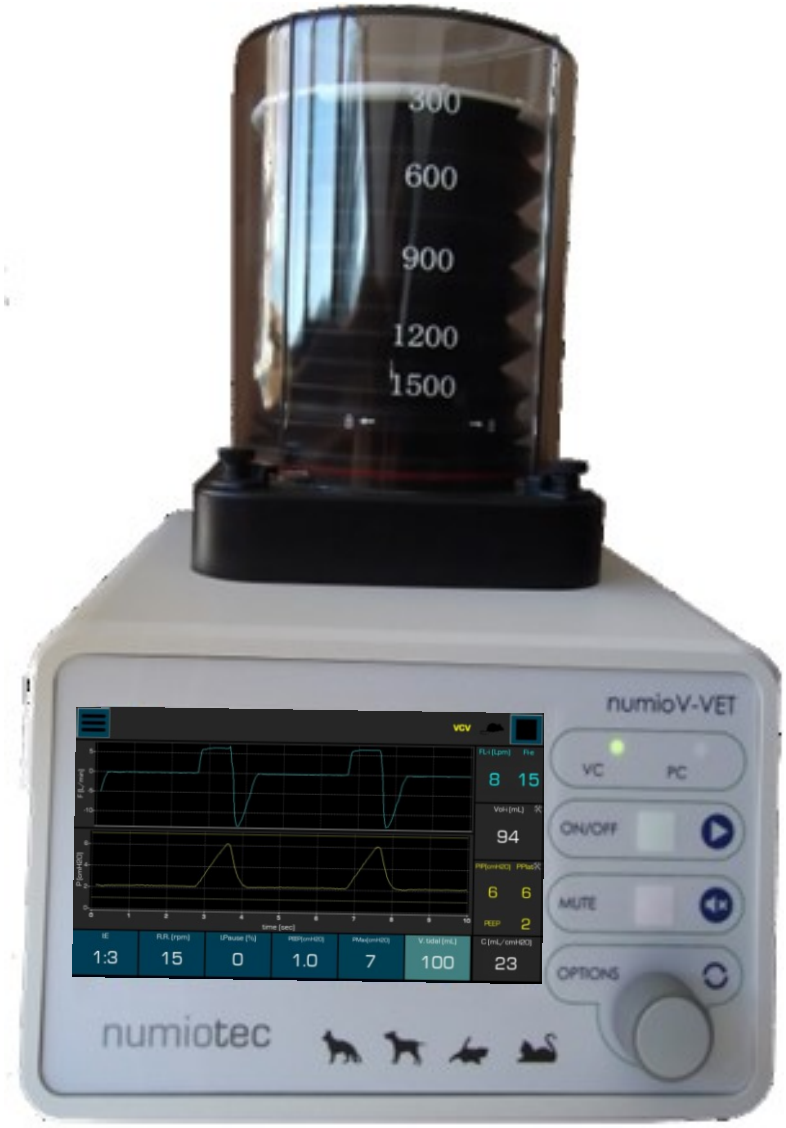

numioV_VET

User manual
Version 2.0

CONTENT

1. SYMBOLS

Symbol	Content	Description
	NOTE	Information to which the user must pay special attention.
	CAUTION	Indicates operation or maintenance procedures that must be executed correctly to prevent damage to the equipment and its properties, or to guarantee its correct operation.
	WARNING	Calls attention to a potential hazard that requires proper performance of procedures or practices to prevent personal injury.
	DANGER	Urgent safety information for hazards that can cause serious personal injury or even death.

2. SECURITY MESSAGES

⚠DANGER

- Do not use this product near a source of water or other liquids.
- Do not place or store this product where it may fall.
- Do not use the equipment if it has come into contact with water or other liquids, disconnect it immediately.
- To install this equipment, carry out maintenance actions and operate the unit, carefully read the instructions in this User Manual.

⚠WARNING

To reduce the risk of burns, electric shock, fire, or personal injury:

- Use the product only for the applications described in this manual. Do not use any extra element not recommended by the manufacturer.
- Never operate this product if: a) The power cord or its connector has been damaged, b) It is not working properly, c) It has been dropped or structurally damaged, d) It has fallen or come into contact with water or other liquids. In any of the cases described above, please return the equipment to the technical service center for examination and repair.
- Keep the power cord away from hot surfaces.
- Do not block the air openings of this product or allow objects to fall or be inserted into them.
- Do not place the equipment on unstable surfaces such as stretchers to avoid falls and breaks.

⚠CAUTION

To avoid damage to the ventilator and/or its parts:

- Unpack the equipment and its accessories carefully.
- Before turning on the equipment, make sure that the pneumatic and electrical connections have been made correctly according to the instructions in this User Manual.
- Use an external stabilizer system (UPS) in case of using the equipment in places with instabilities of the power source (greater than 10%).
- In case of accidental disconnection of the pneumatic tubes, turn off the ventilator immediately and make sure that they have been reconnected properly before it is turned on again.

3. PRODUCT DESCRIPTION

The numioV_VET system is a portable mechanical ventilator specifically for veterinary use. It is controlled by an internal computer and allows the use of inhalational anesthetic agents. It incorporates physiological measurements and allows for more advanced studies of respiratory physiology.

Among the benefits during ventilation and anesthesia of animals are:

- Allows sophisticated or complex interventions to be carried out safely,
- Provides the user with measurements of the animal's respiratory physiology,
- Minimizes risks during the intervention,
- Guarantees the correct physiological state of the animal during ventilation,
- It controls the parameters of the animal and protects it, avoiding undesirable accidents during the intervention.

Functional Characteristics

- Tactile and robust equipment,
- Compatible with anesthesia systems available on the veterinary market,
- It operates in two different modes:
    a) Volume-controlled ventilation (VCV) or with constant inspiratory flow, and
    b) Pressure-controlled ventilation (PCV) with decreasing inspiratory flow
- Monitors parameters of the animal's respiratory physiology:
    a) Pulmonary pressure,
    b) Inspiratory and expiratory flow,
    c) Inspired volume,
    d) Pressure-Volume curve with calculation of lung compliance.
- The measurement of the physiological parameters is carried out in the same mouth of the animal,

- Calculates Peak Inspired Pressure (PIP), Positive Expiratory Pressure (PEEP), and Plate Pressure (PP),
- Allows the adjustment of PEEP by the user,
- Allows you to adjust the inspiratory pause based on the inspiratory time (in %),
- Allows planning and executing an alveolar recruitment maneuver (MRA),
- Protects the animal in real-time against pulmonary overpressure,
- Generates acoustic alarms:

  a) to indicate the absence of gas in the bellow,

  b) to indicate gas overpressure in the bellow,

  c) to indicate low inlet air pressure to the ventilator,(The inlet air pressure must be greater than 4bar to guarantee the maximum precision of the device)
- Simple and intuitive user interface,
- Quick access to the parameters of the active ventilation mode.

4. TECHNICAL SPECIFICATIONS

parameters	Worth	units
Lung protection in real time	< 40	cmH2O
inspiratory flow	1 to 70	l/min
Tidal Volume	20 to 1200	ml
PEEP monitoring	0 to 20	cmH2O
Breathing frequency	6 to 40	rpm
inspiratory pause	0 to 100	% of inspiratory time
Parameter measurement accuracy	> 90	%
In-Cycle Reproducibility	< 1	more
Inspiration time: expiration ratio (I:E)	1:10 to 5:1	
maximum inspiratory pressure	10 to 65	cmH2O
air inlet pressure	3 to 5 (recommended 4)	Bar

5. INSTALLATION INSTRUCTIONS

The installation of the system is done quickly, easily and intuitively. All installation is done on the back of the ventilator. Figure 1 shows the correct connection of the pneumatic and electrical parts.

Connect the pipes and electric wires following the descriptions in the figure, and then connect the power cord. Activate the external air source with a pressure between 4.5 to 5.5 bar.

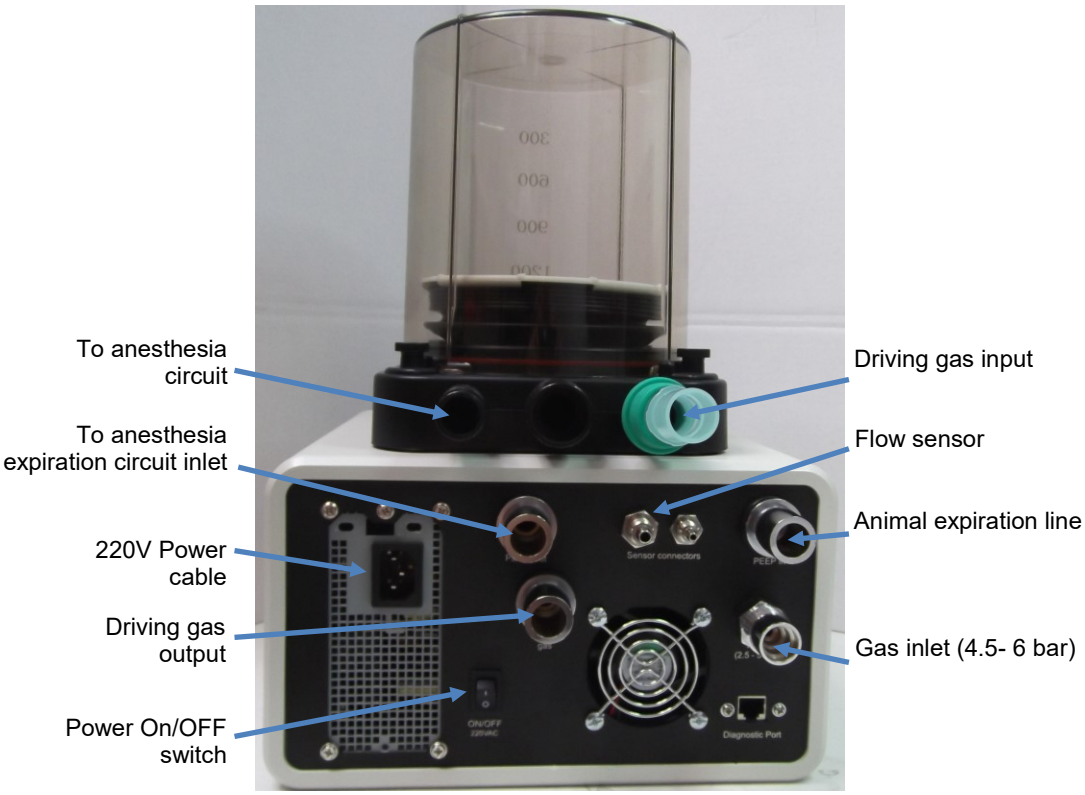

Figure 1: Pneumatic and electrical connections

⚠WARNING: If you have any doubt(s) in the connection of any of the parts, consult the manufacturer. Do not proceed to turn on the ventilator if you are not sure of the connections made.

6. SET UP

⚠WARNING: Before proceeding to use the equipment, make sure that the electrical cables and pneumatic tubes are correctly connected.

⚠CAUTION: Do not connect the anesthesia circuit with the flow sensor to the animal's mouth before turning on the equipment or disconnect this sensor from the rear panel of the ventilator to proceed with turning it on.

Power on the system using the switch on the rear panel of the device. Once turned on, the numioV_VET ventilator will proceed to carry out a series of adjustments and initializations. This process could take between 30 seconds and 1 minute.

⚠NOTE: Depending on the ventilator model used, there may be two switches on the rear panel. Make sure you have both in position 1 to turn on the equipment and both in position zero for proper shutdown of the equipment.

⚠CAUTION: Do not perform any maneuvers with the ventilator or with the anesthesia system while the equipment is being turned on.

To start ventilating attach the flow sensor to the animal's mouth and to the back of the device. Fill the bellow using the anesthesia circuit flow controller. Follow the prompts that will be displayed on the device screen for its operation.

The control buttons on the front panel of the ventilator are shown in figure 2.

Figure 2: Control buttons on the front panel of the ventilator

Alarm mute Button: Allows you to silence the different alarms that are generated in the system. The sound of the alarms is different depending on the type (high level or low level, see chapter 7).

Start / Stop button: It allows executing the selected ventilation mode with the previously configured parameters. This option can also be executed from the work touch interface using the button with the same name.

Selection Wheel: Allows you to navigate between the different ventilator options and execute the selected changes and procedures. These options can also be executed from the working touch interface

7. WORK INTERFACE

The main working window of the numioV-VET ventilator is displayed on the**figure 3**. It is made up of the Pulmonary Pressure and Pulmonary Flow graphs, the physiological measurements and the main operating parameters of the ventilatory mode used, as well as the messages and options area.

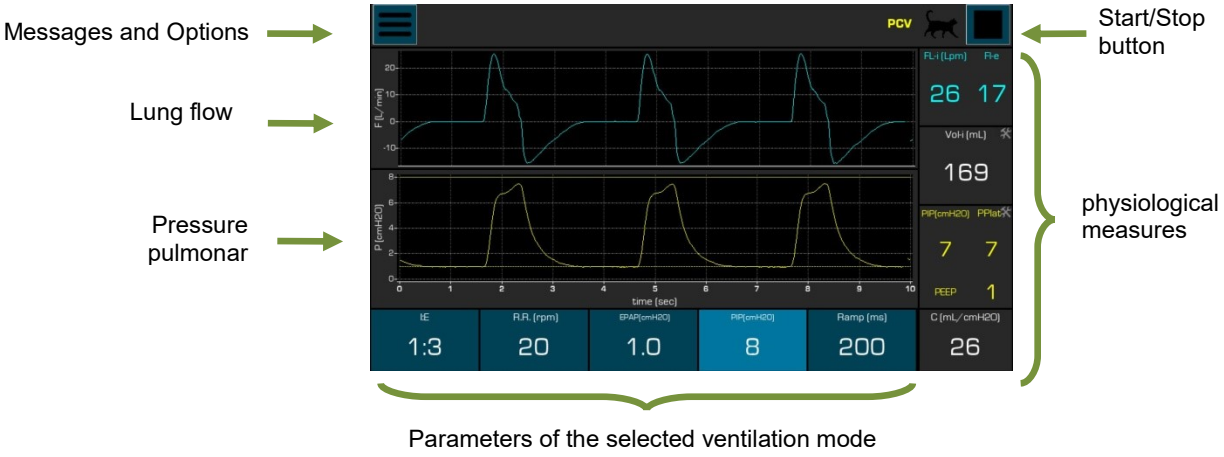

Figure 3: Main work interface

Using the Ventilator Selection wheel or the touch interface, the user can navigate through each of the ventilation parameters and adjust them according to the animal's needs.

⚠NOTE: The physiological measurements and ventilatory parameters displayed will depend on the model of ventilator used and the selected ventilation mode.

⚠CAUTION : Before starting to ventilate, the lung pressure and flow signals must be zeroed. To do this: Select the Options menu and then navigate to the settings icon and press the jog wheel. In the settings window, navigate to the Zero Calib icon and press the jog wheel. Finally navigate to the close window icon (X) and press the selection wheel (Figure 4).

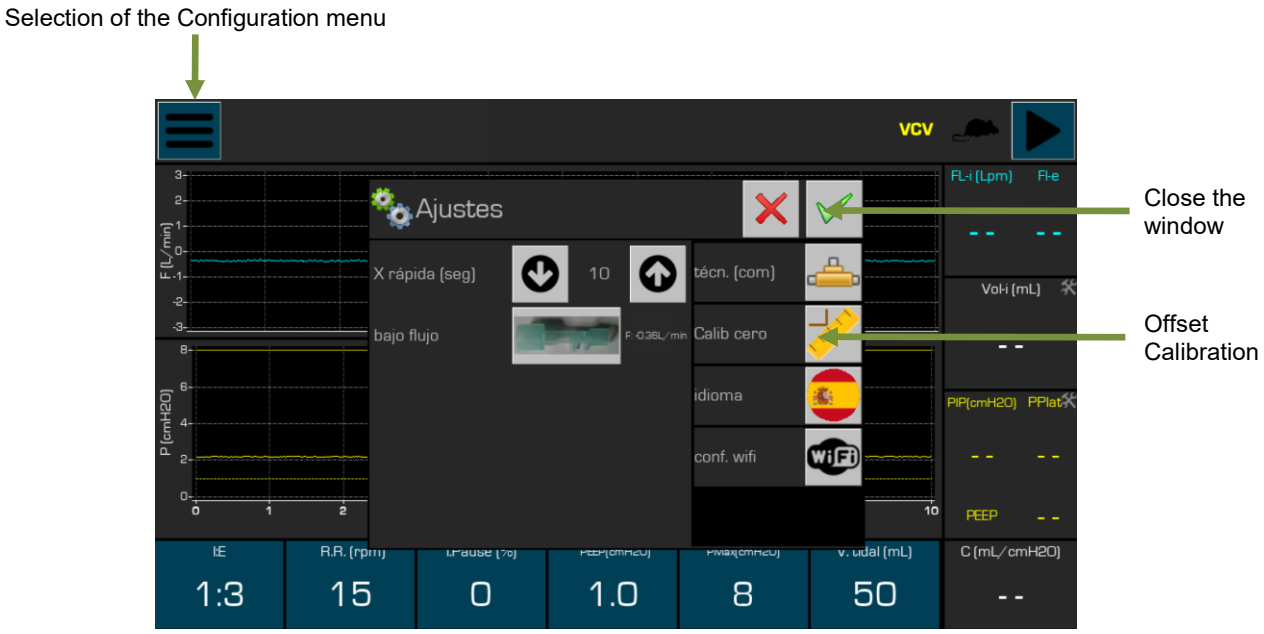

Figure 4: Zero adjustment

Ventilation mode selection

To change the ventilation mode, select the Options menu and then navigate to the ventilation mode, press the jog wheel and change to the desired mode. Finally press the selection wheel again. The new ventilator mode will be displayed in the upper right corner (Figure 5).

Figure 5: Change of ventilation mode

Animal Selection

It is possible to switch settings between different animals by tapping on the animal's switch icon.

When selecting a new animal type, a message will appear on the screen requesting to change the flow sensor (high flow or low flow). The use of the appropriate sensor according to the type of animal, will allow to guarantee the precision in the measurements of flow and tidal volume.

Figure 6: Change of animal type

When a new animal is selected, the last used settings for the selected animal are loaded in the User Interface and in the equipment in general. The parameters included in the animal configuration are:

- Scale of the X and Y graphs,
- alarm limits,
- Graphics and maximum limits allowed for alarms.

The device is configured for three different animals by default: small, medium and medium-large animal. Other animals can be configured on request. If during the operation of the device the user changes the scales, the alarm limits or the maximum allowed limits, the new values will be stored in the device and will be used the next time the animal is selected. Additionally, when the equipment is turned on, the configuration for the last animal used will be selected by default.

Limit selection

To set the limits for each parameter measured by the ventilator, the user must navigate to the desired parameter and press the jog wheel. In the activated window you can increase or decrease the desired limits according to your needs. When the physiological measurements reach the values established in these limits, a visual and audible alarm of high level or low level will be activated depending on the clinical importance of the parameter. Figure 7 shows an example of changing limits in lung pressure measurements.

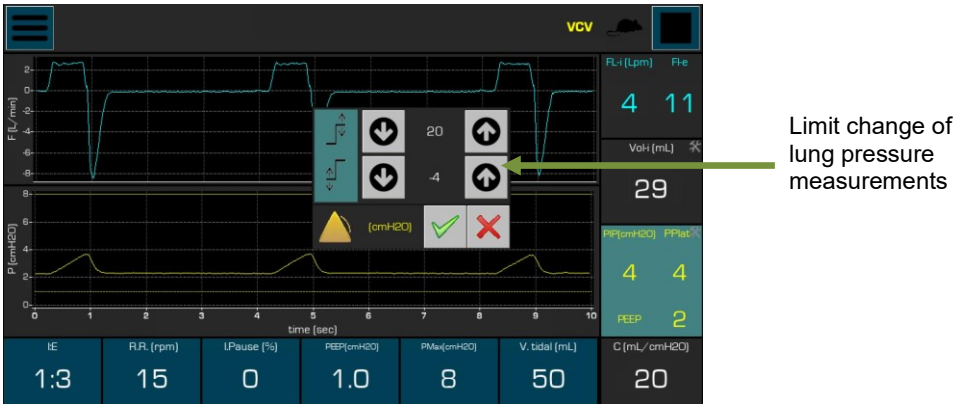

Figure 7: Establishment of limits in the measurements

The different alarms that can be generated in the equipment and their type are detailed below:

Alarm	Level
general system failure	High
Pulmonary overpressure (PIP)	High
Low expiratory pressure (PEEP)	Low
Ventilatory volume out of range	High
Low air inlet pressure	High

The activated alarm will appear in the messages and options area, as shown in figure 8. High level alarms will appear with a red background and low level alarms with a yellow background.

Figure 8: Example of a high level alarm

The vet will be able to silence the alarm for 2 minutes by pressing the jog wheel on the alarm icon or using the touch interface. During this time, a timer will appear below the alarm icon indicating the remaining silenced alarm time. If the user presses the icon again before the two minutes are up, this timer will be reset. In the event of a new alarm appearing in this interval, this timer will be automatically deactivated, reactivating the alarm sound.

scale adjustment

To adjust the scale on the pulmonary pressure and flow graphs, the user must navigate to the desired graph and press the jog wheel. In the new activated window you will be able to select between the option of auto scale or manual scale with the lower and upper limits that you want.

Figure 9: Settings the scale in the graphs

8. OPERATING MODES

The numioV-VET ventilator can work in two ventilation modes (Volume Controlled Ventilation and Pressure Controlled Ventilation). The equipment will display the selected ventilation mode on the main interface. Likewise, the led corresponding to the active mode will light up on the front panel of the ventilator.

Volume Control Ventilation (VCV)

Volume-controlled ventilation requires the veterinarian to set the tidal volume, respiratory rate, and positive end-expiratory pressure (PEEP). Inspiration ends once the inspiratory time set according to the respiratory ratio and the I:E ratio has elapsed. Airway pressures (peak and plateau) depend on both ventilator settings and animal-related variables (lung compliance and airway resistance).

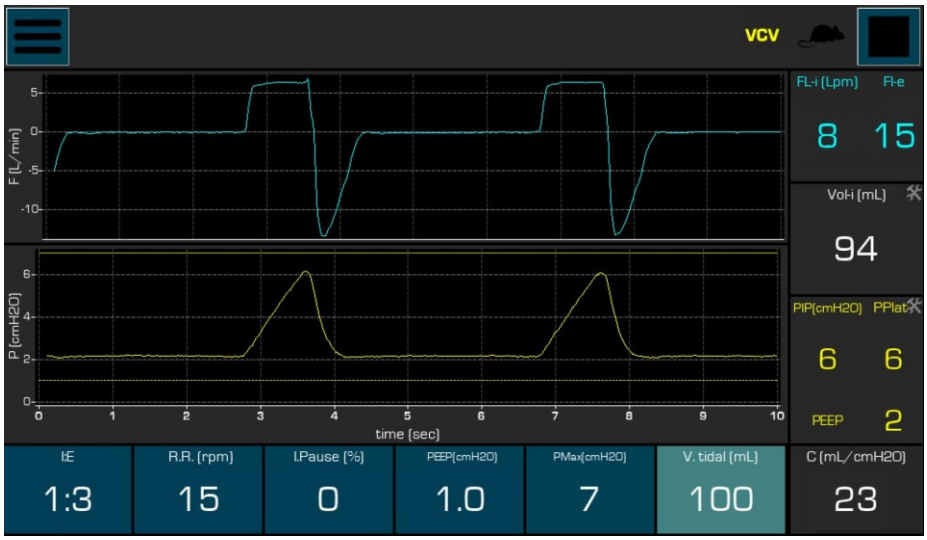

Figure 10: Graphs and parameters in VCV Mode

The VCV mode parameters are detailed below:

I:E:Inspiration/Expiration Ratio. This parameter allows the user to vary the inspiration time based on the previously selected respiratory rate.

Respiratory reason:Respiratory rate in breaths per minute.

Inspiratory Pause:Inspiratory pause. Time elapsed from the end of inspiration to the beginning of the animal's expiration. This parameter is measured in % of the inspiratory time.

PEEP:Positive pressure at the end of expiration. On the Pulmonary Pressure graph a dashed yellow line will mark the level selected by the user.

Maximum pressure:maximum lung pressure. This value allows the animal to be protected against unwanted events that may increase the pressure in the inspiratory line. On the Lung Pressure graph a solid yellow line will mark the level selected by the user. When the lung pressure reaches this value, an audible alarm is emitted by the ventilator and at the same time it will automatically shut off the gas supply to the animal until the next respiratory cycle.

⚠WARNING : If the user selects a Maximum Pressure that is too low, the tidal volume delivered to the animal could be insufficient and not correspond to the established value. The Maximum Pressure in VCV mode should only be used to protect the animal against unwanted pulmonary overpressures (caused by physiological reasons or obstructions in the ventilation tubes). If you need to control the Maximum Pressure of each respiratory cycle, use the Pressure Controlled Ventilatory (PCV) mode.

Tidal Volume:Tidal volume required to ventilate the animal.

Pressure Control Ventilation (PCV)

In pressure-controlled ventilation, the ventilator maintains a set airway pressure for a set inspiratory time. The vet would set the inspiratory pressure level, PEEP, I:E ratio, and respiratory rate. In this mode, the maximum airway pressure is constant (inspiratory pressure + PEEP), while the tidal volume can vary according to the characteristics of the animal (lung compliance, airway resistance) and driving pressures.

Figure 11 shows an example of the pressure controlled ventilatory mode. To execute this ventilation mode, the user must access the PCV option in the ventilator options menu.

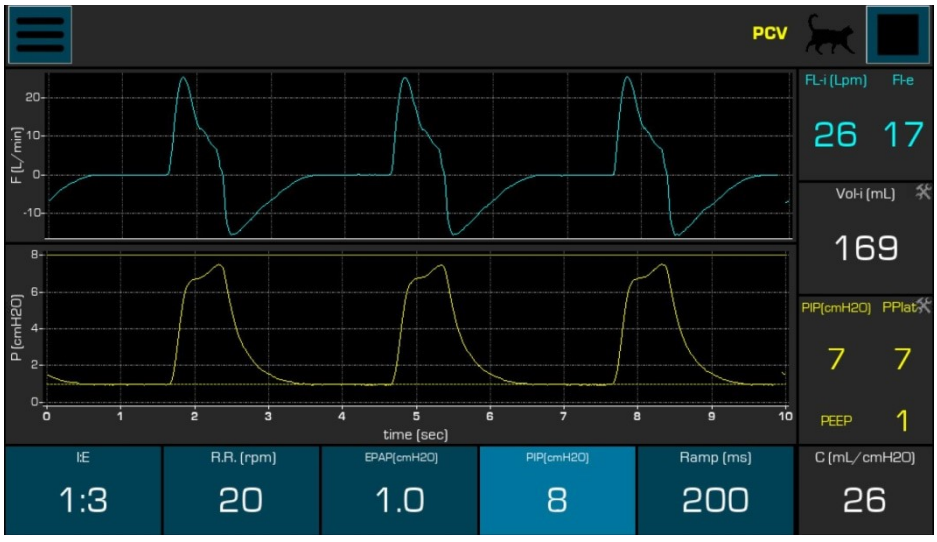

Figure 11: Graphs and parameters in PCV mode

The PCV mode parameters are detailed below:

I:E:Inspiration/Expiration Ratio. This parameter allows the user to vary the inspiratory time based on the previously selected respiratory rate.

Respiratory reason:Respiratory rate in breaths per minute.

EBAP:Positive pressure at the end of expiration. On the Pulmonary Pressure graph a dashed yellow line will mark the level selected by the user.

Inspiratory Pressure:Peak inspiratory pressure desired by the user. On the Lung Pressure graph a solid yellow line will mark the level selected by the user plus 10%.

Ramp:Time during which the selected Inspiratory Pressure is reached at each respiratory rate.

9. SYSTEM SHUTDOWN

To proceed to shutdown the system, use the switch found on the rear panel of the system (zero position).

⚠CAUTION: Before proceeding to turn off the ventilator, it is recommended to stop the ventilation sequence with the Start / Stop button on the front panel.

⚠NOTE: Depending on the ventilator model used, there may be two switches on the rear panel. Make sure you have both in position 1 to turn on the equipment and both in position zero for proper shutdown of the equipment.