



Tafonius Training

Objectives

1. To inform the user about the main points of the machine in terms of hardware
2. To inform the user of the basic operating principles of the machine
3. To instruct the user in the correct setup and closing-down procedures of the machine including cleaning
4. To instruct the user in the normal operation of the machine
5. To instruct the user in the advanced use of the machine
6. To instruct the user where to look and how to look for trouble shooting of the machine

1. Main points of the Tafonius machine in Auxiliary Mode

Power connections

- Mains power should be connected during use
- There is a small RCD (Residual Current Device) situated at the rear of the machine. This must be set to ON so that the small green light is showing
- The indicator "MAINS" will appear at the top centre of the Auxiliary screen when power is applied. If mains power is absent, the word "BATT" will appear instead
- The status of each battery is indicated at the top left of the screen by a voltage and then a condition status. With mains applied, the voltage should be greater than 13v for each battery. If the batteries are charging then the legend "CHG+" will appear after the battery. The machine will not run with both batteries showing a voltage of less than 11v each



Gas connections



- Hospital supply oxygen is supplied via a white hose to the back of the machine
- The Hospital Oxygen supply pressure should be between 35 and 60 psi and is shown on the Hospital Oxygen Pressure gauge. Pressures outside this range may cause running/performance problems
- If the hospital or the bottled oxygen supply should fall below 35 psi then the machine will emit an audible warning and the text " OXYGEN SUPPLY PRESSURE LOW" will appear on the Auxiliary screen
- Two Size E oxygen cylinders can be connected at the side of the machine using the pin-indexed connectors. When connected the cylinder operating pressure is shown on the left-hand gauge (Oxygen Cylinder Pressure)
- NOTE: when oxygen cylinders are connected and their valves opened, they will supply oxygen to the circuit in preference to the hospital supply as their operating pressure is highest. To avoid this, make sure the cylinders are turned off when not required
- Oxygen flow is controlled by a 0-10L Oxygen Flow meter. With the control fully open it will take nearly 2 minutes to fill the cylinder using this method. All oxygen flow controlled by this meter goes through the vaporiser
- There is an Oxygen Flush button that delivers pure oxygen to the patient circuit and does **not** go through the vaporiser. The delivery rate of this oxygen flush is nominally 70L/min, meaning it will take at least 20 seconds to fill the cylinder using this method.
- Scavenging of waste gases from the patient circuit is done through the waste manifold situated inside the back door. All excess gas is delivered to this manifold by the action of the Dump Valve. Removal of gas after that depends on the scavenging system employed. See the document "**Operation of the Dump valve and gas scavenging systems from Tafonius**"
- Unless an active scavenging system using a piped vacuum circuit is used then the Scavenging flow meter should be turned off (fully clockwise)
- If an active scavenging system using a piped vacuum circuit is in use, then the flow meter should be set to 6-10L/min
- The patient circuit pressure is indicated by an analogue pressure manometer gauge labelled "Breathing System Pressure". The pressure is actually measured at the Y-piece via the clear Pressure Sensor tubing, It is very important that this tubing is connected during anaesthesia.



Instrument identification and location



The front of Tafonius has an Auxiliary screen, 3 pressure gauges, 1 or 2 Flow meters, 4 control knobs and 5 control buttons

The Auxiliary screen is a 6" Black & White display used to control and display the status of the machine. The screen is situated on the left next to the Oxygen flow meter and has a back light for night use and improved viewing

The three pressure gauges and flow meters have already been discussed

The 4 control knobs are situated immediately under the Auxiliary screen. Their action and behaviour is context-dependant and will be discussed later.

The 5 control buttons are

- **Mains ON/OFF** button. When this button is illuminated the machine is powered. It takes only a momentary push to start the machine but a prolonged (3 second) hold to turn the machine off
- **RUN/IPPV** button - this button will be illuminated during IPPV only. When the button is not illuminated the machine is in Standby mode
- **Assist Button** - the illumination of this button will depend whether the machine is in Standby or Ventilate mode. This will be discussed fully under the Assist Mode function.
- **PEEP/CPAP** button - this button enables the setting of CPAP (Standby mode) or PEEP (Ventilate mode). This will be discussed fully under the CPAP/PEEP function
- **Dump Valve** button - this button allows the user to manually open the Dump valve to get rid of gas from the patient circuit. At the same time that the valve is opened a slight pressure is applied to force gas from the circuit. Pushing and holding this button will evacuate all the gas in the cylinder via the waste circuit.
- **Add-a-Litre ON/OFF** switch - this switch enables or disables the automatic addition of an extra litre of oxygen if the piston volume goes below 2.5L. This additional oxygen is added through the vaporiser.

Soda Lime location, changing and filling

The Soda Lime is located in a dedicated tray found at the bottom of the cylinder assembly. The Soda Lime tray is locked in position by three cylinder straps and is removed by releasing these three straps, removing the front strap and then pressing on the foot plate to separate the Soda Lime tray from the cylinder. The foot plate should be pressed sufficiently that the metal spring retainers on the pneumatic arms lock into place.



The Soda Lime tray has two halves and is symmetrical so it can be fitted either way round. The half of the soda lime over the Expiratory pipe entrance will turn colour first and will turn colour from the bottom upwards. Use this as a guide to renewal. Allow one side to turn colour until it reaches the top of the first side. Then turn the tray around so that the second side turns colour from the bottom upwards. Once both sides have turned colour at the top level, the soda lime should be discarded and replaced.

Filling the Soda Lime tray

Fill the Soda Lime tray with absorbent to the level of the central divider. If the central divider has a notch in it then fill only to the level of the bottom of the notch. **Filling above these levels will prevent proper initialisation of the cylinder.**

To close the cylinder, fit the Soda Lime tray observing the orientation of the upper and lower seals. Then pull out the two metal spring retainers to allow the pneumatic arms to pull the soda lime tray up into place. Fit the front retaining strap and then snap all three strap clamps into place.

Changing to Manual Mode

Should an un-recoverable fault occur such as loss of power or a vacuum fault the machine can be quickly converted to a manual system where manual IPPV can be given and normal anaesthesia maintained.

To swap to manual mode, remove one of the lower drainage bungs and then connect the manual breathing pipe directly to this port. Turn the machine off by pressing and holding the Mains ON/OFF button until the screen backlight goes off. The machine will then power down automatically. Manual IPPV is given in the normal way using the 30L manual bag and the spill valve. Using this method there is no need to change the scavenging setup as the waste gas is automatically directed to the scavenge system.



2. Basic Operating principles of Tafonius

Tafonius is not a bag-in-a-bottle ventilator. There is no need for a source of pressurised gas to drive air into the patient. Tafonius uses a motor to drive a huge 'syringe' backwards and forwards to allow spontaneous and mechanical ventilation.

However, the best way to think about Tafonius is as a fully controllable rebreathing bag. A bag that can be set to any size and that can be 'squeezed' in different manners to deliver a breath. Continuing with this concept, the animal can freely breathe out into, or from this bag as it offers no resistance. Because Tafonius is essentially a 'virtual rebreathing bag', what can you do with it?

- Allow free spontaneous breathing
- Administer forced inspiration by 'squeezing the bag'
- Allow un-restricted expiration by allowing the patient to breathe into the 'bag'
- Provide CPAP or PEEP by keeping the 'bag' slightly squeezed during spontaneous breathing (CPAP) or at the end of expiration during IPPV (PEEP).

The way this virtual bag works is this: there is a pressure sensor located at the Y-piece that measures the airway pressure to within 0.2cm H₂O pressure. In spontaneous mode, as soon as any pressure change in excess of 0.5cm is detected the piston moves to negate the change in pressure. So if the animal breathes out, the increase in pressure makes the piston move upwards thus expanding the 'bag'. Because the piston does all that is necessary to return the pressure at the Y-piece to zero the patient does not see any of the resistance offered by the valves, tubing, soda lime or other restrictions. In other words the Work of Breathing is reduced to an absolute minimum. The piston appears to float in response to normal breathing efforts and behaves like a perfect re-breathing bag.

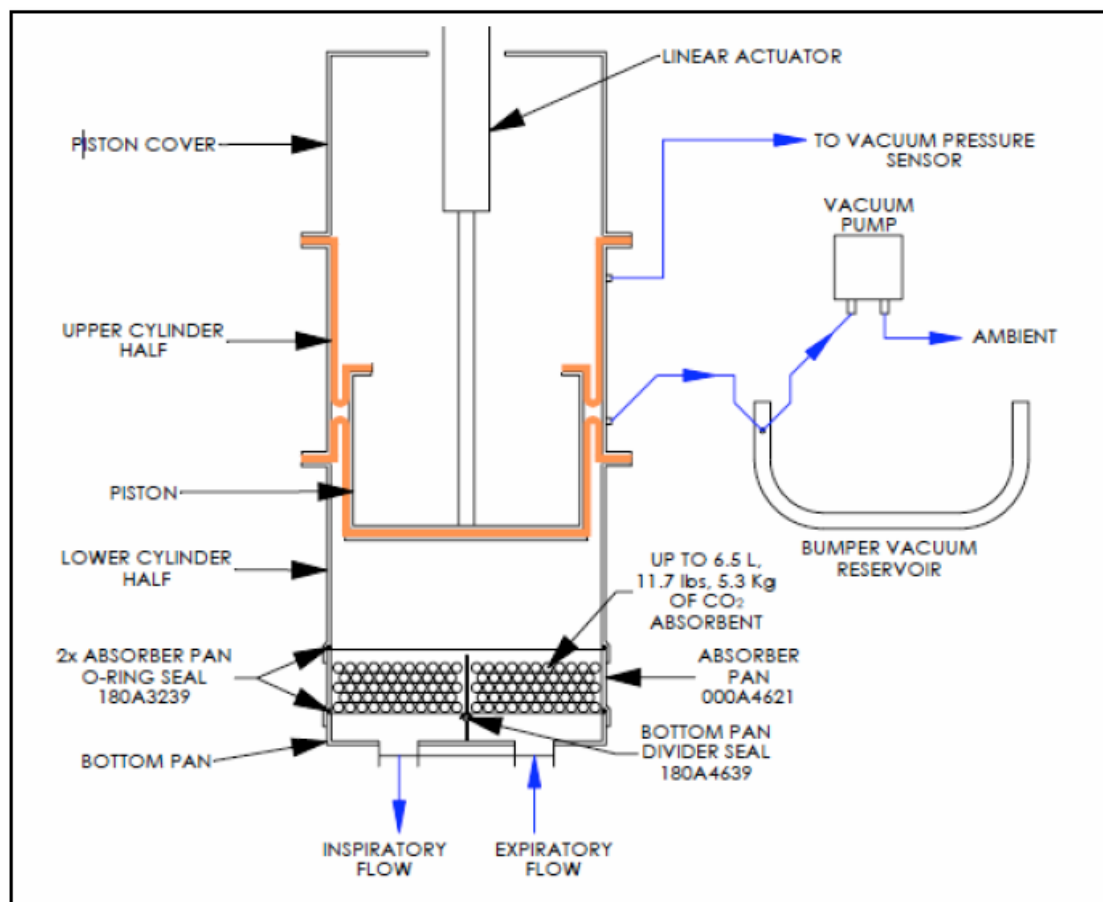
Because of this the system will support animals in spontaneous breathing mode as small as 10kg quite happily. A change in the patient tubing to the foal circuit (22mm) is recommended for patients under 100kg.

Changing the bag size

The size of the bag equates to the total volume in the cylinder and is comprised of two distinct volumes. The first volume is the set Tidal Volume as indicated by the Tidal Volume value on the screen. The second volume is the Buffer volume as indicated by the BV value on the screen. When the cylinder is filled with gas it will fill to a maximum volume of TV + BV. When a mechanical breath is delivered it will deliver only the TV. This allows variation in breath size without losing gas through the spill (Dump) valve or running out of gas during inspiration. It also allows the total volume to be reduced during surgery to minimise the circuit volume and enable low-flow anaesthesia.

Typically for a 500kg horse the settings at the start of surgery will be TV=5.0 and BV= 10.0. This means the cylinder will be pre-filled to a volume of 15L. Attempting to fill any further than this will just result in the Dump Valve opening and voiding gas to the waste circuit. Once anaesthesia is settled the BV can be reduced to 5 or even 2.5 litres to present a very rapid responsive circuit.

The reason that the Tefonius cylinder can behave like a bag and respond so rapidly is because the cylinder has near zero friction. This reduced friction state in a piston system is unusual and is achieved by means of a unique double rolling diaphragm assembly shown in diagram form below:



The lower diaphragm keeps the patient circuit gas from escaping up the sides of the piston and theoretically it only takes one diaphragm to achieve this. However the rolling action of the diaphragm can be much improved and predicted if the diaphragm is itself held tight against the piston. This can be achieved by having a second rolling diaphragm attached to and sealed against the top of the piston and then evacuating the air from between the two diaphragms. Atmospheric pressure then acts to push the diaphragms against the piston and the sides of the cylinder allowing them to roll freely with no



friction. The vacuum is achieved using a small pump that can be heard to run intermittently during normal use.

Please note that the vacuum circuit and the patient circuit are two different circuits and leaks in the patient circuit will have no effect on the vacuum in between the two diaphragms.



3. Setting up Tafonius for first use and closing down after use:

Pre-op Checks - Initialising the Machine - Closing down the machine

Pre-op Checks

Before starting Tafonius make the following checks:

Are both drainage stoppers fitted?

Is the manual take-off port closed and sealed?

Is the Soda-lime fresh?

Is the valve block assembled and tightened down?

Are the Patient hoses and Y-piece attached?

Make sure the Y-piece is **not** stoppered.

Is the Pressure sensor connected to the Y-piece?

Is the sidestream sampling port either stoppered or connected to the sampling line?

Is the Salbutamol port stoppered?

Is the oxygen supply connected?

Is the mains power connected AND the trip switch set to ON?

Initialising the Machine

Press the square Mains ON/OFF button to start the machine

Watch the small screen for any warning or error messages. Each test passed is indicated by a double-beep. If a long beep is heard, check the screen for the explanatory message

At the end of all the pre-run tests the system will then halt, flash the RUN button and display the message:

PISTON NOW NEEDS TO BE INITIALISED

DISCONNECT PATIENT AND PUSH RUN BUTTON

If the cylinder is still open then fit the absorber pan and close the cylinder and press the Run button.

The piston will move slowly to the bottom position and stop

At this stage you can run a leak Test* by pushing any knob when the message:

“PUSH ANY KNOB FOR SYSTEM LEAK TEST” appears

Now fit the stopper to the Y-piece

Set the Vaporiser to your required pre-fill setting

Set your patient Tidal Volume

Set the Buffer Volume to 10

Pre-fill the Cylinder to the required level using the manual Gas flow meters.

Turn off the gas flow

The system is now primed, ready for use



Disconnecting the Patient

Before disconnecting the patient, first check that there is no PEEP or CPAP value selected. If there is, set it to zero
Remove any monitoring lines as appropriate
Set the operating mode to Standby to stop any IPPV
Disconnect the patient and quickly fit the stopper to the Y-piece and hang the Y-piece on the right hand side of the machine
Turn off the gas flow of Oxygen, Nitrous or Air.
Turn off the vaporiser

Closing down the machine

Fit the stopper to the Y-piece
Push the Dump Valve control button to push the gas out of the piston through the scavenging system
Open the cylinder
Remove the absorber pan and soda lime
Press and hold the green square Mains ON/OFF button to shut down the Auxiliary system
Remove the stoppers from the drainage tubes on the absorber pan
Undo the screws from the valve block and remove the valve block, valves and orange O-rings
Disconnect the sidestream monitoring line and the Pressure Sensing line from the Y-piece. Remove the patient tubes from the valve block, flush them through with water/cleaner and then hang up the Y-piece and patient tubes to dry.
Flush water/cleaner through the valve block down to the absorber pan and clean inside the cylinder with a brush. Flush out the absorber pan
Leave the cylinder open and allow to drain and dry

*** Performing a leak test**

At the point in the start up procedure where the screen shows the following text:

PUSH ANY KNOB FOR SYSTEM LEAK TEST, push and hold in any one of the 4 control knobs.

The system then enters a procedure to allow leak testing of the machine.

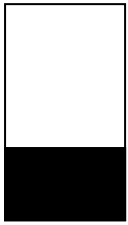
Fit a stopper to the Y-piece and introduce gas into the cylinder by turning on the oxygen flow. The piston is now held steady and so the pressure will rise as indicated by the manometer gauge. To test the system at 20cm H₂O pressure, turn off the gas flow when the pressure on the manometer reaches 20. To test at 30 cm H₂O turn off the gas flow when the gauge reaches 30 cm H₂O. If there is a leak in the system then the needle on the manometer will start to fall. Slowly introduce gas again using the oxygen flow until the needle stops falling. At the point where the incoming FGF matches the leak then the pressure will be held constant and the FGF indicates the leak from the system at that pressure.



4. Normal Operation of the machine

The Auxiliary screen

Starting from the top left hand side of the screen, the features of the screen will be described

B1: 13.3V - (CHG+)		MAINS		RELEASE: 6012	
B2: 13.1V - OK				(210s) Vacuum:- 25	
* OXYGEN SUPPLY PRESSURE LOW*					
		4.8L		MV (LPM) 100	
		BV:10.0		IF (LPM) 300	
		MWPL: 35		IE RATIO 1:2.0	
		ASST: 60		ET (S) 8.0	
		CPAP: 0			
(3.2)	(12)	(1.9)	(23)		
TV	RR	IT	MWPL		
20.0	5.0	4.0	35		

Battery Voltages

There are 2 battery voltages; B1 and B2. The text next to each battery shows the voltage and state of the battery. CHG+ indicates that the battery is being charged. OK means the battery is fully charged.

At the centre of the screen at the top is either the word **MAINS** or **BATT** to indicate the source of the machine's power. In normal use, make sure that the mains is connected and that MAINS is showing.

Version Number

In the top right of the screen is the current working version number of the firmware e.g. 6012.

Vacuum Value

Below the version number is a vacuum value. This indicates the vacuum level in the space between the two rolling diaphragms and is a negative number. The system works continuously to keep this value between -10 and -50 cm H₂O. To the left of this value is another number in parentheses. This is the last vacuum timed interval and represents how long since the last time the vacuum pump was active. This value should typically be greater than 60



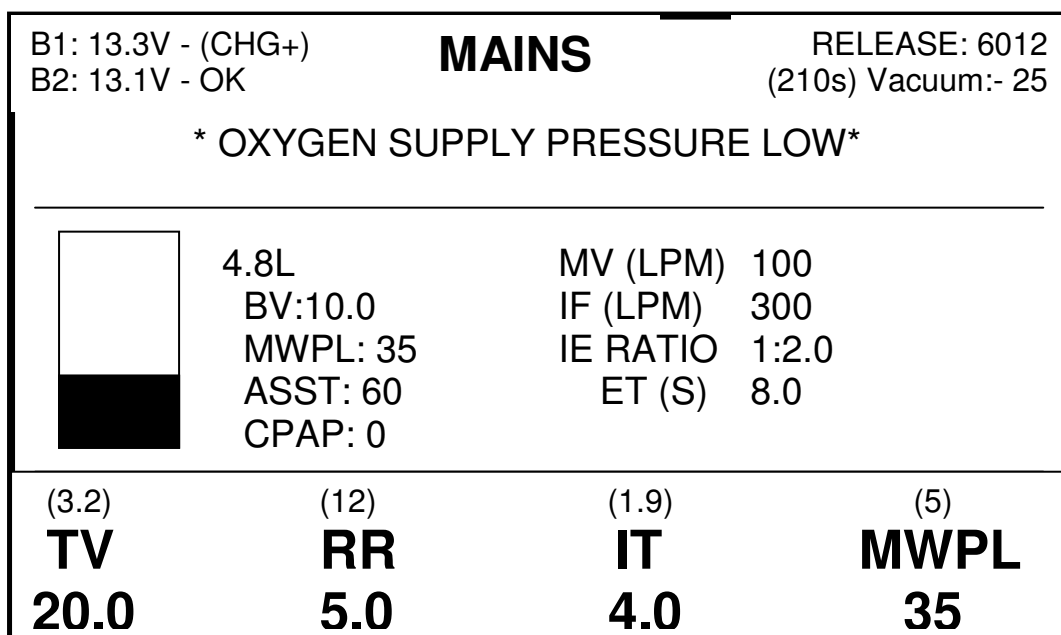
seconds and is usually 100-200. If this value should fall below 30 seconds an Alert will appear on the screen accompanied by a long 2-second beep. The alert has the message "SLOW LEAK IN VACUUM CIRCUIT"

Alarms and Alerts

In the space between the vacuum value and the main screen with all of its values and piston representation is an area reserved for Alarms and Alerts. Alerts are announced by a single 2 second beep and are then silent. The cause of the Alert will be displayed in the space normally occupied by the name JUNIOR or TAFONIUS. Alerts are for information only and just keep you informed of such things as reducing gas volume in the cylinder, an over-full cylinder, a reduction in the vacuum timing interval etc

Alarms are messages accompanied by a repetitive 1 second beep and a flashing message on the screen. Alarms are critical messages that have serious implications for the efficient running of the ventilator. Each Alarm will have an asterisk at the beginning and end of the message and will be flashed on the screen to distinguish it from an Alert. Such Alarms are Oxygen Pressure Loss, Vacuum Loss, Battery too low etc. If these messages persist and cannot be resolved the user should switch to manual ventilation.

The central area of the screen shows a diagrammatic representation of the piston on the left hand side and a series of values to the right of that. The volume in the cylinder under the piston is shown by the shaded region and the actual volume is shown as a value at the top right of the cylinder e.g. 4.8L



BV is the set Buffer Volume. MWPL is the set Maximum Working Pressure Limit. ASST is the set Assist Trigger Value. CPAP is the set CPAP value.



MV, IF, IE RATIO and ET are all dependant values and will change as the independent values (TV,RR and IT) are changed.

In the lower portion of the screen are the independent variables and their associated settings. Above them, for each setting is a value in brackets. The value in the brackets is the measured value. For example, in the diagram above, the patient is breathing spontaneously inspiring a volume of 3.2L, at a respiration rate of 12 breaths per minute, with an IT time of 1.9 seconds and a maximum circuit pressure on expiration of 5 cm H₂O. These figures can be used as an indication of the adequacy of spontaneous ventilation of the patient. They are updated at the end of each breath.

Setting the initial values

Before beginning to fill the cylinder for use, set the Tidal Volume (TV), Inspiratory Time (IT), Respiratory Rate (RR) and Maximum Working Pressure Limit (MWPL). These 4 parameters relate directly to the knobs on the front of the machine. To set a parameter turn the knob until the correct value is reached and then press that knob to commit the value. A beep will be heard and the value set. If a value is not committed then the setting will return to its last saved value.

Tidal Volume should be set for the patient based on 1L/100kg

Inspiratory Time should be set for a nominal value of 2.0 for a 500kg horse

RR should be set between 6 and 15 depending on your requirements

MWPL should be set around 10cm above normal anticipated working PIP. A typical value is 35 cm H₂O

Buffer Volume should be initially set at around 10L

Setting the Buffer Volume

Press and hold the TV (tidal Volume) knob. The machine will beep several times and then the label will change from TV to BV.

Adjust the value to the required setting and then press the knob to commit the value. The BV setting is shown towards the top of the screen to the right of the piston. After 4 seconds the BV label will revert to TV. In general set the BV value at the start of a procedure to

to 2 x Tidal Volume

Now set your vaporiser to the appropriate setting and turn on the Fresh Gas Flow to fill the cylinder. Once the TV+BV point has been reached you will hear the Dump Valve begin to start dumping gas. Turn off the Fresh Gas Flow.

The machine is now primed and ready for connection to a patient. As soon as the animal is connected it can breathe spontaneously



Safety Features

Safety is threatened during use of a mechanical ventilator if circuit pressures are not controlled. There are 2 conditions that require action to protect the patient: a) excessive positive pressure and b) negative pressure

Protection from excessive positive pressure is achieved by the setting of the MWPL control. This control serves to limit the maximum pressure allowed in the patient circuit at any time whether this is during spontaneous ventilation or mechanical ventilation. If at any time the pressure in the patient circuit reaches the value set by the MWPL then the Dump Valve will open to allow release of that pressure. The Dump valve will remain open until the circuit pressure has fallen below the set MWPL value. Please note that setting a CPAP/PEEP value in excess of the MWPL will result in the whole contents of the cylinder being voided through the Dump valve in an effort to control the 'excessive' circuit pressure.

Protection from negative pressure is also very important. If a horse is allowed to breathe in against a closed system, negative pressures can quickly develop in the lung leading to severe damage and pulmonary oedema. Tafonius protects against this by limiting the maximum negative pressure allowed to -8cm H₂O. As soon as this negative limit is reached the Dump Valve will open and air from the Manifold will be drawn back in to provide gas for the patient. This -8cm value is fixed and not controllable by the user.

Both protective measures are easily tested by the user.

Checking the action of the MWPL

Use the following settings:

TV=0.5, IT = 4.0, RR = 10, MWPL = 35

CPAP: OFF

Assist Mode: OFF

Connect the stopper to the Y-piece and press the RUN button. Watch the pressure manometer. The pressure will slowly rise until the pressure reaches 35 cm H₂O at which point the inspiration will terminate, the MWPL Alarm will sound and a warning will appear in the status area of the Auxiliary screen.

Checking the action of the Negative Release

Push the Dump Valve button to take the piston all the way to the bottom of the cylinder. Once at the bottom, breathe in through the Y-piece to create a negative pressure. Watch the pressure manometer. As soon as the pressure value reaches -8 the Dump Valve will open allowing gas into the system.



5. Advanced use of the machine - CPAP/PEEP and Assist modes

CPAP or PEEP??

CPAP is Continuous Positive Airway Pressure and is a term used to describe the maintenance of a constant airway pressure during **spontaneous** breathing. With CPAP the patient can breathe in or out at will, but the airway pressure is maintained as tightly as possible to the CPAP value. This can be seen on the pressure manometer for the patient circuit, but note that the variations seen here will be much larger than those occurring at the Y-piece. The pressure will be held at the CPAP value with slight variations in pressure as the patient breathes in or out. This has the effect of keeping airways open during spontaneous breathing.

PEEP is Positive End Expiratory Pressure and is a measure of the minimum pressure that the system will return to at the end of expiration in an animal receiving IPPV. The pressure manometer will show the rising pressure with each delivered breath and the pressure returning not to zero but to the set PEEP value. This has the effect of preventing airway closure during IPPV

It is easy to set a CPAP or PEEP value using Tafonius. The basis of the bag control is to keep the pressure in the Y-piece at atmospheric pressure. This is done by using atmospheric pressure as the reference. Any deviation away from this reference and the piston moves to correct the error. If the reference is changed to another value then the piston will behave in the same way to keep the pressure in the Y-piece at this new reference value. In this manner Tafonius could be set to achieve any pressure, positive or negative at the Y-piece. In typical use this reference pressure will be either zero or positive.

Setting the CPAP/PEEP value

Push the CPAP button and the MWPL label will change to CPAP. Keeping the CPAP button pressed, adjust the value to the required setting. Push the knob to commit the value. Release the knob. The CPAP setting is shown underneath the BV setting. To cancel CPAP, push the CPAP button and set the CPAP value to zero. Push the knob to commit the change. The legend will change from CPAP to PEEP if ventilation is started.

Assist Mode

An Assist mode allows a patient to make or initiate breaths so that a mechanical ventilator can augment that breath. Typically a ventilator performing this function is said to be set for Synchronised Intermittent Mandatory Ventilation or SIMV.

In Tafonius the trigger for an assisted breath is inspiratory flow. That is, the patient must make a sufficient inspiratory effort to match the trigger flow rate before the ventilator will deliver the set tidal volume. This makes predicting a trigger setting easier than with a negative pressure system. In a negative pressure system the drop in airway pressure will depend on the patient circuit



volume and will therefore vary with circuit set-up. In a flow-triggered system the flow will always be the same irrespective of circuit set-up.

What settings to use?

Inspiratory flow rate is typically around 150 - 200L/min in a spontaneously breathing horse. This will be somewhat subdued by anaesthesia and significantly subdued by moribund conditions such as sepsis and shock. Therefore in estimating the trigger value to set for a given patient take into account its physical fitness as well as its size. A fit healthy 80kg foal may be able to easily make an inspiratory effort of 150L/min, whereas a shocked 500kg horse may struggle to make an inspiratory effort of 60L/min.

What happens if the patient repeatedly fails to trigger a breath?

When Assist mode is selected, the displayed Respiratory Rate changes value to one third of the original setting. For example if the RR was set at 6 Breaths Per Minute then pressing the Assist button will change the RR value to 2. This means that Tafonius will deliver a minimum mandatory respiration rate of one breath every 30 seconds. Should the patient fail to trigger a breath in 30 seconds a full mandatory breath will be given. A beep will be heard if a mandatory breath is given instead of a triggered breath. Timing will begin again from this point. If a patient does trigger a breath, timing begins from the end of the triggered breath. If the RR value is unchanged during Assist mode then when Assist mode is exited the RR value will revert to the original value. However, during Assist mode the user may change the minimum RR value to any value within the normal range. If this is done then the value of RR will not change when Assist mode is exited.

Setting the Assist Mode

In Standby (Spontaneous breathing) mode, push the ASSIST button. The MWPL label changes to SENS (Sensitivity) and the Assist button flashes slowly at about once per second. Adjust the Sensitivity value (using the MWPL knob) to the required setting and then push the knob to commit the value. This sets the system up ready for Assist mode but because the system is in Spontaneous breathing mode, no change is made.

When the RUN/IPPV button is pressed the ASSIST light will change to permanently ON. If the patient inspires at a flow rate greater than or equal to the Assist Trigger setting then Tafonius will deliver a full breath in time with the patient's inspiration.

Press the ASSIST button at any time to turn Assist Mode off.



6. Troubleshooting

For general help on troubleshooting, see the pdf document "Tafonius Troubleshooting guide Ver 2"

Leaks in the Patient Circuit

The most common cause of an error during initialisation is an excessive leak from the Patient Circuit. Follow the instructions for performing a Leak Test to determine the size of the leak. Some leaks can be hard to find. This task can be made much easier by introducing gas to achieve a pressure of 40cm H₂O and keeping the FGF constant while searching for the leak. At this pressure leaks can usually be heard or felt quite easily.

Check the following:

- Absorber Pan Stoppers
- Manual take-off stopper or Manual shut-off valve fully closed
- Correct positioning of the valve block cover
- Sidestream take-off port at Y-piece
- If you suspect the Y-piece circuit, swap it for the Foal Circuit and repeat the test.
- Patient circuit pressure sensor connection at Y-piece
- Full and proper closure of the cylinder - look for small pieces of absorber stuck to the black seals at the bottom of the cylinder and the bottom of the absorber pan
- Correct alignment of the absorber pan in the absorber tray.
- Patient tubing connection at Y-piece and valve block
- Patient tubing along its length for splits - especially near the collars at ends
- The connection of the vacuum sensing line to the vacuum sensor (see below)

Leaks in the Vacuum Circuit

Less common are leaks in the vacuum circuit. This will be apparent either at initialisation where the machine will halt the initialisation process, or during use where an Alert is seen because vacuum timings are less than 30 seconds.

Check the following

- The tubing connections where they enter the cylinder
- The tubing connections where they enter the metal frame at the back of the machine
- Tubing connections to the vacuum pump located near the hinge inside the main hood.



- There is a small non-return valve just before the pump. Check that the connections to this are secure.
- The connection of the vacuum sensing line to the vacuum sensor (see below)

If you need to check the ends of the vacuum and patient circuit sensing lines, open the main hood and inspect the circuit board found on the right-hand side of the machine, looking in from the front.

Check that the vacuum sensing line and Patient airway lines are securely connected on the main PIC motherboard, which lies inside the main cabinet of Tefonius.

