### Ventilator Calculations

**Total Cycle Time (sec.)**

\[
\text{Total Cycle Time (sec.) = \frac{60}{\text{Set Respiratory Rate (bpm)}}}
\]

- **Set Respiratory Rate (bpm)**
- **Inspiratory Time (sec.) = Ti**
- **Inspiratory Rise Time = T \text{ insp. rise}**
- **Inspiratory Pause Time = T \text{ pause}**
- **Expiratory Time**
- **Expiratory Pause Time**
- **I : E Ratio = Inspiratory Times : Expiratory Times**

**Flow Rate (lpm) x Inspiratory Time (sec.) = Tidal Volume (Vt, ml)**

- **Tidal Volume / Inspiratory Time = Flow Rate** (Volume Control Only)
- **Respiratory Rate x Tidal Volume = Minute Volume**

### Total Cycle Time Calculations

\[
\text{Total Cycle Time (sec.)} = \frac{60}{60} = 1 \\
\frac{60}{30} = 2 \\
\frac{60}{20} = 3 \\
\frac{60}{15} = 4 \\
\frac{60}{12} = 5 \\
\frac{60}{10} = 6 \\
\frac{60}{6} = 10
\]

### Ventilator Calculations

- **Peak Inspiratory Pressure = Ppeak (cmH20)**
- **Inspiratory Pause Pressure = Pplat**
- **End Inspiratory Pressure = EIP (Open Lung Tool)**
- **Positive End Expiratory Pressure = PEEP**

\[
\text{Mean Airway Pressure (Pmean) = } \frac{(\text{Inspiratory Time x Ppeak}) + (\text{Expiratory Time x PEEP})}{\text{Total Cycle Time}}
\]

### ONLY!! Two Styles of Ventilation

**Volume Constant Flow Rate**
- Set Constant Flow Rate
- Set Inspiratory Time
- Set Tidal Volume
- **Get** Accelerating - Inspiratory **Pressure**

**Pressure Constant Pressure**
- Set Peak Inspiratory Pressure
- Set Inspiratory Time
- **Get** Variable Tidal Volume
- **Get** Decelerating - Inspiratory **Flow Rate**

### Differences Between Modes

**Control Modes**
- VC, PC, PRVC
  - Set Ppeak or VT
  - Set Inspiratory Time
  - **Get** Variable Tidal Volume
  - **Get** Decelerating - Inspiratory **Flow Rate**

**Support Modes**
- PS, VS
  - Set PIP or Target VT
  - Patient Makes Inspiratory Time
  - Patient Makes Respiratory Rate
  - Gets What Patient Wants
  - "Un-Timed Mode"
Measuring Resistance

Inspiratory Resistance = \( R_i \)

\[ R_i = \frac{\text{Peak - Pause pressures}}{\text{End Inspiratory Flow}} \]

Expiratory Resistance = \( R_e \)

\[ R_e = \frac{\text{Peak - Pause pressures}}{\text{Early Expiratory Flow}} \]

Early Expiratory Pressure and Flow are measured \( T_s + 70\text{ms} \) after start of expiration (Adults)

Calculated breath by breath

*Only Valid in Volume Control Mode and if Inspiratory pause pressure is steady*

Measuring Static Compliance (C static)

\[ C_{\text{static}} = \frac{\text{VT Expiratory Pause - PEEPtot}}{\text{Pressure Insp. Hold then Exp. Hold Keys}} \]

Clinical evaluation of the patient’s lung compliance

Relationship of the Volume delivered to Pressure required to deliver that volume at zero (static) flow

Airway Resistance & Lung Compliance Evaluation

Resistance or Compliance Change?

What Happened Here?

SIMV Volume Control / Pressure Support
Benefits of Volume Control Ventilation

- Ensure Consistent Volume delivery for Ventilation
- Reduce Volutrauma

Pressure Control
Pressure / Flow / Volume - Time Curve

Pressure Control
Controls

What Mode? - Rise Time Min or Max?

Where Does Inspiratory End?... Vt?
Optimal Inspiratory Time – VT

What Happened Here?

Benefits of Pressure Ventilation
- Mimics Normal Spontaneous Breathing
- Improves Patient Comfort
- Improved Oxygenation with Lower Peak Insp. Pressures
- Improves Alveolar Recruitment (FRC)
- Improves Thoracic Compliance
- Control Inspiratory Time
- Manipulate Oxygenation
- Minimal Hemodynamic Side Effects
- Reduce the Risk of Barotrauma

SIMV Pressure Control / Pressure Support

SIMV Pressure Control / Pressure Support Controls
SIMV Pressure Control? / Pressure Support?

Servo®PRVC Start-up

Servo®PRVC’s
Patient Adjustments

Benefits Volume & Pressure Ventilation
PRVC

- Mimics Normal Spontaneous Breathing
- Improves Patient Comfort
- Improved Oxygenation with Lower Peak Insp. Pressures
- Improves Alveolar Recruitment (FRC)
- Improves Thoracic Compliance
- Control Inspiratory Time to:
  - Manipulate Oxygenation Minimal Hemodynamic Side Effects
- Reduce the Risk of Barotrauma and Volutrauma
- Ensure Consistent Volume Delivery for Ventilation

Volume Support
Volume Support - Adjustments

Pressure Support

What Happened Here?

Insp. Cycle Off - Support Modes

Measuring Total PEEP - (PEEPtot)

Total PEEP = set PEEP + auto-PEEP

PEEPtot = Expiratory Pause Pressure x Dyn. Char + Compr. Vol/P

Dyn. Char

Auto-PEEP is caused by Volume trapped in Lung at End Exhalation

End – Expiratory Flow x Time = Volume Trapped

PEEPtot Procedure

Press Exp. Hold Key
PEEPtot – Auto PEEP = ?

Auto-PEEP Trigger Problems

End Expiratory Flow – Adjust until Vee = ? RR?

Total Cycle Time Calculations

60 / Set Respiratory Rate = TCT in Seconds
60 / 60 = 130
60 / 30 = 210
60 / 20 = 35
60 / 15 = 43
60 / 12 = 52
60 / 10 = 62
60 / 6 = 10

Inspiratory Time Set then… Expiratory Time changes

Servo/Ventilator Graphics

Lung Mechanics & Graphic Evaluation