The TAFONIUS
User Guide

T19

(v04Aug2015)

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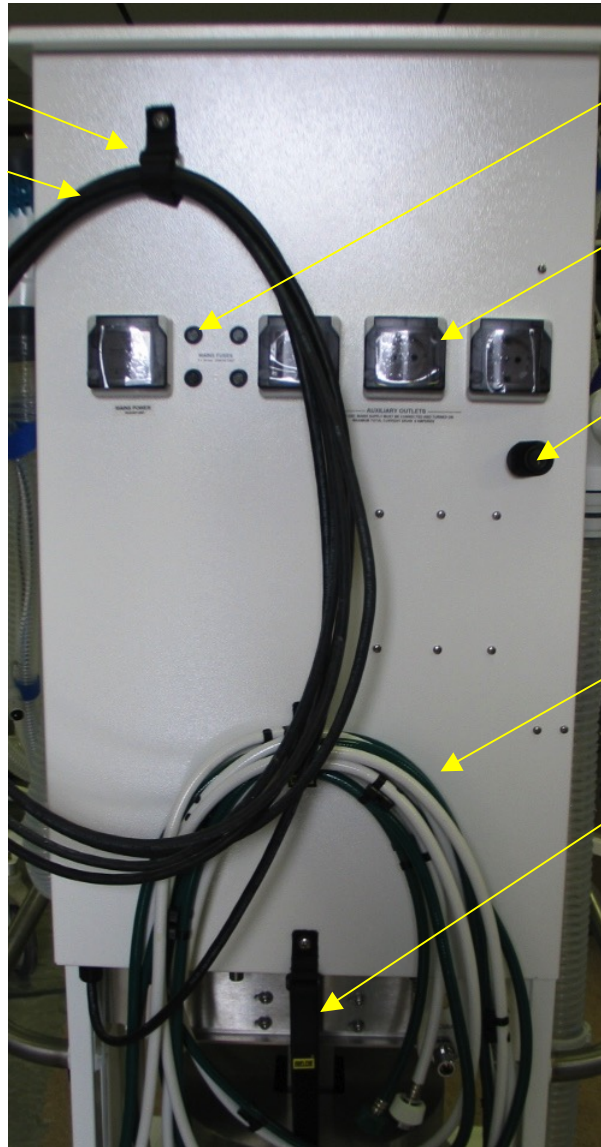
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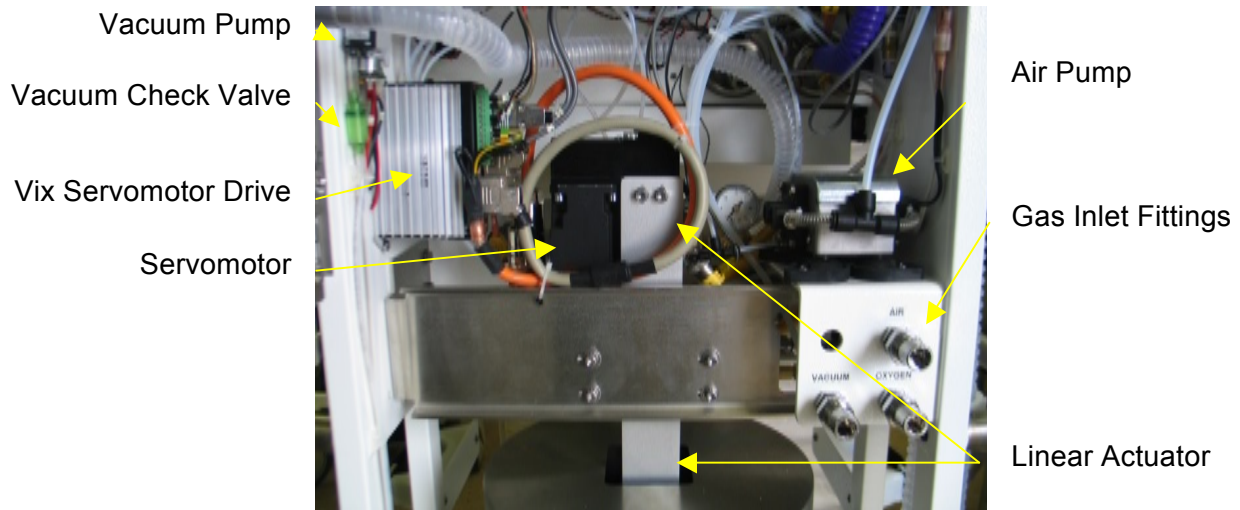
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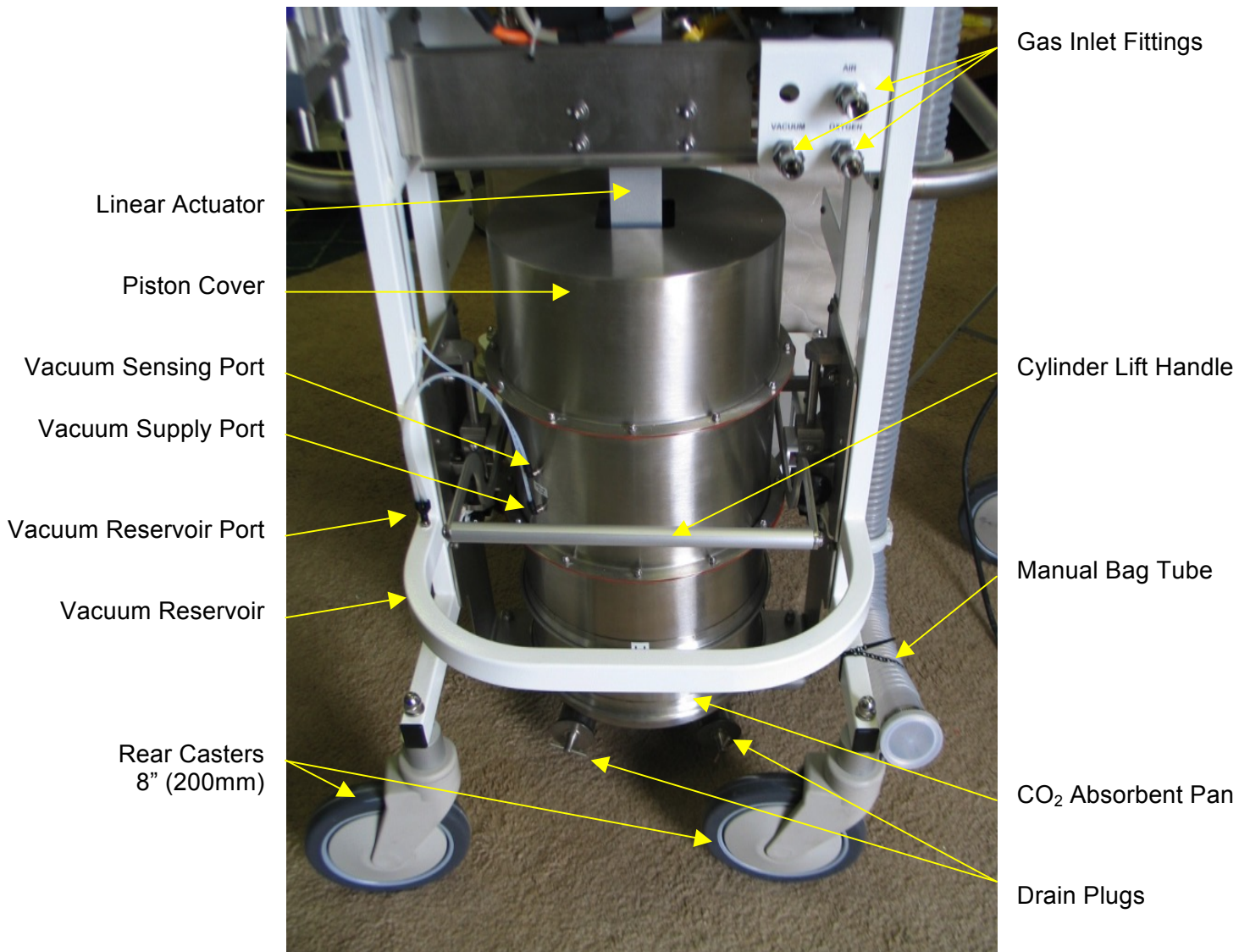
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New Concepts for a new era of LA machines

Elimination of the Anaesthesia Machines Imposed Work-of-Breathing

When a spontaneously breathing animal is connected to any of the last generation of anaesthesia machines and ventilators the animal is obligated to overcome the resistance imposed on them in order to breathe. Resistance imposed by breathing through long tubes, one-way valves, the absorbent and moving the bellows.

Tafonius absorbs this additional WOB. Tafonius actively works to keep the pressure at the patient wye piece zero; to the animal it feels like breathing to ambient albeit through an ET tube.

This ideal performance is accomplished with the Airway Pressure Servo System (APSS) employed by Tafonius. The airway pressure is sensed at the centre of the Y-piece. As soon as a pressure deviation of ±0.5 cmH2O from the ambient pressure is detected the piston is moved so as to negate this pressure change. If the patient breathes out then the piston withdraws upwards, making room for the exhalation. If the patient inspires then the piston moves down, effectively making up for the inhaled air.

Because a motor drives the piston it is the motor that overcomes the resistances of any piping, valving, soda lime and the weight of the bellows. The motor assumes any imposed WOB.

The APSS moves the piston to maintain the set CPAP or PEEP pressure instead of ambient pressure when one is set.

The "Virtual Breathing Bag"

We all understand that with varying sizes of patients it is beneficial to change the size of the breathing bag such that it is large enough but not overly large. This then allows more rapid responses to changes in anaesthetic or oxygen concentrations. Tafonius changes the "bag size" every time you change the tidal volume setting.

The set TV and the use of two fixed buffer volumes, an upper and a lower fixed buffer volume control the size of the "Virtual Bag" in Tafonius. The lower buffer volume is 1.5L and the upper buffer volume is 1.0L. These volumes are constant and are added to the set Tidal Volume to determine the virtual bag size.

The upper volume limit = 1.5L + TV setting + 1.0L.

The lower volume limit = 1.5L

Whenever the piston volume reaches the upper limit, gas is removed from the system. When the piston volume reaches the lower limit, gas is added to the system.

Compliance Compensation

Another problem you work around everyday with older machines is the fact that the animal does not receive the set TV. This is because the volume delivered from the ventilator divides between the animal and the breathing system in a ratio equal to that of their respective compliances. You never know what that ratio actually is and therefore can only estimate the actual ventilation the patient is receiving.

As a part of the initialization process Tafonius measures the compliance of the breathing system in use. That may be with standard breathing tubes, a foal circuit or 30 foot tubes

for MRI. Tafonius then uses this measurement to augment the set TV with the volume that is lost to the compliance of the breathing system. No more guessing the animal now receives the TV you set.

Sessions

ΤΑϜΟΝΙΟⳄ uses the concept of anaesthetic or procedure sessions, one for each patient, for the collection and recording of data. As soon as the ΤΑϜΟΝΙΟⳄ software starts information begins to be stored in the Slow Data file and the session is started. This storage of data continues until a session is finalised at which time another session is immediately started. There is never a time the machine is on that it is not recording data.

Presets

Presets are used to remember how tafonius is setup for any particular type of case or the way any particular doctor likes the machine set up. These presets can they be recalled before starting the next case with a touch to the "Switch to" the selected preset button. The preset remembers initial ventilator settings such as TV, RR, Inspiratory time etc., monitoring traces displayed and their location on the screen along with their sweep rates, sensitivity and filter settings etc, all the individual alarm settings and whether they are enabled or disabled for all monitored parameters ECG, IBP, Agent concentration etc.. Over time you can build a library of presets as shown below in the configuration attribute tab.
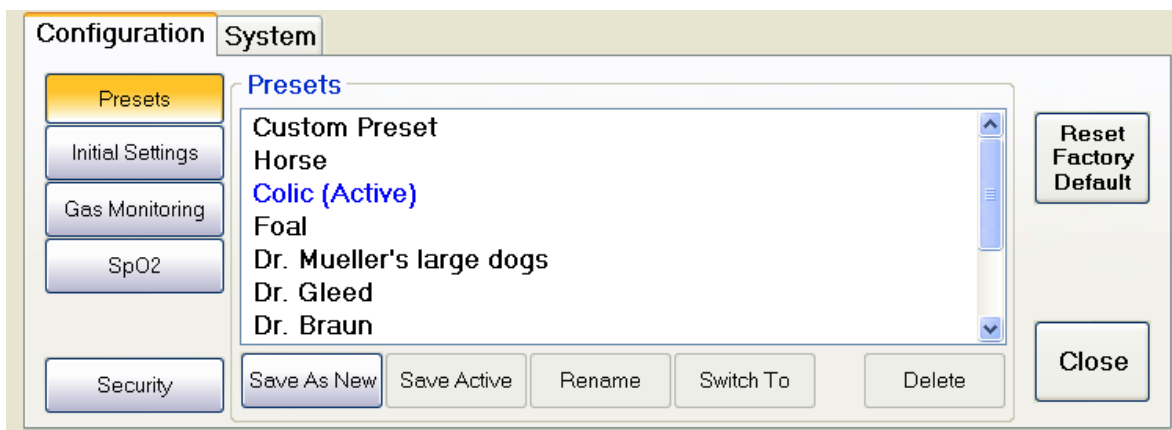
Preparing ΤΑΓΟΝΙΥΣ for use

You will need to:

- [Connect the patient tubing and monitoring lines](#)
- [Fill the soda lime canister and close the piston assembly](#)
- [Connect the piped gas supplies – oxygen, air and nitrous oxide (if fitted)](#)
- [Connecting the Gas scavenging mechanism](#)
- [Connect the mains power supply](#)

Connect the patient tubing and monitoring lines

Connect the two 2" tubing connectors to the valve block on the swivel head and then fit the Y-piece to the other ends. Fit the pressure monitoring line (1) to the luer connector, black luer to black luer, at the end of the short pipe (2) from the top of the Y-piece and fasten securely.
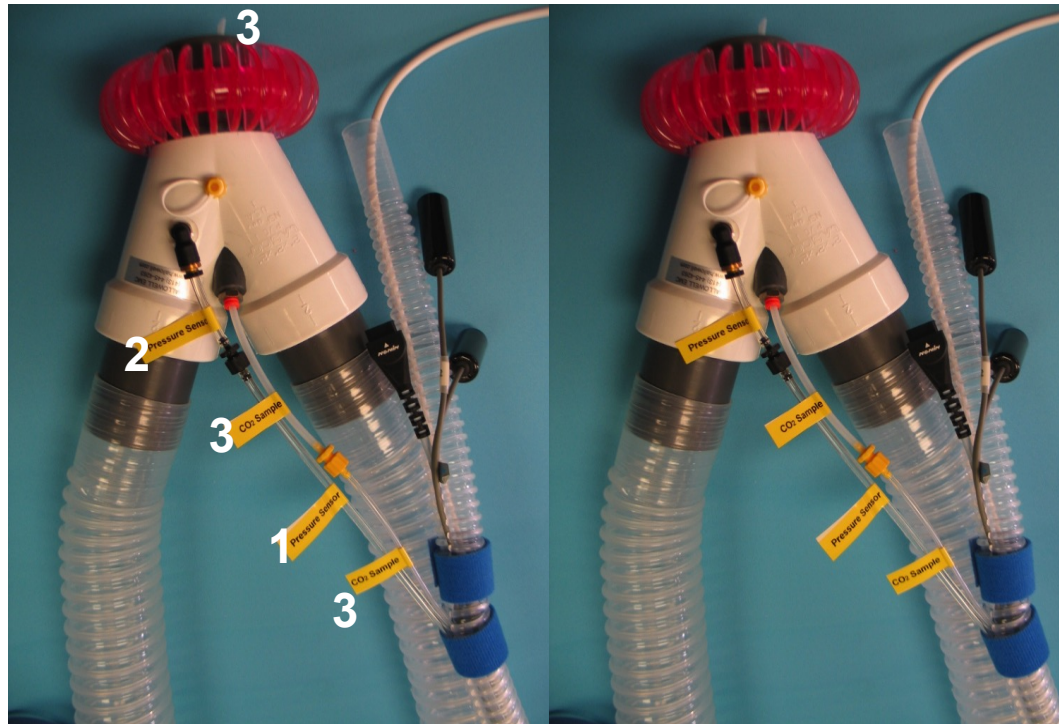
Use the catheter (3) at the back of the Y-piece for sidestream gas sampling. Connect the yellow luer to yellow luer. The catheter can be advanced into the ET tube after intubation. To withdraw the catheter, push in and hold the orange ring around the connector, whilst pulling on the catheter. To prevent gas leaks the catheter must be capped (provided) when not in use.

Fill the Soda Lime tray and close the piston assembly

Open the piston assembly to reveal the soda-lime tray, by pulling each of the large black knobs at the rear of the machine (2) to unlock the piston assembly
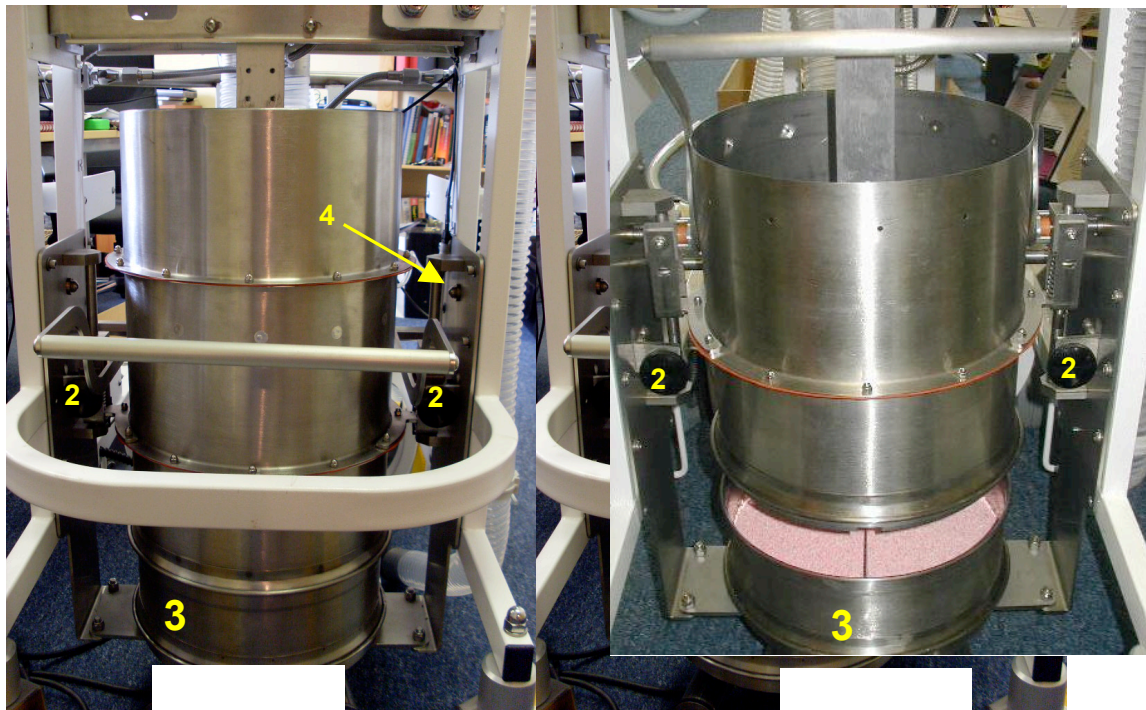
Lift on the cylinder lift handle, be sure the ball nose screws (4) lock it in the up position. In addition It is advisable to secure the handle in the up position with the safety strap (5) now being installed and retrofitted on all machines.

WARNING

Should you neglect this step you chance your fingers looking much like Alex's did a while back… or worse. Sorry Alex!

OUCH !

Lifting the cylinder mechanism revels the CO_2 absorbent in the absorber pan (3).

Remove the absorber pan and fill it to the level of the central divide then replace it. The pan is symmetrical and can be fitted either way round but it is important that the red silicone seal is in alignment with the seal channel on the bottom of the absorber pan (3). Use the alignment arrows as a guide.

With the absorber pan back in position, lower the handle and push down firmly to close and lock, with two definite clicks, and seal the cylinder assembly.

Connect the piped gas supplies – Oxygen, Air and Nitrous Oxide (if fitted)

The piped gases connect to the rear of the machine just below the level of the door on the right hand side. Depending on the country of use these may be NIST or DISS fittings. Screw the pipelines securely to the appropriate connector and then attach the other end into the wall supply. Make sure the manual flow meters are turned off at this point to avoid gas wastage.

Standard Gas Line Colour Codes:

	UK/Europe (ISO)	USA (CGA)
Oxygen	White	Green
Nitrous Oxide	Blue	Blue
Medical Air	Black/White	Yellow
Vacuum/Suction	Yellow	White

Connecting the Gas scavenging mechanism

Waste gas from ⊤⅄ℲON I U⌠ exits through a single evacuation or dump valve (7) that is fixed to the vacuum/scavenging manifold (8) on the inside of the back door.

Gas scavenging can be accomplished by using a properly vented surgical suction or anaesthesia evacuation line, a blower-in-a-box type scavenging system or a passive system.

With a piped suction or evacuation line
Connect the hose to the piped outlet at the back of ⊤⅄ℲON I U⌠ (6). Place a charcoal canister (5) on the smaller, 15mm, port and a 5-liter reservoir bag (4) on the 22mm port. The scavenging flow meter on the front of the machine is used to set the rate of gas withdrawal. When Dump valve (7) is closed no gas can leave the system and the scavenging flow will be made up of room air flowing up
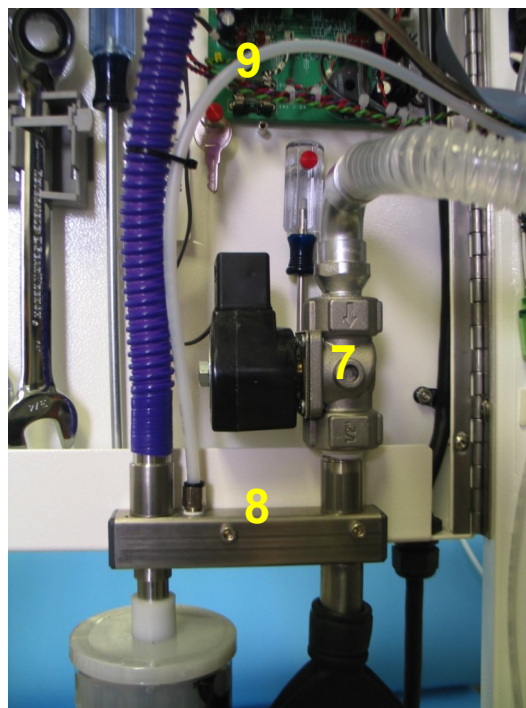
through the charcoal canister, out of the manifold via scavenging tube (9) through the scavenging flowmeter on the front panel and out the vacuum port (6).

Whenever gas is removed from the system by opening the dump valve the evacuation line preferentially takes this gas away due to the pressure drop that is generated across the charcoal filter when room air is drawn through it. Should the scavenging flow rate be insufficient for peak flow rates and the volume of the reservoir bag the excess gas will pass out to ambient via the charcoal canister and be inactivated

When using a blower-in-a-box or passive type system
Remove the charcoal canister and connect a 19mm scavenging pipe to the 19mm shoulder on the same connector. If your scavenging pipe is 22mm use PN 154A5365 to adapt the 15mm portion of that port to 22mm. Blower-in-a-box scavenging systems have their own interface to allow ambient air to enter the system when the reservoir bag is empty.

The scavenging flow meter plays no part and should be left fully closed (turned fully clockwise). When the Dump valve opens waste gas enters the reservoir bag. In the case of a blower-in-a-box type scavenger the -1 cmH$_2$O vacuum draws the bag flat eventually. In the case of a passive system the gas vents as fast as the resistance of the tubing permits.
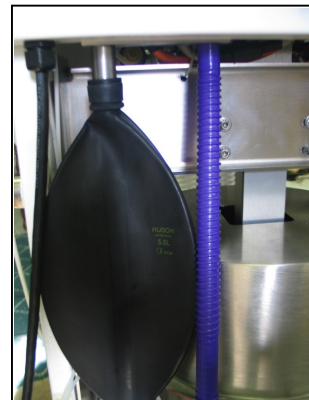
Connect the Mains Power

Connecting the Mains in European Countries
Connect the long mains power cord to the mains supply at the wall (switch this supply on if in the UK). Verify that the small grey switch (9) on the at the back of the machine is pushed in at the top and that the green LED (10) is lit. This will supply power to charge the batteries and run ᴛᴀꜰᴏɴɪᴜꜱ at the same time. Fuses F1-4 are the supply fuses for the two battery chargers. Both Live and Neutral are fused with 5A T, Time-delay/anti-surge fuses.
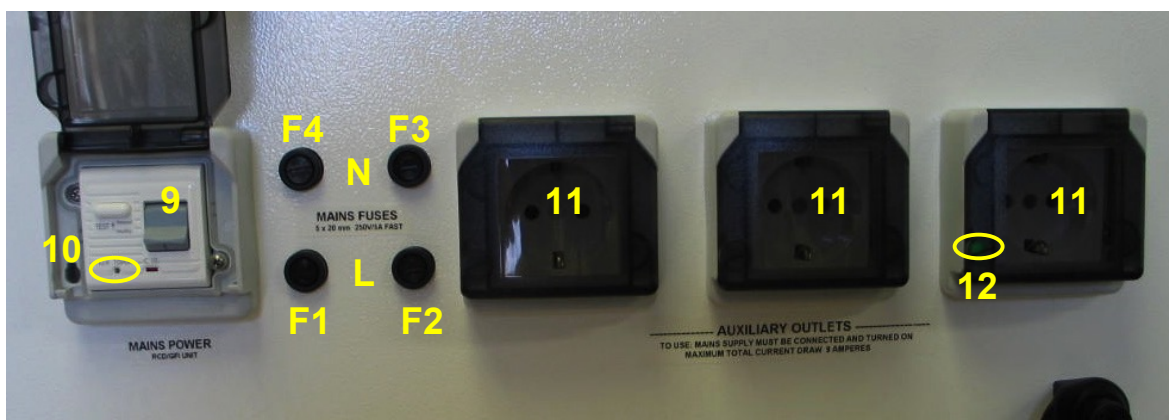
The power outlets (11) can be used for auxiliary mains equipment. Power is only available from these outlets when the mains supply is connected and the RCD switch (9) is ON. Pilot light (12) indicates when these outlets are live.

Connecting the Mains in the Americas (except Canada)
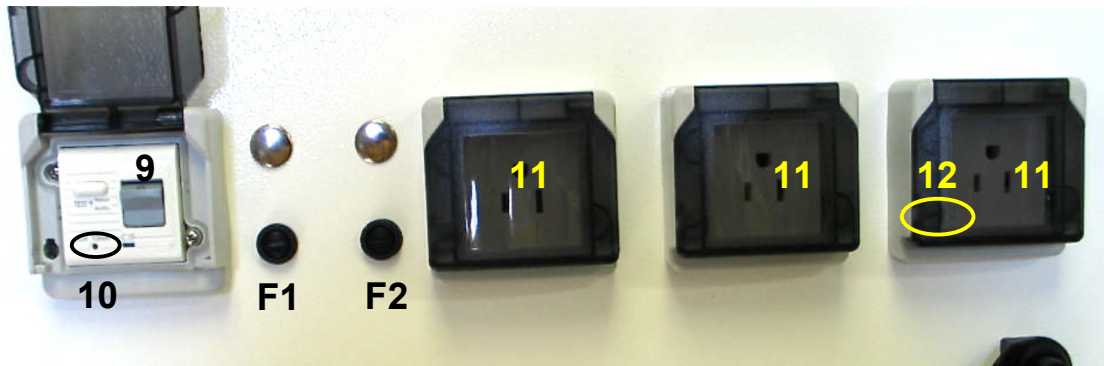
Connecting the Mains in Canada

Connect the long mains power cord to the mains supply at the wall. The "TEST" button of the GFCI outlet is used as an on/off switch to disconnect the mains from everything in the machine before servicing. Normally ᴛᴀꜰᴏɴɪᴜꜱ is left plugged in and this GFCI outlet is in the "RESET" state so the batteries

can remain charged. Verify that the "RESET" button is pressed in and flush with the surface of the GFCI unit. The LED (13) is not a pilot light. It will light only if the GFCI unit needs to be replaced. Fuses F1 and F2 are the supply fuses for the ᴛᴀꜰᴏɴɪᴜꜱ machine. They will supply power to charge the batteries and run ᴛᴀꜰᴏɴɪᴜꜱ at the same time. The power outlets (11), fused with F3 and can be used for auxiliary mains equipment. Power is only available from these outlets when the mains supply is connected and the GFCI switch (9) is "RESET". Pilot light (12) indicates when these outlets are live.

Reserve Battery Power

ᴛᴀꜰᴏɴɪᴜꜱ can run on a set of fully charged batteries for approximately 6-8 hours depending on ventilation frequency and monitoring demands. It is intended that ᴛᴀꜰᴏɴɪᴜꜱ would normally run whilst connected to the mains supply, so that battery usage is reserved for power loss situations or in situations where mains power is not available. The switch over from mains power to battery power is seamless as ᴛᴀꜰᴏɴɪᴜꜱ is connected to the batteries all the time whether the mains supply is connected, charging them and supplying operation power or not.

The ΤΑϜΟΝΙΥƧ Shell

The ΤΑϜΟΝΙΥƧ Shell is the starting point for using the Tafonius software and also the starting point for various related utilities. It appears automatically when ΤΑϜΟΝΙΥƧ is powered on. The use of each button is explained below.

ΤΑϜΟΝΙΥƧ button

This launches the ΤΑϜΟΝΙΥƧ ventilation and monitoring software, more on this in the section on "Start-up and Initialization of ΤΑϜΟΝΙΥƧ".

A Word About Data Storage Locations

Where the data is stored will depend on whether any patient information has been entered. If no patient data has been entered then the data is stored in a folder that is named using the word "Patients", the calendar month and the day.

Several patients or sessions may be held in this folder if no patient information is entered during any of the day's operations. e.g. An operation on September 12th 2008 where no patient information was entered will be stored in a folder called "Patients2008Sep12"

If patient data has been entered then the folder name will be derived from the Patient's name and the patients ID. e.g. Wild Billy , ID 1786394 will have a session folder created called WildBilly_1786394. If there is more than one session recorded for Wild Billy on that day then all sessions will be stored in this folder.

View Data button

This button opens the Record Picker for selecting a patient. All data records are shown in date and time-of-day order with the most recent data at the top of the list. Choose the
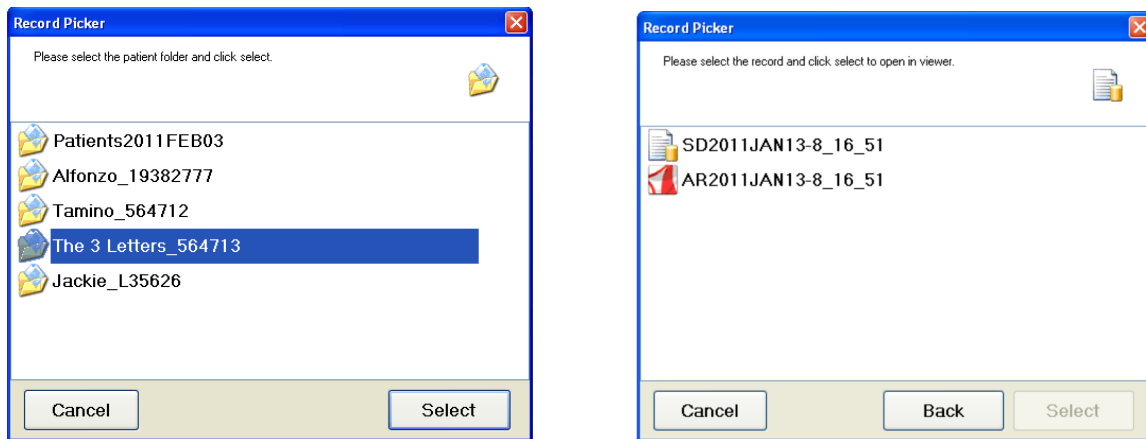
patient's folder by clicking or touching on the name then the Select button. Each patient will have a Slow Data file (SD file) and an Anaesthetic Record file (AR file).

To view the Slow Data information
Select the appropriate patient then touch or click the Select button. The Slow Data is viewed in a spreadsheet format and can be used to show monitoring trends. By touching any of the measured parameter columns (e.g. ECG heart rate, Pulse-Ox saturation) a trend view of the data over the course of the procedure is shown at the bottom of the screen.

For greater versatility, export the data to a USB stick and view the data in the commercial spreadsheet of your choice. All Slow Data files are saved as CSV or comma separated value files.

To view the Anaesthetic Record chart
Highlight the desired AR file and then touch or click Select. A new window opens to show the Anaesthetic Record pdf file.

For printing and archiving of either the Slow Data or the Anaesthetic Record use the Export Data button from the Tafonius Shell to save the data to a USB flash drive and then open the files in your host computer.

Export Data button

This button opens a dialog box allowing you to choose the data to export. All data in the browser is listed in date and time-of-day order with the most recent files at the top of the browser.

First select the patient that you wish to export data for and then click or touch the Next button. Choose your destination drive (usually a USB flash drive named D:\) and touch or click the Export button. The Slow Data and the Anaesthetic Record data will be copied to your chosen destination.
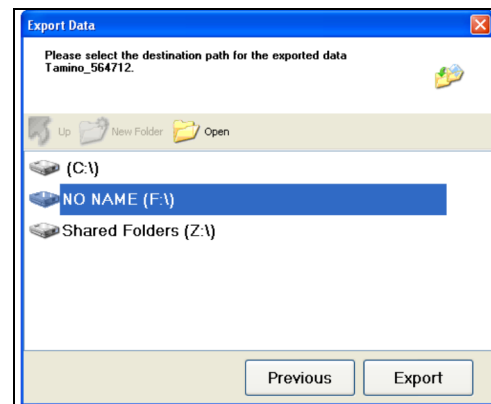
Options button

This opens a small window with 4 facilities.
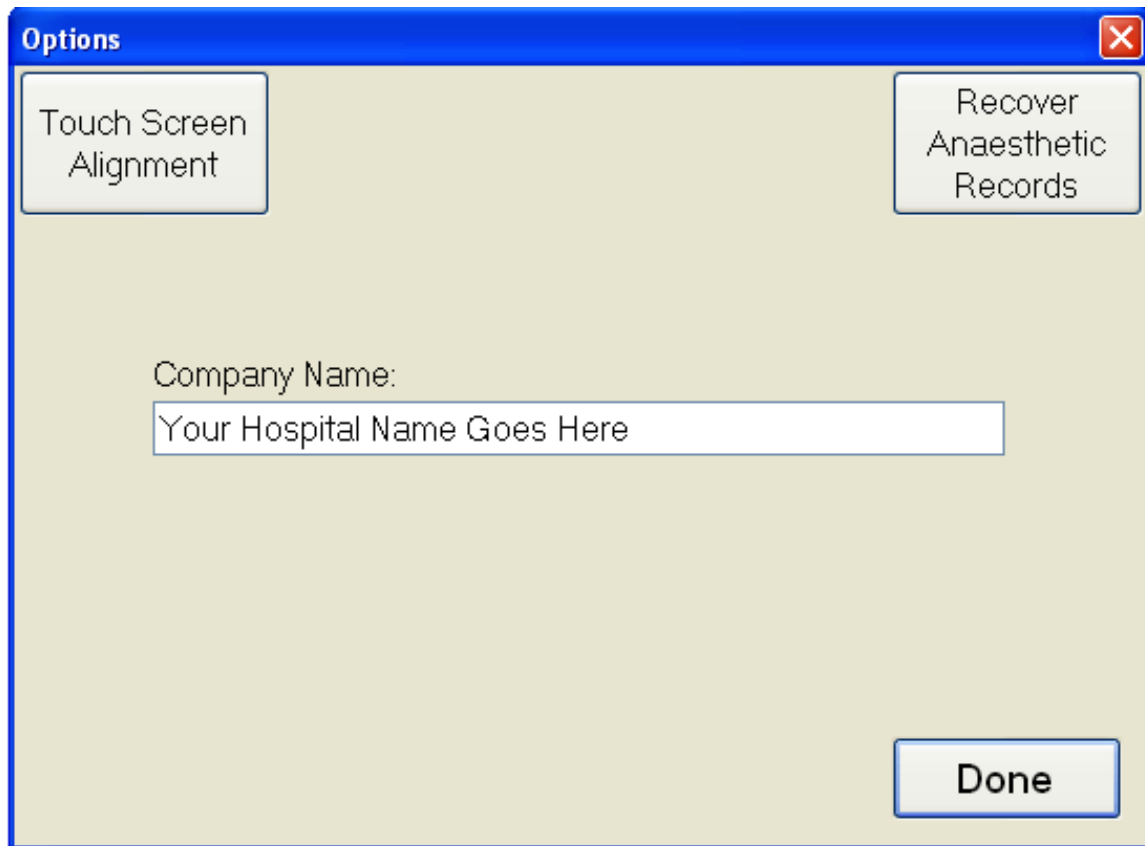
Touch Screen Alignment
Touching or clicking this button starts a utility to align the touch screen to your computers screen. Simply touch the red circles in the way you would normally use the touch screen and follow the prompts to reset the alignment. If you make a mistake simply wait and the utility will time out and be cancelled. You can then try again.

Recover Anaesthetic Records
Touching or clicking this button will create a new Anaesthetic Record chart if the original has been destroyed or corrupted for some reason.

Company Name
Enter your practice or company name here. This will appear on the Tafonius shell as well as at the top of the Anaesthetic Record chart.

Shutdown button

This is the last button on the shell screen. It will shut down the PC only. The PC can be started again by either turning on the Tafonius ventilator or, if the ventilator is already on, by pressing the large ON/OFF button on the side of the PC

Preparing TAFONIUS for a Case

For systems without the touchcomputer and monitoring systems see the document "DOCA4956 Auxiliary Mode Operating Manual".

Otherwise you will need to:

- Start the Tafonius machine
- Launch the Tafonius Software
- Initialise to obtain the piston zero position
- Run the Leak and Compliance test
- Pre-fill the system
- Set Initial Ventilation values or Choose a Preset
- Start the Anesthesia Record
- Connect the Patient

Start the TAFONIUS machine

TAFONIUS is started by pressing the large green square button on the right of the machine at the front, known as the Soft Mains ON/OFF Switch. This button will immediately light up along with the small auxiliary QVGA screen, the blue light on the ELO Touchcomputer and the green lights of the installed options of the monitoring chassis under the top shelf.
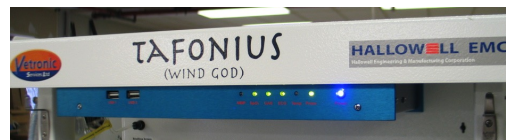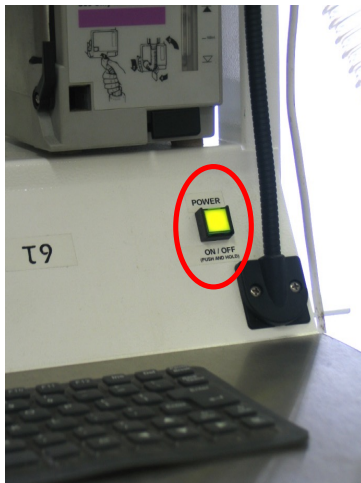
The initialization procedure consists of:

1. Initialising the power supplies

2. Initialising the servo motor controller

3. Establishing and testing communication with different parts of the system

4. Testing the motor controller and power supplies

5. Establishing the zero reference for piston position

All 5 of these procedures must execute and pass the initialization tests before TAFONIUS can be used. The first 4 are the power-on-self-test and are executed automatically by the auxiliary system after which the system pauses and waits for operator insurance that the patient is disconnected before continuing to find the zero piston position.

The auxiliary screen shows each stage of the initialization procedure that is accompanied by audible beeps at each stage of the initialization. When the auxiliary system has completed the power-on-self-test its behaviour depends on the presence of an active PC and whether the PC is running the ΤΑΦΟΝΙΥΣ software.

For systems without a PC, the auxiliary system will finish the system initialization and then wait with the yellow IPPV switch flashing waiting to complete the piston zero referencing procedure. Once the piston initialization procedure is complete the Auxiliary unit will proceed directly to the control screen, announced by 3 short consecutive beeps. The auxiliary system is then ready to use (see the document "DOCA4956 Auxiliary Mode Operating Manual".

For systems with a PC, the auxiliary system screen will show the title ΤΑΦΟΝΙΥΣ and then wait 2 minutes for the Tafonius software to connect and take over. If at the end of the two minutes a PC does not establish connection (or if the user pushes the Run/IPPV switch button) then the auxiliary system will resume control and proceed to piston initialization.

Normally a PC is detected and the Auxiliary system waits. The PC will boot up straight into the Tafonius Shell screen. This screen has a large button labelled Tafonius.

Launching the ΤΑΦΟΝΙΥΣ Software

Once the Tafonius Shell appears touch or click on the Tafonius button to launch the Tafonius program.

The Tafonius software will start up and you will see the following screen:
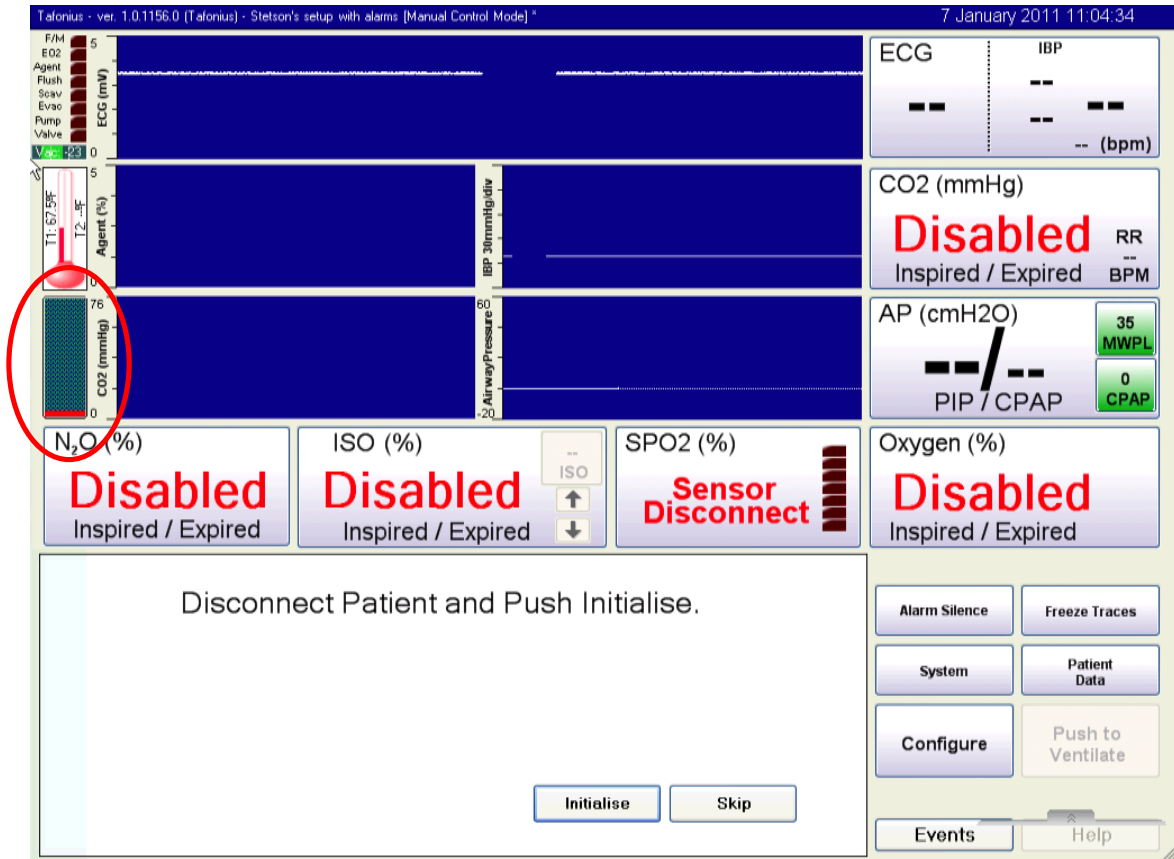
Initialise to obtain the piston zero position

The ᴛᴀꜰᴏɴɪᴜꜱ software has now establish a link with the auxiliary controller. Note the crosshatching that fills the piston graphic. This is an indication that the piston's zero position has not been established yet. It is possible to skip the initialisation procedure here but the ventilator cannot be used until the piston position has been initialised. Touch "Initialise" and the text in the dialog box changes to "Moving Piston to Bottom. Please wait…" while the piston is descending. When it reaches the bottom of it's travel, the zero position, the piston graphic turns green and has a value of 0.00 in it. This indicates the piston has 0.00 liters of gas under it. The piston now rests at the bottom of its travel waiting for you to occlude the patient wye and continue with the leak and compliance tests.

Run the Leak and Compliance test

The system can now be tested for leaks and a measure of its compliance can be taken. To do this fit a stopper to the end of the Y-piece and then press the Leak & Compliance button. The piston moves to the middle of its travel and performs a leak test at 20cm H2O pressure. On completion of this Leak test the value is displayed.

If the value is less than 1500 ml/min the system proceeds immediately to the two compliance test positions and finishes the test. You can watch the process on the airway pressure trace if it is on the screen.

If the leak is in excess of 1500 ml/min (too much leak to do the compliance test) or there are errors during the compliance testing then the procedure will stop and you will be presented with the choice of repeating the tests or aborting the Leak & Compliance testing. If a compliance test is aborted then the last measured compliance values are used to calculate compliance compensation during IPPV. If the system leak and compliance has already been tested you have the option of touching "Skip" to go straight into the program.

Leak and Compliance test complete.

Leak is 252mls/min at 20 cmH2O
System Compliance with 19.2litres under the piston is 33.0mls/cmH2O
System Compliance with 4.6litres under the piston is 26.3mls/cmH2O

Retry   Finish

In either case at the end of the tests you will be given the option of accepting them or retrying the tests. Assuming you concur that the results are acceptable the main TAFONIUS program is now ready for use and data recording has begun.

Pre-filling the system

After TAFONIUS has been initialised the piston is left at the bottom of the cylinder ready for filling. Set the TV as described below. Make sure the Y-piece is capped, turn the vaporizer to the required induction concentration and turn on the manual oxygen flow meter to fill the cylinder with gas. The piston graphic on the left of the screen indicates the volume of gas in litres that is under the piston in the breathing system.
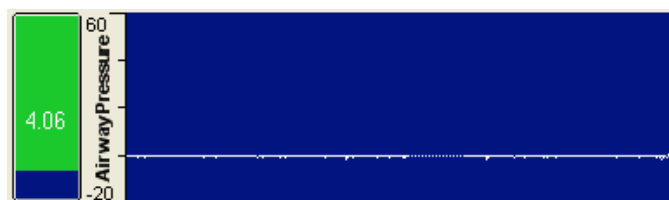
You will see the level increase to 2.5 litres above your TV setting, that is the size of the virtual bag. When this level is reached you will here the Dump Valve open to vent any excess gas to the scavenging system. Turn off the oxygen flow.

The concept of the Virtual Bag is central to how TAFONIUS operates. This action of the ventilator maintains a minimum system volume thereby reducing anaesthetic and oxygen consumption as well as decreasing the system's time constant.

Set Initial Ventilation Values or Choose a Preset

By default the initial settings use by ᴛᴀꜰᴏɴɪᴜꜱ after it powers up are the those on the "Configuration>Initial Settings" page of the last preset used. Those stored values will display on the screen after the leak and compliance tests have completed. At this point they may be changed manually as described below or a different preset may be selected.

Start the Anaesthesia Record

Presumably you will be turning on ᴛᴀꜰᴏɴɪᴜꜱ some time in advance of the patients' arrival. As discussed ᴛᴀꜰᴏɴɪᴜꜱ is always recording data thus there could be a large amount of useless unwanted data at the beginning of the SD file. All this data is retained in the SD file but a mark is put in the file as to where in time you select to begin the anaesthesia record. To mark this point in time touch "Patient Data>Logging>Anaesthesia Record Start".

Connect the Patient

ᴛᴀꜰᴏɴɪᴜꜱ is in standby, spontaneous breathing mode. Connect the patient to the wye piece, the APSS immediately begins tracking the respirations of the patient and actively working to keep the airway pressure zero at the wye piece. As the patient breaths the machine acts as a respiratory monitor and displays the results in blue numbers on the ventilator control section of the touch computer.

Data Finalization and Shutdown

After the case the session must be finalized to close the data files and thereby start the next session.

A session may be finalised by one of the following:

- Clicking/touching the Finalise Recording button on the Patient Data>Logging tab
- Exiting the program through the System and then Exit button
- Exiting the program by pressing and holding the Mains Control button
- An abrupt program closure such as power loss, closure of Windows without closing Tafonius (non-controlled shutdown)

In all but the last two scenario data will be saved **and** associated with all the patient information. Using any of the first two Finalising methods listed above will cause the following dialog to appear.

This dialog presents the current information associated with the recording session. If these are all correct then click or touch the Accept button. To edit any feature shown, click or touch the Change button. This will take you to back to the Patient Data edit region, where any of the details can be changed.

In the event of a non-controlled shutdown there will be NO DATA LOSS, although the patient information will not be associated with the data. In this instance the files associated with the session will be saved with the word "Patients" as a prefix and the Slow Data and Anaesthetic Record will use only the date as identifiers.

For example, a session interrupted by a non-controlled shutdown on January 7th 2009 will have a record named "Patients2009JAN07" with Slow Data and Anaesthetic Records named SD2009JAN7-8_50_56 and AR2009JAN7-8_50_56 respectively. The suffix 8_50_56 indicates that the session began at 08:50:56 on the morning of January 7th.

If all of the details are correct, then clicking or touching the Accept button will cause the following to happen automatically:

- The Session is ended.
- The patient details are used to create the appropriately named Slow Data and Anaesthetic Record files.
- A new Session is started using, either the next set of patient information in the Case list, or the default Patient/Anonymous details.
- Recording for the new Session is started

For more information on entering patient and case information, see the section entitled Patient Data button later in this manual

For more information on the production of an Anaesthetic Record see the section entitled "Creating An Anaesthetic Record Chart" later in this manual.

Control buttons: Controlling the Software

Navigating the Tafonius screen

The Tafonius screen is a touch screen allowing direct access to monitoring and ventilation setup at a single touch. The following picture shows a typical set up of Tafonius.
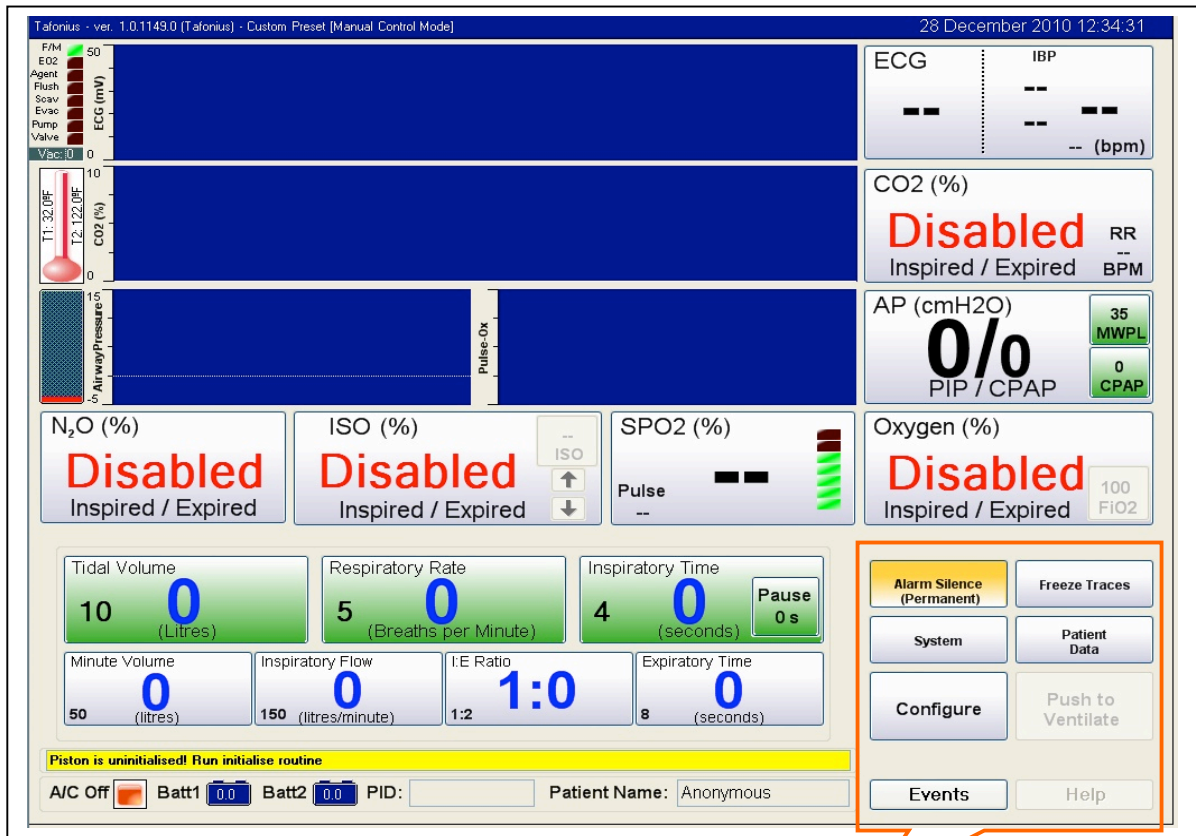

In the lower right corner there are 8 general navigation and control buttons.

Alarm Silence button

Press the button once for a 60-second silence of all alarms. The time in parenthesis indicates the amount of time left before the audio is reactivated.

Press and hold the Alarm Silence button until it shows the legend "Locked". The audio portion of all current alarms is then suppressed. Any new alarm condition will override the locked out condition and again sound the alarm. Touch the button again to release the lock.

Press and hold the Alarm Silence button for longer, the legend changes from "Locked" to "Permanent". No audio will be heard until the operator touches the Alarm Silence button a second time. This is useful at the end of a case when you have disconnected everything and all the alarms are sounding.
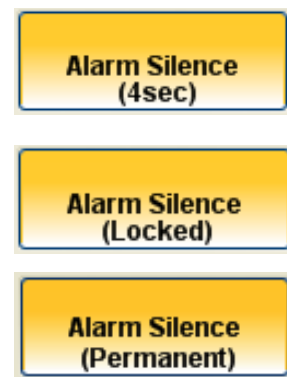
Freeze Traces button

Use this button to freeze all trace information on the screen. All other monitoring and data recording activities continue as normal. The button will change colour to indicate that it is active.

A countdown timer is displayed on the button. At the end of the countdown period the freeze option will be lifted. Alternatively clicking or touching the Freeze button once more will release the freeze option.

The countdown time for Freeze Traces is determined by the Countdown value set in the Initial settings attribute panel.

There are three other buttons that control the look, feel and behaviour of the ΤΑϜΟΝΙΥς software. These three buttons are:

- Patient Data
- System,
- Configure.

Each opens a dialog box with multiple tabs.
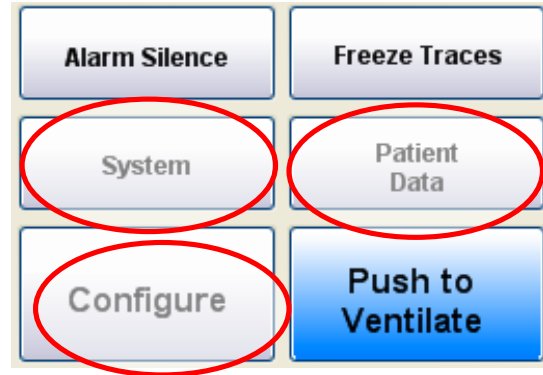
Patient Data button

Touching the Patient Data button opens a dialog box with a number of tabs. Initially the dialog opens to the Patient tab. Later it will open to the tab last opened. Therefore, if you had been viewing trend data one touch of the Patient Data tab will bring you back to that trend display.

Patient Tab

Enter the Hospital Number (if used) then use the tab key to move through the data entry fields. Fields that take numerical data entry will bring up the small on-screen numerical key-pad use this or the flexible keyboard. By default the patient's name is "Anonymous". Edit this to enter your own patient's name. This data will be used when the data is stored and when anaesthesia record is created and the data is finalized.

Cases Tab:

As details are entered on the patient tab a case is created and listed on the Cases Tab. Touch the tab to view the case just entered. This feature is useful for allowing you to pre-entered information about other cases, then select the cases in the order that they go.

By default, when the software is started details appear for a patient called Anonymous with a patient ID of 000000.

The green arrow next to the patient name shows that these patient details are in use. Patient details cannot be deleted if they are in use: you must first select another patient.

Touching or clicking the New button opens the Patient Details tab ready for new patient information. To change patients, click or touch the patient name or ID and then click or touch the Select button.

The selected patient information is then used for the current recording session. When the monitoring/recording session is finalised, the Patient details in use at that time will be the ones used to create the recording files. During the Finalising procedure a dialog box will appear to check that the Patient details to be saved are correct.

Case information entered but not used will be retained next time the machine is powered on. Therefore if you don't get to a case one day the patient information will be there the next day.

The patient name and ID is always shown at the bottom of the Tafonius screen. Click or touch either of these two screen areas to open the Patient attribute dialog.

Notes Tab

Any notes that you want to enter relating to the case can be entered as free text in the Notes tab. These notes will appear in the Anaesthetic Record chart in the area under the Header of general information.

At Presentation Tab: Entering initial patient information

On this tab you can fill in the procedure details along with the rest of the presenting clinical information. Entries can be left blank. The Anaesthetist, Surgeon and Procedure fields are used when an Anaesthetic Record chart is produced. The Anaesthetist, Surgeon and Procedure entries are all taken from a Drop-Down list.

To view the list click or touch the down arrow in the blue box next to the field you wish to enter details for. If the item you require appears on the list click or touch it to select it. This provides a quick way to enter commonly used information. If the item does not appear on the list it must be added. Touch or click on the ellipse button, [...] this opens an editor.

Here the Anaesthetist Drop-Down list has been opened for editing:

Items in the list may be ordered using the Up & Down buttons. The Add, Edit and Delete buttons allow standard editing of the entries in the list. When editing is complete, click or touch the Close button to return to the "At Presentation" tab.

Logging Tab:

What Data is Recorded in the Slow Data File
The Slow Data file is an automatically generated file that records all information gathered during a Session. Data contained in this file includes all the monitoring information in terms of numerical and trend data. This periodic data (Default is every 5 seconds) also contains all events that occur during use. If an alarm condition occurs this is recorded in the Slow Data file. Similarly a change of anaesthetic agent type or the level of the MWPL setting is recorded in the Slow Data file. These are automatic events.

In addition to automatic events, user events can be added to the Slow Data file. User events can be added by clicking or touching the events button at the bottom right hand side of the Tafonius screen.. These events will appear in the Slow Data file as well as being used for the events shown in the Anaesthetic Record chart. For more information on entering manual events see the section entitled "Adding Events During a Procedure" later in this manual.

This raw file is non-editable so that the user can be sure that all events that occurred are recorded. Even the act of editing or deleting an Event is recorded as an Event. For a full description of the data saved in the Slow Data file, see Appendix A, Slow Data Information.

The Slow Data file can be exported to a Flash disk using the Export data function accessed from the Tafonius shell. See the section entitled "Export Data" later in this manual.

Cases	Patient	Notes	At Presentation	Logging	View Trends	

Slow Data Logging: 5   sec

For Anaesthesia Record
Log Heart Rate From

Time
Start: 1:20:34 PM   Elapsed: 00:29:13

- ☉ ECG
- ○ IBP

☐ Record Spontaneous Breaths.
☐ Record Ventilated Breaths.

- ○ Pulse-ox

[Anaesthetic Record Start]   [Finalise Recording]   [Close]

As stated all physiological data and many automatic events are recorded in a file called the Slow Data (SD) file. How often data is entered in this SD file is dictated by the setting in the Data Logging tab. The default value is 5 seconds. A range between 1 second and 360 seconds (6 min) can be entered. Unless you have specific reasons for changing the Slow Data Logging time, leave this set at 5 seconds. Note that this value will have an effect on the final file size. Logging every second will create a substantially larger file than every 5 seconds. Note also the effect of the logging interval as explained below

Effect of the Logging Interval on the Slow Data entries
Whatever the interval period between logging of entries, automatic event entry will always be logged. For example, if the Ventilate button is pressed an automatic event will be generated and added to a temporary list of events. When the next logging episode occurs, all events stored since the previous logging event will be entered into the SD file. This is different from the physiological monitoring data which is simply grabbed at the instant of the periodic logging.

Care should be used when interpreting periodic logged data because events that appear at the same logging event could be separated by up the periodic logging interval.

Some automatic events such as inspiration and expiration can be entered into the SD file. This however can fill the file with information that may not necessarily be required. Spontaneous breaths or ventilated breaths can be selected or deselected for entry in the SD file by checking or un-checking the respective tick-boxes.

The time that a particular recording session began and its duration are also shown in this tab. Note that this is not reset when the anaesthesia record is "started".

Heart rate selection for Anaesthesia Record
TAFONIUS has three means of monitoring heart rate (ECG, IBP & Pulse-Ox) it is necessary to select one to be used for the Anaesthetic Record chart by clicking/touching the desired tick box.

Anaesthetic Record Start button
It is not uncommon to prepare TAFONIUS some time in advance of connecting the patient. During this time there will be continual recording of non-meaningful data. To avoid this data from appearing on the printed record, the start time for the anaesthetic record data can be set using the Anaesthetic Record Start button. Pressing this button will reset the start time for the anaesthetic record data ONLY. Slow data information is not affected. The following dialog will appear:
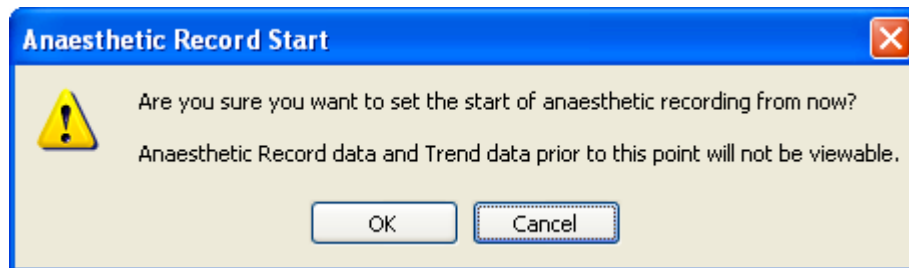
This procedure can be repeated as many times as required, noting that each time, data prior to selecting this option will no longer be available.

After this creation of the Anaesthetic Record chart is automatic and the chart can be viewed from the Tafonius Shell via the View Data button as previously described.

Viewing the Anaesthetic Record chart
The Anaesthetic Record chart can only be viewed from the TAFONIUS Shell, whilst TAFONIUS is **NOT** running. How to view the chart is explained in the first section of this manual on the TAFONIUS Shell.

Finalise Recording button
As soon as the TAFONIUS software starts, data is recorded in the SD file. When a patient session is ended the recording should be finalised. To do this push on the "Finalise Recording" button. A dialog box may appear asking to save the current Preset (see the section on User Presets) and then a further dialog box will appear stating that the data will be committed and that no further changes can be made. Click or touch OK to commit the data and begin a new session. When a session is Finalised, those patient details are removed from the Patient List in the Cases tab.

View Trends Tab

Recorded data can be viewed by two methods: During a recording session in the ventilator control software or after a session in a spreadsheet viewer. The later method has been discussed in the first section on "The ΤΑFΟΝΙUS Shell". To view data on-the-

fly, click or touch on "Patient Data" and then the "View Trends" tab.
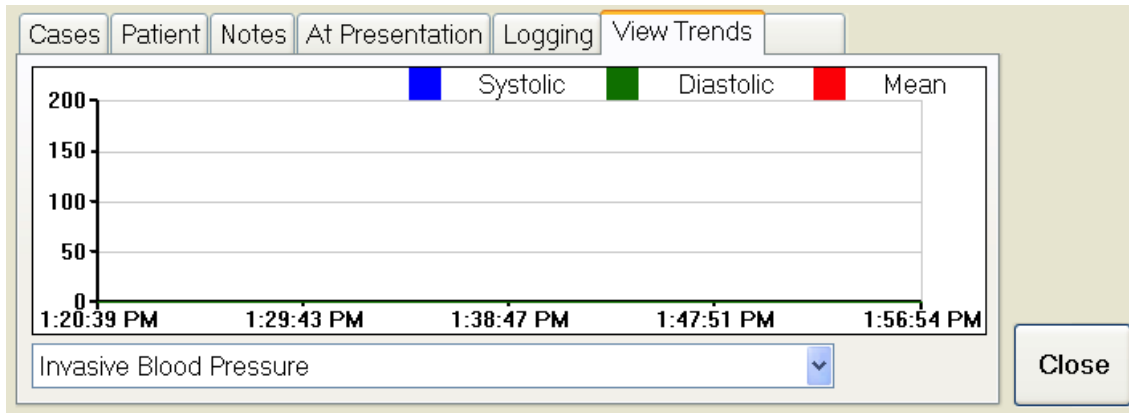
The trend viewer pops up showing the trend of the selected parameter from the beginning of the recording session to the current time. This data is constantly updated at a rate set by the Slow Data logging period.

Use the pop-up list to select the parameter of interest.
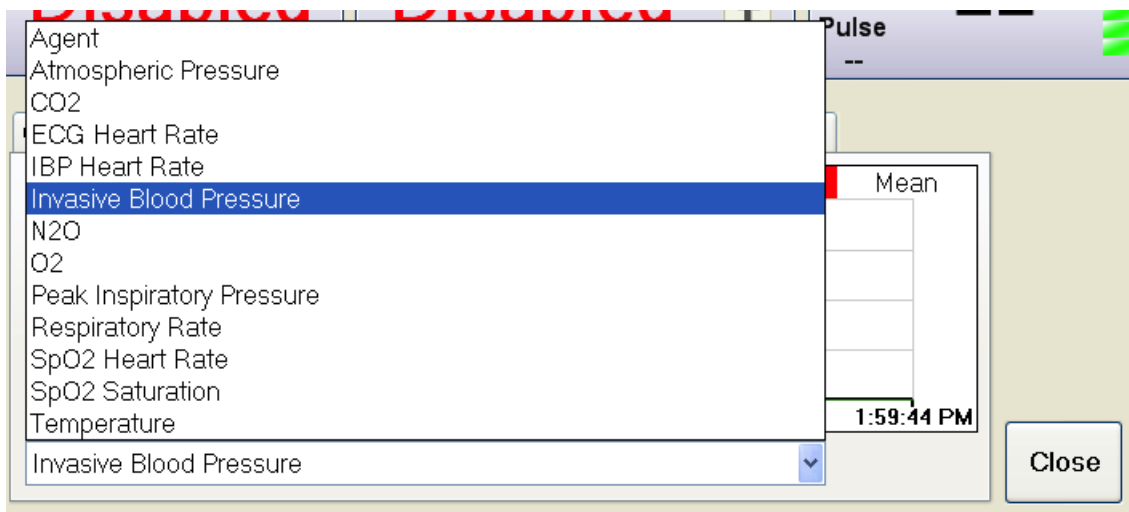
Viewing the instantaneous value using View Trends

Click or touch a point in the graph area of the View Trends tab. A line appears at the point of touch. At the bottom of the line on the x-axis of the graph is the time at which that point of data was recorded. Along the right hand side of the line are the instantaneous value(s) of the associated data.
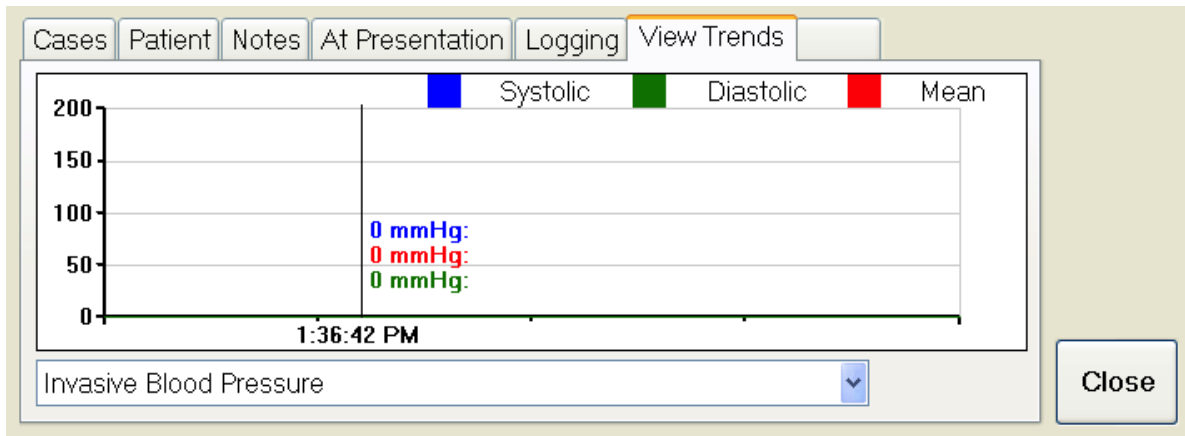
The System button

The System button opens a two-tab screen that contains the Configuration and System tabs. The Configuration tab can also be entered directly from the "Configure" button on the lower right hand side of the screen.
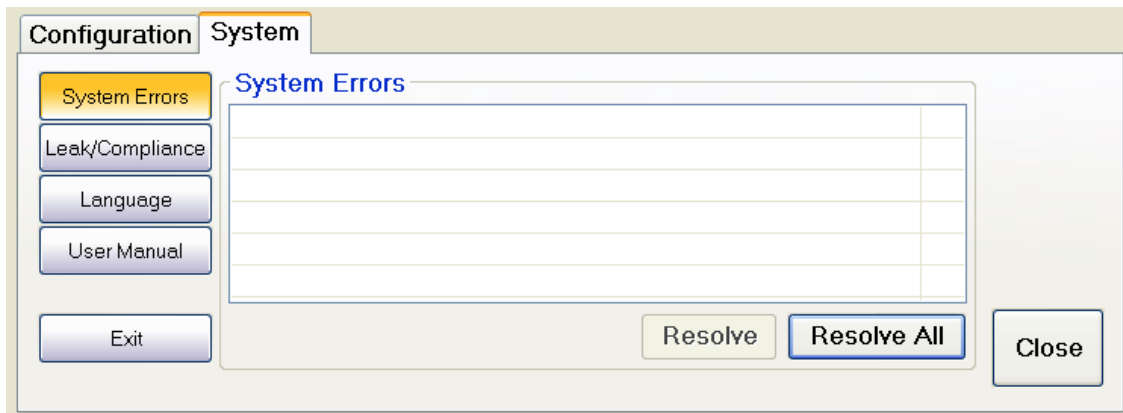
System Tab

The System tab contains buttons for System Errors, Leak/Compliance, Language and User Manual options. Currently the Language is set to English only. Other language options will become available in due course. The User Manual button also presents options which at the time of writing are not yet available. In addition this tab contains a System Errors list, Resolve button, Resolve All button and an Exit button to shut down the ΤΑϜΟΝΙΥϨ Software and returns control to the ΤΑϜΟΝΙΥϨ Shell.

System Errors button

This button returns you to the Systems Errors list. Any error or fault condition that occurs in the ΤΑϜΟΝΙΥϨ software is reported in
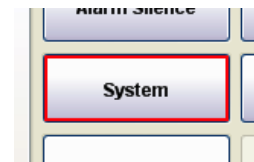
the System Errors list. An error is indicated by the flashing of the border of the System button in red and an audible alarm.

The purpose of the list is to indicate the source of an unexpected alarm or fault condition and to assist with trouble-shooting. Some errors are transient and will self-clear, in which case no action is necessary. Some errors will not self-clear or will remain for example after a device has been removed. In these instances, select the error and then click or touch on the "Resolve" button. If the error is no longer present then it is resolved and disappears from the list.

Leak/Compliance button
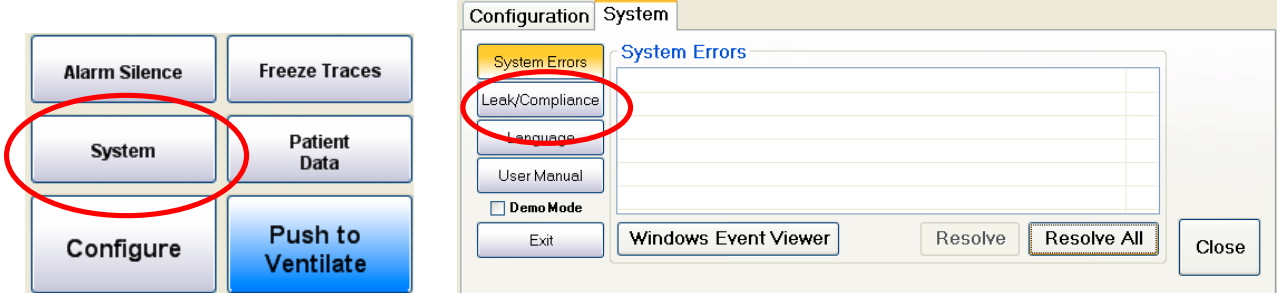
A leak test and Compliance measurement is offered whenever the ΤΑϜΟΝΙΟϒ software is launched. However sometimes it is convenient or necessary to run either utility without having to close the program and start again. Touching or clicking on the Leak/Compliance button starts a sequence of events that proceeds in the following order.

(If the piston is not initialised then Piston Initialisation must be done before either leak testing or compliance measurement.)

Piston Initialisation button
This involves making sure that there is nothing attached to the Y-piece before the piston is sent to the bottom of the cylinder to identify and reset its zero position. If the piston has not been initialised since turn-on then the cylinder representation on the screen will have a hatched background. Once the piston has been initialised this changes to a solid green background. Leak testing and compliance values can then be measured.
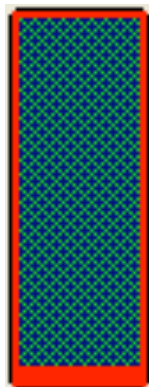
Uninitialised piston background is hatched. Image also has a red flashing border

Initialised piston background is green and shows volume under the piston in litres
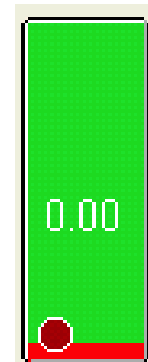
Touch the Zero Piston button to initialize the piston.

Subsequent to piston initialisation the Leak & Compliance button will begin the process of first leak testing and then measuring the compliance of the system.

A dialog appears. After that a second dialog appears asking that any patient be removed from the circuit. When the breathing circuit is ready, press the Leak & Compliance button
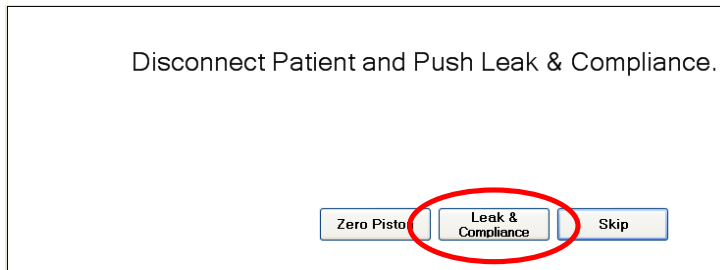
At this point a stopper must be applied to the Y-piece to seal the system. Then press the Leak & Compliance button.
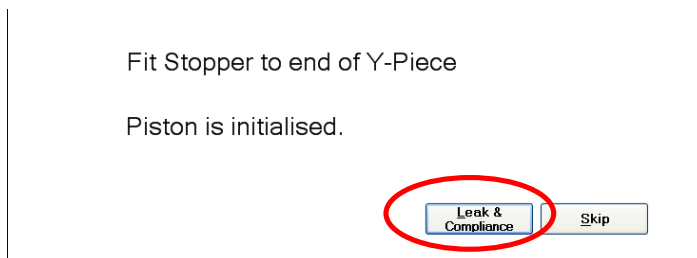
The piston is moved to the mid-point and then stops briefly before establishing a system pressure of 20cm H2O.
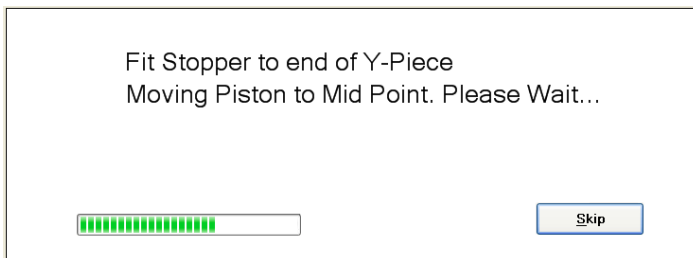
If for any reason there is an excessive leak the following message appears:
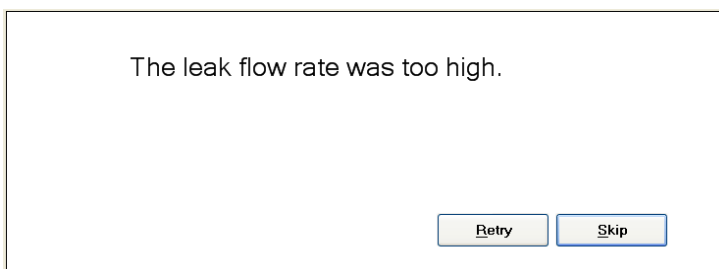
In this instance seal the leak and press the Retry button.

If the leak test is successful the leak value is displayed and the system then proceeds to perform the two compliance measurements.
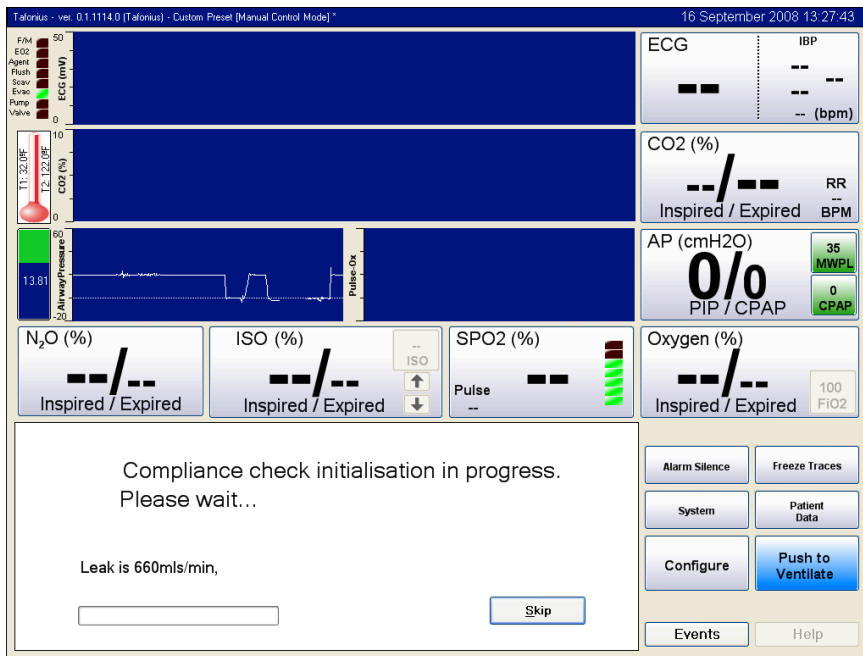
.0L cylinder
the leak
and both compliance values are shown. Note that the values obtained will vary markedly depending on the nature of the breathing circuit connected. The two compliance values are used to obtain the equation for the straight-line graph of compliance for your machine and the breathing system in use at that time. This equation is then used to compute the compliance compensation required at any piston position and pressure.
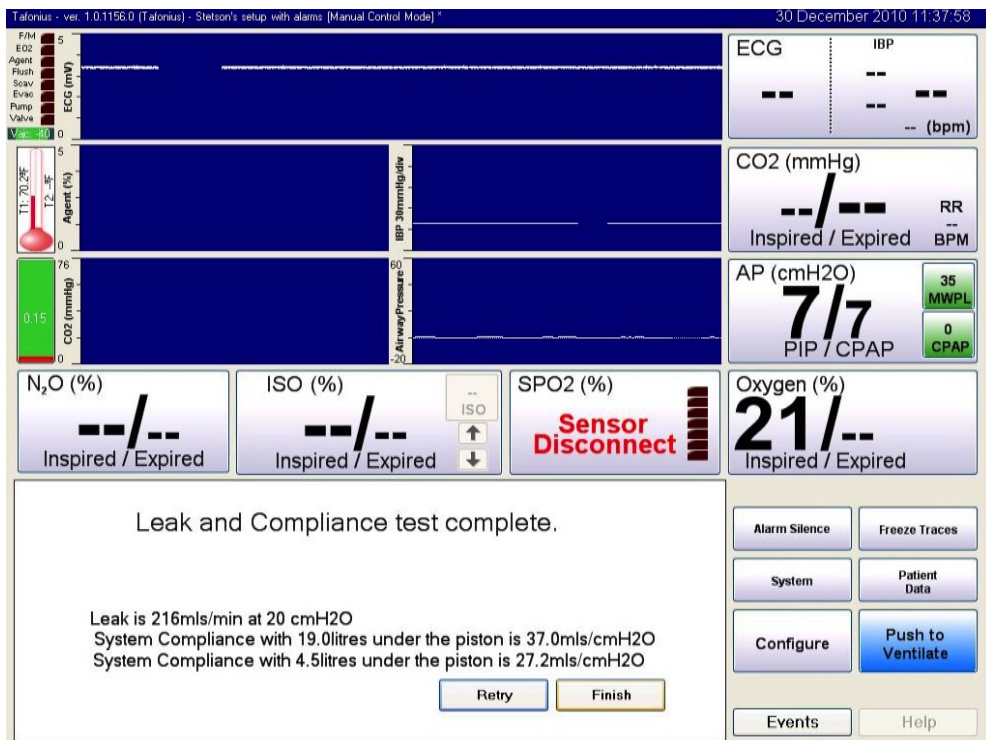
Press "Finish" to leave the Leak & Compliance test procedure.

Configure button

The "Configure" button is used to access the following: Presets, Initial Settings, Gas Monitoring and SPO2 setup. The "Security" button in the Configure window is not active at the time of this writing.

Presets button – Customizing the ΤΑϜΟΝΙΥΣ screen

Presets are a means of individually saving ΤΑϜΟΝΙΥΣ software layouts and initial settings that suit a particular purpose. For example you may have a preset called "Foals" or a preset called "Colics" or even "Senior Anaesthetist".

Each Preset saves the way the screen is configured including how the traces are arranged, the initial values used when the program starts, as well as all the alarm settings and whether they are enabled or not.

There are two ways in which Presets are used to load values at the start of a procedure. There are the Initial Settings, which describe the preferred initial values for such items as Tidal Volume, Respiratory Rate etc and there are the user settings which remember the preferred settings for e.g. ECG speed and trace position. The values for Initial Settings can be changed by clicking on the Configure button at the bottom right hand side of the screen. A new smaller window area appears below the traces area.

Choose the preset you want to change by clicking on it in the Presets list. If it is already in use it will have the word Active after the preset name. If not, then click or touch on the required Preset and then choose the "Switch To" button. The selected Preset will be loaded. Then click or touch on the Initial Settings button on the left hand side.

Initial Settings

Using the keyboard or the on-screen keypad enter the *initial* values you would like in each of the named fields. The fields have the following meanings:

TV: Tidal Volume in litres.
RR: Respiratory rate in breaths per minute
It: Total Inspiratory time
MWPL: Maximum Working Pressure Limit
IP: Inspiratory Pause in seconds
Show **IP** as %☐ : Shows the Inspiratory pause as a percentage of the **It**.
CPAP: Continuous Positive Airway Pressure in cm H_2O
F$_i$O$_2$: Desired initial oxygen fraction. (not available in software version 1.0)
APNOEA: Length of time allowed between breaths before Apnoea alarm sounds
Countdown: Length of countdown timer before pop-up menus close automatically, in seconds
Countdown ☐: Enable the countdown timer for closing pop up menus
Mouse☐: Enable the mouse cursor on the screen

When done, click or touch on the Preset tab again and then choose "Save Active". The next time this Preset is loaded these new initial values will be used.

User settings

During the course of using the ⊤⋏ϝovιυʃ program you may make changes to the screen appearance or to the appearance of a certain monitor trace. When changes such as these are made, that affect the personal way that the screen is viewed the Preset will be marked as altered and an asterisk will appear next to the name in the title bar.

Tafonius - ver. 0.1.1114.0 (Tafonius) - Custom Preset [Manual Control Mode] *   16 Sep

At any time or at the end of a procedure this unique set up of Tafonius can be saved. If this is not done explicitly you will be prompted to save the Preset when finalising a patient session. You can choose to change the active preset by touching SAVE or you may save the current setup as a new setup by touching SAVE AS NEW and renaming it as desired.

Note that you will not be prompted to save a changed Preset when you shut down the Program using the main ON/OFF switch.

Changing Presets

When the ⊤⋏ϝovιυʃ software starts it uses, by default, the last Preset in use. To change a Preset, click or touch on "Configure". The Preset list is displayed. Along the bottom of the Preset Window are 5 buttons, used to control how Presets are created, named, selected and deleted plus two other buttons to Reset Factory Defaults or Close the Configuration dialog.

The Preset currently in use is indicated by the word Active in brackets after the Preset name. This name is also displayed at the top of the screen in the title bar.
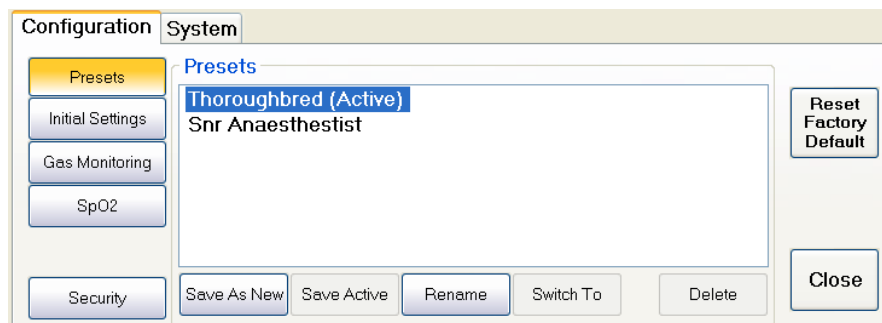
Save As New
This button creates a copy of the Active Preset and names it "Custom Preset". Use the Rename button to change the name to one of your choice. If you have made changes to the stored active preset the new stored preset will include those changes.

Save Active
This button saves any changes made to the Active Preset

Rename
This button allows a Preset to be renamed. Type the new name in the edit box that appears and click or touch "OK".

Switch To
Use this button to change to a different Preset from the Active one. To use this button, click or touch on the Preset you wish to use and then click or touch on the "Switch To" button.

Delete
This button removes the highlighted Preset. Note that it is not possible to delete an active preset.

Reset Factory Default
This button will apply all the default factory settings to the Active Preset. Note that the Preset must be Active for the changes to be made to it. A confirmation dialog box appears stating which Preset will be changed. If this is the Preset that you wish to Reset, then click or touch "OK".

Gas Monitoring

This tab displays all of the status and diagnostic information for the current Gas Monitor in use.

At the current time a mainstream device called IRMA or a sidestream device called Artema AION is used for CO2, O2, N2O and Agent monitoring. Your machine will be fitted with one or other of these units.

Gas monitoring button with the IRMA MainStream Gas Analyser:
Clicking on the Gas Monitoring tab reveals a Window with 5 further tab options: Status, Sensor, Errors, Config & Data

Status tab
Used for fault diagnostic information only
Sensor tab
Used for fault diagnostic information only
Errors tab
Used for fault diagnostic information only

Config tab
Used for fault diagnostic information only
Data tab
Location of the Zero option for the IRMA monitor. See the section on "Use of the IRMA Monitor" for full information on when and how to use the "Zero" option found in this tab.

In most situations it is only necessary for users to use the Data tab. Information from the other tabs may be requested by a service engineer or a technical support person during fault diagnosis.

Gas monitoring button with the Artema AION SideStream Gas Analyser:

Modes/Status
Used for fault diagnostic information only
Status
Used for fault diagnostic information only
Alarms
Used for fault diagnostic information only
Cmds
Used for fault diagnostic information only
Demo
Used for demonstration purposes only.
Calib
Used for fault diagnostic information only

In most situations it is only necessary for users to use the Cmds tab for performing a zero calibration. Information from the other tabs may be requested by a service engineer or a technical support person during fault diagnosis.

Push to Ventilate button

After ΤΑϝΟΝΙΟϟ has powered up and completed it's initialization routines it goes into Standby Mode and waits for a spontaneously breathing animal to be connected and for the operator to adjust the settings. Push this button to change from Standby to IPPV mode.

Events button

This button is used to open a dialog box where you will be able to view, add, update and delete events as well as pop-up list of frequently used events.
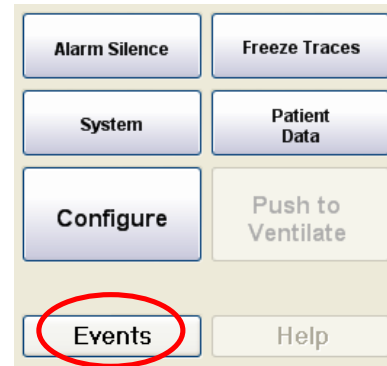
Touch the Events button to open the editing panel as seen below, view the events list.

Events can be added to the Slow Data (SD) record during a procedure. They will also appear on the Anaesthesia Record chart.

Adding an Event during the procedure
Press the Events button then the Add Button to see the following:

Events can be entered at anytime by typing on the water-proof keyboard or they or their heading may be select from a pop-up list of Standard events. Click or touch on the Standard Events pop-up box and click on the event you want. If you select a Standard Event from the list you may add text to describe the specifics. Note that date and time of

the event can be changed from the current date and time if desired. Touch accept when you are finished to store the new event in the Events List.

Editing an Event
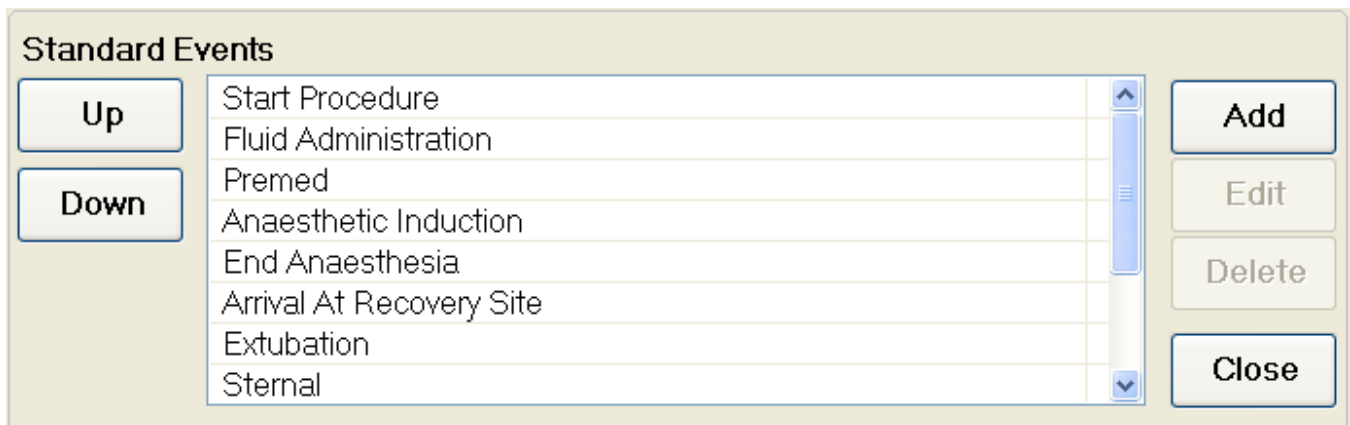
Any event you have previously stored may be edited by touching the event in the list. This action immediately opens the following edit window:

Your choices here are to change the date or time, pick a new standard event, updated the text and touch Update to store your changes or delete the entire event.

Customizing the Standard Events List

The list of Standard Events provided is a list of general milestones common to most cases. This list can be customized to fit your way of working by clicking or touching the Add/Remove Standard Events button seen above which opens a new editor that lists all the current Standard Events. These can be Edited or Deleted by selecting the event of interest and using the Edit/Delete buttons. To add new items to the Standard Event list, click or touch the Add button and then type your new Event title.

Once a new Event has been entered it will appear last on the list. To change the position of this new item in the list, use the UP and Down buttons to move the item. Once the new Event and the order of Events has been set, click or touch the Close button to leave the Standard Events editor.

Help button

The Help button is not functional at the time of this writing.

The Ventilator controls

The ventilator controls, all in green, consist of Tidal Volume, Respiratory Rate, Inspiratory Time, Maximum Working Pressure Limit and a CPAP/PEEP setting. They are the independent controls; all other parameters displayed are dependent on these.

The main controls (Tidal Volume, Respiratory Rate & Inspiratory Time) have two sets of numbers associated with them. These numbers change depending on whether the system is in Standby (spontaneous breathing) mode or Ventilate mode. In Standby mode, the large blue numbers are the measured values derived from the patient's respiratory efforts. The Airway Servo System is working as a respiratory monitor. The smaller black numbers are the ventilator settings that will be used in Ventilate mode. If no breathing is detected after 60 seconds the blue values are all set to zero.
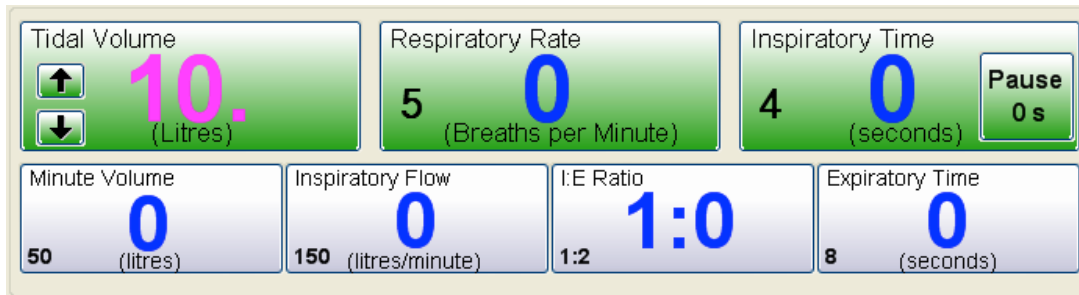
When you touch a button it changes colour and becomes ready to accept a new value for that ventilator setting. A numeric keypad appears in the lower right hand corner of the screen, as seen here, where you can enter a new value. The value may also be changed by means of the UP/DOWN arrows. When the new value has been entered commit it to memory by doing one of the following:

- Touch the body of the button again,
- Touch the "Enter" button on the numeric keypad or
- Touch the body of the next button whose value you want to change.
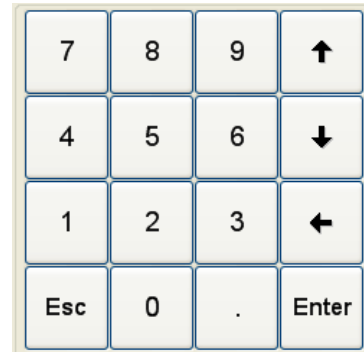
Touching Escape will void whatever entry you had made and return to the previously set value.

Tidal Volume:

In Standby mode: The set Tidal Volume is indicated by the smaller black number and is the volume that will be delivered per breath when the switch is made to Ventilate mode. It also sets the volume of the Virtual Bag used for the patient (See the section The "Virtual Breathing Bag"). The blue value indicates the breath-by-breath tidal volume of the spontaneously breathing patient

In Ventilate Mode: It sets the actual volume delivered to the patient. TAFONIUS uses automatic compliance compensation so the volume received by the patient is the volume entered. The volume displaced by the piston will be more than the set value to compensate for the volume lost to the compliance of the breathing system. The patient actually receives the TV you set regardless of the length of the breathing systems tubes. This is very helpful when 20 or 30 ft tubes are connected to reach a patient in an MRI or when the foal circuit is in use. Valid entries are from 0.05 – 20 Litres unless limited by another setting.

Respiratory Rate:

In Standby mode: The blue figures show the measured respiratory rate, recalculated every 10 seconds on a rolling 1-minute basis. This gives a truer reflection of respiratory rate. The smaller black figure shows the respiratory rate that will be used in Ventilate mode.

In Ventilate Mode: The large black number shows the respiratory rate in use.

Valid entries are 1 - 30 Breaths per Minute unless limited by another parameter.

Inspiratory Time:

The Inspiratory Time button controls the total length of the Inspiratory phase. There is also a smaller sub-button located within the Inspiratory Time button that allows a pause to be included in the Inspiratory time. This inspiratory pause is limited to 40% of the I time. It can be displayed in either seconds or percent of I time, by repeated touches of the sub-button.

In Standby Mode: The blue figures show the measured inspiratory time, recalculated after every breath i.e. on a breath to breath basis. The smaller black figure shows the total Inspiratory Time that will be used in Ventilate mode.

In Ventilate Mode: The large black figure indicates the total time for inspiration. This will be greater than the Inspiratory flow time if the setting for Inspiratory Pause is ≠ 0.

Valid entries for Inspiratory time are 0.5 – 4.0 seconds unless limited by another setting.

Inspiratory Pause:

In Standby Mode: Has no action but it can be set in advance of switching to ventilate.

In Ventilate Mode: Controls the portion of the inspiratory phase in which no inspiratory flow occurs immediately prior to start of the expiratory phase. The maximum pause is limited to 40% of the total Inspiratory time. Increasing the Pause time will increase the time the inspiratory volume is held at the end of the Inspiration stroke. The total Inspiratory Time is unaffected so Inspiratory Flow rates will increase as more Pause time is added.

Touch the Pause button to activate it and open the numeric keypad. Touch it again to toggle between setting the pause as a % of Inspiratory time, or as a finite time. Enter the actual time or percentage required. Press "Enter" on the numeric keypad when done.

In general, as with the ventilator settings above, any button shaded green on the display is a value you can set. These include the following.

Maximum Working Pressure Limit (MWPL)

The Maximum Working Pressure Limit control sets a level, above which ventilation is prevented. This is particularly useful when dealing with neonates or during open-chest surgery when a closed thorax does not restrict lung expansion. The Maximum Working Pressure Limit is an absolute value and is unaffected by any settings of PEEP or CPAP.

If the MWPL value is reached during an Inspiratory phase then the ventilator immediately sounds an alarm and changes to the expiratory phase, where once again the cylinder behaves as a Virtual Bag. The MWPL setting can be useful for patients that are "fighting" the ventilator to prevent excessive pressures developing. Valid entries are 10 – 80 cmH$_2$O.

CPAP/PEEP

In Standby Mode: CPAP or Continuous Positive Airway Pressure can he applied during spontaneous breathing. With CPAP patients inspire and expire normally with no added effort, although the end expiratory pressure is elevated to the CPAP setting. This aids in maintaining open alveoae. The airway pressure is held constant during all phases of spontaneous breathing.

In Ventilator Mode: During IPPV the term PEEP or Positive End Expiratory Pressure applies. Ventilating pressures rise during the Inspiratory phase as normal, but are allowed only to fall as far as the PEEP setting during expiration.

Validating entries

All entries are validated once complete. This means that any invalid entries that would exceed minimum or maximum settings that ΤΑFΟΝΙUS is capable of delivering will not be accepted. When this occurs a warning sound is issued and a description of the input error is shown at the bottom of the screen as a black on yellow text message. In most circumstances the limiting factor preventing the input is also shown. Here, for example a value of 1.0 second has been entered as a Pause Time during an Inspiration Time of 2.0 seconds. This represents 50% of the Inspiratory Time, thus exceeding the maximum of 40% and so is disallowed. The maximum allowable entry of 0.8 seconds is used. Increasing the I time to 2.5 seconds would allow a 0.5 second pause. The Pause Time box is outlined in red to indicate the source of the error.
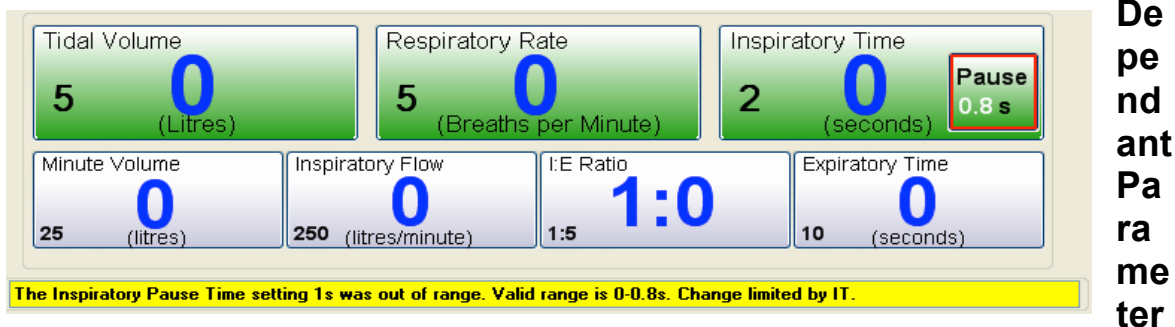
Dependant Parameters

The four buttons below the ventilator controls show the derived values for Minute Volume, Inspiratory Flow, I:E Ratio and Expiratory Time. They are dependent upon the settings of TV, RR, I time and I pause.

In Standby Mode: The large blue figures show the values calculated from the measurements made during normal inspiration and expiration. Respiratory rate is calculated on a rolling minute average that is updated every 10 seconds. The measured minute volume is an integral of the ventilated volume over the last minute. Again this is updated every 10 seconds. If no respiration is detected during a period of 60 seconds then these blue values are all reset to zero. The smaller black figures show the calculated values based on the values set for the three independent ventilator settings (TV, RR & IT). This allows you to in effect set one of the dependent variables by observing its value as you change the independent variable it is dependent on. For instance the I:E ratio can be set by changing either the Rate or Inspiratory time and the Minute Volume can be set by adjusting the Tidal Volume or the Rate.

In Ventilate Mode: The large black figures show the calculated values based on the values set for the 3 independent controls (TV, RR & IT).

Monitoring

ΤΑΦΟΝΙΟΣ has the option of monitoring the following parameters via its in-built software and the trend of all monitored parameters available under Patient Data > View Trends tab.

Single Channel ECG
Single Channel Invasive (Direct) Blood Pressure and Heart Rate
Breath Analysis:
       Inspired/Expired CO_2 and Respiratory Rate
       Inspired/Expired O2
       Inspired/Expired N2O
       Inspired/Expired Anaesthetic Agent:
              Halothane
              Isoflurane
              Sevoflurane
              Desflurane
              Enflurane
Single Channel Pulse-Oximeter; Heart Rate and Saturation
Dual Channel Temperature with Delta
Peak Inspiratory Pressure
Barometric Pressure

Controlling the Appearance of Traces

Each of the above parameters are displayed numerically on the screen. Each of these displays intern is associated with an attribute panel that controls how that parameter is displayed, it's unit of measure, and alarm settings. To access these options for any monitor touch the number panel associated with the parameter of interest. For example to access the options for the ECG monitor, touch the left hand side of the ECG/IBP panel at the top right of the screen.
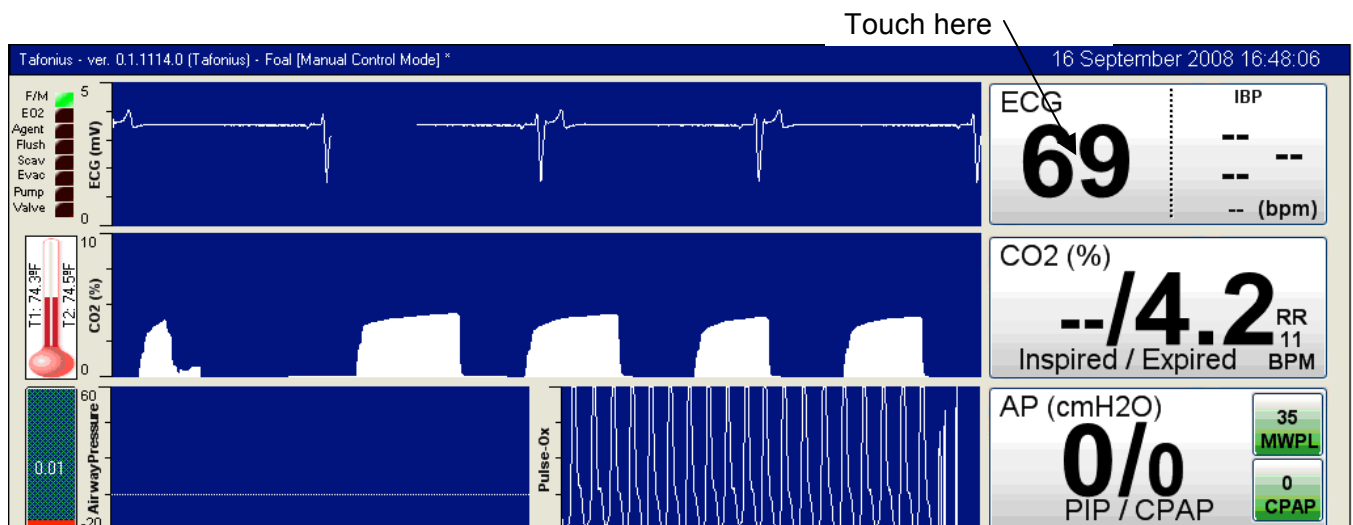
The monitoring attribute panels appear at the bottom of the screen opened at the ECG tab. Note that the ECG attribute tab shares its place with the IBP attribute tab as they are both located on this common ECG/IBP tab. When the left hand side of the ECG/IBP panel is touched, the ECG attributes are shown. If the right hand side of the ECG panel is touched, which has the IBP values, then the attribute tab will be opened with the IBP

attributes showing. To change between ECG and IBP attributes touch the appropriate radio button at the left hand side of the ECG/IBP tab.

All alarm settings and trace settings are particular to any given Preset and so the Preset should be saved after making adjustments to any of the controls in the monitoring attribute panels.

Each attribute panel has two buttons on it one to configure the trace display options and the other for the parameter's alarm settings.

The ECG/IBP Attribute tab
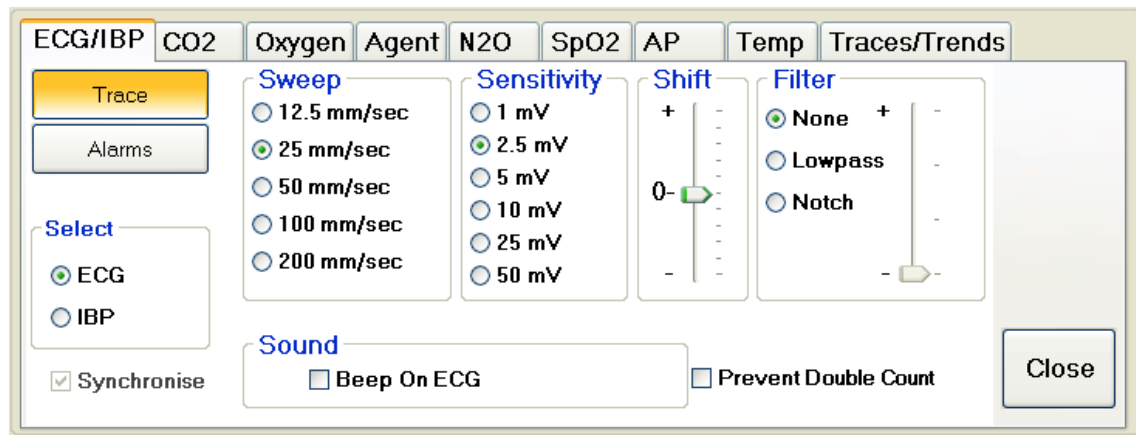
ECG Trace Button

Sweep
Controls the screen sweep speed in units of mm/second.
Sensitivity
Controls the height of the ECG trace seen on the screen
Shift
Shifts the base-line of the ECG up and down the screen. Use this shift feature to centralise the ECG for optimum viewing.
Filter
Allows the setting of a digital filter to remove unwanted signal noise. Use a notch filter for mains interference. Use a Low-pass filter for tremors due to movement e.g. shivering. Move the slider in the Filter box to control the degree of filtering.
Sound
Tick the box next to "Beep on ECG" to produce an audible beep with every detected ECG complex. Note that only one signal can be made to beep at any time. Selecting ECG for example, will mean that any previous selection, such as "Beep On SpO2 Pulse", is overridden.

To change between ECG and IBP attributes touch the appropriate radio button in the "Select" section. Alternatively you can touch the appropriate side of the numerical display.
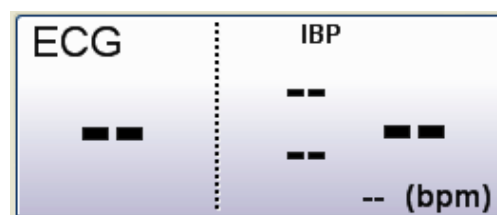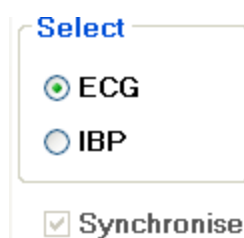
Synchronising the ECG and IBP waveforms
ECG and IBP waveforms can be synchronised in time as long as they have the same trace width on the screen. Normally they would be placed one above the other so that a visual association between the two traces can be made. If the two traces are not synchronised then select the "Synchronise" option in the ECG/IBP tab. If the two traces do not have the same width they cannot be synchronised and the option will be greyed.

Prevent Double Count
        Feature under design.

IBP Trace Button
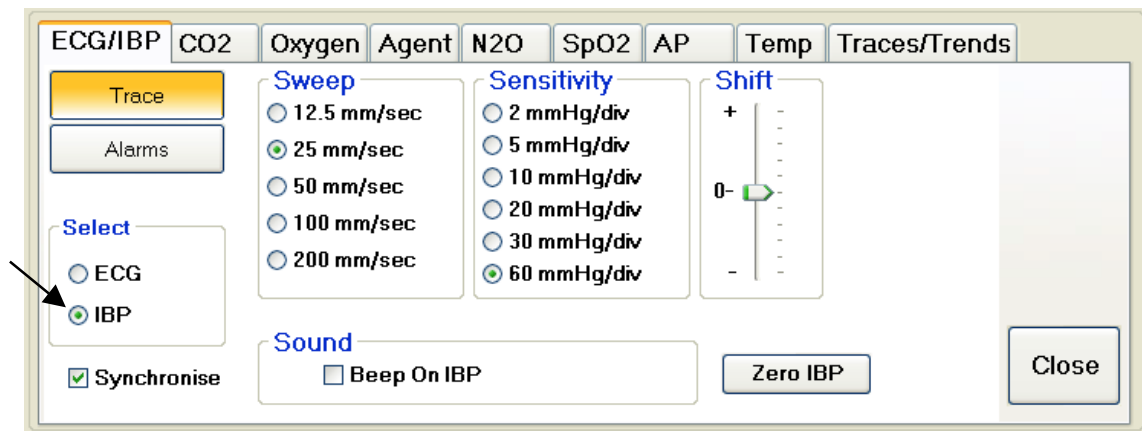
Sweep
Selecting one of the radio buttons will set the sweep speed for the IBP trace. Note that this option may be further controlled or changed depending on the state of the Synchronise check box and, or the presence of ECG and IBP traces on the ᴛᴀꜰᴏɴɪᴜꜱ screen. If the ECG and IBP signals are not synchronised then the sweep speed of ECG and IBP traces can be different. If the traces are synchronised then the IBP sweep speed will be set to and follow the ECG sweep speed and visa-versa.
Sensitivity
This setting will change the full-scale height of the IBP trace, the Y axis scale. Note that there is an **automatic levelling feature** in the IBP trace that means that the bottom of the IBP trace is adjusted after every sweep to lie on the base line. This will always keep the IBP trace in view even if the blood pressure values are slowly changing.
Shift
The Shift slider alters the position of the baseline of the IBP trace.
Sound
Select the box next to "Beep on IBP" to produce an audible beep with every detected pulse waveform. Note that only one parameter can be made to beep at any time. Selecting Beep On IBP for example, will mean that any previous beep selection, such as "Beep On ECG", is overridden.
Zero IBP:
When a direct arterial sampling line has been placed and the sensor positioned at the level of the patient's heart (but with connection to ambient pressure not arterial pressure) the "Zero IBP" button is used to set the current output to zero.
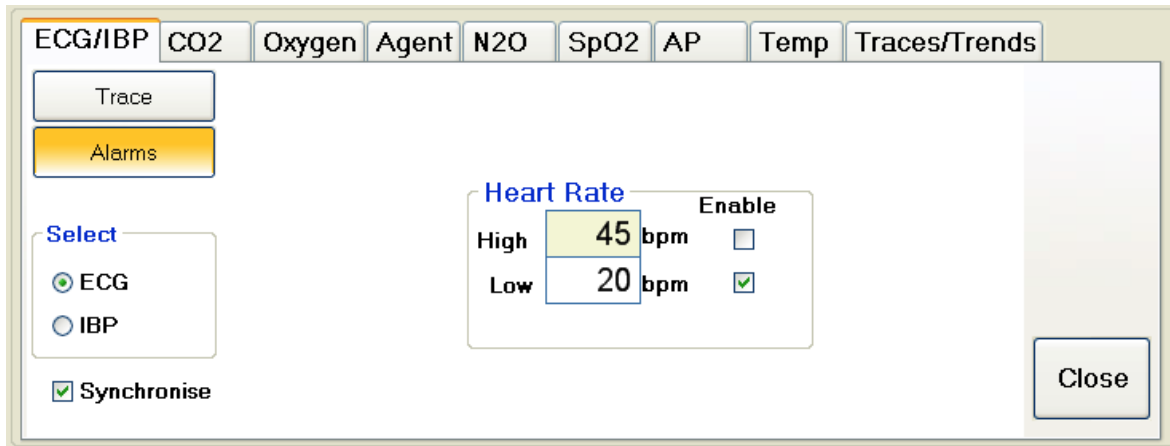
ECG Alarms Button

Click or touch the Alarms button on the ECG tab to show the alarm options for ECG.
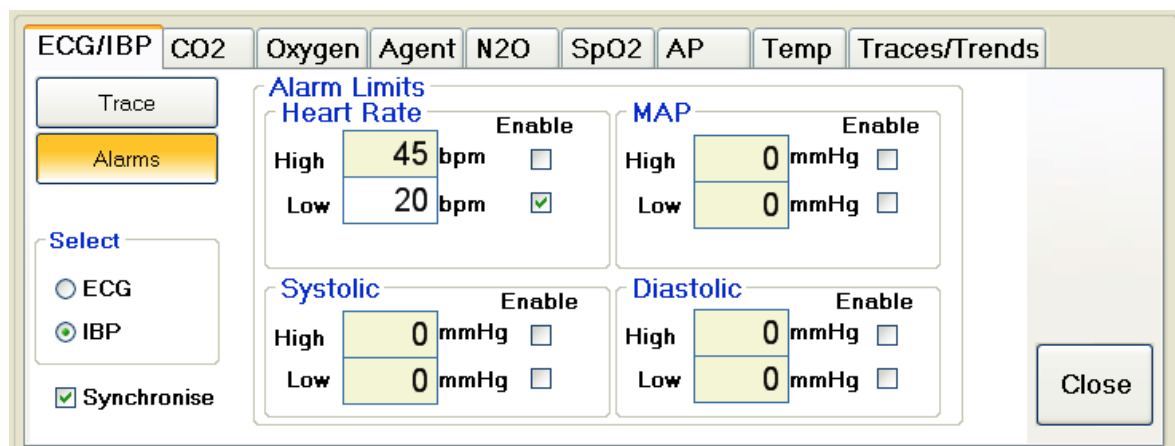
Heart Rate
Upper and lower alarm values can be set for the heart rate derived from the ECG signal. These can be independently enabled or disabled by touching or clicking the Enable box next to the appropriate Alarm edit box.

General Notes on Alarms

The statement above, "These [alarms] can be independently enabled or disabled by touching or clicking the Enable box next to the appropriate Alarm edit box." applies to all alarm settings and will not be repeated from here on out.

The contents of the Alarm Limits grouping on all tabs work in a similar manner. To set any alarm value, click or touch the associated edit box. The numerical keypad will appear on the right of the screen. Use this or the main keyboard to enter the numerical value and then click or touch Enter. Again this applies to all alarm settings and will not be repeated from here on out.

IBP Alarms Button

Heart Rate
Upper and lower alarm values can be set for the heart rate and these can be independently enabled by touching or clicking the Enable box next to the appropriate Alarm edit box.

Systolic

Set high and low limits for the systolic blood pressure value. High and Low alarms can be independently enabled.

Diastolic

Set high and low limits for the diastolic blood pressure value. High and Low alarms can be independently enabled.

Mean Arterial Pressure

Set high and low limits for the mean arterial blood pressure value. High and Low alarms can be independently enabled.

The CO_2 Attribute tab

CO_2 Trace button

Sweep

Selecting one of the radio buttons will set the sweep speed for the CO_2 trace.

Full Scale

Fixes the vertical scale of the CO2 trace.

Units

Set the displayed units as Volume %, millimetres of mercury (mmHg) or as kilopascals (kPa). When units are changed, there is an automatic change in the units applied to alarms so that the corresponding value in the new units is used.

Trace

Select whether to display the Capnogram as a filled trace or as a simple line curve.

Sound

Select this tick box to produce an audible beep with every detected breath. Note that only one parameter can be made to beep at any time. Selecting "Beep On Breath" for example will mean that any previous beep selection, such as "Beep On ECG", is overridden.

CO_2 Alarms Button

To set Alarms associated with CO2 measurement, click or touch the Alarms button

To set an alarm, place a tick in the enable box and then enter the appropriate alarm value. The units of measure can be changed on the CO_2 trace attribute panel.

The Oxygen Attribute tab

Oxygen Trace button

Sweep
Selecting one of the radio buttons will set the sweep speed for the oxygen trace.

Scale
Use this control to set the full-scale height of the oxygen trace window. Note that there is no shift feature with this trace. To view oxygen values in excess of 50%, the 0-100% scale range must be used.

Oxygen Alarms Button
Click or touch the Alarms button to show the Alarm options for oxygen.

Alarms can be set for High and Low Inspired and Expired values.

FiO$_2$
This option is not yet implemented and will be available in the future.

The Agent Attribute tab

Agent Trace Button

Sweep
Selecting one of the radio buttons will set the sweep speed for the oxygen trace

Full Scale
Use this control to set the full-scale height of the Agent trace window. Note that there is no shift feature with this trace. To view Agent values in excess of 5%, the 0-10% scale range must be used.

In Use
Neither the IRMA OR detector or the Artema AION gas analyzer used for agent monitoring have automatic agent ID so it is necessary to set the agent being used. Select the appropriate radio button next to the agent in use. This change will be reflected in the Agent button on the screen.

Agent Alarms Button
Click or touch the Alarms button to show the Alarm options for Agent.

Alarm Limits
Different alarm limits can be entered for each agent. Select the agent "In Use" on the Agent > Trace attribute panel as described above then touch the Alarms button to enter alarm settings for the agent selected as "In Use".

The N$_2$O Attribute tab

N$_2$O Trace Button
Nothing new here, I bet you've got the hang of this by now.
N$_2$O Alarms Button
Ditto.

The SpO$_2$ Attribute tab

SpO$_2$ Trace Button
Here the only selections are for the following.
Sweep
and
Sound
Click or touch the box next to "*Beep On SpO$_2$ Pulse*" to enable audible beeps associated with each detected pulse waveform. Again this will over-ride any other beep selection.

SpO$_2$ Alarms Button
Click or touch the Alarms button to show the Alarm options for SpO2 Attributes settable for SpO$_2$ alarms are for:
Pulse Rate
Low and High

Saturation
Low

Sound
Beep On SpO$_2$ Pulse

The Airway Pressure (AP) Attribute tab

Airway Pressure Trace button
Sweep
This sets the sweep speed of the Airway Pressure trace, which is the speed at which the trace is drawn across the screen.

Full Scale
Full-scale range for this trace is settable to 15, 30, 60, or 120 cmH$_2$O.

Airway Pressure Alarms button
To access the Airway Pressure Alarms, click or touch the Alarms button
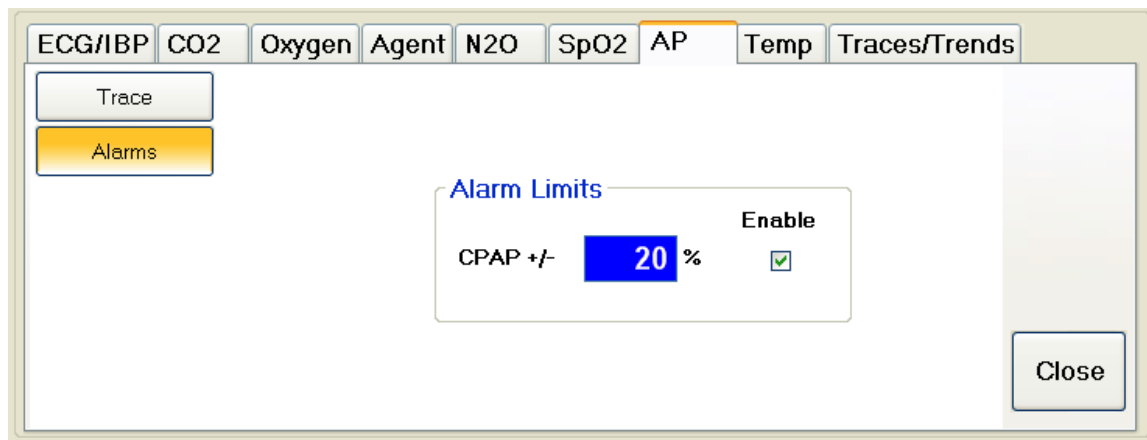
The CPAP alarm allows an alert condition when the measured CPAP pressure deviates outside the plus-or-minus percentage range entered. The alarm units are in percentage deviation of the set CPAP value.

The Temperature Attribute tab

Temperature Trace button
Time
Selecting an option here sets the amount of data displayed in the trace window. By selecting a long Time period, trends can easily be visualised. By choosing a short time period, details in trace changes are more easily observed.

Temperature Scales
Choose to use either Fahrenheit or Celsius as the temperature scale. Alarm values change accordingly.

Temperature Alarms button
Click or touch the Alarms button to show the Alarm options for Temperature.

Temperature Trace button
Here you will find 3 tabs: Alarms for T1 temperature probe, Alarms for T2 temperature probe and Alarms for the Delta temperature. (The Delta temperature is the difference in temperature between the two temperature readings of T1 and T2). Click or touch the enable box to enable the alarm and then enter the appropriate value.

Alarm Silence button
Use this button to silence a temperature alarm. An alarm will sound when a temperature probe is discovered to be absent. Touch the temperature gauge to open this Attribute tab and use the Silence button to silence the alarm.

The Traces/Trends Attribute tab

Organisation of traces
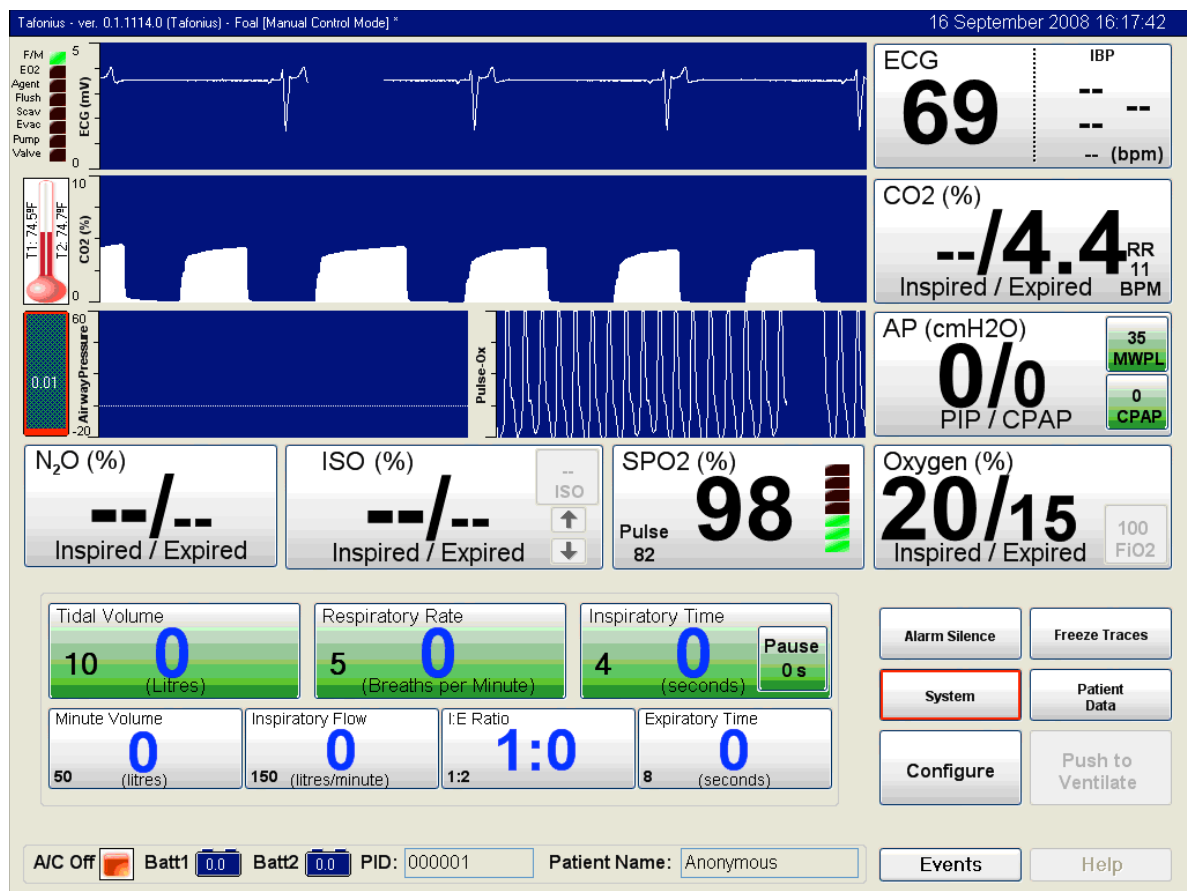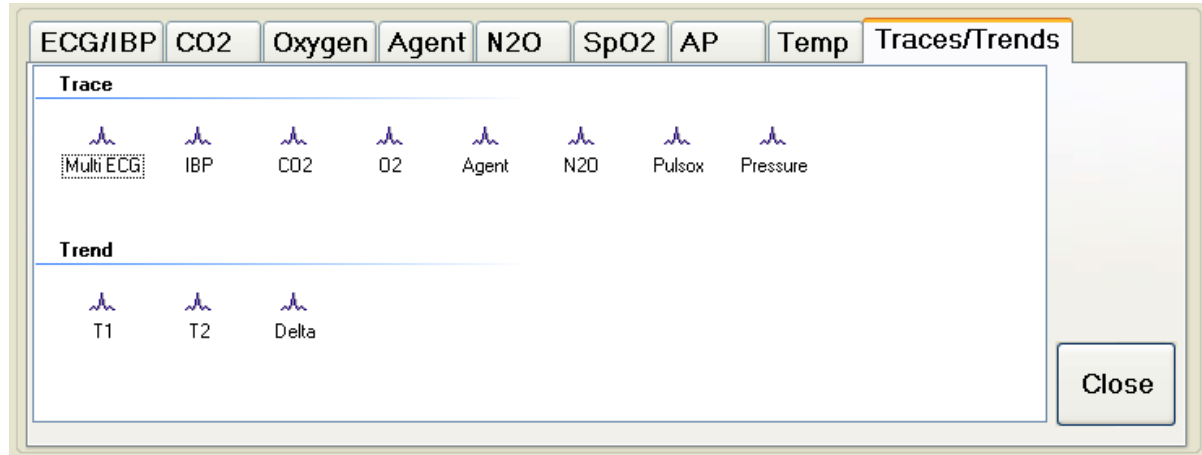
The trace region is centralised on the screen and in the picture above contains the ECG, CO2, Airway Pressure and Pulse-Oximetry trace. This area can be organised as required by placing any trace or combination of traces here. The trace region itself is divided into three horizontal areas each of which is one trace high. It is possible to place

a trace in any of these 3 horizontal areas. Additionally it is possible to have multiple traces in any one of these horizontal areas.

Adding and Removing Traces

To change the trace screen viewing options touch any trace. The Traces/Trends attribute panel appears at the bottom of the screen
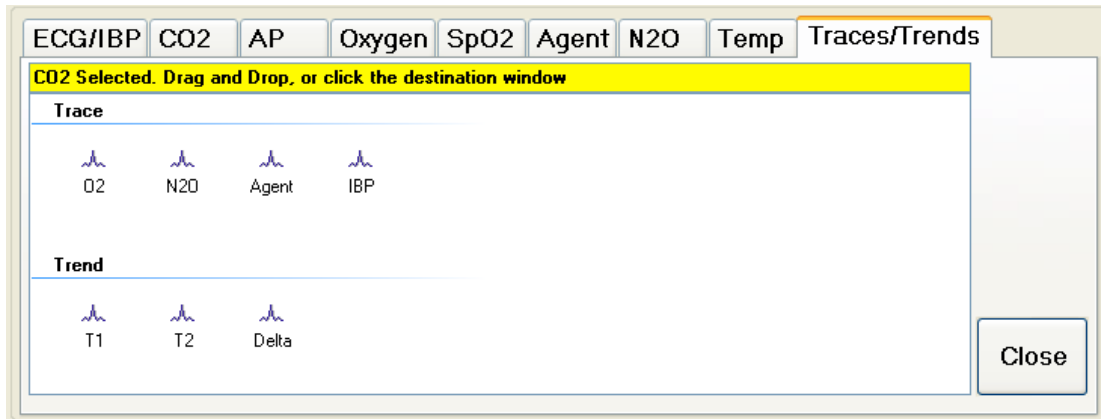
The text in the yellow strip indicates the trace that has been touched (selected). Here the user has two options: Touching inside the Trace/Trend dialog box will remove the trace from the screen and place it in the reserve area. Alternatively touching the screen in another area of the trace region will place that trace alongside and to the left of any other traces in that horizontal area.

Any trace that has been placed in the reserve area can be put back on the screen in any of the three horizontal areas at any time. To do this touch the desired monitor trace in the reserve area then touch the horizontal area of the screen back on the screen. "Pick and put" the desired trace where you want it.

Using the PHASEIN Mainstream IRMA Gas Analyzer

Important Note:
The IRMA mainstream multi-gas probe is intended to be connected to a patient breathing circuit for monitoring of inspired/expired gases of patients in intensive care, anaesthesia and emergency care. It is not intended to be used as the only means of monitoring a patient. It shall always be used in combination with other vital signs monitoring devices and/or professional human judgements of patient condition. The IRMA multi-gas analyser is intended to be used by trained and authorised veterinary professionals only. It is not intended to be used in outdoor transport applications such as in cars or in aircrafts

TOC

IRMA Setup

Plug the IRMA device into the IRMA socket located on the bulkhead behind and below the utility drawer, on the Right Hand Side of the machine.

Snap the IRMA sensor head on top of the IRMA airway adaptor. It will click into place when properly seated

A green LED indicates that the IRMA sensor is ready to use

Connect the 15mm male IRMA/Airway adaptor connector to the breathing circuit. When used with a foal 22mm circuit connect the IRMA device as shown in the next 2 images.

Connect the 15mm female IRMA/Airway adaptor connector to the patient's endotracheal tube

When used with a 50mm mainstream adaptor the IRMA adaptor is integrated into the
Large airway adaptor as shown:

Always position the IRMA sensor with the O2 cell (or top) pointing upwards

Pre-Use check

Before connecting the IRMA adaptor to the breathing circuit, verify the O2 calibration by checking that the O2 reading on the monitor is correct (21%). See the following section "**Oxygen Recalibration**" on how to perform room air calibration.

IRMA Monitor: General Description

The IRMA breath monitor unit is a small cube-shaped unit housing a replaceable Airway Adaptor and Oxygen sensor. The main housing for the unit has an LED in one corner which indicates the status of the sensor. These states are described in detail in the section "IRMA Status & Error Messages" The IRMA unit connects to the ΤΑΓΟΝΙΥƧ monitoring system via a 9-Way Female D Type connector. When the unit is connected and the unit powered ON, the IRMA device runs through a self-test sequence. This is indicated by the LED on the main housing changing alternately through GREEN, RED, BLUE a number of times. Once the initialisation sequence is complete the LED stays GREEN. If the IRMA unit has the capability of detecting anaesthetic agents then the LED will turn BLUE in the presence of these agents.
IRMA units may be connected/disconnected while powered without any problems.

Calibration, self-test and reset

The IRMA unit is self-calibrating and does not require scheduled calibration on a monthly or even annual basis. Calibration is achieved in a number of ways but must be done while the unit is plugged in and powered ON.

<p style="color:red; text-align:center">ALL CALIBRATION MUST BE DONE WITH THE UNIT IN FREE AIR AND NOT WHILST CONNECTED IN A PATIENT CIRCUIT</p>

Oxygen Recalibration

For calibration of the Oxygen sensor, removal of the Airway adaptor forces an automatic recalibration to 21%. For this reason it is important that the removal and refitting of the airway adaptor is done in conditions where the airway concentration is at 21% such as in a well ventilated room.

1. Remove the Airway Adaptor by pulling the white plastic connector away from the main housing.
2. Wait until the LED flashes RED and the alarm sounds on the monitor.
3. Replace the Airway Adaptor.
4. Check that the LED turns green
5. Check that the O2 reading on the Monitor is 21%

CO_2, Nitrous and Agent Calibration (Zero reference calibration)

These can all be reset from the Windows software via the Configure/Gas Monitoring/Data tab route. Only perform this function when asked to do so by the Windows program or when indicated by the following conditions:

1) A repeated "Gas Concentration out of Range" error message that appears when measuring room air and is not cleared by disconnecting and re-connecting the IRMA device.
2) Incorrectly reported high Inspiratory CO_2 concentrations

<p style="color:red; text-align:center">ALL CALIBRATION MUST BE DONE WITH THE UNIT IN FREE AIR AND NOT WHILST CONNECTED IN A PATIENT CIRCUIT</p>

<p style="color:red; text-align:center">THE IRMA UNIT MUST BE ALLOWED TO WARM UP AND BE RUNNING FOR AT LEAST 15 MINUTES BEFORE A ZERO REFERENCE CALIBRATION IS PERFORMED</p>

To RESET the IRMA device, click or touch the "Zero" button in the Data tab of the Gas Monitoring Window found in the Configuration Setup.

A warning dialog box will appear with the following message:
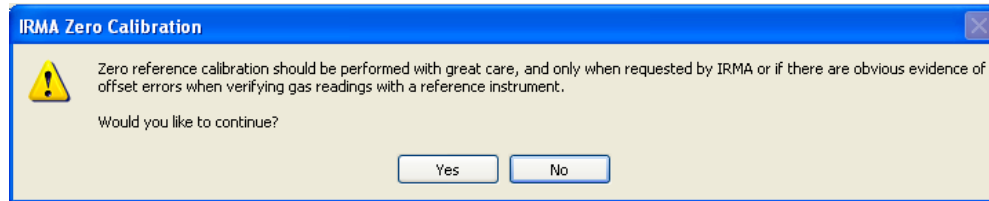
Make sure the conditions for re-calibration are correct before continuing, then click or touch Yes. If you are unsure about the conditions required for calibration, click or touch "No" and read the above paragraphs carefully before running the "Zero" option again.

Using the ARTEMA AION Sidestream Gas Analyser

The Artema AION Gas Analyser is a sidestream gas analyser, drawing the sampled gas from the Y-piece. Other than the physical differences and the inherent latency between breathing and waveform display, the reporting and display of all gas parameters is the same as with the IRMA Gas Analyser.

Sidestream sampling port (capped)

The sidestream sampling line connects to the sampling catheter that enters the Y-piece as shown. The sampling catheter extends down into the ET tube for optimum sampling.

Display of Measured Values

The Gas Analyzer (IRMA or AION) will continuously display and update the numerical and trace information for the patient. The trace region shows the capnogram as either a line or filled trace. The main numerical data region associated with the trace shows the inspired and expired values of CO_2 and the respiratory rate based on the CO_2 waveform.

The larger figure represents the expired value and the smaller figure shows the inspired value. The third value to the right is the respiratory rate in breaths per minute. If a period of apnoea occurs the alarm will sound and a red box, which displays the number of seconds elapsed since the last breath, will replace the respiratory rate.

Clicking or touching this red box will silence the Apnoea alarm. The box will remain red and continue to count the seconds, to a maximum of 255 (4.25 minutes), since the last recorded breath. A fresh breath will clear the Apnoea state and return to displaying Respiratory Rate (RR).

Appendix A : Slow data information

Data recorded in the Slow Data File includes the following:

User control settings

CPAP/PEEP	Set PEEP or CPAP cm H_2O
TV	Set Tidal Volume L
TVcc	Compliance compensated tidal volume L
RR	Respiratory Rate – breaths per minute
IT	Inspiratory Time in milliseconds
IP	Inspiratory Pause time in milliseconds

Resultant parameters calculated from user settings

MV	Minute Volume L
I Flow	Inspiratory Flow L/min
I:E Ratio	Inspiratory:Expiratory ratio
Exp Time	Expiratory time in milliseconds

Measured during Standby

TV	Spontaneous breath Tidal Volume in mls
Insp Time	Inspiratory time in ms
Exp Time	Expiratory time in ms

Resultant parameters calculated from MEASURED values during Standby

RR	Respiratory rate in breaths per minute
MV	Minute Volume in litres
Iflow	Inspiratory flow rate in L/min
I:E Ratio	Inspiratory:Expiratory ratio

Airway Pressure Measurements

CPAP/PEEP	CPAP(Standby) or PEEP(Ventilate) cm H_2O
PIP	Peak Inspiratory Pressure in cm H_2O

Gas analysis Measurements

Insp CO2	Fractional %Volume measurement of inspired CO2
Exp CO2	Fractional %Volume measurement of expired CO2
Resp Rate	Breathing rate in breaths per minute
Insp Agent	Inspired Agent Fractional %Volume measurement
Exp Agent	Expired Agent Fractional %Volume measurement
Insp O2	Inspired Oxygen %Volume measurement
Exp O2	Expired Oxygen %Volume measurement
Atmospheric Pressure	Current Atmospheric pressure in mm Hg
Insp N_2O	Inspired N_2O Fractional %Volume measurement
Exp N_2O	Expired N_2O Fractional %Volume measurement

Nonin SpO2 Measurements

SPO2 HR	Heart rate from pulse-oximeter device
Saturation	Percentage oxygen saturation of arterial blood

IBP Measurements

Mean	Mean arterial blood pressure (mean 4 average)
Systolic	Systolic blood pressure (mean 4 average)

Diastolic	Disatolic blood pressure (mean 4 average) (mmHg for above)
Heart Rate	Patient heart rate from blood pressure device

Temperatures

T1	Temperature from Thermometer 1 in either ^{o}C or ^{o}F
T2	Temperature from Thermometer 2 in either ^{o}C or ^{o}F

ECG HR Heart rate from ECG monitoring device

Battery Data

Batt1	Voltage level of battery 1 (lower 12v battery)
Current1	Charging rate of battery 1 in amps
Batt2	Voltage level of battery 2 (upper 12v battery)
Current2	Charging rate of battery 2 in amps

Piston Position

Units	Shows the piston position in absolute units

In addition to these headings in the file, there will be additional events recorded. The table below shows some typical events that have been recorded.

Date	Time	Events	User control settings						Resultant parameters calculated from user settings				Measured during Standby			Resultant parameters calculated from MEASURED				Airway Pressure Measurements		IRMA Gas analysis Measurements			
			CPAP/PEEP cmH2O	TV liters	TVcc liters	RR bpm	IT ms	IP ms	MV liters	I Flow lpm	I:E Ratio 1:x.x	Exp Time ms	TV ml	Insp Time ms	Exp Time ms	RR bpm	MV liters	I Flow lpm	I:E Ratio 1:x.x	CPAP/PEEP cmH2O	PIP cmH2O	Insp CO2 Fractional %	Exp CO2 Fractional %	Resp Rate bpm	Insp Frac
			XX	XX.XXX	XX.XXX	XX.X	XXXX	XXX	XXX.X	XXXX	XX.X	XXXX	XXXXX	XXXX	XXXX	XX.X	XXX.X	XXXX	XX.X	XX	XX	XX.XX	XX.XX	XX.X	
11/17/2010	12:41:05 PM	[17 November, 2010 12:41:05 PM] Records Started - Tafonius Version 1.0.1154.0.	0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
		[12:41:05 PM.187 - Auxiliary Controller v3021]																							
11/17/2010	12:41:09 PM	[12:41:05 PM.187 - Auxiliary Controller Total: 992:45:35hrs On Time,	0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:14 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:19 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:24 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:29 PM	[12:41:29 PM.343 - Cylinder Open]	0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:34 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:39 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:44 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:49 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:54 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:41:59 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:04 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:09 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:14 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:19 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:24 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:29 PM	[12:42:29 PM.312 - Cylinder Closed]	0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:34 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:39 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:44 PM	[12:42:44 PM.843 - APNOEA Alarm Silenced]	0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:49 PM		0	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:54 PM	[12:42:54 PM.468 - CPAP value changed from 0 to 10]	10	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	
11/17/2010	12:42:59 PM		10	7.000		6.0	2500	0	42.0	168	7.5	0								0	27	0.00	0.00	0.0	

Above is a sample of the SD output as reformatted with the Excel macro provided.

Appendix B : Installing a new release of the ΤΑϝΟΝΙΟΣ software

From time to time you may receive an updated version of the ΤΑϝΟΝΙΟΣ software. This is a very easy process.

1. Copy the .ZIP file sent you onto a USB Stick. It is a good idea to use the USB stick provided with the backup of all the software on our machine. Using that stick will insure that all the latest ΤΑϝΟΝΙΟΣ software is located in one place. This USB stick is velcroed to the back of your touch computer. Remove the cover to gain access to it. See the photo in Appendix E.

2. Insert the USB Stick into one of the USB ports on the monitoring chassis under the top shelf.

3. Turn on ΤΑϝΟΝΙΟΣ. When the ΤΑϝΟΝΙΟΣ shell appears Press Alt-F4 on the keyboard to close the shell and reveal the computer desktop.

4. Navigate to the folder on the USB stick that contains the ZIP file. Via Start>My Computer…

5. UnZipping the file will result in a folder of the same name containing two files, setup.exe and setup.msi.
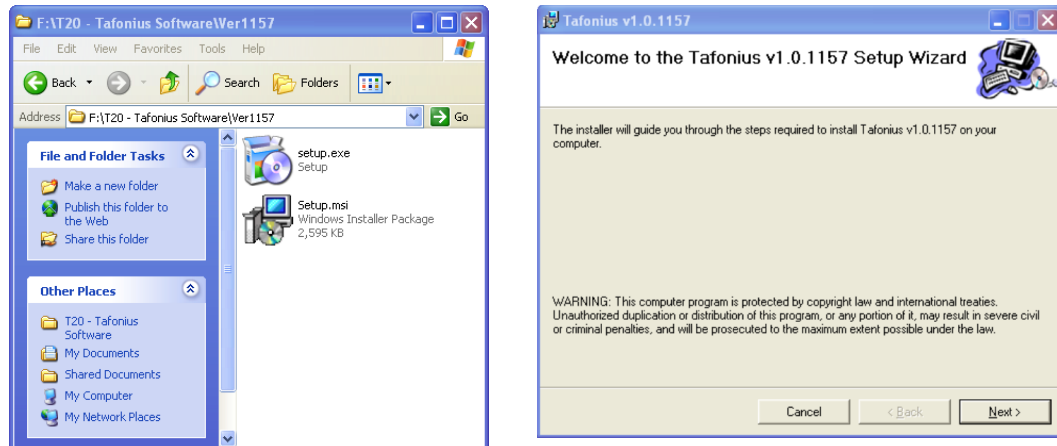
6. Double-click on setup.exe, follow the onscreen prompts by clicking on NEXT for all questions except CLOSE for the last one.

7. Disregard the request at the bottom of the last screen stating "Please use Window Update to check for any critical updates to the .NET Framework."

Appendix C : General Pneumatic Schematic

Note that some minor deviations to this general diagram are to be expected as each machine is customized to the purchaser's requests. This diagram, perhaps amore specific to your machine is also laminated inside the back door of your machine.

Appendix D : ⲦⲀⲯⲞⲚⲒⲨⲤ Cabling Diagram

See SCMC0143G on the next foldout page. This diagram is also laminated inside the back door.

Appendix E : Online Support via TeamViewer

TeamViewer allows us to observe your ⲦⲀⲯⲞⲚⲒⲨⲤ in action, upgrade the software, and troubleshoot certain aspects of your machine over the internet.

TeamViewer is a very secure remote control software package. All versions feature completely secure data channels with key exchange and AES (256 Bit) session encoding, the same security standard used by https/SSL.

Before we can access your machine you must be present to connect the machine to the Internet and launch the Online Support program.

Connect the Ethernet line as shown below. The proper connector will have this Ethernet symbol next to it. The Ethernet line it this photo is blue.
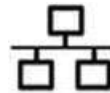
Exit the ⲦⲀⲯⲞⲚⲒⲨⲤ shell by pressing Alt-F4.

Locate the TeamViewer icon on your desktop.

Double click on the icon to launch the program. As long as your Internet connection is good the dialog box below will appear.

If the technician on the phone does not have your ID follow the instructions in blue and give it to him. He will know the password.

Backup Software USB stick
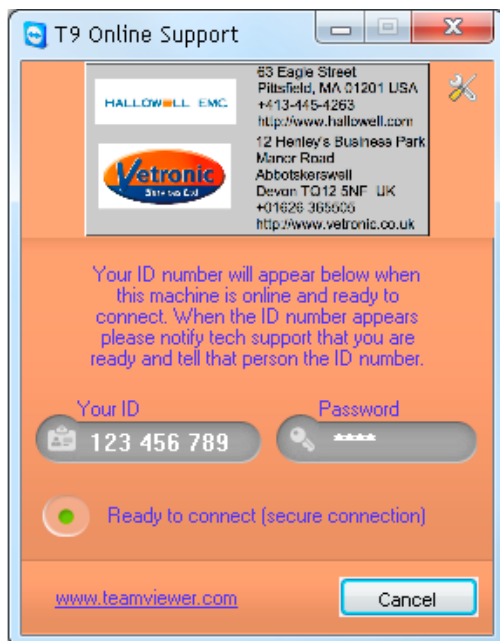
When the session is over simply disconnect the Ethernet connection and quit the Online Support program.

HALLOWELL EMC

Dear Customer,

Please note that the manual for Tafonius Junior is included in back of this Section on the Auxiliary Manual for Tafonius. The Tafonius manual is in revision stages but not complete at the time your unit was shipped.

The photos in the Auxiliary Manual are more in tune to what your machine looks like, however the features and operation of the Auxiliary System are more accurately described in the Tafonius Junior Manual.

Note that Tafonius's Auxiliary system IS the main control system for Tafonius Junior.

You will be supplied with the updated manual when it has been completed.

Please accept my apology for any inconvenience.

Best regards,
Stetson Hallowell
President, Hallowell EMC

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TAFONIUS

Auxiliary Mode Operating Manual
A USERS GUIDE

v16Mar2011
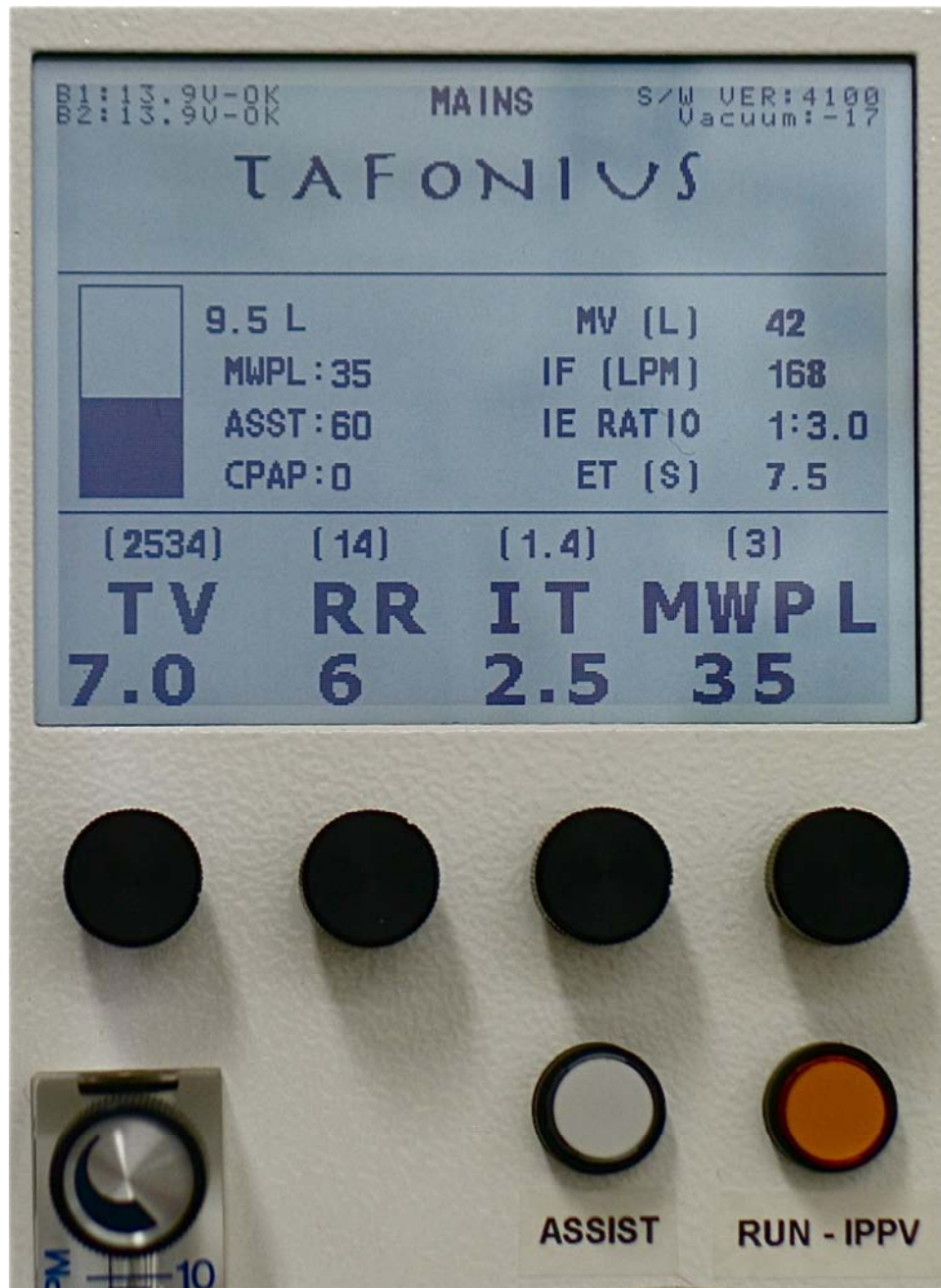
Notes:

Table of Contents

Running ᴛᴀꜰᴏɴɪᴜꜱ with the Auxiliary Control System

Turning ᴛᴀꜰᴏɴɪᴜꜱ On

Press the soft ON/OFF control button (1). The auxiliary screen (2) and the soft ON/OFF button immediately illuminate. There is a single output (beep) from the speaker and the auxiliary screen shows "PUSH ANY KNOB FOR PRESSURE SENSOR SETUP". The user
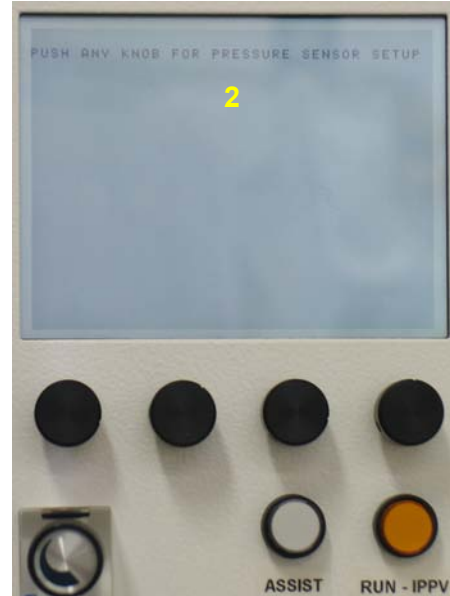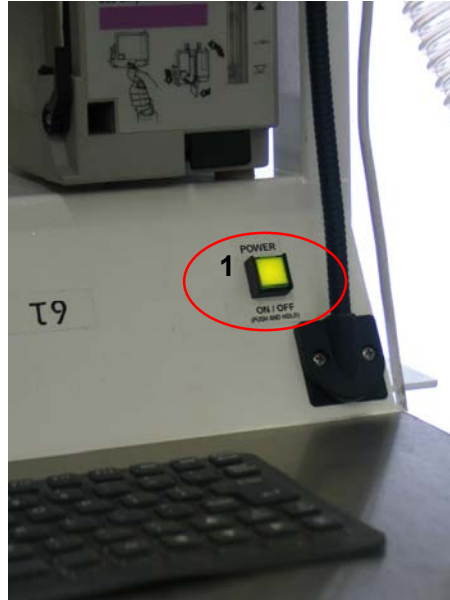
has 2 seconds to push any of the rotary knobs to enter the Pressure Sensor setup screen. Experience over the last 4 years has indicated that this feature will very rarely be needed or used. If there is a discrepancy between the two offset values seen on the screen below, it usually indicates some problem other that pressure sensor drift. Most frequently you'll find water in the pressure sampling line. It is recommended that you blow out the pressure sensing line on a regular basis. To facilitate this process all machines produced after T21 will be shipped with a stopcock at the machine end of the sampling line. You can easily add one to older machines yourself. To flush the line out attach a 60cc syringe to the open port on the stopcock, turn the stopcock handle to shut off the port **entering** the machine and flush the line with the air in the 60cc syringe as shown to the right below.

Should one chooses to enter the Pressure Sensor Setup routine there are two options:

- Pressing any of the four control knobs will use the factory default value as shown.
- Pressing the RUN / IPPV button will use the actual current measured value, which is constantly being updated on the screen.

The chosen value is stored in the non-volatile memory and will remain unchanged until the Pressure Sensor Setup routine is run again.

Use the Pressure Sensor setup routine if there is piston movement when no patient is attached the wye piece is not capped AND you have flushed the sensing line.

The initialisation procedure continues into the Auxiliary Controller Boot Up Sequence.

Auxiliary Controller Boot Up Sequence

After the option for pressure sensor setup, the following sequence occurs:

INITIALISING DRIVE CONTROL
At this stage the servomotor drive, the ViX Drive, is presumed un-initialised and its initialisation begins. The software version is displayed at the bottom left hand corner of the screen. The 24 volt supply line feeding the motor drive as well as the individual battery voltages are measured and its value displayed on the screen e.g.

CHECKING DRIVE VOLTAGE: 27.9 14.0 13.9

If the supply voltage, 27.9 above, is less than 16.0 volts, then the shutdown procedure starts as there is insufficient battery power to safely run the system. In this instance you should connect the mains power and re-start the system.

If the voltages are sufficient one beep is heard as the screen displays the following.

VOLTAGES ALL OK
APPLYING POWER TO VIX DRIVE:

The power to the servomotor drive is applied and tested. Then after successful communications have been established with the ViX drive, two beeps are heard and the following is displayed.

SETTING COMMUNICATIONS TO DRIVE
SETTING COMS RATE TO 19200
  COMMS - SET AT 19200 BAUD - OK

The servomotor drive is then initialised. The next stage checks the Motor Drive Integrity as the following is displayed
NOW TESTING VIX DRIVE INTEGRITY

Assuming all is well then the message
INITIAL DRIVE CHECK OK
is displayed, followed by a string of ones and zeros on the screen. if at any time during this Auxiliary initialisation procedure an error is detected then an error message is displayed and the whole system shuts down. If everything is as it should be then the screen shows

INITIALISATION COMPLETE

At this stage the Auxiliary Screen looks like the screen below.

```
             INITIALISING DRIVE CONTROL
CHECKING DRIVE VOLTAGE: 27.9 14.0 13.9
             VOLTAGES ALL OK
APPLYING POWER TO VIX DRIVE
SETTING COMMUNICATIONS TO DRIVE
SETTING COMMS RATE TO 19200
  COMMS - SET AT 19200 BAUD - OK
      NOW TESTING VIX DRIVE INTEGRITY
0000_0000_0000_0000_0001_0000_0000_0000
0000_0000_1000_0000_0001_0000_0000_0000
00000000
            INITIAL DRIVE CHECK OK
0000_0000_0000_0000_0000_0000_0000_0000

          INITIALISATION COMPLETE



S/W VER:4100
```

The auxiliary controller next displays

CHECKING FOR PC CONNECTION
and waits while it checks for the presence of a USB attached device. If the USB device is detected the display changes (below left) to offer you the chance to do a manual leak test. The operator has two seconds to push any of the four control knobs to enter the leak test routine. After two seconds the display changes to (below right)) and waits for the TAFONIUS software to boot up and take over control. Should the TAFONIUS software not claim control within two minutes auxiliary controller proceeds with piston initialisation and displays instructions to **DISCONNECT THE PATIENT AND PUSH THE RUN BUTTON.**

If the USB device is not detected, as is the case when running without a PC monitor the auxiliary controller will again change the display (to below left) offering to enter the leak test routine. After two seconds elapses without any button being touched the display goes directly to the **DISCONNECT THE PATIENT AND PUSH THE RUN BUTTON** screen seen on the next page.


```
PUSH ANY KNOB FOR SYSTEM LEAK TEST
```



```
             TAFONIUS




       (PUSH RUN BUTTON TO BYPASS HC)
```

ASSIST   RUN - IPPV
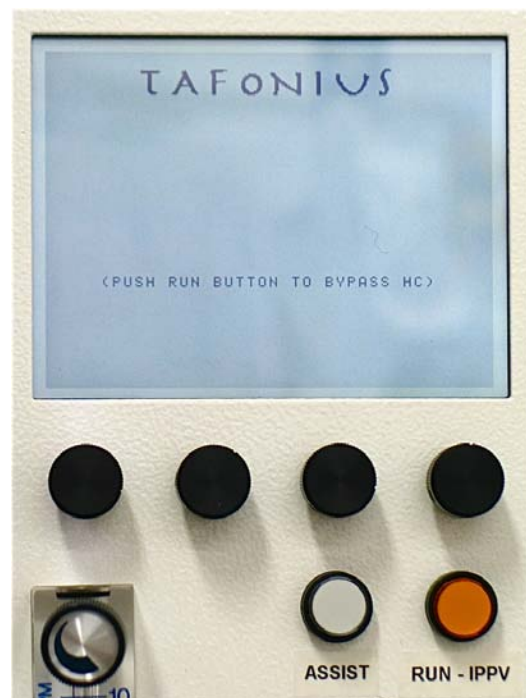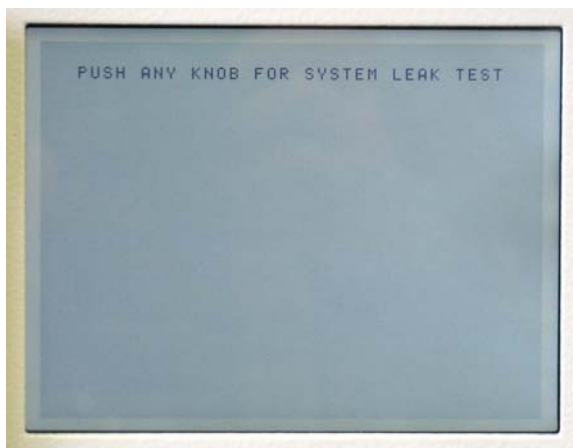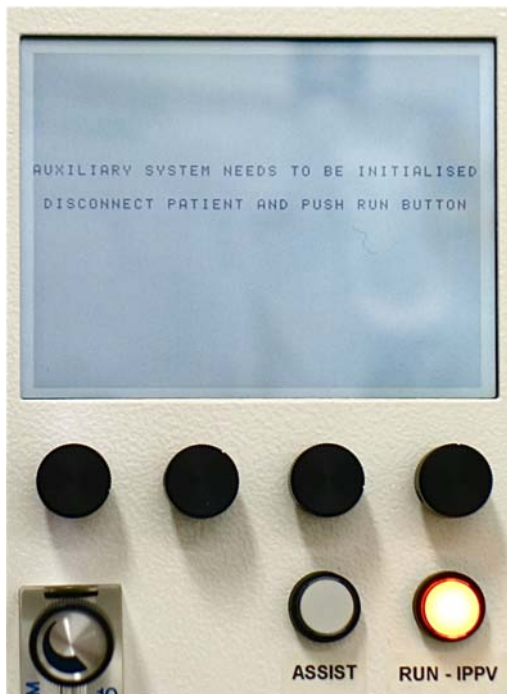
Manual Leak Testing

Should one press a control button within the two-second window in either of the scenarios above the machine will display the following screen.
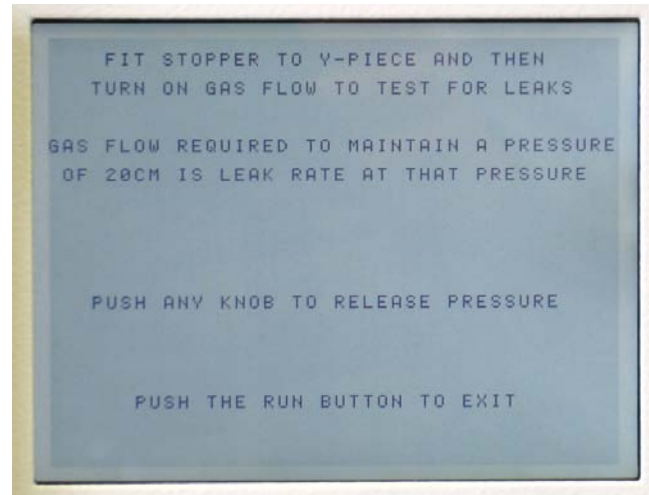
Follow the instructions on the screen. Turn on the gas flow to bring the breathing system pressure up to 20 cmH$_2$O. Adjust the flow rate to hold the pressure steady at 20 cmH$_2$O. The flow observed on the flowmeter is the leak rate at that pressure.

Initialising the Piston

As stated, before Tafonius can be used the system needs to locate the zero position, the bottom of travel, of the piston.

The RUN button will be flashing, after the boot sequence, while waiting for the user. Make sure there is nothing attached to the Y-piece before pushing RUN the button. Once the button is pushed the screen shows the message **MOVING PISTON TO ZERO.** During this piston movement the airway pressure is monitored. If there is a patient attached or an obstruction to airflow then the following message appears:

ERROR. PRESSURE TOO HIGH
DISCONNECT PATIENT
THEN PUSH RUN BUTTON

Clear the obstruction or remove the patient before continuing. There are 2 other possible reasons why the initialisation procedure may be interrupted: The first is that the cylinder is not closed properly. The second is that the vacuum surrounding the piston is too low. In either of these instances warning messages will appear alerting you to the cause and remedy of the interruption. Once the piston reaches the bottom of its travel, a zero reading is taken and **ZEROING PISTON POSITON** is displayed briefly. Three beeps are heard and the control screen is displayed, see below. The piston is at the very bottom waiting for the user to pre-fill the system with oxygen and anaesthetic for induction. T A F O N I U S is ready for use in its Auxiliary Mode.

The Control Screen

TAFONIUS Auxiliary Mode Operating Manual

Before continuing here is an explanation of what you see on the auxiliary screen. It is divided into 4 main regions:

1) Status and message information
2) Piston Graphic and information
3) Resultant Ventilation values
4) Patient Ventilator settings & Measured values
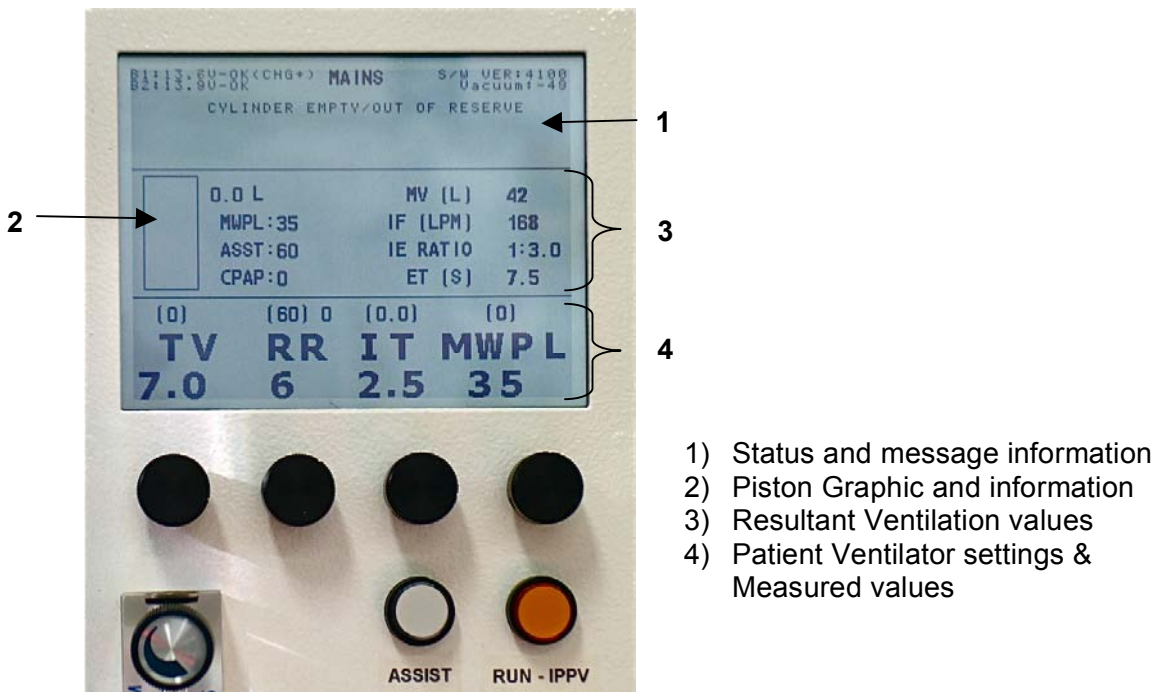
1) Status and message information

Area 1 shows status information on the system batteries, whether the machine is running on mains or battery power, the software version, the vacuum level around the piston and also displays any error or warning messages. The battery information shows the actual voltages of the two batteries used in TAFONIUS and whether or not they are being charged. When there are no warning or error messages, the name TAFONIUS is displayed in this area.

2) Piston Graphic and Information

Area 2 shows a representation of the piston. The dark area represents the volume of gas under the piston and the numerical value at the top of the list to the right displays the amount in litres. See the photo on the front cover as the piston in the photo above is at the bottom with 0.0 litres under it. The piston position and volume is constantly updated showing the position of the piston at all times. Two asterix (* *) will appear at the top of the piston area whenever the Dump Valve, the electric pop-off valve, is open.

Below the volume display in litres are three settings that are not otherwise always display on the screen.

MWPL

The Maximum Working Pressure Limit in cmH$_2$O is generally seen above the right most control knob used to set its value however it will not be displayed there when using the Assist Mode. The MWPL is set as a high pressure safety limit the value of which is continuously compared to the breathing system pressure. TAFONIUS is a volume or time cycled ventilator so the MWPL does NOT set how high the pressure will go but if the pressure should reach the set level the machine will alarm immediately, terminate inspiration and switch to the expiratory phase of the breathing cycle.

ASSIST

The ASSIST function is a mechanism that detects a patient's efforts to breathe then gives an assisted breath if that effort meets or exceeds a user set minimum level. The value next

to the text **ASST** is the level of inspiratory flow, in liters per minute, the patient must generate or exceed to trigger and assisted breath.

In STANDBY mode

In STANDBY, spontaneous breathing, mode this effort level can be set but is not active until the IPPV/RUN button is pushed. To use the ASSIST function, press the ASSIST button once, the ASSIST button will flash slowly and the MWPL legend on the auxiliary screen will be replaced with the text "SENS" for sensitivity followed by a value e.g. 60 LPM. This value of 60 litres per minute is the inspiratory flow rate that the patient must meet or exceed in order to trigger the next IPPV stroke. This will not happen unless the ventilator is in IPPV mode. Pressing the RUN/IPPV button will cause the IPPV button to be lit and the ASSIST button will then remain lit continuously.

In IPPV mode

Alternatively the ASSIST mode can be chosen when the patient is receiving IPPV. In this case the ASSIST mode will be lit continuously to show that the ASSIST mode is active. In this state the ventilator is waiting for an effort from the patient. If this effort level is not met within the time required for 3 breath cycles based on the period dictated by set RR a mandatory breath is given. If the patient triggers a breath then the timing of the mandatory breath is reset. In either case, the delivered breath will be based on the set TV and I-time. Pressing the RUN/IPPV button will return the ventilator to spontaneous mode and cancel the ASSIST function.

This is a new feature and we currently have no guidelines on values to set. The software offers a range of between 1 LPM and 200 LPM as trigger values. We would welcome feedback on the settings found useful or normal in practice.

3) Resultant Ventilation values

Area 3 shows the values that result from the settings of the independent variables Tidal Volume, Respiratory Rate and Inspiratory Time. The dependent variables displayed in this area are Minute Volume (MV) in liters per minute (lpm), Inspiratory Flow Rate (IF) in lpm, I:E ratio and expiratory time (ET) in seconds. These are updated whenever a ventilation parameter is changed. This feature allows the user to see how other parameters are affected by the change being made. One can also "set" a dependent variable. For example you can set the MV by changing the TV and or the RR and watch the resulting effect on the MV display. Similarly one could "set" the I:E Ratio by changing the RR and or the I-time.

4) Patient Ventilator settings & Measured values

Area 4 shows the set values for Tidal Volume (**TV**), Respiratory Rate (**RR**), Inspiratory Time (**IT**) and Maximum Working Pressure Limit (**MWPL**). The values in parentheses above these settings are the measured values taken during spontaneous breathing.

Control of the Ventilator in Auxiliary Mode

In Auxiliary mode the ΤΛϜΟΝΙ∪Ϛ ventilator is controlled via the 4 control knobs below the Auxiliary screen, the RUN/IPPV button, Assist button, CPAP/PEEP button, Oxygen Flush button, Dump Valve button and the soft power ON/OFF switch.

Setting Values using the control knobs – Change & Commit

The process of setting any value uses the concept of "Change & Commit"

Turning the Tidal Volume knob for example will change the value and a small asterisk will appear next to the changed value. To commit this new value push in the Tidal Volume knob (or any of the 4 knobs) until a single beep is heard. The asterisk disappears and the new value is held on the screen. If the value is not committed by pressing a control knob then after 4 seconds the setting will revert to the original value. This process prevents accidental or inadvertent changing of ventilation parameters.

Control setting validation

There are 4 control knobs sitting directly beneath the display of the parameter they control. When adjusting any of the values comparisons are made with existing settings to ensure that settings which exceed the capabilities of the machine are not made. For example if the Inspiratory Time is set to 1.0 seconds then it will be impossible to set the Tidal Volume to anything greater than 17.3L since this would otherwise exceed the machines capacity to deliver the inspiratory stroke at 1000 litres per minute. Similarly a Respiratory Rate of greater than 17 cannot be set if the Inspiratory time is 3.0 seconds and the tidal volume is 17.3L because this would require an expiratory flow rate of over 1000L per minute – if the RR was more than 15 then the Expiratory time would be less than 1 second.

THE CONTROL KNOBS
Tidal Volume: The range is 0.1L to 20.0L in 0.1L increments.
Respiratory Rate: The range is 1 to 30 breaths per minute in 1 BPM increments.
Inspiratory Time: The range is 0.5 to 4.0 in 0.1 second increments.
MWPL: The range is 10cm H_2O to 80cm H_2O in 1 cm increments.

OTHER CONTROLS
Assist: The range is 1 lpm to 200 lpm inspiratory flow, 1 lpm increments**.**
In STANDBY mode
In STANDBY mode, spontaneous breathing, this effort level can be set but is not active until the IPPV/RUN button is pushed. To use the ASSIST function, press the ASSIST button once, the ASSIST button will flash slowly and the MWPL legend on the Control screen will be replaced with the text "SENS" for sensitivity followed by a value e.g. 60 LPM. This value of 60 litres per minute is the inspiratory flow rate that the patient must meet or exceed in order to trigger the next IPPV stroke. This will not happen unless the ventilator is in IPPV mode. Pressing the RUN/IPPV button will cause the IPPV button to be lit and the ASSIST button will then remain lit continuously.

In IPPV mode
Alternatively the ASSIST mode can be chosen when the patient is receiving IPPV. In this case the ASSIST mode will be lit continuously to show that the ASSIST mode is active. In this state the ventilator is waiting for an effort from the patient. If this effort level is not met within the time required for 3 breath cycles based on the period dictated by the set RR a mandatory breath is given. If the patient triggers a breath then the timing of the mandatory breath is reset. In either case, the delivered breath will be based on the set TV and I-time. Pressing the RUN/IPPV button will return the ventilator to spontaneous mode and cancel the ASSIST function.

This is a new feature and we currently have no guidelines on values to set. The software offers a range of between 1 LPM and 200 LPM as trigger values. We would welcome feedback on the settings found useful or normal in practice.

CPAP/PEEP   The range is 0 to 50 cmH$_2$O. in 1 cmH$_2$O increments
In Standby Mode
CPAP or Continuous Positive Airway Pressure can he applied during spontaneous breathing. With CPAP patients inspire and expire normally with no added effort, although the end expiratory pressure is elevated to the CPAP setting. This aids in maintaining open alveoae. The airway pressure is held constant during all phases of spontaneous breathing.

In Ventilator Mode
During IPPV the term PEEP or Positive End Expiratory Pressure applies. Ventilating pressures rise during the Inspiratory phase as normal, but are allowed only to fall as far as the PEEP setting during expiration.

Dump valve button

The dump valve button affords you manual control of the electronic pop-off valve. This is useful when you want to empty the "bag" into the scavenging system at the end of a case or to quickly drop the anaesthetic concentration by replacing the gas under the piston with anaesthetic free oxygen. To do this first apply 2 cmH$_2$O of PEEP then push the dump button. The valve will open for a minimum of 1 second or if held for 1 second after the button is released. After the dump valve closes use the O$_2$ flush button to refill the cylinder.

Controls on the Anesthesia Machine Side

These include the oxygen flowmeter, air and N$_2$O flowmeters if fitted, the scavenging flowmeter and the dump valve switch.

Oxygen Flowmeter

The oxygen flowmeter has a 0 -10 lpm scale but considerably more flow can be delivered when the ball is off the top of the scale. Use this flowmeter as you would on any other anaesthesia machine.

Air Flowmeter

An optional air flowmeter with either a yellow knob or a black and white knob may be installed on your machine as seen to the right on T19 which was built for use in America hence the yellow knob. This allows the user to be able to adjust the FiO_2 delivered to the breathing system.

The nomogram shown below can be used as a guide for setting the FiO_2 but it is easy to remember that:

> Equal flows of air and oxygen yields 60% O_2
> 3 times as much air as oxygen yields 40% O_2
> 3 times as much oxygen as air yields 80% O_2

N_2O Flowmeter

Although the use of N_2O is much a thing of the past this option is still available but should never be used without a working oxygen analyzer.

ΤΑΦΟΝΙUS and Spontaneous Breathing

View the Piston as a "Virtual bag

When the ventilator is idle and a patient is connected, the system behaves like a 'perfect' bag. By a perfect bag we mean that when the patient breathes out there is no expiratory resistance and when the patient breathes in there is no inspiratory resistance. This action is possible because the airway pressure is sensed at the centre of the Y-piece. As soon as a pressure deviation in excess of 0.5 cmH_2O from the ambient pressure is detected the piston is moved so as to negate this pressure change. If the patient breathes out then the piston withdraws, effectively filling. If the patient inspires then the piston moves down, effectively emptying. Because a motor drives the piston it is the motor that overcomes the resistances of any piping, valve or soda lime. To the patient it feels like breathing to room air with no resistance.

Dictating the size of the "Virtual Bag"

The size bag you use on your anaesthesia machine depends on the size of the patient. The breathing bag must be large enough to hold the largest size breath the patient may take. But it should not be overly large because the excess volume increases the time constant of the breathing system making it take longer for changes in vaporizer settings or the FiO_2 setting equilibrate and take effect.

The tidal volume and the concept of fixed buffer volumes control the size of the "Virtual Bag", the volume under the piston, in Tafonius.

There are two fixed buffer volumes; an upper and a lower. The lower buffer volume is 1.5L and the upper buffer volume is 1.0L. These volumes are constant and are added to the tidal volume setting to determine the minimum "Bag" size and to create upper and lower volume limits.

The upper volume limit = Lower Buffer + Tidal Volume + Upper Buffer.
The lower volume limit = Lower Buffer
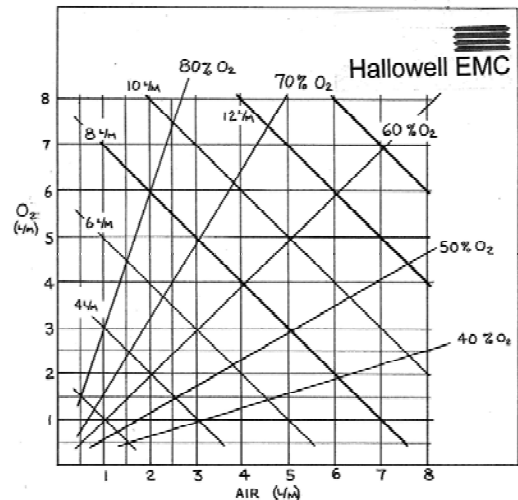
TAFONIUS Auxiliary Mode Operating Manual

Whenever the piston volume exceeds the upper limit, gas is removed from the system. If the piston volume falls below the lower limit then gas is added to the system.

Example 1:
A 300kg patient breathing spontaneously
Rule of thumb would suggest setting the TV control to 3.0L
The upper limit of the piston volume is then 1.5 + 3.0 + 1.0 L = **5.5L**
The lower limit of the piston volume is **1.5L** (it is always 1.5L)

If the patient has just been induced, initial gas flow rates may be of the order of 5-10L per minute. This will tend to fill the system.

Whenever the piston volume exceeds the 5.5L limit the piston stops rising and some gas will be discharged from the system through the electronically controlled Dump Valve. Whenever the piston volume falls below 1.5L, say with a big inspiratory effort from the patient, then an extra 1.0L of oxygen will be added to the system through the vaporiser automatically. In this manner the system is kept at a fairly constant volume of around 5.5L.

If the breathing of the patient is erratic and the piston repeatedly enters the upper and lower limits then it would be appropriate to increase the tidal volume setting until the patient settled, this would increase the "Bag" size temporarily. The tidal volume must be returned to the desired setting when IPPV is required otherwise the extra volume will be delivered to the patient.

Example 2:
A 300kg patient being ventilated with IPPV
Tidal volume set to 3.0L.
The upper and lower limits are the same as before: 5.5L and 1.5L respectively.

The tidal volume setting is then increased to 4.0. This increases the upper limit to 6.5L so the piston is allowed to rise to that level by virtue of the continuously flowing fresh gas flow into the system.

Ventilation measurements during Spontaneous Mode
In Spontaneous or Standby mode the piston position is constantly monitored and will display patient breathing parameters when regular cyclic movements are detected. The values are updated at the beginning of each expiratory phase and show the values for the last breath cycle. The values in parentheses above the Tidal Volume, Respiratory Rate and Inspiratory Time legends are measurements of the respective parameter. The value above the MWPL legend is the maximum airway pressure measured during the last breath cycle. The dependant parameters such as minute Volume, Inspiratory Flow etc are not affected by these measurements and reflect only the settings of the control values.

TAFONIUS and IPPV

Changing between spontaneous breathing mode (standby mode) and ventilation mode is very simple and can be done at any time. As soon as the IPPV / RUN switch is pressed it will illuminate to indicate machine is in IPPV mode and immediately an inspiratory phase begins delivering the tidal volume as set by the TV control. To stop IPPV at any time, simply press the IPPV / RUN switch again. The switch light will go out and the unit will return to standby mode.

In IPPV mode the tidal volume is delivered in the time set by the Inspiratory Time setting (see Control Setting Validation for an explanation of how settings are restricted). After the tidal volume has been delivered then the expiratory phase begins. In the expiratory phase the piston immediately behaves like a "Bag" and allows the patient to breathe out raising the

piston. The piston stays in this state until the end of the expiratory time when the inspiratory phase begins again and the piston is driven downwards delivering gas to the patient.

At all times the piston image on the screen shows the position and actual volume under the piston.

Warning Messages – Alerts and Alarms

There are two levels of warning messages seen whilst operating in auxiliary mode:

Alerts

These messages are accompanied by an initial 2-second audible beep but are then silent. A flashing text message will appear on the screen in Area 1, where the ⊤⅄ꟻ𐊫𐊪ⅠⅡⅤꟻ logo normally sits. alerts are non-critical events encountered during normal operation.

To clear an alert manually press and hold any of the 4 control knobs until two beeps are heard. Here is a list of the alerts.

BATTERY1 LOW VOLTAGE and/or
BATTERY2 LOW VOLTAGE

The indicated battery has a low voltage. This is normally because the machine is being operated without the mains connected. Connect the mains supply and make sure the RCD or GFCI switch at the back of the machine is on.

The alert will stay on screen until cleared. Unless the problem has been resolved the alert will return.

MAX PRESSURE EXCEEDED LIMIT

The airway pressure exceeded the setting of the Maximum Working Pressure Limit. The alert will stay on screen until cleared manually.

LOW SYSTEM RESERVE VOLUME

The piston has entered the lower buffer volume of 1.5L. If this is during an active inspiratory phase then gas will automatically be added through the vaporiser. If the vaporiser is off then gas will still be added, but without agent.

When the piston moves out of the lower buffer zone then the alert will self clear.

CYLINDER EMPTY/OUT OF RESERVE

The piston is at the lower most position, i.e. zero volume. If this is during the inspiratory phase then the full tidal volume will not have been delivered.

When the piston moves away from the zero point the alert will be cleared.

SYSTEM FULL

The piston is at the most full position i.e. maximum volume. The Dump Valve will be opened to allow gas to escape and prevent pressure building up.

When the piston moves away from the top point the alert will be cleared.

CYLINDER OPEN

The cylinder mechanism has been opened. Ventilation will be inhibited in this condition.

When the cylinder is closed the alert will be cleared.

PISTON POSITION INFO ERROR

The piston position reported from the motor is incorrect. This is usually transient and is self correcting. Any permanent loss of position information will result in an alarm condition.

The alert will stay on screen until cleared manually.

Alarms

These messages are accompanied by a repeating intermittent beep of approximately 1 second duration. A flashing text message will appear on the screen in area 1, where the TΛFONIUS logo normally sits. Alarms are critical events that have serious implications for the efficient ventilation or support of the patient. Each alarm that is shown on the screen will have an asterisk at each end of the text, e.g.:

* OXYGEN SUPPLY PRESSURE LOW *

To clear an alarm manually press and hold any of the 4 control knobs until two beeps are heard. Here is a list of the alarms.

* LOW BREATHING SYSTEM PRESSURE *
This Alarm occurs when, at the end of an inspiratory phase during IPPV or Assist, a maximum pressure of 2cm H2O has not been reached. This can occur when the patient has become disconnected from the system. It can also occur when the patient takes a breath at the same time as the ventilator delivers a breath.

The Alarm will continue until either a pressure in excess of 2cm H_2O is registered during an inspiratory phase OR the alarm is cleared manually.

* OXYGEN SUPPLY PRESSURE LOW *
The piped oxygen pressure, whether it is from the hospital supply Line, or from the E-cylinders has fallen below 40 psi. This alarm can only be cleared by connecting a source of oxygen with a pressure greater than 40psi.

* BATTERY 1 CRITICALLY LOW * and/or
* BATTERY 2 CRITICALLY LOW *
Either one of the batteries voltage has reached the critical level. Below this level ventilator function may be severely compromised, particularly with regard to piston movement and the action of the Dump Valve. **The ventilator must be connected to the mains supply immediately.**

* ENCODER BOARD HAS FAILED *
The circuit board for the front control knobs has failed to respond to the main controller. It will not be possible to change any of the ventilation settings. **This is a critical error and the patient should be changed to manual ventilation.**

* CHECK POSITION SENSORS *
The lower or upper position sensor has been moved or is faulty. Check the alignment marks of the position sensors on the piston actuator. Without a lower position sensor the ventilator cannot be initialised and will not run. **The patient should be changed to manual ventilation.**

* RD VACUUM FAILURE *
The vacuum level in the double diaphragm has fallen below a critical level. Continued use of the ventilator will result in severe damage to the piston assembly. The vacuum level must be restored before ventilation is re-enabled. Check the connections of the hose at the vacuum port on the ventilator cylinder. **Until the vacuum has been restored the patient should be changed to manual ventilation.**

TAFONIUS JUNIOR

J2

A USERS GUIDE

v01Jun2017

Notes:

TAFONIUS JUNIOR – A User Guide

Table of Contents

An Overview

There are two versions of JUNIOR. Junior w/gas has a circle system and gas controls the other is a ventilator only, JUNIOR sans gas, for use with an existing gas machine.

JUNIOR sans gas

Shown here with a Matrx VML by Midmark gas machine head.

Optional IV Pole

Control Panel and Display

LA Circle System

Scavenging Flowmeter

Servo Motor

Ventilator to Breathing Bag Connection

Piston Cylinder

6" (152mm) Locking Front Casters

TAFONIUS JUNIOR – A User Guide

Patient Wye Protection Ring
(when you drop it, it'll bounce)
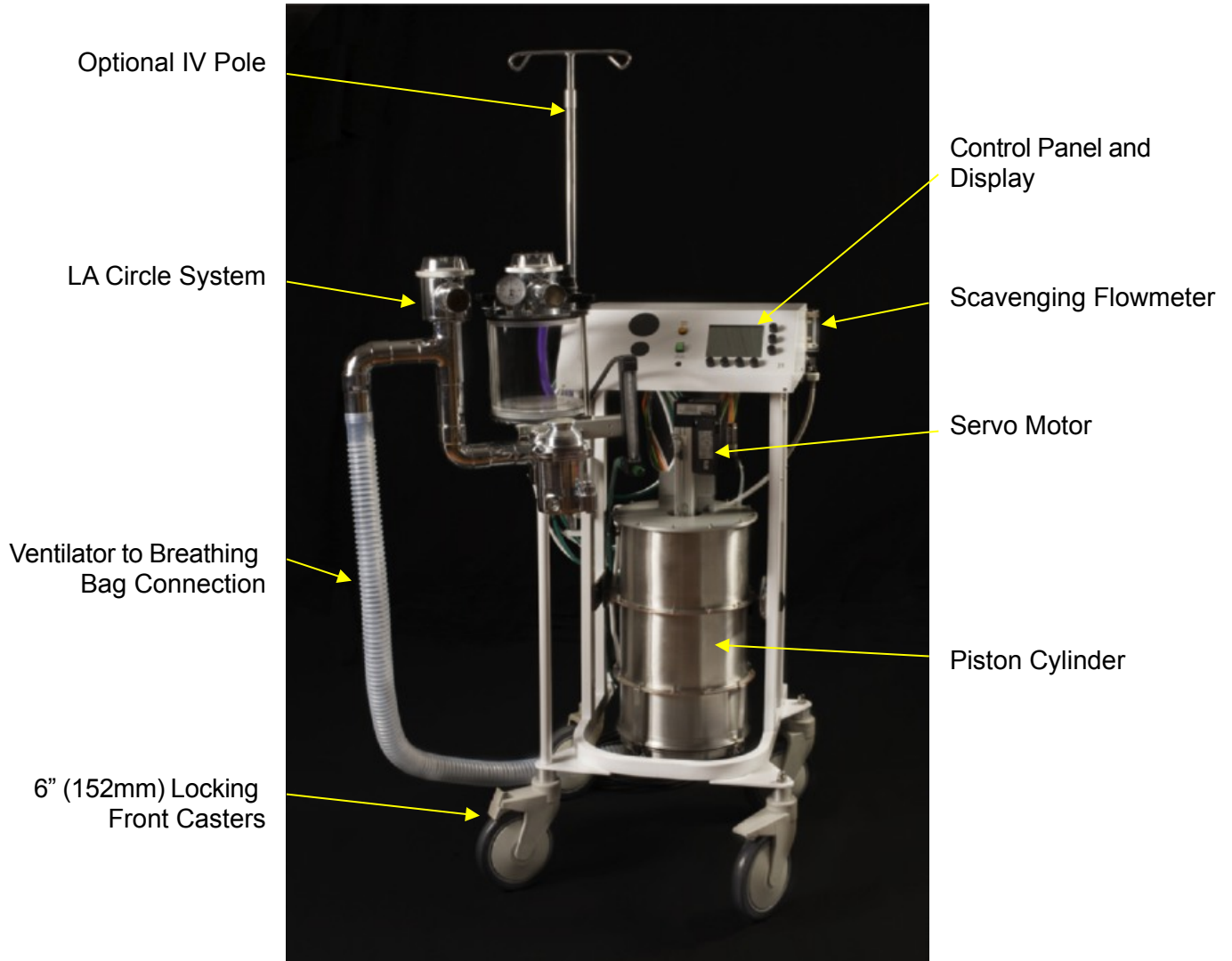
Scavenging flowmeter

Mains fuses

RCD / GFCI mains breaker

Optional two position Select-a-TEC backbar

Power cord & Gas hose hanging straps

Four position gas connection plate

Vacuum Sensing Port

Vacuum Inlet Port

Piston Cylinder

CO2 Absorbent Pan

Locking Front Casters

Cylinder Opening plate
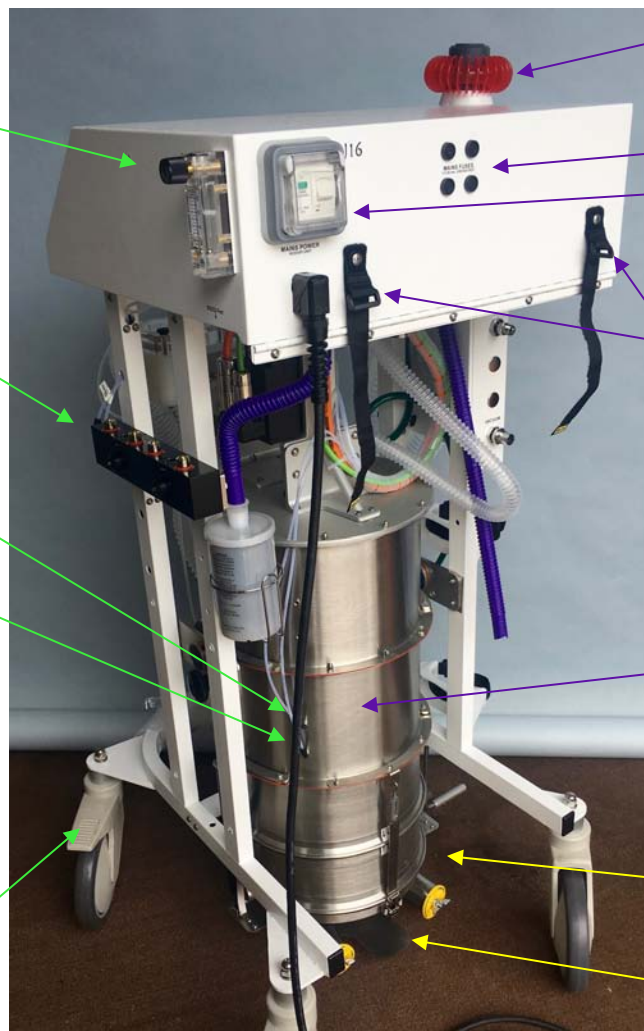
Dump Valve button

qVGA Display

Assist button

CPAP / PEEP button

Ventilate / Standby button

Add-a-Litre on/off

Breathing System Pressure

Hospital Oxygen Pressure

Oxygen Flush
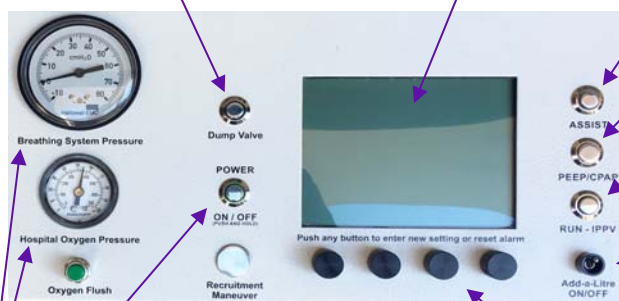
Soft Power Switch

Only on Junior w/gas

Future RM button

TV, RR, It & MWPL controls
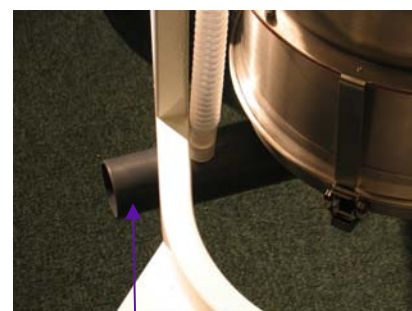
2" (54mm) Breathing Circuit connection port

JUNIOR with gas

This version has the same circle system as the full TAFONIUS s well as mounting space for two vaporizers and two flowmeters, oxygen and air. Only features additional to those in the ventilator only version above are labeled below.

Patient Wye

Oxygen flowmeter

2" (54 mm) Breathing tubes

Inspiratory/Expiratory Valve Block

Breathing system pressure manometer

Oxygen supply pressure gauge

Oxygen flush button

Vaporizer mounting locations

CO2 Absorber pan

Double bottom pan
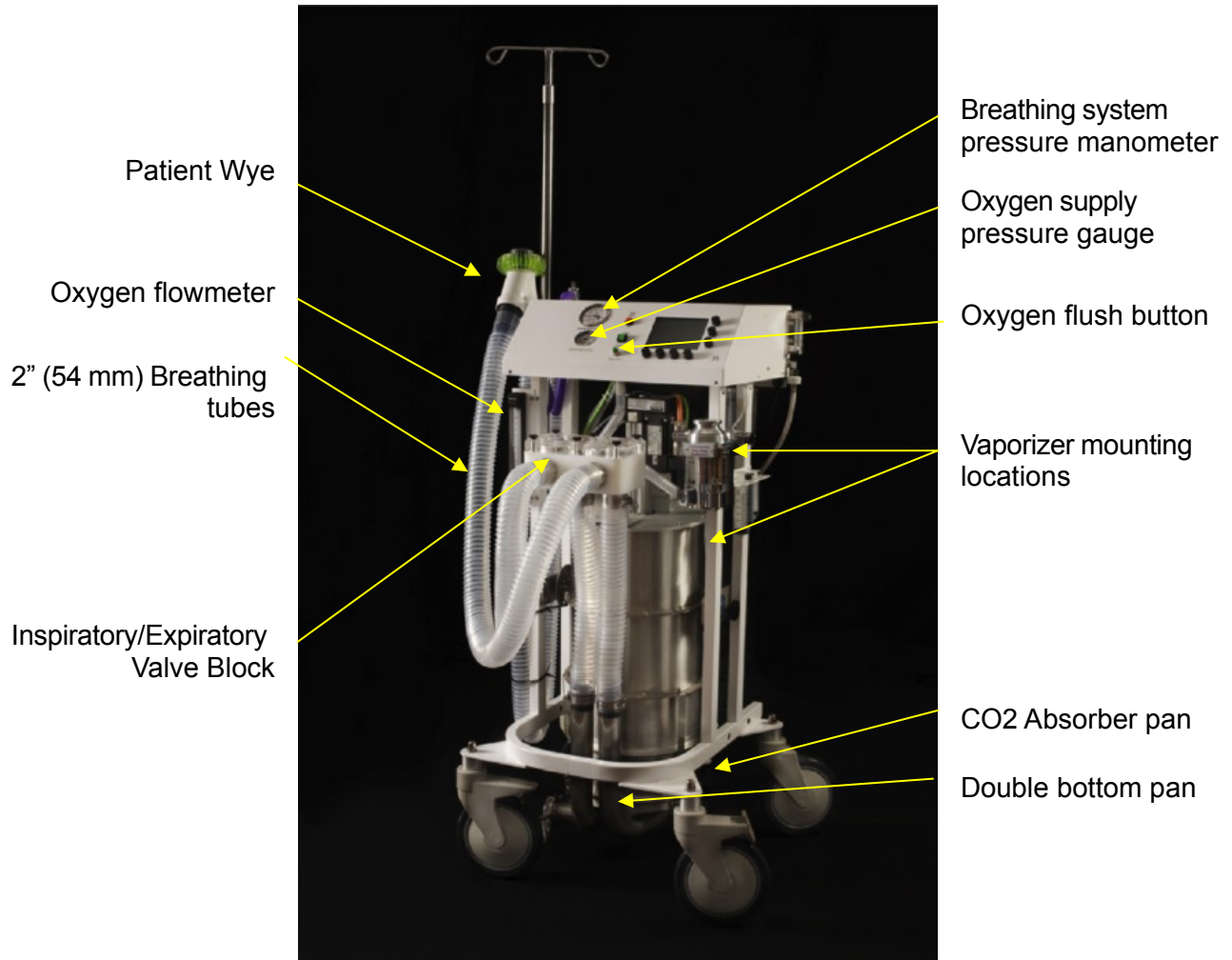
This version of the Users Guide contains information for machines running software version 6021.

Turning JUNIOR On
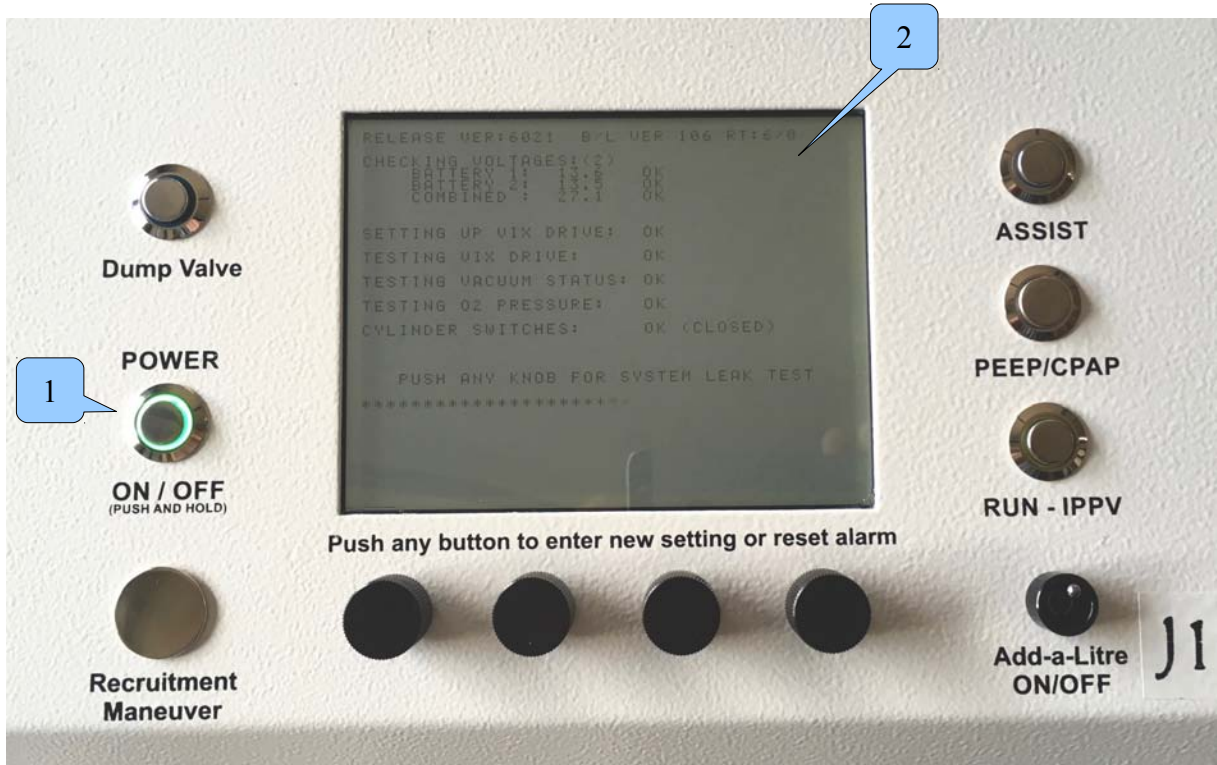
Press the soft ON/OFF control button (1). The Control screen (2) and the soft ON/OFF control button immediately illuminate. The vacuum pump will be heard as the control screen begins to display the power on sequence seen above.

Controller Start Up Sequence

The first line tells you what versions of software running. In this case it is version 6021 with Boot Loader ver. 106 followed buy the Runtime in the format <hours on / hours ventilating>

Next the battery voltages are checked. The result of this and each subsequent test is displayed on the screen. Each successful test is accompanied by a double-beep and a triple-beep when all tests have passed. Should a test fail the cause and instructions for a resolution will be displayed.

The ViX drive is the circuit component that actually runs the servomotor on the linear actuator that moves the piston. First it is setup and communications with it is established then it is tested.

Last the vacuum status is evaluated.
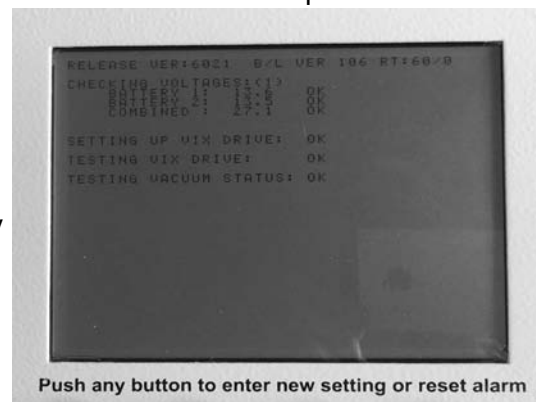
Pressure sensor setup

Following the vacuum test the option is provided for adjusting the zero offset of the pressure transduce. It will be the very rare occasion that this feature is used.

The user has 5 seconds to push any of the rotary knobs to enter the Pressure Sensor setup screen. If there is a discrepancy between the two offset values seen on the screen below, it usually indicates some problem other that pressure sensor drift. Most frequently you'll find water in the pressure sampling line. It is recommended that you blow out the pressure sensing line on a regular basis. To do this remover the sensing line from the underside of the main control box and flush the line out with air from a syringe.
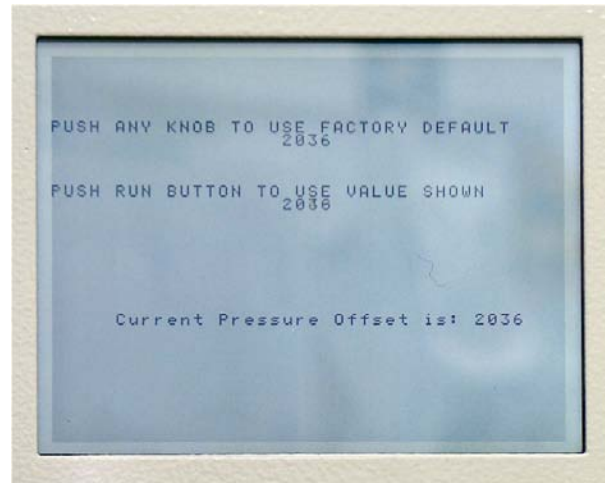
Leak Testing

After the pressure sensor setup the operator is given the chance to leak test the system. Press any of the 4 knobs under the screen within 5 seconds and this screen to the right is displayed.

Follow the instructions on the screen. Fit a stopper to the patient wye piece, turn on the gas flow to bring the breathing system pressure up to 20 cmH$_2$O. Adjust the flow rate to hold the pressure steady at 20 cmH$_2$O. The flow observed on the flowmeter is the leak rate at that pressure. When satisfied press the RUN button to continue.
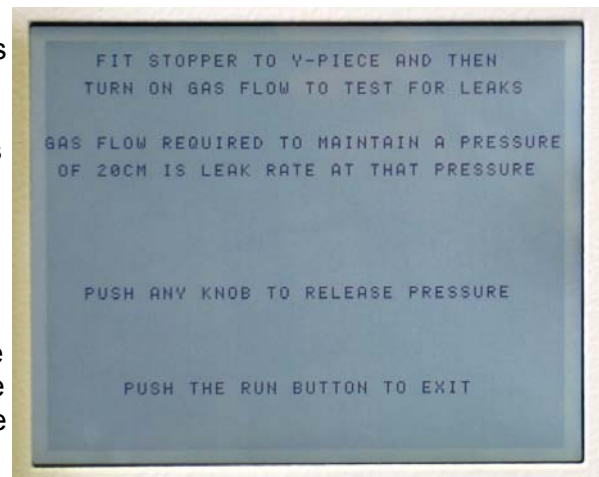
Initialising the Piston

After the leak test has been completed or skipped this text to the right appears:
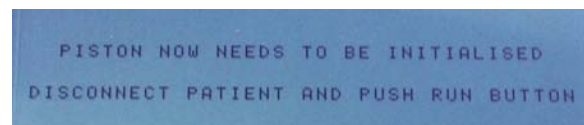
Before JUNIOR can be used the system needs to locate the zero position, the bottom of travel, of the piston.

The RUN button will be flashing, and the screen seen above will be waiting for the user to be sure there is nothing attached to the patient Y-piece before pushing the RUN button to instruct Junior to zero the piston. Once the button is pushed the screen shows the message **MOVING PISTON TO ZERO POINT.** During this piston movement the airway pressure is monitored. If there is a patient attached or an obstruction to airflow then the following message appears.

Clear the obstruction or remove the patient before continuing. Once the piston reaches the
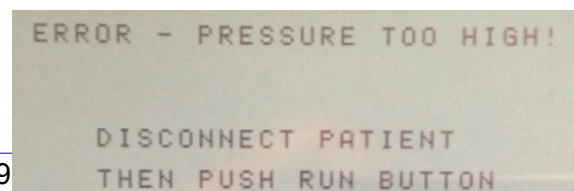
bottom of its travel, a zero reading is taken and **ZEROING PISTON POSITON** is displayed briefly, a beep is heard.

The control screen below is displayed but the piston is left at the very bottom and the warning "CYLINDER EMPTY / OUT OF RESERVE" flashes in area 1 (see below) waiting for the user to pre-fill the system with oxygen and anaesthetic before induction.

JUNIOR is ready for use.

The Control Screen

1) Status And Message Information

2) Piston Graphic And Settings Information

3) Resultant Ventilation Values

4) Ventilator Settings & Measured Values
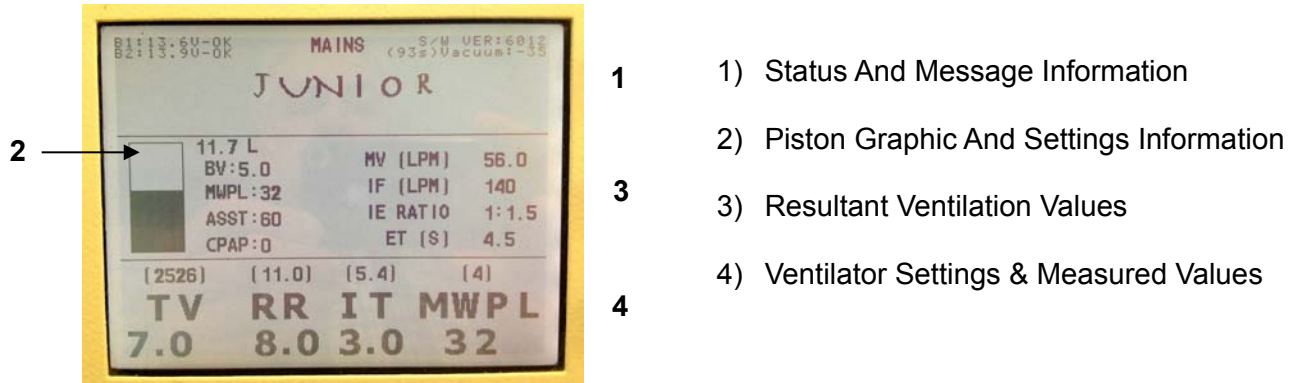
The Control screen is divided into 4 main regions:

1) Status and message information
Area 1 shows status information on the system batteries, left. Displayed is the actual voltages of the two batteries used in JUNIOR and whether or not they are being charged. The centre area indicates whether the machine is running on MAINS or BATTery power. The software version is displayed in the upper right and the vacuum level around the piston with the duration in seconds since the last vacuum cycle below that. When there are no warning or error messages, the name JUNIOR is displayed in this area as seen above. The display of warning and error messages will replace the machine name when they occur.

2) Piston Graphic and Settings Information
Area 2 shows a representation of the piston. The dark area represents the volume of gas under the piston and the numerical value at the top of the list to the right displays the amount in litres (L). The piston position and volume are constantly updated showing the position of the piston at all times. Two asterisks (* *) will appear at the top of the piston area whenever the Dump Valve, the electric pop-off valve, is open.

Below the volume display are four settings that are not otherwise always display on the screen.

BV
The **B**uffer **V**olume is displayed in litres. What the Buffer Volume is and how it is used is described below in the section "Dictating the size of the "Virtual Bag"

MWPL
The **M**aximum **W**orking **P**ressure **L**imit, in cmH$_2$O, is generally seen above the right most control knob used to set its value however it will not be displayed there when

using the Assist Mode. The MWPL is set as a high-pressure safety limit the value of which is continuously compared to the breathing system pressure. JUNIOR is a volume or time cycled ventilator so the MWPL does NOT set how high the pressure will go but if the pressure should reach the set level the machine will alarm immediately, terminate the inspiration and switch to the expiratory phase of the breathing cycle.

ASST

Assist is a mode of ventilation which compares the patient's effort to breathe with a set value of inspiratory flow. Should the patient reach or exceed that setting an assisted breath is delivered by the ventilator. Should the patients breathing not be strong enough to reach or exceed that amount of inspiratory flow within a certain time the ventilator will give a controlled breath. The value next to the text **ASST** is the level of inspiratory flow, in liters per minute that must be generated by the patient to trigger an assisted breath.

CPAP / PEEP

The set CPAP or PEEP pressure setting is displayed in cm H_2O at the bottom of the list.

3) Resultant Ventilation values

Area 3 shows the values that result from the settings of the independent variables Tidal Volume, Respiratory Rate and Inspiratory Time. The dependent variables displayed in this area are Minute Volume (MV) in liters per minute (lpm), Inspiratory Flow Rate (IF) in lpm, I:E Ratio and Expiratory Time (ET) in seconds. These are updated whenever a ventilation parameter is changed. This feature allows the user to see how other parameters are affected by the change being made. One can therefore "set" a dependent variable. For example you can set the MV by changing the TV and or the RR and watch the resulting affect on the MV display. Similarly one could "set" the I:E Ratio by changing the RR and or the I-time. The I:E ratio display will flash on and off when the settings result in an inverse I:E ratio, i.e. less that 1:1

4) Patient Ventilator settings & Measured values

Area 4 shows the values set by the operator for Tidal Volume (**TV**), Respiratory Rate (**RR**), Inspiratory Time (**IT**) and Maximum Working Pressure Limit (**MWPL**) or Trigger sensitivity level (**SENS**) when assist mode is selected. The values in parentheses above these settings are the measured values taken during spontaneous breathing.

Tafonius Junior displays information that no other large animal ventilator is able to display. Take advantage of this information, get use to it, think about it. Especially the Minute Volume (MV) value. MV is the parameter to observe to quantitatively assess the change in gas delivery by the ventilator as you change settings. It is this number that must be changed to raise or lower the PaCO2 all other things being constant. There are many ways to manipulate this setting. Depending on the pathophysiology of the patient there will be better ways that other ways to attain the MV delivery desired.

For example in colic cases already high abdominal pressure pose a unique challenge to the implementation of IPPV. If an increase in MV is required in an attempt to bring the PaCO2 levels down it would be better to increase the RR than the TV. By watching the MV setting it is much easier to quantify the change your making.

Ventilator Controls

JUNIOR'S ventilator is controlled via the 4 control knobs below the Control screen, the RUN/IPPV button, Assist button, CPAP/PEEP button, Oxygen Flush button, Dump Valve button and the soft power ON/OFF switch.

Setting Values using the control knobs – Change & Commit
The process of setting any value uses the concept of "Change & Commit".

Turning the Tidal Volume knob for example will change the value displayed and an asterisk will appear next to the changed value. To commit this new value push in the Tidal Volume knob (or any of the 4 knobs) and hold it until a single beep is heard. The asterisk disappears and the new value is committed to memory. If the value is not committed by pressing a control knob then after 4 seconds the setting will revert to the original value. This process prevents accidental or inadvertent changing of ventilation parameters.

Control setting validation
There are 4 control knobs sitting directly beneath the display of the parameter they control. When adjusting any of the values calculations are made with the settings of the other parameters to ensure that the new combination of settings will not exceed the capabilities of the machine. For example if the Inspiratory Time is set to 1.0 seconds then it will be impossible to set the Tidal Volume to anything greater than 15.0L since this combination would exceed the machines maximum capacity of 900 lpm inspiratory flow. When a limit is reached the setting will not advance as the knob is turned.

THE CONTROL KNOBS
Tidal Volume:	The range is 0.1L to 20.0L in 0.1L increments.
Respiratory Rate:	The range is 1 to 20 breaths per minute.
	0.2 bpm increments between 1 and 2 bpm,
	0.5 bpm increments between 2 and 5 bpm and
	1 bpm increments between 5 and 20 bpm.
Inspiratory Time:	The range is 0.5 to 4.0 in 0.1 second increments.
MWPL:	The range is 10 to 80 cmH_2O in 1 cmH_2O increments.

LIMITS IMPOSED ON SETTINGS
Inspiratory Flow	Maximum of 900 lpm
Expiratory time	Minimum of 0.5 seconds

OTHER CONTROLS
Assist:
When the Assist mode button is pressed you will notice the RR setting changes to 1/3 of its current value. This is the new RR that determines the period at which controlled breaths will be delivered if the patient does not trigger a breath before then. When the patient triggers an assisted breath the period till the next controlled breath is reset. Another way to put this is that during assist mode ventilation if the patient does not trigger a breath within 3 periods of the original RR setting (the RR displayed when the Assist mode was entered) the ventilator will deliver a controlled breath.

Before Pressing Assist
After Pressing Assist

Changing the RR has effect on the dependent parameters MV, I:E and E-time, you will note that these displays change along with the RR when the assist button was pushed thereby entering the Assist mode. By observing these parameters you will know the minimum ventilation Junior will deliver should the patients breathing cease and

never triggers a breath.   **While in Assist Mode, you should verify that the settings as displayed will ALWAYS be enough to sustain the life of the patient.**

The trigger range settable is 1 lpm to 200 lpm inspiratory flow, 1 lpm increments.   Junior behaves somewhat differently if you enter Assist Mode while in Standby or IPPV mode.

In STANDBY mode:
In STANDBY mode, spontaneous breathing, the effort level can be set but is not active until the IPPV/RUN button is pushed. To enter the ASSIST mode, press the ASSIST button once, the ASSIST button will flash slowly and the MWPL legend on the Control screen will be replaced with the text "SENS" for SENSitivity followed by a value e.g. 60 LPM. This value of 60 litres per minute is the inspiratory flow rate that the patient must meet or exceed in order to trigger an assisted breath. This will not happen unless the ventilator is in IPPV mode. Pressing the RUN/IPPV button will cause the IPPV button to be lit, the ASSIST button will stop flashing, remain lit and the assist mode to become active.

In IPPV mode:
ASSIST mode can also be chosen when the patient is receiving IPPV. In this case the ASSIST mode button will be lit continuously to show that the ASSIST mode is active. In this state the ventilator is waiting for an effort from the patient. If this effort level is not met within the time required a mandatory breath is given. If the patient triggers a breath then the timing of the mandatory breath is reset. In either case, the delivered breath will be based on the set TV and I-time. Pressing the RUN/IPPV button will return the ventilator to spontaneous mode and cancel the ASSIST function.

This is a new feature and we currently have no guidelines on sensitivity values to set. The software offers a range of between 1 LPM and 200 LPM as trigger values. We would welcome feedback on the settings found useful or normal in practice.

CPAP/PEEP
The range is 0 to 50 cmH_2O in 1 cmH_2O increments.

In Standby Mode:
CPAP or Continuous Positive Airway Pressure can he applied during spontaneous breathing. With CPAP applied patients inspire and expire normally with no added effort, the end expiratory pressure is held elevated to the CPAP setting. This aids in maintaining open alveoae. The airway pressure is held constant during all phases of spontaneous breathing. The same happens should the patient take a breath during IPPV when PEEP is applied as described below.

In Ventilator Mode:
During IPPV the term PEEP or Positive End Expiratory Pressure applies and the display changes accordingly. Ventilating pressures rise during the Inspiratory phase as normal, but are allowed only to fall as far as the PEEP setting during expiration. Unlike traditional PEEP where the airway pressure would drop to zero or negative should the animal take a breath Junior maintains the PEEP level during the spontaneous breath.

Dump Valve Button
The dump valve button affords you manual control of the dump valve which is the electronic pop-off valve. This is useful when you want to empty the "bag" so to speak, actually dump the volume under the piston into the scavenging system at the end of a case or to quickly drop the anaesthetic concentration by replacing the gas under the piston with anaesthetic free oxygen. To do this press the DV button and hold it until the volume under the piston drops to the desired level. After the dump valve closes use the O_2 flush button to refill the

cylinder. Our service technician can set the rate at which the volume under the piston is eliminated. If you would prefer it work faster or slower give us a call we can make the change for you over the internet.

Buffer Volume Setting
To set the buffer volume depress the TV control and hold it for 3 seconds. The TV display in section 4 of the screen will change to BV, release the knob. Turn the knob to the desired setting and depress it again to save the new setting. The BV value on the display will update with the new BV setting and the knob will revert to controlling the set TV. The default BV setting is 5.0 liters.

Controls on the Anaesthesia Machine Side
These controls are on TAFONIUS JUNIOR w/gas and include the oxygen flowmeter, air and N_2O flowmeters if fitted, the oxygen flush button and scavenging flowmeter. If you have the version of JUNIOR that is sans gas (the ventilator only) these controls would be found on your existing anaesthesia machine if fitted.

Oxygen Flowmeter
The oxygen flowmeter has a 0 -10 lpm scale but considerably more flow can be delivered when the ball is off the top of the scale. Use this flowmeter as you would on any other anaesthesia machine.

Air Flowmeter
An optional air flowmeter with either a yellow knob for the US or a black and white knob for most other countries may be installed on your machine. This allows the user to adjust the FiO_2 delivered to the breathing system.

The nomogram shown below can be used as a guide for setting the FiO_2 but it is easy to remember that:

   Equal flows of air and oxygen yields 60% O_2
   3 times as much air as oxygen yields 40% O_2
   3 times as much oxygen as air yields 80% O_2

N₂O Flowmeter
Although the use of N_2O is much a thing of the past this option is still available but should never be used without a working oxygen analyzer in the breathing circuit.

Oxygen Flush Button
The oxygen flush button delivers a high flow of pure oxygen to the breathing system without going through the vaporizer. It is generally used to fill the system quickly or to quickly dilute the anaesthetic concentration in the system.

Scavenging Flowmeter
This flowmeter is located on the right side near the rear of the machine. It is used only when the machine is connected to a central vacuum system such as is used for surgical suction. Adjust the scavenging flow to the minimum flow possible to extend the life of your vacuum pump. The scavenging flow should be set enough to keep the reservoir bag flat at most times.
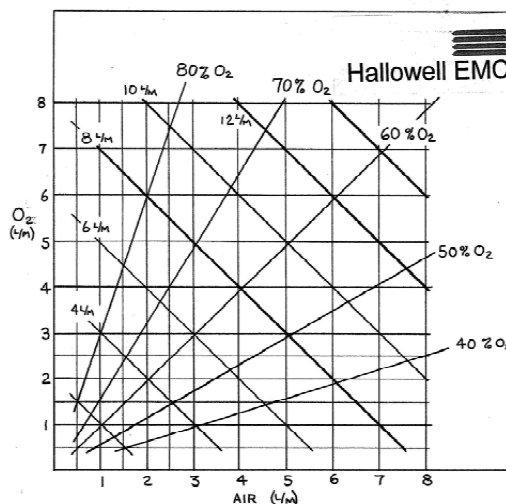
Pressure Gauges

Junior w/gas also has 2 pressure guages on the front panel. One for Breathing System Pressure the range of which is -10 – +60 cmH$_2$O and one for Oxygen Supply pressure with a full scale of 100psi (700kPa).

JUNIOR and Spontaneous Breathing

Thinking of the Piston as a "Virtual bag

When the ventilator is idle and a patient is connected, the system behaves like a 'perfect' bag. By a perfect bag we mean that when the patient breathes out there is no expiratory resistance and when the patient breathes in there is no inspiratory resistance. This action is possible because the airway pressure is sensed at the centre of the Y-piece. As soon as a pressure deviation in excess of 0.5 cmH$_2$O from the ambient pressure is detected the piston is moved so as to negate this pressure change. If the patient breathes out then the piston withdraws, effectively filling. If the patient inspires then the piston moves down, effectively emptying. Because a motor drives the piston it is the motor that overcomes the resistances of any piping, valving or soda lime. To the patient it feels like breathing to room air with no resistance.

Dictating the size of the "Virtual Bag"

The size bag you use on your anaesthesia machine depends on the size of the patient. The breathing bag must be large enough to hold the largest size breath the patient may take. But it should not be overly large because the excess volume increases the time constant of the breathing system making it take longer for changes in vaporizer settings or the FiO$_2$ setting equilibrate and take effect.

The tidal volume and the concept of a buffer volume are used to control the size of the "Virtual Bag", the volume under the piston, in JUNIOR . The piston is not allowed to rise above the combined volumes of TV + BV. Whenever the piston volume reaches this upper limit, gas is allowed to flow out to the scavenging system.

In this manor JUNIOR is changing the Virtual bag size every time you change the TV.

Add-a-Litre feature

In addition to continually managing the maximum volume is the system JUNIOR also works to keep a the minimum volume in the system at all times.   JUNIOR considers the piston to be in the low volume zone whenever it dips below the 1.5 litre point. When this happens gas flows into the system during current and subsequent the inspiratory phase(s) until a liter has been added and the **LOW SYSTEM RESERVE VOLUME** alarm will sound.

Example 1:

A 300kg patient breathing spontaneously. Rule of thumb would suggest setting the TV control to 3.0L in preparation for IPPV. The BV is set to its default of 5.0L. The upper limit of the piston volume is then 3.0 + 5.0 L = 8.0L, the patient is effectively breathing from an 8L bag.

Say the patient has just been induced, initial gas flow rates may be of the order of 5-10L per minute. This will tend to fill the system rather quickly.

When the piston volume reaches the 8.0L limit the piston stops rising and the excess gas will be discharged from the system through the electronically controlled Dump Valve. You will hear the dump valve opening and closing as a clunk... clunk. After induction you would turn the fresh-gas-flow down but lets say you turn it down a little to far. The piston volume falls a little breath by breath, the clunking sound will stop, until finally the piston dips below the 1.5L level towards the end of a cycle. At this point an extra 1.0L of gas will be added to

the system through the vaporiser automatically and the **LOW SYSTEM RESERVE VOLUME** alarm will sound momentarily.

Then you decide to increase the tidal volume setting to 4.0L. This increases the upper limit to 9.0L. Doing so will also drive the piston down in to the low volume zone again causing another alarm. At this point it would be prudent to increase the fresh-gas-flow to avoid repeated alarms and allow the piston to rise to a higher level.

Example 2:
Say the breathing of a spontaneously breathing patient is erratic and the piston repeatedly hits the upper limit and dips into the low volume zone it would be appropriate at this point to increase the tidal volume setting to increase the "Bag" size temporarily. If the tidal volume then seems to great for the animal check the buffer volume setting.

Ventilation measurements during Standby Mode
In Standby mode (during spontaneous breathing) the piston position is constantly monitored and will display patient breathing parameters when regular cyclic movements are detected. The values are updated at the beginning of each expiratory phase and show the values for the last breath cycle. The values in parentheses above the Tidal Volume, Respiratory Rate and Inspiratory Time legends are measurements of the respective parameter. The value above the MWPL legend is the maximum airway pressure measured during the last breath cycle. The dependant parameters such as minute volume, inspiratory flow etc are not affected by these measurements and reflect only their calculated values based on the settings for TV, RR and Itime.

JUNIOR and IPPV

Changing between spontaneous breathing mode (standby) and ventilation mode is very simple and can be done at any time. As soon as the IPPV / RUN switch is pressed it will illuminate to indicate machine is in IPPV mode and immediately an inspiratory phase begins delivering the tidal volume as set by the TV and Itime controls. To stop IPPV at any time, simply press the IPPV / RUN switch again. The switch light will go out and the unit will return to standby mode.

In IPPV mode the tidal volume is delivered in the time set by the Inspiratory Time setting (see Control Setting Validation section for an explanation of how settings are restricted). After the tidal volume has been delivered the expiratory phase begins. In the expiratory phase the piston immediately behaves like a "Bag" and allows the patient to breathe out raising the piston as it does. The piston stays in this state until the end of the expiratory time when the inspiratory phase begins again and the piston is driven downwards delivering gas to the patient again.

At all times the piston image on the screen shows the position and actual volume under the piston.

JUNIOR'S Built-in Scavenging Options

Tafonius junior has a unique scavenging interface that will accommodate a passive system, an active system such as the blower-in-box type and an active system such as a centrally plumbed surgical suction system.

The Passive Scavenging System

A passive interface is nothing more that a 19 or 22mm tube that is put through the wall to the outdoors. There is a scavenging port on Junior that will accept either a 19mm or 22mm hose for this purpose. The other port should then be occluded as shown here with the red cap.

The Blower-in-a-Box Active System

If the Blower-in-a-Box Active system is operating properly it should be connected in the same manner as the Passive system above.

The Surgical Suction Type Active Scavenging System

This type of scavenging system is supplied from a wall outlet or ceiling drop via a properly color-coded hose to the DISS or NIST Vacuum or EVAC connector below the scavenging flowmeter at the right rear side of the machine. In addition a 5 litre reservoir bag and f/air canister should be connected as in the picture below. Adjust the scavenging flowmeter to the minimum flow rate that will keep the reservoir bag flat most of the time. This will extend the life of your vacuum pump. For a more detail discussion of this scavenging interface visit http://hallowell.com/media/DOCA3136.pdf

The charcoal canister on the interface performs two duties. It acts as a pressure differential as room air is pulled through it when there is nothing to scavenge and it works as a backup scavenger when the vacuum fails or is disconnected.

Warning Messages – Alerts and Alarms

There are two levels of warning messages alerts and alarms.

Alerts

These messages are accompanied by an initial 2-second audible beep but are then silent. A flashing text message will appear on the screen in Area 1, where the JUNIOR logo is normally displayed. Alerts are non-critical events encountered during normal operation.

To clear an alert manually press and hold any of the 4 control knobs until two beeps are heard. Here is a list of the alerts.

BATTERY1 LOW VOLTAGE and/or
BATTERY2 LOW VOLTAGE
The indicated battery has a low voltage. This is normally because the machine is being operated without the mains connected or it has been left in storage without being connected to the mains. Connect the mains supply and make sure the RCD/GFCI switch at the back of the machine is on.

The alert will stay on screen until cleared. Unless the problem has been resolved the alert will return.

MAX PRESSURE EXCEEDED LIMIT
The airway pressure exceeded the setting of the Maximum Working Pressure Limit. The Alert will stay on screen until cleared manually.

LOW SYSTEM RESERVE VOLUME
The piston has entered the low volume zone at the 1.5L point. If this is during an active inspiratory phase then a litre of gas will automatically be added to the breathing system through the vaporiser. If the vaporiser is off then gas will still be added, but without agent. Continued occurrence of this warning is an indication that the fresh-gas-flow setting is too low and/or there may be a significant leak in the system or past the ET tube.

When the piston moves out of the low volume zone then the alert will self clear.

CYLINDER EMPTY/OUT OF RESERVE
The piston is at the lower most position, i.e. zero volume. If this is during the inspiratory phase then the full tidal volume will not have been delivered.

When the piston moves away from the zero point the alert will self clear.

SYSTEM FULL
The piston is at the most full position i.e. maximum volume. The Dump Valve will be opened to allow gas to escape and prevent pressure building up.

When the piston moves away from the top point the alert will self clear.

PISTON POSITION INFO ERROR
The piston position reported from the motor is incorrect. This is usually transient and is self-correcting. Any permanent loss of position information will result in an alarm condition.

The alert will stay on screen until cleared manually.

Alarms

These messages are accompanied by a repeating intermittent beep of approximately one second duration. A flashing text message will appear on the screen in area 1, where the JUNIOR logo normally sits. Alarms are critical events that have serious implications for the efficient ventilation or support of the patient. Each alarm that is shown on the screen will have an asterisk at each end of the text, e.g.:

<div align="center">

* OXYGEN SUPPLY PRESSURE LOW *

</div>

To clear an alarm manually press and hold any of the 4 control knobs until two beeps are heard. Here is a list of the alarms.

* OXYGEN SUPPLY PRESSURE LOW *
The piped oxygen pressure, whether it is from the hospital supply Line, or from the E-cylinders has fallen below 40 psi. This alarm can only be cleared by connecting a source of oxygen with a pressure greater than 40psi.

* LOW BREATHING SYSTEM PRESSURE *
This Alarm occurs when, at the end of an inspiratory phase during IPPV or Assist, a maximum pressure of 7 cmH$_2$O has not been reached. This can occur when the patient has become disconnected from the system. It can also occur when the patient takes a breath at the same time as the ventilator delivers a breath.

The Alarm will continue until either a pressure in excess of 7cm H$_2$O is registered during an inspiratory phase OR the alarm is cleared manually.

* BATTERY 1 CRITICALLY LOW * and/or
* BATTERY 2 CRITICALLY LOW *
Either one of the batteries voltage has reached the critical level. Below this level ventilator function may be severely compromised, particularly with regard to piston movement and the action of the Dump Valve. **The ventilator must be connected to the mains supply immediately.**

* NO RESPONSE TO INPUT KNOBS *
The circuit board for the front control knobs has failed to respond to the main controller. It will not be possible to change any of the ventilation settings. **This is a critical error and the patient should be changed to manual ventilation.**

* RD VACUUM FAILURE *
The vacuum level in the double diaphragm has fallen below a critical level. Continued use of the ventilator will result in severe damage to the piston assembly. The vacuum level must be restored before ventilation is re-enabled. Check the connections of the hose at the vacuum port on the ventilator cylinder. **Until the vacuum has been restored the patient should be changed to manual ventilation.**

Technical Specifications:

PHYSICAL

Size:	51" x 30" x 24" , Height x Depth x Width
Weight:	135 lbs (61kg) sans gas, ???kg with gas
Construction:	Powder-coated stainless steel and aluminum
Top shelf dimensions	20" W x 13" D; (50cm x 33cm)

ELECTRICAL

Power Input:	90-240v AC 50/60Hz Universal Input
Power consumption:	400W max
Operational voltage:	12v/24v DC Sealed Lead Acid (SLA) Batteries
Battery Charging:	In-built lead-acid chargers @ max 5A charge

CLINICAL

Tidal Volume	0.1 L to 20.0 L
TV settings resolution	100ml
TV accuracy	better that $\pm$ 25ml
Buffer Volume (BV)	2.0 L to 20 L
Respiratory Rate	1.0 to 30.0 bpm
RR settings resolution	@ 1.0 to 2.0 bpm – 0.2 bpm
	@ 2.0 to 5.0 bpm – 0.5 bpm
	@ 5.0 to 30.0 bpm – 1 bpm
Inspiratory Time	0.5 to 4.0 sec
Itime setting resolution	0.1 sec
Maximum Inspiratory Flow Rate	900 lpm
Maximum Working Pressure Limit	10 to 80 cmH_2O
MWPL settings resolution	1 cmH_2O
Low breathing system pressure alarm threshold	7 cmH_2O
CPAP/PEEP	0 to 60 cmH_2O
CPAP/PEEP settings resolution	1 cmH_2O
Assist Trigger Level	1 to 200 lpm inspiratory flow
Trigger setting resolution	1 lpm
Mounting space to accommodate	2 cage mount vaporizers
	2 gas flowmeters
	2 e-cylinders
	2 IV poles
	2 syringe/ET tube holders

TAFONIUS Troubleshooting guide

Portions of this document to not pertain to Tafonius Jr.

System leaks

If the Leak & Compliance test reports an excessive leak, check the following:

1) Check that the plug used to seal the patient connection on the Y-piece is fitted correctly and not leaking

2) Check that the absorber pan is seated correctly in position. The central divider of the pan must run front to back so that the groove under the pan fits onto the orange silicone rubber seal (A) on the bottom pan:
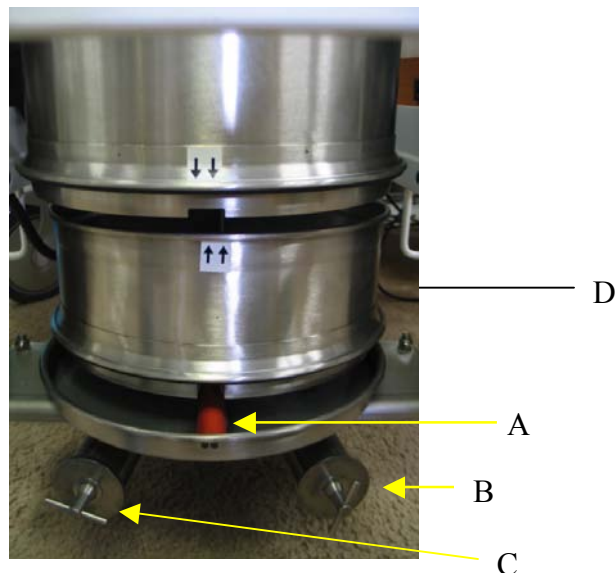
3) Check that the 3 drain plugs on the bottom pan are fitted and securely fastened. (B&C in above photo and D in photo below)
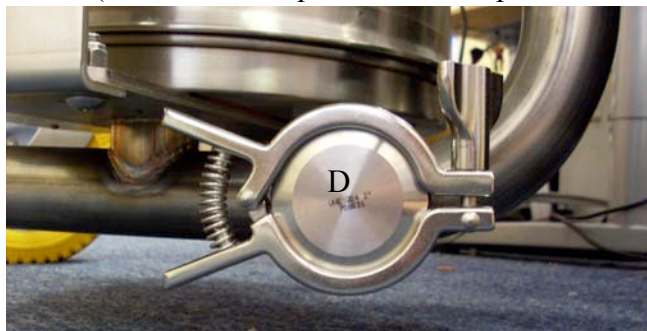
4) Check that the Perspex (Plexiglas) cover of the swivel valve assembly has been fitted correctly. It is possible to fit this part with one of the 'O' rings not located in its groove, which will allow a large leak. If in doubt remove and replace.
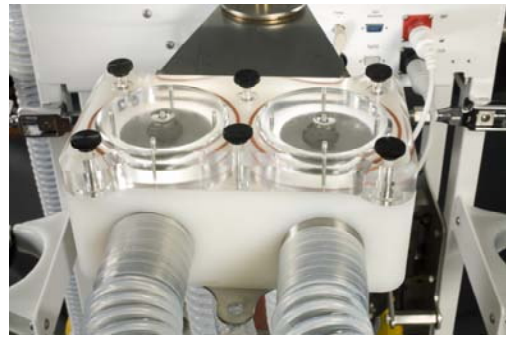
5) Check that the Fresh Gas Flow inlet pipe is fitted and pushed into position (E).

6) Check that the pressure sensing pipe is fitted and pushed into position correctly (F)

7) Check that the Evacuation (dump) pipe is fitted and pushed into position correctly (G)
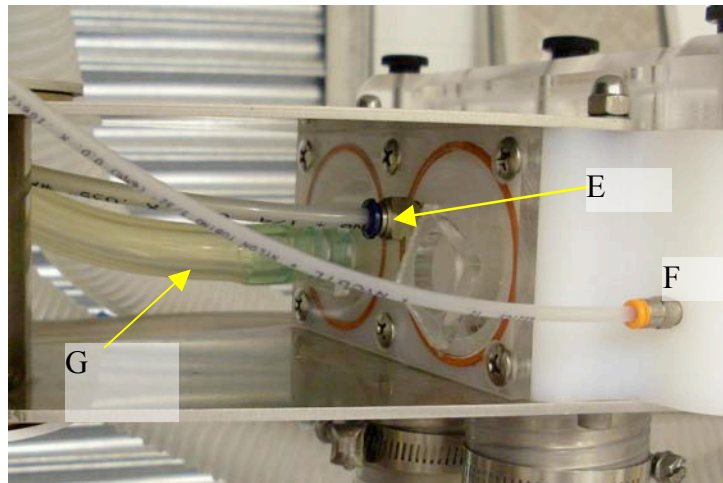
8) Open the back door and check that the Evacuation pipe is connected securely to the Dump valve (H)

9) Check that the patient pressure sensing line is connected to the Y-piece (I)
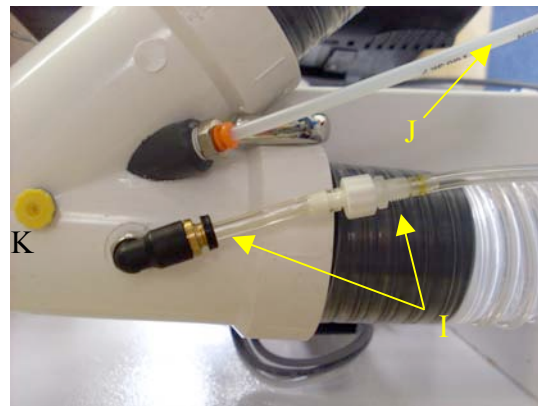
10) Check at the plug on the CO2 sampling port is fitted at the end of the tube (J)

11) Check that the plug on the Salbutamol administration port is fitted (K)

12) If the leak test is performed with an IRMA mainstream adaptor, make sure that the IRMA unit is in place otherwise gas will leak out through the oxygen sampling port

Vacuum Errors

If the system reports an "RD Vacuum Failure", rolling diaphragm vacuum failure, check the following.

1) Can you hear the vacuum pump running? The vacuum pump runs intermittently during normal operation and is heard as a low buzz. If there is no vacuum, then the vacuum pump should be running continuously and be heard as a constant buzz. If the vacuum pump is not running, check the following:

   a. Look at the connectors to the little circuit board on the back of the motor. Make sure they are connected as shown.

CONN2 Power supply (12v) from CONN18 of Main Power Controller Board

CONN1 Pump control signal from CONN13 PIC motherboard

   b. Check that the connectors are fitted correctly on the PIC motherboard (CONN13) and the power supply board (CONN18).

Pump control signal take-off from PIC motherboard
(Note spare pin to left of connector)
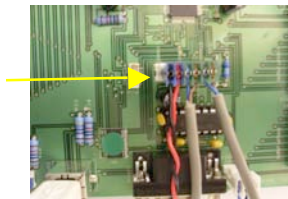
Or

   c. *Technician note: Check that there is 12v on the supply connector CONN1 and that there is 5v on control connector CONN2 of the motor control PCB. If either of these are absent consult the "Technician Fault-finding guide"*

If the pump is running continue on the next page.

2) Check that the vacuum port sampling lines are connected and properly inserted into the cylinder port (L)
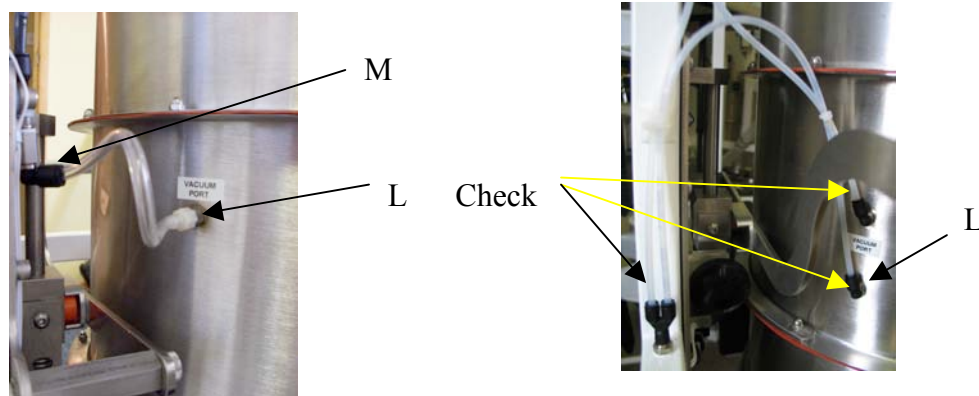
(Note: type of connection will vary depending on date of manufacture)

To refit a pipe push the ring around the pneumatic connector and pull the pipe out. Then push it firmly back into place until resistance is felt and it "pops" into place.

3) Check that the 3-way junction (M) has all of its pipes fitted securely.

4) If 2 & 3 are OK, perform the following vacuum test:

Note: it is VERY important that the cylinder is not allowed to move during this test. Make sure that:

   a. no patient is connected to the circuit,
   b. the Y-piece is open
   c. there is no CPAP or PEEP selected (CPAP/PEEP setting must be zero)
   d. he cylinder is properly closed

Vacuum test: Remove the vacuum supply line from the cylinder "VACUUM PORT" and seal it with your thumb and wait 20 seconds. Does the vacuum pump stop running and does the error message go away, indicating that the vacuum is OK? If so, this indicates a leak in the cylinder either at the cylinder port or rolling diaphragm itself. Check the cylinder port. Is it loose or cracked? On early units check the silver seals (N) around the cylinder body itself, making sure that none have been damaged or removed.
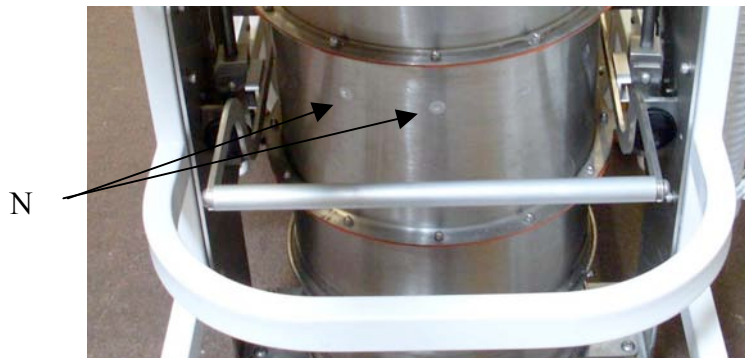
5) Check that the vacuum sensing line is connected securely to the pressure sensor on the main PIC motherboard, which lies inside the main cabinet of TAFONIUS.

Vacuum line →   ← Patient airway line
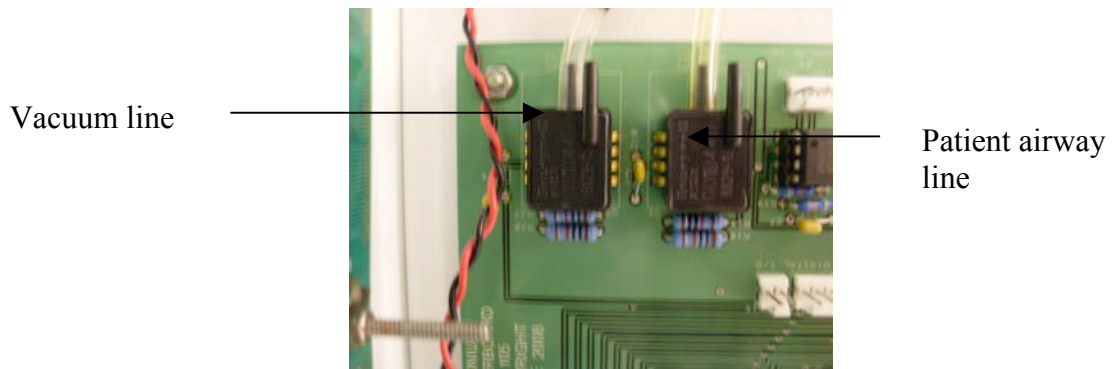
Battery Problems

If you experience problems due to low voltage supplies, this may be because the batteries are low/flat and/or TAFONIUS is not correctly powered from the mains supply.

First check the following:

1) That Tafonius is connected to the mains supply and
2) That the RCD switch is in the ON position with the Green LED (O) is lit

                                    ← O
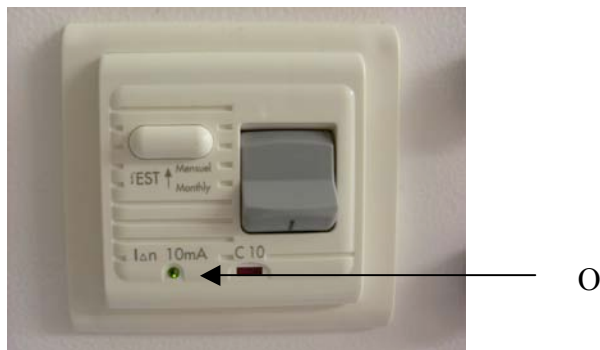
3) That the Green LED (P) of each isolated power supply is ON

                    ← P

The green LED is visible through the screening and should be ON for both isolated power supplies
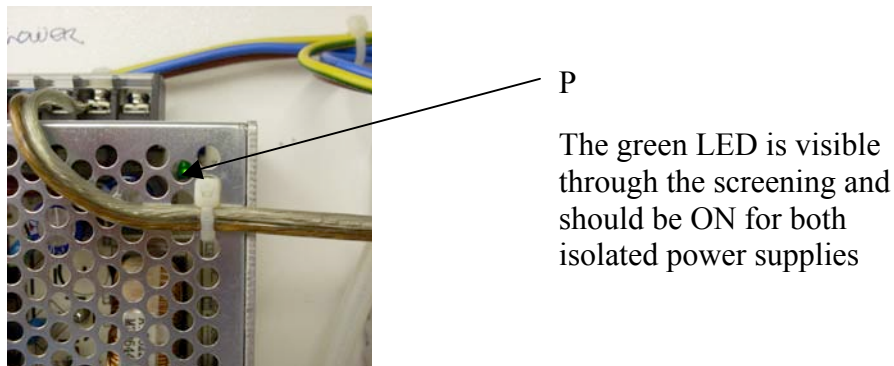
TAFONIUS has 2 batteries referred to as a Lower Battery (Battery1) and an Upper Battery (Battery2). During start-up one of the first messages on the auxiliary screen is the battery voltages, the combined and individual battery voltages. For successful operation the combined voltage must be above 22v and the individual battery voltages must be above 11v each.

When TAFONIUS is running in Auxiliary Mode the power source is shown at the top of the auxiliary screen as either BATT or MAINS. With the Windows software the power icon at the bottom left of the screen is green when connected to the MAINS and red when running from BATTERIES

In standby mode TAFONIUS consumes a small amount of power so that if left disconnected from the mains for a period of a week or more the batteries may run down. If the voltage of either battery falls below 7v then the battery fast-charge circuit cannot operate and the charge circuit starts in trickle mode. During this period TAFONIUS will not initialise and run. For completely flat batteries a period of 2-3 hours may be required in trickle-charge mode before entering fast-charge mode. Once the charger enters fast-charge mode TAFONIUS can be operated as normal.

To check the function of the batteries, open the back door of TAFONIUS and look at the set of LED's located on the power supply board.
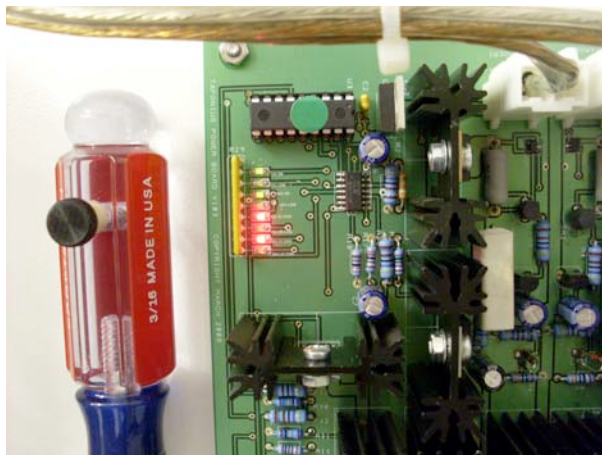
In this picture, the 12v and 24v lines are above the minimum voltage but both batteries are being charged at full rate

If the supply is to be investigated, TAFONIUS should be off, disconnect the mains power lead and look at the LED set:

    LED1 (12v OK)   - - should be GREEN
    LED2 (12v LOW)   - - should be OFF
    LED3 (24v OK)   - - should be GREEN
    LED4 (24v LOW)   - - should be OFF
    LED5 (12v HI CHG)   - - should be OFF
    LED6 (12v LO CHG)   - - should be YELLOW
    LED7 (24v HI CHG)   - - should be OFF
    LED8 (24v LO CHG)   - - should be YELLOW

If this is not what is seen on the circuit board then there is a problem and you should contact your supplier or distributor for more assistance.

Now connect the mains power and make sure the RCD test switch is ON (small green LED is ON). Check also that the Green LED in each of the isolating power supplies is ON

Look again at the LED set

LED1 (12v OK)   - - should be GREEN
LED2 (12v LOW)   - - should be OFF
LED3 (24v OK)   - - should be GREEN
LED4 (24v LOW)   - - should be OFF
LED5 (12v HI CHG)   - - may be ON (RED)
LED6 (12v LO CHG)   - - may be ON (YELLOW)
LED7 (24v HI CHG)   - - may be ON (RED)
LED8 (24v LO CHG)   - - may be ON (YELLOW)

If either LED2 or LED4 is ON (RED) then the indicated battery supply voltage is low and the machine may not start.

Exhausted Batteries

If TAFONIUS is allowed to run on battery power alone for a long time or is left un-plugged between uses for an extended period then the batteries (particularly the lower battery) will become exhausted (terminal voltage below 7v). In this state, TAFONIUS will not start and attempts to start it will either result in no response or TAFONIUS turning itself off after giving a warning message that the battery voltage(s) is too low. In this case TAFONIUS will enter trickle-charge mode as the very low battery voltage would otherwise damage the charging circuit. If a battery is completely flat, allow trickle-charging to continue for about an hour and try again. Then reset the charging circuit by disconnecting the battery at the battery box for 10 seconds and then re-connecting it. Mains power must be OFF whilst you do this. Turn the mains power back ON. If the machine still shows a low battery, repeat the trickle charging for a further hour and then try again.

Strange Piston Response and Drift

This is generally caused by an accumulation of water in the pressure sensing line. The remedy is to flush the line with air. Disconnect the tube from the bulkhead fitting on the machine and blow the water back toward the wye piece. As a matter of convenience you may want to add a stopcock and 60cc syringe to the system as shown here. Just be VERY careful to shut off the port TO THE MACHINE before flushing the line. Damage to the pressure sensor in the machine will not be a warranty repair.

Piston will not Initialize

Open the cylinder to check the level of the CO_2 absorbent. If the absorbent level is too high or not level and piled up on one side the piston will hit it. This will prevent the piston from reaching the zero position.

No EtCO2 or Lower than expected readings

Check the sampling line connections. 1. At the water trap. 2. At the wye piece . AND 3. At the coupling inside the umbilical. We recently had a machine which had no EtCO2 reading as you exhaled past the end of the sampling line. The O_2 however read 21%. When in use on a patient All readings were unreasonably low but there was some reading for EtCO2, Agent and Oxygen.   It was noted also the the system leak seamed more than normal. All this was explained by the disconnect within the umbilical.

ADD PHOTO OF CONNECTION WITHIN UMBILICAL

Piston slowly fills

LINEAR ACTUATOR

PISTON COVER

UPPER CYLINDER HALF

PISTON

LOWER CYLINDER HALF

2x ABSORBER PAN O-RING SEAL 180A3239

BOTTOM PAN

TO VACUUM PRESSURE SENSOR

VACUUM PUMP

AMBIENT

BUMPER VACUUM RESERVOIR

UP TO 6.5 L, 11.7 lbs, 5.3 Kg OF CO_2 ABSORBENT

ABSORBER PAN 000A4621

BOTTOM PAN DIVIDER SEAL 180A4639

INSPIRATORY FLOW

EXPIRATORY FLOW

UPPER ROLLING DIAPHRAGM

LOWER ROLLING DIAPHRAGM

VACUUM HOLDS SILICON ROLLING DIAPHRAGM FIRMLY AGAINST CYLINDER AND PISTON WALLS
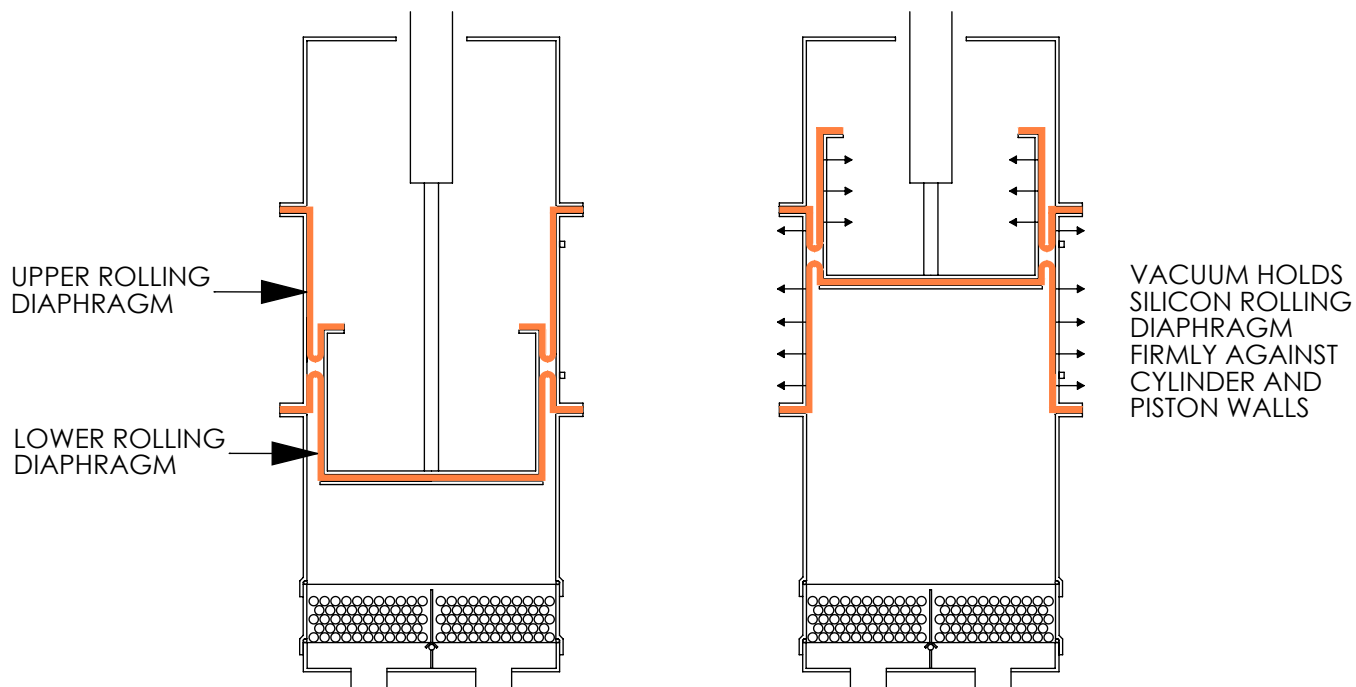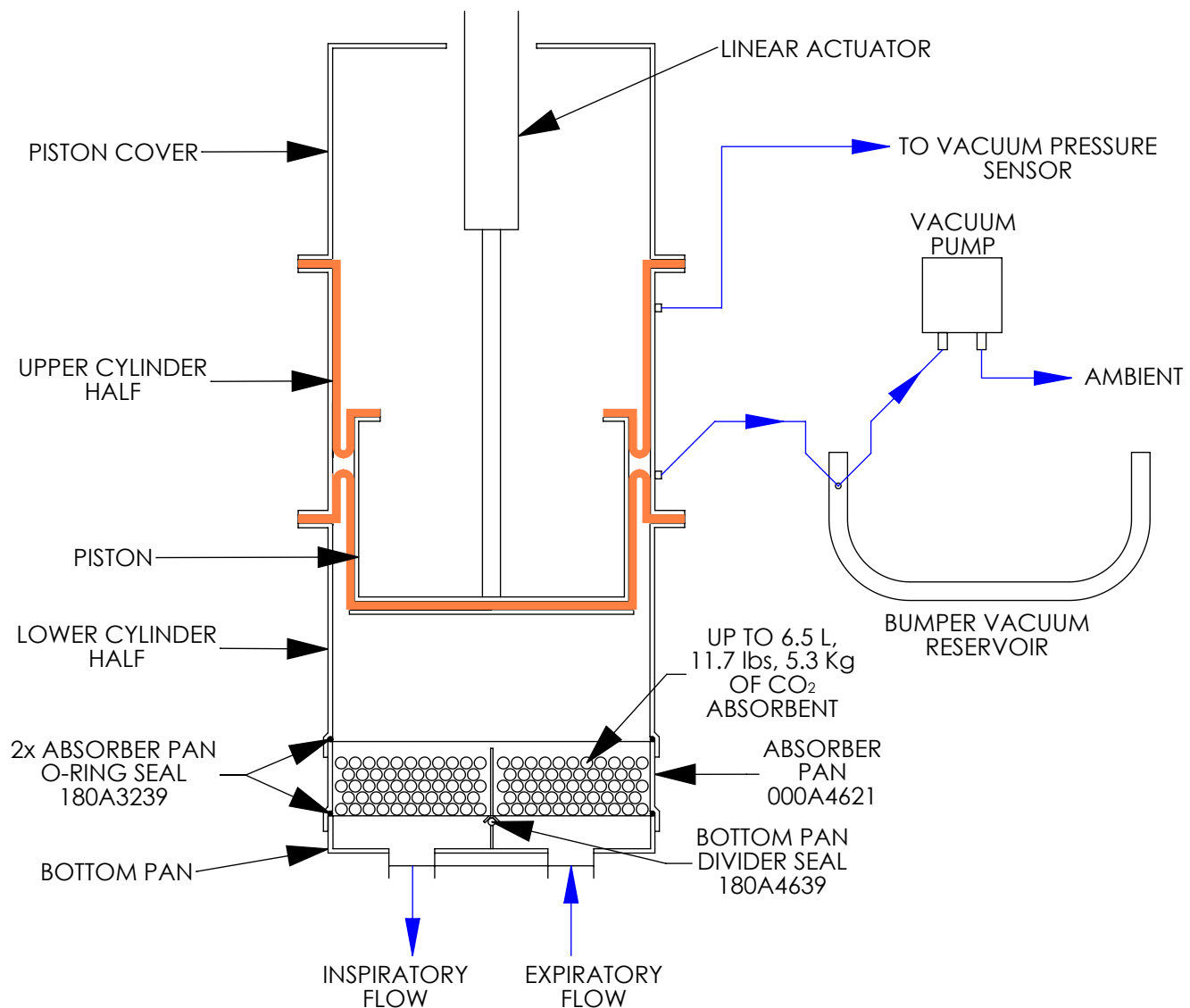
Rolling Diaphragm System of Tafonius

Hallowell EMC

Lead positions for Equine ECG
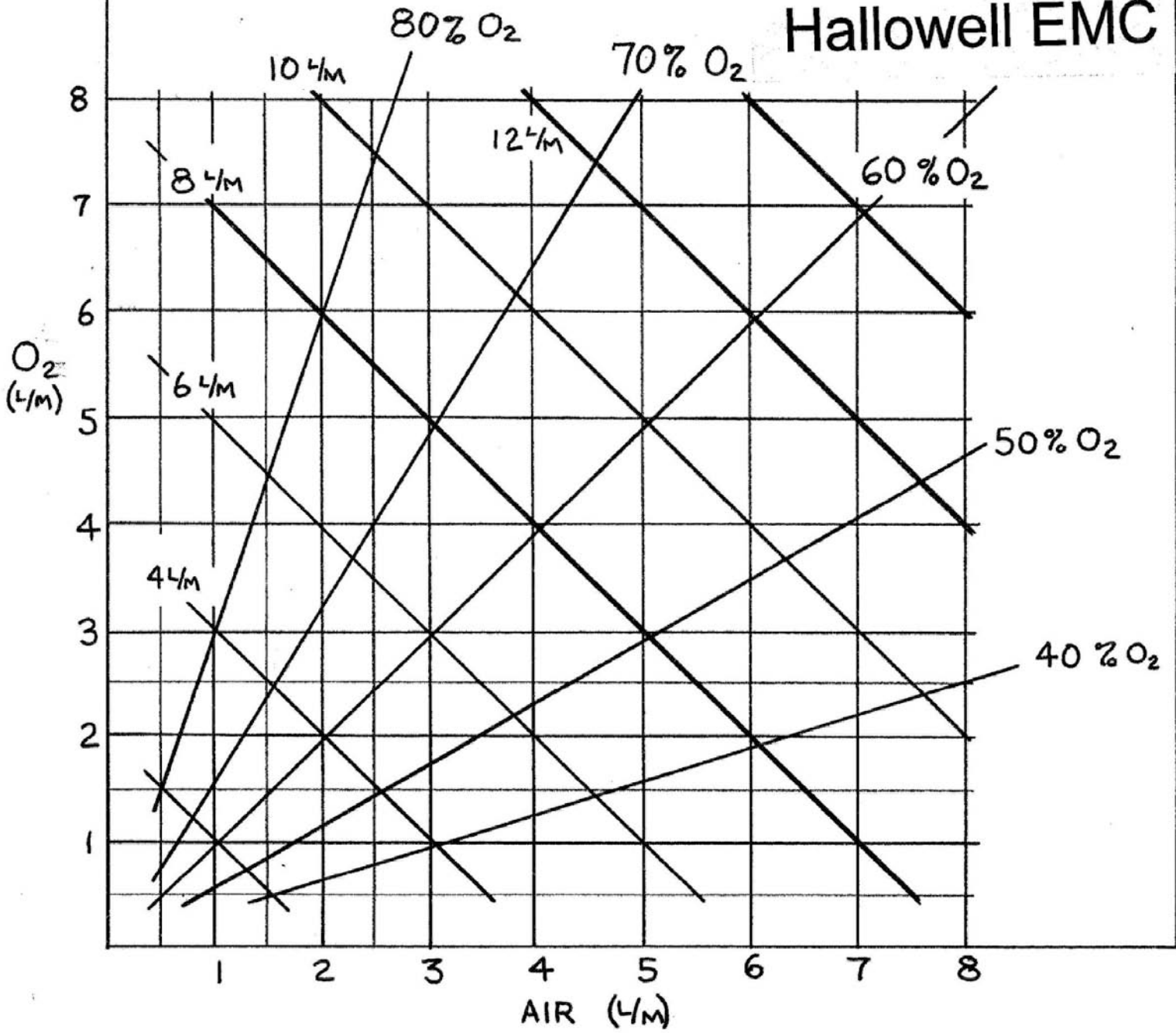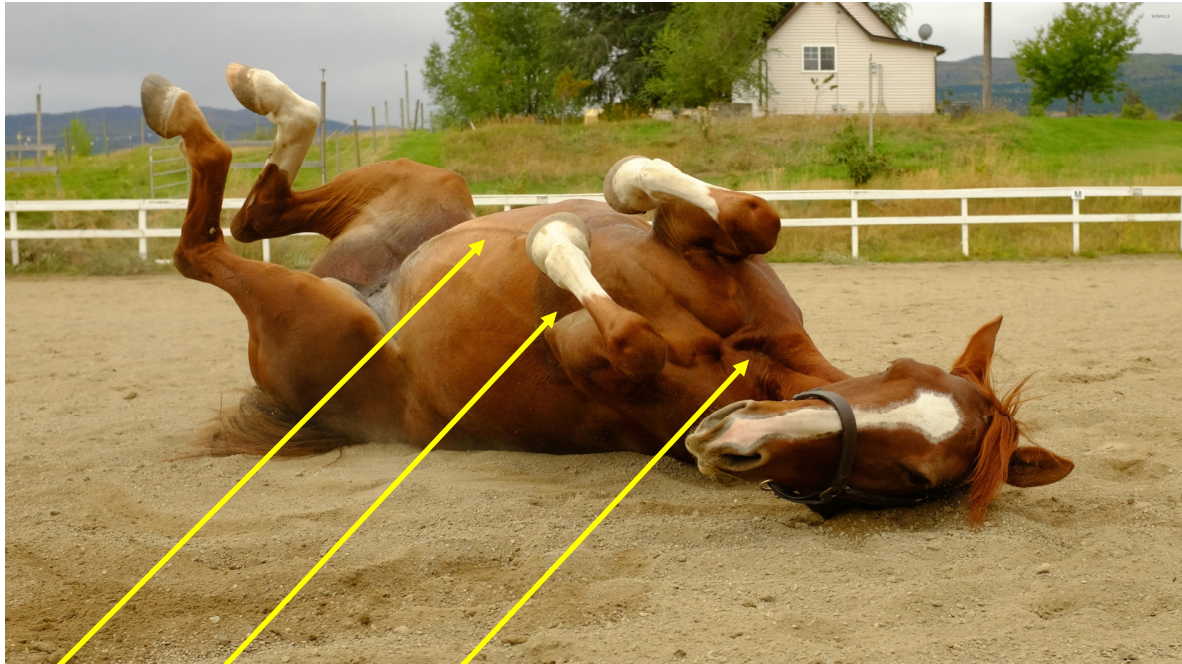
Left Hind
(+ve)

Right Hind
(ref)

Right Fore
(-ve)

UK standard colours:

Right Fore - Red
Left Fore - Yellow
Left Hind - Green
Right Hind - Black

US Colours:

Right Fore - White
Left Fore - Black
Left Hind - Red
Right Hind - Green

Method:

- Put Right Fore Lead in Jugular furrow
- Put Left Hind Lead on sternum near xiphoid process
- Put black somewhere else (reference voltage only)

This will produce a trace in the Lead II channel of the ECG monitor.
The ECG trace will appear to be upside down compared to a standard ECG from a small animal. Reversing the positions of the R Fore/ L Hind leads will reverse the polarity of the signal

www.vetronic.co.uk

Designed by Vets, for Vets

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CRN:4694235; VAT No 585 6341 12. Managing Director: Keith Simpson BVSc MRCVS MIET(Electronics)

Hallowell EMC

USING THE MANUAL BREATHING BAG

1) If the ventilator is still powered, turn it OFF.

2) Remove the expandable drain clamp from either tube under the bottom pan.

3) Fit the manual breathing tube over the pipe .

4) Attach the bag to the connector on the side of the machine. The Oxygen Flowmeter, Vaporizer, Flush Button, Pop-off valve and Breathing Bag can now be used to run the machine.

LBLA5187A

CLEANING PROCEDURE

Turn the Ventilator OFF. The piston will rise to the resting position, generally set to be at the top of the piston cylinder thereby exposing the orange silicone rolling diaphragm for cleaning.

Remove the Y- Piece and the patient tubing. Disconnect the pressure sensor line at the luer fitting.

Remove the pressure sensor tube from the patient tubing by undoing the 4 Velcro retainers.

Remove the Y- circuit from the ventilator. Flush & clean and hang to dry.

Undo and remove the 6 thumbscrews holding the valve block cover. Remove and clean the valve housing, disks and cover.

Remove the absorber pan. Place somewhere dry. Undo and remove the stoppers at the end of the two back drains.

Clean the lower pan area and up inside the piston cylinder. Leave to dry.

After cleaning and drying, re-assembly is the reverse of the above.

MAKE SURE THE PRESSURE SENSOR IS FITTED TO THE Y-PIECE BEFORE TURNING THE VENTILATOR BACK ON

Taking care of the Water Trap and Gas Analyser on Tafonius machines fitted with a Solomon Monitor

The Tafonius ventilator encompasses a Solomon Multi-Parameter monitor which is positioned at the top of the machine behind the PC. It has a single blue light to indicate power and a string of yellow LED's to indicate function. The Solomon monitor has the capability of supporting Sidestream and Mainstream analysers. This document deals with sidestream analysers.

Sidestream Analysers
Sidestream analysers are of the Mindray type and incorporate a water trap and sampling line which comprise the DRYLINE system. There are two DRYLINE systems; DRYLINE I and DRYLINE II.
DRYLINE sampling lines can be used with either system but DRYLINE I and DRYLINE II water traps are **NOT** interchangeable.

Dryline I - Domed top

Dryline II - Flat top

The Water Trap protects the MultiGas Analyser from humidity, secretions, bacterial contamination and dust. The detachable fluid container can be emptied and cleaned when needed and the complete Water Trap may be used for up to one month.

Cleaning
Suitable cleaning agents for the fluid container:
Ethanol 70%, Methylated Spirit 70% or Isopropanolol 70%,
Chlorhexidine/ethanol (e,g, Hibitane), Glutaraldehyde (e,g Cidex),
Hypochlorite solution (e,g Clorox).
Service Interval: Replace the entire Water Trap once a month
Replace the sampling line at the same time or before if frank fluid droplets are seen along its length.

Checking the health of your Water Traps and sampling lines

Sidestream Analysers use an internal pump to suck in the airway gas for sampling and analysis. The sampling rate in Tafonius is selected to be 200mls/min and the Analyser pump will work as hard as required to maintain this sampling rate. Anything that obstructs the passage of gas into and through the internal pump will require the pump to work harder to maintain the 200ml/min rate. At some point, if the obstruction is too great the pump will be unable to maintain the 200ml/min sampling rate. When the pump has to work harder there will be increased noise coming from the Solomon monitor.

Therefore:
1) Be alerted by any increase in pump noise coming from the Solomon monitor
2) Periodically check the sampling rate and performance of the internal pump, as described below.

When Tafonius is running, go to the Configure button and then the Gas Monitoring button to show the Modes/Status Tab:

If the text boxes are blank, click on the Reset button and wait for the unit to start.
The Pump flow is shown in the bottom right hand corner. In the above picture it is shown as 199 ml/minute. The standard flow is 200mls/minute +/- 5mls
If the Flow rate is less than 195 for extended periods of time, check the Water Trap and Sampling line as this indicates reduced flow due to an obstruction. If in doubt, replace the Water Trap and Sampling line with new ones. Sampling lines with visible water droplets along their length should be replaced.

A new Water Trap should allow the free passage of sampled air without obstruction. Obstruction to the Water Trap and, or Sampling line may cause measurement errors and lead to permanent damage to the MultiGas Analyser. When a brand new Water Trap has been fitted, the MultiGas Analyser pump should be heard to run quietly inside the Solomon monitor. Be alert to changes in the pump noise and check the Water Trap and Sampling Line if the pump noise increases.

Checking for leaks in the sampling system

If you are seeing odd waveforms on your capnograph and lower than expected readings for either CO_2, Oxygen or Agent, there could be a leak in either the Water Trap or sampling line. If a leak is suspected, perform the simple test below.

First, remove the sidestream sampling line from the Water Trap. Then use your finger to occlude the inlet to the water trap attached to the side of Solomon. The Flow rate should drop to less than 50mls/min and then the pump should be heard to increase in rate to attempt to clear the occlusion. The Flow and pump status will change to look something like the picture below:

The Pump status changes to Regulating. Release your finger. The rate may well increase to 300 mls/min before dropping back to 200 mls/minute. This is normal.

If the flow rate does not drop below 50 then replace the water trap with a **new** unit and repeat.
If the flow rate still does not fall with occlusion, contact your supplier or distributor for advice.

If the flow rate does drop to less than 50, the Water Trap has a good seal and is not leaking.
Now re-attach the sampling line and then occlude the far end of the sampling line (at the patient end) and watch for a fall in the flow rate. If the flow rate does not fall then there is a leak in the Sampling Line system. Be aware that in some Tafonius machines there is an extension line from the Y-piece to the main Sampling Line and this join may also leak.

Aspiration of fluids
If frank fluid is sucked into the sampling line then this will have a damaging effect on the water trap and the MultiGas Analyser. Initially the special

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membrane in the Water Trap will absorb some of the water and some will pass into the reservoir container. The membrane itself will get saturated very quickly at which point frank water will pass straight into the Analyser clogging the pump and contaminating the sensor. It is unlikely after an event such as this that normal function will return.

What to do if you suspect that fluid has been aspirated into the Analyser

- Remove the water trap and sampling line and discard them.
- Fit a new Water Trap but no sampling line.
- Leave the Tafonius software running so that the Analyser is continuously drawing in room air through the new Water Trap. The hope is that the continuous stream of air will dry out the sensor and pump.
- Leave the system running overnight if necessary
- Periodically connect a sampling line and exhale over the open end to see if a CO2 waveform is displayed

Common mistakes leading to fluid aspiration
The following are circumstances where fluid aspiration can accidentally occur.

- Disconnecting the Y-piece at the end of a procedure and dropping the sampling line on the floor. It is not uncommon after equine surgery for there to be pools of fluid on the floor and this can be aspirated
- Performing a leak test by placing the Y-piece in a bucket of water. This is a recognised procedure for detecting leaks in the Y-piece. However some users have disconnected the sampling line and blocked the end of the Y-piece sampling catheter, leaving the free end of the sampling line to dangle into the bucket...

It is recommended that whenever the sampling line is disconnected from the Y-piece, that the sampling line be disconnected from the water trap as well to prevent such accidents.

Salbutamol and other respiratory agents

Given the close proximity of the Salbutamol port and the end of the sidestream sampling port, it is possible that when administering Salbutamol, some may be aspirated into the Gas Analyser Sampling line. For this reason it is advised that the sampling line be temporarily disconnected from the water trap during, and for 2 breaths after, Salbutamol administration.

END

HALLOWELL EMC

ᴛᴀꜰᴏɴɪᴜꜱ Large Animal Anesthesia Machines
Service Options, Agreements and Warranties

ᴛᴀꜰᴏɴɪᴜꜱ and ᴛᴀꜰᴏɴɪᴜꜱ ᴊᴜɴɪᴏʀ Repair Visit   PN 000A5755
Time & Materials Plus Travel, Lodging & Meals

A repair visit is generated on an on-call basis and covers a technician's on-site visit for the work specifically requested. It will be calculated as the sum of:

- Travel time driving (round trip) @ $70/hour or flying @ $500/day plus ticket, car rental & fuel
- Lodging and meals if required
- Cost of materials
- Time for repair @ $90/hour

Parts and Labor will be warrantied for 90 days.

ᴛᴀꜰᴏɴɪᴜꜱ and ᴛᴀꜰᴏɴɪᴜꜱ ᴊᴜɴɪᴏʀ Annual Service Fee   PN 000A5756
$1,750 Plus Discounted Materials & Travel, Lodging & Meals

The annual service fee will cover an on-site visit for a strip-down, tolerance checks, adjustments, re-assembly and a full system test as described below. Any worn/broken/missing parts will be replaced and charged at a discount rate of 20%. (e.g. split hoses, damaged sampling/pressure lines/seals and gaskets, rolling diaphragms, etc.)

The service strip-down and re-assembly will include but is not limited to:
Visual assessment
Check the battery integrity & power cord
Verify the performance of the Monitoring System
Lubricate the linear actuator
Update the PIC firmware if required/requested
Update the ᴛᴀꜰᴏɴɪᴜꜱ software if required/requested
Piston disassembly & service:
- Check forward and reverse position sensors
- Lubricate the rolling diaphragms
- Check the alignment and tightness of the cylinder closed sensors
- Check the integrity of the cylinder seals, replace if required

Reassemble Piston assembly and test the following:
- Vacuum system and pump
- Dump valve performance
- System Leak Test

Check the caster tightness
Check the alignment and tightness of the Black Knob releasing brackets
Check manual breathing circuit
Check Auxiliary System performance
Check the tightness of the O2/Air flow meters - tighten as necessary
Check the seals on the Select-a-Tec vaporizer back-bar - replace as necessary
Check the operation of the ᴛᴀꜰᴏɴɪᴜꜱ software and the Touch Computer

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Extended TAFONIUS and TAFONIUS JUNIOR Warranty Agreement   PN 000A5757
$2,750 Plus Discounted Materials, Travel, Lodging & Meals

An Extended Warranty agreement may only be purchased as described below under "**Terms and Conditions for the Extended Warranty**".

The Extended Warranty agreement will cover the cost of the annual service as described above with a 20% discount for parts requiring replacement except as indicated below under "**Manufacturers' Warranty**" and extends the manufacturer's warranty for a further year.

Terms & Conditions for the Extended Warranty

The Extended Warranty must be purchased prior to the lapse of the Standard Manufacturer's warranty. The Standard Manufacturer's warranty is valid for one year from the original date of delivery. Should the Standard Manufacturer's or Extended Warranty lapse, an Annual Service Plan must be purchased in addition to the Extended Warranty to ensure the machine to be covered is in good working order prior to the reinstatement of Warranty.

Service Dates
The first service date shall be scheduled within one year of the original delivery date. Extended warranties must be purchased no later than 14 days following a service date. All subsequent services shall be within thirteen months of the previous service date. It is the customer's responsibility to schedule service dates within the Extended Warranty (or Annual Service) timeframe.

Manufacturers' Warranty – Please see our Tafonius Limited Warranty Statement for Full Details
Hallowell EMC warrants TAFONIUS and TAFONIUS JUNIOR to be in good working order and fit for the purpose intended for a period of one year from the date of delivery. In the event that the product is found to be defective within the warranty period the manufacturer will repair or replace, at its discretion, via an on-site visit or common carrier shipment, at its discretion, the item or items free of charge subject to the following conditions:

1)   The failed item(s) are
   a.   Either returned to the Hallowell EMC for inspection prior to replacement and or repair, OR
   b.   Retained by the customer for inspection by a Hallowell EMC appointed technician via a return shipment or on-site visit at the discretion of Hallowell EMC.

2)   Failure to perform or function correctly is a direct result of a component fault or fault in manufacture and does not arise from damage sustained in transit, from misuse, from direct physical abuse or an "act of God".

3)   Where failed items can be shipped (< 50 lbs weight), the customer bears the return cost of secure transportation of the item to either the manufacturer or supplier.

   The manufacturer's warranty does not cover:
   1) Repair or replacement of parts due to normal wear and tear
   2) Any consumables
   3) Replacement product to cover period of repair

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Summary of TAFONIUS and TAFONIUS JUNIOR Warranty and Service Costs and Benefits

Plan	Prerequisite	Work Performed	Cost Plus →	Time[1]	Materials	Travel[2], Lodging & Meals	Warranty Detail	Eligibility
P/N 000A5755 **Repair Visit**	Arrange for an appointment	Only work specifically requested	Zero	See Footnote[1]	List Price	TBD	90 days on parts and work performed	None
P/N 000A5756 **Annual Service**	Arrange for an appointment	Complete service and PM	$1,750	No Charge	20% Discount	TBD	90 days on entire machine[4]	Eligibility for Extended Warranty for 12 months
P/N 000A5757 **Extended Warranty**	An active new machine warranty or extended warranty and arrange for an appointment	Annual Service	$2,750	No Charge	20% Discount	TBD	12 months on entire machine[4]	Eligibility for Extended Warranty for 12 months
Purchase of Extended Warranty after expiration of Manufacturers' Warranty or lapse of Extended Warranty[3]								
Extended Warranty with required Annual Service	Call for an appointment	Annual Service	$4,500	No Charge	20% Discount	TBD	12 months on entire machine[4]	Eligibility for Extended Warranty for 12 months

1-Time: Travel time billed at $70/hour for driving, $500/day plus cost of ticket for flying. Repair time billed at $90/hour.

2-Travel: Mileage is billed at the current standard reimbursement rate as set by the United States Internal Revenue Service if driving. For travel by air, cost of airline ticket, car rental and fuel expenses are included. Additional travel expenses may apply.

3-Purchase of Extended Warranty after expiration of Manufacturer's Warranty: Should the standard Manufacturers' Warranty expire, customer must purchase an Annual Service Plan prior to Extended Warranty and Annual Service must be performed. Customer is responsible for scheduling service and ordering or renewing Plans prior to expiration.

4-Excluding the ELO Touchcomputer. Tyco provides a 3-year warranty on the Touchcomputer used, no other warranty is hereby provided.

TBD – To be determined. Based upon actual cost

Effective date: 01 Jan 2019
DOCA5737D

VSL

Vetronic Services Ltd

TAFONIUS™

A Large Animal Anaesthesia Machine and Ventilator with Integrated Patient Monitoring

What it does
How it does it
And why it's different from anything you've used before...

Why is Tafonius different?

There are several reasons why Tafonius is different from standard conventional large animal ventilators

- No bellows or concertina bag

- No need for a pressurised driving gas

- Ventilator, anaesthesia machine and monitor all in one

- Unique method of monitoring and controlling patient airway pressure

- Silent operation

- Fundamental building blocks allow endless development possibilities

- Suitable for patient sizes from foals to Cart Horses

Tafonius is not another bag-in-a-bottle ventilator. You won't find an ascending or descending bellows anywhere on this machine. In fact Tafonius behaves more like a normal re-breathing bag than anything else.

During spontaneous respiration the cylinder volume rises and falls just like a re-breathing bag. During IPPV the cylinder volume decreases during inspiration exactly like a bag being squeezed and refills in expiration like a re-breathing bag. The way that the 'bag' is squeezed is entirely under your control. Also the emptying and filling of this 'bag' requires no effort from the patient because the motor controlling the cylinder does all the work. This is what we call the TAFONIUS Airway Servo System.

TAFONIUS **Airway Servo System**

Measure airway
pressure & compute
piston movement

Piston behaves like a
'perfect' virtual bag

Move piston to
achieve desired
airway pressure
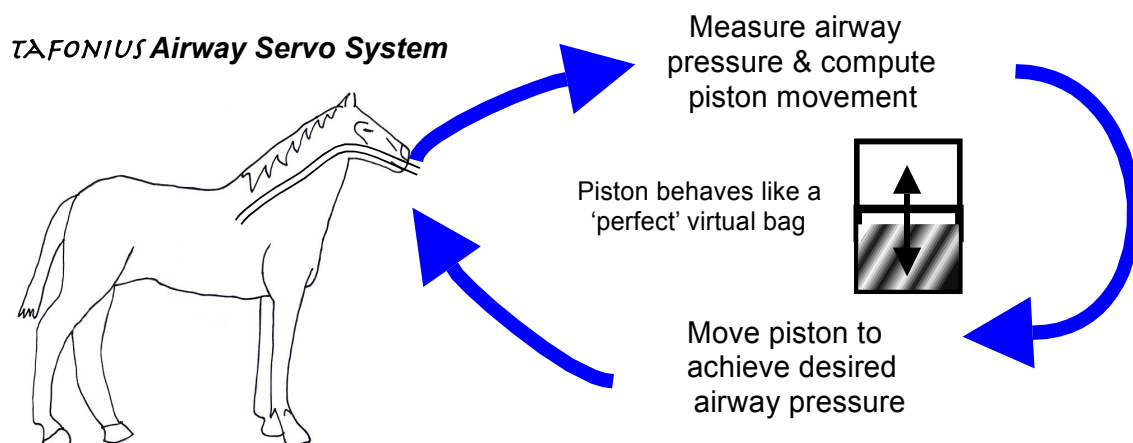
Why is this better?

It removes the effort, work of breathing (WOB) through resistive pipes, valves and airways.

The TAFONIUS Airway Servo System works by measuring the airway pressure of the patient circuit at the Y-piece. If a tiny rise in pressure is detected, such as when the patient starts to breathe out, then the piston withdraws ('bag' fills) and the increased pressure is negated. In this manner the 'bag' fills or empties based on slight changes in pressure in the Y-piece airway. The change in pressure is very slight. In fact it takes only 0.5cm H_2O pressure to move the piston. The effect is most marked in smaller animals such as foals where the work of breathing is virtually eliminated. The resistance of the airway tubes, the system valves and even the soda-lime canister are overcome by the driving energy of the piston and not the patient.

Other features that make TAFONIUS stand out in the field of ventilation

No driving gas

The impact of eliminating the need for a pressurised driving gas should not be under-estimated. In operation TAFONIUS is silent except for the low reassuring sound of the airway valves. There is also a cost implication too. Many hospitals use oxygen as their driving gas and this can be costly. A rough guide for a 500kg horse is that it costs around 85p/hour* to drive a ventilator with oxygen. Over a year of operating at only 6 hours per day that mounts up to over £1300 in oxygen costs alone.
*(based on a 600kg horse at 6 breaths per minute and a venturi efficiency of 40%)

Circuit efficiency

TAFONIUS is able to maintain a close control on circuit volume. Patients can be maintained on their minimum requirement of metabolic volume allowing for very efficient use of both oxygen and anaesthetic agent. For example a 500kg horse can be maintained on a fresh gas flow rate of 2.0L/minute or less. And with the in-built agent and CO2 monitoring you can be sure that your patient is still receiving the gas concentrations that you set.

Safe Waste Gas Elimination

Tafonius has 4 methods of dealing with waste gas. All exhaust gases from the patient circuit are fed to a common manifold at the back of the machine.

1) Fitted to this manifold is a pipe system that connects with a bulkhead connector via a scavenge flow meter. This bulkhead connector is designed for connecting to standard vacuum lines and the flow meter allows control of the actual flow rate of gas from the machine.
2) A 19/22mm connector on the common manifold allows connection to an active blower-in-a-box type scavenging system that uses an air brake setup.
3) The 19/22mm connector on the common manifold allows connection to a passive scavenging system.
4) In addition the charcoal absorber canister on the manifold provides backup scavenging when disconnected from the scavenging system as when moving from induction to surgery or from surgery to recovery.

Touch-Screen control

All ventilator functions can be controlled via the 15" touch-screen PC. This screen shows all monitoring measurements as well as the ventilator controls.
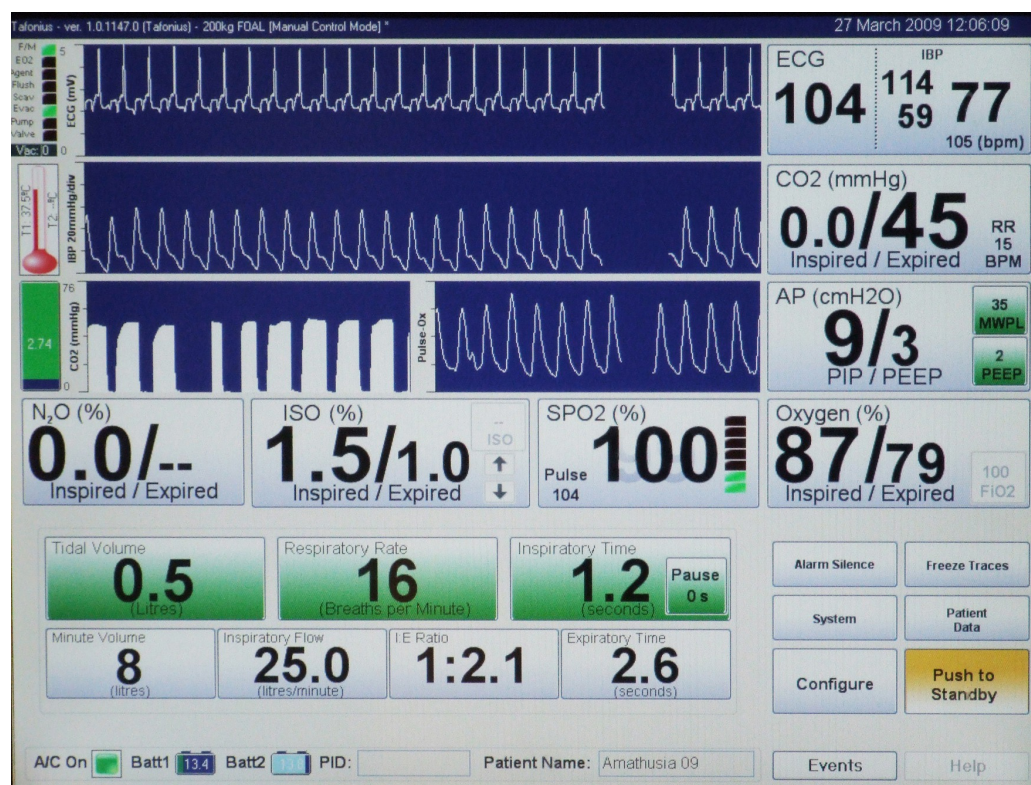
With a single touch-screen input you can

- Set or change the tidal volume, respiratory rate or inspiratory time
- Start or Stop ventilating
- Add an inspiratory pause to your IPPV
- Add CPAP or PEEP
- Review the last hour or more of physiological monitoring trends
- Add events or notes to your patient record

The drive behind the design has been for efficient access to data and controls by minimising the steps needed to perform a particular action.

Easy Cleaning

With the greater threat of MRSA and MRSP these days, efficient cleaning is a must. TAFONIUS has readily accessible airways for cleaning and specially designed drainage channels that allow you to easily flood the piston area with cleaning agent. The soda-lime absorber is readily removed and the piston is automatically retracted when the cylinder is opened to give full and easy access to what corresponds to the inside of the bellows on conventional machines.

Integrated Monitoring

The top-of-the-range version of TAFONIUS boasts complete patient monitoring via an integrated touch-screen computer. This gives many benefits over a separate non pc-based monitoring system

- At-a-glance information on patient and machine status

- Patient data, machine data and physiological data are all correlated

- Integrated data is automatically saved to hard disk and is intrinsically safe

- Recorded data allows real-time viewing of physiological trends

- Monitored inputs can be used to control machine function

- Easy input of events into recorded data

Added Benefits

What may not be immediately obvious from looking at the control screen are the added benefits that an integrated system provides. ꓔꓮꓝꓳꓠꓲꓴꓢ has an automatically collects of both machine and physiological data that is integrated into a data file called the Slow Data file. The Slow Data file records data every 5 seconds and stores it in a csv format, suitable for viewing in Excel or any other spreadsheet package. In the screen-shot below, the left hand column lists all data and events by date and time. The recording interval can be from as little as 1 second to every 5 minutes or more. The default of 5 seconds is recommended for general use as it provides a good record of the patient and machine status, whilst keeping files sizes to a reasonable size. For example, a 4 hour file is typically around 150kb using 5-second recording intervals.

An example screen shot of a Slow Data file open in Microsoft Excel™ is shown below.

ꓔꓮꓝꓳꓠꓲꓴꓢ Slow Data file in an Excel Spreadsheet

Anaesthetic Record generation

Because 𝒯𝒜ℱ𝒪𝒩ℐ𝒰𝒮 has collected data all the way through your anaesthetic procedure, it is able to automatically generate a pdf version of the Anaesthetic Record for you. This is done automatically for every case. Using data entered via the keyboard and touch-screen the Anaesthetic Record holds information on the following fields:

- Hospital Number
- Date
- Animal Name
- Owner Name
- Identifier
- Species

- Breed
- Age, Sex, weight
- Anaesthetist
- Surgeon
- Procedure

There are also fields to enter *notes* about the case prior to the anaesthetic or *events*, these can be added at any time during an anaesthetic.

For the general practitioner TAFONIUS is a workhorse designed to reliably and comfortably helps you through your busy operating schedule. If you are too busy to enter patient details all your information is automatically stored under a unique time and date stamp and saved in a predefined folder so that it can be retrieved as and when you want it.

For the researcher Tafonius is more than a workhorse it is a source of invaluable information and contains many tools that leave it un-matched in terms of anaesthesia control and data collection

An open-ended Research Tool

A bold statement? It may be; but it is true.

The following is a brief summary of the work currently going into TAFONIUS development. These features are not yet available for general use but they are in the advanced stages of development and can be seen in action at one of our booths at the many trade-show exhibitions we attend.

TAFONIUS design began in 2005 and at that stage, elements of the design centred on making the control of the machine completely versatile. An example would be in the control of the piston during IPPV. The standard inspiratory phase of TAFONIUS uses one command to tell the piston to move forward at a set rate for a set time. Simply by varying the time and rate information the piston can be set to deliver differing tidal volumes in differing times. This is what happens in the normal use of TAFONIUS. You set a Tidal Volume and an Inspiratory time and the piston moves accordingly following that single command. But as you have already seen, you can easily add a pause function to the inspiratory phase. This is achieved in 2 commands sent to the piston, one to move at the required rate and one to pause for a set time. Sending 2 commands instead of one is easy for the PC and in fact this capability can easily be extended so that in excess of 100 commands could be sent to the piston to control a single inspiratory phase. How does this help the researcher? Imagine you have a theory that delivering the inspiratory volume as a sine-wave profile is more efficient for gas exchange than a linear profile. You can do your study with the standard Tafonius setup, which delivers tidal volume in a linear mode. Then you could design an inspiratory phase pattern that consisted of 50 or so steps that described a sine-wave delivery. These 50 steps can be converted into 50 commands that are sent to the piston. Now you have exactly what you need to test your theory.

You may want to investigate the effect of Airway Pressure Release Ventilation (APRV). Again you can design a ventilation pattern that will alternate between 25cm H_2O CPAP and 5 cm H_2O CPAP at intervals and duty cycles of your choosing.

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This is all made possible by a simple editing tool that produces csv files that TAFONIUS can read. The editing tool is called the TAFONIUS Phase Editor

The TAFONIUS Phase Editor

TAFONIUS can execute an inspiratory phase using a number of commands from 1 up to 100. In standard use, TAFONIUS uses a single command to perform an inspiratory stroke during IPPV. This command instructs the piston to move at a set rate for a given period of time, thus delivering the required volume. With the TAFONIUS Phase Editor the inspiratory phase is used in a different way and can be constructed from any number of commands lasting from a few milliseconds to several minutes. This makes it very easy to implement APRV for example, where a phase of 20cm CPAP for 5 seconds is followed by a phase of 5cm CPAP for 1 second in a repeated pattern to effect pressure ventilation. The TAFONIUS Phase Editor will display the pattern as you construct it on the screen seen below.
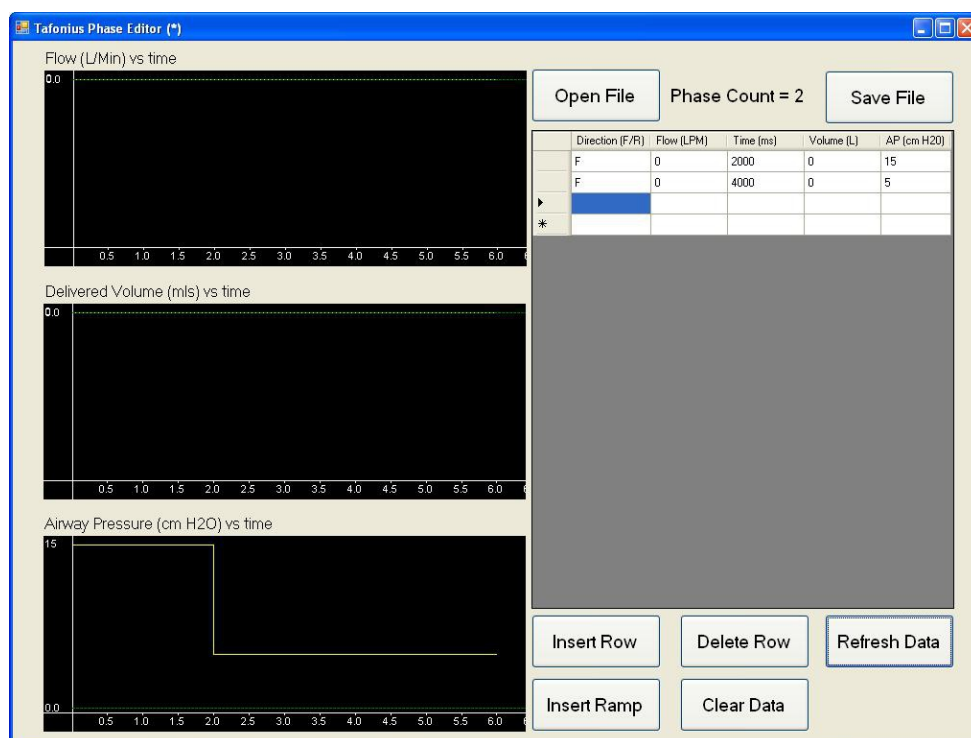
In the example below, a sinusoidal flow pattern has been used to generate a controlled inspiration and expiration with the piston held at the inspired position for 1 second before exhalation begins.
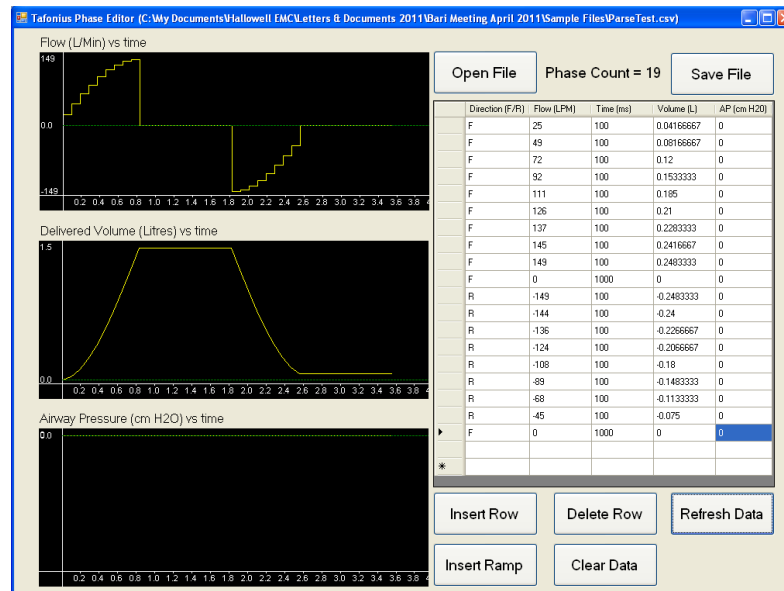
Once a new ventilation pattern has been designed, the file can be saved as a csv file. This file can then be loaded into the TAFONIUS program and run as and when required. The standard features of TAFONIUS are not affected.

FiO$_2$ control

Also put in place back in 2005 was the individual control of the gas and air valves. The PC has the ability to control whether air or oxygen goes through the vaporiser or not, whether gas is automatically added at any rate up to 10L/minute or whether a 70L/minute flush of oxygen should be added. Simply by controlling air and oxygen delivery it is possible to produce any oxygen mix from 21% to 100%. This has now been done. Also, with every TAFONIUS machine is fitted a 10L/min air pump. Using this as the air source, rather than a pipeline supply the realisation of the above feature is available with a software update to all existing machines. Two extra buttons have been added to the oxygen concentration monitor to allow independent setting of the FGF and the FiO$_2$.

Much has been written in the literature of late recommending FiO_2 deliveries of less that 1.0 during anaesthesia ventilation as a method of reducing absorption atelectasis. This new facility makes it extremely easy to reliably and accurately control the oxygen levels in your patient circuit.

New features arising from programmability

One other feature in development is the use of volume capnography to determine lung dead space. Because of the integrated nature of TAFONIUS'S monitoring this is easily achievable and has allowed the determination of both alveolar dead space and main airway dead space on a breath-to-breath basis.

This feature is in the advanced stages of developmental and currently uses a mainstream adaptor for the CO2 information input. Once the method has been refined and proven, this should extend to sidestream monitors as well.

The following screen capture shows the resultant curve and measurements from initial testing of the Single Breath Test (SBT).
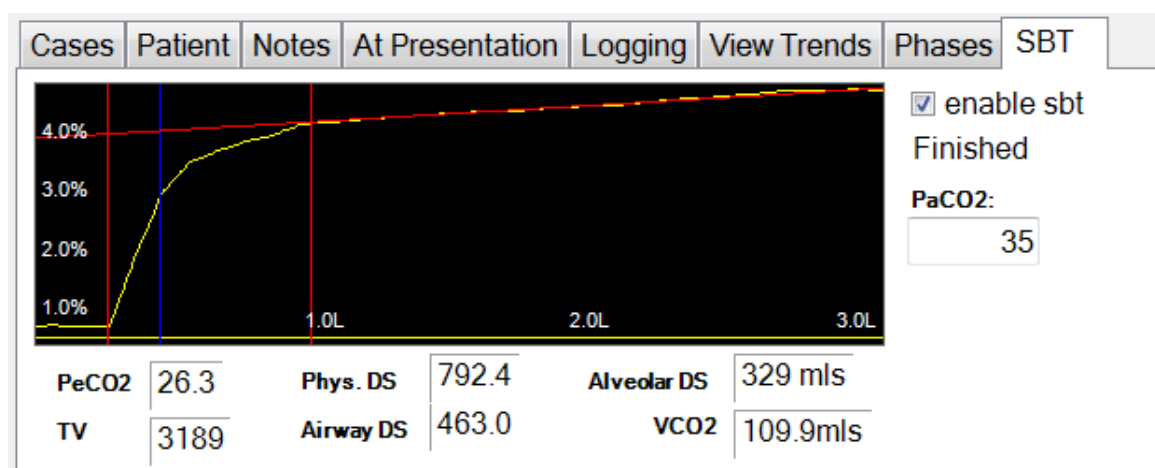
All of the preceding features coupled with the collection of all the physiological data means that TAFONIUS can play a vital role in your equine research study.

Recently added New features

These are improvements or additions to the PC and auxiliary system software have been added based on feedback from our users:

- Control of the Piston Buffer Zone. Originally fixed at 2.5L, a new button now allows setting of any value from 2.5 to 20L

- Display of Static/Instantaneous values for the blood pressure transducer. This allows the measurement of e.g. central venous or bladder pressure, where no pulsatile waveform is present

- Increased alerts/awareness of loss of mains power supply. The mains indicator now flashes insistently at the bottom of the screen when Tafonius is running on batteries.

- Prevention of double counting of the heart rate from ECG's with large spikey T-waves. Using a refractory period this double counting can now be prevented.

- An add-a-litre feature now simplifies the administration of closed circuit anaesthesia by adding a litre of oxygen each time the piston drops to a point where there is less than 1.5L volume left under it. You can leave the oxygen flowmeter turned off.

A new addition to the family – TAFONIUS JUNIOR

TAFONIUS JUNIOR has grown out of the demand for a large animal ventilator with the versatility of TAFONIUS without the inherent cost of the integrated monitoring and touch computer.

JUNIOR fulfils that role by using the auxiliary control system of TAFONIUS as its main control system and the same Airway Servo System driven piston used in TAFONIUS. The footprint of JUNIOR is kept small and the height is reduced compared to TAFONIUS. JUNIOR still has full battery backup and only requires oxygen for patient delivery, not as a driving gas.

JUNIOR has some surprising new features

We have added the following features to JUNIOR that weren't originally on the Auxiliary control built into TAFONIUS:

- CPAP or PEEP facility

- A flow-triggered Inspiratory assist mode

- Manual Exhaust valve control

- Add-a-Litre feature

These features are now standard on all JUNIOR machines.

Variants

JUNIOR comes in a couple of variants. One variant has no anaesthetic circuit included and hence no valves or patient tubes. There is a single tube leading from the piston to your existing large animal anaesthetic circuit. In this format, JUNIOR will immediately integrate with your existing anaesthetic circuit, should you only need the ventilator.

The picture shows JUNIOR connected to a Matrx VML system. The connection is simple to do.

We've added a support bar to JUNIOR to hold the VML system in place, so that the anaesthetic circuit and ventilator move as one unit and take up as little floor area as possible.

The support bar may be used for other anaesthetic circuits but may require additional fixings.

The second variant of JUNIOR is a machine with in-built anaesthetic circuit. A Select-a-Tec™ backbar can be supplied so that you can fit the vaporiser of your choice quickly.

The picture to the left shows JUNIOr with valve block, vaporiser, patient tubes and Y-piece.

The picture below shows the front panel of JUNIOR in close-up, together with the clear back-lit LCD screen and control knobs.

Designed by Vets, for Vets
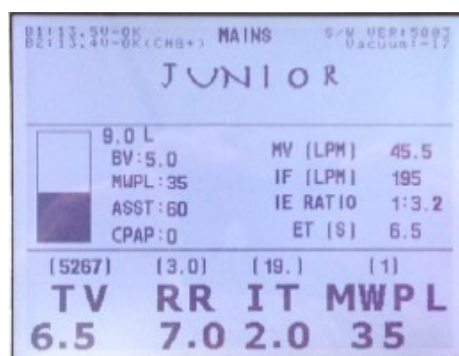
TAFONIUS™

Short on tradition

The "bag in a bottle" or bellows of the traditional ventilator has been replaced in TAFONIUS with a servo-controlled piston. This implementation completely eliminates the mushy pneumatic driving layer used to move the breathing gases that is found in every other large animal ventilator in existence today. It obviates the need for large volumes of high pressure driving gas; in fact it eliminates the need for any driving gas at all. The servomotor used in TAFONIUS moves the piston with a resolution of 20cc; the maximum stroke volume (tidal volume) deliverable is 20 liters. The piston can also be moved at different speeds yielding different inspiratory flow rates; in fact the speed at which the piston moves can be changed every 5ms, 200 phases/second. The maximum speed the piston can move translates to an inspiratory flow rate of 1000 lpm and the maximum pressure that can be developed is 80cmH$_2$O.
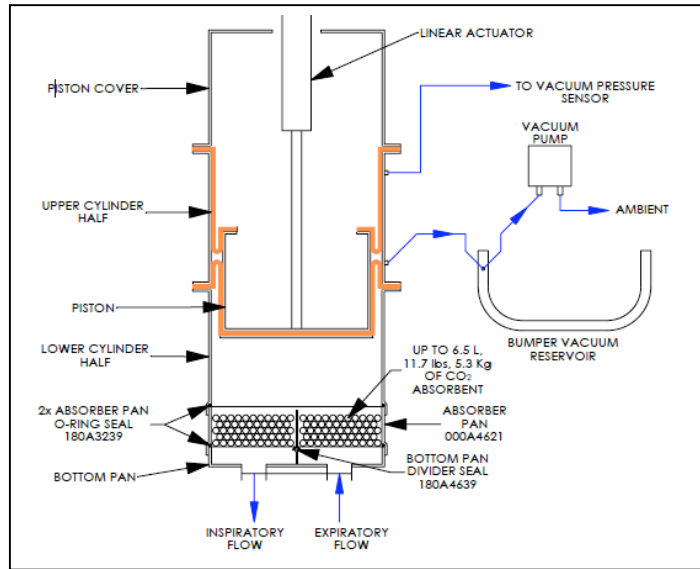
Such fast and precise control of distance and speed permits the development of virtually any inspiratory and/or expiratory waveform imaginable.
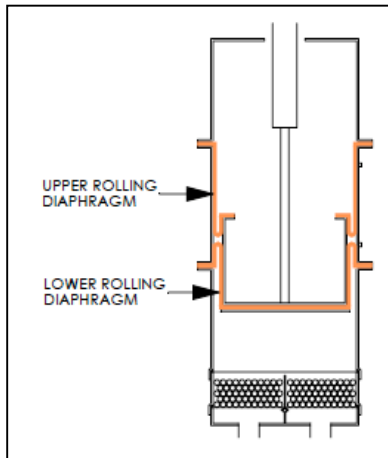
Left: the piston with 5 L under it. Right: 20 L under the piston. The vacuum, indicated by the arrows, holds the silicone rolling diaphragm tight against the cylinder walls facilitating very smooth operation as the piston moves.
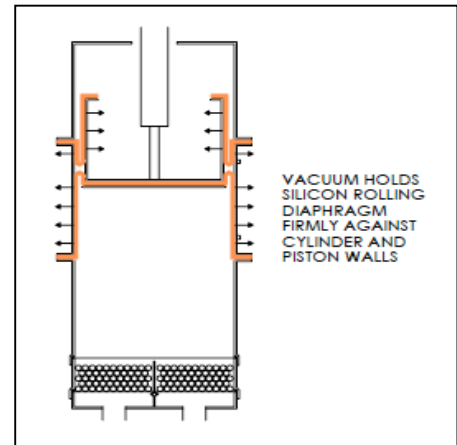
Tafonese, the programming language for TAFONIUS will improve the pace of research by putting complete control of what TAFONIUS does, based on any of the measured, set, newly defined and calculated parameters and time, in the hand of the researcher.

This combination of a flexible programmable control system, sturdy, durable, stainless steel and aluminum construction and the integration of a complete patient monitoring system insures that you will no longer need to buy a new machine every time new features or yet developed modes of ventilation become available.

Features Comparison of Junior and Tafonius Large Animal Machines

Junior sans gas	Junior w/gas	Tafonius (full boat)	
000A5241	000A5242	000A4630	
Ventilator only	Gas machine and ventilator	Gas machine, ventilator, monitoring and advanced features	*Features as of 1 JUN 2019*
√	√	√	• Stainless and Aluminum construction with white powder coated finish
15 seconds	30 seconds	2 seconds	• Quick access to internal cleaning of the "bellows"
√	√	√	• 8" wheels, front wheel locks
√	√	√	• Accommodates a wide range of patients 100 lbs – 2000 lbs (more or less!)
√	√	√	• Future, **new modes of ventilation** as features are **software upgradeable**
√	√	√	• Always powered by two 12v rechargeable batteries, AC keeps them topped off
√	√	√	• Servo driven piston, **NO bellows**
√	√	√	• Control Settings for Tidal Volume, Respiratory Rate, Insp-time, MWPL, CPAP/PEEP, Displays the Resulting MV, I-flow, E-time and I:E ratio
√	√	√	• Displays above parameters when patient is spontaneously breathing; **Respiratory monitoring**
√	√	√	• Tidal volumes up to 20 liters in 100ml increments with 25 ml resolution
Future	Future	√	• Delivers **compliance compensated TVs** insures the patient actually receives the set TV
√	√	√	• Respiratory Rate 1 – 30 breaths per minute
√	√	√	• Maximum Working Pressure Limit adjustable from 10 – 80 cmH2O
√	√	√	• Implementation of **PEEP** and **CPAP** up to 50cmH2O
√	√	√	• Implementation of **Assist Mode** Ventilation
√	√	√	• Inspiratory flow rates up to 900 lpm
√	√	√	• Facilitates the implementation of **Closed Circuit Anesthesia** with add-a-liter feature
√	√	√	• Scavenging flowmeter
√	√	√	• Backup scavenging system
√	√	√	• Uses **NO driving gas** to compress the "bellows"; a major ongoing cost savings
√	√	√	• Oxygen is used only for patient uptake
Optional	√	√	• Airway pressure gauge
Additional	Additional	Additional	• IV pole
	√	√	• 22mm Foal Breathing Circuit included
	√	√	• Lightweight, kink free clear breathing tubes
	√	√	• Accommodates both funnel fit and Bivona/Drager style ET tube adapters
	√	√	• Absorber pan holds 6.5 liters, 11.7 lbs, 5.3 kg of absorbent
	√	√	• Oxygen flowmeter for manual use
	√	√	• Oxygen flush button for manual use
	Additional	√	• Hospital line pressure gauge
	√	√	• Low oxygen supply pressure alarm
	Additional	Additional	• Optional N2O and/or Air flowmeters
	√	√	• Bronchodilator injection port
	n*	√	• Pullout swiveling keyboard tray
	n	√	• Dual mount Select-a-Tec™ vaporizer back bar
	n	√	• Swivel valve block permits the breathing tubes to exit to the right or the left
	n	√	• Stainless hoop handle and bumpers
	n	√	• GFI protected with 3 auxiliary AC power outlets
	n	√	• Panel mount e-cylinder pressure gauge
	n	√	• "Crash cart" drug drawer below work surface
	n	√	• Absorbent can be changed in seconds
	n	√	• Two work lights and a built in maintenance tool kit
	n	√	• Accommodates two oxygen e-cylinders for backup, temporary disconnect or field use
Additional	Additional	Included	• Optional oxygen e-cylinder mount for backup, temporary disconnect or field use
		√	• Footprint 30"wide x 36"deep, height is 72"
		√	• Redundant computer systems
		Main Control	• 15" 1028x768 **touchscreen computer** w/GUI interface and 160 Gigabyte HD
Main Control	Main Control	Backup Control	• Microprocessor with TV, RR, Itime, MWPL, CPAP/PEEP and Assist mode controls
		√	• Settable Ip, inspiratory pause, 0-40% of the Itime
		√	• Settable FiO2, 30% – 100 % (requires Air Option above)
		√	• Choice of automatic or manual modes for FiO2 and anesthetic delivery
		√	• **Fully integrated monitoring** of ECG, IBP, SpO2, Temp, Insp/Expired CO2, O2, Agent, N2O
		√	• Sidestream Gas Analyzer standard
		√	• Paramagnetic oxygen sensor w/ above, no galvanic cells to worry about or replace!
		√	• High and low alarms for all parameters
		√	• **Anesthesia record printout** for clinical use
		√	• **Data collection** to Excel™ for research
		Future	• User programmability for the researcher
		√	• Unlimited presets for recalling all settings and alarms for different doctors or types of cases
		√	• Trend display of all measured parameters
		√	• User configurable display of traces and trends
		√	• Freeze traces function
		√	• Alarm silence/locked/disabled function
√	√		• Alarm silence function only
√	√		• Footprint 24"wide x 28"deep, height is 50"
Additional	Additional		• **ZOO PACKAGE** includes collapsable lifting arms & mayo trays for ease of use in the field
Optional			• VML by MidMark (Matrx) gas machine head and mounting pole
Additional			• VML by MidMark (Matrx) mounting pole only
Optional	Optional	Depends on location	• Up to 2 Days in-service and training at installation

* Note: It is possible to upgrade Junior with gas to have many of the feature of Tafonius. The features that would not be available are indicated by the symbol "n" in the table above. Pricing for features indicated as "Optional" has not been determined. *DOCA4958A*

HALLOWELL EMC

Ventilatory Support Products for Animals of all Sizes

TAFONIUS

Large Animal Machines with TV deliveries from a full 20L all the way down to 0.5L for the smallest foal

TAFONIUS
Our premier large animal anesthesia machine with the first new approach in the industry in over 50 years

TAFONIUS JUNIOR
Complete gas machine
incorporating the same robust piston servo system

TAFONIUS JUNIOR
Sans gas
For use with your current gas machine (Pictured with Matrx VML by Midmark)

Small Animal Machines

Model 2002 PRO
One Machine, three interchangeable bellows and housings

Anesthesia Workstation
A complete heated circle system for animals from the size of rats to cats, small dogs, and now reptiles

20–350 ml TV

1500–3000 ml TV

300–1600 ml TV

5–200 ml TV

We also provide:

Cleaning/Calibration

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For More Information:

www.hallowell.com
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Hallowell EMC
2019 TAFONIUS Spare and Consumable Parts
ORDER FORM

HEMC SO Number:		Date:	
Customer PO Number:		By:	
Customer:	BILL TO:	SHIP TO:	
Address:			Contact:
			Contact Tele:
			Contact email:

Standard spare parts that are included with Tafonius:

Qty	Hallowell PN	Description	List Price ea		Extended prices	Enter Qty U want to order	Extended Cost
4	053A1782	Fuse, 5x20mm @A 250V Fast VDE	$2.20		$8.80		$0.00
1	180A3244	O-ring Spares kit, Tafonius; Contains next 3 items	$24.50		$24.50		$0.00
2	180A3241	Valve Block Top Cover O-Ring	$5.54		$11.08		$0.00
1	180A3243	Bag Port Connector Gasket, Tafonius/Junior DBL	$9.00		$9.00		$0.00
2	180A1440	Foal Breathing Circuit Adapter O-Ring	$4.27		$8.54		$0.00
3	053A1789	Fuse, 5x20mm 10A 250VAC, Fast Acting	$2.30		$6.90		$0.00
6	070A5153	LA ECG Aligator Clip replacement	$1.25		$7.50		$0.00
				Total Value ---->	$76.32		

Other spare parts available for Tafonius:

Qty	Hallowell PN	Description				List Price	Quantity	Extended Cost
1	000A4636B	2" x 22mm Breathing tube Adapter				$64.44		$0.00
1	201A4313	Breathing System Tubing, Clear 2" x 120" (50mm x 3048mm)				$126.07		$0.00
1	201A3372	Breathing System Tubing, Clear 2" x 20" (50mm x 508mm)				$22.52		$0.00
1	201A3371	Breathing System Tubing, Clear 2" x 40" (50mm x 1016mm)				$44.97		$0.00
1	201A1618	Breathing System Tubing, Clear 2" x 60" (50mm x 1525mm)				$87.51		$0.00
1	201A1619	Breathing System Tubing, Clear 2" x 78" (50mm x 1982mm)				$94.66		$0.00
1	200A4439A	Coupling for 2" Breathing System Tubing				$22.33		$0.00
1	210A3845A	Drain Plug, Tafonius & Jr DBL				$16.98		$0.00
1	112A5181A	ECG Patient 3 Lead Set for Solomon/Tafonius (Euro)	Also 112A5182A (USA)/Same Price			$67.50		$0.00
1	112A5060	ECG Trunk Cable Modified for Solomon/Tafonius	Also 112A5060A/Same Price			$67.50		$0.00
1	210A3856	eCylinder Wrench (Non Magnetic Metal)				$4.95		$0.00
1	112A4376	Extension Cable, 3 meters NONIN				$118.00		$0.00
1	000A5360	Extension, Sampling Line (16"; 400mm)				$3.16		$0.00
1	000A4640	Foal Breathing System (22mm) for Tafonius/Junior w/Gas				$163.16		$0.00
1	200A4453	Gas Sampling Tube Assembly, Equine Wye				$12.23		$0.00
1	000A4635	Keyboard, Mini Flexible Waterproof				$37.98		$0.00
1	201A4315	Pressure Sensing Line, Tafonius				$18.80		$0.00
1	210A4142	Quick-Opening Worm-Drive Hose Clamp 1" to 2-1/4" 410 SS				$3.60		$0.00
1	000A4639	Sampling Line, Adult 2.5m, DRYLINE (Artema)				$9.65		$0.00
1	134A4501	Sensor, Pulse Oximeter (NONIN-2000T)				$168.30		$0.00
1	000A4621A	Spare CO2 Absorber Pan with Handles for Quick Exchanges				$556.88		$0.00
1	134A4500	SpO2 Sensor, NONIN Genuine, 2000SL Lingual Clip				$168.30		$0.00
1	112A5184	Temp 1 Cable, Tafonius				$53.07		$0.00
1	112A5185	Temp 2 Cable, Tafonius				$53.07		$0.00
1	112A5186	Temp Extension Cable, 10' (3M)				$33.45		$0.00
1	131A4462	Temperature Probe, YSI 401/401AC compatible, 9' 6"				$116.28		$0.00
1	210A3888	Thumbscrew Assy, Tafonius valve cover				$2.73		$0.00
1	112A4372	Utah Medical IBP Cable, Tafonius				$54.24		$0.00
1	200D0030B	Valve Block Top Cover				$315.00		$0.00
1	190B0174	Valve Disc, Tafonius (Old Style, Stainless Steel)	Also New Style 190B0174A/Same Price			$9.95		$0.00
1	060A1089	Work Light Lamp Bulb, 10W				$14.75		$0.00
1	060A1088	Work Light Lamp Bulb, 5W				$9.75		$0.00
1	220B0256	Wye, 2" (50.8mm) Equine, Tafonius w/ Gas Sampling Port, Pressure Pickup and				$314.87		$0.00

Consumables required for continued operation:

Qty	Hallowell PN	Description				List Price		Extended Cost
1	240A3619	Air inlet Viral/Bacterial Filter, Tafonius				$4.27		$0.00
1	000A4638	Water Trap for Tafonius				$22.07		$0.00
1	000A3448	Water Trap, Adult, DRYLINE II (Artema)				$25.09		$0.00
1	132A1296A	Invasive Blood Pressure Transducer DPT-400				$19.98		$0.00
1	134A4502	Fast Galvanic Oxygen Sensor Replacement for NON-Paramagnetic Units				$142.80		$0.00
1	240A1450	f/air charcoal canister				$13.76		$0.00
		CO2 Absorbent				Not Sold		
		Anesthetics				Not Sold		
						Order Total ------------>		$0.00

Comments, suggestions, questions:

Plus Shipping & Handling

Pricing is valid for the calendar year 2019 and subject to change without notice.