Max Leak (leakage configuration)	ml	5	200	5	OFF	-
Max Rtot	bpm	10	70	1	OFF	Rate

Pi—Inspiratory Pressure

When Relative pressure is set to YES in the Setup menu, Pi allows you to determine inspiratory pressure added to PEEP during the inspiratory phase.

In this configuration, the sum of Pi and PEEP must not exceed 55 mbar.

When Relative pressure is set to OFF in the Setup menu, Pi allows you to determine inspiratory absolute pressure.

In this configuration, Pi and PEEP are related, and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

PEEP—Positive End Expiratory Pressure

PEEP allows you to determine the level of pressure maintained during the exhalation phase.

When Relative pressure is set to YES in the Setup menu, the sum of Pi and PEEP must not exceed 55 mbar.

When Relative pressure is set to OFF, Pi and PEEP are related and their settings must maintain a minimum difference between the two of 2 mbar in leak configuration and 5 mbar in valve configuration.

The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to OFF) in valve configuration.

In leak configuration, the minimum PEEP setting is 4 mbar.

Rise Time

This parameter is used during the inspiration phase to adjust how the pressure setpoint will be reached. This setting indirectly defines the minimum inspiratory time.

The different levels available are as follows:

Rise time ⌐1⌐ = 200 ms

Rise time ⌐2⌐ = 400 ms

Rise time ⌐3⌐ = 600 ms

Rise time ⌐4⌐ = 800 ms

These time ranges are determined by the combination of the pressure setting required, the breath rate and the physiological conditions of the patient.

The pressure rise time built-up at each cycle depends on the inspiratory time corresponding to the combination of the rate setting and the Insp Time setting.

- Rise Time ⌐1⌐ is always possible.

- Rise Time ⌐2⌐ is established only if Insp Time ≥0.7 seconds.

- Rise Time ⌐3⌐ is established only if Insp Time ≥0.9 seconds.

- Rise Time ⌐4⌐ is established only if Insp Time ≥1.1 seconds.

Rate—RESPIRATORY RATE

Rate allows you to define the minimal frequency of mandatory ventilator breaths.

If the patient actuates the inspiration trigger, total Rate may increase.

InspTime—INSPIRATORY TIME

This parameter allows the user to set the inspiratory time to 0.3-6.0 s. When changing Insp Time, the ventilator shows the corresponding I:E ratio or I/T% in the settings window. The maximum I:E setting is constrained to 1:1.

I Sens—INSPIRATORY TRIGGER SENSITIVITY

I Sens allows you to set the level of inspiratory effort the patient has to provide to initiate a machine breath.

The sensitivity levels are 0P, 1P, 2, 3, 4, and 5 (P denotes pediatric use); the lower the number, the more sensitive the trigger sensitivity.

I Sens can be set to OFF.

WARNING:
The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or "autotriggering" of the ventilator. For example, Level 0P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.

Vt Target—TARGET TIDAL VOLUME

Vt Target allows the ventilator to deliver a target volume of air to the patient.

When a Vt Target is set, the ventilator constantly adjusts the target inspiratory pressure between Pi and Max P to ensure the inspired tidal volume remains as close as possible to the Vt target.

Vt Target should be more than 10 ml lower than Max VTI to avoid triggering VTI alarm.

The minimum increase or decrease of target inspiratory pressure is 0.5 mbar and the maximum is 2 mbar.

Setting the Vt Target is not mandatory (it can be set to OFF).

Max P—MAXIMUM INSPIRATION PRESSURE

Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the target tidal volume. (Vt Target)

Pi and Max P are related and the difference between them must be less than 20 mbar.

Max P is not shown when Vt Target is set to OFF.

VTI (Min and/or Max Alarm Settings)—INSPIRATORY TIDAL VOLUME

It is possible to set a Min, Max, or both Tidal Volume alarm threshold for the patient's inspired tidal volume during a cycle.

This setting is used to trigger an alarm if the tidal volume inspired by the patient is lower than the minimum threshold set (LOW VTI alarm), or greater than the maximum threshold set (HIGH VTI alarm). See Chapter *5*, "*Alarms and Troubleshooting*."

Min VTI and Max VTI are related and their settings must be set to values that maintain a minimum difference of 20 ml between the two.

It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read OFF for these settings.

Max Leak

The setting of a high leakage threshold enables a HIGH LEAKAGE alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasite leakage flow observed during the exhalation phase.

Max Rtot (Max Alarm Setting)—TOTAL BREATH RATE

The maximum rate threshold setting is used to warn of hyperventilation or autotriggering of the ventilator. This setting is used to trigger the HIGH RATE alarm. See Chapter *5*, "*Alarms and Trouble-shooting.*"

The Max Rtot threshold must always be set at least 5 bpm higher than the Rate. If the Rate is readjusted, the Max Rtot is automatically readjusted to maintain a minimum difference of 5 bpm.

Setting the Max Rtot is not mandatory (it can be set to OFF), but the measured value is always shown.

3.4 FiO$_2$ For Various Oxygen and Ventilator Settings

Figure 3-7. FiO$_2$ for Oxygen and Ventilator Settings

x   O$_2$ flow (l/min)   y   Inhalation flow (l/min)
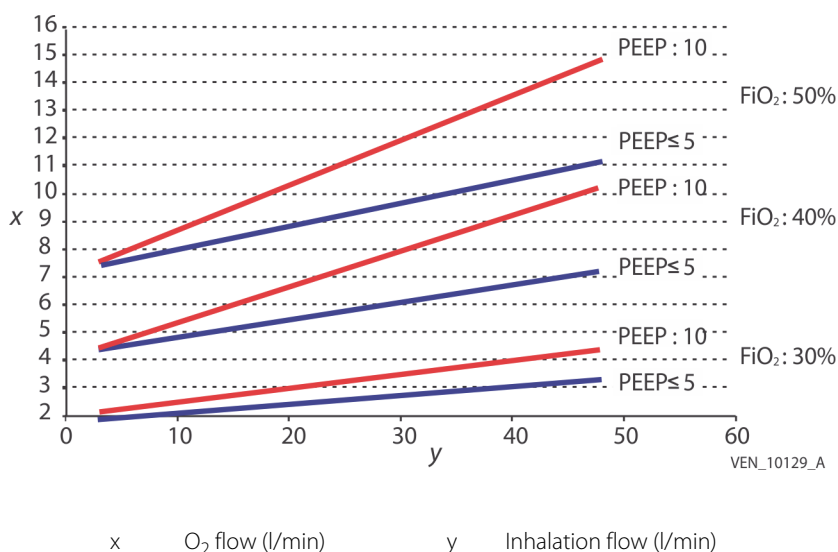
Inhalation flow (LPM) = volume (L) x 60 / inspiratory time (s)

Note:
Tests conducted in a valve configuration. Results can vary according to whether the circuit is configured with or without a valve and patient lung characteristics.

WARNING:
The Puritan Bennett™ 520 Ventilator can be used with an oxygen analyzer with minimum and maximum concentration alarms. Always measure the delivered oxygen with a calibrated oxygen analyzer that features a minimum and maximum concentration alarm in order to ensure that the prescribed oxygen concentration is delivered to the patient.

4 Monitored Parameters

During ventilation, ventilator parameters measured or calculated are highlighted in the menus used for setting the ventilation parameters and the alarms.

In addition to showing monitored ventilation parameters, ventilation is shown graphically, by the pressure bar chart, in the Ventilation parameters setting menu.

Note:

To monitor patient oxygen levels, use an external sensor/alarm.

4.1 Digital Monitoring

The ventilation parameters monitored or calculated are highlighted in each of the main menus:

- Ventilation menu (*Figure 4-1.* , *Figure 4-2.*)

- Alarm menu (*Figure 4-3.* , *Figure 4-4.*)

Figure 4-1. Ventilation Menu: Pressure Leakage Configuration Modes (CPAP, PSV ST, P A/C)

VEN_10855_A
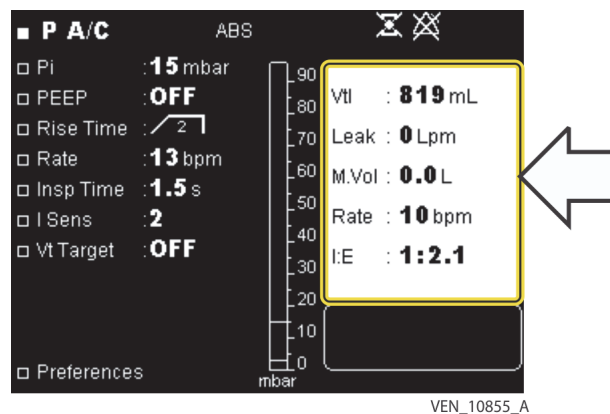
Figure 4-2. Ventilation Menu: Pressure Valve Configuration Modes (PSV ST, P A/C)

VEN_10856_A
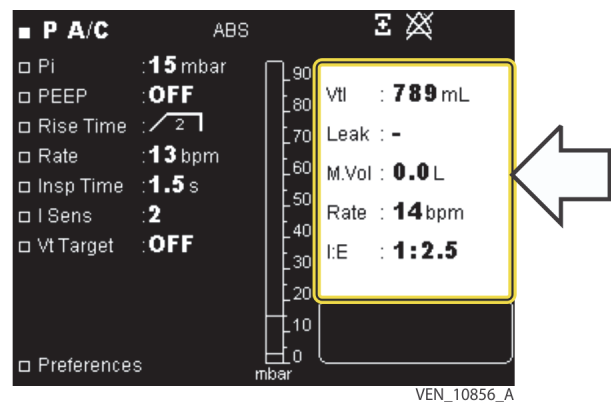
Figure 4-3. Alarm Menu: Pressure Leakage Modes (CPAP, PSV ST, P A/C)

VEN_10857_A
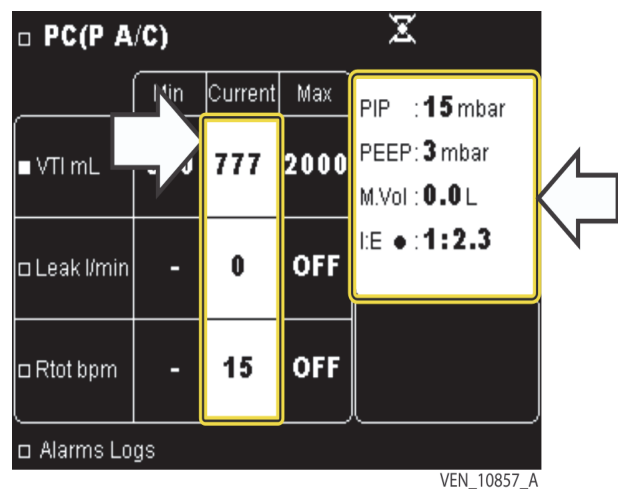
Figure 4-4. Alarm Menu: Pressure Valve Modes (PSV ST, P A/C)

VEN_10858_A
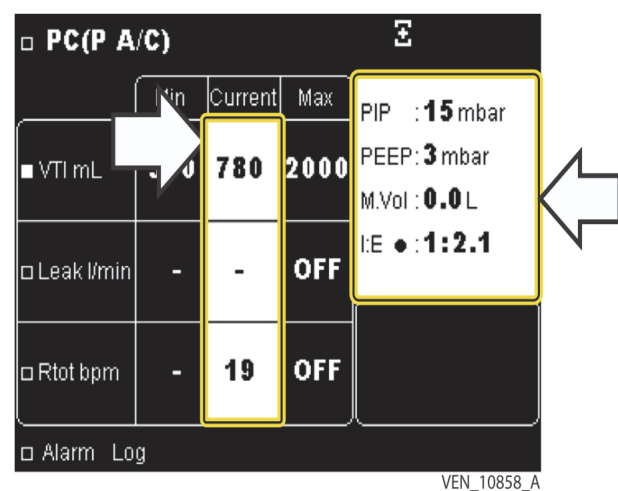
4.1.1 Inspiratory Trigger

● During each inspiration phase triggered by the patient, the Inspiratory effort detected symbol is shown beside the cycling I:E ratio in the Ventilation or Alarm menus (see *Figure 4-5.*).

The patient triggers the ventilator by inhaling the amount of flow and the ventilator responds by delivering either a pressure-based or volume-based breath.

Figure 4-5. Inspiratory Effort Detected Indicator
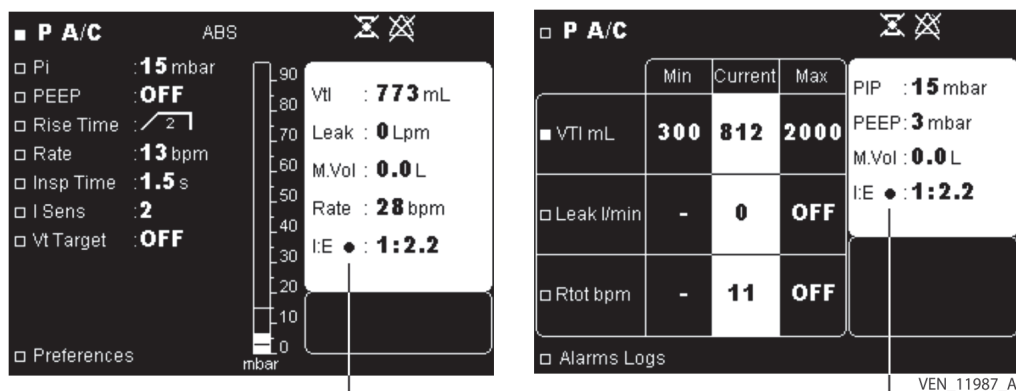
4.1.2 Displayed Monitored Parameters

Table 4-1. Displayed Monitored Parameters

Monitored Parameters	Display	Description
I:E Ratio I/T Ratio (I/T)	I:E I/T	I:E is the ratio of inspiratory time measured to exhalation time measured. The displayed value is updated at each inspiration. I/T is the breath inspiratory time divided by the total breath cycle time expressed as a percentage. The displayed value is updated at each inspiration.
Inspiratory Tidal Volume	VTI	Flow delivered by the ventilator to the patient at each inspiratory phase is measured by the inspiratory transducer and that measurement is used to calculate volume (the flow transducers do not directly measure volume). The displayed value is updated at each inspiration. Currently, when a Pressure Control or Pressure Support breath is delivered in valve ventilation and a leak is present, the ventilator will increase flow to reach the pressure target. The monitored VTI in Pressure Control or Pressure Support breaths reflects the amount of flow the ventilator delivers from the outlet port during inhalation. The monitored value will increase (possibly to an abnormally high number) when a leak is present. This displayed value is not what is delivered to the patient.
Inspiratory Time	I Time	Inspiratory time measured.
Leak	Leak	Available only when patient circuit is in leak configuration.

Table 4-1. Displayed Monitored Parameters (Continued)

Monitored Parameters	Display	Description
Minute Volume	M Vol	Flow delivered at each breath to the patient is measured by the inspiratory transducer and that measurement is used to calculate minute volume (Vt x Rtot) (the flow transducers do not directly measure volume).
		The displayed value is updated at each exhalation.
Inspiratory Pressure	Pi	Highest circuit pressure during each inspiration phase measured with the proximal pressure sensor.
		The displayed value is updated at each exhalation.
Positive End Expiratory Pressure	PEEP	End exhalation pressure is measured by the proximal pressure sensor.
		The displayed value is updated at each inspiration.
Rate	Rtot	Total number of breaths measured per minute.
		The displayed value is based on each breath and is updated at each inspiration.
Peak Airway Pressure	Paw	The average peak pressure during the inspiratory phase, measured by each cycle and over the previous 24-hour period.

4.2 Bargraph Display

In the ventilation menu, the highlighted bargraph dynamically shows pressures established throughout the breath cycle (Figure 4-6.).

Figure 4-6. Bargraph Display

VEN_10862_A
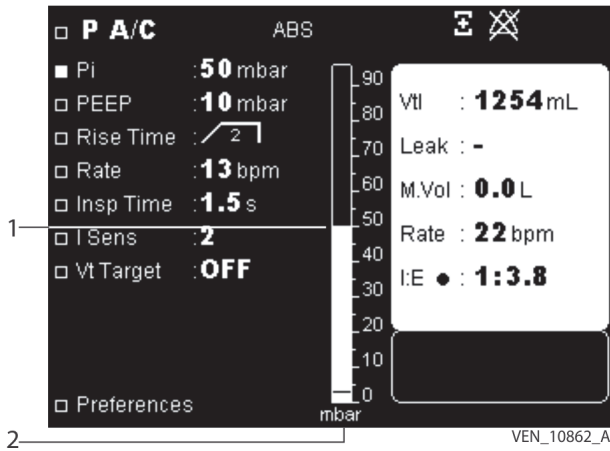
The Pi value reached during a cycle is represented by a line at the top of the bargraph (Figure 4-6. , item 1), which remains shown until the maximum value of the following cycle has been reached.

The PEEP value is represented by a line at the bottom of the bargraph (Figure 4-6. , item 2).

4.3 Ventilation Report

The Ventilation Report is available in the Preferences menu (see Chapter *7*, "*Operating Procedures*"). The Ventilation Report updates daily at 8 AM and shows the average readings from the previous 24 hours. See *Figure 4-7.*

Figure 4-7. Ventilation Report

VEN_10863_A
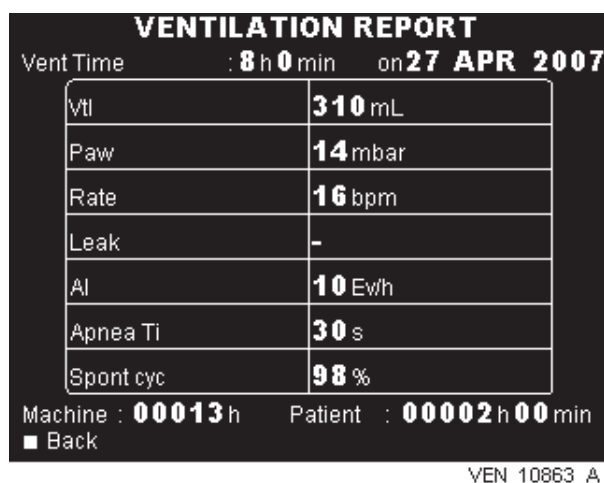
Note:

The values shown in the Ventilation Report are reinitialized when the software is updated or the patient hours counter is reset to 0.

The following data are shown in the Ventilation Report:

Vent Time—Ventilation Time

The ventilation duration data are based on the patient counter and shows the total ventilation time in hours and minutes over the previous 24-hour period.

VTI—Inspired Tidal Volume

When ventilating with an exhalation valve, the VTI is the average inspired tidal volume during each ventilation cycle over the previous 24-hour period.

When ventilating in leak mode, the VTI is the average volume delivered by the ventilator during each ventilation cycle over the previous 24-hour period.

Paw—Peak Airway Pressure

The peak airway pressure is the average peak pressure during the inspiratory phase, measured by each cycle and over the previous 24-hour period.

Rate—Respiratory Rate

The respiratory rate is the average of the total respiratory frequency of the patient and the ventilator measured over the previous 24-hour period.

Leak

When ventilating with a leak configuration circuit, it is the average patient/circuit leak during each cycle and over the past 24-hour period. When ventilating with a single-limb circuit with valve, there is no average leak.

AI—Apnea Index

The apnea index is the average number of apnea events per hour of ventilation. It is based on the Apnea alarm.

Apnea Ti—Apnea Time

This is the accumulated apnea time over the previous 24-hour period.

Spont Cyc—Spontaneous Cycling

This is the percentage of ventilation cycles initiated by the patient and the ventilator over the previous 24-hour period.

Machine

The total time in hours that the ventilator has been switched on since manufacture.

Patient

The total time in hours and minutes that the current patient has been ventilated.

5 Alarms and Troubleshooting

⚠️ **WARNING:**
Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.

⚠️ **WARNING:**
When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.

⚠️ **WARNING:**
Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. The audible alarm vents located at the front of the device should never be obstructed. See section *7.3.4*, "*Alarm Volume*" on page *7-18*.

The alarms or faults generated by your Puritan Bennett™ 520 Ventilator are classified into two categories:

- Ventilation (or utilization) alarms

- Technical faults

Alarms indicate events likely to affect the ventilation in the short term and necessitate rapid intervention (see section *5.8*, "*Troubleshooting*" on page *5-14*).

Some of the ventilator alarms are adjustable, depending on ventilation modes (see Chapter *3*, "*Operating Parameters*"). Automatic, nonadjustable alarms also exist to create a safety net for safer patient ventilation.

📖 **Note:**
Default alarm setting preferences should be entered prior to using the ventilator.

📖 **Note:**
Setting any alarm limits to OFF or to extreme high or low values can cause the associated alarm not to activate during ventilation, which reduces its efficacy for monitoring the patient and alerting the caregiver to situations that may require intervention.

📖 **Note:**
All configurable alarm settings are recorded in the ventilator's nonvolatile internal memory, and are retained when powering down or in the event of a total loss of power.

Technical faults do not directly affect machine operation. Therefore, the user is not alerted to technical faults. Only authorized and trained technicians may consult the maintenance menu (see the Puritan Bennett 520 Ventilator service manual).

5.1 Alarm Level of Priority

The alarm hierarchy for signaling the level of alarm criticality is listed as follows:

- **Very high priority (VHP): immediate critical situation; ventilation is impossible:** Continuous sound signaling / with or without continuous red LED illumination / with or without message / with or without display lighting (it is possible for an alarm condition to occur that may not have both a message and lighting)

- **High priority (HP): critical situation in the short term; ventilation is potentially compromised:** High speed intermittent sound signaling / flashing red LED illumination / with message / with display lighting

- **Medium priority (MP): critical situation in the long term; ventilation is not affected in the short term:** Medium speed intermittent sound signaling / flashing yellow LED illumination / with message / with display lighting

Note:
There are currently no low priority (LP) alarms.

Note:
If there is no corrective action and if the audible alarm is not inhibited (Audio Paused) or reset (Alarm Reset) within 60 seconds, high priority alarms will sound at the maximum level.

5.2 Alarm Display

During operation, when an alarm is activated, the following events occur:

- One of the red or yellow alarm indicators to the left of the **ALARM CONTROL** key illuminates and flashes.

- An alarm tone sounds.

- A message is shown and flashes in reverse video at the bottom of the Ventilation menu or Alarm menu.

Figure 5-1. Alarm Displays

VEN_11969_A
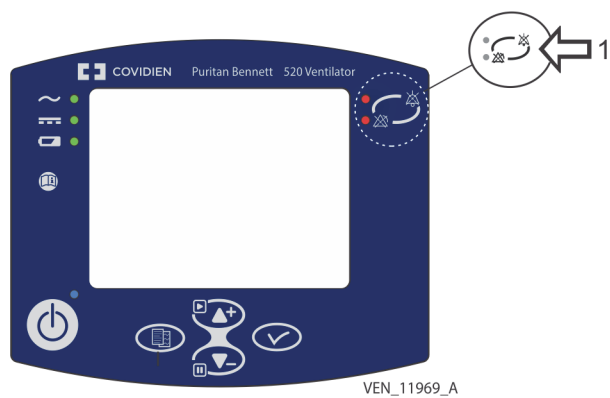
1   Alarm Control key

Ventilation menu   **Alarm menu**

VEN_10865_B
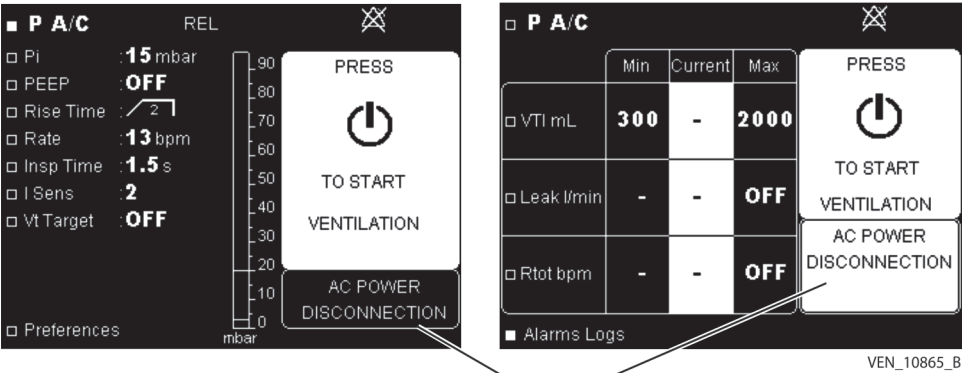
1   Alarm messages

Note:

There are currently no low priority (LP) alarms.

When an alarm is triggered, if the current menu shown is not the Ventilation parameters or Alarm menu, the display automatically switches to one of these menus to show the alarm message.

In the event several alarms are activated at the same time, the highest priority audible and visual alarm is highlighted; however, all active messages are shown, in the sequence in which they occurred.

5.3 Alarm Log Menu

All alarms are recorded in the ventilator's nonvolatile internal memory at the time of activation, and are retained when powering down or in the event of a total loss of power.

The Alarm Logs menu is used to show the last eight alarms activated, along with their date and time of activation.

To access the Alarm Log menu, do the following:

1. Press the **MENU** key to access the Alarm setting menu (if this is not the menu currently shown).

2. Press the **DOWN** key until the cursor is on the Alarm Logs line at the bottom of the page. The screen appears as shown in *Figure 5-2.*

Figure 5-2. Accessing Alarm Log Menu

VEN_11957_A
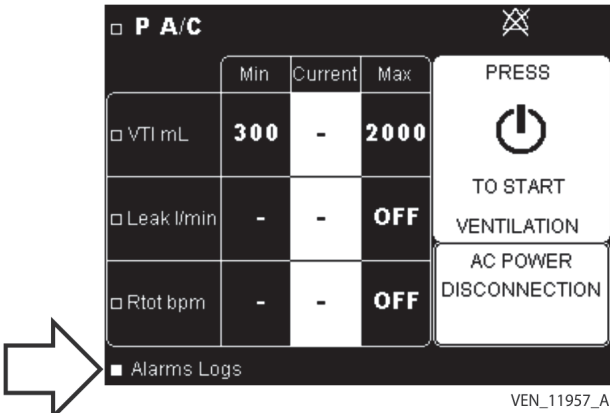
3. Press the **ENTER** key. The Alarm Log screen is shown.

Figure 5-3. Alarm Log Screen

VEN_12010_A
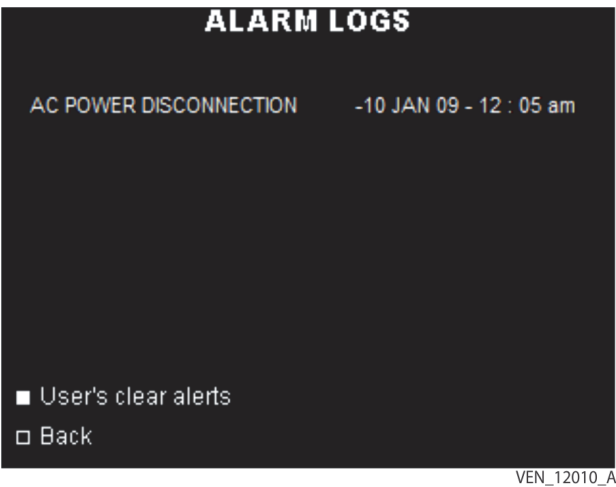
Note:

When no alarm has been activated, NO DATA is shown on the screen (see *Figure 5-4.*).

Figure 5-4. Alarm Log Screen when No Alarm Activated

VEN_10868_B
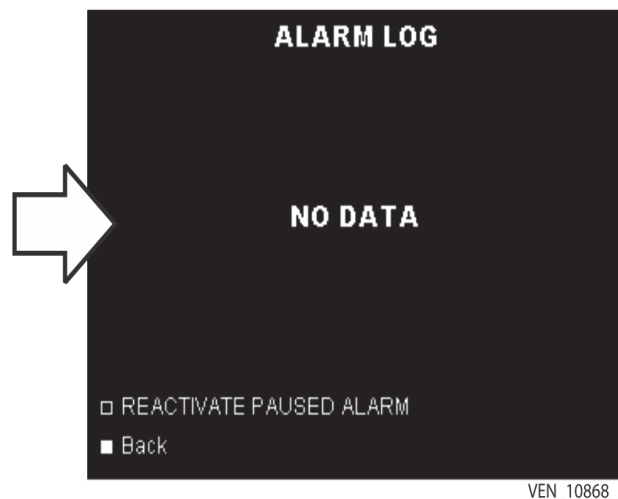
For more information on the User's clear alerts line, see section *5.6*, "*Reactivating Alarms*" on page *5-7*.

To dismiss the Alarm Log screen manually:

Press the **ENTER** key when the cursor is on the Back line.

The Alarm Log screen is dismissed automatically:

- After 15 seconds if no keyboard action is detected

- When a high priority alarm is triggered

Note:

Only qualified service personnel may access all alarms and events recorded by the ventilator. Qualified personnel should see the Puritan Bennett 520 Ventilator service manual for further information.

5.4 Pausing the Audible Portion of Alarms

You may pause the audible portion of alarms for 60 seconds at a time.

To pause the audible portion of activated alarms:

Press the **ALARM CONTROL** key.

- The audible portion of all activated alarms is paused.

- The visual portions (light indicator and message) of activated alarms remain visible.

The Audio Paused symbol is shown at the top right of the screen while the audio pause function is active.

Figure 5-5. Pausing the Audible Portion of Alarms

VEN_10869_A
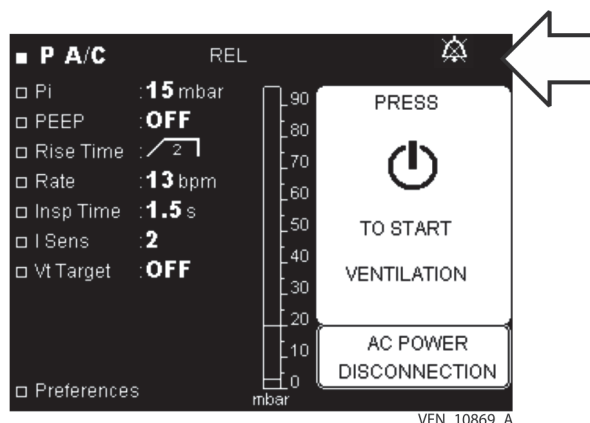
If several alarms are activated at the same time, pressing the **ALARM CONTROL** key affects all current alarms.

The audible portion of activated alarms is automatically reactivated if the following occurs:

- After 60 seconds, if the cause or causes of the alarm or alarms persist

- Whenever a new alarm is activated

Note:
If a key is stuck or held down for 45 seconds, a keypad alarm will occur.

5.5 Pausing/Resetting Alarms

WARNING:
When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.

WARNING:
Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. The audible alarm vents located at the front of the device should never be obstructed. See section *7.3.4*, "*Alarm Volume*" on page *7-18*.

Some alarms are not automatically canceled when the condition causing the alarm clears (for example, HIGH PRESSURE). Some alarms can be paused manually even if the cause or causes of their activation remain.

To manually pause an alarm, proceed as follows:

Press the **ALARM CONTROL** key twice.

- The alarm is paused until the alarm condition is corrected and the condition reoccurs; the audible portion, light indicator, and message are all halted (for the alarms that can be paused manually).

- The Alarm Paused symbol is shown at the top right of the Ventilation and Alarms screens. See *Figure 5-6.*

Figure 5-6. Manually Pausing Alarms

VEN_10870_A
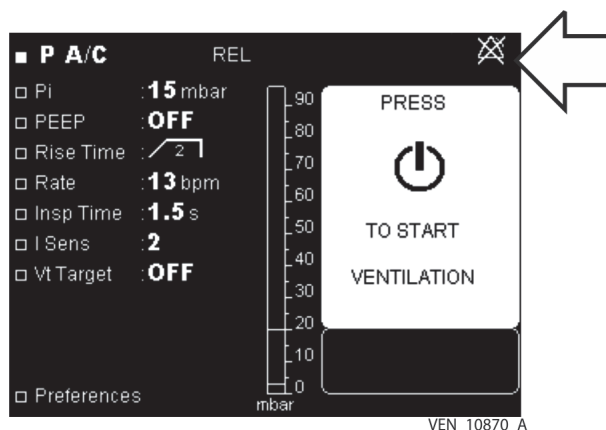
When no other alarms are currently activated, the last alarm canceled is shown continuously in the alarm message window in the Alarms menu, along with the date and time of its activation. The High Pressure alarm must be manually reset. See section *5.7*, "*Overview of Alarms*" on page *5-9*.

To manually reset the High Pressure alarm, proceed as follows:

Press the **ALARM CONTROL** key twice. The visual alarms will be reset.

5.6 Reactivating Alarms

Alarms that have been paused and whose activation conditions continue to exist can be reactivated.

To reactivate alarms, proceed as follows:

1. Press the **MENU** key to access the Alarm Setting menu, if this is not the menu currently shown.

2. Press the **DOWN** key to position the cursor on the Alarm Logs line, if this is not already the case. See *Figure 5-7.*

Figure 5-7. Reactivating Alarms
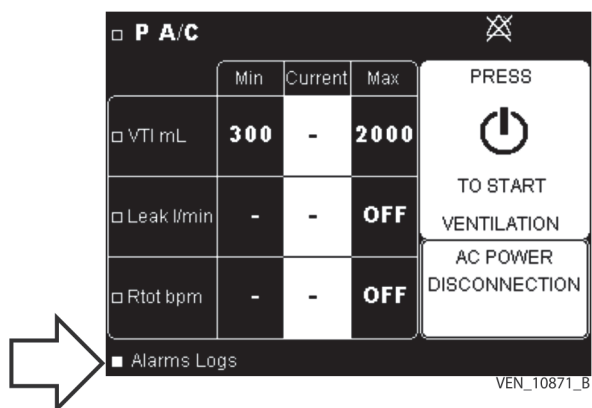
3. Press the **ENTER** key, to confirm access to the Alarm Log menu.

4. Press the **UP** key to position the cursor on the User's clear alerts line. See *Figure 5-8*.

Figure 5-8. Alarm Log
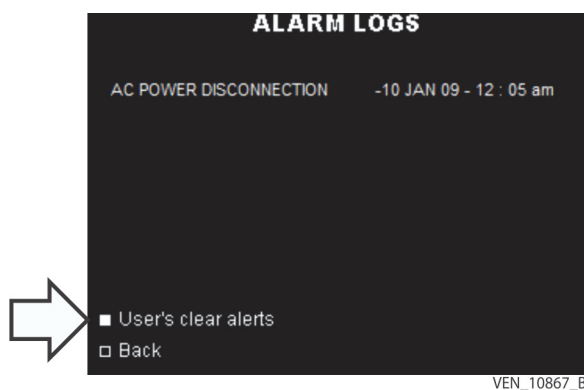
5. Press the **ENTER** key for at least 3 seconds. The following events occur:

- A "beep" sounds.

- An audible alarm sounds.

- An alarm indicator illuminates.

- The messages of all active alarms are shown in a loop in the Ventilation and Alarm menus.

- The Audio Paused symbol disappears (if it was shown).

- The Alarm Paused symbol disappears.

5.7 Overview of Alarms

Note:
The message *IF PERSISTS RESTART/SRVC will occur only if the alarm condition continues for longer than 30 seconds.

Note:
If the message *IF PERSISTS RESTART/SRVC occurs, restart the ventilator. If the alarm condition is not cleared, call a service representative.

For corrective actions and troubleshooting of the following alarms, see *Table 5-2. , Alarms and Corrective Actions*.

Table 5-1. Overview of Alarms

Alarm message	Cause/ventilator response	Priority	Audio Paused available	Alarm Paused available
AC POWER DISCONNECTION	Cut-off of the AC (mains) power supply. Alarm activation occurs: • After 5 seconds if ventilation is stopped • At the start of a ventilation cycle when ventilation is in progress. Consequence: the ventilator will automatically switch to external DC power supply if present; if not, to the internal battery.	MP	Yes	Yes
APNEA	No inspiratory trigger detected by the ventilator after the apnea time set in PSV and CPAP modes. Automatically clears itself after two successive patient breaths.	MP	Yes	Yes (except for CPAP)
BATTERY FAULT1 RESTART/SRVC	Ventilator has detected an internal battery fault. Consequence: the internal battery is disabled from use.	MP	Yes	Yes
BATTERY FAULT2 RESTART/SRVC	No internal battery detected.	MP	Yes	No
BUZZER FAULT1 RESTART/SRVC	Defective operation of the buzzers.	MP	Yes	No
BUZZER FAULT2 RESTART/SRVC	Failure detected in the very high priority buzzer. Consequence: no audible alarm in case of POWER SUPPLY LOSS alarm.	MP	Yes	Yes
BUZZER FAULT3 RESTART/SRVC	Battery charge failure due to incorrect voltage. Contact your service representative for assistance.	HP	Yes	No

Table 5-1. Overview of Alarms (Continued)

Alarm message	Cause/ventilator response	Priority	Audio Paused available	Alarm Paused available
BUZZER LOW BATTERY	Buzzer battery failure. The battery buzzer voltage is too low. Internal technical problem that prevents the battery from sounding the POWER SUPPLY LOSS alarm.	MP	Yes	Yes
CHECK BATTERY CHARGE IF PERSISTS RESTART/ SRVC	Internal battery charging failure. Consequence: charging of the internal battery impossible.	MP	Yes	No
CHECK EXH VALVE* *IF PERSISTS RESTART/ SRVC	Inspired tidal volume during exhalation <20% of inspired tidal volume and inspired tidal volume >20 mL. Exhalation valve obstructed.	HP	Yes	No
CHECK EXH VALVE PRESSURE	Internal ventilation fault related to exhalation valve detection sensor (pressure sensor).	HP	Yes	Yes
CHECK PROXIMAL LINE1* *IF PERSISTS RESTART/ SRVC	Loss of signal from the proximal pressure sensor. Consequence: switch to internal pressure sensor for the pressure measurement. Alarm activation occurs: In the event of signal loss (1): After one ventilation cycle or In the event of signal loss (2) and after the 17th breath cycle: After 17 seconds for P A/C mode, or after the maximum time between 17 seconds and Apnea time + 4 seconds for CPAP and PSV mode.	MP	Yes	No
CHECK REMOTE ALARM	Failure of ventilator remote alarm relay circuit.	MP	Yes	Yes
CHECK SETTINGS	Alarm activation occurs: • Systematically after software versions have changed. • Loss of memorized parameters. Consequence: • Locking Key disabled • Out-of-range settings are replaced by their default values	MP	Yes	Yes
CONNECT VALVE OR CHANGE PRESS	No exhalation valve connected with PEEP set to less than 4 mbar or Pi set to more than 30 mbar when relative pressure is set to OFF.	HP	Yes	No
CONTROLLED CYCLES	The ventilator is delivering apnea ventilation at set back up rate.	N/A	N/A	N/A
COOLING FAN RESTART/ SRVC	Ventilator cooling fan operating speed not suited to the internal ambient temperature of the device.	MP	Yes	Yes
DC POWER DISCONNECTION	Cut-off of the external DC power supply. Consequence: switch-over to the internal battery.	MP	Yes	Yes

Table 5-1. Overview of Alarms (Continued)

Alarm message	Cause/ventilator response	Priority	Audio Paused available	Alarm Paused available
DEVICE FAULT3 RESTART/ SRVC	Failure in the 24 V power supply.	HP	Yes	No
DEVICE FAULT5 RESTART/ SRVC	Detection of a fault in the electrical power supply system. Alarm activation occurs: Once the ventilator is on for at least 3 seconds, and a power supply fault is detected for at least 5 seconds thereafter. Consequence: the internal battery capacity is not shown beside the battery symbol.	MP	Yes	Yes
DEVICE FAULT7 RESTART/ SRVC	Detection of a fault in internal voltage measurement.	HP	Yes	No
DEVICE FAULT9 RESTART/ SRVC	POST RAM Error. RAM read/write does not match memory setting.	VHP	No	No
DEVICE FAULT10 RESTART/SRVC	POST FLASH checksum error. Startup FLASH computed checksum does not match memory setting.	VHP	No	No
DEVICE FAULT11 RESTART/SRVC	POST EEPROM Error. Startup EEPROM does not match memory setting.	VHP	No	No
DEVICE FAULT12 RESTART/SRVC	POST reference voltage error. 5V or 10V reference voltage error.	VHP	No	No
DEVICE FAULT13 RESTART/SRVC	Software version error.	VHP	No	No
EMPTY BATTERY	Internal battery capacity <10 minutes or 3%. (battery voltage <22.5 V) Consequence: ventilation comes to a halt.	HP	No	No
HIGH / LOW BATTERY TEMP* *IF PERSISTS RESTART/ SRVC	Battery temperature out of tolerance. Consequence: battery charging stops.	MP	Yes	Yes
HIGH INT TEMP COOL VENT* *IF PERSISTS RESTART/ SRVC	Device internal ambient temperature out of tolerance range.	MP	Yes	Yes
HIGH LEAKAGE	The leak estimated by the ventilator exceeds the Max leak alarm threshold.	MP	Yes	No

Table 5-1. Overview of Alarms (Continued)

Alarm message	Cause/ventilator response	Priority	Audio Paused available	Alarm Paused available
HIGH PRESSURE	• In PSV, CPAP, or P A/C modes, if inspiratory pressure is higher than (P Support or P Control + PEEP) + 5 mbar up to 29 mbar or + 10 mbar over 30 mbar during three consecutive cycles. or • In PSV or CPAP mode and P Support is set to off, if inspiratory pressure is higher than PEEP + 10 mbar during three consecutive cycles. Alarm activation occurs: • After three consecutive breaths. Consequence: • Switch to exhalation phase.	HP **Note:** When alarm condition clears, alarm priority indicator must be manually reset by pressing the ⚠ key.	Yes	No (The visual portion of the alarm may be paused)
HIGH RATE	Rate measured greater than Max Rtot set during three consecutive breaths. Alarm activation occurs: • After three consecutive breaths.	MP	Yes	No
HIGH VTI	Inspired tidal volume greater than Max VTI set during three consecutive breaths in PSV, CPAP, and P A/C modes. Alarm activation occurs: • After three consecutive breaths.	HP	Yes	No
INTENTIONAL VENT STOP	Ventilation has been stopped voluntarily by the caregiver or patient.	HP	Yes	Yes
KEYPAD FAULT RESTART/ SRVC* *IF PERSISTS RESTART/ SRVC	Keyboard key held down for more than 45 seconds.	HP	No	No
LOW BATTERY	Internal battery capacity <30 minutes or 8%.	HP	Yes	No
LOW VTI	Inspired tidal volume less than Min VTI set during three consecutive breaths in PSV, CPAP, and P A/C modes. Alarm activation occurs: • After three consecutive breaths.	MP	Yes	No
NO PROXIMAL LINE2* *IF PERSISTS RESTART/ SRVC	Proximal pressure <0.6 mbar for 100 ms during inspiration phase of third breath cycle. Ventilator response: Switch to internal pressure sensor for pressure measurement.	MP	Yes	No
OCCLUSION CHECK CIRCUIT* *IF PERSISTS RESTART/ SRVC	Occurs in VALVE configuration when the tidal volume is measured below 20 mL during three consecutive breaths for PSV, CPAP, and PA/C modes. Alarm activation occurs after three consecutive breaths; if tidal volume is less than 20 mL.	HP	Yes	No

Table 5-1. Overview of Alarms (Continued)

Alarm message	Cause/ventilator response	Priority	Audio Paused available	Alarm Paused available
OCCLUSION CHECK CIRCUIT	Occurs in leak configuration when the leak level is not sufficient to flush the CO_2 from patient exhalation. The built-in leak in the mask may be obstructed. The built-in leak for the mask is not sufficient for the settings.	HP	Yes	No
PATIENT DISCONNECTION* *IF PERSISTS RESTART/ SRVC	Alarm activation occurs if conditions remain for the maximum time between: • Disconnection time and 60/R-Rate in P A/C mode • Disconnection time and (Apnea time +2 sec) in CPAP and PSV mode If the flow is greater than 130 lpm during the inspiratory phase. In PSV, CPAP, and P A/C modes if patient pressure is lower than (P Support + PEEP) - 20% or (Pi + PEEP) - 20%.	HP	Yes	No
POWER FAULT RESTART/ SRVC	Detection of a fault in the electrical power supply system.	MP	Yes	Yes
POWER SUPPLY LOSS (no message)	1. Electrical power supply to the machine is interrupted with the I/O switch when ventilation is in progress or 2. Battery fully discharged when it was the only source of power to the ventilator. Consequence: ventilation stops immediately. Ventilation restarts immediately when the switch is pressed in case 1 or after restoration of the AC or DC supply in case 2.	VHP	No—Alarm cancel only	No—Alarm cancel only
PRES SENS FLT1 RESTART/ SRVC	Faulty internal pressure sensor signal. Alarm activation occurs: • After 15 seconds.	HP	Yes	No
PROX SENS FLT2 RESTART/SRVC	Faulty proximal pressure sensor signal. Alarm activation occurs: • After 15 seconds.	MP	Yes	Yes
REMOVE VALVE CPAP MODE	The ventilation settings are not compatible with the type of patient circuit used. Remove exhalation valve to start CPAP ventilation.	HP	Yes	No
REMOVE VALVE OR CHANGE PRES	The ventilation settings are not compatible with the type of patient circuit used. With a valve circuit, the difference between Pi and PEEP should not be less than 5 mbar.	HP	Yes	No
SOFTWARE VERSION ERROR	Detection of a wrong software version.	N/A	N/A	N/A

Table 5-1. Overview of Alarms (Continued)

Alarm message	Cause/ventilator response	Priority	Audio Paused available	Alarm Paused available
TURB OVERHEAT RESTART/SRVC	Turbine speed too low and temperature too high. Consequence: ventilation stops immediately and O_2 supply stops.	HP	No	No
UNKNOWN BATTERY	The internal battery is not recognized as a Puritan Bennett product battery or is not the correct battery for the Puritan Bennett 520 Ventilator.	MP	Yes	No

5.8 Troubleshooting

⚠️ **WARNING:**
This manual tells you how to respond to ventilator alarms, but it does NOT tell you how to respond to the patient.

⚠️ **WARNING:**
To ensure proper servicing and avoid the possibility of physical injury to personnel or damage to the ventilator, only personnel authorized and qualified by Covidien should attempt to service or make authorized modifications to the Puritan Bennett™ 520 Ventilator.

5.8.1 Alarms

Table 5-2. offers a guide to the most likely ventilator alarms, possible reasons for the alarms, and corrective actions.

⚠️ **WARNING:**
Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only personnel authorized and qualified by Covidien should repair, open or service the ventilator.

⚠️ **WARNING:**
When an alarm condition is triggered, or there is evidence of a patient-ventilator fault or problem, examine the patient first before examining the ventilator.

📖 **Note:**
The ventilator screen must be unlocked before setting and parameters can be changed.

Table 5-2. Alarms and Corrective Actions

Alarm message or symptom	Possible reason for the alarm event	Corrective action
AC POWER DISCONNECTION	AC ("mains") power source cut off.	Cancel the alarm, and then check the supply cable and the effective availability of a voltage on the AC power ("mains") port.
	Starting with 12–30 VDC external power supply.	Cancel the alarm.
	Current-limiting fuse of the device blown.	Replace the ventilator and call for the maintenance technician.
APNEA	Patient's breathing effort less than the sensitivity control setting.	Ensure the patient is breathing and adjust the inspiratory setting appropriately based on patient's respiratory needs.
	Patient apnea.	Examine the patient for breathing effort and stimulate if necessary. If patient status has changed, adjust the ventilator settings based on patient's respiratory needs.
	Defective sensors.	Have a qualified technician replace the defective component or components and call your customer service representative.
BATTERY FAULT1 RESTART/SRVC	Battery problem that prevents it from operating.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BATTERY FAULT2 RESTART/SRVC	Internal battery missing or not detected.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER FAULT1 RESTART/SRVC	Defective operation of the buzzers. Consequence: no audible tone when an alarm is activated.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER FAULT2 RESTART/SRVC	Internal technical problem that prevents the very high priority "POWER SUPPLY LOSS" alarm from triggering.	Ensure that the protective cover over the I/O switch located on the rear of the device is intact and functioning properly. This cover helps prevent accidental pressing of the I/O switch and stoppage of the ventilation. Ensure that the device is stabilized. Call your customer service representative.
BUZZER FAULT3 RESTART/SRVC	Internal technical problem that prevents the battery from correctly charging.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
BUZZER LOWBATTERY	Internal technical problem that prevents the battery warning buzzer from sounding POWER SUPPLY LOSS alarm.	Connect the ventilator to an AC power source and power on using the I/O switch located on the rear of the ventilator. Allow the ventilator to charge for a minimum of 15 minutes and up to 2 hours. **If alarm persists, restart ventilator to see if alarm clears. If not, contact Covidien or a local Covidien representative.**
CHECK BATTERY CHARGE	Battery charging impossible.	Do not disconnect the ventilator from the AC power supply. Ensure that the power cable is installed according to the instructions in Chapter *6*, "*Installation and Assembly*," so that the power cable cannot be involuntarily disconnected. In the event the internal battery capacity is low, use an alternate device to ventilate the patient. Call your customer service representative.

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
CHECK EXH VALVE* *IF PERSISTS RESTART/SRVC	Obstruction or abnormal damage of the exhalation valve.	Clean or replace the exhalation valve, its control tube, or both.
	Excessive moisture in the exhalation valve.	Remove moisture from exhalation valve. Verify exhalation valve is seated properly. Reduce temperature of the humidifier.
	Defective connection or defective exhalation valve tubing.	Reconnect the valve or replace the exhalation valve, the exhalation valve pilot pressure tube, or both.
	Defective inspiratory flow sensor.	Have a qualified technician replace the defective component or components and call your customer service representative.
CHECK EXH VALVE PRESSURE	The exhalation valve may not be detected by the ventilator when ventilation is started. The exhalation valve may be falsely detected when ventilation is started.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
CHECK PROXIMAL LINE1* *IF PERSISTS RESTART/SRVC	No connection of the proximal pressure tube when ventilation starts.	Reconnect the proximal pressure line.
	Proximal pressure line disconnected or obstructed.	Reconnect the connection line or replace it if obstructed. Check for moisture or occlusion of the proximal line. Reduce humidifier temperature. Switch to a heated wire circuit.
	Defective proximal pressure sensor or internal leak of the machine.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component or components and call your customer service representative.
CHECK REMOTE ALARM	Nurse call or remote alarm system is disconnected.	Connect the nurse call or remote alarm cable to the ventilator.
	Relay control voltage problem.	Carefully monitor the patient to detect possible alarm triggering and call for the maintenance technician.
CHECK SETTINGS	Loss of memorized parameters.	Check and adjust the prescribed parameters, if necessary.
	Software versions have changed.	Check and adjust the prescribed parameters, if necessary.
CONNECT VALVE OR CHANGE PRESS	The ventilation settings are not compatible with the type of patient circuit used. No exhalation valve connected with PEEP set to less than 4 mbar or Pi set to more than 30 mbar when relative pressure is set to OFF.	Connect exhalation valve. Decrease Pi to less than 30 mbar in absolute pressure. Increase PEEP to more than 3 mbar. 📖 **Note:** Always consult the clinician before changing PEEP, pressure, or Rate settings.
CONTROLLED CYCLES	The ventilator is delivering apnea ventilation at set back up rate.	Check that the patient circuit is correctly attached and the patient is correctly ventilated.
COOLING FAN RESTART/SRVC	Operating speed of the cooling fan not properly adjusted for the internal ambient temperature of the device.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
DC POWER DISCONNECTION	12–30 VDC power supply cut off when there is no AC ("mains") power supply.	Cancel the alarm, and then check the supply wiring and the effective availability of voltage on the external source.
	Ventilator's current-limiting fuse blown.	Replace the ventilator and call your customer service representative.
DEVICE FAULT3 IF PERSISTS RESTART/ SRVC	24 V supply failure.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT5 IF PERSISTS RESTART/ SRVC	Internal problem in the electrical power supply.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT7 IF PERSISTS RESTART/ SRVC	Internal technical problem.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT9 IF PERSISTS RESTART/ SRVC	POST RAM error. RAM read/write does not match memory setting.	If patient has been disconnected, reconnect patient to reset the fault. If persists, restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT10 IF PERSISTS RESTART/ SRVC	POST FLASH checksum error. Startup FLASH computed checksum does not match memory setting.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT11 IF PERSISTS RESTART/ SRVC	POST EEPROM error. Startup EEPROM does not match memory setting.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT12 IF PERSISTS RESTART/ SRVC	POST reference voltage error. 5 V or 10 V reference voltage error.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
DEVICE FAULT13 IF PERSISTS RESTART/ SRVC	Incorrect software version detected.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
EMPTY BATTERY	Internal battery capacity is less than 10 minutes (or 3%)—battery operation over-extended.	Reconnect the device to an AC power outlet, connect it to an external DC power source, or replace the battery. Reminder: the internal battery can be charged only when the ventilator connected to an AC power supply.

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
HIGH INT TEMP COOL VENT	Internal ambient temperature of the device out of the tolerance ranges.	**Note:** Ensure that you are operating the ventilator within the proper temperature range (see Appendix *B*, "*Specifications*"). Put the device in a warmer environment (if the ambient temperature is too low) or in a cooler environment (if the ambient temperature is too high). For example, ensure the ventilator is not in direct sunlight or next to an air conditioning vent. **WARNING: In case of operation in a high ambient temperature, handle the ventilator with care; some portions of the device may have high surface temperatures.** **WARNING: In the case of high ambient temperatures, it may take a significant period of time to cool the internal temperature of the ventilator to the proper operating range. To avoid injury to the patient, ensure that the air inspired by the patient does not exceed 41°C (106°F). If in doubt, replace the ventilator.**
	Defective internal temperature probe or any other technical anomaly.	Replace the ventilator and call your customer service representative.

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
HIGH/LOW BATTERY TEMP* *IF PERSISTS RESTART/ SRVC	Battery temperature out of the tolerance ranges. Defective internal temperature probe or any other technical anomaly inside the battery.	◆ **Caution:** **Ensure that ventilator is being used according to the operating instructions found in Appendix B, "Specifications."** If the ambient temperature is too low, place the device in a warmer environment. If the ambient temperature is too high, place the ventilator in a cooler environment. For example, ensure the ventilator is not in direct sunlight or next to an air conditioning vent. The temperature fault alarm does not interfere with the operation of the ventilator. ⚠ **WARNING:** **In case of operation in a high ambient temperature, handle the ventilator with care; some portions of the device may have high surface temperatures.** Restart ventilator to see if alarm clears. if the alarm message persists, please contact technical services. ◆ **Caution:** **Do not attempt to charge a defective battery; such a battery cannot be charged.**
HIGH LEAKAGE	The leak estimated by the ventilator exceeds the Max leak alarm threshold.	Readjust mask to reduce leakage or increase the alarm settings.

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
HIGH VTI	Adjustment of the Max VTI level too low (for PSV, CPAP, and P A/C modes).	**Note:** Always consult the clinician before changing PEEP, pressure, or Rate settings. Modify the Max VTI level.
	Adjustment of the pressure level too high for the volume required (for PSV, CPAP, and P A/C modes).	**Note:** Always consult the clinician before changing PEEP, pressure, or Rate settings. Modify the pressure level.
	A leak in the patient circuit causing increased bias flow.	Check and properly connect the patient circuit.
	Inappropriate patient circuit.	Replace the patient circuit.
	Defective flow sensor or internal leak in the machine.	Have a qualified technician replace the defective component or components and call your customer service representative.
HIGH PRESSURE	Airway obstruction.	Check patient's trachea and clear the obstruction. If the filter is obstructed, replace the filter.
	Proximal pressure tube or patient circuit obstructed.	Clean the proximal pressure tube or the patient circuit or replace them.
	Coughing or other high-flow exhalation efforts.	Treat patient's cough. Pause the audible alarm, if necessary.
	Patient inspiratory resistance or compliance changes.	Have physician determine if ventilator settings are appropriate for the patient.
	Defective internal circuits of the machine or pressure sensor.	Replace the ventilator and call your customer service representative.
HIGH RATE	Adjustment of the Max Rtot level too low.	Readjust Max Rtot.
	Adjustment of the I Sens level too low.	Adjust I Sens according to the patient.
	Patient hyperventilating.	Pause the audible alarm and call for a medical team if the symptoms persist. Check for autocycling and adjust inspiratory sensitivity, manage leaks, or drain condensation from patient circuit.
	Defective inspiratory flow sensor.	Have a qualified technician replace the defective component or components and call your customer service representative.
INTENTIONAL VENT STOP	The user/caregiver has stopped ventilation using the **VENTILATION ON/OFF** ⏻ key. Ventilation is in standby.	Check that the ventilation was switched off on purpose. This alarm can be deactivated. See section *7.2.2*, "*Changing the Setup Menu Parameters*."

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
KEYPAD FAULT RESTART/SRVC	Pressing a key for more than 45 seconds.	Press and release keys in the normal, prescribed manner. Do not press keys for 45 seconds or more.
	A key on the keyboard is stuck.	If unsuccessful in releasing the stuck key or keys, restart ventilator to see if alarm clears. If not, replace the device and call your customer service representative if the situation persists.
LOW BATTERY	Internal battery capacity is less than 30 minutes (or 8%)—battery operation over-extended.	Immediately connect the ventilator to an AC power outlet, or connect it to an external DC power source. Reminder: the internal battery can be charged only when the ventilator is connected to an AC power supply.
LOW VTI	Adjustment of the Min VTI level too high (for PSV, CPAP, and P A/C modes).	Modify the Min VTI level.
	Adjustment of the pressure level not enough to reach the volume required (for PSV, CPAP, and P A/C modes).	Modify the pressure level according to the physician's prescription.
	Patient circuit obstructed or disconnected.	Clean, unblock, or reconnect the patient circuit.
	Inappropriate patient circuit.	Replace the patient circuit.
	Defective flow sensor or internal leak in the machine.	Check patient, replace the device, and call your technician or customer service representative.
NO PROXIMAL LINE2	The proximal pressure line is disconnected.	Connect proximal pressure line.
PATIENT DISCONNECTION *IF PERSISTS RESTART/SRVC	Leak or loose connection in the patient circuit. Circuit disconnection from patient or ventilator.	Check the patient circuit connections to the ventilator; examine all connections for leakage and tightness. Replace the patient circuit if necessary.
	Inspiratory flow exceeds 130 LPM.	Adjust Apnea alarm setting.
	Inappropriate patient circuit.	Replace the patient circuit.
	Defective internal circuits of the machine or pressure sensor.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component or components or call your customer service representative.
OCCLUSION CHECK CIRCUIT *IF PERSISTS RESTART/SRVC	Patient circuit obstructed.	Clean, unblock, or properly connect the patient circuit.
OCCLUSION CHECK CIRCUIT	A nonvented configuration is being used or the built-in leak in the mask or in the circuit may be obstructed or insufficient for the settings. Note that a high respiratory or backup rate may not sufficiently flush out CO_2 in some vented pediatric masks.	Replace the nonvented circuit with a vented one. Clean, unblock the mask or the circuit of the vented system or switch to a vented system with a larger leak configuration. Try to reduce patient's backup rate if possible.
POWER FAULT RESTART/SRVC	Internal problem in the electrical power supply.	Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.

Table 5-2. Alarms and Corrective Actions (Continued)

Alarm message or symptom	Possible reason for the alarm event	Corrective action
POWER SUPPLY LOSS (without message)	Electrical power supply cut off by the main switch when ventilation is in progress.	Press the **I/O** switch to restore electrical power to the ventilator and allow ventilation to continue. To stop ventilation, press and hold the VENTILATION ON/OFF key for 3 seconds. Press the VENTILATION ON/OFF key again to confirm stop. See Chapter *7*, "*Operating Procedures*."
	The internal battery that supplies the ventilator is entirely discharged.	Immediately connect the ventilator to an AC power outlet or an external DC power source; otherwise, use an alternate device to ventilate the patient.
PRES SENS FLT1 RESTART/SRVC	Defective internal pressure sensor.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component or components and call your customer service representative.
PROX SENS FLT2 RESTART/SRVC	Defective proximal pressure sensor or internal leak of the machine.	Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component or components and call your customer service representative.
REMOVE VALVE OR CHANGE PRES	The ventilation settings are not compatible with the type of patient circuit used.	Remove exhalation valve to start ventilation with less than 5 mbar of difference between PEEP and Pi or increase the difference between PEEP and Pi to a minimum of 5 mbar.
REMOVE VALVE CPAP MODE	The ventilation settings are not compatible with the type of patient circuit used.	Remove exhalation valve to start CPAP ventilation.
SOFTWARE VERSION ERROR	Incorrect software version detected.	Call your customer service representative.
TURB OVERHEAT RESTART/SRVC	Turbine overheated because of blockage during operation.	Ensure lateral and front openings are not obstructed. Check air inlet filter. Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.
UNKNOWN BATTERY	Internal battery not recognized as a Puritan Bennett product battery or the battery is not intended for the Puritan Bennett 520 Ventilator.	Switch to a 2400 MAh battery intended for the Puritan Bennett 520 Ventilator or call your customer service representative.

5.8.2 Additional Troubleshooting

Table 5-3. provides other possible ventilator problems, causes, and corrective actions.

WARNING:
If the device is damaged, its external housing is not correctly closed, or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.

WARNING:
If you cannot determine the cause of a problem with your ventilator, contact your equipment supplier. Do not use the ventilator until the problem has been corrected.

Note:
Buzzer and battery alarms may occur when the unit is first turned on after the internal battery has been completely drained. Connect to an AC power source and recycle power.

Table 5-3. Additional Troubleshooting and Corrective Actions

Conditions	Possible causes	Corrective actions
The screen backlight never switches off during ventilation	Backlight set to YES in Preferences menu.	Set Backlight to OFF in Preferences menu (see section *7.3*, "*Preferences Menu Parameters*").
Alarm sound level too low or too high	Adjustment of the alarm sound level is incompatible with the patient's environment.	Readjust sound level (see section *7.3*, "*Preferences Menu Parameters*").
Poor visibility of the displays	Contrast adjustment is incompatible with the luminosity of the environment.	Readjust contrast (see section *7.3*, "*Preferences Menu Parameters*").
Unusual display on the screen	Problem with the display unit.	Adjust contrast or call your customer service representative if the problem persists. Ensure that the ventilator is not exposed to direct radiation from the sun.
The ventilator does not operate after pressing I/O switch	No external power source and the internal battery is completely discharged.	Connect the ventilator to the AC power source.
Light noise	Turbine noise.	Replace the ventilator and call your customer service representative.
Whistling noise or vibrations	Filter, the turbine silencer, or both have deteriorated.	Replace the ventilator and call your customer service representative.
	Valve membranes damaged.	Replace the ventilator and call your customer service representative.
Excessive heat emitted	Obstruction of main or secondary air inlets of the casings.	Remove obstructions from all blocked ventilator air inlets and outlets.
Condensation inside the device	Liquid entered the device.	Replace the ventilator and call your customer service representative.

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6 Installation and Assembly

⚠ **WARNING:**
Before operating the ventilator, read, understand, and strictly follow the information contained in Chapter *1*, "*Safety Information*."

⚠ **WARNING:**
The ventilator is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

⚠ **WARNING:**
A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection. The use of a bacterial filter at the ventilator's outlet is highly recommended. Refer to Chapter *9*, "*Cleaning*."

6.1 Installing the Ventilator

To install your Puritan Bennett™ 520 Ventilator:

- Choose an area where air can circulate freely. Avoid proximity to loose fabrics, such as curtains, and direct exposure to sunlight.

- Set the ventilator on a flat and stable surface so that its feet are all in contact with the surface. The ventilator may operate in any position, provided that the air inlets are not obstructed and the device cannot fall and possibly cause damage, personal injury, or both.

⚠ **WARNING:**
The operator should connect the ventilator to an AC power source whenever available, for safer operation.

⚠ **WARNING:**
To ensure correct and lasting operation of the ventilator, ensure that its air circulation holes (main inlet or cooling) are never obstructed. Place the device in an area where air can freely circulate around the ventilator and avoid installing it near floating fabrics, such as curtains.

WARNING:

Do not place the ventilator in a position where a child can reach it or in any position that might cause it to fall on the patient or someone else.

WARNING:

Ensure that the ventilator's immediate surroundings allow for the proper operational connection of the device without folding, pinching, or damaging any of the required cables or tubes, and that the connection of the patient circuit to the patient provides for a secure, comfortable fit.

WARNING:

Do not operate the ventilator in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.

WARNING:

If the ambient temperature where the device is operated is greater than 35°C (95°F), the flow supplied at the device outlet may exceed 41°C (106°F). This may lead to undesirable side effects for the patient. To avoid injury to the patient move the patient and the ventilator to a cooler location.

WARNING:

To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

WARNING:

Never connect your ventilator to an electrical outlet controlled by a wall switch because the power may be inadvertently turned off.

WARNING:

Even if the "INTERNAL BATTERY" charging indicator is off, charging of the battery may sometimes be incomplete if the ambient temperature is above 40°C (104°F) because of the battery's internal heat safety device.

WARNING:

The use of any accessory other than those specified, with the exception of the power supplies or cables sold by Covidien, may lead to an increase in electromagnetic emissions or a decrease in the equipment protection against electromagnetic emissions. If the ventilator is used adjacent to such accessories or stacked with such devices, the ventilator's performance should be monitored to verify normal operation.

WARNING:

The Puritan Bennett™ 520 Ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in Appendix *B*, "*Specifications*." In particular, the use of nearby mobile and portable communications

equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC/EN 60601-1-2 standard, may affect its operation. Refer to section *B.10*, "*Manufacturer's Declaration*" on page *B-8*.

WARNING:

The ventilator must not use, nor be connected to, any antistatic or electrically conductive hoses, tubing, or conduits.

6.2 Connecting to External AC Power

Any of four power sources—AC power, 12–30 VDC power, internal battery power, or auxiliary DC car adapter (cigarette lighter)—can be used to power the ventilator. However, when AC power is available, the ventilator will automatically select AC power as its operating power source.

WARNING:

The power supply to which the ventilator is connected (both AC and DC) must comply with all current and applicable standards and provide electrical power corresponding to the voltage characteristics inscribed on the rear of the ventilator to ensure correct operation.

WARNING:

Ensure that the AC power cable is in perfect condition and not compressed. The device should not be turned on if the AC power cable is damaged.

WARNING:

Connect the external electrical power source by first connecting the power cable to the ventilator and then to the external power source. Follow the reverse procedure to disconnect the device from electrical power sources.

WARNING:

Never connect your ventilator to an electrical outlet controlled by a wall switch because the power may be inadvertently turned off.

WARNING:

Do not leave power cables lying on the ground where they may pose a hazard.

To prevent accidental disconnection of the AC power cable, use the power cable holder (*Figure 6-1.* , item 1) that is inserted into the notch (*Figure 6-1.* , item 2) of the battery cover.

Figure 6-1. The Power Cable Holder

VEN_11963_A
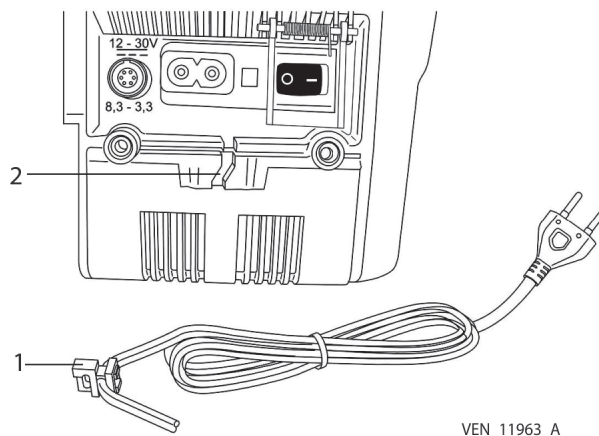
To secure the AC power cable:

1. Insert the power cable holder (*Figure 6-2.* , item 1) into the notch of the battery cover.

Figure 6-2. Inserting the Power Cable Holder Into the Notch

VEN_11937_A
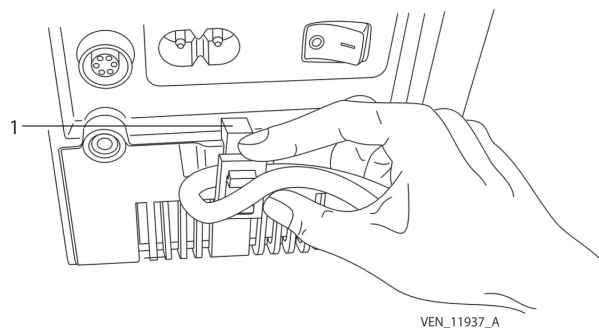
2. Connect the female end of the ventilator's AC power cable (*Figure 6-3.* , item 1) to the AC connector on the back of the ventilator.

Figure 6-3. Power Cable Connected to the Ventilator
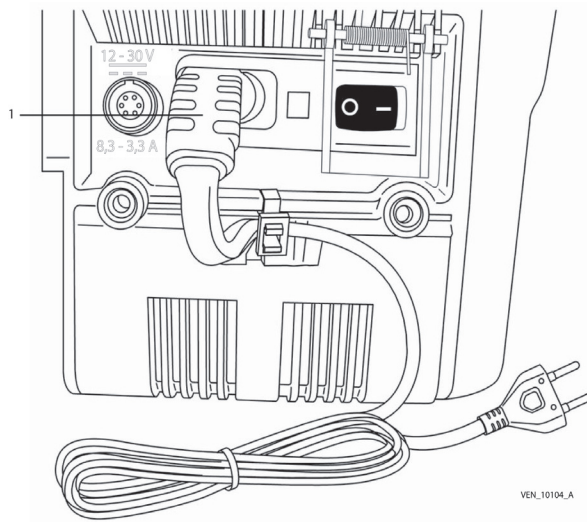
3. Connect the male end of the AC power cable to the AC power outlet.

   - • The **AC POWER** indicator on the top left corner of the ventilator illuminates.

   - • The indicator flashes while the battery charges and then turns off when the battery is fully charged (see *Figure 6-4.* on page *6-6*.).

If the AC power cable becomes disconnected or the AC power source fails, an AC POWER DIS-CONNECTION alarm signals an automatic switch to the external DC power source (if the DC power cable is connected) or to the ventilator's internal battery.

One of three power indicators, located on the upper-left of the ventilator's front panel, illuminates to signal, which of the three possible power sources are currently in use by the device (see *Figure 6-4.*).

Note:
The only time the AC POWER and indicators are illuminated at the same time is when the ventilator is connected to an AC supply and the battery is charging (indicator is flashing).

Figure 6-4. Power Indicators

VEN_10911_A
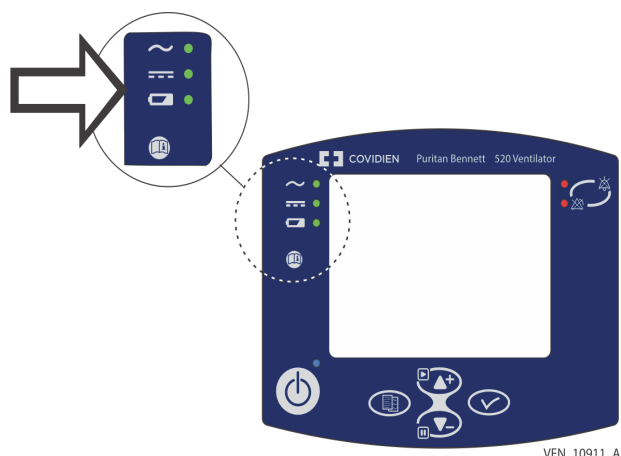
To disconnect the AC power cable:

1. Disconnect the AC power cable from the AC power outlet.

2. Disconnect the AC power cable from the ventilator's AC connector at the rear of the device.

3. Grasp the AC power cable at the level of the power cable holder and turn the cable clockwise while lifting it upwards and out of the holder.

6.3 Connecting to an External DC Power Source

WARNING:
Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12–30 VDC power source (via the DC power cable) does not enable charging of its internal battery.

WARNING:
When using a car auxiliary adapter (cigarette lighter) ensure the car has been started prior to plugging in the ventilator's DC adapter.

Note:
An alternative means of ventilation should always be available, particularly when the patient is in transit or away from wall power.

Note:
While using the ventilator on external battery power it is vital that a qualified caregiver (capable of providing necessary corrective actions in the event of alarm conditions) is present.

Note:
When AC power is not available, use an external DC power prior to using internal battery power.

To connect the ventilator to an external power source, do the following:

1. Ensure the car's engine is started prior to connecting the ventilator.

2. Connect the DC power cable into the ventilator.

3. Connect the DC power cable into the car auxiliary adapter.

Note:

Whenever AC power is unavailable, the ventilator can operate from a continuously powered external 12–30 VDC power source via a DC power cable (*Figure 6-5.*, item 1) that connects to the ventilator's rear panel DC power input connector (*Figure 6-5.*, item 2). The DC power cable is optional; see Appendix *H*, "*Parts and Accessories*," for more information. It is possible to use the DC auxiliary port (cigarette lighter) in a car as a power source.

Figure 6-5. Connecting the Ventilator to an External DC Power Source
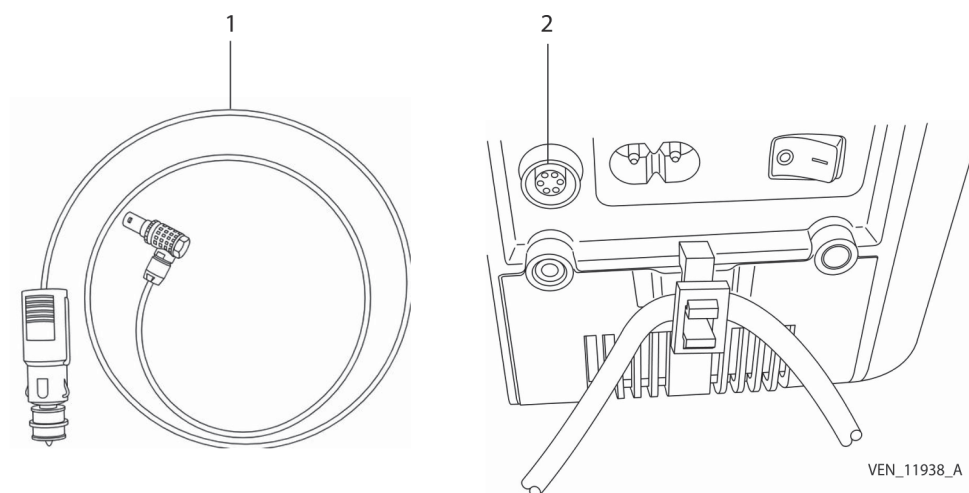
VEN_11938_A

WARNING:
Connect the external DC power source by first connecting the power cable to the ventilator and then to the external DC source. Follow the reverse procedure to disconnect the device from the external DC power source.

To connect the DC power cable to the ventilator:

1. Line up the red marker dot on the ventilator's DC power connector with the marker on the DC power cable (*Figure 6-6.* , item 1).

Figure 6-6. Connecting the DC Power Cable to the Ventilator

VEN_11941_A
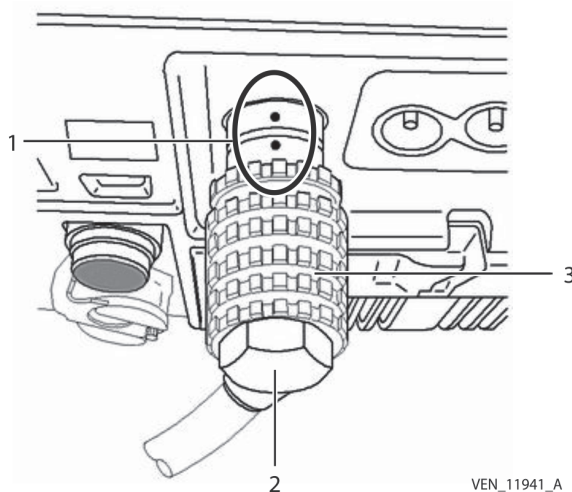
1	Align the red markers (dots or lines) before connecting the cable.	3	To disconnect the DC power cable, slide the locking ring back and pull the cable out
2	Push in to connect the DC power cable		

2. Push the DC power cable onto the ventilator's DC power connector (*Figure 6-6.* , item 2).

   • You will hear a locking "click."

   • The **DC POWER** indicator on the top left corner of the ventilator illuminates (see *Figure 6-4.*).

To disconnect the DC power cable from the ventilator, slide the locking ring (*Figure 6-6.* , item 3) back and pull the plug away from the ventilator's rear panel to disengage it.

A DC POWER DISCONNECTION alarm signals an automatic switch to the internal battery in case the external DC power source fails or becomes disconnected.

6.4 Patient Circuit

⚠ **WARNING:**
Before opening the packaging for the Patient Circuit, ensure that no damage is evident to the packaging or its contents. Do not use if evidence of damage exists.

WARNING:

For pediatric use, ensure that the patient circuit type fits, and, in all respects, is suitable for use with a child. Use a pediatric circuit for patients that weigh under 53 lb. (23 kg). See *Table H-2. List of Circuits* on page *H-2* for a list of recommended patient circuits.

WARNING:

The patient circuit should always be positioned to avoid hindering the patient's movements, to prevent accidental disconnection or leakage, and to minimize the risk of patient strangulation.

WARNING:

Ensure that the ventilator's immediate surroundings allow for the proper operational connection of the device without folding, pinching, or damaging any of the required cables or tubes, and that the connection of the patient circuit to the patient provides for a secure, comfortable fit.

WARNING:

The patient circuit is intended for single use by a single patient ② and should be changed according to the manufacturer's recommendations and according to the patient circuit lifetime. Refer to the instructions for use supplied by the manufacturer of the patient circuit (included with the ventilator) and Chapter *6*, "*Installation and Assembly*."

WARNING:

After assembling, cleaning, or reassembling the patient circuit, and on a daily basis, inspect the hoses and other components to ensure that there are no cracks or leaks and that all connections are secure.

WARNING:

To ensure proper performance of the ventilator, use a patient circuit recommended by Covidien in this manual; refer to Chapter *6*, "*Installation and Assembly*" and Appendix *H*, "*Parts and Accessories*." The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 meters (3.6 feet) to 2.0 meters (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.

WARNING:

Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.

> ⚠ **WARNING:**
> **Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 520 Ventilator.**

6.4.1 Choosing the Patient Circuit Type

Be sure to choose the appropriate circuit in the menu preferences; in particular, ensure that Pediatric Circuit Yes/No is set to YES when using a pediatric circuit (see Appendix *H*, "*Parts and Accessories*").

For information regarding validated circuits, visit the SolvIT^{SM} Center Knowledge Base at www.medtronic.com/covidien/support/solvit-center-knowledge-base/ or contact your Puritan Bennett product representative.

6.4.2 Installing the Patient Circuit

The patient circuit is mounted depending on the setup of the circuit used and the accessories used.

The following procedures describe the installation of the patient circuit with a humidifier. To add other accessories, see the installation instructions for the specific accessories used.
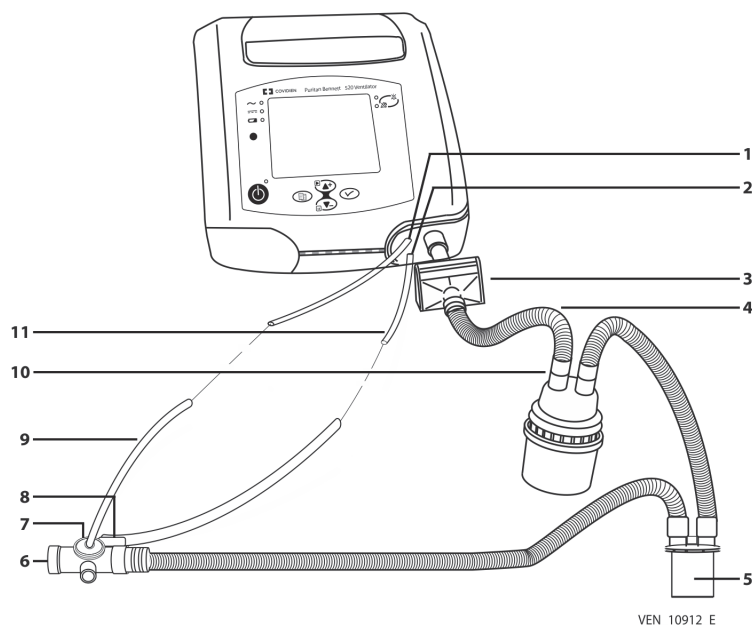
To connect a single-limb circuit with an exhalation valve:
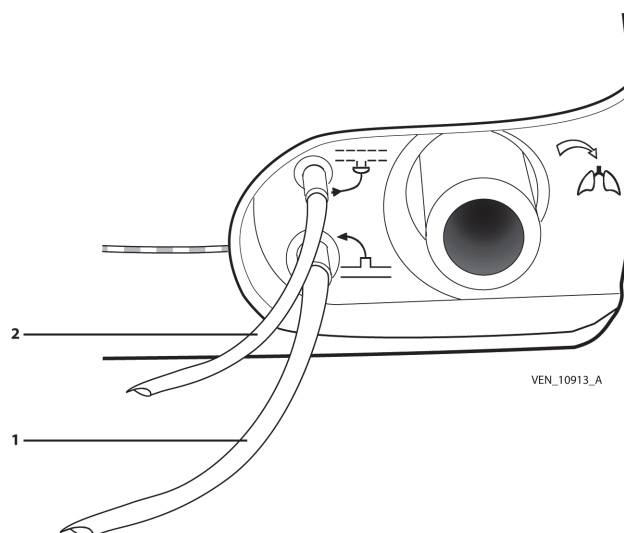
See *Figure 6-7*.

1. Inspect the components of the patient circuit for any signs of damage, such as cracks (which might cause leakage). Do not use damaged components to assemble the patient circuit.

2. Install the bacteria filter (item 3) on the TO PATIENT outlet port, as shown.

3. Attach one end of the short circuit tubing (item 4) to the bacteria filter (item 3).

4. Attach the other end of the circuit tubing (item 4) to the inlet port of the humidifier (item 10).

5. Place a water trap (item 5) between the outlet port of the humidifier and the inlet of the exhalation valve (item 7).

6. Ensure the exhalation valve (item 7) is placed as close as possible to the patient.

7. Connect one end of the proximal pressure tubing (item 11) to the proximal pressure port on the exhalation valve (item 8) and the other end onto the ventilator patient pressure port (item 2).

8. Connect one end of the exhalation valve tubing (item 9) to the exhalation valve port on the exhalation valve (item 7) and the other end onto the ventilator exhalation valve port (item 1).

9. Place a patient interface to the end of the patient circuit (item 6).

Figure 6-7. Single-Limb Patient Circuit With Exhalation Valve

VEN_10912_E

Note:

Although shown here, the humidifier (item 10), water trap (item 5), and tubes upstream of the single-limb patient circuit are not included with the ventilator. Contact your supplier for more information.

Figure 6-8. Close-up of Exhalation Valve Tube and Proximal Pressure Tube

VEN_10913_A

Figure 6-8. shows details of the connections of the proximal pressure tube (item 1) and the exhalation valve tube (item 2).

To connect a single-limb circuit without an exhalation valve (NIV only):

See *Figure 6-9.*

1. Inspect the components of the patient circuit for any signs of damage, such as cracks (which might cause leakage). Do not use damaged components to assemble the patient circuit.

2. Install the bacteria filter (item 1) on the TO PATIENT outlet port, as shown.

3. Attach one end of the short circuit tubing (item 2) to the filter (item 1).

4. Attach the other end of the circuit tubing (item 2) to the inlet port of the humidifier (item 6).

5. Place a water trap (item 3) between the outlet port of the humidifier and the patient end of the patient circuit.

6. Connect one end of the proximal pressure tubing (item 7) as close as possible to the patient at the mask or cannula entry (item 5) and the other end onto the ventilator patient pressure port (item 8).

7. Place a mouthpiece or vented (NIV) interface to the end of the patient circuit (item 4).

Figure 6-9. Single-Limb Patient Circuit Without Exhalation Valve

VEN_10914_D
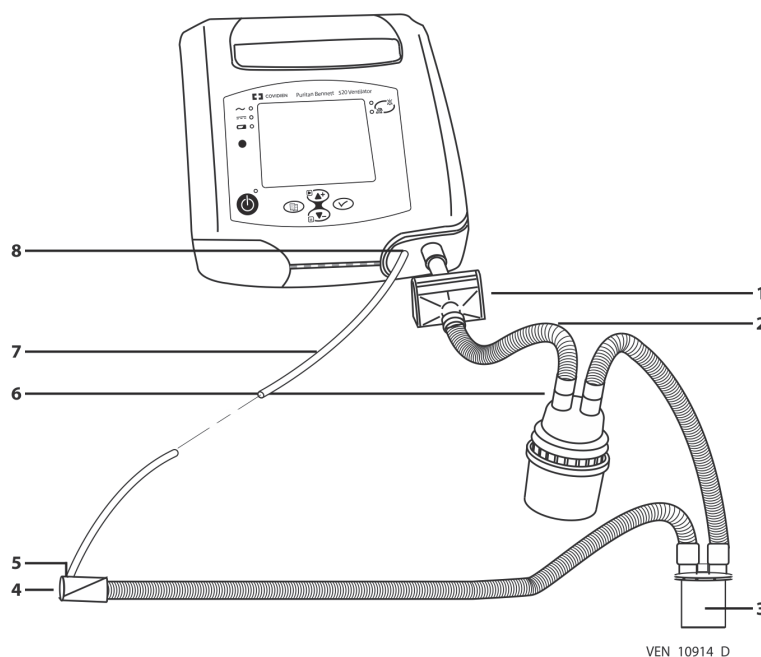
The end of the proximal pressure tube should be connected as close as possible to the patient (at the mouthpiece, mask, or cannula entry, if possible) so that the ventilator can account for all load losses due to the circuit and its potential accessories. If this is not possible, it is best to modify the PATIENT DISCONNECTION triggering threshold by setting a Max VTI alarm limit for pressure modes. As a reminder: Ensure that the length and the internal volume of the patient circuit are compatible with the tidal volume: ringed tube Ø 22 mm for adults and ringed tube Ø 15 mm for pediatric patients with tidal volumes lower than 200 ml. Use, if necessary, a 22F-15M link on the outlet.

WARNING:

When using non-invasive ventilation (NIV), without an exhalation valve, use a vented nose or face mask or a non vented mask combined with a leak accessory. When using non-invasive ventilation (NIV), with an exhalation valve, use a non vented mask.

WARNING:

The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier, HMEs, etc.) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, maximum inspired volume (Max VTI), and minimum inspired volume (Min VTI) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced. Adding attachments to the ventilator breathing system can cause the pressure during exhalation at the patient connection port to increase.

WARNING:

The exhalation valve must allow rapid discharge of the circuit pressure. Ensure that the exhalation valve is always clean and its evacuation aperture (exhaust port) is never obstructed.

WARNING:

Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.

WARNING:

Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.

6.5 Filters

WARNING:

Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see Chapter *10*, "*Routine Maintenance*"). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.
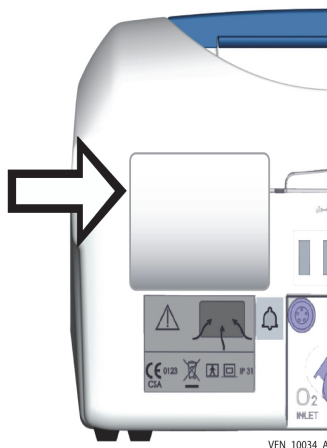
The ventilator features two filter types:

- Air inlet filter

- Bacteria filter

Air Inlet Filter

Consisting of foam and fine particle filter media and located at the rear of the ventilator, this filters the air as it enters the ventilator.

Figure 6-10. Air Inlet Filter

VEN_10034_A

⚠️ **WARNING:**

The air inlet filter is for use on a single patient and is not reusable; do not attempt to wash, clean, or reuse it.

⚠️ **WARNING:**

Failing to replace a dirty air inlet filter, or operating the ventilator without a filter, may cause serious damage to the ventilator.
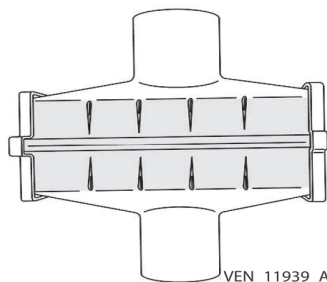
Bacteria Filter

It is highly recommended that you install a bacteria filter (see *Figure 6-11.*) on the single-limb patient circuit, connected to the TO PATIENT port:

This filter protects the ventilator from contamination by the patient (primarily, rebreathed gas). See *Figure 6-8.* , item 1.

Figure 6-11. Bacteria Filter

VEN_11939_A

See the manufacturer's instructions for more information about the use and maintenance of bacteria filters.

6.6 Humidifier

The humidifier (*Figure 6-12.*) adds moisture (water vapor) and warms the gas in the patient circuit. It is inserted into the patient circuit between the main outlet and the patient (see *Figure 6-8.* and *Figure 6-9.*).

⚠ **WARNING:**
During invasive ventilation (when an artificial airway bypasses the patient's upper respiratory system), the patient's upper respiratory system cannot humidify the incoming gas. For this reason, the use of a humidifier, to minimize drying of the patient's airways and subsequent irritation and discomfort, is required.

⚠ **WARNING:**
Always position a humidification device so that it is lower than both the ventilator and the patient. Use water traps, if necessary, to limit water in the patient circuit and periodically empty these water traps.

⚠ **WARNING:**
If a heated humidifier is used, you should always monitor the temperature of the gas delivered to the patient. Gas delivered from the ventilator that becomes too hot may burn the patient's airway.

⚠ **WARNING:**
Adding accessories to the ventilator breathing circuit, such as a humidifier and water trap(s), may result in a decrease in tidal volume delivered to the patient due to the added compressible volume of the accessory. Always assure that the patient is receiving the appropriate inspired volume when altering the breathing circuit configuration.

Figure 6-12. Humidifier

VEN_11948_A
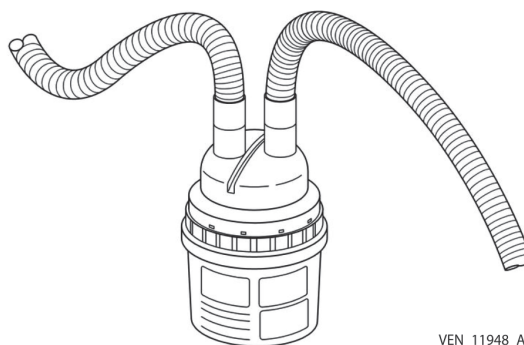
When a humidification device is used, any condensation that forms in the patient circuit is collected in the water trap. If you notice any moisture in the patient circuit, you need to replace the wet circuit components with dry ones.

See the humidification device's instruction for information on operating, cleaning, and sterilizing the humidifier.

6.7 Oxygen

⚠ **WARNING:**
The ventilator must not be used with flammable anesthetic substances.

⚠ **WARNING:**
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

6.7.1 Administering Oxygen

⚠ **WARNING:**
Oxygen therapy for patients with respiratory failure is a common and effective medical prescription. However, be aware that inappropriate oxygen use may potentially lead to serious complications, including, but not limited to, patient injury.

Oxygen administered to the patient is introduced from an external source into the machine through the oxygen connector at the rear of the ventilator. It is then integrated into the total volume of delivered gas. Remove the oxygen inlet connector from the back of the ventilator when external oxygen is not in use.

The specific oxygen flow to the patient depends on the physiological characteristics of the patient and the ventilator settings.

The oxygen flow setting should be adjusted for each patient and established in relation to a calibrated oxygen analyzer. As the factors that affect administered oxygen flow may change over time, you must ensure that these settings always correspond to the current oxygen therapy objectives specified by the physician (see section *3.4*, "*FiO2 For Various Oxygen and Ventilator Settings*").

⚠ **WARNING:**
To avoid injury to the patient and/or possible damage to the ventilator: before using the ventilator, use a flow meter (flow regulator) to regulate the oxygen supply to specifications before connecting the ventilator to the oxygen supply.

⚠ **WARNING:**
Ensure that the oxygen supply pressure to the machine never exceeds 7 psi (50 kPa) or a flow of 15 lpm. Refer to *Table B-8.* on page *B-3* for sensitivity tolerances.

⚠ **WARNING:**
The Puritan Bennett™ 520 Ventilator can be used with an oxygen analyzer with minimum and maximum concentration alarms. Always measure the delivered oxygen with a calibrated oxygen

analyzer that features a minimum and maximum concentration alarm in order to ensure that the prescribed oxygen concentration is delivered to the patient.

6.7.2 Connecting the Oxygen Supply

WARNING:
Ensure that the only gas supplied to the ventilator through the dedicated oxygen supply connector is medical-grade oxygen.
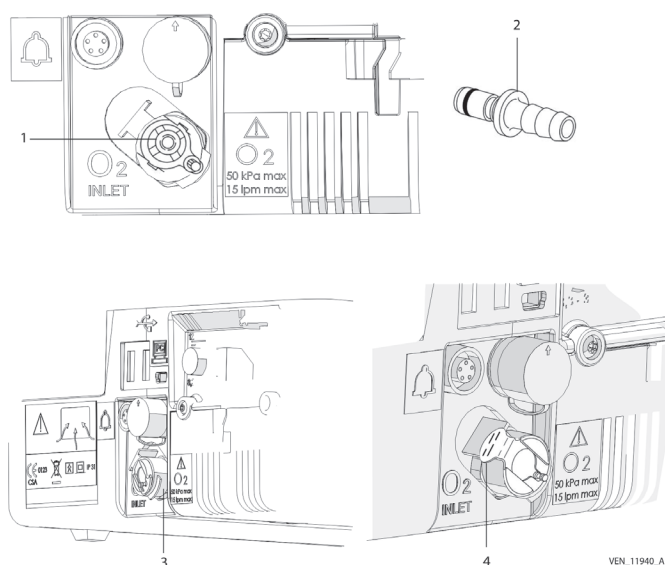
WARNING:
The hose connecting the ventilator to the oxygen source must be designed exclusively for use with medical-grade oxygen. Under no circumstances should the oxygen hose be modified by the user. In addition, the hose must be installed without the use of lubricants.

A connector (*Figure 6-13.*, item 1) for an external low pressure oxygen source is available at the rear of the ventilator. It is essential that you also use the special coupler (item 2) supplied with the ventilator to attach the external low pressure oxygen source to the connector. The connector is also fitted with a non-return airtight valve system. The non-return airtight valve system includes a stud (item 3) and a locking tab (item 4).

Figure 6-13. Rear Panel Oxygen Connector

WARNING:
Before connecting the oxygen supply, ensure that the stud on the oxygen connector (*Figure 6-13.*, item 3) is protruding outwards.

> ⚠️ **WARNING:**
>
> **Inspect the oxygen coupler (*Figure 6-14.* , item 2) before use to ensure it has its black o-ring attached and in good condition. Do not use an oxygen coupler with a missing, damaged, or worn o-ring.**

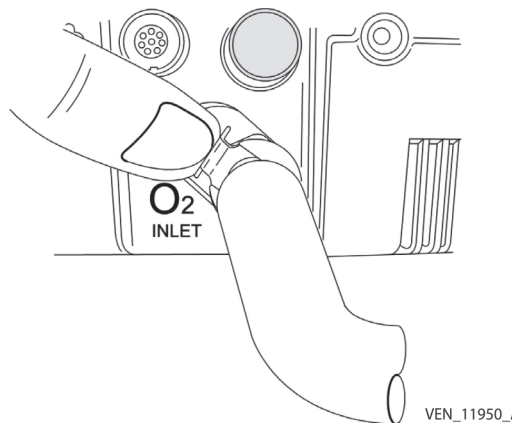### To connect the oxygen supply system to the ventilator:

See *Figure 6-14.*

1. Inspect the oxygen supply's connector (*Figure 6-14.* , item 1) to ensure that connector's black o-ring (item 2) is not missing.

2. Push the oxygen supply's oxygen connector (item 1) into the ventilator's oxygen connector (*Figure 6-14.* , item 3).

   - The ventilator's oxygen connector's locking stud (item 4) retracts.

   - The ventilator's oxygen connector's locking tab (item 5) is released, ensuring that the oxygen connection is locked and secured in place.

Figure 6-14. Connecting the Oxygen Supply System

VEN_11949_A

1   2   4 5 3
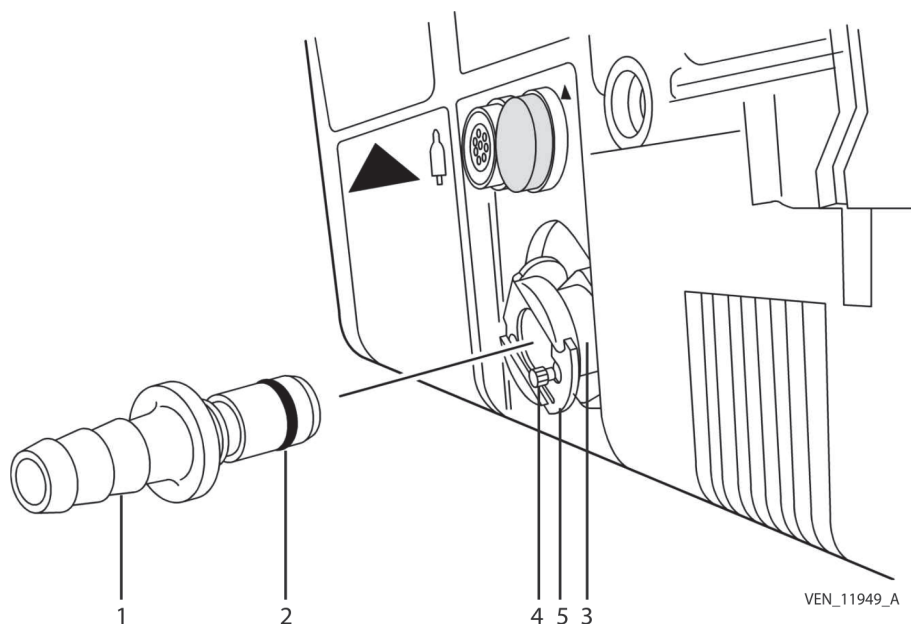
To disconnect the oxygen supply system from the ventilator:

> 📖 **Note:**
>
> Ensure the oxygen source is turned off prior to placing the ventilator in standby or turning off the ventilator.

1. Stop the oxygen flow from the oxygen supply.

2. Press the locking tab of the ventilator's oxygen connector, as shown in *Figure 6-15.* , to unlock the oxygen connection.

Figure 6-15. Disconnecting the Oxygen Supply System

VEN_11950_A

3. Disconnect the oxygen supply's oxygen connector by pulling it toward you.
    The ventilator's oxygen connector's locking stud (*Figure 6-14.* , item 4) will then extend out-wards, which is required before the oxygen connector can be reconnected.

WARNING:

The coupler must not remain connected to the oxygen connector unless it also connected to a leak-proof, external oxygen gas source. When an oxygen supply is not being used with the ventilator, disconnect the oxygen source completely from the ventilator.

WARNING:

In the event of an oxygen leak, shut down the supply of oxygen at its source. In addition, remove and/or keep any incandescent source away from the device, which may be enriched with oxygen. Circulate fresh air into the room to bring the oxygen level down to normal.

WARNING:

To prevent any interference with the internal sensors of the ventilator, do not install a humidifier upstream of the ventilator.

6.8 Fitting the Ventilator into the Dual Bag

The dual bag is a carrying bag with a dual function. It allows the Puritan Bennett 520 Ventilator to either be mounted onto a wheelchair or carried as a backpack (see *Figure 6-16.*).

WARNING:

Ensure that the ventilator is switched off and disconnected from all external power supplies before installation.

To fit the ventilator into the dual bag, do the following:

1. Open the rear panel of the dual bag.

2. Slip the ventilator into the dual bag, pushing it completely to ensure a snug fit.

3. Shut the rear panel of the dual bag, ensuring that the hook and loop fastener strips are securely fastened.

6.9 Mounting the Ventilator on a Wheelchair

WARNING:
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

WARNING:
Due to its limited internal battery's reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.

WARNING:
Do not operate the ventilator in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.

WARNING:
To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

WARNING:
Before using the ventilator's internal battery, ensure that the battery is fully charged and that the charge holds. Back up ventilators or those in storage should be connected to an AC power source to protect the integrity of the battery.

WARNING:
Due to typical voltage fluctuations that occur during normal power wheelchair use, the wheelchair mains battery should never be used to power the Puritan Bennett™ 520 Ventilator, nor should the ventilator's battery be used to power the wheelchair. The ventilator should always be connected to an independent power source (e.g. AC power, extra batteries, or DC power source).

WARNING:
Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see Chapter *10*, "*Routine Maintenance*." This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.

WARNING:

To minimize the risk of damage, you must use the ventilator's Dual Bag to transport the ventilator. See _Table H-1. List of Consumables and Accessories_.

Figure 6-16. Using the Dual Bag

VEN_10985_A
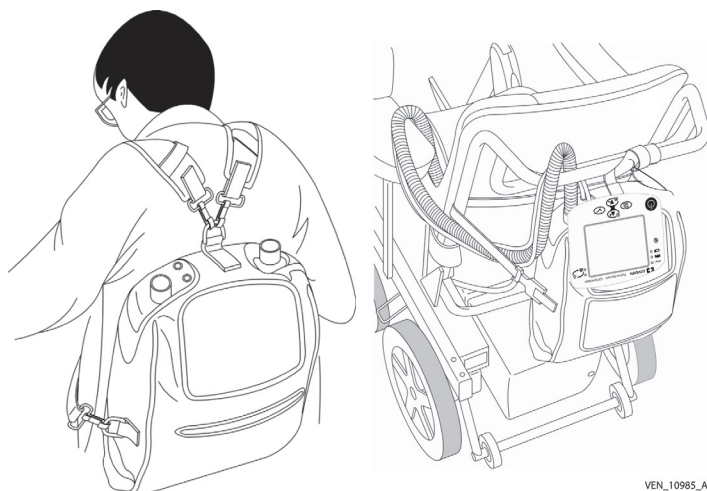
To install the dual bag onto a wheelchair, do the following:

1. Unclip the two backpack straps from the side clips.

2. Clip the suspension belt onto the central ring.

3. Secure the dual bag on the wheelchair's push handle.

4. Attach the nonadjustable side of the maintaining belt to the side clip of the dual bag.

5. Pass the maintaining belt around the back of the wheelchair.

6. Adjust the length of the maintaining belt and attach the adjustable side of the belt to the clip on the other side of the dual bag.

6.10 Mounting the Ventilator on the Utility Cart

Match the mounting holes (item 1) on the bottom of the Puritan Bennett 520 Ventilator to the mounting studs (item 2) on the top of the utility cart platform.

Figure 6-17. Mounting the Ventilator on the Utility Cart

VEN_11942_A

Figure 6-18. Using the Utility Cart

VEN_10915_A

6.11 Connecting the Nurse Call Cable

Connect the nurse call cable (*Figure 6-19.*, item 1) to the nurse call monitor connector (item 2).

Figure 6-19. Connecting the Nurse Call Cable
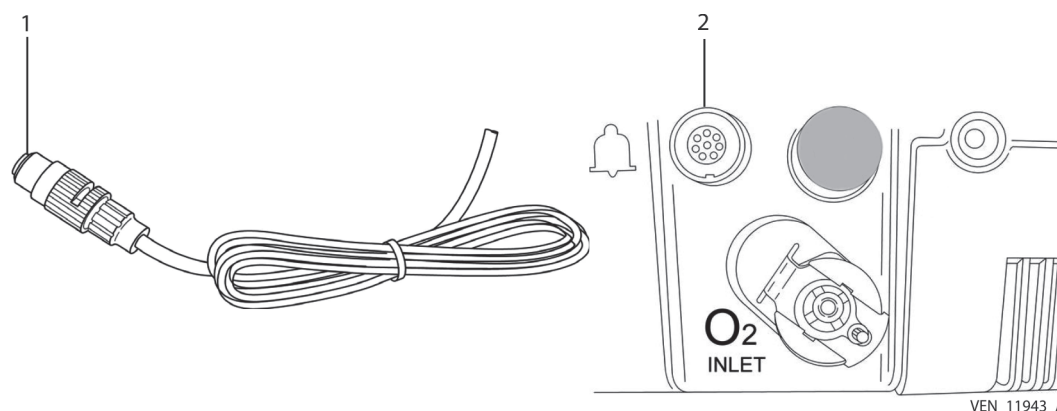
> ⚠️ **WARNING:**
> Before using the Nurse Call system, ensure that its connections are secure and it operates properly.

> ⚠️ **WARNING:**
> To connect the ventilator to a Nurse Call device, check the ventilator's compatibility with the Nurse Call device and order a suitable connection cable.

> ⚠️ **WARNING:**
> Do not use Nurse Call devices that operate based on the closure of an electrical circuit, because the devices often do not take into account possible cable disconnection or a total loss of power. Ensure that the Nurse Call device is always connected to the ventilator.

> 📖 **Note:**
> The Puritan Bennett 520 Ventilator has been designed to accommodate connectivity with nurse call/monitoring systems. Because it is not possible to anticipate every configuration of hardware and software associated with a nurse call/monitoring system, it is the user's responsibility to confirm proper functionality of the system when used in conjunction with the ventilator. Verification of alarms, alerts, and patient data transmissions is required. If the system performance is not as expected, contact Technical Support for assistance troubleshooting the setup. Do not use the Puritan Bennett 520 Ventilator with a nurse call/monitoring system until the functionality of the ventilator/system combination has been confirmed.

> 📖 **Note:**
> Complete a self-test after the cable has been installed and at regular intervals to ensure the system is operating as intended. A self-test consists of inducing an alarm and confirming the nurse call/monitoring system unit emits an audio alarm, and also confirming the audio alarm ceases once the alarm in the ventilator has been reset.

The nurse call function provides for remote alerts of ventilator alarm conditions (for example, when the ventilator is used in an isolation room), and features the following:

- The ventilator signals an alarm using a normally open (NO) or a normally closed (NC) signal.

- A remote alarm is activated when an alarm condition occurs, unless either of the following is true:

    - The audio paused function is active.

    - The ventilator power switch is OFF.

- The alarm delay, once generated from the ventilator, to the nurse call output/input cable connectors is less than 100 ms.

- The remote alarm port is an eight-pin female connector; allowable current is 100 mA at 24 VDC (max).

7 Operating Procedures

7.1 Turning on the Ventilator

⚠️ **WARNING:**
Before operating the ventilator, read, understand, and strictly follow the information contained in Chapter *1*, "*Safety Information*."

⚠️ **WARNING:**
The ventilator is not intended to be used for patients without breathing autonomy or who are ventilator dependent.

⚠️ **WARNING:**
If the ventilator has been transported or stored at a temperature that differs more than ±20°C (± 68°F) from the temperature in which it will be operating, the ventilator should be allowed to stabilize in its operating environment for at least two (2) hours prior to use.

⚠️ **WARNING:**
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.

⚠️ **WARNING:**
While the ventilator is in use, an alternative means of ventilation should always be available in the event of a ventilator problem. Supplementary observation, appropriate for the patient's condition, is also recommended.

⚠️ **WARNING:**
To ensure that ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use.

⚠️ **WARNING:**
Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the

unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.

WARNING:
Users must always possess an additional breathing circuit and exhalation valve while using the Puritan Bennett™ 520 Ventilator.

WARNING:
Verify the functionality of the alarm conditions before connecting the patient to the ventilator. Refer to Appendix *F*, "*Alarms Tests*."

WARNING:
Before starting ventilation, always verify that all settings are properly set in accordance with the required prescription.

WARNING:
If the ventilator fails the alarm tests or if you cannot complete the tests, refer to section *5.8*, "*Troubleshooting*" or call your equipment supplier or Covidien.

WARNING:
Due to its limited internal battery's reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.

To turn the ventilator on:

- Set the **I/O** switch (a covered, rocker-type switch located at the rear of the ventilator) to the **I** position, as shown in *Figure 7-1.*

VEN_10043_A
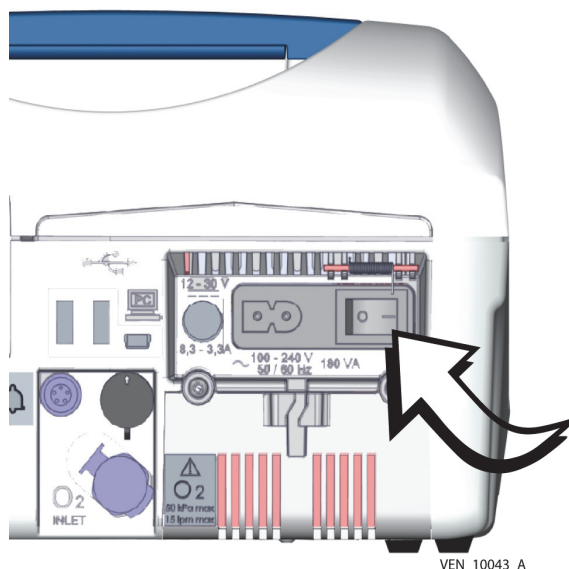
The following events occur:

- The ventilator is turned on.

- A Power On Self Test (POST) is carried out (when plugged in to an AC power source).

- The front panel indicators flash (except for the indicator showing the type of power supply in use, which remains lit).

- The audible alarms briefly sound.

- The display's backlight turns on.

- The PURITAN BENNETT logo is shown momentarily.

- The blue **VENT STDBY** indicator to the right of the **VENTILATION ON/OFF** key illuminates, indicating the device is in standby mode.

- A Welcome menu screen is shown for about 5 seconds, which includes the machine hours counter and patient hours counter, as shown in *Figure 7-2.*

Figure 7-2. Welcome Menu Screen

VEN_10872_A
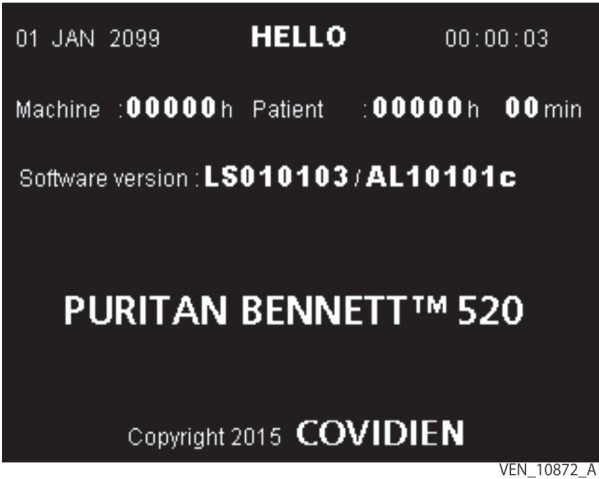
Note:

If the ventilator had been previously stopped by use of the **I/O** switch while ventilation was in progress, the ventilator starts directly in ventilation mode and does not show the Welcome menu screen.

Note:

The alarm, technical fault, and event logs are stored in nonvolatile memory on the main CPU PCB, ensuring that the information is retained when the ventilator is turned off and during power loss conditions.

To skip the Welcome menu:

Press **VENTILATION ON/OFF** to start ventilation immediately.

The Ventilation menu screen is then shown.

Figure 7-3. Ventilation Menu Parameters

VEN_10873_A
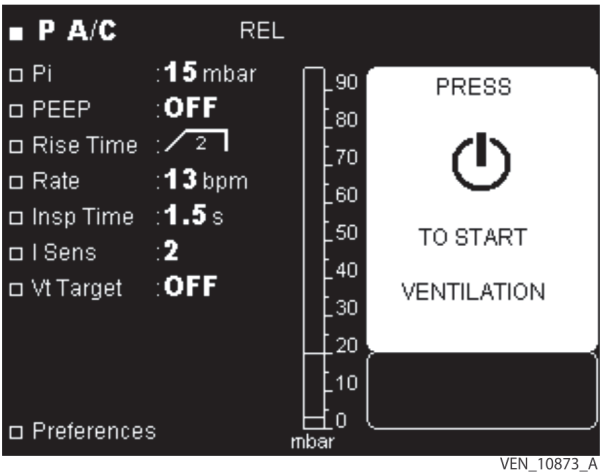
By default, the starting ventilation mode is the last one used, the settings being those that were active when the machine was last stopped.

If the ventilator's memory of the settings is faulty, a CHECK SETTINGS alarm is activated. If this occurs, the desired parameters should be reset and saved; otherwise the machine will operate on default parameter values.

7.2 Setup Menu Parameters

7.2.1 Accessing Setup Configuration

Note:
The Locking key prevents access to the Setup menu (see section *7.8*, "*Locking the Control Panel*" on page *7-36* and section *7.9*, "*Unlocking the Control Panel*" on page *7-37*).

Note:
The Setup menu cannot be accessed if the ventilator had been turned off, without first placing the device into standby.

1. Check that the ventilator's **I/O** switch is set to OFF (**O**) position.

2. Press and hold the **ALARM CONTROL** key while switching the **I/O** switch to ON (**I**). Hold the key until the Setup menu appears (approximately 3 seconds). See *Figure 7-4*.

Figure 7-4. Setup Menu


```
                    SETUP
Machine Hrs          : 00000h
■ Language           : ENGLISH
□ Date               : 01 JAN 2099
□ Time               : 00:04:22
□ Intentional Vent Stop : YES
□ Pressure Unit      : mbar
□ Alarm Tone         : Compliant(softer)
□ Patient Hours      : 00000h  00min
   ◇ Reset Hours       : OFF
□ Restore Defaults   : OFF
□ Maintenance
□ Next
```
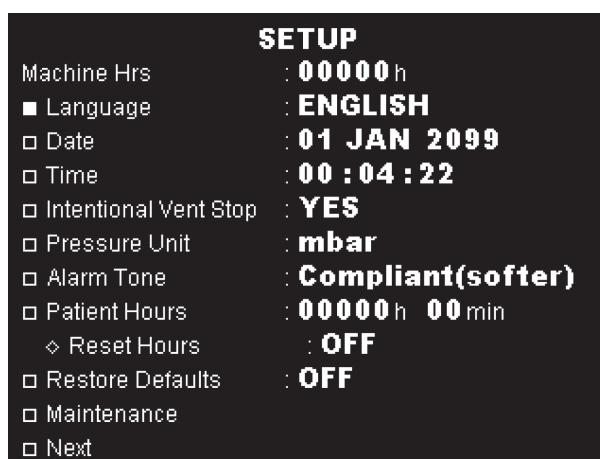
VEN_12103_A

3. Release the **ALARM CONTROL** key.

7.2.2 Changing the Setup Menu Parameters

To change the Setup menu settings:

1. Press **UP** or **DOWN** to position the cursor beside the parameter to be modified.

2. Press **ENTER**.

- The cursor changes.

- The selected parameter value flashes.

3. Press **UP** or **DOWN** to modify the value of the selected parameter.

4. Press **ENTER** to confirm the newly selected value.

Note:
When a parameter contains several setup fields (such as Date and Time) press **ENTER** to move from one field to the next.

Note:
If you do not confirm a change by pressing **ENTER** before 7 seconds elapse, the ventilator restores the setup field's previous value.

The parameters in this menu include the following:

- Machine Hours

- Language

- Date

- Time

- Intentional Vent Stop

- Pressure Unit

- Alarm Tone

- Patient Hours

- Restore Defaults

- Maintenance

- Next

Machine Hours

The counter records the total ventilation time in hours (to the nearest hour) since manufacture.

Note:
The machine hour meter is reset when the CPU board is changed.

Language

The language can be set here. All messages and denominations are automatically shown in the selected language. The languages available are:

Table 7-1. Languages

English (US)	Finnish	Japanese
English (UK)	Russian	Italian
German	Portuguese	French
Danish	Polish	Spanish
Chinese	Norwegian	Swedish
Turkish	Dutch	Korean

Date

The current date can be set here. The date is shown in the format: DD MMM YYYY.

Time

The current time can be set here. The time is shown in the format: HH: MM: SS.

Intentional Vent Stop Alarm

The Intentional Ventilation Stop alarm is an alarm to warn that ventilation has been switched off by the user/caregiver and the ventilator is in standby.

To set the Intentional Vent Stop alarm:

1. Use the **UP** or **DOWN** arrows to place the cursor at the Intentional Vent Stop alarm position.

2. Press **ENTER**.

3. Press **UP** or **DOWN** to set the message to YES.

4. Press **ENTER** to confirm the selection.

Pressure Unit

The unit of pressure can be set here. It can be shown as **mbar**, **cmH20,** or **hPa**.

Alarm Tone

Alarm tone options include Original (louder) or Compliant (softer). The default setting is Compliant. The audible sound of Compliant is softer than the Original tone, and meets the requirements of alarm standard 60601-1-8. Original refers to the alarm tone that was shipped with the ventilator from initial product launch until the LS010101/LS010011 software update.

To change the alarm tone:

1. Use the **UP** or **DOWN** arrows to place the cursor on Alarm Tone.

2. Press **ENTER**.

3. Use the **UP** or **DOWN** arrows to select Compliant or Original.

4. Press **ENTER** to confirm the selection.

Patient Hours

The value of this parameter is equal to the total number of hours that the patient has been ventilated.
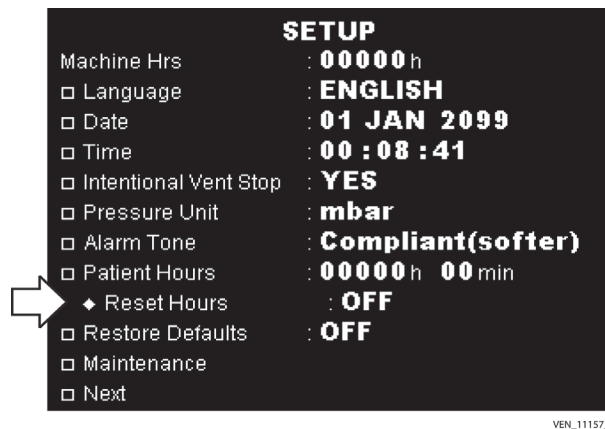
Note:

Resetting the patient hours will also reset the trends stored in the device memory in preparation for a new patient.

To reset the Patient Hours counter to zero:

1. Press **DOWN** to place the cursor at the Patient Hours line, as shown in *Figure 7-5*.
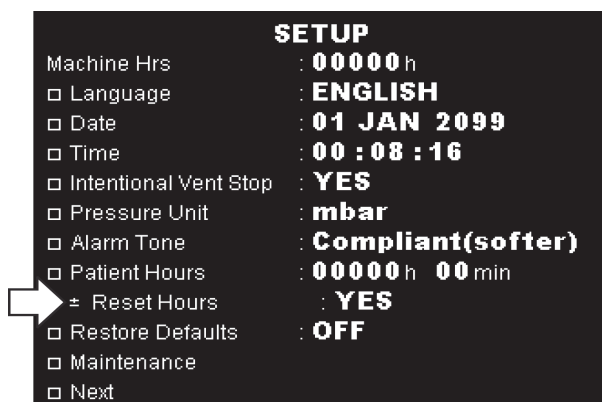
Figure 7-5. Resetting Patient Hours to Zero (1)

VEN_11157_A

2. Press **ENTER**.

   • The cursor is placed on the Reset Hours line.

3. Press **ENTER**.

   • OFF flashes.

4. Press **UP** or **DOWN** to change the OFF message to YES, as shown in *Figure 7-6*.

Figure 7-6. Resetting Patient Hours to Zero (2)

5. Press **ENTER**.

- YES is shown continuously.

- A long "beep" sounds.

- The patient counter display indicates 00000h, as shown in *Figure 7-7.*

Figure 7-7. Resetting Patient Hours to Zero (3)
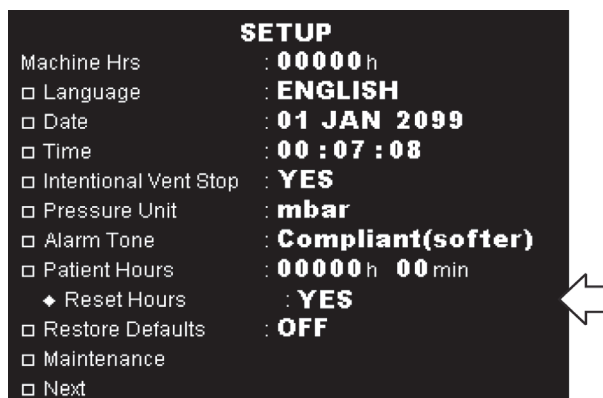
6. Press **UP** or **DOWN**.

- The screen indicates Reset Hours: OFF, as shown in *Figure 7-8.*

Figure 7-8. Resetting Patient Hours to Zero (4)

VEN_11156_A

Restore Defaults

This allows the user to reset all settings back to the original manufacturer defaults except for the Language, Date, and Time.

To restore settings back to the manufacturer defaults:

1. Press **UP** or **DOWN** to position the cursor beside Restore Defaults, as shown in *Figure 7-9*.

**Figure 7-9.** Restoring Default Settings (1)

VEN_12101_A
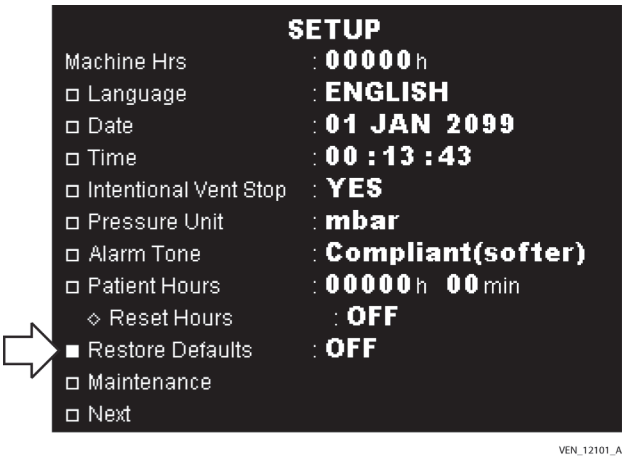
2. Press **ENTER**. OFF flashes.

3. Press **UP** or **DOWN** to change OFF to YES, as shown in *Figure 7-10*.

Figure 7-10. Restoring Default Settings (2)

VEN_12102_A
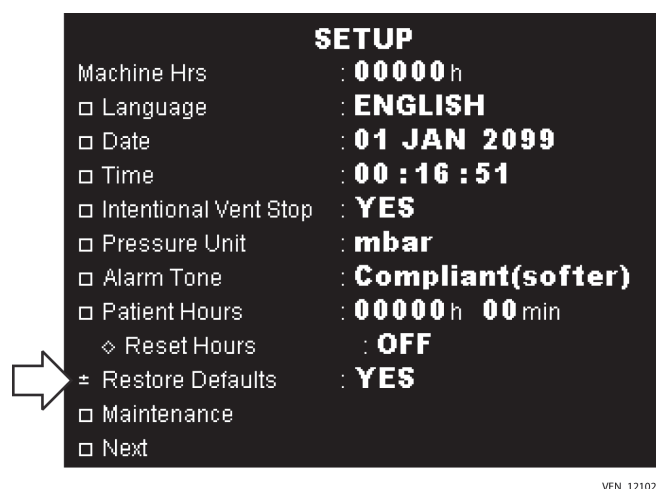
4. Press **ENTER** to reset all settings back to the manufacturer defaults except for Language, Date, and Time. OFF will reappear, as shown in *Figure 7-11*.

Figure 7-11. Restoring Default Settings (3)

VEN_12101_A
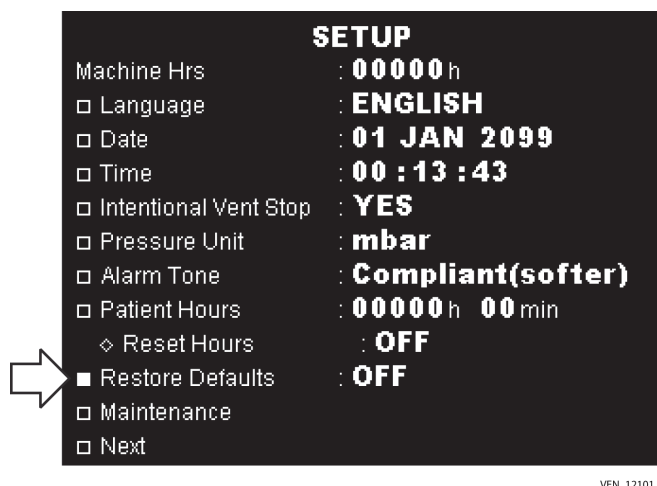
Maintenance

This option is reserved for Service personnel qualified by Covidien to ensure correct maintenance and operation of the device. For information on using the Maintenance option, refer to the Puritan Bennett 520 Ventilator service manual.

Next

This allows the user access to Setup 2 menu. For more information, see section *7.2.3*.

7.2.3 Entering Setup 2 Menu

1. Press **UP** or **DOWN** to position the cursor beside Next.

2. Press **ENTER**.

The Setup 2 menu is shown.

Figure 7-12. Setup 2 Menu

VEN_10164_C
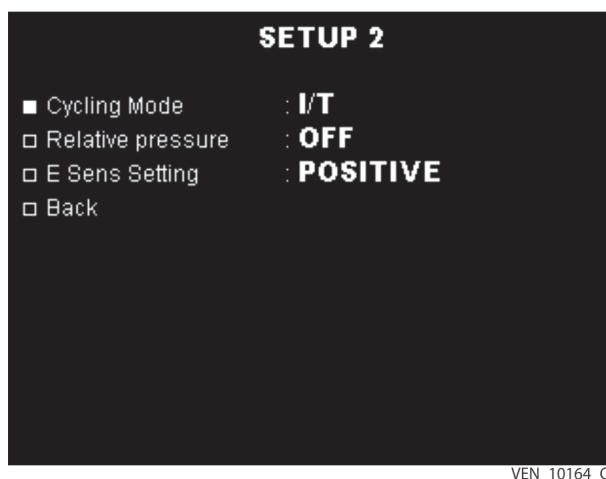
The parameters in this menu include the following:

- Cycling Mode

- Relative pressure

- E Sens Setting

- Back

Cycling Mode

The Cycling Mode is used to set which calculated value (I:E or I/T) appears in the parameter zoom window when changing Insp Time or Rate settings. It is also used to set the monitored data value (I:E or I/T) shown in the monitored data window and graphics screen.

The two cycling modes represent the relationship between inspiration time to exhalation time as follows:

1. I/T is inspiratory time (T_i) as a percentage of the total breath cycle time ($T_i + T_e$).
   I/T (%) = [Ti / ($T_i + T_e$)] x 100

2. I:E is the ratio of inspiratory time (T_i) to exhalation time (T_e).
   I:E = $1/(T_e / T_i)$

In P A/C mode, the cycling ratio changes based on patient inspiration; however, the inspiratory time remains constant and corresponds to the rate and cycling ratio settings.

Absolute and Relative Pressure

The relative pressure for the inspiratory pressure setting (P Control and P Support) in PSV and P A/C, can be set to **OFF** or **YES** and allows the choice between setting the inspiratory pressure relative to PEEP or setting an absolute inspiratory pressure. The default value is absolute (ABS).

If relative pressure is set to **YES**, the PEEP is added to the inspiratory pressure setting to determine the peak inspiratory pressure. If relative pressure is set to **OFF**, the inspiratory pressure setting will determine the peak inspiratory pressure regardless of the PEEP setting.

Relative pressure = YES: Inspiratory pressure setting + PEEP = Peak inspiratory pressure.

Relative pressure = OFF (ABS): Inspiratory pressure setting = Peak inspiratory pressure.

The symbol **ABS** for absolute or **REL** for relative will be shown at the top of the screen as follows:

Figure 7-13. Absolute and Relative Pressure

VEN_11991_A
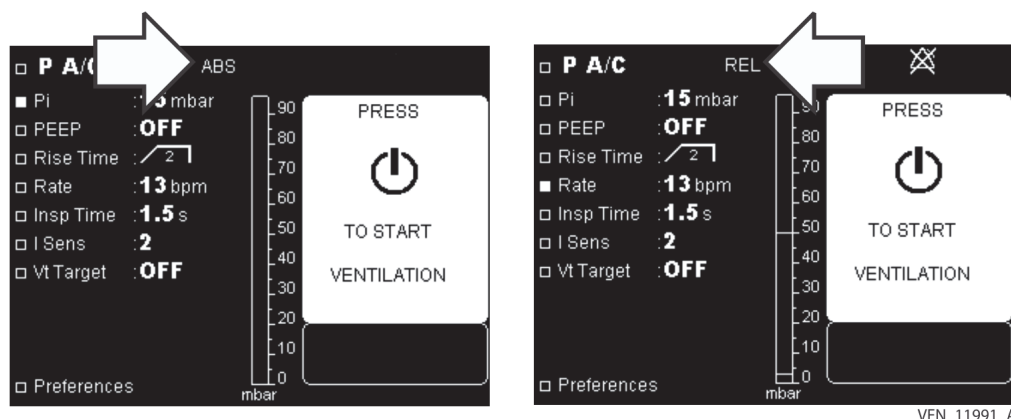
E Sens Setting

E Sens enables the operator to adjust the sensitivity of the expiratory trigger in Pressure Support breaths in PSV mode, which will cycle the breath into the expiratory phase. During a Pressure Support inspiration, the delivered flow will reach a peak value and then begin to decelerate toward zero. The E Sens setting allows the operator to set the flow value, as a percentage of peak flow, that will cycle the breath to exhalation.The E Sens setting can be set to either **POSITIVE** or **NEGATIVE**.

If set to POSITIVE, E Sens is based on the percentage of inspiratory peak flow. If set to NEGATIVE, E Sens is based on the percentage of inspiratory peak flow by which the flow must decrease before exhalation is declared.

Figure 7-14. E Sens Setting

VEN_10188_A

x	Seconds	y2	Exhalation
y1	Inspiration		
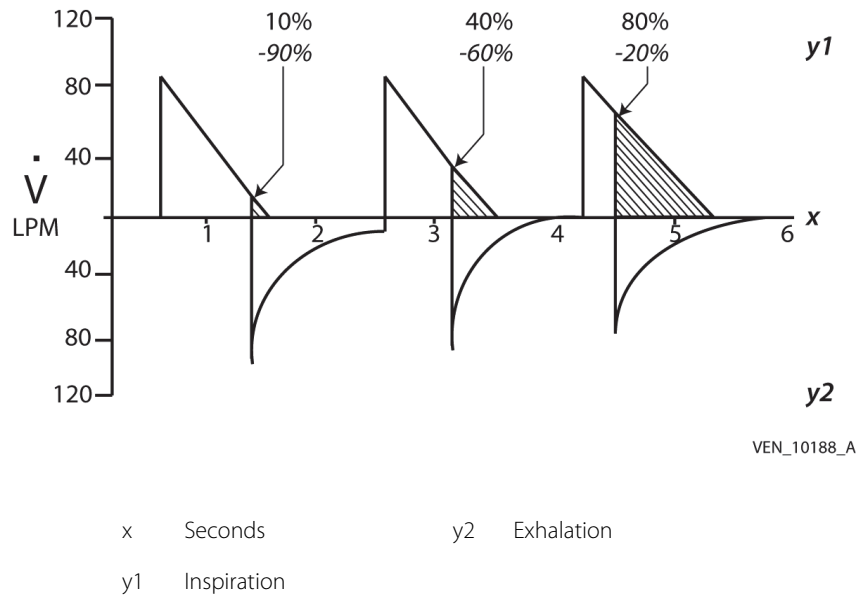
Back

Allows the user to return to the Setup menu.

7.2.4 Exiting the Setup Menu

To exit the Setup menu, you must cycle the ventilator's power.

1. Set the ventilator's rear panel **I/O** switch to OFF (**O**). Wait 30 seconds.

2. Turn the ventilator's **I/O** switch ON (**I**).

The ventilator will run through a Power On Self Test (POST) routine and then return to standby mode.

7.3 Preferences Menu Parameters

The Preferences menu is only accessible if the Locking key has not been enabled (refer to section *7.8*, "*Locking the Control Panel*" on page *7-36* and section *7.9*, "*Unlocking the Control Panel*" on page *7-37*).

The Preferences menu is accessed from the Ventilation parameters menu, when ventilation is either on or off.

⚠ **WARNING:**
Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.

Note:

Default alarm setting preferences should be entered prior to using the ventilator.

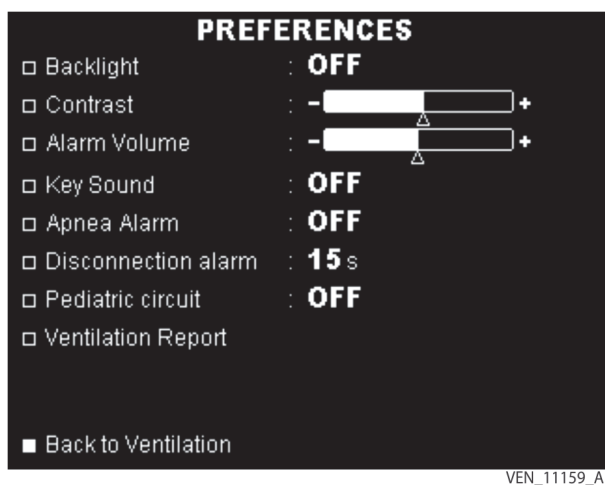## 7.3.1 Preferences Menu

To show the Preferences menu:

1. Press **DOWN** until the cursor is on the Preferences line, as shown in *Figure 7-15*.

Figure 7-15. Selecting the Preferences Menu
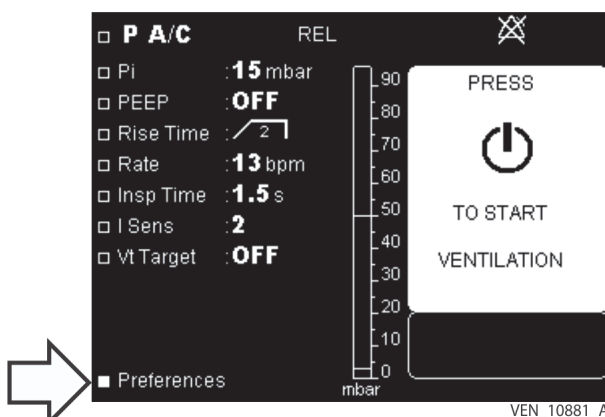
2. Press **ENTER**. The Preferences menu is shown.

Figure 7-16. Changing Settings in the Preferences Menu

To change the settings in the Preferences menu:

1. Press **UP** to place the cursor on the parameter line to be modified.

2. Press **ENTER**.

• The cursor changes to the plus/minus symbol.

- The parameter selected to be modified flashes, or for certain parameters featuring a bar graph, the indicator triangle under the bar graph becomes filled.

See *Figure 7-17.*

Figure 7-17. Modifying the Parameters

1	Cursor: plus/minus symbol	3	Indicator triangle: filled
2	Parameter value: flashing		

3. Press **UP** or **DOWN** to change the selected parameter's value.

4. Press **ENTER** to confirm the new parameter setting.

- The new parameter setting is shown.

- The cursor returns to its initial form.

Note:

If a parameter change is not confirmed by pressing **ENTER** before 7 seconds elapse, the ventilator resets the parameter to its previous value.

The parameters in this menu include the following:

- Backlight

- Contrast

- Alarm Volume

- Key Sound

- Apnea Alarm

- Disconnection Alarm

- Pediatric Circuit

- Ventilation Report

To adjust the various Preferences menu parameters, or to view the Ventilation Report, refer to the instructions provided in this section.

To manually exit from the Preferences menu:

Press **ENTER** when the cursor is on Back to Ventilation.

You will automatically exit from the Preferences menu when the following occurs:

- No keyboard action is detected before 15 seconds elapse, or

- A high priority alarm is triggered.

7.3.2 Backlight

To set the backlight:

1. Select the Backlight parameter on the screen.

2. Set the backlight:

   a. To set the backlight to standby, select **OFF**.

   The effect of this setting is that if no keyboard action occurs before 1 minute elapses, the display's backlight fades almost to off. The display will illuminate when the following occurs:

   - Any one of the keys on the keyboard is pressed

   - An alarm is triggered

   b. To set the backlight to light continuously, select **YES**. This setting ensures that the display is continuously lit.

Note:
If running the ventilator on its internal battery or on an external battery, Covidien recommends keeping the backlight setting to OFF to reduce power consumption.

3. Press **ENTER** to confirm the new Backlight setting.

The default setting for Backlight is **YES** (backlight lit continuously).

7.3.3 Contrast

To set the Contrast:

1. Select the Contrast parameter on the screen.

2. Set the Contrast level:

   a. To increase the contrast, press **UP**. This change can be observed as the cursor moves to the right:

Figure 7-18. Increasing the Contrast
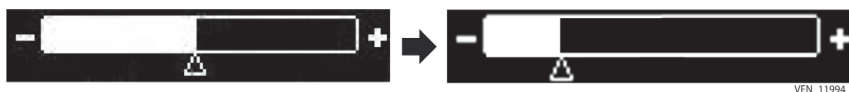

VEN_11993_A
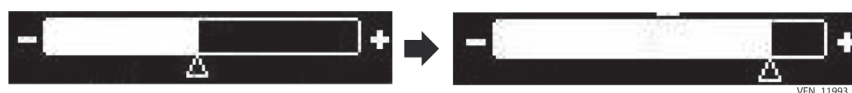
• The display contrast progressively increases.

b. To decrease the contrast, press **DOWN**. This change can be observed as the cursor moves to the left:

Figure 7-19. Decreasing the Contrast

VEN_11994_A

• The display contrast progressively decreases.

3. Press **ENTER** to confirm the new Contrast setting.

When ventilation is stopped, the contrast can also be changed directly from the currently shown menu by pressing **ALARM CONTROL** continuously, while repeatedly pressing **UP** or **DOWN**.

The default setting for Contrast is the medium setting (the middle of the bar graph).

7.3.4 Alarm Volume

WARNING:

The sound level of the alarms should be adjusted according to the installation environment and the size of the area monitored by the patient's caregiver. Ensure that the alarm sound apertures at the front of the device are never obstructed. See section *7.3.4*, "*Alarm Volume*" on page *7-18*.

To set the Alarm Volume:

1. Select the Alarm Volume parameter on the screen. See section *7.3.1*, "*Preferences Menu*" on page *7-15*.

2. Set the Alarm Volume level:

a. To increase the sound level of alarms, press **UP**. This change can be observed as the cursor moves to the right:

Figure 7-20. Increasing the Alarm Volume

VEN_11995_A
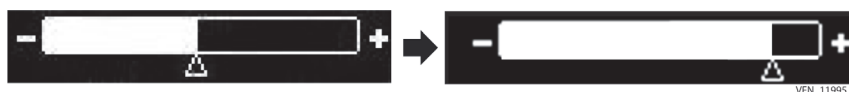
• The buzzer activates and increases in sound level as the setting increases.

b. To decrease the sound level of alarms, press **DOWN**. This change can be observed as the cursor moves to the left:

Figure 7-21. Decreasing the Alarm Volume

VEN_11994_A
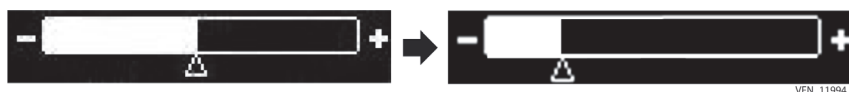
• The buzzer activates and decreases in sound level as the setting decreases.

3. Press **ENTER** to confirm the new Alarm Volume setting.

Current hospital standards require a minimum sound level of 55 dB (A) at a distance of 3 meters (9.84 feet), which corresponds to the lowest possible volume setting. The alarm sound level range is described in section *B.3*, *Indicators and Alarms*. If a high priority alarm is not paused within 60 seconds of activation, the sound level automatically raises to the maximum level, regardless of the original setting.

The default setting for Alarm Volume corresponds to a level halfway between the minimum and maximum values.

7.3.5 Key Sound

This setting is used to select the sound emitted when pressing keys on the ventilator's keyboard.

To set Key Sound:

1.   Select the Key Sound parameter on the screen.

2.   Select one of the following four options:

   •   OFF—No sound is emitted when a key is pressed.

   •   Key tone—A "clock" sound is emitted when a key is pressed.

   •   Accept tone—A "beep" sounds when **ENTER** is pressed to confirm a setting.

   •   All tones on—A "clock" sound is emitted when all keys are pressed and a beep sounds when **ENTER** is pressed to confirm a setting.

3.   Press **ENTER** to confirm the new Key Sound setting.

The default setting for Key Sound is Accept tone.

Note:

Whatever the selected Key Sound setting, pressing the **VENTILATION ON/OFF** key triggers a "beep" at ventilation start and a double "beep" at ventilation stop.
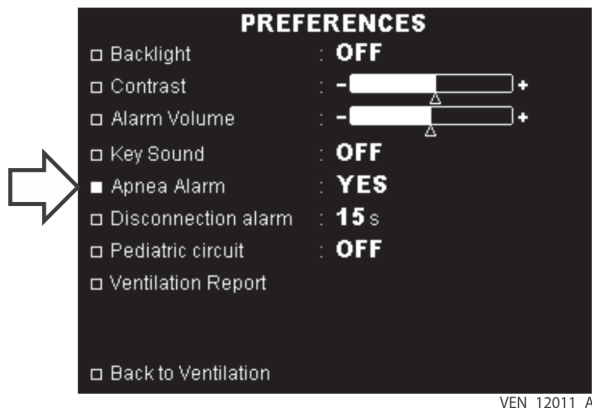
7.3.6 Apnea Alarm

To set the Apnea alarm:

1.   Use the **UP** or **DOWN** arrow keys to place the cursor at the Apnea Alarm position.

2.   Press **ENTER**.

3.   Press **UP** or **DOWN** to set the message to YES. Setting the key to OFF means the Apnea alarm will not sound when the ventilator is stopped.

4.   Press **ENTER** to confirm the selection.

⚠️ **WARNING:**

The Apnea Alarm should be set to YES if an audible alarm is desired when apnea events occur.

Figure 7-22. Setting the Apnea Alarm

VEN_12011_A

📖 **Note:**

This activates/deactivates the Apnea alarm but not the Apnea Time setting. The Apnea Time setting can be set in the Ventilation menu.

7.3.7 Disconnection Alarm

To set Disconnection alarm:

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the Disconnection alarm position.

2. Press **ENTER**.

3. Press **UP** or **DOWN** arrows to adjust the setting between 5 and 62 seconds.

4. Press **ENTER** to confirm the selection.

📖 **Note:**

Values set in the ventilation mode may supersede disconnection alarm values. Refer to Chapter *5*, "*Alarms and Troubleshooting*."

7.3.8 Pediatric Circuit

To choose a pediatric circuit:

1. Use the **UP** or **DOWN** arrows to place the cursor at the Pediatric circuit position.

2. Press **ENTER**.

3. Press **UP** or **DOWN** to set the message to YES. Setting the ventilator to OFF configures the device for an adult circuit.

4. Press **ENTER** to confirm the selection.

Note:
The default setting is OFF (the ventilator is set for adult use).

7.3.9 Ventilation Report

To access the Ventilation Report:

1. Use the **UP** or **DOWN** arrows to place the cursor at the Ventilation Report position.

2. Press **ENTER**.

Figure 7-23. Accessing the Ventilation Report

VENTILATION REPORT

Vent Time : **8** h **0** min on **27 APR 2007**

Vtl	**310** mL
Paw	**14** mbar
Rate	**16** bpm
Leak	-
AI	**10** Ev/h
Apnea Ti	**30** s
Spont cyc	**98** %

Machine : **00012** h   Patient : **00005** h **45** min
■ Back

VEN_10886_A

Note:
The report is shown for 5 minutes then screen reverts to the Preferences menu.

To exit the Ventilation Report:

Press **ENTER**.

7.4 Setting the Ventilation Mode

The ventilation mode can be changed from the Ventilation parameters menu or the Alarm parameters menu, as long as the Locking key is not enabled (refer to section *7.8*, "*Locking the Control Panel*," on page *7-36*, and section *7.9*, "*Unlocking the Control Panel*" on page *7-37*).

The procedure to change the ventilation mode depends on the ventilation status, as described in section *7.4.1* and section *7.4.2*.

> ⚠️ **WARNING:**
>
> **The inspiration trigger threshold should be carefully modified in order to avoid the risk of false triggering or "autotriggering" of the ventilator. For example, Level 0P, the most sensitive mode, is recommended for pediatric use. However, for an adult, this setting may result in autotriggering.**

> ⚠️ **WARNING:**
>
> **This ventilator offers a choice of breath delivery modes and types. Throughout the patient's treatment, the clinician should carefully select the ventilation modes and/or breath type to use for that patient. This selection should be based on the clinician's clinical judgment, considering the condition and needs of the individual patient, as such condition and needs change from time to time, and considering the benefits, limitations and operating characteristics of each mode and/or breath type.**

7.4.1 Changing Modes While Ventilation is on Standby

To change ventilation modes while on standby:

1. Place the cursor on the first line of the menu (general information line) using the **UP** key.

Figure 7-24. Changing Ventilation Modes While on Standby
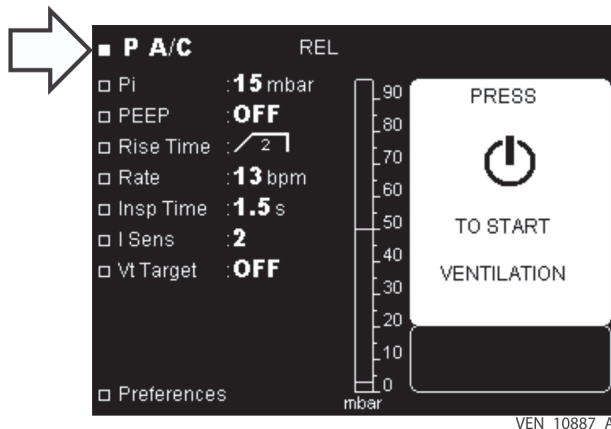
VEN_10887_A

2. Press **ENTER**.

   • The cursor changes to: ✚.

   • The mode name flashes.

3. Press **UP** or **DOWN** until the required mode is shown.

4. Press **ENTER** to confirm the mode selected.

   • The cursor returns to normal.

• The new mode is shown with its ventilation parameters.

Note:

If the ventilation mode change is not confirmed by pressing **ENTER** before 7 seconds elapse, the ventilator restores the previous mode.

7.4.2 Changing Modes During Ventilation

WARNING:

When changing the mode during ventilation, significant transitions of pressure, flow or cycling rate might occur, depending on the difference between the modes. Before setting the new mode, first ensure that the settings between the different modes are compatible. This reduces the risk of discomfort and harm to the patient.

Changing ventilation modes during ventilation:

1. Place the cursor on the first line of the menu (general information line) using the **UP** key (*Figure 7-25.*).

Figure **7-25.** Changing Ventilation Modes During Ventilation
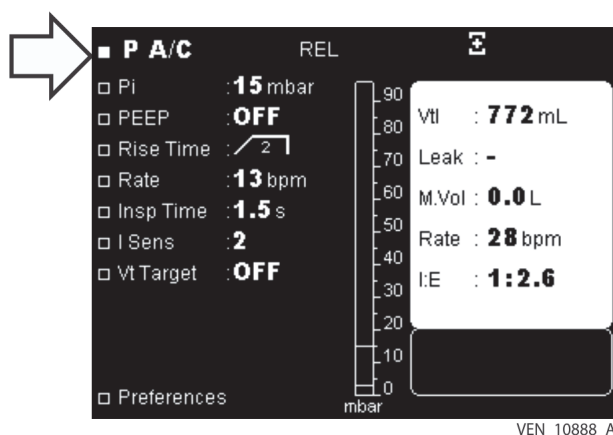
VEN_10888_A

2. Press **ENTER**.

• The cursor changes to: ±.

• The mode name flashes.

3. Press **UP** or **DOWN** until the required mode is shown.

4. Press **ENTER** to confirm the mode selected.

• The name of the new mode selected is shown at the top left followed by the flashing INACTIVE status indicator (*Figure 7-26.* , item 1).

• The settings for the new mode are shown on the left (*Figure 7-26.* , item 2) and the monitored values for the mode in progress on the right (*Figure 7-26.* , item 5).

- The confirmation line "Accept Mode:YES" is shown on the bottom left (*Figure 7-26.* , item 3).

- The name of the mode in progress is shown at the top right followed by the continuous "ACTIVE" status indicator (*Figure 7-26.* , item 4).

Figure 7-26. Showing Active and Inactive Modes

VEN_10889_A
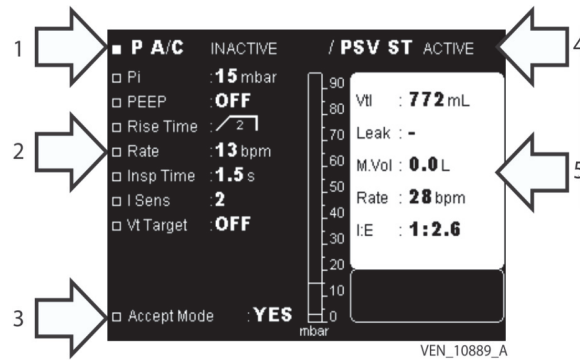
The Alarm menu screen in *Figure 7-27.* indicates the active and inactive mode information being shown, along with the Accept Mode:Yes line, alarm parameter settings, and patient values.

Figure 7-27. Changing the Settings of the New Mode

VEN_10890_A
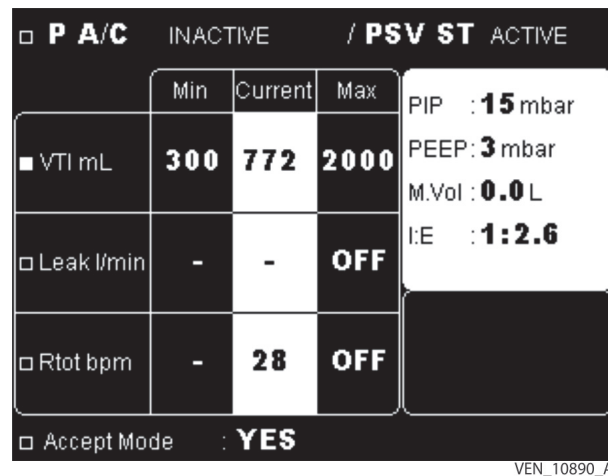
5. Change the settings of the new mode, including alarms, if necessary.

6. Press **DOWN** to place the cursor on the Accept Mode:YES line.

7. Press **ENTER** to confirm the mode change.

- The new mode selected is shown with its settings. It is applied at the beginning of the next exhalation phase if it occurs during inspiration or immediately if it occurs during exhalation.

It is not mandatory to change modes during ventilation (see steps 6 and 7, above). The settings of the next (INACTIVE) mode can be "prepared" while ventilation is in progress in the current

(ACTIVE) mode. The modifications will be saved for this next mode, whether or not it is used immediately afterwards.

When setting the parameters of the future and currently inactive modes, the monitoring data for the mode in progress are shown in the window to the right of the menu and also in the central ("current") column of the table on the Alarm menu screen.

When changing the value of a parameter in this inactive mode, the monitoring data shown in the window on the right side of the screen are temporarily hidden by the display of the value currently being changed. This is shown in *Figure 7-28.*, as the PEEP setting is adjusted in the inactive mode.

Figure 7-28. Changing Ventilation Modes and Parameters

VEN_10891_A
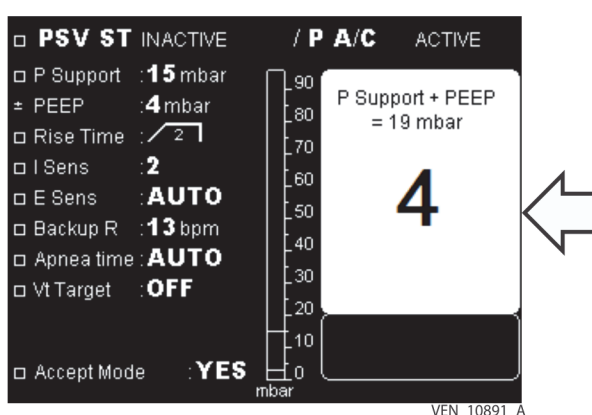
If an alarm is triggered during the setting of an inactive mode, its message is shown in the alarm message area.

When the menu of an inactive mode is shown and no changes are made by the user on the keyboard within 14 seconds, the active ventilation mode in use reappears on the screen and the Accept Mode:YES line disappears.

The menu of the active mode can also be recalled without waiting for this delay by directly restoring the name of the mode on the general information line.

The ventilation parameters of the inactive mode and the current mode remain in memory until some or all of the parameters are modified again; this is true even after the machine is stopped.

7.5 Setting Ventilation Parameters

Ventilation parameters can be changed as long as the Locking key is not activated (refer to section *7.9*, "*Unlocking the Control Panel*" on page *7-37*).

⚠ **WARNING:**
In adult or pediatric use ensure that the adjusted tidal volume is compatible with the needs of the patient.

Ventilation is not interrupted by the adjustment of a value. It continues according to previous settings. The new settings are applied ONLY after they are confirmed and synchronized in the next breath cycle, except for the I Sens setting, which is applied immediately.

To modify a ventilation parameter:

1. Place the cursor on the line of the parameter to be modified using the **UP** or **DOWN** key.

2. Validate your intention to modify the parameters using the **ENTER** button. See *Figure 7-29.*

   - The cursor changes (*Figure 7-29.*, item 1).

   - The parameter value flashes (*Figure 7-29.*, item 2).

   - A zoom of the parameter value is shown in the right-side of the window (*Figure 7-29.*, item 3).

Figure 7-29. Modifying a Ventilation Parameter

VEN_10892_A
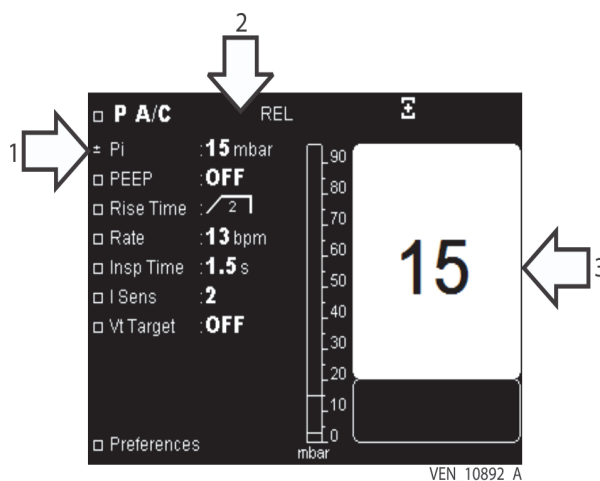
3. Press **UP** or **DOWN** to select the value desired for the parameter (continuing to press on these keys speeds up the progression of values shown).

4. Press **ENTER** to confirm the selected value.

   - The new parameter value is shown continuously.

   - The zoom disappears.

   - The cursor returns to normal.

Note:

If a parameter change is not confirmed by pressing **ENTER** before 7 seconds elapse, the ventilator restores the parameter's previous value.

7.5.1 Links between Ventilation Parameters

The adjustment ranges of certain parameters are limited in order to remain compatible with the levels of other previously set parameters. For additional information on the interdependence between ventilation parameters, refer to Chapter 3, "*Operating Parameters*."

The message "Setting limited by…" is shown and identifies the parameter (or parameters) that is blocking the setting.

Figure 7-30. , item 1, shows that P Support cannot be set above 35 when PEEP is set to 20 and relative pressure is set to **YES**; this value is limited by PEEP because their sum cannot exceed 55 mbar.

Figure 7-30. Setting Links Between Ventilation Parameters
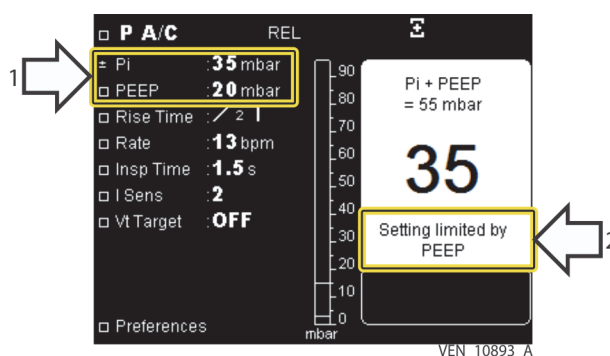
Two possibilities exist in this case:

- Allow the PEEP setting to remain at 20, but the P Support cannot be increased.

- Reduce PEEP so that the P Support setting can be set higher than 35 to ensure that their sum is no greater than 55.

7.5.2 Links between Ventilation and Alarm Parameters

Setting a ventilation parameter takes priority over an alarm threshold setting and leads to automatic readjustment of the alarm setting threshold so that the interdependence between the two remains unchanged.

Once the ventilator is in service at the patient's home, you should use the Locking key to block access to changing any settings (see section 7.8, "*Locking the Control Panel*" on page *7-36*).

⚠ **WARNING:**
Before dispensing the ventilator to caregivers or the patient for home use, ensure the Locking key is activated so that critical ventilator settings are not modified.

7.6 Setting Alarm Parameters

Alarm parameters can be changed from the Alarm menu, if the Locking key is not enabled (refer to section *7.8*, "*Locking the Control Panel*" on page *7-36* and section *7.9*, "*Unlocking the Control Panel*" on page *7-37*).

Note:

Adjustable alarms should not be systematically canceled; instead, they should be adjusted according to the needs and condition of the patient.

Note:

Default alarm setting preferences should be entered prior to using the ventilator.

To modify an alarm parameter:

1. Ensure that the Alarm menu is shown, with a list of alarm parameters and columns for the minimum, current, and maximum alarm parameter values (*Figure 7-31.* on page *7-28*).

2. Put the cursor next to the alarm parameter to be modified using the **UP** or **DOWN** key.

3. Confirm your intention to modify the parameters using the **ENTER** key.

   • The cursor changes. (*Figure 7-31.* , item 1).

   • The parameter in the Min column flashes (*Figure 7-31.* , item 2).

   • A zoom of the Min parameter is shown on the right side of the screen (*Figure 7-31.* , item 3).

Figure 7-31. Modifying Alarm Parameters—Min Value

VEN_10894_B
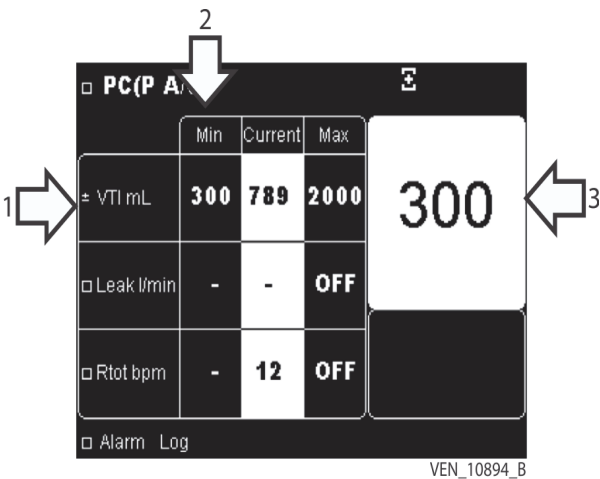
4. Press **UP** or **DOWN** to modify the value of the parameter.

5. Press **ENTER** to confirm the value selected.

   • The new value for the Min column is continuously shown (*Figure 7-32.* , item 1).

- The value of the Max column flashes (*Figure 7-32.* , item 2).

- A zoom of the Max parameter value is shown on the right side of the window (*Figure 7-32.* , item 3).

Figure 7-32. Modifying Alarm Parameters—Max Value
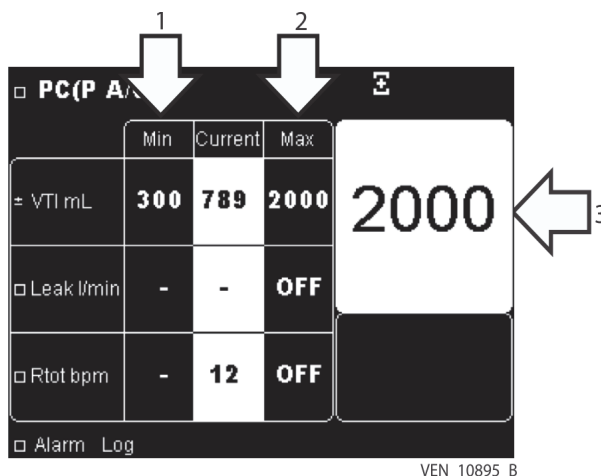
6. Press **UP** or **DOWN** to modify the value of the parameter.

7. Press **ENTER** to confirm the value selected.

- The new value is continuously shown.

- The zoom disappears.

- The cursor returns to normal.

An alarm is set to OFF (the alarm will not be triggered) when its maximum setting limit (for the Max value) or its minimum setting limit (for the Min value) is reached by successively or continuously pressing **UP** or **DOWN**, respectively.

Note:
If a parameter change is not confirmed by pressing **ENTER** before 7 seconds elapse, the ventilator restores the parameter's previous value.

Blocking of an Alarm Threshold Linked to a Ventilation Parameter

Setting a ventilation parameter takes priority over an alarm threshold setting. Therefore, if a ventilation parameter is modified when linked to an alarm threshold, the alarm setting threshold is automatically adjusted so that the interdependences linking them are always maintained.

However, if the alarm setting threshold is modified, it cannot be changed beyond the limit of the interdependence with the ventilation parameter to which it is linked. When the alarm setting limit is reached, the message "Setting limited by..." indicates the name of the linked ventilation parameter(s) that are limiting the parameter's setting value.

Four possibilities exist in this case:
- The alarm parameter remains set to OFF.

- The alarm parameter setting is changed in relation to the value required at the start and the limits on the ventilation parameter (or parameters) remain unchanged.

- The setting of the ventilation parameter (or parameters) is changed to enable the alarm threshold to be set to the required value.

- The alarm parameter is not set to OFF but the ventilation parameter change has no impact on the alarm setting.

WARNING:
The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, maximum inspired volume (Max VTI), and minimum inspired volume (Min VTI) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced.

WARNING:
Adjustable alarms should not be systematically canceled; instead, they should be adjusted according to the needs and condition of the patient.

7.7 USB Menu Parameters

The USB menu is accessible even if the Locking key has been enabled (refer to section *7.8*, "*Locking the Control Panel*" on page *7-36* and section *7.9*, "*Unlocking the Control Panel*" on page *7-37*).

The USB menu is automatically shown when the USB memory device is connected to the ventilator, when ventilation is either on or off.

Only one USB memory device shall be connected at any time, otherwise an error message will be shown. The USB menu is not accessible from the Setup menu or Maintenance menu.

To access patient data via a PC, a dedicated software package, Puritan Bennett Respiratory Insight Software, is available for clinicians. Contact Covidien or your Puritan Bennett product representative for further information.

7.7.1 USB Memory Device Specifications

Characteristics	Supported Formats
USB compatibility	USB flash memory USB 2.0 or USB 1.1, 32 bit format
Number of files	Maximum 999 (sector size: 512-2048 bytes)
USB size	128 MB to 4GB (to guarantee accuracy of transfer time, at least 10% of the USB memory device capacity must be free).

7.7.2 USB Menu

To access the USB menu when a USB memory device is connected:

Press the **MENU** key several times, until the USB menu appears:

Figure 7-33. Selecting the USB Menu

VEN_10896_A
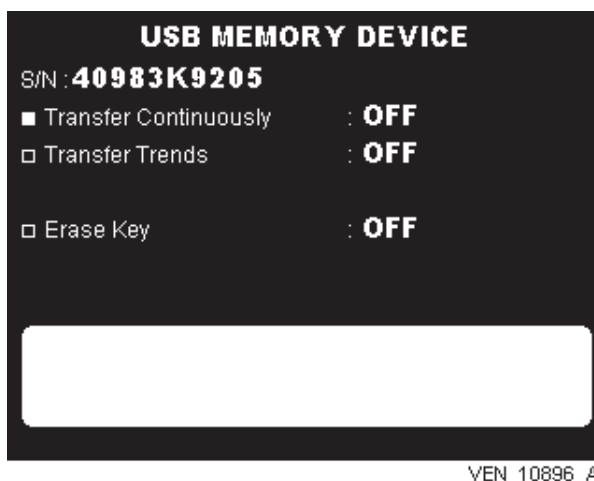
In case of high priority alarm activation, the ventilator will automatically show the alarm page. To return to the USB menu, press the **MENU** key.

The adjustable parameters in this menu include the following:

- Transfer Continuously

- Transfer Trends

- Erase Key

7.7.3 Transfer Continuously

Up to 48 hours worth of data can be transferred from a ventilator to a USB memory device.

To record continuously, the USB memory device must be permanently connected to the ventilator with ventilation active.

The following data will be recorded to the USB memory device:

- Monitoring: pressure, leak waveforms, and inspired flow

- Trends: leaks, VTI, Rate, I:E, M. Vol, PIP, and PEEP measurements.

The data can be accessed by a doctor or service provider using the Puritan Bennett Respiratory Insight Software.

Figure 7-34. Selecting Transfer Continuously

VEN_10898_A
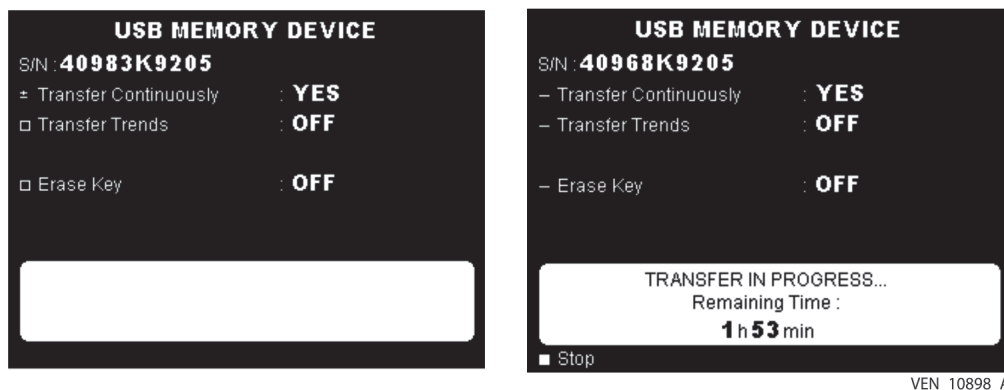
To transfer continuous data from a ventilator to a USB memory device:

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the Transfer Continuously position.

2. Press **ENTER**.

    - The cursor changes to the plus/minus symbol.

    - The parameter selected to be modified flashes.

3. Press **UP** or **DOWN** to change the selected parameter's value.

4. Press **ENTER** to confirm the new parameter setting.

    - The new parameter setting is shown continuously.

    - The cursor is placed at the **STOP** position.

5. To manually stop continuous transfer, press the **ENTER** key.

If a parameter change is not confirmed by pressing **ENTER** before 7 seconds elapse, the ventilator resets the parameter to its previous value.

Note:
All ventilator menus remain accessible during transfer time.

Note:

The message "TRANSFER IN PROGRESS... REMAINING TIME" is shown during the transfer time.

Note:

Other functions of the USB memory device are not available during continuous recording.

Note:

If the memory capacity on the USB memory device is insufficient, the message "TRANSFER NOT ALLOWED - USB CAPACITY INSUFFICIENT" is shown and data transfer is not allowed. Delete the data on the USB memory device before restarting data transfer. Refer to deletion process (section *7.7.5*, "*Erase Data from the USB Memory Device*").
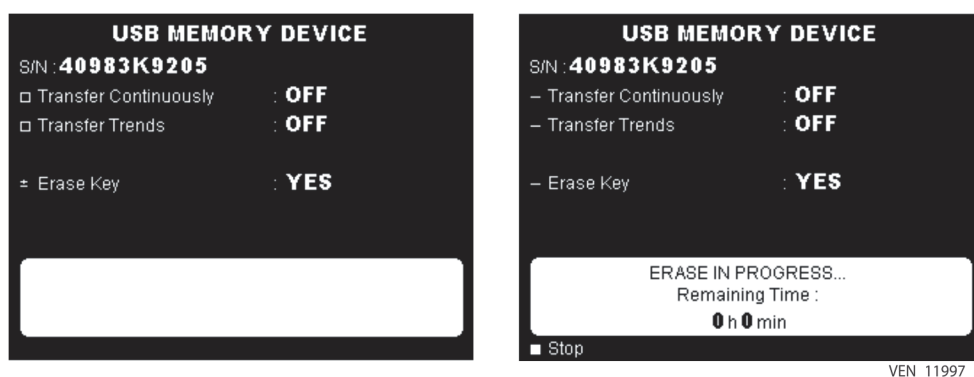
Note:

In case of USB memory device disconnection or transfer error, the message "TRANSFER ERROR - USB DISCONNECTION" or "TRANSFER ERROR - TECHNICAL PROBLEM" is shown. In this case, restart the transfer process. If the problem persists, contact your technical service representative.

7.7.4 Transfer Trends

Up to 1 year's worth of trend data can be transferred from a ventilator to a USB memory device.

Ventilation trends, such as leaks, VTI, Rate, I:E, M. Vol, PIP, and PEEP measurements, can be transferred from the ventilator to a USB memory device.

The data can be accessed by a doctor or service provider using the Puritan Bennett Respiratory Insight Software.

Figure 7-35. Selecting Transfer Trends

VEN_12072_A

To transfer trend data from a ventilator to a USB memory device:

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the Transfer Trends position.

2. Press **ENTER**.

- · The cursor changes to the plus/minus symbol.

- · The parameter selected to be modified flashes.

3. Press **UP** or **DOWN** to change the selected parameter's value.

4. Press **ENTER** to confirm the new parameter setting.

- · The new parameter setting is shown continuously.

- · The cursor is placed at the **STOP** position.

5. To manually stop trend transfer, press **ENTER**.

Note:
If a parameter change is not confirmed by pressing **ENTER** before 7 seconds elapse, the ventilator resets the parameter to its previous value.

Table 7-2. Trends Data Transfer Time from Ventilator to USB Memory Device

Amount of trends data (in months)	Transfer time from ventilator to USB memory device
3 months	Approximately 2 minutes
6 months	Approximately 4 minutes
9 months	Approximately 6 minutes
12 months	Approximately 8 minutes

Note:
The message "TRANSFER IN PROGRESS... REMAINING TIME" is shown during the transfer time.

Note:
Other USB memory device functions are available during transfer of trends.

Note:
If the memory capacity on the USB memory device is insufficient, the message "TRANSFER NOT ALLOWED - USB CAPACITY INSUFFICIENT" is shown and data transfer is not allowed. Delete the data on the USB memory device before restarting data transfer. Refer to deletion process (section *7.7.5*, "*Erase Data from the USB Memory Device*").

Note:
In case of USB memory device disconnection or transfer error, the message "TRANSFER ERROR - USB DISCONNECTION" or "TRANSFER ERROR - TECHNICAL PROBLEM" is shown. In this case, restart the transfer process. If the problem persists, contact your technical service representative.

7.7.5 Erase Data from the USB Memory Device

To erase data from the USB memory device:

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the Erase key position.

2. Press **ENTER**.

  - The cursor changes to the plus/minus symbol.

  - The parameter selected to be modified flashes.

3. Press **UP** or **DOWN** to change the selected parameter's value.

4. Press **ENTER** to confirm the new parameter setting.

  - The new parameter setting is shown continuously.

  - The cursor is placed at the **STOP** position.

Figure 7-36. Erasing Data from the USB Memory Device

VEN_11997_A

⚠ **WARNING:**
Deletion erases ALL files present on the USB memory device.

📖 **Note:**
The message "ERASE IN PROGRESS... REMAINING TIME" is shown during the deletion time.

📖 **Note:**
The deletion time of a full USB memory device is less than 1 minute.

📖 **Note:**
Other USB memory device functions are not available during deletion.

📖 **Note:**
Once deletion of the USB memory device has been started, it cannot be paused, stopped, or canceled.

Note:

All ventilator menus remain accessible during deletion.

Note:

In case of USB memory device disconnection or deletion error, the message "TRANSFER ERROR - USB DISCONNECTION" or "ERASE ERROR - TECHNICAL PROBLEM" is shown. In this case, restart the erase process. If the problem persists, contact your technical service representative.

7.8 Locking the Control Panel

When the machine is in service at a patient's home, it is strongly recommended that you prevent accidental or unauthorized ventilator adjustments from occurring by enabling the Locking key.

The Locking key is a software function that prohibits access to the ventilation and alarm parameter settings and changes to the ventilation mode.

WARNING:

Before dispensing the ventilator to caregivers or the patient for home use, ensure the Locking key is activated so that critical ventilator settings are not modified.

To enable the Locking key:

Simultaneously press the **UP** and the **DOWN** keys for at least 6 seconds.

- The Locking key symbol (*Figure 7-37.*, item 1) appears in the top left corner of the screen.

- Lines which are no longer accessible are preceded by a dash "–" (*Figure 7-37.*, item 2).

- Lines which remain operational keep their initial line access symbol.

Figure 7-37. Enabling the Locking Key

VEN_10903_A
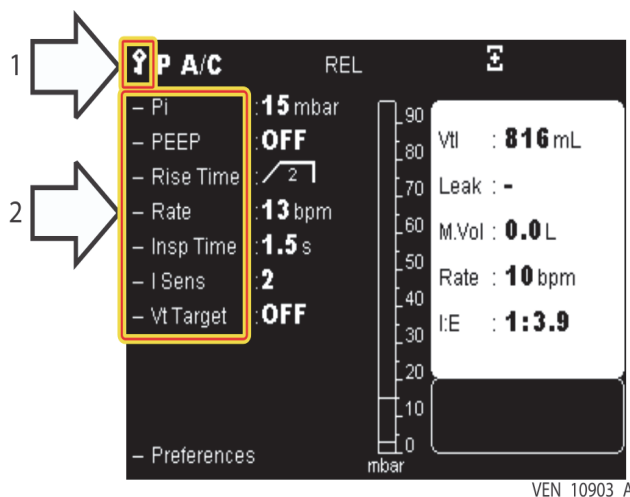
7.9 Unlocking the Control Panel

To disable the Locking key:

Simultaneously press the **UP** and the **DOWN** keys for at least 6 seconds.

- The Locking key symbol disappears.

- The initial line access symbol is shown in front of each line.

7.10 Starting Ventilation

Before starting ventilation, refer to Appendix *E*, "*Operational Verification Checklist*" and set the parameter values in the Preferences menu (refer to section *7.3*, "*Preferences Menu Parameters*" on page *7-14*).

⚠ **WARNING:**
Verify the functionality of the alarm conditions before connecting the patient to the ventilator.

⚠ **WARNING:**
Before starting ventilation, ensure that the device is properly assembled and that the air inlet, cooling vents, and alarm sound diffusion holes are not obstructed. Ensure also that the patient circuit is of the proper configuration, properly connected to the ventilator, and that the circuit hoses are neither damaged nor compressed and contain no obstructions or foreign bodies.

When the ventilator is in standby (the ventilator is on, but ventilation has not started), a message that prompts the ventilator operator to press **VENTILATION ON/OFF** to start ventilation is shown in the right-hand window of the ventilation and alarm menus (*Figure 7-38.*).

Figure 7-38. Prompt to Start Ventilation
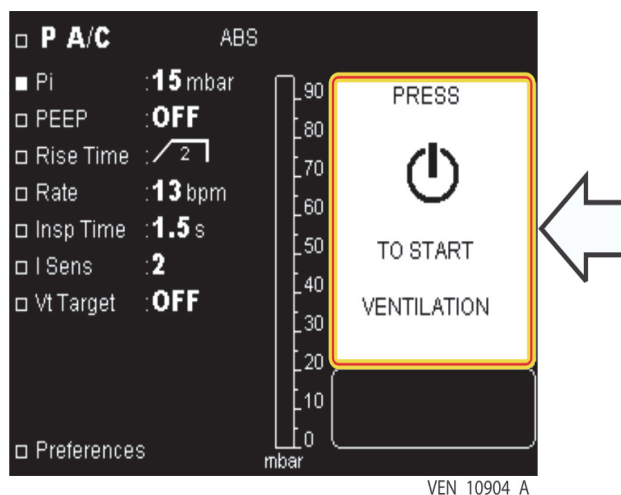
To start ventilation:

Press and release **VENTILATION ON/OFF** (*Figure 7-39.* , item 1).

•   The blue light indicator, at the upper right of the **VENTILATION ON/OFF** key (*Figure 7-39.* , item 2), turns off.

•   A "beep" sounds.

•   The ventilation starts.

•   The values of the monitored parameters are shown in the right-hand window.

Figure 7-39. Starting Ventilation

VEN_10916_A
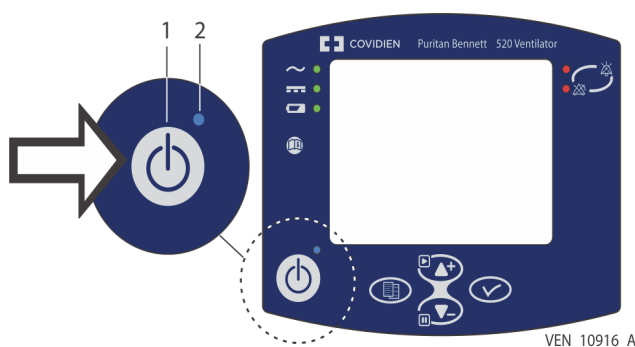
7.11 Stopping Ventilation

⚠ **WARNING:**
Do not allow a patient to remain connected to the ventilator when ventilation is stopped, because a substantial quantity of expiratory gas, primarily carbon dioxide, may be inhaled by the patient. In some circumstances, inhaling carbon dioxide may lead to under-ventilation, suffocation, and serious injury or death.

You can stop your ventilator at any time.

To stop the ventilator:

1.   Press and hold the **VENTILATION ON/OFF** key (*Figure 7-39.* , item 1) for 3 seconds.

•   A message prompting the user to keep the button pressed appears on the monitoring window, as shown in the graphic below:

VEN_10905_A
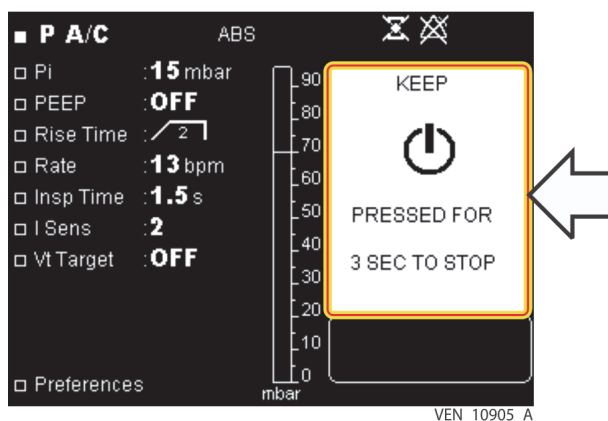
2. While keeping the **VENTILATION ON/OFF** key pressed:

   • A new message appears that directs the user to press the key again to confirm ventilation stop (as shown in *Figure 7-41.*).

Figure 7-41. Stopping Ventilation (2)

VEN_11161_A
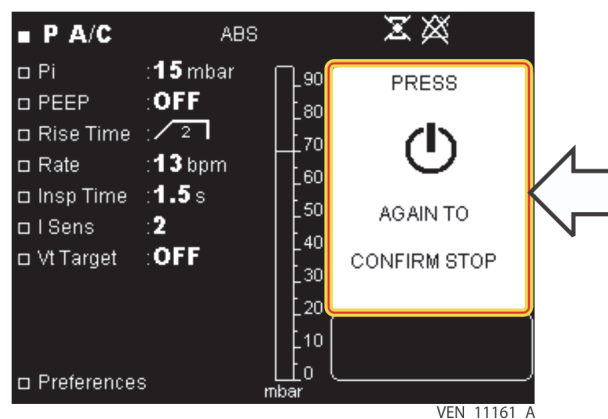
   • A double "beep" sounds.

3. Release the **VENTILATION ON/OFF** key.

   • Press the **VENTILATION ON/OFF** key within 5 seconds to confirm stop, otherwise ventilation will continue.

   • Ventilation stops.

   • The blue LED located to the upper-right of the **VENTILATION ON/OFF** key (*Figure 7-39.* , item 2) illuminates to indicate ventilation is on standby.

   • A prompt for a new start of ventilation is shown (see *Figure 7-38.* on page *7-37*).

7.12 Turning Off the Ventilator

⚠ **WARNING:**
When the ventilator is switched back on after it was switched off while ventilation was in progress, it will immediately begin ventilating—without the user first having to press the VENTILATION ON/OFF key.

⚠ **WARNING:**
Handle the ventilator with care after use, particularly when ambient temperatures are high. Some ventilator surfaces may be very hot, even if safety specifications are not exceeded.

Set the **I/O** switch to the **O** position to turn off the ventilator.

⏻ • The blue LED to the right of the **VENTILATION ON/OFF** key turns off.

• The ventilator screen switches off.

📖 **Note:**
When the ventilator is completely stopped, but is still connected to the AC power source (the green AC POWER indicator is illuminated), the internal battery continues charging.

📖 **Note:**
A continuous alarm condition will be activated if the ventilator power switch is turned off while ventilation is in progress. When the power switch is turned back on again, the ventilation will resume without having to press the VENTILATION ON/OFF button.

8 Internal Battery

⚠ **WARNING:**
Even though the Puritan Bennett™ 520 Ventilator meets current safety standards, and although the internal Lithium-ion battery of the device is considered to be Dangerous Goods for transport in commerce, this devices lithium battery is below the 100Wh threshold and is therefore excepted from being a Class 9 – Miscellaneous - Dangerous Goods (DG). As such, the Puritan Bennett™ 520 Ventilator and/or the associated Lithium-ion battery are subject to some transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport; the Puritan Bennett™ 520 Ventilator is permitted as checked-in or carry-on baggage. Spare batteries may be taken on board as carry-on luggage only. This classification and regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.

⚠ **WARNING:**
Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12–30 VDC power source (via the DC power cable) does not enable charging of its internal battery.

⚠ **WARNING:**
The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years or more prior to its first use.

⚠ **WARNING:**
Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.

8.1 Battery Capacity

The reserve capacity offered by the internal battery depends on the level of ventilation parameters, the environmental conditions (primarily in terms of temperature) and the physiological characteristics of the patient.

With a fully charged battery at a normal room temperature of 25ºC (±5ºC), the ventilator can be expected to operate on internal battery power for the average durations shown in *Table 8-1*.

Checking the battery charge level requires that the ventilator be running on battery power at the time of the battery check. To check the battery charge level, temporarily disconnect the ventilator from AC power (while in standby mode or while providing ventilation) and read the percent charge level shown adjacent to the battery icon at the top of the ventilator's display screen.

Table 8-1. Internal Battery Reserve Capacity

Displayed values	Average operating time on internal battery power[1]
Vt = 200 ml (±5 ml) PIP = 10 mbar (±2 mbar) Rate = 20 bpm	5 hours (–10%)
Vt = 300ml (±5 ml) PIP = 20 mbar (±2 mbar) Rate = 15 bpm	4 hours (–10%)
Vt = 500 ml (±5 ml) PIP = 30 mbar (±2 mbar) Rate = 15 bpm	3 hours (–10%)
Vt = 750 ml (±5 ml) PIP = 45 mbar (±2 mbar) Rate = 20 bpm (maximum ventilation parameters)	2 hours (–10%)

1   Average durations shown are with a fully charged battery having less than 50 charge/recharge cycles.

8.2 Battery Operation

WARNING:
Before using the ventilator's internal battery, ensure that the battery is fully charged and that the charge holds. Back up ventilators or those in storage should be connected to an AC power source to protect the integrity of the battery.

Note:
Buzzer and battery alarms may occur when the unit is first powered on after the internal battery has been completely drained. Connect to an AC power source and recycle power.

In the event of AC power interruption or disconnection of the external AC or DC power supply, the ventilator automatically switches to its internal battery and the following events occur:

- The battery symbol is shown at the top on the general information line.

- Battery reserve capacity is shown on the right of the battery symbol.

•   The internal battery indicator at the top left of the ventilator's front panel is continuously lit (*Figure 8-1.*).

Figure 8-1. Internal Battery Indicator

VEN_11944_A
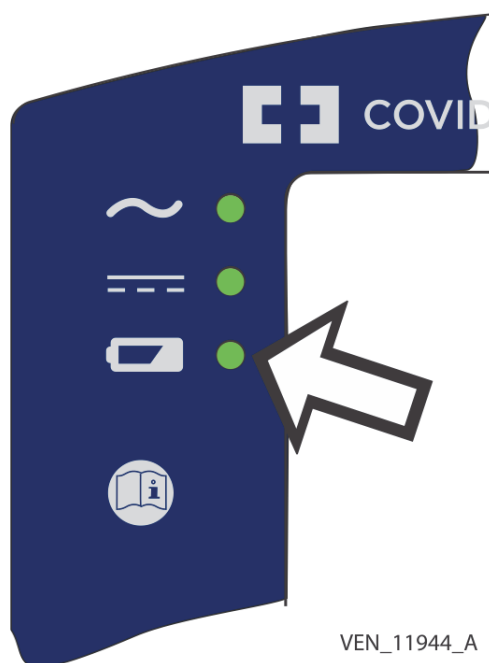
•   A loss of external supply alarm is activated.

If ventilation is stopped, the internal battery reserve capacity is shown as a percentage of battery charge. See *Figure 8-2.*

Figure 8-2. Battery Reserve Capacity as a Percentage

VEN_10366_A
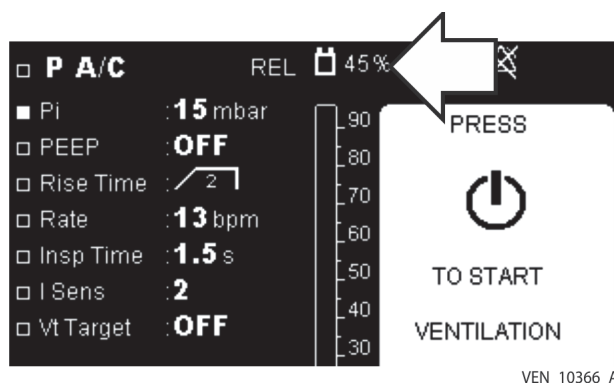
If the ventilator is running, the internal battery reserve is momentarily shown as a percentage. Then, after the ventilator calculates the battery time remaining (which takes about 2 minutes, depending on the power consumption of the ventilator), the internal battery reserve is then shown in hours and minutes (rounded to the nearest 10 minutes). See *Figure 8-3.*

Figure 8-3. Battery Reserve Capacity in Hours and Minutes
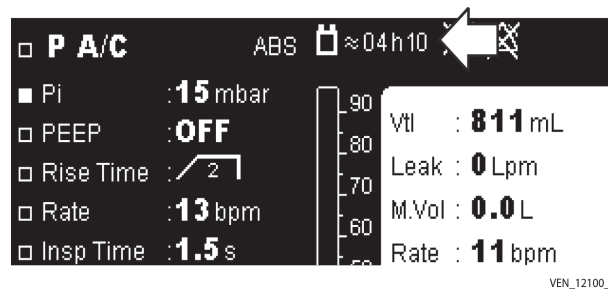
The LOW BATTERY and EMPTY BATTERY alarms (see Chapter *5*, "*Alarms and Troubleshooting*") are triggered when the internal battery reserve is reduced.

WARNING:
Due to its limited internal battery's reserve capacity, the ventilator should only be operated on the internal battery when no other power source is available. Ensure that the internal battery never becomes fully discharged.

WARNING:
When the LOW BATTERY alarm is triggered, immediately connect the ventilator to an AC power supply to maintain ventilation and recharge the internal battery.

From the time that an EMPTY BATTERY alarm is activated, if no external supply is connected to the ventilator, other alarms may be triggered due to insufficient supply voltage.

In the final discharge phase, the EMPTY BATTERY alarm will become continuous, and ventilation may be interrupted at any time during this phase.

Note:
The EMPTY BATTERY alarm symbol may disappear shortly before the ventilator completely stops, but it always triggers a final, continuous alarm.

8.3 Testing the Battery

Your ventilator continuously and automatically checks the state of the internal battery, even when the battery is not used as the main source of energy. The BATTERY FAULT1 alarm is activated whenever a problem is detected in the battery or the charger.

However, on a monthly basis you should disconnect the ventilator from the external power supply to check the integrity of the connections linking the internal battery to other ventilator components.

8.4 Recharging the Battery

In the event that the battery charge level is considered insufficient, as per the reserve capacity display, recharge of the internal battery is necessary. In general, it is recommended that the ventilator be allowed to charge when the battery drops below 80%, and that the ventilator be recharged systematically after storage and before using it again.

Note:

To avoid cycling and extend battery life while connected to an AC power source, the battery will not begin charging until it has dropped below an 85%-90% charge.

To charge the internal battery, do the following:

Connect the ventilator to the AC power source.

- The AC POWER indicator illuminates (*Figure 8-4.* , item 1).

- The INTERNAL BATTERY indicator flashes (*Figure 8-4.* , item 2).

Figure 8-4. Power Indicators When Charging the Battery

VEN_11946_A
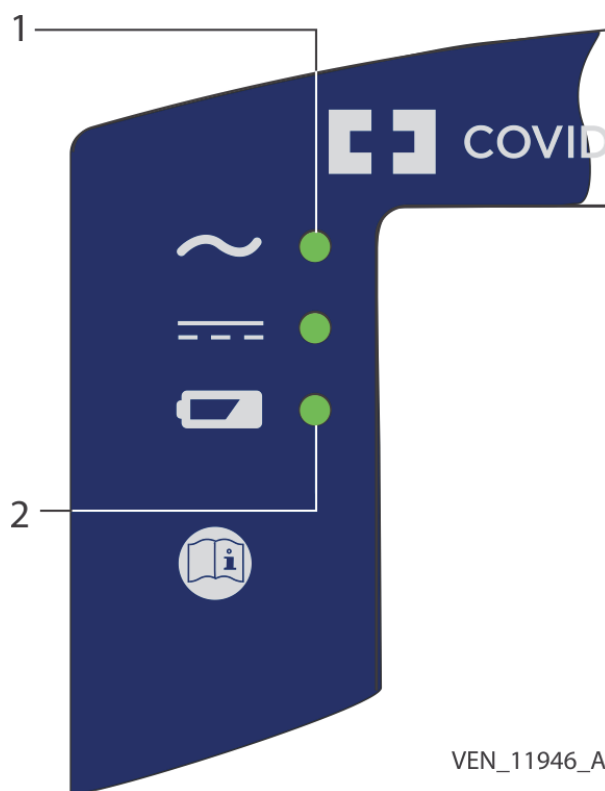
When the battery charge is complete, the INTERNAL BATTERY indicator turns off.

> **WARNING:**
>
> **Even if the INTERNAL BATTERY indicator is off, charge of the battery may sometimes be incomplete regardless of charge time when the ambient temperature is above 40°C (104°F). This is due to the characteristics of the battery's internal heat safety device.**

Although it is not necessary to start the ventilator to charge the battery, charging the battery during operation will increase the time required to fully charge the internal battery.

When recharging a depleted internal battery, it may be necessary to leave the ventilator on charge for up to 6 hours if the ventilator is on standby and about 13 hours if ventilation is operating.

> **WARNING:**
>
> **Ensure that the ventilator's internal battery is fully charged before connecting the ventilator to an external DC power source. Powering the ventilator using an external 12–30 VDC power source (via the DC power cable) does not enable charging of its internal battery.**

8.5 Storage

If the ventilator is to be stored for an extended period of time, it is not necessary to remove the battery. However, the ventilator should be stored in cool, dry, well-ventilated environment, as follows:

- Temperature: approximately 21°C (70°F)

- Humidity: less than 80% RH

> **Note:**
>
> When the device is in storage it should be recharged monthly to maximize battery life.

If the battery is stored for more than 1 month at a temperature greater than 21°C (70°F), or for more than 1 or 2 weeks at a temperature greater than 45°C (113°F), the reserve capacity of the battery may be affected. It will then be necessary to recharge the battery before using it again.

If the ventilator has been in storage for longer than 30 days, connect it to an AC power source, turn on the unit by the I/O switch at the rear of the ventilator, and let it charge for 15 minutes prior to starting ventilation.

The battery should not be stored for more than 2 years, whatever the conditions.

> **Note:**
>
> Fully charge the internal battery prior to disconnecting from AC power source ("mains").

9 Cleaning

⚠️ **WARNING:**
A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection.

⚠️ **WARNING:**
To reduce the risk of infection, wash your hands thoroughly before and after handling the ventilator or its accessories.

9.1 Cleaning the Ventilator

Clean all external panels and surfaces before and after each patient use and as often as necessary to keep the ventilator clean. You should clean the ventilator periodically, whenever it is soiled or dirty, before any maintenance operation, and before storing the ventilator.

⚠️ **WARNING:**
Use all cleaning solutions and products with caution. Read and follow the instructions associated with the cleaning solutions you use to clean your ventilator. Use only those solutions listed in *Table 9-1.*

⚠️ **WARNING:**
The ventilator should never be immersed in any liquid, and any liquid on the surface of the device should be wiped away immediately.

⚠️ **WARNING:**
To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.

To clean the surface of the ventilator:

1. Dip a clean, soft cloth into a mixture of mild soap and water, or other approved cleaning solution. See *Table 9-1.* for a list of approved cleaning solutions.

Table 9-1. Approved Cleaning Solutions for Exterior Ventilator Surfaces

Description
Mild dishwashing detergent
70% isopropyl alcohol (rubbing alcohol)
10% chlorine bleach (90% tap water)
Glutaraldehyde
Hospital disinfectant cleaners
Hydrogen peroxide
15% ammonia (85% tap water)
Ammonia-based household cleaners
Household cleaners

2. Squeeze the cloth thoroughly to remove excess liquid.

3. Lightly wipe the external casing of the ventilator, taking care not to allow excess moisture to enter any of the openings on the ventilator's surface. See the warnings in this section.

4. Dry the ventilator surface with a clean, soft, lint-free cloth.

9.2 Cleaning the Accessories

Follow the accessory manufacturer's instructions for cleaning the ventilator's accessories and components, including the patient circuit.

WARNING:
After assembling, cleaning, or reassembling the patient circuit, and on a daily basis, inspect the hoses and other components to ensure that there are no cracks or leaks and that all connections are secure.

WARNING:
Never use a liquid cleaner inside the patient circuit, or on any component of a gas pathway. Clean the patient circuit only as specified by the manufacturer's instructions.

9.3 Cleaning the Ventilator Between Patients

To prepare the ventilator for use with a new patient, do the following:

1. Change the patient circuit and all filters.

2. Clean the ventilator. (See section *9.1*, "*Cleaning the Ventilator*")

10 Routine Maintenance

⚠️ **WARNING:**
On a DAILY basis, inspect the patient circuit to ensure that it shows no signs of damage, is properly connected, and is operating correctly without leakage.

⚠️ **WARNING:**
Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only personnel authorized and qualified by Covidien should repair, open or service the ventilator.

10.1 Replacing the Air Inlet Filter

⚠️ **WARNING:**
Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over. This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.

⚠️ **WARNING:**
Failing to replace a dirty air inlet filter, or operating the ventilator without a filter, may cause serious damage to the ventilator.

⚠️ **WARNING:**
The air inlet filter is for use on a single patient. It is not reusable; do not attempt to wash, clean, or reuse it.

If the ventilator is used indoors, the condition of the air inlet filter should be checked monthly. If the ventilator is used outdoors or in a dusty environment, the air inlet filter should be checked weekly and replaced as necessary.

To replace the air inlet filter:

1. Hold the filter between your fingers (see *Figure 10-1.* , item 1).

2. Remove the filter (*Figure 10-1.* , item 2) and discard it.

3. Place the new filter in the device, while ensuring that:

   a. The fine particle side of the filter faces outwards, away from the ventilator.

   b. The filter is properly installed in its housing. Proper installation of the filter prevents particles from entering the device.

Figure 10-1. Replacing the Air Inlet Filter

VEN_11945_A
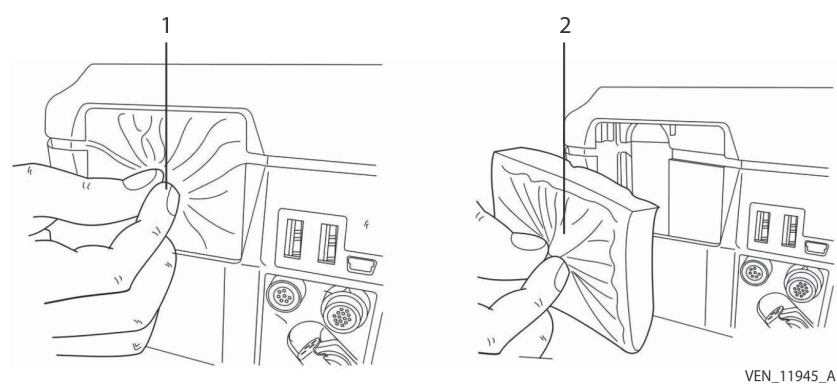
10.2 Recommended Schedule of Maintenance

Consumables and Replacement Intervals

When used under normal circumstances—a relatively dust-free atmosphere, and without damage to the device and its components (shocks, cracks, significant dirt)—the intervals for replacing the ventilator's consumable elements are as follows:

Table 10-1. Consumables and Replacement Intervals

Elements	Recommended replacement intervals
Air inlet filter (foam + fine particle)	Once a month or more often, depending on the extent of soiling
Inspiratory bacteria filter	See manufacturer's recommendation
Patient circuit	See manufacturer's recommendation Single use, single patient ②

Note:

For a list of parts and accessories, see Appendix *H*, "*Parts and Accessories*" or contact your service representative or consult www.covidien.com/rms/.

Note:

For all additional accessories not necessarily considered as consumables, consult the manufacturer's recommendations.

Note:

To prevent any risk of cross contamination, Covidien recommends the use of STERIVENT filters (Ref: 351/5856 or equivalent) to protect the patient outlet port.

WARNING:

Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. Replace it when necessary— even before the recommended replacement period has elapsed, and particularly when the ventilator is installed on the wheelchair. Environmental conditions may cause the filter to become dirty more rapidly.

Failure to observe these recommendations may result in a loss of performance, excessive over-heating, a loss of certain functions and, in the long term, compromise the longevity of the ventilator.

Maintenance of the Internal Battery

The internal battery does not need to be removed to verify its correct operation.

Periodic Test of the Internal Battery

Your ventilator continuously and automatically checks the state of the internal battery, even when the internal battery is not used as the main power source.

However, the battery charge status should be checked MONTHLY by disconnecting the ventilator from external power supplies (see section *8.2*, "*Battery Operation*"). Such a test is imperative after opening the ventilator or after a prolonged period of non-use (1 month or more), in order to ensure the correct operation of internal connections linking the battery to other components.

WARNING:

The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years or more prior to its first use.

WARNING:

Periodic recharging is important to help maximize useful life of the battery. Do not store the internal battery for extended periods, without recharging, as this may reduce the maximum life.

Replacement of the Internal Battery

The internal battery should be replaced when the battery capacity drops below 1920 mAh. Keep in mind that, for environmental protection, the ventilator and its components—including its internal battery—cannot be disposed of with household waste. You must submit the ventilator and its components for suitable selective collection and possible recycling and observe all applicable regulations.

Note:
As the total number of battery charge/discharge cycles approaches 300, a drop in potential of as much as 20% may be detected.

10.3 Service Assistance

WARNING:
If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternative means of ventilation.

WARNING:
Do not attempt to open, repair or otherwise service the ventilator yourself. Doing so might endanger the patient, damage the ventilator, and/or void your warranty. Only qualified service personnel should open, repair or service the ventilator.

In the event of a problem with the ventilator, see Chapter *5*, "*Alarms and Troubleshooting*." If you cannot determine the cause of the problem, contact your equipment supplier or Covidien.

For more information and local Covidien Technical Service contact details, see "*Technical Support*" in the *Preface*.

A Patient/Caregiver Checklist

What the Patient and Caregiver Must Understand

Table A-1. presents a summary of the topics that patients and caregivers must understand in order to use the ventilator successfully. Some topics may not apply to some patients, while other patients may require additional information.

The Clinician's Responsibility

It is the responsibility of the clinician or clinical educator to ensure that both the patient and the caregiver fully understand the topics listed below.

Table A-1. Patient/Caregiver Checklist

List of topics	References
☐ Need for ventilation.	Clinician
☐ Intended use of the ventilator.	Chapter *2*, "*Ventilator Overview*"
☐ The principles of operation for the ventilator.	Appendix *C*, "*Theory of Operation*"
☐ Supplies required for ventilation, and their sources.	Clinician; Appendix *G*, "*Unpacking and Preparation*;" Appendix *H*, "*Parts and Accessories*"
☐ Schedule for ventilation.	Clinician
☐ How and why to monitor the patient's condition.	Clinician
☐ The importance of coordinating care for the patient.	Clinician
☐ Resources for respite care.	Clinician
☐ Choices about future care.	Clinician
☐ The purpose of advanced directives.	Clinician
☐ How to check the patient's vital signs.	Clinician
☐ The significance of the patient's ease of breathing.	Clinician
☐ What to note about the patient's skin, mucus membranes, and secretions, and their significance.	Clinician
☐ How to recognize the signs of infection, and how to respond.	Clinician
☐ Whom to contact for medical emergencies, equipment emergencies, or power emergencies.	Clinician; section *5.8*, "*Troubleshooting*;" section *10.3*, "*Service Assistance*"

Table A-1. Patient/Caregiver Checklist (Continued)

	List of topics	References
☐	Equipment and phone numbers to have available in cases of emergency.	Clinician; Section *10.3*, "*Service Assistance*"
☐	How to contact other resources for assistance (health aides, attendants, therapists).	Clinician
☐	The importance of routine medical appointments and medical testing.	Clinician
☐	Power sources for the ventilator and how to connect them.	Section *6.2*, "*Connecting to External AC Power*" and section *6.3*, "*Connecting to an External DC Power Source*."
☐	The meaning of keys and buttons.	Section *2.7*, "*Control Panel*"
☐	The meaning of symbols and markings.	Section *1.3*, "*Symbols and Markings*"
☐	How to connect the patient to the ventilator via the patient breathing circuit.	Section *6.4*, "*Patient Circuit*"
☐	The parts and purpose of the breathing circuit.	Chapter *6*, "*Installation and Assembly*"
☐	How and when to inspect, clean, and replace the patient circuit.	Chapter *1*, "*Safety Information*"; Chapter *9*, "*Cleaning*;" Section *10.2*, "*Recommended Schedule of Maintenance*"
☐	How to recognize and respond to problems with the breathing circuit.	Chapter *5*, "*Alarms and Troubleshooting*"
☐	The parts and purpose of the nasal interface or mask.	Clinician or manufacturer's instructions for use.
☐	Care of the nasal interface or mask.	Clinician or manufacturer's instructions for use.
☐	How to recognize and respond to problems with the nasal interface or mask.	Clinician or manufacturer's instructions for use.
☐	How to install the humidifier.	Section *6.6*, "*Humidifier*"
☐	How to perform alarms tests, and how to respond if the alarms tests fail.	Appendix *F*, "*Alarms Tests*;" Chapter *5*, "*Alarms and Troubleshooting*"
☐	Replacement interval for outlet filters (per the filter manufacturer's instructions).	Section *10.2*, "*Recommended Schedule of Maintenance*"
☐	Setting ventilation parameters and the importance of each.	Chapter *3*, "*Operating Parameters*"
☐	Ventilator alarm settings; understanding the purpose and function of each.	Section *5.7*, "*Overview of Alarms*"
☐	Recognizing alarm priority level.	Section *5.1*, "*Alarm Level of Priority*"
☐	What to do in case of ventilator alarms and problems.	Chapter *5*, "*Alarms and Troubleshooting*"
☐	What to do if the ventilator alarms inappropriately.	Section *5.8*, "*Troubleshooting*"
☐	The oxygen setting, and why it is required.	Clinician
☐	How to connect the oxygen source to the ventilator.	Clinician; section *6.7.1*, "*Administering Oxygen*"

Table A-1. Patient/Caregiver Checklist (Continued)

	List of topics	References
☐	How to determine the quantity of oxygen being delivered, and how to adjust the quantity.	Clinician; section *6.7.1*, "*Administering Oxygen*"
☐	Safety rules for the use of oxygen.	Chapter *1*, "*Safety Information*;" section *6.7.1*, "*Administering Oxygen*"
☐	How to recognize and respond to problems with the oxygen supply.	Clinician
☐	How to respond to dyspnea.	Clinician
☐	Techniques to prevent aspiration of vomit.	Clinician

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B Specifications

B.1 Physical

Table B-1. Physical Description (Excluding Accessories)

Ventilator weight	9.9 lb. (4.5 kg)
Ventilator dimensions	9.25 in wide x 12.40 in deep x 6.0 in high (235 mm wide x 315 mm deep x 154 mm high)
Connectors	Inspiratory limb connector: ISO 22 mm (OD) conical Oxygen inlet: female connector with valve
Device airway volume	2000 ml
Breathing circuit volume	
• Adult, single limb	550 ml
• Pediatric, single limb	300 ml
Air inlet filter	Dimensions: 70 mm long x 60 mm wide Composition: Polypropylene fiber electrostatic filter material, which is laminated onto polyurethane open-celled foam. Efficiency: 99.999982% at 30 lpm (filtering microbes 3.3 μm)
Inspiratory bacteria filter requirement	Maximum allowable flow resistance: 4 mbar at 60 lpm

B.2 Electrical

Table B-2. AC Electrical Supply

Voltage	Frequency	Consumption
100 VAC to 240 VAC	50 Hz/60 Hz	180 VA max
12 VDC	N/A	8.3 A
30 VDC	N/A	3.3 A

Table B-3. Internal Lithium Ion Battery

Voltage	25.2 VDC
Full-load capacity	2.4 Ah
Ampere-hour rating	On standby: 1.5 Ah
	During ventilation: 0.5 Ah
Watt hour rating	62Wh to 63Wh
Charging current Standby mode Ventilation mode	1.5 A/hr. (duration: <4 hr.) 0.5 A/hr. (duration: <8 hr.)
Average operating time at 25°C (± 5°C) with a fully charged battery (having less than 50 charge/discharge cycles) at the following displayed values: Vt = 200 ml (±5 ml), PIP = 10 mbar (±2 mbar), Rate = 20 bpm 5 hr. (−10%) Vt = 300 ml (±5 ml), PIP = 20 mbar (±2 mbar), Rate = 15 bpm 4 hr. (−10%) Vt = 500 ml (±5 ml), PIP = 30 mbar (±2 mbar), Rate = 15 bpm 3 hr. (−10%) Vt = 750 ml (±5 ml), PIP = 45 mbar (±2 mbar), Rate = 20 bpm 2 hr. (−10%) (maximum settings)	

Table B-4. Remote Alarm

Remote alarm port: Also known as the nurse call port, it provides for remote alerts of ventilator alarm conditions. An example of a setting that requires such a feature is when the ventilator is used in an isolation room. The ventilator signals an alarm using a normally open (NO) or a normally closed (NC) signal. A remote alarm is activated when an alarm condition occurs, unless the audio paused function is active or the ventilator power switch is turned off. The alarm delay, once generated from the ventilator, to the nurse call output/input cable connectors is less than 100 ms. The remote alarm port is an 8-pin female connector. Allowable current is 100 mA at 24 VDC (maximum).	 Nurse call pin-out (view from back of ventilator)
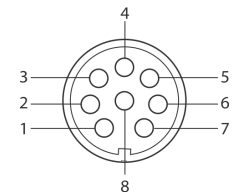
Pin	Signal	Remote alarm wire color
1	relay common	black
2	normally open (NO)	brown
3	normally closed (NC)	orange
4	remote supply—(not used)	N/A
5	RX signal (not used)	N/A
6	TX signal (not used)	N/A
7	remote supply + (not used)	N/A
8	not used	N/A

B.3 Indicators and Alarms

Table B-5. Power Indicators

Ventilation ON/OFF	AC power	DC power	Internal battery
• Blue in standby mode • Not lit if ventilation is in progress	Green	Green	• Flashing if the battery charge is in progress • Continuously lit if the ventilator is powered by the internal battery

Table B-6. Alarm Indicators

High priority	Medium priority
Red flashing LED	Yellow flashing LED

Table B-7. Audio Alarms

Audio paused	Alarm volume
60 s ±1 s	65 to 80 dB (A) ±10% at 1 meter

B.4 Performance

B.4.1 Specifications

Table B-8. Performance Parameter Specifications and Tolerances[1]

Settings	Range	Tolerances
Pressure	5 to 55 mbar	±(1 mbar +10%)
Time	0.3 to 6.0 s	± 10%
Rate	1 to 60 bpm	±1 bpm
Inspiratory Sensitivity	0P to 5	N/A
Exhalation Sensitivity	5 to 95%	± (4 lpm +10% of target exhalation flow) based on E Sens within 50ms
I:E Ratio	1:4 to 1:1	Insp. time ±50 ms and Exh. time ±50 ms or I:E ratio ±10%, whichever is greater
I/T Ratio	20% to 50%	Insp. time ±50 ms and Exh. time ±50 ms or I/T ratio ±10%, whichever is greater

in The ventilator parameters' displayed values could vary based on patient settings.

B.5 Monitored Parameters

Table B-9. Monitored Parameter Tolerances

Ventilator Parameters	Tolerances
Peak Inspiratory Pressure (PIP)	± (2 mbar + 8%)
Positive End Expiratory Pressure (PEEP)[1]	± (2 mbar + 8%)
Inspiratory Tidal Volume (VTI)	± (10 ml + 10%) and ±(20 mL + 20%) in CPAP mode above 200 ml or in NIV configuration
Total Breath Rate (Rtot)	±1 bpm
I:E Ratio (I:E) I/T Ratio (I/T)	Insp. time ±50 ms and Exh. time ±50 ms or I:E ratio ±10%, whichever is greater Insp. time ±50 ms and Exh. time ±50 ms or I/T ratio ±10%, whichever is greater
Inspiratory Time (I Time)	± 100 ms
Inspiratory Minute Volume (M Vol)	±(10 mL + 10% VTI) x Rate (with exhalation valve) and ±(20 mL + 20% VTI) x Rate in NIV configuration (without exhalation valve)
Leak	± (3 lpm + 20%)
Apnea Index (AI)	± 1 ev/h
Apnea Time	± 1 s
% Spontaneous (Spont)	± 1%
Peak Airway Pressure (Paw)	± (2 mbar + 8%)

in   The Puritan Bennett™ 520 Ventilator does not have the capability to reduce pressure below the PEEP pressure during the exhalation phase.

B.6 Range, Resolution, and Accuracy

Table B-10. lists the ranges, resolutions, and accuracies for ventilator settings, alarm settings, and patient data.

Table B-10. Ventilator Range, Resolution, and Accuracy

Ventilator settings	Range, resolution, and accuracy
Mode	Range: P A/C, PSV, CPAP Resolution: N/A Accuracy: N/A Default value: P A/C
Vt Target	Range: 50 mL to 2000 mL Resolution: 10 mL Accuracy: Vt target < VTI < Vt target +20% if Max P is high enough to reach Vt target Default value: OFF (100 mL)

Table B-10. Ventilator Range, Resolution, and Accuracy (Continued)

Ventilator settings	Range, resolution, and accuracy
Inspiratory Pressure (Pi)	Range: 5 mbar to 55 mbar in valve configuration Range: 6 mbar to 30 mbar in leak configuration Resolution: 1 mbar Accuracy: ±(1 mbar + 10%) of Pi + PEEP setting Default value: 15 mbar Depends on: PEEP when Relative Pressure is set to YES
Pressure support (P Support)	Range: OFF or 5 mbar to 55 mbar in valve configuration Range: 6 mbar to 30 mbar in leak configuration Resolution: 1 mbar Accuracy: ±(1 mbar + 10%) of P Support + PEEP setting Default value: 15 mbar Depends on: PEEP when Relative Pressure is set to YES
I:E Ratio (I:E)	Range: from 1:1 to 1:4 Resolution: 1/0.1 Accuracy: Insp. time ±50 ms and Exh. time ±50 ms or I:E ratio ±10%, whichever is greater Default value: 1/2
I/T Ratio (I/T)	Range: 20% to 50% Resolution: 1% Accuracy: Insp. time ±50 ms and Exh. time ±50 ms or I/T ratio ±10%, whichever is greater Default value: 33%
Inspiratory time (Insp Time)	Range: 0.3 s to 6.0 s Resolution: 0.1 s Accuracy: ±10% Default value: 1.5 s Depends on: R-Rate
Respiratory rate (R-Rate)	Range: 1 bpm to 60 bpm in P A/C mode Resolution: 1 bpm Accuracy: ±1 bpm Default value: 13
Inspiratory sensitivity (I Sens)	Range: 0P-5 Resolution: 1 Accuracy: N/A Default value: 2 in CPAP, I Sens is set to 2 and is not adjustable
Exhalation sensitivity (E Sens)	Range: 5% to 95% of peak flow Resolution: 5% Accuracy: ±(4 lpm +10% of target exhalation flow) based on E Sens within 50 ms Default value: 25% In CPAP, E Sens is fixed at 25% and is not adjustable.

Table B-10. Ventilator Range, Resolution, and Accuracy (Continued)

Ventilator settings	Range, resolution, and accuracy
PEEP	Range: OFF (0.5 mbar) to 20 mbar Resolution: 1 mbar Accuracy: ±(1 mbar + 10%) mbar Default value: OFF Depends on: Pi in P A/C and PSV modes when Relative Pressure is set to YES
Rise time	Range: 1-4 Resolution: 1 Default value: 2 Depends on: Insp time
Backup rate	Range: 4-40 bpm Resolution: 1 bpm Default value: 13 Depends on: Min I time
Apnea time	Range: AUTO or 1-60 s Resolution: 1 s Default value: AUTO Depends on: Backup R In PSV, Apnea time: AUTO = 60/Backup R In CPAP, Apnea Time: AUTO = 30
Minimum Inspired Tidal Volume (Min VTI)	Range: 30 mL to 2000 mL Resolution: 10 mL Default value: 300 Depends on: Max VTI
Maximum Inspired Tidal Volume (Max VTI)	Range: 80 mL to 3000 mL Resolution: 10 mL Default value: 2000 mL Depends on: Min VTI
Maximum Respiratory Rate (Max Rtot)	Range: 10 bpm to 70 bpm Resolution: 1 bpm Default value: OFF Depends on: R-Rate
Minimum Inspiratory Time (Min I time)	Range: 0.1 to 2.8s Resolution: 0.1 s Default value: AUTO (Rise time + 300 ms) Depends on: Max I Time, Backup R, Rise time
Maximum Inspiratory Time (Max I time)	Range: 0.8 to 3 s Resolution: 0.1 s Default value: AUTO (minimum of 3 s or 30/Monitored rate) Depends on: Min I Time, R-Rate

B.7 Environmental

The following environmental conditions shall be observed:

Table B-11. Environmental Conditions for Storage or Transport

Temperature	Humidity	Atmospheric pressure	Altitude
-40° C to +70° C (-40°F to +158 °F)	10% to 95% RH	500 hPa to 1060 hPa (7.2 psi to 15.4 psi)	-152 m to 3964 m (-500 ft to 13 000 ft)

Table B-12. Environmental Conditions for Operation

Temperature	Humidity	Atmospheric pressure	Altitude
+5°C to 40°C (+41 °F to104 °F)	10% to 95% RH	600 hPa to 1100 hPa (8.7 psi to 16.0 psi)	-152 m to 3964 m (-500 ft to 13 000 ft)

Under extreme conditions of use, within the limits of a supply voltage of –20% and temperature ranging from normal to 45°C (113°F) with ≤75% RH, the ventilator should not malfunction or endanger the user. However, operating the device for prolonged periods or repeatedly under such extreme conditions could result in premature aging of components and more frequent maintenance.

B.8 USB

Table B-13. USB Memory Device Specifications

Characteristics	Supported formats
USB compatibility	USB flash memory USB 2.0 or USB 1.1
Memory file format	USB 32 bit format (sector size: 512-2048 bytes)
Number of files	Maximum 999
USB size	128 MB to 4 GB

Table B-14. Data Transfer Characteristics

Ventilator data description	Capacity
Trends capacity	86 MB
Events capacity	512 KB or 5500 events
Monitoring capacity	42 MB/48 hours

B.9 Pneumatic

Table B-15. Airway Resistances

Inspiratory	Exhalation
1.0 mbar at 30 lpm flow ±0.1 mbar	0.5 mbar at 30 lpm ± 0.1 mbar
3.7 mbar at 60 lpm flow ±0.1 mbar	1.1 mbar at 60 lpm ± 0.1 mbar

Table B-16. Air Inlet Resistance (Filter)

1.1 cmH$_2$0 (1.079 mbar) at 30 lpm flow ±0.1 cmH$_2$O

Table B-17. Oxygen Inlet Specifications

Maximum pressure	Maximum flow (See *Table B-8. , Performance Parameter Specifications and Tolerances*)
50 kPa (7 psi)	15 lpm

Table B-18. Performance Specifications

Working pressure	Sound pressure level	Maximum pressure limit	Internal compliance (ventilator)	Inspiratory triggering response time (Ttr)
5 mbar – 55 mbar	30 dBA (per NF EN ISO 17510-1 test conditions)	60 mbar	0.0001 l/mbar	100 ms

B.10 Manufacturer's Declaration

The following tables, *Table B-19.* through *Table B-23.* , contain the manufacturer's declarations for the ventilator's electromagnetic emissions, electromagnetic immunity, and recommended separation distances between the ventilator and portable and mobile RF communications equipment, as well as a list of compliant cables.

WARNING:
 The Puritan Bennett™ 520 ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in Appendix *B*, "*Specifications*." In particular, the use of nearby mobile and portable communications equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC 60601-1-2 standard, may affect its operation. Refer to section *B.10* "*Manufacturer's Declaration*."

WARNING:
The use of any accessory other than those specified, with the exception of the power supplies or cables sold by Covidien, may lead to an increase in electromagnetic emissions or a decrease in the equipment protection against electromagnetic emissions. If the ventilator is used adjacent to such

accessories or stacked with such devices, the ventilator's performance should be monitored to verify normal operation.

Table B-19. Electromagnetic Emissions

The Puritan Bennett 520 Ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should assure that it is used in such an environment.		
RF emissions CISPR 11/EN 55011	Group 1	The ventilator uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11/EN 55011	Class B	The ventilator is suitable for use in all establishments including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC/EN 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC/EN 61000-3-3	Complies	

Table B-20. Electromagnetic Immunity

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should ensure that it is used in such an environment.			
Immunity test	**IEC / EN 60601 test level**	**Compliance level**	**Electromagnetic environment–guidance**
Electrostatic discharge (ESD) IEC/EN 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 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/EN 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	AC power ("mains") quality should be that of a typical commercial or hospital environment.
Surge IEC/EN 61000-4-5	±1 kV lines/lines ±2 kV lines/earth	±1 kV lines/lines ±2 kV lines/earth	AC power ("mains") power quality should be that of a typical commercial or hospital environment.

Table B-20. Electromagnetic Immunity (Continued)

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should ensure that it is used in such an environment.			
Voltage dips, short interruptions and voltage variations on power supply input lines IEC/EN 61000-4-11	@ 5% UT (# 95% dip in UT for 0.5 cycle) 40% UT (60% dip in UT for 5 cycles) 70% UT (30% dip in UT for 25 cycles) @ 5% UT (# 95% dip in UT for 5 s)	@ 5% UT (# 95% dip in UT for 0.5 cycle) 40% UT (60% dip in UT for 5 cycles) 70% UT (30% dip in UT for 25 cycles) @ 5% UT (# 95% dip in UT for 5 s)	AC power ("mains") power quality should be that of a typical commercial or hospital environment. If the user of the ventilator requires continued operation during power mains interruptions, it is recommended that the ventilator be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC/EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: UT is the AC mains voltage prior to application of the test level.			

Table B-21. Electromagnetic Immunity—Conducted and Radiated RF

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should assure that it is used in such an environment.			
Immunity test	**IEC/EN 60601-1-2 test level**	**Compliance level**	**Electromagnetic environment– guidance**
			Portable and mobile RF communications equipment should be used no closer to any part of the ventilator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC/EN 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands[1] 10 Vrms inside ISM bands[1]	3 Vrms 150 kHz to 80 MHz outside ISM bands 10 Vrms inside ISM bands	$d = 0.35\sqrt{P}$ $d = 1.2\sqrt{P}$
Radiated RF IEC/EN 61000-4-3	10 V/m 80 MHz to 2.5 GHz	10 V/m 80 MHz to 2.5 GHz	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz 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).[2]Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[3] should be less than the compliance level in each frequency range.[4]Interference may occur in the vicinity of equipment marked with the following symbol:

Table B-21. Electromagnetic Immunity—Conducted and Radiated RF (Continued)

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator should assure that it is used in such an environment.
Note: At 80 MHz and 800 MHz, the higher frequency range applies.   **Note:**   These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

in   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.

cn   The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

an   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 ventilator is used exceeds the applicable RF compliance level above, the Puritan Bennett 520 Ventilator should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Puritan Bennett 520 Ventilator.

'n   Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

Table B-22. Recommended Separation Distances

The ventilator is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ventilator can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ventilator as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter			
	150 kHz to 80 MHz (outside ISM bands) d = 0.35 $\sqrt{P}$	150 kHz to 80 MHz (in ISM bands) d = 1.2 $\sqrt{P}$	80 MHz to 800 MHz d = 1.2 $\sqrt{P}$	800 MHz to 2.5 GHz d = 2.3 $\sqrt{P}$
0.01	0.035 m	0.12 m	0.12 m	0.23 m
0.1	0.11 m	0.38 m	0.38 m	0.73 m
1	0.35 m	1.2 m	1.2 m	2.3 m
10	1.1 m	3.8 m	3.8 m	7.3 m

Table B-22. Recommended Separation Distances (Continued)

100	3.5 m	12 m	12 m	23 m

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:

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

Note:

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:

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

Note:

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

Table B-23. Compliant Cables and Accessories

Cable or accessory	Maximum length
UK AC power cable assembly	1.8 m (5.9 ft)
Japan AC power cable assembly	1.8 m (5.9 ft)
China AC power cable assembly	1.8 m (5.9 ft)
South Africa AC power cable assembly	1.8 m (5.9 ft)
India AC power cable assembly	1.8 m (5.9 ft)
Australia AC power cable assembly	1.8 m (5.9 ft)
Europe AC power cable assembly	1.8 m (5.9 ft)
Canada AC power cable assembly	1.8 m (5.9 ft)
Nurse call cable	5 m (16.4 ft)
12V DC car adapter cable	5 m (16.4 ft)
Oxygen inlet connector	-

B.11 Standards Compliance and IEC Classification

General Standards

- Medical Electrical Equipment: General Requirements for Safety IEC 60601-1:1988 and all its amendments up to 1995 and EN 60601-1:1990.

- The ventilator will be constructed to comply with the following product Classifications as detailed in Clause 5 of 60601-1:

  - Class II Equipment

  - Internally Powered Equipment

  - Type BF Applied Parts

  - IP31 with respect with respect to access to hazardous parts and ingress of moisture

  - Not suitable for use in the presence of flammable anesthetic mixtures

  - Not suitable for sterilization

  - Suitable for continuous operation

  - Detachable power supply cable

- Supplement No. 1-94 to CAN/CSA-C22.2 No. 601.1-M90 - Medical Electrical Equipment - Part 1: General Requirements for Safety.

- UL 60601-1 Medical Electrical Equipment - Part 1: General Requirements for Safety: 2003.

Collateral Standards

- Medical Electrical Equipment - Part 1: General Requirements for Safety -2- Collateral standard Electro-Magnetic Compatibility requirements and tests IEC 60601-1-2:2007 and EN 60601-1-2: 2007.

- Medical Electrical Equipment - Part 1: General Requirements for Safety -2- Collateral standard: Programmable Electrical Medical Systems IEC 60601-1-4:2000 and EN 60601-1-4:2004.

- Medical Electrical Equipment - Part 1: General Requirements for Safety -2- Collateral standard: Usability IEC 60601-1-6:2006 and EN 60601-1-6:2007.

- General Requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems IEC 60601-1-8:2006 and EN 60601-1-8:2007.

Particular Standards

- Lung Ventilator for Medical Use-Particular Requirements for Basic Safety and Essential Performance Part 6: Home-care ventilatory support devices EN ISO 10651-6: 2009.

- Lung Ventilators for Medical Use- Particular Requirements for Basic Safety and Essential Performance Part 1: Home Care Ventilator Support YY 0600.1-2007 (ISO 10651-6:2004, MOD).

• Anesthetic and respiratory equipment - Conical connectors - Part 1: Cones and sockets EN ISO 5306-1:2004.

Air Transportation Standards

• Environmental Conditions and Test Procedures for Airborne Equipment - RTCA/DO-160:2007.

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C Theory of Operation

C.1 Architecture

The Puritan Bennett™ 520 Ventilator's gas delivery system is primarily composed of an airflow generator and a three-way valve to control the patient circuit exhalation valve. The flow generator is a low-inertia, micro-turbine driven by a brushless DC electric motor, while the three-way valve is a proportional solenoid valve.

These two actuators are microprocessor-controlled and perform according to specific control algorithms. The microprocessor control circuit receives its data from the various servo-controlled pressure and feedback flow sensors that are built into the ventilator.

An electrical supply management system performs the energy conversion so the device can switch between the three available power sources to provide power to the internal electronics.

A cooling fan helps maintain the proper operating temperature range for the internal environment of the ventilator. This fan is servo-controlled to maintain the proper temperature for the most heat-sensitive of the ventilator's components.

C.2 Operation

The operation of the device is based on a self-adapting, closed loop drive system. The speed of the flow generator (turbine) is servo-controlled according to the patient pressure signal or the inspired flow signal.

The turbine speed control algorithms themselves are based on equations that vary according to the ventilation modes, settings, and the respiratory cycle phases. Thus, fixing the pressure rise time has an influence on the level of turbine acceleration at the start of the inspiration phase. The transition between the inspiration phase and expiration phase is controlled by a deceleration or braking algorithm proportional to the pressure difference between the two phases.

The exhalation solenoid valve (three-way valve) is fully closed during the inspiratory phase and is proportionally controlled during the exhalation phase to obtain the bias flow. The speed of the turbine adapts to the exhalation pressure threshold during the entire exhalation phase to maintain the operator-set PEEP.

The flow measurement completes the system by enabling detection of patient inspiratory effort and the triggering of inspiration phases. The flow measurement can also be used to determine the end of the inspiration phase in certain ventilation modes.

The flow measurement is automatically corrected as a function of the atmospheric pressure measured inside the ventilator with the Altitude Compensation feature.[*] The flow and volume are in Body Temperature Pressure Saturated (BTPS) conditions. This necessitates that periodic inspections for calibrating the sensors be performed by maintenance technicians authorized by Covidien (see the Puritan Bennett 520 Ventilator service manual).

If the Altitude Compensation feature is active, a corrective algorithm is applied to the inspiration flow.

The sensor measurement range is software limited from 600 to 1100 hpa.

A cooling fan is provided to maintain the internal temperature of the ventilator within specified limits and to help ensure proper performance and longevity of the device.

Finally, the various measurement signals used in control and detection are protected and specifically filtered in order to limit any risk of disturbance to the device and possible problem.

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[*] The Altitude Compensation feature is enabled (set to "YES" on the Setup Screen) by default and should remain at this setting.

Figure C-1. Gas Delivery System

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1	Air inlet filter	7	Exhalation valve exhaust port
2	Turbine	8	Exhalation tubing
3	Inspiratory filter	9	LCD display
4	Inspiratory tubing	10	CPU board
5	Proximal pressure tube	11	Internal battery
6	Exhalation valve		
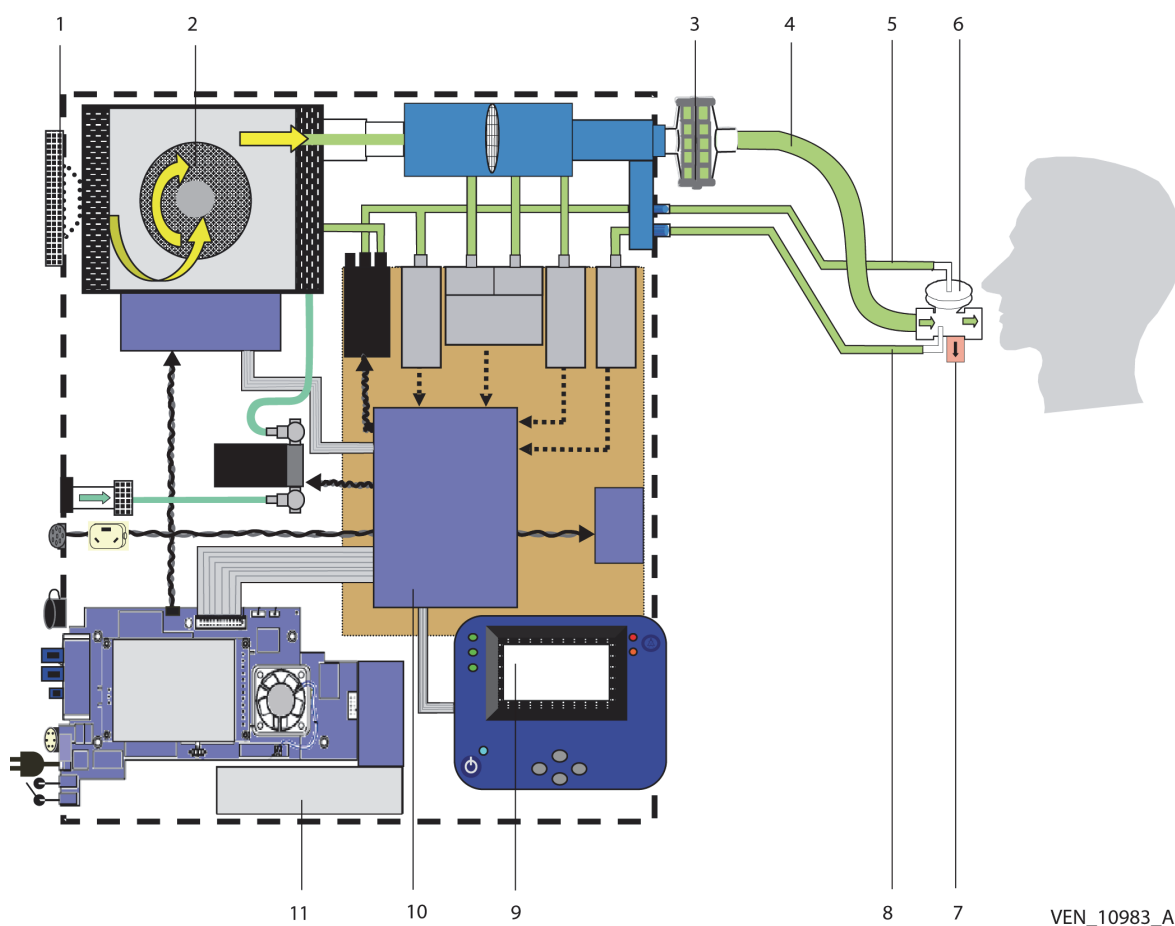
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D Modes and Breath Types

D.1 Modes of Ventilation

This chapter is a general description of the various modes of ventilation and breath types available with the Puritan Bennett™ 520 Ventilator.

Note:
The default ventilation mode setting is P A/C; for more information, see below.

D.1.1 Assist/Control (A/C) Mode

When set to an Assist/Control mode, machine-initiated breaths are delivered at a clinician-set pressure and rate. If the patient triggers a spontaneous breath between machine breaths, the ventilator will deliver a breath based on the pressure settings.

Whether initiated by the patient or the ventilator, all breaths are delivered at the same preset pressure.

The name of the Assist/Control mode is P A/C, if the breaths are based on a pressure setting.

D.1.2 CPAP Mode

In CPAP, the ventilator maintains a constant level of pressure in the patient's airway.

D.1.3 PSV Mode

PSV mode maintains a constant level of pressure in the patient's airway during exhalation. In addition, the ventilator applies a clinician-set pressure (Pressure Support) to each of the patient's breaths. This has the same benefits as CPAP, with the additional benefit of assisting the patient in moving gas into his or her lungs.

D.2 Breath Types

The following breath types are available from the ventilator:
- Pressure controlled breaths in Assist/Control mode (in P A/C)

- Pressure-supported breaths in PSV mode

- CPAP

D.2.1 Pressure Control Breaths in Assist/Control Mode

In Assist/Control mode (P A/C), each delivered breath will maintain the selected pressure (Pi) maintained over the selected inspiratory time. Inspiration is triggered by patient-generated flow (for assisted breaths) or by the ventilator (for controlled breaths; breath rate [R-Rate] is the controlling parameter). For both controlled and assisted breaths, the inspiratory pressure is limited to the pressure (Pi) setting, and is cycled by time.

The shape of the pressure waveform depends on the setting of the pressure rise time (Rise Time).

Figure D-1. Flow Patterns in P A/C Mode

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x	Time	1	Start of inspiration
y1	Airway pressure	2	End of inspiration
y2	Flow		
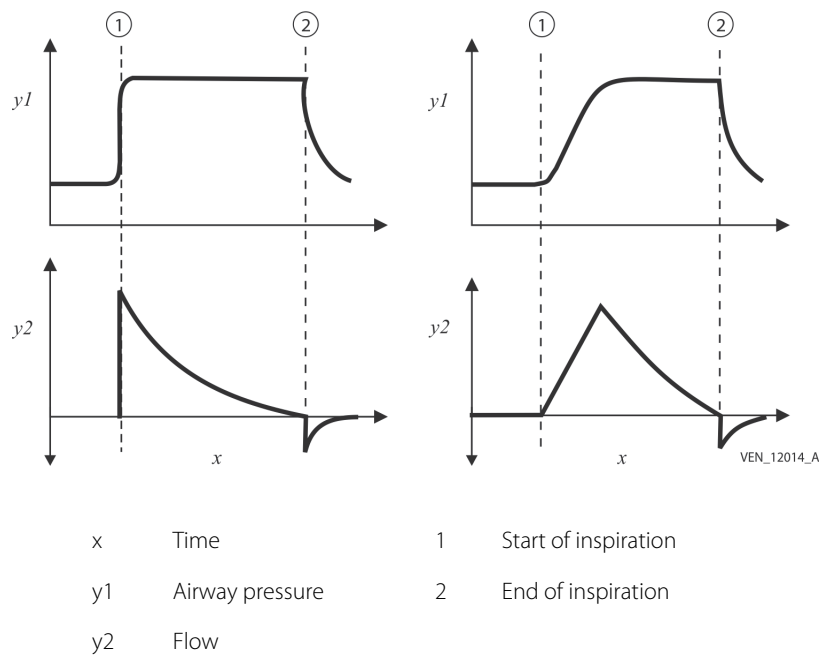
P A/C mode guarantees a maximum period between breaths, as determined by the Breath Rate setting. In *Table D-1.* , the ventilator delivers a controlled (machine) breath, and calculates the time before another controlled breath must be delivered. The ventilator delivers a second controlled breath at the conclusion of the machine calculated breath time (for simplicity, we will use the term period for "machine-calculated breath time"). Following the second controlled breath, but before another period can elapse, the patient's effort triggers an assisted (or patient-initiated) breath. This restarts the period. At the conclusion of the period, the ventilator delivers another controlled breath.

Figure D-2. Controlled Machine Breaths in P A/C Mode

x	Time	2	Machine breath
y	Airway pressure	3	Patient-initiated breath
1	Period		
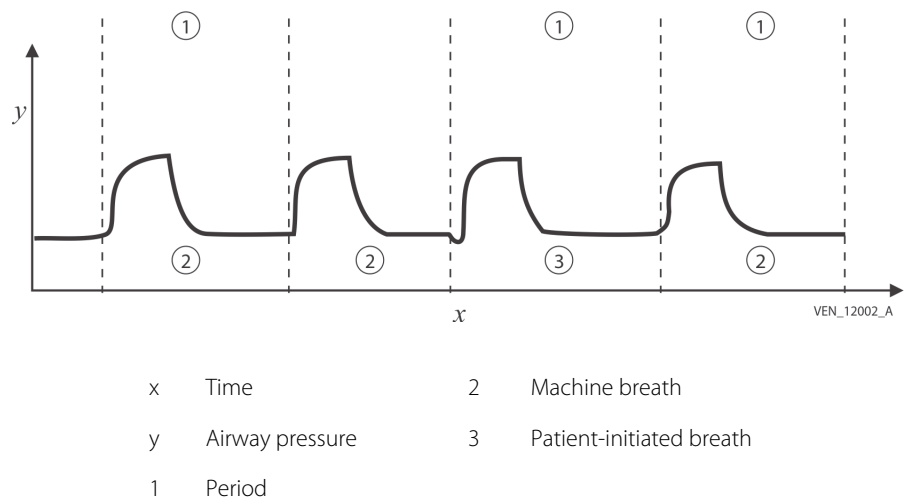
D.2.2 Pressure Supported Breaths in PSV Mode

In PSV mode, the supported breaths maintain the selected pressure (P Support). Inspiration is triggered by patient-generated flow. The inspiration is terminated when inspiratory flow drops to the Exhalation Sensitivity (E Sens) setting.

The shape of the pressure waveform depends on the setting of the pressure rise time (Rise Time). See *Figure D-3.*

Figure D-3. Pressure Supported Breaths in PSV Mode

x	Time	y	Flow
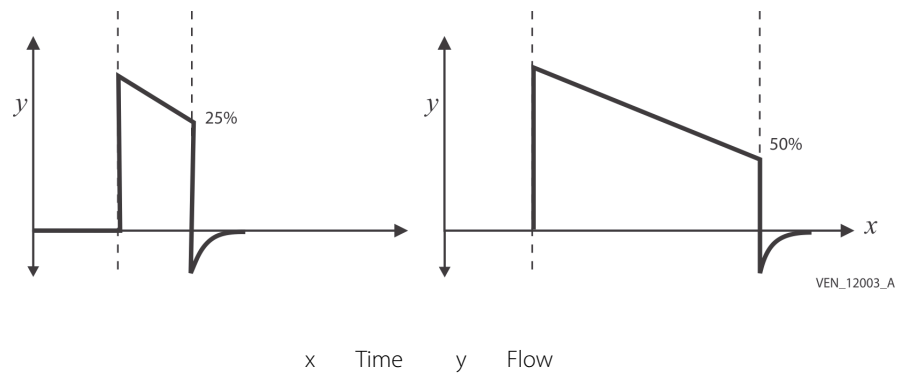
D.2.3 CPAP

In Continuous Positive Airway Pressure (CPAP) the ventilator maintains pressure at the selected PEEP over the entire breath cycle. Inspiration is triggered by patient-generated flow. Inspiration is

limited by the pressure and is cycled by the patient when inspiratory flow drops to the Exhalation Sensitivity threshold (E Sens = 25%). See *Figure D-4.*

Figure D-4. Flow Patterns in CPAP Mode

y1	Airway pressure	y2	Flow
1	Start of inspiration	2	End of inspiration
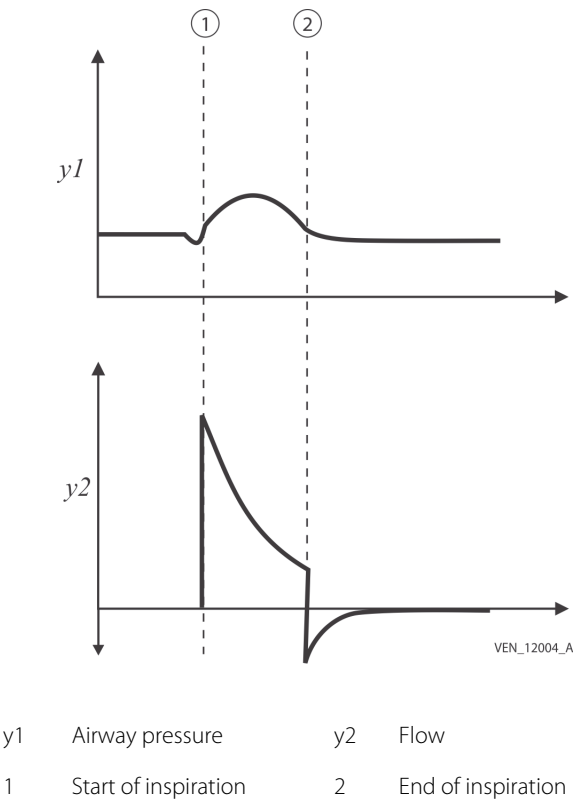
D.3 Ventilation Modes and Apnea

In PSV mode, the back-up rate is activated so that the ventilator will automatically begin to deliver breaths at the breath rate (Backup R) setting if no patient effort occurs for the Apnea Time setting. The pressure during a back-up breath is equal to the Pressure Support (P Support) setting before the apnea condition began. If the patient initiates a spontaneous breath while the back-up rate is in effect, the ventilator will return to the previous operating parameters.

In CPAP, a backup rate is not set, but the operator must still set an apnea time (Apnea Time). In that case, the ventilator will sound an APNEA alarm if no breath is triggered by the patient in the apnea time; however, no back up breaths will be generated.

D.4 Vt Target

The Puritan Bennett 520 Ventilator has the Vt Target (Target Volume) feature as a part of pressure-based ventilation modes. This allows a range of pressures to be used to reach a set volume. If the

mode is PSV ST or P A/C, Vt Target can be selected within the range of 50 to 2000 mL (or OFF) which controls the inspired tidal volume to the target value specified.

Following each delivered breath, the inspired volume is measured and small pressure adjustments (0.5-2 mbar) are made as necessary to maintain the delivered volume within the target Vt range. If the inspired volume is lower than the target volume, the pressure of the next breath increases a small amount and the inspired volume is measured again.

If the inspired volume is higher than the target volume, the pressure of the next breath is decreased slightly, until the inspired volume matches the target volume. The pressure increases stop if the maximum inspiratory pressure is reached.

Figure D-5. Target Volume in Pressure Modes

VEN_11000_A
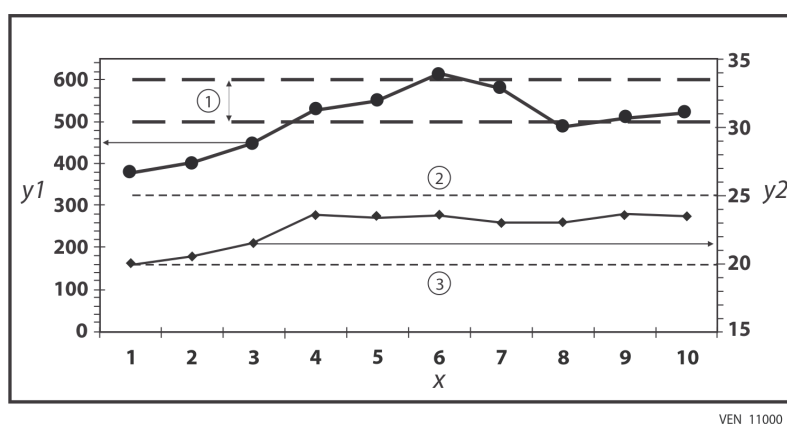
x	Cycle number	1	Vt target
y1	Vt (ml)	2	Max P
y2	PIP (mbar, cmH$_2$0, or hPa)	3	Pi/P support

Table D-1. Volume Target Measurements in Pressure Modes

Cycle number	1	2	3	4	5	6	7	8	9	10
Pi set point (cmH$_2$O, mbar, or hPa)	20	20 + 0.5 = 20.5	20.5 + 1 = 21.5	21.5 + 2 = 23.5	23.5	23.5	23.5 - 0.5 = 23	23	23 + 0.5 = 23.5	23.5
Measured Vti (ml)	380 ▼	400 ▼	450 ▼	530 =	550 =	610 ▲	580 =	490 ▼	510 =	520 =

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E Operational Verification Checklist

The operational verification and safety checks listed in *Table E-1.* below should be performed to ensure the ventilator is operating properly in the following circumstances:

- Prior to using the ventilator with a patient.

- Regularly, according to institutional protocol.

- Following maintenance or changes in ventilator settings.

If the ventilator fails any of the safety checks below, or if you cannot complete these checks, see section *5.8*, "*Troubleshooting*" on page *5-14* or call the equipment supplier or Covidien (see section *10.3*, "*Service Assistance*").

WARNING:
Provide the patient with an alternate means of ventilation before conducting these tests.

WARNING:
To reduce the risk of infection, wash your hands thoroughly before and after handling the ventilator or its accessories.

Table E-1. Operational Verification Checklist

1	Verify the proper appearance and cleanliness of the ventilator.	☐ Pass
2	Verify all of the labels and markings on the ventilator are clear and legible.	☐ Pass
3	Confirm the air inlet filter is clean and correctly installed.	☐ Pass
4	Ensure the AC power cable does not exhibit any signs of damage, such as kinks, breaks, or damaged insulation.	☐ Pass
5	Connect the AC power cable. Ensure that all power supply indicators on the front panel flash, except for the AC power supply (mains) indicator, which should remain lit.	☐ Pass
6	Push the power switch **I/O** to the **I** position to activate the ventilator test: Check that the two alarm indicators and the Standby indicator (located close to the **VENTILATOR ON/ OFF** ⏻ key) flash. Ensure also that the two alarm buzzers sound.	☐ Pass
7	Perform the Functioning Alarms Test regularly according to institutional protocol (see Appendix *F*, "*Alarms Tests*").	☐ Pass
8	Verify the alarm volume is adapted to the patient environment. See section *7.3*, "*Preferences Menu Parameters*" for instructions on changing the alarm volume setting.	☐ Pass

Table E-1. Operational Verification Checklist (Continued)

9	Verify that the preventive maintenance schedule for the ventilator is followed. See Chapter *10*, "*Routine Maintenance*."	☐	Pass
10	Ensure the patient breathing circuit is correctly attached to the ventilator, with all the necessary components, and is free from any signs of damage and leaks.	☐	Pass

F Alarms Tests

Before connecting the ventilator to the patient, perform the following tests to ensure the ventilator's alarms are working properly.

WARNING:
Do not perform ventilator alarm tests while the patient is connected to the ventilator. Provide the patient with an alternate means of ventilation before conducting these tests.

WARNING:
If the ventilator fails any alarm test or if you cannot complete these tests, see the Troubleshooting section (refer to Chapter *5*, "*Alarms and Troubleshooting*") of this manual or call your equipment supplier or Covidien (refer to section *10.3*, "*Service Assistance*" on page *10-4*).

WARNING:
The setting of the Min PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the Low Pressure Test (refer to section *F.1*, "*Low Pressure Test*" on page *F-1*) to ensure the Min PIP alarm is properly set.

Note:
Most of these tests require that an approved patient circuit be connected to the ventilator. Ensure that your patient circuit is properly connected prior to performing these tests.

F.1 Low Pressure Test

WARNING:
The setting of the Min PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the following test to ensure the Min PIP alarm is properly set.

1. Before proceeding, set the ventilation and alarm parameters specified by the patient's clinician and install a single-limb circuit setup.

2. Press the **VENTILATION ON/OFF** key to start ventilation.

3. Keep the patient's end of the breathing circuit open and allow ventilation to continue.

4. Wait for (Apnea time + 2 seconds; Apnea time is not always 5 seconds), then ensure that:

    · The high priority indicator (red color) lights up

    · The "PATIENT DISCONNECTION" alarm is shown

    · The audible alarm sounds

5. Press the **ALARM CONTROL** key once to pause the audible alarm.

6. Press and hold the **VENTILATION ON/OFF** key for 3 seconds, then release it. Press the **VENTILATION ON/OFF** key again to confirm stop. The ventilator switches to standby mode and cancels the alarms.

F.2 Circuit Check Test

F.2.1 Performing a Circuit Check

Perform a circuit check whenever replacing or altering a patient circuit. Ensure the patient is fully disconnected from the ventilator prior to starting this test.

Note:
Before performing a circuit check, stop ventilation using the **VENTILATION ON/OFF** key, not the I/O switch. If the I/O switch was used to stop ventilation, the circuit check function cannot be used unless first stopping ventilation using the **VENTILATION ON/OFF** key.

1. Press and hold the **MENU** key during power up to access the circuit check test screen.

Figure F-1. Circuit Check Screen (Before Starting)
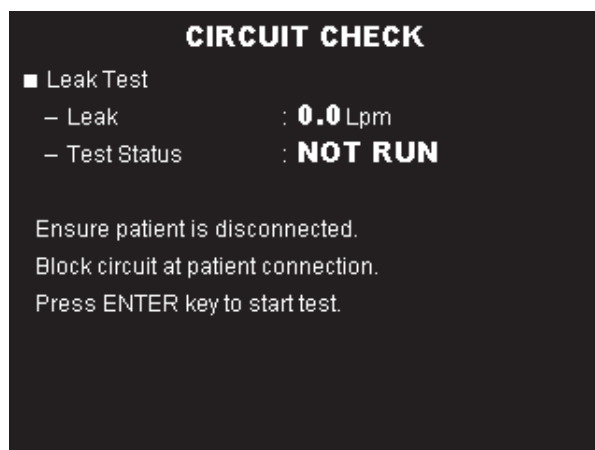
2. Verify that the proximal pressure tube of the patient circuit is properly connected to the proximal pressure port (see section *6.4*, "*Patient Circuit*," on page *6-8*.)

3. Verify that the exhalation valve tube is connected to the exhalation valve port.

4. Block the patient connection port of the patient circuit (see *Figure F-2.*)

Figure F-2. Blocking the Patient End of a Single-Limb Circuit
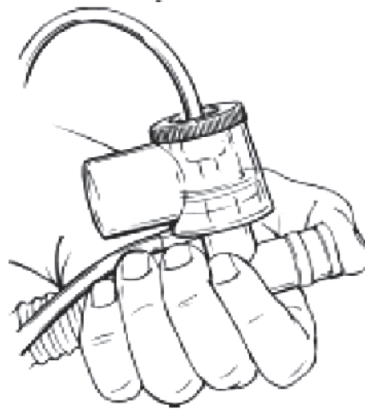
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5. Activate the circuit test by pressing the **ENTER** key.

6. During the circuit check (which typically takes about 10 seconds to complete), the ventilator will do the following:

    a. Sound a short beep

    b. Close the exhalation valve

    c. Show Test Status as RUNNING (see *Figure F-3.*)

Figure F-3. Circuit Check (Running)
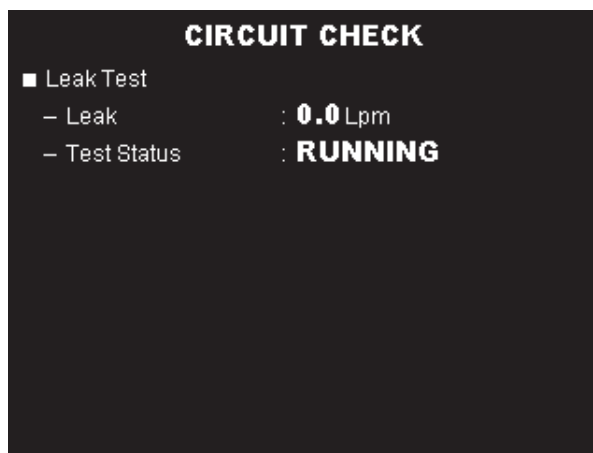
    d. Increase pressure to 30 mbar (±10% with no leak)

    e. Show flow sensor measurement as Leak in Lpm (updated every 2 seconds)

    f. Sound a short beep every time the flow measurement is updated

    g. Sound a long audible beep once the check is complete

    h. Show PASS or FAIL in the Test Status field

Figure F-4. Circuit Check (Complete, Passed)
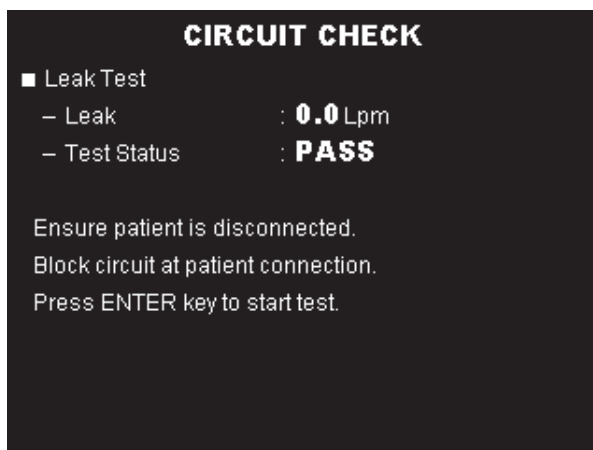
Figure F-5. Circuit Check (Complete, Failed)
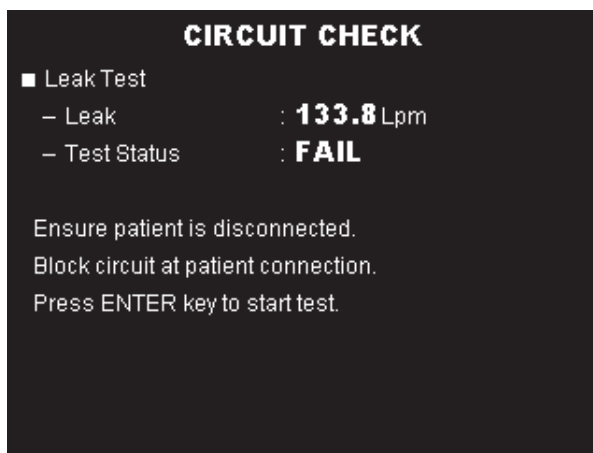
7. Review the results. A FAIL result indicates leak(s) of greater than 1 L/min exist.

To rerun circuit check test, press the **ENTER** key again. To cancel the circuit check while it is running, press the **UP**, **DOWN**, **ENTER**, **VENTILATION ON/OFF**, or **MENU** key.

F.2.2 Troubleshooting a Failed Check

If the circuit check fails, do the following:

1. Ensure an approved circuit is in use. Reference *Table H-2. List of Circuits*.

2. Check patient circuit connections to the ventilator, examining each for leakage and tightness.

3. Replace the patient circuit if necessary.

4. Rerun the circuit check test.

5. If the failure persists, have the ventilator evaluated by a qualified technician.

F.3 Apnea Test

Apnea breaths only apply in PSV, and CPAP modes.

1. Connect the patient end of the patient circuit to a test lung.

2. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (see section *6.4*, "*Patient Circuit*" on page *6-8*).

3. Press the **VENTILATION ON/OFF** key to start ventilation.

   The ventilator will deliver a mandatory breath. Before the second mandatory breath is delivered, verify that the following events occur:

   - The medium priority indicator (yellow color) illuminates

   - The APNEA alarm is shown

   - An audible alarm sounds

4. Press the **ALARM CONTROL** key twice to reset the alarm.

5. Press and hold the **VENTILATION ON/OFF** key for 3 seconds, then release it. Press the **VENTILATION ON/OFF** key again to confirm stop.

   - Ventilation stops.

F.4 Power Failure Test

Note:
If the ventilator is operating on either the external power supply or the internal battery, you must plug it in to an AC power source before beginning this test.

1. Disconnect the ventilator from its AC power supply. Ensure that the following events occur:

   - The medium priority indicator (yellow color) illuminates

   - The AC POWER DISCONNECTION alarm activates

   - An audible alarm sounds

   - The **DC POWER** indicator illuminates if the DC power source is connected; otherwise, the INTERNAL BATTERY indicator illuminates

2. Press the **ALARM CONTROL** key twice to reset the alarm.

3. Reconnect the ventilator to its AC power supply.

F.5 Occlusion Test

1. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (see section *6.4*, "*Patient Circuit*" on page *6-8*).

2. Block the exhalation port on the exhalation valve of the patient circuit. See *Figure F-6*.

Figure F-6. Blocking the Patient End of a Single-Limb Circuit
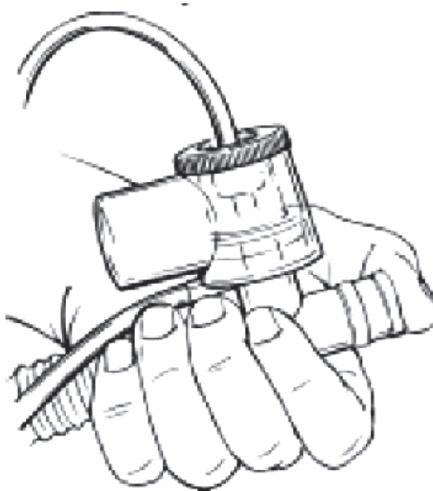
VEN_11951_A

3. Press the **VENTILATION ON/OFF** key to start ventilation.

4. Allow the ventilator to deliver three consecutive breaths. At the beginning of the fourth breath, ensure that the following events occur:

    - The high priority indicator (red color) illuminates

    - The Occlusion alarm activates

    - An audible alarm sounds

5. Press the **ALARM CONTROL** key to pause the audible alarm.

6. Unblock the exhalation port.

    - The occlusion alarm is canceled.

7. Press and hold the **VENTILATION ON/OFF** key for 3 seconds, then release it. Press the **VENTILATION ON/OFF** key again to confirm stop.

    - Ventilation stops.

F.6 Battery Test

The ventilator is capable of testing the power of the battery (see Chapter *8*, "*Internal Battery*"). You can determine which power source the ventilator is using by checking the power indicator, located on the top panel. The indicator light will be lit to indicate which power source is currently available.

1. Disconnect the AC power supply cable and the DC power cable (if it is connected) from the ventilator.

   - A POWER DISCONNECTION alarm will trigger.

2. Press the **ALARM CONTROL** key twice to pause the alarm. Ensure that the following events occur:

   - The INTERNAL BATTERY indicator to the upper-left of the display illuminates

   - The BATTERY symbol is shown at the top of the screen (along with its reserve capacity)

3. Connect the AC (mains) power supply. Ensure that the following events occur:

   - The AC POWER indicator to the upper-left of the display illuminates

   - The indicator to the upper-left of the display is flashing, which indicates that the battery is charging (this only occurs if the ventilator has run on battery power long enough to lose enough charge that the charger will turn on)

   - The BATTERY symbol is no longer shown at the top of the screen

F.7 Involuntary Stop Test

To verify proper functioning of the very high priority audible alarm, perform the following steps:

1. Press the **VENTILATION ON/OFF** key to start ventilation.

2. Set the **I/O** switch to the **O** (off) position to turn off the ventilator during ventilation. Ensure that the following events occur:

   - An audible alarm sounds continuously

   - The ventilator turns off. There should be no alarm indicators illuminated and no alarm messages shown.

3. Press the **ALARM CONTROL** key once to pause the audible alarm.

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G Unpacking and Preparation

The Puritan Bennett™ 520 Ventilator is delivered with the following items:

(1) Printed user's manual (language as requested by the customer)

(1) Clinician's manual on CD (a print copy is available upon request by the customer)

(1) Patient circuit and valve

(1) Set of six combination foam/fine particle air inlet filters

(1) Carrying bag

(1) Oxygen connector

(1) AC power cable

⚠️ **WARNING:**
Users must always possess an additional circuit and valve while using the Puritan Bennett™ 520 Ventilator.

⚠️ **WARNING:**
To minimize the risk of damage, you must use the Dual Bag to transport the Puritan Bennett™ 520 Ventilator. Refer to *Figure G-2.*

To unpack and prepare the ventilator, follow the steps below:

1. From the plastic bag, remove the following:

   • Plastic pocket containing the clinician's manual.

   • The ventilator and its components or accessories.

2. Remove the patient circuit, the AC ("mains") power cable, and the set of fine-particle air inlet filters.

3. Inspect the ventilator for the following items:

   • The ventilator's outer casing and the **I/O** switch's protective cover do not have any dents or scratches, which may indicate possible damage.

   • The ventilator's labels and markings are clear and legible.

   • The AC power cable does not exhibit any signs of damage, such as kinks, breaks, or cuts.

> ⚠️ **WARNING:**
> **Never use a ventilator or any components or accessories that appear to be damaged. If any signs of damage are evident, contact your equipment supplier or Covidien.**

4. Clean the ventilator with a mild soap solution, if necessary (see Chapter *9*, "*Cleaning*").

5. Ensure that the air inlet filter is installed.

Figure G-1. Puritan Bennett 520 Ventilator
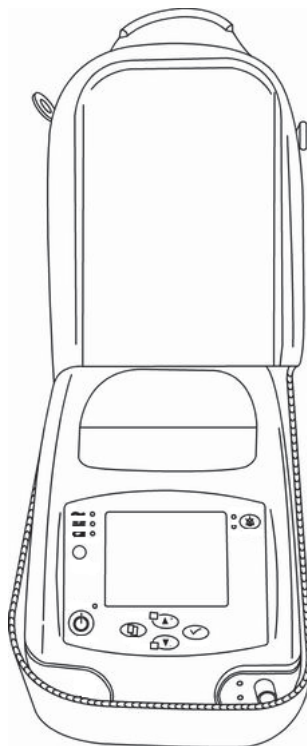
Figure G-2. Dual Bag

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H Parts and Accessories

Table H-1. provides a list of accessories that are available for the Puritan Bennett™ 520 Ventilator.

To order parts or accessories, contact your equipment supplier or Covidien representative.

Note:

The ventilator is delivered with the following items: a printed user's manual, a CD with clinician's manual (printed copy available upon request), one patient circuit with valve, one set of six combination foam/fine particle air inlet filters, one carrying bag, one O_2 connector, and one AC power cable.

Table H-1. List of Consumables and Accessories

Description
Carrying bag (grey)
Oxygen inlet connector
Ventilator cart
Dual bag (blue or pink) delivered with: Backpack padded straps, 2 each Suspension belt Carrying belt ⚠ **WARNING:** **To minimize the risk of damage, you must use the ventilator's Dual Bag to transport the ventilator. See *Figure G-2.* on page *G-3*.**
AC (mains) power cable
DC power cable (for connection to an external DC power source, such as a car 12 volt DC outlet)
Nurse call cable (5 meters)
Inlet air combi-filter, fine (pack of 6) **Note:** This is the "foam plus fine particle" filter listed in *Table 10-1. Consumables and Replacement Intervals* on page *10-2*).

Table H-1. List of Consumables and Accessories

Description
Internal battery
External battery
3-way DAR™ valve
DAR™ inspiratory bacteria filters
Barrierbac
Barrierbac S
Barrierbac S Angled
Hygrobac
Hygrobac S
Hygrobac S Angled
Hygroboy
Hygroster
Hygroster Mini
Sterivent
Sterivent S
Sterivent Mini
Hygrolife II

Table H-2. provides a list of consumable parts available for the ventilator.

⚠️ **WARNING:**

To ensure proper performance of the ventilator, use a patient circuit recommended by Covidien in this manual; refer to Chapter *6*, "*Installation and Assembly*" and Appendix *H*, "*Parts and Accessories*." The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 meters (3.6 ft) to 2.0 meters (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.

Table H-2. List of Circuits

Description	Part Number
DAR™ Single-limb patient circuit with exhalation valve, 180 cm, PVC, ADULT	5093600
DAR™ Single-limb patient circuit with exhalation valve, 180 cm, PVC, PEDIATRIC	5093500
DAR™ Single-limb patient circuit without exhalation valve, 180 cm, PVC, ADULT	5093300
DAR™ Single-limb patient circuit without exhalation valve, 180 cm, PVC, PEDIATRIC	5093100

For more information regarding parts and accessories for the Puritan Bennett 520 Ventilator, contact your service representative or www.covidien.com/rms/products.

I Glossary

AC Power

Alternating current.

Alarm Pause

The audible and visual alarms cease and the ⊠ symbol appears. The symbol will remain until the cause of the alarm is addressed. For example, when the ventilator is running on internal battery, the AC Disconnection alarm may be paused, and the alarm paused symbol will appear until the device is plugged into AC. The paused alarm will be captured in the alarm log screen and can be reactivated.

Alarm Reset

Used only for the High Pressure alarm, this function resets the visual alarm message.

Apnea

The absence of breathing or a breathing pattern capable of supporting an individual's respiratory needs.

Apnea Index (AI)

The apnea index is average number of apnea events per hour of ventilation. It is based on the Apnea alarm.

Apnea Time

Time allowed between breath starts before APNEA alarm occurs when no patient effort is detected.

Assist/Control

In Assist/Control mode, the ventilator delivers an assisted breath of a set pressure when the patient's breathing effort creates a flow or pressure drop that is greater than the SENSITIVITY setting. In absence of patient breathing effort, the ventilator will deliver a controlled breath of the set pressure. (Does not apply in PSV/CPAP mode).

Assisted Breath

A pressure breath triggered by the patient but then controlled and terminated by the ventilator.

Audio Pause

Pauses the audible alarm for 60 seconds at a time and shows the ⊠ symbol.

Back Up Rate

Rate of control cycles in PSV mode during apnea phase.

Battery Level

Display of the remaining battery capacity; located adjacent to the battery symbol.

Bias flow

Turbine flow during exhalation phase through the patient circuit to avoid rebreathing.

bpm

An abbreviation for "breaths per minute," which is the unit of measure for breath rate (see below).

Breath Rate

The total number of breaths, both machine and spontaneous, delivered by a ventilator in one minute.

Caregiver

An individual who assists a patient with the tasks of daily living. This may be a family member, a live-in assistant, or the nursing staff of a health care facility.

cmH_2O

An abbreviation for "centimeters of water," which is a unit of measure for pressure.

Continuous Positive Airway Pressure (CPAP)

Continuous airway pressure maintained throughout a spontaneous breath cycle.

Controlled breath

A pressure breath triggered, controlled and terminated by the ventilator.

DC Power

Direct current.

Exhalation Phase

Phase of the breath cycle during which the patient exhales.

Exhalation Sensitivity

The exhalation sensitivity (E Sens) level is a percentage of peak flow at which a pressure-supported breath will be terminated.

Fraction of Inspired Oxygen (FiO_2)

Amount of oxygen delivered to the patient.

Flow

Volume of gas delivered by the ventilator compared to time, expressed in liters per minute (lpm).

hPa

An abbreviation for "hectopascal," which is a unit of measure for atmospheric pressure.

I:E ratio

Inspiratory time versus exhalation time ratio.

Inspiratory Phase

Phase of the breath cycle during which the patient inspires.

Inspiratory Sensitivity (I Sens)

Level of inspiratory effort the patient has to provide during the initiation of a machine breath. The sensitivity levels (from 0P to 5) correspond to differences in flow compared to the bias flow. Level 0P is the most sensitive (for a pediatric use) and requires the least effort to trigger a breath. Level 5 requires the most amount of effort to trigger a breath.

Inspiratory Tidal Volume (VTI)

Volume delivered to the patient at each inspiratory phase.

Inspiratory Pressure (Pi)

The operator-set inspiratory pressure during a pressure control (PC) mandatory breath.

I Time (Inspiratory Time)

Inspiratory time measure.

Intentional Vent Stop Alarm

Ventilation has been switched off by the user / caregiver and the ventilator is in standby.

I/T Ratio

Inspiratory time versus total breath time ratio.

L

liters (a unit of volume).

Leak

When ventilating in leak configuration, it is the average patient/circuit leak during each cycle and over the past 24 hour period.

LED

Light emitting diode; used as indicator lights on the ventilator's front panel.

lpm

Liters per minute (a unit of volume flow rate).

Machine Hours Counter

Counter for the total ventilation time since manufacture or the last CPU board change.

Mains

AC power supply.

Max Leak

The maximum alarm setting of a high leakage threshold. An alarm will be triggered in the event the calculated leakageflow exceeds this limit.

Max Rtot (Total breath rate)

The maximum alarm setting to prevent hyperventilation or ventilator autotriggering. The HIGH RATE alarm will be triggered if the total breath rate exceeds the maximum limit set.

Max P (Maximum Inspiration Pressure)

Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the target tidal volume (Vt Target).

Mbar

An abbreviation for "millibar," which is a unit of measure for atmospheric pressure.

Mean Airway Pressure

Average patient pressure during each breath.

Minimum Inspiratory Time

Minimum inspiratory time before allowing the patient to exhale.

M Vol (Minute Volume)

Flow delivered at each breath to the patient is measured by the inspiratory flow sensor and that measurement is used to calculate minute volume (Vt x Rtot).

P A/C (Pressure Assist /Control)

A ventilator mode which provides machine-initiated breaths delivered at a clinician-set pressure, inspiratory time, and rate.

Patient Breath

Breathing cycle initiated by the patient.

Patient circuit

Tubing between the ventilator and the patient.

Patient effort

Inspiratory effort initiated by the patient.

Patient Hours Counter

Counter of ventilation time for the patient.

Peak Airway Pressure (Paw)

The peak airway pressure is the average peak pressure during the inspiratory phase, measured by each cycle and over the previous 24-hour period.

Peak Inspiratory Pressure (PIP)

The highest pressure measured in the patient circuit during the inspiration phase.

Positive End Expiratory Pressure (PEEP)

Pressure in the patient circuit at the end of expiration.

Pressure Control (P Control)

Augmentation of the patient's ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained throughout patient inspiratory flow, and is cycled to expiration by time (controlled by the selected Inspiratory Time setting). Used in Assist/Control mode.

Pressure Support (P Support)

Augmentation of the patient's ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained until inspiratory flow is reduced to a percentage of peak flow that depends on the exhalation sensitivity setting for the inspiration, when the ventilator cycles into exhalation.

PSI

Pounds per square inch.

PSV (Pressure Support Ventilation)

Pressure support ventilation.

Rebreathing

The patient breathes his/her exhaled gas.

Respiratory rate

The number of breath cycles (inspiration + expiration) completed within one minute. Normal resting adult respiratory rates are from 12–20 breaths per minute (bpm).

RESTART/SRVC

This is an alarm message. If the message *IF PERSISTS RESTART/SRVC occurs, restart the ventilator. If the alarm condition is not cleared, call a service representative.

Rise Time

This determines how the target pressure will be reached, and indirectly defines the minimum inspiration time.

Rtot

Parameter measured by the ventilator equal to the total number of breaths per minute (bpm).

Sensitivity

This adjustable parameter determines the amount of inspiratory effort required by the patient before the ventilator delivers an assisted breath, or demands flow in the case of a spontaneous breath.

The Puritan Bennett™ 520 Ventilator is pressure-triggered, with sensitivity levels in the range from 0P to 5: the lower the number, the more sensitive the trigger.

Spont Cyc (Spontaneous Cycling)

This is the percentage of ventilation cycles initiated by the patient over the previous 24 hour period.

Standby

The operational mode of the ventilator where it is powered (power supply I/O button set to the I position), but is not ventilating the patient.

Vent Time (Ventilation Time)

The ventilation duration data is based on the patient counter and shows the total ventilation time in hours and minutes over the previous 24-hour period.

Vt Target (Target volume)

The Vt Target feature enables the ventilator to reach a set volume of gas to be delivered to the patient using a range of pressures in the pressure-based ventilation modes.

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