Introduction

▼ The Portable Respironics Volume Ventilator (PLV-100) is a microprocessor controlled, electrically powered volume ventilator designed to provide ventilatory assistance in a variety of applications. The PLV-100 is designed specifically for long term use in the home. It has been clinically proven in this setting to be an efficient and reliable breathing aid.

The PLV-100 is an excellent choice for transport and portable application. It operates from a variety of power sources, and is extremely compact and lightweight.

The capability of the PLV-100 to ventilate a wide variety of patients makes it the choice of clinicians. Adult patients are easily ventilated with this versatile device. Low flow rates and low tidal volumes allow for effective ventilation of pediatric patients. The use of the Respironics External Pressure Limiter further enhances the use of the PLV-100 for pediatrics. A flow rate range up to 120 lpm allows for ventilation of patients with increased minute volume demands or those requiring a longer expiratory time.

Please read this clinical manual, and become familiar with the operation of the PLV-100 before using the ventilator on an individual.

Save the box and all packing material for safe transportation of the PLV-100 back to Respironics for preventive maintenance or service needs.

The PLV-100 is FDA registered, UL listed, FCC and CSA certified. In addition, the PLV-100 is approved by SEMKO, Demko, LGA, and NATA. The French Health Ministry has given the PLV-100 official homologation (approval). Approvals are pending from other agencies.

Due to our continued efforts to improve our products, specifications in this manual are subject to change without notice.

The PLV-100 is manufactured by Respironics, Inc.® under the following patents:

United States Patent 4,493,614 and 4,617,637
Canadian Patent 1,204,090 and 1,237,507
Australian Patent 586,376
Other patents pending.

The information contained in the clinical manual as well as the software programs to which it relates are protected under copyright law.

Respironics® PLV-100 Clinical Manual, p/n 35500 Rev. D

Warnings and Cautions

▼ Throughout this manual the following definitions apply:

- **Warning:**
  A condition that may cause injury to a patient or operator if instructions are not followed.

- **Caution:**
  A condition that may cause damage or shorten the service life of the PLV-100.

Warnings

▲ Personnel using and operating the PLV-100 must become familiar with this instruction manual before initial setup and use.

▲ Equipment that does not function correctly or alerts the user to a potential problem, (by sounding an alarm), must not be used until the problem is corrected.

▲ Use the PLV-100 only per the physician's prescription.

▲ Low Pressure Alarm settings more than 10 cmH2O below the system pressure may prevent the unit from alarming in response to circuit leaks or patient disconnects.

▲ The addition of artificial noses or heat moisture exchangers to the patient circuit may prevent a Low Pressure Alarm from occurring due to the build up of secretions.

▲ Do not use the PLV-100 in the presence of flammable anesthetics.

▲ Ensure client safety through the presence of a trained attendant and alternate emergency equipment.

▲ Do not remove any covers or panels. Refer all servicing to authorized service personnel.

▲ It is recommended that bacteria filters be used in the patient circuit to ensure client safety.

▲ It is recommended that an oxygen analyzer be used to verify FIO_2 when using supplemental oxygen.

▲ Periodically verify that alarms are set correctly and are operational.

▲ To avoid the entrainment of battery gases into the intake ports on the rear panel do not operate the PLV-100 directly above a battery.

▲ Due to the wide variety of disposable tubing, the user must be certain the connection to the patient air outlet fits properly.

Cautions

- ▲ Do not place containers of liquids on the ventilator. Do not spill liquids on the ventilator.
- ▲ The PLV-100 must be periodically checked and maintained to ensure proper operation.
- ▲ Do not use the PLV-100 to charge a deeply discharged external battery.
- ▲ Connect the PLV-100 only to a grounded hospital grade outlet.
- ▲ If either front panel circuit breaker trips, reset by pushing the round circuit breaker knob in until it “clicks” back into position. If the breakers continue to trip after resetting, return the ventilator to an authorized service personnel for repair.
- ▲ Replace the back panel shipping fuse, (when necessary), with a 5 amp slow blow fuse, type 3AG only.
- ▲ Do not position the PLV-100 as to block the air intake ports located on the rear panel.
- ▲ Performance may be affected at temperatures below -5°C (23°F) and above 41°C (106°F).
- ▲ Due to the wide variety of wave forms and voltages produced by inverters, it is recommended that the PLV-100 be operated only on a 12 VDC power supply when used in mobile vehicles such as ambulances and aircraft.
- ▲ Do not disconnect the external battery while the unit is operating under load. This may cause the unit to repeat the diagnostic start-up cycle.
- ▲ Do not operate the unit on the internal batteries in place of external batteries.
- ▲ To decrease the chance of depleting the wheelchair battery, do not use the battery as the external power source for the PLV-100.
- ▲ Storage of the unit with a partially discharged internal battery severely decreases the battery life. Always store the unit with the power plug connected to AC voltage, or only after fully charging the internal battery from AC voltage.
- ▲ Frequent and/or prolonged use of the unit on internal battery shortens the battery life. This requires close monitoring of the battery strength and may require battery replacement sooner than the normal maintenance interval.
- ▲ **Caution:** Federal law restricts this device to sale by or on the order of a physician.

Front Panel Controls

Mode Selection
CONTROL, ASSIST/CONTROL, SIMV

Tidal Volume
0.05 to 0.20 ± 0.02 liters; 0.20 to 3.00 liters ± 10%

Breath Rate
2 to 36 ± 0.5 BPM; 36 to 40 ± 2 BPM

Inspiratory Flow Rate
10 to 120 liters per min (Peak flow rate during inspiratory time)

Battery Test Switch
Internal, External Battery

Main Power Switch
On, Off/Recharge

Circuit Breakers

DC Circuit Breaker	Push-Pull Actuation
AC Circuit Breaker	Push-Pull Actuation

Airway Pressure Limit
5 to 100 ± 5 cm H_2O

Sensitivity
+3 to at least -6 ± 1 cm H_2O

Low Pressure Alarm
2 to 40 ± 2 cm H_2O

Alarm Silence Button
30 seconds, Automatic Reset

Front Panel Visual Indicators

Tidal Volume
Digital Display

Rate/Patient Breaths Per Minute
Digital Display

I:E Ratio
Digital Display

Inspiratory Flow Rate
Digital Display

Front Panel Visual Indicators
(Continued)

Increase Inspiratory Flow
Red Indicator Light

120 (220/240 or 100) VAC Power
Green Indicator Light

Battery Source

Internal Battery	Amber Indicator Light
External Battery	White Indicator Light

Patient Airway Pressure Gauge
-10 to 100 cm H_2O

Assist/Spontaneous
Green Indicator Light

15 Second Delay (Low Pressure Alarm)
Green Indicator Light

Alarm Silenced
Amber Indicator Light

Power Specifications

Power Sources

Domestic Models	120 VAC 50/60 Hz *
International Models	220/240 VAC 50 Hz or 100 VAC 50/60 Hz
12 VDC Internal Battery	Sealed lead acid gel, 2.5 amp hrs.
12 VDC External Battery	105 amp hrs (marine deep cycle recommended)
12 VDC Sources	Automobile or boat battery by direct connection or using Respironics Auto Lighter Cable

***NOTE:** Throughout the entire Operator's Manual "120 VAC 50/60 Hz" shall also imply "220/240 VAC 50 Hz or 100 VAC 50/60 Hz" on international models.

Warranty
(Continued)

Limits of Warranty
This Warranty is in place of all other warranties, expressed or implied. This includes the warranties of merchantability, (an unwritten warranty that the product is of saleable quality), and fitness. This warranty is in place of all other obligations or liabilities on the part of Respironics including, but not limited to, contingent or consequential damages, (the cost of repairing or replacing other property which may be damaged if the unit does not work properly).

This Warranty, and the rights and obligations described in it, will be construed under and governed by the laws of the Commonwealth of Pennsylvania, U.S.A.

Maintenance Contract #51035

Requirements for purchase
A monthly maintenance contract may be purchased at any time. If your equipment is placed under contract while that equipment is not still covered under warranty, then that equipment must first be returned to a Respironics for inspection, servicing and calibration at the owner's expense.

Coverage
A monthly maintenance contract covers the same full line of services offered under the original warranty including preventive maintenance, non-routine service, freight-out and loaner equipment.

Freight
Freight-in is at the owner's expense. Freight-out is the responsibility of Respironics.

Power Specifications
(Continued)

Battery Operation Time*

12 VDC External Battery	approximately 24 hrs.
12 VDC Internal Battery	approximately 1 hr.

***NOTE:** Operation times are decreased by conditions using increased power consumption, such as extreme settings. Conversely, operating times increase by settings using low power consumption.

Battery Charging by PLV-100
Trickle charge to internal and external batteries

Optional External Chargers
2 amp charger
10 amp charger

Alarm or Alert Indicators

Pressure Alarms

Low Pressure	Visual/Continuous Audible
High Pressure	Momentary Audible

Apnea
Visual/Continuous Audible

Inverse I:E Ratio
Visual Warning

Increase Inspiratory Flow
Visual Warning

Battery Alarms

Internal Battery	Visual/Continuous Audible
External Battery	Visual/Continuous Audible
Reverse Battery Connection	Continuous Audible

Power Alarms

Power Failure	Continuous Audible
Power Source Change	Single Audible Tone

Unit Malfunction
Intermittent Audible

Alarm Silence
Continuous Visual (while activated)

Temperature Specifications

Operating Temperature Range
-5°C to +41°C (+23°F to +106°F)

Dimensions and Weight

Dimensions
22.9 x 31.1 x 31.1 cm (9" x 12.25" x 12.25")

Weight
12.8 kg (28.2 lb)

Warranty
(Continued)

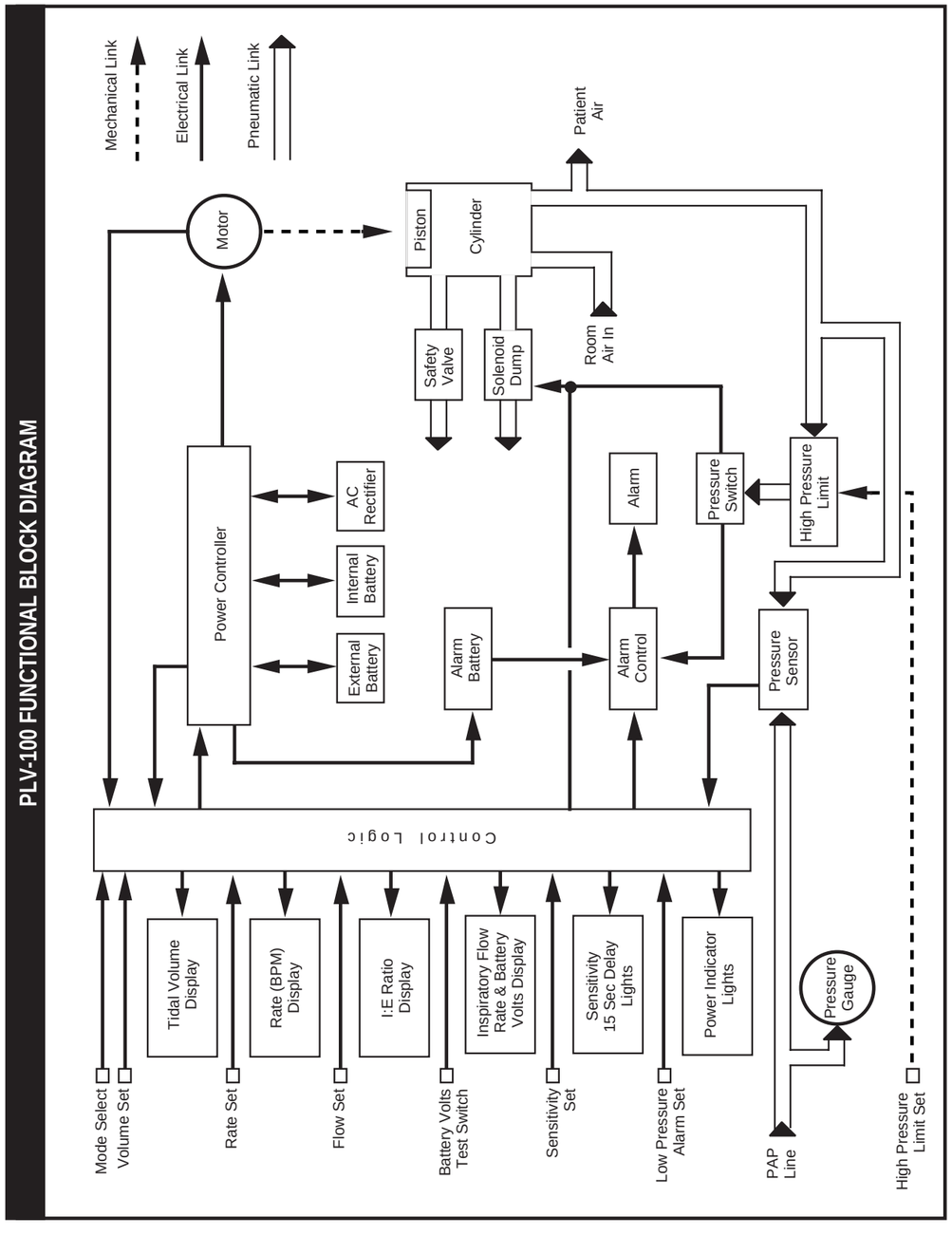
One Year Warranty
Respironics warrants the PLV-100 (“unit”) to be free from defects in materials and workmanship for a period of one year after delivery, provided the unit is properly operated under conditions of normal use as described in the Clinical Manual. Respironics makes replacements, repairs or issue a credit for equipment or parts at Respironics' option which are found to be defective. The defective unit may be returned prepaid to Respironics after the customer has received approval from Respironics to return the unit.

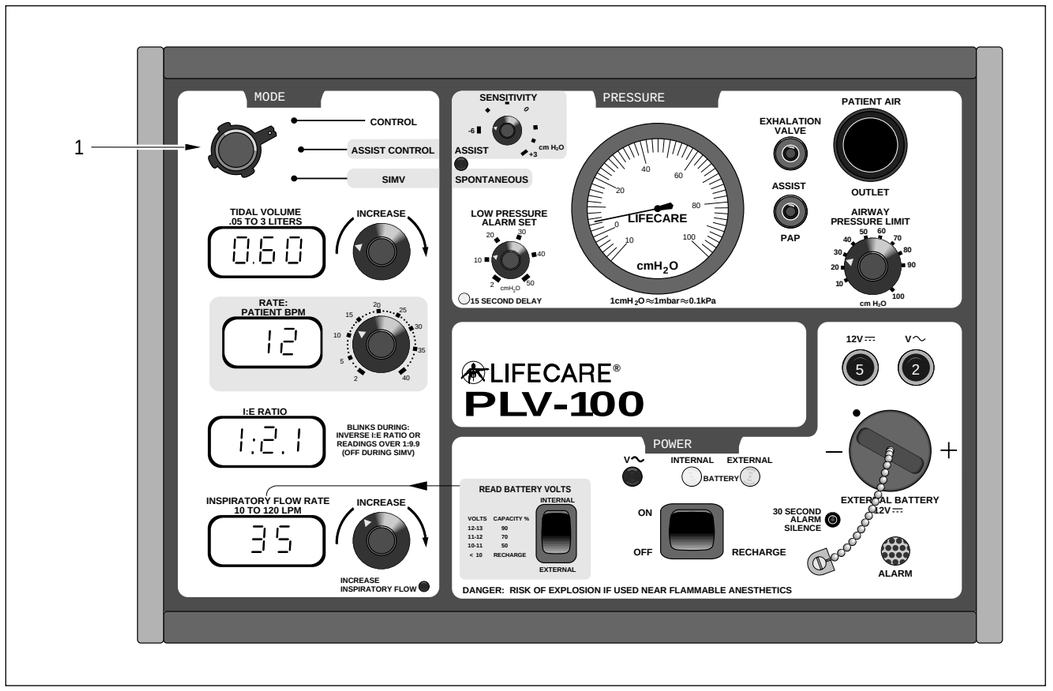
Changes To Equipment
Respironics, its dealers and associates, reserve the right to make changes in equipment built and/or sold by them. These changes do not obligate Respironics to make the same or similar changes to equipment previously built and/or sold by them.

Client Safety
Respironics has made every effort to make a reliable and trouble-free instrument. However, there is always a possibility of unpredicated failure with any mechanical or electronic device. Respironics cannot control the manner in which the unit is used. Therefore, the buyer or user alone must determine the medical and/or mechanical suitability of the unit in every way and decide if other precautionary measures are needed to ensure client safety. If you need safety advice, Respironics is pleased to offer assistance.

What is Not Covered
This Warranty does not apply to any unit or individual parts which have been repaired or altered in a way that, in Respironics’ judgement, affect its stability or reliability, or which has been subjected to misuse, negligence, abuse, or accident.

This Warranty does not cover damage which may occur during shipping. If there is any damage in shipment, please contact the carrier or individual who delivered the unit.





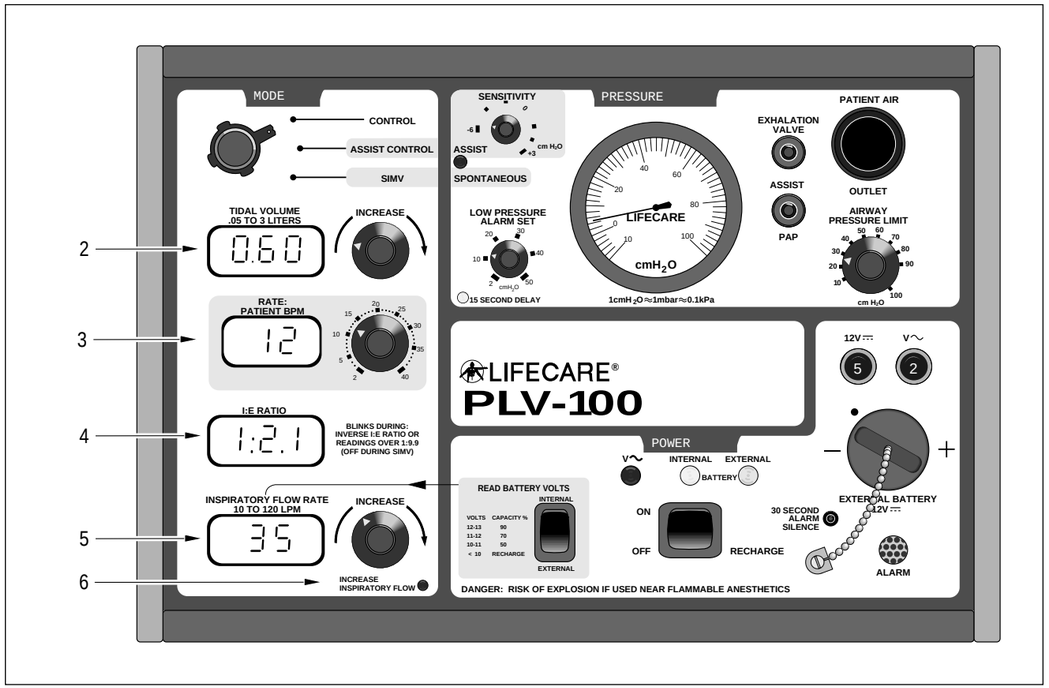
Mode and Operation

1. Mode
The Mode knob controls the selection of three operation modalities.

- **Control Mode**
  All patient breaths are delivered by the ventilator at the preset tidal volume, BPM rate, and inspiratory flow rate independent of patient effort.

- **Assist/Control Mode**
  The patient's spontaneous inspiratory effort may trigger the ventilator to deliver an assisted breath at the preset tidal volume and inspiratory flow rate. If the patient does not trigger an assisted breath, the ventilator delivers breaths at the BPM rate set on the control knob.

- **SIMV Mode (Synchronized Intermittent Mandatory Ventilation)**
  A minimum respiratory rate is set to deliver breaths at a preset tidal volume and inspiratory flow rate. On patient efforts above the minimum respiratory rate, the patient breath comes through either the patient air inlet on the rear panel of the PLV-100 or an IMV "H" valve added to the ventilator circuit. See Section 9, Application Notes, for a detailed description of the SIMV mode.



Mode and Operation

(Continued)

2. Tidal Volume Control and Digital Display
The Tidal Volume is adjustable from 0.05 to 3.0 liters by turning the knob on the front panel. The actual tidal volume set is shown on the digital display adjacent to the knob. This parameter remains constant unless the tidal volume setting is changed.

3. Respiratory Rate/Patient BPM Control and Digital Display
Respiratory Rate or Patient Breaths Per Minute are available from 2 to 40 BPM.

This setting determines the actual number of ventilator delivered breaths in the Control mode. This knob also controls the minimum number of ventilator delivered breaths in the Assist/Control and SIMV modes.

In Control mode, the BPM display indicates the BPM set on the ventilator. In Assist/Control mode, the display indicates the sum of the controlled and assisted breaths. In SIMV mode, the display indicates the sum of ventilator delivered breaths and patient inspiratory efforts. Update of the BPM digital display occurs by averaging the preceding 4 breaths, or whenever a setting change is made.

Troubleshooting Guide

WARNING!: Whenever there is an alarm condition be certain to provide ventilation for the user unless the problem can be found and corrected immediately.

Symptom	Probable Cause	Corrective Action
Unit switched ON and does not operate. Continuous audible alarm sounds.	1. All power supplies exhausted. 2. Circuit breaker disengaged. 3. Shipping fuse disengaged or faulty.	1. Plug into AC source to operate and charge batteries. 2. Reset circuit breakers. 3. Engage or replace shipping fuse.
1.0 or 2.0 displayed in Tidal Volume LCD window. Unit does not operate and “Fast Beep” audible alarm sounds.	1. Pressure transducer failure. 2. Microprocessor failure.	1. or 2. Do Not Use Unit. Refer to an authorized Service Center.
Unit passes diagnostic check and begins operation. Continuous audible alarm sounds.	1. Low Pressure Alarm activated. 2. Low battery voltage.	1. Check for disconnect in ventilator circuit; or set point incorrectly set. 2. Check battery voltage and charge if indicated.
Unit passes diagnostic check and begins operation. Intermittent audible alarm sounds.	1. High Pressure Alarm (alarms with unit cycling). 2. Intermittent Low Pressure Alarm.	1. Check for correct Airway Pressure Limit setting; or patient may need suctioning. 2. Check for correct setting of Low Pressure set-point.
Unit is operating but no pressure seen on manometer. Continuous audible alarm sounds.	1. PAP line disconnected. 2. Circuit disconnected.	1. Reconnect PAP line. 2. Check entire circuit for disconnect.
External battery cable is connected. Continuous audible alarm sounds.	1. Battery Cable Polarity is reversed. 2. External Battery Low.	1. Correctly reconnect cable. 2. Check and recharge External Battery.
Increase Inspiratory Flow LED is flashing. Flow rate and BPM values are altered.	1. Inspiratory flow rate set too low to meet rate and tidal volume selection.	1. Adjust parameters as indicated. See Section 9, Application Notes, for information or Priority Sequence explanation.

Maintenance

(Continued)

Radio Frequency Interference, continued
The user should consult the dealer or an experienced radio/television technician for additional suggestions if necessary. The user may find the following booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 0004-0000-00345-4.

Filter Maintenance
Maintenance of the filters on the rear panel is the only maintenance required to be performed by the user except ventilator circuit cleaning. Check the filters twice a week and clean as necessary. The filters are reusable, discard only if they are worn or significantly discolored.

Battery Maintenance
To maintain the internal batteries in the best condition possible:

- Store the ventilator in a cool environment when it is not being used. Store the unit at or below 20 °C (70 °F) if possible.
- Keep the PLV-100 plugged into AC power when not using and during storage.

Mode and Operation

(Continued)

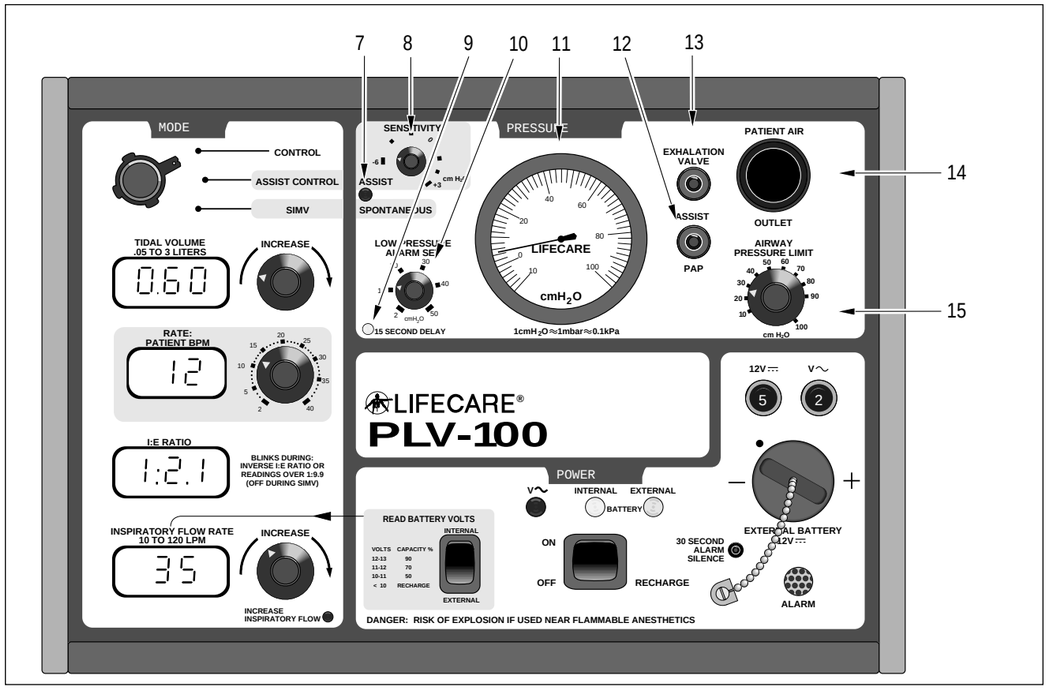
4. I:E Ratio Digital Display
The PLV-100 calculates and displays the inspiratory:expiratory time ratio from the set BPM rate, tidal volume and inspiratory flow rate settings.

> **NOTE:** A flashing display indicates an inverse I:E ratio (inspiratory time is longer than expiratory time) or the I:E ratio exceeds 1:9.9. In Assist/Control mode, the display reads the calculated I:E ratio based on the set BPM rate. In the SIMV mode, the I:E ratio display is blanked.

5. Inspiratory Peak Flow Rate Control and Digital Display
Inspiratory peak flow rate is adjustable from 10 to 120 liters per minute, and is used to set the I:E ratio. As flow rate is increased, and tidal volume and BPM rate remain constant, inspiratory time decreases. The PLV-100 offers a sinusoidal flow pattern on all delivered breaths.

The inspiratory peak flow rate display indicates the peak inspiratory flow rate delivered by the ventilator. This remains constant unless the inspiratory flow parameter is changed, or the flow rate is set inadequately to meet tidal volume and respiratory rate requirements. See Section 9, Application Notes, for further information.

6. Increase Inspiratory Flow LED
This LED flashes whenever set inspiratory flow rate is insufficient to meet other set parameters. The flow rate automatically increases to match the set parameters. See Section 9, Application Notes, for further information.



Pressure

7. Assist/Spontaneous LED
Gives a visual indication of the patient's inspiratory effort. In the Assist/Control mode, illumination of this LED corresponds to patient assisted, ventilator delivered breaths. In the SIMV mode, this LED indicates patient spontaneous breaths as well as assisted breaths, and registers these breaths on the BPM digital display.

8. Sensitivity Control
Adjustable from +3 to -6 cm H_2O. Controls the amount of patient inspiratory effort required to trigger the ventilator in the Assist/Control mode. Also used as a sensor for monitoring and synchronizing spontaneous breaths in the SIMV mode. The PLV-100 senses barometric pressure continually so that the sensitivity level set by the clinician remains stable.

9. 15 Second Delay LED
This LED is illuminated when the system pressure is below the Low Pressure Set Point. The illumination indicates that the 15 second delay has begun and the pressure level set on the Low Pressure Alarm must be crossed within the 15 second delay or the alarm will sound.

Maintenance

WARNING!: Do not open the case of the PLV-100 for any reason. There are no user serviceable parts inside. Unauthorized repairs may void the warranty or maintenance contract. Refer all service needs to Respironics or an authorized Service Center.

Preventive Maintenance
The PLV-100 must have preventive maintenance performed every 8,000 hours or 1 year. The hour meter is located behind the machine air inlet filter located on the back of the PLV-100. This service must be performed by Respironics or an authorized Service Center. A loaner unit may be provided by Respironics for use during service performed under warranty or maintenance contract.

Electrostatic Interference
The PLV-100 contains electrostatic discharge sensitive (ESDS) electronic components. ESDS parts and assemblies may be unknowingly damaged or degraded, upon opening the case to gain access for maintenance and repairs. Customer or client repairs are NOT recommended. Refer service or repair to authorized service personnel only.

Radio Frequency Interference
This equipment generates and uses radio frequency energy. If it is not installed and used in strict accordance with the manufacturer's instructions, it may cause interference to radio and television reception. It has been type tested and found to comply with the limits for FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If the PLV-100 is the cause of the interference, this can be determined by turning the equipment off and on. If this equipment does cause interference to radio or television reception, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the ventilator with respect to the receiver.
- Increase the distance between the ventilator and the receiver.
- Plug the ventilator into a different outlet so that ventilator and receiver are on different electrical branch circuits.

Decontamination of Tubing and Accessories
(Continued)

Cleaning and Disinfection Procedure, continued

9. Drain all parts dry on a clean towel; do not wipe dry. Equipment must be completely dry before storage.

10. Reassemble when equipment is dry; store, ready for use, in a plastic bag or in a dust-free area.

WARNING!: Do not reuse vinegar solution. Effectiveness is significantly lessened if solution is used more than once.

Use all cleaning materials for a single patient's respiratory equipment only.

Commercially prepared quaternary ammonium compounds, such as Control III, are available from home care companies. The cost and practicality of using these solutions for cleaning should be considered by each individual user according to specific requirements. Follow manufacturer's instructions carefully.

A washable, mini-operation instruction card is available for use as a guide when disinfecting respiratory equipment.

For further assistance, contact your local home care company representative or Respironics.

Pressure
(Continued)

10 Low Pressure Alarm Control
This is adjustable from 2 to 40 cm H_2O, and allows the clinician to set a customized low pressure alarm for each patient's needs. Respironics recommends that this alarm be set 5 to 10 cm H_2O below the patient's peak pressure.

WARNING!: Low Pressure Alarm settings more than 10 cmH2O below the system pressure may prevent the unit from alarming in response to circuit leaks or patient disconnects. For a detailed description of the setting and function of this alarm, see Section 6 – Alarm and Alert Systems.

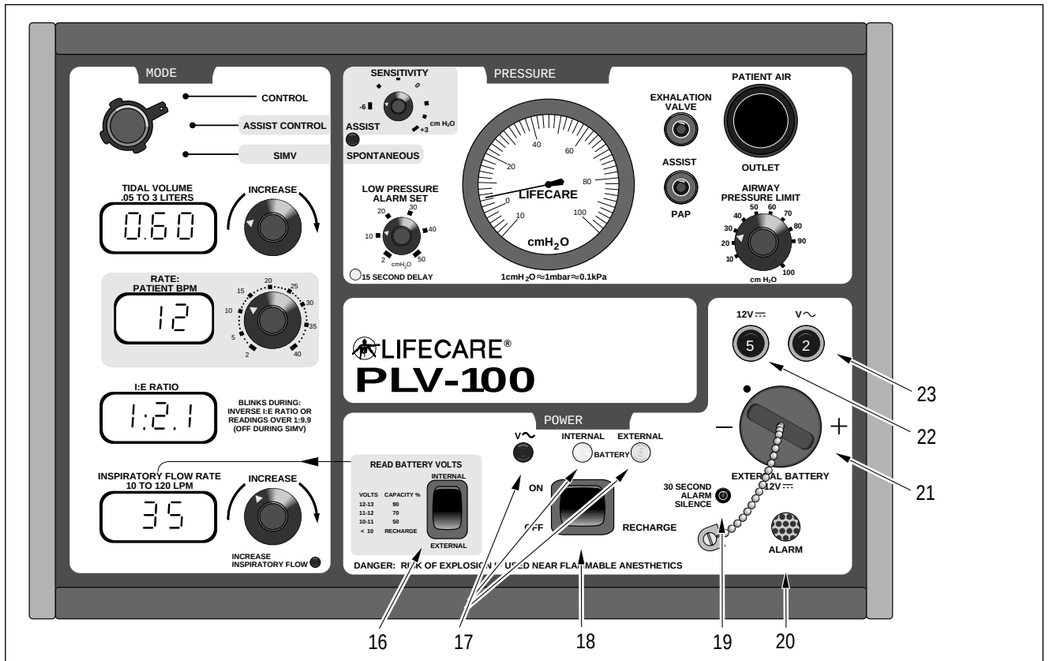
11. Pressure Gauge
Proximal airway pressure displays the pressure as detected in the Proximal Airway Pressure (PAP) tubing. The pressure range is from -10 cm H_2O to 100 cm H_2O.

12. Assist/PAP (Proximal Airway Pressure) Connector
This connector accepts the 3/16" I.D. PAP tubing from the ventilator circuit. The proximal airway pressure and patient inspiratory efforts are sensed through this connector to trigger an assisted breath in the Assist/Control Mode, or to synchronize the breaths and reset the 15 second delay in the SIMV Mode.

13. Exhalation Valve Tubing Connector
This connector accepts the 1/8" I.D. tubing to provide the gas source for the exhalation valve.

14. Patient Air Outlet Connector
Connect the standard 22 mm I.D. ventilator circuit tubing or other adapters to this outlet. The tidal volume delivered to the patient flows through this port.

15. Airway Pressure Limit Control
This control is adjustable from 5 to 100 cm H_2O, and limits the pressure level in the patient/ventilator system to avoid barotrauma to the user. Respironics recommends that this limit be set 10 to 20 cm H_2O above the normal airway pressure. This limit is independent of the PAP system and operates without the PAP tubing being connected.



Power

16. Battery Voltage Test Switch
This rocker-type switch allows the user to read internal or external battery voltage levels. These levels are read in the Inspiratory Flow Rate Digital Display. The PLV-100 must be operating on the selected battery source to display the remaining voltage. The digital display reverts to the inspiratory flow reading when the battery voltage test switch is released. This value is displayed as volts remaining. See Section 7, Power Supply Options, for further information.

CAUTION: When recharging the internal or external batteries, wait 2-3 minutes before checking the battery voltage level. Checking the level immediately after removing the charger may give a falsely high reading. This is a characteristic of all rechargeable batteries.

Decontamination of Tubing and Accessories
(Continued)

Definitions

- **Decontamination:**
  The reduction of microbial contamination to an acceptable level.
- **Cleaning:**
  The process of removing foreign material such as blood, sputum, or dust from objects.
- **Disinfection:**
  The process of killing pathogenic organisms on inanimate objects.
- **Pathogen:**
  A microbe capable of causing disease.

Small Bore Tubing
Do not use this procedure for small bore tubing such as the exhalation valve tubing and PAP tubing. Simply wipe off the outside of this tubing with either a 70% Isopropyl Alcohol solution or mild detergent. This small tubing is difficult to dry effectively inside the tubing. Replace the tubing when it becomes dirty, contaminated or as needed.

Cleaning and Disinfection Procedure
1. Disassemble all tubing and adapters.
2. Wash hands thoroughly prior to cleaning equipment.
3. Prepare a mild detergent solution using warm tap water and liquid dishwashing, or other, soap.
4. Scrub all accessible surfaces thoroughly, using a soft brush.
5. Rinse with tap water, making certain all soap residue is removed.
6. Prepare a solution using one part white vinegar to three parts distilled water. An average beginning quantity is 8 ounces of vinegar to 24 ounces of distilled water, the actual amount varies according to individual needs.. Regardless of the quantity, the ratio must remain at 1:3.
7. Soak equipment in this solution for one hour.
8. Rinse completely with warm tap water.

Cleaning the PLV-100

▼ Clean all accessible surfaces of the PLV-100 by wiping the surfaces with nonabrasive household cleaner every 2 weeks, or more often as necessary. The surface may also be disinfected using a 70% isopropyl alcohol solution on a dampened cloth.

If a high level disinfection is required, the PLV-100 may be disinfected using a glutaraldehyde solution. Contact Respironics or an authorized Service Center for complete information.

CAUTION: Do not use phenol based or quaternary ammonium compounds on the front panel of the PLV-100 as these compounds may cloud the LCD windows and manometer cover over time.

Do not use radiation decontamination.

Do not steam autoclave the PLV-100.

Gas Sterilization
The PLV-100 may be sterilized using Ethylene Oxide provided that humidity does not exceed 60% and the temperature does not exceed 130°F. The duration of exposure in the chamber is determined by the above parameters.

Decontamination of Tubing and Accessories

▼ The cleaning and decontamination of respiratory equipment is of great importance in the hospital and in the home. Equipment infected with bacteria could infect the user's lungs. To prevent this contamination simply and effectively, routinely clean and disinfect the equipment on a regular basis.

Perform the cleaning twice a week under normal conditions. Increase the frequency of cleaning as needed if signs of respiratory infection are evident. Some clients report doing this on regular days such as Monday and Thursday, or Sunday and Wednesday. This makes it easier to remain on schedule.

Power

(Continued)

17. Power Source LED's

- **120 VAC LED (V ~)**
  This green LED is illuminated when the PLV-100 is operating from an AC power source.
- **Internal Battery LED**
  This amber LED is illuminated when the unit is operating from its internal battery. This LED blinks when the internal battery charge is low.
- **External Battery LED**
  This white LED is illuminated when the unit is operating from an external 12 VDC source. This LED blinks when the external battery source is low.

18. Power Switch
Switches between "ON" and "OFF/RECHARGE." The internal battery and external battery, (if connected), are charged as long as the line cord is plugged into a wall outlet regardless of the power switch position.

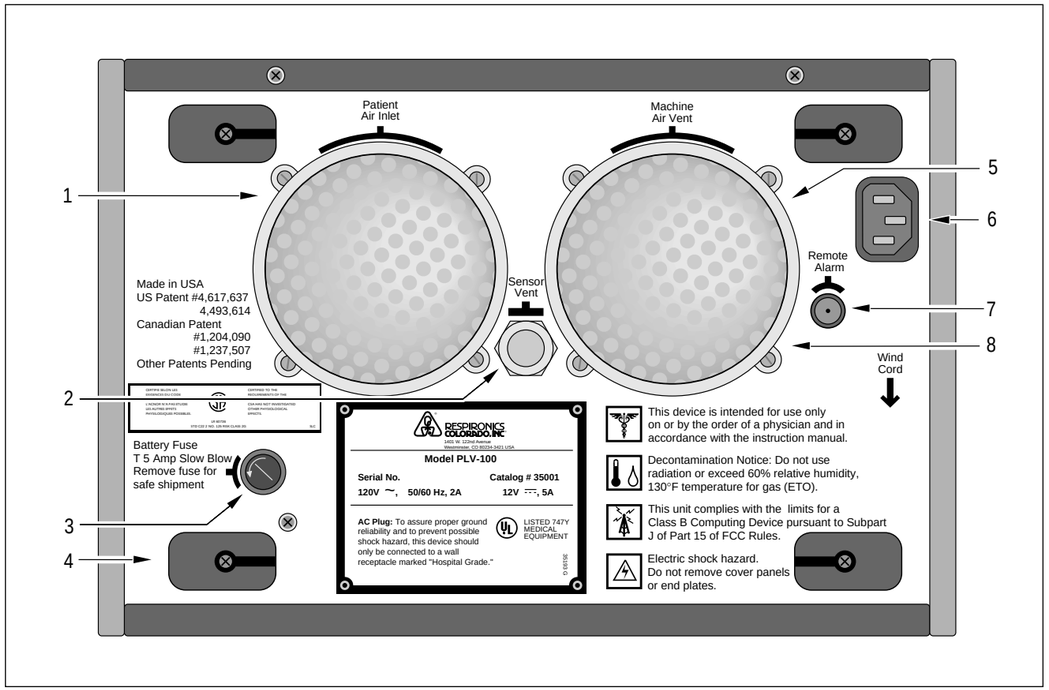
19. Alarm Silence Button
Pressing this button silences most audible alarms for 30 seconds. The alarm silence function automatically resets following 30 seconds. The alarms that cannot be silenced are: Power failure, High pressure, and Microprocessor failure.

20. Alarm Port
Sound outlet for audible alarm.

21. External Battery Receptacle
Connect the auto lighter cable or external battery cable to this receptacle. Align the dot (guide) on the front panel with the dot on the connector. Rotate connector clockwise to lock.

22. DC Circuit Breaker (12 V ⎓)
Press to reset the circuit breaker for the 12 VDC power circuit.

23. AC Circuit Breaker (V ~)
Press to reset the circuit breaker for the 120 VAC power circuit.



Rear Panel

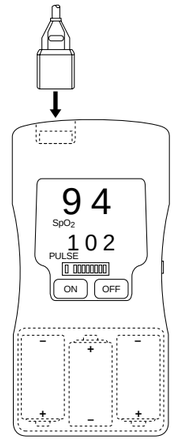
1. Patient Air Inlet
This inlet allows filtered room air to enter the ventilator to be delivered, through the ventilator circuit, to the patient.

NOTE: The Patient Air Inlet houses a reusable foam filter which requires periodically cleaned by the user. See Section 12, Cleaning and Disinfection, for more information on filter changes.

2. Sensor Vent
The PLV-100 samples barometric pressure every minute and recalibrates the sensitivity control to zero. This feature provides a more stable sensitivity set point.

Additional Accessories
(Continued)

Respironics SpotCheck Oximeter 43001
The SpotCheck Oximeter is a hand held noninvasive monitor that is ideal for portable or transport applications. For more information, contact a Respironics representative.



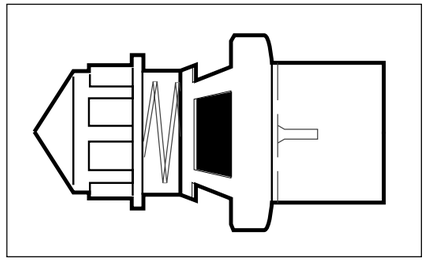
Miscellaneous Accessories

06657	Test Lung, 1 Liter, Foam Lined
35891	Kit Handles, Complete, PLV, side
35503	Video Inservice, PLV-100
35505	Service Manual , PLV-100
35506	Tote Bag, PLV
35508	Dust Cover, PLV
35934	Faceplate Cover Assembly, PLV
35972	Faceplate Cover Assembly, Masked
27916	Pedestal Stand
27921	Pedestal Stand, Tall

For more information on any Respironics accessories please contact your Respironics deal er home care provider.

Additional Accessories
(Continued)

PEEP Valves Reusable / Disposable
The Ambu PEEP Valve 20 is a reusable, position independent, spring-loaded threshold resistor valve adjustable from 1/2 to 20 cm H_2O. The PEEP valve comes standard with a 30 mm I.D. connector. Disposable PEEP valves are also available. Order part #06712 for the complete Ambu PEEP Valve 20.



06712	Complete Ambu PEEP Valve 20 cm H_2O
06333	Connector, 30 mm I.D., PEEP
06336	Connector, 22 mm O.D. PEEP
06511	PEEP Disposable, 30 mm I.D.

Flextubes
These flextubes may be used to decrease tension on the tracheostomy or endotracheal tubes and are reusable.

06485	Fextube, 5-1/2" 22 mm/15 mm, Tapered
06484	Flextube, 2" 22 mm/15 mm, Tapered, Min. Dead Space
06495	Flextube, 8" 22 mm/22 mm, Standard
06500	Flextube, 5-1/2" 22 mm/22 mm, Standard

Manual Resuscitation Bags

562012	BagEasy® with PEEP valve & Circle Seal Mask (6/pack)
562013	BagEasy® with Circle Seal Mask (6/pack)
562038	BagEasy® with PEEP valve & Circle Seal Mask (12/pack)
562039	BagEasy® with Circle Seal Mask (12/pack)
562040	BagEasy® with Peep valve (12/pack)
562041	BagEasy® (12/pack)

Rear Panel
(Continued)

3. Battery Fuse (Shipping fuse)
Remove the 5 amp slow blow fuse during shipping to eliminate the possibility of the unit being accidentally turned on and depleting the internal batteries.

4. Rear Feet/Cord Wraps
The rear feet of the PLV-100 are designed to easily accommodate the power cord. Wrap the cord in a clockwise manner. The feet are also designed to allow the ventilator to be operated in a face-up position, for wheelchair usage, without blocking the air inlet or air vent on the rear panel. Avoid positioning the ventilator in a face-up position on deep shag carpet or surface which might block the air vents.

5. Hour Meter
The real time hour meter is located behind the machine air vent filter. See Section 13, Maintenance and Troubleshooting Guide, for more information on the hour meter.

6. Power Cord Connector
This receptacle allows the use of a removable power cord. If the power cord becomes loose, worn, or damaged, it is replaceable by the customer.

7. Remote or Hospital Central Alarm Connector
This connector is used to interface with the Respironics Remote Alarm, or most hospital central alarm systems. See Section 6, Alarm and Alert Systems, for more information.

8. Machine Air Vent
This vent allows cooling air to enter the ventilator.

NOTE: The Machine Air Inlet houses a reusable foam filter which requires periodically cleaning by the user. See Section 12, Cleaning and Disinfection, for more information on filter changes.

Low Pressure Alarm

▼ The Low Pressure Alarm is adjustable from 2 to 40 cm H_2O by using the front panel knob. An audible alarm is activated when proximal, (near the patient), airway pressure falls below the selected low pressure alarm setting for more than 15 seconds.

A front panel green LED located near the low pressure alarm knob, (labeled "15 Second Delay"), illuminates immediately after the pressure drops below the set point. This is a normal occurrence that indicates the low pressure alarm circuit is enabled and timing. It also simplifies the Low Pressure Alarm setting procedure.

A delay of 15 seconds is built into the Low Pressure Alarm to prevent it from sounding between breaths:

- During the Assist/Control mode, either the machine must deliver a breath every 15 seconds or the patient must trigger a machine breath within 15 seconds to prevent the alarm from sounding.

- During the SIMV mode, the patient can breathe on their own. The PLV-100 senses the negative pressure inspiratory effort and reset the Low Pressure Alarm (15 Sec. Delay). Thus, to prevent the Low Pressure Alarm from sounding, either the machine breath must come up to set point pressure or the patient must breathe on their own.

Additionally, to ensure that an airway disconnect causes an alarm, the airway pressure is compared with the Low Pressure knob set point during each ventilator delivered breath. If the airway pressure does not equal or exceed the set point, an alarm sounds at the end of the breath. This undelayed alarm is effective only in the SIMV Mode and continues until the disconnect is corrected and the Low Pressure Set Point is reached with system pressure.

WARNING!: The user must verify the set point and function of the Low Pressure Alarm to maximize patient safety. Respironics recommends the alarm be set 5 to 10 cm H_2O below the peak pressure. See Section 8, paragraph 9.

Apnea Alarm

▼ The Apnea Alarm is a function of the Low Pressure Alarm and occurs only in the SIMV mode. The alarm occurs unless:

a. The patient makes a detectable inspiratory effort, or

b. The machine cycles to at least the Low Pressure Alarm set point. See Low Pressure Alarm, (above), for a detailed description.

Additional Accessories
(Continued)

Nasal Masks

Custom Nasal Masks
These may be used for a custom fit when leaks or user discomfort are a problem. For Replacement Kits, see your Respironics dealer.

Positive Pressure Ventilation Mouthseal, Complete 06570
For use when noninvasive positive pressure by mouth is used. Order part #06570 for complete mouth seal system. Individual parts are listed.

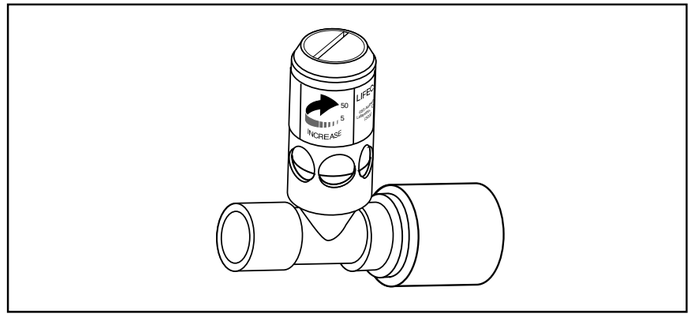
06365	Cushion, Mouthseal
06520	Headstrap, Mouthseal
06585	Mouthpiece, Mouthseal
06642	Shield, Mouthseal
06595	Nose Clip, Mouthseal (order separate)

Mouthpieces
Use the different mouthpieces with the Standard flextube (22 mm) or the tapered flextube (15 mm).

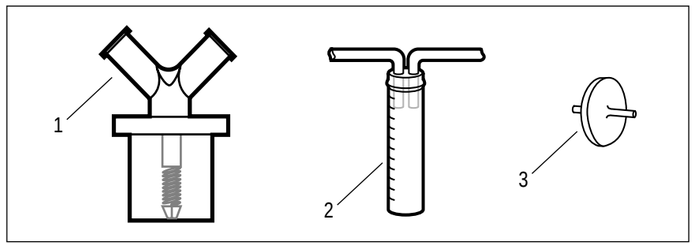
06565	Mouthpiece, Angled, 15 mm
06566	Mouthpiece, Angled, 22 mm

Additional Accessories

External Pressure Limiter 06600
The Respironics External Pressure Limiter is a position independent, spring-loaded threshold resistor valve that is adjustable from 5 to 50 cm H_2O.



Water Traps
Both water traps shown are reusable. Use the large bore water trap in the ventilator circuit and part #06718 or #06441 for the PAP line.



1	06717	H_2O trap, Lg. Bore, 22 mm
2	06718	H_2O trap, PAP, 4.8 mm, (3/16")
3	06441	Hydrophobic Filter

Patient Circuit Support Arm
The support arm may be used with all PLV Series ventilators.

27025	Circuit Support Arm
27909	Assembly Mount
06516	Circuit Hanger, PLV

High Pressure Alarm

▼ The High Pressure Alarm and Limit is adjustable from 5 to 100 cm H_2O. It sounds an alarm and vents excess pressure if the system pressure exceeds the set point. This alarm resets when the pressure falls below the set point. The High Pressure Alarm functions independently of the PAP system and protects the patient from potential barotrauma even if the PAP tubing is disconnected. It is recommended that this Alarm and Limit be set 10 to 20 cm H_2O above the normal airway pressure. Venting of excess pressure is not affected by the alarm silence button. See Section 8, Operating Procedure, for information on setting this alarm.

Inverse I:E Ratio Alert

▼ This alert is a visual indication that the Inspiratory Time has exceeded the Expiratory Time. The I:E Ratio Digital Display flashes when this condition exists. The Digital Display also flashes when the I:E Ratio exceeds 1: 9.9. During SIMV the I:E Ratio Display is blanked to avoid erroneous feedback to the user.

Increase Inspiratory Flow Alert

▼ The Increase Inspiratory Flow red LED flashes if the set inspiratory flow rate is not sufficient to meet the other set parameters of tidal volume and respiratory rate. The Inspiratory Peak Flow automatically increases based on the critical parameter priority sequence. See Section 9, Application Notes, for further information.

Switch to Battery Alert

▼ The PLV-100 sounds a 3 second audible alarm when the unit automatically switches to the internal or external battery from an AC power source. This alerts the user that the PLV-100 is operating on battery power and a limited operation time remains.

Low External Battery Alarm

▼ This alarm condition occurs if the voltage across the external battery, (while in use), falls below 9.5 volts. If this condition continues, the PLV-100 automatically switches to the internal battery source. If the Low External Battery Alarm is activated, an audible alarm sounds and the External Battery LED flashes.

Low Internal Battery Alarm

▼ This alarm condition occurs if the voltage across the internal battery drops below 9.5 volts while in use. An audible alarm sounds and the Internal Battery LED flashes. The machine must have an alternate power source connected immediately to continue operation.

Power Failure Alarm

▼ This audible alarm is activated if the power switch is turned “ON” and all power sources are exhausted or disconnected. This alarm cannot be silenced using the alarm silence button.

Microprocessor Failure Alarm

▼ The PLV-100 uses an internal “watch dog” circuit to monitor the microprocessor operation. In the event of a failure, the diagnostic start-up cycle repeats and an audible alarm sounds continuously. Under failure conditions, the drive to the motor is locked out to prevent uncontrolled motion of the piston.

Under conditions of a stalled piston, the patient may breathe, unassisted, through the PLV-100 ventilator through the patient air inlet on the rear panel. See Section 8, Operating Procedure, for a description of messages seen on the PLV-100 to specifically identify the type of microprocessor failure.

Ventilator Malfunction

▼ Failure of the following internal systems to operate properly causes the audible “fast beep” alarm to sound:

- Pressure transducer failure
- Piston system failure

WARNING!: The ventilator should not be used at any time the audible “fast beep” alarm is sounding.

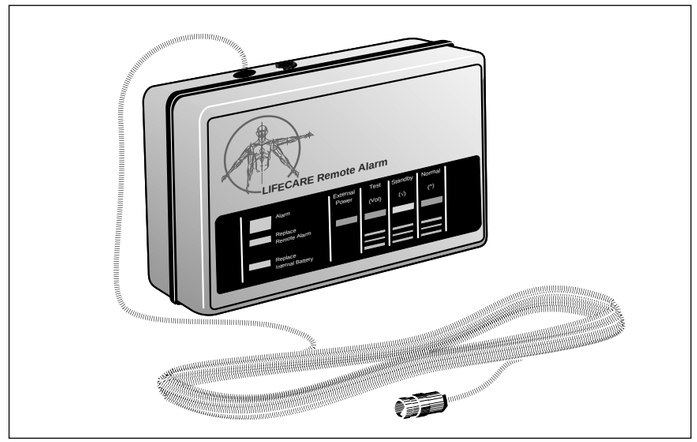
If the fast beep or other visual/audible alarms continue to sound after attempting to correct the cause of the alarm, refer the ventilator to authorized service personnel for servicing.

Alarms

(Continued)

Remote Alarm 34003
The Respironics Remote Alarm alerts the user of an alarm condition at a distance of up to 300 feet from the ventilator. An audible tone sounds and a red light flashes to indicate that an alarm condition exists. Power is supplied by an internal 9 VDC alkaline battery that provides at least two weeks of continuous operation.

The DC converter allows the Remote Alarm can also operate on household current. The Remote Alarm sounds if the cable connecting it to the ventilator becomes disconnected or shorted. A “Self-Test” circuit constantly checks the internal circuitry, and if an internal failure is detected, the alarm sounds to alert the user that the Remote Alarm is not functioning properly. The Remote Alarm can also function with a Call Button. Refer to the Remote Alarm User’s Manual for details of operation and accessory list.

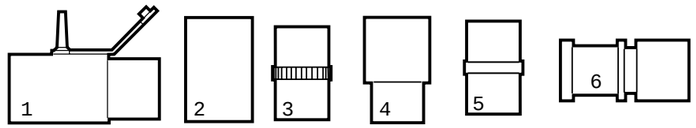


34906 Call button for Remote Alarm

Analyzers

28001 Oxygen Analyzer/Alarm
28005 Oxygen Analyzer

Adapters and Connectors
(Continued)



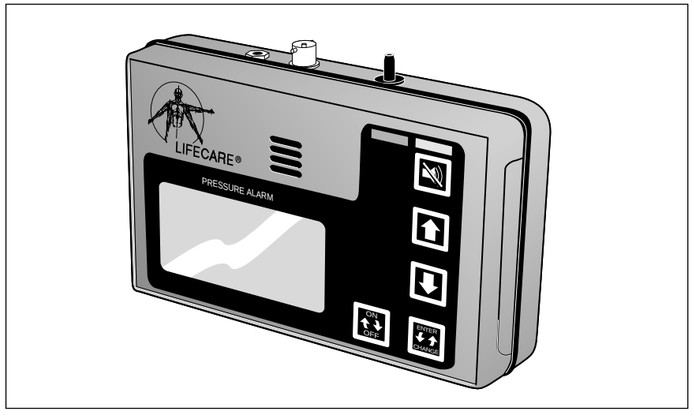
Connectors and Couplers

1	06711	valve, one-way w/O_2 inlet
2	06348	coupler, 22 mm I.D., Silicone
3	06334	connector, 22 mm I.D.
4	06242	30 mm to 22 mm I.D. for exhalation valve
5	06335	connector, 22 mm O.D.
6	06340	connector, 22 mm O.D. both sides, 15 mm I.D. one side, non-disposable
7	06341	connector, 22 mm O.D., both sides, 15 mm I.D. one side, disposable (not shown)

Alarms

Pressure Alarm 23001

The Respironics Pressure Alarm is an excellent choice when an independent pressure alarm is desired. The Pressure Alarm reads both negative and positive pressure, and has an adaptable alarm set point for either positive or negative pressure. The Pressure alarm operates for at least two weeks on a 9 VDC battery, and is designed for use with a 120 VAC power source. Refer to the Respironics Pressure Alarm Operation Manual for details of operation and a list of accessories.



Remote Alarm Interface

▼ Most units have the capability of connecting to the Respironics Remote Alarm. The Remote Alarm provides an audible and visual alarm whenever a PLV-100 alarm condition exists. An optional kit may be used to add this feature to a PLV-100 that does not support this capability. See Section 11, Accessories, for more information.

Hospital Alarm Interface

▼ The PLV-100 has the capability of connecting to most hospital call and alarm systems. The user should verify whether the institution's system is a "Normally OPEN" or "Normally CLOSED" circuit. A "Normally Open" system refers to an alarm system that must detect an open circuit in normal conditions and a closed circuit during alarm conditions. A "Normally Closed" system sees a closed circuit in normal conditions and an open circuit during alarm conditions. The PLV-100 may be changed to interface with either system at Respironics or an authorized Service Center. Some units may require installation of the Remote Alarm/Alarm Silence option to use this feature.

Power Source Selection

▼ The PLV-100 automatically selects the most desirable power source available. Selections of power sources occur in the following order:

1. 120 VAC power source (if connected to a wall outlet),
2. External battery source (if connected),
3. Internal battery source.

120 VAC Source Operation

▼ Connect the detachable power cord securely to the receptacle on the back of the PLV-100, and connect the other end of the cord to a hospital grade grounded 120 VAC outlet. The unit operates indefinitely on this power source.

Whenever possible, leave the PLV-100 connected to the AC power source, even when the unit is not in use, to continue to trickle charge the Internal Battery and External Battery sources.

12 VDC External Battery Source Operation

▼ Connect the battery cable to 12 VDC external battery. To connect to the ventilator, match the front panel dot near the receptacle with the dot on the connector. Push the connector into the receptacle and twist clockwise to lock.

NOTE: Connect the WHITE wire of battery cable to the POSITIVE (+) battery terminal, and the BLACK wire to the NEGATIVE (-) battery terminal. If these conditions are reversed, an alarm will sound but no damage will occur to the PLV-100 or the external battery.

A fully charged 105 amp hour deep cycle marine battery provides up to 24 hours of continuous use depending on BPM rate, tidal volume and pressures. Use an external battery for mobility or during 120 VAC power failure situations.

The optional Respironics Auto Lighter Cable allows for an easy external battery interface when traveling in a car or boat. If the car or boat is operating and continuing to recharge the battery, the PLV-100 operates indefinitely on this power source.

Humidification Accessories

06279	Artificial Nose Disposable, Adult Engstrom
06278	Artificial Nose Disposable, Pediatric Engstrom
06277	Artificial Nose Disposable, Infant Engstrom
06273	Artificial Nose Disposable, Pediatric
06274	Artificial Nose Disposable, Adult
22135	Humidifier, Fisher and Paykel, Heater Base, Model MR 410
22136	Humidifier, Fisher and Paykel, Heater Base, Model MR 480
22149	Chamber, Fisher and Paykel Adult Reusable
22151	Chamber, Fisher and Paykel Pediatric Reusable
22167	Chamber, Fisher and Paykel Home Care Reusable
22182	Chamber, Fisher and Paykel Single Patient Use
22154	Wick refill for 22151
22150	Wick refill for 22149
22068	Bracket, Cascade, Heated
22902	Bracket, Fisher and Paykel

Filters

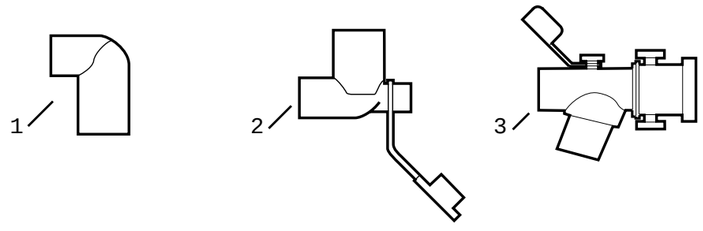
35220	PLV Reusable (pk of 2)
35373	PLV Reusable (pk of 50)

Battery Accessories

07050	Battery Charger Pack, Without Battery
07270	Cable, Battery, 6' With Ring Terminal
07280	Cable, Battery, 12' With Clips
07320	Battery Charger, 10 AMP, Automatic
27905	Cable, Auto Lighter

Adapters and Connectors

Endotracheal Adapters
Use these adapters to connect to endotracheal or tracheostomy tubes.

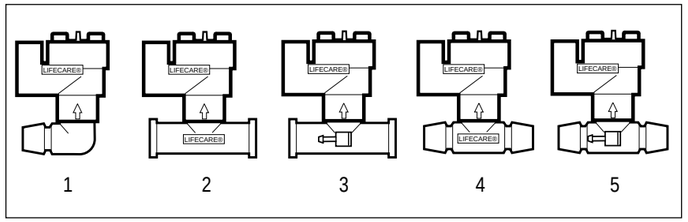


1	06387	elbow, trach adapter
2	06395	elbow, vent adapter w/suction port
3	06390	elbow, trach swivel adapter w/suction port

Exhalation Valve Options

▼ The Respironics Exhalation Valves come complete by ordering the assemblies shown. Select the system that best meets your needs. All 'tee' adapters have 22 mm O.D. ends. The expiratory outlet on the Gas Collecting Valve is 30 mm O.D. All valves are reusable. Individual parts may be ordered separately if desired.

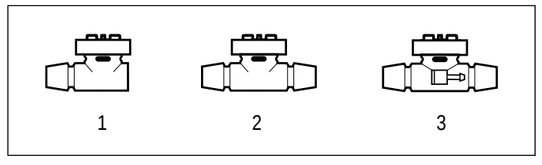
Gas Collecting / PEEP Exhalation Valves
Use these valves in applications where PEEP valves are used or when exhaled gas volumes are measured. These reusable valves offer low resistance and are easily cleaned.



Complete Exhalation Valve Assemblies

1	06710	Assy, Respironics, Elbow (gas collecting, double hose)
2	06706	Assy, Respironics (gas collecting, single hose)
3	06707	Assy, w/PAP adapter (gas collecting, single hose)
4	06708	Assy, w/ISO Tee (gas collecting, single hose)
5	06709	Assy, ISO w/PAP (gas collecting, single hose)

Low Profile Exhalation Valves
The Low Profile valves provide a low resistance, lightweight alternative for the home or hospital when neither PEEP or exhaled gas volumes are required.



Complete Exhalation Valve Assemblies

1	06719	Assy, Low Profile, Elbow (double hose)
2	06720	Assy, Low Profile, ISO Tee (single hose)
3	06724	Assy, Low Profile with PAP, Tee

External Battery Voltage Monitoring

▼ Battery voltage reading while under load is an indication of the state of charge. Pressing the "Read Battery Volts" rocker switch provides a voltage reading that is displayed in the Inspiratory Flow Rate window. To Check the External Battery Voltage:

1. Unplug the AC line cord, External Battery LED illuminates.
2. Wait 2 to 3 minutes after all battery charging sources are disconnected.
3. Press the "Read Battery Volts" rocker switch to the "external" side.
4. Hold the switch down until a breath stroke is delivered by the ventilator.
5. Read remaining battery voltage in the Inspiratory Flow Rate window.
6. Release the switch.

NOTE: Whenever the PLV-100 detects a change in the power supply, an audible alarm sounds for 3 seconds and then automatically resets. This alerts the user to verify the new power source level, if a battery is in use. In addition, the audible alarm sounds if the battery voltage falls below 9.5 volts. See Section 6, Alarm and Alert Systems, for more information.

External 12 VDC Battery Charger Options

Battery Charger Pack (#07050)
This acid proof, polypropylene carrying case comes with an automatic 2 amp charger, built-in voltmeter, and battery cable. It can accommodate an 80 amp/hour deep cycle battery.

10 Amp Battery Charger (#07320)
The automatic 10 amp battery charger is recommended for use in all heavy duty ventilator applications requiring greater than 8 hours per day 12 VDC external battery operation.

This 10 amp charger quickly and efficiently recharges an external 12 VDC battery in 2 to 4 hours depending on state of discharge, and reduces the possibility of deep cycle battery damage due to inadequate charge time.

External 12 VDC Connection Options

Respironics Automobile Lighter Cable (#27905)
This cable allows easy connection to the lighter outlet of a car or boat to power the PLV-100.

6' Battery Cable (#07270)
A 6' acid resistant battery cable is available for connecting the ventilator to an external battery. This battery cable serves well for most bedside and wheelchair external battery uses. It is equipped with ring terminals for securing the cable to the battery and a DC connector for attachment to the PLV-100.

12' Battery Cable (#07280)
A 12' battery cable with clip terminals is available for connecting the PLV-100 to auto or van battery for long distance traveling.

12 VDC Internal Battery Source Operation

▼ The PLV-100 has a built in 12 VDC internal battery to provide approximately 1 hour of continuous operation dependent on BPM rate, tidal volume and pressures. This battery is not designed to be a primary power source. It should be utilized as a backup power source or when it is convenient to use the battery only as a short term power supply.

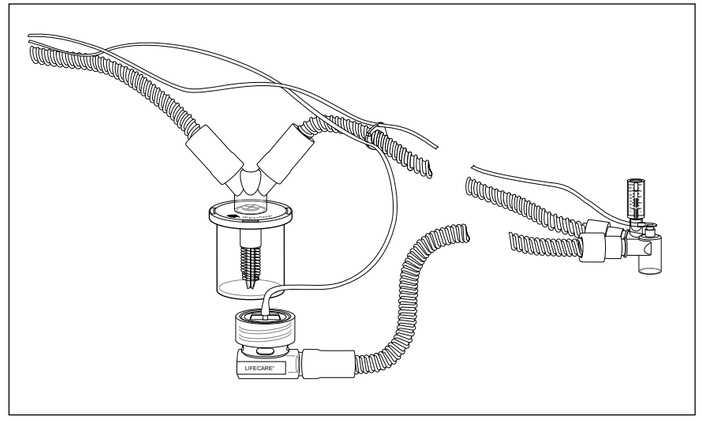
The Internal Battery is a “sealed lead acid battery” rated at 2.5 amp-hours. Operation of the PLV-100 on 120 VAC automatically recharges the Internal Battery.

There is a 3 second audible alert when the PLV-100 switches from either a 120 VAC source or a 12 VDC External Battery source to the internal battery. This alerts the user to verify the internal battery voltage level to assure that a safe operating time remains.

Patient Circuits

(Continued)

Reusable Pediatric Circuit, Low Profile 06150
Low profile exhalation valve; 15mm ID tubing



Pediatric/Neonatal Reusable Circuits

Reusable Pediatric Circuit, Gas Collecting 06152
Gas collecting exhalation valve, 15 mm ID tubing

Reusable Neonatal Circuit, Low Profile 06154
Low profile exhalation valve; 10mm ID tubing

Reusable Neonatal Circuit, Gas Collecting 06155
Gas collecting exhalation valve; 10 mm ID tubing

Neonatal Disposable Circuit, 06130
Non-gas collecting exhalation valve; 10 mm ID tubing

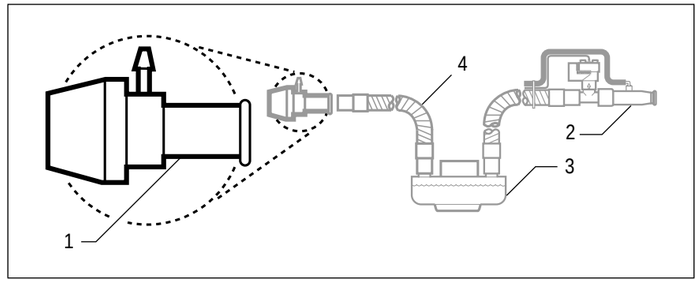
Pediatric Disposable Circuit, 06135
Non-gas collecting exhalation valve; 15 mm ID tubing

Patient Circuits

(Continued)

Oxygen Adapter 06260
For use with the PLV-100. Use this adapter to bleed in oxygen up to 40%.

- On the PLV-100, connect adapter to the patient air outlet.



1	06260	Adapter, O_2 enrichment
2		Circuit, PLV or PVV (ref)
3		Humidifier (ref)
4		Hose, 18" (ref)

Oxygen Accumulator 27096
For use with PLV ventilators. Use to achieve up to 90% oxygen delivery.

1	27104	Oxygen manifold
2	27099	Reservoir bag
3	06526	24" hose
4	27924	Oxygen plate assembly
5	27105	Mounting bracket

Internal Battery Voltage Monitoring

▼ Use the following procedure to check the Internal Battery Voltage Level:

1. Disconnect AC power line, (if connected).
2. Disconnect 12 VDC External Battery Source, (if connected).
3. Wait 2 to 3 minutes after disconnecting any charging system.
4. Press the “Read Battery Volts” rocker switch to the internal side.
5. Hold the switch down until the ventilator cycles a breath.
6. Read the voltage level on the Flow Rate Digital Display.
7. Release the rocker switch.

WARNING!: Whenever using the Internal Battery Source, the user needs to closely monitor the remaining voltage to eliminate the possibility of complete loss of power.

Caution: Storage of the unit with a partially discharged internal battery severely decreases the battery life. Always store the unit with the power plug connected to AC voltage, or only after fully charging the internal battery from AC voltage.

Caution: Frequent and/or prolonged use of the unit on internal battery shortens the battery life. This requires close monitoring of the battery strength and may require battery replacement sooner than the normal maintenance interval.

Diagnostic Self Check on Start-Up

▼ The PLV-100 has been programmed to provide a complete check of the front panel digital displays, LED's, the audible alarm, the operation of the pressure transducer, and the EPROM (Erasable Programmable Read Only Memory).

This 5 second diagnostic sequence of checks is routine each time the ventilator is turned ON and occurs in the following manner:

a. All digital displays reads 8's for 1 second. This confirms the integrity of the digital readouts. (The I:E RATIO display has fixed symbols "1:"; these are always lit.)

b. Each front panel LED illuminates for 0.5 seconds in the following sequence:

1. Increase Inspiratory Flow
2. Assist/Spontaneous
3. 15 Second Delay
4. External Battery
5. Internal Battery
6. 120 VAC

This confirms the integrity of each LED.

c. The tidal volume display reads "0.0." The "0.0" reading confirms the integrity of the pressure transducer. In case of failure in the transducer the display shows "1.0," the diagnostic check stops and the alarm sounds.

d. A checksum test of the EPROM is performed and any error results in a "2.0" being displayed in the Tidal Volume LCD window.

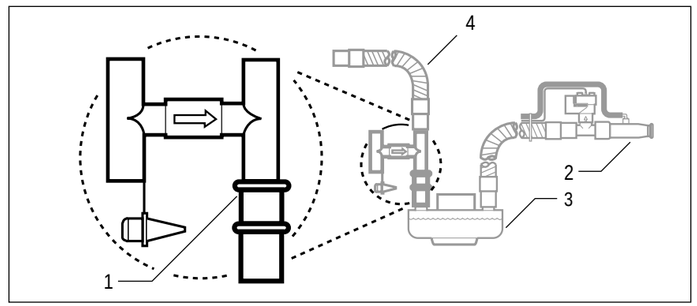
e. The audible alarm sounds to signal the end of the diagnostic check and to confirm the integrity of the alarm.

WARNING!: If any of the above mentioned checks indicate malfunction DO NOT USE THIS EQUIPMENT! Contact your local authorized service personnel.

Patient Circuits

(Continued)

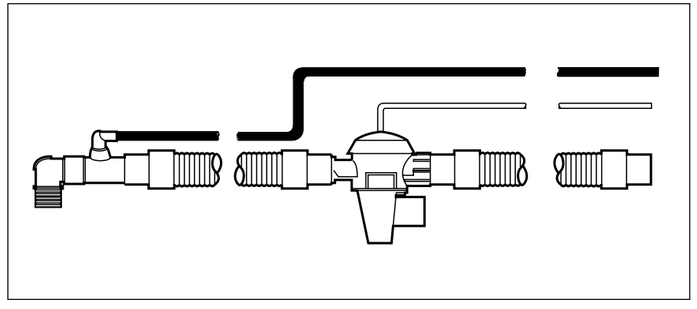
SIMV
Use the IMV manifold to provide a gas source for the spontaneous breaths in SIMV mode.



1	06247	Adapter, SIMV w/H-valve
2	————	Standard Circuit (PLV)
3	————	Humidifier (ref)
4	————	Hose, 18" (ref)

NOTE: If a humidifier with restricted air flow is used, it may be necessary to place the SIMV valve on the patient side of the humidifier or alter the humidifier (e.g. take out a 'tower').

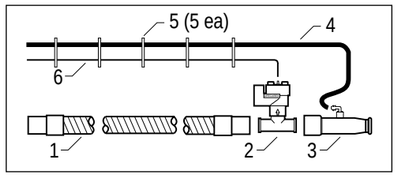
Adult Disposable Circuit 06140
This circuit is designed for use with the PLV-100, 22 mm I.D.



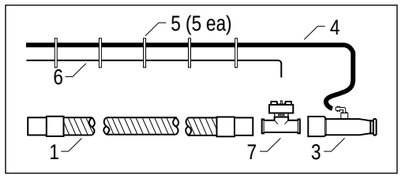
Patient Circuits

Standard Reusable PLV Circuits
Two standard PLV circuits for the PLV-100 are available: 06121, circuit with gas collecting exhalation valve for use with PEEP or measuring exhaled volumes; and 06125, circuit with low profile exhalation valve. These come complete with the items shown below. Other configurations, (e.g. SIMV Hose Assembly, O_2 Enrichment, Humidification), are constructed using the Standard PLV Circuit plus additional items to complete the circuit. Many variations are possible using parts listed in the section.

06121

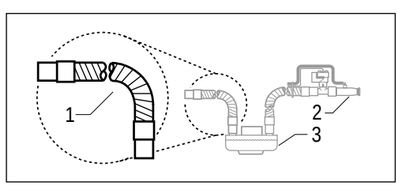


06125



1	06530	Hose, 60" Clear, 22 mm I.D.
2	06706	Valve, Exhalation, Gas Collecting
3	06232	Adapter, PAP Assembly
4	06686	Tubing, 4.8 mm (3/16") I.D., 6.5 ft.
5	06793	Clip, Hose
6	06685	Tubing, 3.2 mm (1/8") I.D., 6.5 ft.
7	06720	Valve, Exhalation, Low Profile

Humidification
Use this tubing to connect the patient air outlet and the inlet port of the humidifier with the PLV-100 ventilator. Other humidification accessories are offered in this section.



1	06525	Hose, 18" Clear, 22 mm I.D.
2	--------	Standard Circuit (PLV)
3	--------	Humidifier (ref)

Operation Guidelines

1. Select Power Supply
The PLV-100 may be operated from 3 different power sources:

- **120 VAC Power Source**
  Use the detachable power cord and connect the unit to a grounded hospital grade outlet.

- **12 VDC External Battery Source**
  Use the battery cable to connect the unit to an external battery source, or use the Respironics Auto Lighter Cable.

- **12 VDC Internal Battery Source**
  The PLV-100 operates for approximately one hour from a fully charged Internal Battery source if no other power source is supplied.

  See Section 7, Power Supply Options, for a detailed explanation of operation of the PLV-100 from different power sources.

2. Connect Selected Ventilator Circuit

a. Connect the 22 mm I.D. tubing to the Patient Air Outlet.

b. Connect the 4.8 mm (3/16") I.D. tubing to the Assist/PAP connector.

c. Connect the 3.2 mm (1/8") I.D. tubing to the Exhalation Valve line connector.

d. Test for proper function of the PLV-100 using a test lung prior to connecting to a patient. Verify proper rate, volume delivery and integrity of the circuit.

WARNING!: Due to the wide variety of disposable tubing, the user must be certain that there is a proper connection both at the ventilator and patient adapter.

See Section 11, Accessories, for a detailed explanation of the various ventilator circuit systems available.

3. Toggle Power Switch to "ON"
The PLV-100 begins the Diagnostic Self-Check, and upon passing the test, (approximately 5 seconds), the unit begins operation. See the beginning of this section for a detailed explanation of the Diagnostic Self Check.

Operation Guideline

(Continued)

4. Select Operating Mode

The PLV-100 may be operated in 3 different modes:

- **Control Mode**
  The unit delivers a preset tidal volume and inspiratory flow rate at a specified respiratory rate. The patient is not permitted to trigger the ventilator in this mode.

- **Assist/Control Mode**
  The PLV-100 operates as in the Control Mode, however the patient may initiate a breath by beginning an inspiratory effort.

- **SIMV Mode**
  The ventilator delivers a minimum respiratory rate at a preset tidal volume and flow rate. However the patient may breathe spontaneously at a rate higher than the set level by making an inspiratory effort.

See Section 4, Front Panel Controls, and Section 9, Application Notes, for more information on the operation modes of the PLV-100.

5. Adjust Tidal Volume Control

The tidal volume is adjustable from 0.05 to 3.00 liters. Set the desired volume per physician order.

a. Turn the knob beside the Tidal Volume display clockwise to increase the amount of delivered volume; counterclockwise to reduce delivered volume.

b. The volume display indicates the machine set volume. Some volume increase may be required to compensate for compliance of the ventilator circuit.

6. Adjust BPM/Respiratory Rate Control

The breathing rate control scale is calibrated and marked in breaths per minute (BPM). The “Patient BPM” display indicates the sum of machine delivered breaths and patient triggered/spontaneous breaths. The digital display reflects the actual number of breaths delivered in the Control Mode. In Assist/Control or SIMV the digital display reflects a BPM rate based upon the average of the last 4 breaths.

SAMPLE VENTILATOR MONITORING RECORD

(Respironics recommmends entries be made every 2 to 4 hours)								SAMPLE ENTRY ONLY
1. DATE								6.3
2. TIME								0900
3. MODE								SIMV
4. TIDAL VOLUME MACHINE/ EXHALED								700 / 690
5. BPM RESPIRATORY RATE SET/ TOTAL								4 / 12
6. I:E RATIO								1:2
7. PEAK INSPIRATORY FLOW								50
8. AIRWAY PRESSURE								30
9. AIRWAY PRESSURE LIMIT/ AUDIBLE ALARM								40 / √
10. LOW PRESSURE SET POINT/ AUDIBLE ALARM								20 / √
11. SENSITIVITY (If Applicable)								-1
12. POWER SOURCE								AC
13. INTERNAL BATTERY CAPACITY								12
14. EXTERNAL BATTERY CAPACITY (If Applicable)								N/A
15. INSPIRED OXYGEN CONCENTRATION (FIO_2)/ANALYZED FIO_2								.21 / N/A
16. OXYGEN SOURCE LEVEL: TANK PRESSURE/LIQUID O_2 LBS.								N/A
17. INSPIRED GAS TEMPERATURE (If Applicable)								34 °C
18. HUMIDIFIER HEATER SETTING (If Applicable)								6
19. HUMIDIFIER WATER LEVEL (If Applicable)								full
20. INITIALS								SPL

Ventilator Monitoring
(Continued)

15. Inspired Oxygen Concentration (FIO_2)
Unless the patient is receiving oxygen the inspired oxygen is room air (0.21). If the patient is on oxygen, record the oxygen percentage from the O_2 analyzer which is placed in the inspiratory line at the time of the ventilator check or record the number of liters per minute that are being delivered to achieve the desired oxygen concentration. If the FIO_2 is incorrect, increase or decrease the oxygen source to achieve the prescribed oxygen percentage. Record the oxygen percentage and liters per minute on the line entitled "Inspired Oxygen Concentration."

16. Oxygen Source Level
Observe and record the level of the remaining oxygen source. If an oxygen tank is in use this value is read in psi (pounds per square inch). If a 50 psi liquid oxygen system is in use, this value is expressed in lbs. (pounds).

17. Inspired Gas Temperature
Observe the temperature reading on the thermometer. Record this value on the line entitled "Inspired Gas Temperature." If an Artificial Nose is used, mark with "N/A."

18. Humidifier Heater Setting
Observe the number setting on the Humidifier Heater. Record this value on the line entitled "Humidifier Heater Setting." This may be a reference number only and may not correspond with any actual temperature. If an Artificial Nose is used, mark with "N/A."

19. Humidifier Water Level
Observe the water level in the humidifier reservoir. Fill if indicated and record this information on the line entitled "Humidifier Water Level."

20. Initials
Indicate your initials on the appropriate line.

Operation Guidelines
(Continued)

a. Respiratory Rate Control is available from 2 to 40 BPM in all modes of operation.

b. Adjust rate control as prescribed by physician.

c. The Assist/Spontaneous LED indicates when the current breath is patient initiated.

7. Adjust Sensitivity Control
The Sensitivity Knob allows an adjustment of the machine's ability to detect a patient's inspiratory effort. In the Assist/Control Mode, this causes the machine to begin an "assisted" breath. In the SIMV Mode, proper adjustment of the sensitivity knob enables the sensing circuit to count the patient's spontaneous breaths and synchronize them with the machine-delivered breaths.

a. To increase ventilator sensitivity, turn the Sensitivity Knob clockwise. If the PLV-100 begins to autocycle, slowly back the Sensitivity Knob counterclockwise towards "Less" until the trigger light goes out.

b. Sensitivity is adjustable from +3 to -6 cm H_2O.

c. The Sensor Vent on the rear panel monitors barometric pressure and assures that the Sensitivity Control maintains its accuracy despite barometric pressure changes.

8. Set Peak Inspiratory Flow Rate
The Peak Inspiratory Flow Control is adaptable from 10 to 120 liters per minute, and is used to determine Inspiratory Time and Inspiratory to Expiratory Time Ratio of the delivered breath.

a. Turn the Inspiratory Flow Rate Control clockwise to increase and counterclockwise to decrease the flow rate.

b. Assure that the patient has an adequate expiratory time to avoid the development of "auto PEEP," especially in patients with COPD. Consult your physician or respiratory therapist for further information.

c. The flow setting may be adjusted while monitoring the I:E ratio display. When the I:E ratio is at the desired value, inspiratory flow rate is correct. (Tidal volume and BPM must be properly adjusted before setting flow rate.)

Operation Guidelines
(Continued)

9. Set Low Pressure Alarm
There is an automatic 15 second delay that begins following the moment that the system pressure drops below the Low Pressure Alarm set point. If the delay reaches 15 seconds, the audible alarm is activated.

a. To raise the Low Pressure Alarm set point, turn the Low Pressure Alarm knob clockwise. To decrease the Low Pressure Alarm set point, turn the Low Pressure Alarm knob counterclockwise.

b. Pressure is monitored through the PAP (proximal airway pressure) line, thus avoiding a back pressure created within the hose assembly and/or humidifier.

c. Respironics recommends the Low Pressure Alarm be set 5 to 10 cm H_2O below peak inspiratory pressure as observed on the manometer during a machine breath.

WARNING!: The Low Pressure Alarm is responsible for alerting the caregiver to patient circuit disconnection, ventilator malfunction, or any condition that creates a loss of integrity of the ventilator to patient system; therefore, it is extremely important to set this alarm correctly. Low Pressure Alarm settings more than 10 cmH_2O below the system pressure may prevent the unit from alarming in response to circuit leaks or patient disconnects. The addition of artificial noses or heat moisture exchangers to the patient circuit may prevent a Low Pressure Alarm from occurring due to the build up of secretions.

10. Set Airway Pressure Limit
The Airway Pressure Limit Control must be correctly set to ensure that the system pressure does not exceed a level that the clinician determines to be a safe maximum pressure. Use the following procedure to verify the Airway Pressure Limit. Be certain to assure adequate ventilation of the patient during this procedure.

a. Observe the peak inspiratory pressure on the manometer for several breaths.

b. Set the Airway Pressure Limit. Respironics recommends the airway pressure limit be set 10 to 20 cm H_2O above peak inspiratory pressure observed on the manometer during a machine breath. The clinician must determine the actual value according to the individual clinical situation.

c. To change the airway pressure limit turn the control clockwise to increase the level and counterclockwise to decrease the level.

Ventilator Monitoring
(Continued)

10. Low Pressure Alarm Set Point/Audible Alarm

NOTE: Manual ventilation may be required while this check is performed. Do not forget to reconnect the circuit to the individual.

Observe the Low Pressure Alarm Set knob and record the value in the top section on the line entitled “Low Pressure Alarm/Audible Alarm.” Respironics recommends the Low Pressure Alarm be set 5 to 10 cm H_2O below the Peak Airway Pressure. Disconnect the circuit from the person and wait 15 to 20 seconds. Place a check mark in the bottom section to document that an audible alarm sounded during the above procedure.

11. Sensitivity
If the ventilator is in the Control mode, mark this section with “N/A.” If the ventilator is in the Assist/Control or SIMV mode, observe both the pressure manometer and assist/spontaneous LED on the front panel. Record the pressure required to either cycle the ventilator or register a breath as evidenced by the lighted LED. This value is recorded as a negative number (e.g., -1, -2, etc.).

12. Power Source
Observe the Power source LED’s on the front panel to see which one is illuminated. Record this information on the line entitled “Power Source.”

13. Internal Battery Voltage
Operate the unit on the internal battery by disconnecting the AC and External Battery sources. Wait 2 to 3 minutes following disconnection for the most accurate value. Using the Battery Test Switch, read the voltage level of the Internal Battery in the Peak Flow Rate LCD. Record this value on the line entitled “Internal Battery Voltage.” Be certain to reconnect the appropriate power source following this check.

14. External Battery Voltage
Disconnect the AC power source. Wait 2 to 3 minutes following disconnection for the most accurate value. Using the Battery Test Switch, read the voltage level of the External Battery in the Peak Flow Rate LCD. Record this value on the line entitled “External Battery Voltage.” Be certain to reconnect the AC power source following this check.

Ventilator Monitoring
(Continued)

6. I:E Ratio
Observe the values displayed on the I:E Ratio LCD and record this information on the line entitled “I:E Ratio.” This display is blanked out in SIMV mode, and is flashing if the ratio is inverse or greater than “1: 9.9.” During Assist/Control mode the I:E Ratio displays the I:E Ratio based on the set parameters.

7. Peak Inspiratory Flow Rate
Observe the Peak Flow Rate displayed on the LCD, and record this level on the appropriate line. This is the flow rate on all machine delivered breaths.

8. Peak Airway Pressure
Observe the highest level that the manometer reaches over several breaths. Record an average of this value in the section entitled “Peak Airway Pressure.”

9. Airway Pressure Limit/Audible Alarm

NOTE: Manual ventilation may be required while this check is performed. Do not forget to reconnect the circuit to the individual.

Disconnect the circuit from the person and partially block air flow at the patient end of the circuit. Observe the point where the needle on the manometer stops rising and the audible alarm sounds.

Respironics recommends the Airway Pressure Limit be set 10 to 20 cm H_2O above the Peak Airway Pressure. Record the value in the top section on the line entitled “Airway Pressure Limit/Audible Alarm.” Place a check mark in the bottom section to document that an audible alarm sounded during the above procedure.

Operation Guidelines
(Continued)

11. Connecting the PLV-100 and Circuit to the Patient
Verify and perform final adjustments on ventilator settings, (e.g. measure exhaled volume), and connect the patient end of the circuit to the patient interface (tracheostomy, nasal mask, etc.).

NOTE: It is recommended that a verification of the effectiveness of mechanical ventilation be secured by obtaining an arterial blood gas to observe the pH, $PaCO_2$ and PaO_2 level within a short time following the application of all ventilators. This verification may also be determined using noninvasive methods such as capnometry and oximetry.

It is also recommended that an accurate record of ventilator monitoring be kept to improve the level of care for ventilator patients. See Section 10, Ventilator Monitoring, for a sample PLV-100 ventilator check sheet.

SIMV Operation

▼ When SIMV (Synchronized Intermittent Mandatory Ventilation) mode is selected using the Mode Control Switch, the PLV-100 synchronizes the delivered volume breath, selected by the user, to the patients own spontaneous breaths. These spontaneous breaths may be taken through the patient air inlet on the back of the PLV-100, however, the use of an IMV "H" valve may further reduce the effort needed to take a spontaneous breath.

The operator selects the tidal volume, inspiratory flow rate and the ventilator respiratory rate. The PLV-100 uses the sensitivity control to detect both spontaneous patient efforts and efforts that initiate a delivered volume breath, it is extremely important that this level is set correctly.

By synchronizing machine delivered breaths to the patient's effort, "stacking" of breaths is prevented; this works as follows:

- The machine operates as in Control Mode and senses spontaneous breaths, (adjustable for sensitivity as in the Assist/Control Mode).

- During the six second period before a mandatory breath is scheduled to be delivered, if the machine senses the beginning of a spontaneous breath it immediately delivers the next scheduled mandatory breath. The current six second period is canceled when patient effort is detected and results in a delivered volume breath. Therefore the time interval between the machine delivered breaths changes depending upon when the patient effort is detected, but the number of machine delivered breaths remains the same.

  For example, at an IMV rate of 10 and the total respiratory rate of 20 BPM the patient receives 10 delivered volume breaths. The additional breaths are the patient's spontaneous tidal volume.

- The machine does not deliver another breath until the next regularly scheduled mandatory breath. The patient may continue to breathe spontaneously through the IMV valve or patient air inlet.

In SIMV mode, the rate display indicates the sum of mandatory plus spontaneous breaths by averaging the preceding 4 breaths. The ventilator deliver only as many mandatory breaths as selected by the rate knob. The patient only causes the time period between mandatory breaths to change slightly.

Refer to the following example for further information.

Ventilator Monitoring

▼ Keep an accurate record of ventilator settings and other information to improve patient care and to meet documentation requirements. The following procedure explains how to perform a ventilator/patient system check on the PLV-100. A sample form may be found following these explanations on page 41.

1. Date
Fill in the date.

2. Time
Fill in the time of day.

3. Mode
Observe the mode switch in the upper left corner of the front panel. Note whether the switch is in Control, Assist/Control, or SIMV mode. Record on the line entitled "Mode."

4. Tidal Volume
Observe the volume LCD next to the volume control knob. This volume does not change unless someone moves the volume control knob to increase or decrease the volume. This setting should not be changed without consulting your physician. If supplemental oxygen is used, the displayed value may be lower than prescribed. Record this volume in the top section on the line entitled "Tidal Volume."

Use an exhaled volume monitor or respirometer to measure the actual exhaled volume. Record this value on the bottom section of the line entitled "Tidal Volume."

5. BPM Respiratory Rate
Record the set Respiratory Rate in the top section of the line entitled "BPM Respiratory Rate." In Control Mode this set level is also the total respiratory rate. In Assist/Control Mode record the set value in the top section and count the total number of breaths of the patient to find the total number of breaths. Record these values on the appropriate line. In SIMV Mode the set value must be counted over 1 minute by counting only the delivered volume breaths. To find the total respiratory rate, count the number of times the patient's chest rises and falls over one minute. Record these values on the appropriate line.

Automatic Priority Sequence

▼ The PLV-100 has a sophisticated method of adjusting key parameters when the operator selected parameters do not permit operation of the unit within the limitations of the machine. Combinations of set parameters that do not allow time for the piston return stroke, start the priority sequence in operation as follows:

1. **Inspiratory Flow Rate**
   The Inspiratory Flow Rate automatically increases. The Increase Inspiratory Flow LED alerts the user that the Flow Rate has been increased. This continues, if necessary, until the flow rate reaches its maximum level of 120 lpm.

2. **Respiratory Rate**
   If the flow rate has reached its maximum level and the return stroke time is not adequate, then the set Respiratory Rate is reduced until the proper return stroke time is reached. The Respiratory Rate LCD flashes the current delivered BPM to alert the user of this condition.

3. **Tidal Volume**
   The Tidal Volume is given the highest priority of the three set parameters and this value does not change.

NOTE: The priority sequence activates immediately when the setting changes are made, and does not occur during the course of normal operation of the PLV-100.

Patient Interfaces

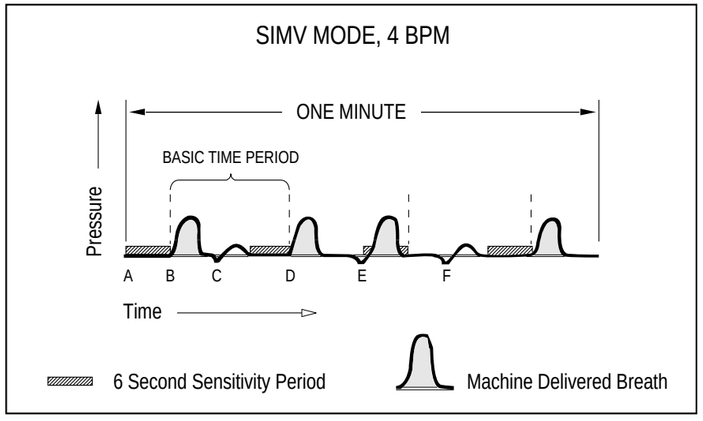
▼ The PLV-100 is designed to be used with a variety of patient interfaces. The wide array of tubing configurations permit adaptation to virtually any system.

The PLV-100 may be used by individuals with artificial airways such as a tracheostomy or an endotracheal tube.

There are also many patients who use the PLV-100 with noninvasive patient interfaces. These methods include nasal masks, oral masks, combination nasal/oral interfaces and custom nasal masks. Contact Respironics or an authorized Service Center for more information on positive pressure ventilation via noninvasive means or custom nasal mask construction.

SIMV Operation

(Continued)



a. No trigger is sensed during the 6 second sensitivity period. There is no change in breath delivery.

b. End of first time period. The PLV-100 delivers a mandatory breath.

c. Patient spontaneous breath detected outside of sensitivity window.

d. End of second time period. Ventilator delivers another mandatory breath.

e. The patient starts a spontaneous breath during the 6 second sensitivity period. The ventilator immediately delivers a mandatory (assisted) breath. The delivery time of the mandatory breath shifts and cancels the current six second window.

f. The patient's spontaneous breath occurs outside of the 6 second sensitivity window. This does not cause a second ventilator delivered breath. For example, if the rate knob is set for 4 BPM (as shown above) only 4 breaths are delivered by the machine.

Oxygen Enrichment

▼ Oxygen may be added to the PLV-100 ventilator circuit using any standard low flow oxygen system such as a compensated flowmeter connected to a 50 PSI oxygen source, a liquid O_2 system, or an oxygen concentrator source. Oxygen may be added using an accumulator, or by using a bleed-in attachment to add oxygen into the hose assembly. See Section 11, Accessories, for adapter information.

Oxygen Enrichment

(Continued)

Volume Adjustment

The addition of oxygen into the hose assembly increases patient tidal volume. Use the following formula to determine the correct volume setting for the PLV-100:

$$\text{Volume Vv (ventilator)} = Vt\ (1\text{-}FIO_2) \div .79$$

where,

Vv = Ventilator volume setting in cc's.

Vt = Desired patient tidal volume in cc's.

FIO_2 = Fractional condition of inspired oxygen.

Oxygen Flow Rate Determination

The following formula should be used to determine the flow rate of oxygen into the hose assembly on control mode, or when the breath rate is constant. If the assisted breath rate is variable or SIMV mode is used, perform a closer monitoring of FIO_2.

$$\text{Flow}\,(O_2) = (Vt - Vv)\ R \div 1000$$

where,

Flow (O_2) = Oxygen flow rate in liters per minute (LPM).

Vt = Desired patient tidal volume in cc's.

Vv = Ventilator volume setting as determined above in cc's.

R = Breaths per minute (BPM) rate.

WARNING!: It is recommended that the volume of gas delivered to a patient be periodically analyzed to ensure an accurate FIO_2 in any oxygen enriched system. This is especially important if the patient's total respiratory rate is variable.

NOTE: In applications where the required FIO_2 exceeds 0.40 or there are significant variations in the patient's total assisted respiratory rate, clinicians may wish to consider utilizing Respironics' PLV-102. The PLV-102 is the only portable volume ventilator with machine controlled FIO_2. This system uses an oxygen proportioning valve to conserve oxygen by delivering only the precise amount necessary during each inspiration. The PLV-102 is also able to account for the dilution of FIO_2 by room air during SIMV operation and make the corresponding correction to delivered FIO_2. Contact Respironics or an authorized Service Center for further information on delivery of oxygen in portable ventilator applications.

Humidification

Whenever the upper airways are bypassed by using a tracheostomy or endotracheal tube it is essential that a humidity system be added to the ventilator circuit to compensate for the humidity deficit presents when artificial airways are used. The addition of a humidification system may also add to patient comfort and aid in avoiding thick secretions when ventilating individuals via nasal or oral mask techniques.

The PLV-100 is designed to mount a humidifier in both face forward and face up positions.

The PLV-100 accepts a wide variety of humidification systems with a number of different mounting brackets.

Artificial Noses (Moisture Retention Humidifiers) may be used to meet humidification needs during portable ventilation application. See Section 11, Accessories, for specific humidification devices offered by Respironics.

Pressure Limited Application

The PLV-100 may be used as a pressure limited ventilator by adding the Respironics External Pressure Limiter (#06600) to the ventilator circuit. The combination of pressure limited ventilation using a volume ventilator allows the clinician the benefit of pressure ventilation without sacrificing the safety and added monitoring of a volume ventilator.

The External Pressure Limiter is adjustable from 5 to at least 50 cm H_2O. For more information on the use of pressure limited ventilation contact Respironics or an authorized Service Center.