



Ventilator

Ventilator Customer Operation Guide



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Focus on the production of anesthesia and respiratory equipment



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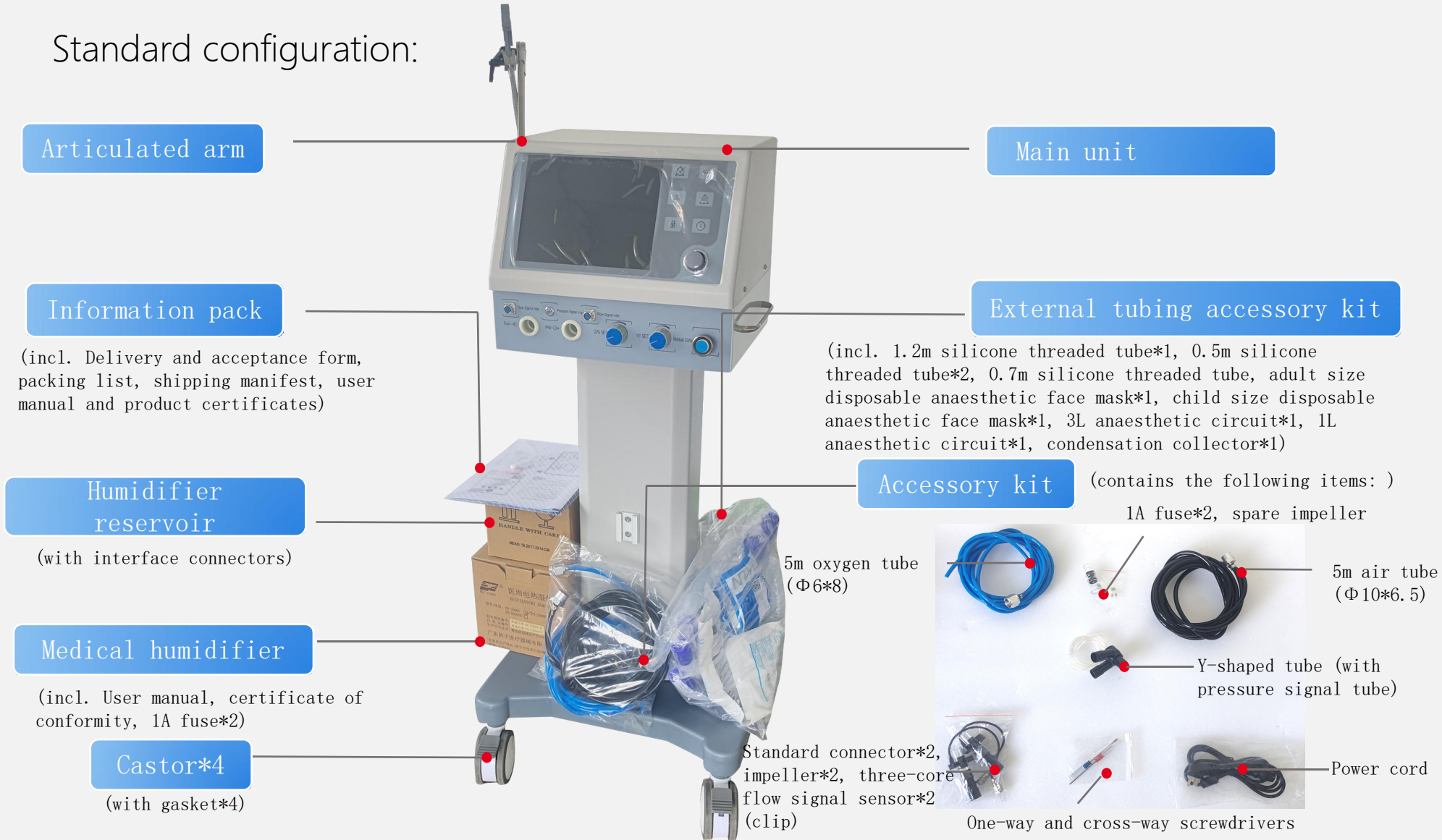
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Standard configuration:



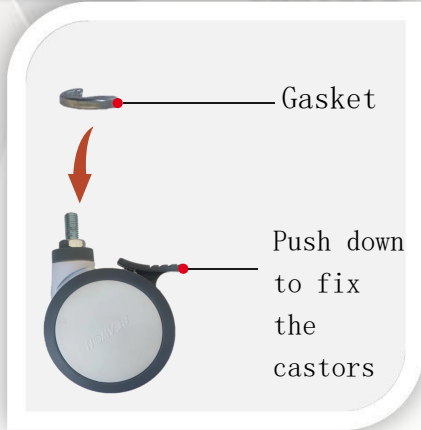
In addition to the above standard configurations, you can also choose from the following optional accessories for your ventilator: air compressor, gas pressure reducer and central oxygen supply connector.





Ventilator Installation

STEP 1 Installation of castors



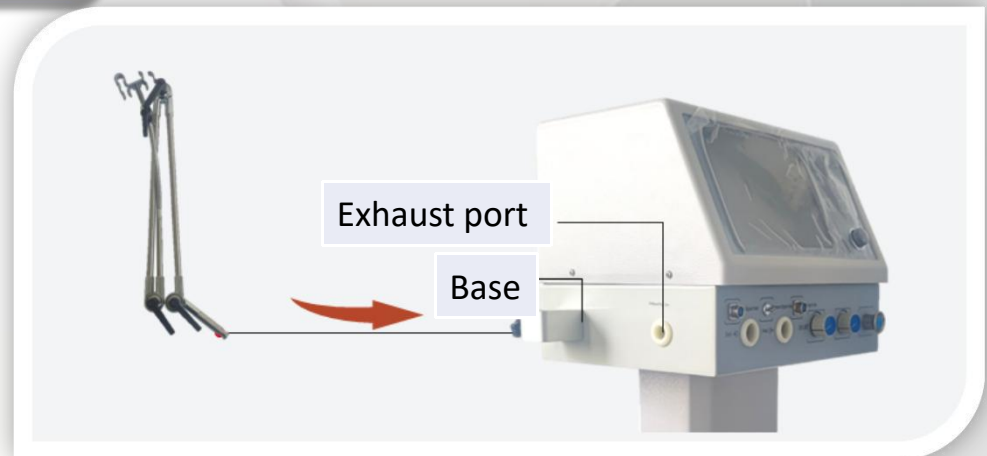
Gently place the ventilator on the floor, secure the 4 castors before placing the gaskets.

Tighten to the ventilator base in a clockwise direction one by one.



STEP 2 Installation of the articulated arm

Loosen the nuts on the base of the ventilator, insert the articulated arm into the base and then tighten the nuts to complete the installation.

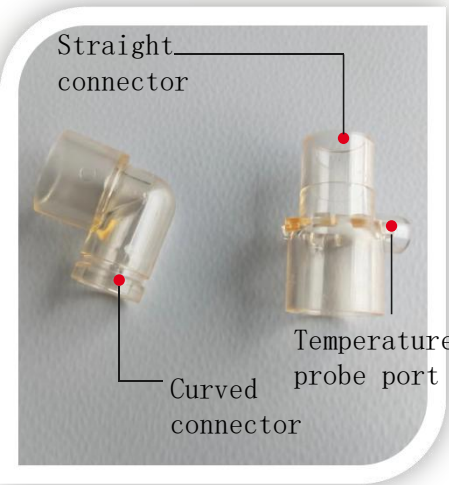


STEP 3 Installation of the humidifier



Hook the humidifier into the holder.

1



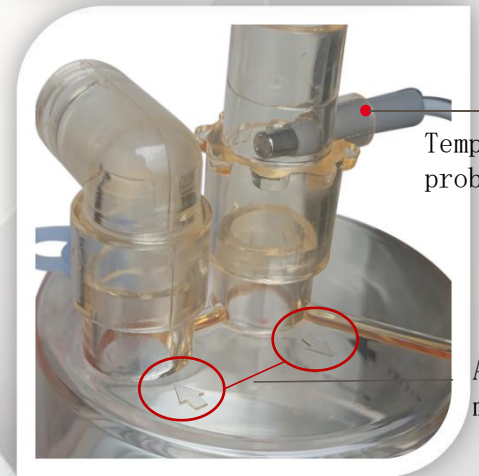
Connect the straight and curved connectors to the "gas outlet" and "gas inlet" of the reservoir respectively.

3

Press down the sump to move the reservoir horizontally into position.

2

4



 The top of the reservoir is marked with arrows pointing outwards for "gas outlet" and inwards for "gas

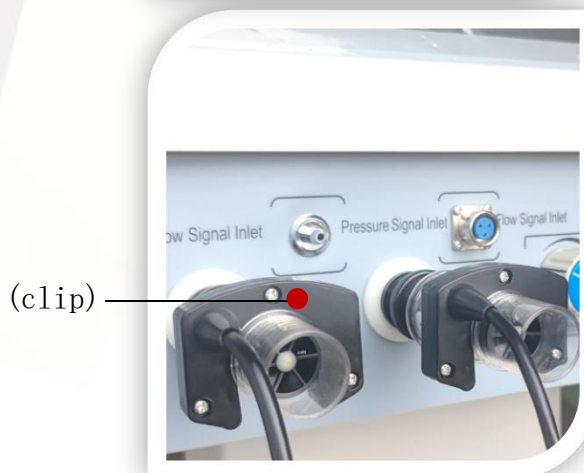
STEP 4 Installation of flow sensor

The flow sensor consists of three-core flow signal sensors (clip) with impellers, which provides the foundation of tidal volume data collection by the ventilator. Therefore, it is essential that the clips and impellers are correctly installed.




1 Connect the standard connectors to the "inspiratory" and "expiratory" ports of the main unit separately.

2 Connect the impellers to the standard connectors on the "inspiratory" and "expiratory" ports separately.

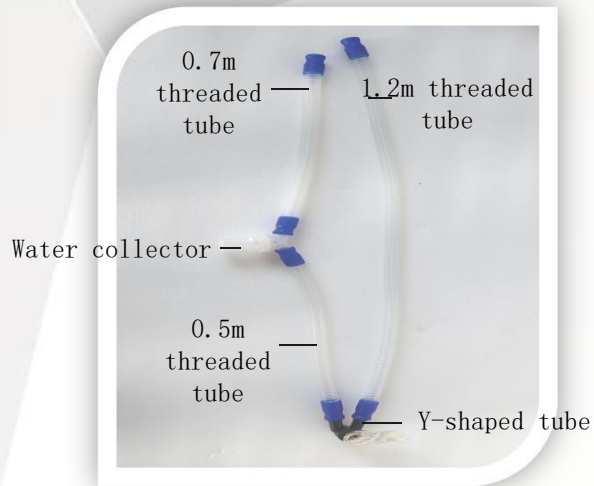


3 Mount the 2 three-core flow signal sensors (clip) face up on the impeller **grooves** separately.

4 Insert the other end to the flow signal inlet. Note that the notch on the three-core airline plug should be pointing upwards. 



STEP 5 Connection of the breathing circuit



Connect the "breathing circuit" as shown on the left.

1

2

Connect another 0.5m threaded tube to the inspiratory port impeller of the main unit, with its other end to the gas inlet of the humidifier reservoir.



3

4

Expiratory port of the ventilator main unit



Connect the 1.2m threaded tube "breathing circuit" to the gas outlet of the humidifier reservoir, and the 0.7m threaded tube to the expiratory port impeller of the main unit.

Lastly, connect the pressure signal sampling tube of the Y-shaped tube to the pressure signal inlet. Thus the breathing circuit connection is completed.



STEP 6 Installation of the oxygen delivery tube

Attach the fixing nut on the oxygen delivery tube to the oxygen inlet of the main unit, tighten it in a clockwise direction.



STEP 7 Connecting to the oxygen source

The ventilator oxygen source can be connected with either a gas pressure reducing gauge or a central oxygen supply connector, depending on the configuration of your choice.



Method I

← After assembling the nozzle of gas pressure reducing gauge, connect it to the oxygen cylinder and fix it clockwise with a large spanner.

Place the central oxygen supply nut over the oxygen delivery tube, insert the oxygen tube into the port, tighten the nut and then plug the nozzle into the central oxygen supply.



Method II



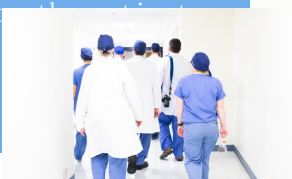


Operation

Now that the installation has been completed, your ventilator is ready to be used to its full potential. We expect you to have met at least the following three basic requirements in advance:

Operated by medical professionals

The ventilator must be monitored by medical personnel on site during use. While monitoring the operating status of the ventilator and humidifier, the physician must also pay attention to the patient's vital signs and blood gas analysis data to adjust the ventilator to the most suitable operating status for the patient.



Compliant gas source

Fresh medical oxygen source (without fresh air) at the pressure of 0.28~0.6MPa and flow rate of not less than 50L/min.

(The image above shows two gas pressure reducing gauges: the left gauge indicates gas source pressure of the ventilator while the right one indicates gas pressure inside the oxygen cylinder)



Compliant power supply

AC 220V±10%, 50±1Hz, not less than 30 VA, single-phase AC power supply with good protective earthing;

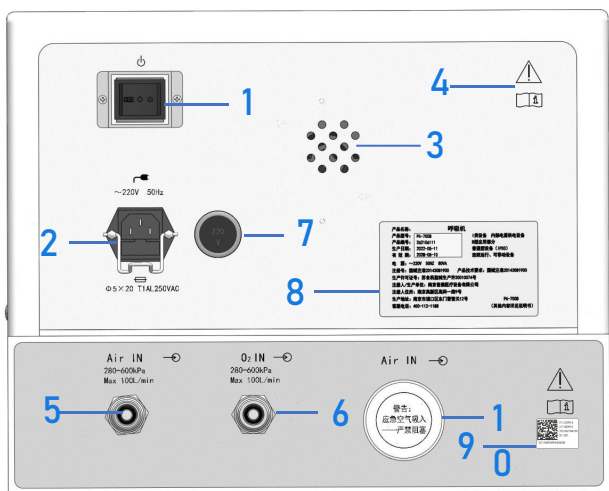
Internal power supply: battery type BT-12M7.0AT, rated voltage DC 12V, rated capacity 7Ah

AC 220V ± 10%
50 ± 1Hz

STEP 1 Diagram of the ventilator

Ventilator

Rear View



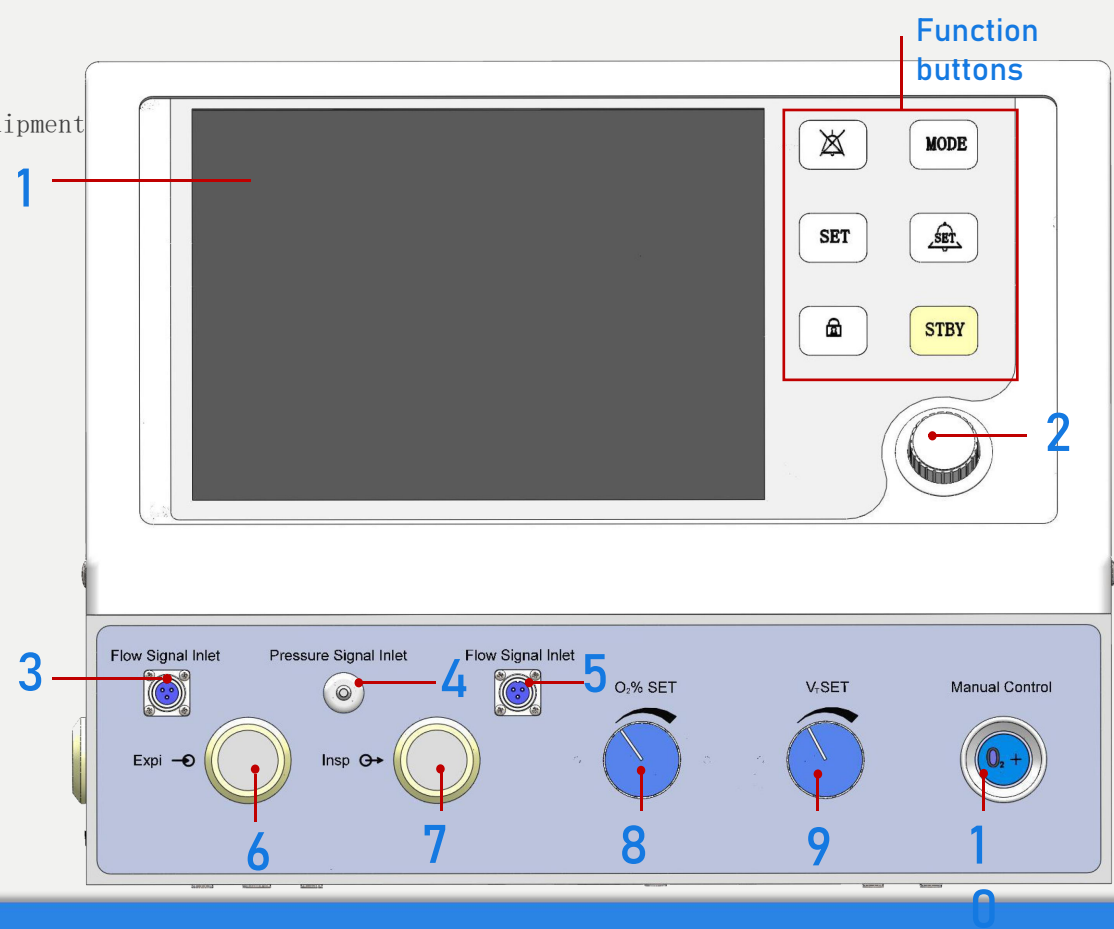
- | | | |
|----------------------|---------------------------|--|
| 1. Power switch | 2. Power socket with fuse | 3. Heat dissipation holes |
| 4. Warning signs | 5. Compressed air inlet | 6. Compressed oxygen inlet |
| 7. Voltage indicator | 8. Nameplate | 9. Unique Device Identifier for medical device |
| 10. Air intake | | |




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Ventilator


Front View





Function buttons

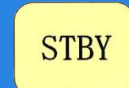
 Mute: When an alarm is triggered, press this button to silence the audio for 110s. If the alarm is not disarmed when the time is up, the audio will resume.

 Mode: Press this button at the operating interface to bring up the basic working parameter setting menu.

 Child lock: Long press the button for more than 2s at the operating interface, the security lock icon will be displayed on the top left corner of the screen. No button operation is available at this point. Long press the button again for more than 2s to unlock.

 Settings: Long press the button for more than 2s to bring up the ventilator system setup menu.

 Alarm settings: Press this button at the operating interface to bring up the alarm setting menu.

 Standby: Long press the button for more than 2s at the operating interface, the ventilator enters standby mode; long press the button again for more than 2s, the ventilator resumes operating.

Control panel



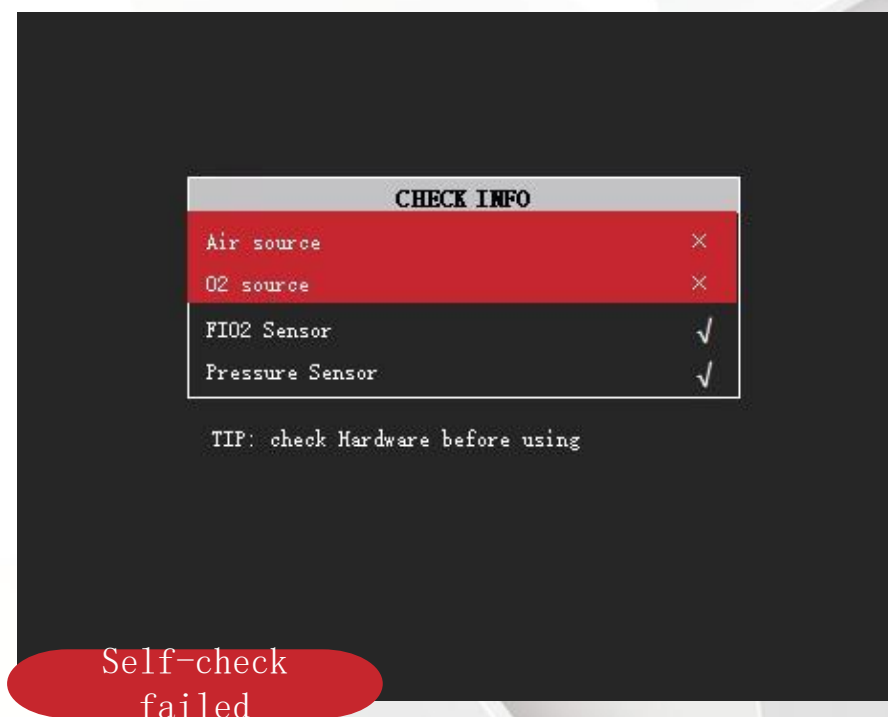
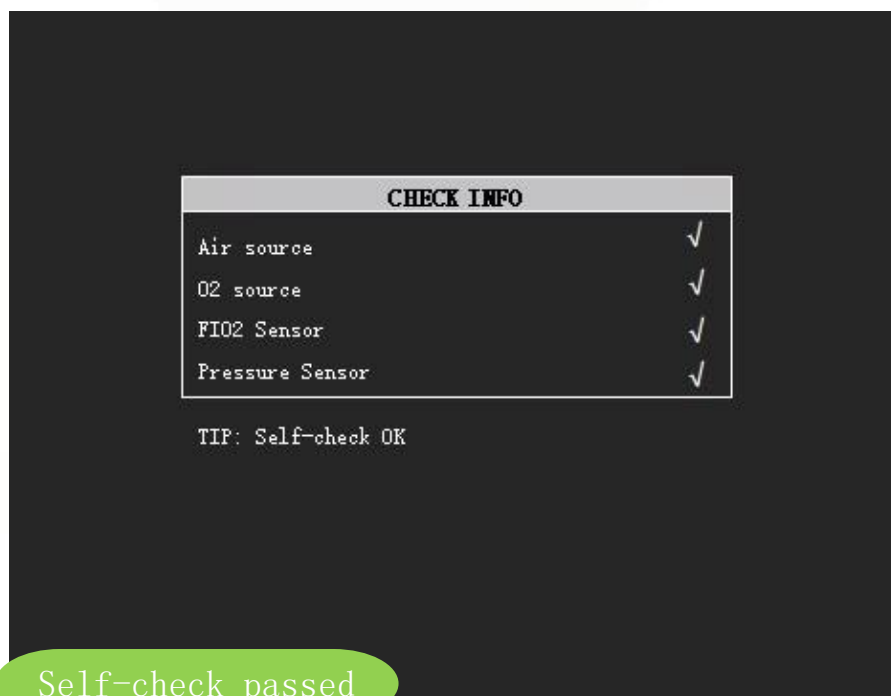
- 1. Display screen
- 2. Knob
- 3. Flow signal inlet of expiratory port
- 4. Pressure signal inlet
- 5. Flow signal inlet of expiratory port
- 6. Expiratory port
- 7. Inspiratory port
- 8. Oxygen concentration setting knob
- 9. Tidal volume setting knob
- 10. Manual control knob

STEP 2 Ventilator operating interface

I. Self-check interface

After turning on the power switch of the ventilator, it will stay in the power-on interface for 5s and then enter the system self-check interface. The ventilator will automatically check the four parameters shown in the figure. When all four parameters have passed the self-check, a tick “√” will be displayed following each parameter and after 3s it will automatically redirect to the operating interface.

If any of the parameters in the self-check interface fails, the option will be red and display a cross “×”. The ventilator will remain in the self-check interface, requiring medical personnel to solve the problem. Under the circumstance that the problem is not solved, long press the standby button STBY to force the ventilator into the operating interface.



II. Operating interface

The operating interface consists of the following sections:

2. Alarm information

The ventilator raises an alarm upon detection of an abnormality - red for high priority alarm and yellow for medium priority alarm

1. Status information

Includes current operating mode, inspiratory and expiratory state switching, system power status and system time

3. Monitoring information

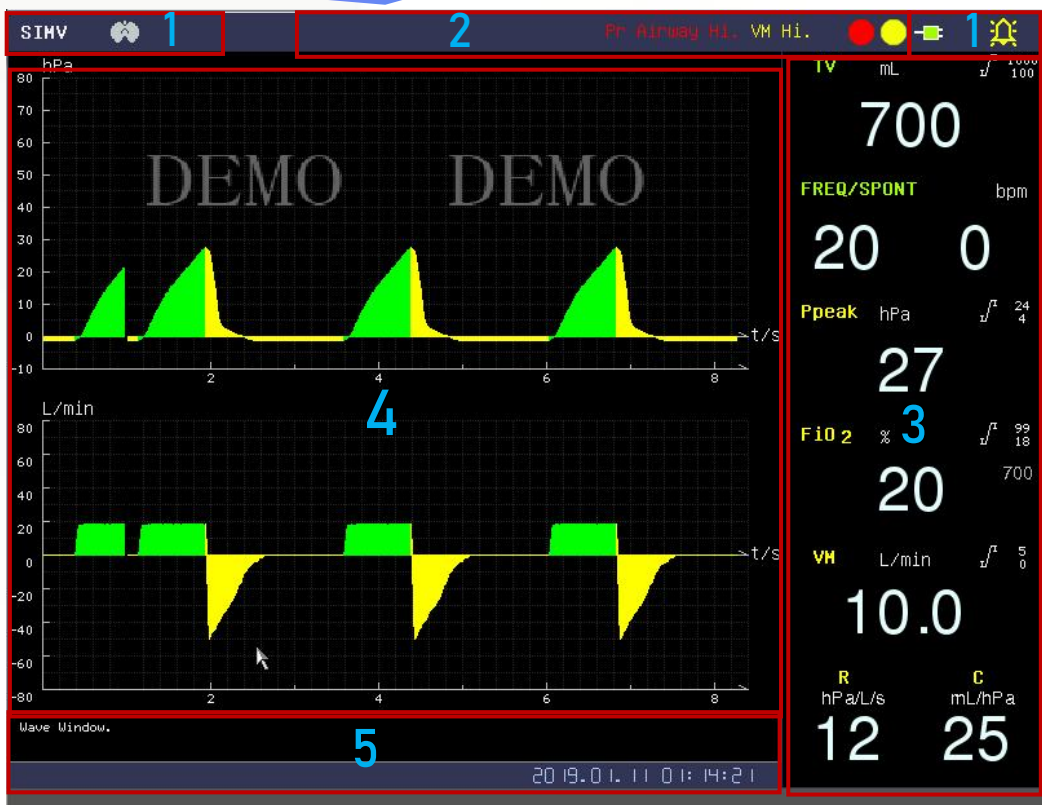
Contains real-time parameters and the ones to be set in various modes

4. Waveform area

Contains pressure-time waveforms and flow rate waveforms

5. Information reminder window

Displays additional information e.g. time



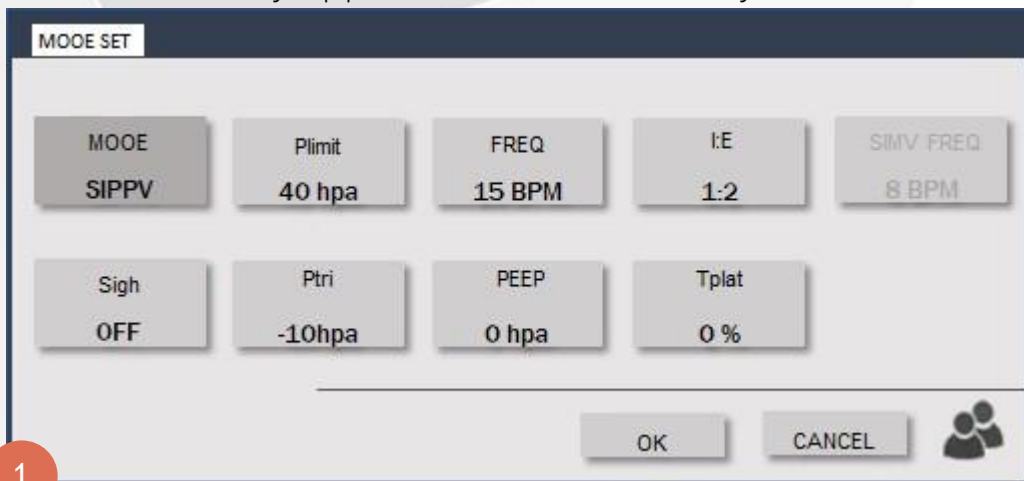
Definition of certain monitoring parameters:

1. Spontaneous breathing: the frequency of patient's spontaneous breathing monitored by the ventilator in one minute
2. Peak pressure value: maximum airway pressure during each respiratory cycle
3. Oxygen concentration: the concentration of oxygen in the gas given to the patient by the ventilator
4. Minute ventilation: the cumulative sum of tidal volume per minute
5. Airway resistance: the pressure difference per unit flow in the airway
6. Lung compliance: the change in lung volume due to a change in unit pressure

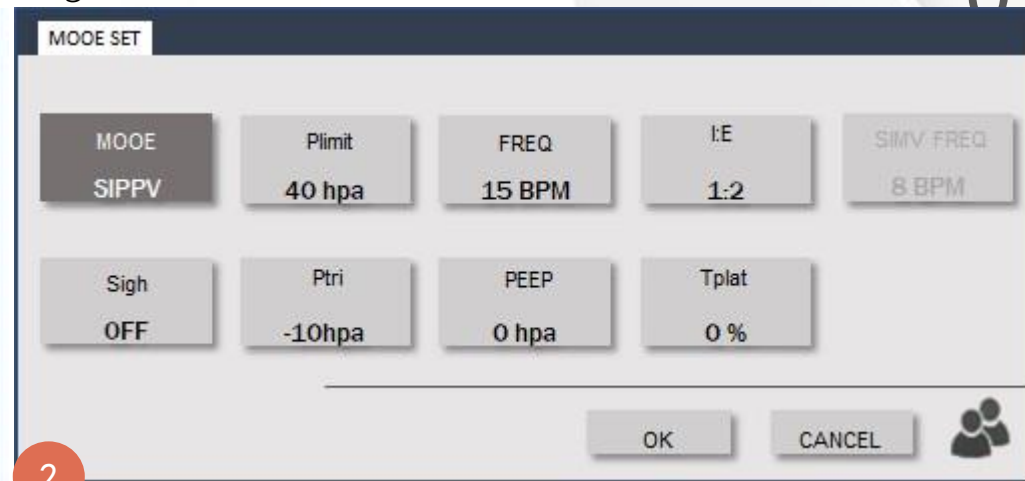
STEP 3 Description of the interface operating methods and working parameters

The following figures illustrate the interface operating methods in ventilation mode "SIMV", which are commonly applied in the alarm and system interface settings.

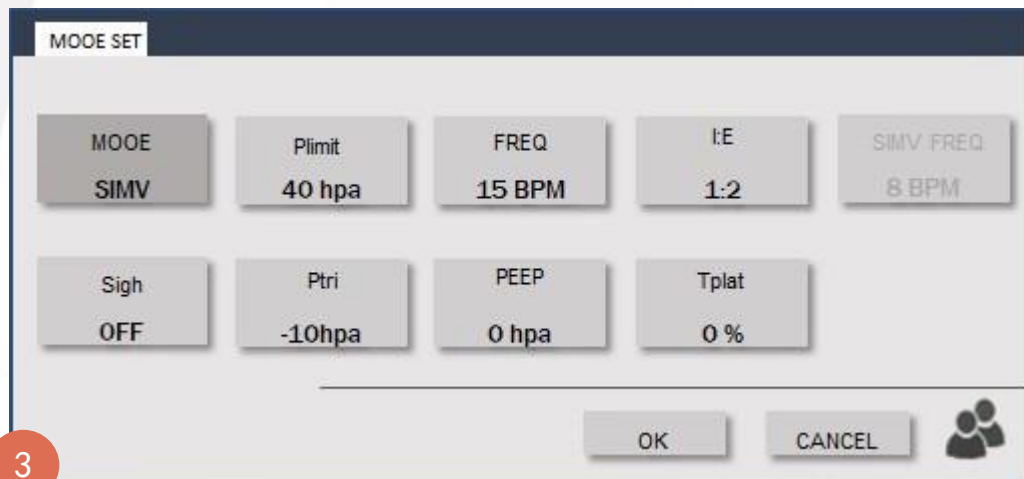
1
0



1 At the operating interface of the ventilator, press the MODE button to enter the parameter setting interface [MODE SET].



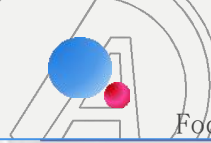
2 Turn the knob cursor to "MODE" and press down, option "MODE" is displayed in reverse colour. You can now select the ventilation mode.



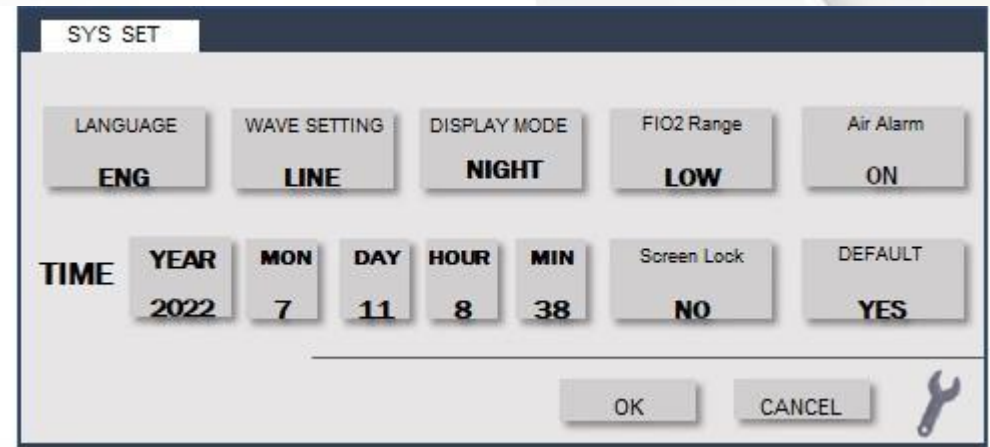
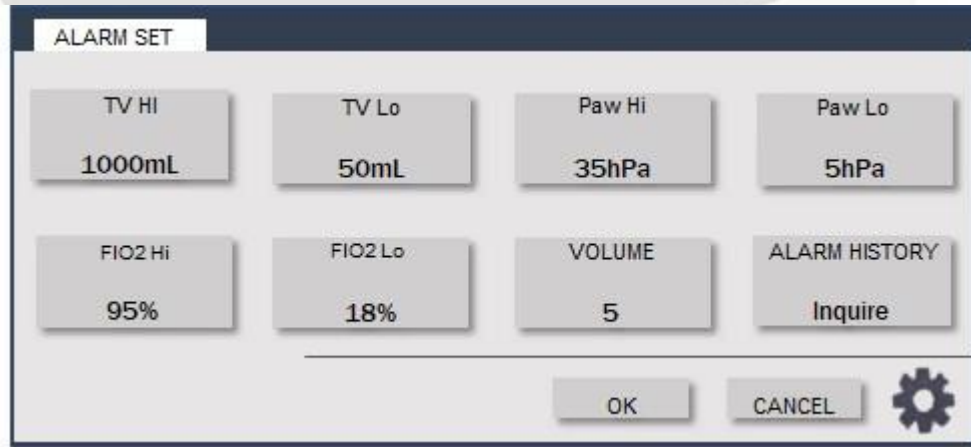
3 Turn the knob until mode "SIMV" is selected. Press the knob to confirm and then exit the ventilation mode selection.





4 To save and apply the previous settings, turn the knob cursor to "OK" and press down to immediately return to the ventilator operating interface. At this point, the ventilation mode has been successfully modified.



The following are the alarm setting [ALARM SET] and system setting [SYS SET] interfaces respectively:



Additional notes:

- ✧ The tidal volume is adjusted by VT SET knob  and the oxygen concentration by O2% SET knob  (due to delay in signal acquisition, the real value is not shown on the parameter display area until a few seconds after rotation)
- ✧ In different modes, if a parameter option affects the interlock condition, it will be greyed out and cannot be selected by the knob cursor to prevent incorrect operations
- ✧ Without the optional air compressor, oxygen concentration cannot be freely adjusted in the range of 21~100%, but only in between 60~100% (depending on the test environment, there is a reasonable error in the actual measurement)

The number of respirations per minute. Recommended setting is 10~20bpm

Frequency

1

The ratio of the time taken by one inspiration to one expiration. Recommended settings are 1:1.5 or 1:2.0

I:E

2

The volume of air exhaled per breath during calm breathing. Recommended setting for adults is 8~12ml/kg (generally about 400~600ml)

Tidal volume

3

Positive end-expiratory pressure must be maintained in the airway to prevent alveolar atrophy and to improve lung compliance. Set 1~4hpa to maintain alveolar expansion, 5~10hpa to improve PaO2

PEEP

4

Limit airway pressure to a safe range. Recommended settings are 40hpa for adults and 20hpa for children

Pressure limit

5

Maintains airway pressure for a certain period of time before expiration at the end of inspiration to prolong inspiratory time

Inspiratory plateau

6

Prevents atelectasis (lung collapse) during long-term IPPV. Provides ventilation at no less than 1.5 times the set value. Setting range is no less than 1~8 sighs per 100 breaths

Sigh

7

Volume level of the ventilator alarm sound

Volume

8

With the optional oxygen compressor, select "low" for an oxygen concentration range between 21~70%, and 60~100% without an oxygen compressor

Oxygen concentration range

9

Please note that it is recommended that the air source alarm is turned off when only the oxygen source is used. This alarm is activated by factory default

Air source alarm

10

STEP 4 Ventilation mode

The Pventilator features five modes - SIPPV (Assist/Control Mode), IPPV (Control Mode), IMV (Intermittent Mandatory Ventilation), SIMV (Synchronized Intermittent Mandatory Ventilation) and Manual Control Mode, of which SIPPV is the default mode when the ventilator is started up. You can select the ventilation mode by pressing the MODE button once the machine is switched on, provided that the required air source (0.28~0.6 MPa) and power supply are connected. See pages 9-10 of this guide for pre-setting the operating parameters on a simulated lung.

1. SIPPV

This mode is mainly applied to patients with no or extremely weak intermittent spontaneous breathing. If the patient shows no spontaneous breathing, the ventilator initiates intermittent positive pressure ventilation (IPPV), i.e. controlled ventilation, on the patient according to set parameters.

When the patient's spontaneous breathing resumes, the ventilator is automatically synchronized with the spontaneous breathing (SIPPV), i.e. assisted ventilation.

In general, the inspiratory trigger pressure can be set at around -2 to -4 hPa, with a 6s interval between controlled and assisted ventilation.

2. IPPV

This mode is only applicable to patients with no spontaneous breathing. The ventilator delivers intermittent positive pressure ventilation to the patient according to pre-set parameters.

3. IMV

This ventilation mode is suitable for patients with spontaneous breathing and can gradually reduce their dependence on the ventilator. During this mode, mandatory ventilation is performed on the patient at regular intervals. Upon completion of one mandatory ventilation, the next one is performed a certain period of time later. During the interval between two mandatory ventilations, the patient can breathe spontaneously at their own rate.

The interval at which mandatory ventilation occurs depends on the setting of the “IMV frequency”.

4. SIMV

Based on IMV mode, SIMV combines the advantages of inspiratory trigger pressure in SIPPV, allowing the ventilator to be synchronized with the patient's spontaneous breathing.

5. Manual Control

In the event that the AC power supply to the ventilator fails, the ventilator can be operated by the emergency battery. The output voltage of the battery will gradually drop during operation. If such voltage drops to a level which is insufficient to power the ventilator, you should replace the battery with a powerful one in time. If it is currently impractical or in case of emergency, “Manual Control” mode can be applied.

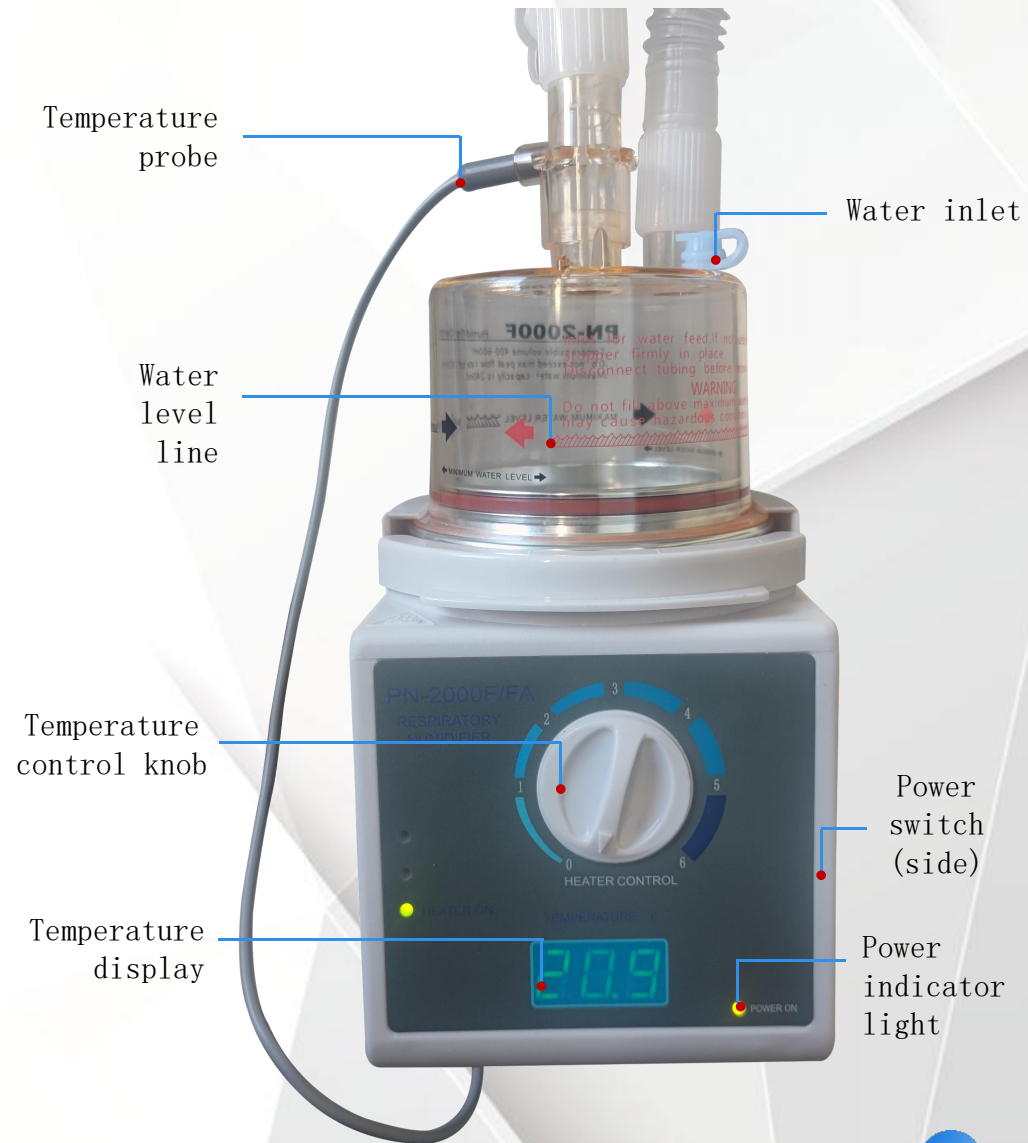
Such mode requires experienced medical personnel to operate. That personnel should press the “Manual Control” button at a certain rhythm to maintain the respiration of the patient. Each press of the button delivers one ventilation to the patient and such parameters as the duration of ventilation, tidal volume, airway pressure, etc. are entirely manually controlled.



STEP 5 Application of the humidifier

Before using the humidifier, you can add water either through the air inlet and outlet of the reservoir or through the water inlet (distilled water recommended, if adding water through the water inlet, the lid needs to be tightened afterwards). Plug in the temperature probe tightly and connect the power cable. Pay attention to the water level in the humidifier to prevent it from dry burning.

The temperature of water inside the humidifier should be carefully adjusted according to the patient's needs. In general, such temperature should be set so that the patient inhales the gas at a temperature between 32°C and 35°C (the temperature control knob is recommended to be set between grade 2 and 3), and not to exceed a maximum of 40°C. Although the higher the temperature the greater the humidity of gas, excessive temperatures can cause adverse reactions in patients and, in severe cases, respiratory burns.





Cleaning, Disinfection & Maintenance

STEP 1 Cleaning and disinfection

The main focus of cleaning and disinfection is the expiratory line of the ventilator, including: threaded tubes, masks and the flow sensor attached. Please follow the manufacturer's recommendations on the frequency of use of the threaded tubes and masks. Replacement of components such as the flow sensor is recommended within two years to ensure the accuracy of data collection.

Cleaning the air let filter of the ventilator

Flush the filter with running water to rinse off any dust. Shake it to dry before putting it back in place. The filter should be changed and cleaned every 24 hours during the operation of the ventilator.

Cleaning the threaded tubes, masks and flow sensor

Wash the inside of the expiratory line with neutral detergent. Pay attention to saliva stains, blood stains, oil and other traces of dirt, then rinse them off with water.

Cleaning the ventilator

Wipe off any dirt and dust appeared on the ventilator outer shell and threaded tube holder with a soft cloth dampened by warm water or neutral detergent, then wipe dry with a dry cloth. Do not let any liquid get inside the ventilator during the cleaning process.

Disinfection Method I

Soak the cleaned threaded tubes and masks etc. in a disinfectant solution for 30~60 minutes (note that silicone products are easily damaged if soaked for too long). Commonly used disinfectant solutions include benzalkonium bromide solution, peracetic acid solution and sodium hypochlorite solution etc. After soaking, rinse the disinfectant off the interior and exterior of the expiratory line with sterile saline solution or distilled water. Hang to dry.

Disinfection Method II

Place the cleaned threaded tubes and masks etc. in an ethylene oxide sterilization tank for routine disinfection.

STEP 2 Maintenance



Maintenance of the ventilator

- ❖ The ventilator must be thoroughly cleaned, disinfected and maintained every six months. A specialist is required. Maintenance records should be kept on file. When a ventilator that has been out of use for more than six months is reactivated, a full performance check must be conducted in advance.

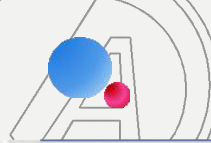
Maintenance of the storage battery

- ❖ The battery must be charged in time after use, with an interval of no more than 12 hours. The charging current must meet the requirements for battery use.
- ❖ If the battery has not been working or discharged for up to 6 months, it is essential to carry out a maintenance care. Operate the ventilator on battery until the power runs out, then shut down the machine and connect it to the mains power. Turn the switch to CHG **CHG** and charge the battery for no less than 8 hours.
- ❖ When replacing the battery, pay close attention to battery polarity - red wire to the positive terminal and blue wire to the negative terminal - which must never be reversed. The terminals must be securely connected to avoid disconnection, overheating, flames, etc.
- ❖ To prevent damage caused by overheating, the battery must not be placed near any heat source (e.g. radiators), exposed to strong sunlight or covered with any object. The battery compartment cover should be kept clean. Any liquid spills must be wiped off immediately and make sure that they do not spill onto the battery, otherwise the battery should be properly wiped clean.
- ❖ The battery must be stored upright during usage, storage and transportation. Avoid upside down or horizontal storage; avoid violent shaking.

Troubleshooting



Problem	Possible Reason	Solution
Unstable or no display of tidal volume	Flow sensor interfered by strong light	Keep the impeller in the flow sensor away from direct strong light
	Poor contact of the flow sensor	Reconnect the flow sensor or replace the plug
	Incorrect connection of the ventilation circuit	Reconnect the ventilation circuit
	The patient suffers from oxygen deprivation due to air leakage from the ventilation circuit	Check whether the humidifier is tightened or the ventilation circuit leaks
	Water vapor inside the impeller	Wash and air dry the impeller after removal
	Low air source pressure	Pressurize the compressed air source to ensure a pressure of 0.35~0.50 MPa
	Inappropriate PEEP setting	Set the appropriate PEEP value
	Inappropriate inspiratory trigger pressure setting	Set the appropriate inspiratory trigger pressure
	Damaged flow sensor	Replace the flow sensor
Inaccurate indication of oxygen or air pressure gauge	Low inlet air source pressure	Adjust the air source pressure
	Respiratory circuit leakage	Check the circuit connector; replace and reinstall the leaking tube
	Pressure regulator failure	Adjust or replace the pressure regulator
Excessive operating frequency	Frequency setting too high; or inappropriate inspiratory trigger pressure setting	Adjust the operating frequency; set the inspiratory trigger pressure to be negative
Tidal volume alarm	Tidal volume or frequency set too high	Set the tidal volume or frequency within the appropriate range
Humidifier not working	AC power not properly connected	Reconnect the AC power
	Blown fuse	Replace the fuse



Problem	Possible Reason	Solution
Ventilator airway pressure alarm indicator light on with continuous airway pressure upper limit alarm	Inappropriate adjustment of tidal volume and I:E ratio	Adjust the tidal volume and I:E ratio
	Inappropriate upper pressure limit setting	Adjust the upper pressure limit
	The patient's spontaneous breathing conflicts with the mechanical ventilation	Adjust the inspiratory trigger pressure or frequency
	The patient suffers from tracheal spasm; or the airway resistance is increased due to secretions	Sputum suction of the patient is recommended and expectorant should be used
Ventilator airway pressure alarm indicator light on with continuous airway pressure lower limit alarm	Tidal volume set too low	Adjust the tidal volume knob
	Airway pressure lower limit set too high	Set an appropriate lower pressure limit
	Insufficient pressure of the oxygen cylinder or central oxygen supply	Replace the oxygen cylinder or increase the air source pressure
	Oxygen cylinder pressure reducer or oxygen circuit failure	Replace the oxygen pressure reducer or the oxygen delivery tubes
	Pressure signal tube dislodgement or water accumulation in the tube	Reconnect the signal tube or drain the water
	The patient suffers from tracheal spasm; or the airway resistance is increased due to secretions	Sputum suction of the patient is recommended and expectorant should be used
Continuous audible alarm	Battery exhaustion or damage after AC power failure	Replace the battery with a sufficient one
Rapid oxygen supply valve not producing gas	Rapid oxygen supply valve spring stuck; dry sealing ring; debris in the valve	Adjust or replace the spring; apply Vaseline to the sealing ring; clear the debris
Rapid oxygen supply valve producing gas all the time	Aged sealing ring; or rapid oxygen supply valve not retracting after being pressed	Re-adjust, install or replace the components
Battery working during normal grid supply	AC power plug not properly connected	Reconnect the power plug
	Blown fuse	Replace the fuse
	Damaged terminal block or power cord	Replace the terminal block or power cord