

SureVent 2 - SV2[®] Gas Powered Automatic Ventilation Resuscitator

Summary of features and
operation specifications

SureVent 2 - SV2®

The Readmed Emergency Resuscitation Ventilator components:

- Is a single patient, multi use automatic resuscitator providing ventilation support for both breathing and non-breathing patients.
- Is a constant flow, pressure cycled device
- Is designed to provide proper tidal volume
- Has a PEEP and PIP airway pressure
- Can be adjusted with respiratory rate knob

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- The SV2[®] is completely gas powered, it doesn't require any electrical power.
- Supply pressures from 1 BAR (15 PSI) to 5 BAR (75 PSI) may be used so long as an adjusted flow rate of 10 to 40 LPM is used.

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Situations where the SV2[®] would be ideal:

- patients weighing over 8 kilograms (18lbs) who are in need of emergency, short term, ventilatory support and a constant flow, pressure cycled device
- patients unable to maintain adequate blood gases (PO₂, PCO₂) and pH during unassisted ventilation Has a PEEP and PIP airway pressure
- patients where cross contamination and pandemic situations are a concern or evident
- patients requiring resuscitation during transportation

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The advantage of the SV2[®], as compared to manual resuscitators:

- It is able to deliver consistent and reliable hands free resuscitation.
- It can provide consistent ventilation as compared to the BVM (Bag Valve Mask) which cannot
- It can provide constant desired levels of PEEP and with constant inspiration rate and BPM which is critical in ventilating patients

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The advantage of the SV2[®], as compared to manual resuscitators cont'd:

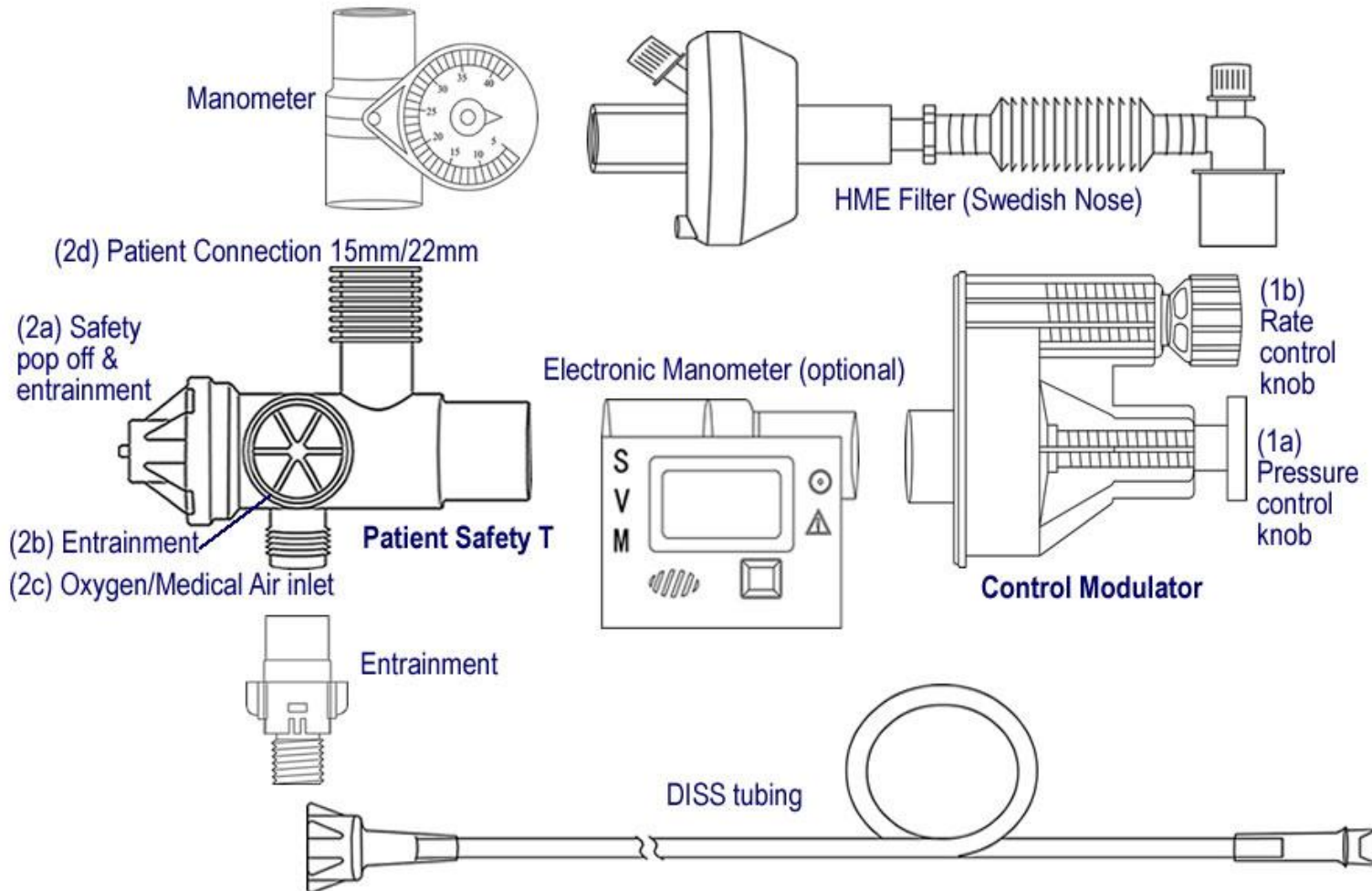
- For the intubate spontaneous breathing patient, the SV2[®] allows the patient to initiate the inhalation phase by drawing down to the set PEEP wherein the SV2[®] will complete one complete respiratory cycle
- The SV2[®] is a constant flow- pressure cycled device therefore changes in patient compliance will result in changes of the respiratory rate. This minimises the possibility of hyper/hypo ventilation and barotrauma.

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- **The above advantages of the SV2® are critical components of emergency ventilation and resuscitation**
- **Absence of the aforementioned can impact mortality and morbidity on a wide range of patients suffering from illness or injury**

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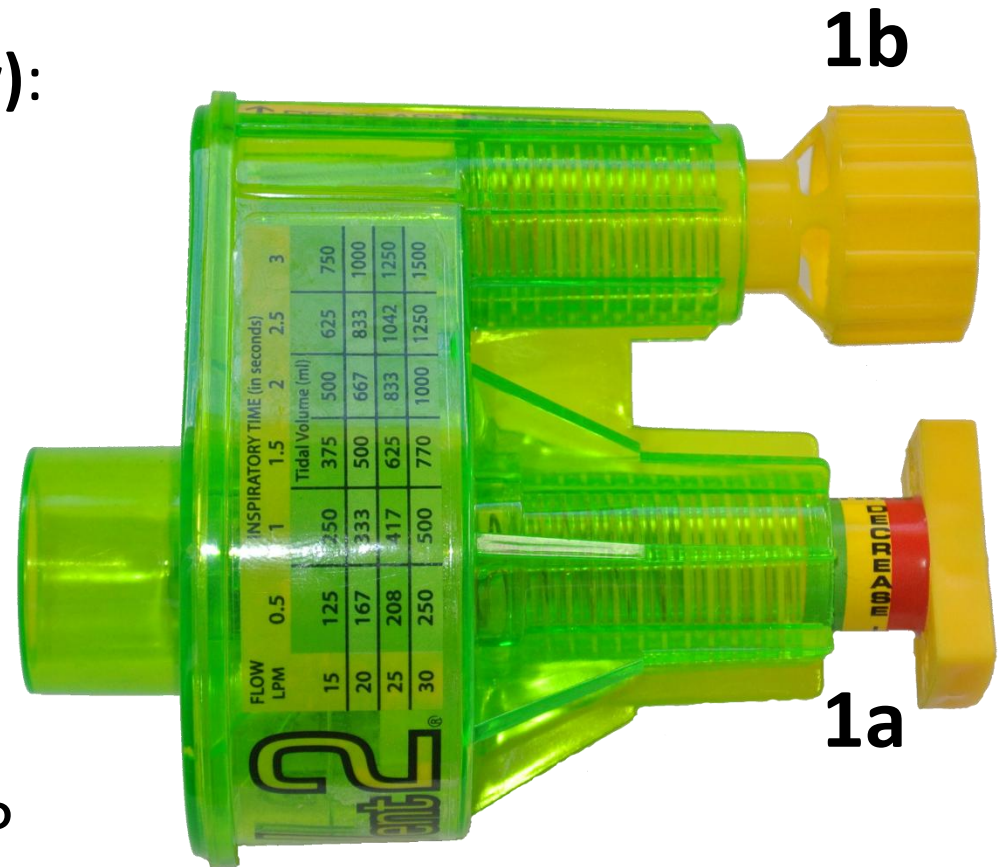
SV2[®] Components (exploded view):



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SV2[®] Components (as shown on exploded view):

1. Control Modulator which incorporates:
 - 1a) Pressure Control Knob (PIP setting)
 - 1b) Rate Control Knob (controls rate and I:E Ratio)
 - 1c) Integrated exhalation valve which opens at PIP and closes at PEEP (not pictured)



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SV2[®] Components (as shown on exploded view):

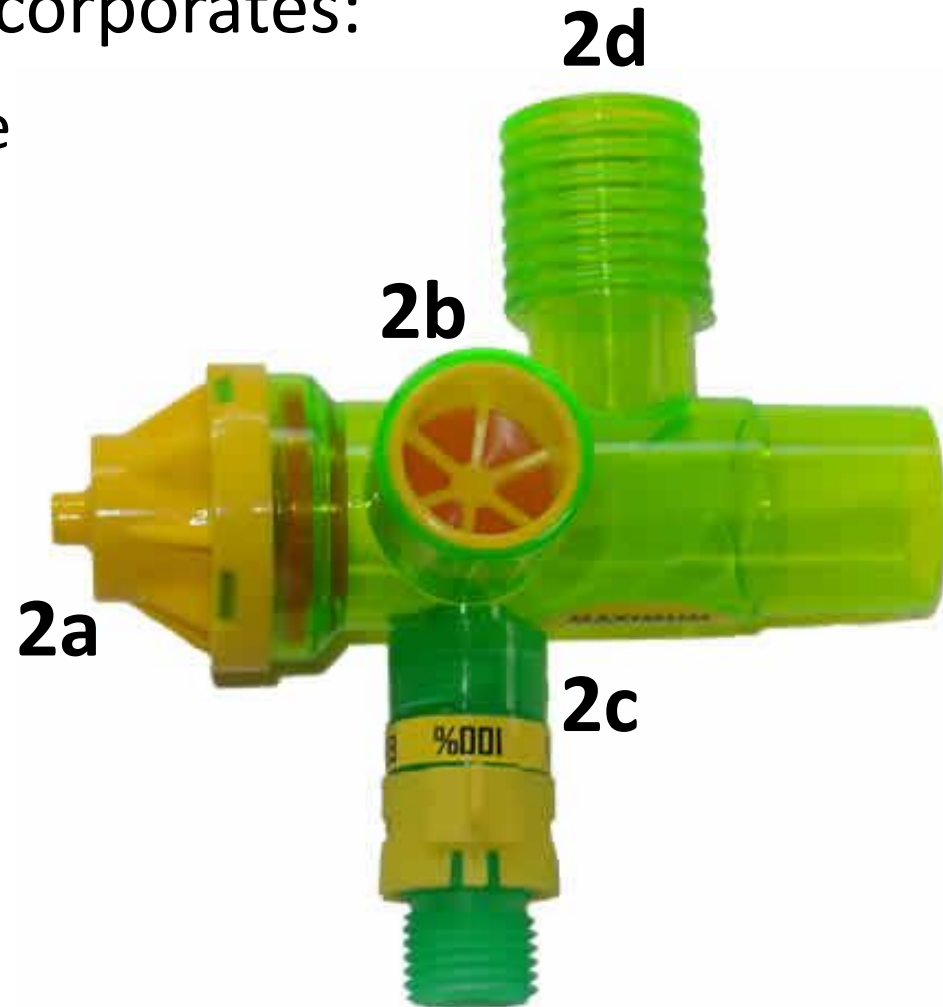
2. Patient Safety T which incorporates:

2a) Dual function high pressure pop-off valve and ambient air entrainment port

2b) A second entrainment port for entraining additional ambient air for the spontaneous breathing patient

2c) Gas inlet for supply gas

2d) Patient connection port



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SV2[®] Components (as shown on exploded view):

3. Manometer
(included with the SV2[®])
4. Optional battery powered electronic manometer (battery powered with alarms)



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Operation Specifications (all quantified specifications are $\pm 10\%$):

- Recommended for body weights of 8kg and higher
- Ventilation frequency: Manual/Auto-adjusting to lung capacity 8 to 30+ BPM
- PIP: adjustable 10 to 40+cm H₂O
- PEEP: auto calculate equal to 25% or $\frac{1}{4}$ of PIP (2 to 12+cm H₂O)
- Inspiratory resistance: 3 ± 1 cm-H₂O/L/sec
- Expiratory resistance: 3 ± 1 cm-H₂O/L/sec

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Operation Specifications cont'd (all quantified specifications are \pm 10%):

- I:E ratio: 1: 1.8 to 1.2
- Dead space: 4 ± 3 ml
- Environmental: Operating limits -18 to $+50^{\circ}\text{C}$ /
Storage limits -40 to $+60^{\circ}\text{C}$
- Patient connection: 15mm/22mm
- Gas connection: DISS Supply hose: DISS and barbed nipple
- Oxygen concentration: 100% when supplied with 100% O_2 or 65% with ambient entrainment port open

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SV2[®] Operation – how to achieve the following:

- **RATE**
- **PAP**
- **PIP**
- **PEEP**
- **I: E ratio**

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RATE Knob:

The Rate Knob is a variable resistor which controls the rate of which gas escape. When the rate knob adjust to a position that the continuous flow of gas does not create more pressure that the set PEEP (set PEEP is approximate $\frac{1}{4}$ to the set PIP), then upon completion of exhalation for the SV2[®] will automatically cycle into inhalation. The SV2[®] is set on both PIP and PEEP.

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RATE Knob operation:

- Runs on a continuous gas flow rate of 10 to 40 L/min
- SV2[®] is ex-factory, set on 13 to 14 BPM with 100% oxygen, with an in-flow rate of 15L/min
- Turning the rate knob clockwise will increase the rate
- Turning the rate knob anti-clockwise will decrease the rate
- Adjust the rate knob slowly as it is very sensitive
- An adjustment in the rate of oxygen flow, e.g. from 15L/min to 10L/min (by opening the entrainment and achieve 20ml/min) may require and adjustment of the rate Control Knob. Failure to do so can put the SV2[®] into PAP mode

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PAP (Positive Airway Pressure): support mode – ventilatory support for a spontaneous breathing patient

- Set the PIP
- The Rate Control Knob should be adjusted clockwise until low enough so the SV2[®] stops automatic cycling
- The Rate Control Knob will now be in a position that the continuous flow of gas doesn't create more pressure than the set PEEP
- Automatic cycling of the SV2[®] can be resumed by adjusting the Rate Control Knob counter clockwise until cycling begins & synchronisation with the patient is accomplished

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PIP (Peak Inspiratory Pressure):

- The SV2[®] is pressure cycled on PIP as well as PEEP
- PIP may be adjusted from 10 & 40cm H₂O
- The pressure settings listed on the pressure control knob are approximate
- Operator sets the PIP according to the patient's pulmonary compliance
- Change of the pulmonary compliance of the patient is compensated by the SV2[®] automatically changing rate. In such an event appropriate clinical measures should be taken
- A manometer should be used to verify all settings & may be connected between the Control Modulator & the Patient Safety T, or between the patient connection on the Patient Safety T and the ET tube connector HME flex tube connector

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PEEP (Positive End Expiratory Pressure):

- It is intrinsic to the SV2[®] with a ratio of 1:4, if PIP is 20cm H₂O, that the PEEP is 5cm H₂O
- It ranges from 2 to 10cm H₂O
- This applies unless in SV2[®] is put into PAP mode

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I:E Ratio affected by:

- The selected flow rate and is related to the calculated tidal volume
- Selected PIP
- Selected calculated tidal volume (V_t)
- The patient's lung compliance (C) and resistance (R_p)
- BPM

Note:

The SV2[®] set ex-factory at 1:2 at flow rate of 15LPM, PIP at 20cm H₂O with 13-14 BPM

The clinician must choose which adjustments will provide the best results and an acceptable ETCO₂

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Tidal volume estimator:

DELIVERED FLOW LPM	INSPIRATORY RATE (in seconds)					
	0.5	1	1.5	2	2.5	3
15	125	250	375	500	625	750
20	167	333	500	667	833	1000
25	208	417	625	833	1042	1250
30	250	500	770	1000	1250	1500
35	292	583	875	1167	1458	1750
40	333	667	1000	1333	1667	2000

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Entrainment valve and Oxygen consumption:

O2 Tank Autonomy

Tank Size	D	E	M	H
Capacity in Litres	387	622	3028	6905
Flow (LPM)	Length of use (minutes)			
6	65	100	500	1150
8	50	80	380	860
10	40	60	300	690
12	30	50	250	570
15	25	40	200	460
20	20	30	150	340
25	15	25	120	270
30	13	20	100	230
35	11	18	80	190
40	10	16	70	170

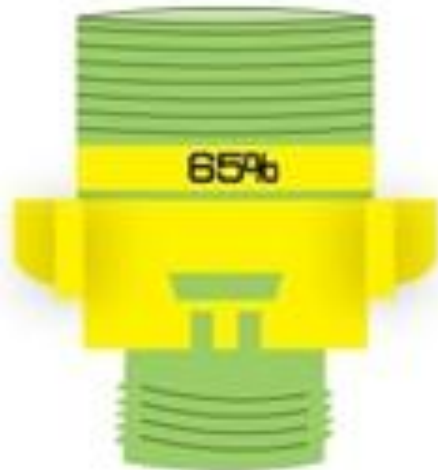
Entrained Flow table

65 % Connector		TOTAL
Supply flow	Entrained flow	delivered flow
(LPM)	(LPM)	(LPM)
6	6	12
8	7	15
10	10	20
Recommended	Initial	65% setting
15	10	25
20	15	35
25	15	40

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Entrainment connection:

The tab on the selector knob (yellow) indicates the chosen FiO₂. In the 100% mode the entrainment port should be closed (pictured). In the 65% mode the entrainment port should be open (not pictured). Please refer the previous chart to achieve the desired flow rate.



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Other features:

- **Spontaneous Breathing Ambient Air Entrainment**
The SV2[®] is equipped with two (2) air entrainment ports (2a & 2b) which allow the spontaneous breathing patients to entrain ambient air with minimal effort



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Other features cont'd:

- **Safety** The Control Modulator limits the pressurization which is manually set (55cmH₂O maximum) with the Pressure Control Knob. The SV2[®] is equipped with an audible (pop, pop, pop) redundant pop-off valve to release pressure at 55cmH₂O outwardly from the Patient Safety T.

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Quick Start:

- 1. Connect oxygen tubing** to the SV2[®] with the DISS fitting and then to the oxygen source
- 2. Set an initial flow meter** rate of 15LPM
- 3. Verify Peak Inspiratory Pressure (PIP)** is:
 - 20 cmH₂O or adjust pressure dial to achieve desired PIP
 - Indicated pressure on the Pressure Control knob is approximately $\pm 10\%$ and may vary depending upon climactic conditions.
 - Verify pressure settings with a manometer
 - **PEEP** is intrinsic to the SV2[®] at 25% or $\frac{1}{4}$ of **PIP**

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Quick Start cont'd:

4. Connect Patient to the SV2[®]:

- Effective ventilation with the **SV2[®]** is best when used in conjunction with an endotracheal tube
- An ETCO₂ monitoring device is advisable
- When using with a mask make sure the mouth and airway are clear of visible foreign bodies and position the patients head to ensure the correct position of the airway
- When using an **LMA** the **PIP** should be restricted to a maximum of 20 cmH₂O.

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Quick Start cont'd:

- 5. Adjust the Rate Control Knob** for desired respiratory rate. The **SV2®** is factory pre-set at 12-14 BPM. Listen to chest sounds as well as expiratory flow from the modulator. Verify the RR using the manometer
- 6.** Tidal Volume can be achieved by referring to the tidal volume chart on each SV2® label or by multiplying the flow

If the patient vomits disconnect the patient Safety T from the SV2®

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Digital Battery operated Alarms:

1. Pressure alarm : $\leq 2\text{cmH}_2\text{O}$ or $\geq 60\text{cmH}_2\text{O}$
2. Breath alarm : ≤ 8 breath/ min or ≥ 40 breath/min
3. Alarm will be triggered in 4 seconds in either of the 1. or 2. situations above
4. Alarm will be audible as a short sharp beeping sound and at the same time a visual red light will display. If the alarm situation has not been resolved past one minute, the visual alarm stays on while the audible alarm will become long sharp peeping sound.
5. The alarm will stop if situations 1. and 2. above no longer exist. The peeping sound and red light will also disappear.

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Battery Low alarm:

- When battery charge is lower than 2.2v, it will trigger the alarm
- When battery charge alarm occurs, a flickering yellow light will display. A low audible alarm will activate to warn the user to change the battery

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Trouble Shooting:

- **Audible, rapid clicking sound is heard:** Check for airway obstruction; check modulator for blockage; check for high pressure
- **Cycling stops:**
 1. Check for a change (softer) in lung compliance: adjust rate control knob counter clockwise in $\frac{1}{4}$ turn increments; adjust pressure
 2. Check for leaks, obstructions, kinks in tubing, defective ET tube
 3. Check gas supply source and flow setting

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Trouble Shooting cont'd:

- **Rate(RR) is too slow and cannot obtain a higher RR:** Increase flow rate and/ or decrease PIP
- **Rate(RR) is too fast and cannot obtain a slower RR:** decrease flow rate and /or increase PIP
- **Inspiratory time is too short:** decrease flow rate; increase PIP
- **Inspiratory time is too long:** increase flow rate; reduce PIP