ResMed VPAP-ST (bi-level) ventilator guidelines for clinicians

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Mount Sinai Health System

Current Working Guidelines – Subject to Revision
These current working guidelines are subject to revision. It is expected this document will be updated and re-released as additional experience is accumulated.

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This document should be used as a clinical adjunct to the protocol “Repurposing bi-level ventilators for use with intubated patients while minimizing risk to health care works during insufficient supply of conventional ventilation for patients with COVID-19” and is shared with our health care colleagues to increase knowledge about potential solutions to increase the capacity and access to mechanical ventilation during the COVID-19 crisis. Icahn School of Medicine does not warrant the contents or effectiveness of the protocol, and the use and implementation of this protocol should be first reviewed and evaluated with each hospital’s medical staff.

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QUICK GLANCE: POTENTIAL CANDIDATES FOR RESMED VPAP-S

To be followed for support of intubated ICU patients if there is a crisis shortage of ventilators

Ideal initial candidates for ResMed VPAP-ST ventilation if there is a crisis induced shortage of ventilators are patients with either:

- Stable or improving P/F ratio
- Decreasing or stable ventilator requirements

**We do not recommend use in newly intubated patients unless no other ventilators are available.** Newly intubated patients should be reassessed and considered for transition to ResMed VPAP-ST once they are stable, as detailed in Table 1.

### Table 1: VPAP ST Criteria

<table>
<thead>
<tr>
<th>Parameter on Conventional Ventilator</th>
<th>Acceptable Limit</th>
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<tbody>
<tr>
<td>FiO₂</td>
<td>≤ 85%</td>
</tr>
<tr>
<td>PEEP*</td>
<td>≤ 15 cm H₂O</td>
</tr>
<tr>
<td>Driving pressure: (P_{Plateau} – PEEP) or inspiratory pressure (Pi)*</td>
<td>≤ 20 cm H₂O</td>
</tr>
<tr>
<td>*Driving Pressure + PEEP</td>
<td>&lt;23</td>
</tr>
</tbody>
</table>

*Driving Pressure + PEEP* of 25 cmH₂O. For safety, given a potential increase of resistance in the VPAP-ST circuit, we recommend that the device is most appropriate for patients with settings on conventional ventilation as follows:

- If patient on Pressure Control mode: check that Inspiratory Pressure (Pi) + PEEP is below 23 cmH₂O
- If patient on Volume Control mode: check that plateau pressure is below 23 cmH₂O
TRANSITIONING FROM CONVENTIONAL VENTILATOR TO RESMED VPAP-ST BILEVEL

This device provides positive pressure ventilation in a manner analogous to pressure control ventilation on traditional ventilators.

*Calculate patient ideal body weight (IBW) from height and goal tidal volume (TV) of 6 - 8 cc/kg with plateau pressure < 30.*

**Settings:**

- **MODE:** ST (bilevel)
- **EPAP = PEEP**
- **IPAP:**
  - If patient is on Pressure Control (AC/PC) mode:
    \[ IPAP = PI + PEEP \]
  - If patient is on Volume Control (VC/PC) mode:
    \[ IPAP = \text{plateau pressure (perform inspiratory pause maneuver)} \]
- **Resp Rate:** Match patient’s rate
- **Ti Max:** Based on respiratory frequency; see chart (Table 2)
- **Ti Min:** Based on respiratory frequency; see chart (Table 2)
- **Rise Time:** Min
- **Trigger:** Low
- **Cycle:** Low

**Oxygen:** 15 lpm via first port, add additional O₂ via second port if needed to achieve goal FiO₂ - of 90-92%. Check PaO₂/SpO₂

**Table 2: Ti settings based on Respiratory Rate (RR):**

<table>
<thead>
<tr>
<th>Respiratory Rate (bpm)</th>
<th>Ti Max = 30/RR</th>
<th>TiMin = ½ TiMax</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>25</td>
<td>1.2</td>
<td>0.6</td>
</tr>
<tr>
<td>20</td>
<td>1.5</td>
<td>0.8</td>
</tr>
<tr>
<td>15</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>12</td>
<td>2.5</td>
<td>1.3</td>
</tr>
</tbody>
</table>

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Whenever a patient is started on the ResMed VPAP-ST or if a change in IPAP or EPAP is made, VERIFY TV reading on VPAP-ST display or on gas sampling/flow monitor:

- TV > 6 – 8 cc/kg IBW → lower IPAP in 3-5 cm H2O increments until at/near goal
- TV < 6 - 8 cc/kg IBW with unacceptable hypercapnia/respiratory acidosis:
  - If not already at device maximum IPAP (25 cm H2O), increase IPAP in 3-5 cm H2O increments until TV at goal
  - If IPAP at maximum of 25 cm H2O, check ABG → if unacceptable degree of hypercapnia/respiratory acidosis, increase RR to maximum of 35 bpm
  - If IPAP at maximum of 25 cm H2O, RR at maximum of 35 bpm, with severe respiratory acidosis, decrease EPAP by 3-5 cm H2O (if oxygenation tolerated as measured)
    - NOTE: More advanced device support may be needed if unable to achieve adequate ventilation and oxygenation despite these adjustments.
- End-tidal CO₂ readings can be used as a surrogate indicator of changes in ventilation if tidal volume readings are not available
- Check FiO₂

**OXYGEN and FIO2**

The circuit will start with oxygen flow at 15 lpm. A second oxygen port can be used to add additional oxygen if needed.

- Check FiO₂ on gas sampling/flow monitor if possible at the start of therapy
- FiO₂ may drop slightly if IPAP or EPAP is increased without increasing oxygen flow rates (especially if using single source of O₂ at 15 lpm)
- Check for changes in SpO₂ and/or PaO₂ after increasing IPAP or EPAP
Comments on LEAK

• The current set up of the circuitry provides the necessary degree of leak needed to prevent CO₂ re-breathing (this value cannot be displayed); this leak is filtered.

• When all tubing circuitry is connected and working properly, the ResMed VPAP-ST screen should read a LEAK of 0 as this display is NOT the total leak, but the leak in excess of that intended and filtered.
  o If reading goes above 0, there may be an unexpected leak in the system (cuff leak, disconnected tubing etc), which can result in:
    ▪ Loss of delivered pressure, unexplained drop in patient SpO₂, sudden change (up or down) in end-tidal CO₂, and drop in TV readings,
    ▪ Exposure of healthcare providers to unfiltered leak

• If you see this, check circuit, including all connections, ETT cuff inflation.