CE 2460

LEISTUNG

LUFT3

Lung Ventilator for ICU
Neonatal, Pediatric & Adult

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Our commitment
to life

Leistung is more than a manufacturer of lung ventilators for ICU and Emergency. Leistung's lung ventilators, besides being products of technological excellence and performance, they also carry the values of all the professionals involved in the process, from its conception to its commercialization, who are aware about the importance of a life-supporting device.

Therefore, we are proud to say that, while we are an industry, our essence lies in the trust that professionals and patients place in us. It is our commitment to life that makes us go further!

LEISTUNG

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LUFT3

TECNOLOGY allied
to QUALITY OF LIFE.

LUFT3

Lung Ventilator for ICU

Adult | Pediatric | Neonatal

The lung ventilator for Intense Care Units (ICU) LUFT3, counts with integrated 17" touch screen technology and offers a complete range of ventilation modes which allows the monitoring of the patient's condition.

VENTILATION MODES

ADULT/PEDIATRIC

- VCV assisted/controlled
- PCV assisted/controlled
- PSV/CPAP
- PRVC assisted/controlled
- SIMV (VCV) + PSV
- SIMV (PCV) + PSV
- MMV + PSV
- PSV + assured VT
- Biphasic pressure (APRV + PSV)
- NIV
- HFNC

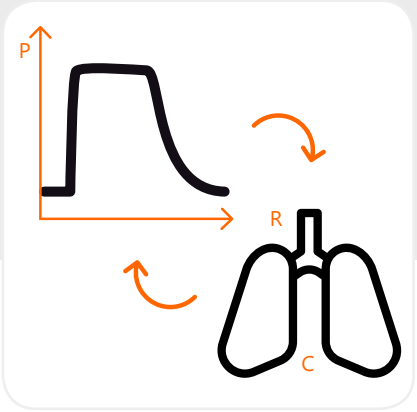
NEONATAL

- VCV assisted/controlled
- PCV assisted/controlled
- PSV/CPAP
- SIMV (PCV) + PSV
- Continuous flow assisted/controlled
- Nasal CPAP
- HFNC

FUNCTIONALITY AND PERFORMACE

STRESS INDEX

The stress index is performed with minimal interference in the ventilatory cycle and results in a numerical value of easy interpretation, promoting a practical, safe and effective analusis of the patient ventilation. It is a measure of respiratory the stress caused in the alveoli either by collapse or hyperdistension.



PRVC

It combines the best of convetional controlled ventilation modes of volume and pressure, providing the volume adjusted by the operator with as little pressure as possible.

The function uses free flow waveform formation, control with feedback of the compliance and resistance of the patient.

LUFT3
Lung Ventilator for ICU

SPECIAL FEATURES

- 100 % oxygen up to 20 min. with automatic alarm silence;
- Adaptation of the patient's interface or change of the circuit with recalibration without having to turn off the equipment and keeping track of the patient's log;
- Automatic theoretical weight calculation and interface selection according to the patient;
- Altitude compesation;
- Configuration of the monitored variables;
- Flow curve 50 % descending;
- Intuitive Interface;
- Gas measurement with BTPS correction;
- Smart ventilator, records the user preference after 10 uses.
- LCD Screen tilt angle adjustment
- Log for 1000 alarms and events with date and time

Adjustment of the **ALARM VOLUME**

6 HOURS battery life

Intuitive Interface with Adjusment of the **MONITORED VARIABLES**

Timed **NEBULIZER** with Inspiration flow and FiO_2 compensation

LUFT3
Lung Ventilator for ICU

GRAPHICAL INTERFACE

INITIAL SCREEN SETUP

- Patient selection
- Gender
- Height
- Weight
- Automatic theoretical weight calculation
- Ventilation level per mL/kg
- Type of artificial airway
- Type of humidification
- Line test
- Circuit compliance measurement
- Last patient function

OPERATIONAL VISUALIZATION

- Graphical pressure bar
- Indicator of spontaneous/controlled cycles
- Battery charge level
- Programation of the ventilatory variables

ADULT AND PEDIATRIC

Customizable selection of up to

5 SIMULTANEOUS GRAPHICS

- Pressure/Time
- Flow/Time
- Volume/Time
- Volume/Pressure
- Flow/Volume
- Pressure/Flow

NEONATAL

Customizable selection of up to

3 SIMULTANEOUS GRAPHICS

- Pressure/Time
- Flow/Time
- Volume/Time

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Lung Ventilator for ICU

LUNG MECHANICS

- AutoPEEP
- Slow vital capacity
- Dymanic compliance
- Static compliance
- PV curve with low flow
- Elastance
- Stress Index
- Tobin Index
- P0.1 - Airway obstruction pressure
- Expiratory resistance
- Inspiratory resistance
- Work of breathing

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Lung Ventilator for ICU

PARAMETERS

CONTROLS	
FiO_2	21 to 100 %
Inspiratory time	0.1 to 30 s
I:E Ratio	5:1 - 1:99
Ventilator Frequency	1 - 180 r.p.m.
Tidal Volume	2.0 to 2500 mL
Minute Volume	0.01 to 25.0 L
Sensibility	By Flow: 0.2 to 15 L/min. | By Pressure: -0.2 to -15.0 cmH_2O (PEEP compensated)
Controlled Pressure (PCV)	1 to 80 cmH_2O (over PEEP)
Support Pressure (PSV)	0 to 80 cmH_2O (over PEEP)
Inspiratory Pressure	-10 to 120 cmH_2O
Rise Time	6 levels
Expiratory Sensibility	5 to 80 %
Apnea Time	5 to 60 s
PEEP/CPAP	0 to 50 cmH_2O
Nebulization	1 to 20 min. synchronized with automatic compensation of the inspired volume and FiO_2
Inspiratory Flow	0 to 200 L/min.
Base Flow	Off up to 50 L/min.
Expiratory Flow	Up to 200 L/min.
Automatic Inspiratory Pause (VCV mode):	0.1 - 2.0 s with plateau pressure value
Manual Inspiratory and Expiratory Pause	Up to 30 s
O_2 100%	1 to 20 min.
Flow Waveform	Square/Descending 100 %/Descending 50 %/Sinusoidal/Ascending
Inspiratory Pressure Inner Safety Valve	Adjusted in 120 cmH_2O
Pressure Regulating Valve for Air and O_2 Input	Built into the equipment
RS232 Signal Connector	For external communication with the software and signals input
USB Signal Connector	For equipment's service and sofware update
TGI	Synchronized with the exhalation phase
Sigh (VCV mode)	Cycles per hour, quantity, maximum tidal volume
Automatics Scales	Automatic for amplitude and adjustable per time
Graphics Freeze	With grid for easy interpretation of the values
Standby	Keep the ventilator in standby mode without changing the setup
Backup Ventilation	Available in all ventilatory modes
Altitude Compensation	0 to 6000 masl
Alarm Sound Level	20 to 100 %

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Lung Ventilator for ICU

PARAMETERS

MONITORIZATION

Airway Pressure: Peak	0 to 120 cmH_2O
Airway Pressure: Plateau	0 to 120 cmH_2O
Airway Pressure: Mean	0 to 120 cmH_2O
Airway Pressure: Base (PEEP)	0 to 50 cmH_2O
Inspiratory Time	0 to 30 s
Expiratory Time	0 to 30 s
I:E Ratio	49:1 to 1:99
Inspiratory Pause	0 to 30 s
Inspired/Expired Tidal Volume (Distal and Proximal)	0 to 2.5 L
Peak Inspiratory Flow (Distal and Proximal)	999 L/min.
Peak Expiratory Flow (Distal and Proximal)	999 L/min.
Dynamic Compliance	999 mL/cmH_2O
Total and Spontaneous Frequency	250 r.p.m.
Graphical Indicator of Spontaneuos and Mechanical Cycles	Symbols and graphs
Minute Volume (Distal and Proximal) total and spontaneous	0 to 25 L/min.
FiO_2 Concentration	21 to 100%
Constant of inspiratory and expiratory time	9.99 s
Compressible Volume	399 mL
Ti/Ttot Ratio	0.98
Total Leakage	50 L/min.
Ventilation Level (mL/kg)	99.0 mL/kg
Battery Charge Level	0 to 100%
Patient Circuit's Compliance	4.0 mL/cmH_2O

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GENERAL

SPECIAL CHARACTERISTICS

- Current time and date
- Time and date when the equipment was turned on
- Touch screen function lock
- Graphical indicator of external power supply and battery
- Proportional indicator of battery charge level
- Indicator bar of the parameters adjustment range
- Graphical bar of the ventilatory pressure with indicator of the alarms level
- FiO_2 reading through Galvanic Cell or Pneumotachograph
- Standby symbol
- Alarms log symbol
- Automatic compensation of the breathing circuit's compliance
- Internal, permanent and non-consumable sensor

PROGRAMMABLE ALARMS

- Maximum pressure
- Minimum pressure
- Maximum tidal volume
- Minimum tidal volume
- Maximum minute volume
- Minimum minute volume
- Maximum frequency
- Minimum frequency
- FiO_2
- PEEP
- Apnea

COMPLEMENTARY MESSAGES

- Without exhalation sensor
- Without proximal sensor
- Active oxygen cell
- Estimated patient weight

AUTOMATIC ALARMS

- Power failure
- Interrupted cycle
- Air/O_2 input pressure (low and high)
- Low Battery (inoperative battery)
- Microprocessor (inoperative ventilator)
- Inverted I:E Ratio
- Patient disconnection
- Proximal sensor disconnection

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PARAMETERS

GRAPHICAL TENDENCIES

Tidal Volume
Minute Volume
Frequency
Dynamic Compliance
Peak and Base Pressure
Flow
Graphical tendencies up to 72 hours with the aid of grids for analysis

NUMERICAL TENDENCIES

AutoPEEP
Dynamic compliance
Static compliance
Inspiratory resistance
Expiratory resistance
Stress Index

INTERNAL POWER SUPPLY

Nominal voltage	10.8 V ~ 11.1 V
Nominal capacity	13.2 Ah
Type	Lithium Battery (Li+)
Battery	360 min. autonomy

PNEUMATIC INPUT

Oxygen	DISS 9/16” – 18 Input
Air	DISS 3/4” – 16 Input
Pressure	250 – 700 kPa (2.5 - 7 bar)
Maximum Flow Consumption	Up to 180 L/min.

PHYSICAL CHARACTERISTICS

Height	1473 mm
Width	550 mm
Depth	530 mm
Equipment’s Weight	28.0 kg
Case’s Weight	10.0 kg
Monitor’s Weight	5.4 kg
Trolley’s Weight	12.6 kg
Touch Screen	17 inches
LCD LED Monitor	With angulation adjustment
Trolley	Anticorrosive plastic material
Castors	4, being 2 with brakes

POWER SUPPLY

Voltage - Current	100 V – 240 V ~ 0.6 A – 0.29 A
Frequency	47 to 63 Hz
Commutation to Battery	Voltages Lower than 90 Vac.

GENERALITIES

Medical Product Classification	Class III
Operation Mode	Continuous Operation
Classification Against Electric Shock (Isolation)	Class I - Internally Energized Equipment
Classification of Protection Against Electric Shock	Type B
Protection Level Against Nocive Penetration of Water	IP22

LEISTUNG

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MADE IN BRAZIL

CE 2460

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VENTILATION MODES

By selecting a ventilation mode, the operator is determining what kind of variable he wants to control during the inspiration.
Access ***"Menu"*** from the ***"Ventilation Modes"***, select the desired mode (by pressing ***"_next"***, you can see the remaining ventilation modes) and confirm the selection, thus displaying on the screen the chosen parameters and resulting curves and values.

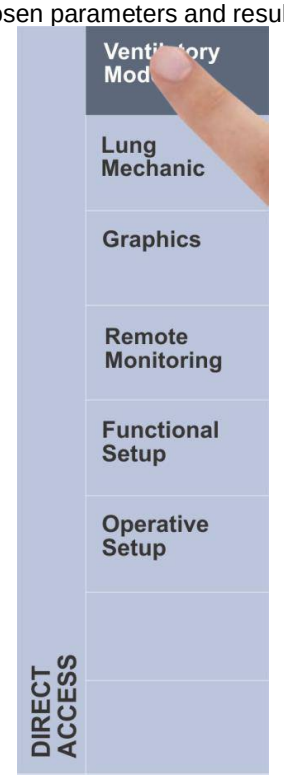

Figure 57

Figure 58

Figure 59

All the modes available on the equipment *(Adult-Pediatric-Neonatal)* have a pre-set configuration from the factory: these configurations are average values and must be adjusted by the doctor to become values appropriated for each patient.
The lung ventilator does not interrupt its operation during the change from one mode to another.
The ventilation modes are divided in basic modes and integrated modes: in the first group, it is included the ventilation modes controlled by pressure and support pressure. In these modes, you can control only one variable continuously while in the integrated modes, even though you only control one variable at a time, you can change the kind of control according to the characteristics of the patient's ventilation.

The inspiratory flow can be adjusted directly or indirectly by the user, through the configuration of ventilatory variables such as volume, inspiratory time, I: E ratio, waveform or directly the flow itself, depending on the ventilatory mode. When the flow is adjusted indirectly, by adjusting the previously mentioned variables, the resultant of this flow is equated by the equipment and informed on the screen in blue coloration. In ventilatory modes with pressure control where the flow is controlled by the equipment based on patient compliance and resistance conditions, the operator can perform a peak flow adjustment by adjusting the Rise Time control variable.

The expiratory flow is adjustable for each type of adult, pediatric and neonatal patient. It is automatically adjusted for leakage compensation or by the user by adjusting the PEEP value that will influence the expiratory resistance.

VOLUME CONTROLLED VENTILATION – (VCV)

In this mode, the ventilator controls the volume delivered to the patient, integrating the air volume and the inspiratory time selected by the operator, i.e., it behaves like a flow controller cycling per volume. Therefore, to perform changes on the flow speed, you shall modify the tidal volume or the inspiratory time, or even both of them together, according to the necessary ventilation.
When controlling the flow, it is possible to choose between constant flows waveforms, descending waveforms, sinusoidal or ascending, being then possible to observe the consequent modifications on the peak flow and the morphology of the curves of Pressure **–** Time and Flow **–** Time.
The resulting pressure is the free variable, which will be determined based on the physical and mechanical conditions of the respiratory system. The inspiratory cycle trigger can be time, flow or pressure because it is an assisted-controlled mode.

PRESSURE CONTROLLED VENTILATION – (PCV)

In this mode, the ventilator will positively pressurize the patient's respiratory system during the inspiratory time programmed by the operator. To obtain it, once the established pressure level is reached, it will start a slowdown on the flow speed. This slowdown is the consequence of the respiratory system's physical condition and is not controlled by the ventilator. It is a pressure controlled mode and cycle by time. It is therefore a pressure controlled mode and cycled by time, being possible for the operator to manually change the peek flow or the “Rise Time”. The resulting tidal volume is the free variables and consequently this kind of ventilation requires an increased pathophysiological analysis of the patient, whom shall be permanently monitored by trained staff, as well as a correct programming of the volume alarms.
The beginning of the ventilatory cycle can occur by time, flow or pressure because it is an assisted-controlled mode. As the inspiratory flow is resulting from the equipment's programming and from the physical conditions of the respiratory system, the produced flow waveform is invariably decelerated, observing variations on the flow's speed by the end of an inspiration, i.e. the inspiration can be finished without the flow reaching the value zero, without reaching the value zero coincided with the end of the inspiration or before that.
An interrupted cycle protection system is activated in all pressure modes such as PCV, PSV and associated, where in case the patient pressure exceeds the programmed pressure by 12cmH2O, the ventilator will immediately cycle and release the gases from the patient to exhalation, thus avoiding possible injuries and increasing patient comfort. The main causes for the protective system to activate are airway obstructions, elevated Rise Time, or a patient's effort such as coughing.

SUPPORT PRESSURE VENTILATION OR CONTINUOUS POSITIVE AIRWAY PRESSURE – (PSV/CPAP)

It is a mode developed to adapt the ventilator to the spontaneous ventilation of the patient, being the level of pressure exchange over the base pressure the only control variable that must be programmed. Because it is a mode controlled by the patient, the flow speed will adapt not only to the physical conditions of the system, but also to the inspiration and exhalation efforts of the patient, respecting the established pressure level. Due to this, it is defined as a spontaneous mode, assisted by the flow and limited by the pressure.
As a spontaneous mode, the beginning of the inspiration will only happen upon detection of a signal of flow or pressure generated by the patient, finishing as standard when the flow speed slows to *25%* of the initial speed. This value can be changed by the operator in about (percentages *60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10, 5*) to adjust the end of the inspiration with the conditions and/or needs of the patient. As safety parameters, it is stipulated a criterion of maximum inspiratory time (*3 seconds*) and a criterion of pressure (*5 cmH2O* over the maximum programmed pressure) which, in case of detection, will make the equipment pass to the exhalation phase.
Once the control variable is the pressure level and the free variable is the volume, it is worth reminding that (in constant physical conditions) the latter will be proportional to the patient's inspiratory effort and the programmed support pressure.

In case of programming *0 (zero)* support pressure, pressure changes will not happen over the established base, therefore you will get a level of continuous positive airway pressure (CPAP), being the only difference in relation to the *PSV* the fact that the volume exchange during the inspiration will depend only on the patient, as the same will not receive any flow assistance. *"To adjust this mode, the backup ventilation shall be previously programmed".*

SYNCHRONIZED INTERMITENT MANDATORY VENTILATION BY VOLUME WITH SUPPORT PRESSURE – SIMV (VCV) +PSV

It is a ventilatory alternative with which the mechanical ventilation can be started, its function is to reduce the amount of mandatory ventilation of the ventilator, in order for the patient to ventilate spontaneously between each cycle, synchronizing the beginning of the mandatory cycle with the patient's inspiratory effort. Mandatory ventilation will be controlled by volume (SIMV / VCV), always remembering that the function of mandatory ventilation is to ensure a level of ventilation and oxygenation, avoiding any respiratory contingency.
The SIMV modality presents common characteristics between the assisted / controlled form and the ventilation with support pressure. In the SIMV mode with support pressure the time window has the principle of punctuality (we consider as punctuality the moment when the pulmonary ventilator complies with its adjustments, regardless of whether or not the patient fires the ventilator, a respiratory cycle will occur after the end of the window of time). The SIMV sync window is enabled 1 second before the end of the mandatory scheduled expiration. The spontaneous stimuli of the patient upon reaching the inspiratory sensitivity value initiate a new cycle that can be by volume controlled or by support pressure, depending on the moment that the triggering occurred. Shooting that occurs within the sync window results in a synchronized controlled volume cycle. Shooting before the sync window initiates a cycle of supportive pressure with inspiratory time determined by the deceleration of the inspiratory flow which will cause the pulmonary ventilator to cycle as it reaches the value of the expiratory sensitivity.

SYNCHRONIZED INTERMITENT MANDATORY VENTILATION WITH SUPPORT PRESSURE – SIMV (PCV) +PSV

It is a ventilatory alternative with which it is possible to start the uncoupling of mechanical ventilation, its function is to reduce the amount of mandatory ventilation of the pulmonary ventilator, so that the patient ventilates spontaneously between each cycle, synchronizing the beginning of the mandatory cycle with the inspiratory effort of the patient. It allows spontaneous breaths with supportive pressure and controlled breaths, resulting in a downward flow and respecting the inspiratory time and the frequency programmed by the operator.
The SIMV modality presents common characteristics between the assisted / controlled form and the ventilation with support pressure. In the SIMV mode with support pressure the time window has the principle of punctuality (we consider as punctuality the moment in which the pulmonary ventilator complies with its adjustments, regardless of whether the patient fires or not the ventilator, a respiratory cycle will occur after the end of the window of time). The SIMV sync window is enabled 1 second before the end of the mandatory scheduled expiration. The spontaneous stimuli of the patient upon reaching the inspiratory sensitivity value initiate a new cycle which may be either controlled pressure or support pressure, depending on the moment the trigger occurred. Shooting that occurs within the sync window results in a synchronized controlled pressure cycle. Shooting before the sync window initiates a cycle of supportive pressure with inspiratory time determined by the deceleration of the inspiratory flow which will cause the pulmonary ventilator to cycle as it reaches the value of the expiratory sensitivity.
Support pressure and controlled pressure differ in the fact that the supportive pressure ends when the minimum patient flow (adjustable through expiratory sensitivity) is reached and the controlled pressure is limited by the inspiratory time programmed by the operator.

PRESSURE REGULATED VOLUME CONTROL – (PRVC)

The ventilatory modality called PRVC is a dual control assisted / controlled mode. PRVC is pressure limited and cyclized in time. The pulmonary ventilator operates under controlled pressure, that is, the controlled pressure increases or decreases with each respiratory cycle in an attempt to maintain the tidal volume desired and previously established by the professional.
The pulmonary ventilator algorithm monitors the patient's airway compliance and resistance characteristics at each cycle, as well as the patient's spontaneous stimuli to adjust the inspiratory pressure level and the delivered flow, so that it results in the volume programmed by the professional.
The inspiratory flow is adjusted automatically so as not to result in peaks of pressures during the inspiratory phase. The inspiratory flow also fits the spontaneous demands of the patient during the inspiratory phase, so that the patient in need of more gases promptly is sent these gases by the pulmonary ventilator to keep the pressure constant. The inspiratory pressure added to PEEP to promote delivery of adjusted tidal volume may vary up to the maximum Maximum Controlled Pressure (Pcon Max - understand that maximum controlled pressure means: A control parameter available for setting by the professional to determine the limit of controlled pressure over PEEP necessary to ensure delivery of the tidal volume).
If patient complacency has reduced and demands more pressure to ensure delivery of tidal volume, the pressure is limited to the adjusted value and the pulmonary ventilator adjusts the flow to maintain the maximum pressure limit and provide the maximum possible volume for the limiting pressure. If patient complacency increases and lower pressures can ensure volume delivery, the equipment will promptly adjust the pressure to operate at pressures below the Pcon Max. The tidal volume set in this mode can be used by the practitioner as feedback, to monitor the patient-pulmonary ventilator interaction in real time. It is important to remember that: tidal volume is an objective parameter that depending on the patient's interactions may oscillate near the programmed value, but on average the tidal volume is maintained. The main advantage of this modality is to ensure the tidal volume with lower pressure level. Very important: the professional can not fail to adjust the Peak Pressure Alarm, since the pressure limit generated in the airway is the sum of the controlled pressure plus PEEP.

NON-INVASIVE VENTILATION (NIV)

This ventilatory mode offers the operator the possibility of ventilating the patient without invading his airway. The pulmonary ventilator monitors and compensates for possible leaks in the mask to ensure pressurizing of the circuit and delivery of gases to the patient. In case of leakage, there is compensation (up to 50 L / min) without self-shooting.
Noninvasive Ventilation (NIV) is an integral part of the pressure ventilatory modes. It is a type of pulmonary ventilation that uses different forms of masks that connect the patient to the pulmonary ventilator in a noninvasive way. The pulmonary ventilator monitors and compensates for leaks to ensure delivery of pressure to the patient. There is no need to activate or select this air leak compensation function, the fan constantly monitors and in case of leakage starts compensation.

MANDATORY MINUTE VENTILATION WITH SUPPORT PRESSURE – (MMV+PSV)

The MMV + PSV ventilatory mode allows the patient to breathe spontaneously (with or without support pressure). In this mode the pulmonary ventilator will send supportive pressure cycling with automatic feedback to maintain the patient minute volume according to the programmed minute volume.
The pulmonary ventilator operates operatively as in the stand-by pressure mode, with the automatic adjustment of the stand pressure which is added to PEEP to keep the minute volume constant. At the start of this ventilatory mode the equipment will send a cycle with the support pressure programmed by the professional, after this cycle the equipment will monitor the tidal volume spontaneously breathed by the patient as well as the respiratory rate of the patient to result in minute volume.
The equipment monitors the minute volume, compliance and airway resistance of the patient, so the lung ventilator will assess whether the current support pressure is sufficient to ensure minute volume. If the support pressure value is not sufficient to guarantee the minute volume, then the ventilator increases or decreases the amount of support pressure sent to the patient until the minute volume is

reached and maintained. The variations in support pressure are mild, at the limit of 2 cmH2O per ventilatory cycle.
Setting the patient-compatible maximum and minimum pressure alarm is necessary to ensure that pressure variations occur within safe limits. It is also necessary to adjust the respiratory rate alarm because the minute volume may not equal the alveolar ventilation, which can cause rapid and superficial respiration.

BIPHASIC PRESSURE VENTILATION – (BIPHASIC)

The BIPHASIC mode is spontaneous, limited to pressure and cycled in time. The patient breathes spontaneously into two levels of pressure (two levels of PEEP). These two levels of PEEP alternate. Thus, the professional adjusts the two levels of PEEP, being a PEEP denominated Superior Pressure (Top P = High PEEP) and the other one of Lower Pressure (Bot P = Low PEEP). The practitioner must also adjust the frequency of alternation between the two pressure levels, through Upper Inspiratory Time (Top T) and Lower Inspiratory Time (Bot T).
The patient can breathe spontaneously at both the upper and lower levels with an independent supportive pressure level. The two pressure levels are equivalent to two pressure levels (base pressure or PEEP) operating with the partially open exhalation valve. The patient may exert effort to trigger the lung ventilator at any level where a support pressure above the pressure level will be sent.

PRESSURE SUPPORT VENTILATION WITH ASSURED TIDAL VOLUME – (PSV+VT)

The PSV + VT mode is spontaneous, offers the comfort of free flow and the safety of the determined minimum tidal volume. The inspiratory flow depends on the impedance of the respiratory system, is free and depends on the patient's effort and the level of support pressure. For this, the professional should set a tidal volume, which will be established as a minimum value for each patient's inspiration.
With this ventilatory modality, once the patient initiates inspiration, the pulmonary ventilator will control the support pressure through the flow assist (support pressure), however, when reaching the flow value that causes the pulmonary ventilator to cycle, that is , in the percentage value of the expiratory sensitivity, and the programmed tidal volume has not yet been reached, it will behave as a flow controller until the amount of volume fixed by the professional is inflated, in this condition the inspiratory time will be increased.
If the patient's current tidal volume in the cycle is equal to or greater than that programmed, the pulmonary ventilator will cycle and maintain baseline pressure awaiting the next spontaneous release of the patient.

HFNC – HIGH FLOW NASAL CANNULA

This mode allows the user to establish the flow level and inspired oxygen concentration by adjusting FiO2 by connecting the patient through a high-flow nasal cannula. The ventilator will compensate for leakage, keeping the flow level and FiO2 established and allowing spontaneous ventilation of the patient.

NEONATAL VENTILATION MODES

It has the ventilatory modes VCV, PCV, PSV / CPAP, Nasal CPAP, SIMV, Continuous Flow and HFNC. The modes (VCV, PCV, PSV, SIMV and HFNC) function conceptually in the same way as in the adult and pediatric categories, and the operator must adapt the programmed values to the patient category being ventilated. In neonatal, the guaranteed volume is performed by the ventilatory mode VCV where the lung volume of each cycle is controlled and guaranteed by the equipment according to the operator's programming.

CONTINUOUS FLOW

In this ventilatory modality the operator must establish mainly the parameters of the flow velocity, the inspiratory pressure (P CONT) that will be added to the PEEP in addition to the time parameters such as inspiratory time and respiratory rate. Once these values are established, the equipment will offer flow at a set speed, this flow is available to the patient and passing through the patient circuit from the inspiratory branch to the expiratory branch. The exhalation valve actively operates to increase the pressure of the circuit during the inspiratory phase and maintain the level of PEEP during the expiratory phase. The proximal flow sensor can monitor only the portion of the flow that the patient is using for breaths, informing the pulmonary ventilator display of tidal volume and minute volume values.
Reminder: It is important for the professional to attend to each patient's inspiratory flow demand for individualized adjustment, since if the patient's inspiratory flow demand is large, the suggestion is to raise the flow to avoid slow airway pressurization.
This ventilatory mode is also known as TCPL (Time Controlled Pressure Limited).

NASAL CPAP

This mode allows the user to set the CPAP level and connect the patient through a nasal cannula. The pulmonary ventilator maintains the constant flow offered and a positive pressure continues in the circuit. The patient breathes spontaneously on the CPAP level. The adjusted flow should be higher than the leaks in the nasal cannula for the pulmonary ventilator to maintain adequately the CPAP level.

BACKUP VENTILATION

In case one which to visualize the configured parameters in Backup Ventilation during patient ventilation, you must enter the "Ventilation Mode Menu", selecting the current mode will automatically open the backup ventilation window with the configured parameters.

The purpose of back-up ventilation is to ensure patient ventilation during a spontaneous ventilatory mode in the event of prolonged apnea or any event that makes it difficult for the equipment to recognize the patient's inspiratory effort. Backup ventilation is available in all ventilator modes. That is, in all ventilatory modes, the pulmonary ventilator will send controlled ventilatory cycles if the patient does not exert efforts that overcome the inspiratory sensitivity, maintaining the oxygenation of the patient.
In spontaneous ventilatory modes, its programming is of paramount importance, since, once the patient does not make any effort, the equipment will respect the time and the programmed configuration, delivering the back-up ventilation (support). The parameters to modify are:
Ventilation Mode: By default, the device proposes a volume controlled mode, but the operator can opt for a pressure controlled mode.
Apnea Time: Maximum period tolerable by the ventilator without the patient having started an inspiration, after this, the equipment will emit a sonorous and luminous warning, ventilating the patient in controlled mode, determined and programmed by the operator.
Time of the phase and cycling variables: Ti, rate, Vol. or Pres.
The PEEP level continues to be programmed in advance of the time apnea occurred. In order for the equipment to operate in the desired spontaneous mode, the operator must "confirm" the backup ventilation configuration from the Control Panel.

If the selected mode is PSV / CPAP, VNI, (MMV) + PSV, (PSV + VT ensured), Nasal CPAP, Biphasic will appear the "Backup Ventilation" window where programming is mandatory. To confirm the programming, the operator must press the "confirm" key.
If the selected mode is SIMV (VCV) + PSV, SIMV (PVC) + PSV, (Biphasic), the respirator will give the operator the possibility of using the back-up ventilation; for this you must "confirm" or "cancel" in the Control Panel. The respirator will automatically exit in case the patient recovers spontaneous ventilation.
In controlled modalities such as VCV, PCV and PRVC, backup ventilation is adjusted by the respiratory rate in which the minimum respiratory rate of the patient is determined, if the patient has spontaneous responses and the inspiratory sensitivity threshold is exceeded, respiratory rate will be higher than programmed, but will never be less than the programmed backup frequency.

VENTILATION MODES

By selecting a ventilation mode, the operator is determining what kind of variable he wants to control during the inspiration.
Access ***"Menu"*** from the ***"Ventilation Modes"***, select the desired mode (by pressing ***"_next"***, you can see the remaining ventilation modes) and confirm the selection, thus displaying on the screen the chosen parameters and resulting curves and values.

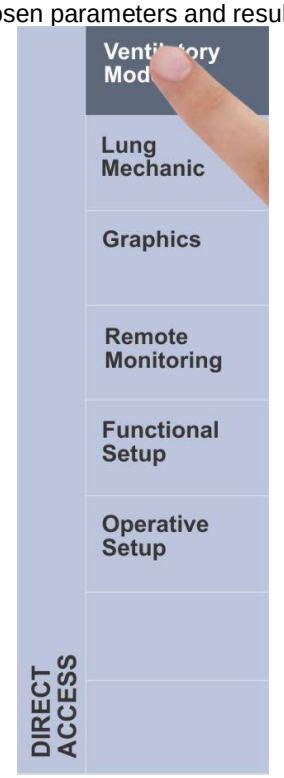

Figure 57

Figure 58

Figure 59

All the modes available on the equipment *(Adult-Pediatric-Neonatal)* have a pre-set configuration from the factory: these configurations are average values and must be adjusted by the doctor to become values appropriated for each patient.
The lung ventilator does not interrupt its operation during the change from one mode to another.
The ventilation modes are divided in basic modes and integrated modes: in the first group, it is included the ventilation modes controlled by pressure and support pressure. In these modes, you can control only one variable continuously while in the integrated modes, even though you only control one variable at a time, you can change the kind of control according to the characteristics of the patient's ventilation.

The inspiratory flow can be adjusted directly or indirectly by the user, through the configuration of ventilatory variables such as volume, inspiratory time, I: E ratio, waveform or directly the flow itself, depending on the ventilatory mode. When the flow is adjusted indirectly, by adjusting the previously mentioned variables, the resultant of this flow is equated by the equipment and informed on the screen in blue coloration. In ventilatory modes with pressure control where the flow is controlled by the equipment based on patient compliance and resistance conditions, the operator can perform a peak flow adjustment by adjusting the Rise Time control variable.

The expiratory flow is adjustable for each type of adult, pediatric and neonatal patient. It is automatically adjusted for leakage compensation or by the user by adjusting the PEEP value that will influence the expiratory resistance.

VOLUME CONTROLLED VENTILATION – (VCV)

In this mode, the ventilator controls the volume delivered to the patient, integrating the air volume and the inspiratory time selected by the operator, i.e., it behaves like a flow controller cycling per volume. Therefore, to perform changes on the flow speed, you shall modify the tidal volume or the inspiratory time, or even both of them together, according to the necessary ventilation.
When controlling the flow, it is possible to choose between constant flows waveforms, descending waveforms, sinusoidal or ascending, being then possible to observe the consequent modifications on the peak flow and the morphology of the curves of Pressure **–** Time and Flow **–** Time.
The resulting pressure is the free variable, which will be determined based on the physical and mechanical conditions of the respiratory system. The inspiratory cycle trigger can be time, flow or pressure because it is an assisted-controlled mode.

PRESSURE CONTROLLED VENTILATION – (PCV)

In this mode, the ventilator will positively pressurize the patient's respiratory system during the inspiratory time programmed by the operator. To obtain it, once the established pressure level is reached, it will start a slowdown on the flow speed. This slowdown is the consequence of the respiratory system's physical condition and is not controlled by the ventilator. It is a pressure controlled mode and cycle by time. It is therefore a pressure controlled mode and cycled by time, being possible for the operator to manually change the peek flow or the “Rise Time”. The resulting tidal volume is the free variables and consequently this kind of ventilation requires an increased pathophysiological analysis of the patient, whom shall be permanently monitored by trained staff, as well as a correct programming of the volume alarms.
The beginning of the ventilatory cycle can occur by time, flow or pressure because it is an assisted-controlled mode. As the inspiratory flow is resulting from the equipment's programming and from the physical conditions of the respiratory system, the produced flow waveform is invariably decelerated, observing variations on the flow's speed by the end of an inspiration, i.e. the inspiration can be finished without the flow reaching the value zero, without reaching the value zero coincided with the end of the inspiration or before that.
An interrupted cycle protection system is activated in all pressure modes such as PCV, PSV and associated, where in case the patient pressure exceeds the programmed pressure by 12cmH2O, the ventilator will immediately cycle and release the gases from the patient to exhalation, thus avoiding possible injuries and increasing patient comfort. The main causes for the protective system to activate are airway obstructions, elevated Rise Time, or a patient's effort such as coughing.

SUPPORT PRESSURE VENTILATION OR CONTINUOUS POSITIVE AIRWAY PRESSURE – (PSV/CPAP)

It is a mode developed to adapt the ventilator to the spontaneous ventilation of the patient, being the level of pressure exchange over the base pressure the only control variable that must be programmed. Because it is a mode controlled by the patient, the flow speed will adapt not only to the physical conditions of the system, but also to the inspiration and exhalation efforts of the patient, respecting the established pressure level. Due to this, it is defined as a spontaneous mode, assisted by the flow and limited by the pressure.
As a spontaneous mode, the beginning of the inspiration will only happen upon detection of a signal of flow or pressure generated by the patient, finishing as standard when the flow speed slows to *25%* of the initial speed. This value can be changed by the operator in about (percentages *60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10, 5*) to adjust the end of the inspiration with the conditions and/or needs of the patient. As safety parameters, it is stipulated a criterion of maximum inspiratory time (*3 seconds*) and a criterion of pressure (*5 cmH2O* over the maximum programmed pressure) which, in case of detection, will make the equipment pass to the exhalation phase.
Once the control variable is the pressure level and the free variable is the volume, it is worth reminding that (in constant physical conditions) the latter will be proportional to the patient's inspiratory effort and the programmed support pressure.

In case of programming *0 (zero)* support pressure, pressure changes will not happen over the established base, therefore you will get a level of continuous positive airway pressure (CPAP), being the only difference in relation to the *PSV* the fact that the volume exchange during the inspiration will depend only on the patient, as the same will not receive any flow assistance. *"To adjust this mode, the backup ventilation shall be previously programmed".*

SYNCHRONIZED INTERMITENT MANDATORY VENTILATION BY VOLUME WITH SUPPORT PRESSURE – SIMV (VCV) +PSV

It is a ventilatory alternative with which the mechanical ventilation can be started, its function is to reduce the amount of mandatory ventilation of the ventilator, in order for the patient to ventilate spontaneously between each cycle, synchronizing the beginning of the mandatory cycle with the patient's inspiratory effort. Mandatory ventilation will be controlled by volume (SIMV / VCV), always remembering that the function of mandatory ventilation is to ensure a level of ventilation and oxygenation, avoiding any respiratory contingency.
The SIMV modality presents common characteristics between the assisted / controlled form and the ventilation with support pressure. In the SIMV mode with support pressure the time window has the principle of punctuality (we consider as punctuality the moment when the pulmonary ventilator complies with its adjustments, regardless of whether or not the patient fires the ventilator, a respiratory cycle will occur after the end of the window of time). The SIMV sync window is enabled 1 second before the end of the mandatory scheduled expiration. The spontaneous stimuli of the patient upon reaching the inspiratory sensitivity value initiate a new cycle that can be by volume controlled or by support pressure, depending on the moment that the triggering occurred. Shooting that occurs within the sync window results in a synchronized controlled volume cycle. Shooting before the sync window initiates a cycle of supportive pressure with inspiratory time determined by the deceleration of the inspiratory flow which will cause the pulmonary ventilator to cycle as it reaches the value of the expiratory sensitivity.

SYNCHRONIZED INTERMITENT MANDATORY VENTILATION WITH SUPPORT PRESSURE – SIMV (PCV) +PSV

It is a ventilatory alternative with which it is possible to start the uncoupling of mechanical ventilation, its function is to reduce the amount of mandatory ventilation of the pulmonary ventilator, so that the patient ventilates spontaneously between each cycle, synchronizing the beginning of the mandatory cycle with the inspiratory effort of the patient. It allows spontaneous breaths with supportive pressure and controlled breaths, resulting in a downward flow and respecting the inspiratory time and the frequency programmed by the operator.
The SIMV modality presents common characteristics between the assisted / controlled form and the ventilation with support pressure. In the SIMV mode with support pressure the time window has the principle of punctuality (we consider as punctuality the moment in which the pulmonary ventilator complies with its adjustments, regardless of whether the patient fires or not the ventilator, a respiratory cycle will occur after the end of the window of time). The SIMV sync window is enabled 1 second before the end of the mandatory scheduled expiration. The spontaneous stimuli of the patient upon reaching the inspiratory sensitivity value initiate a new cycle which may be either controlled pressure or support pressure, depending on the moment the trigger occurred. Shooting that occurs within the sync window results in a synchronized controlled pressure cycle. Shooting before the sync window initiates a cycle of supportive pressure with inspiratory time determined by the deceleration of the inspiratory flow which will cause the pulmonary ventilator to cycle as it reaches the value of the expiratory sensitivity.
Support pressure and controlled pressure differ in the fact that the supportive pressure ends when the minimum patient flow (adjustable through expiratory sensitivity) is reached and the controlled pressure is limited by the inspiratory time programmed by the operator.

PRESSURE REGULATED VOLUME CONTROL – (PRVC)

The ventilatory modality called PRVC is a dual control assisted / controlled mode. PRVC is pressure limited and cyclized in time. The pulmonary ventilator operates under controlled pressure, that is, the controlled pressure increases or decreases with each respiratory cycle in an attempt to maintain the tidal volume desired and previously established by the professional.
The pulmonary ventilator algorithm monitors the patient's airway compliance and resistance characteristics at each cycle, as well as the patient's spontaneous stimuli to adjust the inspiratory pressure level and the delivered flow, so that it results in the volume programmed by the professional.
The inspiratory flow is adjusted automatically so as not to result in peaks of pressures during the inspiratory phase. The inspiratory flow also fits the spontaneous demands of the patient during the inspiratory phase, so that the patient in need of more gases promptly is sent these gases by the pulmonary ventilator to keep the pressure constant. The inspiratory pressure added to PEEP to promote delivery of adjusted tidal volume may vary up to the maximum Maximum Controlled Pressure (Pcon Max - understand that maximum controlled pressure means: A control parameter available for setting by the professional to determine the limit of controlled pressure over PEEP necessary to ensure delivery of the tidal volume).
If patient complacency has reduced and demands more pressure to ensure delivery of tidal volume, the pressure is limited to the adjusted value and the pulmonary ventilator adjusts the flow to maintain the maximum pressure limit and provide the maximum possible volume for the limiting pressure. If patient complacency increases and lower pressures can ensure volume delivery, the equipment will promptly adjust the pressure to operate at pressures below the Pcon Max. The tidal volume set in this mode can be used by the practitioner as feedback, to monitor the patient-pulmonary ventilator interaction in real time. It is important to remember that: tidal volume is an objective parameter that depending on the patient's interactions may oscillate near the programmed value, but on average the tidal volume is maintained. The main advantage of this modality is to ensure the tidal volume with lower pressure level. Very important: the professional can not fail to adjust the Peak Pressure Alarm, since the pressure limit generated in the airway is the sum of the controlled pressure plus PEEP.

NON-INVASIVE VENTILATION (NIV)

This ventilatory mode offers the operator the possibility of ventilating the patient without invading his airway. The pulmonary ventilator monitors and compensates for possible leaks in the mask to ensure pressurizing of the circuit and delivery of gases to the patient. In case of leakage, there is compensation (up to 50 L / min) without self-shooting.
Noninvasive Ventilation (NIV) is an integral part of the pressure ventilatory modes. It is a type of pulmonary ventilation that uses different forms of masks that connect the patient to the pulmonary ventilator in a noninvasive way. The pulmonary ventilator monitors and compensates for leaks to ensure delivery of pressure to the patient. There is no need to activate or select this air leak compensation function, the fan constantly monitors and in case of leakage starts compensation.

MANDATORY MINUTE VENTILATION WITH SUPPORT PRESSURE – (MMV+PSV)

The MMV + PSV ventilatory mode allows the patient to breathe spontaneously (with or without support pressure). In this mode the pulmonary ventilator will send supportive pressure cycling with automatic feedback to maintain the patient minute volume according to the programmed minute volume.
The pulmonary ventilator operates operatively as in the stand-by pressure mode, with the automatic adjustment of the stand pressure which is added to PEEP to keep the minute volume constant. At the start of this ventilatory mode the equipment will send a cycle with the support pressure programmed by the professional, after this cycle the equipment will monitor the tidal volume spontaneously breathed by the patient as well as the respiratory rate of the patient to result in minute volume.
The equipment monitors the minute volume, compliance and airway resistance of the patient, so the lung ventilator will assess whether the current support pressure is sufficient to ensure minute volume. If the support pressure value is not sufficient to guarantee the minute volume, then the ventilator increases or decreases the amount of support pressure sent to the patient until the minute volume is

reached and maintained. The variations in support pressure are mild, at the limit of 2 cmH2O per ventilatory cycle.
Setting the patient-compatible maximum and minimum pressure alarm is necessary to ensure that pressure variations occur within safe limits. It is also necessary to adjust the respiratory rate alarm because the minute volume may not equal the alveolar ventilation, which can cause rapid and superficial respiration.

BIPHASIC PRESSURE VENTILATION – (BIPHASIC)

The BIPHASIC mode is spontaneous, limited to pressure and cycled in time. The patient breathes spontaneously into two levels of pressure (two levels of PEEP). These two levels of PEEP alternate. Thus, the professional adjusts the two levels of PEEP, being a PEEP denominated Superior Pressure (Top P = High PEEP) and the other one of Lower Pressure (Bot P = Low PEEP). The practitioner must also adjust the frequency of alternation between the two pressure levels, through Upper Inspiratory Time (Top T) and Lower Inspiratory Time (Bot T).
The patient can breathe spontaneously at both the upper and lower levels with an independent supportive pressure level. The two pressure levels are equivalent to two pressure levels (base pressure or PEEP) operating with the partially open exhalation valve. The patient may exert effort to trigger the lung ventilator at any level where a support pressure above the pressure level will be sent.

PRESSURE SUPPORT VENTILATION WITH ASSURED TIDAL VOLUME – (PSV+VT)

The PSV + VT mode is spontaneous, offers the comfort of free flow and the safety of the determined minimum tidal volume. The inspiratory flow depends on the impedance of the respiratory system, is free and depends on the patient's effort and the level of support pressure. For this, the professional should set a tidal volume, which will be established as a minimum value for each patient's inspiration.
With this ventilatory modality, once the patient initiates inspiration, the pulmonary ventilator will control the support pressure through the flow assist (support pressure), however, when reaching the flow value that causes the pulmonary ventilator to cycle, that is , in the percentage value of the expiratory sensitivity, and the programmed tidal volume has not yet been reached, it will behave as a flow controller until the amount of volume fixed by the professional is inflated, in this condition the inspiratory time will be increased.
If the patient's current tidal volume in the cycle is equal to or greater than that programmed, the pulmonary ventilator will cycle and maintain baseline pressure awaiting the next spontaneous release of the patient.

HFNC – HIGH FLOW NASAL CANNULA

This mode allows the user to establish the flow level and inspired oxygen concentration by adjusting FiO2 by connecting the patient through a high-flow nasal cannula. The ventilator will compensate for leakage, keeping the flow level and FiO2 established and allowing spontaneous ventilation of the patient.

NEONATAL VENTILATION MODES

It has the ventilatory modes VCV, PCV, PSV / CPAP, Nasal CPAP, SIMV, Continuous Flow and HFNC. The modes (VCV, PCV, PSV, SIMV and HFNC) function conceptually in the same way as in the adult and pediatric categories, and the operator must adapt the programmed values to the patient category being ventilated. In neonatal, the guaranteed volume is performed by the ventilatory mode VCV where the lung volume of each cycle is controlled and guaranteed by the equipment according to the operator's programming.

CONTINUOUS FLOW

In this ventilatory modality the operator must establish mainly the parameters of the flow velocity, the inspiratory pressure (P CONT) that will be added to the PEEP in addition to the time parameters such as inspiratory time and respiratory rate. Once these values are established, the equipment will offer flow at a set speed, this flow is available to the patient and passing through the patient circuit from the inspiratory branch to the expiratory branch. The exhalation valve actively operates to increase the pressure of the circuit during the inspiratory phase and maintain the level of PEEP during the expiratory phase. The proximal flow sensor can monitor only the portion of the flow that the patient is using for breaths, informing the pulmonary ventilator display of tidal volume and minute volume values.
Reminder: It is important for the professional to attend to each patient's inspiratory flow demand for individualized adjustment, since if the patient's inspiratory flow demand is large, the suggestion is to raise the flow to avoid slow airway pressurization.
This ventilatory mode is also known as TCPL (Time Controlled Pressure Limited).

NASAL CPAP

This mode allows the user to set the CPAP level and connect the patient through a nasal cannula. The pulmonary ventilator maintains the constant flow offered and a positive pressure continues in the circuit. The patient breathes spontaneously on the CPAP level. The adjusted flow should be higher than the leaks in the nasal cannula for the pulmonary ventilator to maintain adequately the CPAP level.

BACKUP VENTILATION

In case one which to visualize the configured parameters in Backup Ventilation during patient ventilation, you must enter the "Ventilation Mode Menu", selecting the current mode will automatically open the backup ventilation window with the configured parameters.

The purpose of back-up ventilation is to ensure patient ventilation during a spontaneous ventilatory mode in the event of prolonged apnea or any event that makes it difficult for the equipment to recognize the patient's inspiratory effort. Backup ventilation is available in all ventilator modes. That is, in all ventilatory modes, the pulmonary ventilator will send controlled ventilatory cycles if the patient does not exert efforts that overcome the inspiratory sensitivity, maintaining the oxygenation of the patient.
In spontaneous ventilatory modes, its programming is of paramount importance, since, once the patient does not make any effort, the equipment will respect the time and the programmed configuration, delivering the back-up ventilation (support). The parameters to modify are:
Ventilation Mode: By default, the device proposes a volume controlled mode, but the operator can opt for a pressure controlled mode.
Apnea Time: Maximum period tolerable by the ventilator without the patient having started an inspiration, after this, the equipment will emit a sonorous and luminous warning, ventilating the patient in controlled mode, determined and programmed by the operator.
Time of the phase and cycling variables: Ti, rate, Vol. or Pres.
The PEEP level continues to be programmed in advance of the time apnea occurred. In order for the equipment to operate in the desired spontaneous mode, the operator must "confirm" the backup ventilation configuration from the Control Panel.

If the selected mode is PSV / CPAP, VNI, (MMV) + PSV, (PSV + VT ensured), Nasal CPAP, Biphasic will appear the "Backup Ventilation" window where programming is mandatory. To confirm the programming, the operator must press the "confirm" key.
If the selected mode is SIMV (VCV) + PSV, SIMV (PVC) + PSV, (Biphasic), the respirator will give the operator the possibility of using the back-up ventilation; for this you must "confirm" or "cancel" in the Control Panel. The respirator will automatically exit in case the patient recovers spontaneous ventilation.
In controlled modalities such as VCV, PCV and PRVC, backup ventilation is adjusted by the respiratory rate in which the minimum respiratory rate of the patient is determined, if the patient has spontaneous responses and the inspiratory sensitivity threshold is exceeded, respiratory rate will be higher than programmed, but will never be less than the programmed backup frequency.

ANNEX 2 – PREVENTIVE MAINTENANCE

A preventive maintenance shall be performed according to the following schedule:

Maintenance	Hours of Use
1st	3500
2nd	7000
3rd	10500
4th	14000
5th	17500

It is recommended to contact Leistung Equipment to send the equipment by exceeding the hours of use in the table above or after one year of the last preventive maintenance.

The preventive maintenance shall be performed by qualified personnel and respecting the protocol R 07-01(73) Reparation tests protocol.

To access the function where it indicates the preventive maintenances press **"Menu"**, **"Operative Setup"**, **"Maintenance"**.