

## INITIALS SYSTEM SETUP – Driving Ventilator Settings

Step 1:	Ventilation Mode: Pressure Control
Step 2:	Driving Pressure = 60 m H <sub>2</sub> O
Step 3:	Pressure limit = 65 cm H <sub>2</sub> O <ul style="list-style-type: none"> <li>(5 cm H<sub>2</sub>O above set driving pressure)</li> </ul>
Step 4:	Frequency/Respiratory Rate (RR) = 10 – 30 breathes per minute
Step 5:	Inspiratory time = 0.8 s (range = 0.6 – 1.0 s) I:E ratio = value needed to satisfy inspiratory time. <ul style="list-style-type: none"> <li><b>LOWER LIMIT = 1:2</b></li> </ul>
<p>Depending on the ventilator, inspiratory time may be separately set on the ventilator resulting in a defined I:E ratio for a given RR OR The I:E ratio is set resulting in a fixed inspiratory time for a given RR</p> <p>Note that as RR increases, the I:E ratio must be decreased to maintain inspiratory time in appropriate range.</p> <ul style="list-style-type: none"> <li>For RR = 10. I:E = 1:6.5 in order to obtain an inspiratory time of 0.8 s</li> <li>For RR = 30. I:E = 1:2.33 in order to obtain an inspiratory time of 0.6 s</li> </ul>	
Step 6:	Rise Time = 50%
Step 7:	PEEP = 0
Step 8:	O <sub>2</sub> = 21%
Step 9:	Flow Rate = 2 L/min
Step 10:	Volume Alarm = DISABLED <ul style="list-style-type: none"> <li>Note: Alarm is disabled at start-up for patient titration</li> </ul>
<p>After desired patient settings are titrated for each patient the <b>VOLUME ALARM must be set</b> as directed in “Alarms” instructions</p>	

### Connecting Patient

Step 1:	Set Fresh gas flow = 4 L/min <ul style="list-style-type: none"> <li>100% O<sub>2</sub> or desired blended FiO<sub>2</sub></li> </ul>
Step 2:	Ensure each secondary circuit PEEP valve is set to 5 cm H <sub>2</sub> O <ul style="list-style-type: none"> <li>Confirm driving ventilator PEEP is set to 0 cm H<sub>2</sub>O</li> </ul>
Step 3:	Connect patient to Cerebrus system via patient secondary circuit
Step 4:	Confirm peak inspiratory pressure on each manometer is no greater than clinically desired peak inspiratory pressure <ul style="list-style-type: none"> <li>Peak inspiratory pressure should be less than or equal to 35 cm H<sub>2</sub>O</li> <li>If peak pressure exceeds clinically desired level, then fresh gas flow for the secondary patient circuit must be decreased to lower tidal volume until peak pressure is in desired range <ul style="list-style-type: none"> <li>Refer to instructions on “How to adjust tidal volume (for a given respiratory rate)”</li> </ul> </li> </ul>
Step 5:	Confirm the PEEP as indicated by the manometer is at least 5 cm H <sub>2</sub> O <ul style="list-style-type: none"> <li>Note: due to intrinsic PEEP generated by the ventilated patients fresh gas flow rate, measured PEEP will be 2-5 cm H<sub>2</sub>O above the set PEEP.</li> </ul>
Step 6:	Titrate each ventilated patient to desired parameters
Step 7:	Observe ventilation for 2 minutes following titration of both patients to ensure steady state ventilation is reached
Step 8:	Set volume alarms as described in instructions on “Alarm Settings”

## How to Read Inline Manometer

- Manometer lowest reading = Patient's individualized PEEP
- Manometer highest reading = peak inspiratory pressure
  - If fresh gas flow is sufficiently high one will notice that there is no static peak inspiratory pressure. Instead one will observe a brief pause in the manometer during patient inspiration followed by a gradual rise in pressure on the manometer.
    - *Peak inspiratory pressure is defined as the absolute highest reading on the manometer.* (This definition is used to conservatively ventilate the patient while ensuring the most protective lung ventilation)

<b>How to Adjust Tidal Volume (for a given respiratory rate)</b>	
Step 1:	Silence ventilator volume alarms
Step 2:	Ensure the inspiratory time on the driving ventilator is between 0.6 – 1.0 second <ul style="list-style-type: none"> <li>optimal = 0.8 seconds</li> </ul>
Depending on the ventilator, inspiratory time may be separately set on the ventilator resulting in a defined I:E ratio for a given RR OR The I:E ratio is set resulting in a fixed inspiratory time for a given RR <b>I:E LOWER LIMIT = 1:2</b>	
Step 3:	Adjust fresh gas flow up or down by 1 L/min increments until either desired tidal volume is achieved or clinically desired peak inspiratory pressures are reached. <ul style="list-style-type: none"> <li><b>Fresh Gas Flow UPPER LIMIT = 14 L/min</b></li> <li></li> </ul>
Theoretical maximum deliverable tidal volume = Fresh gas flow rate / respiratory rate <ul style="list-style-type: none"> <li>If RR = 10 → with Fresh gas flow = 5 L/min, the approximate tidal volume is (5000 mL/min) / 10 breaths/min = 500 mL/ breath (TV)</li> <li>If RR = 30 → with fresh gas flow = 5 L/min, the approximate tidal volume is (5000 mL/min) / 30 breaths/min = 166.67 mL/ breath (TV)</li> </ul>	
Step 4:	Using inline manometer or spirometer, confirm the PEEP for the patient measures at desired level. <ul style="list-style-type: none"> <li>If not, adjust individual patient PEEP valve to desired level by following the instructions for “How to adjust patient PEEP”</li> </ul>
Note: due to intrinsic PEEP generated by the ventilated patients fresh gas flow rate, measured PEEP will be 2-5 cm H <sub>2</sub> O above the set PEEP.	
Step 5:	Observe ventilation for 2 minutes following titration to ensure steady state ventilation is reached
Step 6:	<b>Set volume alarms as described in instructions on “Alarm Settings”</b>

### How to Adjust Respiratory Rate

Step 1:	Reduce fresh gas flow rate on both secondary patient circuits to 4 L/min <ul style="list-style-type: none"><li>This is done to ensure peak inspiratory pressures are not exceeded with a change in respiratory rate</li></ul>
Step 2:	Set respiratory rate to new desired rate on the driving ventilator
Step 3:	Set inspiratory time = 0.6 -1. S <ul style="list-style-type: none"><li>Optimal = 0.8 s</li></ul>
Depending on the ventilator, inspiratory time may be separately set on the ventilator resulting in a defined I:E ratio for a given RR OR The I:E ratio is set resulting in a fixed inspiratory time for a given RR <b>I:E LOWER LIMIT = 1:2</b>	
Step 4:	Increase tidal volume to desired level according to instructions provided for “How to adjust tidal volume (for a given respiratory rate)”
Step 5:	<b>Set volume alarms as described in instructions on “Alarm Settings”</b>

## How to Adjust Patient Specific PEEP

At higher fresh gas flow rates infer a clinically significant intrinsic PEEP to the system.

Step 1: Determine the set value needed for the individual PEEP value

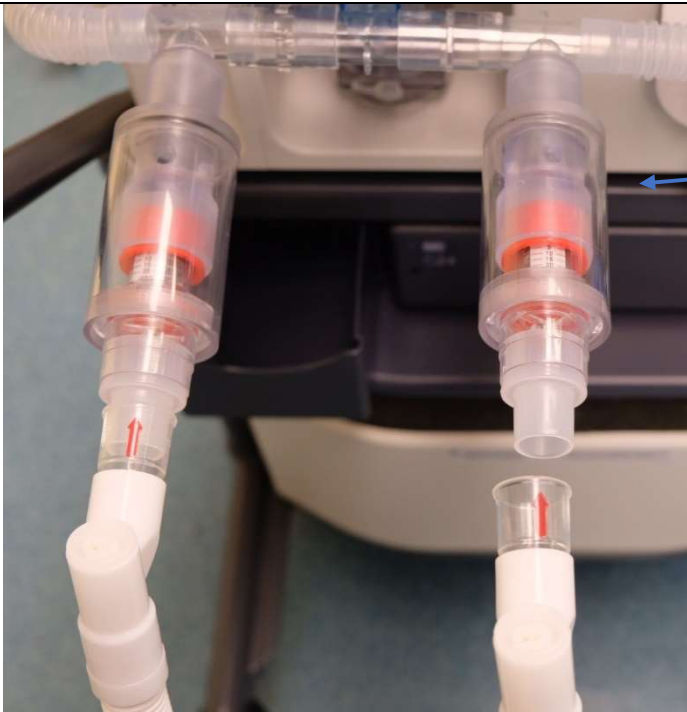
Step 2: Clamp patient at endotracheal tube

- This is done to preserve PEEP the patient currently has while the level is adjusted

*Volume alarms will trigger for inadequate volume return. This is expected and will resolve with reconnection of circuit after new PEEP target is set.*

Step 3: Disconnect secondary circuit patient expiratory limb between the proximal one way valve and the PEEP valve



Step 4:	<p>Adjust PEEP valve to desired value. Prescribed value can be seen through the translucent external casing.</p> <ul style="list-style-type: none"> <li>• To adjust PEEP valve. Rotate the large diameter casing while valve casing is still connected to common expiratory limb tree of the driving ventilator <ul style="list-style-type: none"> <li>○ Increased PEEP = clockwise rotation</li> <li>○ Decreased PEEP = counter clockwise rotation</li> </ul> </li> </ul>
	
Step 5:	: Reconnect the secondary circuit patient expiratory limb to PEEP valve
Step 6:	Unclamp the endotracheal tube

Step 7:	<p>Using manometer or spirometry, confirm that changes in PEEP has not resulted in peak inspiratory pressures greater than clinically desired peak inspiratory pressures</p> <ul style="list-style-type: none"> <li>• If peak inspiratory pressure exceeds clinically desired peak inspiratory pressure, decrease fresh gas flow in 1 L/min decrements until tidal volume decreases lower peak inspiratory pressures to desired thresholds. <ul style="list-style-type: none"> <li>○ Refer instructions provided for “How to adjust tidal volume (for a given respiratory rate)”</li> </ul> </li> </ul>
Step 8:	Using manometer or spirometry, confirm the PEEP is measured as desired patient individualized PEEP
Step 9:	Repeat steps 2-8 until desired PEEP is achieved
Step 10:	Observe ventilation for 2 minutes following titration to ensure steady state ventilation is reached
Step 11:	<b>Set volume alarms as described in instructions on “Alarm Settings”</b>



<b>How to disconnect a patient from the Cerebrus System (while co-ventilated patient remains)</b>	
Step 1:	For patient to be disconnected, clamp ETT to maintain patient specific PEEP during transfer.
<i>Volume alarm will trigger as it is correctly recognized as a disconnect</i>	
Step 2:	Using spirometry or observation of chest rise and breathing-delivery bag cycling, ensure the non-disconnected patients ventilation is unchanged.
Step 3:	Place disconnected patient onto one-to-one vent with desired setting for continued treatment
Step 4:	Place new patient on the Cerebrus System by following instructions for: <ol style="list-style-type: none"> <li>1. “Connecting Patient”</li> <li>2. “How to adjust tidal volume (for a given respiratory rate)”</li> <li>3. “How to adjust patient specific PEEP”</li> </ol>
Step 5:	Observe ventilation for 2 minutes following titration to ensure steady state ventilation is reached
Step 6:	<b>Set volume alarms as described in instructions on “Alarm Settings”</b>

**NOTE:**

if only one patient is to remain on system then patient should be changed to normal ventilator tubing and initiated on one-to-one ventilation.


### Alarm Settings

*The volume alarm must be adjusted to appropriate levels following any changes in either co-ventilated patient's ventilation parameters*

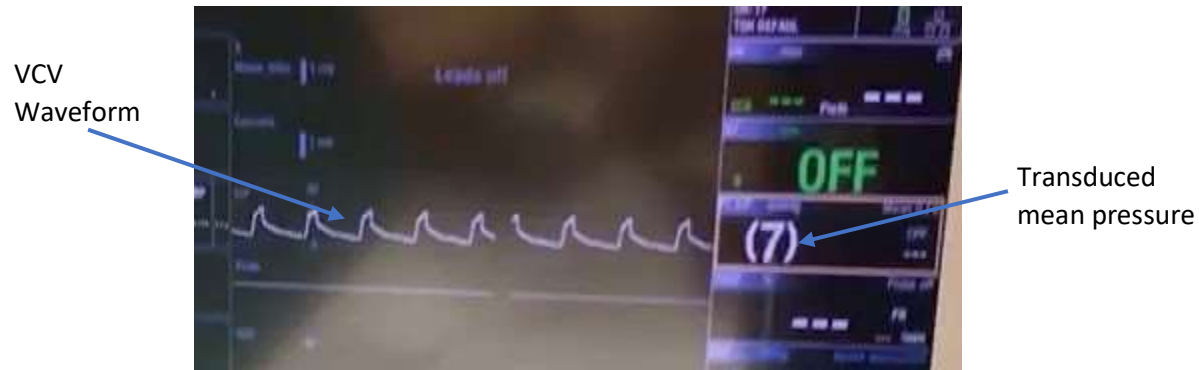
Step 1:	Titrate each co-ventilated patient's ventilation parameters as desired using instructions for: 1. "How to adjust tidal volume (for a given respiratory rate)" 2. "How t adjust respiratory rate" 3. "How to adjust patient specific PEEP"
Step 2:	Observe ventilation for 2 minutes following titration of both co-ventilated patient to ensure steady state ventilation is reached
Step 3:	Note the total volume returned to the ventilator as indicated on the monitors.
Step 4:	Set High Volume Alarm = "Total Volume Returned" + 100 mL
Step 5:	Set Low Volume Alarm = "Total Volume Returned" – 100 mL

#### Note

**If pop-off valve is incorporated into secondary circuit patient expiratory limb then the above volume alarm settings will trigger for either secondary circuit disconnect or obstruction**

<b>Elevated Airway Pressure Monitoring</b> (in the absence of pop-off valve in the patient secondary circuit expiratory limb) <ul style="list-style-type: none"> <li>Requires ability to monitor pressure wave forms using a standard hemodynamic monitoring system</li> <li>DOES NOT provide true measure of inspiratory pressure. Refer to inline manometer for true inspiratory pressure</li> </ul>	
Step 1:	Set up arterial line transducer <ul style="list-style-type: none"> <li><u>NO</u> fluid or pressure bag needed; leave IV spike end for IV bag <u>OPEN</u> to air</li> <li>Zero art line transducer</li> <li>Attach patient end of transducer to stopcock at HME filter</li> <li></li> </ul>
<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <p>P<sub>ETC</sub>O<sub>2</sub> stopcock - Off in picture as not sampling continuously</p> </div>  <div style="flex: 1;"> <p>To arterial line transducer</p> <p>To Inline manometer</p> <p>Pressure stopcock for pressure monitoring</p> </div> </div>	
Step 2:	Set up pressure transducer on ICU monitor (Varies with make of monitor) <ol style="list-style-type: none"> <li>Connect arterial line transducer to ICU monitor</li> <li>Select label with mean pressure ie: ICP</li> <li>Relabel “ICP” with “Ventilator” or tape and write ventilator pressure</li> <li>DO NOT USE Arterial pressure labels. Ie. ART, FEM, ABP</li> <li>Suggested sweep speed = lowest sweep possible on monitor</li> </ol>
Step 3:	Titrate each co-ventilated patient’s ventilation parameters as desired using instructions on: <ol style="list-style-type: none"> <li>“How to adjust tidal volume (for a given respiratory rate)”</li> <li>“How t adjust respiratory rate”</li> <li>“How to adjust patient specific PEEP”</li> </ol>

Note: pressure tracing seen on monitor represents volume control ventilation (VCV)



Step 4:	Observe ventilation for 2 minutes following titration to ensure steady state ventilation is reached
Step 5:	Note the transduced mean pressure of the volume control wave form
Step 6:	Set the mean pressure alarm for the transduced pressure wave form to <b>Mean Pressure</b> (noted in Step 5) + 1 mm Hg

With the above settings, any increase in mean pressure resulting in alarm triggering OR change in waveform should prompt investigation of the patient for acute obstruction or dramatic increases in compliance.

- **Immediate action = check peak inspiratory pressure using inline manometer**

