



## Using the Tafonius Phase Editor

**Scope:** This document should be used in conjunction with Tafonius Phase Editor Version 1.0.5 and later

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The Tafonius Phase Editor allows you to design and simulate respiratory patterns that can be later downloaded to Tafonius and run as a set of integrated instructions. This will allow you, for example to design a recruitment manoeuvre based on pressure changes that can be run as and when required.

### How does it work?

When Tafonius delivers a standard single breath, it sends commands to the piston controller that indicate 3 main parameters - Direction, Speed and Time. A collection of these 3 parameters is called a **Phase**. In the case of normal ventilation a single phase is sent to the controller and the piston moves forward at a set speed (inspiratory flow rate) for a given time thereby delivering a fixed volume (integral of flow and time is volume) in the required inspiratory time.

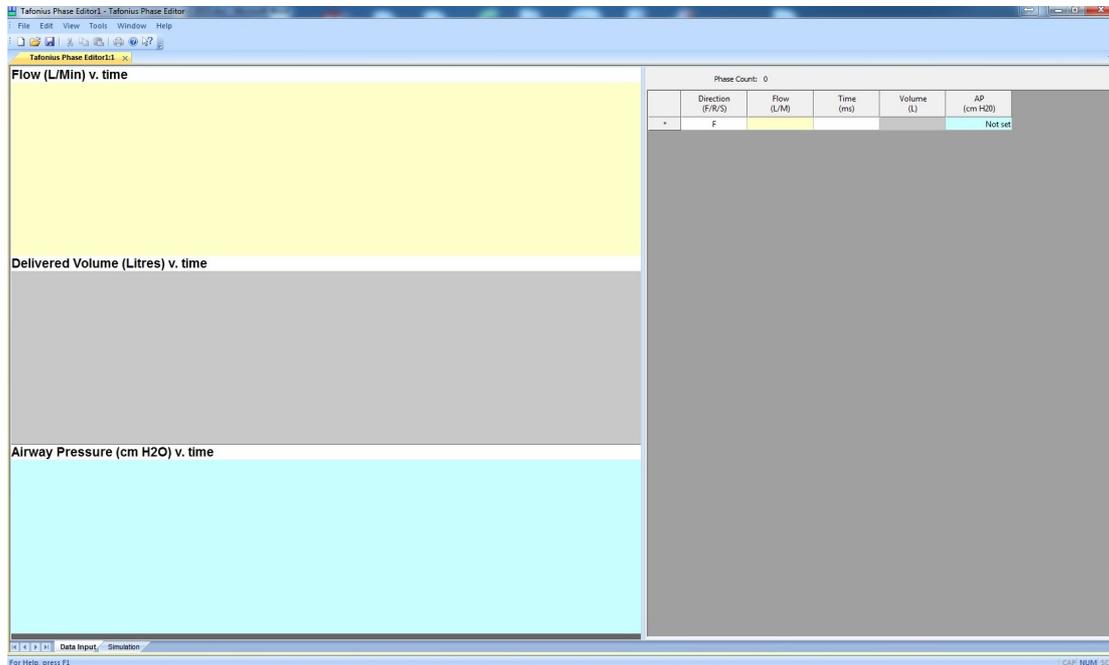
During expiration or spontaneous breathing, phase calculations are made 200 times a second to move the piston according to the measured pressure. These are still single phases using speed, direction and time but the time element is only 5ms.

The design concept of Tafonius allows for over 100 phases to be used in a single respiratory cycle. This means that if you want an inspiratory phase to follow a sinusoidal flow pattern then it can be programmed to do so. If you want to deliver a linear flow, hold for 500ms and then deliver a second but slower linear flow then you can.

The Tafonius Phase Editor software program allows you to design the respiratory phases and visualise their performance.

### Using the Phase Editor

When the Phase Editor program is run there is a blank spreadsheet-like area to the right of the screen and to the left there are three trace windows, labelled Flow, Delivered Volume and Airway Pressure.



To see how the Phase Editor works, let's design a single phase that will replicate what Tafonius does when you press the Ventilate Button. In the first cell on the right hand side of the screen select 'F' to indicate that the piston is moving forward. Tab across to the Time cell and enter 2000. All timings are in milliseconds and this will give our volume delivery a duration of 2 seconds. Then tab across to the Volume cell and enter 5.0. AP (Airway Pressure) will be left as Not Set. On the left of the screen we now see that the Volume trace shows a linearly increasing volume from zero to 5.0L in 2 seconds. This corresponds to a constant flow of 150L/min. This value has been automatically calculated by the editor and inserted into the correct cell. The flow is also shown in the top trace as a straight line at the 150L height mark. The Airway pressure has no trace as no directions have been given on the pressure. Now tab to the second line and this time in the Direction cell, put the letter 'S'. 'S' indicates Servo and what this means is that the piston will servo to the pressure value we set in the AP (Airway Pressure) Column. Tab across to the Time cell and put a value of 4000 in here. Then tab to the AP cell and enter the value 0. In this instance we put a zero meaning the horse will be allowed to breathe out to ambient atmospheric pressure. This command means that Tafonius will perform its servo action around atmospheric pressure. we now have a phase that last 6 seconds and if we were to run this we would have: RR=10, It=2.0, TV=5.0



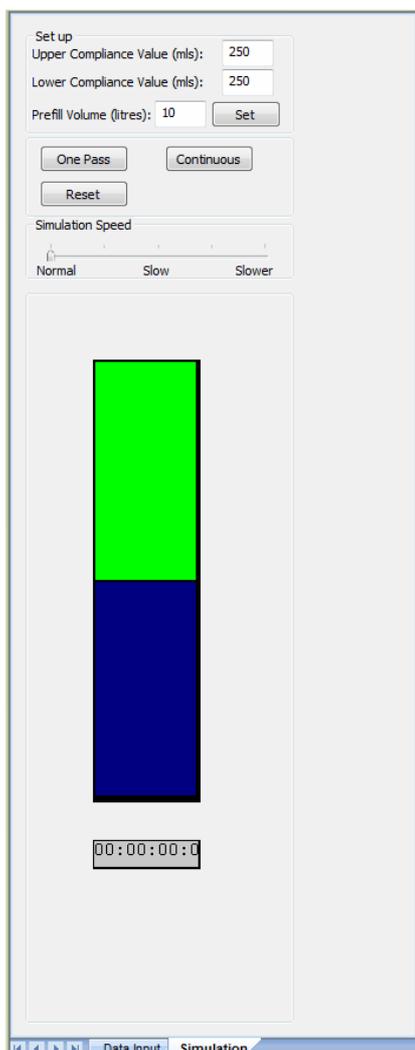
Your design sheet should look like this:

Phase Count: 2					
	Direction (F/R/S)	Flow (L/M)	Time (ms)	Volume (L)	AP (cm H2O)
1	F	150	2000	5.000	Not set
2	S	0	4000	0.000	0
>	F				Not set

This sets all the parameters we need to ventilate a horse.

Now click on the Simulation tab at the bottom of the screen to reveal a new set of traces.

If this is the first time the program has been run then you will need to set a few parameters before beginning the simulation.



We want to simulate a horse weighing around 500kg and having a tidal volume of 5.0L. The maximum inspiratory pressure in such a horse would typically be around 20cm H<sub>2</sub>O so we will set the upper and lower compliance values the same and both at 250. With this we will see a pressure rise of 1cm for every 250 mls of delivered volume. The typical compliance of Tafonius when the piston is at the top is around 35 mls/cm, so the compliance of the horse will dominate this. Set both values to 250. Set the prefill volume to 10L. This is the starting point of the piston.

Now press 'Set' to commit and save these values.

Below the Setup options there are 3 more buttons: One Pass, Continuous and Reset.

The One Pass button will execute one single pass of your set of phases.

The Continuous button will repeatedly execute your set of phases with no gap between the last entered phase and the first entered phase.

The Reset button will stop the execution and make the software ready for another run.

Click on the 'One Pass' button.



You will see the piston move downwards in the same manner that it does on the Tafonius screen. At the same time the delivered volume and rising pressure are shown on the Volume and Airway Pressure traces. After the 2 seconds, the piston returns to the resting 10L position as Tafonius lets the patient breathe out. To improve viewing ability, use the slider in the Simulation Speed box to slow down the simulation. The current time and piston volume are shown as text below and beside the piston respectively.

Now click on the 'Continuous' button and watch the piston move in the same way it would when ventilating a horse. If you look at the beginning and ending of expiration you will see that it takes 0.5 seconds for the pressure to drop to zero. This represents the time it takes the piston to move at maximum speed (600L/sec) to allow the lungs to empty.

If you were to save this file and load it into Tafonius and run it, then Tafonius would behave in exactly the same way that it normally does when ventilating a horse with a TV of 5.0L and an IT of 2.0 seconds.

Now let's add a respiratory pause. Right-click on the second row and chose Insert Row.

Leave the Direction as 'F' but make sure that Flow and Volume are set to zero. Set the Time to 500ms and leave AP as not set. With this phase there are no instructions on how to move the piston so the piston will be held in this position for 500ms.

	Direction (F/R/S)	Flow (L/M)	Time (ms)	Volume (L)	AP (cm H2O)
1	F	150	2000	5.000	Not set
2	F	0	500	0.000	Not set
3	S	0	4000	0.000	0
*	F				Not set

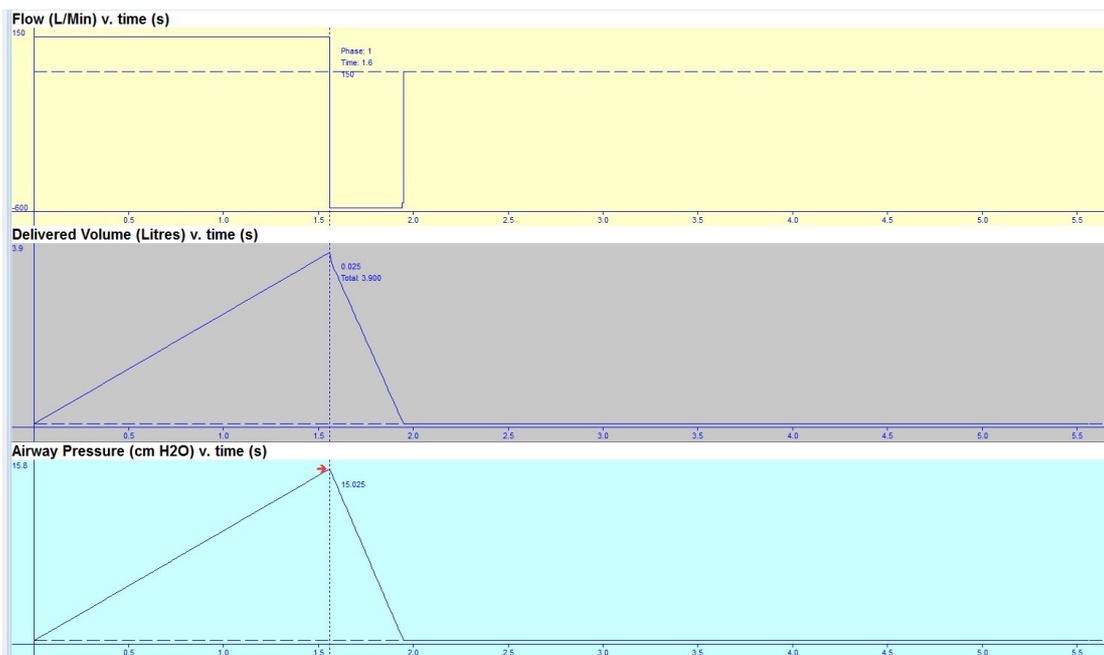
Go back to the Simulation screen and run the Phases. You will see that the piston halts for 0.5 seconds at the end of inspiration before the expiratory phase begins. This can also be seen on the Volume and Pressure traces where they are held steady for 0.5 seconds. Simultaneously of course the flow drops to zero during this pause.

Using these phases, we see that the pressure rises to 20cm H2O when the full volume has been delivered. If this pressure rise is too high for your design model you can limit it at any value by inserting a value into the AP box at the end of the row for volume delivery. If you enter a value of 15 here you will see that the cell background turns to red as shown below.



Phase Count: 4					
	Direction (F/R/S)	Flow (L/M)	Time (ms)	Volume (L)	AP (cm H2O)
1	F	150	2000	5.000	15
2	F	0	2000	0.000	Not set
3	S	0	4000	0.000	0
4	F				Not set
>	F				Not set

Now when you run the Phase Editor you will see that the delivered volume is limited to 3.9L because at that point the pressure has reached 15cm. You can see any value along the trace lines by holding down the left mouse button:



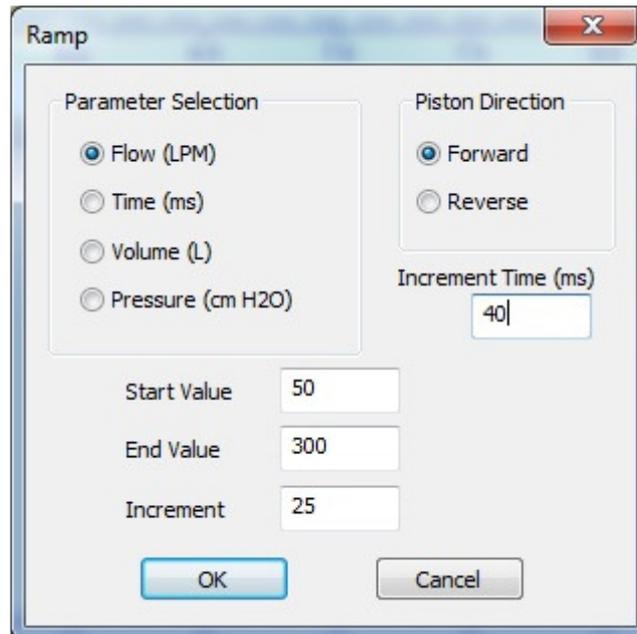
The mouse information shows that the pressure reached a peak of 15.08cm pressure at a delivered volume of 3.90 litres. It will also be seen that once this pressure has been reached that this particular instruction is ended and the ventilator moves to the next row of information, which in this case is the Servo mode to zero pressure. This feature allows the prediction of ventilator behaviour when certain constraints such as maximum pressure are known.



### Ramp data

For ease of data entry, cell blocks can be populated using an automatic feature that will add incremental or decremental information. For example it may be that you wish to deliver gas using a linearly increasing flow rate. To do this right click on the first column and choose Insert Ramp.

In the dialog box that appears insert values as shown below and then press OK.



The screenshot shows a 'Ramp' dialog box with the following settings:

- Parameter Selection:** Flow (LPM) (selected), Time (ms), Volume (L), Pressure (cm H2O)
- Piston Direction:** Forward (selected), Reverse
- Increment Time (ms):** 40
- Start Value:** 50
- End Value:** 300
- Increment:** 25

Buttons: OK, Cancel

This will add 11 rows of data with a Flow rate starting at 50L/min increasing every 40ms by 25L/min until a maximum of 300L/min is reached. This will produce a constant step-wise increase in flow rate which in turn will produce a non-linearly increasing volume and hence pressure.

Note that it is necessary to choose the piston direction when making this selection with Flow. When Ramp Data is entered using Volume the Start Value is prefilled based on the calculated position of the Piston. The End Value will then determine the piston direction, which will change automatically as you enter data.

### Removing data

To remove a row of data, click on the left hand column to select the row. Then right-click and choose Delete Row. To delete a group of data, click on the left hand column and drag the mouse down the rows that you wish to delete. Then right-click and choose Delete Row. You will be prompted to check that you wish to delete all the selected rows before the data is removed.

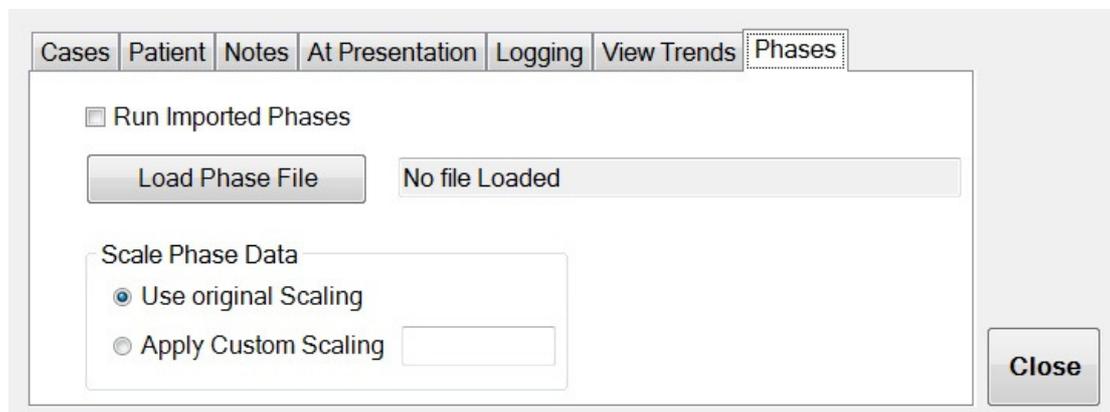


### Data limitations

Whilst the system can handle many rows of information, it is suggested that files be kept to a minimum wherever possible and that files loaded onto Tafonius be checked using a patient model before testing on a real patient. A suggested maximum number of rows of data is 50

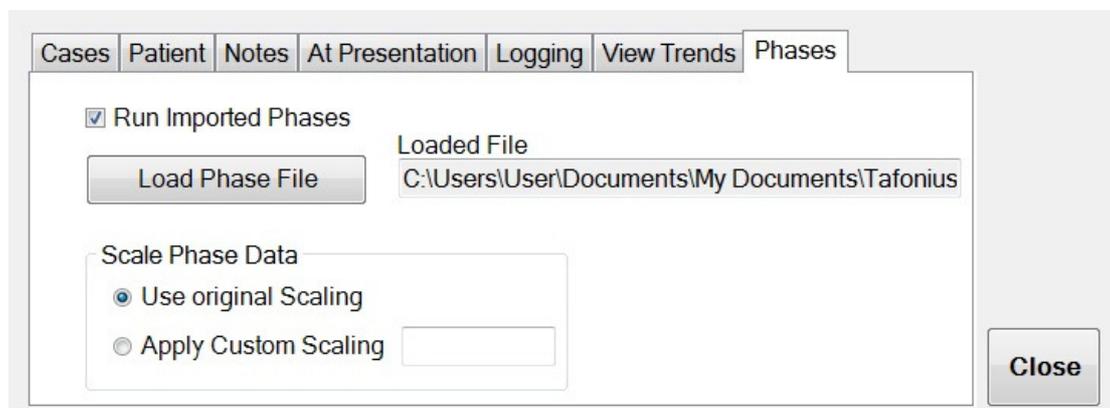
### How to transport your new Respiration Data to Tafonius

Once you are happy with the performance of the data, use **File\ Save** or **File\Save As** to save the file as a csv file to a location of your choice. It is probably easiest to save the file to a USB stick for easy transfer to Tafonius. In the Tafonius program select the Patient Data button and then choose the Phases tab on the right of the configuration area.



Use the Load Phase File button to open a browser that allows you to navigate to your new csv Tafonius Phase Editor file.

Once the file is loaded the path to it is shown to the right of the Load button. Then tick the Run Imported Phases check-box and then Close the configuration box.



You will then see that the blue Ventilate button now says "Push To Run Phases" rather than the usual, "Push to Ventilate".



In Standby mode the machine behaves exactly as it normally does. When the Push To Run Phases button is pressed the phase information is sent to the Auxiliary system and the processor immediately begins running the phase information detailed in the file. When the Standby button is pressed the new phase information is halted and the machine reverts to normal Standby mode. If the Ventilate button is pressed again, the phase information is started again from the **beginning** of the file.

### Scaling

This refers to volume deliveries in phase information. For example, if a particular phase file has been produced for a 500kg horse then it can be run on a 250kg horse by choosing 0.5 as the Scaling Value:

Cases Patient Notes At Presentation Logging View Trends Phases

Run Imported Phases

Loaded File  
C:\Users\User\Documents\My Documents\Tafonius

Load Phase File

Scale Phase Data

Use original Scaling

Apply Custom Scaling 0.5

Close

Note: this ONLY applies to volume delivery. Flow rates and pressure values are not affected.

When running Phase File data remember that the machine will still behave as usual in respect of maximum allowed pressures, so if your MWPL setting is below a predicted resulting pressure value during ventilation then the alarm will sound and the dump valve will open when the MWPL is exceeded.



## Getting Started

The best way to get familiar with the system is to run a simple file which has the following entries:

Phase Count: 2					
	Direction (F/R/S)	Flow (L/M)	Time (ms)	Volume (L)	AP (cm H2O)
1	S	0	2000	0.000	20
2	S	0	4000	0.000	5
>	F				Not set

Attach a 5L bag to the Y-piece and make sure the piston volume is over 10L before you start. Then import the file and run the phases data. The ventilator will ventilate the bag by changing between 5cm pressure and 20cm pressure. Once you have this working, design, simulate and run your own files to create new ventilation or recruitment patterns.

## Final Note

This is new and experimental software so there may be bugs or behaviour features that we are unaware of. Please help us by giving us plenty of feedback and letting us know about any problems or features that you particularly like.