THE PURITAN BENNETT™ 980 VENTILATOR

CLINICAL APPLICATIONS LESSON PLAN
OVERVIEW

This guide is provided as a convenience companion document to the Operator’s Manual. It is not intended to replace the Operator’s Manual, which should always be available while using the ventilator. It is important to familiarize yourself with all information in the Operator’s Manual relevant to your institution’s use of the ventilator, including on-screen help, instructions, warnings and cautions.
CONTENTS

- Puritan Bennett™ Leak Sync Software
- Noninvasive Ventilation
- Volume Control Plus
- Pressure Control
- Puritan Bennett™ BiLevel Software
- Puritan Bennett™ PAV™ *+ Software
- Tube Compensation Software
- Volume Support
- Puritan Bennett™ NeoMode 2.0 Software
- Puritan Bennett™ Proximal Flow Sensor
PURITAN BENNETT™
LEAK SYNC SYNC SOFTWARE
PROBLEM: WHERE DO LEAKS COME FROM?

- Patient interface
  - ETT (cuffed, deflated cuff or cuffless)
    - Trach tube (cuffed, deflated cuff or cuffless)
  - Mask or other external interface
- Breathing circuit system
PROBLEM: COMMON LEAK CHALLENGES

- Auto-triggering
- Late cycling-off of pressure support and volume support breaths
- Overestimation of delivered tidal volume/flow
- The possible need for frequent manual adjustments
PROBLEM: LEAKS

Studies show that air leaks occur in up to 70% of children and can lead to significant clinical consequences, including\(^1,2\):

- Inconsistent ventilatory delivery\(^1\)
- Unreliable lung function testing\(^2\)
- Inappropriate clinical assessment due to error in monitored volume\(^1\)
- Increased work of breathing due to trigger asynchronies\(^2\)

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Key Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Mahmoud(^1)</td>
<td>An air leak of 40% indicated the displayed (V_T) was underestimated by 1.2 mL/kg, thus by about 24% of target (V_T) (generally 5 mL/kg).</td>
</tr>
<tr>
<td>2001</td>
<td>Main(^2)</td>
<td>Leaks larger than 20% resulted in inconsistent tidal volume delivery and gross overestimation of compliance (C) and resistance (R) regardless of ventilator mode.</td>
</tr>
</tbody>
</table>

SOLUTION: PURITAN BENNETT™ LEAK SYNC SOFTWARE

- Leak Sync software may reduce leak-related ventilation and monitoring problems* during both inspiration and exhalation.¹

¹ Oto J et al. A Comparison of Leak Compensation in Acute Care Ventilators During Noninvasive and Invasive Ventilation: A Lung Model Study Respir Care 2013;58(12):2027–2037 (Puritan Bennett™ 840 Leak comp software was in the study).

*Compared to when Leak Sync is off
SOLUTION: PURITAN BENNETT™ LEAK SYNC SOFTWARE

- Reduces auto-triggering and delayed cycling\(^1\)
- Leak compensates the data values for \(V_{TI}\) (displayed as \(V_{TL}\)) and \(V_{TE}\)
- Servo-controls breath delivery based on leak-compensated values
- Works in VC+ and VS

---

1. Oto J et al. A Comparison of Leak Compensation in Acute Care Ventilators During Noninvasive and Invasive Ventilation: A Lung Model Study Respir Care 2013;58(12):2027–2037 (Puritan Bennett™ 840 Leak comp software was in the study).
- Name: “Leak Compensation” changed to “Leak Sync”
- VC+ and VS added
- Defaults to ON with NIV and neonatal
POTENTIAL BENEFITS OF PURITAN BENNETT™ LEAK SYNC SOFTWARE

- May reduce manual adjustments of sensitivity settings¹
- Improves triggering and cycling²
- Leak compensates the data values for inspiratory and expiratory volumes to make them more relevant to the clinical situation¹
- Allows for VC+ and VS
- Enables avoidance of nuisance alarms
- May provide reassurance of appropriate level of ventilatory support by servo-controlling volume-targeted breath types from a leak-compensated $V_{TI}$ (displayed at $V_{TL}$) data value¹

2. Oto J et al. A Comparison of Leak Compensation in Acute Care Ventilators During Noninvasive and Invasive Ventilation: A Lung Model Study Respir Care 2013;58(12):2027–2037 (Puritan Bennett™ 840 Leak comp software was in the study).
PURITAN BENNETT™ LEAK SYNC SOFTWARE SETUP

- Menu tab/setup/more settings
- Enabled or disabled
  - Enabled by default with neonatal patient type and also when NIV is selected
- Set $D_{SENS}$ in L/min
DISPLAY CHANGES WITH LEAK SYNC SOFTWARE ENABLED

- **LS** on vent setup button
- **DSENS** = L/min (not %)
- **V_{TL}** and **V_{TE}** = estimated patient values
- Graphic displays estimated lung flows
- Data displayed:
  - **V_{LEAK}**
  - **%LEAK**
  - LEAK (leak rate@PEEP)
The Puritan Bennett™ 840 ventilator with Leak Compensation software outperformed all other ventilators included in the studies.¹

<table>
<thead>
<tr>
<th>Invasive ventilation</th>
<th>The Puritan Bennett™ 840 ventilator outperformed all other ventilators in this study by requiring fewer breaths to achieve synchronization during increasing and decreasing leaks.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noninvasive ventilation</td>
<td>The study demonstrated wide variations between the ability of ventilators to compensate for an air leak during noninvasive ventilation.¹</td>
</tr>
<tr>
<td></td>
<td>The Puritan Bennett™ 840 and Philips Respironics™* V60 ventilators were the only ventilators in this study that adapted well to increasing or decreasing leaks.¹</td>
</tr>
</tbody>
</table>

HOW PURITAN BENNETT™ LEAK SYNC SOFTWARE WORKS

- Defaults on: NIV or Neonatal
- Defaults off: INV/Pediatric or Adult
- Adjusts within ~ 3 breaths
- $V_{TL}$ and $V_{TE}$ compensated display
- Flow/volume graphics leak compensated
- Bias flow automatically adjusted
CAPABILITIES AND LIMITATIONS

Capabilities

- Neonate, pediatric and adult invasive and non-invasively
- Dynamic compensation of leaks during invasive and noninvasive ventilation

Limitations

Leak Sync software not active with:
- Tube compensation (TC)
- Proportional Assist™* Ventilation (PAV™*+ software)
NONINVASIVE VENTILATION
Mechanical ventilation may lead to significant asynchrony.\textsuperscript{1}
Leaks may impact patient tolerance to NIV.\textsuperscript{2}
Leaks may result in monitoring errors, breath management issues, and trigger and cycle asynchrony.\textsuperscript{2}


SOLUTION: NON-INVASIVE VENTILATION (NIV) WITH PURITAN BENNETT™ LEAK SYNC SOFTWARE

- NIV ventilation selection
- Use with mask or other leak-prone patient interface
- Works with various modes/breath types
- Leak Sync software enabled
POTENTIAL BENEFITS OF NIV WITH PURITAN BENNETT™ LEAK SYNC SOFTWARE

- Help patients tolerate NIV so they can continue using NIV
- Help avoid complications associated with intubation/artificial airways

1. Epstein S. Should a Patient Be Extubated and Placed on Noninvasive Ventilation After Failing a Spontaneous Breathing Trial? Respir Care 2010;55(2):198–206
NIV SETUP

- Setup button
- Menu tab/vent
- NIV
- Shows applicable settings
- CPAP mode is available
  - Flow trigger
  - $T_{\text{SPONT}}$ limit
  - $D_{\text{SENS}}$ defaults to OFF
HOW NIV SOFTWARE WORKS

- NIV-compatible selection of mode and breath types (NEO CPAP added) is available
  - Volume alarms are disabled to reduce nuisance alarms
- Leak Sync software automatically enabled
NIV CAPABILITIES AND LIMITATIONS

Only flow triggering is available.

### Capabilities
- Stable respiratory drive
- Neonatal
- Pediatric
- Adult

### Limitations
Not available with:
- Tube compensation (TC)
- BiLevel
- VC+ and VS
- Proportional Assist™ Ventilation Plus (PAV™ *+ software) breath types
VOLUME CONTROL PLUS
PROBLEM: FIXED FLOW PATTERNS MAY RESULT IN DISCOMFORT AND ASYNCHRONY
SOLUTION: VOLUME CONTROL PLUS (VC+)

- VC+ breaths deliver a variable flow.
- The ventilator manages inspiratory pressure to achieve the desired tidal volume target.
POTENTIAL BENEFITS OF VC+

- Unlike standard VC, VC+:
  - Provides variable flow delivery and volume
  - Uses the lowest pressure necessary for volume delivery
  - Escalates pressure if volume delivery decreases
- Active valve accommodates breathing variations.
VC+ SETUP

- Select:
  - Gender and height or predicted body weight (PBW)
  - Invasive vent type
  - AC or SIMV mode
  - VC+ mandatory breath type
- Adjust all available settings.
- Set all appropriate alarms.
HOW VC+ SOFTWARE WORKS AND ALARM STRATEGY

- Variable flow with active exhalation valve
- Titration of pressure
- $1 - 3$ cmH$_2$O/breath
- Alarm strategy
  - $\uparrow P_{\text{PEAK}}$ limit (determines max target pressure)
  - $\downarrow P_{\text{PEAK}}$ limit
  - Volume not delivered
  - $\uparrow V_{\text{Ti}}$ limit
TROUBLESHOOTING INADEQUATE V_T DELIVERY

- Check that T_i is long enough.
- Check that Rise Time is fast enough.
- Check that the set tidal volume is not too high in comparison with the \( \uparrow P_{PEAK} \) limit.
- Check for auto-PEEP causing \( \uparrow P_{PEAK} \) limit and resolve.
CAPABILITIES AND LIMITATIONS

Capabilities

- Neonate, pediatric and adult
- Leak Sync software compatible

Limitations

- Invasive only
- High effort may result in regulating of pressure down to undesirable levels.

- Leaks without Leak Sync software enabled may result in regulating of pressure down to undesirable levels.
PRESSURE CONTROL
TWO PROBLEMS

- Fixed flow patterns in VC may result in discomfort and asynchrony.
- VC+ may not always provide a consistent delivered pressure.
PC breaths deliver variable flow and volume.

The inspiratory pressure target remains constant.
POTENTIAL BENEFITS OF PC

Mean airway pressure more consistent while allowing more natural breathing.
PC SETUP

- Enter the patient’s **gender and height** or **predicted body weight** (PBW).
- Select **INV** or **NIV**.
- Touch **AC** or **SIMV** mode.
- Touch the **PC** mandatory breath type.
- Adjust all available settings.
- Set all appropriate alarms.
HOW TO USE THE TIMING PADLOCKS

- The user determines whether to set Inspiratory Time, I:E Ratio or Expiratory Time as the primary setting.
- Changes in the preset rate will not alter the primary variable set in the timing padlocked area.
HOW PC SOFTWARE WORKS

- Mandatory, assisted/controlled pressure-based breath
- INV or NIV
- The user sets inspiratory time, inspiratory pressure/PEEP and pressure rise.
- The ventilator manages flow to meet the patient’s needs and control pressure delivery.
CAPABILITIES AND LIMITATIONS

Capabilities
- May be used with neonate, pediatric and adult patients.
- May be combined with Leak Sync.

Limitations
- Tidal volume is variable.
TWO PROBLEMS

- The limitations of volume control may lead to additional sedation.¹
- Inverse ratios and monitoring are limitations in traditional PCV.

Mandatory-assisted and spontaneous-assisted pressure-based breath types

Active valve

Strategies for boosting mean airway pressure

Normal I:E or extended inverse available (>4:1)
POTENTIAL CLINICAL BENEFITS OF PURITAN BENNETT™ BILEVEL SOFTWARE

- Flow and volume variable
- Active valve
- Conventional or APRV style of breath timing
- Potential for improved oxygenation
- Potential for reduction in sedation

- Enter **gender and height** or **predicted body weight** (PBW).
- Touch **Invasive**.
- Touch **BiLevel** mode.
- Adjust available settings. Note:
  - $P_H$: Above ambient, not above PEEP; must be set at least 5 above $P_L$
  - Spontaneous Type: TC or PS
- Set all appropriate alarms.
User determines the primary setting. Options:
- $T_H$ (Time High)
- $T_H$ ratio to $T_L$ (Time High to Time Low ratio)
- $T_L$ (Time Low)

Changes in set frequency will not alter the primary variable set in the timing padlocked area.
- $P_H$: Pressure during the $T_H$ period
- $P_L$: Pressure during the $T_L$ period
- When $T_H:T_L > 4:1$, with the $T_L$ period locked, changes in set $f$ will change the $T_H$, but the $T_L$ will remain constant regardless of patient effort period to accommodate the new $f$ setting while maintaining the set $T_L$ period.
HOW PURITAN BENNETT™ BILEVEL SOFTWARE WORKS

- Two pressure levels, breath availability and active valve
- Conventional or APRV breath timing
- Alarm strategy
- $P_{PEAK}$ (peak pressure) may be 1 to 2 cmH$_2$O higher than set pressure
Pressure support
- Works on $P_L$ and $P_H$
- $P_L + PS = \text{target pressure}$
- May be left at “0” cmH$_2$O
- Tube Compensation
CAPABILITIES AND LIMITATIONS

Capabilities

- Neonate, pediatric, adult
- APRV inverse ratio settings
- Support Spont breaths with PS, TC

Limitations

- Only invasive
- Limited respiratory mechanics
DESCRIBE CHANGES THAT MAY IMPACT OXYGENATION

- $P_H$ – High Pressure
- $T_H$ – High Pressure Time

PROBLEM: WHEN THE VENTILATOR CONTROLS BREATHS INSTEAD OF THE PATIENT, ATROPHY OF DIAPHRAGM FIBERS HAPPENS RAPIDLY DUE TO DISUSE

24% of mechanically ventilated patients exhibit patient-ventilator asynchrony in >10% of their respiratory efforts.

Asynchrony

↓

Sedation

↓

Prolonged ventilation time¹

↓

Possible muscle atrophy² and VAP³

↓

Weaning is delayed

PROBLEM: ASSOCIATED ASYNCHRONY COSTS

- 24% of ICU patients exhibit asynchrony in greater than 10% of their breaths.

- Asynchrony is associated with 18 extra days on the ventilator: duration of mechanical ventilation 7 (3-20) days vs. 25 (9-42) days \( p=0.005 \) ventilation (days; IQR).

- Average cost per day in the ICU for a patient receiving mechanical ventilation is $4,000.

---

Monitors patient’s demand breath by breath
Monitors compliance and resistance
Allows variable volume, flow, inspiratory time and pressure
Promotes natural breathing*

*Compared to VC, VC+ and PS
POTENTIAL BENEFITS OF PURITAN BENNETT™ PAV™** SOFTWARE

- Encourages use of the diaphragm¹
- Increases support as the patient’s demand increases
- Improves patient-ventilator synchrony¹,²
- May help the clinician better manage a patient’s work of breathing³

³ Eumorfia Kondili, George Prinianakis, Christina Alexopoulou, Eleftheria Vakouti, Maria Klimathianaki, Dimitris Georgopoulos Respiratory Load compensation during mechanical ventilation-proportional assist ventilation with load-adjustable gain factors versus pressure support Intensive Care Med DOI 10.1007/s00134-006-0110-0
PURITAN BENNETT™ PAV™*+ SOFTWARE SETUP

- Enter **gender and height** or **predicted body weight** (≥25 kg).
- **Touch:**
  - **Invasive** vent type
  - **SPONT** mode
  - **PAV™+**
  - Select **% Support**, **PEEP** and **FiO₂**.
  - Select tube type.
  - Adjust the tube ID (6-10 mm ID).
  - Adjust the alarms.
- $\uparrow P_{\text{PEAK}}$
- $\uparrow V_{\text{TI}}$ limit
- $\downarrow V_{\text{E}}$ or $\downarrow V_{\text{T}}$
- PA to PAV™*+ description
- Default support starts at 70% Support
- Two graphs and WOB bar
- Enhanced calculation of compliance and resistance
HOW PURITAN BENNETT™ PAV™*+ SOFTWARE WORKS: MEASUREMENTS

Measures values that create work

- Assesses compliance and resistance (4 - 10 breaths with an automatic plateau)
- Measures flow and volume every 5 msec
- Uses the “equation of motion”
• % Support, PEEP and $O_2$% 
• Tube size and type 
• Monitors: 
  • Compliance, resistance and PEEP$_I$ 
  • Work of breathing bar 
    • WOB$_{TOT}$ and WOB$_{PT}$ 
  • Elastic and resistance work 
• Estimated lung pressure shadow trace 
• Flow and volume waveforms
- High inspired tidal volume (↑$V_{TI}$)
- High circuit pressure (↑$P_{PEAK}$)
- PAV STARTUP TOO LONG
- PAV R&C NOT ASSESSED
- Set all other traditional alarms
SUMMARY OF HOW PURITAN BENNETT™ PAV™*+ SOFTWARE WORKS

- PAV™*+ software measures work variables.
- The primary settings are % Support, PEEP and O₂ %.
- The software amplifies patient efforts to offset the total work of breathing.
- The software adjusts delivered pressure within the same breath.
- The breath stops when patient inspiratory flow ceases.
- Delivered pressure adjusts dynamically to patient effort.
CAPABILITIES AND LIMITATIONS

Capabilities

- Intact respiratory drive
- 25 kg (55 lb.) or greater
- 6.0 I.D. tube or greater

Limitations

- Apnea
- Oversedation
- Abnormal respiratory drive
- Leaks
- <25 kg (55 lb.)
- Severe air trapping
- Pneumatic nebulizer
- Not available with NIV
TUBE COMPENSATION
PROBLEM: IMPOSED WOB FROM A TRACH OR AN ET TUBE

- An endotracheal or tracheostomy tube can impose an increased work of breathing.¹
- Pressure Support limitations:
  - Fixed delivery pressure approach
  - T-Piece trials reduce the monitoring capabilities.

¹ Maeda Y. Does the tube-compensation function of two modern mechanical ventilators provide effective work of breathing relief? Critical Care 2003, 7:R92-R97
Tube Compensation (TC) assists the patient in overcoming the flow resistance of the artificial airway.

TC software supports spontaneous breaths.

Only to the point of overcoming the artificial airways

TC may reduce the work of breathing.¹

---

¹ Maeda Y. Does the tube-compensation function of two modern mechanical ventilators provide effective work of breathing relief? Critical Care 2003, 7:R92-R97
POTENTIAL BENEFITS OF TUBE COMPENSATION

- Provide variable pressure with variable effort.
- Reduce the imposed work associated with artificial airways.\(^1\)
- Allow for enhanced monitoring compared to the T-Piece approach.

1. Maeda Y. Does the tube-compensation function of two modern mechanical ventilators provide effective work of breathing relief? Critical Care 2003, 7:R92-R97
Select **TC** for spontaneous type.

In particular, mention:

- % Support: 10% to 100%
- Tube I.D.
- Tube type
- $\uparrow P_{\text{PEAK}}$
- $\uparrow V_T$
• Supports spontaneous breathing in SPONT, BiLevel and SIMV.
• TC checks the flow rate every 5 ms.
• TC uses flow, the % Support setting and a look-up table to determine delivered pressure.
• % Support settings are from 10% to 100% (in 5% increments).
TC-SPECIFIC ALARM STRATEGY

- $\uparrow P_{\text{PEAK}}$
- $\uparrow$Inspired tidal volume
- All of typical alarms
CAPABILITIES AND LIMITATIONS

Capabilities

- Intact respiratory drive
- 7.0 kg (15.4 lb.) or greater
  - 4.5 I.D. tube or bigger

Limitations

- Oversedation
- NeoMode <7.0 kg (15.4 lb.)
- <4.5 I.D. tube
- Apnea
VOLUME SUPPORT
PROBLEM: LIMITATIONS OF PRESSURE SUPPORT

- Pressure support does not provide a target tidal volume.
- Pressure support does not down-regulate pressure automatically.
SOLUTION: VOLUME SUPPORT (VS)

- Clinician can set a target tidal volume.
- Automated pressure delivery is based on inspired volume.
- VS provides variable flow.
POTENTIAL BENEFITS OF VOLUME SUPPORT

- Encourages the use of the diaphragm
- Automatically decreases support pressure if target tidal volume is exceeded (1 – 3 cmH₂O)
- Increases pressure if the patient’s ability to take an adequate breath is compromised (1 – 3 cmH₂O)

### COMPARING VOLUME SUPPORT TO PRESSURE SUPPORT

<table>
<thead>
<tr>
<th>Feature</th>
<th>Volume Support</th>
<th>Pressure Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest pressure for the set volume</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Escalates if needed</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Adjusts for changes in Raw and C</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
VOLUME SUPPORT SETUP

- Select **SPONT** mode
- Select **VS** for spontaneous type
- Select:
  - $V_{T\text{ SUPP}}$
  - Trigger setting
  - Oxygen %
  - Rise %
  - $E_{SENS}$
  - PEEP
  - $\uparrow V_{TI}$
  - $\uparrow P_{PEAK}$
- VS varies the inspiratory pressure to deliver the operator-set target tidal volume.
- During VS, the inspiratory pressure target cannot be lower than PEEP + 1.5 cmH₂O and cannot exceed the ↑P_{PEAK} limit - 3 cmH₂O.
- Pressure adjust a max of +/- 3 cmH₂O/breath if needed.
- Test breath at startup. “VS startup” is displayed in the GUI’s prompt area.
VS-SPECIFIC ALARM STRATEGY

- \( \uparrow P_{PEAK} \) limit (determines max target pressure)
- Volume not delivered
- \( \uparrow V_{TI} \) limit
**Capabilities**
- Neonatal to adult
- Spontaneously breathing patients
- Invasive ventilation only
- SPONT mode only

**Limitations**
- Oversedation
- Apnea
- High effort may result in regulating of pressure down to undesirable levels.
- Leaks without Leak Sync software enabled may result in regulating of pressure down.
- NIV
GENERAL PROBLEM

- Small tidal volume requirements
- Ability to use AC and SIMV to ventilate with NIV
- Auto-triggering and delayed cycling
- Management of nuisance alarms with CPAP
- Reducing excessive oxygen exposure
- Excessive tidal volume delivery

POTENTIAL SOLUTION: PURITAN BENNETT™ NEOMODE 2.0 SOFTWARE

- Puritan Bennett™ Leak Sync software
- A wide spectrum of modes both INV and NIV
- Volume targeted availability down to 2.0 mL

- Assist Control (VC, VC+ and PC)
- SIMV (VC, VC+ - Dual Mode and PC)
- BiLevel software
- Spontaneous
- Volume Support – Dual Mode
- Pressure Support

- Assist Control (VC, PC)
- SIMV (VC, PC)
- Spontaneous (PS)
- CPAP
POTENTIAL SOLUTION: PURITAN BENNETT™ NEOMODE 2.0 SOFTWARE

- A NIV CPAP-specific mode with nuisance alarm management
- A configurable temporary elevate oxygen feature
- Enhanced monitoring of $C_{20}/C$ and mL/kg
POTENTIAL SOLUTION/BENEFITS OF PURITAN BENNETT™ NEOMODE 2.0 SOFTWARE

- One machine for all patient sizes
- Possible reduced use of invasive ventilation
- Automatic management of leaks
- Reduced alarms in the NICU with NCPAP
- Better management of oxygen exposure
- Intended delivered volume managed by monitoring

- $C_{20}/C$
- PBW/kg
PURITAN BENNETT™ NEOMODE 2.0 SOFTWARE SETUP

- Install the neonatal adapter door and the single patient use neonatal expiratory filter.
- Connect a neonatal breathing circuit to the ventilator.
- Select the neonatal breathing circuit type in Short Self-Test (SST).
- Neonatal-specific settings and safety boundaries are activated.
Select **actual patient weight**
- Range for neonates is 0.3 kg to 7.0 kg (0.66 lb. to 15 lb.)

Select **INV** or **NIV** and modes
- Includes A/C, SIMV, Spont, BiLevel and CPAP
- Breath type VC, VC+ or PC
- All other specific settings

Configurable elevated FiO₂

Leak Sync software automatically enabled
HOW NEOMODE 2.0 SOFTWARE WORKS: ALARM STRATEGIES IN CPAP

- When in NeoMode 2.0 mode, if NIV CPAP is used:
  - $V_{ETOT}$, $V_{TE\,SPONT}$ and $\uparrow V_{TI}$ alarms are not available.
  - $V_E$ and $V_Te$ displays are not available.
  - $T_A$ can be adjusted but defaults to off to avoid inadvertent alarms.
  - Adjust the $D_{SENS}$ alarm.
CAPABILITIES AND LIMITATIONS OF PURITAN BENNETT™ NEOMODE 2.0 SOFTWARE

**Indications:**
- 0.3 kg (0.66 lb.) and above
- \( V_T \) 2 mL and above
- Neonatal breathing circuit
- Neonatal adapter door and neonatal expiratory filter

**Limitations:**
- Pediatric or adult breathing circuit
- >7.0 kg (15 lb.) PBW
PURITAN BENNETT™
PROXIMAL FLOW SENSOR
PROBLEMS: ACCURATE GRAPHICS AND PROXIMAL FLOW SENSOR ISSUES

- Circuit volume affecting graphs
- Calibrations during ventilation
- Water contamination of Proximal Flow Sensor
SOLUTION: PURITAN BENNETT™ PROXIMAL FLOW SENSOR AND MONITORING SOFTWARE

- Measures flow and volume reflected at the patient wye
- Displays both proximal flow and proximal pressure
- Uses proximal flow values in the display of graphics.
- Requires no manual calibration
- Weight 6.6 g; dead space <1 mL
POTENTIAL BENEFITS OF THE PURITAN BENNETT™ PROXIMAL FLOW SENSOR

- Improved graphics for patient management
- Improved patient data
PURITAN BENNETT™ PROXIMAL FLOW OPTION COMPONENTS

- Proximal Flow Hardware
- Proximal Flow Sensor
To disable or enable the Proximal Flow Option:
1. Touch the Configure wrench icon
2. Touch the Options tab
3. Touch the Prox tab
4. Touch the Enabled or Disabled button
5. Touch Accept

Periodic expiratory phase purging occurs regularly for accurate measurements.
PROXIMAL FLOW SENSOR SETUP WITH PURITAN BENNETT™ NEOMODE 2.0 SOFTWARE

- Installed during the SST (prompts are given)
- Two connections:
  - Install monitoring end at the patient circuit wye
  - Install connector end on the ventilator’s front panel behind a clear door
- Neonatal invasive ventilation only
Alarms respond to values monitored with the flow sensor
Breaths are controlled from the internal flow sensors (prox flow values are for monitoring only)
Prox inoperative
HOW THE PURITAN BENNETT™ NEONATAL PROXIMAL FLOW SENSOR WORKS

- Measures flows, pressures and tidal volumes
- Requires NeoMode 2.0 software option
- Purge and auto-zero
- Waveform Monitoring:
  - $P_{CIRCY}$
  - $V_Y$
  - $V_{TY}$
- Monitored data:
  - $V_{TlY}$
  - $V_{TLY}$
  - $V_{TEY}$
  - $V_{TE SPONTY}$
  - $V_{TE MANDY}$
  - $V_{ETOTY}$
  - $LEAK_Y$
COMPARING THE VALUES FOR LEAK AND $LEAK_Y$

![Graph showing comparison between Patient + Circuit and Patient](image)
CAPABILITIES AND LIMITATIONS

Capabilities

- Measuring flows, pressures and tidal volumes of invasively ventilated neonatal patients
- PBW of 0.3 kg (0.66 lb) to 7.0 kg (15.4 lb) using ET tube sizes from 2.5 mm to 4.0 mm

Limitations

- Non-invasive (NIV)
- Pediatric and adult
- ET >4.0 mm
- PBW >7.0 kg (15.4 lb)
- Nebulized medications