Copyright information

COVIDIEN, COVIDIEN with logo, the Covidien logo and positive results for life are U.S. and internationally registered trademarks of Covidien AG. All other brands are trademarks of a Covidien company.

© 2012, 2015 Covidien.

The information contained in this manual is the sole property of Covidien and may not be duplicated without permission. This manual may be revised or replaced by Covidien at any time and without notice. You should ensure that you have the most current applicable version of this manual; if in doubt, contact Covidien’s Technical Support department or visit the product manual web page at:

http://www.covidien.com/rms/sales-support/product-manuals

While the information set forth herein is believed to be accurate, it is not a substitute for the exercise of professional judgment.

The ventilator should be operated and serviced only by trained professionals. Covidien's sole responsibility with respect to the ventilator, and its use, is as stated in the limited warranty provided.

Nothing in this manual shall limit or restrict in any way Covidien's right to revise or otherwise change or modify the equipment (including its software) described herein, without notice. In the absence of an express, written agreement to the contrary, Covidien has no obligation to furnish any such revisions, changes, or modifications to the owner or user of the equipment (including its software) described herein.
Table of Contents

Preface

Purpose of This Manual ........................................................... xi
Qualification of Personnel ......................................................... xi
Warranty ..................................................................................... xi
Extended Service ....................................................................... xi
Technical Support ....................................................................... xii

1 Safety Information

1.1 Definitions .............................................................................. 1-1
1.2 Warnings ................................................................................. 1-1
  1.2.1 Fire Hazard Warnings ......................................................... 1-1
  1.2.2 Warnings About Reducing Infection .................................. 1-2
  1.2.3 Warnings Before Using Equipment .................................... 1-2
  1.2.4 Warnings Regarding Environment of Use .......................... 1-4
  1.2.5 Warnings Regarding Electromagnetic Interference .............. 1-5
  1.2.6 Warnings Regarding Settings ............................................ 1-6
  1.2.7 Warnings Applicable During Use of Equipment ............... 1-8
  1.2.8 Warnings Regarding Electrical Power ............................... 1-10
  1.2.9 Warnings Regarding Oxygen ............................................ 1-12
  1.2.10 Warnings Regarding Hoses and Accessories ................... 1-14
  1.2.11 Warnings Regarding Maintenance .................................. 1-17
  1.2.12 Warnings to Protect the Environment ............................. 1-20
  1.2.13 Warnings Regarding USB Memory Device ..................... 1-20
1.3 Symbols and Markings .......................................................... 1-21
1.4 Labels / Identification and Instruction Information .................. 1-26

2 Ventilator Overview

2.1 Indications for Use ............................................................... 2-1
2.2 Contraindications ................................................................ 2-2
2.3 Operational Use ..................................................................... 2-2
2.4 Device Classification ............................................................. 2-4
2.5 Front Panel .......................................................................... 2-5
2.6 Back Panel ........................................................................... 2-6
2.7 Control Panel ....................................................................... 2-7
2.8 Ventilation Menu .................................................................... 2-8
2.9 Alarm Menu .......................................................................... 2-9
2.10 USB Memory Device Menu .................................................. 2-10
2.11 If Ventilator Failure Occurs .................................................. 2-10
Table of Contents

6.9 Mounting the Ventilator on a Wheelchair .................................................. 6-20
6.10 Mounting the Ventilator on the Utility Cart ............................................. 6-21
6.11 Connecting the Nurse Call Cable ............................................................... 6-23

7 Operating Procedures

7.1 Turning on the Ventilator ................................................................. 7-1
7.2 Setup Menu Parameters ............................................................... 7-5
  7.2.1 Accessing Setup Configuration .............................................. 7-5
  7.2.2 Changing the Setup Menu Parameters ................................ 7-5
  7.2.3 Entering Setup 2 Menu .......................................................... 7-12
  7.2.4 Exiting the Setup Menu .......................................................... 7-15
7.3 Preferences Menu Parameters ............................................................ 7-16
  7.3.1 Preferences Menu ................................................................. 7-16
  7.3.2 Backlight ................................................................................. 7-18
  7.3.3 Contrast .................................................................................... 7-19
  7.3.4 Alarm Volume .......................................................................... 7-19
  7.3.5 Key Sound ................................................................................ 7-20
  7.3.6 Apnea Alarm ............................................................................ 7-21
  7.3.7 Disconnection Alarm ............................................................... 7-21
  7.3.8 Pediatric Circuit ......................................................................... 7-22
  7.3.9 Ventilation Report ...................................................................... 7-22
7.4 Setting the Ventilation Mode ............................................................... 7-23
  7.4.1 Changing Modes While Ventilation is on Standby .................... 7-24
  7.4.2 Changing Modes During Ventilation ....................................... 7-24
7.5 Setting Ventilation Parameters ............................................................ 7-27
  7.5.1 Links between Ventilation Parameters .................................. 7-28
  7.5.2 Links between Ventilation and Alarm Parameters .................... 7-29
7.6 Setting Alarm Parameters ............................................................... 7-29
7.7 USB Menu Parameters ................................................................................. 7-32
  7.7.1 USB Memory Device Specifications ...................................... 7-32
  7.7.2 USB Menu ................................................................................. 7-32
  7.7.3 Transfer Continuously ............................................................ 7-33
  7.7.4 Transfer Trends ................................................................. 7-35
  7.7.5 Erase Data from the USB Memory Device .............................. 7-37
7.8 Locking the Control Panel ............................................................... 7-38
7.9 Unlocking the Control Panel ............................................................... 7-39
7.10 Starting Ventilation ................................................................. 7-39
7.11 Stopping Ventilation ................................................................. 7-41
7.12 Turning Off the Ventilator ............................................................... 7-42
8 Internal Battery

8.1 Battery Capacity .................................................. 8-1
8.2 Battery Operation ................................................. 8-2
8.3 Testing the Battery ............................................... 8-4
8.4 Recharging the Battery ......................................... 8-5
8.5 Storage .............................................................. 8-6

9 Cleaning

9.1 Cleaning the Ventilator ........................................ 9-1
9.2 Cleaning the Accessories ....................................... 9-2
9.3 Cleaning the Ventilator Between Patients ................. 9-2

10 Routine Maintenance

10.1 Replacing the Air Inlet Filter ............................... 10-1
10.2 Recommended Schedule of Maintenance ................. 10-2
10.3 Service Assistance ............................................ 10-4

A Patient/Caregiver Checklist

B Specifications

B.1 Physical ............................................................ B-1
B.2 Electrical ........................................................... B-1
B.3 Indicators and Alarms .......................................... B-3
B.4 Performance ...................................................... B-3
B.4.1 Specifications ................................................... B-3
B.5 Monitored Parameters ......................................... B-4
B.6 Range, Resolution, and Accuracy ......................... B-4
B.7 Environmental .................................................... B-7
B.8 USB ................................................................. B-7
B.9 Pneumatic .......................................................... B-8
B.10 Manufacturer’s Declaration ................................. B-8
B.11 Standards Compliance and IEC Classification .......... B-14

C Theory of Operation

C.1 Architecture ........................................................ C-1
C.2 Operation ............................................................ C-1
# Table of Contents

## D Modes and Breath Types

**D.1 Modes of Ventilation** ....................................................... D-1  
  D.1.1 Assist/Control (A/C) Mode ........................................... D-1  
  D.1.2 CPAP Mode .............................................................. D-1  
  D.1.3 PSV Mode ............................................................... D-1  

**D.2 Breath Types** ............................................................... D-1  
  D.2.1 Pressure Control Breaths in Assist/Control Mode ............................ D-2  
  D.2.2 Pressure Supported Breaths in PSV Mode .................................... D-3  
  D.2.3 CPAP ................................................................. D-3

**D.3 Ventilation Modes and Apnea** ........................................ D-4  

**D.4 Vt Target** ................................................................. D-4

## E Operational Verification Checklist

## F Alarms Tests

**F.1 Low Pressure Test** ...................................................... F-1  
**F.2 Circuit Check Test** ..................................................... F-2  
  F.2.1 Performing a Circuit Check ........................................ F-2  
  F.2.2 Troubleshooting a Failed Check .................................... F-4  
**F.3 Apnea Test** ............................................................. F-5  
**F.4 Power Failure Test** .................................................... F-5  
**F.5 Occlusion Test** ........................................................ F-6  
**F.6 Battery Test** ............................................................ F-7  
**F.7 Involuntary Stop Test** ................................................ F-7

## G Unpacking and Preparation

## H Parts and Accessories

## I Glossary
List of Figures

Figure 1-1. Locations of Labels—Top-Front View ................................................................. 1-27
Figure 1-2. Location of Labels and Markings—Rear View ...................................................... 1-27
Figure 1-3. Location of Labels—Bottom View ................................................................. 1-28
Figure 2-1. Front Panel ....................................................................................................... 2-5
Figure 2-2. Back Panel ....................................................................................................... 2-6
Figure 2-3. Control Panel ................................................................................................... 2-7
Figure 2-4. Ventilation Menu Display ................................................................................ 2-8
Figure 2-5. Alarm Menu ..................................................................................................... 2-9
Figure 2-6. USB Memory Device Menu ............................................................................. 2-10
Figure 3-1. Menus in PSV Mode with Exhalation Valve Configuration ......................... 3-1
Figure 3-2. Menus in PSV Mode with Leakage Configuration ......................................... 3-2
Figure 3-3. Exhalation Trigger Sensitivity ......................................................................... 3-5
Figure 3-4. Menus in CPAP Mode in Leakage Configuration ........................................... 3-8
Figure 3-5. Menus in P A/C Mode with Exhalation Valve Configuration ....................... 3-10
Figure 3-6. Menus in P A/C Mode with Leakage Configuration ....................................... 3-11
Figure 3-7. FiO2 for Oxygen and Ventilator Settings ....................................................... 3-15
Figure 4-1. Ventilation Menu: Pressure Leakage Configuration Modes (CPAP, PSV ST, P A/C) ................................................................. 4-1
Figure 4-2. Ventilation Menu: Pressure Valve Configuration Modes (PSV ST, P A/C) .... 4-2
Figure 4-3. Alarm Menu: Pressure Leakage Modes (CPAP, PSV ST, P A/C) .................. 4-2
Figure 4-4. Alarm Menu: Pressure Valve Modes (PSV ST, P A/C) .................................... 4-2
Figure 4-5. Inspiratory Effort Detected Indicator ............................................................ 4-3
Figure 4-6. Bargraph Display ............................................................................................ 4-4
Figure 4-7. Ventilation Report .......................................................................................... 4-5
Figure 5-1. Alarm Displays .............................................................................................. 5-3
Figure 5-2. Accessing Alarm Log Menu .......................................................................... 5-4
Figure 5-3. Displaying the Alarm Log Screen ................................................................. 5-4
Figure 5-4. Alarm Log Display when No Alarm Activated .............................................. 5-5
Figure 5-5. Pausing the Audible Portion of Alarms .......................................................... 5-6
Figure 5-6. Manually Pausing Alarms .............................................................................. 5-7
Figure 5-7. Reactivating Alarms ...................................................................................... 5-8
Figure 5-8. Alarm Log ....................................................................................................... 5-8
Figure 6-1. The Power Cable Holder .............................................................................. 6-4
Figure 6-2. Inserting the Power Cable Holder Into the Notch ......................................... 6-4
Figure 6-3. Power Cable Connected to the Ventilator .................................................... 6-5
Figure 6-4. Power Indicators .......................................................................................... 6-6
Figure 6-5. Connecting the Ventilator to an External DC Power Source ...................... 6-7
Figure 6-6. Connecting the DC Power Cable to the Ventilator ......................................... 6-8
Figure 6-7. Single-Limb Patient Circuit With Exhalation Valve ...................................... 6-11
Figure 6-8. Close-up of Exhalation Valve Tube and Proximal Pressure Tube ............... 6-11
Figure 6-9. Single-Limb Patient Circuit Without Exhalation Valve ............................... 6-12
Figure 6-10. Air Inlet Filter ............................................................................................. 6-14
Figure 6-11. Bacteria Filter ............................................................................................. 6-14
Figure 6-12. Humidifier ................................................................................................. 6-15
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-37</td>
<td>Enabling the Locking Key</td>
<td>7-39</td>
</tr>
<tr>
<td>7-38</td>
<td>Prompt to Start Ventilation</td>
<td>7-40</td>
</tr>
<tr>
<td>7-39</td>
<td>Starting Ventilation</td>
<td>7-41</td>
</tr>
<tr>
<td>7-40</td>
<td>Stopping Ventilation (1)</td>
<td>7-41</td>
</tr>
<tr>
<td>7-41</td>
<td>Stopping Ventilation (2)</td>
<td>7-42</td>
</tr>
<tr>
<td>8-1</td>
<td>Internal Battery Indicator</td>
<td>8-3</td>
</tr>
<tr>
<td>8-2</td>
<td>Battery Reserve Capacity as a Percentage</td>
<td>8-3</td>
</tr>
<tr>
<td>8-3</td>
<td>Battery Reserve Capacity in Hours and Minutes</td>
<td>8-4</td>
</tr>
<tr>
<td>8-4</td>
<td>Power Indicators When Charging the Battery</td>
<td>8-5</td>
</tr>
<tr>
<td>10-1</td>
<td>Replacing the Air Inlet Filter</td>
<td>10-2</td>
</tr>
<tr>
<td>C-1</td>
<td>Gas Delivery System</td>
<td>C-3</td>
</tr>
<tr>
<td>D-1</td>
<td>Flow Patterns in P A/C Mode</td>
<td>D-2</td>
</tr>
<tr>
<td>D-2</td>
<td>Controlled Machine Breaths in P A/C Mode</td>
<td>D-3</td>
</tr>
<tr>
<td>D-3</td>
<td>Pressure Supported Breaths in PSV Mode</td>
<td>D-3</td>
</tr>
<tr>
<td>D-4</td>
<td>Flow Patterns in CPAP Mode</td>
<td>D-4</td>
</tr>
<tr>
<td>D-5</td>
<td>Target Volume in Pressure Modes</td>
<td>D-5</td>
</tr>
<tr>
<td>F-1</td>
<td>Circuit Check Screen (Before Starting)</td>
<td>F-2</td>
</tr>
<tr>
<td>F-2</td>
<td>Blocking the Patient End of a Single Limb Circuit</td>
<td>F-3</td>
</tr>
<tr>
<td>F-3</td>
<td>Circuit Check (Running)</td>
<td>F-3</td>
</tr>
<tr>
<td>F-4</td>
<td>Circuit Check (Complete, Passed)</td>
<td>F-4</td>
</tr>
<tr>
<td>F-5</td>
<td>Circuit Check (Complete, Failed)</td>
<td>F-4</td>
</tr>
<tr>
<td>F-6</td>
<td>Blocking the Patient End of a Single-Limb Circuit</td>
<td>F-6</td>
</tr>
<tr>
<td>G-1</td>
<td>Puritan Bennett™ 520 Ventilator</td>
<td>G-2</td>
</tr>
<tr>
<td>G-2</td>
<td>Dual Bag</td>
<td>G-3</td>
</tr>
</tbody>
</table>
List of Tables

Table 1-1. Ventilator Symbols ................................................. 1-21
Table 1-2. Ventilator Labels and Markings ................................. 1-26
Table 3-1. Ventilation Parameters in PSV Menu ......................... 3-2
Table 3-2. Alarm Parameters in PSV Mode ............................... 3-3
Table 3-3. Ventilation Parameters in CPAP Menu ....................... 3-8
Table 3-4. Alarm Parameters in CPAP Mode .............................. 3-8
Table 3-5. Ventilation Parameters in PA/C Mode menu ............... 3-11
Table 3-6. Alarm Parameters in PA/C Mode .............................. 3-12
Table 4-1. Displayed Monitored Parameters .............................. 4-3
Table 5-1. Overview of Alarms .............................................. 5-9
Table 5-2. Alarms and Corrective Actions ............................... 5-15
Table 5-3. Additional Troubleshooting and Corrective Actions ........ 5-23
Table 7-1. Languages ......................................................... 7-7
Table 7-2. Trends Data Transfer Time from Ventilator to USB Memory Device ............................... 7-37
Table 8-1. Internal Battery Reserve Capacity ......................... 8-2
Table 9-1. Approved Cleaning Solutions for Exterior Ventilator Surfaces ............................................. 9-2
Table 10-1. Consumables and Replacement Intervals ................ 10-2
Table A-1. Patient/Caregiver Checklist .................................. A-1
Table B-1. Physical Description (Excluding Accessories) ............ B-1
Table B-2. AC Electrical Supply ............................................ B-1
Table B-3. Remote Alarm .................................................... B-2
Table B-4. Internal Lithium Ion Battery ................................ B-2
Table B-5. Power Indicators ............................................... B-3
Table B-6. Alarm Indicators ................................................ B-3
Table B-7. Audio Alarms ..................................................... B-3
Table B-8. Performance Parameter Specifications and Tolerances ........................................... B-3
Table B-9. Monitored Parameter Tolerances ......................... B-4
Table B-10. Ventilator Range, Resolution, and Accuracy .......... B-4
Table B-11. Environmental Conditions for Storage or Transport .... B-7
Table B-12. Environmental Conditions for Operation ............... B-7
Table B-13. USB Memory Device Specifications ................... B-7
Table B-14. Data Transfer Characteristics ............................. B-7
Table B-15. Airway Resistances ........................................... B-8
Table B-16. Air Inlet Resistance (Filter) ................................. B-8
Table B-17. Oxygen Inlet Specifications ................................ B-8
Table B-18. Performance Specifications ................................. B-8
Table B-19. Electromagnetic Emissions ................................ B-8
Table B-20. Electromagnetic Immunity ................................ B-9
Table B-21. Electromagnetic Immunity—Conducted and Radiated RF ................................................ B-11
Table B-22. Recommended Separation Distances ...................... B-12
Table B-23. Compliant Cables and Accessories ....................... B-13
Table D-1. Volume Target Measurements in Pressure Modes .... D-5
Table E-1. Operational Verification Checklist ......................... E-1
<table>
<thead>
<tr>
<th>Table</th>
<th>List of Items</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>List of Consumables and Accessories</td>
<td>H-1</td>
</tr>
<tr>
<td>H-2</td>
<td>List of Circuits</td>
<td>H-3</td>
</tr>
</tbody>
</table>
Preface

Purpose of This Manual

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

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

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

Qualification of Personnel

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

Warranty

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

Extended Service

The Puritan Bennett™ 520 Ventilator offers extended service contracts/warrantees for purchase when the ventilator is purchased. Please contact your local Covidien sales or service representative for additional information.
For online technical support, visit the SolvIT™ Center Knowledge Base by clicking the link at: http://www.covidien.com/rms/sales-support/.
Here, you will find answers to frequently asked questions about the product and other Covidien products 24 hours a day, 7 days a week. If you require further assistance, contact your local Covidien representative.

**Technical Support**

<table>
<thead>
<tr>
<th>Technical Service Contacts:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Covidien Argentina</strong></td>
</tr>
<tr>
<td>Vedia 3616</td>
</tr>
<tr>
<td>Buenos Aires</td>
</tr>
<tr>
<td>Argentina</td>
</tr>
<tr>
<td>Tel: (5411) 4863-5300</td>
</tr>
<tr>
<td>Fax: (5411) 4863-4142</td>
</tr>
<tr>
<td><strong>Covidien Australia</strong></td>
</tr>
<tr>
<td>52A Huntingwood Drive</td>
</tr>
<tr>
<td>Huntingwood, NSW 2148</td>
</tr>
<tr>
<td>Australia</td>
</tr>
<tr>
<td>Telephone (+61) 1800 350702</td>
</tr>
<tr>
<td>Fax +612 9671 8118</td>
</tr>
<tr>
<td><strong>Covidien Austria GmbH</strong></td>
</tr>
<tr>
<td>Campus21</td>
</tr>
<tr>
<td>Europaring F09402</td>
</tr>
<tr>
<td>Brunn am Gebrige</td>
</tr>
<tr>
<td>A-2345 Osterreich</td>
</tr>
<tr>
<td>+43 1 20609 1143</td>
</tr>
<tr>
<td>+43 1 20609 2457</td>
</tr>
<tr>
<td><strong>Covidien Belgie S.A.-N.V.</strong></td>
</tr>
<tr>
<td>Generaal De Wittelaan 9/5</td>
</tr>
<tr>
<td>Mechelen</td>
</tr>
<tr>
<td>2800</td>
</tr>
<tr>
<td>België</td>
</tr>
<tr>
<td>Tel +32 220 08260</td>
</tr>
<tr>
<td>Fax +32 270 06690</td>
</tr>
<tr>
<td><strong>Covidien Brazil</strong></td>
</tr>
<tr>
<td>Praça Agrícola La Paz Tristante, 121 Osasco – São Paulo / CEP 06276-035 São Paulo, SP Brasil</td>
</tr>
<tr>
<td>Tel: +55 11 2187 6543</td>
</tr>
<tr>
<td>Fax: (5511) 2187-6380</td>
</tr>
<tr>
<td><strong>Covidien Chile</strong></td>
</tr>
<tr>
<td>Lo Boza 107</td>
</tr>
<tr>
<td>Pudahuel</td>
</tr>
<tr>
<td>Santiago de Chile, Chile</td>
</tr>
<tr>
<td>Tel: (562) 2739-3000</td>
</tr>
<tr>
<td>Fax: (562) 231-3527</td>
</tr>
<tr>
<td><strong>Covidien Colombia</strong></td>
</tr>
<tr>
<td>Edificio Prados de la Morea</td>
</tr>
<tr>
<td>Carretera Central Del Norte</td>
</tr>
<tr>
<td>(Cra 7A) Kilometro 18,</td>
</tr>
<tr>
<td>Chia-Cundinamarca</td>
</tr>
<tr>
<td>Bogota, Colombia</td>
</tr>
<tr>
<td>Tel: (571) 668-3777</td>
</tr>
<tr>
<td>Fax: (571) 668-3777 x. 181</td>
</tr>
<tr>
<td><strong>Covidien Costa Rica</strong></td>
</tr>
<tr>
<td>Global Park, Parkway 50</td>
</tr>
<tr>
<td>La Aurora, Heredia, 40104</td>
</tr>
<tr>
<td>Costa Rica</td>
</tr>
<tr>
<td>Tel: (506) 2293-4854</td>
</tr>
<tr>
<td>Fax: (506) 2239-9108</td>
</tr>
<tr>
<td><strong>Covidien ECE s.r.o. organizační složka</strong></td>
</tr>
<tr>
<td>Prosek, Prosecká 852/66</td>
</tr>
<tr>
<td>190 00 Praha 9</td>
</tr>
<tr>
<td>Tel:+420 241 095 735</td>
</tr>
<tr>
<td>Fax:+420 239 016 856</td>
</tr>
<tr>
<td><strong>Covidien Danmark A/S</strong></td>
</tr>
<tr>
<td>Langebro ogade 6E, 4. sal</td>
</tr>
<tr>
<td>1411 København K</td>
</tr>
<tr>
<td>Danmark</td>
</tr>
<tr>
<td>Tel +45 43 68 21 71</td>
</tr>
<tr>
<td>Fax:+45 43 31 48 99</td>
</tr>
<tr>
<td><strong>Covidien Deutschland GmbH</strong></td>
</tr>
<tr>
<td>Technisches Service Center</td>
</tr>
<tr>
<td>Raffineriestr. 18</td>
</tr>
<tr>
<td>93333 Neustadt / Donau</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>Tel +49 69 51 709670</td>
</tr>
<tr>
<td>Fax +49 69 29 9571608</td>
</tr>
</tbody>
</table>
## Technical Service Contacts:

<table>
<thead>
<tr>
<th>Company</th>
<th>Address</th>
<th>Phone Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covidien ECE</td>
<td>Galvanio 7/a, 821 04 Bratislava, Slovenska Republika</td>
<td>Tel: +42 124 821 45 73, Fax: +42 124 821 45 01</td>
</tr>
<tr>
<td>Covidien Finland Oy</td>
<td>Rahtitie 3, FI-01530 Vantaa, Finland</td>
<td>Tel: +358 9 725 192 88, Fax: +358 9 725 192 89</td>
</tr>
<tr>
<td>Covidien France SA</td>
<td>Parc d’affaires Technopolis, Bat. Sigma, 3 Avenue du Canada, LP 851 Les Ulis, 91975 Courtaboeuf Cedex France</td>
<td>Tel: +33 1 57 32 35 10, Fax: +33 1 57 32 70 10</td>
</tr>
<tr>
<td>Covidien Italia S.p.A.</td>
<td>Via S.Bovio 3, San Felice, 20090 Segrate (MI), Italy</td>
<td>Tel: +39 02 91483320 (option 3), Fax: +39 02 91294863</td>
</tr>
<tr>
<td>Covidien Japan Inc.</td>
<td>Technical Support Center, 83-1, Takashimadaira 1-Chome, Itabashi-ku, Tokyo 175-0082 Japan</td>
<td>Tel: +81 (0) 3 6859 0120, Fax: +81 (0) 3 6859 0142</td>
</tr>
<tr>
<td>Covidien Nederland BV</td>
<td>Hogeweg 105, 5301 LL Zaltbommel, Nederland</td>
<td>Tel: +31 202061470, Fax: +31 707 709229</td>
</tr>
<tr>
<td>Covidien Norge AS</td>
<td>Postboks 343, 1372 Asker, Norway</td>
<td>Tel: +472415 9887, Fax: +47 2302 4955</td>
</tr>
<tr>
<td>Covidien Polska</td>
<td>Al. Jerozolimskie 162, Warszawa, 02-342 Polska</td>
<td>Tel: +48 22 30 60034, Fax: +48 22 30 60853</td>
</tr>
<tr>
<td>Covidien Portugal Lda.</td>
<td>Estrada do Outeiro de Polina, Lote 10-1º Abóboda, 2785-521 S. Domingos de Rana, Portugal</td>
<td>Tel: +351 21 761 62 44, Fax: +351 800 781385</td>
</tr>
<tr>
<td>Covidien Russia</td>
<td>53 bld. 5 Dubinininskaya Street, Moscow, RUSSIA, 119054 Россия</td>
<td>Tel: +70 495 933 64 69, Fax: +70 495 933 64 68</td>
</tr>
<tr>
<td>Covidien Saglik A.S.</td>
<td>Maslak Mahallesi Bilim Sokak No: 5, Sun Plaza Kat: 2-3, Sisli, Istanbul 34398, Turkey</td>
<td>Tel: +90 212 366 20 00, Fax: +90 212 276 35 25</td>
</tr>
<tr>
<td>Covidien South Africa</td>
<td>Corporate Park North, 379 Roan Crescent, Randjespark, Midrand, South Africa</td>
<td>Tel: +27 115 429 500, Fax: +27 115 429 547</td>
</tr>
<tr>
<td>Technical Service Contacts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Covidien Spain S.L.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servicio Técnico</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WTC Almeda Park</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plaça de la Pau, S/N - Edif. 7, 3ª Planta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08940 Cornellá de Llobregat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcelona, Spain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tel +34 91 275 48 54 (Opción 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax +34 91 276 89 33</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Covidien Sverige AB</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Box 54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>171 74 Solna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tel +46 8 517 615 73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax + 46 8 502 521 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Covidien Switzerland</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roosstr. 53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wollerau</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8832</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schweiz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tel +41 44 511 82 71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax +41 44 511 16 34</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Covidien UK and Ireland</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit 2, Talisman Business Park</td>
<td></td>
<td></td>
</tr>
<tr>
<td>London Road, Bicester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OX26 6HR, United Kingdom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tel +44 20 3027 1757</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax +44 20 3684 8869</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asia: Tyco Healthcare Pte Ltd</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore Regional Service Centre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Pioneer Hub, #06-04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore 627753</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tel (65) 6578 5187 / 8 / 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax (65)6515 5260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email: <a href="mailto:Tech_support@covidien.com">Tech_support@covidien.com</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1 Safety Information

1.1 Definitions

This manual uses three indicators to highlight critical information: Warning, Caution, and Note. They are defined as follows:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Warning Icon] | **WARNING**
Indicates a condition that can endanger the patient or the ventilator operator. |
| ![Caution Icon] | **Caution**
Indicates a condition that can damage the equipment. |
| ![Note Icon] | **Note**
Indicates points of particular emphasis, that make operation of the ventilator more efficient or convenient. |

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

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

1.2 Warnings

1.2.1 Fire Hazard Warnings

![Warning Icon]

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

![Warning Icon]

**WARNING:**
To reduce the risk of a fire hazard, keep matches, lighted cigarettes, and all other sources of ignition (such as flammable anesthetics and/or heaters) away from the ventilator and oxygen hoses.
WARNING: Never expose any batteries to direct flame.

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

1.2.2 Warnings About Reducing Infection

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

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

WARNING: Single Use accessories should not be reused.

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

1.2.3 Warnings Before Using Equipment

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

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

WARNING: The ventilator must be used according to its intended use. Refer to 2.1, “Indications for Use.”
WARNING:
Do not start ventilation until you ensure that the device is suitably assembled, that the air inlet filter is properly installed and is not obstructed, and that there is proper clearance all around the unit. Also ensure that the patient circuit is suitably connected to both the ventilator and the patient and that the patient circuit, including all hoses, is not damaged or obstructed.

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

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

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

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

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

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

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

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

1.2.4 Warnings Regarding Environment of Use

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

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

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

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

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

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

**WARNING:**
If the ventilator has been transported or stored at a temperature that differs more than ±20 °C (±36 °F) from the temperature in which it will be operating, the ventilator should be allowed to stabilize in its operating environment for at least two (2) hours prior to use.

**WARNING:**
If the ambient temperature where the device is operated is greater than 35 °C (95 °F), the flow supplied at the device outlet may exceed 41 °C (106 °F). This may lead to undesirable side effects for the patient. To avoid injury to the patient move the patient and the ventilator to a cooler location.
**WARNING:**
The default setting for altitude compensation is YES. Altitude compensation should always be set to YES for accurate volume delivery calculations at all elevations.

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

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

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

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

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

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

### 1.2.5 Warnings Regarding Electromagnetic Interference

**WARNING:**
The Puritan Bennett™ 520 ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in Appendix B, “Specifications.” In particular, the use of nearby mobile and portable communications...
equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC 60601-1-2 standard, may affect its operation. Refer to section B.10, “Manufacturer’s Declaration.”

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

1.2.6 Warnings Regarding Settings

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

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

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

WARNING:
Alarm volume should be adjusted with respect to the ventilator’s operating environment and so that the patient’s caretakers can hear the alarms. See 7.3.4, “Alarm Volume.”

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

WARNING:
Monitor the patient’s state of health in order to ensure that the ventilator’s settings are always suited to the patient’s current physiological requirements.
WARNING: In adult or pediatric use ensure that the adjusted tidal volume is compatible with the needs of the patient.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WARNING: If the device is damaged, its external housing is not correctly closed, or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.
WARNING:
Handle the ventilator with care during and after use, particularly when ambient temperatures are high. Some ventilator surfaces may become hot, even if safety specifications are not exceeded.

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

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

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

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

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

WARNING:
To avoid damage to the ventilator, in particular the batteries or electrical components, fluids must not be allowed to enter the device, particularly through the air inlet filter or the cooling apertures located in the side, rear, and bottom panels of the ventilator.
**WARNING:**
To ensure correct and lasting operation of the device, ensure that the ventilator is installed and operated in the environmental conditions recommended in Appendix B, “Specifications.”

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

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

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

### 1.2.8 Warnings Regarding Electrical Power

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

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

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

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

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

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

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

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

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

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

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

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

WARNING:
Even if the “INTERNAL BATTERY” charging indicator is off, charging of the battery may sometimes be incomplete if the ambient temperature is above 40 °C (104 °F) because of the battery’s internal heat safety device.
WARNING: When the “LOW BATTERY” alarm is triggered, immediately connect the ventilator to an AC power supply to maintain ventilation and recharge the internal battery.

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

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

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

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

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

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

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

1.2.9 Warnings Regarding Oxygen

WARNING: Oxygen therapy for patients with respiratory failure is a common and effective medical prescription. However, be aware that inappropriate oxygen use may potentially lead to serious complications, including, but not limited to, patient injury.
WARNING:
Strictly follow the instructions provided in section 6.7.2, “Connecting the Oxygen Supply,” which include the use of a special oxygen connector.

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

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

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

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

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

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

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

WARNING:
The coupler must not remain connected to the oxygen connector unless it also connected to a leak-proof, external oxygen gas source. When an oxygen supply is not being used with the ventilator, disconnect the oxygen source completely from the ventilator.
WARNING: To ensure stability, when the Puritan Bennett™ 520 Ventilator is mounted on a cart, the weight of the oxygen bottle should not exceed 14 kg (30 lbs).

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

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

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

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

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

1.2.10 Warnings Regarding Hoses and Accessories

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

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

WARNING: The patient circuit should not be changed during ventilation.

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

WARNING: Single Use accessories should not be reused.

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

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

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

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

WARNING: For pediatric use, ensure that the patient circuit type fits, and, in all respects, is suitable for use with a child. Use a pediatric circuit for patients that weigh under 53 lb. (23 kg). To ensure proper performance of the ventilator, see Table H-2. List of Circuits, on page H-3, for a list of recommended patient circuits.

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

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

WARNING: Always ensure that the humidification device is positioned lower than both the ventilator and the patient. Use water traps, if necessary, to limit water in the patient circuit and periodically empty these water traps.
WARNING:
If a heated humidifier is used, you should always monitor the temperature of the gas delivered to the patient. Gas delivered from the ventilator that becomes too hot may burn the patient’s airway.

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

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

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

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

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

WARNING:
When using non-invasive ventilation (NIV) without an exhalation valve, use a vented nose or face mask or a non vented mask combined with a leak accessory. When using non-invasive ventilation (NIV) with an exhalation valve, use a non-vented mask.
WARNING: Before using the Nurse Call system, ensure that its connections are secure and it operates properly.

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

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

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

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

1.2.11 Warnings Regarding Maintenance

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

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

WARNING: If the ventilator is damaged or its external housing is not correctly closed or it behaves in a way that is not described in this manual (excessive noise, heat emission, unusual odor, alarms not triggered during the start-up procedure), the oxygen and power supplies should be disconnected and use of the device stopped immediately.
WARNING: If the ventilator fails the alarm tests or if you cannot complete the tests, refer to section 5.8, “Troubleshooting” or call your equipment supplier or Covidien.

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

WARNING: Regularly clean the ventilator’s Dual Bag according to manufacturer’s recommendations.

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

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

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

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

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

WARNING: Before cleaning the ventilator, first disconnect the ventilator and the patient circuit. If the ventilator is used indoors, the condition of the air inlet filter should be checked monthly. If the ventilator is used outdoors or in a dusty environment, the filter should be checked weekly and replaced as necessary.
WARNING:
To ensure proper servicing and avoid the possibility of physical injury to personnel or damage to the ventilator, only personnel authorized and qualified by Covidien should attempt to service or make authorized modifications to the Puritan Bennett™ 520 Ventilator.

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

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

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

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

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

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

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

WARNING:
A patient treated by mechanical ventilation is highly vulnerable to the risks of infection. Dirty or contaminated equipment is a potential source of infection. Clean the ventilator and its accessories regularly and systematically before and after each use and following any maintenance procedure to reduce the risks of infection.
WARNING:
Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. If necessary, replace the filter before the recommended replacement period is over (see Chapter 10, “Routine Maintenance”). This is particularly important when the ventilator is installed on a wheelchair, because environmental conditions may cause the filter to become dirty more rapidly.

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

1.2.12 Warnings to Protect the Environment

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

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

1.2.13 Warnings Regarding USB Memory Device

WARNING:
Always verify the file ID before using a USB memory device to transfer data between the ventilator and a PC.
### 1.3 Symbols and Markings

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

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Checkmark" /></td>
<td>This symbol appears on the ventilator’s front panel ENTER key; see Figure 2-3. on page 2-7, item 5. This key is used to confirm command actions.</td>
</tr>
<tr>
<td><img src="image" alt="Alarm" /></td>
<td>This symbol appears on the ventilator’s front panel ALARM CONTROL key; see Figure 2-3. on page 2-7, item 2. This key is used to: cancel the audible portion of alarms for 60 seconds at a time; cancel an alarm. For more information, see Appendix F, Alarms Tests.</td>
</tr>
<tr>
<td><img src="image" alt="Menu" /></td>
<td>This symbol appears on the ventilator’s front panel MENU key; see Figure 2-3. on page 2-7, item 7. This key is used to access the ventilator’s menus via the ventilator’s front panel LCD display.</td>
</tr>
<tr>
<td><img src="image" alt="Ventilation ON/OFF" /></td>
<td>This symbol (IEC 60417– 5009) appears on the ventilator’s front panel VENTILATION ON/OFF button; see Figure 2-3. on page 2-7, item 8. This key is used to Start and Stop ventilation.</td>
</tr>
<tr>
<td><img src="image" alt="To Patient" /></td>
<td>To patient port. This symbol appears on the front right of the ventilator, adjacent to the To Patient port; see Figure 1-1. , item 1.</td>
</tr>
<tr>
<td><img src="image" alt="Patient Proximal Pressure" /></td>
<td>Patient proximal pressure port. This symbol appears on the front right of the ventilator, adjacent to the To Patient port; see Figure 1-1. on page 1-27, item 3 and Figure 1-3. on page 1-28.</td>
</tr>
<tr>
<td><img src="image" alt="Exhalation Valve Pilot" /></td>
<td>Exhalation valve pilot port. This symbol appears on the front right of the ventilator, adjacent to the To Patient port indicating the connection of the tubing between the patient circuit exhalation valve; see Figure 1-1. on page 1-27, and Figure 1-3. on page 1-28, item 3.</td>
</tr>
<tr>
<td><img src="image" alt="Oxygen Inlet" /></td>
<td>Oxygen inlet. This marking appears on the back panel of the ventilator, adjacent to the oxygen inlet port; see Figure 1-2. on page 1-27, item 2.</td>
</tr>
<tr>
<td><img src="image" alt="Nurse Call" /></td>
<td>Nurse Call connector. This symbol appears on the back panel of the ventilator, adjacent to the nurse call connector; see Figure 1-2. on page 1-27, item 10.</td>
</tr>
<tr>
<td><img src="image" alt="Switch Off" /></td>
<td>Switch in “Off” position (IEC 60417-5008). This symbol appears on the I/O (power on/off) switch on the back panel of the ventilator to indicate the switch’s “Off” position. See Figure 2-2. on page 2-6, item 2.</td>
</tr>
<tr>
<td><img src="image" alt="Switch On" /></td>
<td>Switch in “On” position (IEC 60417-5007). This symbol appears on the I/O (power on/off) switch on the back panel of the ventilator to indicate the switch’s “On” position. See Figure 2-2. on page 2-6, item 2.</td>
</tr>
<tr>
<td><img src="image" alt="Software Lock" /></td>
<td>Software Lock Enabled. This symbol appears on the upper-left of the ventilator’s LCD display when the keyboard Locking Key is enabled; see 7.8, “Locking the Control Panel.”</td>
</tr>
<tr>
<td>Symbols</td>
<td>Descriptions</td>
</tr>
<tr>
<td>---------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| ![Internal Battery](image) | Internal Battery.  
This symbol appears on the top-center of ventilator's LCD display to indicate that the ventilator is being powered by its internal battery. See Figure 2-4, on page 2-10, item 1 and Chapter 8, “Internal Battery,” for more information. |
| ![Pressure rise time](image) | Pressure rise time (inspiratory phase) parameter.  
These symbols appear on the ventilation mode menu screens. For more information, see 3, “Operating Parameters.” In pressure ventilation modes, you can select one of four rise times with setting 1 representing the fastest rise time and setting 4 representing the slowest. |
| ![Selected line](image) | Selected line (filled square).  
When making menu choices, this graphic indicates the line on which the cursor is currently positioned. | Figure 7-15, “Selecting the Preferences Menu,” on page 7-16. |
| ![Non-selected line](image) | Non-selected line (empty square).  
When making menu choices, this graphic indicates a line on which the cursor is currently not positioned. |
| ![Locked parameter line](image) | Locked parameter line.  
When making menu choices, this graphic indicates a line that cannot be selected (the Locking Key is enabled). |
| ![Active parameter line](image) | Active parameter line.  
When making menu choices, this graphic indicates that the current parameter is selected and can be changed. See Chapter 7, “Operating Procedures.” |
| ![Inspiratory Effort Detected](image) | Inspiratory Effort Detected.  
This symbol appears in the front panel display’s Status window when the patient triggers a breath. |
| ![Parameter adjustment bar](image) | Parameter adjustment bar.  
This graphic shows the current setting for parameters such as display contrast and alarm volume in the Preferences menu. See 7.3, Preferences Menu Parameters. |
| ![WEEE](image) | WEEE (Waste Electrical and Electronic Equipment).  
This symbol means that this product must not be disposed of with household waste. Observe local ordinances for proper disposal. See Table 1-2, item 4. |
| ![Year of Manufacture](image) | Year of Manufacture. |
| ![Manufacturer](image) | Manufacturer. |
| ![Audio Paused](image) | Audio Paused (alarm key once).  
This symbol means the sounding of audible alarms is currently disabled. This period lasts for 60 seconds. For more information, see 5.4, “Pausing the Audible Portion of Alarms.” |
### Table 1-1. Ventilator Symbols (Continued)

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Descriptions</th>
</tr>
</thead>
</table>
| ![Alarm Paused](image) | Alarm Paused (alarm key twice).  
This symbol means one or more alarms have been paused, or reset/canceled. The alarm is paused until the alarm condition is corrected and the condition reoccurs. For more information, see 5.5, “Pausing/Resetting Alarms.” |
| ![Alarm Off](image) | Alarm Off (Apnea Off).  
This symbol means that the Apnea Alarm has been set to OFF in the Preference menu. For more information, see 5.5, “Pausing/Resetting Alarms.” |
| ![Exhalation Valve detected](image) | Exhalation Valve detected.  
This symbol means that an exhalation valve has been detected during ventilation. |
| ![No Exhalation Valve detected](image) | No Exhalation Valve detected.  
This symbol means that no exhalation valve has been detected during ventilation. |
| ![Follow instructions for use](image) | Follow instructions for use (ISO 7000-1641).  
This symbol directs the user to observe and adhere to the instructions contained in the product’s user manuals. |
| ![USB port](image) | USB port.  
This symbol indicates a communications port for interfacing with a USB connector. See Figure 1-2, item 9. |
| ![PC connector](image) | PC connector.  
This symbol indicates a port that can be used by authorized Puritan Bennett product service personnel or Covidien service personnel for software maintenance. See Figure 1-2, item 8. |
<p>| <img src="image" alt="Atmospheric pressure limitation" /> | Atmospheric pressure limitation. |
| <img src="image" alt="Humidity limitations" /> | Humidity limitations. |
| <img src="image" alt="Temperature limitations" /> | Temperature limitations. |
| <img src="image" alt="Fragile" /> | Fragile. |</p>
<table>
<thead>
<tr>
<th>Symbols</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Keep dry" /></td>
<td>Keep dry.</td>
</tr>
<tr>
<td><img src="image" alt="Keep away from direct sunlight" /></td>
<td>Keep away from direct sunlight.</td>
</tr>
<tr>
<td><img src="image" alt="This side up" /></td>
<td>This side up.</td>
</tr>
</tbody>
</table>
1.4 Labels / Identification and Instruction Information

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

Table 1-2. Ventilator Labels and Markings

<table>
<thead>
<tr>
<th>#</th>
<th>Label Description</th>
<th>Figure References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patient Gas Inlet Label</td>
<td>1-2, 1-3</td>
</tr>
<tr>
<td>2</td>
<td>Oxygen Inlet Marking and Label</td>
<td>1-2</td>
</tr>
<tr>
<td>3</td>
<td>Exhalation Valve and Patient Pressure Connection Label</td>
<td>1-2, 1-3</td>
</tr>
<tr>
<td>4</td>
<td>Air Inlet Label</td>
<td>1-2</td>
</tr>
<tr>
<td>5</td>
<td>Identification Label</td>
<td>1-3</td>
</tr>
<tr>
<td>6</td>
<td>AC Power (Mains) Cable Connector Marking</td>
<td>1-2</td>
</tr>
<tr>
<td>7</td>
<td>External Cable Connector Marking</td>
<td>1-2</td>
</tr>
<tr>
<td>8</td>
<td>PC Connection marking</td>
<td>1-2</td>
</tr>
<tr>
<td>9</td>
<td>USB Port marking</td>
<td>1-2</td>
</tr>
<tr>
<td>10</td>
<td>Nurse Call Cable Connector Marking</td>
<td>1-2</td>
</tr>
</tbody>
</table>
Note:
The item number callouts in the following figures refer to those listed in *Table 1-2*.

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

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

2.1 Indications for Use

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

Target Patients

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

- Positive Pressure ventilation
- Assist/Control, PSV, or CPAP modes of ventilation
- Breath types including Pressure Control and Pressure Support

Target Environments

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

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

WARNING:

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

**Target Operators**

The ventilator may be operated by:
- respiratory therapists
- doctors
- nurses
- homecare providers
- patient and patient’s families

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

**WARNING:**

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

**WARNING:**

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

### 2.2 Contraindications

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

### 2.3 Operational Use

The Puritan Bennett™ 520 Portable Ventilator uses a micro-turbine to provide ventilatory support to patients. Clinicians may use a variety of interfaces to connect patients to the ventilator for continuous or intermittent ventilatory support. Some examples include mouthpieces; nasal masks or full face masks; endotracheal tubes or tracheotomy tubes. User-selectable ventilation modes are:
- Assisted Controlled Pressure (P A/C)
- Continuous Positive Airway Pressure (CPAP)
• Pressure Support Ventilation with apnea ventilation (PSV/ST)

**Safety Net**

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

⚠️ **WARNING:**

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

**Settings**

A software key, known as the “Locking Key,” restricts access to ventilation parameter settings and ventilation mode changes in order to distinguish between “clinician” usage and “patient” usage (see section 7.8, “Locking the Control Panel” on page 7-38).

**Oxygen Enrichment**

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

⚠️ **WARNING:**

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

⚠️ **WARNING:**

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

⚠️ **WARNING:**

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

**Breathing Circuit**

The ventilator is used with a single-limb patient circuit. For more information, see section 6.4, “Patient Circuit” on page 6-8.
2.4 Device Classification

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

- protection/insulation class (electric shock): Class II
- protection index of enclosure: IP31
- medical device directive classification: II B
- degree of protection against risk of electric shock: BF
- power: external (AC – mains, or DC – cigarette lighter) or internal (DC – battery)
- operation mode: continuous operation

For additional information, see Appendix B, “Specifications.”
2.5 Front Panel

**Figure 2-1. Front Panel**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>LCD Display</strong> – Displays information about the ventilator including patient hours and software version, ventilation modes and settings, and monitored and calculated patient data. The display also allows the user to view and, using the Control Panel, adjust the ventilator's operating and alarm configuration settings.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Control Panel</strong> – Features the controls for setting up and operating the ventilator, and LEDs to indicate the ventilator’s power source, ventilation On/Off status, and alarm priority level. Control functions include turning on and off the ventilation, configuring ventilation modes, pausing audible alarms, canceling alarms, and setting device and alarm parameters.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Patient Connection Port</strong> – Provides an outlet for the gas to be delivered to the patient via the patient circuit.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Patient Pressure Monitoring Port</strong> – Nipple for monitoring proximal patient pressure.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Exhalation Valve Port</strong> – Nipple for providing piloting pressure to the exhalation valve. Controls the open-closed position of the exhalation valve.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Lateral and Front Openings</strong> – Vents that allow for air circulation to cool the ventilator’s internal components. In addition, these openings function as sound ports for audible alarms. <strong>WARNING:</strong> Do not cover or obstruct these openings.</td>
</tr>
</tbody>
</table>
### 2.6 Back Panel

#### Figure 2-2. Back Panel

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ergonomic carrying handle.</td>
</tr>
</tbody>
</table>
| 2 | On/Off (I/O) switch with protective cover:  
Device powered on in position I; device switched off in position 0. |
| 3 | AC power ("Mains") cable connector. |
| 4 | AC power ("Mains") cable holding system:  
Secures AC power cable to avoid accidental disconnection. |
| 5 | Access cover for the internal battery. |
| 6 | DC power cable connector with key. |
| 7 | PC Cable Connector:  
USB mini-B connector used for Puritan Bennett™ Ventilator Test Software. |
| 8 | O₂ Inlet Port:  
Connects the ventilator to a low pressure oxygen source via an adapter connected to the O₂ Inlet (see section 6.7.1, "Administering Oxygen" on page 6-16). |
| 9 | Nurse Call Output Connector:  
Used to connect the ventilator to the nurse call system. |
| 10 | USB Memory Device connection:  
USB connection to be used with Puritan Bennett™ Respiratory Insight Software. There are two USB type A ports. |
| 11 | Air Inlet Filter:  
Filters air as it enters the ventilator. |

**WARNING:**

Do not cover or obstruct these openings.
### 2.7 Control Panel

#### Figure 2-3. Control Panel

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alarm indicators (two LEDs):&lt;br&gt;Red indicator:&lt;br&gt;• Continuous: Very High Priority (VHP) alarm activated&lt;br&gt;• High priority (HP) alarm activated.&lt;br&gt;Yellow indicator:&lt;br&gt;• Medium priority (MP) alarm activated.</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>ALARM CONTROL key:&lt;br&gt;• Press once to pause an audible alarm for 60 seconds.&lt;br&gt;• Press twice to halt visual and audible alarms. If alarm is remedied, the alarm is canceled (other than the high pressure alarm).</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Display screen:&lt;br&gt;Display of modes, ventilation settings, patient data, configuration of the ventilator and alarm management.</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>UP Key:&lt;br&gt;• Moves the cursor up and increases parameter values.</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>ENTER key:&lt;br&gt;• Access to a setting value and validation of the modification of this setting.&lt;br&gt;• Access to a sub-menu.</td>
<td>10</td>
</tr>
</tbody>
</table>
2.8 Ventilation Menu

**Figure 2-4. Ventilation Menu Display**

<table>
<thead>
<tr>
<th>1</th>
<th>General information line: Displays the current ventilation mode, along with the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Battery symbol if the device is powered by the internal battery.</td>
</tr>
<tr>
<td></td>
<td>• Audio paused symbol if an alarm is currently inhibited.</td>
</tr>
<tr>
<td></td>
<td>• Alarm paused symbol if an alarm has been canceled manually and the cause of the alarm remains.</td>
</tr>
<tr>
<td></td>
<td>• Apnea Alarm deactivation.</td>
</tr>
<tr>
<td></td>
<td>• Exhalation valve symbol.</td>
</tr>
<tr>
<td></td>
<td>• No exhalation valve symbol.</td>
</tr>
<tr>
<td></td>
<td>• Absolute ABS symbol.</td>
</tr>
<tr>
<td></td>
<td>• Relative REL symbol.</td>
</tr>
</tbody>
</table>

| 2 | Ventilation settings: Displays the specific ventilation parameter values for the currently selected ventilation mode. See Chapter 3, “Operating Parameters” for more information. |

| 3 | Preferences menu access line: Highlight this line and press the ENTER key to display the Preferences menu. See manual section 7.3, “Preferences Menu Parameters” on page 7-16 for more information. |

| 4 | Bargraph: Displays pressure generation during ventilation. |

<table>
<thead>
<tr>
<th>5</th>
<th>Status/monitored data window:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Ventilation stopped (Standby): displays the message, “PRESS TO START VENTILATION.”</td>
</tr>
<tr>
<td></td>
<td>• Ventilation on: parameters are monitored and displayed.</td>
</tr>
<tr>
<td></td>
<td>• The Inspiratory Effort Detected symbol appears adjacent to the monitored I:E ratio when the patient actively triggers a breath.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6</th>
<th>Alarm conditions window:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• For Active alarms, scrolls through active alarm messages in flashing reverse video.</td>
</tr>
<tr>
<td></td>
<td>• For Inactive alarms, displays the last alarm along with its trigger date and end-of-event time. See Chapter 5, “Alarms and Troubleshooting” for details.</td>
</tr>
</tbody>
</table>
### 2.9 Alarm Menu

#### Figure 2-5. Alarm Menu

**Alarm menu with ventilation on standby.**

<table>
<thead>
<tr>
<th>Alarm menu with ventilation on standby.</th>
<th>Alarm menu when not in standby.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.jpg" alt="Alarm Menu" /></td>
<td><img src="image.jpg" alt="Alarm Menu" /></td>
</tr>
</tbody>
</table>

**Alarm menu with ventilation on standby.**

1. **Title line:**
   - Displays ventilation mode and the following symbols:
     - Battery [ ] symbol if the ventilator is powered by the internal battery.
     - Audio paused [ ] if an alarm is currently inhibited.
     - Alarm paused [ ] if an alarm has been canceled manually and the cause of the alarm remains.
     - Apnea Alarm deactivation [ ].
     - Exhalation valve [ ] symbol.
     - No exhalation valve [ ] symbol.

2. **Alarm settings:**
   - Displays the specific alarm parameter values for the currently selected ventilation mode, which are:
     - Min and Max alarm threshold settings, and
     - Current monitored patient readings, or hyphen (-) when ventilation is in standby.

3. **Access line to Alarm Log menu.**
   - Highlight this line and press the ENTER key to display the Alarm Logs menu.
   - See manual section 5.3, "Alarm Log Menu" on page 5-1.

4. **Status/monitored data window:**
   - Ventilation stopped (Standby): displays the message, "PRESS TO START VENTILATION."
   - Ventilation on: parameters are monitored and displayed.
   - The Inspiratory Effort Detected symbol [ ] appears adjacent to the monitored I:E ratio when the patient actively triggers a breath.

5. **Alarm message window:**
   - For Active alarms, scrolls through active alarm messages in flashing reverse video.
   - For Inactive alarms, displays the last alarm along with its trigger date and end-of-event time.
   - See Chapter 5, "Alarms and Troubleshooting" for details.
2.10 **USB Memory Device Menu**

![USB Memory Device Menu Diagram]

1 Title line  
2 Ventilator serial number  
3 USB Memory Device Menu  
4 Dialog box

2.11 **If Ventilator Failure Occurs**

If a problem with the ventilator is suspected, FIRST CHECK THAT THE PATIENT IS NOT IN DANGER. If necessary, remove the patient from the ventilator and provide an alternate means of ventilation. Keep in mind that troubleshooting information is available in this manual to assist you in the event of a problem. See Chapter 5, "Alarms and Troubleshooting."

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

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

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

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

Note:
Before choosing settings for operating parameters and alarms, be sure to carefully review the Warnings Regarding Settings. See section 1.2, “Warnings” on page 1-1.

3.1 PSV Mode Parameters and Setting Ranges

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

Figure 3-1. Menus in PSV Mode with Exhalation Valve Configuration
The ventilation parameters and setting ranges available in PSV mode are listed in *Table 3-1.*

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Adjustment Resolution</th>
<th>Default Value</th>
<th>Linked Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Support</td>
<td>cmH₂O, mbar or hPa</td>
<td>Standby: 2</td>
<td>Standby: 55</td>
<td>1</td>
<td>15</td>
<td>PEEP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valve configuration: 5</td>
<td>Valve configuration: 55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leak configuration: 6</td>
<td>Leak configuration: 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEEP</td>
<td>cmH₂O, mbar or hPa</td>
<td>Standby: OFF</td>
<td>20</td>
<td>1</td>
<td>OFF</td>
<td>P Support Max P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valve configuration: OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leak configuration: 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise Time</td>
<td>–</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>I Time</td>
</tr>
<tr>
<td>I Sens</td>
<td>–</td>
<td>0P</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>E Sens¹</td>
<td>%</td>
<td>5 (-95)</td>
<td>95 (-5)</td>
<td>5</td>
<td>Auto</td>
<td>–</td>
</tr>
<tr>
<td>Backup R</td>
<td>bpm</td>
<td>4</td>
<td>40</td>
<td>1</td>
<td>13</td>
<td>Min I Time</td>
</tr>
<tr>
<td>Apnea Time</td>
<td>s</td>
<td>1</td>
<td>60</td>
<td>1</td>
<td>Auto</td>
<td>Backup R</td>
</tr>
<tr>
<td>Vt Target</td>
<td>ml</td>
<td>50</td>
<td>2000</td>
<td>10</td>
<td>OFF = 100</td>
<td>–</td>
</tr>
<tr>
<td>Min I Time</td>
<td>s</td>
<td>0.1</td>
<td>2.8</td>
<td>0.1</td>
<td>Auto</td>
<td>Max I Time</td>
</tr>
<tr>
<td>Max P</td>
<td>mbar</td>
<td>8</td>
<td>55</td>
<td>1</td>
<td>Pi + 3</td>
<td>–</td>
</tr>
<tr>
<td>Max I Time</td>
<td>s</td>
<td>0.8</td>
<td>3</td>
<td>0.1</td>
<td>Auto</td>
<td>Min I Time</td>
</tr>
</tbody>
</table>

¹. See Chapter 7, “Operating Procedures” for information on positive and negative E Sens settings.
Table 3-2. lists the available alarm settings in PSV mode.

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Adjustment Resolution</th>
<th>Default Value</th>
<th>Linked Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min VTI</td>
<td>ml</td>
<td>30</td>
<td>2000</td>
<td>10</td>
<td>300</td>
<td>Max VTI</td>
</tr>
<tr>
<td>Max VTI</td>
<td>ml</td>
<td>80</td>
<td>3000</td>
<td>10</td>
<td>2000</td>
<td>Min VTI</td>
</tr>
<tr>
<td>Max Leak (with leak configuration)</td>
<td>lpm</td>
<td>5</td>
<td>200</td>
<td>5</td>
<td>OFF</td>
<td>-</td>
</tr>
<tr>
<td>Max Rtot</td>
<td>bpm</td>
<td>10</td>
<td>70</td>
<td>1</td>
<td>OFF</td>
<td>Backup R</td>
</tr>
</tbody>
</table>

**P Support—Pressure Support**

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

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

When Relative Pressure is set to OFF in the Setup Menu, P Support allows you to determine inspiratory Absolute pressure.

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

**PEEP—Positive End Expiratory Pressure**

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

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

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

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

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

**Rise Time**

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

The different levels available are as follows:

- Rise time $1 = 200$ ms
- Rise time $2 = 400$ ms
- Rise time $3 = 600$ ms
Rise time $\mathcal{G} = 800 \text{ ms}$

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

**I Sens—Inspiratory Trigger Sensitivity**

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

The sensitivity levels decrease from 0P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

- **I Sens 0 (P)** = Bias flow + (0.4 lpm to 0.6 lpm) (P = Pediatric use)
- **I Sens 1 (P)** = Bias flow + (0.4 lpm to 0.8 lpm) (P = Pediatric use)
- **I Sens 2** = Bias flow + (0.7 lpm to 1.3 lpm)
- **I Sens 3** = Bias flow + (0.9 lpm to 1.5 lpm)
- **I Sens 4** = Bias flow + (1.0 lpm to 1.6 lpm)
- **I Sens 5** = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO$_2$).

The inspiratory trigger is initiated after a time delay of between 300 ms to 2000 ms, depending on the preceding peak inspiratory flow.

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

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

**E Sens—Exhalation Sensitivity**

E sens is available in PSV mode.

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

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

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

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

*Figure 3-3. Exhalation Trigger Sensitivity*

![Exhalation Trigger Sensitivity Diagram]

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

**Backup R**

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

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

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

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

Backup R breath is delivered at the Pressure Support settings.

Setting a Backup Rate is not optional; it is always set.
3.1.1 Apnea Time

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

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

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

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

**Note:**
If the Apnea Alarm is set to OFF in the Preferences Menu, the Apnea Time setting will still be active.

**Vt Target—TARGET TIDAL VOLUME**

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

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

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

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

**Max P—MAXIMUM INSPIRATION PRESSURE**

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

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

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

**Min and Max I Time—MINIMUM / MAXIMUM INSPIRATION TIME**

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

Min I Time defines the minimum duration of time the inspiratory phase is maintained. It takes priority over activation of the exhalation trigger which can only be triggered after the Min I Time has expired.
The Backup R is linked to the Min I Time so that the Min I Time setting cannot be greater than half the inspiratory phase of a cycle triggered by the ventilator.

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

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

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

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

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

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

It is possible to set a minimum and/or maximum Tidal Volume alarm threshold for the patient’s inspired tidal volume during a cycle.

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

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

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

**Max Leak (Max Alarm Settings)**

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

Max Leak is displayed when ventilating without an exhalation valve.

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

**Max Rtot (Max Alarm Setting)—TOTAL BREATH RATE**

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

The alarm setting is used to trigger the “HIGH RATE” alarm. See Chapter 5, “Alarms and Troubleshooting.”
Operating Parameters

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

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

### 3.2 CPAP Mode Parameters and Setting Ranges

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

![Figure 3-4: Menus in CPAP Mode in Leakage Configuration](image)

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

**Table 3-3. Ventilation Parameters in CPAP Menu**

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Adjustment Resolution</th>
<th>Default Value</th>
<th>Linked Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>cmH₂O, mbar or hPa</td>
<td>4</td>
<td>20</td>
<td>1</td>
<td>10</td>
<td>Pi</td>
</tr>
<tr>
<td>Apnea Time²</td>
<td>s</td>
<td>1</td>
<td>60</td>
<td>1</td>
<td>Auto</td>
<td>Backup R</td>
</tr>
</tbody>
</table>

² Not available if Apnea Alarm is set to OFF in Preferences Menu.

**Table 3-4. Alarm Parameters in CPAP Mode**

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Adjustment Resolution</th>
<th>Default Value</th>
<th>Linked Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min VTI</td>
<td>ml</td>
<td>30</td>
<td>2,000</td>
<td>10</td>
<td>300</td>
<td>Max VTI</td>
</tr>
<tr>
<td>Max VTI</td>
<td>ml</td>
<td>80</td>
<td>3,000</td>
<td>10</td>
<td>2,000</td>
<td>Min VTI</td>
</tr>
<tr>
<td>Max Leak</td>
<td>lpm</td>
<td>5</td>
<td>200</td>
<td>5</td>
<td>OFF</td>
<td>-</td>
</tr>
<tr>
<td>Max Rtot</td>
<td>bpm</td>
<td>10</td>
<td>70</td>
<td>1</td>
<td>OFF</td>
<td>Backup R</td>
</tr>
</tbody>
</table>
WARNING:  
The CPAP mode does not provide a set respiratory rate. Do not use this mode if it is not appropriate for the patient’s condition.

Note:  
Only leak configuration is available in CPAP mode.

PEEP—Positive End Expiratory Pressure

PEEP allows you to determine the level of pressure maintained during the exhalation phase.
The ventilation mode can be adjusted without PEEP (PEEP is nearly 0 mbar when set to “OFF”).
A PEEP value can be set to determine the level of pressure maintained during the inspiratory phase and the exhalation phase.

Apnea Time

Apnea time allows the user to monitor and detect interruptions to the patient’s spontaneous breathing pattern. The ventilator declares apnea when no breath has been delivered by the time that the operator-selected apnea interval elapses.
The Apnea Time “AUTO” setting is 30 seconds.
Apnea Time is not available if Apnea Alarm is set to OFF in the Preferences Menu.

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

It is possible to set a Min and/or Max Tidal Volume alarm threshold for the patient’s inspired tidal volume during a cycle.
This setting is used to trigger an alarm if the Tidal volume inspired by the patient is lower than the minimum threshold set (“LOW VTI” alarm) or greater than the maximum threshold set (“HIGH VTI” alarm). See Chapter 5, “Alarms and Troubleshooting.”
Min VTI and Max VTI are related, and their settings must be set to values that maintain a minimum difference of 20 ml between the two.
It is not mandatory to set the minimum and maximum VTI alarm limits. When the minimum and maximum VTI alarm limits are not set, the display will read “OFF” for these settings.

Max Leak (Max Alarm Settings)

The setting of a high leakage threshold enables a “HIGH LEAKAGE” alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasite leakage flow observed during the exhalation phase.
It is not mandatory to set the maximum LEAK alarm limit. When the maximum LEAK alarm limit is not set, the display will read “OFF” for these settings.

Max Rtot (Max Alarm Setting)—TOTAL BREATH RATE

The maximum rate threshold set is used to warn of hyperventilation or ventilator autotriggering.
The alarm setting is used to trigger the “HIGH RATE” alarm. See Chapter 5, “Alarms and Troubleshooting.”

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

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

**I Sens—INSPIRATORY TRIGGER SENSITIVITY**

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

**E Sens—EXHALATION TRIGGER SENSITIVITY**

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

### 3.3 P A/C Mode Parameters and Setting Ranges

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

**Figure 3-5.** Menus in P A/C Mode with Exhalation Valve Configuration
The Ventilation parameters adjustable in P A/C mode are listed in Table 3-5.

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Adjustment Resolution</th>
<th>Default Value</th>
<th>Linked Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pi</td>
<td>cmH₂O, mbar or hPa</td>
<td>Standby: 2 Valve configuration: 5 Leak configuration: 6</td>
<td>Standby: 55 Valve configuration: 55 Leak configuration: 30</td>
<td>1</td>
<td>15</td>
<td>PEEP</td>
</tr>
<tr>
<td>PEEP</td>
<td>cmH₂O, mbar or hPa</td>
<td>Standby: OFF Valve configuration: OFF Leak configuration: 4</td>
<td>20</td>
<td>1</td>
<td>OFF</td>
<td>Pi</td>
</tr>
<tr>
<td>Rise Time</td>
<td>–</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>Rate</td>
</tr>
<tr>
<td>Rate</td>
<td>bpm</td>
<td>1</td>
<td>60</td>
<td>1</td>
<td>13</td>
<td>Max Rtot</td>
</tr>
<tr>
<td>Insp Time</td>
<td>s</td>
<td>0.3</td>
<td>6.0</td>
<td>0.1</td>
<td>1.5</td>
<td>Rate</td>
</tr>
<tr>
<td>I Sens</td>
<td>–</td>
<td>OFF</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Vt Target</td>
<td>ml</td>
<td>50</td>
<td>2000</td>
<td>10</td>
<td>OFF</td>
<td>Min VTI Max VTI</td>
</tr>
<tr>
<td>Max P</td>
<td>cmH₂O, mbar or hPa</td>
<td>8</td>
<td>55</td>
<td>1</td>
<td>Pi + 3</td>
<td>Pi PEEP</td>
</tr>
</tbody>
</table>
Table 3-6. lists the adjustable alarm parameters in P A/C mode.

<table>
<thead>
<tr>
<th>Name</th>
<th>Units</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Adjustment Resolution</th>
<th>Default Value</th>
<th>Linked Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min VTI</td>
<td>ml</td>
<td>30</td>
<td>2,000</td>
<td>10</td>
<td>300</td>
<td>Max VTI</td>
</tr>
<tr>
<td>Max VTI</td>
<td>ml</td>
<td>80</td>
<td>3,000</td>
<td>10</td>
<td>2000</td>
<td>Min VTI</td>
</tr>
<tr>
<td>Max Leak (leakage configuration)</td>
<td>ml</td>
<td>5</td>
<td>200</td>
<td>5</td>
<td>OFF</td>
<td>-</td>
</tr>
<tr>
<td>Max Rtot</td>
<td>bpm</td>
<td>10</td>
<td>70</td>
<td>1</td>
<td>OFF</td>
<td>Rate</td>
</tr>
</tbody>
</table>

**Pi—Inspiratory Pressure**

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

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

When Relative Pressure is set to OFF in the Setup Menu, Pi allows you to determine inspiratory Absolute pressure.

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

**PEEP—Positive End Expiratory Pressure**

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

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

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

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

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

**Rise Time**

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

The different levels available are as follows:

\[
\text{Rise time } 1 = 200 \text{ ms} \\
\text{Rise time } 2 = 400 \text{ ms}
\]
Rise time $\sqrt[3]{3} = 600$ ms

Rise time $\sqrt[4]{4} = 800$ ms

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

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

- Rise Time $\sqrt[1]{1}$ is always possible.
- Rise Time $\sqrt[2]{2}$ is established only if Insp Time $\geq 0.7$ seconds.
- Rise Time $\sqrt[3]{3}$ is established only if Insp Time $\geq 0.9$ seconds.
- Rise Time $\sqrt[4]{4}$ is established only if Insp Time $\geq 1.1$ seconds.

**Rate—RESPIRATORY RATE**

Rate allows you to define the minimal frequency of mandatory ventilator breaths. If the patient actuates the inspiration trigger, Total Rate may increase.

**InspTime—INSPIRATORY TIME**

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

**I Sens—INSPIRATORY TRIGGER SENSITIVITY**

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

The sensitivity levels decrease from 0P to 5: the lower the number, the more sensitive the trigger sensitivity. These levels correspond to differences in flow compared to the bias flow.

- I Sens 0 (P) = Bias flow + (0.4 lpm to 0.6 lpm) (P = Pediatric use)
- I Sens 1 (P) = Bias flow + (0.4 lpm to 0.8 lpm) (P = Pediatric use)
- I Sens 2 = Bias flow + (0.7 lpm to 1.3 lpm)
- I Sens 3 = Bias flow + (0.9 lpm to 1.5 lpm)
- I Sens 4 = Bias flow + (1.0 lpm to 1.6 lpm)
- I Sens 5 = Bias flow + (1.2 lpm to 1.8 lpm)

The bias flow consists of turbine flow through the patient circuit, during the exhalation phase, that helps the patient avoid rebreathing exhaled gas (CO₂).
The inspiratory trigger is initiated after a time delay of between 300 ms to 2,000 ms, depending on the preceding peak inspiratory flow. Sens can be set to OFF.

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

Vt Target—TARGET TIDAL VOLUME
Vt Target allows the ventilator to deliver a target volume of air to the patient.

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

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

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

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

Max P—MAXIMUM INSPIRATION PRESSURE
Max P allows the ventilator to adjust the inspiratory pressure up to a maximum limit in order to reach the Target Tidal Volume. (Vt Target)

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

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

VTI (Min and/or Max Alarm Settings)—INSPIRATORY TIDAL VOLUME
It is possible to set a Min and/or Max Tidal Volume alarm threshold for the patient’s inspired tidal volume during a cycle.

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

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

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

Max Leak
The setting of a high leakage threshold enables a “HIGH LEAKAGE” alarm to be triggered in the event the calculated leakage flow exceeds this limit. The displayed value corresponds to the mean parasite leakage flow observed during the exhalation phase.
Max Rtot (Max Alarm Setting)—TOTAL BREATH RATE

The maximum rate threshold setting is used to warn of hyperventilation or autotriggering of the ventilator. This setting is used to trigger the “HIGH RATE” alarm. See Chapter 5, “Alarms and Troubleshooting.”

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

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

3.4 FiO₂ For Various Oxygen and Ventilator Settings

Figure 3-7. FiO₂ for Oxygen and Ventilator Settings

Inhalation flow (LPM) = Volume (L) x 60 / Inspiratory time (S)

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

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

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

In addition to the display of monitored ventilation parameters, ventilation is displayed graphically, by the pressure bar chart, in the ventilation parameters setting menu.

Note:
To monitor patient Oxygen levels use an external sensor/alarm.

4.1 Digital Monitoring

The ventilation parameters monitored or calculated are highlighted in each of the main menus:
- Ventilation menu (Figure 4-1, Figure 4-2)
- Alarm menu (Figure 4-3, Figure 4-4)

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

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

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

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

During each inspiration phase triggered by the patient, the Inspiratory Effort Detected symbol is displayed beside the cycling I:E ratio in the ventilation or alarm menus (see Figure 4-5). The patient triggers the ventilator by inhaling the amount of flow and the ventilator responds by delivering either a pressure-based or volume-based breath.

Figure 4-5. Inspiratory Effort Detected Indicator

4.1.2 Displayed Monitored Parameters

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

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

![Bargraph Display](image)

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

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

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

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

![Ventilation Report](VEN_10863_A)

**Note:**
The values displayed in the Ventilation Report are reinitialized when the software is updated or the patient hours counter is reset to zero.

The following data are displayed in the Ventilation Report:

**Vent Time—Ventilation Time**
The ventilation duration data are based on the patient counter and shows the total ventilation time in hours and minutes over the previous 24 hour period.

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

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

**Paw—Peak Airway Pressure**
The Peak Airway Pressure is the average peak pressure during the inspiratory phase, measured by each cycle and over the previous 24 hour period.

**Rate—Respiratory Rate**
The Respiratory Rate is the average of the total respiratory frequency of the patient and the ventilator measured over the previous 24 hour period.
**Leak**

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

**Al—Apnea Index**

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

**Apnea Ti—Apnea Time**

Accumulated apnea time over the previous 24 hour period.

**Spont Cyc—Spontaneous Cycling**

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

**Machine**

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

**Patient**

Total time in hours and minutes that the current patient has been ventilated.
5 Alarms and Troubleshooting

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

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

**WARNING:**
Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. The audible alarm vents located at the front of the device should never be obstructed. See section 7.3.4, “Alarm Volume” on page 7-19.

The alarms or faults generated by your Puritan Bennett™ 520 Ventilator are classified into two categories:
- Ventilation (or utilization) alarms
- Technical faults

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

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

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

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

**Note:**
All configurable alarm settings are recorded in the ventilator's non-volatile internal memory, and are retained when powering down or in the event of a total loss of power.
Technical faults do not directly affect machine operation. Therefore, the user is not alerted to technical faults. Only authorized and trained technicians may consult the maintenance menu (see the Puritan Bennett™ 520 Ventilator Service Manual).

5.1 Alarm Level of Priority

The alarm hierarchy for signaling the level of alarm criticality is listed below.

- **Very High Priority (VHP): Immediate critical situation; ventilation is impossible:**
  Continuous Sound Signaling / With or Without Continuous Red LED Illumination / With or Without Message / With or Without Display Lighting (it is possible for an alarm condition to occur that may not have both a message and lighting).

- **High Priority (HP): Critical situation in the short term; ventilation is potentially compromised:**
  High Speed Intermittent Sound Signaling / Flashing Red LED Illumination / With Message / With Display Lighting

- **Medium Priority (MP): Critical situation in the long term; ventilation is not affected in the short term:**
  Medium Speed Intermittent Sound Signaling / Flashing Yellow LED Illumination / With Message / With Display Lighting

**Note:**
There are currently no Low Priority (LP) Alarms.

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

5.2 Alarm Display

During operation, when an alarm is activated:

- One of the red or yellow alarm indicators to the left of the ALARM CONTROL key illuminates and flashes.
- An alarm tone sounds.
- A message is displayed and flashes in reverse video at the bottom of the Ventilation Menu or Alarm Menu.
There are currently no Low Priority (LP) Alarms.

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

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

All alarms are recorded in the ventilator’s non-volatile internal memory at the time of activation, and are retained when powering down or in the event of a total loss of power. The Alarm Log menu is used to display the last eight (8) alarms activated, along with their date and time of activation.

To access the Alarm Log menu, do the following:

1. Press the **MENU** key to access the alarm setting menu (if this is not the menu currently displayed).
2. Press the **DOWN** key until the cursor is on the “Alarm Log” line at the bottom of the page. The display appears as follows:

   ![Figure 5-2. Accessing Alarm Log Menu](image)

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

   ![Figure 5-3. Displaying the Alarm Log Screen](image)

**Note:**
When no alarm has been activated, “NO DATA” is displayed on the screen (see Figure 5-4.)
Pausing the Audible Portion of Alarms

For more information on the "USER’S CLEAR ALERTS" line, see section 5.6, “Reactivating Alarms” on page 5-7.

To dismiss the Alarm Log screen manually:

Press the ENTER key when the cursor is on the “Back" line.

The Alarm Log screen is dismissed automatically:

- after 15 seconds if no keyboard action is detected
- when a High Priority alarm is triggered

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

5.4 Pausing the Audible Portion of Alarms

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

To pause the audible portion of activated alarms:

Press the ALARM CONTROL key.

- The audible portion of all activated alarms is paused.
- The visual portions (light indicator and message) of activated alarms remain visible.
- The Audio Paused symbol is displayed at the top right of the screen while the audio pause function is active.
If several alarms are activated at the same time, pressing the **ALARM CONTROL** key affects all current alarms.

**The audible portion of activated alarms is automatically reactivated:**
- after 60 seconds, if the cause(s) of the alarm(s) persist(s)
- whenever a new alarm is activated

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

### 5.5 Pausing/Resetting Alarms

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

**WARNING:**
Alarm volume should be adjusted with respect to the ventilator's operating environment and so that the patient's caretakers can hear the alarms. The audible alarm vents located at the front of the device should never be obstructed. See section 7.3.4, “Alarm Volume” on page 7-19.

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

**To manually pause an alarm, proceed as follows:**

Press the **ALARM CONTROL** key twice.
- The alarm is paused until the alarm condition is corrected and the condition reoccurs; the audible portion, light indicator, and message are all halted (for the alarms that can be paused manually).
The Alarm Paused symbol is displayed at the top right of the Ventilation and Alarms screens. See Figure 5-6.

Figure 5-6. Manually Pausing Alarms

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

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

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

5.6 Reactivating Alarms

Alarms that have been paused and whose activation conditions continue to exist can be reacti-vated.

To reactivate alarms, proceed as follows:

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

2. Press the DOWN key to position the cursor on the “Alarm Log” line, if this is not already the case. See Figure 5-7.
3. Press the **ENTER** key, to confirm access to the “Alarm Log” menu.

4. Press the **UP** key to position the cursor on the "USER'S CLEAR ALERTS" line. See Figure 5-8.

5. Press the **ENTER** key for at least three (3) seconds. The following events occur:
   - A “beep” sounds.
   - An audible alarm sounds.
   - An alarm indicator illuminates.
   - The messages of all active alarms are displayed in a loop in the Ventilation and Alarm menus.
   - The Audio Paused symbol disappears (if it was displayed).
   - The Alarm Paused symbol disappears.
5.7 Overview of Alarms

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

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

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

### Table 5-1. Overview of Alarms

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Cause/Ventilator Response</th>
<th>Priority</th>
<th>Audio Paused Avail.</th>
<th>Alarm Paused Avail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC POWER DISCONNECTION</td>
<td>Cut-off of the AC (mains) power supply. Alarm activation occurs:</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>• After 5 seconds if ventilation is stopped</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• At the start of a ventilation cycle when ventilation is in progress.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consequence: the ventilator will automatically switch to external DC power supply if present; if not, to the internal battery.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APNEA</td>
<td>No inspiratory trigger detected by the ventilator after the apnea time set in PSV and CPAP, modes. Automatically clears itself after two successive patient breaths.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes – except for CPAP</td>
</tr>
<tr>
<td>BATTERY FAULT1 RESTART/SRVC</td>
<td>Ventilator has detected an internal battery fault. Consequence: the internal battery is disabled from use.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>BATTERY FAULT2 RESTART/SRVC</td>
<td>No internal battery detected.</td>
<td>MP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>BUZZER FAULT1 RESTART/SRVC</td>
<td>Defective operation of the buzzers.</td>
<td>MP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>BUZZER FAULT2 RESTART/SRVC</td>
<td>Failure detected in the Very High Priority buzzer. Consequence: no audible alarm in case of POWER SUPPLY LOSS alarm.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>BUZZER FAULT3 RESTART/SRVC</td>
<td>Battery Charge Failure due to incorrect voltage. Contact your service representative for assistance.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table 5-1. Overview of Alarms (Continued)

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Cause/Ventilator Response</th>
<th>Priority</th>
<th>Audio Paused Avail.</th>
<th>Alarm Paused Avail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUZZER LOW BATTERY</td>
<td>Buzzer Battery Failure. The Battery Buzzer Voltage is too low. Internal technical problem that prevents the battery from sounding the POWER SUPPLY LOSS alarm.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CHECK BATTERY CHARGE</td>
<td>Internal battery charging failure. Consequence: charging of the internal battery impossible.</td>
<td>MP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>CHECK EXH VALVE*</td>
<td>Inspired tidal volume during exhalation &lt; 20% of Inspired tidal volume and Inspired tidal volume &gt; 20 mL. Exhalation valve obstructed.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>CHECK PROXIMAL LINE1*</td>
<td>1. Loss of signal from the proximal pressure sensor. Consequence: switch to internal pressure sensor for the pressure measurement. Alarm activation occurs: In the event of signal loss (1): After one ventilation cycle or In the event of signal loss (2) and after the 17th breath cycle: After 17 seconds for P A/C mode, or after the maximum time between 17 seconds and Apnea Time + 4 seconds for CPAP and PSV mode.</td>
<td>MP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>CHECK REMOTE ALARM</td>
<td>Failure of ventilator remote alarm relay circuit.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CHECK SETTINGS</td>
<td>Alarm activation occurs: • Systematically after software versions have changed. • Loss of memorized parameters Consequence: • Locking Key disabled • Out-of-range settings are replaced by their default values</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CONNECT VALVE OR CHANGE PRESS</td>
<td>No exhalation valve connected with PEEP set to less than 4 mbar or Pi set to more than 30 mbar when relative pressure is set to OFF.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>CONTROLLED CYCLES</td>
<td>The ventilator is delivering apnea ventilation at set back up rate.</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
### Table 5-1. Overview of Alarms (Continued)

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Cause/Ventilator Response</th>
<th>Priority</th>
<th>Audio Paused Avail.</th>
<th>Alarm Paused Avail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOLING FAN RESTART/SRVC</td>
<td>Ventilator cooling fan operating speed not suited to the internal ambient temperature of the device.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DC POWER DISCONNECTION</td>
<td>Cut-off of the external DC power supply. Consequence: switch-over to the internal battery.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DEVICE FAULT3 RESTART/SRVC</td>
<td>Failure in the 24 V power supply.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>DEVICE FAULT5 RESTART/SRVC</td>
<td>Detection of a fault in the electrical power supply system. Alarm activation occurs: Once the ventilator is on for at least 3 seconds, and a power supply fault is detected for at least 5 seconds thereafter. Consequence: the internal battery capacity is not displayed beside the battery symbol.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DEVICE FAULT7 RESTART/SRVC</td>
<td>Detection of a fault in internal voltage measurement.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>DEVICE FAULT9 RESTART/SRVC</td>
<td>POST RAM Error. RAM Read/Write does not match memory setting.</td>
<td>VHP</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>DEVICE FAULT10 RESTART/SRVC</td>
<td>POST FLASH Checksum Error. Startup FLASH computed checksum does not match memory setting.</td>
<td>VHP</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>DEVICE FAULT11 RESTART/SRVC</td>
<td>POST EEPROM Error. Startup EEPROM does not match memory setting.</td>
<td>VHP</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>DEVICE FAULT12 RESTART/SRVC</td>
<td>POST Reference Voltage Error. 5V or 10V reference voltage error.</td>
<td>VHP</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>DEVICE FAULT13 RESTART/SRVC</td>
<td>Software Version Error</td>
<td>VHP</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>EMPTY BATTERY</td>
<td>Internal battery capacity &lt; 10 min. or 3%. (battery voltage &lt; 22.5V) Consequence: ventilation comes to a halt.</td>
<td>HP</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>HIGH / LOW BATTERY TEMP*</td>
<td>Battery temperature out of tolerance. Consequence: battery charging stops.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HIGH INT TEMP COOL VENT*</td>
<td>Device internal ambient temperature out of tolerance range.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HIGH LEAKAGE</td>
<td>The LEAK estimated by the ventilator exceeds the Max LEAK alarm threshold.</td>
<td>MP</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table 5-1. Overview of Alarms (Continued)

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Cause/Ventilator Response</th>
<th>Priority</th>
<th>Audio Paused Avail.</th>
<th>Alarm Paused Avail.</th>
</tr>
</thead>
</table>
| **HIGH PRESSURE**      | • In PSV, CPAP or P A/C, modes, if Inspiratory Pressure is higher than (P Support or P Control + PEEP) + 5 mbar up to 29 mbar or + 10 mbar over 30 mbar during three consecutive cycles.  
• In PSV or CPAP mode and P Support is set to off, if Inspiratory Pressure is higher than PEEP + 10 mbar during three consecutive cycles.  
Alarm activation occurs:  
• After three consecutive breaths.  
Consequence:  
• Switch to exhalation phase.  
### Note:  
When alarm condition clears, alarm priority indicator must be manually reset by pressing the key.  
(The visual portion of the alarm may be paused) | HP       | Yes                           | No       |
| **HIGH RATE**          | Rate measured greater than Max Rtot set during three consecutive breaths.  
Alarm activation occurs:  
• After three consecutive breaths. | MP       | Yes                           | No       |
| **HIGH VTI**           | Inspired tidal volume greater than Max VTI set during three consecutive breaths in PSV, CPAP, and P A/C modes.  
Alarm activation occurs:  
• After three consecutive breaths. | HP       | Yes                           | No       |
| **INTENTIONAL VENT STOP** | Ventilation has been stopped voluntarily by the caregiver or patient. | HP       | Yes                           | Yes       |
| **KEYPAD FAULT RESTART/SRVC** | Keyboard key held down for more than 45 seconds. | HP       | No                           | No       |
| *IF PERSISTS RESTART/SRVC* |                                                |          |                                |          |
| **LOW BATTERY**        | Internal battery capacity < 30 min. or 8%.                                                | HP       | Yes                           | No       |
| **LOW VTI**            | Inspired tidal volume less than Min VTI set during three consecutive breaths in PSV, CPAP and P A/C modes.  
Alarm activation occurs:  
• After three consecutive breaths. | MP       | Yes                           | No       |
| **NO PROXIMAL LINE2**  | Proximal pressure < 0.6 mbar for 100 ms during inspiration phase of third breath cycle.  
Ventilator response: Switch to internal pressure sensor for pressure measurement. | MP       | Yes                           | No       |
| *IF PERSISTS RESTART/SRVC* |                                                |          |                                |          |
| **OCCLUSION CHECK CIRCUIT** | Occurs in VALVE configuration when the tidal volume is measured below 20 mL during three consecutive breaths for PSV, CPAP, and P A/C modes.  
Alarm activation occurs after three consecutive breaths; if tidal volume is less than 20 mL. | HP       | Yes                           | No       |
### Table 5-1. Overview of Alarms (Continued)

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Cause/Ventilator Response</th>
<th>Priority</th>
<th>Audio Paused Avail.</th>
<th>Alarm Paused Avail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCCLUSION CHECK CIRCUIT</td>
<td>Occurs in LEAK configuration when the LEAK level is not sufficient to flush the CO₂ from patient exhalation. The built-in LEAK in the mask may be obstructed. The built-in leak for the mask is not sufficient for the settings.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>PATIENT DISCONNECTION*</td>
<td>Alarm activation occurs if conditions remain for the maximum time between: • disconnection time and 60/R-Rate in P A/C mode • disconnection time and (Apnea time +2 sec) in CPAP and PSV mode If the flow is greater than 130 lpm during the inspiratory phase. In PSV, CPAP, and P A/C modes if patient pressure is lower than (P Support + PEEP) - 20% or (Pi + PEEP) - 20%.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>POWER FAULT RESTART/ SRVC</td>
<td>Detection of a fault in the electrical power supply system.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>POWER SUPPLY LOSS (no message)</td>
<td>1. Electrical power supply to the machine is interrupted with the I/O switch when ventilation is in progress or 2. Battery fully discharged when it was the only source of power to the ventilator. Consequence: ventilation stops immediately. Ventilation restarts immediately when the switch is pressed in case 1 (above) or after restoration of the AC or DC supply in case 2 (above).</td>
<td>VHP</td>
<td>No—Alarm Cancel Only</td>
<td>No—Alarm Cancel Only</td>
</tr>
<tr>
<td>PRES SENS FLT1 RESTART/ SRVC</td>
<td>Faulty internal pressure sensor signal. Alarm activation occurs: • After 15 seconds.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>PROX SENS FLT2 RESTART/SRVC</td>
<td>Faulty proximal pressure sensor signal. Alarm activation occurs: • After 15 seconds.</td>
<td>MP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>REMOVE VALVE CPAP MODE</td>
<td>The ventilation settings are not compatible with the type of patient circuit used. Remove exhalation valve to start CPAP ventilation.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>REMOVE VALVE OR CHANGE PRES</td>
<td>The ventilation settings are not compatible with the type of patient circuit used. With a valve circuit, the difference between Pi and PEEP should not be less than 5 mbar.</td>
<td>HP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SOFTWARE VERSION ERROR</td>
<td>Detection of a wrong software version.</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
5.8 Troubleshooting

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

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

### 5.8.1 Alarms

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

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

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

**Note:**
The ventilator screen must be unlocked before setting and parameters can be changed.
### Table 5-2. Alarms and Corrective Actions

<table>
<thead>
<tr>
<th>Alarm Message or Symptom</th>
<th>Possible Reason(s) For The Alarm Event</th>
<th>Corrective Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC POWER DISCONNECTION</td>
<td>AC (&quot;mains&quot;) power source cut off.</td>
<td>Cancel the alarm then check the supply cable and/or the effective availability of a voltage on the AC power (&quot;mains&quot;) port.</td>
</tr>
<tr>
<td></td>
<td>Starting with 12 – 30 VDC external power supply.</td>
<td>Cancel the alarm.</td>
</tr>
<tr>
<td></td>
<td>Current-limiting fuse of the device blown.</td>
<td>Replace the ventilator and call for the maintenance technician.</td>
</tr>
<tr>
<td>APNEA</td>
<td>Patient’s breathing effort less than the Sensitivity control setting.</td>
<td>Ensure the patient is breathing and adjust the inspiratory setting appropriately based on patient’s respiratory needs.</td>
</tr>
<tr>
<td></td>
<td>Patient apnea.</td>
<td>Examine the patient for breathing effort and stimulate if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If patient status has changed adjust the ventilator settings based on patient’s respiratory needs.</td>
</tr>
<tr>
<td></td>
<td>Defective sensors.</td>
<td>Have a qualified technician replace the defective component(s) and call your customer service representative.</td>
</tr>
<tr>
<td>BATTERY FAULT1 RESTART/SRVC</td>
<td>Battery problem that prevents it from operating.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td>BATTERY FAULT2 RESTART/SRVC</td>
<td>Internal battery missing or not detected.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td>BUZZER FAULT1 RESTART/SRVC</td>
<td>Defective operation of the buzzers. Consequence: no audible tone when an alarm is activated.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td>BUZZER FAULT2 RESTART/SRVC</td>
<td>Internal technical problem that prevents the very high priority &quot;POWER SUPPLY LOSS&quot; alarm from triggering.</td>
<td>Ensure that the protective cover over the I/O switch located on the rear of the device is intact and functioning properly. This cover helps prevent accidental pressing of the I/O switch and stoppage of the ventilation. Ensure that the device is stabilized. Call your customer service representative.</td>
</tr>
<tr>
<td>BUZZER FAULT3 RESTART/SRVC</td>
<td>Internal technical problem that prevents the battery from correctly charging.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td>BUZZER LOWBATTERY</td>
<td>Internal technical problem that prevents the battery warning buzzer from sounding POWER SUPPLY LOSS alarm.</td>
<td>Connect the ventilator to an AC power source and power on using the I/O switch located on the rear of the ventilator. Allow the ventilator to charge for a minimum of 15 minutes and up to 2 hours. If alarm persists, restart ventilator to see if alarm clears. If not, contact Covidien or a local Covidien representative.</td>
</tr>
<tr>
<td>CHECK BATTERY CHARGE</td>
<td>Battery charging impossible.</td>
<td>Do not disconnect the ventilator from the AC power supply. Ensure that the power cable is installed according to the instructions in Chapter 6, &quot;Installation and Assembly,&quot; so that the power cable cannot be involuntarily disconnected. In the event the internal battery capacity is low, use an alternate device to ventilate the patient. Call your customer service representative.</td>
</tr>
</tbody>
</table>
### Table 5-2. Alarms and Corrective Actions (Continued)

<table>
<thead>
<tr>
<th>Alarm Message or Symptom</th>
<th>Possible Reason(s) For The Alarm Event</th>
<th>Corrective Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK EXH VALVE*</td>
<td>Obstruction or abnormal damage of the exhalation valve.</td>
<td>Clean or replace the exhalation valve and/or its control tube.</td>
</tr>
<tr>
<td>*IF PERSISTS RESTART/SRVC</td>
<td>Excessive moisture in the exhalation valve.</td>
<td>Remove moisture from exhalation valve.</td>
</tr>
<tr>
<td></td>
<td>Verify exhalation valve is seated properly.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduce temperature of the humidifier.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defective connection or defective exhalation valve tubing.</td>
<td>Reconnect the valve or replace the exhalation valve and/or the exhalation valve pilot pressure tube.</td>
</tr>
<tr>
<td></td>
<td>Defective inspiratory flow sensor.</td>
<td>Have a qualified technician replace the defective component(s) and call your customer service representative.</td>
</tr>
<tr>
<td>CHECK EXH VALVE PRESSURE</td>
<td>The exhalation valve may not be detected by the ventilator when ventilation is started.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td></td>
<td>Or the exhalation valve may be falsely detected when ventilation is started.</td>
<td></td>
</tr>
<tr>
<td>CHECK PROXIMAL LINE1*</td>
<td>No connection of the proximal pressure tube when ventilation starts.</td>
<td>Reconnect the proximal pressure line.</td>
</tr>
<tr>
<td>*IF PERSISTS RESTART/SRVC</td>
<td>Proximal pressure line disconnected or obstructed.</td>
<td>Reconnect the connection line or replace it if obstructed.</td>
</tr>
<tr>
<td></td>
<td>Check for moisture or occlusion of the proximal line.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduce humidifier temperature.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Switch to a heated wire circuit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defective proximal pressure sensor or internal leak of the machine.</td>
<td>Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) and call your customer service representative.</td>
</tr>
<tr>
<td>CHECK REMOTE ALARM</td>
<td>Nurse Call or remote alarm system is disconnected.</td>
<td>Connect the Nurse Call or remote alarm cable to the ventilator.</td>
</tr>
<tr>
<td></td>
<td>Relay control voltage problem.</td>
<td>Carefully monitor the patient to detect possible alarm triggering and call for the maintenance technician.</td>
</tr>
<tr>
<td>CHECK SETTINGS</td>
<td>Loss of memorized parameters.</td>
<td>Check and adjust the prescribed parameters, if necessary.</td>
</tr>
<tr>
<td></td>
<td>Software versions have changed.</td>
<td>Check and adjust the prescribed parameters, if necessary.</td>
</tr>
<tr>
<td>CONNECT VALVE OR CHANGE PRESS</td>
<td>The ventilation settings are not compatible with the type of patient circuit used.</td>
<td>Connect exhalation valve.</td>
</tr>
<tr>
<td></td>
<td>No exhalation valve connected with PEEP set to less than 4 mbar or Pi set to more than 30 mbar when relative pressure is set to OFF.</td>
<td>Decrease Pi to less than 30 mbar in absolute pressure.</td>
</tr>
<tr>
<td></td>
<td>Increase PEEP to more than 3 mbar.</td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td>Always consult the clinician before changing PEEP, pressure or Rate settings.</td>
<td></td>
</tr>
<tr>
<td>CONTROLLED CYCLES</td>
<td>The ventilator is delivering apnea ventilation at set back up rate.</td>
<td>Check that the patient circuit is correctly attached and the patient is correctly ventilated.</td>
</tr>
<tr>
<td>COOLING FAN RESTART/SRVC</td>
<td>Operating speed of the cooling fan not properly adjusted for the internal ambient temperature of the device.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td>Alarm Message or Symptom</td>
<td>Possible Reason(s) For The Alarm Event</td>
<td>Corrective Action(s)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>DC POWER DISCONNECTION</strong></td>
<td>12 – 30 VDC power supply cut off when there is no AC (&quot;mains&quot;) power supply.</td>
<td>Cancel the alarm then check the supply wiring and/or the effective availability of voltage on the external source.</td>
</tr>
<tr>
<td></td>
<td>Ventilator’s current-limiting fuse blown.</td>
<td>Replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT3 IF PERSISTS RESTART/ SRVC</strong></td>
<td>24 V supply failure.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULTS IF PERSISTS RESTART/ SRVC</strong></td>
<td>Internal problem in the electrical power supply.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT7 IF PERSISTS RESTART/ SRVC</strong></td>
<td>Internal technical problem.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT9 IF PERSISTS RESTART/ SRVC</strong></td>
<td>POST RAM Error. RAM Read/Write does not match memory setting.</td>
<td>If patient has been disconnected, reconnect patient to reset the fault. If persists restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT10 IF PERSISTS RESTART/ SRVC</strong></td>
<td>POST FLASH Checksum Error. Startup FLASH computed checksum does not match memory setting.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT11 IF PERSISTS RESTART/ SRVC</strong></td>
<td>POST EEPROM Error. Startup EEPROM does not match memory setting.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT12 IF PERSISTS RESTART/ SRVC</strong></td>
<td>POST Reference Voltage Error. 5V or 10V reference voltage error.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>DEVICE FAULT13 IF PERSISTS RESTART/ SRVC</strong></td>
<td>Incorrect software version detected.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>EMPTY BATTERY</strong></td>
<td>Internal battery capacity is less than 10 min. (or 3%) — battery operation overextended.</td>
<td>Reconnect the device to an AC power outlet, connect it to an external DC power source, or replace the battery. Reminder: the internal battery can be charged only when the ventilator connected to an AC power supply.</td>
</tr>
</tbody>
</table>
### Table 5-2. Alarms and Corrective Actions (Continued)

<table>
<thead>
<tr>
<th>Alarm Message or Symptom</th>
<th>Possible Reason(s) For The Alarm Event</th>
<th>Corrective Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH INT TEMP COOL VENT</td>
<td>Internal ambient temperature of the device out of the tolerance ranges.</td>
<td>Note: &lt;br&gt;Ensure that you are operating the ventilator within the proper temperature range (see Appendix B, “Specifications”). &lt;br&gt;Put the device in a warmer environment (if the ambient temperature is too low) or in a cooler environment (if the ambient temperature is too high). For example, ensure the ventilator is not in direct sunlight or next to an air conditioning vent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WARNING: &lt;br&gt;In the case of high ambient temperatures, it may take a significant period of time to cool the internal temperature of the ventilator to the proper operating range. To avoid injury to the patient, ensure that the air inspired by the patient does not exceed 41 °C (106 °F). If in doubt, replace the ventilator.</td>
</tr>
<tr>
<td></td>
<td>Defective internal temperature probe or any other technical anomaly.</td>
<td>Replace the ventilator and call your customer service representative.</td>
</tr>
</tbody>
</table>
Table 5-2. Alarms and Corrective Actions (Continued)

<table>
<thead>
<tr>
<th>Alarm Message or Symptom</th>
<th>Possible Reason(s) For The Alarm Event</th>
<th>Corrective Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH/LOW BATTERY TEMP*</td>
<td>Battery temperature out of the tolerance ranges.</td>
<td>Caution: Ensure that ventilator is being used according to the operating instructions found in Appendix B, “Specifications.” If the ambient temperature is too low, place the device in a warmer environment. If the ambient temperature is too high, place the ventilator in a cooler environment. For example, ensure the ventilator is not in direct sunlight or next to an air conditioning vent. The temperature fault alarm does not interfere with the operation of the ventilator.</td>
</tr>
<tr>
<td>*IF PERSISTS RESTART/ SRVC</td>
<td>Defective internal temperature probe or any other technical anomaly inside the battery.</td>
<td>WARNING: In case of operation in a high ambient temperature, handle the ventilator with care; some portions of the device may have high surface temperatures. Restart ventilator to see if alarm clears. If the alarm message persists, please contact technical services.</td>
</tr>
<tr>
<td>HIGH LEAKAGE</td>
<td>The LEAK estimated by the ventilator exceeds the Max LEAK alarm threshold.</td>
<td>Caution: Do not attempt to charge a defective battery; such a battery cannot be charged. Readjust mask to reduce leakage or increase the alarm settings.</td>
</tr>
</tbody>
</table>
### Table 5-2. Alarms and Corrective Actions (Continued)

<table>
<thead>
<tr>
<th>Alarm Message or Symptom</th>
<th>Possible Reason(s) For The Alarm Event</th>
<th>Corrective Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH VTI</strong></td>
<td>Adjustment of the Max VTI level too low (for PSV, CPAP and P A/C modes).</td>
<td><strong>Note:</strong> Always consult the clinician before changing PEEP, pressure or Rate settings. Modify the Max VTI level.</td>
</tr>
<tr>
<td></td>
<td>Adjustment of the pressure level too high for the volume required (for PSV, CPAP and P A/C modes).</td>
<td><strong>Note:</strong> Always consult the clinician before changing PEEP, pressure or Rate settings. Modify the pressure level.</td>
</tr>
<tr>
<td></td>
<td>A leak in the patient circuit causing increased bias flow.</td>
<td>Check and properly connect the patient circuit.</td>
</tr>
<tr>
<td></td>
<td>Inappropriate patient circuit.</td>
<td>Replace the patient circuit.</td>
</tr>
<tr>
<td></td>
<td>Defective flow sensor or internal leak in the machine.</td>
<td>Have a qualified technician replace the defective component(s) and call your customer service representative.</td>
</tr>
<tr>
<td><strong>HIGH PRESSURE</strong></td>
<td>Airway obstruction.</td>
<td>Check patient’s trachea and clear the obstruction. If the filter is obstructed, replace the filter.</td>
</tr>
<tr>
<td></td>
<td>Proximal pressure tube or patient circuit obstructed.</td>
<td>Clean the proximal pressure tube or the patient circuit or replace them.</td>
</tr>
<tr>
<td></td>
<td>Coughing or other high-flow exhalation efforts.</td>
<td>Treat patient’s cough. Pause the audible alarm, if necessary.</td>
</tr>
<tr>
<td></td>
<td>Patient inspiratory resistance or compliance changes.</td>
<td>Have physician determine if ventilator settings are appropriate for the patient.</td>
</tr>
<tr>
<td></td>
<td>Defective internal circuits of the machine or pressure sensor.</td>
<td>Replace the ventilator and call your customer service representative.</td>
</tr>
<tr>
<td><strong>HIGH RATE</strong></td>
<td>Adjustment of the Max Rtot level too low.</td>
<td>Re-adjust Max Rtot.</td>
</tr>
<tr>
<td></td>
<td>Adjustment of the I Sens level too low.</td>
<td>Adjust I Sens according to the patient.</td>
</tr>
<tr>
<td></td>
<td>Patient hyperventilating.</td>
<td>Pause the audible alarm and call for a medical team if the symptoms persist. Check for auto-cycling and adjust inspiratory sensitivity, manage leaks or drain condensation from patient circuit.</td>
</tr>
<tr>
<td></td>
<td>Defective inspiratory flow sensor.</td>
<td>Have a qualified technician replace the defective component(s) and call your customer service representative.</td>
</tr>
<tr>
<td><strong>INTENTIONAL VENT STOP</strong></td>
<td>The user / caregiver has stopped ventilation using the VENTILATION ON/OFF key. Ventilation is in stand-by.</td>
<td>Check that the ventilation was switched off on purpose. This alarm can be deactivated. See Chapter 7.2.2, &quot;Changing the Setup Menu Parameters.&quot;</td>
</tr>
</tbody>
</table>
### Table 5-2. Alarms and Corrective Actions (Continued)

<table>
<thead>
<tr>
<th>Alarm Message or Symptom</th>
<th>Possible Reason(s) For The Alarm Event</th>
<th>Corrective Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEYPAD FAULT RESTART/SRVC</td>
<td>Pressing a key for more than 45 seconds.</td>
<td>Press and release keys in the normal, prescribed manner. Do not press keys for 45 seconds or more.</td>
</tr>
<tr>
<td></td>
<td>A key on the keyboard is stuck.</td>
<td>If unsuccessful in releasing the stuck key(s), restart ventilator to see if alarm clears. If not, replace the device and call your customer service representative if the situation persists.</td>
</tr>
<tr>
<td>LOW BATTERY</td>
<td>Internal battery capacity is less than 30 min. (or 8%)—battery operation overextended.</td>
<td>Immediately connect the ventilator to an AC power outlet, or connect it to an external DC power source. Reminder: the internal battery can be charged only when the ventilator is connected to an AC power supply.</td>
</tr>
<tr>
<td>LOW VTI</td>
<td>Adjustment of the Min VTI level too high (for PSV, CPAP and P A/C modes).</td>
<td>Modify the Min VTI level.</td>
</tr>
<tr>
<td></td>
<td>Adjustment of the pressure level not enough to reach the volume required (for PSV, CPAP and P A/C modes).</td>
<td>Modify the pressure level according to the physician's prescription.</td>
</tr>
<tr>
<td></td>
<td>Patient circuit obstructed or disconnected.</td>
<td>Clean, unblock, and/or reconnect the patient circuit.</td>
</tr>
<tr>
<td></td>
<td>Inappropriate patient circuit.</td>
<td>Replace the patient circuit.</td>
</tr>
<tr>
<td></td>
<td>Defective flow sensor or internal leak in the machine.</td>
<td>Check patient, replace the device and call your technician or customer service representative.</td>
</tr>
<tr>
<td>NO PROXIMAL LINE2</td>
<td>The proximal pressure line is disconnected.</td>
<td>Connect proximal pressure line.</td>
</tr>
<tr>
<td>PATIENT DISCONNECTION</td>
<td>Leak or loose connection in the patient circuit.</td>
<td>Check the patient circuit connections to the ventilator; examine all connections for leakage and tightness. Replace the patient circuit if necessary.</td>
</tr>
<tr>
<td></td>
<td>Circuit disconnection from patient or ventilator.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inspiratory flow exceeds 130 LPM.</td>
<td>Adjust Apnea alarm setting.</td>
</tr>
<tr>
<td></td>
<td>Inappropriate patient circuit.</td>
<td>Replace the patient circuit.</td>
</tr>
<tr>
<td></td>
<td>Defective internal circuits of the machine or pressure sensor.</td>
<td>Restart ventilator to see if alarm clears. If not, have a qualified technician replace the defective component(s) or call your customer service representative.</td>
</tr>
<tr>
<td>OCCLUSION CHECK CIRCUIT</td>
<td>Patient circuit obstructed.</td>
<td>Clean, unblock, and/or properly connect the patient circuit.</td>
</tr>
<tr>
<td>*IF PERSISTS RESTART/ SRVC</td>
<td>A non-vented configuration is being used or the built-in leak in the mask or in the circuit may be obstructed or insufficient for the settings. Note that a high respiratory or backup rate may not sufficiently flush out CO₂ in some vented pediatric masks.</td>
<td>Replace the non-vented circuit with a vented one. Clean, unblock the mask or the circuit of the ventilator or switch to a vented system with a larger leak configuration. Try to reduce patient’s backup rate if possible.</td>
</tr>
<tr>
<td>OCCLUSION CHECK CIRCUIT</td>
<td>Internal problem in the electrical power supply.</td>
<td>Restart ventilator to see if alarm clears. If not, replace the ventilator and call your customer service representative.</td>
</tr>
</tbody>
</table>
### Table 5-2. Alarms and Corrective Actions (Continued)

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

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

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

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

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

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

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

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

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

### 6.1 Installing the Ventilator

To install your Puritan Bennett™ 520 Ventilator:

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

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

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

**WARNING:**
To ensure correct and lasting operation of the ventilator, ensure that its air circulation holes (main inlet or cooling) are never obstructed. Place the device in an area where air can freely circulate around the ventilator and avoid installing it near floating fabrics, such as curtains.
**WARNING:**
Do not place the ventilator in a position where a child can reach it or in any position that might cause it to fall on the patient or someone else.

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

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

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

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

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

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

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

**WARNING:**
The Puritan Bennett™ 520 Ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in
Appendix B, “Specifications.” In particular, the use of nearby mobile and portable communications equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC / EN 60601-1-2 standard, may affect its operation. Refer to section B.10, “Manufacturer's Declaration” on page B-8.

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

6.2 Connecting to External AC Power

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

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

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

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

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

WARNING:
Do not leave power cables lying on the ground where they may pose a hazard.
To prevent accidental disconnection of the AC power cable, use the power cable holder (Figure 6-1., item 1) that is inserted into the notch (Figure 6-1., item 2) of the battery cover.

**Figure 6-1.** The Power Cable Holder

To secure the AC power cable:

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

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

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

- The **AC POWER** indicator on the top left corner of the ventilator illuminates.
- The indicator flashes while the battery charges and then turns off when the battery is fully charged (see Figure 6-4. on page 6-6.).

If the AC power cable becomes disconnected or the AC power source fails, an “AC POWER DISCONNECTION” alarm signals an automatic switch to the external DC power source (if the DC power cable is connected) or to the ventilator’s internal battery.

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

**Note:**
The only time the AC POWER and indicators are illuminated at the same time is when the ventilator is connected to an AC supply and the battery is charging (indicator is flashing).
To disconnect the AC power cable:
1. Disconnect the AC power cable from the AC power outlet.
2. Disconnect the AC power cable from the ventilator’s AC connector at the rear of the device.
3. Grasp the AC power cable at the level of the power cable holder and turn the cable clockwise while lifting it upwards and out of the holder.

6.3 Connecting to an External DC Power Source

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

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

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

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

**Note:**
When AC power is not available use an external DC power prior to using internal battery power.
To connect the ventilator to an external power source, do the following:
1. Ensure the car’s engine is started prior to connecting the ventilator.
2. Connect the DC power cable into the ventilator.
3. Connect the DC power cable into the car auxiliary adapter.

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

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

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

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

2. Push the DC power cable onto the ventilator’s DC power connector (Figure 6-6, item 2).
   - You will hear a locking “click”.
   - The DC POWER indicator on the top left corner of the ventilator illuminates (see Figure 6-4).

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

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

### 6.4 Patient Circuit

**WARNING:**
Before opening the packaging for the Patient Circuit, ensure that no damage is evident to the packaging or its contents. Do not use if evidence of damage exists.
**WARNING:**
For pediatric use, ensure that the patient circuit type fits, and, in all respects, is suitable for use with a child. Use a pediatric circuit for patients that weigh under 53 lb. (23 kg). See Table H-2. *List of Circuits* on page H-3 for a list of recommended patient circuits.

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

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

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

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

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

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

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

### 6.4.1 Choosing the Patient Circuit Type

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

For information regarding validated circuits, visit the SolvITSM Center Knowledge Base by clicking the link at http://www.covidien.com/rms/sales-support/solvit-center-knowledge-base or contact your Puritan Bennett™ product representative.

### 6.4.2 Installing the Patient Circuit

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

The following procedures describe the installation of the patient circuit with a humidifier. To add other accessories, see the installation instructions for the specific accessories used.

**To connect a single-limb circuit with an exhalation valve:**

See *Figure 6-7.*

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

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

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

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

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

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

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

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

9. Place a patient interface to the end of the patient circuit (item 6).
Figure 6-7. Single-Limb Patient Circuit With Exhalation Valve

![Image of single-limb patient circuit with exhalation valve]

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

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

![Image of close-up of exhalation valve tube and proximal pressure tube]

Figure 6-8. shows details of the connections of the proximal pressure tube (item 1) and the exhalation valve tube (item 2).
To connect a single-limb circuit without an exhalation valve (NIV only):

See Figure 6-9.

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

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

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

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

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

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

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

The end of the proximal pressure tube should be connected as close as possible to the patient (at the mouthpiece, mask, or cannula entry, if possible) so that the ventilator can account for all load losses due to the circuit and its potential accessories. If this is not possible, it is best to modify the PATIENT DISCONNECTION triggering threshold by setting a Max VTl alarm limit for pressure modes. As a reminder: Ensure that the length and the internal volume of the patient circuit are compatible with the tidal volume: ringed tube Ø 22 mm for adults and ringed tube Ø 15 mm for pediatric patients with tidal volumes lower than 200 ml. Use, if necessary, a 22F-15M link on the outlet.
WARNING: When using non-invasive ventilation (NIV), without an exhalation valve, use a vented nose or face mask or a non-vented mask combined with a leak accessory. When using non-invasive ventilation (NIV), with an exhalation valve, use a non vented mask.

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

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

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

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

6.5 Filters

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

The ventilator features two filter types:

- air inlet filter
- bacteria filter
Air Inlet Filter

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

![Air Inlet Filter](image)

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

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

Bacteria Filter

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

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

![Bacteria Filter](image)

See the manufacturer’s instructions for more information about the use and maintenance of the bacteria filter(s).
6.6 **Humidifier**

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

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

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

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

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

![Figure 6-12. Humidifier](image)

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

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

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

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

6.7.1 Administering Oxygen

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

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

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

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

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

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

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

6.7.2 Connecting the Oxygen Supply

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

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

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

*Figure 6-13.* Rear Panel Oxygen Connector

**WARNING:**
Before connecting the oxygen supply, ensure that the stud on the oxygen connector (*Figure 6-13.*, item 3) is protruding outwards.
WARNING: 
Inspect the oxygen coupler (*Figure 6-14.*, item 2) before use to ensure it has its black o-ring attached and in good condition. Do not use an oxygen coupler with a missing, damaged, or worn o-ring.

To connect the oxygen supply system to the ventilator:

See *Figure 6-14.*

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

2. Push the oxygen supply’s oxygen connector (item 1) into the ventilator’s oxygen connector (*Figure 6-14.*, item 3).
   - The ventilator’s oxygen connector’s locking stud (item 4) retracts.
   - The ventilator’s oxygen connector’s locking tab (item 5) is released, ensuring that the oxygen connection is locked and secured in place.

*Figure 6-14.* Connecting the Oxygen Supply System

To disconnect the oxygen supply system from the ventilator:

Note:
Ensure the oxygen source is turned off prior to placing the ventilator in Standby or turning off the ventilator.

1. Stop the oxygen flow from the oxygen supply.

2. Press the locking tab of the ventilator’s oxygen connector, as shown in *Figure 6-15.*, to unlock the oxygen connection.
3. Disconnect the oxygen supply’s oxygen connector by pulling it towards you. The ventilator’s oxygen connector’s locking stud (Figure 6-14, item 4) will then extend outwards, which is required before the oxygen connector can be reconnected.

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

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

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

### 6.8 Fitting the Ventilator into the Dual Bag

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

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

To fit the ventilator into the Dual Bag, do the following:

1. Open the rear panel of the Dual Bag.

2. Slip the ventilator into the Dual bag, pushing it completely to ensure a snug fit.
3. Shut the rear panel of the Dual Bag ensuring that the hook and loop fastener strips are securely fastened.

6.9 Mounting the Ventilator on a Wheelchair

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

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

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

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

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

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

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

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

![Figure 6-16. Using the Dual Bag](image)

To install the Dual Bag onto a wheelchair, do the following:

1. Unclip the two backpack straps from the side clips.
2. Clip the suspension belt onto the central ring.
3. Secure the Dual Bag on the wheelchair’s push handle.
4. Attach the non adjustable side of the maintaining belt to the side clip of the Dual Bag.
5. Pass the maintaining belt around the back of the wheelchair.
6. Adjust the length of the maintaining belt and attach the adjustable side of the belt to the clip on the other side of the Dual Bag.

**6.10 Mounting the Ventilator on the Utility Cart**

Match the mounting holes (item 1) on the bottom of the Puritan Bennett™ 520 Ventilator to the mounting studs (item 2) on the top of the utility cart platform.
Figure 6-17. Mounting the Ventilator on the Utility Cart

Figure 6-18. Using the Utility Cart
6.11 Connecting the Nurse Call Cable

Connect the Nurse Call cable (Figure 6-19., item 1) to the Nurse Call Monitor Connector (item 2).

Figure 6-19. Connecting the Nurse Call Cable

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

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

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

Note: The PB520 has been designed to accommodate connectivity with Nurse Call/monitoring systems. Because it is not possible to anticipate every configuration of hardware and software associated with Nurse Call/monitoring system, it is the user's responsibility to confirm proper functionality of the system when used in conjunction with the PB520. Verification of alarms, alerts, and patient data transmissions is required. If the system performance is not as expected, contact Technical Support for assistance troubleshooting the setup. Do not use the PB520 ventilator with a Nurse Call/monitoring system until the functionality of the ventilator/system combination has been confirmed.

Note: Complete a self-test after the cable has been installed and at regular intervals to ensure the system is operating as intended. A self-test consists of inducing an alarm and confirming the Nurse Call/monitoring system unit emits an audio alarm, and also confirming the audio alarm ceases once the alarm in the ventilator has been reset.
The Nurse Call function provides for remote alerts of ventilator alarm conditions (for example, when the ventilator is used in an isolation room), and features the following:

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

- A remote alarm is activated when an alarm condition occurs, unless either of the following is true:
  - The audio paused function is active.
  - The ventilator power switch is OFF.

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

- The remote alarm port is an 8-pin female connector; allowable current is 100 mA at 24 VDC (max).
7.1 Turning on the Ventilator

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

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

**WARNING:**
If the ventilator has been transported or stored at a temperature that differs more than ±20 °C (±36 °F) from the temperature in which it will be operating, the ventilator should be allowed to stabilize in its operating environment for at least two (2) hours prior to use.

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

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

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

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

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

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

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

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

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

**To turn the ventilator on:**
- Set the I/O switch (a covered, rocker-type switch located at the rear of the ventilator) to the I position, as shown in Figure 7-1.
The following events occur:

- The ventilator is powered on.

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

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

- The audible alarms briefly sound.

- The display's backlight turns on.

- The PURITAN BENNETT logo is displayed momentarily.

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

- A Welcome Menu screen is displayed for about five (5) seconds, which includes the machine hours counter and patient hours counter, as shown in **Figure 7-2**.
Note:
If the ventilator had been previously stopped by use of the I/O switch while ventilation was in progress, the ventilator starts directly in ventilation mode and does not show the Welcome Menu screen.

Note:
The Alarm, Technical Fault, and Event logs are stored in non-volatile memory on the Main CPU PCB, ensuring that the information is retained when the ventilator is powered off and during power loss conditions.

To skip the Welcome Menu:
Press VENTILATION ON/OFF to start ventilation immediately.
The Ventilation menu is then displayed.
By default, the starting ventilation mode is the last one used, the settings being those that were active when the machine was last stopped.

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

7.2 Setup Menu Parameters

7.2.1 Accessing Setup Configuration

Note:
The Locking Key prevents access to the Setup menu (see section 7.8, “Locking the Control Panel” on page 7-38 and section 7.9, “Unlocking the Control Panel” on page 7-38).

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

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

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

Figure 7-4. Setup Menu

3. Release the ALARM CONTROL key.

7.2.2 Changing the Setup Menu Parameters

To change the Setup Menu settings:
1. Press **UP** or **DOWN** to position the cursor beside the parameter to be modified.

2. Press **ENTER**.
   - The cursor changes.
   - The selected parameter value flashes.

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

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

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

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

**The parameters in this menu are:**
- Machine Hours
- Language
- Date
- Time
- Intentional Vent Stop
- Pressure Unit
- Alarm Tone
- Patient Hours
- Restore Defaults
- Maintenance
- Next

**Machine Hours**
The counter records the total ventilation time in hours (to the nearest hour) since manufacture.
Note:
The machine hour meter is reset when the CPU board is changed.

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

<table>
<thead>
<tr>
<th>Language</th>
<th>English (US)</th>
<th>Finnish</th>
<th>Japanese</th>
</tr>
</thead>
<tbody>
<tr>
<td>English (UK)</td>
<td>Russian</td>
<td>Italian</td>
<td></td>
</tr>
<tr>
<td>German</td>
<td>Portuguese</td>
<td>French</td>
<td></td>
</tr>
<tr>
<td>Danish</td>
<td>Polish</td>
<td>Spanish</td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>Norwegian</td>
<td>Swedish</td>
<td></td>
</tr>
<tr>
<td>Turkish</td>
<td>Dutch</td>
<td>Korean</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

To set the Intentional Vent Stop Alarm:
1. Use the UP or DOWN arrows to place the cursor at the “Intentional Vent Stop” alarm position.
2. Press ENTER.
3. Press UP or DOWN to set the message to “YES”.
4. Press ENTER to confirm the selection.

Pressure Unit
The unit of pressure can be set here. It can be displayed as mbar, cmH20, or hPa.

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

To change the alarm tone:
1. Use the UP or DOWN arrows to place the cursor on Alarm Tone.
2. Press ENTER.

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

4. Press ENTER to confirm the selection.

**Patient Hours**

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

**Note:**

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

**To reset the Patient Hours counter to zero:**

1. Press DOWN to place the cursor at the “Patient Hours” line, as shown in Figure 7-5.

2. Press ENTER.
   - The cursor is placed on the “Reset Hours” line.

3. Press ENTER.
   - “OFF” flashes.

4. Press UP or DOWN to change the “OFF” message to “YES”, as shown in Figure 7-6.
5. Press **ENTER**.
   - “YES” is displayed continuously.
   - A long “beep” sounds.
   - The patient counter display indicates 00000h, as shown in *Figure 7-7*.

6. Press **UP** or **DOWN**.
   - The display indicates “Reset Hours: OFF”, as shown in *Figure 7-8*. 

![Figure 7-6. Resetting Patient Hours to Zero (2)](image1)

![Figure 7-7. Resetting Patient Hours to Zero (3)](image2)
Figure 7-8. Resetting Patient Hours to Zero (4)

Figure 7-9. Restoring Default Settings (1)

**Restore Defaults**

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

To restore settings back to the manufacturer defaults:

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

2. Press **ENTER**. “OFF” flashes.

3. Press **UP** or **DOWN** to change “OFF” to “YES,” as shown in Figure 7-10.
Figure 7-10. Restoring Default Settings (2)

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

Figure 7-11. Restoring Default Settings (3)

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

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

7.2.3 Entering Setup 2 Menu

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

2. Press ENTER.
The Setup 2 menu is displayed.

**Figure 7-12. Setup 2 Menu**

The parameters in this menu are:
- Cycling Mode
- Relative pressure
- E Sens Setting
- Back

**Cycling Mode**

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

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

1. \( \frac{I}{T} \) is inspiratory time (\( T_i \)) as a percentage of the total breath cycle time (\( T_i + T_e \)).
   \[
   \frac{I}{T} (\%) = \left(\frac{T_i}{T_i + T_e}\right) \times 100
   \]

2. \( \frac{I}{E} \) is the ratio of inspiratory time (\( T_i \)) to exhalation time (\( T_e \)).
   \[
   \frac{I}{E} = \frac{T_i}{T_e} 
   \]

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

**Absolute and Relative Pressure**

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

Relative pressure = YES: Inspiratory pressure setting + PEEP = Peak Inspiratory pressure.
Relative pressure = OFF (ABS): Inspiratory pressure setting = Peak Inspiratory pressure.

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

**Figure 7-13. Absolute and Relative Pressure**

---

**E Sens Setting**

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

If set to **POSITIVE**, E Sens is based on the percentage of inspiratory peak flow. If set to **NEGATIVE**, E Sens is based on the percentage of inspiratory peak flow by which the flow must decrease before exhalation is declared.
Figure 7-14. E Sens Setting

7.2.4 Exiting the Setup Menu

To exit the Setup menu, you must cycle the ventilator’s power.
1. Set the ventilator’s rear panel I/O switch to OFF (O). Wait 30 seconds.
2. Turn the ventilator’s I/O switch ON (I).

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

7.3 Preferences Menu Parameters

The Preferences menu is only accessible if the Locking Key has not been enabled (refer to section 7.8, "Locking the Control Panel" on page 7-38 and section 7.9, "Unlocking the Control Panel" on page 7-38).

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

⚠️ WARNING:
Setting Alarm limits to extreme values can cause the ventilator alarms to malfunction.
Note:
Default alarm setting preferences should be entered prior to using the ventilator.

7.3.1 Preferences Menu

To display the Preferences menu:

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

   Figure 7-15. Selecting the Preferences Menu

2. Press ENTER. The Preferences menu is displayed.

   Figure 7-16. Changing Settings in the Preferences Menu

To change the settings in the Preferences menu:

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

2. Press ENTER.
   - The cursor changes to the plus/minus symbol.
• The parameter selected to be modified flashes, or for certain parameters featuring a bar graph, the indicator triangle under the bar graph becomes filled.

See Figure 7-17.

Figure 7-17. Modifying the Parameters

![Figure 7-17](ven_11992_a)

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

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

4. Press **ENTER** to confirm the new parameter setting.
   - The new parameter setting is displayed.
   - The cursor returns to its initial form.

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

**The parameters in this menu are:**
- Backlight
- Contrast
- Alarm Volume
- Key Sound
- Apnea Alarm
- Disconnection Alarm
- Pediatric Circuit
- Ventilation Report

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

**To manually exit from the Preferences menu:**

Press **ENTER** when the cursor is on “Back to Ventilation“.
You will automatically exit from the Preferences menu when:

- No keyboard action is detected before 15 seconds elapse, or
- A High Priority alarm is triggered.

### 7.3.2 Backlight

**To set the backlight:**

1. Select the Backlight parameter on the display.

2. Set the backlight:
   
   a. To set the backlight to standby, select **OFF**. The effect of this setting is that if no keyboard action occurs before one minute elapses, the display's backlight fades almost to off. The display will illuminate when the following occurs:
      - Any one of the keys on the keyboard is pressed
      - An alarm is triggered
   
   b. To set the backlight to light continuously, select **YES**. This setting ensures that the display is continuously lit.

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

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

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

### 7.3.3 Contrast

**To set the Contrast:**

1. Select the Contrast parameter on the display.

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

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

![Figure 7-19. Decreasing the Contrast](image)

- The display contrast progressively decreases.

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

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

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

### 7.3.4 Alarm Volume

**WARNING:**

The sound level of the alarms should be adjusted according to the installation environment and the size of the area monitored by the patient’s caregiver. Ensure that the alarm sound apertures at the front of the device are never obstructed. See section **7.3.4, “Alarm Volume”** on page 7-19.

To set the Alarm Volume:

1. Select the Alarm Volume parameter on the display. See section **7.3.1, “Preferences Menu”** on page 7-16.

2. Set the Alarm Volume level:

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

   ![Figure 7-20. Increasing the Alarm Volume](image)

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

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

   ![Figure 7-21. Decreasing the Alarm Volume](image)

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

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

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

7.3.5 Key Sound

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

To set Key Sound:
1. Select the Key Sound parameter on the display.
2. Select one of the following four options:
   - OFF – No sound is emitted when a key is pressed.
   - Key tone – A “clock” sound is emitted when a key is pressed.
   - Accept tone – A “beep” sounds when ENTER is pressed to confirm a setting.
   - All tones on – A “clock” sound is emitted when all keys are pressed and a beep sounds when ENTER is pressed to confirm a setting.
3. Press ENTER to confirm the new Key Sound setting.

The default setting for Key Sound is Accept tone.

Note:
Whatever the selected Key Sound setting, pressing the VENTILATION ON/OFF key triggers a “beep” at ventilation start and a double “beep” at ventilation stop.

7.3.6 Apnea Alarm

To set the Apnea Alarm:
1. Use the UP or DOWN arrow keys to place the cursor at the “Apnea Alarm” position.
2. Press ENTER.
3. Press UP or DOWN to set the message to “YES”. Setting the key to “OFF” means the Apnea Alarm will not sound when the ventilator is stopped.
4. Press ENTER to confirm the selection.
WARNING:
The Apnea Alarm should be set to YES if an audible alarm is desired when apnea events occur.

Figure 7-22. Setting the Apnea Alarm

Note:
This activates / deactivates the Apnea alarm but not the Apnea Time Setting. The Apnea Time Setting can be set in the Ventilation Menu.

7.3.7 Disconnection Alarm

To set Disconnection Alarm:

1. Use the UP or DOWN arrow keys to place the cursor at the "Disconnection Alarm" position.
2. Press ENTER.
3. Press UP or DOWN arrows to adjust the setting between 5 and 62 seconds.
4. Press ENTER to confirm the selection.

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

7.3.8 Pediatric Circuit

To choose a pediatric circuit:

1. Use the UP or DOWN arrows to place the cursor at the "Pediatric Circuit" position.
2. Press ENTER.
3. Press **UP** or **DOWN** to set the message to “YES.” Setting the ventilator to “OFF” configures the device for an Adult circuit.

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

**Note:**
The default setting is “OFF” (the ventilator is set for Adult use).

### 7.3.9 Ventilation Report

**Accessing the Ventilation Report:**

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

2. Press **ENTER**.

![Ventilation Report](VEN_10686_A)

**Note:**
The report is displayed for five minutes then screen reverts to the Preferences Menu.

To exit the Ventilation report:

Press **ENTER**.

### 7.4 Setting the Ventilation Mode

The ventilation mode can be changed from the ventilation parameters menu or the alarm parameters menu, as long as the Locking Key is not enabled (refer to section 7.8, “Locking the Control Panel,” on page 7-38, and section 7.9, “Locking the Control Panel” on page 7-38).
The procedure to change the ventilation mode depends on the ventilation status, as described in section 7.4.1 and section 7.4.2.

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

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

### 7.4.1 Changing Modes While Ventilation is on Standby

To change ventilation modes while on standby:

1. Place the cursor on the first line of the menu (general information line) using the **UP** key.

   ![Figure 7-24. Changing Ventilation Modes While on Standby](image)

2. Press **ENTER**.
   - The cursor changes to:  
   - The mode name flashes.

3. Press **UP** or **DOWN** until the required mode is displayed.

4. Press **ENTER** to confirm the mode selected.
   - The cursor returns to normal.
• The new mode is displayed with its ventilation parameters.

Note:
If the ventilation mode change is not confirmed by pressing ENTER before seven (7) seconds elapse, the ventilator restores the previous mode.

7.4.2 Changing Modes During Ventilation

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

Changing ventilation modes during ventilation:

1. Place the cursor on the first line of the menu (general information line) using the UP key (Figure 7-25).

2. Press ENTER.
   • The cursor changes to: 🏞️.
   • The mode name flashes.

3. Press UP or DOWN until the required mode is displayed.

4. Press ENTER to confirm the mode selected.
   • The name of the new mode selected is displayed at the top left followed by the flashing "INACTIVE" status indicator (Figure 7-26, item 1).
   • The settings for the new mode are displayed on the left (Figure 7-26, item 2) and the monitored values for the mode in progress on the right (Figure 7-26, item 5).
• The confirmation line “Accept Mode: YES” is displayed on the bottom left (Figure 7-26, item 3).

• The name of the mode in progress is displayed at the top right followed by the continuous “ACTIVE” status indicator (Figure 7-26, item 4).

![Image: Figure 7-26. Displaying Active and Inactive Modes]

The Alarm menu screen is shown in Figure 7-27. shows the active and inactive mode information being displayed, along with the “Accept Mode: Yes” line, alarm parameter settings, and patient values.

![Image: Figure 7-27. Changing the Settings of the New Mode]

5. Change the settings of the new mode, including alarms, if necessary.

6. Press DOWN to place the cursor on the “Accept Mode: YES” line.

7. Press ENTER to confirm the mode change.

   • The new mode selected is displayed with its settings. It is applied at the beginning of the next exhalation phase if it occurs during inspiration or immediately if it occurs during exhalation.

It is not mandatory to change modes during ventilation (see steps 6 and 7, above). The settings of the next (“INACTIVE”) mode can be “prepared” while ventilation is in progress in the current
(“ACTIVE”) mode. The modifications will be saved for this next mode, whether or not it is used immediately afterwards.

When setting the parameters of the future and currently inactive modes, the monitoring data for the mode in progress are displayed in the window to the right of the menu and also in the central (“current”) column of the table on the Alarm menu screen.

When changing the value of a parameter in this inactive mode, the monitoring data displayed in the window on the right side of the screen are temporarily hidden by the display of the value currently being changed. This is shown in Figure 7-28, as the PEEP setting is adjusted in the inactive mode.

![Figure 7-28. Changing Ventilation Modes and Parameters](image)

If an alarm is triggered during the setting of an inactive mode, its message is displayed in the alarm message display.

When the menu of an inactive mode is displayed and no changes are made by the user on the keyboard within 14 seconds, the display of the active ventilation mode in use reappears on the screen and the “Accept Mode:YES” line disappears.

The menu of the active mode can also be recalled without waiting for this delay by directly restoring the name of the mode on the general information line.

The ventilation parameters of the inactive mode and the current mode remain in memory until some or all of the parameters are modified again; this is true even after the machine is stopped.

7.5 Setting Ventilation Parameters

Ventilation parameters can be changed as long as the Locking Key is not activated (refer to section 7.9, "Unlocking the Control Panel" on page 7-38).

⚠️ WARNING:
In adult or pediatric use ensure that the adjusted tidal volume is compatible with the needs of the patient.
Ventilation is not interrupted by the adjustment of a value. It continues according to previous settings. The new settings are applied ONLY after they are confirmed and synchronized in the next breath cycle, except for the I Sens setting, which is applied immediately.

To modify a ventilation parameter:

1. Place the cursor on the line of the parameter to be modified using the UP or DOWN key.

2. Validate your intention to modify the parameters using the ENTER button. See Figure 7-29.
   - The cursor changes (Figure 7-29, item 1).
   - The parameter value flashes (Figure 7-29, item 2).
   - A zoom of the parameter value is displayed in the right-side of the window (Figure 7-29, item 3).

3. Press UP or DOWN to select the value desired for the parameter (continuing to press on these keys speeds up the progression of values displayed).

4. Press ENTER to confirm the selected value.
   - The new parameter value is displayed continuously.
   - The zoom disappears.
   - The cursor returns to normal.

Note:
If a parameter change is not confirmed by pressing ENTER before seven (7) seconds elapse, the ventilator restores the parameter’s previous value.
7.5.1 Links between Ventilation Parameters

The adjustment ranges of certain parameters are limited in order to remain compatible with the levels of other previously set parameters. For additional information on the interdependence between ventilation parameters, refer to Chapter 3, “Operating Parameters.”

The message “Setting limited by...” is displayed and identifies the parameter(s) that is (are) blocking the setting.

Figure 7-30. item 1, shows that P Support cannot be set above 35 when PEEP is set to 20 and relative pressure is set to YES; this value is limited by PEEP because their sum cannot exceed 55 mbar.

Two possibilities exist in this case:
• Allow the PEEP setting to remain at 20, but the P Support cannot be increased.
• Reduce PEEP so that the P Support setting can be set higher than 35 to ensure that their sum is no greater than 55.

7.5.2 Links between Ventilation and Alarm Parameters

Setting a ventilation parameter takes priority over an alarm threshold setting and leads to automatic readjustment of the alarm setting threshold so that the interdependence between the two remains unchanged.

Once the ventilator is in service at the patient’s home, you should use the Locking Key to block access to changing any settings (see section 7.8, “Locking the Control Panel” on page 7-38).

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

Alarm parameters can be changed from the Alarm menu, if the Locking Key is not enabled (refer to section 7.8, “Locking the Control Panel” on page 7-38 and section 7.9, “Unlocking the Control Panel” on page 7-38).

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

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

**To modify an Alarm Parameter:**
1. Ensure that the Alarm menu is displayed, showing a list of alarm parameters and columns for the minimum, current, and maximum alarm parameter values. *(Figure 7-31. on page 7-30).*
2. Put the cursor next to the alarm parameter to be modified using the **UP** or **DOWN** key.
3. Confirm your intention to modify the parameters using the **ENTER** key.
   - The cursor changes. *(Figure 7-31. , item 1).*
   - The parameter in the “Min” column flashes *(Figure 7-31. , item 2).*
   - A zoom of the Min parameter is displayed on the right side of the screen *(Figure 7-31. , item 3).*
4. Press **UP** or **DOWN** to modify the value of the parameter.
5. Press **ENTER** to confirm the value selected.
- The new value for the “Min” column is continuously displayed (*Figure 7-32.*, item 1).
- The value of the “Max” column flashes (*Figure 7-32.*, item 2).
- A zoom of the Max parameter value is displayed on the right side of the window (*Figure 7-32.*, item 3).

*Figure 7-32.* Modifying Alarm Parameters—Max Value

6. Press **UP** or **DOWN** to modify the value of the parameter.
7. Press **ENTER** to confirm the value selected.
   - The new value is continuously displayed.
   - The zoom disappears.
   - The cursor returns to normal.

An alarm is set to “OFF” (the alarm will not be triggered) when its maximum setting limit (for the Max value) or its minimum setting limit (for the Min value) is reached by successively or continuously pressing **UP** or **DOWN**, respectively.

**Note:**
If a parameter change is not confirmed by pressing **ENTER** before seven (7) seconds elapse, the ventilator restores the parameter’s previous value.

**Blocking of an Alarm Threshold Linked to a Ventilation Parameter**

Setting a ventilation parameter takes priority over an alarm threshold setting. Therefore, if a ventilation parameter is modified when linked to an alarm threshold, the alarm setting threshold is automatically adjusted so that the interdependences linking them are always maintained.

However, if the alarm setting threshold is modified, it cannot be changed beyond the limit of the interdependence with the ventilation parameter to which it is linked. When the alarm setting limit is reached, the message “Setting limited by...” indicates the name of the linked ventilation parameter(s) that are limiting the parameter’s setting value.
Four possibilities exist in this case:

- The alarm parameter remains set to “OFF”.
- The alarm parameter setting is changed in relation to the value required at the start and the limits on the ventilation parameter(s) remain unchanged.
- The setting of the ventilation parameter(s) is changed to enable the alarm threshold to be set to the required value.
- The alarm parameter is not set to OFF but the ventilation parameter change has no impact on the alarm setting.

**WARNING:**

The level of inspiratory resistance of the circuit and accessories (bacteria filter, humidifier) must be as low as possible. Settings—particularly the PATIENT DISCONNECTION alarm, maximum inspired volume (Max VTI), and minimum inspired volume (Min VTI) settings—must be periodically adjusted according to changes in the patient circuit resistance—especially when filters are replaced.

**WARNING:**

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

### 7.7 USB Menu Parameters

The USB menu is accessible even if the Locking Key has been enabled (refer to section 7.8, “Locking the Control Panel” on page 7-38 and section 7.9, “Unlocking the Control Panel” on page 7-38).

The USB menu is automatically displayed when the USB memory device is connected to the ventilator, when ventilation is either on or off.

Only one USB memory device shall be connected at any time, otherwise an error message will be displayed. The USB Menu is not accessible from the Setup Menu or Maintenance menu.

To access patient data via a PC, a dedicated software package, Puritan Bennett™ Respiratory Insight Software, is available for Clinicians. Contact Covidien or your Puritan Bennett product representative for further information.
7.7.1 **USB Memory Device Specifications**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Supported Formats</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB compatibility</td>
<td>USB flash memory USB 2.0 or USB 1.1, 32 bit format</td>
</tr>
<tr>
<td>Number of files</td>
<td>Maximum 999 (sector size: 512-2,048 bytes)</td>
</tr>
<tr>
<td>USB size</td>
<td>128 MB to 4GB (to guarantee accuracy of transfer time, at least 10% of the USB memory device capacity must be free).</td>
</tr>
</tbody>
</table>

7.7.2 **USB Menu**

To access the USB menu when a USB memory device is connected:

Press the **MENU** key several times, until the USB Menu appears:

![Figure 7-33. Selecting the USB Menu](image)

In case of high priority alarm activation the ventilator will automatically display the alarm page. To return to the USB Menu, press the **MENU** key.

The adjustable parameters in this menu are:

- Transfer continuously
- Transfer trends
- Erase key

7.7.3 **Transfer Continuously**

Up to 48 hours worth of data can be transferred from a ventilator to a USB memory device.

To record continuously, the USB memory device must be permanently connected to the ventilator with ventilation active.
The following data will be recorded to the USB memory device:

- Monitoring: pressure, leak waveforms and inspired flow
- Trends: leaks, VTl, Rate, I:E, M. Vol, PIP, and PEEP measurements.

The data can be accessed by a doctor or service provider using the Puritan Bennett™ Respiratory Insight Software.

**Figure 7-34.** Selecting Transfer Continuously

---

**To transfer continuous data from a ventilator to a USB memory device:**

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the “Transfer Continuously” position.
2. Press **ENTER**.
   - The cursor changes to the plus/minus symbol.
   - The parameter selected to be modified flashes.
3. Press **UP** or **DOWN** to change the selected parameter’s value.
4. Press **ENTER** to confirm the new parameter setting.
   - The new parameter setting is displayed continuously.
   - The cursor is placed at the **STOP** position.
5. To manually stop continuous transfer, press the **ENTER** key.

**Note:**

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

All ventilator menus remain accessible during transfer time.
USB Menu Parameters

Note:
The message “TRANSFER IN PROGRESS... REMAINING TIME” is displayed during the transfer time.

Note:
Other functions of the USB memory device are not available during continuous recording.

Note:
If the memory capacity on the USB memory device is insufficient the message “TRANSFER NOT ALLOWED - USB CAPACITY INSUFFICIENT” is displayed and data transfer is not allowed. Delete the data on the USB memory device before restarting data transfer. Refer to deletion process (section 7.7.5, "Erase Data from the USB Memory Device").

Note:
In case of USB memory device disconnection or transfer error, the message “TRANSFER ERROR - USB DISCONNECTION” or “TRANSFER ERROR - TECHNICAL PROBLEM” is displayed. In this case restart the transfer process. If the problem persists contact your technical service representative.

7.7.4 Transfer Trends

Up to one year’s worth of trend data can be transferred from a ventilator to a USB memory device. Ventilation trends such as leaks, VTI, Rate, I:E, M. Vol, PIP, and PEEP measurements can be transferred from the ventilator to a USB memory device.

The data can be accessed by a doctor or service provider using the Puritan Bennett™ Respiratory Insight Software.

**Figure 7-35. Selecting Transfer Trends**

To transfer trend data from a ventilator to a USB memory device:

1. Use the UP or DOWN arrow keys to place the cursor at the “Transfer Trends” position.
2. Press **ENTER**.
• The cursor changes to the plus/minus symbol.
• The parameter selected to be modified flashes.

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

4. Press **ENTER** to confirm the new parameter setting.
   • The new parameter setting is displayed continuously.
   • The cursor is placed at the **STOP** position.

5. To manually stop trend transfer, press **ENTER**.

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

### Table 7-2. Trends Data Transfer Time from Ventilator to USB Memory Device

<table>
<thead>
<tr>
<th>Amount of trends data (in months)</th>
<th>Transfer time from ventilator to USB memory device</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months</td>
<td>Approximately 2 minutes</td>
</tr>
<tr>
<td>6 months</td>
<td>Approximately 4 minutes</td>
</tr>
<tr>
<td>9 months</td>
<td>Approximately 6 minutes</td>
</tr>
<tr>
<td>12 months</td>
<td>Approximately 8 minutes</td>
</tr>
</tbody>
</table>

**Note:**
The message “TRANSFER IN PROGRESS... REMAINING TIME” is displayed during the transfer time.

**Note:**
Other USB memory device functions are available during transfer of trends.

**Note:**
If the memory capacity on the USB memory device is insufficient the message “TRANSFER NOT ALLOWED - USB CAPACITY INSUFFICIENT” is displayed and data transfer is not allowed. Delete the data on the USB memory device before restarting data transfer. Refer to deletion process (section 7.7.5, “Erase Data from the USB Memory Device”).

**Note:**
In case of USB memory device disconnection or transfer error, the message “TRANSFER ERROR - USB DISCONNECTION” or “TRANSFER ERROR - TECHNICAL PROBLEM” is displayed. In this case restart the transfer process. If the problem persists contact your technical service representative.
7.7.5 Erase Data from the USB Memory Device

To erase data from the USB memory device:

1. Use the **UP** or **DOWN** arrow keys to place the cursor at the “Erase key” position.

2. Press **ENTER**.
   - The cursor changes to the plus/minus symbol.
   - The parameter selected to be modified flashes.

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

4. Press **ENTER** to confirm the new parameter setting.
   - The new parameter setting is displayed continuously.
   - The cursor is placed at the **STOP** position.

**Figure 7-36.** Erasing Data from the USB Memory Device

⚠️ **WARNING:**
Deletion erases ALL files present on the USB memory device.

🔍 **Note:**
The message “ERASE IN PROGRESS... REMAINING TIME” is displayed during the deletion time.

🔍 **Note:**
The deletion time of a full USB memory device is less than one minute.

🔍 **Note:**
Other USB memory device functions are not available during deletion.

🔍 **Note:**
Once deletion of the USB memory device has been started, it cannot be paused, stopped or canceled.
Note:
All ventilator menus remain accessible during deletion.

Note:
In case of USB memory device disconnection or deletion error, the message "TRANSFER ERROR - USB DISCONNECTION" or "ERASE ERROR - TECHNICAL PROBLEM" is displayed. In this case restart the erase process. If the problem persists contact your technical service representative.

7.8 Locking the Control Panel

When the machine is in service at a patient’s home, it is strongly recommended that you prevent accidental or unauthorized ventilator adjustments from occurring by enabling the Locking Key. The Locking Key is a software function that prohibits access to the ventilation and alarm parameter settings and changes to the ventilation mode.

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

To enable the Locking Key:
Simultaneously press the UP and the DOWN keys for at least six (6) seconds.

- The Locking Key symbol (Figure 7-37, item 1) appears in the top left corner of the screen.
- Lines which are no longer accessible are preceded by a dash “–” (Figure 7-37, item 2).
- Lines which remain operational keep their initial line access symbol.

Figure 7-37. Enabling the Locking Key
7.9 Unlocking the Control Panel

To disable the Locking Key:

Simultaneously press the **UP** and the **DOWN** keys for at least six (6) seconds.
- The Locking Key symbol disappears.
- The initial line access symbol is displayed in front of each line.

7.10 Starting Ventilation

Before starting ventilation, refer to Appendix E, "Operational Verification Checklist" and set the parameter values in the Preferences menu (refer to section 7.3, "Preferences Menu Parameters" on page 7-16).

**WARNING:**
Verify the functionality of the alarm conditions before connecting the patient to the ventilator.

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

When the ventilator is in standby (the ventilator is on, but ventilation has not started), a message that prompts the ventilator operator to press **VENTILATION ON/OFF** to start ventilation is displayed in the right-hand window of the ventilation and alarm menus (Figure 7-38).

![Figure 7-38. Prompt to Start Ventilation](VEN_10904_A)
To start ventilation:

1. **Press and release** VENTILATION ON/OFF (**Figure 7-39.**, item 1).
2. • The blue light indicator, at the upper right of the VENTILATION ON/OFF key (**Figure 7-39.**, item 2), turns off.
   - A “beep” sounds.
   - The ventilation starts.
   - The values of the monitored parameters are displayed in the right-hand window.

**Figure 7-39.** Starting Ventilation

### 7.11 Stopping Ventilation

**WARNING:**

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

You can stop your ventilator at any time.

**To stop the ventilator:**

1. **Press and hold** the VENTILATION ON/OFF key (**Figure 7-39.**, item 1) for three (3) seconds.
   - A message prompting the user to keep the button pressed appears on the monitoring window, as shown in the graphic below:
2. While keeping the VENTILATION ON/OFF key pressed:
   - A new message appears that directs the user to press the key again to confirm ventilation stop (as shown in the following graphic).

3. Release the VENTILATION ON/OFF key.
   - Press the VENTILATION ON/OFF key within 5 seconds to confirm stop, otherwise ventilation will continue.
   - Ventilation stops.
   - The blue LED located to the upper-right of the VENTILATION ON/OFF key (Figure 7-39, item 2) illuminates to indicate ventilation is on Standby.
   - A prompt for a new start of ventilation is displayed (see Figure 7-38, on page 7-39).
7.12 Turning Off the Ventilator

WARNING: When the ventilator is switched back on after it was switched off while ventilation was in progress, it will immediately begin ventilating—without the user first having to press the VENTILATION ON/OFF key.

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

Set the I/O switch to the O position to power off the ventilator.

- The blue LED to the right of the VENTILATION ON/OFF key turns off.
- The ventilator screen switches off.

Note: When the ventilator is completely stopped, but is still connected to the AC power source (the green AC POWER indicator is illuminated), the internal battery continues charging.

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

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

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

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

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

8.1 Battery Capacity

The reserve capacity offered by the internal battery depends on the level of ventilation parameters, the environmental conditions (primarily in terms of temperature) and the physiological characteristics of the patient.
With a fully charged battery at a normal room temperature of 25 °C (± 5 °C), the ventilator can be expected to operate on internal battery power for the average durations shown in Table 8-1.

Checking the battery charge level requires that the ventilator be running on battery power at the time of the battery check. To check the battery charge level, temporarily disconnect the ventilator from AC power (while in Stand By mode or while providing ventilation) and read the percent charge level displayed adjacent to the battery icon displayed at the top of the ventilator's display screen.

### Table 8-1. Internal Battery Reserve Capacity

<table>
<thead>
<tr>
<th>Displayed Values</th>
<th>Average Operating Time on Internal Battery Power¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vt = 200 ml (± 5 ml)</td>
<td>5 hours (–10%)</td>
</tr>
<tr>
<td>PIP = 10 mbar (± 2 mbar)</td>
<td></td>
</tr>
<tr>
<td>Rate = 20 bpm</td>
<td></td>
</tr>
<tr>
<td>Vt = 300 ml (± 5 ml)</td>
<td>4 hours (–10%)</td>
</tr>
<tr>
<td>PIP = 20 mbar (± 2 mbar)</td>
<td></td>
</tr>
<tr>
<td>Rate = 15 bpm</td>
<td></td>
</tr>
<tr>
<td>Vt = 500 ml (± 5 ml)</td>
<td>3 hours (–10%)</td>
</tr>
<tr>
<td>PIP = 30 mbar (± 2 mbar)</td>
<td></td>
</tr>
<tr>
<td>Rate = 15 bpm</td>
<td></td>
</tr>
<tr>
<td>Vt = 750 ml (± 5 ml)</td>
<td>2 hours (–10%)</td>
</tr>
<tr>
<td>PIP = 45 mbar (± 2 mbar)</td>
<td></td>
</tr>
<tr>
<td>Rate = 20 bpm</td>
<td>(Maximum Ventilation Parameters)</td>
</tr>
</tbody>
</table>

¹. Average durations shown are with a fully charged battery having less than 50 charge/recharge cycles.

### 8.2 Battery Operation

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

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

In the event of AC power interruption or disconnection of the external AC or DC power supply, the ventilator automatically switches to its internal battery and the following events occur:

- The battery symbol is displayed at the top on the general information line.
- Battery reserve capacity is displayed on the right of the battery symbol.
- The internal battery indicator at the top left of the ventilator’s front panel is continuously lit (Figure 8-1).

Figure 8-1. Internal Battery Indicator

- A loss of external supply alarm is activated.

If ventilation is stopped, the internal battery reserve capacity is displayed as a percentage of battery charge. See Figure 8-2.

Figure 8-2. Battery Reserve Capacity as a Percentage

If the ventilator is running, the internal battery reserve is momentarily displayed as a percentage. Then, after the ventilator calculates the battery time remaining (which takes about two minutes, depending on the power consumption of the ventilator), the internal battery reserve is then displayed in hours and minutes (rounded to the nearest 10 minutes). See Figure 8-3.
The “LOW BATTERY” and “EMPTY BATTERY” alarms (see Chapter 5, “Alarms and Troubleshooting”) are triggered when the internal battery reserve is reduced.

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

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

From the time that an “EMPTY BATTERY” alarm is activated, if no external supply is connected to the ventilator, other alarms may be triggered due to insufficient supply voltage.

In the final discharge phase, the “EMPTY BATTERY” alarm will become continuous, and ventilation may be interrupted at any time during this phase.

⚠️ Note: The “EMPTY BATTERY” alarm symbol may disappear shortly before the ventilator completely stops, but it always triggers a final, continuous alarm.

### 8.3 Testing the Battery

Your ventilator continuously and automatically checks the state of the internal battery, even when the battery is not used as the main source of energy. The “BATTERY FAULT1” alarm is activated whenever a problem is detected in the battery or the charger.

However, on a monthly basis you should disconnect the ventilator from the external power supply to check the integrity of the connections linking the internal battery to other ventilator components.
8.4 Recharging the Battery

In the event that the battery charge level is considered insufficient, as per the reserve capacity display, recharge of the internal battery is necessary. In general, it is recommended that the ventilator be allowed to charge when the battery drops below 80%, and that the ventilator be recharged systematically after storage and before using it again.

**Note:**
To avoid cycling and extend battery life while connected to an AC power source, the battery will not begin charging until it has dropped below an 85%-90% charge.

**To charge the internal battery, do the following:**

Connect the ventilator to the AC power source.
- The “AC POWER” indicator illuminates (*Figure 8-4.*, item 1).
- The “INTERNAL BATTERY” indicator flashes (*Figure 8-4., item 2).

*Figure 8-4. Power Indicators When Charging the Battery*

When the battery charge is complete, the “INTERNAL BATTERY” indicator turns off.
**WARNING:**
Even if the “INTERNAL BATTERY” indicator is off, charge of the battery may sometimes be incomplete regardless of charge time when the ambient temperature is above 40 °C (104 °F). This is due to the characteristics of the battery’s internal heat safety device.

Although it is not necessary to start the ventilator to charge the battery, charging the battery during operation will increase the time required to fully charge the internal battery.

When recharging a depleted internal battery, it may be necessary to leave the ventilator on charge for up to six (6) hours if the ventilator is on standby and about 13 hours if ventilation is operating.

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

### 8.5 Storage

If the ventilator is to be stored for an extended period of time, it is not necessary to remove the battery. However, the ventilator should be stored in cool, dry, well-ventilated environment, as follows:

- Temperature: approximately 21 °C (70 °F)
- Humidity: less than 80% RH

**Note:**
When the device is in storage it should be recharged monthly to maximize battery life.

If the battery is stored for more than one month at a temperature greater than 21 °C (70 °F), or for more than one or two weeks at a temperature greater than 45 °C (113 °F), the reserve capacity of the battery may be affected. It will then be necessary to recharge the battery before using it again.

If the ventilator has been in storage for longer than 30 days, connect it to an AC power source, turn on the unit by the I/O switch at the rear of the ventilator, and let it charge for 15 minutes prior to starting ventilation.

The battery should not be stored for more than two years, whatever the conditions.

**Note:**
Fully charge the internal battery prior to disconnecting from AC Power source (“mains”).
9 Cleaning

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

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

9.1 Cleaning the Ventilator

Clean all external panels and surfaces before and after each patient use and as often as necessary to keep the ventilator clean. You should clean the ventilator periodically, whenever it is soiled or dirty, before any maintenance operation, and before storing the ventilator.

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

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

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

To clean the surface of the ventilator:
1. Dip a clean, soft cloth into a mixture of mild soap and water, or other approved cleaning solution. See Table 9-1. for a list of approved cleaning solutions.
2. Squeeze the cloth thoroughly to remove excess liquid.

3. Lightly wipe the external casing of the ventilator, taking care not to allow excess moisture to enter any of the openings on the ventilator’s surface. See the warning, above.

Dry the ventilator surface with a clean, soft, lint-free cloth.

9.2 Cleaning the Accessories

Follow the accessory manufacturer’s instructions for cleaning the ventilator’s accessories and components, including the patient circuit.

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

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

9.3 Cleaning the Ventilator Between Patients

To prepare the ventilator for use with a new patient, do the following:

1. Change the patient circuit and all filters.

2. Clean the ventilator. (See section 9.1, "Cleaning the Ventilator")
10 Routine Maintenance

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

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

10.1 Replacing the Air Inlet Filter

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

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

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

If the ventilator is used indoors, the condition of the air inlet filter should be checked monthly. If the ventilator is used outdoors or in a dusty environment, the air inlet filter should be checked weekly and replaced as necessary.
To replace the air inlet filter:
1. Hold the filter between your fingers (see Figure 10-1, item 1).
2. Remove the filter (Figure 10-1, item 2) and discard it.
3. Place the new filter in the device, while ensuring that:
   a. The fine particle side of the filter faces outwards, away from the ventilator.
   b. The filter is properly installed in its housing. Proper installation of the filter prevents particles from entering the device.

Figure 10-1. Replacing the Air Inlet Filter

10.2 Recommended Schedule of Maintenance

Consumables and Replacement Intervals
When used under normal circumstances - a relatively dust-free atmosphere, and without damage to the device and its components (shocks, cracks, significant dirt) - the intervals for replacing the ventilator's consumable elements are as follows:

Table 10-1. Consumables and Replacement Intervals

<table>
<thead>
<tr>
<th>Elements</th>
<th>Recommended Replacement Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Inlet Filter (Foam + Fine Particle)</td>
<td>Once a month or more often, depending on the extent of soiling</td>
</tr>
<tr>
<td>Inspiratory Bacteria Filter</td>
<td>See manufacturer’s recommendation</td>
</tr>
<tr>
<td>Patient Circuit</td>
<td>See manufacturer’s recommendation</td>
</tr>
<tr>
<td></td>
<td>Single use Single patient</td>
</tr>
</tbody>
</table>

Note:
For a list of parts and accessories, see Appendix H, “Parts and Accessories” or contact your service representative or consult http://www.covidien.com/rms/.
Recommended Schedule of Maintenance

Note:
For all additional accessories not necessarily considered as consumables consult the manufacturer’s recommendations.

Note:
To prevent any risk of cross contamination Covidien recommends the use of STERIVENT filters (Ref: 351/5856 or equivalent) to protect the patient outlet port.

WARNING:
Regularly check the cleanliness of the air inlet filter located on the rear of the ventilator. Replace it when necessary—even before the recommended replacement period has elapsed, and particularly when the ventilator is installed on the wheelchair. Environmental conditions may cause the filter to become dirty more rapidly.

Failure to observe these recommendations may result in a loss of performance, excessive overheating, a loss of certain functions and, in the long term, compromise the longevity of the ventilator.

Maintenance of the Internal Battery
The internal battery does not need to be removed to verify its correct operation.

Periodic Test of the Internal Battery
Your ventilator continuously and automatically checks the state of the internal battery, even when the internal battery is not used as the main power source.

However, the battery charge status should be checked MONTHLY by disconnecting the ventilator from external power supplies (see section 8.2, “Battery Operation”). Such a test is imperative after opening the ventilator or after a prolonged period of non-use (one month or more), in order to ensure the correct operation of internal connections linking the battery to other components.

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

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

Replacement of the Internal Battery
The internal battery should be replaced when the battery capacity drops below 1920 mAh. Keep in mind that, for environmental protection, the ventilator and its components—including its internal battery—cannot be disposed of with household waste. You must submit the ventilator and its components for suitable selective collection and possible recycling and observe all applicable regulations.
Note:
As the total number of battery charge/discharge cycles approaches 300, a drop in potential of as much as 20% may be detected.

10.3 Service Assistance

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

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

In the event of a problem with the ventilator, see Chapter 5, "Alarms and Troubleshooting." If you cannot determine the cause of the problem, contact your equipment supplier or Covidien.

For more information and local Covidien Technical Service Contact details, see "Technical Support" in the Preface.
A  Patient/Caregiver Checklist

What the Patient and Caregiver Must Understand

*Table A-1.* presents a summary of the topics that patients and caregivers must understand in order to use the ventilator successfully. Some topics may not apply to some patients, while other patients may require additional information.

The Clinician’s Responsibility

It is the responsibility of the clinician or clinical educator to ensure that both the patient and the caregiver fully understand the topics listed below.

<table>
<thead>
<tr>
<th>List of Topics</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for ventilation.</td>
<td>Clinician</td>
</tr>
<tr>
<td>Intended use of the ventilator.</td>
<td>Chapter 2, “Ventilator Overview”</td>
</tr>
<tr>
<td>The principles of operation for the ventilator.</td>
<td>Appendix C, “Theory of Operation”</td>
</tr>
<tr>
<td>Supplies required for ventilation, and their sources.</td>
<td>Clinician; Appendix G, “Unpacking and Preparation;” Appendix H, “Parts and Accessories”</td>
</tr>
<tr>
<td>Schedule for ventilation.</td>
<td>Clinician</td>
</tr>
<tr>
<td>How and why to monitor the patient’s condition.</td>
<td>Clinician</td>
</tr>
<tr>
<td>The importance of coordinating care for the patient.</td>
<td>Clinician</td>
</tr>
<tr>
<td>Resources for respite care.</td>
<td>Clinician</td>
</tr>
<tr>
<td>Choices about future care.</td>
<td>Clinician</td>
</tr>
<tr>
<td>The purpose of advanced directives.</td>
<td>Clinician</td>
</tr>
<tr>
<td>How to check the patient’s vital signs.</td>
<td>Clinician</td>
</tr>
<tr>
<td>The significance of the patient’s ease of breathing.</td>
<td>Clinician</td>
</tr>
<tr>
<td>What to note about the patient’s skin, mucus membranes, and secretions, and their significance.</td>
<td>Clinician</td>
</tr>
<tr>
<td>How to recognize the signs of infection, and how to respond.</td>
<td>Clinician</td>
</tr>
<tr>
<td>Whom to contact for medical emergencies, equipment emergencies, or power emergencies.</td>
<td>Clinician; section 5.8, “Troubleshooting;” section 10.3, “Service Assistance”</td>
</tr>
<tr>
<td>List of Topics</td>
<td>References</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Equipment and phone numbers to have available in cases of emergency.</td>
<td>Clinician; Section 10.3, &quot;Service Assistance&quot;</td>
</tr>
<tr>
<td>How to contact other resources for assistance (health aides, attendants, therapists).</td>
<td>Clinician</td>
</tr>
<tr>
<td>The importance of routine medical appointments and medical testing.</td>
<td>Clinician</td>
</tr>
<tr>
<td>Power sources for the ventilator and how to connect them.</td>
<td>Section 6.2, &quot;Connecting to External AC Power&quot; and section 6.3, &quot;Connecting to an External DC Power Source.&quot;</td>
</tr>
<tr>
<td>The meaning of keys and buttons.</td>
<td>Section 2.7, &quot;Control Panel&quot;</td>
</tr>
<tr>
<td>The meaning of symbols and markings.</td>
<td>Section 1.3, &quot;Symbols and Markings&quot;</td>
</tr>
<tr>
<td>How to connect the patient to the ventilator via the patient breathing circuit.</td>
<td>Section 6.4, &quot;Patient Circuit&quot;</td>
</tr>
<tr>
<td>The parts and purpose of the breathing circuit.</td>
<td>Chapter 6, &quot;Installation and Assembly&quot;</td>
</tr>
<tr>
<td>How and when to inspect, clean, and replace the patient circuit.</td>
<td>Chapter 1, &quot;Safety Information&quot;; Chapter 9, &quot;Cleaning&quot;; Section 10.2, &quot;Recommended Schedule of Maintenance&quot;</td>
</tr>
<tr>
<td>How to recognize and respond to problems with the breathing circuit.</td>
<td>Chapter 5, &quot;Alarms and Troubleshooting&quot;</td>
</tr>
<tr>
<td>The parts and purpose of the nasal interface or mask.</td>
<td>Clinician or manufacturer's instructions for use.</td>
</tr>
<tr>
<td>Care of the nasal interface or mask.</td>
<td>Clinician or manufacturer's instructions for use.</td>
</tr>
<tr>
<td>How to recognize and respond to problems with the nasal interface or mask.</td>
<td>Clinician or manufacturer's instructions for use.</td>
</tr>
<tr>
<td>How to install the humidifier.</td>
<td>Section 6.6, &quot;Humidifier&quot;</td>
</tr>
<tr>
<td>How to perform alarms tests, and how to respond if the alarms tests fail.</td>
<td>Appendix F, &quot;Alarms Tests&quot;; Chapter 5, &quot;Alarms and Troubleshooting&quot;</td>
</tr>
<tr>
<td>Replacement interval for outlet filters (per the filter manufacturer's instructions).</td>
<td>Section 10.2, &quot;Recommended Schedule of Maintenance&quot;</td>
</tr>
<tr>
<td>Setting ventilation parameters and the importance of each.</td>
<td>Chapter 3, &quot;Operating Parameters&quot;</td>
</tr>
<tr>
<td>Ventilator alarm settings; understanding the purpose and function of each.</td>
<td>Section 5.7, &quot;Overview of Alarms&quot;</td>
</tr>
<tr>
<td>Recognizing alarm priority level.</td>
<td>Section 5.1, &quot;Alarm Level of Priority&quot;</td>
</tr>
<tr>
<td>What to do in case of ventilator alarms and problems.</td>
<td>Chapter 5, &quot;Alarms and Troubleshooting&quot;</td>
</tr>
<tr>
<td>What to do if the ventilator alarms inappropriately.</td>
<td>Section 5.8, &quot;Troubleshooting&quot;</td>
</tr>
<tr>
<td>The oxygen setting, and why it is required.</td>
<td>Clinician</td>
</tr>
<tr>
<td>How to connect the oxygen source to the ventilator.</td>
<td>Clinician; section 6.7.1, &quot;Administering Oxygen&quot;</td>
</tr>
<tr>
<td>List of Topics</td>
<td>References</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>How to determine the quantity of oxygen being delivered, and how to adjust the quantity.</td>
<td>Clinician; section 6.7.1, <em>Administering Oxygen</em></td>
</tr>
<tr>
<td>Safety rules for the use of oxygen.</td>
<td>Chapter 1, <em>Safety Information</em>; section 6.7.1, <em>Administering Oxygen</em></td>
</tr>
<tr>
<td>How to recognize and respond to problems with the oxygen supply.</td>
<td>Clinician</td>
</tr>
<tr>
<td>How to respond to dyspnea.</td>
<td>Clinician</td>
</tr>
<tr>
<td>Techniques to prevent aspiration of vomit.</td>
<td>Clinician</td>
</tr>
</tbody>
</table>
B Specifications

B.1 Physical

Table B-1. Physical Description (Excluding Accessories)

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator Weight</td>
<td>9.9 lb. (4.5 kg)</td>
</tr>
<tr>
<td>Ventilator Dimensions</td>
<td>9.25 in wide x 12.40 in deep x 6.0 in high (235 mm wide x 315 mm deep x 154 mm high)</td>
</tr>
<tr>
<td>Connectors</td>
<td>Inspiratory limb connector: ISO 22 mm (OD) conical Oxygen inlet: Female Connector with valve</td>
</tr>
<tr>
<td>Device airway volume</td>
<td>2000 ml</td>
</tr>
<tr>
<td>Breathing circuit volume</td>
<td></td>
</tr>
<tr>
<td>• Adult, single limb</td>
<td>550 ml</td>
</tr>
<tr>
<td>• Pediatric, single limb</td>
<td>300 ml</td>
</tr>
<tr>
<td>Air Inlet Filter</td>
<td>Dimensions: 70 mm long x 60 mm wide Composition: Polypropylene fiber electrostatic filter material, which is laminated onto polyurethane open-celled foam. Efficiency: 99.999982% at 30 Lpm (filtering microbes 3.3 μm)</td>
</tr>
<tr>
<td>Inspiratory Bacteria Filter Requirement</td>
<td>Maximum allowable flow resistance: 4mbar at 60 lpm</td>
</tr>
</tbody>
</table>

B.2 Electrical

Table B-2. AC Electrical Supply

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Frequency</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 VAC to 240 VAC</td>
<td>50 Hz / 60 Hz</td>
<td>180 VA max</td>
</tr>
<tr>
<td>12 VDC</td>
<td>NA</td>
<td>8.3 A</td>
</tr>
<tr>
<td>30 VDC</td>
<td>NA</td>
<td>3.3 A</td>
</tr>
</tbody>
</table>
Table B-3. Internal Lithium Ion Battery

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>25.2 VDC</td>
</tr>
<tr>
<td>Full-load capacity</td>
<td>2.4 Ah</td>
</tr>
<tr>
<td>Ampere-hour rating</td>
<td>On standby: 1.5 Ah During ventilation: 0.5 Ah</td>
</tr>
<tr>
<td>Watt hour rating</td>
<td>62Wh to 63Wh</td>
</tr>
<tr>
<td>Charging current</td>
<td>1.5 A/hr. (duration: &lt; 4 hr.) 0.5 A/hr. (duration: &lt; 8 hr.)</td>
</tr>
</tbody>
</table>

Average operating time at 25 °C (± 5 ºC) with a fully charged battery (having less than 50 charge/discharge cycles) at the following displayed values:

- Vt = 200 ml (± 5 ml), PIP = 10 mbar (± 2 mbar), Rate = 20 bpm: 5 hr. (–10%)
- Vt = 300 ml (± 5 ml), PIP = 20 mbar (± 2 mbar), Rate = 15 bpm: 4 hr. (–10%)
- Vt = 500 ml (± 5 ml), PIP = 30 mbar (± 2 mbar), Rate = 15 bpm: 3 hr. (–10%)
- Vt = 750 ml (± 5 ml), PIP = 45 mbar (± 2 mbar), Rate = 20 bpm (maximum settings): 2 hr. (–10%)

Table B-4. Remote Alarm

Remote Alarm Port: Also known as the Nurse's Call port, it provides for remote alerts of ventilator alarm conditions.

An example of a setting that requires such a feature is when the ventilator is used in an isolation room. The ventilator signals an alarm using a normally open (NO) or a normally closed (NC) signal.

A remote alarm is activated when an alarm condition occurs, unless the audio paused function is active or the ventilator power switch is turned off.

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

The remote alarm port is an 8-pin female connector. Allowable current is 100 mA at 24 VDC (maximum).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Remote Alarm Wire color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>relay common</td>
<td>black</td>
</tr>
<tr>
<td>2</td>
<td>normally open (NO)</td>
<td>brown</td>
</tr>
<tr>
<td>3</td>
<td>normally closed (NC)</td>
<td>orange</td>
</tr>
<tr>
<td>4</td>
<td>remote supply - (not used)</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>RX Signal (not used)</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>TX Signal (not used)</td>
<td>N/A</td>
</tr>
<tr>
<td>7</td>
<td>remote supply + (not used)</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>not used</td>
<td>N/A</td>
</tr>
</tbody>
</table>
B.3 Indicators and Alarms

Table B-5. Power Indicators

<table>
<thead>
<tr>
<th>Ventilation ON/OFF</th>
<th>AC power</th>
<th>DC power</th>
<th>Internal Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Blue in standby mode</td>
<td>Green</td>
<td>Green</td>
<td>• Flashing if the battery charge is in progress.</td>
</tr>
<tr>
<td>• Not lit if ventilation is in progress.</td>
<td></td>
<td></td>
<td>• Continuously lit if the ventilator is powered by the internal battery.</td>
</tr>
</tbody>
</table>

Table B-6. Alarm Indicators

<table>
<thead>
<tr>
<th>High Priority</th>
<th>Medium Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red flashing LED</td>
<td>Yellow flashing LED</td>
</tr>
</tbody>
</table>

Table B-7. Audio Alarms

<table>
<thead>
<tr>
<th>Audio Paused</th>
<th>Alarm Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 s ± 1 s</td>
<td>65 to 80 dB (A) ± 10% at 1 meter</td>
</tr>
</tbody>
</table>

B.4 Performance

B.4.1 Specifications

Table B-8. Performance Parameter Specifications and Tolerances

<table>
<thead>
<tr>
<th>Settings</th>
<th>Range</th>
<th>Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>5 to 55 mbar</td>
<td>± (1 mbar +10%)</td>
</tr>
<tr>
<td>Time</td>
<td>0.3 to 2.4 s</td>
<td>± 50 ms or 10%, whichever is greater</td>
</tr>
<tr>
<td>Rate</td>
<td>1 to 60 bpm</td>
<td>± 1 bpm</td>
</tr>
<tr>
<td>Inspiratory Sensitivity</td>
<td>0P to 5</td>
<td>N/A</td>
</tr>
<tr>
<td>Exhalation Sensitivity</td>
<td>5 to 95%</td>
<td>± (4 lpm +10%) of target exhalation flow based on E Sens within 50ms</td>
</tr>
<tr>
<td>I:E</td>
<td>1:4 to 1:1</td>
<td>± 50 ms or 10%, whichever is greater</td>
</tr>
<tr>
<td>I/T</td>
<td>20% to 50%</td>
<td>± 50 ms or 10%, whichever is greater</td>
</tr>
</tbody>
</table>

1. The ventilator parameters’ displayed values could vary based on patient settings.
B.5 Monitored Parameters

Table B-9. Monitored Parameter Tolerances

<table>
<thead>
<tr>
<th><strong>Ventilator Parameters</strong></th>
<th><strong>Tolerances</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Inspiratory Pressure (PIP)</td>
<td>± (2 mbar + 8%)</td>
</tr>
<tr>
<td>Positive End Expiratory Pressure (PEEP)</td>
<td>± (2 mbar + 8%)</td>
</tr>
<tr>
<td>Inspiratory Tidal Volume (VTI)</td>
<td>± (10 ml + 10%VTI) x Rate</td>
</tr>
<tr>
<td>Total Breath Rate (Rtot)</td>
<td>± 1 bpm</td>
</tr>
<tr>
<td>I:E Ratio (I:E)</td>
<td>± 50 ms or 10%, whichever is greater</td>
</tr>
<tr>
<td>I/T Ratio (I/T)</td>
<td>± 50 ms or 10%, whichever is greater</td>
</tr>
<tr>
<td>Inspiratory Time (I Time)</td>
<td>± 100 ms</td>
</tr>
<tr>
<td>Inspiratory Minute Volume (M Vol)</td>
<td>± (10ml + 10%)</td>
</tr>
<tr>
<td>Leak</td>
<td>± (3 lpm + 20%)</td>
</tr>
<tr>
<td>Apnea Index (AI)</td>
<td>± 1 ev/h</td>
</tr>
<tr>
<td>Apnea Time</td>
<td>± 1 s</td>
</tr>
<tr>
<td>% Spontaneous (Spont)</td>
<td>± 1 %</td>
</tr>
<tr>
<td>Peak Airway Pressure (Paw)</td>
<td>± (2 mbar + 8%)</td>
</tr>
</tbody>
</table>

1. The Puritan Bennett™ 520 Ventilator does not have the capability to reduce pressure below the PEEP pressure during the exhalation phase.

B.6 Range, Resolution, and Accuracy

Table B-10. lists the ranges, resolutions, and accuracies for ventilator settings, alarm settings, and patient data.

Table B-10. Ventilator Range, Resolution, and Accuracy

<table>
<thead>
<tr>
<th><strong>Ventilator Settings</strong></th>
<th><strong>Range, Resolution, and Accuracy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Range: P A/C, PSV, CPAP</td>
</tr>
<tr>
<td></td>
<td>Resolution: N/A</td>
</tr>
<tr>
<td></td>
<td>Accuracy: N/A</td>
</tr>
<tr>
<td></td>
<td>Default value: P A/C</td>
</tr>
<tr>
<td>Vt Target</td>
<td>Range: 50 mL to 2000 mL</td>
</tr>
<tr>
<td></td>
<td>Resolution: 10 mL</td>
</tr>
<tr>
<td></td>
<td>Accuracy: Vt target &lt; VTI &lt; Vt target +20% if Max P is high enough to reach Vt target</td>
</tr>
<tr>
<td></td>
<td>Default value: OFF (100 mL)</td>
</tr>
</tbody>
</table>
Inspiratory Pressure

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| Inspiratory Pressure (Pi) | Range: 5 mbar to 55 mbar in valve configuration  
Range: 6 mbar to 30 mbar in leak configuration  
Resolution: 1 mbar  
Accuracy: \( \pm (1 \text{ mbar} + 10\%) \) of Pi + PEEP setting  
Default value: 15 mbar  
Depends on PEEP when Relative Pressure is set to YES |

Pressure support (P Support)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| Pressure support (P Support) | Range: OFF or 5 mbar to 55 mbar in valve configuration  
Range: 6 mbar to 30 mbar in leak configuration  
Resolution: 1 mbar  
Accuracy: \( \pm (1 \text{ mbar} + 10\%) \) of P Support + PEEP setting  
Default value: 15 mbar  
Depends on PEEP when Relative Pressure is set to YES |

I:E Ratio (I:E)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| I:E Ratio (I:E) | Range: from 1:1 to 1:4  
Resolution: 1/0.1 s  
Accuracy: \( \pm 50 \text{ ms} \) or 10%, whichever is greater  
Default value: 1/2 |

I/T Ratio (I/T)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| I/T Ratio (I/T) | Range: 20% to 50%  
Resolution: 1%  
Accuracy: \( \pm 50 \text{ ms} \) or 10%, whichever is greater  
Default value: 33% |

Inspiratory time (Insp Time)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| Inspiratory time (Insp Time) | Range: 0.3 s to 6.0 s  
Resolution: 0.1 s  
Accuracy: \( \pm 50 \text{ ms} \) or 10%, whichever is greater  
Default value: 1.5 s  
Depends on: R-Rate |

Respiratory rate (R-Rate)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| Respiratory rate (R-Rate) | Range: 1 bpm to 60 bpm in P A/C mode  
Resolution: 1 bpm  
Accuracy: \( \pm 1 \text{ bpm} \)  
Default value: 13 |

Inspiratory sensitivity (I Sens)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| Inspiratory sensitivity (I Sens) | Range: 0P-5  
Resolution: 1  
Accuracy: NA  
Default value: 2  
in CPAP, I Sens is set to 2 and is not adjustable |

Exhalation sensitivity (E Sens)

<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| Exhalation sensitivity (E Sens) | Range: 5% to 95% of peak flow  
Resolution: 5%  
Accuracy: \( \pm (4 \text{ lpm} + 10\%) \) of target exhalation flow based on E Sens within 50ms  
Default value: 25%  
In CPAP, E Sens is fixed at 25% and is not adjustable |
<table>
<thead>
<tr>
<th>Ventilator Settings</th>
<th>Range, Resolution, and Accuracy</th>
</tr>
</thead>
</table>
| PEEP                               | Range: OFF (0.5 mbar) to 20 mbar  
Resolution: 1 mbar  
Accuracy: ± (1 mbar + 10%) mbar  
Default value: OFF  
Depends on: Pi in P A/C and PSV modes when Relative Pressure is set to YES                                                                                       |
| Rise time                          | Range: 1-4  
Resolution: 1  
Default value: 2  
Depends on: Insp time                                                                                                                                                                                                          |
| Backup rate                        | Range: 4-40 bpm  
Resolution: 1 bpm  
Default value: 13  
Depends on: Min I time                                                                                                                                                                                                           |
| Apnea time                         | Range: AUTO or 1-60 s  
Resolution: 1 s  
Default value: AUTO  
Depends on: Backup R  
In PSV, Apnea time: AUTO = 60/Backup R  
In CPAP, Apnea Time: AUTO = 30                                                                                                                                                                                                 |
| Minimum Inspired Tidal Volume (Min VTI) | Range: 30 mL to 1990mL  
Resolution: 10 mL  
Default value: 300  
Depends on: Max VTI                                                                                                                                                                                                              |
| Maximum Inspired Tidal Volume (Max VTI) | Range: 80 mL to 3000 mL  
Resolution: 10 mL  
Default value: 2000 mL  
Depends on: Min VTI                                                                                                                                                                                                              |
| Maximum Respiratory Rate (Max Rtot) | Range: 10 bpm to 70 bpm  
Resolution: 1 bpm  
Default value: OFF  
Depends on: R-Rate                                                                                                                                                                                                                  |
| Minimum Inspiratory Time (Min I time) | Range: 0.1 to 2.8s  
Resolution: 0.1 s  
Default value: AUTO (Rise time + 300 ms)  
Depends on: Max I Time, Backup R, Rise time                                                                                                                                 |
| Maximum Inspiratory Time (Max I time) | Range: 0.8 to 3 s  
Resolution: 0.1 s  
Default value: AUTO (Min [3 s; (30/R-Rate)])  
Depends on: Min I Time, R-Rate                                                                                                                                                                                                 |
B.7 Environmental

The following environmental conditions shall be observed:

**Table B-11. Environmental Conditions for Storage or Transport**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Humidity</th>
<th>Atmospheric pressure</th>
<th>Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40°C to +70°C</td>
<td>10% to 95% RH</td>
<td>500 hPa to 1060 hPa</td>
<td>-152 m to 3964 m</td>
</tr>
<tr>
<td>(-40°F to +158 °F)</td>
<td></td>
<td>(7.2 psi to 15.4 psi)</td>
<td>(-500 ft to 13,000 ft)</td>
</tr>
</tbody>
</table>

**Table B-12. Environmental Conditions for Operation**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Humidity</th>
<th>Atmospheric pressure</th>
<th>Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5°C to 40°C</td>
<td>10% to 95% RH</td>
<td>600 hPa to 1100 hPa</td>
<td>-152 m to 3964 m</td>
</tr>
<tr>
<td>(+41 °F to 104 °F)</td>
<td></td>
<td>(8.7 psi to 16.0 psi)</td>
<td>(-500 ft to 13,000 ft)</td>
</tr>
</tbody>
</table>

Under extreme conditions of use, within the limits of a supply voltage of –20% and temperature ranging from normal to 45 °C (113 °F) with ≤ 75% RH, the ventilator should not malfunction or endanger the user. However, operating the device for prolonged periods or repeatedly under such extreme conditions could result in premature aging of components and more frequent maintenance.

B.8 USB

**Table B-13. USB Memory Device Specifications**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Supported formats</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB compatibility</td>
<td>USB flash memory USB 2.0 or USB 1.1</td>
</tr>
<tr>
<td>Memory file format</td>
<td>USB 32 bit format (sector size: 512 - 2,048 bytes)</td>
</tr>
<tr>
<td>Number of files</td>
<td>Maximum 999</td>
</tr>
<tr>
<td>USB size</td>
<td>128 MB to 4 GB</td>
</tr>
</tbody>
</table>

**Table B-14. Data Transfer Characteristics**

<table>
<thead>
<tr>
<th>Ventilator data description</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trends capacity</td>
<td>86 MB</td>
</tr>
<tr>
<td>Events capacity</td>
<td>512 KB or 5,500 events</td>
</tr>
<tr>
<td>Monitoring capacity</td>
<td>42 MB / 48 hours</td>
</tr>
</tbody>
</table>
B.9 Pneumatic

Table B-15. Airway Resistances

<table>
<thead>
<tr>
<th>Inspiratory</th>
<th>Exhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 mbar at 30 lpm flow ± 0.1 mbar</td>
<td>0.5 mbar at 30 lpm ± 0.1 mbar</td>
</tr>
<tr>
<td>3.7 mbar at 60 lpm flow ± 0.1 mbar</td>
<td>1.1 mbar at 60 lpm ± 0.1 mbar</td>
</tr>
</tbody>
</table>

Table B-16. Air Inlet Resistance (Filter)

1.1 cmH2O (1.079 mbar) at 30 lpm flow +/- 0.1 cmH2O

Table B-17. Oxygen Inlet Specifications

<table>
<thead>
<tr>
<th>Maximum pressure</th>
<th>Maximum flow (See Table B-8, Performance Parameter Specifications and Tolerances)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 kPa (7 psi)</td>
<td>15 lpm</td>
</tr>
</tbody>
</table>

Table B-18. Performance Specifications

<table>
<thead>
<tr>
<th>Working pressure</th>
<th>Sound pressure level</th>
<th>Maximum pressure limit</th>
<th>Internal compliance (ventilator)</th>
<th>Inspiratory triggering response time (Ttr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 mbar – 55 mbar</td>
<td>30 dBA (per NF EN ISO 17510-1 test conditions)</td>
<td>60 mbar</td>
<td>.0001 l/mbar</td>
<td>100 ms</td>
</tr>
</tbody>
</table>

B.10 Manufacturer’s Declaration

The following tables, Table B-19. through Table B-23., contain the manufacturer’s declarations for the ventilator’s electromagnetic emissions, electromagnetic immunity, and recommended separation distances between the ventilator and portable and mobile RF communications equipment, as well as a list of compliant cables.

WARNING:
The Puritan Bennett™ 520 ventilator requires special precautions for electromagnetic compatibility and should be installed and started according to the recommendations found in Appendix B, “Specifications.” In particular, the use of nearby mobile and portable communications equipment using radio frequencies, such as mobile telephones or other systems exceeding the levels set in the IEC 60601-1-2 standard, may affect its operation. Refer to section B.10 “Manufacturer’s Declaration.”

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

Table B-19. Electromagnetic Emissions

<table>
<thead>
<tr>
<th>RF emissions</th>
<th>Group 1</th>
<th>The ventilator uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISPR 11 / EN 55011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF emissions</td>
<td>Class B</td>
<td>The ventilator is suitable for use in all establishments including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.</td>
</tr>
<tr>
<td>CISPR 11 / EN 55011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic emissions</td>
<td>Class A</td>
<td></td>
</tr>
<tr>
<td>IEC / EN 61000-3-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage fluctuations/flicker emissions</td>
<td>Complies</td>
<td></td>
</tr>
<tr>
<td>IEC / EN 61000-3-3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table B-20. Electromagnetic Immunity

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>IEC / EN 60601 Test Level</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment—Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge (ESD)</td>
<td>± 6 kV contact ± 8 kV air</td>
<td>± 6 kV contact ± 8 kV air</td>
<td>Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.</td>
</tr>
<tr>
<td>IEC / EN 61000-4-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical fast transient/burst</td>
<td>± 2 kV for power supply lines ± 1 kV for input/output lines</td>
<td>± 2 kV for power supply lines ± 1 kV for input/output lines</td>
<td>AC power (“mains”) quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC / EN 61000-4-4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surge</td>
<td>± 1 kV lines/lines ± 2 kV lines/earth</td>
<td>± 1 kV lines/lines ± 2 kV lines/earth</td>
<td>AC power (“mains”) power quality should be that of a typical commercial or hospital environment.</td>
</tr>
<tr>
<td>IEC / EN 61000-4-5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Voltage dips, short interruptions and voltage variations on power supply input lines

<table>
<thead>
<tr>
<th>Voltage (UT%)</th>
<th>Duration</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 5% UT</td>
<td>0.5 cycle</td>
<td>95% dip</td>
</tr>
<tr>
<td>40% UT</td>
<td>5 cycles</td>
<td>60% dip</td>
</tr>
<tr>
<td>70% UT</td>
<td>25 cycles</td>
<td>30% dip</td>
</tr>
<tr>
<td>@ 5% UT</td>
<td>5 s</td>
<td>95% dip</td>
</tr>
</tbody>
</table>

AC power (“mains”) power quality should be that of a typical commercial or hospital environment. If the user of the ventilator requires continued operation during power mains interruptions, it is recommended that the ventilator be powered from an uninterruptible power supply or a battery.

Power frequency (50/60 Hz) magnetic field

<table>
<thead>
<tr>
<th>Magnetic Field (A/m)</th>
<th>Duration</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 A/m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

**Note:**

UT is the AC mains voltage prior to application of the test level.
**Table B-21. Electromagnetic Immunity—Conducted and Radiated RF**

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

<table>
<thead>
<tr>
<th>Immunity Test</th>
<th>IEC / EN 60601-1-2 Test Level</th>
<th>Compliance Level</th>
<th>Electromagnetic Environment—Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted RF</td>
<td></td>
<td></td>
<td>Portable and mobile RF communications equipment should be used no closer to any part of the ventilator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</td>
</tr>
<tr>
<td>IEC / EN 61000-4-6</td>
<td>3 Vrms</td>
<td>3 Vrms</td>
<td><strong>Recommended separation distance</strong></td>
</tr>
<tr>
<td></td>
<td>150 kHz to 80 MHz outside ISM bands</td>
<td>150 kHz to 80 MHz outside ISM bands</td>
<td>d = 0.35√P</td>
</tr>
<tr>
<td></td>
<td>10 Vrms inside ISM bands</td>
<td>10 Vrms inside ISM bands</td>
<td>d = 1.2√P</td>
</tr>
<tr>
<td>Radiated RF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC / EN 61000-4-3</td>
<td>10 V/m 80 MHz to 2.5 GHz</td>
<td>10 V/m 80 MHz to 2.5 GHz</td>
<td>d = 1.2√P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80 MHz to 800 MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d = 2.3√P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>800 MHz to 2.5 GHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interference may occur in the vicinity of equipment marked with the following symbol: ![symbol]</td>
</tr>
</tbody>
</table>
Specifications

Table B-21. Electromagnetic Immunity—Conducted and Radiated RF (Continued)

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

Note:

At 80 MHz and 800 MHz, the higher frequency range applies.

Note:

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

1. The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

2. The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

3. Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ventilator is used exceeds the applicable RF compliance level above, the Puritan Bennett™ 520 Ventilator should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Puritan Bennett™ 520 Ventilator.

4. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

Table B-22. Recommended Separation Distances

The ventilator is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ventilator can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ventilator as recommended below, according to the maximum output power of the communications equipment.

<table>
<thead>
<tr>
<th>Rated Maximum Output Power of Transmitter (W)</th>
<th>Separation Distance According to Frequency of Transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 kHz to 80 MHz (outside ISM bands)</td>
<td>150 kHz to 80 MHz (in ISM bands)</td>
</tr>
<tr>
<td>d = 0.35 \sqrt{P}</td>
<td>d = 1.2 \sqrt{P}</td>
</tr>
<tr>
<td>0.01</td>
<td>0.035 m</td>
</tr>
<tr>
<td>0.1</td>
<td>0.11 m</td>
</tr>
<tr>
<td>1</td>
<td>0.38 m</td>
</tr>
<tr>
<td>10</td>
<td>1.1 m</td>
</tr>
<tr>
<td>80 MHz to 800 MHz</td>
<td>800 MHz to 2.5 GHz</td>
</tr>
<tr>
<td>d = 1.2 \sqrt{P}</td>
<td>d = 2.3 \sqrt{P}</td>
</tr>
<tr>
<td>0.12 m</td>
<td>0.23 m</td>
</tr>
<tr>
<td>0.38 m</td>
<td>0.73 m</td>
</tr>
<tr>
<td>1.2 m</td>
<td>2.3 m</td>
</tr>
<tr>
<td>3.8 m</td>
<td>7.3 m</td>
</tr>
</tbody>
</table>
For transmitters rated at a maximum output power not listed above, the recommended separation distance $d$ in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

**Note:**

At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

**Note:**

The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

**Note:**

An additional factor of $10/3$ is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.

**Note:**

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

### Table B-22. Recommended Separation Distances (Continued)

<table>
<thead>
<tr>
<th>100</th>
<th>3.5 m</th>
<th>12 m</th>
<th>12 m</th>
<th>23 m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table B-23. Compliant Cables and Accessories

<table>
<thead>
<tr>
<th>Cable or Accessory</th>
<th>Maximum length</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>Japan AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>China AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>South Africa AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>India AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>Australia AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>Europe AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>Canada AC power cable assembly</td>
<td>1.8 m (5.9 ft)</td>
</tr>
<tr>
<td>Nurse call cable</td>
<td>5 m (16.4 ft)</td>
</tr>
<tr>
<td>12V DC car adapter cable</td>
<td>5 m (16.4 ft)</td>
</tr>
<tr>
<td>Oxygen inlet connector</td>
<td>-</td>
</tr>
</tbody>
</table>
B.11 **Standards Compliance and IEC Classification**

**General Standards**
- The ventilator will be constructed to comply with the following product Classifications as detailed in Clause 5 of 60601-1:
  - Class II Equipment
  - Internally Powered Equipment
  - Type BF Applied Parts
  - IP31 with respect to access to hazardous parts and ingress of moisture
  - Not suitable for use in the presence of flammable anesthetic mixtures
  - Not suitable for sterilization
  - Suitable for continuous operation
  - Detachable power supply cable

**Collateral Standards**

**Particular Standards**

**Air Transportation Standards**

C Theory of Operation

C.1 Architecture

The Puritan Bennett™ 520 Ventilator’s gas delivery system is primarily composed of an airflow generator and a three-way valve to control the patient circuit exhalation valve. The flow generator is a low-inertia, micro-turbine driven by a brushless DC electric motor, while the three-way valve is a proportional solenoid valve.

These two actuators are microprocessor-controlled and perform according to specific control algorithms. The microprocessor control circuit receives its data from the various servo-controlled pressure and feedback flow sensors that are built into the ventilator.

An electrical supply management system performs the energy conversion so the device can switch between the three available power sources to provide power to the internal electronics.

A cooling fan helps maintain the proper operating temperature range for the internal environment of the ventilator. This fan is servo-controlled to maintain the proper temperature for the most heat-sensitive of the ventilator’s components.

C.2 Operation

The operation of the device is based on a self-adapting, closed loop drive system. The speed of the flow generator (turbine) is servo-controlled according to the patient pressure signal or the inspired flow signal.

The turbine speed control algorithms themselves are based on equations that vary according to the ventilation modes, settings, and the respiratory cycle phases. Thus, fixing the pressure rise time has an influence on the level of turbine acceleration at the start of the inspiration phase. The transition between the inspiration phase and expiration phase is controlled by a deceleration or braking algorithm proportional to the pressure difference between the two phases.

The exhalation solenoid valve (three-way valve) is fully closed during the inspiratory phase and is proportionally controlled during the exhalation phase to obtain the bias flow. The speed of the turbine adapts to the exhalation pressure threshold during the entire exhalation phase to maintain the operator-set PEEP.

The flow measurement completes the system by enabling detection of patient inspiratory effort and the triggering of inspiration phases. The flow measurement can also be used to determine the end of the inspiration phase in certain ventilation modes.
The flow measurement is automatically corrected as a function of the atmospheric pressure measured inside the ventilator with the Altitude Compensation feature*. The flow and volume are in Body Temperature Pressure Saturated (BTPS) conditions. This necessitates that periodic inspections for calibrating the sensors be performed by maintenance technicians authorized by Covidien (see the Puritan Bennett™ 520 Ventilator Service Manual).

If the Altitude Compensation feature is active, a corrective algorithm is applied to the inspiration flow.

The sensor measurement range is software limited from 600 to 1100 hpa.

A cooling fan is provided to maintain the internal temperature of the ventilator within specified limits and to help ensure proper performance and longevity of the device.

Finally, the various measurement signals used in control and detection are protected and specifically filtered in order to limit any risk of disturbance to the device and possible problem.

* The Altitude Compensation feature is enabled (set to "YES" on the Setup Screen) by default and should remain at this setting.
Figure C-1. Gas Delivery System

1. Air inlet filter
2. Turbine
3. Inspiratory filter
4. Inspiratory tubing
5. Proximal pressure tube
6. Exhalation valve
7. Exhalation valve exhaust port
8. Exhalation tubing
9. LCD display
10. CPU board
11. Internal battery
D.1 Modes of Ventilation

This chapter is a general description of the various modes of ventilation and breath types available with the Puritan Bennett™ 520 Ventilator.

**Note:**
The default ventilation mode setting is P A/C; for more information, see below.

D.1.1 Assist/Control (A/C) Mode

When set to an Assist/Control mode, machine-initiated breaths are delivered at a clinician-set pressure and rate. If the patient triggers a spontaneous breath between machine breaths, the ventilator will deliver a breath based on the pressure settings.

Whether initiated by the patient or the ventilator, all breaths are delivered at the same preset pressure.

The name of the Assist/Control mode is P A/C, if the breaths are based on a pressure setting.

D.1.2 CPAP Mode

In CPAP, the ventilator maintains a constant level of pressure in the patient's airway.

D.1.3 PSV Mode

PSV mode maintains a constant level of pressure in the patient’s airway during exhalation. In addition, the ventilator applies a clinician-set pressure (Pressure Support) to each of the patient’s breaths. This has the same benefits as CPAP, with the additional benefit of assisting the patient in moving gas into his or her lungs.

D.2 Breath Types

Breath types available from the ventilator are:

- Pressure controlled breaths in Assist/Control mode (in P A/C)
• Pressure-supported breaths in PSV mode
• CPAP

D.2.1 Pressure Control Breaths in Assist/Control Mode

In Assist/Control mode (P A/C), each delivered breath will maintain the selected pressure (Pi) maintained over the selected inspiratory time. Inspiration is triggered by patient-generated flow (for assisted breaths) or by the ventilator (for controlled breaths; breath rate [R-Rate] is the controlling parameter). For both controlled and assisted breaths, the inspiratory pressure is limited to the pressure (Pi) setting, and is cycled by time.

The shape of the pressure waveform depends on the setting of the pressure rise time (Rise Time).

**Figure D-1. Flow Patterns in P A/C Mode**

| y1 | Airway pressure | 1 | Start of inspiration |
| y2 | Flow | 2 | End of inspiration |

P A/C mode guarantees a maximum period between breaths, as determined by the Breath Rate setting. In *Table D-1.*, the ventilator delivers a controlled (machine) breath, and calculates the time before another controlled breath must be delivered. The ventilator delivers a second controlled breath at the conclusion of the machine calculated breath time (for simplicity, we will use the term period for “machine-calculated breath time”). Following the second controlled breath, but before another period can elapse, the patient’s effort triggers an assisted (or patient-initiated) breath. This restarts the period. At the conclusion of the period, the ventilator delivers another controlled breath.
D.2.2 Pressure Supported Breaths in PSV Mode

In PSV mode, the supported breaths maintain the selected pressure (P Support). Inspiration is triggered by patient-generated flow. The inspiration is terminated when inspiratory flow drops to the Exhalation Sensitivity (E Sens) setting.

The shape of the pressure waveform depends on the setting of the pressure rise time (Rise Time). See Figure D-3.

D.2.3 CPAP

In Continuous Positive Airway Pressure (CPAP) the ventilator maintains pressure at the selected PEEP over the entire breath cycle. Inspiration is triggered by patient-generated flow. Inspiration is
limited by the pressure and is cycled by the patient when inspiratory flow drops to the Exhalation Sensitivity threshold (E Sens = 25%). See Figure D-4.

Figure D-4. Flow Patterns in CPAP Mode

---

D.3 Ventilation Modes and Apnea

In PSV mode, the back-up rate is activated so that the ventilator will automatically begin to deliver breaths at the breath rate (Backup R) setting if no patient effort occurs for the Apnea Time setting. The pressure during a back-up breath is equal to the Pressure Support (P Support) setting before the apnea condition began. If the patient initiates a spontaneous breath while the back-up rate is in effect, the ventilator will return to the previous operating parameters.

In CPAP, a backup rate is not set, but the operator must still set an apnea time (Apnea Time). In that case, the ventilator will sound an APNEA alarm if no breath is triggered by the patient in the apnea time; however, no back up breaths will be generated.

D.4 Vt Target

The Puritan Bennett™ 520 Ventilator has the Vt Target (Target Volume) feature as a part of pressure-based ventilation modes. This allows a range of pressures to be used to reach a set volume.
If the mode is PSV ST or P A/C, Vt Target can be selected within the range of 50 to 2000 mL (or OFF) which controls the inspired tidal volume to the target value specified.

Following each delivered breath, the inspired volume is measured and small pressure adjustments (0.5-2 mbar) are made as necessary to maintain the delivered volume within the target Vt range. If the inspired volume is lower than the target volume, the pressure of the next breath increases a small amount and the inspired volume is measured again.

If the inspired volume is higher than the target volume, the pressure of the next breath is decreased slightly, until the inspired volume matches the target volume. The pressure increases stop if the maximum inspiratory pressure is reached.

**Figure D-5.** Target Volume in Pressure Modes

<table>
<thead>
<tr>
<th>x</th>
<th>Cycle number</th>
<th>y1</th>
<th>Vt (ml)</th>
<th>y2</th>
<th>PIP (mbar, cmH₂O, or hPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vt target</td>
<td>2</td>
<td>Max P</td>
<td>3</td>
<td>Pi/P support</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cycle number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pi set point (cmH₂O, mbar or hPa)</td>
<td>20</td>
<td>20 + 0.5 = 20.5</td>
<td>20.5 + 1 = 21.5</td>
<td>21.5 + 2 = 23.5</td>
<td>23.5</td>
<td>23.5</td>
<td>23.5 - 0.5 = 23</td>
<td>23</td>
<td>23 + 0.5 = 23.5</td>
<td>23.5</td>
</tr>
<tr>
<td>Measured Vti (ml)</td>
<td>380 ▼</td>
<td>400 ▼</td>
<td>450 ▼</td>
<td>530 =</td>
<td>550 =</td>
<td>610 ▲</td>
<td>580 =</td>
<td>490 ▼</td>
<td>510 =</td>
<td>520 =</td>
</tr>
</tbody>
</table>
The operational verification and safety checks listed in Table E-1. below should be performed to ensure the ventilator is operating properly in the following circumstances:

- Prior to using the ventilator with a patient.
- Regularly, according to institutional protocol.
- Following maintenance or changes in ventilator settings.

If the ventilator fails any of the safety checks below, or if you cannot complete these checks, see section 5.8, "Troubleshooting" on page 5-14 or call the equipment supplier or Covidien (see section 10.3, “Service Assistance”).

**WARNING:**
Provide the patient with an alternate means of ventilation before conducting these tests.

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

<table>
<thead>
<tr>
<th></th>
<th>Operational Verification Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verify the proper appearance and cleanliness of the ventilator.</td>
</tr>
<tr>
<td>2</td>
<td>Verify all of the labels and markings on the ventilator are clear and legible.</td>
</tr>
<tr>
<td>3</td>
<td>Confirm the air inlet filter is clean and correctly installed.</td>
</tr>
<tr>
<td>4</td>
<td>Ensure the AC power cable does not exhibit any signs of damage, such as kinks, breaks, or damaged insulation.</td>
</tr>
<tr>
<td>5</td>
<td>Connect the AC power cable. Ensure that all power supply indicators on the front panel flash, except for the AC power supply (mains) indicator, which should remain lit.</td>
</tr>
<tr>
<td>6</td>
<td>Push the power switch I/O to the I position to activate the ventilator test: Check that the two alarm indicators and the Standby indicator (located close to the VENTILATOR ON/OFF key) flash. Ensure also that the two alarm buzzers sound.</td>
</tr>
<tr>
<td>7</td>
<td>Perform the Functioning Alarms Test regularly according to institutional protocol (see Appendix F, “Alarms Tests”).</td>
</tr>
<tr>
<td>8</td>
<td>Verify the alarm volume is adapted to the patient environment. See section 7.3, “Preferences Menu Parameters” for instructions on changing the alarm volume setting.</td>
</tr>
</tbody>
</table>
Table E-1. Operational Verification Checklist (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Operational Verification Checklist (Continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Verify that the preventive maintenance schedule for the ventilator is followed. See Chapter 10, “Routine</td>
</tr>
</tbody>
</table>
<pre><code> | Maintenance.”                                                                                                  |
</code></pre>
<p>| 10| Ensure the patient breathing circuit is correctly attached to the ventilator, with all the necessary compo-   |
| nents, and is free from any signs of damage and leaks.                                                      |</p>
Before connecting the ventilator to the patient, perform the following tests to ensure the ventilator’s alarms are working properly.

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

**WARNING:**
If the ventilator fails any alarm test or if you cannot complete these tests, see the Troubleshooting section (refer to Chapter 5, “Alarms and Troubleshooting”) of this manual or call your equipment supplier or Covidien (refer to section 10.3, “Service Assistance” on page 10-4).

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

**Note:**
Most of these tests require that an approved patient circuit be connected to the ventilator. Ensure that your patient circuit is properly connected prior to performing these tests.

### F.1 Low Pressure Test

**WARNING:**
The setting of the Min PIP alarm must be adjusted for the patient, but must also be set high enough to allow the PATIENT DISCONNECTION alarm to trigger properly. Perform the following test to ensure the Min PIP alarm is properly set.

1. Before proceeding, set the ventilation and alarm parameters specified by the patient’s clinician and install a single-limb circuit setup.

2. Press the **VENTILATION ON/OFF** key to start ventilation.

3. Keep the patient’s end of the breathing circuit open and allow ventilation to continue.
4. Wait for (Apnea Time + 2 seconds; Apnea time is not always 5 seconds), then ensure that:
   - the High priority indicator (red color) lights up
   - the “PATIENT DISCONNECTION” alarm is displayed
   - the audible alarm sounds

5. Press the ALARM CONTROL key once to pause the audible alarm.

6. Press and hold the VENTILATION ON/OFF key for three (3) seconds, then release it. Press the VENTILATION ON/OFF key again to confirm stop. The ventilator will switches to Standby mode and cancels the alarms.

F.2 Circuit Check Test

F.2.1 Performing a Circuit Check

Perform a circuit check whenever replacing or altering a patient circuit. Ensure the patient is fully disconnected from the ventilator prior to starting this test.

Note:
Before performing a circuit check, stop ventilation using the VENTILATION ON/OFF key, not the I/O switch. If the I/O switch was used to stop ventilation, the circuit check function cannot be used unless first stopping ventilation using the VENTILATION ON/OFF key.

1. Press and hold the MENU key during power up to access the circuit check test screen.

   Figure F-1. Circuit Check Screen (Before Starting)

   **CIRCUIT CHECK**
   - Leak Test: 0.0 Lpm
   - Test Status: NOT RUN

   Ensure patient is disconnected.
   Block circuit at patient connection.
   Press ENTER key to start test.

2. Verify that the proximal pressure tube of the patient circuit is properly connected to the proximal pressure port (see section 6.4, “Patient Circuit,” on page 6-8.)

3. Verify that the exhalation valve tube is connected to the exhalation valve port.
4. Block the patient connection port of the patient circuit (see Figure F-2.)

![Figure F-2. Blocking the Patient End of a Single Limb Circuit](image1)

5. Activate the circuit test by pressing the **ENTER** key.

6. During the circuit check (which typically takes about 10 seconds to complete), the ventilator will do the following:
   
   a. Sound a short beep
   b. close the exhalation valve
   c. display Test Status as RUNNING (see Figure F-3.)

![Figure F-3. Circuit Check (Running)](image2)

- **CIRCUIT CHECK**
  - **Leak Test**
    - Leak: 0.0 Lpm
    - Test Status: **RUNNING**
  - increase pressure to 30 mbar (± 10% with no leak)
  - display flow sensor measurement as Leak in Lpm (updated every two seconds)
  - sound a short beep every time the flow measurement is updated
  - sound a long audible beep once the check is complete
  - display PASS or FAIL in the Test Status field.
7. Review the results. A FAIL result indicates leak(s) of greater than 1 L/min exist.

To rerun circuit check test, press the ENTER key again. To cancel the circuit check while it is running, press the UP, DOWN, ENTER, VENTILATION ON/OFF, or MENU key.

**F.2.2 Troubleshooting a Failed Check**

If the circuit check fails, do the following:
1. Ensure an approved circuit is in use. Reference Table H-2. List of Circuits.
2. Check patient circuit connections to the ventilator, examining each for leakage and tightness.
3. Replace the patient circuit if necessary.
4. Rerun the circuit check test.
5. If the failure persists, have the ventilator evaluated by a qualified technician.
F.3 Apnea Test

Apnea breaths only apply in PSV and CPAP modes.

1. Connect the patient end of the patient circuit to a test lung.

2. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (see section 6.4, “Patient Circuit” on page 6-8).

3. Press the VENTILATION ON/OFF key to start ventilation.

   The ventilator will deliver a mandatory breath. Before the second mandatory breath is delivered, verify that the following events occur:
   • the Medium priority indicator (yellow color) illuminates
   • the “APNEA” alarm is displayed
   • an audible alarm sounds

4. Press the ALARM CONTROL key twice to reset the alarm.

5. Press and hold the VENTILATION ON/OFF key for three (3) seconds, then release it. Press the VENTILATION ON/OFF key again to confirm stop.

   • Ventilation stops.

F.4 Power Failure Test

Note:
If the ventilator is operating on either the external power supply or the internal battery, you must plug it in to an AC power source before beginning this test.

1. Disconnect the ventilator from its AC power supply. Ensure that the following events occur:
   • the Medium priority indicator (yellow color) illuminates
   • the “AC POWER DISCONNECTION” alarm activates
   • an audible alarm sounds
   • the DC POWER indicator illuminates if the DC power source is connected; otherwise, the INTERNAL BATTERY indicator illuminates

2. Press the ALARM CONTROL key twice to reset the alarm.

3. Reconnect the ventilator to its AC power supply.
F.5 Occlusion Test

1. Verify that the pressure tube of the patient circuit is properly connected to the appropriate fitting on both the ventilator and the proximal pressure port (see section 6.4, “Patient Circuit” on page 6-8).

2. Block the exhalation port on the exhalation valve of the patient circuit. See Figure F-6.

   Figure F-6. Blocking the Patient End of a Single-Limb Circuit

3. Press the VENTILATION ON/OFF key to start ventilation.

4. Allow the ventilator to deliver three (3) consecutive breaths. At the beginning of the fourth breath, ensure that the following events occur:
   - the High priority indicator (red color) illuminates
   - the “Occlusion” alarm activates
   - an audible alarm sounds

5. Press the ALARM CONTROL key to pause the audible alarm.

6. Unblock the exhalation port.
   - the occlusion alarm is canceled.

7. Press and hold the VENTILATION ON/OFF key for three (3) seconds, then release it. Press the VENTILATION ON/OFF key again to confirm stop.
   - Ventilation stops.
F.6 Battery Test

The ventilator is capable of testing the power of the battery (see Chapter 8, “Internal Battery”). You can determine which power source the ventilator is using by checking the power indicator, located on the top panel. The indicator light will be lit to indicate which power source is currently available.

1. Disconnect the AC power supply cable and the DC power cable (if it is connected) from the ventilator.
   - a POWER DISCONNECTION alarm will trigger.

2. Press the ALARM CONTROL key twice to pause the alarm. Ensure that the following events occur:
   - the INTERNAL BATTERY indicator to the upper-left of the display illuminates
   - the BATTERY symbol is displayed at the top of the screen (along with its reserve capacity)

3. Connect the AC (mains) power supply. Ensure that the following events occur:
   - the AC POWER indicator to the upper-left of the display illuminates
   - the indicator to the upper-left of the display is flashing, which indicates that the battery is charging (this only occurs if the ventilator has run on battery power long enough to lose enough charge that the charger will turn on)
   - the BATTERY is no longer displayed at the top of the screen

F.7 Involuntary Stop Test

To verify proper functioning of the Very High Priority audible alarm, perform the following:

1. Press the VENTILATION ON/OFF key to start ventilation.

2. Set the I/O switch to the O (off) position to power-down the ventilator during ventilation. Ensure that the following events occur:
   - An audible alarm sounds continuously
   - The ventilator turns off. There should be no alarm indicators illuminated and no alarm messages displayed.

3. Press the ALARM CONTROL key once to pause the audible alarm.
G Unpacking and Preparation

The Puritan Bennett™ 520 Ventilator is delivered with the following items:

- (1) Printed User’s Manual (language as requested by the customer)
- (1) Clinician’s Manual on CD (a print copy is available upon request by the customer)
- (1) Patient circuit and valve
- (1) Set of six (6) combination foam/fine particle air inlet filters
- (1) Carrying bag
- (1) Oxygen connector
- (1) AC power cable

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

⚠️ WARNING:
To minimize the risk of damage, you must use the Dual Bag to transport the Puritan Bennett™ 520 Ventilator. Refer to Figure G-2.

To unpack and prepare the ventilator, follow the steps below.

1. From the plastic bag, remove the following:
   - Plastic pocket containing the Clinician’s Manual.
   - The ventilator and its components or accessories.

2. Remove the patient circuit, the AC (“Mains”) power cable, and the set of fine-particle air inlet filters.

3. Inspect the ventilator and ensure that:
   - the ventilator’s outer casing and the I/O switch’s protective cover do not have any dents or scratches, which may indicate possible damage.
   - the ventilator’s labels and markings are clear and legible.
   - the AC power cable does not exhibit any signs of damage, such as kinks, breaks, or cuts.
WARNING:
Never use a ventilator or any components or accessories that appear to be damaged. If any signs of damage are evident, contact your equipment supplier or Covidien.

4. Clean the ventilator with a mild soap solution, if necessary (see Chapter 9, “Cleaning”).

5. Ensure that the air inlet filter is installed.

Figure G-1. Puritan Bennett™ 520 Ventilator
Figure G-2. Dual Bag
**H Parts and Accessories**

*Table H-1.* provides a list of accessories that are available for the Puritan Bennett™ 520 Ventilator.

To order parts or accessories, contact your equipment supplier or Covidien representative.

**Note:**
The ventilator is delivered with the following items: a printed User’s Manual, a CD with Clinician’s Manual (printed copy available upon request); one patient circuit with valve; one set of six (6) combination foam/fine particle air inlet filters; one carrying bag; one O₂ connector; and one AC power cable.

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrying bag (grey)</td>
</tr>
<tr>
<td>Oxygen inlet connector</td>
</tr>
<tr>
<td>Ventilator Cart</td>
</tr>
<tr>
<td>Dual Bag (blue or pink)</td>
</tr>
<tr>
<td>delivered with:</td>
</tr>
<tr>
<td>Backpack Padded Straps, 2 ea.</td>
</tr>
<tr>
<td>Suspension belt</td>
</tr>
<tr>
<td>Carrying belt</td>
</tr>
</tbody>
</table>

**WARNING:**
To minimize the risk of damage, you must use the ventilator’s Dual Bag to transport the ventilator. See *Figure G-2.* on page *G-3.*

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC (mains) power cable</td>
</tr>
<tr>
<td>DC power cable (for connection to an external DC power source, such as a car 12 volt DC outlet)</td>
</tr>
<tr>
<td>Nurse call cable (5 meters)</td>
</tr>
</tbody>
</table>
Table H-2 provides a list of consumable parts available for the ventilator.

**WARNING:**
To ensure proper performance of the ventilator, use a patient circuit recommended by Covidien in this manual; refer to Chapter 6, “Installation and Assembly” and Appendix H, “Parts and Accessories.” The total specified length of the patient circuit tubing as measured from the ventilator outlet to the ventilator inlet is 1.1 meters (3.6 ft) to 2.0 meters (6.6 feet). The tubing must conform to all applicable standards and must be fitted with Ø 22 mm terminals that also conform to all applicable standards. Ensure that both the length and the internal volume of the patient circuit are appropriate for the tidal volume: a corrugated tube of Ø 22 mm for adult patients, and a corrugated tube of Ø 15 mm for pediatric patients with a tidal volume lower than 200 ml.
Table H-2. List of Circuits

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAR™ Single-limb patient circuit with exhalation valve, 180 cm, PVC, ADULT</td>
<td>5093600</td>
</tr>
<tr>
<td>DAR™ Single-limb patient circuit with exhalation valve, 180 cm, PVC, PEDIATRIC</td>
<td>5093500</td>
</tr>
<tr>
<td>DAR™ Single-limb patient circuit without exhalation valve, 180 cm, PVC, ADULT</td>
<td>5093300</td>
</tr>
<tr>
<td>DAR™ Single-limb patient circuit without exhalation valve, 180 cm, PVC, PEDIATRIC</td>
<td>5093100</td>
</tr>
</tbody>
</table>

For more information regarding parts and accessories for the Puritan Bennett™ 520 Ventilator contact your service representative or http://www.covidien.com/rms/products.
I Glossary

**AC Power**
Alternating current.

**Alarm Pause**
The audible and visual alarms cease and the symbol appears. The symbol will remain until the cause of the alarm is addressed. For example, when the ventilator is running on internal battery, the AC Disconnection alarm may be paused, and the alarm paused symbol will appear until the device is plugged into AC. The paused alarm will be captured in the alarm log screen and can be reactivated.

**Alarm Reset**
Used only for the High Pressure alarm, this function resets the visual alarm message.

**Apnea**
The absence of breathing or a breathing pattern capable of supporting an individual's respiratory needs.

**Apnea Index (AI)**
The Apnea index is average number of apnea events per hour of ventilation. It is based on the Apnea Alarm.

**Apnea Time**
Time allowed between breath starts before APNEA alarm occurs when no patient effort is detected.

**Assist/Control**
In Assist/Control mode, the ventilator delivers an assisted breath of a set pressure when the patient's breathing effort creates a flow or pressure drop that is greater than the SENSITIVITY setting. In absence of patient breathing effort, the ventilator will deliver a controlled breath of the set pressure. (Does not apply in PSV/CPAP mode).

**Assisted Breath**
A pressure breath triggered by the patient but then controlled and terminated by the ventilator.

**Audio Pause**
Pauses the audible alarm for 60 seconds at a time and shows the symbol.
**Back Up Rate**
Rate of control cycles in PSV mode during apnea phase.

**Battery Level**
Display of the remaining battery capacity; located adjacent to the battery symbol.

**Bias flow**
Turbine flow during exhalation phase through the patient circuit to avoid rebreathing.

**bpm**
An abbreviation for "breaths per minute," which is the unit of measure for breath rate (see below).

**Breath Rate**
The total number of breaths, both machine and spontaneous, delivered by a ventilator in one minute.

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

**cmH₂O**
An abbreviation for "centimeters of water," which is a unit of measure for pressure.

**Continuous Positive Airway Pressure (CPAP)**
Continuous airway pressure maintained throughout a spontaneous breath cycle.

**Controlled breath**
A pressure breath triggered, controlled and terminated by the ventilator.

**DC Power**
Direct current.

**Exhalation Phase**
Phase of the breath cycle during which the patient exhales.

**Exhalation Sensitivity**
The exhalation sensitivity (E Sens) level is a percentage of peak flow at which a pressure-supported breath will be terminated.

**Fraction of Inspired Oxygen (FiO₂)**
Amount of oxygen delivered to the patient.

**Flow**
Volume of gas delivered by the ventilator compared to time, expressed in liters per minute (lpm).

**hPa**
An abbreviation for "hectopascal," which is a unit of measure for atmospheric pressure.
I:E ratio
Inspiratory time versus exhalation time ratio.

Inspiratory Phase
Phase of the breath cycle during which the patient inspires.

Inspiratory Sensitivity (I Sens)
Level of inspiratory effort the patient has to provide during the initiation of a machine breath. The sensitivity levels (from 0P to 5) correspond to differences in flow compared to the bias flow. Level 0P is the most sensitive (for a pediatric use) and requires the least effort to trigger a breath. Level 5 requires the most amount of effort to trigger a breath.

Inspiratory Tidal Volume (VTI)
Volume delivered to the patient at each inspiratory phase.

Inspiratory Pressure (Pi)
The operator-set inspiratory pressure during a pressure control (PC) mandatory breath.

I Time (Inspiratory Time)
Inspiratory time measure.

Intentional Vent Stop Alarm
Ventilation has been switched off by the user / caregiver and the ventilator is in stand-by.

I/T Ratio
Inspiratory time versus total breath time ratio.

L
liters (a unit of volume).

Leak
When ventilating in leak configuration, it is the average patient/circuit leak during each cycle and over the past 24 hour period.

LED
Light Emitting Diode; used as indicator lights on the ventilator’s front panel.

lpm
Liters Per Minute (a unit of volume flow rate).

Machine Hours Counter
Counter for the total ventilation time since manufacture or the last CPU board change.

Mains
AC power supply.

Max Leak
The maximum alarm setting of a high leakage threshold. An alarm will be triggered in the event the calculated leakage flow exceeds this limit.

**Max Rtot (Total breath rate)**

The maximum alarm setting to prevent hyperventilation or ventilator autotriggering. The HIGH RATE alarm will be triggered if the total breath rate exceeds the maximum limit set.

**Max P (Maximum Inspiration Pressure)**

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

**Mbar**

An abbreviation for “millibar,” which is a unit of measure for atmospheric pressure.

**Mean Airway Pressure**

Average patient pressure during each breath.

**Minimum Inspiratory Time**

Minimum inspiratory time before allowing the patient to exhale.

**M Vol (Minute Volume)**

Flow delivered at each breath to the patient is measured by the inspiratory flow sensor and that measurement is used to calculate minute volume (Vt x Rtot)

**P A/C (Pressure Assist /Control)**

A ventilator mode which provides machine-initiated breaths delivered at a clinician-set pressure, inspiratory time, and rate.

**Patient Breath**

Breathing cycle initiated by the patient.

**Patient circuit**

Tubing between the ventilator and the patient.

**Patient effort**

Inspiratory effort initiated by the patient.

**Patient Hours Counter**

Counter of ventilation time for the patient.

**Peak Airway Pressure (Paw)**

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

**Peak Inspiratory Pressure (PIP)**

The highest pressure measured in the patient circuit during the inspiration phase.
**Positive End Expiratory Pressure (PEEP)**
Pressure in the patient circuit at the end of expiration.

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

**Pressure Support (P Support)**
Augmentation of the patient’s ventilation synchronously with inspiratory effort until a preset pressure is met. Pressure is maintained until inspiratory flow is reduced to a percentage of peak flow that depends on the exhalation sensitivity setting for the inspiration, when the ventilator cycles into exhalation.

**PSI**
Pounds Per Square Inch.

**PSV (Pressure Support Ventilation)**
Pressure support ventilation.

**Rebreathing**
The patient breathes his/her exhaled gas.

**Respiratory rate**
The number of breath cycles (inspiration + expiration) completed within one minute. Normal resting adult respiratory rates are from 12 – 20 breaths per minute (bpm).

**RESTART/SRVC**
This is an alarm message. If the message “*IF PERSISTS RESTART/SRVC*” occurs, restart the ventilator. If the alarm condition is not cleared, call a service representative.

**Rise Time**
This determines how the target pressure will be reached, and indirectly defines the minimum inspiration time.

**Rtot**
Parameter measured by the ventilator equal to the total number of breaths per minute (bpm).

**Sensitivity**
This adjustable parameter determines the amount of inspiratory effort required by the patient before the ventilator delivers an assisted breath, or demands flow in the case of a spontaneous breath.

The Puritan Bennett™ 520 Ventilator is pressure-triggered, with sensitivity levels in the range from 0P to 5: the lower the number, the more sensitive the trigger.
**Spont Cyc (Spontaneous Cycling)**

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

**Standby**

The operational mode of the ventilator where it is powered (power supply I/O button set to the I position), but is not ventilating the patient.

**Vent Time (Ventilation Time)**

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

**Vt Target (Target volume)**

The Vt Target feature enables the ventilator to reach a set volume of gas to be delivered to the patient using a range of pressures in the pressure-based ventilation modes.
Index

A
AC power
connecting to ........................................ 6-3
indicator ........................................... 8-5
AC power cable
disconnecting ........................................ 6-6
securing to ventilator .............................. 6-4
AC POWER DISCONNECTION alarm message .... 5-9, 5-15
Accessories
cleaning .................................................. 9-2
Air circulation (Warning) ......................... 1-4, 6-1
Air inlet filter ......................................... 6-14
replacement interval .................................. 10-2
replacing ............................................... 10-1
Air inlet filter, replacing (figure) ................. 10-2
Air outlet (antibacterial) filter
replacement interval .................................. 10-2
Air transport
Air transportation standard .......................... 8-15
use on commercial aircraft ......................... 2-1
Alarm levels .......................................... 5-2
Alarm Logs menu
dismissing automatically ............................ 5-5
dismissing manually ................................ 5-5
Alarm messages
AC POWER DISCONNECTION ................. 5-9, 5-15
APNEA ............................................. 5-9, 5-15
BATTERY FAULT1 ................................. 5-9, 5-15
BATTERY FAULT2 ..................................... 5-9, 5-15
BUZZER FAULT1 ..................................... 5-9, 5-15
BUZZER FAULT2 ..................................... 5-9, 5-15
BUZZER FAULT3 ..................................... 5-9, 5-15
BUZZER LOW BATTERY ............................. 5-10
CHECK BATTERY CHARGE ....................... 5-10, 5-15
CHECK EXH VALVE .................................. 5-10, 5-16
CHECK EXH VALVE PRESSURE ............... 5-10, 5-16
CHECK PROXIMAL LINE1 ...................... 5-10, 5-16
CHECK REMOTE ALARM ......................... 5-10, 5-16
CHECK SETTINGS .................................. 5-10, 5-16
CONNECT VALVE OR CHANGE PRESS .... 5-10, 5-16
CONTROLLED CYCLES ......................... 5-10, 5-16
COOLING FAN ...................................... 5-11, 5-16
DC POWER DISCONNECTION ................. 5-11, 5-17, 6-8
DEVICE FAULT 11 ................................ 5-11
DEVICE FAULT10 ................................ 5-11, 5-17
DEVICE FAULT11 ................................ 5-11, 5-17
DEVICE FAULT12 ................................ 5-11, 5-17
DEVICE FAULT13 ................................ 5-11, 5-17
DEVICE FAULT3 .................................... 5-11, 5-17
DEVICE FAULT5 .................................... 5-11, 5-17
DEVICE FAULT7 .................................... 5-11, 5-17
DEVICE FAULT9 .................................... 5-11, 5-17
EMPTY BATTERY .................................. 5-11, 5-17, 8-4
HIGH INT TEMP COOL VENT .................. 5-11, 5-18
HIGH LEAKAGE .................................... 5-11, 5-19
HIGH PRESSURE .................................. 5-12, 5-20
HIGH RATE ....................................... 5-12, 5-20
HIGH VT1 ........................................ 5-12, 5-20
HIGH/LOW BATTERY TEMP ..................... 5-11, 5-19
INTENTIONAL VENT STOP ...................... 5-12, 5-20
KEYPAD FAULT .................................... 5-12, 5-21
LOW BATTERY ...................................... 5-12, 5-21, 8-4
LOW VT1 .......................................... 5-12, 5-21
NO PROXIMAL LINE2 .............................. 5-12, 5-21
OCCLUSION CHECK CIRCUIT .................. 5-12, 5-21
PATIENT DISCONNECTION ................. 5-13, 5-21
POWER FAULT ...................................... 5-13, 5-21
POWER SUPPLY LOSS ............................ 5-13, 5-22
PRESS SENS FLT1 ................................. 5-13, 5-22
PROX SENS FLT2 .................................. 5-13, 5-22
REMOVE VALVE CPAP MODE ................. 5-13, 5-22
REMOVE VALVE OR CHANGE PRES ......... 5-13, 5-22
SOFTWARE VERSION ERROR ................. 5-13, 5-22
TURB OVERHEAT .................................. 5-14, 5-22
UNKNOWN BATTERY ............................... 5-14, 5-22
Alarm Parameters
P Arc Mode Menu .................................. 3-10
Alarm parameters
CPAP Mode Menu .................................. 3-8
PSV Mode Menu .................................... 3-3
Alarm tests
Apnea test .......................................... F-5
Involuntary stop test ............................... F-7
Alarm thresholds
and linked Ventilation parameters .......... 7-29
Alarms
display of ........................................... 5-2
Level of priority ..................................... 5-2
Logs menu .......................................... 5-4
menu ............................................... 2-9
NO DATA message ................................ 5-4
overview of ........................................ 5-9
pausing ............................................. 5-5
re-activating ....................................... 5-7
resetting ............................................. 5-7
setting parameters ................................. 7-29
tests ................................................... F-1
thresholds, blocking when linked to a ventilation parameter .7-31
Troubleshooting .................................. 5-14
volume, setting of ................................ 7-19
Alarms and troubleshooting ................. 5-1
Alarms tests
Circuit Test ........................................... F-2
continuing pressure ................................ F-6
low pressure ...................................... F-6
power failure ..................................... F-1
Alarms, utilisation ................................. 5-1
Alarms, ventilation ................................. 5-1
Altitude compensation feature .............. C-2
Antibacterial filter ................................. 6-14
Apnea
and ventilation modes ......................... D-4
APNEA message .................................. 5-9, 5-15
Apnea alarm test ................................ F-5
Apnea Time .......................................... 3-6, 3-9
Audible alarms
pausing ............................................. 5-5
B
Back panel .......................................... 2-6
Backlight, display
setting of ........................................... 7-18
Backup R .................................................. 3-5
Bar chart, pressure ..................................... 4-1
Bar graph display ........................................ 4-4
Battery
heat safety device ....................................... 6-2
BATTERY FAULT1 alarm message ................ 5-9, 5-15, 8-4
BATTERY FAULT2 alarm message ............... 5-9, 5-15
Battery, internal
capacity .................................................. 8-1
indicator, front panel (figure) ....................... 8-3
operation ............................................... 8-2
reserve capacity display, ventilation running (figure) ............................................... 8-3
reserve capacity display, ventilation stopped (figure) ............................................... 8-3
symbol .................................................. 8-2
Beep ..................................................... 8-6
Blocking an alarm threshold .......................... 7-31
Breath types ............................................ D-1
Breathing Circuit ........................................ 6-8
BUZZER FAULT1 alarm message ................. 5-9, 5-15
BUZZER FAULT2 alarm message ................. 5-9, 5-15
BUZZER FAULT3 alarm message ................. 5-9, 5-15
BUZZER LOW BATTERY alarm message ........ 5-10

C
Capacity of the battery ................................ 8-1
Carbon dioxide
risk of inhalation and suffocation ................. 7-41
Carrying bag, ventilator (figure) ................. G-2
Changing ventilation modes .......................... 7-25
CHECK BATTERY CHARGE alarm message ..... 5-10, 5-15
CHECK EXH VALVE alarm message .............. 5-10, 5-16
CHECK EXH VALVE PRESSURE alarm message 5-10, 5-16
CHECK PROXIMAL LINE alarm message ....... 5-10, 5-16
CHECK REMOTE ALARM alarm message ....... 5-10, 5-16
CHECK SETTINGS alarm message ................. 5-10, 5-16
circuit check test ..................................... F-2
performing a circuit check ......................... F-2
troubleshooting a failed check .................... F-4
Circuit Test ............................................. F-2
Classification of device ................................ 2-4
Cleaning
accessories .......................................... 9-2
solutions and products, approved ............... 9-2
ventilator ............................................. 9-1
Clinician
responsibilities ....................................... A-1
CONNECT VALVE OR CHANGE PRESS alarm message 5-10, 5-16
Connecting to
AC power ............................................. 6-3
DC power ............................................. 6-6
oxygen ................................................. 6-17
oxygen supply (figure) .............................. 6-18
the oxygen supply ................................... 6-17
Consumables
replacement intervals ............................... 10-2
Continuing pressure test ............................ F-6
Contraindications
against use of ventilator ............................ 2-2
Contrast (display), setting ......................... 7-19
CONTROLLED CYCLES alarm message ........ 5-10, 5-16
Cooling fan ........................................... C-1

COOLING FAN alarm message ...................... 5-11, 5-16
CPAP mode ........................................... 3-8
CPAP Mode Menu
Alarm parameters .................................... 3-8

D
DC power
cable connecting to ventilator .................... 6-8
disconnecting from ventilator ..................... 6-8
connecting to ........................................ 6-6
DC POWER DISCONNECTION alarm message . 5-11, 5-17, 6-8
Device classification .................................. 2-4
DEVICE FAULT 1 alarm message ................. 5-11
DEVICE FAULT 10 alarm message ................. 5-11, 5-17
DEVICE FAULT11 alarm message ............... 5-11, 5-17
DEVICE FAULT12 alarm message ............... 5-11, 5-17
DEVICE FAULT13 alarm message ............... 5-11, 5-17
DEVICE FAULT14 alarm message ............... 5-11, 5-17
DEVICE FAULT5 alarm message ................. 5-11, 5-17
DEVICE FAULT7 alarm message ................. 5-11, 5-17
DEVICE FAULT9 alarm message ................. 5-11, 5-17
Digital monitoring .................................. 4-1
Display
of alarms ............................................. 5-2
setting the backlight ............................... 7-18
setting the contrast ................................ 7-19
Display, bargraph ................................... 4-4
Displayed parameters
monitored ........................................... 4-3
Dual Bag (figure) ..................................... G-3

E
E Sens .................................................. 3-4
Electrical specifications ................................ 8-1
Electromagnetic compatibility
and mobile/portable communications equipment 6-2
Electromagnetic emissions
and use of accessories .............................. 6-2
EMPTY BATTERY alarm message ................. 5-11, 5-17, 8-4
Environment
suitable for use of ventilator ..................... 2-1
Environmental specifications ..................... 8-7
Erase Data, USB Memory Device .................. 7-37

F
FAA requirements ..................................... 2-1
Faults, technical ..................................... 5-1
Filters .................................................. 6-13
air inlet .............................................. 6-14
antibacterial ........................................ 6-14
FIO2
oxygen and ventilator settings .................... 3-15
Front panel .......................................... 2-5

G
Gas delivery system (diagram) ..................... C-3

H
Heat safety device, battery ......................... 6-2
HIGH INT TEMP COOL VENT alarm message .. 5-11, 5-18
Index

HIGH LEAKAGE alarm message  . 5-11, 5-19
HIGH PRESSURE alarm message  . 5-12, 5-20
HIGH RATE alarm message  . 5-12, 5-20
HIGH VTI alarm message  . 5-12, 5-20
HIGH/LOW BATTERY TEMP alarm message  . 5-11, 5-19
Holes, air circulation  . 1-4, 6-1
Hot surfaces
  ventilator  . 7-42
Humidifier  . 6-15

I
I.Sens  . 3-4, 3-10, 3-13
Ignition sources (warning)  . 7-3
Indications for use  . 2-1
Indicator
  VENT STDBY  . 7-3
Indicator and alarm specifications  . 8-3
Indicators
  AC power  . 8-5
  INTERNAL BATTERY  . 8-3, 8-5
Inhalation port closeup (figure)  . 6-11
Inspiratory Sensitivity  . 3-13
Inspiratory Tidal Volume  . 3-7, 3-9
Inspiratory trigger  . 4-3
Installation
  placing the ventilator  . 6-1
  instrumentation and assembly  . 6-1
  INTENTIONAL VENT STOP alarm message  . 5-12, 5-20
Internal battery
  charging (Warning)  . 6-2, 8-6
  maintenance (none required)  . 10-3
  recharging  . 8-5
  replacement interval  . 10-3
  storing  . 8-6
  test interval  . 10-3
  testing  . 8-4, F-7
INTERNAL BATTERY indicator  . 8-5
Involuntary stop test  . F-7

K
Key sound
  setting of  . 7-20
Keyboard
  locking of  . 7-38
  unlocking  . 7-39
KEYPAD FAULT alarm message  . 5-12, 5-21
Keys
  VENTILATION ON/OFF  . 7-3

L
Labels  . 1-26
Linked ventilation parameters
  setting  . 7-28
Liquids
  avoid ingress into ventilator (Warning)  . 1-4
Locking key
  disabling  . 7-39
  enabling  . 7-39
Locking Key and SETUP menu  . 7-5
Locking the keyboard  . 7-38
Logs menu
  alarms  . 5-4
  LOW BATTERY alarm message  . 5-12, 5-21, 8-4
  Low pressure test  . F-1
  LOW VTI alarm message  . 5-12, 5-21

M
Machine counter  . 7-3
Maintenance
  configuration  . 7-5
  reserved for service personnel  . 7-12
  schedule, recommended  . 10-2
  Manufacturer’s declaration specifications  . 8-8
  Markings  . 1-21, 1-26
  Max Leak  . 3-7, 3-9, 3-14
  Max Rpm  . 3-7, 3-9, 3-15
Menu
  alarms  . 2-9
  Preferences, parameters  . 7-16
  ventilation  . 2-8
  Min/Max I Time  . 3-6
  Modes
    ventilation
      setting  . 7-23
    Modes of Ventilation  . D-1
    Monitored parameters
      displayed  . 4-3
      specifications  . B-4
    Waveform menu (figure)  . 4-2
  Monitoring, digital  . 4-1

N
NO DATA message, Alarm Logs screen  . 5-4
NO PROXIMAL LINE2 alarm message  . 5-12, 5-21
Notes
  definition of  . 1-1
  Nurse Call cable  . 6-23
  Nurse call system
    connecting the cable to the ventilator  . 6-23

O
OCCLUSION CHECK CIRCUIT alarm message  . 5-12, 5-21
OCCULSION CHECK CIRCUIT alarm message  . 5-21
Operational verification checklist  . E-1
Operator/Users
  targeted for use of ventilator  . 2-2
O-ring, oxygen coupler (Caution)  . 6-18
Oxygen
  connecting the supply  . 6-17
  connector stud  . 6-17
  disconnecting the supply from the ventilator  . 6-18
  enrichment  . 2-3
  rear panel connector (figure)  . 6-17
  special coupler  . 6-17, 6-18
  supply connection  . 6-17
  using medical-grade only (Warning)  . 6-17

P
P A/C mode  . 3-10
### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/A/C Mode</td>
<td>3-8</td>
</tr>
<tr>
<td>Inspiratory Tidal Volume (VTI)</td>
<td>3-9</td>
</tr>
<tr>
<td>Inspiratory Trigger Sensitivity (I Sens)</td>
<td>3-10</td>
</tr>
<tr>
<td>Max Leak</td>
<td>3-9</td>
</tr>
<tr>
<td>Max Rtot</td>
<td>3-9</td>
</tr>
<tr>
<td>Positive End Expiratory Pressure (PEEP)</td>
<td>3-9</td>
</tr>
<tr>
<td>Peak inspiratory pressure (PIP)</td>
<td>3-12</td>
</tr>
<tr>
<td>Positive Expiratory Pressure (PEEP)</td>
<td>3-12</td>
</tr>
<tr>
<td>Respiratory Rate (Rate)</td>
<td>3-13</td>
</tr>
<tr>
<td>Rise Time</td>
<td>3-12</td>
</tr>
<tr>
<td>PSV mode</td>
<td>3-1</td>
</tr>
<tr>
<td>Apnea Time</td>
<td>3-6</td>
</tr>
<tr>
<td>Backup R</td>
<td>3-5</td>
</tr>
<tr>
<td>Inspiratory Tidal Volume (VTI)</td>
<td>3-7</td>
</tr>
<tr>
<td>Inspiratory Trigger Sensitivity (I Sens)</td>
<td>3-4</td>
</tr>
<tr>
<td>Max Leak</td>
<td>3-7</td>
</tr>
<tr>
<td>Max Rtot</td>
<td>3-7</td>
</tr>
<tr>
<td>Min/Max Inspiration Time (Min I Time/Max I Time)</td>
<td>3-6</td>
</tr>
<tr>
<td>Positive End Expiratory Pressure (PEEP)</td>
<td>3-3</td>
</tr>
<tr>
<td>Pressure Support (P Support)</td>
<td>3-3</td>
</tr>
<tr>
<td>Rise Time</td>
<td>3-3</td>
</tr>
<tr>
<td>PSV mode Exhalation sensitivity (E Sens)</td>
<td>3-4</td>
</tr>
<tr>
<td>Exhalation Sensitivity</td>
<td>H-1</td>
</tr>
<tr>
<td>Patient</td>
<td></td>
</tr>
<tr>
<td>outlet port connections (figure)</td>
<td>6-11</td>
</tr>
<tr>
<td>Patient circuit</td>
<td>6-8</td>
</tr>
<tr>
<td>attaching to ventilator</td>
<td>6-8</td>
</tr>
<tr>
<td>choosing</td>
<td>6-10</td>
</tr>
<tr>
<td>installing</td>
<td>6-10</td>
</tr>
<tr>
<td>length and internal volume</td>
<td>6-12</td>
</tr>
<tr>
<td>replacement interval</td>
<td>10-2</td>
</tr>
<tr>
<td>Patient counter</td>
<td>7-3</td>
</tr>
<tr>
<td>PATIENT DISCONNECTION alarm message</td>
<td>5-13, 5-21</td>
</tr>
<tr>
<td>Patient hours</td>
<td>7-8</td>
</tr>
<tr>
<td>Patient/ Caregiver Checklist</td>
<td>A-1</td>
</tr>
<tr>
<td>Patients</td>
<td></td>
</tr>
<tr>
<td>targeted for use of ventilator</td>
<td>2-1</td>
</tr>
<tr>
<td>Peak inspiratory flow</td>
<td>3-4</td>
</tr>
<tr>
<td>Peak inspiratory pressure</td>
<td>3-12</td>
</tr>
<tr>
<td>PEEP</td>
<td>3-9, 3-12</td>
</tr>
<tr>
<td>Performance specifications</td>
<td>B-3</td>
</tr>
<tr>
<td>Physical specifications</td>
<td>B-1</td>
</tr>
<tr>
<td>PIP</td>
<td>3-12</td>
</tr>
<tr>
<td>Placing the ventilator (installing)</td>
<td>6-1</td>
</tr>
<tr>
<td>Pneumatic specifications</td>
<td>B-8</td>
</tr>
<tr>
<td>Positive end expiratory pressure</td>
<td>3-12</td>
</tr>
<tr>
<td>Power failure test</td>
<td>F-5</td>
</tr>
<tr>
<td>POWER FAULT alarm message</td>
<td>5-13, 5-22</td>
</tr>
<tr>
<td>Power On Self Test (POST)</td>
<td>7-3</td>
</tr>
<tr>
<td>POWER SUPPLY LOSS alarm message</td>
<td>5-13, 5-22</td>
</tr>
<tr>
<td>Precautions for use</td>
<td></td>
</tr>
<tr>
<td>electromagnetic interference</td>
<td>1-21</td>
</tr>
<tr>
<td>Precautions for use, cautions</td>
<td>1-21</td>
</tr>
<tr>
<td>general installation</td>
<td></td>
</tr>
<tr>
<td>environment</td>
<td>1-21</td>
</tr>
<tr>
<td>maintenance</td>
<td>1-21</td>
</tr>
<tr>
<td>Precautions for use, warnings</td>
<td></td>
</tr>
<tr>
<td>general installation</td>
<td>1-1</td>
</tr>
<tr>
<td>maintenance</td>
<td>1-21</td>
</tr>
<tr>
<td>oxygen</td>
<td>1-21</td>
</tr>
<tr>
<td>settings</td>
<td>1-21</td>
</tr>
</tbody>
</table>

### SOFTWARE VERSION ERROR alarm message

- 5-13, 5-22

### Risk of fire (warning)

- 10-1, 10-3

### Replacement intervals

- air filter                                      | 10-2|
- air outlet (antibacterial) filter               | 10-2|
- consumables                                     | 10-2|
- patient circuit                                 | 10-2|

### R

- Range, resolution, and accuracy specifications  | 8-4|
- Rate (Respiratory Rate)                         | 3-13|
- Reactivating alarms                             | 5-7|
- Recharging the internal battery                 | 8-5|
- REMOVE VALVE CPAP MODE alarm message            | 5-13, 5-22|
- REMOVE VALVE OR CHANGE PEEP alarm message       | 5-13, 5-22|
- Repairing the ventilator                        | 5-13, 5-22|

### S

- Safety
  - onboard alarm system                          | 2-3|
  - Service assistance information                | 10-4|
- Setting ventilation parameters                  | 7-27|
- Setup Configuration                             | 7-5|

### SETUP screen

- changing parameters                            | 7-5|
- screen shot                                     | 7-5|
- SOFTWARE VERSION ERROR alarm message            | 5-13, 5-22|

### Specifications
Index

electrical ......................................................... 8-1
environmental ................................................... B-7
indicators and alarms ........................................... 8-3
manufacturer’s declaration ...................................... 8-8
monitored parameters ........................................... 8-4
performance ..................................................... B-3
physical .......................................................... B-1
pneumatic ......................................................... B-8
range, resolution, and accuracy .................................. 8-4
standards compliance and IEC classification .................... B-14
ventilator .......................................................... B-1
Standards, compliance, and IEC classification specifications 8-1
Starting ventilation .............................................. 7-39
Stopping ventilation ............................................. 7-41
Storing the internal battery ...................................... 8-6
Stud, oxygen connector ........................................... 6-17
T
Technical faults ................................................... 5-1
Testing ................................................................ 8-4, F-7
internal battery ................................................... 8-4, F-7
Transfer continuously, USB Memory Device ................. 7-33
Transfer Trends USB Memory Device ......................... 7-35
Transport, emergency ........................................... 7-2
ventilator not intended for ....................................... 2-2
Trigger threshold setting ......................................... 7-42
modifying (Caution) .............................................. 3-4
Troubleshooting .................................................... 5-14
alarms ................................................................ 5-14
other problems ................................................... 5-23
TURB OVERHEAT alarm message ............................... 5-14, 5-22
Turning off the ventilator ......................................... 7-42
Turning on the ventilator ......................................... 7-1

U
UNKNOWN BATTERY alarm message ........................... 5-14, 5-22
Unlocking the keyboard .......................................... 7-39
Unpacking and preparing the ventilator ......................... G-1
USB Memory Device ............................................. 7-32
Characteristics ..................................................... 7-32
Erase Data .......................................................... 7-37
Specifications ....................................................... 7-32
Supported formats ................................................. 7-32
Transfer continuously ............................................ 7-33
Transfer Trends .................................................... 7-35
USB Menu .......................................................... 7-32
USB Menu parameters ........................................... 7-32

V
VENT STDBY indicator ......................................... 7-3
test ................................................................. 7-3
Ventilation
menu ................................................................. 2-8
starting ............................................................. 7-39
stopping ............................................................ 7-41
Ventilation modes ................................................. 2-2, D-1
and apnea ......................................................... D-4
changing during ventilation ................................... 7-25
changing while on standby ..................................... 7-24
setting ............................................................. 7-23
VENTILATION ON/OFF key ................................... 7-3
Ventilation parameters ........................................... 7-3
digital monitoring .................................................. 4-1
modifying .......................................................... 7-27
setting ............................................................. 7-27
setting when linked to alarm thresholds ....................... 7-29
setting when linked to other parameters ....................... 7-28
Ventilator
architecture of ..................................................... C-1
carrying bag (figure) ............................................. G-2
cleaning ............................................................. 9-1
connecting the nurse call cable .................................. 6-23
connections, proper (Warning) ................................ 1-4, 6-2, 6-9
failure of ............................................................ 2-10
filters ................................................................. 6-13
mounting on a wheelchair ....................................... 6-20
operation (description of) ....................................... C-1
parts and accessories ............................................. H-1
patient outlet port connections (figure) ....................... 6-11
potentially hot surfaces .......................................... 7-42
principles of operation ......................................... C-1
specifications ....................................................... B-1
symbols and markings .......................................... 1-21
turning off ........................................................ 7-42
turning on ......................................................... 7-1
unpacking and preparation ...................................... G-1
Ventilator, and liquid ingress (Warning) ......................... 1-4
Volume, alarms ................................................... 7-19
Vt Target ............................................................ 3-7, 3-9, 3-14
W
Warnings
definition of ...................................................... 1-1
general list of ..................................................... 1-1
Warranty ............................................................ 1-xi
Waveform menu
monitored parameters (figure) .................................. 4-2
Welcome Menu screen
display of ........................................................ 7-3
skipping ........................................................... 7-4
Wheelchair
mounting the ventilator onto .................................... 6-20