# NARKOVET PRO
## SMALL ANIMAL ANESTHESIA MACHINE

### USER MANUAL



Art. No. 213040, 213041

# Copyright

Version: B00

No.: 046-00001019-02

Revision date: 2024.08

Product Name: Veterinary Anesthesia Machine

Product Model: NarkoVet PRO

Software Version: V1

Software Name: Veterinary Anesthesia Machine Software

Date of Manufacture: Refer to the Nameplate

Service life: 10 years

Registrant / Manufacturer: Eickemeyer – Medizintechnik für Tierärzte KG

Address: Eltastraße 8 | 78532 Tuttlingen | Germany

# Statement

# Warranty

EICKEMEYER® will be responsible for the safety, reliability and performance of the product within the limited warranty period, if all of the following conditions are satisfied:

■ The product is used in accordance with this Manual.

■ The product is installed, maintained or upgraded by approved or authorized personnel by EICKEMEYER®.

■ The storage, operating and electrical environments for the product comply with the product specifications.

■ The serial number label or manufacturing mark of the product is clearly legible. It has been certified by EICKEMEYER® and confirmed that the product is manufactured by EICKEMEYER®.

■ The damage is not caused by human factors.

■ All replaceable components, accessories, and consumables for maintaining are originally supplied by EICKEMEYER® or recognized by EICKEMEYER®.

EICKEMEYER® provides services free of charge for all products based on EICKEMEYER®'s Warranty Service conditions. EICKEMEYER® may charge service fees for any service not within the product's warranty. The user shall bear any or all transportation costs (including custom duties) incurred during transportation of the products back to EICKEMEYER®.

# Return Procedure

If you need to return the product to EICKEMEYER®, please follow the procedure below:

Request for product return: Contact EICKEMEYER®'s After-sales Service Department and inform them of the product serial number marked on the product's nameplate. If the product serial number is not clear and legible, product return will not be accepted. Please indicate the product serial number, manufacturing date, and a brief description of the reasons for returning.

# After-sales Service Department

Name: Eickemeyer – Medizintechnik für Tierärzte KG

Address: Eltastraße 8 | 78532 Tuttlingen | Germany

Tel.: +49 7461 96 580 0

Fax: +49 7461 96 580 90

Email: info@eickemeyer.com

## Preface

This user manual provides details on the performance, operations and safety instructions about the product NarkoVet PRO veterinary anesthesia machine. Please carefully read and understand the contents of this manual so as to ensure the safety of animals and operators.

This manual introduces the product of the most complete configurations. Some configurations or functions may not be available on the product you have purchased. If you have any questions, please contact us.

Please keep this manual near the device for easy and prompt access when needed.

## Intended Readers

This manual is intended for use only by professionally trained anesthesiologists or technical maintenance personnel authorized by EICKEMEYER®.

## Illustrations

All illustrations provided herein are for reference only. The menus, options, values and functions shown in the illustrations may be not exactly identical to those shown on the product.

## Conventions

- ■ →: This symbol is used to indicate operating steps.
- ■ [**Character**]: This is used to represent character strings in the software.
- ■ *Bold and italic*: This is used to represent chapters quoted.

# Table of Contents

## 1.1 Safety Information

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⚠ WARNING

● Alerts you to situations that may result in serious consequences or adverse events or endanger personal safety. Failure to observe the warning may cause serious injury or death of users or animals.

---

⚠ CAUTION

● Alerts you to potential dangers or unsafe operations, which, if not avoided, may result in minor injury, product failure or damage, or property damage, or cause more serious injury in the future.

---

⚠ NOTE

● Emphasizes important precautions and provides instructions or explanations for better use of the product.

---

⚠ WARNING

● Do not operate the device before reading this manual.

● This product and its independent assemblies cannot be used in MR environment.

● This product is intended for use only by professional veterinary anesthesiologists or technical maintenance personnel authorized by EICKEMEYER®.

● Before operating the device, the operator must ensure that the device, wiring and accessories are in good condition and function properly.

● All analog and digital equipment connected to the device must be certified by the specified IEC standards, such as IEC 60950 Information technology equipment and IEC60601-1 Medical Electrical Equipment Standard. All configurations should comply with the content of IEC60601-1-1 valid version. The person who connects optional equipment to the input/output signal port shall be

responsible for configuring the medical system and ensuring that the system complies with IEC60601-1-1.

- Do not open the enclosure of the device. All repairs or upgrades to the device shall only be carried out by personnel trained and authorized by EICKEMEYER®.

- This product has not been disinfected when delivered. Please clean and disinfect it before using for the first time.

- Connect the device to the AC power supply before the internal battery runs out.

- Adjusting the alarm volume to a low level may prevent medical staff from detecting the alarm in time, which may cause danger to the animal.

- Check all parts of the breathing system carefully before each use. Ensure that all parts are free of any obstacles or debris that could potentially cause a danger to animal.

- Flammable anesthetic agents such as ether and cyclopropane shall not be used in this device to avoid the risk of explosion. Use only non-flammable anesthetic agents that meet the requirements of ISO 80601-2-13.

- Disposable items may be considered potentially biohazardous and shall not be reused. Dispose of these items should be in accordance with hospital and local regulations regarding contaminants and biohazardous materials.

- The disposal of end-of-life anesthesia machines and packaging materials must comply with relevant local regulations or the hospital's waste disposal policy. End-of-life anesthesia machines and packaging materials must be placed out of the reach of children, and be disposed properly to prevent harm to the surrounding environment.

- Do not turn off fresh gas supply before the anesthetic vaporizer is turned off. Anesthesia vaporizer shall not be turned off without fresh gas; otherwise, high concentration of anesthetic vapor can enter the device pipelines and surrounding air, causing harm to people and objects.

- Please always set alarm limits so that alarms can be triggered before a dangerous situation arises. Setting alarm limits incorrectly may cause the operator to be unaware of a dramatic change of the animal's condition.

- To prevent electric shock and fire hazards, do not clean the equipment while it is turned on and/or powered on.

- To prevent electric shock, connect the device only to the power cable with protective grounding.

- To avoid damage to animals, do not test or maintain the device while it is in use.

- Do not use the device close to or in a stack with other devices. When it is necessary to use the device in this way, observe the device closely to ensure that it can work properly in the configuration.

- It is recommended that the exhaust port of this device be connected to the hospital exhaust system to protect medical staff from exposure to gases from this device.

- Do not use the anesthesia machine when there are leaks in the breathing system.

- If the device is damaged in any way that endangers the safety of the animal or the user, please stop using the device and attach a visible sign stating that the device cannot be used. Please contact EICKEMEYER® for technical support.

- Do not remove low pressure regulating valve and flowmeter device or connector under pressure. The sudden release of pressure can cause injury.

- Check the specifications of the AGSS transmission and receiving system as well as the specifications of this device to ensure compatibility and prevent mismatch of the receiving system.

- Reusing unsterilized breathing circuits or reusable accessories can lead to cross-infection. Please disinfect the breathing circuit and reusable accessories before use.

- Using accessories with damaged packaging may cause biological contamination or malfunction. The operator shall check the packaging of accessories before use and ensure the integrity of storage.

- Using incorrect connectors can be dangerous. Make sure all components are fitted with the correct connectors.

- After replacing the $CO_2$ absorbent or installing the $CO_2$ absorbent canister, please ensure that the $CO_2$ can be fully absorbed by the absorbent.

- To avoid injury to animals, do not maintain the device when it is in use.

- Before moving the anesthesia machine, remove items from the top plate and rack to avoid tipping.

---

⚠ CAUTION

- To ensure animal safety, please use the accessories specified in this manual.

- The device may lose balance if it is tilted more than 10 degrees. Be extremely careful when moving or placing it on a slope exceeding 10 degrees and do not hang objects on its sides to avoid excessive imbalance.

- Please follow the checklist for daily checks. If there is a system malfunction, do not operate the device until the malfunction is cleared.

- Before starting the device, the user must be familiar with the information contained in this manual. The device must be inspected and repaired by qualified maintenance personnel as required.

- If the device does not work as described in the instructions, it must be inspected and repaired by qualified maintenance personnel before it is put into use again.

- Operate the device carefully to prevent damage or malfunction.

- When the device and its accessories exceed their life limit, they must be disposed of in accordance

with the guidelines for the management of such products and the local regulations for the management of contaminants and biohazardous materials.

- Magnetic fields interfere with the performance of the device. The equipment used in vicinity with the device must comply with EMC requirements accordingly. Mobile phones, X-rays, or MRI equipment are possible interference sources because they all produce strong electromagnetic radiation.

- Make sure that the air source for the device is always in accordance with relevant technical specifications.

- Do not subject any part of this device to high temperature and high pressure unless it is specifically stated in this Manual that it is high temperature resistant and high pressure resistant. Clean the device as specified in this Manual.

- Do not fumigate the device with peracetic acid or formaldehyde.

- If the bellows is wet after cleaning, the folds on the surface of the bellows may adhere and fail to expand. Make sure to wipe all moisture off the bellows after cleaning.

- Do not connect any device to the USB port of the device except the USB storage device approved by EICKEMEYER®.

- Unlocked casters may cause accidental movement. The operator shall lock the casters when using the device.

- Unsecured device may slide down from the top plate. The device shall be securely mounted on the top plate.

- Do not use any flow outlet as handle when moving the device. The flow outlet may be damaged. Please use the metal side bar on the device to move it.

- To ensure the measurement precision and avoid damage to the device, please use the cable and accessories approved by EICKEMEYER® only.

- Please use the power cord supplied by EICKEMEYER®. If it is necessary to replace the power cable, use only the power cable that meets the specifications.

- Do not use damaged equipment or accessories. During normal use, please check all cables periodically (such as AC power cables) for damage. If there is any damaged cable, please replace it.

- The voltage of auxiliary sockets shall be the same as that of the socket this anesthesia machine is inserted into. Ensure that the rated voltage of the device plugged into the auxiliary socket is the same as the power supply voltage of this anesthesia machine.
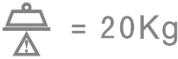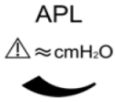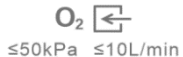
> ⚠ **NOTE**
>
> - **Please put the device in a place where observation, operation and maintenance are convenient.**
>
> - **Please keep this manual near the device for easy and prompt access when needed.**
>
> - **The accuracy of flow could be affected by the changes of inlet pressure, outlet resistance and the environment temperature.**
>
> - **The battery of the device in not a user-serviceable part. Only authorized maintenance staff can replace the battery. If the system is not use for a long time, please contact the maintenance staff for battery disconnection. If the battery reaches the end of its service life, please follow the local regulations when dispose of the battery.**
>
> - **This manual describes the device in the most complete configurations. Some configurations or functions may not be available on the product you have purchased.**
>
> - **The anesthetic gas delivery device is used in conjunction with the anesthetic gas monitoring module conforming to ISO 21647:2004. A sampling line shall be used to connect the animal circuit to the anesthesia gas monitoring module.**
>
> - **When using this device, the concentration of anesthetic agent shall be continuously monitored to ensure accurate output of anesthetic agent.**
>
> - **The device system is designed with an anesthetic gas delivery device in accordance with ISO 8835-4:2004.**
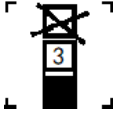
## 1.2 Contraindications

It's not yet clear.

## 1.3 Device Symbols

| Symbol | Description | Symbol | Description |
|--------|-------------|--------|-------------|
| ⚠ | General warning | | Refer to operation manual / booklet |
| = 20Kg | Maximum bearing weight is 20kg | | Audio paused |

| Symbol | Description | Symbol | Description |
|--------|-------------|--------|-------------|
| ⊙/Ȯ | System turn-on/off | Standby | Standby |
| | Battery indicator light | ∼ | Alternating current |
| APL ⚠ ≈cmH₂O | Direction and unit of APL valve knob | OFF ◀ ACGO ▶ ON | ACGO switch |
| | Manual ventilation | | Mechanical ventilation |
| | Locking | | Unlocking |
| O₂+ | O₂ flush | | Flow regulation |
| O₂ 280-600kPa | O₂ input | AIR 280-600kPa | Air input |
| O₂ ≤50kPa ≤10L/min | Low pressure O₂ input | AGSS ⚠ | Exhaust gas vent |
| | Inspiration/expiration valve removal/assembling | IPX1 | IP rating |
| MAX | Soda-lime absorbent canister | | Gas outlet |
| | Defibrillation-proof type BF applied part | O₂% | Oxygen concentration |
| O₂ | O₂ tubing pressure gauge | AIR | Air tubing pressure gauge |
| | USB interface | | Equipotentiality |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| 品 | Network port | ⚠ ⊕→ | Input/output port |
| T10AL250V ⚠ 100-240V∿ 50/60Hz | Power port | (MR) | Do not use in MR environment |
| (manufacturer symbol) | Manufacturer | (factory date symbol) | Date of Manufacture |
| SN | Serial Number | ⬆⬆ | This way up |
| (fragile symbol) | Fragile, handle with care | 3 | Stacking limit by number |
| (keep dry symbol) | Keep dry / Keep away from rain | (do not roll symbol) | Do not roll |
| (center of gravity symbol) | Center of gravity | (recyclable symbol) | Recyclable |
| (recycle symbol) | General symbol for recovery/recyclable | (temperature symbol) | Temperature limit |
| (humidity symbol) | Humidity limit | (pressure symbol) | Atmospheric pressure limit |

# Chapter 2  Product Overview

The design of this device conforms to the relevant China and International Safety Standards for medical electrical device. This chapter provides you with an overview of the anesthesia machine and its functions.

## 2.1 Structure and Composition

The anesthesia machine is composed of main unit, anesthesia ventilator, flow control system, control and monitor display panel, anesthetic vaporizer, ventilation system, AGSS, AG module, $CO_2$ module and accessories.

## 2.2 Intended Use

This anesthesia machine is applied to inhalational anesthesia and respiratory management during the operation for large and small animals.

⚠ **WARNING**

- **The anesthesia machine must be operated only by a trained veterinary anesthesiologist or technical maintenance staff authorized by EICKEMEYER®.**

⚠ **NOTE**

- **This manual introduces the product of the most complete configurations. Some configurations or functions may not be available on the product you have purchased.**

## 2.3 Product Appearance

### 2.3.1 Front View
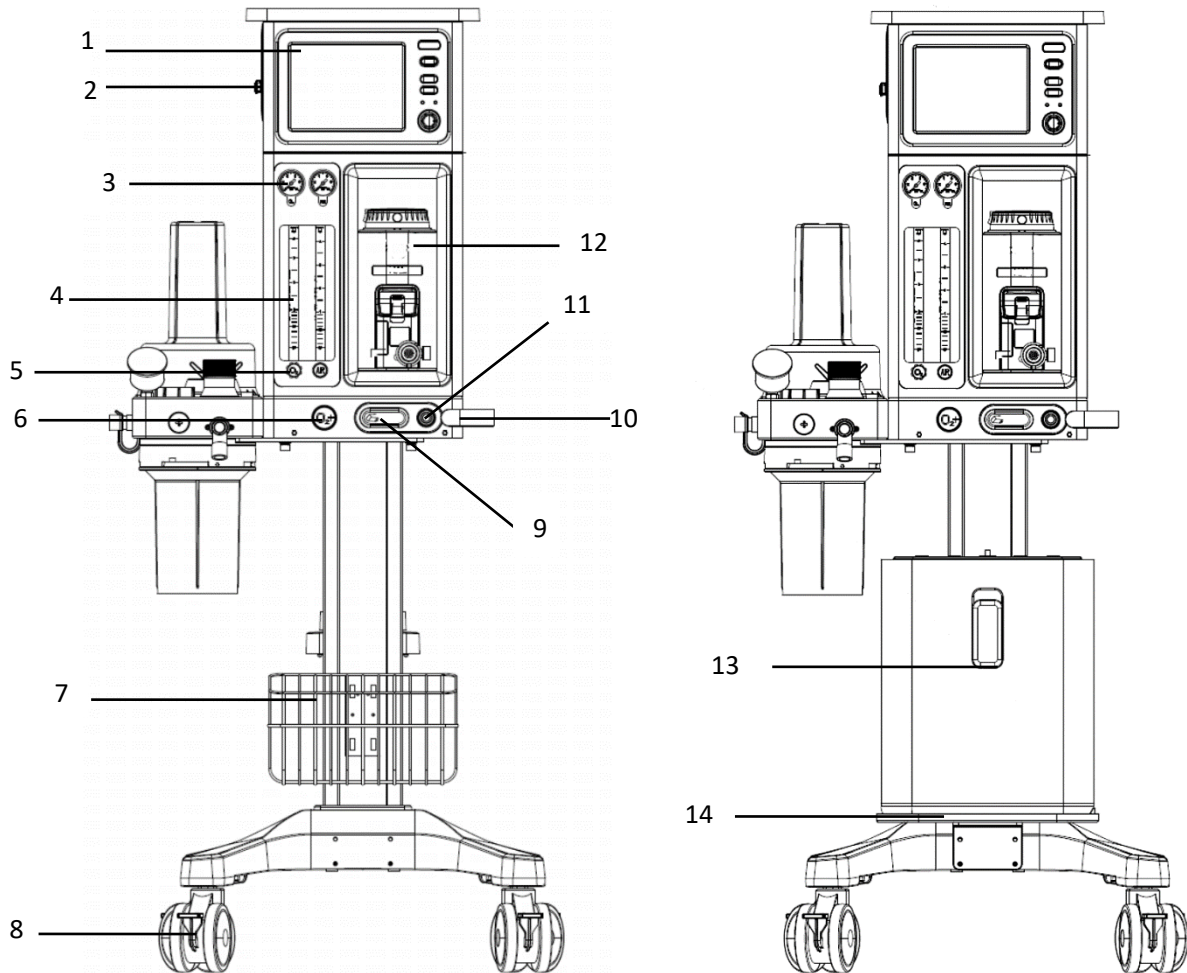


Fig. 2-1 Front View of NarkoVet PRO Anesthesia Machine

| 1 | Control panel | 8 | Caster brake |
|---|---|---|---|
| 2 | Module slot | 9 | ACGO switch |
| 3 | Pipeline pressure gauge | 10 | Handle |
| 4 | Tubular flowmeter | 11 | ACGO port |
| 5 | Flow control knob | 12 | Anesthetic vaporizer |
| 6 | Oxygen flush button | 13 | Oxygen concentrator |
| 7 | Storage basket | 14 | Tray for oxygen concentrator |

- **The Control Functions to Be Implemented Through the Front of NarkoVet PRO Anesthesia Machine**

| Item | Name | Description |
|------|------|-------------|
| 2 | Module slot | Used to insert and recognize the $CO_2$ module and the AG module mentioned in this manual. |
| 3 | Pipeline pressure gauge | Used to observe the pressure values of pipeline. |
| 4 | Tubular flowmeter | Used to observe the flow values of gases. |
| 5 | Flow control knob | Turn the control knob anticlockwise to increase the flow and clockwise to reduce it. |
| 6 | Oxygen flush button | Press $O_2$+ flush button to provide high flow of oxygen to breathing system. |
| 8 | Caster brake | The anesthetic machine can be braked by stepping on the brake plate with the foot. |
| 9 | ACGO switch | Enable/disable ACGO and output fresh gas through the ACGO port. |
| 12 | Anesthetic vaporizer | A device that can effectively evaporate liquid anesthetic agent and accurately deliver it to the anesthetic breathing system at a certain concentration. |

## 2.3.2 Back View
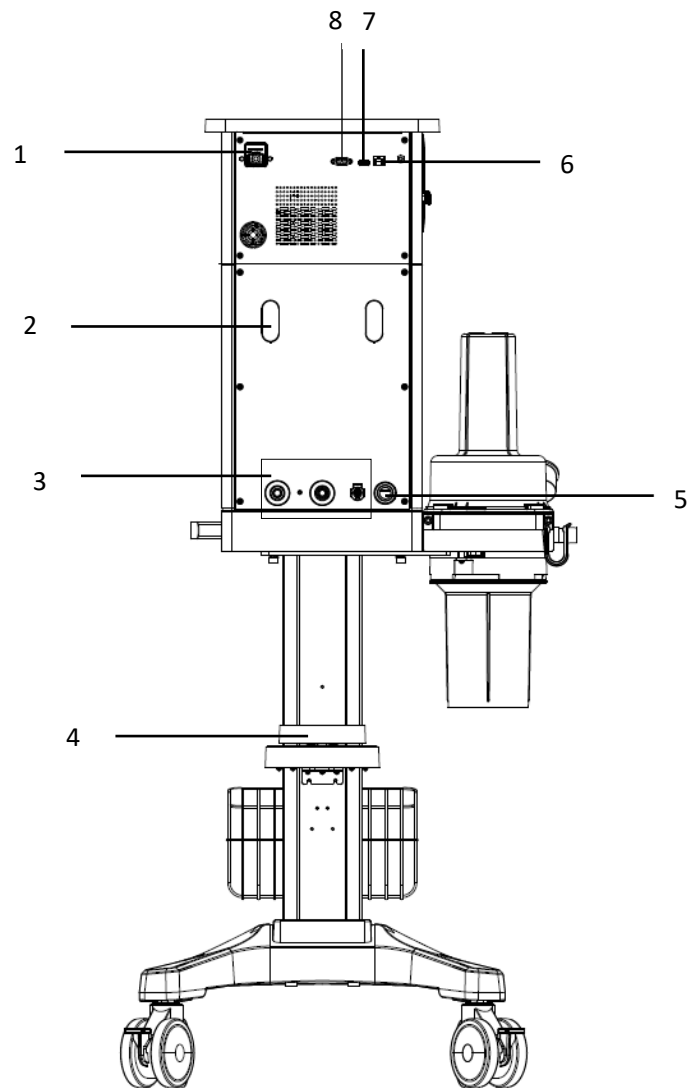


Fig. 2-2 Back view of NarkoVet PRO Anesthesia Machine

| 1 | Power inlet | 5 | Exhaust port |
|---|---|---|---|
| 2 | Wire hook | 6 | Network port |
| 3 | Pipeline gas inlets | 7 | USB port |
| 4 | Weighing device | 8 | DB9 serial port |

● **The Control Functions to Be Implemented Through the Back Side of NarkoVet PRO Anesthesia Machine**

| Item | Name | Description |
|------|------|-------------|
| 3 | Gas supply port | Used to connect to oxygen and air supply. |
| 4 | Weighing device | Monitors the weight of the exhaust gas absorbent canister in real time. |
| 5 | Exhaust port | Used to connect to AGSS. |
| 6 | Network port | RJ45 network port, supporting data transfer among medical systems. |
| 7 | USB port | USB 2.0 port, supporting data transmission and software upgrade during factory maintenance. |
| 8 | DB9 serial port | Support data transmission. |

## 2.4 Assemblies

⚠ **WARNING**

- **To avoid explosion hazard, please do not use flammable anesthetic agents on the device.**
- **Do not use antistatic breathing tubes and masks as they may cause combustion if used near high-frequency surgical equipment.**

## 2.4.1 Breathing System Assembly
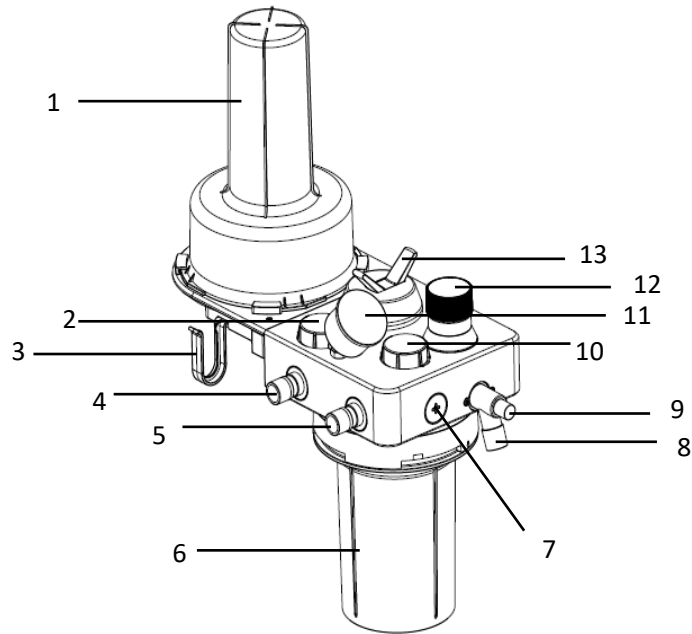


Fig. 2-3 Breathing System of NarkoVet PRO Anesthesia Machine

| | | | |
|---|---|---|---|
| 1 | Bellows assembly | 8 | Manual bag port |
| 2 | Expiratory check valve | 9 | Leak tester |
| 3 | Hook | 10 | Inspiratory check valve |
| 4 | Expiratory port | 11 | Airway pressure gauge |
| 5 | Inspiratory port | 12 | APL valve |
| 6 | $CO_2$ absorbent canister | 13 | Bag/Vent switch |
| 7 | $O_2$ sensor or sensor plug | | |

● **Breathing system functions of the NarkoVet PRO anesthesia machine**

| Item | Name | Description |
|---|---|---|
| 6 | $CO_2$ absorbent canister | A container for carbon dioxide absorbent. |
| 12 | APL valve | Adjust the pressure limit of the breathing system during manual/spontaneous ventilation. Its scale indicates the approximate |

| | | |
|---|---|---|
| | | pressure values. Adjust it clockwise to increase the value, or anticlockwise to reduce. The minimum scale is "MIN", and the maximum scale is "75". |
| 13 | Bag/Vent switch | Select manual/spontaneous mode (manual bag) or volume control mode (ventilator). When manual/spontaneous mode is selected, set the switch to bag position ☝. If volume control mode is selected, set the switch to the ventilator position ⊠. |

⚠ **NOTE**

● **The bellows cover is a transparent cover. The larger bellows has the scale marks from 300 to 1500ml while the smaller one from 100 to 300ml. These scale marks are for reference only. VT shall be read from the user interface. The delivered VT is the sum of the bellows displacement and the fresh gas flow.**

● **The values on the APL valve and the airway pressure gauge are for reference only. Calibrated patient airway pressure is displayed on the user interface.**

## 2.4.2 Anesthesia Ventilator Control

### 2.4.2.1 Ventilation Mode

The ventilation modes below may be configured for the anesthesia machine.

● Volume control ventilation(VCV)

● Volume support (VS)

● Pressure control ventilation (PCV)

● Synchronized intermittent mandatory ventilation - pressure control (SIMV-PC)

● Continuous positive airway pressure/pressure support ventilation (CPAP/PSV)

● Pressure regulated volume control ventilation (PRVC)

● Synchronized intermittent mandatory ventilation - Pressure regulated volume control ventilation (SIMV-PRVC)

● Pressure support ventilation protection (PSVPro)

● Manual/Spont (Manual)

## 2.4.2.2 Control Panel
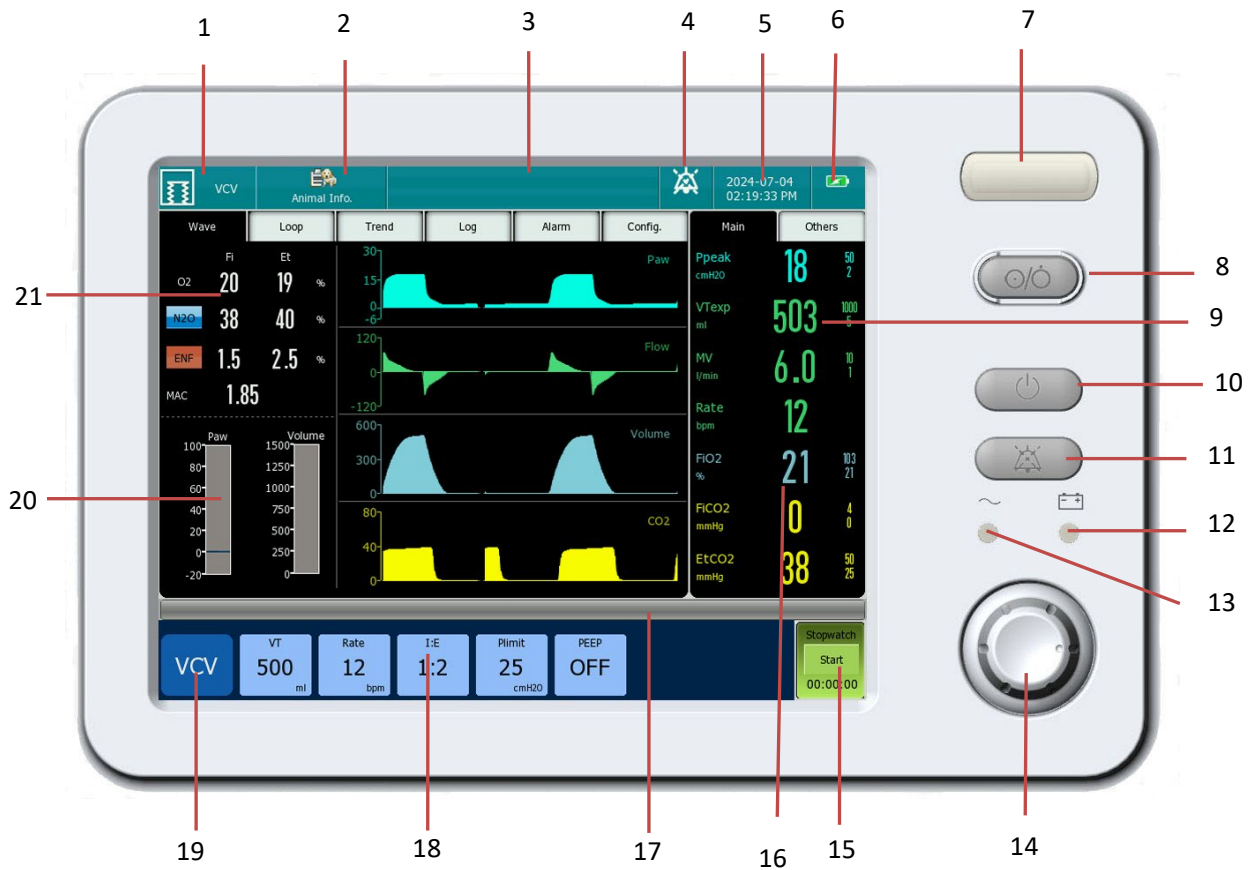


Fig. 2-4 Control Panel of NarkoVet PRO Anesthesia Machine

| | | | |
|---|---|---|---|
| 1 | Ventilation mode | 12 | Battery status indicator |
| 2 | Animal information | 13 | AC power indicator |
| 3 | Alarm message area | 14 | Rotary knob |
| 4 | Alarm sound state | 15 | Stopwatch |
| 5 | System time | 16 | $CO_2$ and $O_2$ concentration monitoring area |
| 6 | AC power supply and battery status | 17 | Prompt message area |
| 7 | Alarm indicator | 18 | Ventilation mode and parameters settings |
| 8 | System switch | 19 | Ventilation mode settings area |
| 9 | Ventilator monitoring values | 20 | Pressure and volume columns |
| 10 | Standby key | 21 | Anesthetic gas concentration monitoring area |
| 11 | Alarm audio pause key | | |

# Chapter 3  Installation and Connection

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> ⚠ **NOTE**
>
> - **In order to ensure the normal operation of the device, please read this Chapter and *Chapter 1 Safety* before use, and install the device as instructed herein.**
>
> - **This device has not been disinfected before delivery. Please clean and disinfect the device before using for the first time.**

## 3.1 Unpacking and Checking

Carefully take the device and its accessories out of the packing box; keep the packaging materials properly for use in future transportation or storage. Check the accessories according to the Packing List. Check to see if there is any mechanical damage. Check all exposed lead wires and some accessories with plugs. In case of any problem, contact EICKEMEYER® Sales Department or agency immediately.

> ⚠ **WARNING**
>
> - **If you find any damage, contact the related hospital staff or After-sales Service Department of EICKEMEYER®.**

## 3.2 Trolley and Main Unit Installation

1. Put the ⌀10 flat washer and the ⌀10 spring washer on the M10*25 hexagon screw to make up a screw assembly.



M10*25 hexagon screw

⌀10 spring washer

⌀10 flat washer
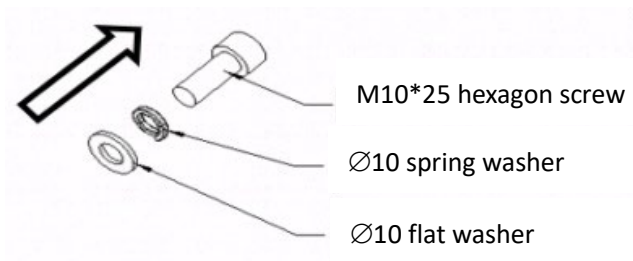
2. Install the column into the base (please pay attention to the direction), and then tighten the four screw assemblies.



Column

Base

Install here
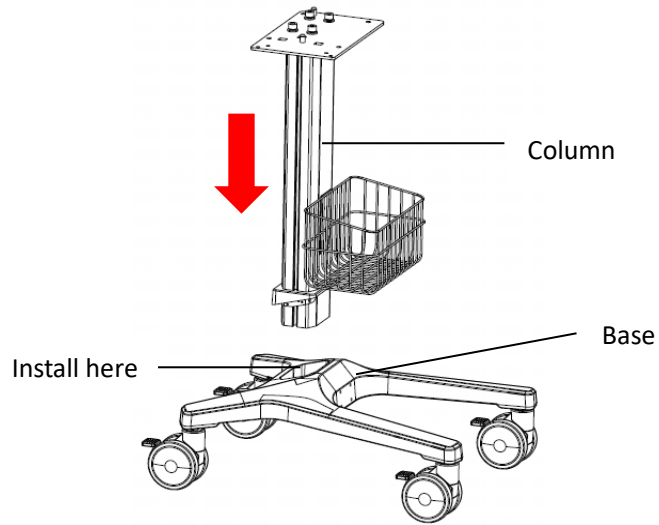
3. The guide column holes on both sides of the main unit bottom should be aligned with the guide column on the trolley during installation.
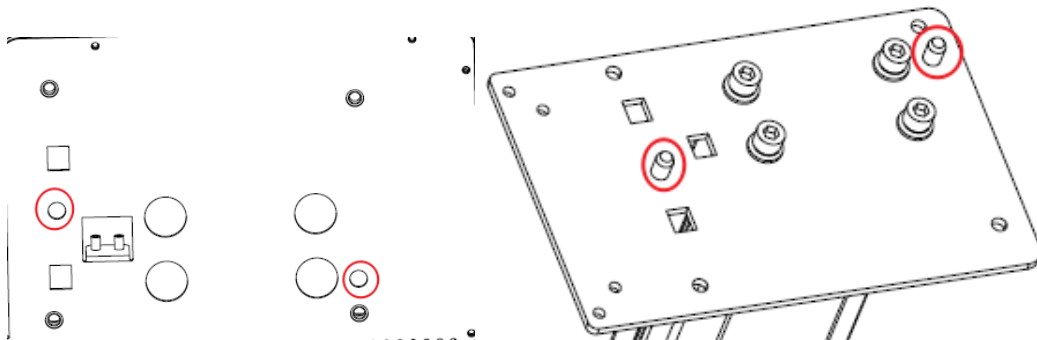


4. Fasten the main unit by tightening the four M8*25 screws at the bottom with a hexagon spanner.
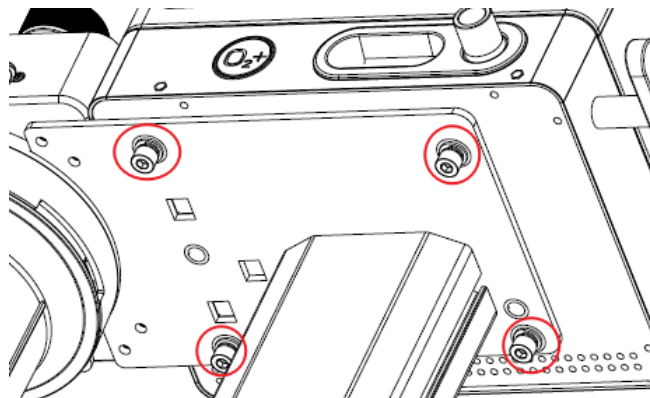
## 3.3 Anesthetic Vaporizer Installation

1. Remove the rear panel of the device, align the pipeline connector on the vaporizer to the two holes of the machine, and then push till the end.
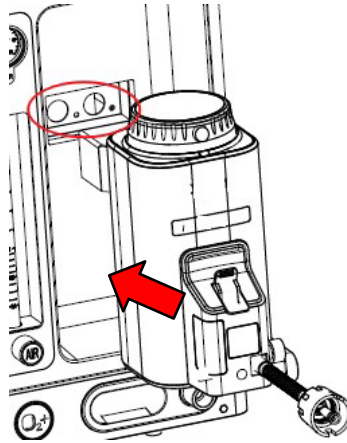


2. Hold the vaporizer and observe whether the four screw holes are aligned, and then tighten the four M4*8 screws with a hexagon spanner.
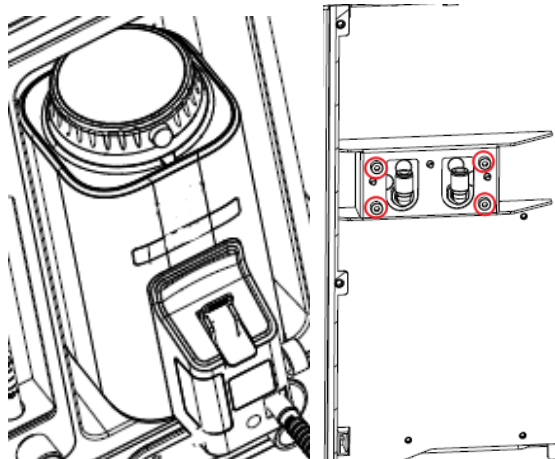


3. To connect the vaporizer, insert the inlet tube (the PU tube on the ACGO port on the left) and the outlet tube (the PU outlet tube of flowmeter on the right) into the pipeline connector of the vaporizer. And then install the rear panel by tightening the screws.

Inlet

Outlet
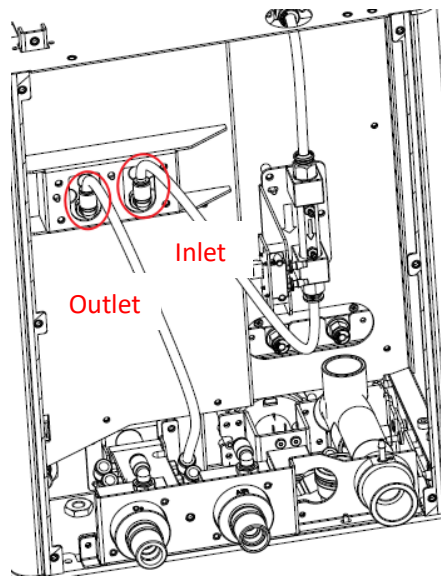
## 3.4 Breathing System Installation

> ⚠ **NOTE**
>
> - **After using the device, attention shall be paid to treatment of the breathing system, and the detection of CO₂ absorbent in the CO₂ canister and the anesthetic agent in the anesthetic vaporizer to ensure that the device runs well.**
> - **Please do not press bag port with hands or hang heavy objects on the bag port.**

### 3.4.1 Breathing System Installation

1. Align the guide column hole on the side of the main body of the breathing system with the guide column of the adapter block.
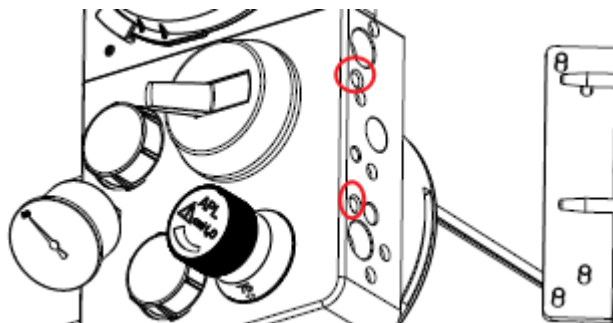


2. Gently push the main body of the breathing system into the adapter block until they are connected seamlessly, and then tighten the four M6*16 screws at the bottom with a hexagon spanner.
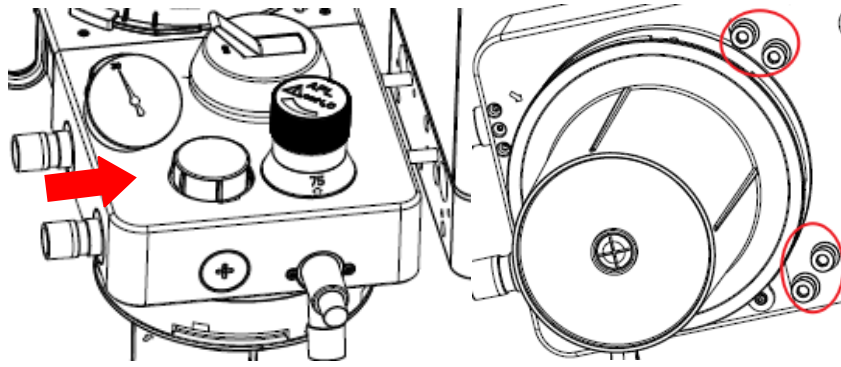
### 3.4.2 Manual Bag Installation

Put the manual bag on the bag connector.
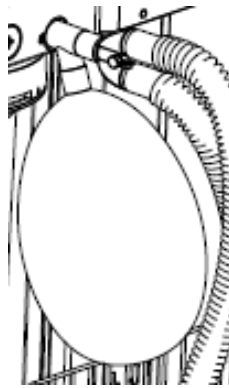


### 3.4.3 Breathing Tube, Y-piece Installation

> ⚠ **NOTE**
>
> ● When installing the breathing tube, hold the connectors on both sides of the breathing tube to prevent damages.

1. Connect the mask and filter to the Y-piece.

2. Connect the expiratory and inspiratory hose respectively to the expiratory and inspiratory port on the breathing system.
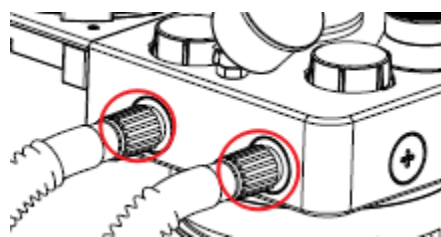
### 3.4.4 O$_2$ Sensor Installation

---

⚠ **WARNING**

- Before installation, check if the seal ring of the oxygen sensor is in good condition. Replace the oxygen sensor with a new one if there is no seal ring or the seal ring is damaged.

- The installation of the O$_2$ sensor must be correct. All parts should be screwed in place correctly without misalignment.

- The O$_2$ sensor must be installed properly; otherwise, gas leakage may occur in the breathing system.

1. Align the oxygen sensor with the oxygen sensor port "O$_2$%" on the breathing system, and insert it into the port and assemble it securely.

2. Insert the other end of oxygen sensor cable into the corresponding position at the bottom of the main machine.
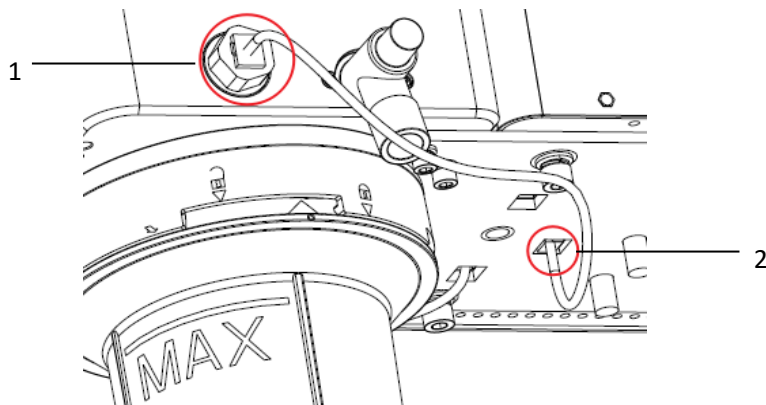


### 3.4.5 Bag/Vent Switch Signal Lead Installation

---

Connect one end of the Bag/Vent switch signal lead (on the breathing circuit) to Bag/Vent switch cable on the button of the main unit.
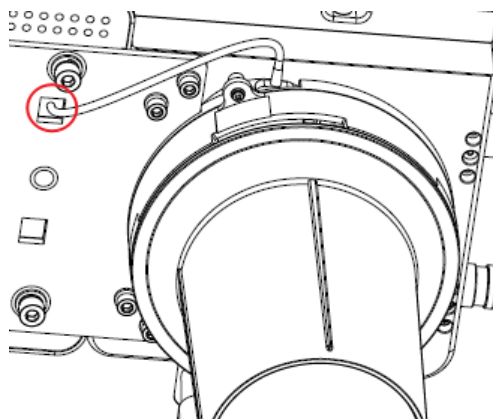
### 3.4.6 CO₂ Canister Installation

> **⚠ WARNING**
>
> - **Do not use the canister together with chloroform or trichloroethylene.**
>
> - **Change absorbent frequently to prevent the deposition of non-metabolic gases when the system is not in use.**
>
> - **Using dry $CO_2$ absorbent may cause danger to animals. Appropriate precautions shall be taken to ensure that the $CO_2$ absorbent in the canister does not get dry.**
>
> - **Do not allow your skin or eyes to be exposed to the substances contained inside the $CO_2$ absorbent canister. If your skin or eyes are exposed to the substances, rinse the affected parts with fresh water immediately, and take medical treatment.**
>
> - **Every time a case is finished or during operation, check the color of $CO_2$ absorbent, and take corresponding treatment measures. For details of $CO_2$ absorbent color change, please refer to the label attached on the package of $CO_2$ absorbent. The $CO_2$ absorbent may restore to its original color when it is not in use.**
>
> - **Please clean the $CO_2$ absorbent canister and replace the $CO_2$ canister sponge frequently. Otherwise, the $CO_2$ absorbent powder deposited in the $CO_2$ canister may enter the breathing system.**
>
> - **To assemble the $CO_2$ absorbent canister, check the rim of the canister, supporting piece and the seal for attached $CO_2$ absorbent particles. If there are any, remove the particles; otherwise, they might result in leakage in the breathing system.**

1. When filing $CO_2$ absorbent, ensure that the filled $CO_2$ absorbent is not higher than the "-MAX-" mark on the $CO_2$ absorbent canister.
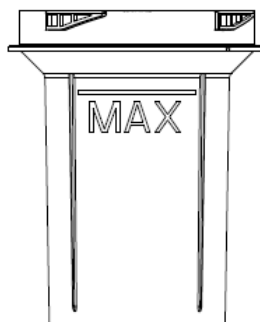


2. Align the mark △ on the edge of the $CO_2$ canister with the slot (which is marked with ▽) on the breathing system, clamp the outer wall of the canister with both hands, and then screw it clockwise. Screw it from the mark ▽ to ▽ to lock the $CO_2$ canister, as shown in the photo here:
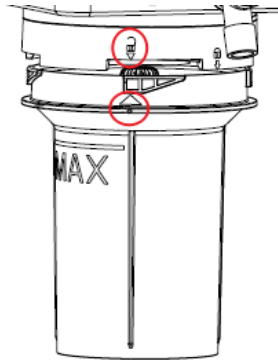
3. $CO_2$ canister is successfully installed, as shown in the photo here:
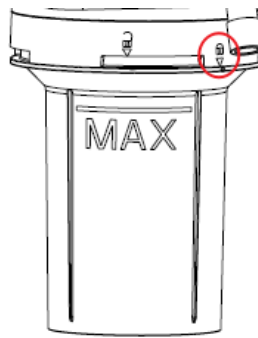


### 3.4.7 $CO_2$ Canister Replacement

1. Please refer to **3.4.6 $CO_2$ Canister Installation**, and operate from the final step to the first step to disassembly the canister.

2. Clamp the outer wall of the canister with both hands and rotate the canister anticlockwise. The $CO_2$ canister can be removed when it is rotated from the mark  to  .

3. When filling $CO_2$ absorbent, ensure that the filled $CO_2$ absorbent is not higher than the "-MAX-" mark on the $CO_2$ absorbent canister.

4. Reinstall the $CO_2$ absorbent canister by following the steps mentioned in **3.4.6 $CO_2$ Canister Installation**.

### 3.4.8 $CO_2$ Absorbent Replacement

> ⚠ **NOTE**
>
> - **The color gradient of the $CO_2$ absorbent in the $CO_2$ canister indicates the absorption of carbon dioxide ($CO_2$). The color change of $CO_2$ absorbent is for reference only. Please use a $CO_2$ monitor to determine whether $CO_2$ absorbent shall be replaced.**
>
> - **Once discolors, $CO_2$ absorbent should be disposed in accordance with relevant local regulations or**

hospital waste management system. Since $CO_2$ absorbent will return to its original color after several hours, it may mislead the user. In order to avoid misleading, it is recommended to replace $CO_2$ absorbent or use $CO_2$ monitor before each operation.

● EICKEMEYER® recommends you to use Medisorb$^{TM}$ $CO_2$ absorbent.

1. Refer to **3.4.7 $CO_2$ Canister Replacement** for removal of the $CO_2$ canister.

2. Pour out discolored $CO_2$ absorbent.

3. Pour new $CO_2$ absorbent into the $CO_2$ canister. When loading, be careful to pour in from around the $CO_2$ canister and avoid pouring $CO_2$ absorbent on the vent on the support frame. Otherwise it may lead to residual $CO_2$ absorbent or increase of air resistance.

4. When replacing $CO_2$ absorbent, ensure that the filled $CO_2$ absorbent is not higher than the "-MAX-" mark on the $CO_2$ absorbent canister.

5. Refer to the steps in the **3.4.6 $CO_2$ Canister Installation** to reinstall the $CO_2$ canister.

⚠ WARNING

● **When reinstalling the $CO_2$ canister after replacing $CO_2$ absorbent, check whether the $CO_2$ canister is locked and installed properly.**

# 3.5 Module Installation

## 3.5.1 Mainstream $CO_2$ Module Installation

1. Insert the module into the module slot.
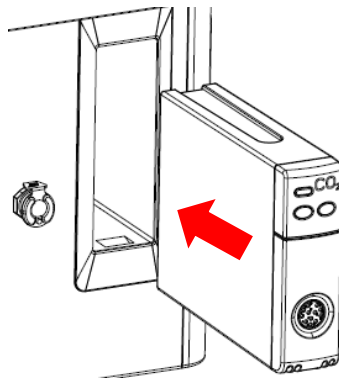


2. Push the module until the lever at its bottom gives a "Click" sound, indicating that the module is fixed in a correct position. The indicator light on the module turns on, indicating the module is installed properly.

Indicator light
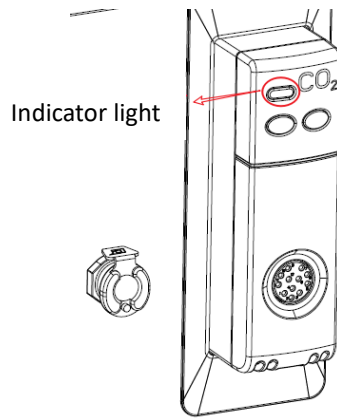
3.  Insert the connector to the sampling port, with the triangle mark on the connector facing upward.
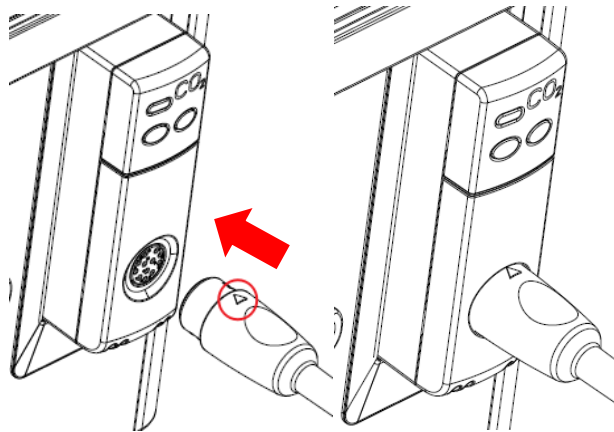


### 3.5.2 Sidestream AG/CO$_2$ Module Installation

1.  Install the module into the module slot.
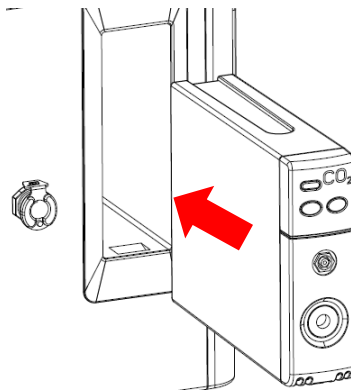


2.  Push the module until the lever at its bottom gives a "Click" sound, indicating that the module is fixed in a correct position. The indicator light on the module turns on, indicating the module is installed properly.

Indicator light
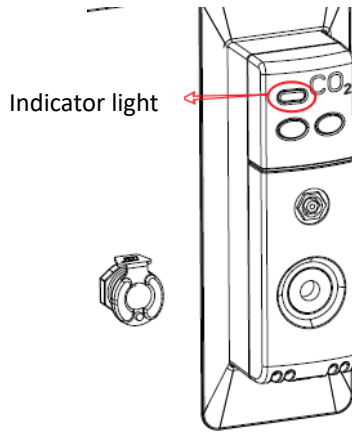
3. Insert one end of the exhaust tube into the exhaust outlet on the module and ensure that the insertion is secure.
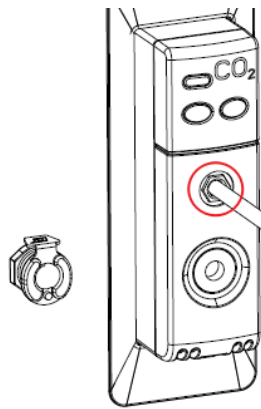


4. Insert the other end of the exhaust tube into the exhaust outlet on the anesthesia machine. A "Click" sound indicates the tube is installed in place.
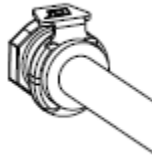


5. Insert the sampling line into the sampling port.
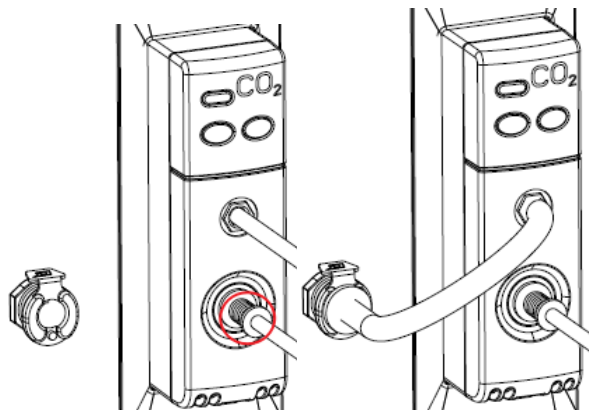
### 3.5.3 Mainstream CO$_2$ Module Detachment

1. Pull the connector out of the sampling port.
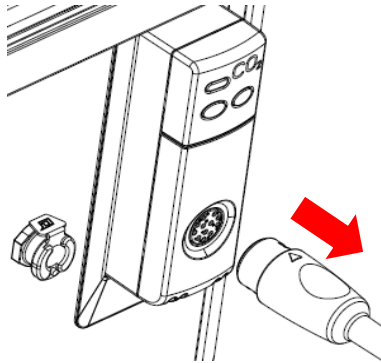


2. Push the lever at the bottom of the module upwards, and pull out the module.
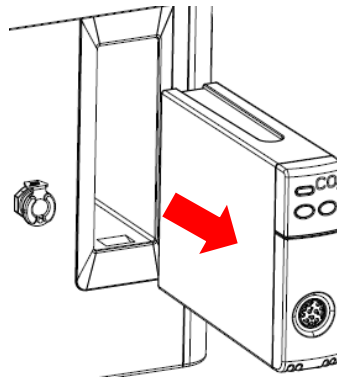


### 3.5.4 Sidestream AG/CO$_2$ Module Detachment

1. Pull out the sampling line.
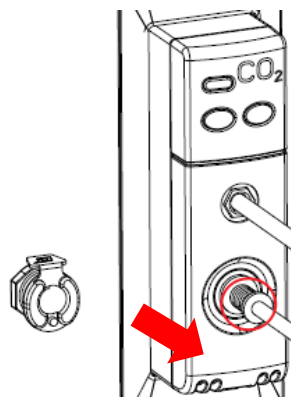
2. Press down the clip at the exhaust outlet of the anesthesia machine to release the exhaust tube, and then remove the tube.
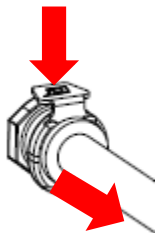


3. Pull the exhaust tube out from the exhaust outlet of the module.
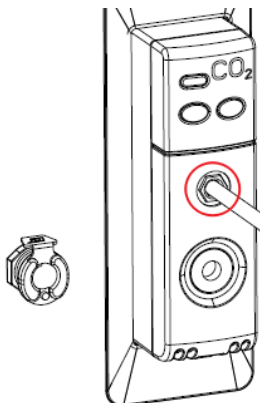


4. Push the lever at the bottom of the module upwards, and pull out the module.
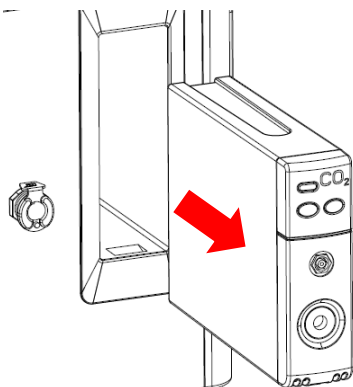
# Chapter 4  Pre-operations Check

> ⚠ **WARNING**
>
> ● **Before using the device, please read the User's Manual and understand the operation and maintenance of all components.**
>
> ● **Do not use the device if it fails to pass the pre-use tests. Please contact EICKEMEYER® for service.**

## 4.1 Check before Use

### 4.1.1 Test Interval

Pre-use test shall be performed:

1.    Before the anesthesia machine is used every day;

2.    Before the anesthesia machine is used for each animal;

3.    After the anesthesia machine is repaired or maintained.

The recommended test time and test items are given as follows:

| Test items | Before the first use every day | Before the use on each animal | After repair or maintenance |
|---|---|---|---|
| System check | √ | | √ |
| Power-on self-test | √ | | √ |
| Alarm test | √ | √ | √ |
| Bag leak test and ventilator leak test | √ | √ | √ |
| Gas supply pipeline test | √ | | √ |
| Anesthesia vaporizer test | √ | √ | √ |
| Breathing system test | √ | √ | √ |
| $O_2$ flush test | √ | √ | √ |

| AGSS test | √ | | √ |
|-----------|---|---|---|

## 4.1.2 Before the First Use Every Day

1. Check whether the equipment is in good condition, and the components are connected correctly.

2. Check whether the pipeline gas supply system is connected and that the displayed pressure values are correct.

3. Check whether the amount of liquid anesthetic agent in the anesthesia vaporizer is appropriate, and check whether the anesthesia vaporizer and the anesthesia vaporizer mounting seat are well fitted.

4. Check whether the breathing circuit is properly connected and intact and the $CO_2$ canister is adequately loaded with new $CO_2$ absorbent.

5. Connect the exhaust gas discharge system and check whether the system can work normally.

6. Make sure there is an adequate supply of stored oxygen.

7. For the anesthesia machine with AGSS, check whether the AGSS float is located between the Min and Max scales. For the anesthesia machine with the anesthetic exhaust absorbent canister, check whether its increased weight has exceeded the specified range.

8. Turn on the power switch and conduct the system self-test, bag leak test and ventilator leak test by following the prompt on the screen interface.

## 4.1.3 Before the Use for Each Animal

1. Check whether the amount of liquid anesthetic agent in anesthesia vaporizer is appropriate.

2. Check whether the waste gas absorbent canister is overweight.

3. Check whether the breathing circuit is properly connected and intact and the breathing system contains sufficient absorbent.

4. Make sure the check valve on the breathing system is working properly.

## 4.1.4 After Repair or Maintenance

For details, please refer to the *4.1.2 Before the First Use Every Day*.

# 4.2 Check the System

> ⚠ **WARNING**

- **Make sure the breathing system is properly connected and intact.**

- **When installing the canister, please check whether the sealing ring is installed correctly. If the sealing ring is not properly installed, the breathing system may leak.**

- **The maximum bearing weight of top plate is 20kg.**

Ensure that the following requirements are met during system check:

1. The device is intact.

2. All components are properly connected.

3. There is no damage on the flowmeter, anesthetic vaporizer, barometer and gas supply pipeline.

4. The breathing system is properly connected; the pipeline is intact; adequate $CO_2$ absorbent is provided.

5. The anesthesia vaporizer is locked in place and filled with sufficient anesthetic agent (no overflow).

6. The air supply system is connected correctly and the pressure is normal.

7. Equipment for airway maintenance and endotracheal intubation is available and in good condition.

8. Appropriate anesthetic agent and emergency medicines are available.

9. Check the color of soda lime in the canister. If the color changes obviously, replace the soda lime immediately.

10. Make sure the foot brake is not damaged or loose. Lock the brake so that the anesthesia machine cannot move.

11. Make sure the breathing system of the anesthesia machine is fitted properly and the breathing system is locked.

12. Connect the power cord to the AC supply. After connection, the AC power indicator and the battery indicator shall be on. If the two indicators are not turned on after connection, the system is not powered.

13. Make sure the $O_2$ flush button is working properly.

## 4.3 Power-on Self-test

1. The system performs a self-test once it is turned on. Ensure that the alarm system (alarm speaker) and hardware board are working properly.

2. After the power-on self-test passes, the System Selftest interface is entered automatically. If the system selftest fails, a failure prompt message is displayed.

3. Perform operations or troubleshooting based on the self-test result.

## 4.4 Leak Test

<div style="border: 2px solid orange;">

⚠ **NOTE**

- **The system leak test includes the leak tests of the anesthetic breathing system and the anesthetic ventilator.**

- **The system leak test must be conducted when the system is in the standby state.**

- **Ensure that the breathing system is properly connected and breathing pipeline is intact before the system leak test.**

- **If leak test fails, check all possible causes of gas leaks, such as leakage from bellows, breathing system pipeline, $CO_2$ canister and their connectors. Check if they are intact and properly connected. During the check of the $CO_2$ canister, ensure that no $CO_2$ absorbent particle is attached on the seal components of the canister. Remove them if there are any.**

- **If the breathing system leaks, do not use the equipment. Contact the maintenance personnel or after-service department of EICKEMEYER®.**

- **A loose connection between the bellows and the intubation tube will result in leakage of the breathing circuit, making VT supply abnormal.**

</div>

### 4.4.1 Leak Test in Mechanical Ventilation Mode

1. Ensure that the system is in the standby status. If not, press the Standby key ⏻ Standby↵ to enter the Standby interface.

    2. Select [**Leak Test**] → [**Vent. Leak Test**].

    3. Operate by following the instruction on the screen.

### 4.4.2 Leak Test in Manual Ventilation Mode

1. Ensure that the system is in the standby status. If not, press the Standby key ⏻ Standby↵ to enter the Standby interface.

2. Select [**Leak Test**] → [**Bag Leak Test**].

3. Operate by following the instruction on the screen.

## 4.5 Gas Supply Pipeline Test

1. Connect air or oxygen supply to the air source port of the anesthesia machine.

2. Rotate the flow control knob to adjust the flow to the middle level of measuring range.

3. Make sure that the pressure values indicated by each pipeline pressure gauge are in the range of 280-600 kPa.

4. Cut off the air supply.

5. Make sure that the pressure gauges of the corresponding air source return to their zero positions.

## 4.6 Ventilator Test

> ⚠ **NOTE**
>
> ● **Ventilators shall be equipped with anesthesia systems in accordance with ISO 80601-2-13.**

1. Ensure that the air supply pressure is sufficient.

2. Ensure that ventilator parameters and alarm limits are set to the applicable clinical level. For details, please refer to the relevant sections of *6.4.1 Alarm Settings for Ventilator Parameters* and *Appendix II Specifications*.

3. Set the Bag/Vent switch to Ventilator position.

4. Connect the manual bag to the animal port under the ventilator control mode.

5. Set different VT, Rate, I:E and other parameters of the anesthesia machine to observe whether the measured value and setting values of the anesthesia machine and the actual tidal volume on the bellows of the breathing system meet the clinical requirements.

## 4.7 Breathing System Test

> ⚠ **WARNING**
>
> ● **Foreign bodies in the breathing system can block air flow to the animal, which can lead to death or injury. Make sure there are no test plugs or other foreign bodies in the breathing system.**

1. Make sure the breathing system is intact and properly connected.

2. Make sure the check valve on the breathing system is working properly.

3. If the inspiratory check valve opens during inspiration and closes immediately at the beginning of expiration, the inspiratory check valve is working properly.

4. If the expiratory check valve opens during expiration and closes immediately at the beginning of inspiration, the expiratory check valve is working properly.

### 4.7.1 Bellows Tightness Test

1. Ensure that the breathing system is intact and properly connected.

2. When the breathing system is disconnected, the anesthesia machine will report an alarm of "Breathing Circuit Not Connected".

3. Ensure that the check valve on the breathing system works properly:

4. If the inspiratory check valve opens during inspiration and closes immediately at the beginning of expiration, the inspiratory check valve is working properly.

5. If the expiratory check valve opens during expiration and closes immediately at the beginning of inspiration, the expiratory check valve is working properly.

### 4.7.2 APL Valve Accuracy Test

1. Attach the manual bag to its port.

2. Plug the Y-piece on the bellows into the leak test plug on the bag port and block the outlet of Y-piece.

3. Adjust the APL valve control knob to a pressure of 30 $cmH_2O$.

4. Set $O_2$ flow to 3 l/min to fill the manual bag, and turn off other gases.

5. Make sure the reading on the airway pressure gauge is in the range of 20~40 $cmH_2O$.

6. Adjust the APL valve control knob to minimize the opening pressure of the APL valve (MIN position).

7. Make sure the reading on the airway pressure gauge is less than 5 $cmH_2O$.

8. Press the $O_2$ flush button to ensure that the reading on the airway pressure gauge does not exceed 10 $cmH_2O$.

9. Turn the $O_2$ flow control knob to set the $O_2$ flow to the minimum and make sure the reading on the airway pressure gauge does not drop below 0 $cmH_2O$.

## 4.8 Alarm Test

The anesthesia machine automatically performs a self-test once it is turned on. The alarm light flashes in the order of red-yellow, and then a beep is given. A System Selftest interface is displayed, and the pre-use check, ventilator leak test and manual bag leak test are conducted before entering the Standby interface. The audible and visual alarm indicators have started to work normally when the Standby interface is entered.

> ⚠ **NOTE**
>
> ● During the alarm test, the operator shall stay in a position where the alarm light and prompt messages can be observed and the alarm sound can be heard.

### 4.8.1 O$_2$ Concentration Monitoring and Alarm Test

> ⚠ **NOTE**
>
> ● It is unnecessary to conduct the testing if the O$_2$ sensor is not configured.

1. Set the Bag/Vent switch to the Manual Bag position 🖐.

2. Take the O$_2$ sensor out of the breathing system and measure the room air after 2~3 minutes; verify that the measured O$_2$ concentration [**FiO$_2$**] is approximately 21%.

3. Set the [**Low Limit**] of [**FiO$_2$**]: On the screen, select [**Alarm**] menu → [**Ventilator**] → select [**FiO$_2$**] [**Low Limit**] menu, and set the low alarm limit of the parameter to 50%.

4. Observe the alarm message area on the screen, and make sure that the alarm [**Low FiO$_2$**] is triggered.

5. Set the [**Low Limit**] of [**FiO$_2$**] to a value lower than the current monitored value of [**FiO$_2$**], and make sure that the alarm of [**Low FiO$_2$**] is cleared.

6. Re-install the O$_2$ sensor into the breathing system.

7. Set the [**High Limit**] of [**FiO$_2$**]: Select [**Alarm**] menu → [**Ventilator**] → select [**FiO$_2$**] [**High Limit**] menu, and set the high alarm limit of the parameter to 50%.

8. Connect the manual bag to the corresponding connector of the breathing system. Push the oxygen flush button to fill the manual/spontaneous bag, and make sure that the O$_2$ concentration [**FiO$_2$**] measured by the sensor is approximately 100%.

9. Observe the physiological alarm message on the screen, and make sure that the alarm [**High FiO$_2$**] is triggered.

10. Set the [**High Limit**] of [**FiO$_2$**] alarm to 100%, and make sure that the alarm [**High FiO$_2$**] is cleared.

### 4.8.2 Minute Volume (MV) Alarm Test

1. Make sure [**MV**] alarm is set to "ON".

2. Set the [**Low Limit**] for the alarm of [**MV**]: On the screen, select [**Alarm**] menu → [**Ventilator**] → select [**MV**] [**Low Limit**] menu, and set the low alarm limit of the parameter to 6.0 l/min.

3.  When the MV is lower than the low alarm limit, observe the alarm message area on the screen, and make sure that the alarm [**Low MV**] is triggered.

4.  Set the [**High Limit**] alarm of [**MV**]: On the screen, select [**Alarm**] menu → access [**Ventilator**] → select [**MV**] [**High Limit**] menu, and set the high alarm limit of the parameter to 9.0 l/min.

5.  When the MV is higher than the high alarm limit, observe the alarm message area on the screen, and make sure that [**High MV**] is displayed.

### 4.8.3 Apnea Alarm Test

1.  Connect the manual bag to the corresponding connector of the breathing system.

2.  Set the Bag/Vent switch to the Manual Bag position (☞).

3.  Rotate the APL valve control knob to the position with the minimum opening pressure.

4.  Squeeze the manual bag, and make sure that one complete respiratory cycle takes place.

5.  Stop squeezing the manual bag, and wait for at least 10 seconds. Make sure that [**Apnea**] alarm is displayed on the screen.

6.  Squeeze the manual bag several times, and make sure that the [**Apnea**] alarm on the screen disappears.

### 4.8.4 High Paw Alarm Test

1.  Set the Bag/Vent switch to Ventilator position (▨).

2.  On the screen, select [**Alarm**] menu → [**Ventilator**] → select [**Ppeak**] menu, and set [**Low Limit**] of Ppeak to 0 cmH$_2$O and [**High Limit**] to 10 cmH$_2$O.

3.  Ensure that that alarm [**High Pressure**] is displayed on the screen.

4.  Set the [**High Limit**] to 40 cmH$_2$O.

5.  Make sure that the alarm [**High Pressure**] disappears.

### 4.8.5 Low Paw Alarm Test

1.  Set the Bag/Vent switch to Ventilator position (▨).

2.  On the screen, select [**Alarm**] menu → [**Ventilator**] → select [**Ppeak**] menu, and set the [**Low Limit**] of Ppeak to 2 cmH$_2$O.

3.  Remove the manual bag from the animal port of Y-piece.

4.  Wait for 20 seconds, observe the alarm message area on the screen, and ensure that the alarm [**Low**

**Pressure**] is displayed on the screen.

5. Connect the manual bag to the connector port on the breathing system.

6. Make sure that [**Low Pressure**] disappears.

### 4.8.6 CO₂ Monitor Alarm Test

1. Refer to *Chapter 7 Physiological Alarms and Technical Alarms*.

2. Connect a carbon dioxide gas sampler to a $CO_2$ analyzer.

3. Select [**Alarm**] menu →[**CO₂**] → select the [**High Limit**] of [**FiCO₂**] and [**EtCO₂**], and set the alarm [**High Limit**] to 20 mmHg.

4. Make sure that the alarm [**High FiCO₂**] is displayed on the screen when the concentration of $CO_2$ is higher than the alarm limit.

5. Set the [**Low Limit**] of [**FiCO₂**] [**EtCO₂**] alarms of [**CO₂**] to 10 mmHg.

6. Set the [**Low Limit**] of $CO_2$ to a value higher than the standard gas concentration.

7. Make sure that the alarm [**Low FiCO₂**] is displayed on the screen when the concentration of $FiCO_2$ is lower than the alarm limit.

## 4.9 AGSS Transfer and Receiving Systems Test

Turn on the anesthetic gas scavenging system and check whether the float rises up and exceeds the scale mark "MIN". If the float sticks during movement or gets damaged, contact the manufacturer for maintenance.

> ⚠ **NOTE**
>
> ● **Do not block the pressure compensation port of AGSS during inspection.**

If the float cannot rise up, possible causes could be:

1. The float is stuck. Turn the AGSS upside down and check whether the float can move up and down freely.

2. The float rises slowly. The filter mesh may be blocked. Please contact the manufacturer for checks and maintenance.

3. The high-flow AGSS is not working or the pumping flow rate is less than 50 l/min (normal working rate). Please contact the manufacturer for checks and maintenance.

4. The low-flow AGSS system is not working or the pumping flow rate is less than 25 l/min (normal working rate). Please contact the manufacturer for checks and maintenance.

# Chapter 5  Basic Operations

> ⚠ **WARNING**
>
> - **Anesthesia machine alarms indicate potential dangerous situation for the animal. All causes for alarms should be made clear to ensure animal safety.**
>
> - **When using sevoflurane, ensure that there is enough fresh gas flow.**
>
> - **When dry (dehydrated) absorbent material is exposed to inhaled anesthetic agent, dangerous chemical reaction may be produced. Caution: Do not let the absorbent dry out. After using the system, turn off all air supply.**
>
> - **Before using this equipment, check whether it is installed properly and is intact.**
>
> - **Operators should not touch animals and other electric equipment at the same time.**
>
> - **Signal input/output port can only be connected to specified peripheral devices.**

## 5.1 Power on the Device

1.  Connect the gas supply and ensure that the gas supply has enough pressure (gas supply pressure is between 280 kPa and 600 kPa).

2.  Plug the power cord into a power socket. The AC power indicator light is on when the AC power supply is connected. If the battery power is low, the battery will charge automatically.

3.  Press and hold the system switch to turn on the device.

a)  The alarm indicator flashes once in the order of red-yellow, and then the buzzer sounds a "beep".

b)  The system is turned on and EICKEMEYER®'s logo is displayed on the screen.

c)  The system automatically performs a series of self-tests. After self-tests are completed, the results are displayed.

d)  After the completion of self-tests, [**Vent. Leak Test**] is performed.

e)  According to the prompt on the interface, select [**Start**] for [**Vent. Leak Test**]. Start [**Bag Leak Test**] after passing the ventilator leak test.

If the test fails, refer to *4.4.1 Leak Test in Mechanical Ventilation Mode* for retesting.

f)  According to the prompt on the interface, select [**Start**] for [**Bag Leak Test**]. Enter the [**Standby**] interface after passing the test, and press [**Start Ventilation**] to enter the user interface.

If the test fails, refer to *4.4.2 Leak Test in Manual Ventilation Mode* for retesting.

## 5.2 Connect Gas Supplies

On the anesthesia machine, there are three types of gas supply connector ($O_2$ and AIR), among which, two are $O_2$ supply connector (one is low-pressure oxygen). The gas supply hoses are marked with different colors, and the hose connectors of different types cannot be interchanged. The steps to connect gas supply hose and anesthesia machine are given below:

1. Before connecting the gas supply pipeline, check whether the seal ring of the connector is intact. If the seal ring is damaged, the pipeline cannot be used, and the seal ring must be replaced; otherwise, gas leak may take place.

2. Align the gas supply hose and connector with the gas supply inlet on the back of the anesthesia machine and insert it.

3. Make sure the gas supply hose is securely connected to the gas supply inlet, and tighten the hose nut by hand.

⚠ **NOTE**

- **Gas supply hoses shall meet the standards of ISO 5359.**

## 5.3 Input Gas Flow

1. Connect the gas supply and make sure that it has sufficient pressure.

2. The flow input of fresh gas is controlled by the flow knob, and the corresponding flowmeter displays the flow value of each gas.

## 5.4 Install the Anesthesia Vaporizer

Press the "0" button and rotate the control dial anticlockwise to the desired anesthetic agent concentration.

For the filling and discharge of anesthetic agent, please refer to the user manual of the vaporizer.

⚠ **WARNING**

- **Please check whether the control dial can be rotated normally before operation.**

- **Do not use the vaporizer when it is tilted more than 30°. Otherwise, there may be a risk of incorrect output concentration or anesthetic agent spillage.**

- **Before operation, check the filling level from the sight glass. If it is below the scale mark of "MIN", anesthetic agents shall be added.**

## 5.5 Set the Volume for Alarm, Prompt and Key

1. Press and hold the system switch key and set it to $\odot$ status.

2. On the screen, select [**Alarm**] →access [**Volume**] menu.

3. The minimum volume can be regulated in the maintenance mode. The range of [**Alarm Volume**] is level 2~8. The ranges of [**Alert Volume**][2] and [**Key Volume**][3] are both 0~7. The green area and the number on it indicate the current volume level.



Fig. 5-1 Volume

---

⚠ **NOTE**

- **1: Alarm volume is set to adjust the volume of all high, medium and low level audible alarms.**

- **2: Alert volume is the volume issued by the prompt information appearing in the prompt area.**

- **3: Key volume is the volume of sound produced when the soft key on the touchscreen is touched.**

---

## 5.6 Turn on/off CPB

In manual/spontaneous ventilation mode:

1. Press and hold the system switch to turn on the system "$\odot$".

2. Rotate the APL valve control knob to adjust the pressure in the breathing system to a proper range.

3.    Set the Bag/Vent switch to Manual Bag ☞ position, then screen displays [☞**Manual/Spont**].

4.    On the user interface, select [**Manual/Spont**] menu in the lower part of the screen→ enter [**CPB**] menu.

5.    Press and turn the rotary knob to switch between [**ON**] and [**OFF**].

6.    After selection, press the rotary knob to confirm the current option.

7.    Rotate the rotary knob to return to the [**Manual/Spont**] menu and the previous menu.

In mechanical ventilation mode, the system sets [**CPB**] to [**OFF**] automatically, and the user cannot change it.

⚠ **WARNING**

- **When [CPB] is set to [ON], some of the physiologic alarm messages may not be triggered; therefore, the setting shall be applied cautiously. The physiologic alarms include: Apnea, Apnea>2min, Low Paw, High MV, Low MV.**

## 5.7 Use Rapid Oxygenation

◆    During anesthetization, if the animal requires emergency oxygen supply without anesthetic agent supply:

1.    Set the anesthetic vaporizer dial to the "0" position and unplug the breathing connector.

2.    Press the $O_2$ flush button and discharge anesthetic gas from the circuit of the breathing system.

3.    Reconnect the breathing connector and press the $O_2$ flush button, allowing the animal to inhale pure oxygen.

◆    During anesthesia, if the animal needs emergency oxygen supply.

Press the $O_2$ flush button so that the animal can inhale pure oxygen.

⚠ **WARNING**

- **When using rapid oxygenation ($O_2$ flush), pay close attention to the flowmeter indicator to avoid excessive pressure inside the system.**

## 5.8 Set $CO_2$/AG Module

On the screen, select [**Config.**] menu → [**Gas Module**] or press the setting button on the $CO_2$ module to enter the setting menu.
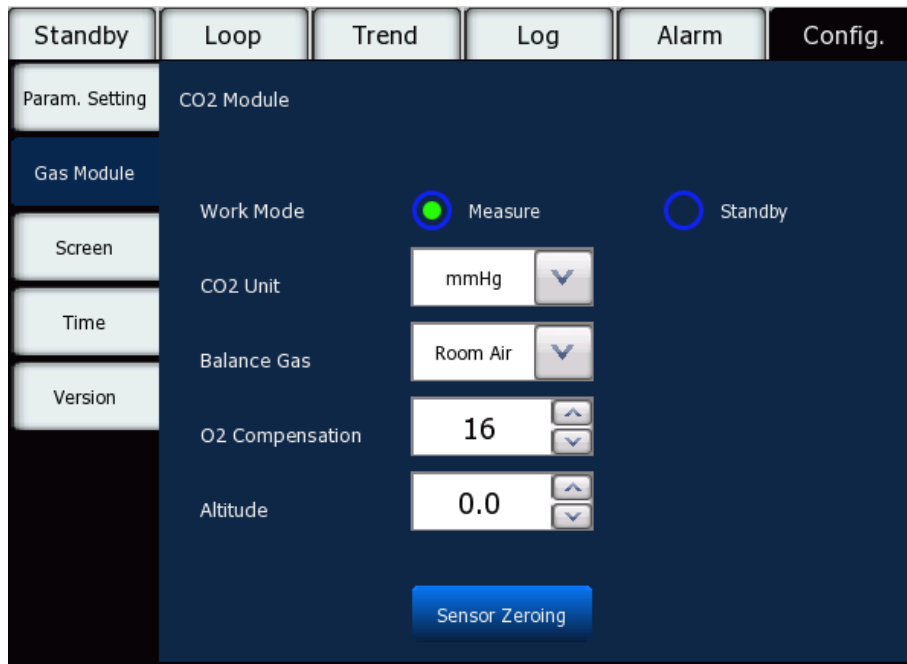
Fig. 5-2 Gas Module

## 5.9 Set Ventilation Mode

### 5.9.1 Ventilation Mode and Parameter Settings
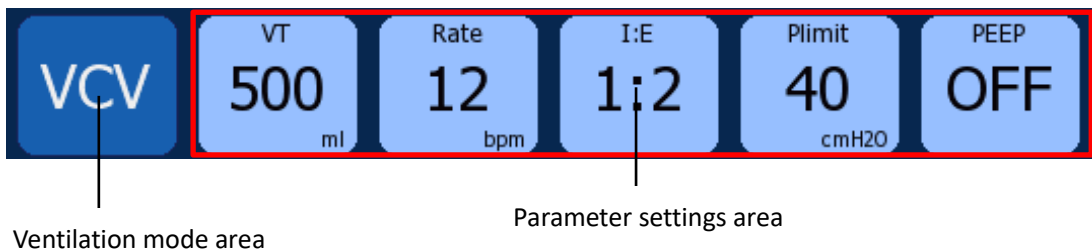


Ventilation mode area

Parameter settings area

◆ Ventilation mode setting method:

1. In the ventilation mode area, press the rotary knob or touch the screen to select a ventilation mode.

2. Press the rotary knob to confirm the setting.

◆ Ventilation parameter setting method:

1. In the parameter setting area, press the rotary knob or touch the screen to select a parameter.

2. Turn the rotary knob to set the parameters to the appropriate values.

3. Press the rotary knob or touch the screen to confirm the setting.

## 5.9.2 Mechanical Ventilation Mode

The system is configured with 8 mechanical ventilation modes:

- VS
- VCV
- PCV
- SIMV-PC
- CPAP/PSV
- PRVC
- SIMV-PRVC
- PSVPro

### 5.9.2.1 Start Mechanical Ventilation

1. Press and hold the system switch to turn on the machine.

2. Select [**VS**] → [**VT**].

3. Enter the setting mode through the rotary knob or touch screen operation. Rotate the knob to set a proper value for [**VT**], and then confirm the parameter setting via the rotary knob or touch operation.

4. Check ACGO switch, and make sure ACGO is OFF.

5. Set the Bag/Vent switch to ⊠ Ventilator/Auto position.

6. If necessary, press the $O_2$+ oxygen flush button to inflate bellows until the bellows rises to the top.

7. Start the mechanical ventilation by pressing the [**Start Ventilation**] button.

> ⚠ **NOTE**
>
> - **Make sure all relevant parameters are set properly before starting up a new mechanical ventilation mode.**

### 5.9.2.2 VS Ventilation Mode

VS means volume support ventilation. During the first respiratory cycle, a trial ventilation is performed according to the preset pressure. The measured pressure, compliance and resistance are used as the calculation of the next respiratory ventilation. The respiratory rate is automatically controlled by the animal's lung characteristics when the inspiratory trigger level is detected. And pressure-control ventilation is performed by increasing or decreasing the pressure according to the set tidal volume and by automatically adjusting the I:E until the target [**VT**] is reached. When no inspiratory trigger level is detected, the respiratory rate is controlled by the [**MinRate**] set by the ventilator, and the pressure is increased or decreased according

to the set tidal volume and the I:E is automatically adjusted to the target [**VT**] to perform pressure-control ventilation. When the expiratory trigger level is reached, expiration begins immediately. PEEP can be set.

Parameter settings of VS mode:

- VT
- MinRate
- PEEP
- Inspiratory trigger

### 5.9.2.3 VCV Ventilation Mode

VCV means volume control ventilation. During the first respiratory cycle, a trial ventilation is performed according to the preset pressure. The measured pressure, compliance and resistance are used as the calculation of the next respiratory ventilation. The inspiration time control will be calculated according to [**Rate**] and [**I:E**] preset by the ventilator. And pressure-control ventilation is performed by increasing or decreasing the pressure according to the set tidal volume until the target [**VT**] is reached. When inspiration time ends, expiration begins immediately. When the adjusted pressure reaches the preset [**Plimit**], the system alarm is triggered and the Plimit ventilation is maintained.

In the VCV mode, [**PEEP**] can be set to improve $EtCO_2$ discharge and increase oxygenation during the respiratory process.

Parameters settings of VCV Mode:

- VT
- Rate
- I:E
- Plimit
- PEEP

### 5.9.2.4 PCV Ventilation Mode

In the PCV mode, a constant inspiratory pressure will be provided. According to the preset [**Rate**] and [**I:E**], the inspiratory time can be calculated by the ventilator. The ventilator increases pressure for animal side of the breathing circuit through a higher initial airflow, and reduces the airflow after the pressure reaches the preset value in order to maintain the preset inspiratory pressure, until the respiratory time turns to the expiratory time.

The ventilator pressure sensor monitors the airway pressure of the animal side of the breathing circuit in real-time. The ventilator maintains the preset pressure through the feedback of flow corresponding to the pressure.

In the PCV mode, [**PEEP**] can be set to improve $EtCO_2$ discharge and increase oxygenation during the respiratory process.

Parameter Settings of PCV Mode:

- Pinsp
- Rate
- I:E
- Tslope
- Plimit
- PEEP

### 5.9.2.5 SIMV-PC Ventilation Mode

In the SIMV-VC mode, ventilation is conducted on an animal at a preset [**Rate**] and [**Pinsp**]. In the respiratory interval (trigger window), the animal conducts spontaneous respiration at its respiratory rate and tidal volume.

The ventilator waits for the animal's spontaneous respiration as per the preset interval. [**Trigger**] includes flow trigger or pressure trigger. If the spontaneous respiration reaches the threshold of [**Trigger**] during the [**Trig. Window**], the ventilator uses the preset inspiratory pressure and inspiratory time to deliver fresh gas synchronously, otherwise, it will conduct mechanical ventilation as per the preset clinical parameter of [**Rate**].

In this mode, pressure support ventilation from the ventilator can be obtained to support animal's spontaneous respiration. Thus the animal can overcome the resistance in the circuit system and the artificial airway and conduct ventilation with the preset support pressure.

Parameters Settings of SIMV-VC Mode:

- Pinsp
- SIMV Rate
- Tinsp
- Tslope
- △Pps
- Plimit
- PEEP
- Trigger Window
- Trigger
- Exp%

### 5.9.2.6 CPAP/PSV Mode

CPAP/PSV (continuous positive airway pressure/pressure support ventilation) mode is an auxiliary respiratory ventilation mode.

In this mode, the ventilator conducts ventilation at the preset [**MinRate**]. In the preset interval, if the spontaneous respiration reaches the level of [**Trigger**], the ventilator starts to deliver gas to increase the pressure in the airway to the preset [**Pps**] quickly, and then maintains the pressure at the same level. After the

spontaneous inspiratory flow reduces to [**Exp%**], the ventilator stops delivering gas and the animal starts to exhale. If the spontaneous respiration does not reach the triggering level, the ventilator will conduct mandatory ventilation once with the [**ΔPapnea**], [**Apnea.IE**], ensuring the minimum ventilation volume for the animal.

In this mode, the tidal volume is the monitored value, which depends on various factors like the inspiratory force of the animal, preset [**Pps**] level, the compliance and the resistance between the animal and the whole system of the ventilator, etc.

Parameter Settings of CPAP/PSV Mode:

- ΔPps
- MinRate
- Trigger
- Tslope
- Plimit
- PEEP
- Exp%
- ΔPapnea
- Apnea.IE

### 5.9.2.7 PRVC Mode

The PRVC mode is a controlled ventilation mode in which pressure regulates volume control.

In the PRVC mode, the first respiratory cycle is a trial ventilation performed according to preset pressure, [**Rate**] and [**I:E**]. The measured plateau pressure, compliance and resistance are used for the next respiratory ventilation cycle. Starting from the second respiratory cycle, the inspiratory pressure values, [**Tslope**], [**Rate**], and [**I:E**] are used for pressure control ventilation. During ventilation, inspiratory pressure is automatically adjusted according to the characteristics of the animal's lungs, in order to achieve the target tidal volume.

When the adjusted suction pressure reaches the preset [**Plimit**], the system will provide an alarm and maintain Plimit ventilation.

Settings of pressure regulating volume control ventilation mode:

- VT
- Rate
- I:E
- Tslope
- Plimit
- PEEP

### 5.9.2.8 SIMV-PRVC Mode

SIMV-PRVC is a mode in which ventilation is delivered to an animal with synchronized intermittent command and pressure regulated volume control.

In the SIMV-PRVC mode, the ventilator waits for the animal to inspire at a specified time interval. The inspiratory trigger depends on the preset [**Trigger**] threshold. The inspiratory trigger can be set to the flow trigger or pressure trigger mode. If the inspiratory trigger threshold is reached within the [**Trig. Window**] time, the ventilator simultaneously delivers PRVC control ventilation according to the preset [**VT**], [**Rate**], [**Tinsp**], and [**Tslope**]. If the animal does not inspire in the trigger window, the ventilator sends PRVC control ventilation to the animal when the trigger window ends. During the pressure control ventilation, the inspiratory pressure will be automatically adjusted according to the lung characteristics of the animal to achieve the target tidal volume.

The first respiratory cycle is a trial ventilation performed according to preset pressure, [**Rate**] and [**I:E**]. The measured plateau pressure, compliance and resistance are used for the next respiratory ventilation cycle. The subsequent PRVC ventilation is pressure control ventilation with the plateau pressure measured at the trial ventilation stage as the control pressure.

In the SIMV-PRVC mode, spontaneous breathing outside the trigger window can obtain pressure support ventilation to help the animal overcome the resistance of the animal's circuit system and artificial airway and perform ventilation according to the preset [**Pps**].

Settings of pressure adjustment and control synchronization ventilation mode:

- VT
- SIMV Rate
- Tinsp
- Plimit
- ΔPps
- Tslope
- PEEP
- Trigger Window
- Trigger
- Exp%

### 5.9.2.9 PSVPro Mode

PSVPro is a pressure support ventilation mode with Apnea backup ventilation.

In PSV Pro mode, when the animal's spontaneous respiration reaches the [**Trigger**] threshold, the ventilator provides pressure support ventilation to the animal according to the preset [**Pps**], [**Exp%**], and [**Tslope**]. During pressure support ventilation, the inspiratory time and tidal volume are determined by the animal's inspiratory

strength and preset [**Pps**] levels, as well as the compliance and resistance of the animal and the ventilator's entire system.

When the animal stops breathing or stops triggering for more than the preset apnea time [**Tapnea**], the ventilator will automatically switch to SIMV-PC/PS backup ventilation mode and ventilate according to the preset [**Trig. Window**], [**Pinsp**], [**Tslope**] and [**Pps**], and provide an alarm of apnea ventilation.

When the ventilator is switched to backup ventilation mode, the apnea ventilation alarm will continue until the PSVPro restarts. When the number of continuous triggering ventilations of the animal reaches the preset [**Exit Backup**], the ventilator will restart PSVPro ventilation. When [**Exit Backup**] is set to OFF, the user may select PSVPro ventilation mode manually to switch to PSVPro ventilation mode.

Settings of PSVPro mode settings:

- ΔPps
- Trigger
- Exp%
- Tapnea
- Plimit
- PEEP
- Pinsp
- Tslope
- Tinsp
- SIMV Rate
- Trigger Window
- Exit Backup

### 5.9.3 Manual/Spont Mode

1. Turn the rotary knob of the APL valve to adjust the pressure inside the breathing system to appropriate range.

2. Set the Bag/Vent switch to Manual Bag position ☞, and a prompt message [**Manual/Spont**] will be displayed on the screen.

3. If necessary, press the $O_2+$ oxygen flush button to inflate the manual bag.

4. In Manual/Spont mode, the APL valve is used to regulate the peak pressure in the breathing system and the gas volume in the manual bag. When the pressure in the breathing system reaches the threshold, the APL valve is opened to discharge the excessive gas in the breathing system.

> ⚠ **NOTE**
>
> - **When using this device on animals, ensure that Manual/Spontaneous mode is always available.**

## 5.10 Stopwatch

The stopwatch is positioned in the right bottom corner of the interface. It is helpful for an anesthetist to record the duration of an operation or count time for some special operations during the operation. The user can start, stop or reset the stopwatch by operating the rotary knob and the touch screen. The default state of the stopwatch is OFF, as shown in the figure below.
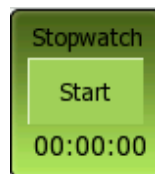


## 5.11 Weighing Device

The function of the weighing device is to monitor the weight of the anesthetic waste gas absorbent canister in real time. When the increased weight of the anesthetic waste gas absorbent canister exceeds the set replacement value, please replace the anesthetic waste gas absorbent canister with a new one. In the standby mode, click the [**Weighing Device**] button on the right side of the interface, zero the weighing device by following the steps prompted on the interface, and set the increased weight for anesthetic waste gas absorbent canister replacement.

## 5.12 Ventilator Parameter Monitoring

The parameter monitoring of the ventilator falls into two categories: waveform monitoring and parameter monitoring of breathing mechanics.

Currently the system displays four breathing waveforms: pressure waveform, flow waveform, volume waveform, and $EtCO_2$ waveform.

The system monitors the following breathing-related parameters: [**VTinsp**], [**VTexp**], [**MV**], [**Rate**], [**I:E**], [**Ppeak**], [**Pplat**], [**PEEP**], [**Pmean**], [**Raw**], [**Compl**], [**FiO₂**], [**EtCO₂**], [**FiCO₂**], anesthetic agent concentration and depth of anesthesia.

Under the non-standby interface, the parameter interface is divided to the [**Wave**] parameter area in the center and the parameter display area on the right, as shown in the figure below:
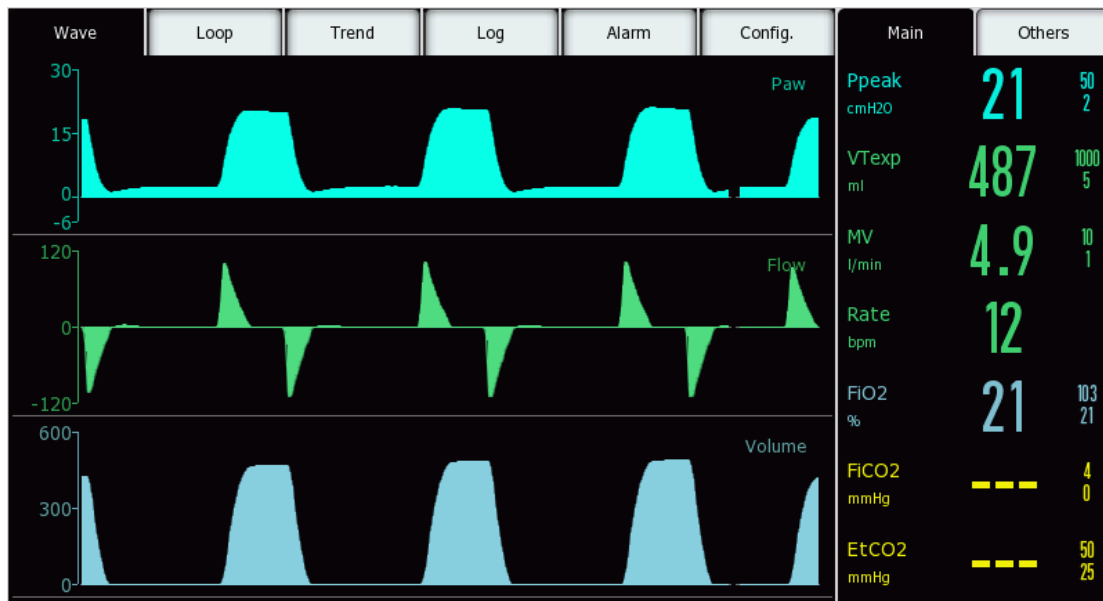
Fig. 5-4 Parameter Monitoring of the Ventilator

## 5.12.1  Parameter Display

The system can display the monitoring parameter in 2 ways: big font interface and non-big font interface. In the big font interface, only the parameter values, pressure column and volume column are displayed; in the non-big font interface, both the parameter waveform and parameter values are displayed.

The default interface of the system is the non-big font interface. Select [**Config.**] → [**Param. Setting**] → [**Big Font**] → [**ON**] / [**OFF**] to display the big font interface or the non-big font interface.

The big font interface is shown as below.
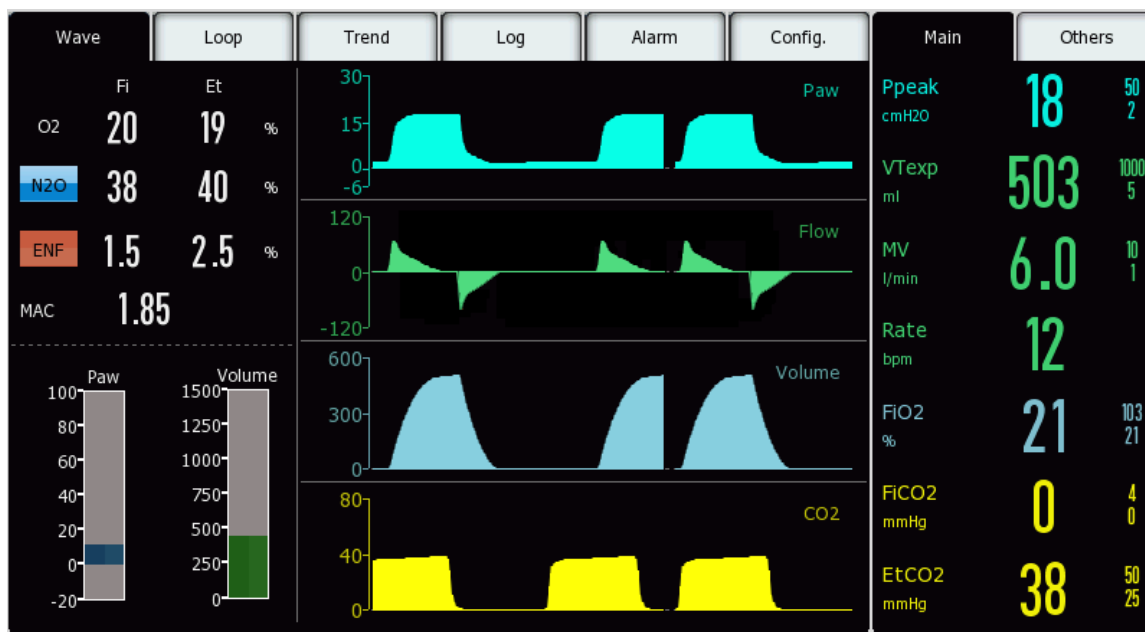
### 5.12.2 Pressure Monitoring

In the non-standby interface, the user can monitor the airway pressure waveform and the values of airway peak pressure, platform pressure, positive end-expiratory pressure and mean pressure.

The unit of the pressure parameter can be set by the user. Currently, the system provides three units: [**cmH₂O**], [**kPa**] and [**mbar**], of which the [**cmH₂O**] is the default unit. The user can select a unit by choosing [**Config.**] → [**Param. Setting**] → [**Pressure Unit**].

### 5.12.3 Tidal Volume Monitoring

In the non-standby interface, the user can monitor the real-time flow waveform and VTexp, VTinsp, per-minute volume.

The display of the flow waveform is optional. To enable/disable this display, the user can select [**Config.**] → [**Screen**] → [**Flow Wave**] → [**ON**]/[**OFF**]**.**

The display of the parameter [**VTinsp**] is optional. To enable/disable this display, the user can select [**Config.**] → [**Param. Setting**] → [**VTinsp Display**] → [**ON**]/[**OFF**]**.**

### 5.12.4 Volume Monitoring

In the non-standby interface, the user can monitor the real-time volume waveform.

The display of the volume waveform is optional. To enable/disable this display, the user can select [**Config.**] → [**Screen**] → [**Volume Wave**] → [**ON**]/[**OFF**]**.**

### 5.12.5 Oxygen Concentration Monitoring

1.  Select [Config.] → [Param. Setting] → [O₂ Sensor Monitor].

2.  Set oxygen sensor to [ON]/[OFF] as required.

> ⚠ **NOTE**
>
> - **When you use the oxygen sensor for the first time or replace the oxygen sensor, please check whether the oxygen concentration monitoring is accurate. If the monitoring error is obvious, please calibrate the sensor.**
>
> - **When the O₂ sensor monitor is set to [OFF] and FiO₂ value is invalid, the oxygen concentration monitoring and the related alarms of the O₂ sensor become disabled.**

## 5.13    Spirometry Loop

The spirometry loop reflects mechanical ventilation conditions and animal's lung function, such as animal's compliance, circuit leakage condition, airway blocking, etc., which plays an important role in the clinical test. Two loops and related respiratory mechanics parameters of the reference loop are displayed in the interface, which is shown below:
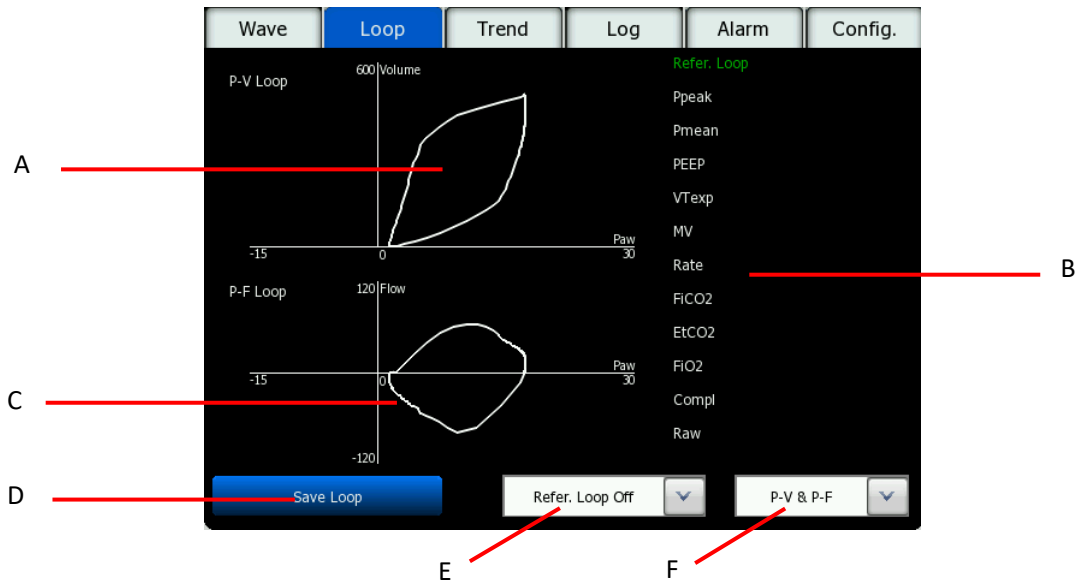


| | | | |
|---|---|---|---|
| A | P-V (Pressure-Volume) Loop | D | Save Loop |
| B | Loop Parameters | E | Switch of Reference Loop |
| C | P-F (Pressure- Flow) Loop | F | Loop Option |

Three spirometry loops are available:

● Pressure–Volume (P-V)

● Volume-Flow (V-F)

● Pressure–Flow (P-F)

### 5.13.1    Select Loop

Two loops can be displayed on the system loop interface. There are three types of loop options that the user can select on the screen: [**P-V**] loop and [**P-F**] loop; [**P-V**] loop and [**V-F**] loop; [**V-F**] loop and [**P-F**] loop.

### 5.13.2    Save Reference Loop

Select [**Loop**] → [**Save Loop**] to save the loop. The saved reference loop will be displayed in another color, and the related respiratory mechanics parameters of the reference loop will be displayed on the right of the loop area.

## 5.14    Trend

### 5.14.1    Trend Table

Trend Table is used to review the data of animal physiological parameters recorded at a certain moment. It describes the changes in parameter measuring results. Trend Table provides VTexp, VTinsp, MV, Ppeak, Pplat, Pmean, PEEP, Rate, $FiO_2$, $FiCO_2$ and $EtCO_2$. It stores data for 60 continuous hours at the resolution of 5s. The Trend Table refreshes when the machine is restarted.

On the screen, select [**Trend**] → [**Table**] to check the trend table.

### 5.14.2    Trend Graph

Trend Graph is used to review the trend of parameter values recorded at certain moments. The measured physiological values recording at different moments are drawn into a curve to illustrate the animal parameter's trend. Trend graph provides data review for VTexp, VTinsp, MV, Rate, Ppeak, Pmean, PEEP, $FiO_2$, Compliance, Raw, $FiCO_2$, $EtCO_2$, PIF, PEF, Plimit, Tinsp and Texp. It records data for 60 continuous hours at the resolution of 5s. The Trend Graph refreshes when the machine is restarted.

On the screen, select [**Trend**] → [**Graph**] to check the trend graph.

> ⚠ **NOTE**
>
> - **If the trend graph does not show any data, press the [Time] regulation knob, and the time recorded on the coordinate axis becomes the latest time on the system.**

## 5.15    Alarm Log

The alarm log can save up to 2000 messages. Log messages are stored chronologically. The earliest event will be overwritten if a new event takes place after 2000 messages have been stored. Alarm log storage includes both technical alarm logs, physiologic alarm logs, indicate logs and setting logs.

On the screen, select [**Log**] to open a window.

> ⚠ **NOTE**
>
> - **When the anesthesia machine is completely powered off or turned off, only physiological and technical alarms would be save in Flash. Setting logs and prompt messages would not be saved.**
> - **If audible alarms do not generate any longer, the user can access the alarm log to view the events that**

> **trigger alarms.**

## 5.16    Power off

Please follow the steps below to shut down when you do not intend to use the machine:

1.    Ensure it is safe for the machine to be switched off.

2.    Press and hold the system switch key for 3 seconds to turn off the machine. If the machine is in ventilation state, press and hold the system switch key for 3 seconds, click [**Confirm**] in the [**Shut Down Now**] dialog box to shut down the machine immediately, or click [**Cancel**] and return to ventilation status.

3.    Unplug the power cord to disconnect the power.

4.    Remove the gas supply hose to disconnect the gas source.

## 6.1 Overview

Alarms given by the anesthesia machine have audible and visual indications to the medical care personnel when the animal using the anesthesia machine shows abnormal changes in vital signs or the anesthesia machine cannot work normally due to a fault condition.

> ⚠ **NOTE**
>
> - **When the equipment is turned on, the system checks whether the audible alarm and the alarm lamp are working normally. If they are, the equipment gives a "Beep" sound, and the alarm lamp illuminates once yellow/red. If the audible alarm and alarm lamp are abnormal, do not use the equipment. Please contact EICKEMEYER® immediately.**
>
> - **In case multiple different alarms occur simultaneously, the equipment will give audible and visual alarms relevant to the highest priority alarm that is occurring.**
>
> - **The user shall set the alarm volume and alarm limits as per actual conditions of the animals. Do not only rely on the audible alarm system for animal monitoring. If the alarm tone is adjusted to a lower volume, animals' safety may be endangered. The user shall pay close attention to the actual clinical status of the animals.**
>
> - **Information such as physiological parameters and alarms displayed on the screen of the equipment are for clinicians' reference only, and must not be directly used as basis for clinical treatment.**

### 6.1.1  Alarm Types

Alarms given by the anesthesia machine are divided into physiologic alarms, technical alarms and prompting messages as per the properties of alarms.

1.    Physiological Alarms

Physiological alarms are usually given when the physiological parameter of the animal exceeds the preset high/low alarm limits or some physiological abnormality of the animal takes place. The alarm messages of physiological alarms are displayed in the physiological alarm area at the upper part of the screen.

2.    Technical Alarms

Technical alarms, which are also known as system error messages, indicate the alarms triggered when some system function cannot work normally resulting from misoperation or system malfunction, or the monitoring results are distorted. Alarm messages of technical alarms are displayed in the technical alarm area at the upper

part of the screen.

3.   Prompting Messages

Strictly speaking, prompting messages do not fall into the scope of alarms. Apart from the physiological alarm messages and technical alarm messages, the anesthesia machine can display prompting messages which are related to the system state. The prompting messages usually do not relate to the vital signs of animals. The prompting messages are displayed in the system message area.

## 6.1.2  Alarm Levels

As per the severity of alarms, physiological alarms given by the anesthesia machine are divided into high level alarms, medium level alarms, and low level alarms.

1.   High Level Alarms

The animal is in a critical condition endangering its life, and immediate emergency treatment is required.

2.   Medium Level Alarms

The physiological sign of the animal appears abnormal, and corresponding measures shall be taken or treatment shall be conducted immediately.

3.   Low Level Alarms

The physiological sign of animal appears abnormal, and corresponding measures may possibly be taken or treatment may possibly be conducted.

Levels of all technical alarms and some physiological alarms are already preset before the anesthesia machines are shipped, and cannot be modified by the users. Levels of some physiological alarms may be modified.

## 6.2 Alarm Indications

When an alarm occurs, the anesthesia machine reminds the user through the following audible and visual indications:

● Visual alarms

● Audible alarms

● Alarm messages

● Parameter flashing

Of which, the alarm levels of visual alarms, audible alarms and alarm messages are presented in different ways respectively.

### 6.2.1 Visual Alarms

When an alarm occurs, the alarm lamp indicates alarms of different levels by different colors and flashing frequencies.

- High level alarms: red; the flashing frequency is 2.5Hz.
- Medium level alarms: yellow; the flashing frequency is 0.625Hz.
- Low level alarms: yellow; always on, without flashing.

### 6.2.2 Audible Alarms

When an alarm occurs, the anesthesia machine prompts alarms of different levels by different sound characteristics.

- High level alarm: Five high tones continuously; repeats twice.
- Medium level alarm: Three high tones continuously.
- Low level alarm: A single tone.

### 6.2.3 Alarm Messages

Alarm messages are displayed in the physiological alarm area or technical alarm area of the anesthesia machine when an alarm occurs. The system adopts a different background color to differentiate alarm messages levels.

- High level alarm: Red
- Medium level alarm: Yellow
- Low level alarm: Yellow

The following marks are added in front of alarm messages to differentiate alarm message levels:

- High level alarm: !!!
- Medium level alarm: !!
- Low level alarm: !

### 6.2.4 Parameter Flashing

When a parameter alarm occurs, the parameter flashes once every second.

## 6.3 Alarm Volume

On the screen, select [**Alarm**] →[**Volume**]→ access [**Alarm Volume**] menu. The default range of alarm volume is level 2~8. The minimum volume can be further regulated in the maintenance mode.

## 6.4 Alarm Limit

> ⚠️ **NOTE**
>
> - When the parameter value is higher than the high alarm limit or lower than the low alarm limit, an alarm will be triggered.
>
> - When using the equipment, always ensure that the alarm limits are set to suitable values. Set high alarm limit and low alarm limit as per clinical requirements. If alarm limits are set beyond a reasonable range, the alarm system may become ineffective.

On the screen, select [**Alarm**] menu → [**Ventilator**], [**AG**] and [**CO₂**] and set the alarm [**High Limit**] and [**Low Limit**] of each parameter; or select [**Load Default Alarm Limit**] to use the default high/low alarm limits.



Fig. 6-1 Setting Alarm Limit

> ⚠️ **WARNING**
>
> - In the manual mode, when the alarm is set to OFF, alarms related to MV and VTexp will not be triggered. Please use this function cautiously.
>
> - When the anesthesia machine is restarted, the alarm set 30 seconds before the shutdown will be reloaded.

## 6.4.1 Alarm Settings for Ventilator Parameters

| Parameter | | Setting Range | Step Size | Default Value | Remarks |
|---|---|---|---|---|---|
| VT | High Limit | 5~1600 ml | 5 ml | 1000 ml | High Limit> Lower limit |
| | Low Limit | 0~(High Limit-5) ml | 5 ml | 5 ml | |
| MV | High Limit | 2.0~100.0 l/min | 1 l/min | 10 l/min | High Limit> Lower limit |
| | Low Limit | 0.0~(High Limit-2.0) l/min | 1 l/min | 1 l/min | |
| FiO$_2$ | High Limit | 20~105% | 1% | 103% | High Limit> Lower limit |
| | Low Limit | 18~(High Limit-2)% | 1% | 21% | |
| Paw | High Limit | VS Mode: 10~100 cmH$_2$O 10~100 hPa 10~100 mbar Other Modes: 15~100 cmH$_2$O 15~100 hPa 15~100 mbar | 1 cmH$_2$O 1 hPa 1 mbar | 50 cmH$_2$O 50 hPa 50 mbar | High Limit> Lower limit |
| | Low Limit | 0 ~ (High Limit-2) cmH$_2$O 0 ~ (High Limit-2) hPa 0 ~ (High Limit-2) mbar | 1 cmH$_2$O 1 hPa 1 mbar | 2 cmH$_2$O 2 hPa 2 mbar | |
| | Negative pressure alarm is triggered when Paw is lower than -10 cmH$_2$O | | | | |
| Alarm pause | 120s | | | | |

## 6.4.2 Module Alarm Settings

| | | | | |
|---|---|---|---|---|
| EICKEMEYER® EtCO$_2$ Alarm | Alarm High Limit | Low Limit +2 mmHg ~ 150 mmHg | Step Size: 1 mmHg | Default high limit: 50 |
| | Alarm Low Limit | 0 mmHg ~ High Limit -2 mmHg | Step Size: 1 mmHg | Default low limit: 25 |
| EICKEMEYER® FiCO$_2$ Alarm | Alarm High Limit | Low Limit +2 mmHg ~ 76 mmHg | Step Size: 1 mmHg | Default high limit: 4 |
| | Alarm Low Limit | 0 mmHg ~ 74 mmHg | Step Size: 1 mmHg | Default low limit: 0 |
| Masimo EtCO$_2$ Alarm | Alarm High Limit | Low Limit +2 mmHg ~ 190 mmHg | Step Size: 1 mmHg | Default high limit: 50 |
| | Alarm Low Limit | 0 mmHg ~ High Limit -2 mmHg | Step Size: 1 mmHg | Default low limit: 25 |
| Masimo FiCO$_2$ Alarm | Alarm High Limit | Low Limit +2 mmHg ~ 99 mmHg | Step Size: 1 mmHg | Default high limit: 4 |
| | Alarm Low Limit | 0 mmHg ~ 97 mmHg | Step Size: 1 mmHg | Default low limit: 0 |
| AG Alarm | EtCO$_2$ High Limit | (Low Limit+2 mmHg) ~ 190 mmHg | Step Size: 1 mmHg | Default high limit: 50 |
| | EtCO$_2$ Low Limit | 0 mmHg ~ (High Limit -2 mmHg) | Step Size: 1 mmHg | Default low limit: 25 |
| | FiCO$_2$ High Limit | (Low Limit + 2 mmHg) ~ 99 mmHg | Step Size: 1 mmHg | Default high limit: 4 |
| | FiCO$_2$ Low Limit | 0 mmHg ~ (High Limit -2 mmHg) | Step Size: 1 mmHg | Default low limit: 0 |
| | EtN$_2$O High Limit | (Low Limit + 2%) ~ 100 % | Step Size: 1% | Default high limit: 55 |
| | EtN$_2$O Low Limit | 0% ~ (High Limit-2%) | Step Size: 1% | Default low limit: 0 |
| | FiN$_2$O High Limit | (Low Limit + 2%) ~ 100 % | Step Size: 1% | Default high limit: 53 |
| | FiN$_2$O Low Limit | 0% ~ (High Limit-2%) | Step Size: 1% | Default low limit: 0 |
| | EtHAL/EtENF/EtISO/EtSEV/EtDES High Limit | (Low Limit + 0.2%) ~ 25.0% | Step Size: 0.1% | Default high limit: 5.0 |
| | EtHAL/EtENF/EtISO/EtSEV/EtDES Low Limit | 0% ~ (High Limit-0.2%) | Step Size: 0.1% | Default low limit: 0 |
| | FiHAL/FiENF/FiISO/FiSEV/FiDES High Limit | (Low Limit + 0.2%) ~ 25.0 % | Step Size: 0.1% | Default high limit: 2.0 |
| | FiHAL/FiENF/FiISO/FiSEV/FiDES Low Limit | Low Limit ： 0% ~ (High Limit-0.2%) | Step Size: 0.1% | Default low limit: 0 |

## 6.5 Alarm Level

Set AG alarm level: select [**Alarm**] menu → [**AG**]. The [**High Limit**] of AG can be distinguished as follows:

- EtN$_2$O high limit alarm (High, Medium, Low)
- EtAA high limit alarm (High, Medium)

## 6.6 Alarm Sound State

Press the alarm audio pause key to set the system to alarm audio paused state. All audible alarms will be paused, and a 120s countdown is displayed in the upper right corner of the screen. The audio paused state is canceled and the 120s countdown disappears when the user presses the alarm audio pause key again, or when a new alarm is triggered.

> ⚠ **NOTE**
>
> - **In the alarm audio paused state, all alarm modes work normally except for the audible alarm.**
> - **Once the 120s countdown ends, the system will automatically exit the current alarm audio paused status and reactivate the audible alarms.**
> - **When the alarm [Insufficient O$_2$ Pressure] appears and the alarm audio is paused, the system will cancel alarm pause automatically and a high level technical alarm is triggered. In this situation, the alarm audio pause key is ineffective. The key returns to normal when the alarm [Insufficient O$_2$ Pressure] disappears.**
> - **When inspiratory hold is turned on, the prompt message [Inspiratory Hold] is shown on the alarm sound state area. If the audible alarm is paused before, it returns to normal at this moment.**

## 6.7 Setting the Alarm Switch

Set the CO$_2$ module alarm switch: select the [**Alarm**] menu → [**CO$_2$**], set the CO$_2$ module alarm to [**ON**] or [**OFF**].

Set the AG module alarm switch: select the [**Alarm**] menu → [**AG**], set the AG module alarm to [**ON**] or [**OFF**].

## 6.8 Measures When an Alarm Occurs

If the anesthesia machine gives an alarm, carry out the following steps:

1. Check the status of animals.

2. Verify the alarming parameter or alarm types.

3. Find out the causes of the alarm.

4. Take measures to eliminate the alarm causes.

5. Check whether the alarm stops.

For specific measures for each alarm, refer to *Chapter 7 Physiological Alarms and Technical Alarms*.

# Chapter 7  Physiological Alarms and Technical Alarms

Most of the essential physiological and technical alarm messages are listed in this chapter, however, some alarm messages are not necessarily listed.

In this chapter, H indicates high level; M indicates medium level; L indicates low level.

Corresponding measures are listed for each alarm message. In case the problem still exists after action is taken, contact the maintenance personnel.

## 7.1 Physiologic Alarms

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| High Pressure | H | Airway peak pressure ≥ the set value of high alarm limit. Reduce Ppeak, or increase the high alarm limit of Ppeak. |
| Low Pressure | H | In continuous 3 respiratory circles, airway peak pressure ≤ the set value of low alarm limit. Increase Ppeak, or reduce the low alarm limit of Ppeak. |
| High MV | M | MV is higher than the high alarm limit. Reduce the preset tidal volume and respiratory frequency, or increase the high alarm limit. |
| Low MV | M | MV is lower than the low alarm limit. Increase the preset tidal volume and respiratory frequency, or reduce the low alarm limit. |
| High VTexp | H | In continuous 6 respiratory circles, VTexp > the set value of high alarm limit. Reduce the preset tidal volume or increase the high alarm limit. |
| Low VTexp | H | In continuous 3 respiratory circles, VTexp < the set value of low alarm limit. Increase the preset tidal volume or reduce the low alarm limit. |
| High FiO$_2$ | M | FiO$_2$ is higher than high alarm limit. Reduce oxygen flow or increase the high alarm limit. |
| Low FiO$_2$ | H | FiO$_2$ is lower than the low alarm limit. Increase oxygen flow or reduce the low alarm limit. |
| Apnea | M | The time when no breathe is detected exceeds the preset apnea time. Check the pipeline connection or the turbine or the position of the Bag/Vent switch. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Apnea>2min | H | No respiration takes place within 120 seconds.<br>Check the pipeline and the animal's state. Use Manual/spontaneous mode to aid the animal breathing. |
| Pressure Limited | L | Paw ≥ Plimit (in VS mode, Plimit is 5 lower than the alarm high limit of Ppeak).<br>Increase the Plimit, or reduce the tidal volume or the respiratory rate. |
| Continuous Airway Pressure High | H | Paw has been higher than the preset PEEP+15 $cmH_2O$ for 15 seconds.<br>Check whether the breathing circuit or AGSS is occluded. |
| Negative Pressure | H | Paw < -10 $cmH_2O$.<br>Check whether the animal is conducting autonomous respiration. Increase the fresh gas flow. Check whether there is high speed air flow passing through the scavenging system. If yes, check the negative pressure relief valve on the receiver. |
| High $EtCO_2$ | M | $EtCO_2$ is higher than the alarm high limit.<br>Increase the high limit of the alarm setting. |
| Low $EtCO_2$ | M | $EtCO_2$ is lower than the alarm low limit.<br>Reduce the low limit of the alarm setting. |
| High $FiCO_2$ | M | $FiCO_2$ is higher than the alarm high limit.<br>Increase the high limit of the alarm setting. |
| Low $FiCO_2$ | M | $FiCO_2$ is lower than the alarm low limit.<br>Reduce the low limit of the alarm setting. |
| High $EtN_2O$ | M | $EtN_2O$ is higher than the alarm high limit.<br>Decrease $N_2O$ flow or increase the high limit of the alarm setting. |
| Low $EtN_2O$ | M | $EtN_2O$ is lower than the alarm low limit.<br>Increase $N_2O$ flow or reduce the low limit of the alarm setting. |
| High $FiN_2O$ | M | $FiN_2O$ is higher than the alarm high limit.<br>Decrease $N_2O$ flow or increase the high limit of the alarm setting. |
| Low $FiN_2O$ | L | $FiN_2O$ is lower than the alarm low limit.<br>Increase $N_2O$ flow or reduce the low limit of the alarm setting. |
| High EtHAL | M | EtHAL is higher than the alarm high limit.<br>Decrease HAL flow or increase the high limit of the alarm setting. |
| Low EtHAL | M | EtHAL is lower than the alarm low limit.<br>Increase HAL flow or reduce the low limit of the alarm setting. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| High FiHAL | M | FiHAL is higher than the alarm high limit.<br>Decrease HAL flow or increase the high limit of the alarm setting. |
| Low FiHAL | L | FiHAL is lower than the alarm low limit.<br>Increase HAL flow or reduce the low limit of the alarm setting. |
| High EtENF | M | EtENF is higher than the alarm high limit.<br>Decrease ENF flow or increase the high limit of the alarm setting. |
| Low EtENF | M | EtENF is lower than the alarm low limit.<br>Increase ENF flow or reduce the low limit of the alarm setting. |
| High FiENF | M | FiENF is higher than the alarm high limit.<br>Decrease ENF flow or increase the high limit of the alarm setting. |
| Low FiENF | L | FiENF is lower than the alarm low limit.<br>Increase ENF flow or reduce the low limit of the alarm setting. |
| High EtISO | M | EtISO is higher than the alarm high limit.<br>Decrease ISO flow or increase the high limit of the alarm setting. |
| Low EtISO | M | EtISO is lower than the alarm low limit.<br>Increase ISO flow or reduce the low limit of the alarm setting. |
| High FiISO | M | FiISO is higher than the alarm high limit.<br>Decrease ISO flow or increase the high limit of the alarm setting. |
| Low FiISO | L | FiISO is lower than the alarm low limit.<br>Increase ISO flow or reduce the low limit of the alarm setting. |
| High EtSEV | M | EtSEV is higher than the alarm high limit.<br>Decrease SEV flow or increase the high limit of the alarm setting. |
| Low EtSEV | M | EtSEV is lower than the alarm low limit.<br>Increase SEV flow or reduce the low limit of the alarm setting. |
| High FiSEV | M | FiSEV is higher than the alarm high limit.<br>Decrease SEV flow or increase the high limit of the alarm setting. |
| Low FiSEV | L | FiSEV is lower than the alarm low limit.<br>Increase SEV flow or reduce the low limit of the alarm setting. |
| High EtDES | M | EtDES is higher than the alarm high limit.<br>Decrease DES flow or increase the high limit of the alarm setting. |
| Low EtDES | M | EtDES is lower than the alarm low limit.<br>Increase DES flow or reduce the low limit of the alarm setting. |
| High FiDES | M | FiDES is higher than the alarm high limit. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| | | Decrease DES flow or increase the high limit of the alarm setting. |
| Low FiDES | L | FiDES is lower than the alarm low limit. Increase DES flow or reduce the low limit of the alarm setting. |

## 7.2 Technical Alarm

### 7.2.1 VCM Alarm

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Please calibrate flow sensor | L | During power-on self-test, no calibration data was found in EEPROM memory. The alarm is triggered only when the machine is turned on. Use Manual/spontaneous mode to assist the animal to breathe. Calibrate the flow sensor. |
| Please calibrate pressure sensor | L | During power-on self-test, no calibration data was found in EEPROM memory. The alarm is triggered only when the machine is turned on. Use Manual/spontaneous mode to assist the animal to breathe. Calibrate the pressure sensor. |
| Please calibrate $O_2$ sensor | L | During power-on self-test, no calibration data was found in EEPROM memory. The alarm is triggered only when the machine is turned on. Calibrate or replace the $O_2$ sensors. |
| Please calibrate weighing device | L | During power-on self-test, no calibration data was found in EEPROM memory. The alarm is triggered only when the machine is turned on. Please calibrate or replace the weighing device. |
| Self-check Error | L | There is error in I2C port of EEPROM memory. The software sends a request to EEPROM via inter-integrated circuit, but there is no response from EEPROM. The alarm is triggered only when the machine is turned on. Please contact the manufacturer for service. |
| Power Error 101# | H | The power supply 5V_LIMT is not within the range of 4.25~5.75V. Please contact the manufacturer for service. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Power Error 102# | H | The power supply 3V3_P is not within the range of 2.805~3.795V.<br>Please contact the manufacturer for service. |
| Power Error 103# | H | The power supply DVCC_12V is not within the range of 10.2~13.8V. Please contact the manufacturer for service. |
| Power Error 104# | H | The power supply VB32V is not within the range of 25.6~38.4V.<br>Please contact the manufacturer for service. |
| Power Error 105# | H | The power supply VB32VP is not within the range of 25.6~38.4V.<br>Please contact the manufacturer for service. |
| Power Error 106# | H | The power supply VM is not within the range of 25.6~38.4V.<br>Please contact the manufacturer for service. |
| Power Error 107# | H | The power supply 10VA is not within the range of 8.5~11.5V.<br>Please contact the manufacturer for service. |
| Power Error 108# | H | The power supply 5VA is not within the range of 4.25~5.75V.<br>Please contact the manufacturer for service. |
| Power Error 109# | H | The power supply V5C is not within the range of 4.25~5.75V.<br>Please contact the manufacturer for service. |
| External Watchdog Error | H | During the power-on self-test, the external watchdog does not reset in about 2.52 seconds.<br>Please contact the manufacturer for service. |
| Turbine Temperature Too High | H | The alarm is triggered when the turbine temperature exceeds 90℃. It is cancel when the temperature is lower than 85℃.<br>Contact the manufacturer for service. |
| Weighing Device Error | L | There is error in the weighing device.<br>Contact the manufacturer for service. |
| $O_2$+ Flush Error | M | The $O_2$+ Flush button cannot return to its original position in 30 seconds since it is stuck or the switch is faulty.<br>Contact the manufacturer for service. |
| ACGO in Use | L | The alarm appears when ACGO function is enabled and is being used.<br>No measure should be done. |
| No $O_2$ Sensor Connected | L | The $O_2$ sensor is not connected when the $O_2$ sensor monitoring function is turned on.<br>Ensure that oxygen sensor and cables are connected properly. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Replace $O_2$ Sensor | M | The $O_2$ sensor is beyond its service life or gets faulty. Expose the $O_2$ sensor to air, and the alarm is triggered when the AD value of $O_2$ sensor is below 249.<br>Replace the oxygen sensor. |
| Flow Sensor Error | M | Communication between the monitor and the flow sensor is faulty.<br>Contact the manufacturer for service. |
| Flow Sensor Error 2# | M | Communication between the monitor and the flow sensor is faulty.<br>Contact the manufacturer for service. |
| Pressure Monitor Channel Error | M | In the power-on self-test, the airway pressure sensor is faulty or the zero point is abnormal.<br>Please check the airway pressure sensor or contact the manufacturer for service. |
| Pressure Monitor Channel Error 2# | M | 1. In the power-on self-test, the turbine pressure sensor is faulty or the zero point is abnormal.<br>2. These conditions are satisfied simultaneously: ①During the inspiratory phase of ventilation, the turbine sampling pressure is below the lower limit of the zero point. ②Turbine pressure is lower than the airway pressure. ③Turbine pressure is less than 1 cmH$_2$O.<br>Please check the turbine pressure sensor or contact the manufacturer for service. |
| Check the power fan state | M | The power fan is not connected or malfunctions, or its revolving speed is not high enough.<br>Please check the power fan or contact the manufacturer for service. |
| CPU Error | H | Power supply error; CPU resets due to interruption of watchdog feeding caused by abnormal software reset or program upgrade. An abnormal memory card may also lead to CPU reset.<br>Please contact the manufacturer for service. |
| Monitor communication with host failed | H | Without receiving the heartbeat package from the host in continuous 15 seconds, the monitor VCM sends an alarm.<br>Please contact the manufacturer for service. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Host communication with monitor failed | H | Without receiving the heartbeat package from the monitor in continuous 15 seconds, the host sends an alarm.<br>Please contact the manufacturer for service. |
| Monitor communication with backup CPU failed | H | Without receiving the heartbeat package from the backup CPU in continuous 15 seconds, the monitor VCM sends an alarm.<br>Please contact the manufacturer for service. |
| Host communication with backup CPU failed | H | Without receiving the heartbeat package from the backup CPU in continuous 15 seconds, the host sends an alarm.<br>Please contact the manufacturer for service. |
| Host communication with keyboard failed | H | Without receiving the heartbeat package from the keyboard CPU in continuous 15 seconds, the host sends an alarm.<br>Please contact the manufacturer for service. |
| Keyboard communication with host failed | H | Without receiving the heartbeat package from the host in continuous 15 seconds, the keyboard sends an alarm.<br>Please contact the manufacturer for service. |
| Monitor comm. with weighing board failed | H | Without receiving the heartbeat package from the weighing board CPU in continuous 15 seconds, the monitor VCM sends an alarm.<br>Please contact the manufacturer for service. |
| Weighing board comm. with monitor failed | H | Without receiving the heartbeat package from the monitor CPU in continuous 15 seconds, the weighing board sends an alarm.<br>Please contact the manufacturer for service. |
| Pinsp Not Achieved | L | The following two conditions are met in three consecutive periods:<br>1. In pressure control ventilation mode, Ppeak < 2* Pinsp/3;<br>2. In pressure control ventilation mode, Ppeak < Pinsp -3;<br>Check whether there is air leakage; whether the gas supply pressure is normal; and whether the turbine works normally. |
| VT Not Achieved | L | In volume control ventilation mode, the set VT - VTexp > (Set VT/10 + 10) in 15 consecutive periods.<br>Please check the condition of the animal, the air path connection, and the flow sensor. |
| Patient Circuit Leak | M | In consecutive 500ms, -1 $cmH_2O$ < inspiratory end pressure < 1 $cmH_2O$, and 1.5 * Pinsp + 3 $cmH_2O$ < turbine end pressure.<br>Please check the breathing system and the connection of the flow sensor. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
| --- | --- | --- |
| Insufficient Fresh Gas | L | Fresh gas flow is lower than 0.2 l/min during ventilation. Please check whether fresh gas compensation is turned on or check the flow sensor. |
| Please replace absorbent canister | L | The increased weight of waste gas is not lower than the set value. Please check whether the absorbent canister is overweight or check the weighing sensor. |
| Inspiration is holding | M | The alarm is triggered when the inspiratory holding function is enabled. The alarm is canceled when the inspiratory holding function is disabled. |
| Fresh Gas Flow Too High | L | Fresh gas flow is higher than 10 l/min. Please check whether fresh gas compensation is excessive or check the flow sensor. |
| Fresh gas is not turned off | L | In the standby state, fresh gas flow is higher than 0.2 l/min. Please check whether fresh gas compensation is turned off or check the flow sensor. |
| Turbine Error 100# | H | The read and write of drive configuration of the DRV8323 turbine chip are inconsistent. Please contact the manufacturer for service. |
| Turbine Error 101# | H | The Hall sensor of the turbine is faulty. Please contact the manufacturer for service. |
| Turbine Error 102# | H | The threshold value of Hall three-phase current is not within the range of (0.1V~3.3V). Please contact the manufacturer for service. |
| Turbine Error 103# | H | The fixed duty cycle is 10% and the sampling revs is less than 5000 rad/min. Please contact the manufacturer for service. |
| Turbine Error 104# | H | The internal temperature sensor exceeds the normal range of ~20-115℃. Please contact the manufacturer for service. |
| Turbine Error 107# | H | When the turbine does not turn, its voltage is not within the range of 1.485 V~1.815V; or the register is faulty. Please contact the manufacturer for service. |

### 7.2.2 VPM Alarm

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| VPM Pressure Monitor Channel Error | M | The airway pressure sensor is faulty or the zero point is abnormal.<br>Please contact the manufacturer for service. |
| VPM Pressure Monitor Channel Error 2# | M | Turbine pressure sensor is faulty or the zero point is abnormal.<br>Please contact the manufacturer for service. |
| Backup CPU communication with monitor failed | H | Without receiving the heartbeat package from the monitor in continuous 15 seconds, VPM sends an alarm.<br>Please contact the manufacturer for service. |
| Backup CPU communication with host failed | H | Without receiving the heartbeat package from the host in continuous 15 seconds, VPM sends an alarm.<br>Please contact the manufacturer for service. |
| Power Error 201# | H | Power VCM_3V3 is not within the range of 3.135~3.456V.<br>Please contact the manufacturer for service. |
| Power Error 202# | H | Power VCM is not within the range of 4.75~5.25V.<br>Please contact the manufacturer for service. |
| VPM Airway Pressure High | H | Airway pressure is 15 cmH$_2$O higher than the high limit of Paw alarm.<br>Please check the discharge pipeline or the airway pressure sensor or contact the manufacturer for service. |

### 7.2.3 Battery Alarm

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Low Battery | H | The battery voltage is below 9.5V.<br>Please connect AC supply immediately. If power is cut off, use manual/spontaneous mode to aid the animal to breathe. If the battery cannot be fully charged within 24 hours, contact the manufacturer for service. |
| System down for battery depletion | H | This alarm is triggered 15 minutes after the "Low Battery" alarm.<br>Please connect AC supply immediately. If power is cut off, use manual/spontaneous mode to aid the animal to breathe. If the battery cannot be fully charged within 24 hours, contact the manufacturer for service. |
| Battery in Use | L | Battery is in use. |

| | | Please connect AC supply timely to prevent the battery from running out. |
|---|---|---|
| No Battery | M | A battery is not connected, or the battery cable is faulty. Please connect AC supply or the battery. If the alarm continues after connection, please contact the manufacturer for service. |

## 7.2.4 AG Module Alarms

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| AG starts zeroing | L | AG module is zeroing. Please wait until zeroing is completed. |
| No Sampling Line | L | The sampling line is not connected or the connection is improper. Please check the connection of sampling line. |
| Sampling Line Occluded | L | The sampling line is occluded. Please replace the sampling line of the sidestream module. |
| Zero Calibration Required | L | The module needs manual zero calibration. Please zero the module manually. |
| Span calibration in progress... | L | $CO_2$ span calibration is in progress. The alarm disappear when the module zeroing is completed. |
| AG Communication Stops | H | The AG module fails to communicate with the main system. Contact the manufacturer for service. |
| AG Calibration Failed | L | AG module calibration failed. Please calibrate the module again. If the calibration fails, contact the manufacturer for service. |
| AG Zeroing Failed | L | AG module zeroing failed. Please contact the manufacturer for service. |
| Span Calibration Failed | L | $CO_2$ span calibration failed. Please contact the manufacturer for service. |
| AG Accuracy Error | L | The monitoring accuracy of the AG module is faulty. Please calibrate or zero the module. If the alarm does not disappear after that, please contact the manufacturer for service. |
| $O_2$ Out of Specified Accuracy Range | L | The concentration of $O_2$ exceeds the measurable range of the module. Please replace the sensor. If the problem still exists, please contact the manufacturer for service. |

| | | |
|---|---|---|
| CO$_2$ Out of Specified Accuracy Range | L | The concentration of CO$_2$ exceeds the measurable range of the module.<br>Adjust the CO$_2$ concentration to the measurable range. If the alarm does not disappear, please contact the manufacturer for service. |
| N$_2$O Out of Specified Accuracy Range | L | The concentration of N$_2$O exceeds the measurable range of the module.<br>Adjust the N$_2$O concentration to the measurable range. If the alarm does not disappear, please contact the manufacturer for service. |
| At least 1 anesthetic gas out of accuracy range | L | At least 1 anesthetic gas exceeds the measurable range of the module.<br>Adjust the concentration to the measurable range. If the alarm does not disappear, please contact the manufacturer for service. |
| AG% Unreliable | L | There is gas that the AG module cannot recognize.<br>Please check this unknown gas. |
| 2 anesthetic gases detected | M | Two anesthetic gases are detected in the animal breathing circuit.<br>Please contact the manufacturer for service. |
| EtCO$_2$ Alarm Limit Error | L | The alarm limit of EtCO$_2$ parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| FiCO$_2$ Alarm Limit Error | L | The alarm limit of FiCO$_2$ parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| EtO$_2$ Alarm Limit Error | L | The alarm limit of EtO$_2$ parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| FiO$_2$ Alarm Limit Error | L | The alarm limit of FiO$_2$ parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| EtN$_2$O Alarm Limit Error | L | The alarm limit of EtN$_2$O parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| FiN$_2$O Alarm Limit Error | L | The alarm limit of FiN$_2$O parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| EtAA Alarm Limit Error | L | The alarm limit of EtAA parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| FiAA Alarm Limit Error | L | The alarm limit of FiAA parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| awRR Alarm Limit Error | L | The alarm limit of awRR parameters is abnormal.<br>Check or reinstall the module. If the error still exists, please contact the manufacturer for service. |
| $O_2$ Sensor Error | L | The data monitored by the $O_2$ Sensor is normal.<br>Please contact the manufacturer for service. |
| AG Software Error. Please reboot the sensor | L | The software of AG module is faulty.<br>Reboot the module. If the alarm does not disappear, please contact the manufacturer for service. |
| AG Hardware Error. Please update the sensor | H | The hardware of AG module is faulty.<br>Reboot the module. If the alarm does not disappear, please contact the manufacturer for service. |
| AG Speed Out Of Bound | L | The motor speed of the module is too fast.<br>Reboot the module. It the alarm does not disappear, please contact the manufacturer for service. |
| Atmospheric Pressure Out of Range | M | Atmospheric pressure is out of range.<br>Please contact the manufacturer for service. |
| Internal Temperature Out of Range | L | The internal temperature of the module is out of the normal range.<br>Suspend the work of the module for a while and reboot it. If the alarm does not disappear, please contact the manufacturer for service. |
| AG Factory Calibration Lost | L | The factory setting default is lost.<br>Please contact the manufacturer for service. |

## 7.2.5  $CO_2$ Module

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| $CO_2$ is zeroing | L | $CO_2$ module is calibrating.<br>Please wait until zeroing is completed. |
| $CO_2$ No Sampling Line | L | The sampling line is not connected or the connection is improper.<br>Please check the connection of sampling line. |
| $CO_2$ No Adapter | L | The adapter is not connected or the connection is improper.<br>Please check the connection of adapter. |
| $CO_2$ Sampling Line Occluded | L | The sampling line is occluded.<br>Please replace the sampling line of the Sidestream module. |

| Alarm Messages | Alarm Level | Causes and Corrective Measures |
|---|---|---|
| Replace $CO_2$ Adapter | L | The adapter is faulty.<br>Please replace the adapter of Mainstream module. |
| $CO_2$ Requires Zero | L | The module requires manual zeroing.<br>Please zero the module manually. |
| CO2 span calibration in progress | L | The machine is calibrating $CO_2$ span.<br>The alarm disappear when the module zeroing is completed. |
| $CO_2$ Span Calibration Failed | L | $CO_2$ span calibration failed.<br>Please contact the manufacturer for maintenance. |
| $CO_2$ Initialize Error | H | Initialization information of the $CO_2$ module is not available.<br>Please reinstall the module. If the error still exists, contact the manufacturer for maintenance. |
| $CO_2$ Communication Stops | H | The $CO_2$ module is faulty or there is communication error.<br>Please check the module again or reinstall the module. If the error still exists, contact the manufacturer for maintenance. |
| $CO_2$ Out of Specified Accuracy Range | L | The concentration of $O_2$ exceeds the measurable range of the module<br>Adjust the $O_2$ concentration to the measurable range.<br>If the error still exists, contact the manufacturer for maintenance. |
| $CO_2$ Alarm Limit Error | L | The alarm limit of $CO_2$ parameters is abnormal.<br>Please check the module again or reinstall the module. If the error still exists, contact the manufacturer for maintenance. |
| $CO_2$ Software Error. Please reboot the sensor | L | The software of the $CO_2$ module is faulty.<br>Reboot the module. If the alarm does not disappear, please contact the manufacturer for service. |
| $CO_2$ Hardware Error. Please update the sensor | L | The hardware of the $CO_2$ module is faulty.<br>Reboot the module. If the alarm does not disappear, please contact the manufacturer for service. |
| $CO_2$ Speed Out of Bound | L | The motor speed of the module is too fast.<br>Reboot the module. If the alarm does not disappear, please contact the manufacturer for service. |
| $CO_2$ Pressure Out of Range | L | Atmospheric pressure is out of range.<br>Please contact the manufacturer for service. |
| $CO_2$ Temp. Out of Range | L | The internal temperature of the module is out of the normal range.<br>Suspend the work of the module for a while and reboot it. If the alarm does not disappear, please contact the manufacturer for service. |
| $CO_2$ Factory Calibration Lost | L | The factory setting default is lost.<br>Please contact the manufacturer for service. |

# 7.3 Prompt Information

## 7.3.1 The Prompt Message Displayed in the Alarm Bar

| Prompt Message | Remark |
|---|---|
| AG Module Alarm Off | This prompt message will appear when the AG module alarm is switched off. |
| $CO_2$ Module Alarm Off | This prompt message will appear when the $CO_2$ module alarm is switched off. |
| $CO_2$ Alarm Off | This prompt message will appear when the AG module is used and the $CO_2$ module is switched off. |
| AG Module on Standby | This prompt message will appear when the AG module is in standby state. |
| $CO_2$ Module on Standby | This prompt message will appear when the $CO_2$ module is in standby state. |
| Alarms of VTexp, MV, Apnea, etc are off | This prompt message will appear when the Bag/Vent switch is set to manual and the alarm is set to OFF. |
| Apnea Ventilation | Patient's respiration is not detected over the set Apnea time, and then ventilation for Apnea is enabled. Check the animal's respiration or increase the set Apnea time. |

## 7.3.2 The Prompt Message Displayed in the Information Bar

| Prompt Messages | Remark |
|---|---|
| Machine Ventilation Stops | This prompt message will appear when the ACGO switch is turned on and an external gas outlet is used. |
| $O_2$+ Flush | This prompt message will appear when you press the $O_2$ flush button. |
| Manual Ventilation | This prompt message will appear when the Bag/Vent switch is set to manual. |

# Chapter 8  Maintenance

## 8.1 Maintenance Schedule

> ⚠ **NOTE**
>
> - **This schedule illustrates the minimum number of maintenance for a typical device with 2000 hours of service per year. If the service time is longer than 2000 hours each year, the device shall be maintained more frequently.**
>
> - **During cleaning and installation, please check whether the parts and sealing rings are damaged, and replace or repair them if necessary.**

| Minimum maintenance times | Maintenance |
| --- | --- |
| Every day | Clean external surfaces.<br>21% $O_2$ calibration ($O_2$ sensor on the breathing system).<br>In the manual/spontaneous mode, check the APL accuracy. |
| Every month | 100% $O_2$ calibration ($O_2$ sensor on the breathing system).<br>Check the AGSS filter. |
| During cleaning and installation | Check whether the parts and sealing rings are damaged, and replace or repair them if necessary. |
| Every year | Replace the fitting seat of the vaporizer and the sealing rings on the breathing system port. For details, please contact EICKEMEYER®'s after-sale service department.<br>$CO_2$ module calibration. |
| Every three year | Replace the inner battery.<br>For details, please contact EICKEMEYER®'s after-sale service department. |
| As needed | If the color of $CO_2$ absorbent changes, please replace the $CO_2$ absorbent in the canister.<br>If the measurement deviation of the $O_2$ sensor is too large and cannot be corrected after repeated calibration, replace the $O_2$ sensor.<br>If the sealing ring of the flow sensor is damaged, the diaphragm is cracked or deformed, or the sensor itself is deformed or cracked, replace the flow sensor. |

| Minimum maintenance times | Maintenance |
|---|---|
|  | The turbine filter cotton fails. Replace the filter cotton. If the hose of the transmission system and its silicone hose are damaged, replace them. |

⚠ **WARNING**

- **The internal battery can only be replaced by specified maintenance personnel. Users must not replace the battery on their own.**
- **If the battery is replaced by untrained personnel, fire or explosion could be caused.**

## 8.2 Cleaning and Disinfection

⚠ **NOTE**

**Please comply with applicable safety precautions.**

- **For the breathing system and its reusable accessories, re-use without disinfection can lead to cross-infection. Disinfection before each operation is recommended.**
- **Please clean and disinfect the device as required before the first use. Refer to this chapter for cleaning and disinfection methods.**
- **In order to prevent leakage of the breathing system, please avoid damage to all parts when disassembling and reinstalling, and ensure correct installation, especially the sealing ring installation; when cleaning and disinfecting, please ensure that the cleaning and disinfection methods are correct and applicable to each component.**
- **Do not use abrasive detergents (such as steel velvet and silver polishes or detergents). The cleaning solution must have a PH between 7.0 and 10.5.**
- **All liquids shall be kept away from electronic components.**
- **Prevent liquid from permeating into the device housing.**

Some parts of the device can be cleaned and disinfected. The requirements for cleaning and disinfection methods vary for different components. According to the actual situation, choose appropriate methods to clean and disinfect each part timely and correctly to prevent cross infection between users and animals.

The following table is the recommended cleaning and disinfection methods, including the methods for the first use and repeated use.

| Components | Recommended Time Interval | Cleaning | | Disinfection | | | |
|---|---|---|---|---|---|---|---|
| | | ① Wipe | ② Soak | A Wipe | B Soak | C Autoclave | D UV |
| **Outer surface** | | | | | | | |
| Outer surface (including housing, power cord, air source hose, plug-in module) | Per animal/per day | ① | | A or D | | | |
| Touchscreen | Per animal/per day | ① | | A or D | | | |
| Dust screen on the air inlet | Every four weeks/as needed | ② | | A | | | |
| **Others** | | | | | | | |
| Breathing circuit system | Each animal | A or D | | | | | |
| Breathing pipeline | Each animal | Please refer to the cleaning and disinfection methods provided in the accessory manual. | | | | | |

Cleaning Method (Wipe and Bath Immersion):

① Wipe: wipe with a wet cloth soaked in weak alkaline detergent (soapy water, etc.) or alcohol solution, and dry with a dry lint-free cloth.

② Soak: rinse with water first, then soak with weak alkaline detergent (soapy water, etc.) solution (recommended water temperature is 40℃) for about 3 minutes, and finally clean with water and dry by airing.

Disinfection Method (Autoclave):

A. Wipe: wipe with a wet cloth soaked in intermediate or high-level disinfectant (alcohol or isopropyl alcohol, etc.) solution, and dry with a dry lint-free cloth.

B. Soak: soak in intermediate or high-level disinfectant (alcohol or isopropyl alcohol) solution (recommended soaking time is more than 30 minutes), then clean with water and dry by airing thoroughly.

C. Autoclave: high temperature and high-pressure steam disinfection (134℃); the recommended disinfection time is 4 minutes.

D. UV: UV radiation disinfection; the recommended disinfection time is 30~60 minutes.

As needed *: If the device is used in a dusty environment, please shorten the time interval between cleaning and disinfection to ensure that the appearance is not blocked by dust. The inspiratory safety valve assembly needs to be cleaned and disinfected only if the animal's exhaled air may contaminate the inspiratory branch.

The following table lists the detergents, disinfectants and efficient disinfection methods that can be used for the device.

| Name | Category |
|------|----------|
| Soapy water (PH 7.0~10.5) | Detergent |
| Clear water | Detergent |
| Alcohol (75%) | Intermediate-level disinfectant |
| Isopropyl alcohol (70%) | Intermediate-level disinfectant |
| Glutaraldehyde (2%) | High-level disinfectant |
| O-phthalaldehyde disinfectant (e.g. Cidex®OPA) | High-level disinfectant |

The following table lists the detergents, disinfectants and methods that are **prohibited** on the device.

| Name/Ingredient | Category |
|-----------------|----------|
| Contains acetone | Detergent |
| Contains trichloroethylene | |
| Contains cresol soap (lysol water) | |
| Contains phenolic compound | |
| Alkaline | |
| Acid | |
| Contains chlorine dioxide | Disinfectant |
| Contains trichloroisocyanuric acid | |
| Contains peroxyacetic acid | |
| Contains benzalkonium bromide or benzalkonium chloride | Disinfectant |
| Contains chlorhexidine gluconate or chlorhexidine acetate | |
| Contains quaternary ammonium salt | |
| Contains potassium bisulfate | |
| Contains potassium permanganate | |
| Iodophor or iodine tincture | |
| Ozone disinfection | Disinfection method |
| Autoclaving | |
| High temperature disinfection | |

⚠ **WARNING**

- **Use only the accessories specified in this chapter. Using other accessories may result in incorrect measured values or device failure.**

- **Disposable accessories can only be used once. Repeated use may lead to performance degradation or cross-infection.**

- **Do not use the accessory if you find it or its packaging damaged.**

- **Waste accessories shall be disposed of in accordance with local regulations or the hospital's waste disposal policy. Do not discard them at will.**

- **When device and its accessories reach the end of their service life, they must be disposed of in accordance with the guidelines governing the handling of such products and local regulations for contaminants and biohazardous goods.**

**List of anesthesia breathing circuit and accessories**

| Name | Remarks | Material Code | Model | Recommended Replacement | Manufacturer |
|---|---|---|---|---|---|
| Anesthesia circuit | Animal Bain anesthesia pipeline, | 040-00001156 | AB0422 | Disposable | GaleMed (Xiamen) Co., |
| Animal mask | VM-2 Animal Mask #0, 15M (external diameter) | 040-00001222 | AM0008 | Disposable | GaleMed (Xiamen) Co., Ltd. |
| | VM-2 Animal Mask #1, 15M (external diameter) | 040-00001223 | AM0009 | Disposable | |
| | VM-2 Animal Mask #2, 22F (inner hole) | 040-00001224 | AM0010 | Disposable | |
| | VM-2 Animal Mask #3, 22F (inner hole) | 040-00001225 | AM0011 | Disposable | |
| | VM-2 Animal Mask #4, 22M (inner hole) | 040-00001226 | AM0012 | Disposable | |
| | VM-2 Animal Mask #5, 22M (inner hole) | 040-00001227 | AM0013 | Disposable | |
| | Animal mask PC straight connector, 22/15mm, 22M | 040-00000950 | AC0163 | Disposable | |
| Absorbent canister | Active carbon | / | 800-1000kg | | EICKEMEYER® Ltd. |
| Monitor adapter | / | / | Material package | | EICKEMEYER® Ltd. |
| Oxygen concentrator | ZY-3AW | / | 0-5L, 93±3% | | Haier |

# Appendix II  Specifications

1.  Product Features

| Type of protection against electric shock | Class I device, with internal power supply |
|---|---|
| Level of protection against electric shock | Type BF applied part; sampling line/adapter and breathing circuit are Type BF. |
| Degree of protection by enclosure | IPX1 |
| Disinfection and sterilization method recommended by the manufacturer | Disinfect and sterilize the device according to the methods recommended by the manufacturer |
| Safety degree under coexistence of flammable anesthetic gas and air or oxygen or nitrous oxide | Not applicable in the place with flammable anesthetic gas |
| Operation mode | Continuous-operation Device |
| Whether there is defibrillation-proof applied part | All applied part shall be defibrillation-proof |
| Whether there is signal input/output part | Yes |
| Permanent connected equipment or non-permanent connected equipment | Non-permanent connected equipment |

2.  Physical Specifications

| **Whole Machine Dimensions** | |
|---|---|
| Size | 635 mm (length) × 670 mm (width) × 1400 mm (height) |
| **Top Plate** | |
| Maximum bearing weight | Maximum bearing weight of top plate is 20 kg. |
| Size | 535 mm × 235 mm |
| **Caster** | |
| Caster | 4 inches |
| **Display Screen** | |
| Type | Color TFT Liquid Crystal Display, allowing touch control |

| Size | 8 inches |
|---|---|
| Resolution | 800 × 600 |
| Brightness | Adjustable brightness level: 1-8 levels |

| **LED Indicator Light** | |
|---|---|
| AC indicator light | Green LED<br><br>When the machine is connected to AC power supply, the light is on. Without AC power supply, the light is off. |
| Battery indicator light | Green LED<br><br>When the machine is connected to AC power supply, the battery indicator light keeps on.<br><br>When the machine is powered by battery, the battery indicator light flashes in the frequency of 1 Hz. |
| Alarm indicator light | 1 indicator light (yellow, red. It only flashes in red when high-level and medium-level alarms occur simultaneously). |

| **Audible Indication** | |
|---|---|
| Speaker | 1 speaker. It gives out alarm tone and key tone.<br><br>Supports multiple-level volume and the sound pressure range of function alarm is within 45db-85db.<br><br>The alarm tone conforms to IEC 60601-1-8. |
| Buzzer | 1 buzzer. It may give out alarm tone in case the system cannot work normally. |

| **External AC Power Supply** | |
|---|---|
| Input voltage | 100~240 Vac |
| Input frequency | 50/60 Hz |
| Input current | 7.0A~3.5 A |
| Fuse | T10AL 250 V |
| Power cord | 5 m |

| **Internal Battery** | |
|---|---|
| Number of battery | 1 battery |

| Battery type | Li-ion battery |
|---|---|
| Rated battery voltage | 11.1 VDC |
| Battery capacity | 4400 mAh |
| Minimum power-on time | At least 120 min in the standard configuration |
| **Interface** | |
| Power supply | 1 AC power supply interface |
| Communication interface | 1 RJ45 interface for network connection. TCP/IP communication protocol.<br><br>1 USB2.0 port for software upgrade. Standard USB2.0 communication protocol.<br><br>1 DB9 serial port for calibration of transmit data. Serial port communication protocol. |

3.    Environmental Specifications

| **Main Unit** | | | |
|---|---|---|---|
| Item | Temperature (℃) | Humidity (non-condensing) | Atmospheric Pressure (kPa) |
| Operating environment | 10-40 | ≤93 % | 70.0-106.0 |
| Storage and transportation environment | -20-60 ($O_2$ sensor:<br><br>-20 ~50 ℃) | ≤93 % | 50.0-106.0 |

4.    Gas Circuit Specifications

| **Gas Supply** | |
|---|---|
| Pipeline gas supply | Pure oxygen, oxygen+air |
| Pipeline gas connection | NIST/DISS |
| Pipeline inlet pressure | 280-600 kPa |
| Inlet pressure of low pressure oxygen | Oxygen concentrator: not more than 50 kPa, not more than 10 l/min |
| **Flowmeter ($O_2$ or $O_2$+air)** | |

| Display range | Type: | Float flowmeter |
| --- | --- | --- |
| | Range: | 0-4 l/min; when the float is in the range of 1-4 l/min, the accuracy of scale should be within ±10 % of the measured value. When in other ranges, accuracy is not defined. |

| $O_2$+ Flush | | |
| --- | --- | --- |
| $O_2$+ Flush | When the $O_2$+ flush button is pressed, the machine provides flow (between 10 and 30 l/min). | |

| ACGO (Common Gas Outlet) | |
| --- | --- |
| Connector | Tapered coaxial connector with 22 mm outer and 15 mm inner diameter |
| Back pressure behind the anesthetic vaporizer and in front of ACGO during oxygen flush | Not more than 8 kPa |

| Leak and Compliance | |
| --- | --- |
| Leak of the breathing system and its circulatory absorption components | At 3 kPa pressure, the leak is not greater than 99 ml/min |
| Compliance of breathing system and its circulatory absorption components | ≤4 ml/cmH$_2$O |
| Leak of CO$_2$ canister | At 3 kPa pressure, the leak is not more than 50 ml/min. |
| Leak of APL valve | At 3 kPa pressure, the leak is not more than 50 ml/min (APL valve scale is 75). |

| CO$_2$ Absorption Device | |
| --- | --- |
| Volume of CO$_2$ absorption device | About 2000 ml |
| Interface and Connector | |

| Expiratory end | Tapered coaxial connector with 22 mm outer and 15 mm inner diameter |
|---|---|
| Inspiratory end | Tapered coaxial connector with 22 mm outer and 15 mm inner diameter |
| Bag end | Tapered coaxial connector with 22 mm outer and 15 mm inner diameter |
| Exhaust end | Tapered connector with 30 mm outer diameter |

| **Pipeline Pressure Gauge** | |
|---|---|
| Range | -20 ~100 cmH$_2$O |
| Accuracy | ± (4% of full-scale reading + 4% of actual reading) |

| **APL Valve** | |
|---|---|
| Range | 1~75 cmH$_2$O |
| Touch instructions | Above 30 cmH$_2$O |
| Minimum opening pressure | 0.3 cmH$_2$O (dry) |
| Accuracy | ± 10 cmH$_2$O or ± 15% of the measured value, whichever is larger. |

| Rapid discharge function are optional |
|---|
| Expiration impedance of the breathing system and its circulatory absorption assembly (CO$_2$ absorbent canister filled with Medisorb$^{TM}$ absorbent) |
| Impedance under the manual mode and mechanical mode: ≤ 6 cmH$_2$O (the testing flow is two-way sine wave with 20 bpm frequency and 1l of tidal volume) |
| Inspiration impedance of the breathing system and its circulatory absorption assembly (CO$_2$ absorbent canister filled with Medisorb$^{TM}$ absorbent) |
| Impedance under the manual mode and mechanical mode: ≤ 6 cmH$_2$O (the testing flow is two-way sine wave with 20 bpm frequency and 1l of tidal volume) |

5. Ventilator Specification

| **Parameter Setting Range of Ventilator** | | | |
|---|---|---|---|
| **Parameter** | **Setting Range** | **Step** | **Working Mode** |
| Inspiratory pressure (Pinsp) | 5 ~ 50 cmH$_2$O | 1 cmH$_2$O | PCV, SIMV-PC, PSVPro |

| | | | |
|---|---|---|---|
| Pressure Limit (Plimit) | 10 ~ 55 cmH$_2$O | 1 cmH$_2$O | VCV, PCV, SIMV-PC, PRVC, SIMV-PRVC, CPAP/PSV, PSVPro |
| Support Pressure (△Pps) | OFF, 3 ~ 50 cmH$_2$O | 1 cmH$_2$O | SIMV-PC, SIMV-PRVC, CPAP/PSV, PSVPro |
| Positive end-expiratory pressure (PEEP) | OFF, 3 ~ 30 cmH$_2$O | 1 cmH$_2$O | VS, VCV, PCV, SIMV-PC, PRVC, PRVC, SIMV-PRVC, CPAP/PSV, PSVPro |
| Apnea Pressure | 3 ~ 50 cmH$_2$O | 1 cmH$_2$O | CPAP/PSV |
| Tidal volume (VT) | 5 ~ 1500 ml | 5 ~ 100 ml: 5 ml<br>100 ~ 300 ml: 10 ml<br>300 ~ 1500 ml: 25 ml | VS, VCV, PRVC, SIMV-PRVC |
| Respiratory Rate (Rate) | 4 ~ 100 bpm | 1 bpm | VCV, PCV, PRVC |
| Inspiratory-expiratory time ratio (I:E) | 4:1 ~ 1:10 | 0.5 | VCV, PCV, PRVC |
| Apnea. IE | 4:1 ~ 1:8 | 0.5 | CPAP/PSV |
| Inspiratory time (Tinsp) | 0.2 ~ 10.0 s | 0.1 s | SIMV-PC, SIMV-PRVC, PSVPro |
| Trig Window | 5% ~ 90% | 1% | SIMV-PC, SIMV-PRVC, PSVPro |
| SIMV Rate | 4 ~ 60 bpm | 1 bpm | SIMV-PC, SIMV-PRVC, PSVPro |
| Inspiratory Trigger | Trigger pressure: -20 cmH$_2$O ~ -1cmH$_2$O<br>Trigger flow: 0.2 ~ 15 l/min | Trigger pressure: -0.5 cmH$_2$O<br>Trigger flow: 0.1 l/min | VS, SIMV-PC, SIMV-PRVC, CPAP/PSV, PSVPro |
| Tslope | 0 ~ 2.0s | 0.1s | PCV, SIMV-PC, PRVC , SIMV-PRVC, CPAP/PSV, PSVPro |
| Inspiratory Stop | 5 ~ 80% | 1% | SIMV-PC, SIMV-PRVC, |

| Level | | | CPAP/PSV, PSVPro |
|---|---|---|---|
| Min Rate | 2 ~ 60 bpm | 1 bpm | VS, CPAP/PSV |
| Tapnea | 10 ~ 30s | 1s | PSVPro |
| Exist Backup | OFF, 1-5 | 1 | PSVPro |
| **Weighing device specification** | | | |
| Weighing | | 0-2000g, ±10g; the maximum weighing capacity is 2000g. | |

6. Accuracy of Ventilator

| Ventilator Control Parameters | Requirement for Setting Range and Accuracy |
|---|---|
| Pinsp | Setting range: 5 cmH$_2$O ~ 50 cmH$_2$O. Error range: ±3.0 cmH$_2$O or ±8% of the setting value, whichever is larger. |
| Plimit | Setting range: 10 cmH$_2$O ~ 55 cmH$_2$O. Error range: ±3.0 cmH$_2$O or ±10% of the setting value, whichever is larger. |
| △Pps | Setting range: OFF, 3 cmH$_2$O ~ 50 cmH$_2$O. When in the state of OFF, the error range is not defined. In the range of 3cmH$_2$O ~ 50cmH$_2$O, the error range is ±3.0 cmH$_2$O or ±8% of the setting value, whichever is larger. |
| PEEP | Setting range: OFF, 3 cmH$_2$O ~ 30 cmH$_2$O. In the range of 3 cmH$_2$O ~ 30 cmH$_2$O, the error range is ±2.0 cmH$_2$O, or ±10% of the setting value, whichever is larger. When in the state of OFF or in other ranges, the error range is not defined. |
| Apnea pressure | Setting range: 3 cmH$_2$O ~ 50 cmH$_2$O. Error range: ±3.0 cmH$_2$O or ±8% of the setting value, whichever is larger. |
| VT | a) Setting range: 5 ml ~ 1500 ml (VS, VCV, PRVC, SIMV-PRVC)<br><br>b) Error range:<br><br>1) In the range of 5 ml ~ 75 ml (75 ml is exclusive): ±15 ml.<br><br>2) In the range of 75 ml ~ 1500 ml: ±20 ml or ±10% of the setting value, whichever is larger. |
| Rate | Setting range: 4 bpm ~ 100 bpm; error range: ±1 bpm or ±5% of the setting value, whichever is larger. |
| I:E | Setting range: 4:1 ~ 1:10. |

|  | 1) In the range of 2:1 ~ 1:4: the error range is ±10% of the readings. |
|---|---|
|  | 2) In other ranges: the error range is ±25% of the readings. |
| Apnea.IE | Setting range: 4:1 ~ 1:8.<br><br>1) In the range of 2:1 ~ 1:4: the error range is ±10% of the readings.<br><br>2) In other ranges: the error range is ±25% of the readings. |
| Tinsp | Setting range: 0.2s ~ 10.0s; error range: ±0.2s. |
| Trig Window | 5% ~ 90% |
| SIMV Rate | 4 ~ 60 bpm; error range: ±1 bpm or ±5% of the setting value, whichever is larger. |
| Trigger | Setting range for pressure trigger: -20 cmH$_2$O ~ -1 cmH$_2$O.<br><br>Setting range for flow trigger: 0.2 ~ 15 l/min. |
| Tslope | 0 ~ 2.0s |
| Inspiratory Stop Level (exp%) | 5 ~ 80% |
| Min Rate | 2 ~ 60 bpm: error range: ±1 bpm or ±5% of the setting value, whichever is larger. |
| Tapnea | 10 ~ 30s |
| Exist Backup | OFF, 1-5 |
| Maximum Inspiratory Flow | Not lower than 80 l/min. |

| Ventilator Monitor Parameters | Parameter Range and Accuracy Requirement |
|---|---|
| VTexp | Monitor range: 0 ml ~ 1500 ml; error range: in the range of <75ml: ±15 ml; in the range of 75 ml ~ 1500 ml: ±20 ml or ±10% of the readings, whichever is greater; in other ranges: not defined. |
| VTinsp | Monitor range: 0 ml ~ 1500 ml; error range: in the range of <75ml: ±15 ml; in the range of 75 ml ~ 1500 ml: ±20 ml or ±10% of the readings, whichever is greater; in other ranges: not defined. |
| MV | Monitor range: 0 l/min ~ 100 l/min; Error range: 0 l/min ~ 30 l/min: ±1 l/min or ±15% of the readings, whichever is greater; >30 l/min: not defined. |
| Rate | Monitor range: 0 bpm ~ 100 bpm; error range: ±1 bpm or ±5% of setting value, whichever is greater; in other ranges: not defined. |
| I:E | Monitor range: 4:1 ~ 1:10. Error range: in the range of 2:1 ~ 1:4 (2:1 and 1:4 are exclusive): ±10% of the readings; in the range of 4:1 ~ 2:1 and the range 1:4 ~ 1:10, ±25% of the readings; in other ranges: not defined. |
| Paw | Monitor range: -20cmH$_2$O ~ 120cmH$_2$O. Error range: ±3.0 cmH$_2$O or ±8% of setting value, whichever is greater; in other ranges: not defined. |
| PEEP | Monitor range: 0cmH$_2$O ~ 70cmH$_2$O. Error range: ±3.0 cmH$_2$O or ±10% of setting value, whichever is greater; in other ranges: not defined. |
| Pplat | 0 cmH$_2$O ~ 120 cmH$_2$O |
| Pmean | -20 cmH$_2$O ~ 120 cmH$_2$O |
| Compliance | 0 ml/cmH$_2$O ~ 100 ml/cmH$_2$O |
| Resistance | 0 cmH$_2$O/(l/s) ~ 500 cmH$_2$O/(l/s) |

7. Module Specification

| Gas Module Monitor Parameters | | | Parameter Range |
|---|---|---|---|
| $O_2$ concentration monitor | $O_2$ sensor | | Monitoring range: 18%~100%; error range: ±5% (V/V); the other ranges are not defined. |
| EtCO$_2$ concentration monitoring | Masimo $CO_2$ Mainstream and Sidestream | | $CO_2$ measured range: 0~150 mmHg, 0~19.7% (at 760 mmHg). $CO_2$ accuracy (all condition): ± {0.3% (V/V)+4% of the readings}. |
| | EICKEMEYER® $CO_2$ Mainstream and Sidestream | | $CO_2$ measured range: 0~99 mmHg, 0.0 %~13.0%, 0~13.2 kPa (at 760 mmHg). $CO_2$ accuracy: in the range of 0~40 mmHg: ±2 mmHg; in the range of 41 mmHg ~ 70 mmHg: ±5% of the readings; in the range of 71 mmHg ~ 99 mmHg: ±8% of the readings. |
| AG concentration monitoring | Masimo AG | SEV | The measured range of sevoflurane (SEV) shall be 0% ~ 25%. In the range of 0% ~ 10%, the accuracy should be ±{0.15% (V/V) + 5% of the readings}; in the range of 10% ~ 25%, the accuracy is not defined. |
| | | ISO | The measured range of isoflurane (ISO) shall be 0% ~ 25%. In the range of 0% ~ 8%, the accuracy should be ±{0.15% (V/V) +5% of the readings}; in the range of 8% ~ 25%, the accuracy is not defined. |
| | | $N_2O$ | The measured range shall be 0% ~ 100%. The accuracy should be ±{2% (V/V) +2% of the readings}. |
| | | $CO_2$ | The measured range shall be 0% ~ 25% (0 ~ 190mmHg). In the range of 0% ~ 15%, the accuracy should be ± ({0.2% (V/V) + 2% of the readings}; in the range of 15% ~ 25%, the accuracy is not defined. |

8. Anesthesia Waste Gas Treatment System

The user can choose disposable waste gas absorbent or AGSS for waste gas treatment. There are two types of anesthesia waste gas treatment system: 1H high flow treatment system and 1L low flow treatment system.

| Physical Parameters | |
| --- | --- |
| Weight | 2.2 Kg |
| Dimensions | 535×120×155mm (Height × Width × Thickness) |
| Applicable laws and regulations | ISO 80601-2-13 |
| Pressure relief device | Pressure compensation port facing atmosphere |
| Filter | Stainless steel mesh, aperture 60-100 μm |
| Treatment system status indications | AGSS-H: When the treatment system is not working or the suction flow is less than 50 l/min, the float drops below the "MIN" scale mark on the sight glass. AGSS-L: When the treatment system is not working or the suction flow is less than 25 l/min, the float drops below the "MIN" scale mark on the sight glass. |
| Treatment system connector | Standard connectors as specified in ISO9170-2 or |

| Performance Parameters | | |
| --- | --- | --- |
| Parameter / Model | AGSS-H | AGSS-L |
| Applicable treatment system types | 1H high flow treatment system: suction flow not less than 75 l/min | 1L low flow treatment system: suction flow of 25~50 l/min |
| Adjustable rated suction flow range | 50-80 l/min | 25-50 l/min |
| Sight glass scale display | MIN scale mark, MAX scale mark | |
| Operating method | Continuous suction flow, floater between MIN and MAX scale marks. | |
| Working mode | Connect the treatment system for continuous transmission and absorption. | |

| | | |
|---|---|---|
| Under normal condition | 30 l/min inlet flow impedance | Not more than 0.5 cmH$_2$O |
| | 75 l/min inlet flow impedance | Not more than 3.5 cmH$_2$O |
| | Induced flow | Not more than 50 ml/min |
| | Rated maximum extract flow pressure drop impedance | AGSS outlet not less than 10 cmH$_2$O |
| | Rated minimum extract flow pressure drop impedance | AGSS outlet not more than 20 cmH$_2$O |
| | Spillage | Not more than 100 ml/min |
| | Leak | Lower than 90 ml/min at 10±0.5 l/min of inlet |
| Single fault condition | 75 l/min inlet flow impedance | Not more than 10 cmH$_2$O |
| | Induced flow | Not more than 100 ml/min |
| | Rated maximum extract flow pressure drop impedance | AGSS inlet pressure drop impedance does not exceed 0.5 cmH$_2$O. |
| | Spillage | May exceed 100 ml/min |

9. Anesthesia Vaporizer

For the parameters, please refer to the user manual of the vaporizer.

⚠ **WARNING**

- This device shall not be used adjacent to or stacked with other equipment. If the device has to be used adjacent to or stacked with other equipment, closely observe whether the device is functioning properly under the current configuration.

- Using accessories or cables that are not from the manufacturer may increase or decrease the electromagnetic compatibility of the device.

- If NarkoVet PRO anesthesia machine is operated below or with minimum value specified in this manual, inaccuracy may be resulted.


⚠ **NOTE**

- The NarkoVet PRO anesthesia machine meets the EMC requirements of IEC60601-1-2 and ISO 21647.

- The user should install and use the device according to the EMC documents packaged with the device.

- Portable and mobile RF equipment may affect the device performance. Avoid strong EMC interference, such as being close to a mobile phone or a microwave, when you are using the device.

- Refer to the information guide and the manufacturer's statement below.

| Guidance and manufacturer's declaration –electromagnetic emissions | | |
|---|---|---|
| The anesthesia machine is intended for use in the electromagnetic environment specified below. The customer or the user should ensure that it is used in such an environment. | | |
| **Emissions test** | **Compliance** | **Electromagnetic environment - guidance** |
| RF emissions CISPR 11 | Group 1 | The anesthesia machine uses RF energy only for their internal function. Therefore, their RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. |
| RF emissions CISPR 11 | Class B | The anesthesia machine is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes. |
| Harmonic emissions IEC 61000-3-2 | Class A | |
| Voltage fluctuations/flicker emissions IEC 61000-3-3 | Complies | |

| Guidance and manufacturer's declaration – electromagnetic immunity | | | |
|---|---|---|---|
| The anesthesia machine is intended for use in the electromagnetic environment specified below. The customer or the user of the anesthesia machine should ensure that it is used in such an environment. | | | |
| **Immunity test** | **IEC 60601 test level** | **Compliance level** | **Electromagnetic environment –guidance** |
| Electrostatic discharge (ESD) IEC 61000-4-2 | ±8 kV contact ±15 kV air | ±8 kV contact ±15 kV air | Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %. |
| Electrical fast transient/burst IEC 61000-4-4 | ±2 kV power lines ±1 kV input/output lines | ±2 kV power lines | Mains power quality should be that of a typical commercial or hospital environment. |
| Surge IEC 61000-4-5 | ±1 kV differential mode voltage ±2 kV common mode voltage | ±1 kV differential mode voltage ±2 kV common mode voltage | Mains power quality should be that of a typical commercial or hospital environment. |
| Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11 | <5% $U_T$, lasting for 0.5 cycle ($U_T$, > 95% dips) 40% $U_T$, lasting for 5 cycles ($U_T$, 60% dips) 70% $U_T$, lasting for 25 cycles ($U_T$, 30% dips) <5% $U_T$, lasting for 5s ($U_T$, > 95% dips) | < 5% $U_T$, lasting for 0.5 cycle ($U_T$, > 95% dips) 40% $U_T$, lasting for 5 cycles ($U_T$, 60% dips) 70% $U_T$, lasting for 25 cycles ($U_T$, 30% dips) < 5% $U_T$, lasting for 5 s ($U_T$, > 95% dips) | Mains power quality should be that of a typical commercial or hospital environment. If the user of the anesthesia machine requires continued operation during power mains interruptions, it is recommended that the anesthesia machine be powered from an uninterruptible power supply or a battery. |
| Power frequency magnetic field IEC 61000-4-8 | 3 A/m | 3 A/m | Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment. |
| **NOTE** $U_T$ is the a.c. mains voltage prior to application of the test level. | | | |

| Guidance and Manufacturer's Declaration – Electromagnetic Immunity | | | |
|---|---|---|---|
| The anesthesia machine is intended for use in the electromagnetic environment specified below. The customer or the user of the anesthesia machine should ensure that it is used in such an environment. | | | |
| **Immunity test** | **IEC 60601 test level** | **Compliance level** | **Electromagnetic environment – guidance** |
| Conducted RF IEC 61000-4-6 <br><br> Radiated RF IEC 61000-4-3 | 3 Vrms outside the ISM bands between 150kHz to 80MHz <br><br> 10 Vrms in ISM bands between 150kHz to 80MHz <br><br> 10 V/m 80 MHz to 2.5 GHz | 3 Vrms <br><br><br><br> 10 Vrms <br><br><br><br> 10 V/m | Portable and mobile RF communications equipment should be used no closer to any part of the anesthesia machine, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. <br><br> Recommended separation distance: <br><br> $d = 1.2\sqrt{P}$ <br><br> $d = 1.2\sqrt{P}$ <br><br> $d = 1.2\sqrt{P}$  80 MHz to 800 MHz <br><br> $d = 2.3\sqrt{P}$  800 MHz to 2.5 GHz <br><br> where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and $d$ is the recommended separation distance in meters (m). <br><br> Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, a should be less than the compliance level in each frequency range. <br><br> Interference may occur in the vicinity of equipment marked with the following symbol: <br><br>  |

NOTE 1 At 80MHz and 800MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

A     The ISM frequency band between 150 kHz and 80 MHz refers to 6.765 MHz ~ 6.795 MHz, 13.553 MHz ~ 13.567 MHz, 26.957 MHz ~ 27.283 MHz and 40.66 MHz ~ 40.70 MHz.

B     The additional factor of 10/3 is used to calculate the recommended isolation distance for transmitters in the ISM band of 150 kHz to 80 MHz and in the frequency range of 80 MHz to 2.5 GHz to reduce the possibility of interference if portable/mobile communication devices are accidentally brought into the animal area.

C     Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and VT broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the anesthesia machine is used exceeds the applicable RF compliance level above, the anesthesia machine should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the anesthesia machine.

D     Over the frequency range 150 kHz ~ 80 MHz, field strengths should be less than 3 V/m.

| Recommended Separation Distances between Portable and Mobile RF Communication Equipment and Anesthesia Machine | | | | |
|---|---|---|---|---|
| The anesthesia machine is intended to work in an electromagnetic environment with controlled RF radiation disturbance. The user can prevent electromagnetic interference by maintaining the following recommended separation distance between the portable and mobile RF communication equipment (transmitters) and the anesthesia machine, subject to the maximum rated output power of such communication equipment. | | | | |
| Rated maximum output power of transmitter (W) | Recommended separation distances between transmitter and the device/m | | | |
| | 150 KHz to 80 MHz outside the ISM band $d = 1.2\sqrt{P}$ | 150 KHz to 80 MHz in the ISM band $d = 1.2\sqrt{P}$ | 80 MHz ~ 800 MHz $d = 1.2\sqrt{P}$ | 800 MHz ~ 2,5 GHz $d = 2.3\sqrt{P}$ |
| 0,01 | 0.12 | 0.12 | 0.12 | 0.23 |
| 0,1 | 0.38 | 0.38 | 0.38 | 0.73 |
| 1 | 1.2 | 1.2 | 1.2 | 2.3 |
| 10 | 3.8 | 3.8 | 3.8 | 7.3 |
| 100 | 12 | 12 | 12 | 23 |

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: The ISM frequency band between 150 kHz and 80 MHz refers to 6.765 MHz ~ 6.795 MHz, 13.553 MHz ~ 13.567 MHz, 26.957 MHz ~ 27.283 MHz and 40.66 MHz ~ 40.70 MHz.

NOTE 3: The additional factor of 10/3 is used to calculate the recommended separation distance for transmitters in the ISM band of 150 kHz to 80 MHz and in the frequency range of 80 MHz to 2.5 GHz to reduce the possibility of interference if portable/mobile communication devices are accidentally brought into the animal area.

NOTE 4: These guidelines may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

# Appendix IV Terminology and Abbreviation

| Term/abbreviation | Definition |
| --- | --- |
| A | / |
| AA | Anesthetic agent |
| ACGO | Auxiliary common gas outlet |
| AGSS | Anesthetic gas scavenging system |
| AIR | Air |
| APL | Adjustable pressure limiting valve |
| C | / |
| $CO_2$ | Carbon dioxide |
| Compl | Compliance |
| CPAP/PSV | Continuous Positive Airway Pressure/Pressure-support ventilation |
| CPB | Cardiopulmonary bypass |
| E | / |
| Et | Exhale gas concentration |
| $EtCO_2$ | Expiratory-end tidal $CO_2$ concentration |
| $EtO_2$ | Expiratory-end tidal $O_2$ concentration |
| Exp | Expiratory |
| EMG | Electromyography: reflects the electrical power and high frequency pseudo difference of muscle activity |
| F | / |
| Fi | Inspired gas concentration |
| $FiO_2$ | Fraction of inspired $O_2$ |
| $FiCO_2$ | Fraction of inspired $CO_2$ |
| I | / |
| I:E | Inspiratory:Expiratory time ratio |
| Insp | Inspiratory |

| Term/abbreviation | Definition |
| --- | --- |
| M | / |
| MAC | Minimum alveolar concentration |
| MinRate | Minimum breath rate |
| MV | Per minute ventilation |
| N | / |
| N$_2$O | Nitrous oxide |
| O | / |
| O$_2$ | Oxygen |
| P | / |
| P-F | Pressure-Flow loop |
| P-V | Pressure-Volume loop |
| Paw | Airway pressure |
| PCV | Pressure-control ventilation |
| PEEP | Positive end expiratory pressure |
| Pinsp | Inspiratory pressure |
| Plimit | Pressure limit |
| Pmean | Mean pressure |
| Ppeak | Peak pressure |
| Pplat | Plateau pressure |
| ΔPps | Pressure support level |
| PRVC | Pressure regulated volume control ventilation |
| PSVPro | Pressure-support ventilation protection |
| R | / |
| Rate | Breathing rate |
| Raw | Airway resistance |
| S | / |
| SIMV-PC | Synchronized intermittent mandatory ventilation-pressure control (SIMV pressure) |

| Term/abbreviation | Definition |
|---|---|
| SIMV-PRVC | Synchronized intermittent mandatory ventilation-pressure regulated volume control ventilation |
| SR | Suppression ratio: the percentage of time during the last 60 seconds when EEG is considered to be suppressed. |
| SQI | Signal quality index: reflect the signal quality and provide the reliability of BIS and SR value recorded during the last minute. |
| T | / |
| Tinsp | Inspiration time |
| Tpause | Inspiratory pause |
| Trigger | Inspiratory trigger |
| Tslope | Pressure slope |
| V | / |
| V-F | Volume-Flow loop |
| VCV | Volume control ventilation |
| Vol | Volume |
| VS | Volume support ventilation |
| VT | Tidal volume |
| VTexp | Expiratory tidal volume |
| VTinsp | Inspiratory tidal volume |

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