

LP6 Plus Volume Ventilator -And- LP10 Volume Ventilator With Pressure Limit Clinician's Manual



Important Note: Read this manual in its entirety before using the ventilator. Keep this manual for future reference.

**PURITAN
BENNETT**

For more information: Contact your Puritan Bennett representative for information on our full line of medical equipment and related services. Or, you may contact Puritan Bennett directly.

Puritan Bennett Technical Services: 1.800.255.6774

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Introduction

Purpose of the Manual

This Clinician's Manual will help you understand the operation of the LP6 Plus and LP10 Volume Ventilators. It provides detailed information for physicians and other clinical personnel about the installation, safe use, and verification of the operation of the LP6 Plus and LP10 Volume Ventilators. It provides the caregiver guidelines for safe ventilation that are specific to the ventilator. It is not a complete maintenance document. Therefore, it contains no disassembly, repair, or reassembly instructions or diagrams.

Carefully read and understand all instructions before using the ventilator. Use the instructions contained herein in conjunction with those set by the patient's physician. No instruction in this manual is intended to replace accepted medical practice regarding the use of the ventilator or the care of the patient.

As you read this manual, you will notice **Cautions** and **Warnings** in boxes on many pages. Pay very special attention to these boxes. They will tell you what to do and what to avoid as you use the ventilator.

The difference between **Warnings** and **Cautions** is:

A **Warning** contains information about possible hazards to the patient, the care provider, or the service technician.

A **Caution** includes information about how to avoid equipment damage.

The **Notes** and **Accessories** sections found at the back of this manual are for your use in applying this manual's information to a specific patient. Puritan Bennett-supplied accessories include information concerning their use with the ventilator.

Symbols and definitions

The following symbols appear on the LP6 Plus and LP10 ventilators.

I	Power switch ON position, connection to mains power
O	Power switch OFF position, disconnection from mains power
	Attention, consult accompanying manual.
~AC	Alternating current
—	Direct current
V	Volts
A	Amperes
	Standby mode of operation
	Canadian Standards Association
	Battery test switch
	Alarm silence switch
	Alarm
	Power
	Patient pressure
	External battery connection
	Remote alarm
	Battery test level
	Manual reset

Warnings and Cautions

Warnings

Always follow the physician's prescription when using the ventilator.

Always operate and store the ventilator according to the specifications and instructions set forth in this manual.

Use only Puritan Bennett-approved accessories and products with the ventilator. The use of other accessories may damage the unit and endanger the patient.

Perform daily and monthly verification of the ventilator's operation as identified in this manual.

Always stabilize and verify ventilator performance before connecting the patient to the unit.

All alarms indicate a potential risk to patient safety. When an alarm sounds, provide immediate attention, care, and support to the patient as dictated by the situation.

The LP6 Plus and LP10 ventilators shall not be used with flammable anesthetic agents.

Do not use in direct sunlight.

Cautions

Refer any adjustments or procedures exceeding the scope of this manual to a Puritan Bennett Technical Service Representative. Refer to the Puritan Bennett Service Policy on page 62.

Caution: Federal Law (U.S.A.) restricts this device to sale or use by or on the order of a licensed physician.

Electrical Interference

Caution

Your ventilator is an electronic instrument. Any electronic instrument is subject to electrical interference. Electrical interference in excess of 10 V/m may keep your ventilator from working properly.

Television sets, cordless or cellular telephones, microwave ovens, air conditioners, food processors, and other appliances can be sources of electrical interference. To avoid electrical interference between your ventilator and these appliances, you must follow these instructions:

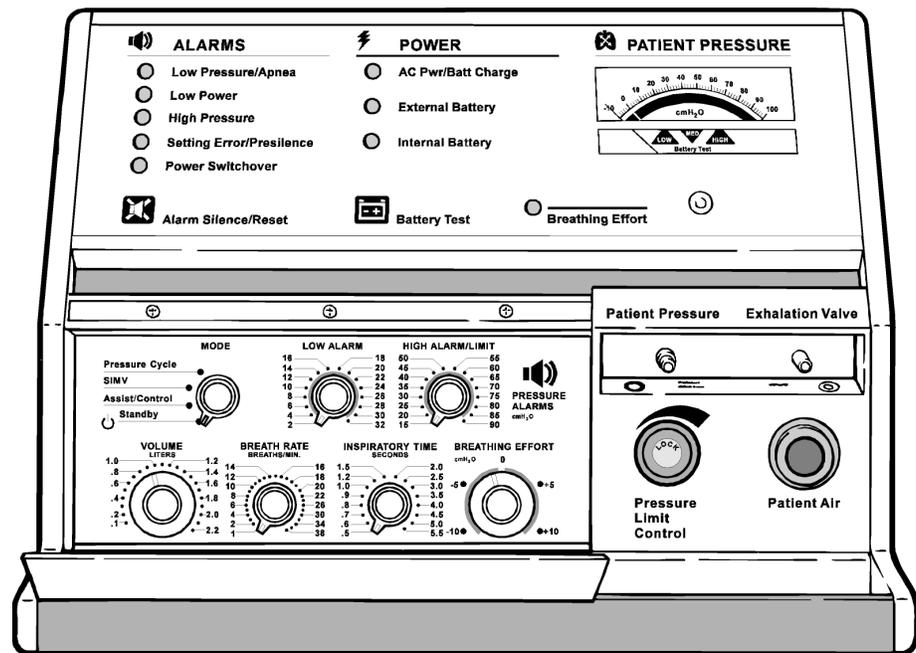
- Never place your ventilator near these appliances.
- Never plug the ventilator into the same A.C. electrical outlet as these appliances, nor into electrical outlets on the same circuit as these appliances.
- Never place the cables from ventilator accessories near these appliances.

Warning

Electrical interference may keep your ventilator from working properly, which may create a hazard to the patient.

Note The ventilator is exempt under Section 15.801 (c)(5) of the no interference regulations adopted by the FCC. If television interference does occur, contact Technical Services at Puritan Bennett, Inc. or a television repair technician for suggestions. Or, move the television to an A.C. electrical outlet that does not allow interference.

General Description



The Puritan Bennett LP6 Plus and LP10 Volume Ventilators are intended for use in a non-acute care institution or transport, on pediatric and adult patients. It is to be operated in accordance with the product labeling contained in this instruction manual.

The LP6 Plus and LP10 Volume Ventilators are microprocessor-controlled volume ventilators. They provide continuous respiratory support for patients with respiratory insufficiencies in a skilled nursing facility or hospital, or during transport. Because of the compact design and light weight, the units are highly portable.

The ventilators offer a wide range of delivery volumes, inspiratory times, and breathing rates. The physician or the respiratory therapist can set the appropriate ventilation via the controls located in the recessed front panel. The magnetically latched door panel and the control knobs are designed to prevent tampering and accidental resetting.

Audible and visual alarms quickly identify problems. See pages 6 through 10 for a complete discussion of these alarms.

Alarm Condition

Warnings

All alarms indicate a potential risk to patient safety. When an alarm sounds, provide immediate attention, care, and support to the patient as dictated by the situation.

Any device is subject to unpredictable failures. To ensure patient safety, an appropriately trained caregiver should monitor ventilation. If the patient's condition warrants the use of an independent secondary alarm, remote alarm, or another external monitoring device, the physician should prescribe it. The physician should also determine to what level the patient may require an alternate means of ventilation.

Certain types of ventilators, including the *LP Series*, have a Low Inspiratory Pressure Alarm. The purpose of this alarm is to alert the clinician or caregiver when the pre-set alarm parameters are violated. As set forth in the LP Series Clinician's and User's Manuals, a number of environmental factors and circuit accessories/components can affect the pressure in the breathing circuit. These factors may prevent circuit pressure from violating the low-pressure parameters, even in the event of a circuit being disconnected from the patient. Therefore, it is important for the clinician to consider and monitor these environmental factors when establishing pressure alarm parameters. Depending on the specific clinical situation (e.g., risk of disconnect perceived as high, patient is ventilator dependent) a secondary means of monitoring ventilation (e.g., pulse oximetry) should be considered.

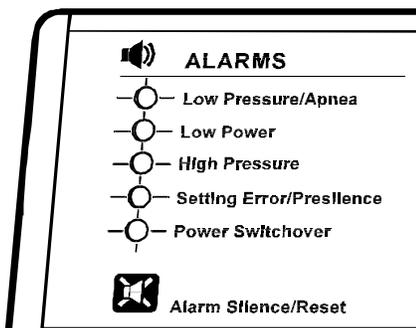


Responding to Alarms

The ventilator has visual and audible alarms. The audible alarm is usually a pulsating tone. Both the ventilator and the remote alarm emit these tones. Flashing or steady light(s) on the ventilator indicate the source of the problem.

A Pulsating Audible Alarm and Flashing Light(s):

The Low Power, High Pressure, Setting Error, and Power Switchover alarms all use this type of alert signal.





A Steady Audible Alarm and Steady Lights:

This combination indicates a detected microprocessor error in the ventilator.

Single Reminder Tone:

A single tone sounds every five minutes when the internal battery powers the ventilator.

Note In Assist/Control and SIMV modes, the High Pressure Alarm sounds whenever the air pressure exceeds the selected high pressure limit. In the Pressure Cycle mode, however, the High Pressure Alarm sounds only when the air pressure exceeds the selected high pressure limit by 10 cmH₂O/hPa.



When an alarm sounds:

First, attend to the patient immediately. Then, check the flashing or steady light(s) on the ventilator to identify the source of the problem.

You may press the Alarm Silence/Reset button to silence the alarm. This turns off the signal for one minute. If the alarm condition is corrected during that minute, the alarm light will turn off.

A microprocessor error cannot be silenced. You cannot silence an alarm before it occurs.

Note If a High Pressure, or Setting Error alarm condition is corrected before you press Alarm Silence/Reset, the audible alarm will stop but the light will continue to flash. Press Alarm Silence/Reset to turn off the light.

If a Low Pressure/Apnea, Low Power or Power Switchover alarm condition is corrected before you press Alarm Silence/Reset, both the audible and visual alarms will continue. You must press Alarm Silence/Reset to turn off the audible alarm and the light.

Warning

If alarms continue to sound, provide another means of ventilation and contact your homecare dealer.

Troubleshooting Guide

Conditions	Probable Cause	Solution
<p>All lights turn on and audible alarm sounds</p>	<p>Normal condition. Alarms test when unit is turned on.</p> <p>Normal; manual alarm test.</p> <p>Microprocessor error.</p>	<p>Alarms will stop in two seconds.</p> <p>Alarms will stop in one second.</p> <p>Turn vent off and set mode to Standby. Wait a few seconds. Return switches to prescribed settings. If alarm persists, provide another means of ventilation.</p>

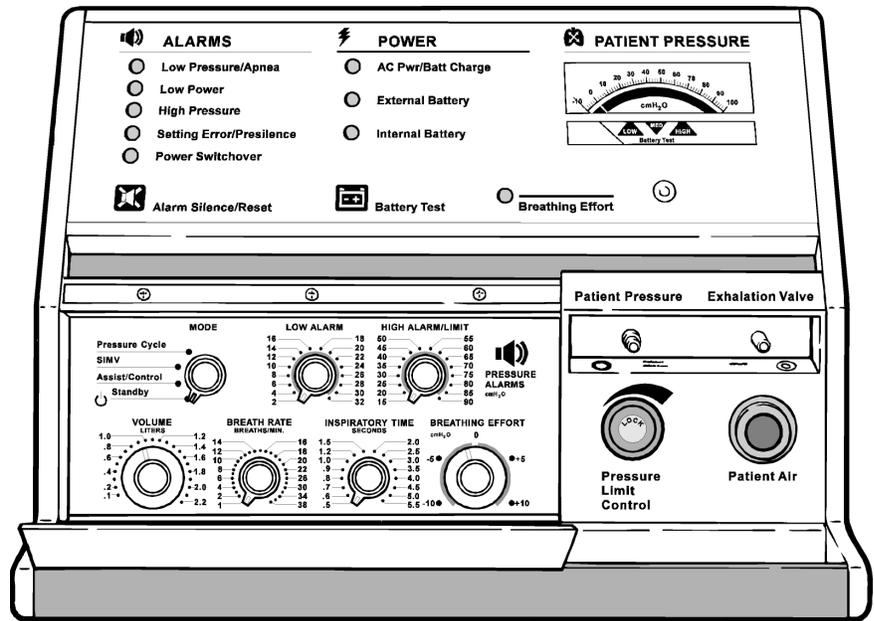
Conditions	Probable Cause	Solution
Low Pressure/Apnea Alarm: Pulsating audible tone with flashing light	The patient is not breathing.	Check the patient for breathing effort.
	Leaks or loose connections in the patient circuit.	Check connection of the patient circuit to the ventilator; check all connections for leaks and tightness, especially at the humidifier, trach tube, and exhalation valve.
	Water in small-bore tubing.	Inspect and remove water from small-bore tubing.
	Crimped small-bore tubing.	Uncrimp the small-bore tubing.
	PEEP pressure set higher than the Low Alarm control setting.	Set Low Alarm control setting higher than the PEEP pressure.
	The patient's breathing effort is less than the Breathing Effort control setting.	Set Breathing Effort so the patient's breathing effort turns on the Breathing Effort light.
	Patient speech or other activities lower patient airway pressure.	Low pressure alarm sounds whenever low pressure limit is not reached for two consecutive breaths. Review the section on alarms.
	Low alarm setting is higher than Pressure limit setting. (LP10 only)	Correct to the prescribed value.
	Volume set below patient's tidal volume.	Correct to the prescribed value.
	Pressure Limit level is set too low. (LP10 only)	Correct to the prescribed value.
Low Power Alarm: Pulsating audible tone with flashing light	Incorrect control settings.	Reset to prescribed values.
	Leaks or obstructions in the patient circuit.	Check for leaks or crimped tubing.
	Other causes.	Notify your physician and your home-care dealer
	Failure to recharge the Internal battery.	Operate the ventilator on AC power for at least three hours, or place ventilator in Standby Mode while on AC power; use backup ventilator.

Conditions	Probable Cause	Solution
High Pressure Alarm: Pulsating audible tone with flashing light	Water in the tubing.	Remove water from tubing.
	Crimped tubing.	Straighten crimped tubing.
	Coughing or other high-flow expiratory efforts.	Treat patient's cough. The alarm is appropriate for these conditions.
	Patient inspiratory resistance or compliance changes.	Have physician determine new ventilator settings.
	A sticky Pressure Limit control.	Occlude the end of the patient circuit to free the valve.
	Airway obstruction	Check for trach obstruction or for a condition in which the patient requires suctioning.
	Malfunction in the exhalation manifold.	See the manifold manufacturer's instructions.
Setting Error Alarm	Pressure Limit setting is higher than the High Alarm setting. (LP10 only)	Reset both to the prescribed values.
	Inappropriate setting or settings beyond the capabilities of the machine.	Readjust settings to the physician's prescription.
Internal Battery light flashes	Dirty inlet filter.	Replace filter.
	Unit has not switched to external battery.	Check for unconnected or misconnected battery cable. Check for blown fuse in the battery cable. Use another external battery.
Single tone	DC circuit breaker is open.	Reset by pushing in protruding rod.
	Unit is operating on internal battery.	Check for unconnected or misconnected battery cable. Check for blown fuse in the battery cable. Use another external battery.
Green AC Power light does not glow	AC circuit breaker is open.	Turn it back ON.
	AC power cord is not connected.	Plug in the cord.
	No power at the wall outlet.	Use an active outlet.

Warning

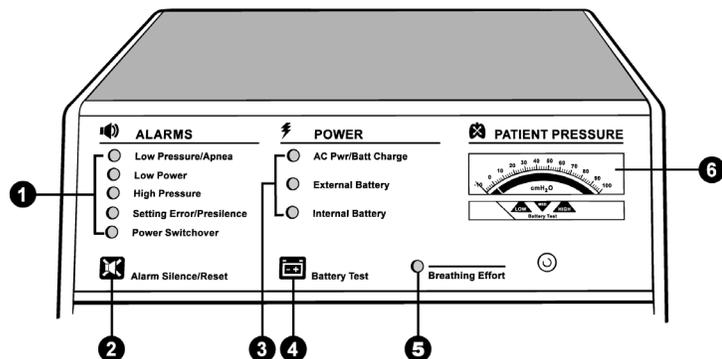
If the problems continue, provide another means of ventilation and contact your homecare dealer.

Front Panel



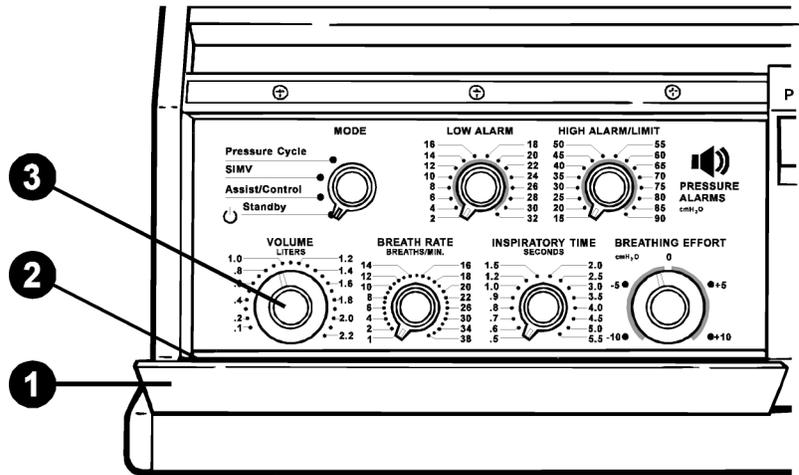
The Front Panel of the ventilator has three sections:

- The upper section has small lights, two touch button pads, and a meter.
- The lower left section has the operating controls. The physician prescribes their setting. To prevent accidental resetting, they are behind a closed panel.
- The lower right section has the Pressure Limit control and the connections for the Patient Circuit.



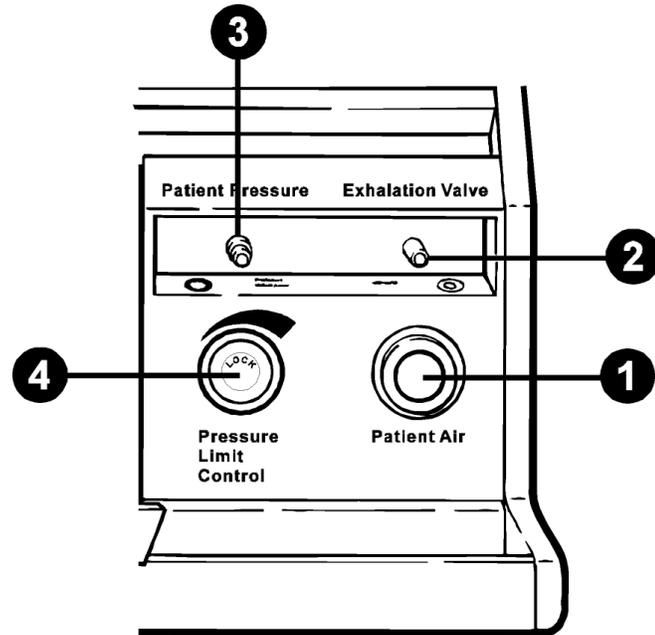
- Upper Section**
1. **Alarm Lights:** When flashing or continuously lit, they identify a condition that demands immediate attention. There is also an audible tone when these lights begin flashing.
 2. **Alarm Silence/Reset Button: This has five uses.**
 - Push to test the alarms.
 - Push to silence alarms for 60 seconds.
 - Push to reset the alarm after correcting the problem.
 - Push simultaneously with the Battery Test Button for operating hours. (See the Scheduled Maintenance portion of the manual, page 61.)
 - Use this button with other controls to start the self-test. (See page 31.)
 3. **Power Source Lights:**
 - The top light is green when the ventilator is AC powered.
 - The middle light is amber when an external battery powers the ventilator.
 - The bottom light flashes amber when the ventilator's internal battery is in use. A single tone also beeps every five minutes.
 4. **Battery Test Button:** It has four uses.
 - When pressed, the Pressure Meter displays the charge status of the battery in use (internal or optional external battery).
 - Push simultaneously with the Alarm Silence/Reset button for an indication of operating hours. (See the Scheduled Maintenance portion of this manual, page 56.)
 - Press the button to print a report from an attached printer.
 - Use this button with other controls to start the self test. (See page 31.)
 5. **Breathing Effort Light:** This light turns green whenever the ventilator senses the patient's effort to breathe. The Breathing Effort control sets the sensitivity.
 6. **Patient Pressure Meter:** The meter displays three pieces of information:
 - Pressure at the Exhalation Manifold.
 - The number of hours of ventilator operation.
 - The charge status of the internal or attached external battery.

Lower Left Section



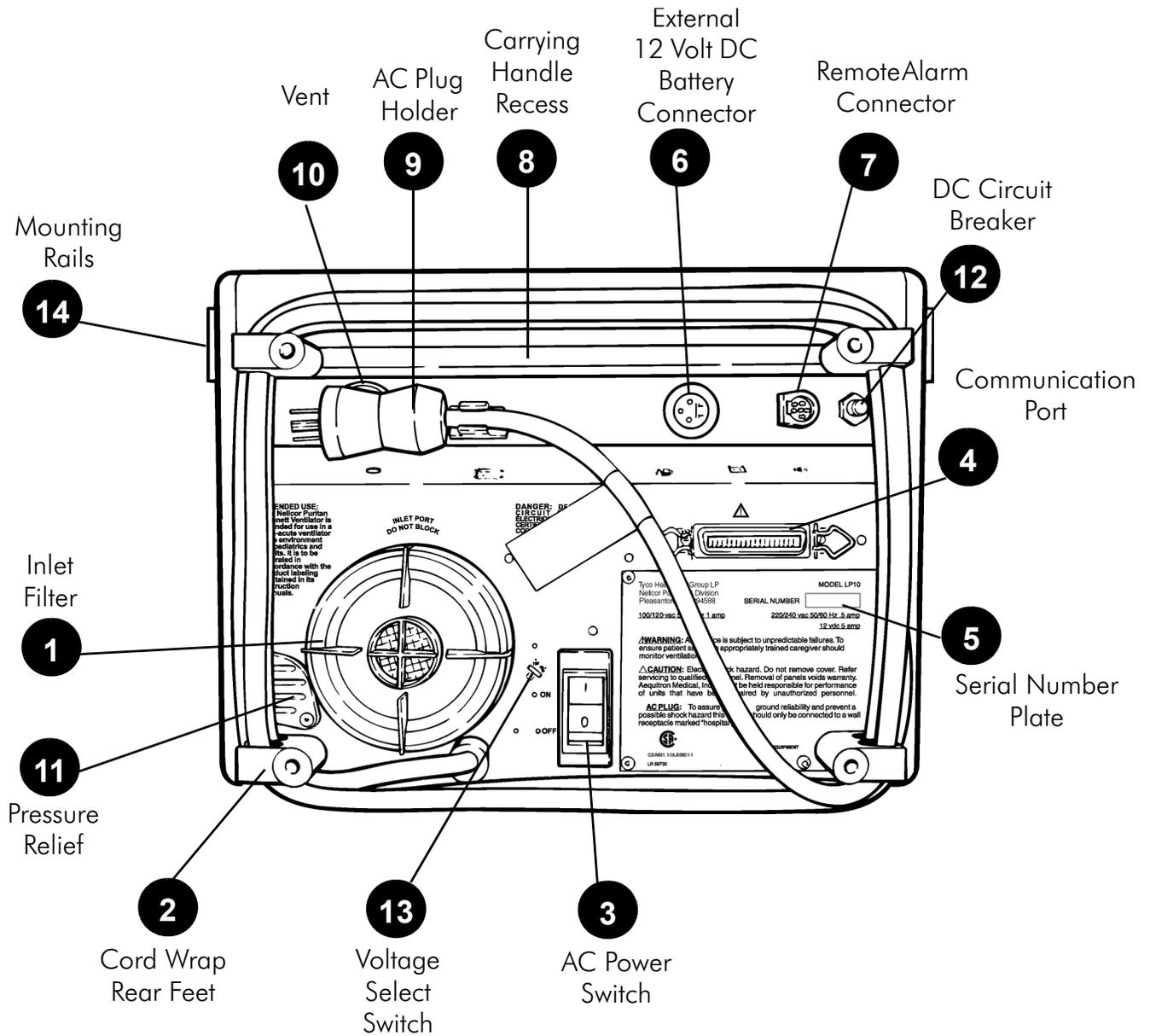
1. **Control Panel Door:** This door is latched magnetically to protect the controls from accidental resetting.
2. **Alarm Reference Guide:** Consult this guide for a summary of alarms and the action you should take. You will find the Guide on the inside of the Control Panel Door.
3. **Control Knobs:** They are behind the closed Control Panel Door. The patient's physician prescribes the settings for these controls. See pages 17 through 23 for details.

Lower Right Section



1. **Patient Air Tube:** The Patient air hose connects to this tube. The ventilator delivers air through this tube.
2. **Exhalation Valve Port:** The Exhalation Pressure Tube of the Patient Circuit connects to this port.
3. **Patient Pressure Port:** The Patient Pressure Tube of the Patient Circuit connects to this port.
4. **Pressure Limit Control (LP10 Only):** This control sets the air pressure limit during a forced or assisted breath. For use in Assist/Control or SIMV modes only; use in other modes may not allow effective ventilation. See pages 24 through 26.

Rear Panel



1. **Inlet Filter:** The ventilator draws in air through this filter.

Warning Do not block the inlet filter. (Keep away from curtains.)

2. **Cord Wrap and Rear Feet:** There is a foot at each corner.
3. **AC Power Switch/Circuit Breaker:** This is the ON/OFF switch for AC power. It also has a built-in circuit breaker. 1 is power connected to mains and 0 is power disconnected from mains.
4. **Communications Port:** A special cable fits here and leads to an optional printer.

Note The ventilator and printer should be turned off before connection or disconnection of the printer.

5. **Serial Number Plate:** This has Puritan Bennett's identification number for the ventilator. It also lists the unit's power requirements.
6. **External 12 Volt DC Battery Connector:** This is where you plug in an external battery cable.
7. **Remote Alarm Connection:** A remote alarm (optional) can summon the caregiver when an alarm sounds.
8. **Rear Carrying Handle Recess**
9. **AC Plug Holder**
10. **Vent:** Warm air from the unit's circuitry leaves the ventilator and cool air enters through this vent. This cools the ventilator.

Warning Do not block rear panel vent

11. **Pressure Relief:** This prevents the air pressure from exceeding approximately 100 cmH₂O/hPa.

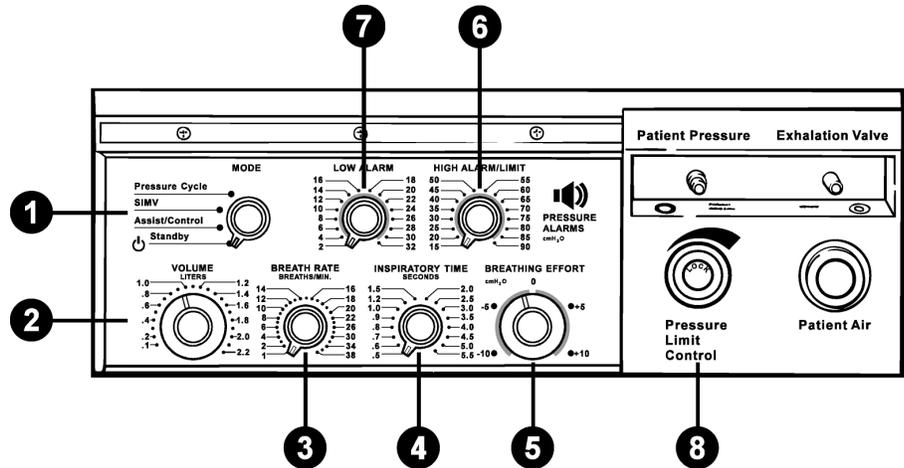
Warning Do not block the pressure relief valve.

12. **DC Circuit Breaker:** This circuit breaker protects the ventilator when it is powered by an external battery.
13. **Voltage Select Switch:** This switch selects 110 or 220 volts when it is powered by an external battery

Caution An incorrect switch setting may damage your ventilator.

14. **Mounting Rails:** These are used to mount and connect accessories to the ventilator.

Operating Controls



Warning

Periodically check the control settings to be sure they are at the prescribed setting. Always verify that the controls are set correctly before connecting and using the ventilator. Do not change them without a physician's orders.

1. **Mode:** This control selects the operating mode for the ventilator.
2. **Volume:** This sets the amount of air the patient receives for each breath. To change the setting, push in the control and then turn it to the selected setting. Any change made during operation results in a maximum change of 100 milliliters from breath to breath until the new volume is reached.

Warning

For more precise accuracy in setting the volume control (indicator), the use of an external volume measuring device is recommended.

3. **Breath Rate:** This setting controls the minimum number of breaths per minute (BPM) delivered by the ventilator.
4. **Inspiratory Time:** This sets the time it takes for the ventilator to deliver a breath.

5. **Breathing Effort:** This adjusts the ventilator's sensitivity to the patient's breathing effort. When the patient's effort reaches the setting, the Breathing Effort light turns on and the ventilator delivers a breath. Push in the control knob to change the setting.
6. **High Alarm/Limit:** This sets the point at which the High Pressure alarm will sound. If the pressure exceeds this limit, the High Pressure alarm sounds (except in the Pressure Cycle mode). Delivery of this breath stops after the pressure reaches this limit. The audible alarm is automatically silenced if the following breath does not exceed the setting.

Often, when the high alarm sounds, the patient circuit has an obstruction. Clearing the circuit will stop the alarm.

7. **Low Alarm:** This establishes the pressure which must be exceeded with "controlled" or "assisted" breath. The alarm sounds only when two consecutive breaths do not reach the selected limit, or if the limit is reached but the pressure fails to return to a level below the limit. Normally, this setting is just below the pressure you need for proper ventilation.

If this alarm sounds, look for a leak in the patient circuit. A leak or disconnection of the circuit is often the cause for the alarm.

Note Some circuit components will prevent a Low Pressure alarm by keeping the pressure in the circuit above the alarm limit. Examples of these components include hydrated heat and moisture exchangers (HMEs) and tracheostomy tubes. If the patient circuit is disconnected from the patient, but still connected to these components, a Low Pressure alarm may not sound.

Where such disconnections from a ventilator-dependent patient are possible, you must set the Low Pressure alarm to a level that permits an alarm to sound. To do this, simulate the disconnection; if a Low Pressure/Apnea alarm does not sound after two breath cycles, increase the alarm limit until an alarm sounds.

8. **Pressure Limit (LP10 Only):** This limits the maximum pressure developed for each breath. For use with Assist/Control or SIMV modes only; use in other modes may not allow effective ventilation. See Operating Modes section, below, for details.

Operating Modes

Assist/Control In this mode, if the breathing effort is strong enough to trigger the Breathing Effort light, the ventilator assists breathing. The ventilator then delivers the selected prescribed volume of air. If the patient makes no effort to breathe and, thus, fails to activate the Breathing Effort light, the ventilator takes control. It delivers breaths at the selected rate.

Breath Rate set at 1 - 5 BPM

If the patient does not start a breath on his/her own for 10 seconds, the Apnea alarm sounds and alerts the caregiver. Meanwhile, the ventilator delivers breaths at 10 BPM at the selected volume.

Breath Rate set at 6 BPM or more

No alarms sound if the patient fails to start a breath. The ventilator continues to deliver breaths at the selected rate and volume.

Assist/Control with Pressure Limit (LP10 Only) The ventilator functions as described under the Assist/Control mode. The only difference is that the ventilator will limit the pressure during a delivered breath.

Note Since the pressure limit function bleeds off air to limit pressure, the volume of air delivered will be less than the set value.

SIMV (Synchronized Intermittent Mandatory Ventilation) In this mode, the patient can breathe unassisted and on his/her own between ventilator delivered breaths. The ventilator monitors these spontaneous breaths.

If the patient's effort is not strong enough to turn on the Breathing Effort light or the patient makes no effort, the ventilator delivers a controlled breath. All this depends on the breath rate setting:

Breath Rate set at 1 - 5 BPM

If the patient does not start a breath on their own for 20 seconds, the Apnea alarm sounds and alerts the caregiver. Meanwhile, the ventilator delivers breaths at 10 BPM at the selected volume.

Breath Rate set at 6 BPM or more

No alarms sound if the patient fails to start a breath. The ventilator continues to deliver breaths at the selected rate and volume.

SIMV with Pressure Limit The ventilator functions as described under the SIMV mode. The only difference is that the ventilator will limit the pressure during a delivered breath.

Pressure Cycle In this mode, the ventilator assists or controls the patient's breathing as it does in the Assist/Control mode. But, there's a difference. If the air pressure exceeds the level set on the High Alarm/Limit, delivery of the breath is stopped and the high pressure alarm does not sound. The high pressure alarm sounds only if the air pressure happens to exceed the High Alarm/Limit by 10 cmH₂O/hPa.

Note The high pressure alarm sounds only if the air pressure happens to exceed the limit by 10 cmH₂O/hPa.

Breath Rate set at 1 - 5 BPM

If the patient does not start a breath on his/her own for 10 seconds, the Apnea alarm sounds and alerts the caregiver. Meanwhile, the ventilator delivers breaths at 10 BPM.

Breath Rate set at 6 BPM or more

No alarms sound if the patient fails to start a breath. The ventilator continues to deliver breaths at the selected rate and volume.

Warning

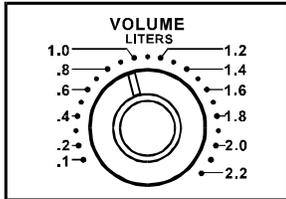
In this mode, when the pressure reaches the level of the High Alarm/Limit, the ventilator is designed to cycle into expiration without sounding an alarm. It is unlikely that the pressure will exceed the set limit by 10 cmH₂O/hPa.

Standby The ventilator will not deliver breaths with the control in this mode. It will, however, charge the internal or connected external battery, but only when the AC Pwr/Batt charge is ON with the unit plugged into a wall outlet. The patient may breathe through the patient circuit in this mode.

External and internal batteries charge equally well in all Modes.

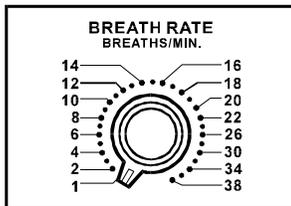
Ventilator Parameters

Volume



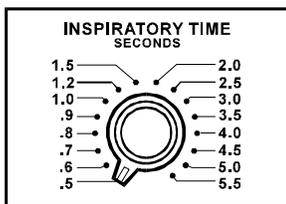
Set the delivered, or tidal volume, with the front panel Volume control. This push-to-turn knob sets the piston excursion. Its range is from 100 to 2200 ml.

Breath Rate



Adjust the rate (breaths per minute) with the Breath Rate control. Increments are 1 BPM for rates of 1 to 20 BPM, and 2 BPM for rates of 22 to 38 BPM. To find the maximum inspiratory flow rate, see the upper table on the next page.

Inspiratory or I-Time



This control adjusts the rate at which the prescribed tidal volume is delivered to the patient's lungs. Increments are 0.1 seconds for times of 0.5 to 1.0 seconds and 0.5 seconds from 1.5 to 5.5 seconds. You may also select an intermediate setting of 1.2 seconds.

Inspiratory time and Breath Rate determine both the Expiratory time and the I:E ratio. The Volume and Inspiratory Time setting determine the flow rate. (Example: 1.0 liters of vol. @ 1.0 sec Inspiratory Time = 60 LPM flow rate.) See the lower table on the next page.

Note

Breath Rate and Inspiratory Time settings that produce an inverse I:E ratio cause a Setting Error alarm. The ventilator will not deliver inverse I:E ratios. It will deliver breaths at the set inspiratory time, an I:E ratio of 1:1.

To determine the maximum inspiratory time or BPM values, use one of these formulas:

$$30 \text{ divided by Inspiratory Time} = \text{Maximum Breath Rate, or}$$

$$30 \text{ divided by Breath Rate} = \text{Maximum Inspiratory Time.}$$

Ventilator Parameters

Inspiratory Flow Rate Table

Cross reference set volume and inspiratory time to find average flow rate (liters per minute)

		Volume (liters)																
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	
Inspiratory Time (seconds)	0.5	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0	120.0							
	0.6	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	120.0						
	0.7	8.6	17.1	25.7	34.3	42.9	51.4	60.0	68.6	77.1	85.7	102.9	120.0					
	0.8	7.5	15.0	22.5	30.0	37.5	45.0	52.5	60.0	67.5	75.0	90.0	105.0	120.0				
	0.9	6.7	13.3	20.0	26.7	33.3	40.0	46.7	53.3	60.0	66.7	80.0	93.3	106.7	120.0			
	1.0	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0	60.0	72.0	84.0	96.0	108.0	120.0		
	1.2	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	
	1.5	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	40.0	48.0	56.0	64.0	72.0	80.0	88.0	
	2.0	3.0	6.0	9.0	12.0	15.0	18.0	21.0	24.0	27.0	30.0	36.0	42.0	48.0	54.0	60.0	66.0	
	2.5	2.4	4.8	7.2	9.6	12.0	14.4	16.8	19.2	21.6	24.0	28.8	33.6	38.4	43.2	48.0	52.8	
	3.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	24.0	28.0	32.0	36.0	40.0	44.0	
	3.5	1.7	3.4	5.1	6.9	8.6	10.3	12.0	13.7	15.4	17.1	20.6	24.0	27.4	30.9	34.3	37.7	
	4.0	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0	18.0	21.0	24.0	27.0	30.0	33.0	
	4.5	1.3	2.7	4.0	5.3	6.7	8.0	9.3	10.7	12.0	13.3	16.0	18.7	21.3	24.0	26.7	29.3	
	5.0	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	14.4	16.8	19.2	21.6	24.0	26.4	
	5.5	1.1	2.2	3.3	4.4	5.5	6.5	7.6	8.7	9.8	10.9	13.1	15.3	17.5	19.6	21.8	24.0	

(Volume/Inspiratory Time) X 60 = Average Inspiratory Flow Rate

I:E Ratio Table

Cross reference set breath rate and inspiratory time to find ratio of inspiratory time to expiratory time

		Breath Rate (BPM)																															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38			
Inspiratory Time (seconds)	0.5	1:119	1:59	1:39	1:29	1:23	1:19	1:16	1:14	1:12	1:11	1:10	1:9	1:8	1:8	1:7	1:7	1:6	1:6	1:5	1:5	1:4	1:4	1:4	1:3	1:3	1:3	1:3	1:2	1:2			
	0.6	1:99	1:49	1:32	1:24	1:19	1:16	1:13	1:12	1:10	1:9	1:8	1:7	1:7	1:6	1:6	1:5	1:5	1:5	1:4	1:4	1:4	1:3	1:3	1:3	1:2	1:2	1:1.9	1:1.8	1:1.6			
	0.7	1:85	1:42	1:28	1:20	1:16	1:13	1:11	1:10	1:9	1:8	1:7	1:6	1:6	1:5	1:5	1:4	1:4	1:4	1:4	1:3	1:3	1:3	1:2	1:2	1:1.9	1:1.7	1:1.5	1:1.4	1:1.3			
	0.8	1:74	1:37	1:24	1:18	1:14	1:12	1:10	1:8	1:7	1:7	1:6	1:5	1:5	1:4	1:4	1:4	1:3	1:3	1:3	1:3	1:2	1:2	1:1.9	1:1.7	1:1.5	1:1.3	1:1.2	1:1.1				
	0.9	1:66	1:32	1:21	1:16	1:12	1:10	1:9	1:7	1:6	1:6	1:5	1:5	1:4	1:4	1:3	1:3	1:3	1:3	1:3	1:2	1:2	1:1.8	1:1.6	1:1.4	1:1.2	1:1.1						
	1.0	1:59	1:29	1:19	1:14	1:11	1:9	1:8	1:7	1:6	1:5	1:4	1:4	1:4	1:3	1:3	1:3	1:3	1:2	1:2.2	1:2	1:1.7	1:1.5	1:1.3	1:1.1	1:1.0							
	1.2	1:49	1:24	1:16	1:12	1:9	1:7	1:6	1:5	1:5	1:4	1:4	1:3	1:3	1:3	1:2	1:2	1:1.9	1:1.8	1:1.6	1:1.5	1:1.3	1:1.1										
	1.5	1:39	1:19	1:12	1:9	1:7	1:6	1:5	1:4	1:3	1:3	1:3	1:2	1:2	1:1.9	1:1.7	1:1.5	1:1.4	1:1.2	1:1.1	1:1.0												
	2.0	1:29	1:14	1:9	1:7	1:5	1:4	1:3	1:3	1:2	1:2	1:1.7	1:1.5	1:1.3	1:1.1	1:1.0																	
	2.5	1:23	1:11	1:7	1:5	1:4	1:3	1:2	1:2	1:1.7	1:1.4	1:1.2	1:1.0																				
	3.0	1:19	1:9	1:6	1:4	1:3	1:2	1:1.9	1:1.5	1:1.2	1:1.0																						
	3.5	1:16	1:8	1:5	1:3	1:2	1:1.9	1:1.4	1:1.1																								
	4.0	1:14	1:7	1:4	1:3	1:2	1:1.5	1:1.1																									
	4.5	1:12	1:6	1:3	1:2	1:1.7	1:1.2																										
	5.0	1:11	1:5	1:3	1:2	1:1.4	1:1.0																										
	5.5	1:10	1:4	1:3	1:1.7	1:1.2																											

((60/Breath Rate) - Inspiratory Time)/Inspiratory Time = I:E Ratio

Breathing Effort This push-to-turn knob sets the patient effort needed to trigger an assisted breath. It also sets the effort needed to reset the Apnea BPM rate with breath rates from 1 to 5 BPM. The settings are continuous from -10 to +10 cmH₂O/hPa, with zero being atmospheric pressure. When the patient's breathing effort is sufficient, the green Breathing Effort indicator lights up. Use the control settings above zero (the plus settings) to compensate for Positive End Expiratory Pressure (PEEP).

Warning

Positive Breathing Effort settings, without the use of PEEP, will cause the ventilator to autocycle (i.e., deliver breaths based on the selected inspiratory time at a 1:1 ratio).

Pressure Alarms Low Alarm sets the low pressure limit. The increments are 2 cmH₂O/hPa for settings from 2 to 32 cmH₂O/hPa. Adjust the setting to a value just below the pressure necessary for proper patient ventilation.

The low pressure alarm sounds only when two consecutive breaths do not reach the selected limit, or if the limit is reached but the pressure fails to return to a level below the limit. **You must manually reset the low pressure alarm by pushing Alarm Silence/Reset.**

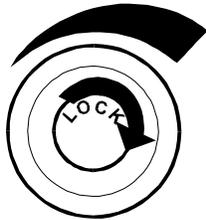
The High Alarm/Limit control sets the high pressure limit. The high pressure alarm sounds when the limit is exceeded in the Assist/Control or SIMV operating modes or when the limit is exceeded by 10 cmH₂O/hPa in the Pressure Cycle mode. The inspiratory phase stops if the high pressure limit is exceeded. The audible alarm is automatically silenced if the following breath does not exceed the setting. The settings are 15 to 90 cmH₂O/hPa with increments of 5 cmH₂O/hPa.

Note Some circuit components will prevent a Low Pressure alarm by keeping the pressure in the circuit above the alarm limit. Examples of these components include hydrated heat and moisture exchangers (HMEs) and tracheostomy tubes. If the patient circuit is disconnected from the patient, but still connected to these components, a Low Pressure alarm may not sound.

Where such disconnections from a ventilator-dependent patient are possible, you must set the Low Pressure alarm to a level that permits an alarm to sound. To do this, simulate the disconnection; if a Low Pressure/Apnea alarm does not sound after two breath cycles, increase the alarm limit until an alarm sounds.

Note Parameter settings beyond the capabilities of the machine will produce a Setting Error alarm.

Pressure Limit Control (LP10 Only)



Pressure Limit Control

The Pressure Limit Control is a mechanical, spring-loaded valve that operates independently of the ventilator's microprocessor. The control is designed for optional use in the Assist/Control and SIMV operating modes. It allows the ventilator to function like a pressure limited, time-cycled ventilator.

Note Pressure limit control ventilation is intended for use with uncuffed tracheostomy tubes, or in other patient circuit configurations which ensure an intentional artificial airway leak.

When the Pressure Limit Control is activated, the normal waveform of the LP10-I Ventilator is altered and the ventilator provides extended or plateaued pressures.

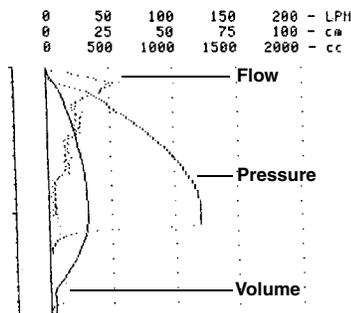
The figures below illustrate two printouts depicting waveforms with and without Pressure Limit.

```

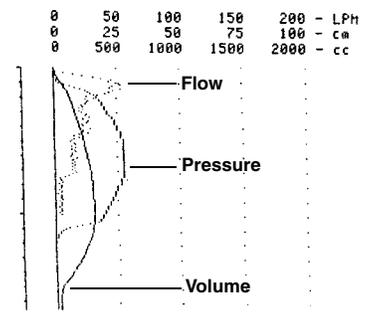
REQUITRON LP6+/10 VENTILATOR S/N      5
NAME:----- ROOM:-----
TIME: 07-07-92 12:54:00 HOURS: 1
MODE: ASSIST/CONTROL PHR: AC
ALARMS: NONE
      SET      ACTUAL
VOLUME-Liters      .310      .312
RATE-BPH:          30.0      29.6
INSP TIME-sec:     1.00      1.01
I:E RATIO:         1: 1.0    1: 1.0
FLOW-L per min:    19        19
*BREATHING EFFORT-cm: -4.5
HIGH ALARM-cm:     90
LOW ALARM-cm:      2
PEAK PROX PRESS-cm:          59.9
MEAN PROX PRESS-cm:          22.0
MIN PROX PRESS-cm:          .0
    
```

```

*REQUITRON LP6+/10 VENTILATOR S/N      5
NAME:----- ROOM:-----
TIME: 07-07-92 12:52:29 HOURS: 1
MODE: ASSIST/CONTROL PHR: AC
ALARMS: NONE
      SET      ACTUAL
VOLUME-Liters      .310      .312
RATE-BPH:          30.0      29.9
INSP TIME-sec:     1.00      1.00
I:E RATIO:         1: 1.0    1: 1.0
FLOW-L per min:    19        19
BREATHING EFFORT-cm: -4.7
HIGH ALARM-cm:     90
LOW ALARM-cm:      2
PEAK PROX PRESS-cm:          27.3
MEAN PROX PRESS-cm:          10.5
MIN PROX PRESS-cm:          .0
    
```



Without Pressure Limit

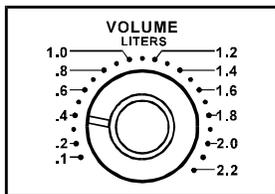


With Pressure Limit

Note The illustrations are actual reproductions of printouts from the printer.



Pressure Limit Control



Use the following instructions to activate and adjust the Pressure Limit Control.

To set the Pressure Limit level on the LP10:

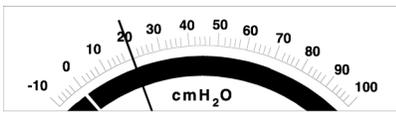
1. Disconnect the patient from the ventilator. Provide another means of ventilation.
2. Turn the Pressure Limit Control counter-clockwise until it stops. This reduces the pressure to near zero.

Note The outside ring of the knob must be pushed in before the center adjustment knob can be moved.

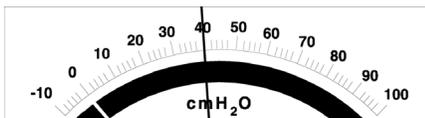
3. Set all controls to the prescribed settings.
4. A guide for setting the Volume Control is a calculation based on the patient's body weight. This factor should be approximately 7 ml/lb (18 ml/kg), or 100 ml, whichever is greater. Example: Patient weight = 55 lbs., set volume at 385 ml. Note that the Volume Control setting is a prescribed setting.
5. Block the Exhalation Manifold at the port that connects to the patient to observe the pressure on the Pressure Meter.

Warning

Wash hands thoroughly. Do not introduce germs or contaminants into the patient circuit while performing this task.

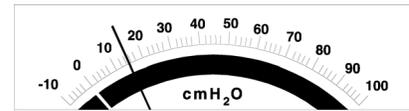
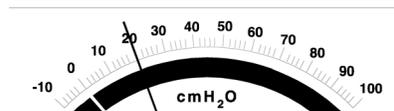


Pressure Limit Control



6. Watch the needle on the Patient Pressure Meter. Note the highest pressure achieved during a machine-delivered breath.
7. Turn the Pressure Limit Control clockwise in small increments each breath until the meter needle reaches, but does not exceed, the pressure value prescribed by the physician.
8. When the prescribed Pressure Limit is reached, allow the machine to cycle for several breaths to verify stable operation.
9. Reconnect the patient to the ventilator.

10. When you first connect the patient to the ventilator, the value of the limited pressure may drop. (See Figures.) Watch the needle on the Patient Pressure Meter. Slight increases in the Pressure Limit setting may be required to increase the maximum pressure to the prescribed limit. Allow the machine to cycle several breaths to verify stable operation.



Pressure before patient connection

Pressure after patient connection

11. Check to ensure that all settings are in agreement with the physician's prescription.
12. Monitor the patient and the ventilator closely.
13. Set high pressure alarm approximately 5 cmH₂O/hPa above the pressure limit.



Warning

The normal operation of the Pressure Limit control will not allow a High Pressure alarm to occur, even when the tracheostomy tube or the patient circuit is blocked. The High Pressure alarm will sound only if the Pressure Limit valve fails to open.

Note

Use a printer during setup and routine safety checks to confirm precise opening pressure of the Pressure Limit Control.

Power Sources

When used in the hospital, plug the ventilator into a convenient wall socket. If you use the ventilator in a wheelchair or in a car, connect it to an external 12 Volt DC battery. Your ventilator has an internal battery. Use the internal battery for short-term emergencies only, for example, when moving from one power source to another. Make sure you recharge the internal battery **immediately** after each use.

Warning

The batteries contain toxic chemicals and no attempt to remove or replace the batteries should be made by any one other than the homecare dealer or an authorized service center.

AC Power

Plug the ventilator into an appropriate AC grounded wall outlet.

110



220

The ventilator automatically operates from AC power when you plug it in and the rear panel Power switch is on. Make sure that you plug the cord into a properly grounded outlet.

Warning

The ventilator must be set to the proper voltage before plugging it into the AC outlet.

Warnings



Where the integrity of the external protective conductor (earth ground) in the installation is in doubt, equipment shall be operated from its internal electrical power source. This should be considered an emergency situation, and a suitable AC or DC power source should be found immediately. The ventilator must be properly grounded when operating on AC power. If you have any doubts about the outlet's ground connection, have a qualified electrician examine the outlets.

AC power sources in ambulances and aircraft are frequently unregulated. As a result, the ventilator may be exposed to high voltage levels that can damage it. Operation of the ventilator on improper power sources voids the warranty and will seriously damage the unit.

Do not use a power convertor as a power source for the ventilator.

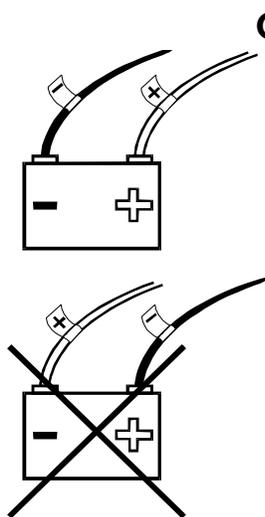
Your ventilator automatically recharges its internal battery whenever it is:

- plugged into an AC outlet, and
- the AC Power Switch is ON (1)

You can also recharge an external battery that is properly connected to your ventilator. See "Battery Performance" on page 40.

External Battery 12 Volt DC

The ventilator can operate when properly connected to a 12 VDC external battery. If the AC power fails, the ventilator will automatically switch to an attached external battery. A Power Switchover alarm signals the changes from AC to DC (the external battery).



Caution

Do not use the ventilator with a 24 VDC external battery.

A deep-cycle battery (74 amp-hour), in good condition, can power the ventilator without recharging for about 20 hours. A gel-cell type battery (34 amp-hour) can power the unit for about 10 hours before needing a recharge. Though the ventilator can recharge an external battery, it is less efficient than an Puritan Bennett-approved battery charger. Recharge an external battery 3 hours for each hour of use. For the battery test procedure, see page 41.

Note

Do not reverse the positive and negative cables when connecting a battery to the ventilator. If you accidentally reverse the connections, a protective fuse in the battery cable or the ventilator's DC circuit breaker opens. The cable will not provide power to the ventilator. You must first correct the connections and install a correct replacement fuse in the cable. Reset the DC circuit breaker on the ventilator. Only then will the external battery power the ventilator.

Note

Dispose of batteries according to your local environmental regulations.

Cautions

Recharge an external battery immediately after use. You must use an approved battery charger (available from Puritan Bennett) to recharge external batteries used for extended periods of time. Do not use the ventilator's internal charger to recharge deeply discharged batteries.

Never connect a battery charger to an external battery while the battery is connected to the ventilator.

Using a Car Battery

The ventilator will operate from a car battery. Connect the ventilator to the car with a cigarette plug cable from Puritan Bennett. Make sure the

vehicle is running when the ventilator is drawing power. Otherwise, the ventilator may run down the car's battery.

Caution

Always start the vehicle before connecting the ventilator to the car battery. Starting a vehicle when the ventilator is connected may damage the ventilator and void the warranty.

Internal Battery 12 Volt DC

ALARMS	
	ALARMS
	Low Pressure/Apnea
	Low Power
	High Pressure
	Setting Error/Presilence
	Power Switchover

POWER	
	POWER
	AC Pwr/Batt Charge
	External Battery
	Internal Battery

The ventilator automatically switches to its internal battery if the AC power fails or the unit is disconnected from AC power and there is no adequate external battery connected. The internal battery also automatically takes over when an external battery's power becomes inadequate. A power Switchover alarm signals the change to the internal power source.

The ventilator operates from 30 to 60 minutes on a fully charged internal battery. The time depends on many factors, primarily, the selected settings. The amber Internal Battery light flashes continuously and an audible alarm sounds every five minutes when the internal battery is in use. When approximately five minutes of power remain, a continuous Low Power alarm sounds. At this signal, **immediately switch to another power source.** Use the internal battery only for emergency power back-up.

If the internal battery is not used, exercise it every four to six weeks. That is, run the ventilator on its internal battery until the low power alarm sounds. Immediately switch to AC power and recharge the internal battery.

With AC power ON, the ventilator will recharge the internal battery in any Mode, including Standby. Recharge a discharged internal battery for at least three hours before turning off the ventilator. This action will help prolong battery life.

Note Dispose of batteries according to your local environmental regulations.

Warning

If the patient's health or safety would be jeopardized by long-term power failure, a reliable back-up power source is mandatory. Do not regard the internal battery as a long-term back-up power source.

Caution

Recharge the Internal Battery for at least three hours immediately after use. An external battery cannot recharge the internal battery.

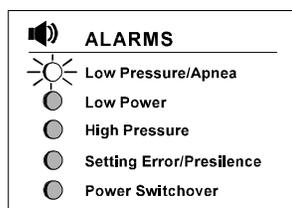
Routine Safety Check

Note Use this information along with instructions from the patient's physician. The procedure takes about ten minutes to complete and can be performed by a trained caregiver.

Warning

Disconnect the patient from the ventilator and provide another means of ventilation before starting these tests.

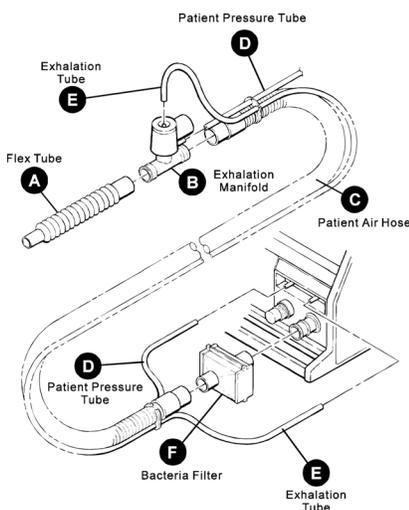
ALWAYS complete a routine safety check BEFORE connecting the patient to the ventilator.

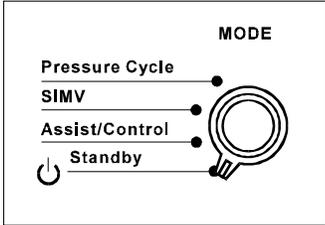


1. Check the Low Pressure Alarm.
 - If the patient is not connected to the ventilator, connect a patient circuit and test lung to the ventilator. Then turn the ventilator on and switch it to an operating mode.
 - Disconnect the small patient pressure tube from its port near the bacteria filter. Wait for two or three breaths.
 - The Low Pressure/Apnea light should start flashing and the audible alarm should sound.
 - Push the Alarm Silence/Reset button to silence the alarm.
 - Reconnect the pressure tube to the ventilator. The Low Pressure/Apnea light should stop flashing after a breath or two.

2. Check all the settings.
 - Compare the current settings to your written record of the prescribed settings.
 - Make sure that all seven controls (located behind the front panel door) are set to the doctor's prescription.

3. Check the Patient Circuit.
 - Check every connection in the circuit you are using or plan to use. Make sure that the tubing is routed correctly, that all connections are tight, and that there are no leaks.
 - Check every part of the circuit for cracks and water. Each part must be in good condition. There should be no water in any part of the circuit.



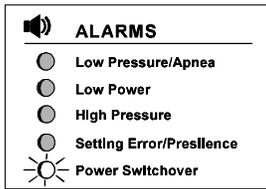


4. Check all the alarm signals.

- Turn the Mode switch to Standby.
- Wait one second and turn the Mode switch to Assist/Control.
- All nine lights (on the top section of the front panel) should turn on and the audible alarm should sound for two seconds.

Note

If the ventilator is not plugged in or if the AC power switch is off, only eight lights will turn on. (The AC Power/Battery Charge light will not turn on.)

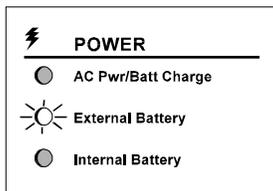
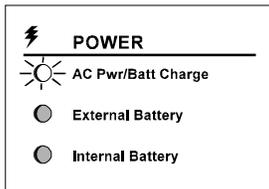


- Any connected accessories that signal an alarm (such as a remote alarm) also test their alarms.
- If the Power Switchover alarm is on, push the Alarm Silence/Reset button to turn it off.
- Push the Alarm Silence/Reset button and hold for three seconds.
- All nine (or eight) lights should turn on and the alarms should sound for one second. The accessories also signal their alarms for one second.

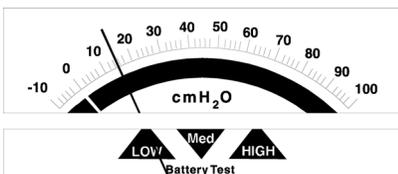
5. Perform a battery test.

Note

If you do **not** have an external battery connected to the ventilator, ignore the part of this test printed in italics.



- Make sure the ventilator is operating on AC power and the green AC Power/Battery Charge light is on.
- Turn off the AC power by pushing the "0" on the AC power switch located on the back panel.
- Make sure that the Power Switchover light starts flashing and the alarm begins to sound. Push the Alarm Silence/Reset button to turn it off.
- *The External Battery light should be on.*
- *Press and hold the Battery Test button. The needle on the Patient Pressure Meter will point to low, medium, or high (within the lower window). If the needle points to low, recharge your external battery. See "Testing the Batteries" on page 41.*
- *Disconnect the external battery.*
- *Make sure that the Power Switchover light starts flashing and the alarm sounds. Push the Alarm Silence/Reset button to turn them off.*
- The Internal Battery light should be flashing.
- Press and hold the Battery Test button. The needle in the Patient Pressure Meter will point to low, medium, or high (within the lower window). If the needle points to low, recharge the internal battery **immediately** after completing the daily safety check. See page 43. Perform Battery test after 3 hours of recharging.



- Connect a fully charged external battery to the ventilator. Verify that the External Battery light on the front panel turns on.
- Turn the AC power on. Make sure that the green AC Power/Battery Charge light (located on the front panel) turns on.

Warning

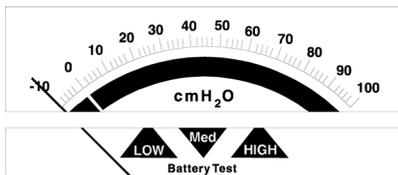
If the ventilator does not pass the daily safety check or you cannot complete this check, call your vent supplier or an Puritan Bennett Service Representative immediately.

Monthly Safety Check

Note Use this information along with instructions from the patient's physician. The tests take about ten minutes to complete.

Warning

Disconnect the patient from the ventilator for the monthly safety check. Provide another means of ventilation before starting these tests.

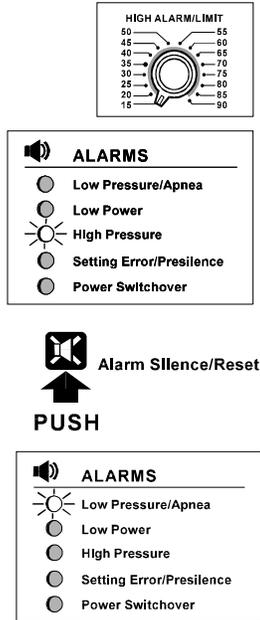


1. With the ventilator turned off, confirm that the pressure meter is resting at $-10 (\pm 1.0)$ cmH₂O/hPa.
2. Unplug the AC power cord. Visually inspect the plug and cord for damage or exposed wires which could cause a shock hazard.
3. Check the High Pressure and Low Pressure alarms.
 - Plug the ventilator into AC power.
 - Connect the patient circuit to the ventilator.
 - Use your hand to block the part of the Exhalation Manifold that connects to the patient. Make sure no air comes out.

Warning

Wash hands thoroughly. Do not introduce germs or contaminants into the circuit while performing this test.

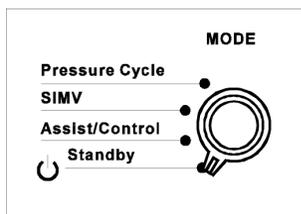
Note If you are checking an LP6 Plus, **ignore** the steps marked with an asterisk.



- Turn the ventilator on and set the mode to Assist/Control.
- *Observe the Patient Pressure Meter. The maximum pressure displayed should be only a few cmH₂O/hPa above the pressure limit prescribed by your doctor.
- *Change the High Alarm/Limit switch to 15 cmH₂O/hPa.
- At the next attempt to deliver a breath, the High Pressure light should flash and the alarm should sound.
- The Exhalation Manifold should make a soft popping noise. Air should also come out of the large opening at the top of the Exhalation Manifold.
- *Change the High Alarm/Limit control back to the setting prescribed by your doctor.
- Push the Alarm Silence/Reset button to turn off the High Pressure alarm.
- Remove your thumb from the opening in the Exhalation Manifold.
- Make sure the Low Pressure/Apnea light starts flashing after two or three breaths and that the alarm sounds.
- Push the Alarm Silence/Reset button to silence the audible alarm.
- Connect a test lung to the Exhalation Manifold. The Low Pressure/Apnea light should stop flashing after a breath or two.

4. Use the built in Self Test.

Note Self Test will not function properly with pressure limit in use.



- Turn the mode switch to Standby.
- Connect a patient circuit to the ventilator.
- Block the end of the circuit completely. Allow no air to escape.
- Press and hold the Alarm Silence/Reset and Battery Test buttons simultaneously. While holding these buttons, switch to the Assist/Control mode. Release the two buttons.
- The ventilator will test itself. Some lights will turn ON and OFF and the needle on the Patient Pressure Meter will move back and forth.

- If the self test is satisfactory, no red alarm lights will be lit. To use the ventilator, turn the mode switch to Standby. Then, perform the Routine Safety Check.
- If the ventilator fails the self test, one of the alarm lights will flash and an audible alarm will sound. Call your homecare dealer or an Puritan Bennett Service Representative **immediately**.

Warnings

If the ventilator fails the monthly safety check or you cannot complete this check, refer to the Troubleshooting Guide on pages 8 through 10, and/or call your homecare dealer or an Puritan Bennett Service Representative immediately.

With the AC power cord unplugged, visually check the AC power cord for damage or exposed wires that could cause a shock hazard.

Installation

Caution

Do not use the ventilator in a highly magnetic environment such as Magnetic Resonance Imagery (MRI). Doing so may damage the ventilator and affect operation.

Warning

Explosion hazard if used in the presence of flammable anesthetics.

Mounting or Positioning

Position the ventilator on a table or nightstand within six feet of an electrical outlet.

Keep the rear panel free of draperies or other items that could impede the air flow to the Inlet Filter port.

Warning

Do not block the inlet port.

Protect the ventilator from accidental liquid spills. Never place food or liquids on top of the ventilator. When used in a humid environment, and when cleaning,

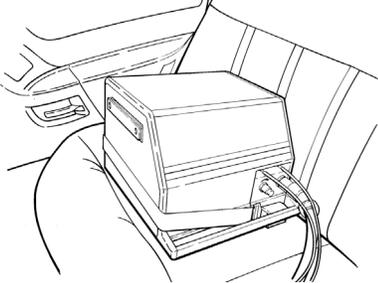
- take precautions to protect the setting switches;
- keep the front panel door closed; and
- avoid spilling or allowing liquid to enter the unit.

Allow for the space requirements of additional equipment, e.g., humidification and supplemental oxygen. When in use, keep active humidifiers or the patient circuit at an elevation lower than the patient's trach. Moreover, keep them lower than the ventilator's Patient Air tube to prevent moisture from entering the ventilator.

Warning

Do not subject the internal ventilator components to excessive moisture under any circumstances. Doing so may damage the ventilator and affect operation.

Mounting or Positioning



During transport in cars and vans, securely position the ventilator and strap it down to avoid inadvertent jarring or damage. Use an external 12 VDC battery to power the ventilator.

You may connect the ventilator to the car's battery power with an accessory power cable equipped with a cigarette lighter plug. Connect the ventilator to the cigarette lighter cable/plug only after the car's motor is running.

Warning

Do not block the alarm port.

Emergency Vehicle

In an emergency vehicle, employ a deck or mounting bracket to secure the ventilator. Maintain at least four inches between the rear panel Inlet Filter and the vehicle's wall. Position the ventilator to easily view all indicators with ready access to all operating controls.

Warning

AC power sources in ambulances and aircraft are frequently unregulated. As a result, the ventilator may be exposed to high voltage levels that can damage it. Operation of the ventilator on improper power sources voids the warranty and will seriously damage the unit.

Before plugging the ventilator into an unknown power source, check the voltage. If the voltage set switch is at 110 V, the supplied voltage must be between 100-120 VAC. If the voltage set switch is set to 220, the supplied voltage must be between 220 and 240 VAC. If the power source exceeds the proper range at any time, or if the voltage cannot be verified, use a 12 VDC battery, rather than risk damage to the ventilator.

Warnings

Stabilize and verify proper ventilator performance before connecting the patient to the ventilator.

Do not use a power converter as a power source for the ventilator.

Wheelchair Mounting instructions vary from chair to chair. Consult the wheelchair manufacturer for standard wheelchair adaptations.

Warning

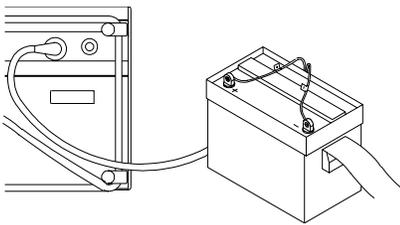
Never place an external battery above the ventilator. Use separate batteries to simultaneously power an electric wheelchair and the ventilator.

Caution

Never place a humidifier above the ventilator.

Here are some general guidelines to consider when using the ventilator in a wheelchair.

- When using a tray, place a partition between the battery and ventilator.
- Insert a partition in the tray mount between the ventilator and battery. Locate this partition as far as possible from the ventilator's Inlet Filter. If the ventilator and battery are in the same tray, cut drain holes in the tray to prevent any leaking battery fluid from reaching the ventilator. Place the battery in a plastic container to help insulate the ventilator from battery fluid.
- Always provide an external battery as the power source.
- Never use the same battery to power a motorized wheelchair and the ventilator at the same time.
- Protect the ventilator from spills and water seepage during bad weather or other conditions when using the unit on a wheelchair.
- Check the air Inlet Filter frequently when using the ventilator outdoors, especially when the air inlet is pointed toward the ground.
- To maintain a full charge on the internal battery, you must routinely connect any ventilator mounted on a wheelchair to AC power while the wheelchair is not in use. You must connect the ventilator to AC power as soon as possible after internal battery operation, no matter how short a time the ventilator operated on internal battery.



Warning

Always locate the external battery as far away from the ventilator as possible. The distance will help prevent battery gases from drifting toward the ventilator's air inlet.

Power Connections

General Any one of three power sources can power the ventilator.

- External AC,
- External 12 VDC battery, or
- Internal 12 VDC battery.

When plugged into a functioning wall outlet with the AC power switch ON, the ventilator automatically selects the AC power source. It will operate indefinitely on AC. All three sources may be connected to the ventilator at the same time. If the AC power fails, the ventilator automatically switches to the next best power source.

AC Power The ventilator requires 1 amp at 110 VAC. If the voltage select switch is set to 110 V, the supplied voltage must be between 100 and 120 VAC.

The ventilator requires 0.5 amps at 220 VAC. If the voltage select switch is set to 220 V, the supplied voltage must be between 220 and 240 VAC.

The ventilator has a hospital grade, 3-pronged AC power connector. Note, however, that the connector's hospital grading depends solely on its use in a hospital grade electrical outlet. If you encounter a 2-pronged outlet, replace it with a properly grounded 3-pronged outlet.

When traveling to another country (or a region with a different power system), you may encounter two problems. First, the nominal voltage may be different. Note the ranges given above for 110 and 220 VAC respectively.

Warning

Set the Power Select Switch before plugging the ventilator into a new power system.

The second problem you may encounter is the plug itself. It may not fit into the outlet. There are two solutions. First, have a qualified electrician remove and replace the ventilator's plug with one designed for the local outlets. Second, you may use an adaptor. Make certain that the adaptor has no active electronic components and that it is not a power converter.

Caution

If you have any questions about the power system or how the ventilator will operate, contact a qualified electrician and/or Puritan Bennett.

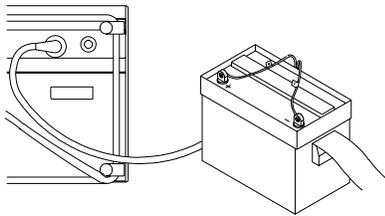
Warning

If you have any doubts about the ground connection, have a qualified electrician examine the outlets. If necessary have them properly grounded.

When operating on AC power, the ventilator will recharge the internal battery or a properly connected external battery in any mode setting, including Standby.

External Battery 12 Volt DC

Whenever AC power is unavailable, the ventilator can operate from a 12 VDC battery. Use a special cable from Puritan Bennett to connect the ventilator to the battery. Puritan Bennett recommends deep-cycle, gel-cell batteries. A Power Switchover alarm signals a change from AC to battery power.



Carefully connect the 12 VDC battery to the ventilator. Follow the battery manufacturer's instructions. Connect the red wire (marked "+") to the positive (+) battery terminal. Connect the black wire (marked "-") to the negative (-) battery terminal.

Note Use only Puritan Bennett's cables.

Check to see if the ventilator's External Battery light is lit. This light signals that your ventilator is properly connected and is using the external battery.

Note Do not reverse the positive and negative cables when connecting a battery to your ventilator. If you accidentally reverse the connections, a protective fuse in the battery cable or the ventilator's DC circuit breaker opens. With an open circuit, the cable will not provide power to the ventilator. You must first correct the connections and install a correct replacement fuse in the cable. Reset the DC circuit breaker on the ventilator. Only then will the external battery power the ventilator.

You may order batteries and connecting cables from Puritan Bennett. These accessories come with specific instructions for connection and use. The battery and case provided by Puritan Bennett have a cable with a 3-pin connector. When properly used, this cable/connector ensures against reversing the connections between the battery and ventilator. Use of other cables may damage the ventilator or make it inoperable when the cable connections are accidentally reversed.

Battery Performance As they age and due to their chemical make-up, batteries lose their capacity to retain an electrical charge. Typically lead-acid batteries lose 7% of their capacity each year. For best performance, follow the manufacturer's instructions.

The following affect the life of the battery:

- Ambient temperature,
- Charge level,
- Storage conditions,
- Time, and
- The number of "deep cycles."

For maximum efficiency, operate or store the battery at room temperatures. It will charge and discharge most efficiently in such an environment.

To ensure maximum running time of the ventilator on any external battery, keep the battery fully charged. Some batteries need to be discharged and recharged monthly. Refer to the battery manufacturer's instructions. Recharge any external battery immediately after use. Use a standard battery charger. The time required to recharge a battery varies. Generally, with a 10 amp standard charger, there is a 1:1 ratio (one hour of recharge for each hour of use).

Cautions

Recharge an external battery immediately after use. You must use a Puritan Bennett-approved battery charger to recharge external batteries used for extended periods of time. Do not use the ventilator's internal charger to recharge deeply discharged batteries.

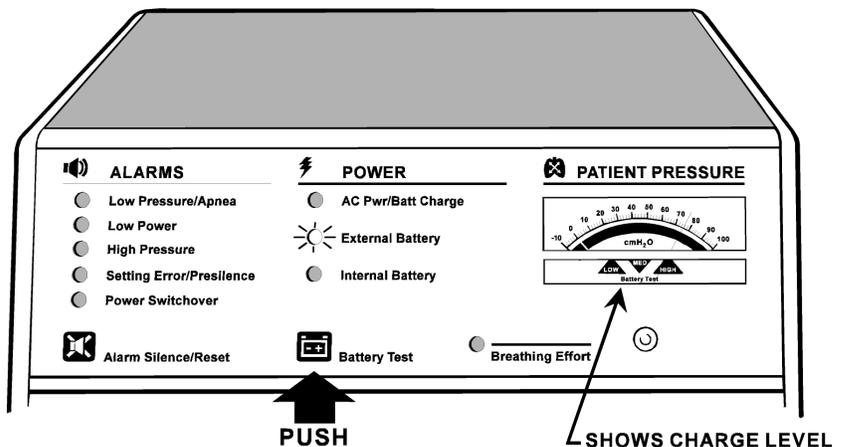
First connect the battery to the standard charger. Then connect the charger to AC power.

NEVER connect a battery charger to an external battery while the battery is connected to the ventilator.

A 30 to 40 amp hour battery, in good condition can power the ventilator for about 10 hours without recharging. A 75 to 80 amp hour battery provides power for about 20 hours between charges.

Testing the Batteries

Make sure that the external or internal battery is powering the ventilator before testing the battery condition. To run the test, press and hold the Battery Test button. The needle on the Patient Pressure Meter registers the battery status in the window below. A fully charged battery in good condition will register in the Normal/High range.



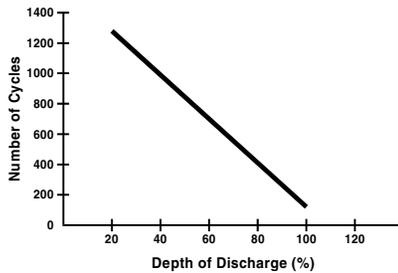
Notes

The Battery Test meter is only a relative indicator of the remaining battery charge. An older battery may register a high charge level, but discharge more rapidly. Carefully monitor battery power sources. Always have a back-up power source available.

The total life expectancy of any battery is affected by the number of times it is deep cycled, i.e., nearly 100% discharged.

Power Connections

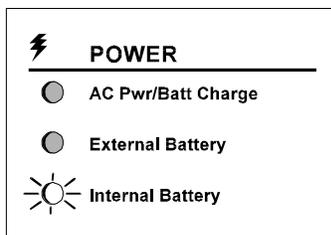
LP6 Plus and LP10 Clinician's Manual



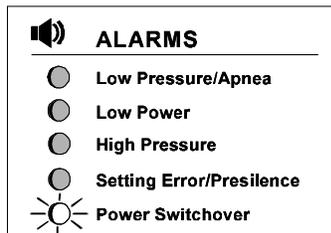
The percentage of discharge relates directly to the number of cycles the battery can deliver. As a battery ages its ability to power the ventilator decreases. Take this into account in all applications, but especially in portable applications where another power source may not be readily available.

The graph displays the relative impact of deep discharge on battery life.

The time since recharge when a battery is being stored affects how long it can adequately power the ventilator.



The ventilator will switch to the internal battery and signal an alarm when the external battery's voltage drops below a preset limit. The alarm indicates the ventilator can no longer operate reliably on the external battery.



Special precautions when using an external battery

Place the battery as far away as possible from the ventilator's Inlet Filter (located on the rear panel).

When using a tray to hold both the battery and the ventilator, put a partition between the battery and ventilator.

Batteries need to be discharged and recharged monthly. Refer to the battery manufacturer's instructions.

Using an external battery has nothing to do with the emergency internal battery. An external battery neither recharges nor maintains the charge of the internal battery.



Warning

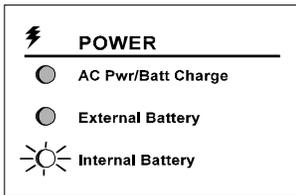
NEVER place the battery above or on top of the ventilator. Use separate batteries to power a motorized wheelchair and the ventilator.

You may use some gel-cell, spill-proof batteries aboard commercial aircraft. Follow these regulations:

- F.A.A.: Title 49 C.F.R., parts 100 - 199, paragraphs 173.250A and 170.260D.
- C.A.B.: Air Transport of Restricted Articles, Circular No. 6D, page 57, Article # 1924.
- I.A.T.A.: Restricted Articles Regulations, Article # 1924, Packaging Note 802, Section VI p. 149 and Section X p. 207.

Internal Battery 12 Volt DC

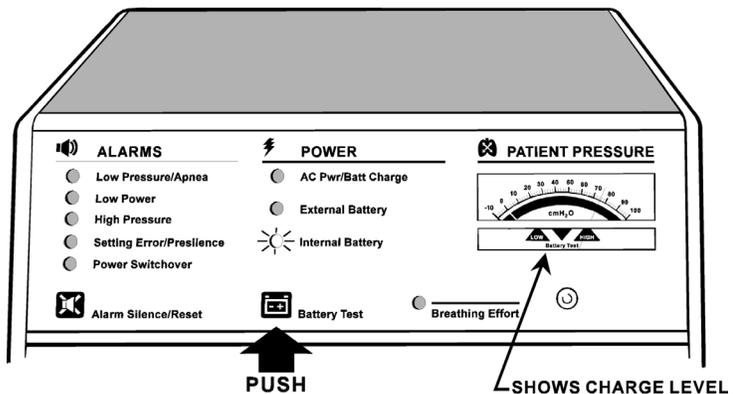
Use the Internal 12 VDC battery for emergency use only. It requires no special connections. The ventilator switches to the internal battery when other power sources fail or drop below adequate levels. The Power Switchover alarm signals whenever the ventilator switches from AC or an external DC battery to its internal emergency battery.



When powered by the internal battery, the amber Internal Battery light flashes continuously. In addition, an audible tone sounds every five minutes. When approximately five minutes of power remain, a continuous audible alarm sounds. **Immediately** switch to another power source.



A fully charged internal emergency battery will power the ventilator from 30 to 60 minutes depending on the operating conditions. Test the charge level of the internal battery by pushing the Battery Test button. Read the charge level on the Battery Condition scale of the Patient Pressure meter.



Note The ventilator must be operating on internal battery power to obtain a reading of the internal battery's charge level.

Warning

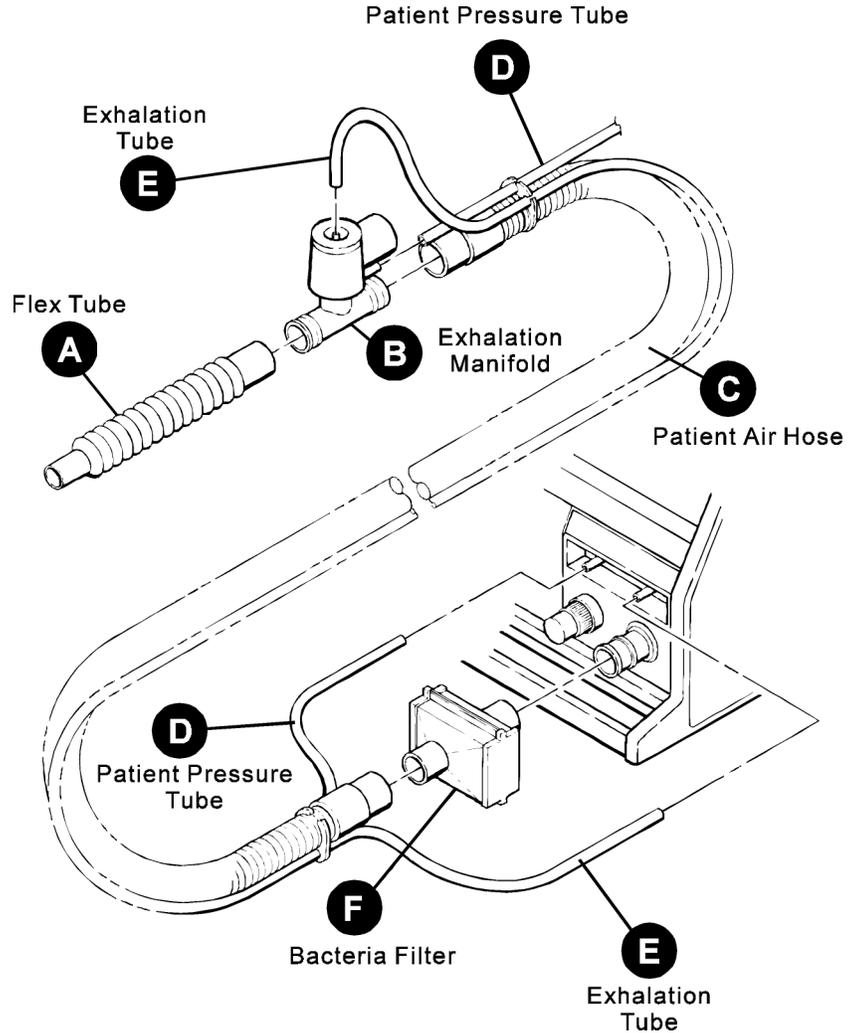
To prevent shortened longevity, recharge the internal battery for at least three hours after each use. Always recharge the internal battery before turning off AC power to the ventilator.

Keep the internal battery fully charged at all times. The ventilator charges the internal battery when it is connected to an AC power source and is in any operating mode **including Standby**. An external battery cannot recharge the internal battery.

The information on external battery performance also applies to the internal battery. See pages 39 through 41.

Exercise the internal battery every four to six weeks. That is, run the ventilator on its internal battery until the low power alarm sounds. Immediately switch to AC power and recharge the internal battery for at least three hours.

Patient Ventilator Circuit



The Patient Ventilator Circuit has a long flexible hose and several other parts shown in the diagram. It attaches to the ventilator and is the patient's link to the breaths needed. Inspect it every day.

- Make sure there are no cracks in the hose.
- Be certain all the connections fit securely to prevent leaks.
- Clean the Exhalation Manifold daily.
- Replace parts regularly before they wear out. Regular replacement is essential for successful ventilation. See the instructions that come with the patient circuit.

- A. **Flex Tube:** Use this tube to connect the Patient Ventilator Circuit to a tube adaptor on your trach tube. The tube's flexibility makes the circuit more comfortable.
- B. **Exhalation Manifold:** This part contains a mechanism that controls inhalation and exhalation. During inhalation, the white mushroom inflates and allows air to enter the patient's lungs. During exhalation, the mushroom deflates and allows air to be expelled.
- C. **Patient Air Hose:** This is the large hose between the Bacteria Filter and the Exhalation Manifold.

Re-order part numbers:

Reusable Adult Circuit, metal reinforced Y-6267
Reusable Adult Circuit, plastic reinforced Y-6268
Disposable Adult Circuit Y-6463
Disposable Pediatric Circuit Y-6464

Warning

Do not use antistatic or conductive hoses or tubing.

- D. **Patient Pressure Tube** (included with patient air hose): This small tube connects the Patient Pressure port on the ventilator to the Exhalation Manifold.
Re-order part number: Tubing, Replacement Pressure Line, 8' lengths Y-6197
- E. **Exhalation Tube** (included with patient air hose): This small tube connects the Exhalation Valve port to the Exhalation Manifold.
Re-order part number: Tubing, Replacement Exhalation Valve, 8' lengths Y-6196
- F. **Bacteria Filter:** This filter cleans the incoming air before the patient inhales it.
Re-order part numbers:

Filter, Bacteria L-006197-000
Filter, DAR® Sterivent® 351U5856

Warning

Ensure the proper connection and operation of the Patient Circuit.

There are other accessories available. Some add oxygen or moisture to the incoming air. Others set Positive End Expiratory Pressure, or print a permanent record of the ventilator's operation. Contact Puritan Bennett for a complete list of available accessories.

Caution

Adding attachments or other components to the breathing system will increase inspiratory and expiratory resistance.

Exhalation Manifold

The Exhalation Manifold directs the flow of gases to and from the patient. Broadly speaking, this assembly consists of a manifold body, a mushroom valve, and a cap. Refer to the manufacturer's instructions. Before using it with the patient, secure all connections, ensure the seating of the mushroom valve. Make sure this valve prevents the escape of any gases during inspiration and that it releases properly during exhalation.

Warning

Ensure the proper connection and operation of the exhalation manifold daily. The patient could be at risk if the manifold fails to function as intended. Connecting patient pressure and exhalation tubes to the opposite port prevents proper patient ventilation.

Note

To safeguard the patient, upon start-up, the ventilator dumps the first breath through the exhalation manifold. The unit's microprocessor requires one cycle to establish its reference point, that is, the operating mode and settings to use. This operation prevents delivery of incorrect volumes that could result in excessive pressure build-up.

Humidification

Short Term

When using humidification for a short period or during transport, use an artificial nose with the ventilator. Connect this regenerative humidifier to the patient circuit between the trach connector and the flextube. Or follow the manufacturer's instructions.

Extended Use

The patient's physician will usually prescribe humidification of the delivered gases. Due to their popularity, Puritan Bennett offers special humidifier mounting brackets. The brackets include instructions for use.

For complete instructions on the operation, cleaning, and sterilization of the humidifier, refer to the appropriate sections of the humidifier manu-

facturer's instruction manual.

Warnings

Always position the humidifier at a level lower than the patient. The humidifier should also be at the same or lower level than the ventilator. This will help prevent excessive moisture from entering the patient or ventilator.

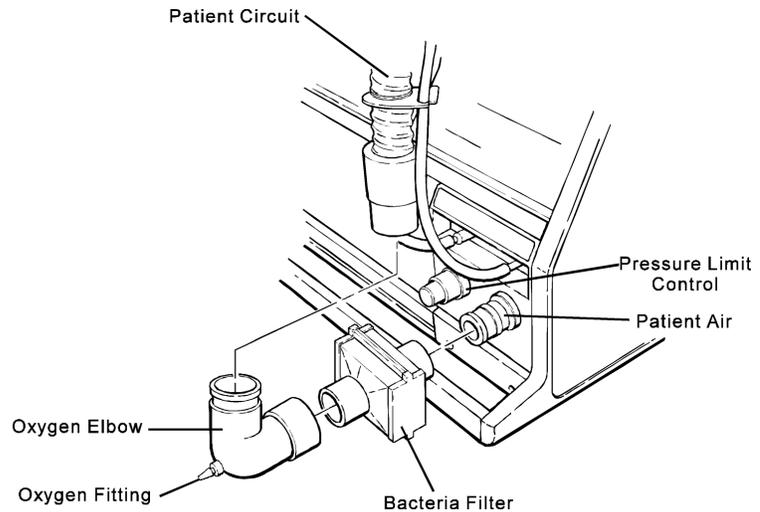
Some active humidifiers do not have temperature monitoring or alarm capabilities. Failure to monitor air temperature may allow inspired air to become too hot. Thermal injury to the patient's airway may result. Always follow the recommendations of the humidifier manufacturer.

Warnings

Condensation forms in the Patient Circuit over time. Periodically check for moisture in the Patient Circuit. When present, remove the moisture. Before attempting to dry the circuit, disconnect it from the ventilator. Never subject the internal ventilator components to moisture or high pressure. Doing so may damage the ventilator. Always drain the tubing away from the patient connection.

Do NOT use compressed gas to clear moisture from the pressure line when connected to the patient. First disconnect the ventilator and circuit.

Supplemental Oxygen



Methods At times, the attending physician prescribes supplemental oxygen. In such cases, the ventilator has two oxygen enrichment methods.

1. You can bleed oxygen into the Patient Circuit for concentrations up to approximately 40%.
2. You may deliver oxygen into the rear panel Inlet Filter Port for concentrations up to 100%.

In hospitals, oxygen comes through piped systems or high pressure tanks. Liquid reservoirs, oxygen concentrators, or high pressure tanks are sources of oxygen in the home setting.

Oxygen concentration guidelines on the next page are based on 100% oxygen sources. The concentrations are somewhat less when using an oxygen source below 100%.

Warnings

To ensure the prescribed oxygen concentrations at the proximal airways, measure them with a calibrated analyzer.

Liquid and gaseous oxygen are not flammable, but can cause other materials to burn faster than normal. Skin exposed to liquid oxygen may become frostbitten. When using oxygen devices, always follow the manufacturer's instructions. Keep oxygen warnings visible to the caregiver and the patient.

Oxygen Delivery into the Patient Circuit. (Method 1 for concentrations up to 40%)

First, connect the Bacteria Filter to the Patient Air tube. Then connect the Oxygen Elbow to the Bacteria Filter. Finally, attach the Patient Circuit to the Oxygen Elbow.

Warnings

If you are using the 90° elbow (see illustration on page 49) to deliver supplemental oxygen, care should be taken to securely attach the oxygen line to the elbow's oxygen fitting. If the oxygen tube becomes disconnected from the 90° elbow, the drop in pressure may not be significant enough to sound the ventilator's Low Pressure Alarm. This means that the patient may not receive the prescribed levels of oxygen and the tidal volume may be decreased, but you may not be alerted by the ventilator's audible alarm system. To prevent this, you should push the oxygen line tubing as far down on the elbow's oxygen fitting as possible, to reduce the possibility of inadvertent disconnection.

The formula below is a guideline to the flow of 100% oxygen to be bled into the Patient Circuit to achieve desired oxygen concentrations:

$$\text{LPM} = \{(\text{BPM} \times \text{V}_T) (\text{C} - 0.21)\} \div 0.79$$

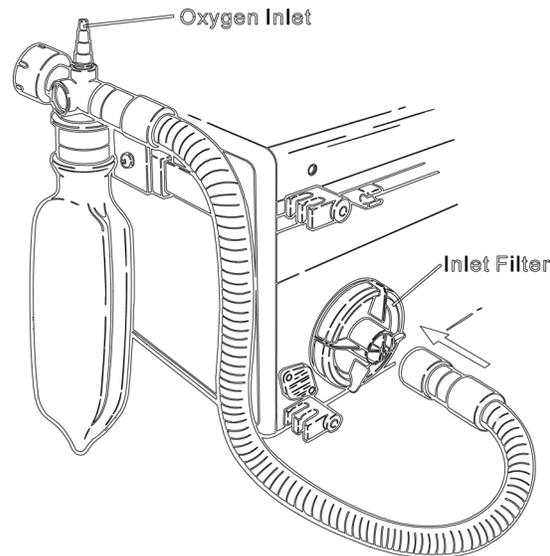
Where:

- LPM = 100% O₂ Flow in Liters/Minute
- BPM = Breathing Rate in Breaths/Minute
- VT = Tidal Volume in Liters
- C = Patient O₂ Concentration desired (i.e. 30% = 0.3)

Note Oxygen bled into the circuit is additional volume. Adjust for this volume when setting the ventilator volume.

Oxygen Delivery Through the Inlet Filter. (Method 2 for concentrations up to 100%)

You can achieve high oxygen concentrations at the proximal airway by delivering source oxygen directly into the air Inlet Port located on the rear panel of the ventilator. Use an optional Oxygen Enrichment kit. The kit contains complete instructions.



Accessories

A number of accessories are available for the ventilator, including a remote alarm and a printer. See your Puritan Bennett representative for details.

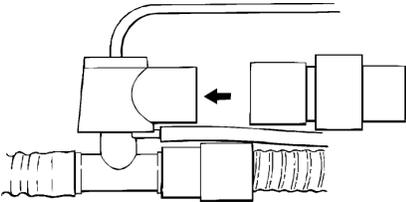
Caution

Use Puritan Bennett-approved accessories in conjunction with the ventilator. The use of other accessories may prevent proper operation of the ventilator or may damage the unit.

Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (e.g. IEC 60950 for data processing equipment and IEC 60601-1 for medical equipment). Furthermore, all configurations shall comply with the system standard IEC 60601-1-1. Any person who connects additional equipment to the signal input part or signal output part configures a medical system, and is therefore responsible for ensuring that the system complies with the requirements of the system standard IEC 60601-1-1. If in doubt, consult Puritan Bennett Technical Services at 1.800.255.6774 or your local representative.

Positive End Expiratory Pressure (PEEP)

The patient's physician may prescribe PEEP. An accessory PEEP valve maintains a positive pressure in the patient's airway during exhalation. This valve is attached to the Exhalation Manifold of the Patient Circuit. (See Figure for proper connections.) Puritan Bennett supplies PEEP valves. See your Puritan Bennett representative for details and model numbers.



You may set the trigger sensitivity up to +10 cmH₂O/hPa with the Breathing Effort control to compensate for PEEP pressures during the patient's inspiration.

Note When used with uncuffed tracheostomy tubes or other patient circuits which ensure an intentional leak in the artificial airway, PEEP valves will have difficulty maintaining set PEEP levels. Leaks may be supported by the use of continuous flow; examples of two commonly used techniques of continuous flow are diagrammed on the next page.

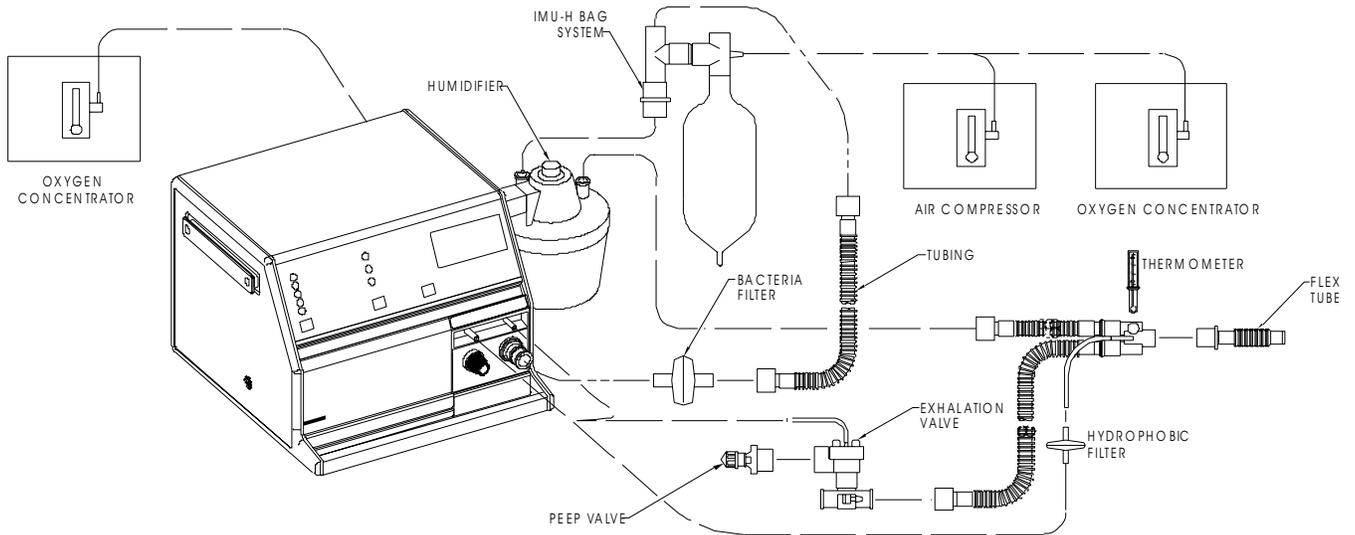
Caution Continuous flows of greater than 20 LPM may result in setting error alarms. Certain patient profiles and circuit configurations may result in a setting error alarm at flows of less than 20 LPM.

Note PEEP, when used with low tidal volumes, may affect the delivered volume. Monitor volume delivery to assure accuracy.

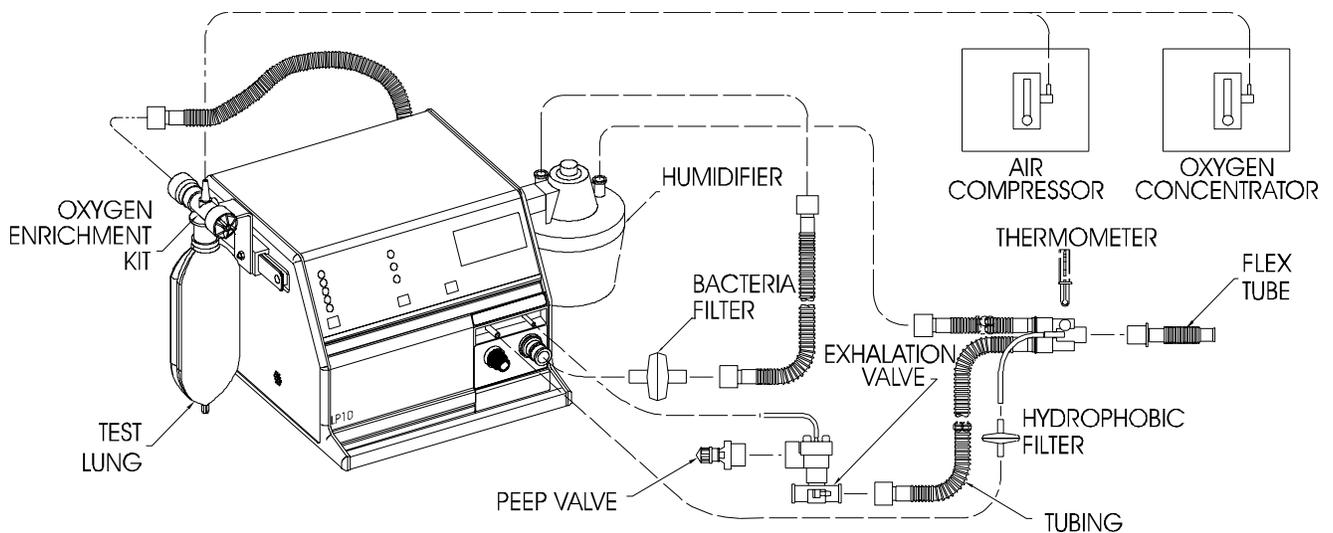
You must set the Low Alarm level above the PEEP value or the ventilator will give constant Low Pressure/Apnea alarms.

Warning Breathing effort control settings above zero without PEEP will cause the ventilator to autcycle (i.e., deliver breaths based on the selected inspiratory time at a 1:1 I:E ratio).

Accessories

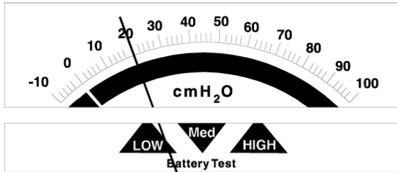


IMV-H Bag: Used successfully to support the patient's spontaneous breaths associated with SIMV. It also helps to stabilize and maintain PEEP. Best suited for high spontaneous inspiratory flow and demands. Maintains stability and ensures PEEP. Requires two sources of oxygen.



O₂ Enrichment Kit: Used successfully to support the patient's spontaneous breaths associated with SIMV. It also helps to stabilize and maintain PEEP. Oxygen delivered through the Inlet Filter (for concentrations up to 100%). Requires only one oxygen source.

Pressure Monitoring



Use either the ventilator's pressure meter or the optional printer to monitor proximal low and high pressure. The ventilator's pressure meter provides a *relative indication* of the cycling pressures created by the volume of delivered air.

The optional printer, on the other hand, provides a *precise pressure reading* generated by the electronic pressure transducer. You may also use a properly calibrated, commercially available external manometer to determine precise pressure readings.

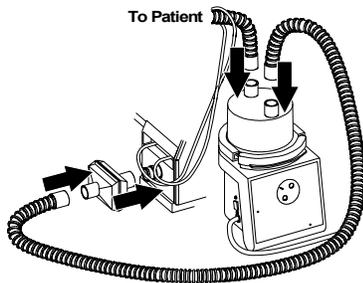
Supplemental Oxygen

The ventilator has provisions for the addition of prescribed supplemental oxygen. With an oxygen elbow accessory, the ventilator delivers up to approximately 40% oxygen concentration. With an oxygen enrichment accessory, the ventilator can deliver concentrations up to 100%. Instructions accompanying these accessories describe how they deliver supplemental oxygen. Use a calibrated analyzer to measure and ensure prescribed oxygen concentrations at the proximal airway. (See pages 50 through 51.)

Warnings

If you are using the 90° elbow (see illustration on page 48) to deliver supplemental oxygen, care should be taken to securely attach the oxygen line to the elbow's oxygen fitting. If the oxygen tube becomes disconnected from the 90° elbow, the drop in pressure may not be significant enough to sound the ventilator's Low Pressure Alarm. This means that the patient may not receive the prescribed levels of oxygen and the tidal volume may be decreased, but you may not be alerted by the ventilator's audible alarm system. To prevent this, you should push the oxygen line tubing as far down on the elbow's oxygen fitting as possible, to reduce the possibility of inadvertent disconnection.

Humidification



During normal extended ventilation, the physician may recommend an active humidifier. Several humidification devices are compatible with the ventilator. Instructions for connecting a humidifier accompany Puritan Bennett's mounting bracket accessory. See "Humidification" on page 48.

You may use a passive, in-line regenerative humidifier such as an "Artificial Nose" to preserve humidification during patient transport or wheelchair transport. This accessory is intended for short term use only. A regenerative humidifier retains portions of the exhaled heat and humidity, to aid in conditioning subsequent inhalations.

Note

Hydrated artificial noses may prevent a Low Pressure alarm by keeping the pressure in the circuit above the alarm limit. If the circuit is disconnected from the patient, but still connected to the artificial nose, a Low Pressure alarm may not sound.

Where such disconnections from a ventilator-dependent patient are possible, you must set the Low Pressure alarm to a level that permits an alarm to sound. To do this, simulate the disconnection; if a Low Pressure/Apnea alarm does not sound after two breath cycles, increase the alarm limit until an alarm sounds.

Remote Alarm You may connect a remote alarm to the ventilator. This ventilator relays any alarm signal to locations up to 200 feet away from the ventilator. Contact your Puritan Bennett representative for details.

Printer The optional printer produces a permanent record of the ventilator's performance. See the manual supplied with the printer for detailed operating instructions and interpretation of printed reports.

Cleaning and Maintenance

This section contains instructions for cleaning and maintaining the LP6 Plus and LP10 Ventilators. You must also consult such instructions for the various accessories used with the ventilator.

Note Use the information in this and the accessories' sections, as well as established procedure and your homecare dealer's instructions, to clean your ventilator.

Warnings

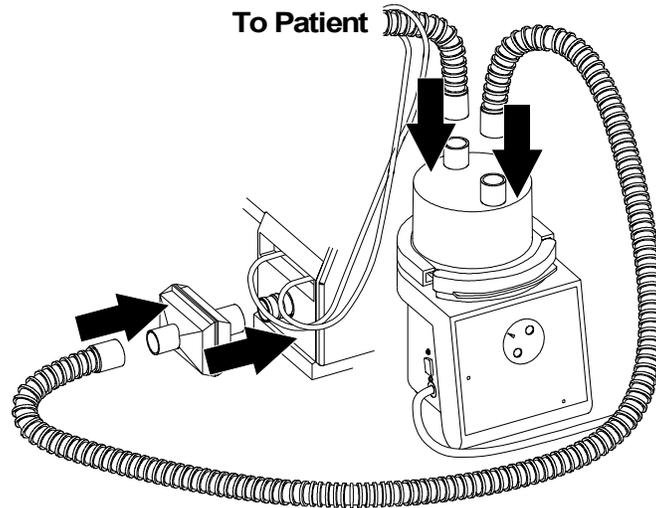
A ventilator patient is highly susceptible to respiratory infections. Dirty or infected equipment may be a source of infection. Clean equipment is essential for successful ventilation. Be sure to wash your hands thoroughly before and after cleaning the ventilator or accessories.

Do not sterilize the ventilator with ethylene oxide (ETO). Doing so may expose the patient to hazardous residues.

Caution

Do not use MEK, trichlorethylene, or alcohol to clean the ventilator. Their use may damage the unit's surface. Do not sterilize the ventilator with steam. This process will expose the ventilator to excessive moisture.

Patient Circuit and Humidifier



Follow the cleaning instructions recommended by the humidifier manufacturer.

Warnings

After reassembling the patient circuit, check to see if the exhalation manifold is operating properly. Always follow the manufacturer's instructions. Do NOT use compressed gas to clear moisture from the pressure line when connected to the patient. First disconnect the ventilator and circuit.

Condensation forms in the Patient Circuit over time. Periodically check for moisture in the Patient Circuit. When present, remove the moisture. Before attempting to dry the circuit, disconnect it from the ventilator. Never subject the internal ventilator components to moisture or high pressure. Doing so may damage the ventilator and endanger the patient.

Warning

Do NOT use compressed gas to clear moisture from the pressure line when connected to the patient. First disconnect the ventilator and circuit.

Inlet Air Filter

Frequency Check the filter weekly; daily when the ventilator is used during transport or outdoors. Replace the filter when it becomes dirty. A blocked inlet filter may cause a setting error alarm. Failure to change the filter may cause serious damage to the ventilator. It could also invalidate the warranty.

Warning

Do not operate the ventilator without an inlet air filter. Using the ventilator without a filter may damage the ventilator. Use only filters supplied by Puritan Bennett.

Supplies The only supplies needed are replacement filters.

- Procedure**
1. Twist the plastic cover over the inlet filter.
 2. Remove the two particle screens that sandwich the air filter. Periodically wash the screens in a mild soap solution. Discard the old filter.
 3. Place the new filter between the particle screens. Position the new filter with the printed side toward the ventilator. Make sure the black o-ring is in place.
 4. Place the assembly into position. Twist the plastic cover into place over the filter assembly.

Note Do NOT reuse filters. Discard them after removal.

Re-order part number: Filter, inlet L-002917-000

Ventilator Surface

Frequency Clean as often as the surface becomes soiled.

Supplies Use a mild soap solution and a damp cloth.

- Procedure**
1. Clean with a mild soap solution and a damp cloth. Squeeze the cloth thoroughly before applying it to the unit's surface.

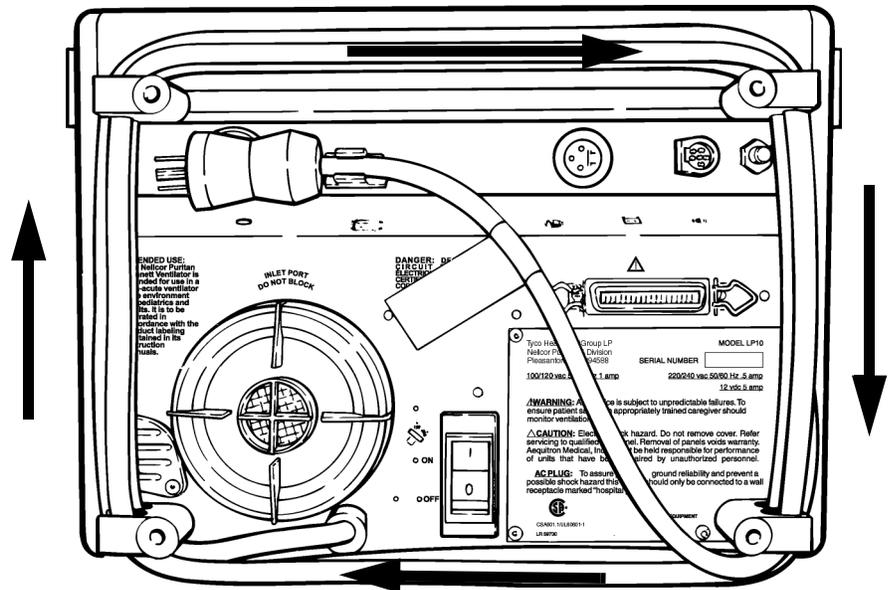
- 2. DO NOT allow liquids to enter the ventilator.

Warning

Never allow liquids to contact internal ventilator components under any circumstances. Liquid will damage the ventilator and endanger the patient.

We recommend using a ventilator cover to protect against liquids getting into the ventilator.

Storage of the Ventilator



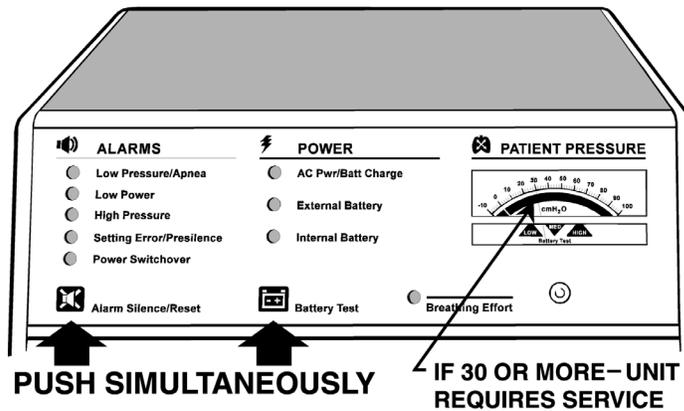
Before storage, charge the internal battery for a minimum of 10 hours. When storing the ventilator for extended periods, exercise the internal battery monthly. Run the ventilator on its internal battery until the low power alarm sounds. Immediately switch to AC power and recharge the internal battery for at least ten hours.

Wrap the AC power cord around the Cord Wrap/Rear Feet. Begin the wrap by placing the cord in the lower left foot. Use the inner groove. Continue to the upper left, upper right, and lower right feet. Keep the first and second wraps in the inner groove. At the start of the third wrap, place the cord in the outer groove of the lower left foot. Place the plug in the holder located at the top of the rear panel.

Scheduled Maintenance

The ventilator needs periodic maintenance. Follow the schedule below to ensure peak performance from the ventilator.

Maintenance	Interval	Action Required
Change the Inlet Air Filter	As Needed	See page 59.
Preventive Maintenance	Every twelve (12) months, or 6000 operating hours, whichever occurs first.	Contact your dealer
Battery Discharge/Recharge	Monthly	See pages 40 and 41.



You can check the total operating time on the Patient Pressure meter. To do so, press the Alarm Silence/Reset and Battery Test buttons simultaneously.

When the needle points to 30 or more, contact your homecare dealer for service.

Warning

The ventilator must be serviced per Puritan Bennett recommendation by authorized personnel to ensure proper performance.

Service Policy

The LP6 Plus and LP10 Volume Ventilators are warranted against defects in workmanship and materials. The full warranty on page 72 provides details. Do not make any service repairs on this equipment during the stated warranty period. Any unauthorized work immediately voids the warranty. If you need information or assistance, or if the information in this manual is insufficient, contact your local Puritan Bennett representative. Or, call Puritan Bennett Technical Services at: 1.800.255.6774

Puritan Bennett does not recognize the owner of a ventilator as an authorized service representative. Puritan Bennett will not be liable for any repairs attempted by the owner. Any such attempted repairs other than specified non-warranty repairs voids the warranty. Parts and labor costs incurred by the owner will not be reimbursed Nellcor Puritan Bennett.

Puritan Bennett will make available on request diagrams, component parts lists, descriptions, calibration procedures and instructions to assist in the repair of parts classified by Puritan Bennett as repairable.

Before returning any device to Puritan Bennett, you must get a Return Authorization Number by calling Puritan Bennett at one of the numbers given above.

Specifications

LP6 Plus and LP10 Volume Ventilators

IEC/EN 60601-1 classification:	Protection class I, Type BF, internally powered, continuous operation
Power Line:	110 VAC range (100-120 VAC), 1 Ampere or 220 VAC range (220-240 VAC), 0.5 Ampere, 50/60 Hz., external voltage selector switch
Power Usage	
Maximum:	630 kw hours per year.
Nominal:	315 kw hours per year.
Extension Cord Gauge:	Use 3-conductor harmonized cord only; up to 49' use 18 gauge cord; up to 99', use 16 gauge cord; up to 200', use 14 gauge cord.
External Battery:	12 VDC. 5 Amperes. Approximately 20 hrs. operation with 75-80 Amp-hour 12 VDC deep-cycle, gel-cell battery. Approximately 10 hrs operation with 35-40 Amp-hour 12 VDC deep-cycle, gel-cell battery.
Internal Battery:	Approximately 1 hour operation.
Type:	Volume ventilator.
Motor:	Brushless induction.
Pump:	Piston, 100 to 2200 ml tidal volume capability.
Front Panel Controls:	
Alarm Silence/Reset:	Push button to silence alarms during events or reset after events; used with Battery Test button to read machine operating hours on Patient Pressure meter.
Battery Test:	Push button to show battery charge level on the lower window of Patient Pressure meter.
Mode:	Rotary switch to set ventilator operating mode: Standby Assist/Control, SIMV, or Pressure Cycle.
Low Alarm:	Rotary switch to set limit for Low Pressure alarm: 2 to 32 cmH ₂ O/hPa in increments of 2 cmH ₂ O/hPa
High Alarm Limit:	Rotary switch to set limit for Assist/Control Pressure Cycle mode: 15 to 90 cmH ₂ O/hPa in increments of 5 cmH ₂ O/hPa
Volume:	Push-to-turn knob to set volume: continuously adjustable from 100 to 2200 ml.
Breath Rate:	Rotary switch to set breathing rate: 120 BPM in increments of 1 BPM and 2238 BPM in increments of 2 BPM.
Inspiratory Time:	Rotary switch to set time for delivery of set volume: 0.5 to 1.0 sec. in increments of 0.1 sec.; 1.2 sec.; and 1.5 to 5.5 sec. in increments of 0.5 sec.
Breathing Effort:	Push-to-turn knob to set pressure level for detecting breathing effort; continuously adjustable from -10 to +10 cmH ₂ O/hPa
Pressure Limit (LP10 Only):	Locking knob sets pressure limit level from 15 to 50 cmH ₂ O/hPa or closes off the pressure limit feature.
Input	
Patient Pressure:	Port for connection to the proximal pressure line of the patient circuit.

Outputs

Patient Air:	22 mm tube for connection to the bacteria filter.
Exhalation Valve:	Port for connection to the exhalation valve of the patient circuit.

Indicators

Normal Events

Patient Pressure Meter:	Displays patient pressure, -10 to +100 cmH ₂ O/hPa; also displays battery charge and machine hours of operation when appropriate buttons are pressed.
Breathing Effort:	Green LED activated by adequate patient breathing effort.
Power:	LEDs indicate operating power source: green AC Pwr/Batt Charge, amber External Battery, flashing amber Internal Battery.
Alarms:	Flashing red LEDs: Low pressure /Apnea, Low Power, High Pressure, Setting Error, Power Switchover.

Audible Alarms

Pulsating Tone:	Low Pressure/Apnea, Low Power, High Pressure, Setting Error, Power Switchover.
Steady Tone:	Loss of microprocessor control.
Reminder Tone:	Every five minutes when powered by Internal battery, each time accessory printer generates a report.

Rear Panel Controls

AC Circuit Breaker	Internal to the AC Power Switch (1 for ON; 0 for OFF), 1 Ampere
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Inputs

Inlet Filter:	Intake for patient air. Screw off cap for filter change.
External Battery:	Connection for 12 VDC battery.
Communications Port	Calibration information during service procedure.

Outputs

Vent:	Cooling vent for internal ventilator components
Remote Alarm	Connection for optional alarm accessories.
Communications Port	Connector for optional printer

Environment:

Operating:	5° C to 40° C (41° F to 104° F), 10% to 90% RH.
Storage:	-20° C to 50° C (5° F to 104° F), 10% to 90% RH; when moving the LP6 Plus or LP10 Ventilator from a non-operating to an operating environment, allow a minimum of one hour temperature stabilization before use.

Maintenance:

Preventative maintenance must be performed by qualified personnel every twelve (12) months or 6000 operating hours, whichever occurs first.

Dimensions:

9.75" X 14.5" X 13.25" (24.6 X 36.8 X 33.6 cm)

Weight:

Approximately 34 pounds (15.5 kg)

Resistance Factor:

Maximum of 5 cmH₂O @ 60 LPM

Compliance Factor:

0.57 ml/cmH₂O for A/C breaths

Emergency Pressure Relief:

100 cmH₂O/hPa (approximately)

Flow:

20-100 LPM

Sensors

Primary Pressure

Purpose	Measures the proximal pressure for use in pressure control and pressure monitoring.
Location	Proximal
Type	Gauge pressure sensor

Range	-20 cmH ₂ O/hPa to 120 cmH ₂ O/hPa (compensated). Temperature Range: -18° C to +63° C.
Accuracy	±2.5 cmH ₂ O/hPa.

Relative Motor Position

Purpose	Senses the relative motion of the piston drive motor.
Location	Stator of motor
Type	Hall sensor
Range	Digital
Accuracy	NA

Manufacturer's Declaration

The following tables contain the manufacturer's declarations for the *LP6/LP10 Ventilator System* electromagnetic emissions, electromagnetic immunity, recommended separation distances between ventilator and portable and mobile RF communications equipment, and a list of compliant cables.

Warning

Portable and mobile RF communications equipment can affect the performance of the *LP6/LP10 Ventilator System*. Install and use this device according to the information contained in this manual.

Warning

The *LP6/LP10 Ventilator System* should not be used adjacent to or stacked with other equipment, except as specified elsewhere in this manual. If adjacent or stacked use is necessary, the *LP6/LP10 Ventilator System* should be observed to verify normal operation in the configurations in which it will be used

Table 1: Electromagnetic Emissions

<p>The <i>LP6/LP10 Ventilator System</i> is intended for use in the electromagnetic environment specified below. The customer or the user of the <i>LP6/LP10 Ventilator System</i> should assure that it is used in such an environment.</p>		
Emissions Test	Compliance	Electromagnetic environment–guidance
RF emissions CISPR 11	Group 1	<p>The <i>LP6/LP10 Ventilator System</i> 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.</p> <p>The <i>LP6/LP10 Ventilator System</i> 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.</p>
RF emissions CISPR 11	Class B	
Harmonic emissions IEC 61000-3-2	Class D	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Table 2: Electromagnetic Immunity

<p>The <i>LP6/LP10 Ventilator System</i> is intended for use in the electromagnetic environment specified below. The customer or the user of the <i>LP6/LP10 Ventilator System</i> should assure that it is used in such an environment.</p>			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment–guidance
Electrostatic discharge (ESD) IEC 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 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.

Table 2: Electromagnetic Immunity (Continued)

The LP6/LP10 Ventilator System is intended for use in the electromagnetic environment specified below. The customer or the user of the LP6/LP10 Ventilator System should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment—guidance
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5% U_T (> 95% dip in U_T for 0.5 cycle) 40% U_T (60% dip in U_T for 5 cycles) 70% U_T (30% dip in U_T for 25 cycles) < 5% U_T (> 95% dip in U_T for 5 s)	< 5% U_T (> 95% dip in U_T for 0.5 cycle) 40% U_T (60% dip in U_T for 5 cycles) 70% U_T (30% dip in U_T for 25 cycles) < 5% U_T (> 95% dip in U_T for 5 s)	Mains power quality should be that of a typical commercial or hospital environment. If the user of the LP6/LP10 Ventilator System requires continued operation during power mains interruptions, it is recommended that the LP6/LP10 Ventilator System be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	10 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Table 3: Electromagnetic immunity–conducted and radiated RF

The LP6/LP10 Ventilator System is intended for use in the electromagnetic environment specified below. The customer or the user of the LP6/LP10 Ventilator System should assure that it is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment–guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	10 Vrms 150 kHz to 80	<p>Portable and mobile RF communications equipment should be used no closer to any part of the LP6/LP10 Ventilator System, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p>Recommended separation distance</p> $d = 0.35\sqrt{P}$
Radiated RF IEC 61000-4-3	3V/m 80 MHz to 2.5 GHz	10 V/m 80 MHz to 2.5 GHz	$d = 0.35\sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = 0.7\sqrt{P} \quad 800 \text{ MHz to } 2.5 \text{ GHz}$ <p>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).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey^a, should be less than the compliance level in each frequency range^b.</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 

Table 3: Electromagnetic immunity–conducted and radiated RF (Continued)

<p>The LP6/LP10 Ventilator System is intended for use in the electromagnetic environment specified below. The customer or the user of the LP6/LP10 Ventilator System should assure that it is used in such an environment.</p>			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment–guidance
<p>Notes:</p> <ul style="list-style-type: none"> • At 80 MHz and 800 MHz, the higher frequency range applies. • These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people. <p>^a 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 LP6/LP10 Ventilator System is used exceeds the applicable RF compliance level above, the LP6/LP10 Ventilator System should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the LP6/LP10 Ventilator System.</p> <p>^b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.</p>			

Table 4: Recommended separation distances between portable and mobile RF communications equipment and the LP6/LP10 Ventilator System

<p>The LP6/LP10 Ventilator System is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the LP6/LP10 Ventilator System can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the LP6/LP10 Ventilator System as recommended below, according to the maximum output power of the communications equipment.</p>			
Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter (m)		
	150 kHz to 80 MHz $d = 0.35\sqrt{P}$	80 MHz to 800 MHz $d = 0.35\sqrt{P}$	800 MHz to 2.5 GHz $d = 0.7\sqrt{P}$
0.01	0.035	0.035	0.07
0.1	0.11	0.11	0.22
1	.35	.35	0.7

Table 4: Recommended separation distances between portable and mobile RF communications equipment and the LP6/LP10 Ventilator System (Continued)

The LP6/LP10 Ventilator System is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the LP6/LP10 Ventilator System can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the LP6/LP10 Ventilator System 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 (m)		
	150 kHz to 80 MHz $d = 0.35\sqrt{P}$	80 MHz to 800 MHz $d = 0.35\sqrt{P}$	800 MHz to 2.5 GHz $d = 0.7\sqrt{P}$
10	1.1	1.1	2.2
100	3.5	3.5	7

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.

Notes:

- At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
- These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Table 5: Compliant cables

<p>The listed cables and accessories comply with the following standards:</p> <ul style="list-style-type: none"> •RF emissions, CISPR 11 Group 1, Class B •EN 60601-1-2: 2001 <p>Warning</p>	
<div style="border: 3px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>The use of accessories and cables other than those specified, with the exception of parts sold by Puritan Bennett as replacements for internal components, may result in increased emissions or decreased immunity of the LP6/LP10 Ventilator System.</p> </div>	
Cable or Accessory	Maximum length
Y-101748-00A Power cord	10 ft (3 m)
L-007916-000 Power Cord, international	10 ft (3 m)
Y-CG1111 Cable, battery, right angle	7 ft (2.1 m)
Y-CG1113 Cable, battery, straight	7 ft (2.1 m)
Y-CG1655 Cable, adapter	22 in (56 cm)
Y-CG1719 Cable, battery, right angle	4 ft (1.2 m)
Y-CG2133 Cable, adapter	18 in (46 cm)
L-005367-000 Cable, interface	10 ft (3 m)

Limited Warranty

Puritan Bennett warrants to the owner that the LP6 and LP10 Volume Ventilator, exclusive of expendable parts and other accessories, shall be free from defects in material and workmanship for 24 months from the original date of sale. Puritan Bennett's sole obligation, with respect to any such defect, is limited to the repair or, at Puritan Bennett's option, replacement of the ventilator. Purchaser pays return freight charges.

This warranty is made on the condition that prompt notification of a defect is given to Puritan Bennett within the warranty period, and that Puritan Bennett has the sole right to determine whether a defect exists.

This warranty is conditional on the performance of Preventive Maintenance at a minimum of once every 6000 operating hours, or recertification every twelve (12) months (whichever occurs first) by service personnel qualified by Puritan Bennett. The warranty does not apply to ventilators that have been partially or completely disassembled; altered; subjected to misuse, negligence, or accident; or operated other than in accordance with the instructions provided by Puritan Bennett. This includes repair by unauthorized personnel.

This warranty represents the exclusive obligation of Puritan Bennett and the exclusive remedy of the purchaser regarding defects in the ventilator.

THIS WARRANTY IS GIVEN IN LIEU OF ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

No person is authorized to modify, in any manner, Puritan Bennett's obligation as described above.

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