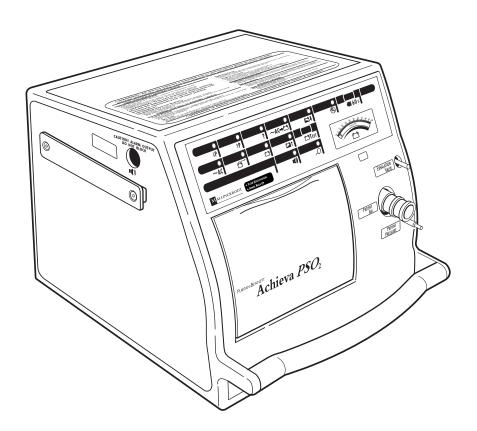
Puritan Bennett Achieva® Ventilators

with Flow Acceleration and Apnea Back Up **Clinician's Manual**



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Chapter 1: Introduction

This introduction describes the information available in this manual and lists other sources of information about Achieva TM ventilators. It also describes the conventions used throughout this manual.

Warning

You must read and understand all of this manual before you try to operate Achieva ventilators. Operating the ventilator without understanding the information in this manual may result in unsafe conditions or misapplication of the device.

This manual is intended for physicians, respiratory therapists, and other clinical personnel who use Achieva ventilators. It provides detailed information about the installation, safe use, and verification of Achieva ventilators. Since it is not a complete maintenance document, it contains no disassembly, repair, or reassembly instructions or diagrams.

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.

Chapters

The following is a list of the chapters in this manual, and a brief description of each.

Overview This chapter is an overview of Achieva ventilators, and includes a comparison of the models. It also includes general warnings and cautions, as well as information on what to do if the ventilator fails to operate properly.

Description This chapter gives the intended uses and contra-indications for Achieva ventilators. It describes the features, controls, and labels on the ventilator. Some of the accessories used with Achieva ventilators are also described.

Setup This chapter has instructions for unpacking and setting up the Achieva ventilators. It includes a visual inspection and user verification test. Instructions for setting the Low Pressure alarm are also included.

Operation This chapter contains information on starting and stopping the ventilator, as well as instructions for setting the various modes and menu selections. It includes a monthly safety check, and a list of the information the patient and caregiver must know to use the ventilator safely and effectively.

Alarms Instructions on responding to ventilator alarms. A list of all ventilator alarms is included.

Troubleshooting This chapter discusses basic troubleshooting for the Achieva ventilators.

Maintenance This chapter has cleaning and maintenance information for the ventilator and a maintenance schedule.

Ventilator data This chapter tells how to print a report from the ventilator and describes the information in that report. It also describes how to transfer information from the ventilator to a computer equipped with Achieva Report Generator software from Puritan Bennett.

Glossary This appendix presents the definitions of terms used in this manual.

Resources A brief bibliography and a list of organizations of interest to clinicians, caregivers, and patients.

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Theory of operation Operating theory for Achieva ventilators. It includes a description of the modes and sample waveforms.

Specifications Complete technical specifications for Achieva ventilators.

Service Information on obtaining service for the ventilator, including the limited warranty.

Index An alphabetical list of the topics covered in this manual.

Additional information

For additional information about Achieva ventilators, read the *Achieva Ventilators User's Manual* and the *Achieva Ventilators Technical Manual*. For information on the Achieva Report Generator, see the *Achieva Report Generator User's Guide* and the Report Generator software's on-line help file.

Puritan Bennett publishes newsletters, conducts seminars, and supports organizations of interest to clinicians and patients. For more information on these sources, contact Puritan Bennett at 1-800-635-5267 or www.puritanbennett.com.

Conventions

Introduction

Throughout this manual, Warnings, Cautions, and Notes mean the following:

Directions that warn of conditions that put the patient, caregiver, or other individuals at risk of injury.	
Directions that help you avoid damaging the ventilator or losing data.	Caution
Directions that make it easier to use the ventilator.	Note

Warning

Anything that damages the ventilator may cause potential danger to the patient.

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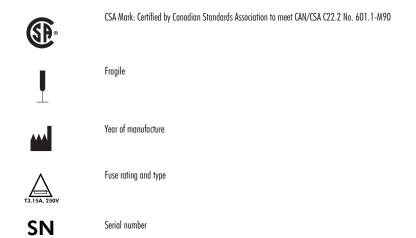
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Symbols and their definitions



I/E	I/E Ratio LCD indicator
₽¥	Low Pressure alarm setting switch
P₹	High Pressure alarm setting switch
Sens.	Sensitivity parameter setting switch
02%	F_1O_2 (oxygen) parameter setting switch
V	Flow LCD indicator
←	Start/Enter function setting switch
•	Ventilate function setting switch
P₹	Low Pressure/Apnea LED alarm indicator
P₹	High Pressure LED alarm indicator
?	Setting Error LED alarm indicator
~ AC⇒ <u></u> ⊟	Power Switchover LED alarm indicator
₩	Low Power LED alarm indicator
Q ₂)	O ₂ Fail LED alarm indicator
~AC	AC (alternating current) LED power source indicator
 →	External Battery LED power source indicator
	Internal Battery LED power source indicator
	Alarm Control LED indicator
	Battery Charging LED indicator
	Assist/Spontaneous LED indicator
→	Keep dry.
UL DESCRIPTION	UL Mark: Classified by Underwriters Laboratories Inc. with respect to electric shock, fire and mechanical hazards only in accordance with UL2601-1

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Chapter 2: Overview

This chapter is an overview and comparison of Achieva ventilators. This chapter includes general warnings and cautions and information on what to do if the ventilator fails to operate properly.

Puritan Bennett Achieva ventilators provide continuous respiratory support for pediatric to adult patients with respiratory insufficiencies or failures, in a home, in an institution, or in portable settings. Because of their compact design, light weight, and use of portable oxygen and power sources, the units are highly portable.

Achieva ventilators provide the user with therapeutic support. For the user, the portability of Achieva ventilators is an advantage over hospital devices.

The ventilator offers a wide range of delivery volumes, inspiratory times, and breath rates. The doctor, respiratory therapist or other care provider can set the appropriate ventilation mode and parameters with the controls on the front panel. The magnetically latched door panel and setting switches are designed to prevent tampering and accidental resetting.

Features

Achieva ventilators are available in three separate models. The table on the following page lists the features available with each model. The model you have is displayed on the front of the ventilator.

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Features of Achieva Ventilators

	Achieva	Achieva PS	Achieva		
			PSO ₂		
Modes of Ventilation					
Assist/Control	Yes	Yes	Yes		
with Pressure Control Capability	Yes	Yes	Yes		
SIMV	Yes	Yes	Yes		
with CPAP	Yes	Yes	Yes		
with Pressure Support	No	Yes	Yes		
Spontaneous (Pressure Support)	No	Yes	Yes		
with CPAP	No	Yes	Yes		
Apnea Back Up Rate (in spontaneous mode)	No	Yes	Yes		
Dial-in PEEP (3-20 hPa)	Yes	Yes	Yes		
Flow Triggering	Yes	Yes	Yes		
Internal 0 ₂ Blender	No	No	Yes		
Access to Stored Events with the Achieva	Yes	Yes	Yes		
Report Generator Software					
Pediatric Capability	Yes	Yes	Yes		
Internal Battery	Yes	Yes	Yes		
External Battery Capability	Yes	Yes	Yes		
Portability	Yes	Yes	Yes		

Electromagnetic interference

Caution

Your ventilator is an electronic instrument. Any electronic instrument may create and is subject to electrical interference. Electrical interference in excess of 20 V/m may keep your ventilator from working properly.

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Note

If television interference does occur, contact Technical Services at Puritan Bennett or a television repair technician for suggestions. Or, move the television to an electrical outlet that does not allow interference.

If another device interferes with your ventilator:

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, follow these instructions:

- •Do not place your ventilator near the appliances.
- Do not plug the ventilator into the same AC electrical outlet nor into the electrical outlets on the same circuit as the appliances.
- •Do not place the ventilator cables near the appliances.

If your ventilator causes interference in another device:

If the ventilator causes interference to other devices, follow the instructions below:

- •turn the antenna on the affected device (e.g. radio, television, cordless phone)
- •move the device away from the ventilator
- •connect the equipment to an outlet which is on a different circuit from the affected device
- •consult the dealer or an experienced radio/TV technician for help

Software Errors

The manufacturer has sought to minimize the risks posed by software errors in a number of ways. The measures taken include the use of external watchdog circuitry that verifies the operation of the software, a redundant timebase, and multiple response circuits. Ongoing confidence testing is also employed to limit the effect of errors.

General warnings and cautions

The following warnings and cautions apply whenever the ventilator is in use.

Warnings

Not to be used in an explosive atmosphere.

Do not use Achieva ventilators with flammable anesthetic agents.

Anything that damages the ventilator may cause potential danger to the patient.

Electric shock hazard. Do not operate the ventilator without the covers and panels in place.

Do not cover or otherwise hinder the flow of air around the ventilator.

Do not use in direct sunlight, in accordance with EN794-2.

Use only Puritan Bennett-approved accessories with Achieva ventilators. Use of other accessories may be hazardous to the patient.

Cautions

Do not service Achieva ventilators. Refer all servicing to qualified personnel.

To avoid a fire hazard, always use the same type and rating of fuses as were originally supplied.

If the ventilator fails

The caregiver and, where appropriate, the patient must be trained to respond to ventilator failure. Refer to the *Alarms* and *Troubleshooting* chapters in this manual for detailed information.

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Warning

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

Overview

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Chapter 3: Description

This chapter gives the intended uses and contra-indications for Achieva ventilators. It describes the features, controls, and labels on the ventilator. Some of the accessories used with Achieva ventilators are also described.

Intended use

This device is intended to provide ventilatory support for pediatric and adult patients who require positive pressure mechanical ventilation (pediatric patients should weigh no less than 5kg {11 lbs.}). This device is for use in home, institutional, and portable settings.

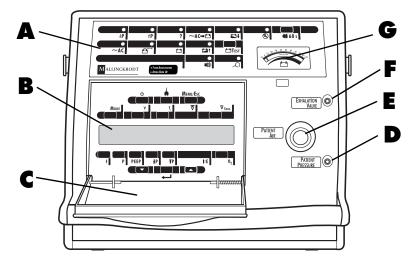
Contra-indications

Achieva ventilators are not intended for the delivery of anesthetic gases.

Do not use or store in the presence of strong electromagnetic fields such as those surrounding MRI equipment.

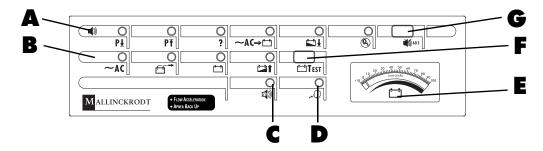
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Front panels



- A Top panel
- **B** Controls and display
- C Door label
- **D** Patient pressure port
- **E** Patient air port
- **F** Exhalation valve port
- **G** Patient pressure meter

Top panel



A ALARM (ALERT) LIGHTS

The ventilator's lights will flash when an alarm condition is

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detected. The lights are turned off when the alarm condition is corrected and the Alarm Silence/Reset () switch is pressed. See Chapter 6: Alarms and alerts for more details.

Achieva ventilators are equipped with the following alarm lights:

Low Pressure/Apnea (P↓)

High Pressure (P↑)

Setting Error (?)

Power Switchover (~AC⇒□)

Low Power (□↓)

O₂ Fail (②) (Only on Achieva PSO₂)

Note

For the Achieva and Achieva PS models, which do not have the oxygen function, the O_2 alarm light position is present, but it has no light or label.

B POWER LIGHTS

The power lights indicate which electrical source the ventilator is currently using and if the internal battery is being charged. The power lights include:

C Alarm Control ()) Light

The Alarm Control () light flashes when the audible alarm has been presilenced. The Alarm Control () light will light continuously when the non-latching audible alarm feature is active. See Latching and non-latching on page 6-5.

■ Assist/Spontaneous (¬☐) Light

This LED lights when the patient's inspiratory effort is greater than the sensitivity setting, or when the flow and pressure sensors detect a change greater than the flow sensor or pressure trigger setting. This is usually an indication of patient effort.

Description Achieva Ventilator Clinician's Manual

The Patient Pressure Meter shows the level of pressure which is currently in the patient circuit. When the Test Battery (TEST) switch is pressed, the patient pressure meter shows the charge level of the battery currently in use. In some fast-cycle situations the meter reading may not reflect the actual pressure. When precise pressure readings are required, reference the actual values on the display screen.

F Test Battery (☐ TEST)

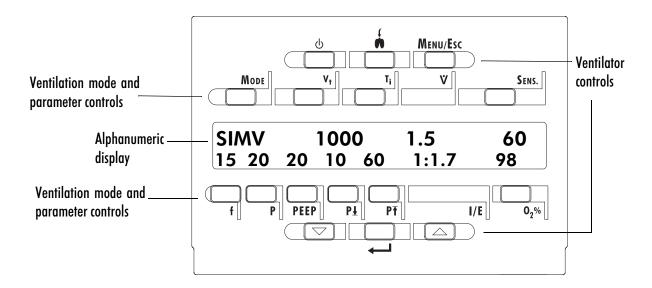
When the Test Battery (TEST) switch is pressed, the meter shows the charge level of the battery currently in use. The test battery switch is also used to activate the ventilator's printer output. See Printing reports from the ventilator on page A-1.

G Alarm Silence/Reset (₩ 60 s)

The Alarm Silence/Reset () switch silences the audible alarm during an alarm condition. The Alarm Silence/Reset () switch can be used to presilence the audible alarm for a period of 60 seconds. If an alarm condition occurs while the 60 second presilence period is in effect, or while Alarm Silence/Reset is active, the LCD will display the alarm condition. This switch can also be used to reset an alarm after the alarm condition has been corrected.

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Controls and display



The control-display panel consists of:

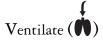
- an alphanumeric display showing the set or current actual values of operating parameters and ventilator information.
- push-button switches that the operator uses to make selections.

The control-display panel is located behind the ventilator's front door panel. After beginning a ventilating mode, the display panel shows the set values for ten seconds and then displays the actual values for each parameter. The set value also appears for ten seconds after the value of a setting is changed or the Start/Enter switch is pressed. Certain parameters, such as the low pressure and high pressure alarm settings, do not have an actual value. For these dashes (---) are displayed instead.

Following is a description of the switches' functions. For further details see Operating the controls on page 4-21.

Standby (🛈)

Use the Standby (\circlearrowleft) switch to place the ventilator in the standby mode, a state where air is not being delivered.



Use the Ventilate () switch to deliver air to the patient.

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MENU/Esc

The **MENU/ESC** switch activates the menu options on the ventilator's display.

Up and Down arrow keys

The up and down arrow keys operate in three ways:

- •When a ventilation parameter is flashing, use the up/down keys to scroll to the required setting.
- When the **MENU/ESC** button has been pushed, use the up/down keys to scroll to the required menu.
- Pressing the up/down keys when neither a menu nor a parameter is active will cause the last alarm message to be displayed.

Start/Enter ()

When the ventilator is in Standby, pressing the Start/Enter (switch will activate the display. Start/Enter (switch is also used to accept the currently flashing parameter as the new setting.

Mode

The **MODE** section of the display screen shows the current ventilation mode setting. Pressing the **MODE** switch causes the current mode on the display to flash and allows the ventilation mode to be changed.

Volume (**V**_•)

The Volume (\mathbf{V}_{\dagger}) section of the display screen shows the set or actual volume of air that is to be delivered to the patient's lungs during volume breaths. Pressing the Volume (\mathbf{V}_{\dagger}) switch causes the current set value of the volume setting to flash and allows it to be changed.

Inspiratory Time (T_i)

The Inspiratory Time (T_i) section of the display screen shows the length of time it takes the ventilator to deliver the volume and pressure control breaths to the patient. Pressing the Inspiratory Time (T_i) switch causes the current set value of inspiratory time to flash and allows it to be changed.

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Flow (**V**)

The Flow (**V**) section of the display shows the average air flow delivered to the patient. This calculated value is given in liters/minute.

Sensitivity (SENS.)

The Sensitivity (**SENS.**) section of the display screen shows the amount of flow generated by the patient that will trigger an assisted breath. Pressing the Sensitivity (**SENS.**) switch causes the current set value for sensitivity to flash and allows it to be changed.

Sensitivity (**F**, **P**, or **M**)

The letters **F**, **P**, or **M** on the alphanumeric display indicate whether breath cycles are initiated by the patient (**F** standing for Flow, **P** for Pressure) or by the ventilator (**M** for Machine breath).

When using PEEP, use the pressure trigger along with sensitivity (Flow Trigger). The pressure trigger setting can be accessed and changed as a menu option. See Pressure trigger on page 5-5.

Breath Rate (f)

The Breath Rate (f) section of the display screen shows the rate at which volume and pressure control breaths are delivered. (After entering Spontaneous mode, use the up and down arrows to select "Y" or "N" in the alphanumeric display to activate or deactivate the automatic apnea back-up rate). Pressing the Breath Rate (f) switch causes the current set value for breath rate to flash and allows it to be changed.

Pressure (P)

The Pressure (**P**) section of the display shows the pressure level maintained during either a pressure supported breath or a pressure controlled breath. Pressing the Pressure (**P**) switch causes the current set value for pressure to flash and allows it to be changed.

PEEP

The **PEEP** (Positive End Expiratory Pressure) section of the display screen shows the pressure maintained at the end of a delivered breath. Pressing the **PEEP** switch causes the current **PEEP** setting to flash and allows it to be changed. You should consider setting the pressure trigger when using PEEP. This allows the patient to initiate either an

Note

assisted or supported breath. The pressure trigger will function relative to the PEEP setting baseline. When using PEEP, use the pressure trigger along with sensitivity (Flow Trigger). The pressure trigger setting can be accessed and changed as a menu option. See Pressure trigger on page 5-5.

Low Pressure (**P**↓)

The Low Pressure ($P \downarrow$) limit section of the display shows the minimal pressure limit that must be exceeded to prevent a Low Pressure alarm. The Low Pressure alarm sounds after two consecutive cycles below the low pressure limit. The Low Pressure alarm sounds for a valley alarm after two consecutive breath cycles that do not fall below the low pressure limit. See Valley Pressure Alarm on page 6-6. Pressing the Low Pressure ($P \downarrow$) switch causes the current low pressure limit setting to flash and allows it to be changed. When adjusting the Pressure ($P \downarrow$) setting, the Low Pressure ($P \downarrow$) will adjust automatically to at least 1 cmH₂O above the PEEP setting.

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/Apnea (P1) alarm may not sound. See Setting the low pressure alarm on page 4-26.

High Pressure (₱₸)

The High Pressure (PT) section of the display shows the highest pressure the ventilator will allow without sounding the High Pressure alarm. Pressing the High Pressure (PT) switch causes the current high pressure limit setting to flash and allows it to be changed.

I/E Ratio (I/E)

The I/E Ratio (display shows the ratio of inspiratory to expiratory time. Achieva ventilators permit a range of inspiratory times from 0.2 seconds to 5.0 seconds. The I:E ratio is calculated according to the formula:

I:E Ratio = (1/(Breath Rate) - (Inspiratory Time)) / (Inspiratory Time)

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 F_1O_2 ($\mathbf{0_2\%}$) (Only on Achieva PSO₂)

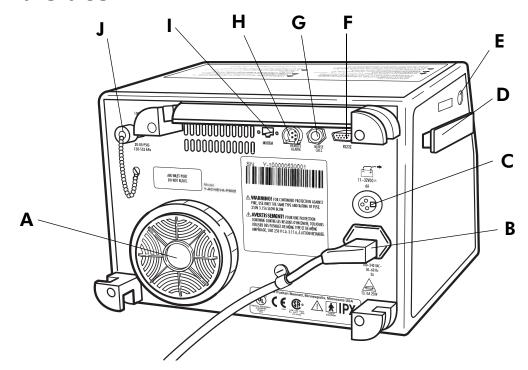
The $F_IO_2(\mathbf{0_2\%})$ display shows the set enriched oxygen level. Pressing the $F_IO_2(\mathbf{0_2\%})$ switch causes the current setting to flash and allows it to be changed. A setting of over 21 will activate the internal O_2 blender.

Note

For the Achieva and Achieva PS models that do not have the oxygen function, the F_IO_2 switch is present, but it has no label and is inoperative.

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Back and sides



A Inlet filter
Filters air as it enters the ventilator.

- **B** Power cord connector
- **C** External battery connector Used for connecting an external battery.
- **D** Side rails
 Used for mounting some accessories on the ventilator.
- Audible alarm port (on side of ventilator)
 DO NOT BLOCK.
- **F** Communications connector

This connector is used to connect a printer, external modem or a computer (with the Achieva Report Generator software) directly to the ventilator. Follow the accessory manufacturer's connection instructions for the appropriate connection procedure.

G Nurse call output

The ventilator can be connected to nurse call stations through this output. See Connecting to a nurse call system on page 4-19.

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H Remote alarm connector

The remote alarm cable plugs into the remote alarm cable jack on the back of the ventilator. Be sure it is firmly in place. The cable slips in only if you have the button on the end of the connector facing down. To remove the cable from the ventilator, press the button and pull the connector straight out.

- Modem connector (North America only. Outside North America use an external modem.) For all models there is a label but no connector.
- J Oxygen input connection (only on Achieva PSO₂). Connect the optional internal O₂ blender to an oxygen source with a standard oxygen connection hose. Screw the hose fitting tightly onto the oxygen input connection. The hose fitting must be compatible with a 9/16-18, DISS 1240 male connector.

For the Achieva and Achieva PS models there is a label but no connector. NIST adapter kits are available.

Flow is measured at the output port of the ventilator. These measurements must be corrected for altitude (using the Altitude setting) and have an accuracy of ± 2 LPM at nominal barometric pressures. Pressure measurements are taken at the patient end of the breathing circuit. Pressure measurements are relative to the current atmospheric pressure and have an accuracy of ± 2.5 hPa.

Note

Note

Inside door label

The following are the labels that appear on your ventilator.

INTENDED USE This device is intended to provide ventilatory support for pediatric (Patients should weigh no less than 11 lbs (Skg)) and adult patients who require positive pressure mechanical ventilation. This device is for use in home, institutional, and portable settings. DANGERI EXPLOSION HAZARD. DO NOT USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS. DANGERI RISQUE D'EXPLOSION. NE PAS EMPLOYER EN PRÉSENCE D'ANESTHÉSIQUES INFLAMMABLES. CAUTION! Electrical shock hazard. Do not remove cover. Refer servicing to qualified personnel. Removal of panels voids warranty. Mallinkchod will not be held responsible for performance of units that have been repaired by unauthorized personnel.

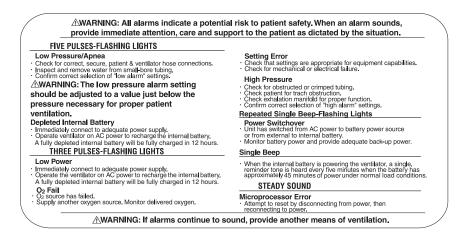
This label appears on the inside of the door and provides the following information:

- The intended use for the ventilator.
- A warning not to use the ventilator where flammable anesthetics are present (English and French).
- A caution against opening the ventilator, and against attempting to service it.
- A warning that the ventilator, like all devices, can fail unpredictably (English and French).
- A statement that you must read and understand this manual before operating the ventilator.

Top label

This label is located on the top of your ventilator. It provides abbreviated information on responding to alarms. For more information, see *Alarms on page 6-1*.

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Side label

This label cautions you not to block the opening for the audible alarm. Blocking the opening may prevent you from hearing the alarm.



Agency symbols label

This label, on the back of the ventilator, gives regulatory certification information concerning your ventilator.



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Back panel label

The following information is printed on the back of your ventilator:

★ WARNING! FOR CONTINUED PROTECTION AGAINST FIRE, USE ONLY THE SAME TYPE AND RATING OF FUSE. 250V 3.15A SLOW BLOW.

AVERTISSEMENT! POUR UNE PROTECTION CONTINUE CONTRE LES RISQUES D'INCENDIE, TOUJOURS UTILISER DES FUSIBLES DE MÊME TYPE ET DE MÊME AMPÉRAGE, SOIT 250 V C.A. 3.15 A, À ACTION RETARDÉE.

The paragraphs warn of a fire hazard if you use replacement fuses that are not the same type and rating as the original fuses.

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Accessories

The instructions for the proper use of accessories will vary depending on the manufacturer. Follow the directions given to you by the manufacturer.

The use of accessory equipment not complying with the equivalent safety requirements of the equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include evidence that the safety certification of the accessory has been performed in accordance to the appropriate IEC 601-1 and/or IEC 601-1-1 harmonized national standard.

Caution

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

Accessories you may need include:

- Patient circuit
- Exhalation valve
- Air inlet filter
- Bacteria filter
- Humidifier system
- Printer
- Modem
- External battery
- Remote alarm
- Achieva Report Generator

Refer to the Achieva *Approved Accessories Sheet* that was shipped with your ventilator for more information.

Description

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Chapter 4: Set up

This chapter provides instructions for unpacking and setting up Achieva ventilators. This chapter includes a visual inspection and user self test for the ventilator. Instructions for setting the low pressure alarm are included.

Unpacking

To unpack your ventilator, follow the directions on the package. The information presented here is for your convenience.

- Remove the manuals and other material from the top of the package.
- **2.** Pull the ventilator out of the box using the handles on the insert.
- **3.** Remove the ventilator from the insert and from the plastic bag.

Save all packaging material. Always ship the ventilator in the supplied packaging material. If you need replacements for your packaging, contact Puritan Bennett.

Inspection

- **1.** When you first get your ventilator you should perform a visual inspection of the device. Make sure that:
 - •The power cord does not have any kinks, breaks or damaged insulation.
 - The connectors, rubber feet, filter housings, etc. are not loose or broken.
 - •The outer casing has no dents or scratches which may indicate dropping or other abuse.
 - •All the labels and markings on the ventilator are clear and legible.

If the ventilator does not pass the visual inspection, contact your equipment supplier or Puritan Bennett Technical Support at 1-800-255-6774.

This visual inspection should be performed each time the ventilator is used after storage as well as periodically during normal use. If the ventilator does not pass the inspection, provide an alternate means of ventilation and contact your equipment supplier or Puritan Bennett Technical Support.

- **2.** Wipe the ventilator with a mild soap solution, if necessary.
- **3.** Make sure that a new air filter has been installed. See Flatpak filter on page 8-3.
- **4.** Plug in the ventilator to a functioning, grounded electrical outlet.

Note

During storage the internal battery may lose its electrical charge. Leave the ventilator plugged in for a minimum of twelve hours to recharge the battery fully.

- 5. The ventilator will activate the audible alarm and all the visual alarms for a period of one or two seconds. Verify that all the visual alarm indicators light up and the audible alarm makes a tone. If not, the ventilator is in need of repair. Do not use the ventilator until the problem has been corrected.
- **6.** Turn the ventilator on. See Starting the ventilator on page 5-1.

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Achieva Ventilator Clinician's Manual Set up

7. Follow the steps for the self test. See User self test on page 4-23.

If the ventilator does not pass the self test, contact your equipment supplier or Puritan Bennett Technical Support.

If the ventilator passes the self test, set the ventilator's parameters according to the prescription. See Operating the controls on page 4-21.

Accessory checklist

Achieva ventilators need the following items to function properly:

- AC source or external battery
- Bacteria filter
- Patient circuit
- Air inlet filter
- Means of connection to patient

Power

Any one of three power sources can power the ventilator:

- External AC
- Internal 24 VDC battery
- External 24 or 12 VDC battery (Use 24 VDC for optimum performance.)

When plugged into a functioning wall outlet the ventilator automatically selects AC power. 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 has a hospital grade, 3-pronged AC power connector. Note, however, that the connector's hospital grading depends on its use in a hospital grade outlet. If you encounter a 2-pronged outlet, have an electrician replace it with a properly grounded 3-pronged outlet. Where the integrity of the external protective earth conductor arrangement is in doubt, the ventilator shall be operated from its internal electrical power source.

Warning

This equipment must be protectively earthed.

Mains isolation is accomplished by disconnecting the power cord from AC power.

The plug may not fit the outlets in some countries. There are two solutions. Replace the ventilator's plug with one designed for the local outlets or use an adaptor.

Caution

If you have questions about the power line, contact a qualified electrician or Puritan Bennett.

Caution

If you have questions about how the ventilator will operate, contact Puritan Bennett Technical Support.

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Warning

If you have 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 in any ventilation mode, including Standby. The internal battery will charge from the external battery only when the ventilator is operating (not in standby). AC power does not recharge the external battery when connected to the ventilator. The external battery can be charged by a battery charger only.

External Battery 24 Volt DC

Whenever AC power is unavailable, the ventilator can operate from an external 24 VDC battery. Use a special cable from Puritan Bennett to connect the ventilator to the battery. Use only Puritan Bennett-approved batteries. A power switchover alarm signals a change from AC to external battery or from external to internal battery.

Puritan Bennett recommends use of a 24 VDC external battery for optimal perfomance. Although a 12 V battery can power the ventilator, a Setting Error alarm is more likely to occur with the use of a 12 V battery under extremely heavy load. Refer to Appendix E (Specifications) for normal and heavy load conditions. If you are using a 12 V battery, run the ventilator at the intended settings before connecting it to the patient to make sure the ventilator is able to function fully at the selected settings. As the battery discharges, a setting alarm is more likely to occur.

Carefully connect the 24 VDC battery to the ventilator. Follow the battery manufacturer's instructions.

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 may open in the battery box or in the ventilator. With the resulting open circuit, the external battery will not provide power to the ventilator. You must first correct the connections and install a correct replacement fuse in the system. Only then will the external battery power the ventilator.

Note Always keep a spare fuse with your battery and cable. Contact your equip-

ment supplier or Puritan Bennett.

Note Batteries and connecting cables are available from Puritan Bennett. These

accessories come with instructions for connection and use. The battery and case provided by Puritan Bennett have a cable with a three pin connector. When properly used, this cable and connector prevent reversed connections between the battery and ventilator. Use of other cables may damage the ventilator or make it inoperable if the cable connections are

accidentally reversed.

External Battery 12 Volt DC

The ventilator can also operate from an external 12 VDC battery. However, a Setting Error alarm is more likely to occur with the use of a 12 VDC battery, as the ventilator may not be able to deliver gases at the selected parameters. Use of a 24 VDC battery is recommended if at all possible.

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Battery Performance

The internal battery will charge from the external battery only when the ventilator is operating (not in Standby); but charging from the external battery will reduce the power remaining in the external battery.

As they age batteries lose their capacity to retain an electrical charge. For best performance, follow the manufacturer's instructions.

The following affect the life of the battery:

- Ambient temperature
- Charge level
- Storage conditions
- Age of battery
- The number of times, and the extent to which, the battery is discharged and recharged
- Type (12 V or 24V)

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 Puritan Bennett-approved battery charger. The time required to recharge a battery varies. With a Puritan Bennett charger, a fully depleted external battery will be fully charged in twelve hours.

Every four to six weeks run the ventilator on the external battery until the ventilator switches to the internal battery. Immediately disconnect the external battery, switch to AC power and recharge the external battery until it is fully charged.

Caution

Recharge an external battery immediately after use. You should use a Puritan Bennett-approved battery charger to recharge external batteries.

Caution

There is a possibility of reduced performance when the ventilator is powered by a 12 VDC battery. In this event, you will get a Setting Error alarm (Volume

Error, Rate Error, or Inspiratory Error alarm).

Caution

When recharging the external battery, first connect the battery to the charger, then connect the charger to AC power.

Caution

Never connect a battery charger to an external battery while the battery is connected to the ventilator. This may cause permanent damage to the ventilator.

With a 24 or 12 volt battery, the ventilator can operate for at least 19 hours with NORMAL LOAD operating parameters. See *Appendix E: Specifications* for more details. There is a possibility of reduced performance with a 12 volt battery.

Testing the Batteries

Make sure the battery to be tested is powering the ventilator before performing the battery test; failure to do so will result in an erroneous reading of the battery condition. To run the test, press and hold the Test Battery (TEST) switch. The needle on the meter registers the battery charge. A fully charged battery, in good condition, will register approximately 100% on the scale.

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 amount of power available is directly related to the battery's age, as well as the number and depth of cycles the battery has delivered. As a battery ages, its ability to power the ventilator decreases. The extent to which a battery is discharged each time it is used also affects its longevity. A battery that is nearly or completely discharged each time it is used will age more quickly than one that is only partially discharged. Take both the age of the battery and its history of use into account in all applications, but especially in portable applications where another power source may not be readily available. The power required by the ventilator varies with the ventilation parameters.

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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.

External battery precautions

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 instructions.

Warning

Never place the battery above or on top of the ventilator.

Caution

Always use separate batteries to power a motorized wheelchair and the ventilator.

Internal Battery 24 Volt DC

Before use, run the ventilator on AC power for twelve hours to make sure the internal battery is charged. The internal battery can maintain its charge for at most three months when the system is OFF.

The internal 24 VDC battery is intended for backup 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 battery.

Warning

If your health or safety would be jeopardized by a long-term power failure, a reliable backup power source is mandatory. Do not regard the internal battery as a long-term backup power source.

When powered by the internal battery, the Internal Battery (ight is continuously lit. As the battery nears depletion the ventilator will give the

following alarm indications (times are based on normal load conditions as defined in Appendix E - Specifications):

- Low Internal Battery Alarm: When approximately 45 minutes of power remains, the audible alarm sounds a single beep every five minutes. Switch to an external power source.
- Extremely Low Internal Battery Alarm: When approximately 10 minutes of power remains, the low power light flashes and the alarm sounds three pulses (repeating) which can be silenced for five minutes at a time by pressing the Alarm Silence/Reset () switch. Switch immediately to another power source.
- Battery Charge Depleted: When the internal battery is nearly depleted, the Low Power () light continues to flash and the alarm sounds five pulses (repeating) that cannot be reset or silenced. You must respond immediately and provide another source of ventilation. Switch to an external power source and reset the ventilator. For instructions on how to recover from this condition, see Response to Low Internal Battery Power or Extremely Low Internal Battery Power alarms on page 6-18.

Note

During Low Battery and Extremely Low Battery alarms, other alarms (such as Setting Error) can occur when the ventilator is no longer able to deliver gases at the selected parameters.

Test the charge level of the internal battery by pushing the Test Battery (TEST) switch. Read the charge level on the Battery Condition scale of the patient pressure meter. A fully charged battery, in good condition, will register approximately 100% on the scale.

Note

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

Caution

To retain the electrical charge of the internal battery, recharge it by plugging the unit into an AC power outlet after each use. A fully depleted internal battery will be fully charged in twelve hours. Always charge the internal battery before disconnecting AC power from the ventilator.

4-10 November 2003

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.

Every four to six weeks, 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 twelve hours.

Warning

Batteries contain toxic chemicals and no attempt to remove or replace the internal battery should be made by anyone other than the equipment supplier or a trained service center.

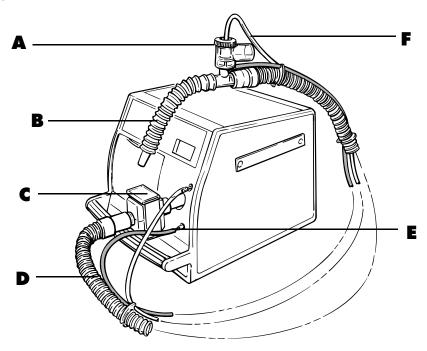
Attaching the patient circuit

The patient circuit has a long flexible hose and several other parts shown in the diagram. It attaches to the ventilator. Inspect it every day to:

- Make sure there are no cracks in the hose.
- Be certain all the connections are secure and free of leaks.

Clean the exhalation manifold according to the manufacturer's instructions.

Each time the Patient Circuit is reassembled you need to do a user self test to make sure the circuit is functioning properly. See User self test on page 4-23.



The following instructions are for a reusable patient circuit, as illustrated. Disposable patient circuits are also available from Puritan Bennett, and include instructions.

A EXHALATION MANIFOLD

The exhalation manifold directs the flow of gases to and from the patient. The exhalation manifold is also used to control PEEP and regulate pressure during Pressure Control. 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 and ensure the seating of the mushroom valve.

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During inhalation, the "mushroom" inflates and allows air to enter the lungs. During exhalation, the "mushroom" deflates and allows air to be expelled from the lungs. The exhalation valve is a critical component. During pressure ventilation and PEEP the exhalation valve is controlled to regulate pressure and PEEP.

B FLEX TUBE

This tube connects the patient circuit to the tracheostomy tube. The tube's flexibility makes the circuit more comfortable.

Caution

The flex tube may contain natural rubber latex which may cause allergic reactions.

C BACTERIA FILTER

This filter cleans the incoming air before the patient inhales it.

D PATIENT AIR TUBE

This is the large tube between the bacteria filter and the exhalation manifold.

Warning

Anti-static or conductive hoses or tubing should not be used.

E PATIENT PRESSURE TUBE

This small tube connects the patient pressure port on the ventilator to the proximal pressure port on the exhalation manifold.

F EXHALATION TUBE

This small tube connects the exhalation valve port to the mushroom valve in the patient circuit.

Warning

Ensure the proper connection and operation of the patient circuit at least daily. The patient could be at risk if the manifold does not function as intended. Connecting patient pressure and exhalation tubes to the incorrect port prevents proper patient ventilation. Be aware that adding attachments or other components to the breathing system will increase inspiratory and expiratory resistances.

Warning

A ventilator patient is highly susceptible to respiratory infections. Dirty or contaminated equipment may be a source of infection. Clean equipment and proper use of bacteria filters are essential to reduce the chance of infection.

Warning

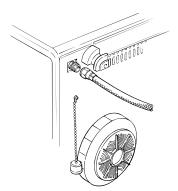
For patients with respiratory failure conditions ventilated in pressure-controlled or pressure-supported modes, the physician must determine at what level the patient may require an alternative means of monitoring effective ventilation.

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Attaching oxygen

Connect an external oxygen source to the oxygen input connector on the back of the ventilator (available only on Achieva PSO_2). The connector is a DISS 1240 fitting. Input pressure range is 138–552 kPa (20–80 PSIG). NIST adapter kits are available from Puritan Bennett.

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To start the oxygen blender, the F_1O_2 ($\mathbf{0_2\%}$) setting must be above 21%. The F_1O_2 ($\mathbf{0_2\%}$) level should be set according to the prescription. The O_2 Fail ($\mathbf{0_2}$) alarm will sound if the ventilator does not detect a flow source.

Supply pressures of less than 355 kPa (45 PSIG) may result in reduced oxygen performance at some settings. Optimum performance is achieved at 443 kPa (65 PSIG) oxygen supply pressure. It may take several minutes for the oxygen concentration to stabilize. An oxygen supply capable of delivering a minimum of 80 SLPM (Standard Liters per Minute) is required to realize the full capacity of the blender.

The capacity of the oxygen blender is a function of tidal volume and inspiratory time, which in combination influence peak flow. As peak flows increase (i.e. large tidal volumes combined with short inspiratory times), the limit of the oxygen flow capacity is approached. The set oxygen concentration cannot be delivered if the flow capacity of the oxygen blender has been exceeded.

Warning

This device does not include an oxygen analyzer. Always measure the delivered gases with a calibrated analyzer having high and low concentration alarms in order to ensure that the prescribed oxygen concentrations are delivered to the patient.

Caution

Altitude changes and oxygen source pressure can affect the ventilator's oxygen blender. To ensure correct oxygen blending, verify that the correct altitude has been entered into the ventilator's parameters (see The Altitude Testing section in this manual).

Two other methods of supplemental oxygen delivery are available:

- •the 90° elbow with oxygen fitting
- •the oxygen enrichment kit

90° Elbow with oxygen fitting Use the elbow to bleed oxygen directly into the patient circuit. This method can achieve concentrations up to 40%. Connect the elbow between the bacteria filter and the patient circuit. Connect a low-pressure oxygen line to the fitting on the elbow. Use the formula below to calculate the volume of pure oxygen to be bled into the patient circuit to achieve the desired oxygen concentration:

$$LPM = \frac{BPM \times V_t \times (C \oplus 0.21)}{0.79}$$

Where:

LPM=100% oxygen flow in liters per minute

BPM=breath rate in breaths per minute

 V_t = tidal volume in liters

C= desired patient oxygen concentration (i.e., 30% = 0.3)

Note

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

Oxygen enrichment kit You can achieve high oxygen concentrations at the proximal airway by delivering source oxygen directly into the Air Inlet port on the back of the ventilator. Use the optional Oxygen Enrichment Kit. This kit contains complete instructions.

Short term humidification

When using humidification for a short time, or during transport, you can use a heat and moisture exchanger (HME, or 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.

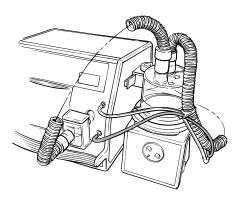
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Warning

The use of an HME or humidifier may affect the ventilator's low pressure alarm. See Setting the low pressure alarm on page 4-26.

Extended Use

The patient's doctor will usually prescribe humidification of the delivered gases. 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 manufacturer's instruction manual.

Warning

Always position the humidifier at a level lower than the patient and at the same, or lower, level than the ventilator. This will help prevent excessive moisture from entering the system.

Warning

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.

Caution

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.

Warning

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

Warning

Always drain the tubing away from the patient connection.

Caution

Always disconnect the tubing from the ventilator before drying with pressurized air. Failure to do so may damage the ventilator.

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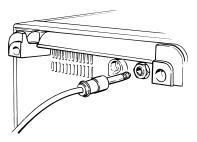
Achieva Ventilator Clinician's Manual Set up

Connecting to a nurse call system

The nurse call output on the back of Achieva ventilators is connected to the contacts of a normally-open relay. During low pressure alarms, the contacts open and close (1.67Hz, 50% duty cycle). During all other alarms, the contacts remain closed. The contacts are also closed while the ventilator is in Standby (non-ventilate) mode.

Pressing the Alarm Silence/Reset () button resets the contacts in the open position.

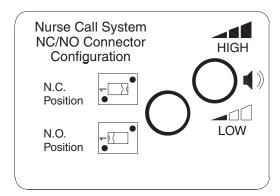
Use a ¼" phone plug (available from Puritan Bennett) to connect this output to a nurse call station. The relay is rated at 30V, 0.5A.



If your application requires a normally-closed (open on alarm) connection, you can change the setting by following these instructions:

- Make sure the ventilator is unplugged and fully powered down (no power source LED lit).
- 2. Use a 1/8" hex driver to remove the two screws securing the left side rail and the left side cover (the side with the alarm). Remove the left side rail.
- **3.** Remove the plastic left side cover.

4. There is a label on the left side panel that looks like the sample shown below:

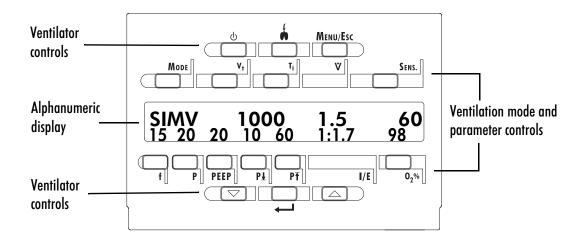


- **5.** Insert a small, nonconductive screw driver through the left adjustment hole in the side panel and slide the switch to the right until it clicks into position. (The right adjustment hole is for changing the alarm volume level.)
- **6.** Insert the tabs on the bottom of the plastic left side cover into the groove at the bottom of the left side panel. Reposition the left side cover into place.
- **7.** Secure the left side rail and the left side cover using a 1/8" hex driver and the two screws removed in step two.
- **8.** Connect the nurse call system that will be used to the nurse call jack on the back of the ventilator and test for proper operation. The nurse call system should be alerted during an alarm condition, or when the ventilator is set to Standby.

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Achieva Ventilator Clinician's Manual Set up

Operating the controls



After beginning a ventilating mode, the display panel shows the set values for ten seconds and then displays the actual values for each parameter. The set value also appears for ten seconds after the value of a setting is changed. Certain parameters, such as the low pressure and high pressure alarm settings, do not have an actual value. For these dashes (---) are displayed instead.

To set the ventilator's parameters:

- **1.** Press the Start/Enter (← →) switch. The current settings will be displayed.
- **2.** Press the switch for the parameter that you wish to change. The displayed setting will begin to flash.
- **3.** Use the up and down arrow keys to adjust the parameter's value.
- **4.** When the prescribed value is displayed, press the Start/Enter () switch to accept the setting.

If a setting is not displayed: Some parameter selections make it unnecessary to select certain other parameters; for example, spontaneous mode makes it unnecessary to select a breath rate. If a parameter is not

displayed, one of your other selections has made that parameter unnecessary.

If a setting is flashing: If a parameter is flashing, the ventilator is waiting for you to enter a value for that parameter. Use the up and down arrows to select the appropriate value, then press Start/Enter ().

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User self test

While in the Standby mode, you can perform tests that assess whether or not the ventilator's pneumatic system is working properly. This test requires your assistance. The user self test is accessible only when in Standby.

- 1. While in Standby, press the MENU/ESC key.
- **2.** The user self test is the first item in the menu.

Press ENTER to begin

User Self Test

3. Press the Start/Enter (\(\) key.

The following message will display:

Occlude patient Õ s

end of breathing circuit.

4. Block the part of the exhalation manifold that connects to the patient. It is important that you make a tight seal and do not let any air escape.

Warning

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

The following message will display:

Press ENTER when ready

to begin test

5. When you have a good seal on the Exhalation Manifold, press the Start/Enter (\(\) key.

The ventilator will push air into the circuit as it runs the test.

6. If the ventilator passes the test, the following message will display:

TEST PASSED.

ENTER: repeat ESC: exit

Press the Start/Enter () switch if you wish to repeat the test, or the **MENU/ESC** switch to end the test and place the ventilator into Standby.

7. If the ventilator fails the test, one of three messages will be displayed.

Test ERROR.

Refer to MANUAL

If this message is displayed, it means the test was not conducted properly.

• Press the ALARM SILENCE/RESET switch. The display screen will indicate that the test was a failure:

Test FAILED.

ENTER: repeat ESC: exit

- Check all the connections in the patient circuit, including the blockage in the exhalation manifold.
- Press START/ENTER to repeat the test.

Leak Test FAILED.

Refer to MANUAL.

- If this message is displayed, it means that there is a leak in the patient circuit somewhere between the patient air port and the blockage you created at the exhalation manifold.
- Acknowledge the alarm condition by pressing the ALARM SILENCE/ RESET switch. The display screen will indicate that the test was a failure.

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Test FAILED.

ENTER: repeat ESC: exit

- Press START/ENTER to repeat the test.
- If the ventilator fails the test again try using a new patient circuit and repeat the test. If the ventilator fails with a new patient circuit, contact your equipment supplier or Puritan Bennett.

Relief valve test FAILED.

Refer to MANUAL

If this message is displayed, it means that the ventilator's relief valve did not function properly

• If the ventilator fails the test again, contact your equipment supplier or Puritan Bennett.

Setting the low pressure alarm

Warning

Throughout this procedure, the ventilator must be disconnected from the patient. Provide another means of ventilation.

Some patients will be in danger if they become disconnected from the ventilator. The purpose of the low pressure alarm is to detect such a disconnection, but the ventilator can only do so if it is adjusted properly.

Warning

Some patient circuit components can defeat a low pressure alarm by keeping the pressure in the circuit above the alarm limit. Examples of such components include hydrated heat and moisture exchangers (HMEs) and tracheostomy tubes.

For all ventilator patients who cannot respond appropriately to this situation, the clinician must set the low pressure alarm to a level that permits an alarm to be detected in the event of a disconnection.

Before adjusting the low pressure alarm keep these points in mind:

- The low pressure alarm must be set for the exact configuration of patient circuit components, including the tracheostomy tube, and the mode of ventilation. If you add, remove or change components, readjust the low pressure alarm.
- When PEEP is used, the low pressure alarm setting cannot be set lower than the PEEP setting. The settings will flash together if you try to set the low pressure alarm below the PEEP setting.
- The HME is a substitute for an active humidifier; do not use the two together.
- The HME's resistance to air flow increases as it becomes moist with use. After a period of time, which will depend on the patient and the HME, the low pressure alarm must be readjusted. Consult your doctor and the manufacturer of the HME to determine the appropriate period.

4-26 November 2003

Follow these steps to set the low pressure alarm:

- **1.** Assemble the patient circuit exactly as it will be used by the patient. Attach all accessories, including the HME (if used), the tracheostomy tube or inner cannula of dual lumen tracheostomy tubes.
- **2.** Verify that the ventilator's parameters are set as prescribed by the doctor. Change them if necessary.
- **3.** Press Ventilate () to begin breath delivery.
- **4.** Adjust the Low Pressure (**P**↓) setting until a low pressure alarm occurs. Note that it takes two breath cycles for the alarm to sound.

Warning

Repeat this procedure whenever you change, replace, remove or reconnect components of the patient circuit, or alter the ventilator's parameters.

Warning

It is possible that with the low pressure alarm set as described above, the patient's breathing effort will cause continuous low pressure alarms. In this case, you may lower the low pressure setting until alarms no longer occur during normal operation, but an independent method of measuring ventilation will be mandatory.

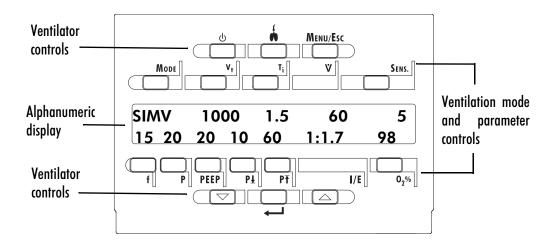
4-28 November 2003

Achieva Ventilator Clinician's Manual Operation

Chapter 5: Operation

This chapter provides information on starting and stopping the ventilator and setting the various modes and menu selections. It includes a monthly safety check, and a list of the information the patient and caregiver must know to use the ventilator safely and effectively.

Starting the ventilator



In the standby mode of operation the ventilator does not deliver air to the patient. The ventilator can be kept in the standby mode indefinitely when it is connected to AC power. While on Standby, the ventilator charges the internal battery, and the power indicators AC (~AC) and Battery Charging (will light. When powered from a battery, the ventilator will remain in standby for 30 seconds and then switch automatically to the low power mode. Press the Start/Enter (will switch to bring the ventilator out of the low power mode.

To start the ventilator:

1. Press the Start/Enter (◀——) switch.

The ventilator will be in Standby and the current parameter settings will be displayed.

2. Check to make sure the parameters are set according to the physician's prescription.

If the parameters are set incorrectly, adjust them at this time. See Operating the controls on page 4-22.

3. Press the Ventilate () switch to start ventilation.

As ventilation starts, check the following:

- •The ventilator's LEDs will light and an audible alarm will sound for one second. Then ventilation will begin. Verify that all the LED indicators light up and the alarm sounds an audible tone. If not, the ventilator is in need of repair. Do not use the ventilator until the problem has been corrected.
- •Read the pressure trigger and altitude settings that flash on the display when the Ventilate () switch is pressed. Verify that these settings agree with the prescribed values.

For the patient's safety, when the ventilator is plugged into AC or switched up from low power mode, the ventilator releases 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.

Stopping the ventilator

To stop the ventilator, disconnect the ventilator from the patient. Then press and hold the Standby (\Diamond) switch for at least three seconds.

Note

The ventilator can remain in standby indefinitely when connected to AC power. While in Standby, the ventilator charges the internal battery, and

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the power indicators (A.C. (^AC) and Battery Charging (ight) will light. When connected to battery power (internal or external), the units will be on Standby for 30 seconds, then switch to the low power mode.

Sensitivity and adjustment

By default, Achieva ventilators use flow to trigger patient-initiated breaths. The ventilator can also be set to trigger on both flow and pressure. Flow triggering is always active. (Pressure triggering may result in improved response to patient demand.) If the ventilator is set to trigger on both flow and pressure, it will respond to the threshold that is reached first. When using PEEP, consider setting the Pressure Trigger, along with the sensitivity setting (Flow Trigger). See Pressure trigger on page 5-5.

Display of settings

Achieva ventilators display the set values for all parameters when not ventilating. In a ventilating mode, the ventilator displays the set values for ten seconds and then displays the actual values. The set value also appears for ten seconds after the value of a setting is changed or the Start/Enter key is pressed. The set values and the actual values are never displayed at the same time. Certain parameters (e.g. low pressure and high pressure alarm settings) do not have an actual value and dashes (---) are displayed instead.

Changing modes

When beginning ventilation in any particular mode, the settings in effect the last time that mode was used are saved. Before starting ventilation again or when switching to a different mode of ventilation, check the values for all parameters.

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Flow trigger

Use the sensitivity parameter to set the amount of flow the patient must generate before the ventilator will deliver a patient-triggered breath. The sensitivity parameter range is 3 to 25 LPM (liters per minute) in increments of 1 LPM. The breath will be delivered to the patient when flow is within ± 0.5 LPM of the sensitivity setting.

To set flow sensitivity:

- **1.** If the settings are not displayed, press Start/Enter (). The settings will appear on the display.
- **2.** Press the Sensitivity (**SENS.**) switch. The displayed setting will begin to flash.
- **3.** Use the up and down arrow keys to select the flow, in liters per minute.
- **4.** When the prescribed value is displayed, press the Start/Enter (←) switch to accept the setting.

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Pressure trigger

The pressure trigger can be set to OFF, or 1 to 15hPa (in increments of 1hPa) below the baseline pressure. When using PEEP, set the Pressure Trigger, along with the sensitivity setting (Flow Trigger). See Flow trigger on page 5-4.

To set the pressure trigger level:

- 1. Press the MENU/ESC switch.

 The display shows the first many item.
 - The display shows the first menu item.
- **2.** Use the up and down arrows to scroll to the message:

Press ENTER to change pressure trigger

3. Press the Start/Enter () switch.

The display shows the message:

Trigger Level: XXX UP/DN: change ENTER: keep

- **4.** Use the up and down arrow keys to select the prescribed pressure trigger level.
- **5.** Press Start/Enter () to accept the setting.

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Altitude setting

Changes in barometric pressure can affect the operation of the Achieva PSO_2 ventilator's oxygen blender. Each ventilator must be set for the altitude of the location where it will be used. The altitude can be set from 0 meters (0 feet) to 4500 meters (14,760 feet), in increments of 100 meters (328 feet).

To set or change the altitude setting:

1. Press the MENU/ESC switch.

The display shows the first menu item.

2. Use the up and down arrows to scroll to the message:

Press ENTER to change operating altitude

3. Press the START/ENTER switch.

The display shows the message:

Altitude: XXXX m XXXXX ft

UP/DN: change ENTER: keep

- **4.** Use the up and down arrow keys to select the prescribed altitude setting.
- **5.** Press **START/ENTER** to accept the setting.

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Assist/Control mode, volume breaths

To operate the ventilator in Assist/Control mode, delivering breaths of a selected volume:

- **1.** Press MENU/ESC to enter the ventilator's menu system.
- **2.** Set alarm latching (see Latching and non-latching on page 6-4), or pressure trigger level (see Pressure trigger on page 5-5) and/or operating altitude (see Altitude setting on page 5-6) from the menu, as needed.
- **3.** From standby, press Start/Enter (to display the parameters.
- 4. Set MODE to A/C.
- **5.** Set the prescribed volume.
- **6.** Set the prescribed inspiratory time.
- **7.** Set the inspiratory sensitivity to an appropriate level.
- **8.** Set the breath rate.
- **9.** Set Pressure to 0.
- **10.** Set PEEP as required.
- **11.** Set the low pressure and high pressure alarm levels. See Setting the low pressure alarm on page 4-27.
- **12.** If required, set F_1O_2 (available only on Achieva PSO₂).
- **13.** Press Ventilate () to begin breath delivery.

Limiting inspiratory flow (Flow Acceleration)

When using pressure control in modes with pressure-supported and pressure-controlled breaths, you can set the ventilator to limit the inspiratory flow rate. The flow acceleration can be turned on or off. When flow acceleration is off, the ventilator delivers maximum flow with relatively little pressure integration. When on, the flow is metered to 180 lpm maximum.

Warning

The clinician must be aware that limiting flow below the patient's inspiratory demand will limit airway pressure and may prevent adequate ventilation. Close monitoring of patient parameters is essential to ensure that the patient is adequately ventilated.

To set inspiratory flow limitation:

- **1.** Press the MENU/ESC key.
- **2.** Press the up or down arrow keys until the display shows the message:

Press ENTER to change flow acceleration

3. Press the **START/ENTER** key. The display shows the current setting:

Flow acceleration: OFF

UP/DN: change ENTER: keep

- **4.** Use the up and down arrow keys to enable ("ON") or disable ("OFF") flow acceleration.
- **5.** Press **START/ENTER** to accept the setting.

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Expiratory sensitivity

The expiratory sensitivity level is a percentage of peak flow at which a pressure-supported breath will be terminated. The expiratory sensitivity level has settings of 15% to 55% in 10% increments. To set the expiratory sensitivity:

- **1.** Press the MENU/ESC key.
- **2.** Press the up or down arrow keys until the display shows the message: Press ENTER to set Expiratory Sensitivity.
- **3.** Press the ENTER key.
- **4.** Use the up or down arrow keys to change the expiratory sensitivity level in 10% increments.
- **5.** Press ENTER to accept the setting.

Assist/Control mode, pressure-controlled

Warning

For patients with respiratory failure conditions ventilated in the pressure-controlled or pressure-supported modes, the physician must determine at what level the patient may require an alternate means of monitoring effective ventilation.

To operate the ventilator in Assist/Control mode, pressure controlled:

- **1.** Press MENU/ESC to enter the ventilator's menu system.
- **2.** Set alarm latching (see Latching and non-latching on page 6-5), or pressure trigger level (see Pressure trigger on page 5-5) and/or operating altitude (see Altitude setting on page 5-6) from the menu, as needed.
- **3.** From standby, press Start/Enter (to display the parameters.
- 4. Set MODE to A/C.
- **5.** Set pressure support to the level prescribed (greater than 0). Volume will not be displayed.
- **6.** Set inspiratory sensitivity to an appropriate level.
- **7.** Set the breath rate.
- **8.** Set inspiratory time for the period the ventilator must maintain the pressure.
- **9.** Set PEEP as required.
- **10.** Set the low pressure and high pressure alarm levels. See Setting the low pressure alarm on page 4-27.
- **11.** If required, set F_1O_2 (available only on Achieva PSO₂).
- **12.** Set Flow Acceleration to ON or OFF.
- **13.** Press Ventilate () to begin air delivery.

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SIMV mode with pressure support

Warning

For patients with respiratory failure conditions ventilated in the pressure-controlled or pressure-supported modes, the physician must determine at what level the patient may require an alternate means of monitoring effective ventilation.

To operate the ventilator in SIMV mode with pressure support (Achieva PS and PSO₂ only):

- **1.** Press MENU/ESC to enter the ventilator's menu system.
- **2.** Set alarm latching (see Latching and non-latching on page 6-5), pressure trigger level (see Pressure trigger on page 5-5) and/or operating altitude (see Altitude setting on page 5-6) from the menu, as needed.
- **3.** From standby, press Start/Enter (to display the parameters.
- **4.** Set **MODE** to SIMV.
- **5.** Set the prescribed volume.
- **6.** Set the prescribed inspiratory time.
- **7.** Set the inspiratory sensitivity to an appropriate level.
- **8.** Set the breath rate for the prescribed number of volume breaths per minute. All other breaths delivered will be pressure-supported breaths.
- **9.** Set both pressure support and PEEP to the prescribed level of pressure support.
- **10.** Set the low pressure and high pressure alarm levels. See Setting the low pressure alarm on page 4-27.
- **11.** If required, set F_1O_2 (available only on Achieva PSO₂).
- **12.** Set the Expiratory Sensitivity
- **13.** Press Ventilate () to begin breath delivery.

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SIMV mode with CPAP

To operate the ventilator in SIMV mode with CPAP:

- **1.** Press MENU/ESC to enter the ventilator's menu system.
- **2.** Set alarm latching (see Latching and non-latching on page 6-5), or pressure trigger level (see Pressure trigger on page 5-5) and/or operating altitude (see Altitude setting on page 5-6) from the menu, as needed.
- **3.** From standby, press Start/Enter (← →) to display the parameters.
- **4.** Set **MODE** to SIMV.
- **5.** Set the prescribed volume.
- **6.** Set the prescribed inspiratory time.
- **7.** Set inspiratory sensitivity to an appropriate level.
- **3.** Set the breath rate to the prescribed number of volume breaths per minute. All other breaths delivered will be CPAP supported breaths.
- **9.** Set pressure support to 0.
- **10.** Set PEEP to the prescribed level of CPAP.
- **11.** Set the low pressure and high pressure alarm levels. See Setting the low pressure alarm on page 4-27.
- **12.** If required, set F_1O_2 (available only on Achieva PSO₂).
- **13.** Press Ventilate (to begin breath delivery.

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Spontaneous mode with pressure support (Flow acceleration)

When using pressure control in the Spontaneous mode, you can set the ventilator to limit the inspiratory flow rate. The flow acceleration can be turned on or off. When flow acceleration is off, the ventilator delivers maximum flow with relatively little pressure integration. When on, the maximum flow is metered to 180 lpm. For more information on Flow acceleration, see Limiting inspiratory flow (Flow Acceleration) on page 5-8.

To operate the ventilator in spontaneous mode with pressure support (Achieva PS and Achieva PSO₂):

- **1.** Press MENU/ESC to enter the ventilator's menu system.
- **2.** Press the up or down arrow keys until the display shows the message:

Press ENTER to change flow acceleration

3. Press the START/ENTER key. The display shows the current setting:

Flow acceleration: OFF

UP/DN: change ENTER: keep

- **4.** Use the up and down arrow keys to enable ("ON") or disable ("OFF") flow acceleration.
- **5.** Press **START/ENTER** to accept the setting.
- **6.** Set alarm latching (see Latching and non-latching on page 6-5), or pressure trigger level (see Pressure trigger on page 5-5) and/or operating altitude (see Altitude setting on page 5-6) from the menu, as needed. Select whether or not back up breaths should be delivered. For more details, see page 5-16.
- **7.** From standby, press Start/Enter (to display the parameters.
- **8.** Set **MODE** to SPON.
- **9.** Set the inspiratory sensitivity to an appropriate level.
- **10.** Set pressure support to the prescribed level (greater than 0).

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- **11.** Set PEEP as required.
- **12.** Set the low pressure and high pressure alarm levels. See Setting the low pressure alarm on page 4-27.
- **13.** If required, set F_1O_2 (available only on Achieva PSO₂).
- **14.** Set the Expiratory Sensitivity.
- 15. Press Ventilate () to begin breath delivery.

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Spontaneous mode with CPAP (Achieva PS and Achieva PSO₂)

To operate the ventilator in Spontaneous mode with CPAP (Achieva PS and Achieva PSO₂):

- **1.** Press MENU/ESC to enter the ventilator's menu system.
- **2.** Set alarm latching (see Latching and non-latching on page 6-5), or pressure trigger level (see Pressure trigger on page 5-5) and/or operating altitude (see Altitude setting on page 5-6) from the menu, as needed. Select whether or not back up breaths should be delivered. For more details, see page 5-16.
- **3.** From standby, press Start/Enter (← →) to display the parameters.
- **4.** Set **MODE** to SPON.
- **5.** Set inspiratory sensitivity to an appropriate level.
- **6.** Set pressure support to 0.
- **7.** Set PEEP to the level of CPAP required.
- **8.** Set the low pressure and high pressure alarm levels. See Setting the low pressure alarm on page 4-27.
- **9.** If required, set F_1O_2 (available only on Achieva PSO₂).
- **10.** Press Ventilate () to begin breath delivery.

Ventilation modes and apnea

In Assist/Control mode with breath rate settings of less than 6 BPM, the ventilator will sound an apnea alarm if no patient effort occurs for 10 ± 1 seconds. During an apnea alarm, the ventilator delivers controlled breaths at a rate of 10 BPM. If the patient initiates a spontaneous breath, the ventilator will stop the controlled breaths and return to the previous operating parameters.

In SIMV mode with breath rate settings of less than 6 BPM, the ventilator will sound an apnea alarm if no patient effort occurs for 20 ±1 seconds. During an apnea alarm, the ventilator delivers controlled breaths at a rate of 10 BPM. If the patient initiates a spontaneous breath, the ventilator will stop the controlled breaths and return to the previous operating parameters.

In Spontaneous mode (Achieva PS and Achieva PSO₂ only), the user may choose to activate an optional apnea back-up rate, so that the ventilator will automatically begin to deliver breaths at 10 BPM if no patient effort occurs for 20 ±1 seconds. Upon choosing Spontaneous mode the alphanumeric display will show the option to enter backup rate. Use the up and down arrows to select "Y" or "N". The pressure setting during the spontaneous back-up mode is equal to the Pressure Support setting before the apnea condition began, and the I:E ratio is 1:2. If the patient initiates a spontaneous breath while the back-up rate option is in effect, the ventilator will return to the previous operating parameters.

If the back-up rate option is not chosen, the ventilator will sound an apnea alarm if no breath is triggered by the patient in 20 seconds.

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Monthly safety check

Perform this check at least monthly while the ventilator is in use.

Warning

Throughout this check, the ventilator must be disconnected from the patient. Provide another means of ventilation.

- **1.** Perform a visual inspection of the device. Make sure that:
 - •The power cord does not have any kinks, breaks or damaged insulation.
 - The connectors, rubber feet, filter housings, etc. are not loose or broken.
 - •The outer casing has no dents or scratches which may indicate dropping or other abuse.
 - •All the labels and markings on the ventilator are clear and legible.

This visual inspection should be performed each time the ventilator is used after storage as well as periodically during normal use. If the ventilator does not pass the inspection, provide an alternate means of ventilation and contact your equipment supplier or Puritan Bennett Technical Support.

- **2.** Perform a user self test. See User self test on page 4-24.
- 3. Test the audible alarm and the indicator lights. Press and hold the Alarm Silence/Reset (♠๑) switch (while an alarm condition does not exist) for at least five seconds. The audible alarm must sound and all the ventilator's indicator lights must light.
- **4.** Connect a patient circuit to the ventilator. Connect the ventilator to AC power.

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5. Set the ventilator mode to Assist/Control (A/C). Press Ventilate



Block the end of the patient circuit. It is important that you make a tight seal and do not let any air escape.

Warning

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 contact with the patient circuit.

At the next attempt to deliver a breath, a high pressure alarm must occur.

7. Unblock the end of the patient circuit. Press Alarm Silence/Reset
(→∞ s) to reset the high pressure alarm.

A Low pressure/Apnea alarm must occur after two or three breath cycles.

8. Press and hold (for at least three seconds) the Standby (①) switch to put the ventilator in Standby mode. Press the Alarm Silence/
Reset (****) switch to reset the Low Pressure/Apnea alarm.

Verifying Alarm Functions

Before using the ventilator, complete the following procedures to test the function of the various alarms on Achieva ventilators. Unless stated otherwise, the initial ventilator settings for these tests are:

Breath rate:12 BPM High Pressure: 80 hPa Low Pressure: 3 hPa Volume: 500 ml

Inspiratory Time: 1.0 seconds

FIO2: 21 percent

Ventilation Mode: Assist/Control

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Low Pressure

- **1.** With the ventilator in Assist/Control mode, adjust the Volume setting to 500ml, Inspiratory Time to 0.4 seconds, and the Low Pressure alarm to 5 hPa.
- **2.** Attach an approved breathing circuit to the output port of the ventilator.
- **3.** With the patient-end of the breathing circuit open to the atmosphere, allow the ventilator to deliver three consecutive breaths. At the beginning of inspiration of the third breath check that:
 - •the LED for the Low Pressure alarm lights up,
 - the LCD display indicates that a Low Pressure alarm has occurred,
 - •the audible alarm sounds.
- **4.** Place the ventilator back in Standby mode by pressing and holding the Standby button for three seconds. Reset the alarm.

Apnea

- **1.** With the ventilator in Standby mode, adjust the Volume setting to 500ml, Inspiratory Time to 0.5 seconds, and the Breath Rate to 5 BPM.
- **2.** Place the ventilator in Assist/Control mode by pressing and holding the ventilate button for one second while the parameter settings are shown on the LCD display. The ventilator will deliver a mandatory breath upon entering Assist/Control mode.
- **3.** Before the next mandatory breath is delivered check that:
 - •the LED for the Low Pressure alarm lights up,
 - •the LCD display indicates that an Apnea alarm has occurred,
 - •the audible alarm sounds.
- **4.** Place the ventilator back in Standby mode by pressing and holding the Standby button for three seconds. Reset the alarm.

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Power Failure

- Plug in the ventilator to an AC source and allow it to run in Assist/Control mode.
- **2.** Unplug the ventilator. Check that:
 - •the Power Switchover LED lights up,
 - •the message on the LCD display states that the AC source is no longer powering the ventilator,
 - •the LED power-source indicators also indicate that the AC is no longer powering the ventilator,
 - •the audible alarm sounds.

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Continuing Pressure (Valley)

- **1.** With the ventilator in Standby mode, adjust the Volume setting to 200ml and Inspiratory Time to 0.5 seconds.
- **2.** Attach an approved breathing circuit to the output port of the ventilator.
- **3.** Connect the patient-end of the breathing circuit to a 1 liter elastic bag (make sure that the pressure tube of the breathing circuit is connected to the appropriate fitting on both the ventilator and the proximal pressure port).
- **4.** Place the ventilator in Assist/Control mode by pressing and holding the ventilate button for 1 second while the parameter settings are showing on the LCD display. Occlude the exhalation port of the breathing circuit's exhalation valve.
- **5.** Allow the ventilator to deliver four consecutive breaths. At the beginning of the fourth breath check that:
 - •the LED for the Low Pressure alarm lights up,
 - •the LCD display indicates that a Valley alarm has occurred,
 - •the audible alarm sounds.
- **6.** Remove the occlusion and set the ventilator to Standby mode by pressing and holding the Standby button for 3 seconds. Reset the alarm.

Inspiratory Time (Low Volume)

- **1.** With the ventilator in Standby mode, adjust the Volume setting to 500ml, Inspiratory Time to 0.4 seconds, and Low Pressure alarm to 50 hPa.
- **2.** Attach an approved breathing circuit to the output port of the ventilator (make sure that the pressure tube of the breathing circuit is connected to the appropriate fitting on both the ventilator and the proximal pressure port).
- **3.** Place the ventilator in Assist/Control mode by pressing and holding the ventilate button for 1 second while the parameter settings are showing on the LCD display.

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- **4.** Keep the patient-end of the breathing circuit open to the atmosphere and allow the ventilator to deliver one breath. During the inspiratory phase of the breath occlude the patient end of the breathing circuit and check that:
 - •the LED for the Setting alarm lights up (a High Pressure alarm will accompany the Setting alarm),
 - •the LCD display indicates that an Inspiratory Time alarm has occurred,
 - •the audible alarm sounds.
- **5.** Remove the occlusion and set the ventilator to Standby mode by pressing and holding the Standby button for 3 seconds. Reset the alarm.

This concludes the Monthly Safety Check.

Warning

If the ventilator fails the monthly safety check or you cannot complete this check, refer to the Troubleshooting Chapter of this manual, or call your equipment supplier or Puritan Bennett.

Menu selections

The following items are set from the menu. To access the menu, press the **MENU/ESC** switch.

User self test

This selection is only available if you press the **MENU/ESC** switch while the ventilator is on Standby. The user self test includes a circuit leak test and a pressure relief valve test. For more information User self test on page 4-23.

Ventilating hours

The ventilator hours menu selection allows you to see the number of operating hours on the ventilator since the last preventive maintenance. To

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keep the ventilator operating within specifications, preventive maintenance must be performed every 6000 operating hours, or recertification every twelve (12) months (whichever occurs first).

To display the ventilator operating hours:

- 1. Press the MENU/ESC key.
- **2.** Press the up or down arrow key until the display screen says:

Ventilating hours since

last maintenance: XXXXX

Pressure trigger

The pressure trigger menu selection allows the clinician to enable or disable pressure triggering of breath delivery, in addition to flow triggering. When using PEEP, consider using Pressure Trigger, along with the sensitivity setting (Flow Trigger). See Pressure trigger on page 5-5.

Date and time

The date and time menu selection allows you to set the date and time in the ventilator's internal memory. This information will appear in the printed reports and the data transferred to the Report Generator software. For information on the printed reports, see Printing reports from the ventilator on page 1. For information on the Report Generator software, see the *Achieva Report Generator User's Guide*.

To set the date and time:

- 1. Press the MENU/ESC key.
- **2.** Press the up or down arrow key until the display screen says:

Press ENTER to modify

Date and Time

3. Press Start/Enter ().

The display screen will show the date and time.

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05/18/96 01:23:30

UP/DN: change ENTER: keep

- **4.** The first variable in the date and time will flash. This indicates that this value can be changed. Press the up or down arrow key to change the value.
- **5.** When the correct setting is displayed on the screen press Start/
 Enter (to accept the setting and move to the next date or time variable.
- When all six variables have been accepted, press Start/Enter (← →), then pressMENU/ESC.

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What the patient and caregiver must know

The following checklist presents a summary of the topics that patients and caregivers must understand in order to use ventilators successfully. Some topics do not apply to some patients; some patients may require additional information. It is the responsibility of the clinician or clinical educator to ensure that the patient and caregiver understand the appropriate topics fully.

For a detailed list of learning objectives for patients and caregivers, see *Learning Objectives for Positive Pressure Ventilation in the Home* (National Center for Home Mechanical Ventilation, Denver CO, July 1993). This publication is available from Puritan Bennett.

The patient a	nd caregiver must understand
	The need for ventilation.
	The schedule for ventilation.
	The supplies required for ventilation, and the sources of each.
	Whom to contact for medical emergencies, equipment emergencies, or power emergencies.
	How to contact other resources for assistance (health aides, attendants, therapists, etc.)
	The principles of operation for the ventilator.
	Power sources for the ventilator, and how to connect each.
	The settings for the ventilator parameters, and the importance of each.
	How to perform a user self test of the ventilator, and how to respond if the self test fails.
	The preventive maintenance schedule for the ventilator.
	The ventilator alarm settings, with the purpose and function of each.
	How to respond to ventilator alarms.
	What to do if the ventilator alarms inappropriately.
	The parts and purpose of the patient circuit.
	How and how often to clean and replace the patient circuit.
	How to recognize and respond to problems with the patient circuit.
	The parts and purpose of the tracheostomy and the tracheostomy tube.
	Care of the tracheostomy and tracheostomy tube.
	How to recognize and respond to problems with the tracheostomy and tracheostomy tube.
	The parts and purpose of the nasal mask.
	Care of the nasal mask.
	How to recognize and respond to problems with the nasal mask.
	The parts and purpose of the mouth piece.
	Care of the mouth piece.

The patient and caregiver must understand	
	How to recognize and respond to problems with the mouth piece.
	The purpose of the humidifier or HME.
	How to connect the humidifier or HME to the ventilator and the patient circuit.
	How to clean and change the humidifier or HME.
	How to recognize and respond to problems with the humidifier or HME.
	The oxygen setting, and why it is required.
	How to connect the oxygen source to the ventilator.
	How to determine the amount of oxygen available, and how to acquire more.
	Safety rules for the use of oxygen.
	Why a back up ventilation system is necessary, and how to use it.
	How the back up ventilation system differs from the main system.
	How to recognize and respond to problems with the back up ventilation system.
	How to use additional equipment, such as external monitors and alarms.

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The patient ar	The patient and caregiver must understand		
	How and why to monitor the patient's condition.		
	How to check the patient's vital signs.		
	The significance of the patient's ease of breathing.		
	What to note about the patient's skin, mucous membranes, and secretions, with their significance.		
	How to recognize the signs of infection, and how to respond.		
	The importance of routine medical appointments and medical testing.		
	The need and processes used to clear airway secretions.		
	The use of manually assisted coughing.		
	When, why, and how to use tracheal suctioning.		
	How to recognize and respond to problems with suctioning.		
	Equipment and phone numbers to have available in cases of emergency.		
	When and how to use a manual resuscitator.		
	How to respond to dyspnea.		
	How to recognize and respond to problems with the ventilator.		
	How to recognize and respond to problems with the oxygen supply.		
	How to perform cardiopulmonary resuscitation.		
	Techniques to prevent aspiration of vomit.		
	Why and how to use a delee catheter.		
	The importance of coordinating care for the patient.		
	Resources for respite care.		
	Choices about future care.		
	The purpose of advanced directives.		

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Chapter 6: Alarms and alerts

This chapter provides instructions on responding to ventilator alarms. A list of all ventilator alarms and alerts is included

To manually initiate a test of the alarms, press and hold the Alarm Silence/Reset (60s) switch (when an alarm condition does not exist) for at least five seconds. The ventilator will activate the audible and visual alarms for a period of one or two seconds. Verify that all the visual alarm indicators light up and the audible alarm makes an audible tone. If not, the ventilator is in need of repair. Do not use the ventilator until the problem has been corrected.

Alerts indicate conditions caused by interactions between the ventilator and the patient that are not serious enough to constitute a direct risk, but which the operator should be aware of. They are signaled by a visual indicator and no audible alarm.

The alarm volume can be set louder or softer to one of two levels. Contact Puritan Bennett's Technical Support at (800) 255-6774 for instructions on making the necessary changes.

Warning

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.

Pressing Alarm Silence/Reset prevents any audible alarm from sounding for 60 seconds even if new alarms occur during that time. If an alarm condition occurs while the 60 second presilence period is in effect, or while Alarm Silence/Reset is active, the LCD will display the alarm condition.

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Warning

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 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 in the event of ventilator failure.

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Alarm sounds

Following is a list of the alarm sounds and alerts generated by Achieva ventilators:

Repeating burst of five pulses

- Low pressure/apnea
- Battery charge depleted
- Vent Inop

Repeating burst of three pulses

- Extremely low internal battery
- High pressure
- Setting error
- O₂ fail

Single reminder beep

- Low internal battery (beep is repeated every five minutes)
- Minor fault condition (beep is repeated every 30 minutes)
- Serious fault condition (beep is repeated every 15 minutes) detected during a ventilating mode

Single three-second tone

 Serious fault condition detected while ventilator is not in a ventilating mode

Steady audible alarm

• Microprocessor failure

Repeated single beep

Power switchover

Visual indicator with no audible alarm: alert status

- Volume setting error
- Inspiratory setting error

Alert messages are only visible if no alarms are present.

Warning If alarms continue to sound, provide another means of ventilation.

Latching and non-latching

Some of the ventilator's alarms (those that cause the low pressure LED to flash) have the option of operating in either a latching or non-latching mode:

- In the non-latching mode, the audible alarm will be silenced as soon as the condition that caused the alarm is corrected. (Some alarm conditions correct themselves.)
- In the latching mode, the audible alarm will not be silenced until the Alarm Silence/Reset (60 s) switch is pressed.

To set the latching status of the alarms:

- 1. Press the MENU/ESC key.
- **2.** Press the up or down arrow key until the screen displays:

Press ENTER to change

Alarm Latching Status

- **3.** Press the Start/Enter () switch. The display indicates the alarm's latching status and gives directions to change the status.
- **4.** If you change the latching status of the alarms the ventilator will indicate the new status and ask for the change to be saved.

Alarms NONLATCHING.

ENTER: save ESC: exit

Press Start/Enter () to save the new setting or **MENU/ESC** to exit without saving.

Note If you exit without saving, the alarm latching status will not change.

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Presilence

Alarm conditions frequently occur during setup of the ventilator. Because the audible part of such alarms can be annoying, they can be presilenced. Pressing the Alarm Silence/Reset (605) switch, when an alarm condition does not exist and no alarm LEDs are lit, will prevent the audible alarm from sounding for one minute. The alarm control LED will flash to indicate that the audible alarm has been presilenced. Pressing the Alarm Silence/Reset (605) switch during the presilence condition will cancel the presilence condition. If an alarm condition has been corrected while the audible alarm was presilenced, the alarms will be reset and the lights will be deactivated.

Resetting alarms

Pressing the Alarm Silence/Reset (60 s) switch, after an alarm condition has been corrected, will reset the alarms and deactivate the lights.

Alarm conditions

Low Pressure/Apnea Alarms			
Low Pressure Alarm	Low Pressure Alarm		
Visual Indicator	Low Pressure/Apnea (P 1) light will flash.		
Audible Alarm Tone	Five pulses		
Display screen	WARNING: Low Pressure. Attend to patient.		
Cause	A low pressure alarm condition exists if the proximal pressure does not rise above the low pressure setting during the last two consecutive breath cycles. The exception is in SIMV mode when the Low Pressure alarm setting is higher than the Pressure setting. Then the Low Pressure alarm will occur if the peak proximal pressure of the last two consecutive volume breaths never rises above the Low Pressure setting.		
Latching Status	Latching/Non-Latching		
Valley Pressure Alarm	Valley Pressure Alarm		
Visual Indicator	Low Pressure/Apnea (P 1) light will flash.		
Audible Alarm Tone	Five pulses		
Display screen	WARNING: Valley Pressure Alarm. Attend to patient.		
Cause	A valley pressure alarm condition exists if the proximal pressure does not drop below the low pressure setting during the last two consecutive machine breaths.		
Latching Status	Latching/Non-Latching		
Exhale Fail Alarm			
Visual Indicator	Low Pressure/Apnea (P 1) light will flash.		
Audible Alarm Tone	Five pulses		
Display screen	WARNING: Exhale Fail Alarm. Check exhalation valve.		
Cause	An Exhale fail alarm condition exists when, at the start of the inspiratory cycle, the pressure in the patient's circuit is greater than or equal to the high pressure alarm setting.		
Latching Status	Latching/Non-Latching		

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Apnea Alarm			
Visual Indicator	Low Pressure/Apnea (P 1) light will flash.		
Audible Alarm Tone	Five pulses		
Display screen	WARNING: Apnea Alarm. Check sens setting.		
Cause	An apnea alarm condition exists when there is no patient breathing effort or machine cycle for 10 seconds while in Assist/Control Mode or 20 seconds in SIMV or Spontaneous modes.		
Latching Status	Latching/Non-Latching		
User Self Test Error	User Self Test Error		
Visual Indicator	Low Pressure/Apnea (P 1) light will flash.		
Audible Alarm Tone	Five pulses		
Display screen	Test ERROR. Refer to USER'S MANUAL.		
Cause	A user self test error condition exists if during the User Self Test the pressure in the patient circuit does not reach a sufficient level to perform the test.		
Latching Status	Latching/Non-Latching		

Leak Test Failure Alarm		
Visual Indicator	Low Pressure/Apnea (P 1) light will flash.	
Audible Alarm Tone	Five pulses	
Display screen	Leak test FAILED. Refer to USER'S MANUAL.	
Cause	A leak test failure alarm condition exists when the patient circuit does not maintain the appropriate pressure or the exhalation valve fails to open and reduce the pressure in the patient circuit.	
Latching Status	Latching/Non-Latching	

Response to Low Pressure Alarms

- **1.** Attend to the patient first.
- **2.** Check the patient circuit for kinks or loose connections.
- **3.** Fix or replace the patient circuit.

If the alarm is not corrected

- **1.** Attend to patient first.
- **2.** Check to see if the ventilator's settings are correct.
- **3.** Correct any setting errors.
- **4.** If the ventilator's settings are set according to a doctor's prescription, contact your doctor or equipment supplier.

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High Pressure Alarms		
High Pressure Alarm		
Visual Indicator	High Pressure (P ↑) light will flash.	
Audible Alarm Tone	Three pulses	
Display screen	WARNING: High Pressure Alarm. Attend to patient.	
Cause	The pressure in the patient circuit exceeds the high pressure limit setting.	
Latching Status	Non-Latching	
Relief Valve Test Failure		
Visual Indicator	High Pressure (P ↑) light will flash.	
Audible Alarm Tone	Three pulses	
Display screen	Relief valve test FAILED. Refer to USER'S MANUAL.	
Cause	The relief valve failed to open while the pressure was above the relief valve threshold pressure.	
Latching Status	Non-Latching	

Response to a High Pressure Alarm

- **1.** Attend to patient first.
- Check the patient circuit for kinks.
- **2. 3.** Fix or replace the patient circuit.

If the alarm is not corrected

- Attend to patient first.
- 2. Check to see if the ventilator's settings are correct.
- 3. Correct any setting errors.
- If the ventilator's settings are set according to a doctor's prescription, contact your doctor or equipment supplier.

Setting Error Alarms	
Invalid I:E Ratio Alarm	
Visual Indicator	The Setting Error (?) light will flash.
Audible Alarm Tone	Three pulses
Display screen	WARNING: Invalid I:E ratio. Check settings.
Cause	A combination of setting(breath rate and inspiratory time) resulting in an inspiratory time that exceeds the expiratory time.
Latching Status	Non-Latching
High Pres < Low Pres Alarm	
Visual Indicator	The Setting Error (?) light will flash.
Audible Alarm Tone	Three pulses
Display screen	SETTING ERROR: High Pressure < Low Pressure setting.
Cause	The low pressure limit setting is the same or higher than the high pressure setting.
Latching Status	Non-Latching
Volume Error Alarm	
Visual Indicator	The Setting Error (?) light will flash.
Audible Alarm Tone	Three pulses
Display screen	WARNING: Volume error. Attend to patient.
Cause	During a volume breath the ventilator did not deliver the set volume (±12%).
Latching Status	Non-Latching
Volume Error Alert	
Visual Indicator	The Setting Error (?) light will flash.
Audible Alarm Tone	No audible alarm tone
Display screen	WARNING: Volume error. Attend to patient.
Cause	With a pressure support breath the last two breaths did not stop within three seconds, or
	For a pressure control breath or a pressure support breath the piston reached the end of travel on the last two breaths.
Latching Status	Non-Latching
Pressure Differential Alarm	
Visual Indicator	The Setting Error (?) light will flash.

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Audible Alarm Tone	Three pulses.
Display screen	Pressure Differential Error. Refer to manual.
Cause	The pressure levels detected by two independent sensors differ by more than 15 $\mathrm{cmH_2O}$
Latching Status	Non-Latching

Rate Error Alarm			
Visual Indicator	The Setting Error (?) light will flash.		
Audible Alarm Tone	Three pulses		
Display screen	WARNING: Breath rate error. Attend to patient.		
Cause	In Assist/Control Mode, breaths are delivered slower than the set breath rate, or		
	If the breath is a volume breath (SIMV mode), the breath rate is slower than the Breath Rate setting, or		
	If the breath is an assisted breath (SIMV mode), the breath rate is slower than two times the Breath Rate setting.		
Latching Status	Non-Latching		
Inspiratory Error Alarm	Inspiratory Error Alarm		
Visual Indicator	The Setting Error (?) light will flash.		
Audible Alarm Tone	Repeated single beep		
Display screen	WARNING: Inspiratory time error. Attend to patient.		
Cause	During volume breath delivery the last measured inspiratory time differed by 12% from the inspiratory setting.		
Latching Status	Non-Latching		
Inspiratory Error Alert			
Visual Indicator	The Setting Error (?) light will flash.		
Audible Alarm Tone	No audible alarm tone		
Display screen	WARNING: Inspiratory time error. Attend to patient.		
Cause	During pressure-controlled breath delivery the measured inspiratory time differed by 12% from the inspiratory setting for the last two consecutive breaths.		
Latching Status	Non-Latching		
	•		

Response to a Setting Error Alarm

- **1.** Attend to patient first.
- **2.** Check the ventilator settings.
- **3.** Correct any setting errors.
- **4.** If the ventilator's settings are set according to a doctor's prescription, contact your doctor or equipment supplier.

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Equipment Alarm		
Visual Indicator	The Setting Error (?) light will flash.	
Audible Alarm Tone	The alarm will beep for one second every 30 minutes during a minor fault.	
	The alarm will beep once every fifteen minutes if the ventilator is currently ventilating and a serious fault is detected.	
	The alarm will sound for three seconds if the ventilator is not ventilating and a serious fault is detected.	
Display screen	Ventilator hardware error. Refer to manual.	
Cause	An Equipment failure has been detected.	
Latching Status	Non-Latching	

Response to an Equipment Alarm

- **1.** Check the patient circuit and accessory equipment.
- **2.** Replace if necessary.
- **3.** If the ventilator will not start ventilation and the alarm is beeping once every fifteen minutes, contact your equipment supplier.

Vent Inop Alarm	
Visual Indicator	The Setting Error (?) light will flash.
Audible Alarm Tone	Five pulses.
Display screen	WARNING: Equipment error. Refer to Manual.
Cause	An Equipment failure has been detected.
Latching Status	Non-Latching

Response to a Vent Inop Alarm

- **1.** Switch to an alternate means of ventilation.
- **2.** Press the Standby (**b**) switch. If this clears the error, resume normal ventilation. If not, proceed.
- **3.** Unplug the ventilator from AC power and wait 30 seconds without touching any controls until the unit goes to the OFF state. Plug the ventilator into AC power and resume normal ventilation. If the alarm has not cleared, proceed to the next step.
- 4. Unplug the ventilator from AC power, press and hold Standby

 (b) for three or more seconds. Plug the ventilator into AC power and resume normal ventilation. If the alarm has not cleared, contact your equipment supplier.

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Oxygen Alarm	
Oxygen Alarm	
Visual Indicator	O ₂ Fail (O ₂) light will flash.
Audible Alarm Tone	Three pulses
Display screen	WARNING: Oxygen error. Attend to patient.
Cause	The O_2 Fail alarm will sound if the ventilator does not detect a flow source at the oxygen connector.
Latching Status	Non-Latching

Response to an Oxygen Alarm

- **1.** Attend to patient first.
- **2.** Check and correct the connections to the oxygen source.
- **3.** Check the oxygen setting.
- **4.** Check the oxygen supply. If the supply is empty, switch to an alternate oxygen source.

If there is an oxygen alarm in the absence of other alarm conditions, or if there is a problem with the oxygen supply, oxygen settings or the ventilator, contact your equipment supplier.

Warning

This device does not include an oxygen analyzer. Always measure the delivered gases with a calibrated analyzer having high and low concentration alarms in order to ensure that the prescribed oxygen concentrations are delivered to the patient.

Power Switchover Alarm	
AC Source to External Battery Alarm	
Visual Indicator	Power Switchover (~AC ⇒□) light will flash.
Audible Alarm Tone	Repeated single beep
Display screen	Power source is now the external battery.
Cause	Power is switched from the AC power source to the external battery source.
Latching Status	Non-Latching Non-Latching
AC Source to Internal Battery Alarm	
Visual Indicator	Power Switchover (~AC ⇒ □) light will flash.
Audible Alarm Tone	Repeated single beep
Display screen	Power source is now the internal battery.
Cause	The ventilator switches from an AC power source to the internal battery.
Latching Status	Non-Latching
External Battery to Internal Battery Alarm	
Visual Indicator	Power Switchover (~AC ⇒ □) light will flash.
Audible Alarm Tone	Repeated single beep
Display screen	Power source is now the internal battery.
Cause	The ventilator switches from an external battery to the internal battery.
Latching Status	Non-Latching

Response to a power switchover alarm

The power switchover alarms are used to indicate that the ventilator has switched to another power source. Acknowledge the change by pressing the Alarm/Silence reset switch.

Low Power Alarms	During low power conditions, other alarms (such as Setting Error) can occur when the ventilator is unable to deliver gases at the selected parameters.
Low Internal Battery Power	
Visual Indicator	Low Power (➡ ↓) light will flash.
Audible Alarm Tone	Single beep every five minutes
Display screen	WARNING: Low Internal Battery Power.

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Cause	The ventilator is powered from the internal battery and can provide approximately 45 minutes of operation with the current settings.		
Latching Status	Non-Latching		
Extremely Low Internal Battery Power			
Visual Indicator	Low Power (Low Po		
Audible Alarm Tone	Three pulses. This tone can be silenced for five minutes by pressing the Alarm Silence/Reset () 60 s) switch.		
Display screen	WARNING: Extremely Low Internal Battery Power.		
Cause	The ventilator is powered from the internal battery and can provide approximately 10 minutes of operation with the current settings.		
Latching Status	Non-Latching		

Response to Low Internal Battery Power or Extremely Low Internal Battery Power alarms

Connect the ventilator to a functioning AC electrical outlet or charged external battery. The ventilator will continue operation and the internal battery will begin to charge.

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Battery Charge Depleted			
Visual Indicator	Low Power (Low Po		
Audible Alarm Tone	Five pulses that cannot be reset or silenced.		
Display screen	WARNING: Battery charge depleted.		
Cause	The ventilator is powered from the internal battery and the internal battery's charge is depleted.		
Latching Status	Latching		

Responses to Battery Charge Depleted alarm

Condition 1: Ventilator continues to operate.

Disconnect the ventilator from the patient. To reset, press the Standby (4) switch (for at least 3 seconds) and then allow 30 seconds to pass without touching any controls. The ventilator will switch to low power standby. Connect an external power source and:

•If the unit is connected to AC, it will automatically exit the low power standby mode and begin to charge the internal battery.

Press the Ventilate () switch to resume ventilation.

•If the unit is connected to a charged external battery, you must press the Start/Enter () switch to restart. The internal battery will not begin to recharge until the ventilator is put into the ventilate mode.

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Condition 2: All the indicator lights are illuminated and the ventilator no longer operates.

Disconnect the ventilator from the patient. To reset, press and hold the Standby (\circlearrowleft) switch for at least 3 seconds. The unit will switch to the low power standby mode. Connect an external power source and:

•If the unit is connected to AC, it will automatically exit low power standby mode and begin to charge the internal battery.

Press Ventilate (to resume ventilation.

•If the unit is connected to a charged external battery, you must press the Start/Enter () switch to restart. The internal battery will not begin to recharge until the ventilator is put into the ventilate mode.

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Alarms and alerts

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Chapter 7: Troubleshooting

This chapter provides basic troubleshooting of Achieva ventilators.

Troubleshooting chart

When there is a problem with the ventilator or its accessories, you must first check to make sure the patient is not in danger. If necessary, provide an alternate means of ventilation. When the patient is out of danger, proceed with your inspection of the ventilator and equipment.

If the cause of the problem cannot be determined, contact your equipment supplier or Puritan Bennett. Do not use the ventilator and equipment until the problem has been corrected.

Conditions	Display Message	Probable Cause	Solution
All lights turn on and audible alarm sounds	No display message.	Normal condition, Alarms test when the unit is turned on.	Alarms will stop in two seconds.
		Normal; manual alarm test.	Alarms will stop in one second.
		Microprocessor error.	Disconnect the ventilator from external power. Press and hold Standby () 3 seconds or more. Reconnect external power. If the unit is connected to AC, it will automatically exit low power standby mode and begin to charge the internal battery. Press Ventilate () to resume ventilation. If the unit is connected to a charged external battery, press the Start/Enter
			switch to restart. The internal battery will not begin to recharge until the ventilator is put into the ventilate mode.
			Press Start/Enter () and check parameter settings for
			accuracy. Press Ventilate (). If alarm persists, unplug the ventilator and provide another means of ventilation.

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Conditions	Display Message	Probable Cause	Solution
Low Pressure/Apnea Alarm(P 1): Five-pulse audible tone with flashing light	Apnea Alarm. Check sensitivity setting.	The patient is not breathing.	Check the patient for breathing effort and stimulate if necessary.
		Water in small-bore tubing.	Inspect and remove water from small-bore tubing.
		Kink in small-bore tubing.	Unkink and straighten the small- bore tubing.
		Leaks or loose connections in the large bore tubing of 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.
		The patient's breathing effort is less than the Sensitivity control setting.	Set the sensitivity so the patient's breathing effort turns on the Assist/Spontaneous light, or call the doctor.
		Volume set below patient's tidal volume	Reset the Volume to the pre- scribed value.
			If values are correct, call doctor.
		Incorrect control settings	Reset all controls to the pre- scribed values.
			If values are correct, call doctor.
		Obstructions in the patient pressure tube.	Check for leaks or kinks in the patient tubing.
		Other causes.	Notify your physician and your equipment supplier.
Low Pressure/Apnea Alarm(₱↓): Five-pulse audi-	Exhale Fail Alarm. Check exhale valve.	Water in small-bore tubing.	Inspect and remove water from small-bore tubing.
ble tone with flashing light		Kink in small-bore tubing.	Unkink and straighten the small- bore tubing.

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Conditions	Display Message	Probable Cause	Solution
Low Pressure/Apnea Alarm(P \(\frac{1}{2} \)): Five-pulse audible tone with flashing light	Low Pressure Alarm. Attend to patient.	Water in small-bore tubing.	Inspect and remove water from small-bore tubing
		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.
		Kink in small-bore tubing.	Unkink and straighten the small- bore tubing.
		Leaks or loose connections in the large bore tubing of 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.
		Incorrect control settings	Reset all controls to the pre- scribed values.
			If values are correct, call doctor.
		Obstructions in the patient pressure tube.	Check for leaks or kinks in the patient tubing.
		Other causes.	Notify your physician and your equipment supplier.
Low Pressure/Apnea Alarm(P↓): Five-pulse audi-	Valley Pressure Alarm. Attend to patient.	Water in small-bore tubing.	Inspect and remove water from small-bore tubing.
ble tone with flashing light		Kink in small-bore tubing.	Unkink and straighten the small- bore tubing.
		Incorrect control settings.	Reset all controls to the pre- scribed values.
			If values are correct, call doctor.
		Other causes.	Notify your physician and your equipment supplier.
Low Power (Low Internal Battery Power. OR Extremely Low Internal Battery Power OR Battery Charge Depleted.	Failure to recharge the internal battery.	Plug ventilator into AC power. OR Plug ventilator into a charged external battery.

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Conditions	Display Message	Probable Cause	Solution
High Pressure (P ★) Alarm.	High Pressure Alarm. Attend to	Water in the tubing.	Remove water from tubing.
Three-pulse audible tone with	patient.	Crimped tubing.	Uncrimp tubing.
flashing light.		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.
		Airway obstruction.	Check for trach obstruction or for a condition in which the patient requires suctioning
		Malfunction in the exhalation manifold.	Replace the exhalation manifold.
Setting Error (?) Alarm. Three-pulse audible tone with flashing light	High Pres < Low Pres. OR Volume error. Attend to patient. OR Breath Rate error. Attend to patient. OR Insp Time error. Attend to patient. OR Invalid I:E ratio. Check settings.	Inappropriate setting or settings beyond the capabilities of the machine.	Readjust settings to the doctor's prescription.
Setting Error (?) Alarm. Three-pulse audible tone with flashing light.	Ventilator hardware error. Refer to manual OR Equipment error. Refer to manual.	Hardware or equipment malfunction.	Press Alarm Silence/Reset () 60 s). If alarm remains, disconnect the ventilator from the patient. Then press and hold Standby () for 3 seconds. If alarm clears, press Ventilate ()). If alarm didn't clear, disconnect external power. After all lights are off, reconnect external power and press Ventilate (). If alarm returns, notify your physician and equipment supplier.
Green AC Power (~AC) light does not glow.	No display message.	AC power cord is not connected. The ventilator's fuse has been	Plug in the cord. Replace the fuse, see Changing
		blown.	the fuse on page 8-5.
		No power to the wall outlet.	Use an active outlet.

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Conditions	Display Message	Probable Cause	Solution
O ₂ Fail Alarm: Three-pulse audi- ble tone with flashing light	Oxygen error. Attend to equip- ment.	Low O ₂ source pressure.	Increase 0_2 source pressure.
		O ₂ source disconnected.	Connect an O ₂ source.
		O ₂ source empty.	Replace O ₂ source.

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Chapter 8: Maintenance

This chapter provides cleaning and maintenance information, a list of replaceable parts and a maintenance schedule.

Cleaning and sterilization

This section contains instructions for maintaining and cleaning the ventilator. You must also consult the corresponding cleaning instructions for the various accessories used with the ventilator.

Warning

A ventilator patient is highly susceptible to respiratory infections. Dirty or contaminated 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.

Caution

Do not sterilize the ventilator with ethylene oxide (ETO) or steam. Doing so may damage the ventilator.

Caution

Do not use MEK, trichloroethylene, or alcohol to clean the ventilator. Their use may damage the unit's surfaces.

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Ventilator surface

Clean as often as the surface becomes soiled.

- 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. Excessive moisture will damage the ventilator.

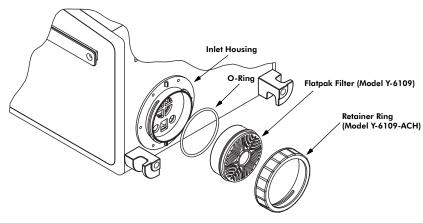
Note

Contact Puritan Bennett for alternate cleaning methods.

Flatpak filter

The model Y-6109 Inlet Filter (Flatpak) is a standard part for the ventilator. Inspect the filter monthly (weekly if used outdoors, portably, or in a dusty atmosphere). Replace with a new filter when it shows signs of discoloration. The Flatpak filter is disposable; do not attempt to wash or otherwise clean it.

- **1.** Twist off the retainer ring of the Inlet Filter (Flatpak) from the back panel of the ventilator and replace the Flatpak filter cartridge.
- **2.** If you are replacing a Model Y-6106 Inlet Filter, keep the existing O-ring for use with the Flatpak filter. You may discard the existing screens and filter cap.
- **3.** Reassemble the O-ring, Flatpak filter, and Retainer Ring as shown:



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Caution

Failure to change a dirty filter may cause serious damage to the ventilator. A blocked inlet filter may cause a setting error alarm.

Caution

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.

Note

Do not reuse filters. Discard them after removal.

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Changing the fuse

A fuse may need to be replaced if the ventilator is plugged into an electrical outlet but the charging light is not illuminated.

The fuses for the ventilator are rated at 250 V, 3.15 A, 5 x 20 mm, slow blow. Replacement fuses are available from your equipment supplier or Puritan Bennett.

Caution

For continued protection against fire hazard, replace only with identically rated fuses.

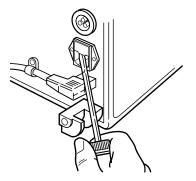
Warning

Before changing the fuse, unplug the power cord.

The fuse holder is located above the power cord connector.

To remove the fuse holder:

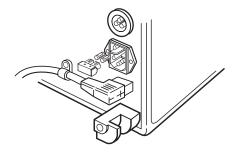
1. Insert a small screwdriver into the small slots on the under side of the fuse holder.



- **2.** Pull upward with the screwdriver.
- **3.** The fuse holder should pop out slightly.
- **4.** Pull the fuse holder out.

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5. Remove the fuses.



- **6.** Place the new fuses directly into the fuse holder.
- **7.** Replace the fuse holder in the ventilator. You should feel a click when it is secure.
- **8.** Reconnect the power cord.

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Periodic maintenance

The ventilator requires 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 ventilator is intended to function within its specified parameters if the service schedule is followed.

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Achieva ventilators are warranted against defects in workmanship and materials. The full warranty 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 Puritan Bennett.

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, void the warranty. Parts and labor costs incurred by the owner will not be reimbursed by Puritan Bennett.

Before returning any device to Puritan Bennett, you must get a Return Authorization Number by calling Puritan Bennett.

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Appendix A: Ventilator data

This chapter tells how to print a report from the ventilator and describes the information in that report. It also describes how to transfer information from the ventilator to a computer equipped with the Achieva Report Generator software.

Achieva ventilators store data which can be used to evaluate the ventilation program. Some information is available in a report that can be printed directly from the ventilator. More complete reports can be made with the Achieva Report Generator software.

For more information on the Report Generator, see the Achieva Report Generator User's Guide.

Printing reports from the ventilator

You can use a printer to create a permanent copy of the patient information and ventilator operation. The printer must be Epson-compatible with a serial input (or a serial-to-parallel adaptor).

- **1.** Connect a printer to the Communications port on the back of the ventilator.
- **2.** Load the printer with paper and ink, as required.
- **3.** Connect the printer to power. Turn it on and ensure that the printer is Selected or On Line. See the printer manufacturer's instructions for details.
- **4.** On the ventilator, briefly press the Test Battery (TEST) switch.

The printout will contain the ventilator's settings and measured or calculated parameters as of the last breath (inspiration and expiration) completed before the printout was created.

Reports are printed automatically:

- after any alarm
- after any parameter change
- every four hours

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The header of the printout displays:

- model and serial number for the ventilator
- blanks for writing in the patient's name and room
- date and time of the printout, with machine operating hours since the last maintenance
- mode and power source at the time of the printout
- any alarm condition
- latched or non-latched Low Pressure alarms. See Latching and non-latching on page 6-4.

The remainder of the printout displays the set and/or actual values for:

- tidal volume and breath rate
- inspiratory time and inspiratory to expiratory ratio (set and actual for each)
- average and maximum inspiratory flow (set and actual for each)
- sensitivity, pressure limit, and PEEP settings (actual only)
- selected oxygen concentration (set) and estimated oxygen concentration
- low pressure setting (set) and minimum pressure (actual)
- high pressure setting (set) and maximum pressure (actual)
- average expiratory and inspiratory pressures (actual for each).

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Local data transfer

You can connect the ventilator directly to the computer through the ventilator's communications port (on the back panel). For more information on the Report Generator, see the *Achieva Report Generator User's Guide*.

Note

You cannot start ventilation during a local data transfer, however you can continue ventilation started before the data transfer.

- **1.** Connect one end of the RS-232 communications cable to the communications port on the back of the ventilator.
- **2.** Connect the other end of the cable to the computer's COM1 (or other COM port, as selected in the Report Generator software).

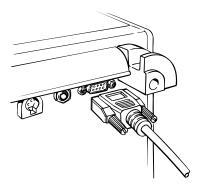
Note

Your computer may require a 9 pin-to-25 pin adaptor.

- **3.** On the computer, start the Report Generator software.
- **4.** On the main Report Generator display, select Connection, and Local Connection. The computer will display:

Connected to VEN (ventilator serial number), Patient (patient name)

5. On the computer, click OK.



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Download procedure

- **1.** On the ventilator, press the Start/Enter switch.
- 2. Press the MENU/ESC switch.
- **3.** Press the up or down arrow keys until its display screen reads:

Press ENTER for local data transfer

OR

Press ENTER for remote data transfer

- **4.** Press the Start/Enter **\(\bigsim \)** switch.
- **5.** While the ventilator is sending the data, the display will read:

Sending Data É

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Achieva Ventilator Clinician's Manual Appendix A

6. After the "Sending Data ..." is displayed and the download is complete, one of the four messages will be displayed.

Transfer Successful

or

Transfer Failed

Hanging up

or

Failed to initialize modem

or

Failed to connect to remote computer

"Failed to initialize modem" indicates a problem with the modem. Check switch settings and connections for the external modem. If you are using an internal modem, contact Puritan Bennett.

"Failed to connect to remote computer:" Check the connections between the Achieva Report Generator-equipped computer and the ventilator. Make sure the computer is set to use the correct COM port. Retry the transfer. See the *Achieva Report Generator User's Guide* for details.

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Appendix A Achieva Ventilator Clinician's Manual

Remote data transfer

You can connect the ventilator to a computer through an external modem.

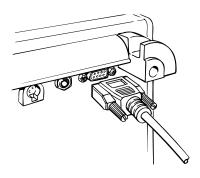
The phone number for the location of the Achieva Report Generator computer must be entered into the ventilator via a local (RS-232 cable) connection. For more information, see the *Achieva Report Generator User's Guide*.

Note

You cannot start ventilation during a remote data transfer, however you can continue ventilation started before the data transfer.

- **1. External modem:** Connect one end of the communication cable to your ventilator's communications port, and the other end to your modem. Connect the modem to the telephone line per the manufacturer's instructions.
- **2.** Make sure the Achieva Report Generator computer is connected to a modem and set to either Remote Attended or Remote Unattended, to wait for a call.
- **3.** On the Report Generator application screen, select Connection and Remote Attended or Remote Unattended.

Follow the *Download procedure on page A-4*.



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Appendix B: Glossary

This appendix contains the definitions of terms used in this manual.

Airway pressure P_{aw} . Measured by the ventilator at the point where the proximal pressure line connects to the patient circuit.

Alarm latching/non-latching Latching alarms continue to sound until the Alarm Silence/Reset (605) switch is pressed, regardless of whether the alarm condition has been corrected. Non-latching alarms will stop sounding as soon as the condition is corrected, although the alarm LED will stay on until the Alarm Silence/Reset (605) switch is pressed. The user has a menu option to set some alarms (those that cause the Low Pressure LED to flash) to either latching or non-latching operation.

Alert Alerts signify a condition that occurs between the patient and the ventilator which is not an immediate danger to the patient, but of which the operator should be aware.

Apnea During Assist/Control ventilation, an absence of breath delivery or inspiratory effort for 10 ± 1 seconds. During SIMV or Spontaneous ventilation (Achieva PS and Achieva PSO₂), an absence of breath delivery or inspiratory effort for 20 ± 1 seconds.

Assist/Control In Assist/Control mode, the ventilator delivers an assisted breath of a set volume or set pressure when the patient's breathing effort creates a flow that is greater than the sensitivity setting; optionally, assisted breaths will be delivered when the patient's breathing effort reduces pressure in the patient circuit by the amount selected.

When the patient's breath rate falls below the breath rate setting, the ventilator will deliver a controlled breath of the set volume or pressure. (Does not apply in Spontaneous mode.)

Assist/Spontaneous Assist/Spontaneous LED indicates inspiratory effort sufficient to trigger delivery of a breath.

Caregiver An individual who assists a patient with the tasks of daily living. This may be a family member, a live-in assistant, or the nursing staff of a healthcare facility.

Caution Directions that warn of potential damage to the ventilator or of data loss.

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Continuous Positive Airway Pressure (CPAP) Airway pressure maintained above ambient pressure. Available in SIMV mode from all Achieva ventilator models. Available in Spontaneous mode from Achieva PS and Achieva PSO₂ only. Achieve CPAP by setting Pressure Support to 0 and PEEP to the prescribed level of CPAP.

Expiratory sensitivity The expiratory sensitivity level is a percentage of peak flow at which a pressure supported breath will be terminated. The expiratory sensitivity level has settings of 15% to 55% in 10% increments.

Flow \dot{V} . The average inspiratory air flow, calculated as V_t / t_i .

Flow acceleration The inspiratory Flow Acceleration feature controls flow during pressure supported and pressure controlled breaths. When the flow acceleration feature is ON, the actual flow rate during inspiratory phase of a pressure supported or a pressure controlled breath cannot exceed 180 LPM.

Modem (modulator/demodulator) Device for converting binary signals into tones that can be transmitted over telephone lines.

Note Directions that make it easier to use the ventilator.

Nurse call output Connector on the ventilator for use with call systems in use at many healthcare facilities. Connected to a relay that switches during alarm conditions. See Connecting to a nurse call system on page 4-20.

O₂ Fail The O_2 Fail (**Q**₂) alarm will sound after 10 breaths if the ventilator does not detect a flow source at the oxygen inlet.

Positive End Expiratory Pressure (PEEP) Pressure in the patient circuit at the end of expiration, above ambient.

Presilence Pressing the Alarm Silence/Reset () switch while no alarm conditions exist and no alarm LEDs are lit. Prevents the audible alarm from sounding for 60 seconds. Useful for routine procedures that would otherwise cause an alarm.

Pressure Control Augmentation of the patient's ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained throughout patient inspiratory flow, and is cycled to expiration by time (controlled by the selected Inspiratory Time setting). Used in Assist/Control mode by setting Pressure above 0.

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Pressure Support Augmentation of the patient's ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained until inspiratory flow is reduced to a percentage of peak flow (between 15% and 55%) that depends on the expiratory sensitivity setting for the inspiration, when the ventilator cycles into exhalation. Available in SIMV or Spontaneous modes (Achieva PS and Achieva PSO₂ only).

Respiratory Failure The inability of a patient to spontaneously ventilate at a level that maintains normal respiration for any period of time.

Respiratory Insufficiency The inability of a patient to spontaneously ventilate at a level that maintains normal respiration for some time period (usually less than 12 hours), leading to negative effects over a prolonged period.

Sensitivity Level at which the ventilator delivers an assisted breath. The Sensitivity (**SENS.**) switch sets the flow (in liters per minute) the patient must generate to trigger inspiration. The clinician can also set the pressure below the baseline that will trigger inspiration. Pressure triggering may result in greater sensitivity to patient demand in low-flow conditions. When using PEEP, use the pressure trigger along with sensitivity (Flow Trigger). The pressure trigger setting can be accessed and changed as a menu option. See Pressure trigger on page 5-6.

Spontaneous A ventilation mode that delivers assisted breaths only.

Warning

Spontaneous mode does not provide breaths if the patient does not make an inspiratory effort greater than the sensitivity settings and the apnea backup is off, but an apnea alarm will occur.

Standby The operational mode of the ventilator where it is connected to power, but is not ventilating the patient.

Synchronous Intermittent Mandatory Ventilation (SIMV) A ventilator mode which provides a mechanism for synchronizing the ventilator-delivered breaths with a patient's inspiration, as detected by the ventilator.

Tidal volume V_r Volume of gas entering or leaving the patient.

User self test A ventilator test, performed with user assistance, that checks for leaks in the patient circuit, and tests operation of the high pressure relief valve.

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Volume breath Inspiration of the selected volume, delivered over the selected inspiratory time.

Warning Directions that warn of conditions that put the patient, caregiver, or other individuals at risk of injury.

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Appendix C: Resources

This chapter provides a brief bibliography, and a list of organizations of interest to clinicians, caregivers, and patients.

Bibliography

ACCP Consensus Conference on Mechanical Ventilation. Respir Care 1993; 38:1389–1417

Consensus Conference on the Essentials of Mechanical Ventilators. Respir Care 1992; 37:999–1130 [special issue]

Murray JE. Payment Mechanisms for Pediatric Home Care. Caring Oct. 1989: 33–35

The National Center for Home Mechanical Ventilation. Learning Objectives for Positive Pressure Ventilation in the Home. Denver CO, 1993

Organizations

Puritan Bennett's Ventilator Users Network Network of healthcare professionals with the purposes of aiding communication among clinicians regarding special ventilator applications, sharing news on ventilation, and working together to meet the needs of ventilated individuals and improve their quality of life.

Contact: Tyco Healthcare Group LP

Nellcor Puritan Bennett Division

4280 Hacienda Drive Pleasanton, CA 94588

(800) 635-5267

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Congenital Central Hypoventilation Syndrome (CCHS) Family Network

Publishes the CCHS Family Network Newsletter, and supports camps for ventilator-dependent children.

Editor: 71 Maple St

Contact:

Oneonta NY 13820 607.432.8872

I.V.U.N. (International Ventilator Users Network) Links ventilator users with each other and with home care professionals interested in home mechanical ventilation.

Publishes spring and fall issues of I.V.U.N. NEWS

Publisher: Gazette International Networking Institute (GINI)

5100 Oakland Ave #206 St. Louis, MO 63110 314.534.1475

Executive Director

National Spinal Cord Association This is a membership, consumer-based organization whose purpose is to address the needs of persons with spinal cord injury or disease (which includes many ventilator-dependent individuals). The association conducts programs in the area of research and services, includes a network of local chapters providing direct services, and compiles a resource directory. The directory provides information on services, programs, and resources available for persons with limited mobility.

Address: 600 W Cummings Park, Suite 2000

Wooburn, MA 01801

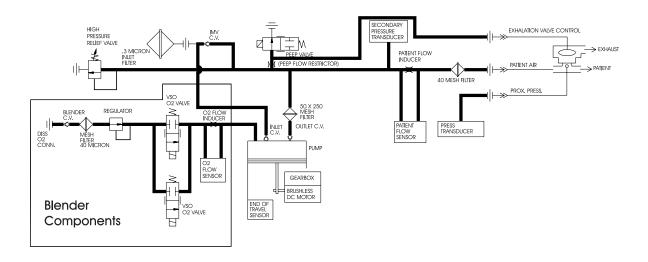
617.935.2722

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Appendix D: Theory of operation

This appendix provides an operating theory for Achieva model ventilators. It includes a description of the ventilation modes and sample waveforms.

Pneumatic diagram



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The following is a theory of operation for the pneumatic system in Achieva ventilators. For a complete theory of operation, see the *Achieva Ventilator Technical Manual*.

Text in a sans-serif font refers to the labels in the illustration, see Pneumatic diagram on page D-1.

Air enters the ventilator through a .3 micron inlet filter. Negative pressure for entrainment is accomplished by the withdraw stroke of the piston in the mechanical piston pump (7" diameter cylinder). Passing through an inlet c.v. (check valve), the air enters the cylinder and is mixed with oxygen from the blender. The combined gases become pressurized by the forward piston stroke. Gas exits through a pump outlet c.v. (check valve) and through a 50 X 250 mesh filter. Before exiting to the patient through the patient air outlet tube, the gas passes through one additional 40 mesh filter.

Ventilator by-pass is accomplished by use of a parallel path incorporated into the manifold. This path bypasses the pump and allows air to move directly to the patient air outlet tube after passing through the .3 micron inlet filter and the ventilator by-pass c.v. (check valve). This allows the patient to breathe spontaneously in the event of complete ventilator failure.

The **PEEP valve** is a voltage sensitive orifice (VSO) that controls the mushroom valve in the exhalation manifold. With the VSO open, the mushroom valve is deflated, resulting in a PEEP level of 0 /hPa. With the VSO fully closed, the mushroom valve is fully seated, and the maximum PEEP pressure in the patient circuit is 20 hPa. As a safety measure, the VSO is normally open to deflate the mushroom valve. This allows the patient, in the event of ventilator failure, to exhale through the exhalation manifold (and inhale through the ventilator).

The **patient flow sensor** operates on the principle of heat transfer due to the airflow directed across the surface of the sensing element. The **patient flow inducer** creates a small airflow to feed the sensor by creating a pressure drop across an orifice.

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The **pressure transducer** is connected to the proximal pressure line of the patient circuit. The transducer functions from -10 to +100 hPa. The **secondary pressure transducer** is part of the ventilator check for gross failure. Pressure differences between the transducers greater than 15 hPa (averaged over a 100 millisecond period) will result in a ventilator fault alarm.

The **high pressure relief** valve limits the pressure delivered to the patient to a maximum of 90 hPa ± 10 hPa.

The internal oxygen blender (available only on Achieva PSO₂) is shown in the solid line on the pneumatic diagram. Oxygen 138-552 kPa (20-80 PSIG) enters the blender through the DISS O₂ connector, and passes through the blender c.v. (check valve) and the mesh filter (40 micron). The **regulator** drops the pressure to 400 kPa (55 PSIG) before feeding the oxygen to two parallel VSO O₂ valves. The oxygen flow supplying the pump is controlled from 0 to 100% capacity by varying the voltage sensitive orifices (VSOs) from fully closed to fully opened. Oxygen concentrations available to the patient are reduced by low pressure supplied to the blender and high volume of total gases delivered to the patient. The O₂ flow sensor measures the oxygen volume delivered to the pump. This is compared to the total volume, to determine the percentage of oxygen concentration delivered to the patient. At low flow rates, total gas flow is calculated based on tidal volume. When the ventilator determines that the measured flow rates are insufficient for the F_IO₂ **(02%)** setting, the O_2 FAIL (**Q**) alarm will sound.

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Breaths and ventilation modes

Breaths available from the ventilator are:

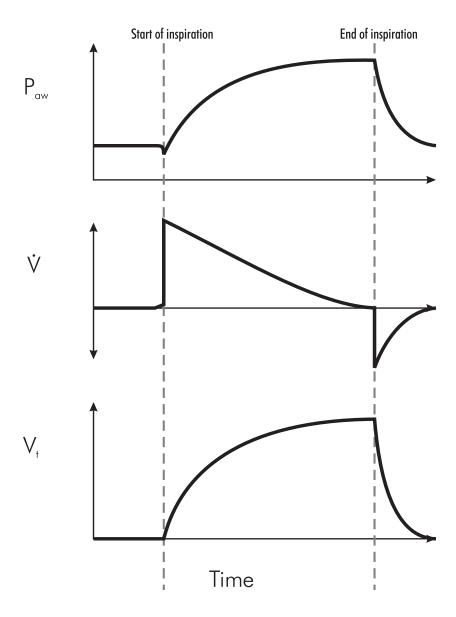
- Volume breaths in Assist/Control mode
- Pressure controlled in Assist/Control mode
- Mandatory volume breaths in SIMV mode
- Pressure supported breaths in SIMV or Spontaneous modes
- CPAP in SIMV or Spontaneous modes

Volume breaths in Assist/ Control mode

In Assist/Control mode, with Pressure set to 0, each delivered breath will be of the selected Volume, delivered over the selected Inspiratory Time. Inspiration is triggered by patient-generated flow or pressure drop (for assisted breaths) or by the ventilator (for controlled breaths; Breath Rate is the controlling parameter). For both controlled and assisted breaths, the inspiration is limited by the volume, and is cycled by volume and time.

See the waveforms on the following page.

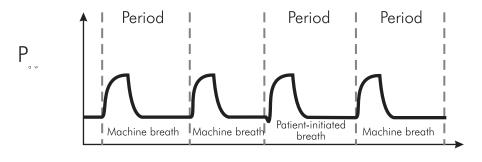
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Assist/Control mode guarantees a maximum period between breaths, as determined by the Breath Rate setting. In the waveform below, the ventilator delivers a controlled (machine) breath, and calculates the time before another controlled breath must be delivered. The ventilator delivers a second controlled breath at the conclusion of that machine-calculated breath time (for simplicity, we will use the term *period* for "machine-calculated breath time"). Following the second controlled breath, but before another period can elapse, the patient's effort triggers an assisted (or patient-initiated) breath. This restarts the period. At the conclusion of the period, the ventilator delivers another controlled breath.



Time

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Pressure controlled in Assist/ Control mode

In Assist/Control mode, with Pressure set greater than 0, each delivered breath will maintain the selected Pressure, maintained over the selected Inspiratory Time. Inspiration is triggered by patient-generated flow or pressure drop (for assisted breaths) or by the ventilator (for controlled breaths; Breath Rate is the controlling parameter). For both controlled and assisted breaths, the inspiratory pressure is limited to the Pressure setting, and is cycled by time.

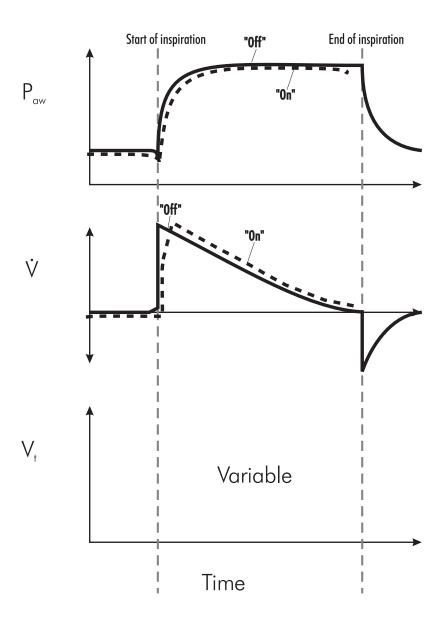
Inspiratory Flow Acceleration and Expiratory Sensitivity Inspiratory flow acceleration controls flow and increases pressure rise time during a pressure supported or pressure controlled breath. By selecting the inspiratory Flow Acceleration feature, the operator can control flow during pressure supported and pressure controlled breaths. The inspiratory flow acceleration feature has settings of ON or OFF. When the flow acceleration feature is ON, the actual flow rate during inspiratory phase of a pressure supported or a pressure controlled breath cannot exceed 180 LPM.

The operator can also set the expiratory sensitivity level, which is a percentage of peak flow at which a pressure supported breath will be terminated. The expiratory sensitivity level has settings of 15% to 55% in 10% increments.

See the waveforms on the opposite page.

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Mandatory volume breaths in SIMV mode

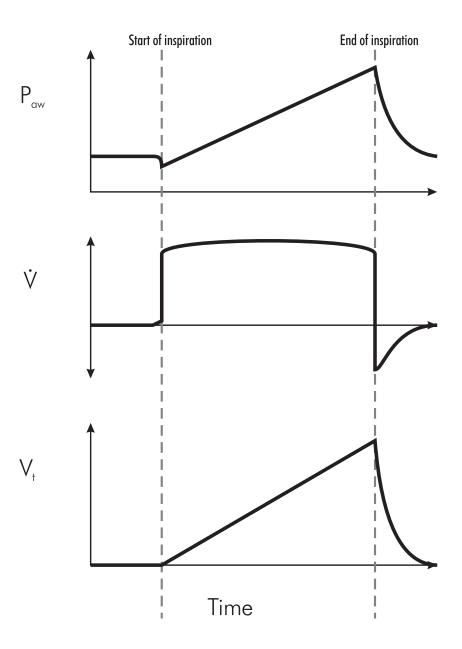
In Synchronized Intermittent Mandatory Ventilation (SIMV), the mandatory volume breaths deliver the selected Volume over the selected Inspiratory Time. Inspiration is triggered by patient-generated flow or pressure drop (for assisted breaths) or by the ventilator (for controlled breaths; Breath Rate is the controlling parameter). For both controlled and assisted breaths, the inspiration is limited by the volume, and is cycled by volume and time.

See the waveforms on the following page.

SIMV mode will also deliver pressure-supported breaths. For a description of pressure-supported breaths, see page D-13. For a discussion of how mandatory volume and pressure-supported breaths interact in SIMV mode, see page D-12.

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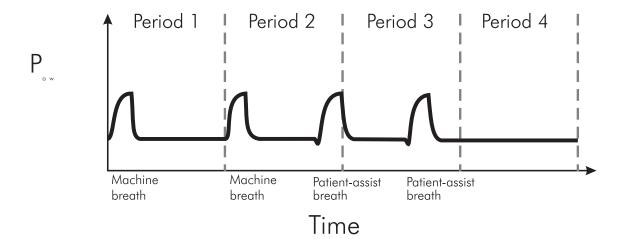
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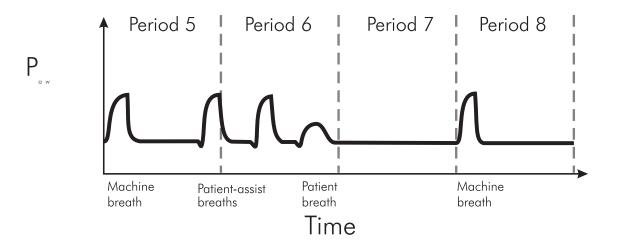
In SIMV mode, the ventilator delivers volume breaths, as determined by the Breath Rate setting, with all additional breaths delivered as pressure supported breaths. See Pressure supported breaths on page D-13. In the waveforms on the opposite page, the breath in the first machine-calculated breath time is due to a lack of patient effort in the preceding machinecalculated breath time; that is, the first breath shown is actually associated with a preceding machine-calculated breath time (for simplicity, we will use the term *period* for "machine-calculated breath time"). The second breath shown is delivered because of the absence of patient effort in the first period shown. Before the next period elapses, the patient initiates an assisted, volume breath. Although it continues into the third period, it fulfills the requirements of the second period. The second patient-initiated volume breath fulfills the requirements of the third period. Therefore, the ventilator does not deliver another breath until the fourth period has elapsed. The patient-initiated breath that starts in the fifth period fulfills the requirements for the fifth period. The first patient-initiated breath in period six fulfills the requirements for period six; therefore, the second patient-initiated breath in period six is delivered as a pressure supported breath. Because of the patient activity in period 6, no breath is delivered in period seven; therefore, a breath is delivered at the start of period eight, to fulfill the requirements of period seven.

In SIMV mode for Achieva PS and Achieva PSO₂, spontaneous breaths are supported to the baseline pressure (either 0 hPa or, if used, the selected PEEP setting).

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Pressure supported breaths

In SIMV or Spontaneous modes, the supported breaths maintain the selected pressure. Inspiration is triggered by patient-generated flow or pressure drop. When Flow Acceleration is on, maximum flow is limited to 180 lpm. When Flow Acceleration is off, the maximum flow is delivered and is cycled by the patient when flow drops to the Expiratory Sensitivity setting (between 15% and 55% of peak flow).

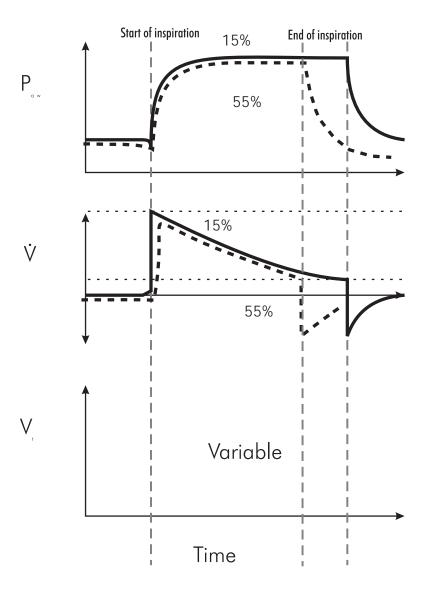
In SIMV, additional mandatory volume breaths will be delivered, dependent on the selected Breath Rate. See *Mandatory volume breaths in SIMV mode* on page D-10.

Available on Achieva PS and Achieva PSO₂ only.

See the waveforms on the following page.

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CPAP

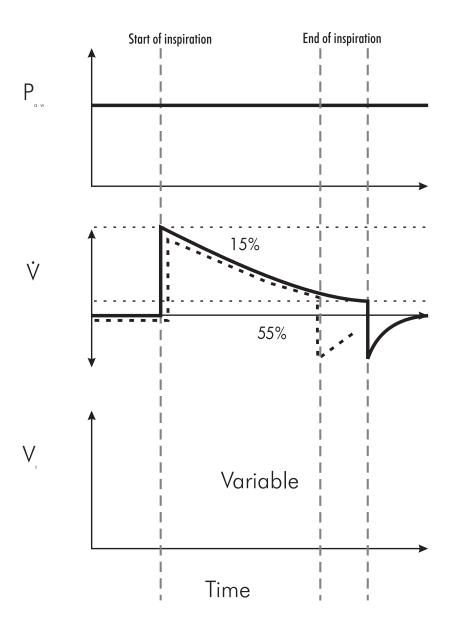
Continuous Positive Airway Pressure (CPAP) is available in SIMV (all models) or Spontaneous modes (Achieva PS only). Pressure must be set to 0. The ventilator maintains pressure at the selected PEEP over the entire breath cycle. Inspiration is triggered by patient-generated flow or pressure drop. Inspiration is limited by the pressure, and is cycled by the patient when flow drops to the Expiratory Sensitivity setting (between 15% and 55% of peak flow).

In SIMV, additional mandatory volume breaths will be delivered, dependent on the selected Breath Rate. See *Mandatory volume breaths in SIMV mode* on page D-10.

See the waveforms on the following page.

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Achieva Ventilator Clinician's Manual Appendix E

Appendix E: Specifications

This appendix provides complete specifications for Achieva ventilators and information regarding connection of the ventilator's modem (Achieva PS and Achieva PSO $_2$ only) to the telephone lines.

Power		
Power Line	100 to 240 VAC, 50 to 60 Hz, 2 Amps	
External DC Power	11.6 to 32.0 VDC (24 VDC optimal)	
	Operating time: At least 19 hours under normal load, and 5 hours 30 minutes under heavy load* 24 VDC or 12 VDC, 32 Ah (Amp-Hour)	
Internal Battery	24 VDC (nominal)	
	Operating time: At least 4 hours under normal load, and 1.0 hour under heavy load*	
	Gel cell, sealed Lead Acid	
	Lithium Battery	
Standard Power Converters	90 to 200 VAC	
Fuses	\$ 250 V, 3.15A, 5X20 mm, slow blow	
Power Usage		
Maximum	75 W	
Minimum	10 W	
Туре	Positive Pressure Volume ventilator	
Motor	3-phase brushless motor	
Pump	Piston, 50ml to 2200ml tidal volume capability	
Protection against electrical shock	Type of protection: Class 1 Degree of protection: Type BF	
*Normal Load: Mode = Assist/Control, Volume = 1000 ml, Breath Rate = 10 BPM, Inspiratory Time = 1.5 sec., F_1O_2 = 21%, Sensitivity = 5 LPM, PEEP = 0 hPa, Vent pres. = 30 hPa Heavy Load: Mode = Assist/Control, Volume = 1500 ml, Breath Rate = 20 BPM, Inspiratory Time = 1.0 sec., F_1O_2 = 100%, Sensitivity = 5 LPM, PEEP = 20 hPa, Vent pres. = 60 hPa		

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Indicators		
Normal Events		
Patient Pressure Meter	Displays patient pressure, -10 to $+$ 100 hPa; also displays battery charge when TEST BATTERY button is pressed.	
Alphanumeric Display	Shows current operating parameters and ventilator information.	
Power	Green LEDs indicate operating power source: AC (~AC), External Battery (;),	
	Internal Battery (+++++++++++++++++++++++++++++++++++	
Battery Charging (🗀 🛊)	Green LED indicates the unit is charging the internal battery.	
Assist/Spontaneous (🔎	Green LED indicates that the patient's effort exceeds the sensitivity setting.	
Alarm Control () Red LED flashes at 1 second intervals during a presilence condition and continuo latching alarm feature is active.		
Alarms	Flashing red LEDs: Low Pressure/Apnea ($\mathbf{P}\underline{\downarrow}$), Low Power ($\mathbf{L}\underline{\downarrow}$), High Pressure	
	($\mathbf{P}\uparrow$), Setting Error ($\mathbf{?}$), Power Switchover (\sim AC \Rightarrow $\stackrel{\square}{=}$), 0_2 Fail	
	$(\mathbf{Q}_{\mathbf{s}})$ (0_2 Fail available only on Achieva PSO $_2$).	
Audible Alarms		
One Second Beep	Relief Valve Test Failure, User Self Test Error, Leak Test Failure	
Repeated Single Beep	Power switchover	
Repeated Three Pulses	Extremely Low Internal Battery, High Pressure, Invalid I:E Ratio, High Pres <low alarm,="" differential="" error,="" error<="" inspiratory="" oxygen="" pres,="" pressure="" rate="" th="" volume=""></low>	
Repeated Five Pulses	Low Pressure, Valley, Exhale Fail, Apnea, Battery Charge Depleted, Vent Inop	
Continuous Tone	Microprocessor failure	
Single Beep Every Five Minutes	Low internal battery	
One Second Beep Every Thirty Minutes	Minor Fault	
One Beep Every Fifteen Minutes	One Beep Every Fifteen Minutes Ventilator is ventilating and serious fault is detected.	
Three Second Tone Ventilator is not ventilating and a serious fault is detected.		
Alarm Volume 85 db or 70 db at distance of 1 meter		

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Controls			
Alarm Silence/Reset (♠∅ 60 s)	Silences audible alarms during an alarm condition. 2. Silences an alarm before a known alarm condition occurs. 3. Used to reset an alarm after the alarm condition has been corrected. 4. Indicator and audible alarm tests.		
Test Battery (TEST)	When the test battery switch is pressed, the Patient Pressure Meter shows the charge level of the battery currently in use. 2. Starts printer output activation. Used to place the ventilator in the Non-ventilate State, disabling the delivery of air. Enables the ventilator to deliver air to the patient.		
Standby (\circlearrowleft)			
Ventilate (
Mode	Causes the current mode on the display to flash and allows the mode to be changed.		
Setting Switches	Volume (V_{\uparrow}) , Inspiratory Time (T_{i}) , Sensitivity $(SENS_{\bullet})$, Breath Rate (f) , Pressure (P) , PEEP $(PEEP)$, Low Pressure $(P \downarrow)$, High Pressure $(P \uparrow)$, FIO ₂ $(O_{2}\%)$ (Achieva PSO ₂)		
Menu/Esc	Activates and deactivates the menu on the ventilator's display.		
START/ENTER (Used to accept the currently flashing parameter as the new setting. Activates display.		
Up and Down Arrow Keys	Increases or decreases the parameter settings or menu levels. Pressing when the sub menu is not active and a parameter has not been selected will cause the last alarm message to be displayed.		
Settings			
Volume $(\mathbf{V_t})$	For Assist/Control 50ml to 2200ml in 10 ml steps. For SIMV 50ml to 1750ml in 10 ml steps. Accurate to \pm 10 ml for 50-100 ml and \pm 10 % (max 75 ml) for 100-2200 ml of the setting to a maximum delivered volume error of 75 ml.		
Inspiratory Time $(\mathbf{T_i})$	0.2 to 5.0 seconds in increments of 0.1 seconds. Accurate to $\pm 10\%$.		
Sensitivity (SENS.)	Flow: 3 to 25 LPM in 1 LPM increments. Accurate to ± 2.0 LPM. Off or 1 to 15 hPa in 1 hPa increments. Accurate to ± 2.5 hPa. 1 BPM to 80 BPM in steps of 1BPM. Accurate to $\pm 10\%$ or 1 BPM which ever is greater.		
Breath Rate (f)			
Pressure (P)	0 to 50 hPa in 1 hPa increments. Accurate to ± 2.5 hPa of the setting once the pressure reaches the setting.		
PEEP	0 and 3 to 20 hPa in 1 hPa increments. Accurate to ± 2.5 hPa.		
Low Pressure (P↓)	1 to 59 hPa in increments of 1 hPa. Activates within ± 2.5 hPa.		
High Pressure (P ↑)	2 to 80 hPa in increments of 1 hPa. Activates within ± 2.5 hPa.		
Flow Acceleration	OFF or ON (Inspiratory Flow \leq 180 lpm) $15\% \text{ to } 55\% \text{ in increments of } 10\%. \text{ Accurate to } \pm 15\% \text{ at } 15\%, \text{ to } \pm 5\% \text{ at } 25\% - 55\%.$		
Expiratory Trigger			
	I		

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$\mathbf{0_2}$ Level $(\mathbf{0_2\%})$ Achieva $\mathbf{PSO_2}$

21% to 100% for tidal volumes greater than or equal to 100 ml, 21% to 70% for tidal volumes less than 100 ml in 1% increments. Accuracy: 50 to 90 ml, 0₂ settings $<=70\%\pm10\%$ 0₂; 100 to 2200 ml, 0₂ settings <50%, $\pm5\%$ 0₂, all other 0₂ settings, \pm 10% of settings.

Supply pressures of less than 355 kPa (45 PSIG) may result in reduced 0_2 performance at some settings. Optimum performance is achieved at 443 kPa (65 PSIG) 0_2 supply pressure. It may take several minutes for the oxygen concentration to stabilize. The capacity of the 0_2 blender is a function of tidal volume and inspiratory time, which in combination influence peak flow. As peak flows increase (i.e. large tidal volumes combined with short inspiratory times), the limit of the 0_2 flow capacity is approached. The set 0_2 concentration cannot be delivered if the flow capacity of the 0_2 blender has been exceeded. To ensure the prescribed oxygen concentration is delivered to the patient, measure the delivered gases with a calibrated oxygen analyzer at all times.

Altitude

0 to 4500 meters in increments of 100 meters (or 0 to 14,760 feet in increments of 328 feet).

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Connectors		
Communications Port	RS-232 connector for Report generator computer, printer or external modem.	
0 ₂ Inlet (Achieva PSO ₂)	9/16 - 18, DISS 1240 THD 3 pin male receptacle for 24 Volt DC input	
External Battery Connector		
Power Entry Module	EIA dual fuse power entry module	
	Provides connections for hot, neutral and grounded conductors.	
	The receptacle incorporates fuses in the hot and neutral lines.	
Inlet Filter	Intake for patient air. Screw off cap for filter change. 98% efficient at 0.3 microns. Port for connection to the proximal pressure line of the patient circuit. 3/16" I.D. tube.	
Patient Pressure Port		
Remote Alarm Connector	Connector for remote alarm	
Nurse Call Connector	Connector for Nurse Call Station	
Patient Air	22mm 0.D./15 mm I.D. ISO Fitting	
Exhalation Valve Port	Port for connection to the exhalation valve of the patient circuit. 1/8" I.D. tube.	

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Sensors			
Primary Pressure			
Purpose	Measures the proximal pressure for use in pressure control and pressure monitoring.		
Location	Proximal		
Туре	Gauge pressure sensor		
Range	-20 hPa to 120 hPa (compensated) Temperature Range: -18°C to $+63^\circ$ C		
Accuracy	±2.5 hPa		
Secondary Pressure			
Purpose	Provides backup pressure measurement for safety reasons.		
Location	Distal		
Туре	Gauge pressure sensor		
Range	1 psi (compensated) Temperature Range: 0°C to +55°C		
Accuracy	±8 hPa		
Oxygen Flow			
Purpose	Measures the amount of oxygen entering the piston chamber during piston retraction.		
Location	Inlet to piston chamber		
Туре	Mass flow sensor		
Range	Range 0 LPM to 180 LPM		
Temperature Range	-25°C to +85°C		
Accuracy	$\pm 3.5\%$ of reading over $+5^{\circ}$ C to $+60^{\circ}$ C		
Condition	Nominal barometric pressure. (Changes in gas density due to changes in altitude are compensated for via the Altitude setting.)		
Primary Flow			
Purpose	Measures the amount of gas discharged from the ventilator's output port.		
Location	Patient output port		
Туре	Mass flow sensor		
Range	0 LPM to 180 LPM		
Temperature Range	-25°C to +85°C		
Accuracy	$\pm 3.5\%$ of reading over $+5^{\circ}\text{C}$ to $+60^{\circ}\text{C}$		
Condition	Nominal barometric pressure. (Changes in gas density due to changes in altitude are compensated for via the Altitude setting.)		
Relative Motor Position	1		
Purpose	Senses the relative motion of the piston drive motor.		
Location	tion Stator of motor		
Туре	pe Hall sensor		
Range	Digital		
	l .		

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Accuracy	NA NA	
Environment		
Operating 5°C to 40°C (41°F to 104°F), 10% to 90% RH.		
Storage	-20°C to 50°C (-4°F to 140°F), 10% to 90% RH.	
	When moving the ventilator from a non-operating to an operating environment, allow a minimum of one hour temperature stabilization before use.	
	When storing the ventilator, the battery must be recharged every thirty days. Storage above or below specified operating temperatures may affect battery life.	

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Miscellaneous			
Maintenance	Preventative maintenance must be preformed by qualified personnel every 6000 operating hours recertification every twelve (12) months, whichever occurs first.		
Dimensions	27.3 X 33.8 X 39.6 cm (10.75" X 13.30" X 15.60")		
Weight	Less than 32lbs.		
Resistance Factor	Maximum of 4.5 hPa @60 LPM		
Compliance Factor	1.25 mL/hPa for A/C breaths 2.50 mL/hPa for Pressure Support breaths		
Emergency Pressure Relief	$90 \pm 10 \text{ hPa}$		
Response time	75 milliseconds (under the following conditions): Resistance $= 5 \text{hPa/L/sec.}$; Compliance $= 50 \text{ml/hPa}$; Breath Rate $= 20 \text{BPM}$; Volume $= 1500 \text{ml}$; Pressure support $= 10 \text{hPa}$; PEEP $= 5 \text{hPa}$. Response time varies inversely with the displayed flow rate, and directly with the selected trigger level.		
Flow	2.0 LPM to 180 LPM		

Achieva ventilators are intended to operate within their specifications if they are properly maintained and the service schedule is followed.

Achieva ventilators are protected against electrostatic discharge of up to eight kilovolts (8 kV). Electrostatic discharge greater than eight kilovolts may damage the ventilator.

Standard compliance

The ventilator complies with the following international agency standards:

- *IEC 601-1 Medical Electrical Equipment, 1988 Part 1: General Requirements for Safety
- IEC 601-1-2 Medical Electrical Equipment, Part 1: General Requirements for Safety, Part 2: Collateral Standard Electromagnetic Compatibility Requirements and Tests
- *CAN/CSA-C22.2 No.601.1-M90 Medical Electrical Equipment Part
 1: General Requirements for Safety
- *UL2601-1 Medical Electrical Equipment, Part I: General Requirements for Safety (1994)

*Classified as Class 1 and internally powered; Type BF; drip proof, not suitable for use in the presence of flammable anesthetics, continuous operation.

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Appendix F: Service

This appendix provides service information and the limited warranty.

Service information

Achieva ventilators are warranted against defects in workmanship and materials. The full text of the warranty provides the 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 Puritan Bennett.

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 void the warranty. Parts and labor costs incurred by the owner will not be reimbursed by 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.

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Limited warranty

Puritan Bennett warrants to the owner that the Achieva ventilator, exclusive of expendable parts and other accessories, shall be free from defects in material and workmanship for twelve 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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Reorder model number Y-102672-UK rev C

This device complies with the requirements of Medical Device Directive 93/42/EEC.

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