Contraindications for the use

The application of mechanical ventilation is associated to the possibility of emerging complications. The knowledge of them is responsibility of the professional in charge of the equipment and exceeds the level of information contained in this manual.

SPECIFICATIONS OF THE VENTILATOR

LUFT 3 configurations		
Adult – Pediatric – Neonatal	**Adult – Pediatric**	**Pediatric – Neonatal**

Ventilation modes		
Patient	**Type**	**Ventilation**
ADULT AND PEDIATRIC	ASSISTED / CONTROLLED	VOLUME CONTROLLED (VCV)
		PRESSURE CONTROLLED (PCV)
		PRESSURE REGULATED VOLUME CONTROL (PRVC)
	SPONTANEOUS	PRESSURE SUPPORT (PSV)
		CONTINUOUS POSITIVE PRESSURE (CPAP)
		NON-INVASIVE (NIV)
		HFNC - HIGH-FLOW NASAL CANNULA
	VARIABLES	SIMV (VCV) + PSV
		SIMV (PCV) + PSV
		MINUTE (MMV) + PSV
		PSV + ASSURED TIDAL VOLUME
		BIPHASIC PRESSURE (APRV+PSV)
NEONATAL	ASSISTED CONTROLLED	VOLUME CONTROLLED (VCV)

		PRESSURE CONTROLLED (PCV)
		CONTINUOUS FLOW
	SPONTANEOUS	PRESSURE SUPPORT (PSV)
		CPAP
		Nasal CPAP
		HFNC - HIGH-FLOW NASAL CANNULA
	VARIABLES	SIMV (PCV) + PSV

Specifications	
Backup Ventilation Emergency Ventilation	PCV or VCV in adult, pediatric and neonatal In all ventilatory modalities
FIO_2	21 to 100%
Inspiration Time	0,10 to 30,0 seconds
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 l
Sensibility	• BY FLOW: 0,2 to 15 L/min • BY PRESSURE: -0,2 to -15,0 cm H_2O (compensated PEEP)
Pressure Controlled (PCV)	1 to 80 cm H_2O over PEEP (with adjustable "Rise Time")
Pressure Support (PSV)	0 to 80 cm H_2O over PEEP (with adjustable "Rise Time")
Inspiration Pressure	-10 to 120 cmH_2O
Rise Time	6 levels
Expiration Sensibility	Adjustable from 5% to 80% of the initial flow
Apnea Time	5 to 60 seconds
PEEP / CPAP	0 to 50 cm H_2O
Nebulization	1 to 20 min. Synchronized with the inspiratory phase and with automatic inspiratory volume and FiO_2 compensation.
TGI	Synchronized with the expiration phase
Inspiratory Flow	In VCV: Automatic regulation 0 up to 200 L/min. In PCV and PSV: 0 up to 200 L/min. Continuous Flow in Neonatal: 2 to 15 L/min. Inspiratory Flow in Neonatal: 2 to 30 L/min. Maximum flow in any mode of 250 L/min.
Base Flow	Off up to 50 L/min.
Expiratory Flow	Up to 200 L/min.
Sigh (VCV mode)	Cycles per hour, quantity, maximum tidal volume and manual trigger.
Automatic Inspiratory Pause (VCV mode)	0,1 - 2,0 seconds with plateau value
Manual Inspiratory Pause	0,1 to 30 seconds

Manual Expiratory Pause	0,1 to 30 seconds
O_2 100%	Oxygenation for aspiration with synchronized system – 1 to 20 min.
Flow waveform	Square / 100% Descending ramp / 50% Descending ramp / Sinusoidal / Ascending ramp.
Automatic By Pass of the AIR – O_2 Net	In case of failure in one of the networks of the Air or O_2, it keeps the operation of the equipment.
Inspiratory Pressure Internal Safety Valve	Adjusted in 120 cmH_2O.
Regulatory Pressure Valve of Air and O_2 input	Internally incorporated in the equipment.
STAND BY	To maintain the configuration without cycling.
SCALES	Automatic update for vertical and horizontal readings.
FREEZE	Possibility of reading graphics.
RS232 signal connector	For external communication with software and signals input.
USB signal connector	For equipment's Service and Software update

	THE CONDITIONS UNDER WHICH IT IS EXPRESSED FLOW, VOLUME AND LEAKAGE SPECIFICATIONS ARE EXPRESSED IN STPD CONDITIONS (OPERATING TEMPERATURE OF *20º* AND ATMOSPHERIC PRESSURE OF *101,3 KPA*) EXCEPT THOSE ASSOACIATED WITH THE VENTILATOR'S BREATHING SYSTEM, WHICH ARE EXPRESSED IN CONDITIONS *BTPS* (ENVIRONMENT ATMOSPHERIC PRESSURE AND OPERATING TEMPERATURE OF *37ºC*).
	ALL THE VENTILATION VARIABLES MEASURED ARE FILTERED AT *30 Hz* AND CONDITIONED USING ANALOGICAL AND DIGITAL TECHNIQUES OF DATA PROCESSING.
	THE ACCURACY OF THE PRESSURE MEASUREMENTS IS OF ± *2%* OF FULL SCALE (*120 cmH_2O*) + *4%* OF THE ACTUAL READING. THE REMAINING OF THE SPECIFIED VALUES HAVE A MAXIMUM ERROR OF *+/- 10%*.
	THE EQUIPMENT COUNTS WITH A SAFETY VALVE OF MAXIMUM PRESSURE WHICH OPENS AT *120 cmH_2O*, RELEASING THE EXCESSIVE PRESSURE.
	NEGATIVE PRESSURE (SUBATMOSPHERIC) IS NOT AVAILABLE ON THE EXHALATION PHASE.
	WHEN ADDING ACCESSORIES, COMPONENTS OR SUBASSEMBLIES TO THE VENTILATOR'S FAN SYSTEM (BREATHING SYSTEM DELIMITED BY THE GAS INPUT PORTS AND THE CONNECTION PORT TO THE PATIENT AND/OR EXHAUST PORT), THE PRESSURE GRADIENT BETWEEN THE VENTILATOR'S FAN SYSTEM AND THE CONNECTION PORT TO THE PATIENT MAY INCREASE.

Output parameters (monitoring)
Airway pressure: peak, plateau, mean, base (PEEP)
Inspiratory time
Exhalation time
I:E ratio and spontaneous breathings
Inspiratory pause
Inspired / exhaled tidal volume (distal & proximal) total and spontaneous
Inspiratory peak flow (distal & proximal)
Exhalation peak flow (distal & proximal)
Dynamic compliance
Total and spontaneous frequency
Graphic indicator of spontaneous and mechanical cycles
Minute volume (distal & proximal) total, controlled and spontaneous
Inspiratory time constant (INS RC)
Exhalation time constant (EXH RC)
FiO_2 concentration
Compressible volume
TI/TTOT ratio
Total leakage
Ventilation level (mL/Kg)
Lung mechanics
AutoPEEP
Dynamic compliance
Static compliance
Inspiratory resistance
Expiratory resistance
Slow vital capacity
P0.1 (airway obstruction pressure)
P-V curve with low flow
Tobin index
Stress index
Inspiratory work of breathing
Alarms
Inspiratory maximum airway pressure
Inspiratory minimum airway pressure
Maximum/minimum exhaled tidal volume
Maximum/minimum exhaled minute volume
Apnea with adjustable time

Maximum respiratory frequency
Minimum respiratory frequency
Disconnection of the patient circuit
Disconnection of the proximal sensor
Maximum/minimum peep and continuous pressure
Gas supply source (AIR - O_2) (high and low pressure)
Power outage
Low battery charge
Microprocessor (dead fan)
Interrupted cycle in pressure modes
Maximum/minimum FIO2
Inverted I:E ratio

	THE ALARMS ARE TRIGGERED IN PRIORITY ORDER WITH AUDIBLE WARNINGS AND/OR MESSAGES ON THE SCREEN

Graphics
Pressure – time
Flow – time
Volume – time
Volume – pressure loop
Flow – volume loop
Pressure – flow loop
Tendency curves (up to 72 hours)
Inspiratory pressure
Flow
Tidal volume
Minute volume
Frequency
Dynamic compliance
Alarms and events logs
Last 1000 events with date, time and alarm or event
Other menus
Menu of indication of hours of use and services performed
Altitude adjustment for volume compensation
Possibility of changing the language
Adjustment of the alarms' audio volume
Change/test of circuit

Change of patient
Initial self tests
Altitude compensation
Atmospheric pressure capture
Oxygen cell detection
Patient circuit self tests
Verification of hours of use
Sensors calibration
Proximal sensor detection
Proximal sensor calibration
Circuit leakage measurement
Circuit compliance calibration
Exhalation flow sensor calibration
Oxygen cell calibration
Internal flow sensors calibration
Air proportional valve test
O_2 proportional valve test
PEEP controller valve calibration
Other safety characteristics
Automatic compensation of gases
Leakage compensation in all ventilation modes (NIV)
Memory of events and alarms saves even with energy fall
Warning of maintenance needed by hours of use
Possibility of operating without flow sensor
Possibility of operating without proximal sensor
Possibility of operating without oxygen cell

	THE LINE TEST (SELF-TEST) IS PERFORMED BY THE OPERATOR WHENEVER THE EQUIPMENT IS TURNED ON. ONCE THE SELF-TEST IS FINISHED, THE DEVICE PERFORMS A CALIBRATION WITHOUT THE OPERATOR'S INTERVENTION. WHEN IT'S NECESSARY, THE EQUIPMENT PERFORMS AN AUTOMATIC CLEANING ON THE FLOW SENSORS (EXHALATION VALVE) WITHOUT INTERRUPTING ITS OPERATION.
	IN CASE OF LEAKAGE IN THE PATIENT CIRCUIT DURING THE INITIAL TEST (SELF-TEST), THE EQUIPMENT WILL DISPLAY ON THE SCREEN A MESSAGE INDICATING THE LEAKAGE VALUES. FOR THE CORRECT OPERATION OF THE EQUIPMENT, IT IS IMPORTANT TO HAVE NO LEAKAGE IN THE CIRCUIT.
	DURING THE EXHALATION FLOW TEST, THE GAS LINES (AIR E O2) MUST DELIVER A MINIMUM FLOW OF *100 L/min*, SO THAT IT DOES NOT INTERFERE THE OPERATION OF THE SAME. IN CASE OF BAD CONNECTION, WRONG ASSEMBLY OR INVERSION OF THE SENSORS, THE EQUIPMENT WILL DISPLAY ON THE SCREEN A MESSAGE INDICATING FLOW READING ERROR, AND THE OPERATOR SHALL CONFIRM WHETHER THE EQUIPMENT WILL

	WORK WITH OR WITHOUT EXHALATION FLOW READINGS.
	BY THE END OF THE CIRCUIT'S COMPLIANCE TEST, THE EQUIPMENT WILL DISPLAY ON THE SCREEN THE VALUES TO BE COMPENSATED AND THE OPERATOR MAY CHOOSE BETWEN COMPESATING THEM OR NOT. THE EQUIPMENT WILL ONLY COMPENSATE IF THE OPERATOR CHOOSES TO DO SO, OTHERWISE IT WILL NOT BE COMPENSATED.
	ALL THE MEASURED AND/OR COMPUTED VENTILATORY VARIABLES, WHICH ARE DISPLAYED OR USED FOR CONTROL, ARE SAMPLED AT A FREQUENCY OF *30HZ* AND PROCESSED BY DIGITAL AND ANALOGIC PROCESSING TECHNIQUES.
	THE TIME REQUIRED FOR THE OXYGEN CONCENTRATION IN THE VOLUME DELIVERTS TO CHANGE FROM 21% TO 90% IS LESS OR EQUAL TO 15 SECONDS.
	IF USING MASK FOR VENTILATION, THE PATIENT EXPIRED VOLUME MAY DIFFER FROM THE EXPIRED VOLUME MEASURED DUE TO LEAKS AROUND THE MASK.

ELECTRONIC BLENDER OPERATION (AIR-O_2 MIXER)

FiO_2 *(Fraction Inspired of Oxygen)* indicates the amount of Oxygen that is mixed with the gas breathed by the patient. Generally speaking, it may vary from *21% (79% Nitrogen and 21% O_2)* up to 1*00% (pure Oxygen)*, for example, a *60%* ***FiO2*** means that *60%* of the volume breathed by the patient will be *Oxygen* and the other *40%* will be *Nitrogen* and other gases.

The ***FiO_2*** found in the **Mechanical Ventilator Luft 3** is generated by an electronic blender system, which dispenses any external mixer. The mixture is performed by two proportional actuators, known as Proportional Valves, named this way because they control proportionally the *Air* and *O_2* flows that passes through each one of them. Each flow is read by their respective pneumotachographs (device used for flow measuring), which send to the CPU the current value of the flow generated by the Proportional Valves. The ***FiO_2*** value is given by the fraction of gas delivered through each Proportional Valve, where each one of them is responsible only by part of the total inspired gas volume. This system is very accurate because it works with physical values well known, such as volume, pressure and flow and the variations on the Oxygen concentration on the Ambient Air are small, as well as the percentage of the Oxygen 100% provided. This is enough for the control to calculate the value of the flow that each valve will have to deliver to the patient, there obtaining, with a very low error chance, the correct FiO2.

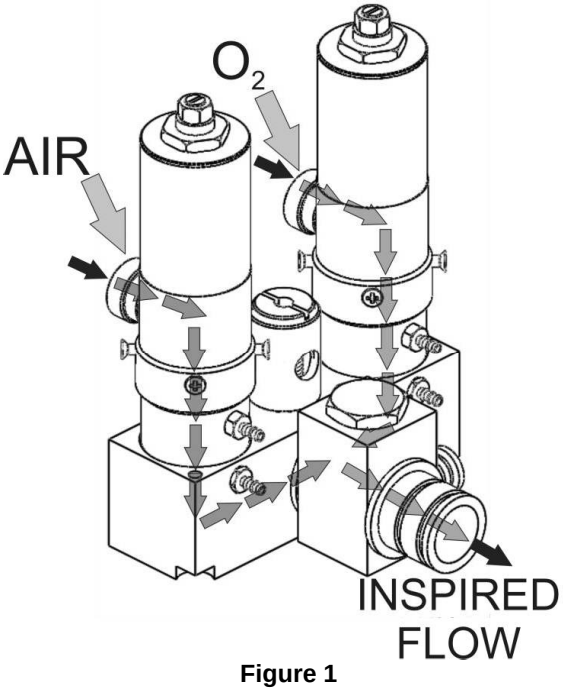

Figure 1

FIO_2 READING

The FiO2 reading is performed through the non-consumable permanent internal sensor, which monitors the patient's FIO2 in the inspiratory branch and does not require maintenance or replacement. The permanent internal sensor is standard for the pulmonary ventilator LUFT3.
It is possible to monitor the FIO2 through the optional oxygen cell (Galvanic technology) or Paramagnetic cell that is installed internally to the cabinet.
If the galvanic cell is used, the equipment checks the integrity and calibration during the initial test of the equipment. If any malfunction in the oxygen cell is identified, the equipment automatically switches to the permanent internal sensor without loss or damage in monitoring the patient's FIO2. To maintain the oxygen cell, refer servicing to authorized service personnel. The permanent internal sensor requires no maintenance and is calibrated during preventive maintenance.