PneuView®3.1 Software Manual
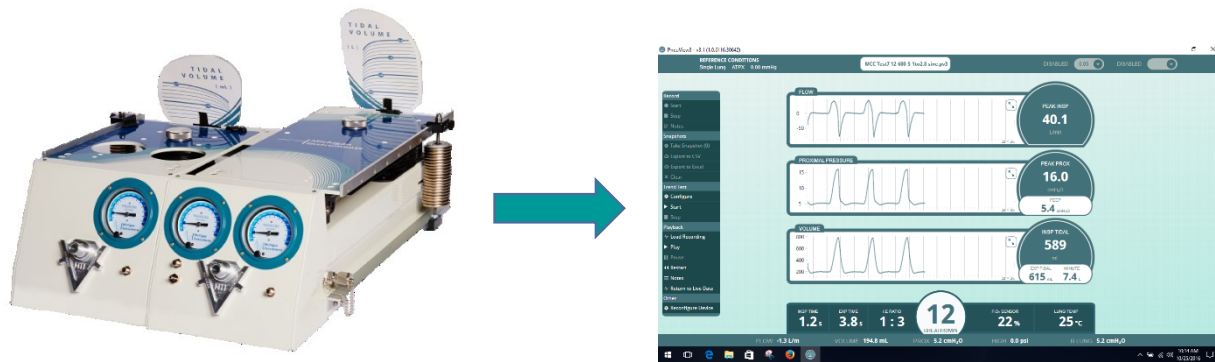
Michigan Instruments

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System Overview

The Michigan Instruments' PneuView® System is comprised of a PneuView Lung Simulator (multiple models available), a PneuView Electronics Module, and dedicated PneuView Software which acquires and interprets data from the Electronics Module.

This system is intended to provide an adjustable, passive, mechanical simulation of human lungs and allow for the interpretation of data from the simulated lungs and airway during ventilation.

Common Applications

The simulation and data gathering capabilities of the PneuView System make it an ideal tool for applications such as:

- Training healthcare professionals on the use of mechanical ventilators and other respiratory support devices
- Periodically testing on the proficiency in use of mechanical ventilators and other respiratory support devices
- Designing ventilation devices and other equipment related to lung ventilation
- Performing periodic functional testing on mechanical ventilators and related equipment
- Diagnosing and Troubleshooting device malfunctions and limitations

The PneuView Electronic Module

The PneuView Electronic Module is the interface between the PneuView Lung Simulator and the PneuView Software. This module is built into the Lung Simulator, as shown on the left. It incorporates pressure transducers, environmental sensors, signal conditioning and analog-to-digital converter circuitry. The Electronic Module communicates with PneuView Software installed on a host computer.

During ventilation of the simulator, the software captures and presents real-time data, displaying numerical and graphical results. This data can be graphed, tabulated, or digitally recorded, then retrieved for later review and analysis. PneuView®3 Software is specifically designed and intended to be used with Michigan Instruments' PneuView3 Lung Simulators.

Data Acquisition & Analysis

PneuView software uses pressure data and other directly measured environmental data to make calculations of timing, volume, and flow parameters. Pressures are "sampled" at a rate of 500 Hz (500 times per second) using high resolution pressure transducers connected to the airway and lung(s) of the PneuView Lung Simulator. This raw data is used to calculate a variety of ventilation parameters.

This pressure data is then plotted and processed using known compliance characteristics (volume-pressure relationship) over time to calculate breath-to-breath volume and flow values.

PneuView System Breath Calculation Engine Overview
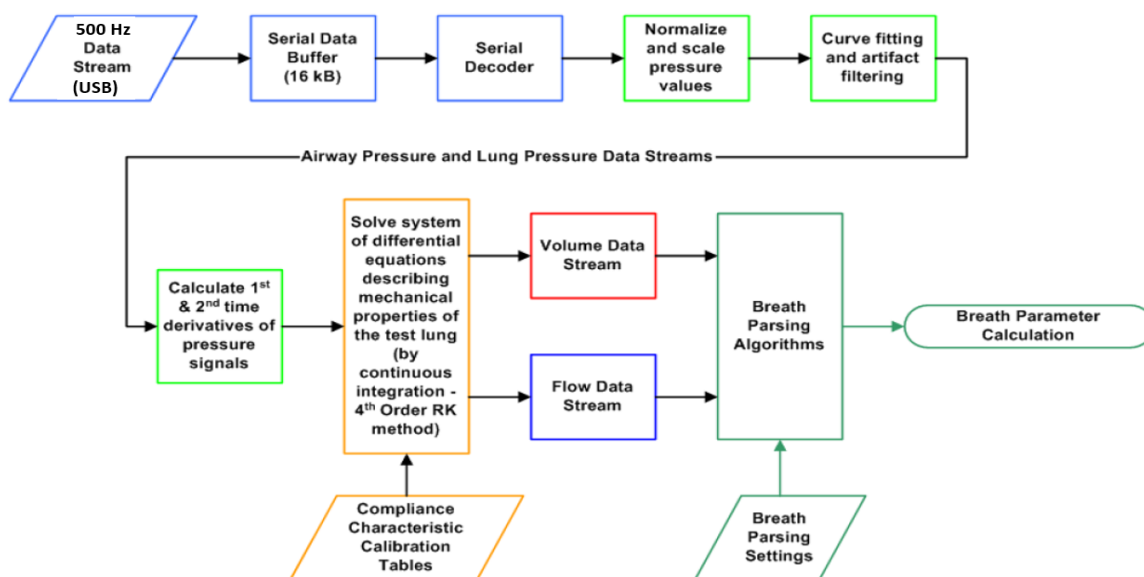
Accuracy of these measurements and calculations displayed by PneuView Software is dependent on the following:

1. Proper calibration of the PneuView Lung Simulator
   Of particular importance is the performance and calibration of the Lung Compliance Spring(s) on the unit. (Michigan Instruments recommends that PneuView Lung Simulators be calibrated by a factory-authorized service provider at least every 2 years to confirm their calibration and performance.)
2. Proper setup / configuration of the software when acquiring data
   Especially important is ensuring the lung compliance is entered correctly on the Main PneuView Screen, but settings of Gas Standard and Atmospheric Pressure also play a role in accuracy.

Measured and Calculated Data - Standard PneuView Notations and Nomenclatures

Parameter	Notation/Nomenclature	Units	Resolution
Breath Rate	Breaths/Min or BPM	Breaths/Min	1 BPM
Tidal Volume	INSP or EXP TIDAL	mL	1 mL
Minute Volume	MINUTE	L (liters)	0.1 L
Real-time Volume	VOLUME	mL	0.1 mL
Peak Inspiratory Flowrate	PEAK INSP	L/min	0.1 L/min
Real-time Flow	FLOW	L/min	0.1 L/min
Airway Pressure	PEAK PROX	cmH2O	0.1 cmH2O
Right and Left Lung Pressure	R LUNG	cmH2O	0.1 cmH2O
	L LUNG	cmH2O	
PEEP Pressure	PEEP	cmH2O	0.1 cmH2O
Inspiratory Time	INSP TIME	seconds	0.1 sec
Expiratory Time	EXP TIME	seconds	0.1 sec
Insp. to Exp. Ratio	I:E RATIO	--	0.1 : 0.1
Oxygen Percentage	FiO2	%	xx%
Lung Temperature	LUNG TEMP	˚C	xx˚C
High (Supply) Pressure	HIGH	psi	0.1 psi

Unpacking Your PneuView System

Upon receipt and unpacking of PneuView System, please inspect your Lung Simulator and all accessories for damage or missing components. If you note damage or any missing items, contact Michigan Instruments immediately.

Standard Components and Accessories

Every PneuView System is shipped with the following standard accessories*.

- ✓ PneuView Lung Simulator
- ✓ PneuView Lung Simulator Accessory Kit
- ✓ Simulator Carrying Case
- ✓ Power Supply for PneuView Electronics Module
- ✓ USB Communication Cable (USB 2.0 A-B configuration)
- ✓ PneuView User Manuals and Installation Software (on USB Flash Drive)
- ✓ Certificate of Calibration with Final Test Data
- ✓ Laptop Computer with latest version of PneuView Software installed

*Shipped with above standard accessories, unless otherwise specified and arranged prior to shipment.

PneuView Lung Simulator Setup

The setup for the PneuView Lung Simulators is described in the User Manual for that Model of Simulator. The manual can be found on the flash drive shipped with the unit, or it may be downloaded from the Michigan Instruments website: www.michinst.com.

Computer Requirements for PneuView3 Software

- Intel Core i3 Processor or better
- 4 GB Memory (minimum)
- 500 GB Hard Disk Drive
- 1366x768 pixel resolution or higher Display
- Intel HD Graphics 5500 or higher
- Windows 8.1 or higher Operating System (32 or 64 bit)
- 1 USB 2.0 or higher port

Limitations of Liability

Michigan Instruments, Inc. warrants that the PneuView® software will conform to the published specifications and documentation, if it is used on a computer system for which it is designed. Michigan Instruments also warrants that the supplied distribution media and documentation are free from defects in materials and workmanship for 90 days after delivery. Michigan Instruments will replace defective media or documentation at no charge, provided the item is returned to Michigan Instruments within 90 days of delivery.

Except as provided above, Michigan Instruments makes no warranty or representation, implied or expressed, with respect to this program or documentation, including their quality, performance, merchantability, or fitness for a particular purpose.

Because computer programs are inherently complex and may not be completely free of errors, you are advised to verify your work. In no event, will Michigan Instruments be liable for direct, indirect, special, incidental, or consequential damages arising out of the possibility of such damages. In particular, Michigan Instruments is not responsible for any costs including, but not limited to those incurred as a result of lost profits or revenues, loss of use of the PneuView® program or computer hardware, loss of data, claims by third parties or for other similar costs. In no case shall Michigan Instruments' liability exceed the amount of the purchase price.

Software Installation Procedure

If the complete PneuView package was purchased, a laptop computer that already has PneuView Software installed may be included. If this is the case, proceed to "Making Connections" and "Launching PneuView" below.

The latest version of PneuView Software is available from Michigan Instruments, supplied on a USB flash drive (memory stick).

From the flash drive follow the procedure below to complete the software installation:

Step 1: Insert the flash drive into any USB port on your computer.
Step 2: Copy the PneuView folder onto the computer desktop.

The following subfolders and their contents can be found inside the PneuView3 folder.

Info - promotional brochures and videos for Michigan Instruments products
Install – the setup file to install the PV3 software
Manuals – TTL and PV3 software operation manuals in .pdf format
Photos – a picture of each available model to use for desktop wallpaper if desired
Michigan Instruments .com – a shortcut to our website

Step 3: Open the Install folder and double-click on the setup file.
During the installation you will be asked where to install the software and if you want to install a desktop shortcut (which is recommended). After the installation is complete, you have the option to launch the PV3 Software.

Making Connections

Step 1: With the Lung Simulator set up as desired, connect the 12VDC power supply to the PneuView Electronic Module.

Step 2: Connect the Lung Simulator to a computer running PneuView Software using the USB 2.0 A-B cable provided with your system. (This is a commonly available USB cable configuration.)

Step 3: Flip the switch on the PneuView Module to the On position. A green LED indicator on the switch will light up to confirm power to the unit.
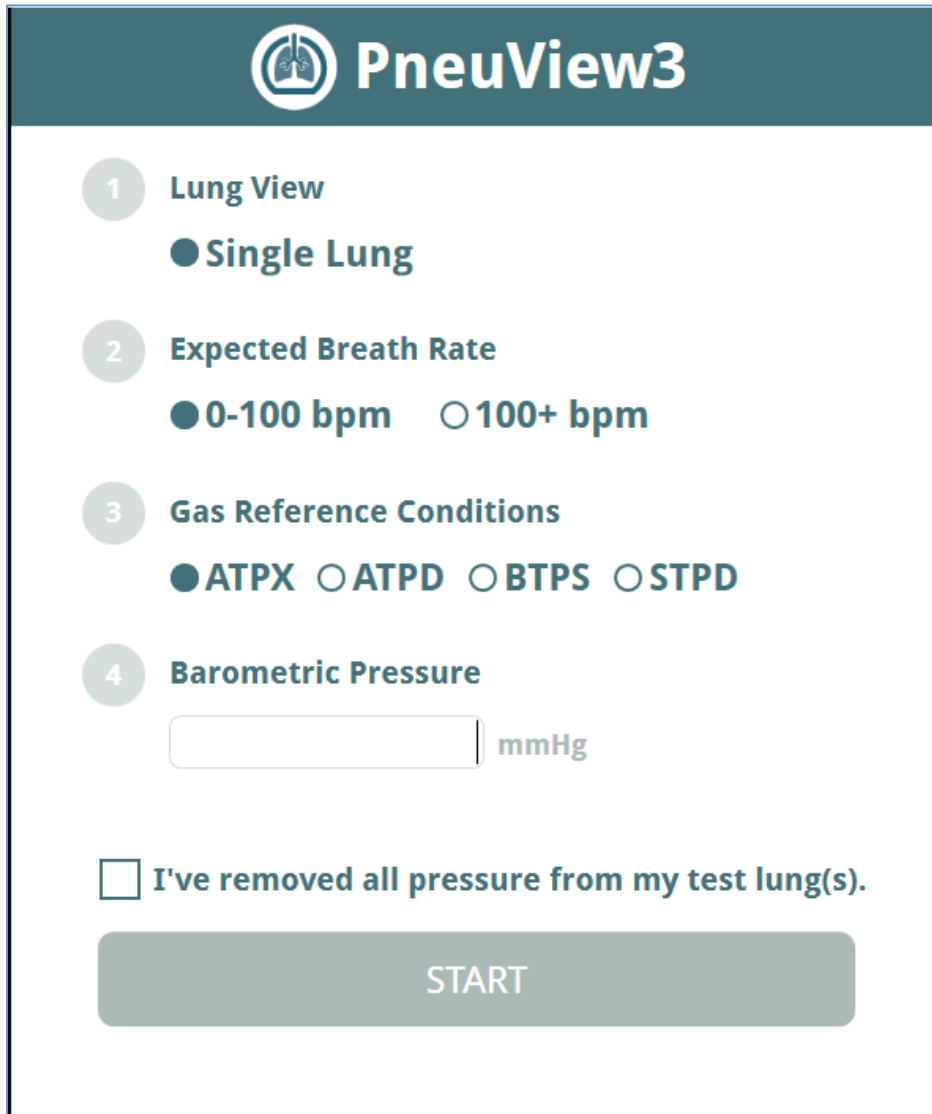
Launching PneuView

During PneuView Software installation, an icon to start PneuView can be created on the computer's desktop, as shown below. Double click on the PneuView icon to launch the PneuView application.
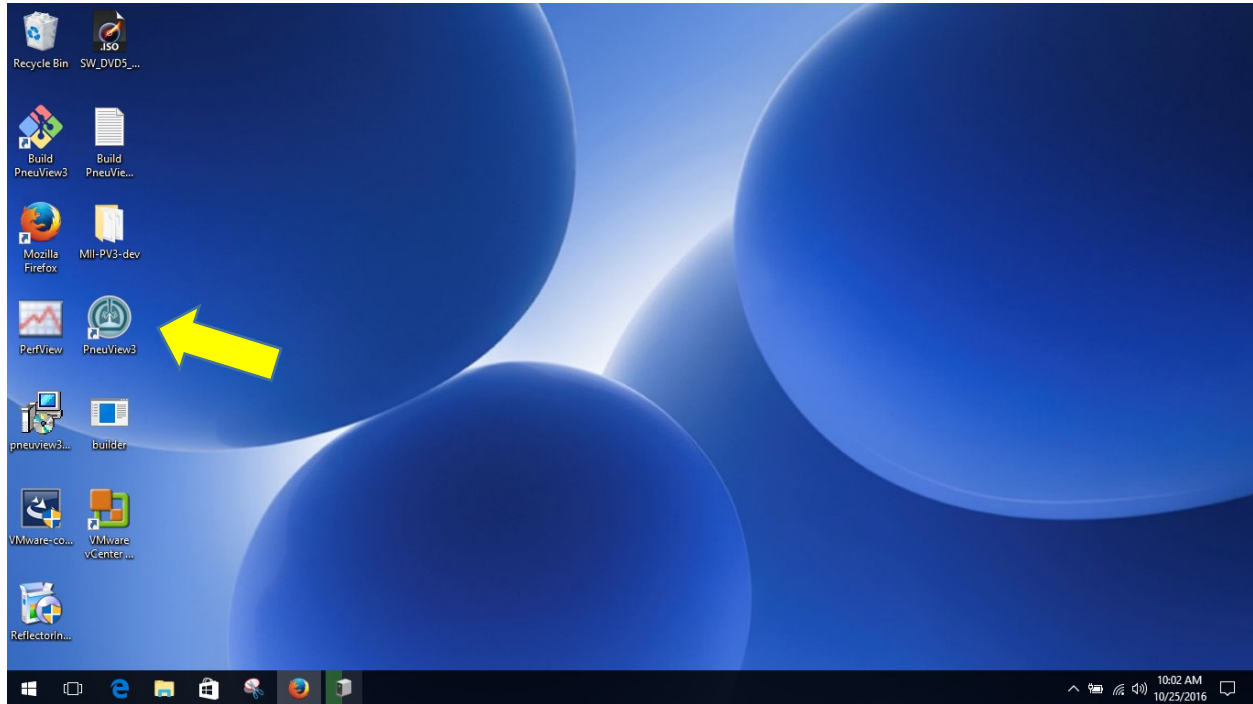
PneuView may also launched by locating the PneuView3 folder in Program Files and double clicking the PneuView3 application file in that folder.

PneuView Setup Screen (When Connected to Lung Simulator)

When launched, PneuView's Setup Screen appears (as above).
You must make selections or entries for the following fields.

Lung View

Selects active lung chamber(s) for data acquisition. If using a single lung, this selection is
automatically set and no selection is required.

Expected Breath Rate

Select the anticipated breath rate range. The options are 0-100 or 100+ breaths per minute (bpm).

Gas Reference Conditions

Selects reference values. The options are:

ATPX - **A**mbient **T**emperature and **P**ressure, Relative (**X**) humidity (Actual Conditions)

ATPD - **A**mbient **T**emperature and **P**ressure, Dry (Actual Temp, 760 mmHg, 0% humidity)

BTPS – Body Temperature, Pressure, Saturated (37ºC, 760 mmHg, 100% humidity)

STPD - **S**tandard **T**emperature and **P**ressure, **D**ry (21ºC, 760 mmHg, 0% humidity)

Barometric Pressure

Set reference barometric pressure. This will help to fine-tune the pressure, volume and flow readings displayed by the lung. Please note that this reference does not affect the oxygen sensor reading.

Before selecting "Start", confirm that the lung is not being pressurized with gas. Once confirmed by checking the box, click the START button to advance to the Main Screen for live data acquisition.

PneuView Setup Screen (When Not Connected to Lung Simulator)

If the PV Lung Simulator is not plugged in or turned on, "START" may still be selected to enter the Main Screen without live data streaming. The only functionality in this mode is Playback, where a previously saved recording may be recalled and played.

If the Lung Simulator is turned On and the USB data cable is properly connected, "RECONNECT" may be selected to launch the full Setup Screen.

PneuView Main Working Screen

All data acquisition Modes are initiated in PneuView's Main Working Screen, hereinafter referred to as the "Main Screen" as shown below.
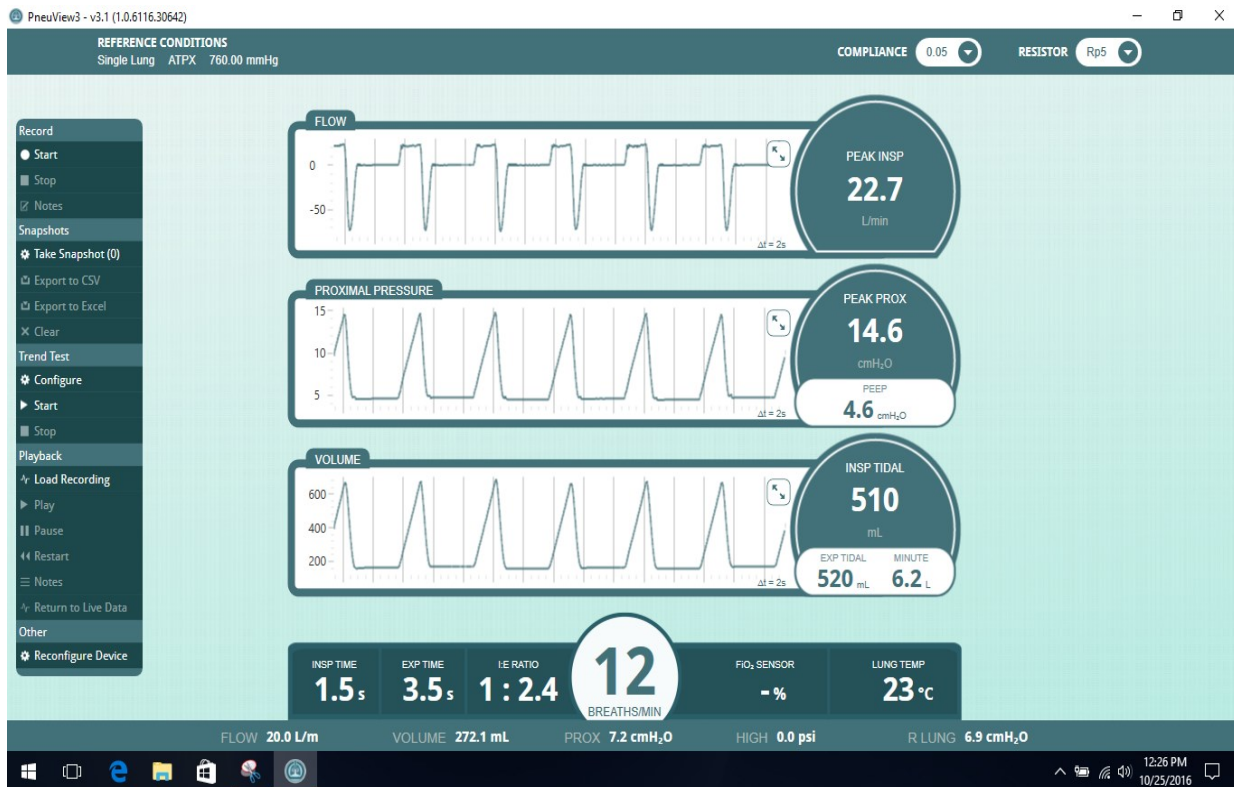
The Main Screen is divided up into the following regions

Breath-to-breath Values
- Peak Inspiratory Flow
- Peak Airway Pressure
- PEEP Pressure
- Tidal Volume (Inspiratory)
- Tidal Volume (Expiratory)
- Breath Rate
- Inspiratory Time
- Expiratory Time
- I:E Ratio

Real-time Values

- Tidal Volume (Right and Left if working with Dual Adult simulator)
- Airway Pressure
- Lung Pressure
- FiO2
- Temperature (lung)

FLOW -10.3 L/m	VOLUME 190.5 mL	PROX 5.7 cmH$_2$O	HIGH 0.0 psi	R LUNG 5.8 cmH$_2$O

Reference Conditions

- Gas Standard
- Barometric Pressure
- Compliance Setting (Right and Left if working with Dual Adult simulator)
- Resistance Setting (Right and Left if working with Dual Adult simulator)

REFERENCE CONDITIONS
Adult Lung   ATPX   760.00 mmHg   **COMPLIANCE** 0.05 ▼   **RESISTOR** Rp20 ▼

Waveform Displays
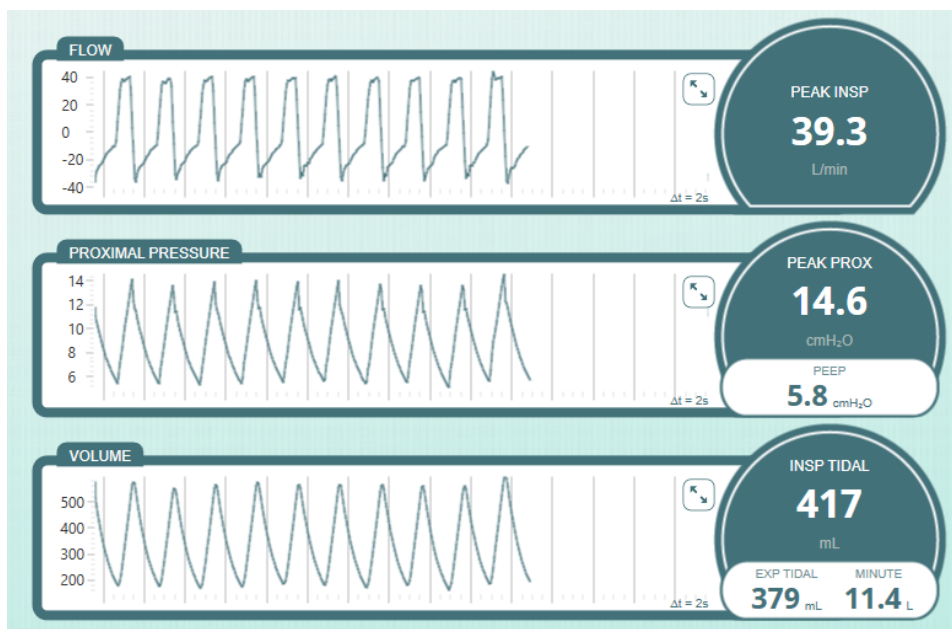
- The waveforms displayed are Flow, Pressure, and Volume.
- The Y-axis can be scaled for optimal viewing by using the scaling icon in each waveform.
- The X-axis of the display is set for 20 seconds.

Modes of Operation

PneuView software offers the following "Modes" to view, record, store, and review ventilation data.

Record
- ● Start
- ■ Stop
- ☑ Notes

Snapshots
- ⚙ Take Snapshot (0)
- 📋 Export to CSV
- 📋 Export to Excel
- ✕ Clear

Trend Test
- ⚙ Configure
- ▶ Start
- ■ Stop

Playback
- ⅄ Load Recording
- ▶ Play
- ❚❚ Pause
- ◀◀ Restart
- ≡ Notes
- ⅄ Return to Live Data

Other
- ⚙ Reconfigure Device
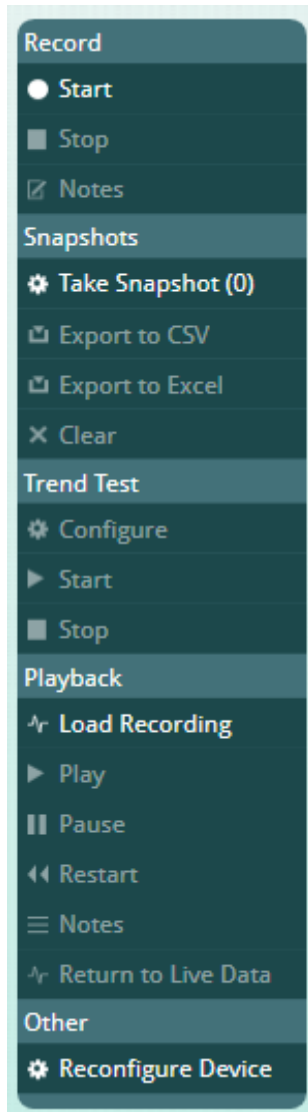
Live Data Acquisition Mode
This is the initial Mode of operation when a powered PneuView Lung Simulator is connected via USB to a computer running the PneuView application. Real-time data is displayed on the screen. The accuracy of the data is dependent on the variables mentioned above (Data Acquisition & Analysis).

Recording Mode
This Mode is available to Record a run of lung ventilation data. All raw data is saved during a Recording session. The user determines the Start and End points of a recording.

Snapshot Mode
The Snapshot Mode is used to "grab" a set of numeric data when it appears on the screen. There is no limit to the number of Snapshots that can be taken in a session. They are saved in a .csv or .xls table format and can be viewed with an appropriate spreadsheet application.

Trend Testing Mode
This Mode is used to look at the values for the measured and calculated ventilation parameters over an extended period.

Playback Mode
Playback mode is used to replay previously saved recordings. The Playback mode is stand alone and does not require a connection the lung simulator.

Operating Modes How-To Guides

With live data being streamed and displayed on the Main Screen, all modes of operation are available. If the PneuView Software is loaded without live data, only the Playback Mode will be active and available for selection.

Recording Mode

PneuView 3 Software allows recording a "run" of ventilation data, as seen in real time by the system. This recording can be retrieved and replayed in the "Playback Mode" as described in the following pages. Recordings can be from less than 1 second to many hours in length. This is only limited by the available memory or other capabilities of the computer being used.

During recording, the raw, real-time data being captured by the software is temporarily recorded to volatile memory of the computer. It is not saved as a file until the "Save" command is selected. When saving a Recording, the file is written to the location of your choice.

Make a Recording

Step 1: Ensure setup and references are correct, and data is being actively acquired.

Check that the Reference Conditions, Compliance, and Resistance values shown on the Main Screen are correct. Ensure that live data is being displayed on the Main Screen.

Step 2: Select "Start" under Record in the Mode Selection Menu.
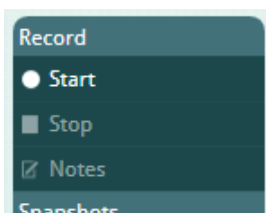
Once a recording has started, the Start selection will dim and the Stop selection will brighten, thus available for selection.

Step 3: Select "Stop" under Record in the Mode Selection Menu.

NOTE: There is no practical limit as to the length of a recording. It is determined by available storage space and the processing capabilities of your computer. During recording, the data is held in "volatile memory", then written to the specified drive when the file is saved.

Step 4: Add a Note to your recording (optional)
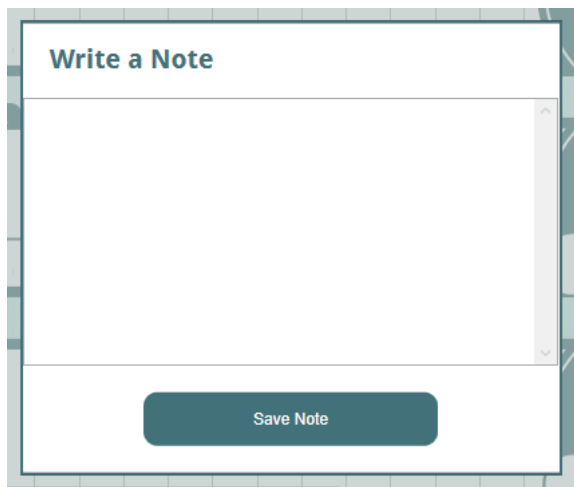
Notes may be added while recording or once the recording is stopped. The "Write a Note" dialog box will always appear, but adding a note is optional. Select "Save Note" to move on to save or discard your recording.

Step 5: Save the Recording

Once you click on "Save Notes", you are prompted to save the file using normal Windows file-saving protocols (as shown below). By default, Recording files are saved with a .pv3 file extension.
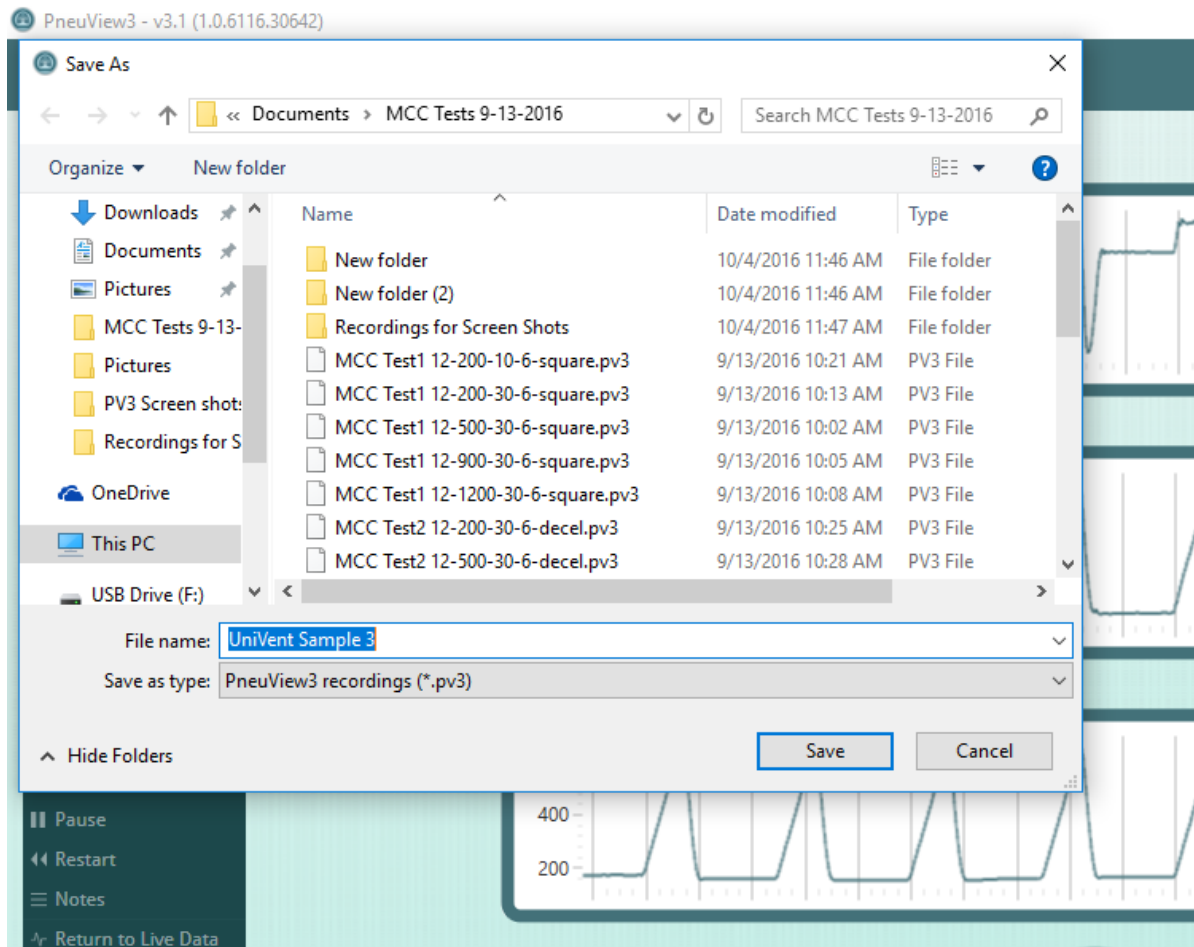
We recommend not changing that extension, as PneuView may not retrieve and play back recordings properly if saved with an alternate extension.

Playback Mode

Once Recordings have been saved, they can be retrieved and played back. The playback does not require a connection to the PneuView Lung Simulator. The Playback mode uses the raw data from the recorded file to display waveforms and data, as seen during the live data acquisition.

Play Back a Recording

Step 1: Load a Recording

While viewing the Main Screen, select "Load Recording" under Playback in the Mode Selection Menu. You will be prompted to select a Recording file using standard Windows file selection protocols. (Double-click a .pv3 file or highlight the file and click "Open" to load the file to the Main Screen.)

Step 2: Pause, Restart, and View Notes during Playback

Once the Playback of a Recording has started, the Pause, Restart, and Notes items become active in the Mode Menu. These selections work as follows:
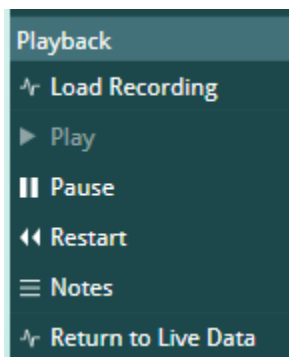
Pause – Stops the playback at its current point and freezes the waveform and numerical display. The Play selection then becomes active.

Play – The selection becomes active when playback has been paused. Selecting Play will resume the recording playback from its current point.

Restart – Selecting Restart begins the playback of this recording from its beginning.

Notes – The Notes item may be selected at any time after loading a recording. This will display the notes associated with this recording.

Return to Live Data – Selection of this command will take you from Playback mode to live data acquisition. This option is not available if the connection to the lung simulator is not active.

Snapshot Mode

PneuView Software allows you to create a table of information by taking "Snapshots" of the numerical data on the screen. These tabulated Snapshots can then be exported to a .csv or .xls spreadsheet for storage and review. The Snapshot Mode is often used for collection and comparison of results against target or standard settings.

NOTE: The Snapshot mode only records numerical data at a point in time. If waveforms or a streaming data replay is desired, please use the Recording mode.

Make a Table of Snapshots

Step 1: Take a "Snapshot" to start a new table.

While viewing live data on the Main Screen, select "Take Snapshot" under Snapshot in the Load Selection Menu. The counter next to this command will incrementally increase with each snapshot that is taken. Breath data from the last displayed breath will be recorded to the table.

Step 2: Add snapshots to the table.
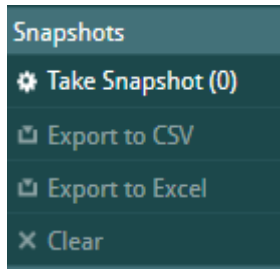
Continue to take snapshots as desired. The counter will continue to track the number of snapshots taken.

NOTE: There is no practical limit to the number of snapshots that can be added to a table. It is determined by available storage space and the processing capabilities of your computer. During the snapshot session, the data is held in "volatile memory", then written to the hard drive when the file is saved.

Step 3: Save results by selecting "Export to CSV" or "Export to Excel".

Step 4: Name and save your file.

Once saved as a .csv or .xls file, the tabulated Snapshot data can be viewed, sorted, and manipulated as allowed by the spreadsheet capabilities.

Note: Comments or notes to a Snapshot file can be added in the spreadsheet being used to view the table or results.

Step 5: Once results are exported, select "Clear" to clear the Snapshots from the data table in memory.

Trend Test Mode

PneuView's Trend Test Mode can be used to look at the consistency or variability of ventilation parameters over time. This can be very useful for applications such as:

- Troubleshooting intermittent ventilator performance problems.
- Confirming ventilator performance following repair or upgrade.
- Quantifying the variability of a ventilation device or technique over time.

The Trend Test can be used to track the following breath parameters:

- Tidal Volume
- Peak Inspiratory Flow
- Peak Proximal Pressure
- I:E Ratio
- Breath Rate
- Inspiratory Time
- Expiratory Time
- PEEP Pressure
- Minute Volume
- High Pressure (psi)

Run a Trend Test

Step 1: Configure the test.

To set up a Trend Test, select "Configure" below Trend Test in the Mode Selection Menu. The following screen appears.

a. Select the parameters that define whether the test "Passed" or "Failed".
    Click on the box to the left of the parameter name to select and un-select the parameter.
    All parameters are tracked during a trend test, but only those selected are used to
    determine the final Pass/Fail status of the test.
b. Set the test duration.
    A test duration can range from 1 to 1999 hours
c. Select the sampling rate.
    The sampling rate can be set for 60, 4, or 1 per minute. Depending on the setting, the
    software will record a set of numerical results every 1, 15, or 60 seconds and store them
    in the trend results file.
d. Choose the output directory for your Trend Test file. The trend results are stored as a
    .csv file that can be read by most spreadsheet applications.

Choose "Start" to begin the test or select "Cancel" to return to the Main Screen. A trend test can also be started from the Main Screen as shown in step one.

Step 2: Start the test.

Once Start is selected from the Configuration or the Main Screen, a Trend Test timer appears at the top of the Main Screen showing progress of the test.

Step 3. Stop the test.

When set duration for the test is completed, a message in the center of the screen notifies you that the Trend Test is finished. It also provides an Overall result (Pass or Fail) and displays the duration of the test. The results have been saved in the folder designated during configuration. The two options are available: "Go to results" or "Finish trend test".

A Trend Test may be stopped at any time using the Stop selection below the Trend Test in the Mode Selection Menu. A confirmation dialog box will appear. If stopping the Trend Test is confirmed, you will be prompted as shown in the above paragraph.

Step 4: Save the Trend Test results.

Trend Test results are saved in a .csv file format. CSV files can be opened in a spreadsheet application, such as Microsoft Excel®. When a trend file is opened all saved data is available. At this point, the trend data can be formatted and/or graphed.

Viewing Recordings, Tables, and Trend Results

Files are "saved" in the following formats:

PneuView File Type	Format (Saved as…)
Recordings	Customized PneuView file – Extension of .pv3
Snapshot / Table	CSV* or Excel** file – Extension of .csv or .xls
Trend Test File	CSV file – Extension of .csv

*CSV is a simple file format used to store tabular data, such as a spreadsheet or database. Files in the CSV format can be imported to and exported from programs that store data in tables, such as Microsoft Excel** or OpenOffice Calc. **CSV** stands for "comma-separated values".

**Excel® is a licensed spreadsheet application product of Microsoft Corporation.

The location of these files is determined by the user, during the setup of a Trend Test or at the time of saving Recordings and Snapshot files.

Viewing Recordings

Recordings are viewed using the Playback Mode as described in the earlier "How-to" section.

Viewing Snapshot Tables

A table of Snapshots is saved in a .csv or .xls format. These files are most easily viewed, analyzed, and manipulated using Microsoft Excel or a similar spreadsheet program. The data is shown below. Note that all settings and parameters are recorded.

Name	Impact Uni-Vent								
Date	10/26/2016								
Notes	Vent settings: Rate 12, I:E 1:2.5, PEEP 5 Vt measurements at 200, 400, 600, 800, and 1000 mL.								
Snapshot #	Time	L Comp	R Comp	L Res	R Res	BPM	VT Insp	VT Exp	PIP	PEEP
1	16:42:33		0.05		Rp5	12	193	193	9.2	5.3
2	16:43:07		0.05		Rp5	12	391	391	13.0	5.4
3	16:43:38		0.05		Rp5	12	598	598	16.5	5.1
4	16:44:08		0.05		Rp5	12	799	799	20.3	5.2
5	16:44:58		0.05		Rp5	12	996	996	23.9	4.9

Snapshot #	Time	Peak Flow	Min Vol	I-Time	E-Time	I:E Ratio	FiO2	Temp	P High
1	16:42:33	9.6	2393.4	1.5	3.5	0.4		20	0.0
2	16:43:07	17.1	4770.6	1.5	3.5	0.4		20	0.0
3	16:43:38	26.3	7458.8	1.5	3.5	0.4		20	0.0
4	16:44:08	35.3	9286.2	1.5	3.5	0.4		20	0.0
5	16:44:58	46.6	11849.9	1.5	3.5	0.4		20	0.0

Data may be reformatted and edited to produce the desired reports. (See sample below of a reformatted Snapshot table using the above "raw" results.)

Name	Impact Uni-Vent						
Date	10/26/2016		Operator	Mary Johnson			
TEST OF TIDAL VOLUME ACCURACY							
Notes	Vent settings: Rate 12, I:E 1:2.5, PEEP 5 Vt measurements at 200, 400, 600, 800, and 1000 mL.						
Snapshot #	Time	R Comp	R Res	BPM	VT Setting	VT Measured	Pass / Fail
1	16:42:33	0.05	Rp5	12	200	193	PASS
2	16:43:07	0.05	Rp5	12	400	391	PASS
3	16:43:38	0.05	Rp5	12	600	598	PASS
4	16:44:08	0.05	Rp5	12	800	799	PASS
5	16:44:58	0.05	Rp5	12	1000	996	PASS

Viewing Trend Test Results

Upon completion of a trend test, the data taken will be stored in two (2) .csv files in the folder specified in the trend test setup window (set by clicking on the "Select Output Directory"). These 2 files are "running" and "summary". Data can be analyzed and formatted by opening the .csv files created by a trend test. These files are most easily interpreted via Microsoft Excel or a similar program.

Trend "Summary' Files

A "summary" file provides the basics of any Trend Test. All 10 trended parameters are shown along with any target and tolerance that may have been entered. The minimum, maximum, and average of each parameter for the entire duration of the test is shown, along with the time at which the minimum and maximum were recorded.

A sample of the unformatted (raw) summary .csv data is shown below.

paramete	low	target	high	minimum	average	maximum	unit	min time	max time
inspirator	450	500	550	495.4212	498.7302	502.4758	mL	0:02:21	0:00:01
peak flow	19.8	22	24.2	21.70687	22.09722	33.40058	L/m	0:03:26	0:06:02
peak prox	14.4	16	17.6	14.60987	14.8773	15.07743	cmH2O	0:02:21	0:01:26
ie ratio	0.475	0.5	0.525	0.414496	0.41608	0.417564		0:04:37	0:00:31
breath rat	11.4	12	12.6	11.98562	11.99776	12.00961	bpm	0:04:42	0:04:37
high press	0	0	0	-0.05513	-0.01694	0	psi	0:07:26	0:00:00
inspirator	1.425	1.5	1.575	1.464	1.4694	1.474	s	0:04:37	0:00:31
expiratory	3.325	3.5	3.675	3.528	3.531522	3.536	s	0:00:35	0:04:40
peep	5.7	6	6.3	5.041689	5.327516	5.518029	cmH2O	0:03:25	0:02:55
minute vc	5.7	6	6.3	5.808007	6.053233	6.319295	L	0:03:30	0:01:30

The data can be re-formatted or copied to a template where the results can be displayed and recorded as needed. A sample of the above data in a formatted trend summary file is shown below.

Name	Final Trend Test - #799234579								
Date	20.10.16	Time							
Operator	Kurt Gruber								
Notes	Trend Test of Transport Ventilator								
Parameter	Low	Target	High	Min	Avg	Max	Unit	Min time	Max time
Insp Tidal Volume	450.00	500.00	550.00	495.42	498.73	502.48	mL	0:02:21	0:00:01
Peak Insp Flow	19.80	22.00	24.20	21.71	22.10	33.40	L/m	0:03:26	0:06:02
Peak Prox Pressure	14.40	16.00	17.60	14.61	14.88	15.08	cmH2O	0:02:21	0:01:26
I:E Ratio	0.48	0.50	0.53	0.41	0.42	0.42		0:04:37	0:00:31
Breaths/Min	11.40	12.00	12.60	11.99	12.00	12.01	bpm	0:04:42	0:04:37
High Pressure	0.00	0.00	0.00	-0.06	-0.02	0.00	psi	0:07:26	0:00:00
Insp Time	1.43	1.50	1.58	1.46	1.47	1.47	s	0:04:37	0:00:31
Exp Time	3.33	3.50	3.68	3.53	3.53	3.54	s	0:00:35	0:04:40
PEEP	5.70	6.00	6.30	5.04	5.33	5.52	cmH2O	0:03:25	0:02:55
Minute Volume	5.70	6.00	6.30	5.81	6.05	6.32	L	0:03:30	0:01:30

Trend "Running" Files

When a "running" trend file is opened, a data table will be displayed in which the 10 parameters charted by a trend test appear across 40 columns. Each parameter is represented by four consecutive columns displaying minimum, maximum, average and tolerance values, respectively. If any of the first three values fall outside of the tolerance that was specified during setup, then the tolerance column will read "FALSE," otherwise "TRUE" will be displayed.

Rows on the data table represent data samples in the order that they were taken. Columns are labeled with the name of the parameter that they represent and appear in the following order:

Inspiratory tidal volume field (Columns A-D)

Peak flow rate field (Columns E-H)

Peak proximal pressure field (Columns I-L)

Inspiratory/expiratory ratio field (Columns M-P)

Breath rate field (Columns Q-T)

High pressure value field (Columns U-X)

Inspiratory time field (Columns Y-AB)

Expiratory time field (Columns AC-AF)

Positive end expiratory pressure field (Columns AG-AJ)

Minute volume field (Columns AK-AN)

A sample of unformatted* (raw) trend running data is shown below.

*In the illustration that follows, data was moved to one page for viewing purposes, but otherwise, it is as it appears when the file is first opened.

peak prox	peak prox	peak prox	peak prox	ie ratio mi	ie ratio m	ie ratio av	ie ratio wi	breath rat	breath rate max
14.72	15.07	14.92	TRUE	0.42	0.42	0.42	FALSE	11.99	12
14.65	15.08	14.86	TRUE	0.42	0.42	0.42	FALSE	11.99	12
14.61	15.06	14.86	TRUE	0.42	0.42	0.42	FALSE	11.99	12
14.62	15.06	14.87	TRUE	0.42	0.42	0.42	FALSE	11.99	12
14.77	14.98	14.88	TRUE	0.41	0.42	0.42	FALSE	11.99	12.01
14.7	14.99	14.83	TRUE	0.42	0.42	0.42	FALSE	11.99	12
14.78	14.98	14.87	TRUE	0.42	0.42	0.42	FALSE	11.99	12
14.81	14.98	14.91	TRUE	0.42	0.42	0.42	FALSE	12	12
14.78	15.04	14.89	TRUE	0.42	0.42	0.42	FALSE	12	12

inspirator	inspirator	expiratory	expiratory	expiratory	expiratory	peep min	peep max	peep aver	peep within tolerance
1.47	TRUE	3.53	3.53	3.53	TRUE	5.13	5.47	5.32	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.08	5.48	5.29	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.06	5.52	5.31	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.04	5.52	5.31	FALSE
1.47	TRUE	3.53	3.54	3.53	TRUE	5.22	5.47	5.33	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.16	5.46	5.3	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.22	5.45	5.33	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.25	5.51	5.39	FALSE
1.47	TRUE	3.53	3.53	3.53	TRUE	5.23	5.5	5.36	FALSE

minute vc	minute vc	minute vc	minute volume within tolerance
5.92	6.28	6.08	TRUE
5.89	6.32	6.06	FALSE
5.86	6.22	6.05	TRUE
5.81	6.28	6.06	TRUE
5.94	6.16	6.06	TRUE
5.93	6.16	6.04	TRUE
5.96	6.15	6.04	TRUE
5.96	6.13	6.05	TRUE
5.93	6.14	6.03	TRUE

The information can be reformatted as needed. A sample of formatted trend data follows.

Stability Trend Test			Device	Impact Uni-Vent®			
			Date	10/30/2016			
			Operator	Kevin Smith			

Sample	Vt-I min	VT-I max	Vt-I avg	Pass	Flow-I min	Flow-I max	Flow-I avg	Pass
1	499.6	502.48	500.88	TRUE	21.87	22.09	21.99	TRUE
2	496.56	501.8	499.47	TRUE	21.85	22.14	22.01	TRUE
3	495.42	500.53	498.87	TRUE	21.92	22.16	22.04	TRUE
4	497.33	500.66	499.14	TRUE	21.71	22.24	21.96	TRUE
5	497.5	499.73	498.73	TRUE	21.89	22.11	22.03	TRUE
6	495.99	499.62	497.73	TRUE	21.79	22.19	21.99	TRUE
7	495.92	498.56	497.59	TRUE	21.82	33.4	22.94	FALSE
8	496.71	499.7	498.21	TRUE	21.84	22.09	21.97	TRUE
9	496.16	500.01	497.96	TRUE	21.82	22.13	21.96	TRUE

Sample	P prox min	P prox max	P prox avg	Pass	BPM min	BPM max	BPM avg	Pass
1	14.72	15.07	14.92	TRUE	11.99	12	12	TRUE
2	14.65	15.08	14.86	TRUE	11.99	12	12	TRUE
3	14.61	15.06	14.86	TRUE	11.99	12	12	TRUE
4	14.62	15.06	14.87	TRUE	11.99	12	12	TRUE
5	14.77	14.98	14.88	TRUE	11.99	12.01	12	TRUE
6	14.7	14.99	14.83	TRUE	11.99	12	12	TRUE
7	14.78	14.98	14.87	TRUE	11.99	12	12	TRUE
8	14.81	14.98	14.91	TRUE	12	12	12	TRUE
9	14.78	15.04	14.89	TRUE	12	12	12	TRUE

Sample	I time min	I time max	I time avg	Pass	E time min	E time max	E time avg	Pass
1	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
2	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
3	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
4	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
5	1.46	1.47	1.47	TRUE	3.53	3.54	3.53	TRUE
6	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
7	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
8	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE
9	1.47	1.47	1.47	TRUE	3.53	3.53	3.53	TRUE

Sample	PEEP min	PEEP max	PEEP avg	Pass	Vmin min	Vmin max	Vmin avg	Pass
1	5.13	5.47	5.32	FALSE	5.92	6.28	6.08	TRUE
2	5.08	5.48	5.29	FALSE	5.89	6.32	6.06	FALSE
3	5.06	5.52	5.31	FALSE	5.86	6.22	6.05	TRUE
4	5.04	5.52	5.31	FALSE	5.81	6.28	6.06	TRUE
5	5.22	5.47	5.33	FALSE	5.94	6.16	6.06	TRUE
6	5.16	5.46	5.3	FALSE	5.93	6.16	6.04	TRUE
7	5.22	5.45	5.33	FALSE	5.96	6.15	6.04	TRUE
8	5.25	5.51	5.39	FALSE	5.96	6.13	6.05	TRUE
9	5.23	5.5	5.36	FALSE	5.93	6.14	6.03	TRUE

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