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# R650 Series Veterinary Anesthesia Machine

User Manual

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# **1-Introduction**

#### **1.1 Overview**

First of all, sincerely thanks for selecting the R650 Series Veterinary Anesthesia Machine of RWD.

Before installing and using this product for the first time, be sure to read all the materials attached carefully to help you use this product better.

RWD Life Science Co., Ltd. is committed to continuously improving product functions and service quality. RWD reserves the right to make changes to any product described in this manual and the content of this manual without prior notice.

To get the latest product information, call us or visit our website (www.rwdstco.com). Please contact RWD if you find any discrepancy between this manual and the actual situation of the product during the use of the equipment, or have any questions or suggestions.

This user manual applies to the following RWD anesthesia machines:

- R650-IE Anesthesia Machine Mobile/Isoflurane/Easy Fill
- R650-IK Anesthesia Machine Mobile/Isoflurane/Key Fill
- R650-SE Anesthesia Machine Mobile/Isoflurane/Easy Fill



The anesthesia machine for small animals should be operated and managed by trained professionals!



This equipment is intended for use in animal clinical and research purposes only and is prohibited for use on humans!

#### **1.2 Features**

- Inhalation anesthesia is specially designed for animals such as cats, dogs, monkeys, and pigs weighing no greater than 100 kg.
- Small footprint and ability to support anesthesia-related small to medium-sized equipment and accommodate anesthesia machine consumables.
- 0.1 ~ 4 L/min, compatible with 0.1 ~ 10 L/min O<sub>2</sub> flowmeter for real-time adjustment and observation with precise control.
- Quick oxygenation function, removing anesthesia gas mixture that resides in the pipe at 10 ~ 15 L/min and enabling quick oxygenation to anesthetized animals.
- Adjustable pressure limiting (APL) valve, with a pressure scale and allowing for adjusting the upper limit of circuit pressure. Independent pressure relief and one-button close functions, protecting animals from injuries caused by excessive gas pressure.
- Equipped with a 2100 mL CO<sub>2</sub> absorption canister, with a quick detaching and switching design that facilitates the replacement of calcium lime and a front mounting design that makes it easier to observe.
- Adopt a novel vaporizer that offers improved adaptability to high flowrates, making it well-suited for large animal experiments or surgeries.

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- The vaporizer enables adjustable output concentrations of 0 ~ 5% (isoflurane) and 0 ~ 8% (sevoflurane). The output remains unaffected by changes in flowrate, temperature, flow speed, or pressure. The safe locking mechanism prevents accidental anesthetic volatility.
- Oxygen concentrator tray and ventilator tray are optional. The anesthesia machine can accommodate veterinary oxygen concentrators and ventilators, making it convenient for the integrated management of animal respiratory anesthesia equipment.
- The anesthesia machine has a compact and aesthetically appealing structure, along with user-friendly operation.

#### **1.3 Product applications**

This product is designed for most clinical operations on animals such as dogs, cats, monkeys, and pigs. It can be used in various scenarios such as animal surgeries, imaging, and experiments, meeting the requirements of the majority of veterinary professionals.

#### **1.4 Environmental requirements**

Please prepare the equipment operating environment according to the conditions listed in the table below to ensure the operability and safety of the system.

Environment for the equipment	Detailed Description
	Temperature: 10°C ~ 35°C
Working environment	Humidity: 5% ~ 90% (non-condensing)
	Air pressure: 86 kPa ~ 106 kPa
	Temperature: $-10^{\circ}C \sim 55^{\circ}C$
Storage and transportation	Humidity: 5% ~ 90% (non-condensing)
	Air pressure: 86 kPa ~ 106 kPa

#### **1.5 Product parameters**

Item	Specification
Dimensions	$L x W x H: \le 360 \text{ mm } x 380 \text{ mm } x 1400 \text{ mm}$
Weight	≤ 33 kg
Material	Mainly aluminum alloy
Gas source flowrate	$0.2 \sim 10$ L/min when the required concentration is no greater than 4%, $0.2 \sim 8$ L/min
Gas source quality requirements	Medical pure oxygen
Gas source pressure range	< 0.5 Mpa
Controlled concentration range	Isoflurane: $0 \sim 5\%$ (v/v); Sevoflurane: $0 \sim 8\%$ (v/v)
Concentration renge value	Isoflurane: $0 \sim 0.5 \sim 1.0 \sim 1.5 \sim 2.0 \sim 2.5 \sim 3.0 \sim 3.5 \sim 4.0 \sim 5.0$ % (v/v)
Concentration range value	Sevoflurane: $0 \sim 0.5 \sim 1.0 \sim 2.0 \sim 3.0 \sim 4.0 \sim 5.0 \sim 6.0 \sim 7.0 \sim 8.0 \% (v/v)$

Item	Specification		
Anesthetic perfusion	Approx. 120 mL between the minimum and maximum scales of the visible liquid level		
Anesthetic consumption	Approx. 3 x supply gas flowrate (L/min) x set concentration value (% (v/v)) Example: When the concentration of isoflurane is 2% and the gas flowrate is adjusted to 600 mL/min, theoretically a 100 mL bottle of isoflurane can be used for about 28 hours		
Anesthetic loss	22°C, 0 scale, less than 0.5 mL/24 h		
Maximum pressure load	50 kPa (vaporizer)		
Maximum angle of inclination for use	30°		

## **1.6 Product Configuration**

Note: Due to the differences between different versions of the user manual, this product list is for reference only. Please check the delivered parts against the enclosed packing list upon receipt and contact your RWD service immediately if any discrepancies are identified.

Configuration	Name	Quantity	Usage description
Standard	Mobile anesthesia machine - main unit	1 pcs	Used to anesthetize animals
Standard	Anesthesia machine trolley	1 pcs	Supports the main unit of the anesthesia machine
Standard	Reusable non-latex breathing bag -0.5 L	1 pcs	Connects to the anesthesia circuit for
Standard	Reusable non-latex breathing bag -1 L	1 pcs	
Standard	Reusable non-latex breathing bag -2 L	1 pcs	Sus surreining
Standard	Anesthesia breathing circuit – middle branch-22mm (M)/ 15mm (F), 1.5m	1 pcs	Forms a rebreathing circuit (RB)
Standard	Mapleson F type non-rebreathing circuit (Jakson-Rees) – Chinese	1 pcs	Forms a non-rebreathing circuit (NRB)
Standard	Bellows-ID 22.0mm, L1.2m	1 pcs	Connects to the filter canister and discharges exhaust anesthesia gas
Standard	Oxygen tube -ID8.0-9/ 16 union -M16*1.5 union -2M	1 pcs	Connects high-pressure oxygen sources
Standard	Gas filter canister – large	1 pcs	Used to filter exhaust anesthesia gas
Standard	Storage basket	1 pcs	Accommodates anesthesia items
Standard	Calcium lime (1.2KG/barrel)	1 pcs	It is filled into a carbon dioxide absorption box to absorb carbon dioxide exhaled by animals in a rebreathing circuit

Configuration	Name	Quantity	Usage description
Optional	Oxygen pressure reducing valve - single gauge/without pressure adjustment handle/input 4 MPa, output 0.4 ~ 0.45 MPa	1 pcs	Connects high-pressure oxygen sources
Optional	Tracheal cannula (1 set)	1 pcs	For tracheal cannula procedures in animals
Optional	Miller bulb laryngoscope (5 lenses + handle + carrying case)	1 pcs	Used to assist in tracheal cannula procedures
Optional	Oxygen concentrator tray	1 pcs	Supports the veterinary oxygen concentrator
Optional	R420 ventilator tray	1 pcs	For supporting the R420 veterinary electric turbo ventilator

## 2-System Safety

▲ Note: For safety reasons, please read the safety instructions carefully.

If you have any questions or suggestions, please reach out to us for further technical support!

#### 2.1 Important symbols

Symbol	Description
RB 🕞 NRB	Rebreathing/Non-rebreathing
	Gas inlet
	Gas outlet
	Ventilator or Breathing bag port labeling
MIN	Minimum (ALP valve open)

#### 2.2 Use restrictions

The RWD R650 series veterinary anesthesia machine is intended for use in animal experimentation or veterinary medicine only, and all operation and maintenance must be carried out in accordance with the instructions in this manual.

The following improper uses may cause injuries to animals and operators:

- Using gas sources with inappropriate compositions.
- Using gas sources at pressures exceeding the equipment's limit.
- Using incorrect anesthetic.
- Unauthorized modifications to the equipment's structure.

#### 2.3 Safety information

#### 2.3.1 Animal and personal safety

- If conditions permit, please ensure that a spare anesthesia machine is made available for an emergency.
- Please read and familiarize yourself with this product instruction manual before installing and operating the equipment.
- To ensure the stable operation of the system, please read the "4- Operating Instructions" carefully before inspection.
- Please ensure that this system is operated by trained personnel.
- After the warranty period, it is advisable to arrange an annual inspection service to ensure the system's continued stability. Only personnel authorized by RWD are allowed to maintain the product or replace internal components.

- This product should not be used in environments containing open flames and flammable or explosive materials (e.g., ether, acetone, etc.).
- Do not place any objects weighing over 8 kg on the anesthesia machine.
- Ensure that the gas source pipe is clear and prevent it from being folded and clogged.
- It is advisable to wear personal protective equipment during the experiment.
- Ensure that the proper connection between the gas source pipe and the anesthesia machine before experiments.
- Ensure that the anesthetic gas exhaled by animals is filtered through the exhaust gas treatment device before being vented into the environment.
- It is advisable to monitor animals' vital signs during the anesthesia process to ensure their safety.
- In case of any signs of abnormal functioning, turn off the system and contact RWD for further after-sales support.
- Do not pour any liquid other than the specified anesthetic agent into the vaporizer. The vaporizer is designed to be used with compatible anesthetics only. Please carefully observe the usage instructions indicated on the exterior of the vaporizer.
- Ensure that the gas pressure of the gas source does not exceed 0.5 MPa.

#### 2.3.2 System protection

- Prevent the anesthetic liquid from contact with animal masks and other parts. If a small
  amount overflows, allow it to evaporate naturally without attempting to wipe it with a cloth.
- Do not place any objects weighing over 8 kg on the anesthesia machine.
- For system maintenance, refer to "7-Maintenance and Upkeeping".
- Ensure that there is sufficient distance between the anesthesia machine, the wall, and other equipment.
- Ensure the stability of the gas source.

#### 2.3.3 Environmental hygiene

- Promptly collect and clean any excess anesthetic gas mixture that may escape due to
  excessive pressure.
- Ensure adequate ventilation when using the anesthesia machine in a confined space.
- Dispose of waste and hazardous substances in accordance with local laws and regulations.

#### 2.4 System malfunction

In the event of abnormal system operation, please refer to "6 - Troubleshooting" for detailed descriptions of issues, potential causes, and recommended solutions. If you encounter equipment failure that cannot be resolved, please reach out to your local agent or RWD for assistance with after-sales service.

# **3-System Structure**

• Front view



Figure 3-1

SN.	Name	Description
1	Main support	Used to install and support all components except the anesthesia machine trolley.
2	O <sub>2</sub> flowmeter	Controls the oxygen flowrate into the anesthesia system and achieves accurate regulation by turning the $O_2$ flowrate turnknob.
3	Airway pressure gauge	Measures and displays the gas mixture pressure in the anesthesia breathing circuit. Note: It is crucial to closely monitor the pressure during veterinary anesthesia. Pressure exceeding 30 cmH <sub>2</sub> O can lead to internal damage of the pressure gauge itself and potential lung injury or fatality in animals.
4	O <sub>2</sub> flush button	When pressed, it directly connects the oxygen source to the internal gas circuit of the equipment, allowing oxygen to enter the system circuit directly, and is generally used for flushing residual anesthetic gas from the system and for

SN.	Name	Description
		emergency oxygen supply for animals.
5	Adjustable pressure limiting (APL) valve	It has independent pressure relief and one-button closing functions. The user can set the maximum pressure limit in the breathing circuit by adjusting the adjustable pressure limiting (APL) valve which can be closed by turning it clockwise and opened by turning it counterclockwise. The valve has scale marking (in cmH <sub>2</sub> O), with a range from 0 to 70 cmH <sub>2</sub> O. Pressing the button will increase the pressure scale by approximately 30 cmH <sub>2</sub> O. Note: When performing non-airtightness checks or using the ventilator, do not completely close the adjustable pressure limiting (APL) valve. Closing it entirely may result in lung injury or fatality for the animal.
6	CO <sub>2</sub> absorption canister knob switch	For securely locking the CO <sub>2</sub> absorption canister. It can be released by turning counterclockwise and loced by turning clockwise.
7/18	Inspiration valve assembly/expiration valve module	A one-way valve assembly composed of a floatable breathing diaphragm and a nickel-plated brass valve is used to control the gas flow in the breathing circuit of the equipment, ensuring the one-way flow of gas when the animal is inhaling and exhaling, thus ensuring that the animal does not inhale the freshly exhaled gas, but only the new anesthetic mixture and the gas that has passed through the $CO_2$ absorption canister. The floatable breathing diaphragm will rise and fall with the breathing of the animal, and the transparent dome design allows the user to easily observe the rise and fall of the breathing diaphragm, thus assisting in determining whether the breathing state of the animal is normal.
8	Handle	For moving the anesthesia machine.
9	Breathing bag port	Used to attach a breathing bag. It can provide the necessary gas cushion when the animal is breathing and also can determine whether the breathing status of the animal is normal according to the rise and fall of the breathing bag.
10	Rebreathing circuit port plug	Used to place and block the tracheal cannula/mask port on the breathing circuit and plays an important role in checking the air tightness of the system, adjusting the pressure limit value of the system and flushing the circuit.
11	CO <sub>2</sub> absorption canister	Used to place a $CO_2$ absorbent (such as calcium lime) that absorbs $CO_2$ exhaled by the animal during the breathing cycle, increasing the efficiency of absorption while also reducing resistance to gas flow. The chemical reaction in the absorption canister creates the proper heat and humidity and is added to the anesthetic breathing cycle of the animal.
12	Gas filter canister	Used to adsorb gases such as isoflurane, sevoflurane, and enflurane. For single-use only.
13	Column	Used to assemble and support the main unit, filter canister, storage basket, and oxygen concentrator tray.
14	Storage basket	Used to hold anesthesia-related items.
15	H-shaped base	Anesthesia machine trolley, which can be equipped with casters.
16	Casters	3-inch universal casters, each with a locking button.
17	Vaporizer	The vaporizer converts the liquid anesthetic into gas and then adds it to the oxygen by volume percentage (vol.%), which is adjusted by the digital dial on the top of the vaporizer, and the gas that comes out of the outlet is the set

SN.	Name	Description
		concentration of the anesthetic mixture. The vaporizer is the most complex and costly component of the anesthesia machine, requiring special attention for both operation and maintenance. It is recommended to contact RWD after-sales for calibration on a regular basis. The internal design of the vaporizer varies depending on different anesthetics. Please use the anesthetic as stated on the label of the vaporizer. Using the wrong anesthetic may damage the equipment and cause harm to the animals.
19	Non-rebreathing circuit port	A non-rebreathing circuit is recommended for animals generally weighing less than 7 kg. By simply switching the breathing circuit to the NRB position, the exhaust gas exhaled by the animal no longer passes through the CO <sub>2</sub> absorption canister, but is directly discharged into the gas filter canister or outside.
20	Circuit switch	Allows switching between using the rebreathing circuit (RB) or the non-rebreathing circuit (NRB) with one button.
21/22	Rebreathing circuit port	Used to connect the rebreathing circuit by setting the breathing circuit switch to the RB position. The internal inspiration/expiration valve module works together to prevent animals from inhaling exhaled gas, allowing them to only inhale fresh anesthesia gas mixture and gas that has passed through the CO <sub>2</sub> absorption canister.
23	Canister holder	Used to hold the gas filter canister.
24	Anesthesia machine trolley	Used to support the main body of the anesthesia machine for easy movement of the equipment.

Back view

a



SN.	Name	Description
a	Non-rebreathing circuit tracheal port plug	Used to place and block the tracheal cannula/mask port on the breathing circuit and plays an important role in checking the air tightness of the system, adjusting the pressure limit value of the system and flushing the circuit.
b	Gas inlet	Used to connect the oxygen source with pressure not exceeding 0.5 Mpa.
с	Exhaust gas outlet	When switching to the rebreathing circuit (RB), the exhaust anesthesia gas is vented through this outlet. Use the bellows to connect this outlet to the exhaust gas filter canister, ensuring that the exhaust anesthesia gas is fully filtered before being released into the environment.

# **4-System Preparation**

▲ Note: Please prepare the equipment operating environment under the conditions listed in *1.4 Equipment Environmental Requirements* to ensure system operability and safety. Tip: Please save all boxes and packing materials for subsequent transportation.

#### 4.1 Unpacking

The RWD R650 series veterinary anesthesia machine is carefully packaged at the factory to ensure safe and smooth delivery to users. Upon receiving the product, please follow the steps below:

- 1) Check against the shipping document to ensure that all packaging boxes have been delivered.
- Inspect the external packaging of the box for any obvious damage. If severe damage is found, immediately notify the carrier and contact RWD. It is advisable to take photos of the damaged packaging as evidence.
- 3) If the packaging is intact and there is no obvious damage, carefully open the packaging box and take out all the equipment components. Keep all packaging boxes and packing materials for future transportation.
- Check the bill of sale or invoice to ensure that all ordered product components are present. If you have any inquiries or need assistance, please contact RWD for service support.

#### 4.2 Installation steps

#### 4.2.1 Assembling the anesthesia machine mobile bracket



Figure 4-1

#### Tools required: Allen wrench, Phillips screwdriver

SN.	Steps	Schematic diagram			
1	<ul> <li>Installing the column</li> <li>Insert the column into the base in the direction shown in the diagram.</li> <li>Screw in four Allen screws (M6*60mm) from the bottom of the base to fix the column and the base.</li> </ul>	Front side			
2	<ul> <li>Installing the oxygen concentrator tray (optional)</li> <li>Loosen four Allen screws (M6*16mm), hang the tray on the screws of the slider, and then lock the screws.</li> </ul>				
3	<ul> <li>Installing the storage basket</li> <li>Loosen four Allen screws (M4*10mm), hang the storage basket on the screws of the slider, and then lock the screws.</li> </ul>				
4	<ul> <li>Installing the filter canister</li> <li>Loosen two Allen screws (M4*10mm), hang the bracket on the screws of the slider and then lock the screws.</li> <li>Put the filter canister into the canister support.</li> </ul>				

#### 4.2.2 Installing the main frame

#### 4.2.2.1 General installation

Tools required: Allen wrench



Install the trolley connector on the trolley, and lock the four holes in [frame 650] with four M6 hexagon socket head combination screws.

#### 4.2.2.2Installing R420 ventilator

Tools required: Allen wrench



Attach the trolley connector on the trolley, and lock the four holes in [R650+R420 frame] with four M6 hexagon socket head combination screws.



Attach the ventilator tray under the base of the main unit with three M6 Allen screws.



Align the main unit with the pins on the trolley connector, hold the main unit of the anesthesia machine above it steady, and install the main unit on the trolley connector with four M6 Allen screws.



Align the main unit with the pins on the trolley connector, hold the main unit of the anesthesia machine above it steady, and install the main unit on the trolley connector with four M6 Allen screws.



Place the ventilator at the foot pad hole of the ventilator tray.

#### 4.2.3 Installing the CO<sub>2</sub> absorption canister

Tools required:/



Fit the absorption canister into the main body of the circuit along the track.

Ensure that the absorption canister slide has been pushed to the end.



Secure the absorption canister by turning the locking knob clockwise.

Note: Ensure that the absorption canister slides into the track and pushes it to the end.

#### 4.2.4 Installing the breathing bag

Tools required:/

1) Cover the breathing bag directly upward at the Breathing bag port and rotate to secure it.



Note: Please choose a suitable breathing bag according to the size of the animal. Too big or too small may cause adverse consequences. If the airbag stops breathing, please check whether the animal is breathing normally and whether the circuit is unobstructed. Breathing bag recommendations:

Maximum animal weight	Breathing bag size	
4.5 kg	1/2 L	
4.6 ~ 9 kg	1 L	
9.1 ~ 27.2 kg	2 L	
37.3 ~ 54.4 kg	3 L	
Greater than 54.4kg	5 L	

#### 4.3 System connection

#### 4.3.1 Installing the rebreathing circuit

Connect the rebreathing circuit lines as shown below.



Figure 4-2

#### 4.3.2 Installing the non-rebreathing circuit

Connect the non-rebreathing circuit as shown in the figure below.



Figure 4-3

#### 4.4 Preparation for operation

#### 4.4.1 Materials and supplies

- 1) Oxygen source
- 2) Oxygen source connection tube
- 3) Veterinary anesthesia breathing circuit
- 4) CO<sub>2</sub> absorbent
- 5) Anesthetics (select the appropriate drug according to the type of vaporizer, e.g. isoflurane)
- 6) Wrench tool

Note: When connecting the high-pressure oxygen concentrator, it is necessary to pre-dry the gas. Please seek assistance from your oxygen concentrator supplier.

#### 4.4.2 System regulating

- 1) Move the anesthesia machine to the use area.
- 2) Fill the CO<sub>2</sub> absorption canister with CO<sub>2</sub> absorbent as follows:
  - a. Loosen the retaining knob and remove the absorption canister.
  - b. Put the CO<sub>2</sub> absorbent into the absorbent canister, making sure not to exceed the maximum capacity scale line.
  - c. Install the absorbent canister back onto the main circuit and tighten the retaining knob.



Figure 4-4

- 3) Check the airtightness of the system:
  - a. Ensure that all open ends of the anesthesia machine are closed
  - b. Ensure that the dial of the vaporizer is in the "0" position.



c. Rotate the adjustable pressure limiting (APL) valve clockwise to fully close it.



Figure 4-6

- d. Turn on the gas source from the oxygen cylinder, ensuring that the anesthesia machine's working pressure is within the range of  $0.2 \sim 0.4$  MPa.
- e. Slowly turn the  $O_2$  flowrate turnknob counterclockwise to introduce the oxygen into the anesthesia machine's tubing for pressurizing, and observe the airway pressure gauge. The pressure can be increased rapidly using the  $O_2$  flush button until it reaches 30 cmH<sub>2</sub>O. Then, turn the  $O_2$  flowrate turnknob clockwise to completely close it.



Figure 4-7

- f. Observe the pointer of the airway pressure gauge. If the pointer falls back not greater than one small bar (2 cmH2O) in 10 seconds, the air tightness is good. If the pointer drops more than 2 cmH<sub>2</sub>O within 10 seconds, it indicates a leakage in the system. Please inspect the connections of components.
- g. After the airtightness check, turn the adjustable pressure limiting (APL) valve counterclockwise to the "MIN" scale to ensure that the circuit is open.



Figure 4-8

#### 4.4.3 Anesthetic filling

The method of filling anesthetic varies depending on the chosen vaporizer. RWD offers vaporizers with three filling types: Pour Fill, Easy Fill, and Key Fill.



Filling Method of Pour-Fill Filling Method of Easy-Fill

Filling Method of Key-Fill

#### Figure 4-9

Ensure that the correct anesthetic is administered, as the wrong anesthetic can cause serious injury to the animal. If the anesthetic is accidentally spilled on the surface of the equipment, let it evaporate naturally. Wiping with a dry cloth may damage the protective layer on the surface of the component.



- Ensure that the correct anesthetic is administered, as the wrong anesthetic can cause serious injury to the animal.
- If the anesthetic is accidentally spilled on the surface of the equipment, let it evaporate naturally. Wiping with a dry cloth may damage the protective layer on the surface of the component.
- For the initial fill or if the anesthesia machine has been unused for an extended period, allow the anesthetic to settle for 40 to 60 minutes before use.

#### 4.4.3.1 Pour Fill

- 1) Unscrew and remove the filling seal cap from the vaporizer, and check that the black sealing ring on the sealing cap is in good condition.
- 2) Carefully pour the anesthetic into the filling port and observe the liquid level indicator window to make sure the anesthetic liquid level is between the upper and lower scales.
- 3) After filling, lock the filling seal cap tightly.



Figure 4-10

#### 4.4.3.2Easy Fill

- 1) Unscrew and remove the filling seal cap from the vaporizer, and check that the black sealing ring on the sealing cap is in good condition.
- 2) Screw the dosing adapter on the mouth of the anesthetic vial, and then attach it to the vaporizer pouring inlet, and press it to the end.
- 3) Observe the liquid level indicator window during anesthetic filling to make sure that the liquid level is between the upper and lower scales.
- 4) After filling, lock the filling seal cap tightly.



Figure 4-11

#### 4.4.3.3Key Fill

- 1) Turn the upper ejector rod counterclockwise to loosen it and remove the flow limit block.
- 2) Ensure that the return lever is tightened, and insert the dosing adapter into the vaporizer pouring port. Turn the top lever clockwise to tighten it and lift the anesthesia bottle upward to keep it upright for filling.
- 3) After filling, loosen the upper ejector rod and take out the dosing adapter, insert the flow limit block back into the dosing port of the vaporizer, and tighten the upper ejector rod.







Figure 4-12



# **5-Operating Instructions**

#### 5.1 Check before use

RWD recommends performing the following checks before using the R650 veterinary anesthesia machine to ensure stable equipment operation:

- For the first use of the anesthesia machine, allow the anesthetic to settle for 40 to 60 minutes.
- Ensure that a sufficient amount of anesthetics have been added to the vaporizer.
- Ensure that the vaporizer dial indication is set to "0".
- Ensure that the oxygen source is tightly connected to the anesthesia machine.
- Ensure that the gas source pressure does not exceed 0.5 MPa and that there is adequate gas for the entire operation.
- Ensure that the O<sub>2</sub> flowmeter knob can work normally.
- Ensure that the breathing circuit is clear and clean, and check the ventilation and cleanliness of the experimental environment.

#### 5.2 Veterinary anesthesia

- 1) After inducing anesthesia for the animal, insert a tracheal cannula or wear a mask.
- Turn the O<sub>2</sub> flowrate turnknob counterclockwise to enable oxygen to enter the tubing system of the anesthesia machine.

Note: Take the upper edge of the red float as the reference.

 Press the scale dial lock button, toggle the vaporizer scale dial, and adjust the anesthesia gas concentration to the appropriate value.

Note: When reducing the concentration, simply toggle the scale dial.





 Connect the breathing circuit port to the tracheal cannula or anesthesia mask to administer anesthesia gas to the animal.

Tip: The vaporizer dial can be adjusted at any time during the animal's anesthesia to change the concentration of the output anesthetic gas and achieve different levels of anesthesia depth.

#### 5.3 Using the quick oxygenation switch

The quick oxygenation function is required if the animal requires an emergency oxygen supply during anesthesia. To use it, follow the following steps:

 Set the vaporizer dial to "0", unplug the breathing circuit port from the animal's mask or tracheal cannula, and attach it to the port plug of the main unit to close it.



 Press the quick oxygenation switch and squeeze the breathing bag to expel as much anesthetic gas from the system as possible.



- 3) Then reconnect the breathing circuit port to the mask or tracheal cannula, and the animal can breathe pure oxygen.
- 4) Assist the animal's respiration by pressing the breathing bag with both hands.
- 5) To continue anesthesia, you can directly adjust the vaporizer dial to a high concentration and then adjust it back to the maintenance anesthesia concentration after the animal's state is stable.

Note: It is also important to observe the indication of the system pressure gauge during usage to prevent excessively high internal system pressure.

#### 5.4 Using non-rebreathing and rebreathing circuits

It is advisable to use the non-rebreathing circuit to supply anesthesia gas to animals weighing less than 7 kg. By simply switching the breathing circuit switch to the **non-rebreathing position** (NRB), the exhaled gas will bypass the CO<sub>2</sub> absorption canister and directly vent into the gas filter canister or outside. When using the non-rebreathing circuit, it is forbidden to close the thumb valve, as closing it may cause lung injury or death to the animal. It is recommended to fully close the adjustable pressure limiting (APL) valve to prevent the exhaust gas from entering the rebreathing circuit.



Figure 5-1



It is advised to supply anesthesia gas to animals exceeding 7 kg. The user only needs to switch the breathing circuit selector to the **rebreathing position** (RB). When using a non-rebreathing circuit, **it is essential not to close the adjustable pressure limiting (APL) valve, otherwise, this may cause lung injury or death to the animal**. It is recommended to completely close the switch (thumb valve) on the non-rebreathing circuit (to prevent waste gas from entering the non-rebreathing circuit).





Figure 5-2

# 5.5 Adjusting the maximum pressure limit in the breathing circuit

When the pressure within the breathing circuit exceeds the set value, gas will be vented from the valve to maintain a relatively stable circuit pressure. Follow the steps below to adjust the maximum pressure limit:

 Turn the adjustable pressure limiting (APL) valve counterclockwise to the "MIN" position, ensuring that the airway pressure gauge returns to "0."



Figure 5-3

 Remove the breathing bag and disconnect the circuit at the expiration end of the breathing circuit, then connect it to the Breathing bag port.





Figure 5-4

 Slowly turn the O<sub>2</sub> flowrate turnknob counterclockwise to allow oxygen to enter the anesthesia machine's circuit system.





- 4) Then, slowly turn the adjustable pressure limit valve (APL) clockwise to the desired scale while observing that the airway pressure gauge does not exceed the set value. Generally, it is recommended not to exceed 20 cmH<sub>2</sub>O.
- 5) After the system airtightness check and adjusting the maximum pressure in the breathing circuit, turn the O<sub>2</sub> flowrate turnknob clockwise to close it. Then reconnect the breathing circuit to the expiration port and reattach the breathing bag to the Breathing bag port.

#### 5.6 Post-anesthesia operation

When the anesthesia is completed, please follow the following steps:

- 1) Toggle the vaporizer dial to the "0" scale.
- 2) Unplug the breathing circuit from the anesthesia mask or tracheal cannula, and connect the breathing port to the port plug of the main unit to close it.
- Press the quick oxygenation switch and squeeze the breathing bag to promptly eliminate the anesthetic gas and CO<sub>2</sub> from the system tubing.
- 4) Turn off the oxygen source.
- 5) Adjust the O<sub>2</sub> flowrate turnknob until the flow reading indicates "0".
- Record and check the duration of absorbent usage in the CO<sub>2</sub> absorption canister. Note:
  - a) Typically, the CO<sub>2</sub> absorbent should be replaced after 12 hours of cumulative usage, even if it has not been used for a full 12 hours within one month. During replacement, prevent dust spillage and fill the absorption canister up to the Fill Line.
  - b) Failure to replace it in a timely manner may lead to high CO<sub>2</sub> concentration in the circuit, leading to respiratory acidosis in animals due to excessive CO<sub>2</sub> inhalation.
  - c) For replacement procedures, please refer to "4-System Preparation" (The color of the absorbent is provided for reference only, as relying solely on color judgment may result in delayed replacement and ultimately cause respiratory acidosis in animals.)
- If the anesthesia machine is not used for an extended period, refer to "7-Maintenance and Upkeeping" to empty the anesthetic from the vaporizer.
- 8) Thoroughly the anesthesia machine, refer to "7-Maintenance and Upkeeping".

## 6-Troubleshooting

Hazardous substances may be utilized during the troubleshooting process. Please dispose of contaminated waste according to local laws and regulations. Remember to wear basic personal protective equipment (e.g., gloves, masks, goggles, etc.) throughout this process.

Unless otherwise stated, connect the anesthesia machine to the gas source when troubleshooting. However, ensure that both the gas source and vaporizer are turned off before proceeding with any operations. Follow the provided troubleshooting guide for subsequent steps.

It is advisable to maintain a record of the troubleshooting process after addressing the fault. This record should include details such as time, location, fault description, troubleshooting steps, etc., for future reference.

Symptom	Possible Causes	Solution	
	The vaporizer works normally, but the gas is not supplied to the animal	Check the breathing circuit, Breathing bag port, inspiration and expiration connectors of the system for gas leakage, rupture or holes, etc., to ensure that the anesthesia mask or tracheal cannula fits the animal well	
There is no or little	The anesthetic agent in the vaporizer has been used up	Add an appropriate amount of anesthetic agent into the vaporizer.	
output of anesthetic gas mixture	The vaporizer is off	Press and hold the dial lock button and turn the vaporizer dial to adjust it to the appropriate output concentration value.	
	There is gas leakage at the filling port of the vaporizer.	Ensure that the sealing cap of the filling port is fully tightened.	
	Internal failure of the vaporizer	Please contact RWD for after-sales service support	
The adjustable pressure limiting (APL) valve is difficult to rotate	The adjustable pressure limiting (APL) valve needs to be cleaned	Please contact RWD for after-sales service support	
The pointer of the system airway pressure gauge is stuck	Mechanical damage to the airway pressure gauge	Replace with a new airway pressure gauge, and contact RWD for after-sales support.	
The indicator of the	The gas flowrate is too low	Increase the gas flowrate	
system airway pressure gauge is negative	Mechanical damage to the airway pressure gauge	Replace with a new airway pressure gauge, and contact RWD for after-sales support	
	The vaporizer is off	Press and hold the scale dial lock button and turn the dial to the appropriate concentration range	
The animal is anesthetized too lightly	The anesthetic agent in the vaporizer has been used up	Add an appropriate amount of anesthetic agent to the vaporizer Note: Adding anesthetics during the surgical process is prohibited	
	The anesthetic gas concentration is too low.	Adjust the vaporizer scale dial to increase the anesthetic gas concentration	

Symptom	Possible Causes	Solution	
	There is a gas leak in the veterinary anesthesia breathing circuit.	Check the system's breathing circuit for leaks, ruptures, or holes to ensure a good seal between the anesthesia mask or tracheal cannula and the animal	
n greek grege	Excessive accumulation of $CO_2$ in the breathing circuit.	<ol> <li>Check the length of time the calcium lime has been used and replace it with a new one</li> <li>Check the inspiration and expiration circuits</li> </ol>	
n and tanning a second	There is gas leakage at the filling port of the vaporizer.	Ensure that the sealing cap of the filling port is fully tightened	
	The anesthetic gas concentration is too high	Adjust the vaporizer scale dial to decrease the anesthetic gas concentration	
The animal is anesthetized too deeply	Vaporizer failure	Please contact RWD for after-sales service support	
	Flowmeter fault	Please contact RWD for after-sales service support	
	The adjustable pressure limiting (APL) valve is closed	Open adjustable pressure limiting (APL) valve	
The breathing bag is overinflated	The adjustable pressure limiting (APL) valve outlet is clogged	Check and clean the outlet of the adjustable pressure limiting (APL) valve	
	Wrong airbag selection	Replace with the correct breathing bag, refer to <i>4.2.4 Installing the breathing bag</i>	
The breathing bag does	The breathing bag is damaged.	Replace the breathing bag with a new one.	
not inflate during gas flow.	Abnormal airtightness of the anesthesia machine	Check the airtightness, refer to 4.4.2 System regulating	
	The gas source is closed	Open the gas source	
	The gas storage cylinder is empty	Replace with a new gas storage cylinder	
No gas flow	The gas source pipe is not connected properly.	<ol> <li>Ensure that the gas source is properly connected to the anesthesia machine</li> <li>Ensure that a safe and secure connection between the gas source and the anesthesia machine</li> </ol>	
	O <sub>2</sub> flowmeter off	Turn the O <sub>2</sub> flowmeter turnknob counterclockwise until the desired flow value is obtained	
	Gas source failure	Check and replace the gas source	
Insufficient gas flow The gas source flowrate setting too low		Adjust the flowmeter turnknob to increase gas flow	

Symptom	Possible Causes	Solution	
	There is gas leakage at the filling port of the vaporizer	<ol> <li>Ensure that the filling seal cap is fully locked</li> <li>Check the filling port for animal hair and other residues</li> </ol>	
	There is gas leakage in the veterinary anesthesia breathing circuit	Check all tubing connections, especially the connection between the tubing and the mask or tracheal cannula	
	There is gas leakage in the CO <sub>2</sub> absorption canister	<ol> <li>Turn off the anesthesia machine</li> <li>Remove the CO<sub>2</sub> absorption canister</li> <li>Clean absorbent or foreign material from the slide, screw holes in the top of the absorption canister, and the gasket.</li> <li>Reinstall the absorption canister</li> </ol>	
The quick oxygenation switch is stuck Internal valve failure Please contact RW support		Please contact RWD for after-sales service support	
The float in the O <sub>2</sub> flowmeter is stuck	Debris in the flowmeter circuit	Please contact RWD for after-sales service support	
The O <sub>2</sub> flowmeter turnknob is difficult to turn	Debris trapped or damage inside the turnknob	Please contact RWD for after-sales service support	
O <sub>2</sub> flowmeter failure	Internal failure	Please contact RWD for after-sales service support	
There is noticeable gas leakage noise near the	Loose tubing connection	Ensure that the tubing connection is secured firmly	
oxygen pipe	Misaligned tubing connection	Replace with suitable tubing	

# 7-Maintenance

#### 7.1 Safety precautions

During maintenance, hazardous substances may be used. Please follow local laws, regulations, and rules for the disposal of contaminated waste. During this process, basic personal protective measures should be taken (e.g., wearing gloves, masks, goggles, etc.).

#### 7.2 Annual inspection

RWD recommends a thorough inspection of the anesthesia machine once a year. For details, please contact RWD. Annual inspections help keep equipment in good working order.

#### 7.3 Equipment condition

Unless otherwise specified, during maintenance, the anesthesia machine should be connected to the gas source according to this manual, but make sure that the gas source and vaporizer are off.

#### 7.4 Record and Save

It is recommended to keep a record of the process after maintenance, including time, place and maintenance procedure for future reference.

#### 7.5 Component materials

If some parts or materials need to be replaced during maintenance, please contact RWD after-sales service for support.

#### 7.5.1 Necessary materials and items

- Surface cleaning solution (sterilizing cleaning solution, such as 3% hydrogen peroxide or 75% alcohol, etc.).
- Clean water and a clean cleaning cloth.
- Personal protective equipment (gloves, mask, goggles, etc.).

## 7.6 Equipment cleaning

- 1) It is recommended to wipe the surface of the anesthesia machine with a clean cloth and an appropriate amount of neutral cleaning solution once a week.
- 2) Clean hair, dust, and other debris from the vaporizer, especially around the dial and the filling port of the anesthesia machine.
- If there are impurities in the rebreathing circuit and non-rebreathing circuit, they can be soaked in soapy water, cleaned, and air-dried. Regular cleaning using this method is also recommended.
- 4) The anesthesia machine trolley can be cleaned using common cleaning agents (e.g., diluted bleach, ammonia, or alcohol solution) and mild non-abrasive solutions. Prevent any liquids from entering the interior of the anesthesia machine trolley.



Avoid contact with some harmful materials or substances during cleaning. It is recommended to wear personal protective equipment (gloves, masks, eye shields, etc.) when cleaning the equipment.

#### 7.7 Equipment disinfection

- Disinfection with alcohol: The surfaces of instruments (except for O<sub>2</sub> flowmeter, vaporizer, and CO<sub>2</sub> absorption canister) can be disinfected by using a clean cleaning cloth dipped in 75% alcohol.
- 2) UV disinfection: UV disinfection should not be performed too close to the light source.

#### 7.8 Weekly equipment maintenance

RWD recommends complete maintenance of the anesthesia machine once a week. The steps are as follows:

- 1) Wipe the surface of the anesthesia machine with a clean cleaning cloth. An appropriate amount of neutral cleaning solution is allowed.
- Clean hair, dust, and other debris from the vaporizer, especially around the dial and the filling port of the anesthesia machine.
- 3) Check if the gas filter canister exceeds 1 kg; replace if it exceeds 1 kg.
- 4) Perform routine checks before use, refer to "5 Operating Instructions."

#### 7.9 Upkeeping

- Check that the CO<sub>2</sub> absorbent has not expired. Note the duration of use of the CO<sub>2</sub> absorbent. The CO<sub>2</sub> absorbent typically needs replacement after 12 hours of continuous use. If not used for the entire 12 hours within a month, refer to "7.9.1 CO<sub>2</sub> absorbent Replacement" for guidance.
- 2) Replace the gas filter canister if it exceeds 1kg.
- Perform routine checks for the airtightness of the entire anesthesia machine system, refer to "4.4.2 System Adjustment".
- 4) Perform routine checks before use, refer to "5.1- Check Before Use".
- 5) Check the cleanliness and amount of the oxygen source.
- 6) Empty the vaporizer, refer to "7.9.2 Vaporizer Emptying".

#### 7.9.1 CO<sub>2</sub> absorbent replacement

 Remove the CO<sub>2</sub> absorption canister from the anesthesia main support and clean out the expired absorbent.



Do not knock the absorption canister heavily, as it may damage the sealing surface!

- 2) Clean the absorption canister with warm water and thoroughly dry it.
- 3) Wipe the sealing gasket of the absorption canister under the bracket with a clean, damp cloth to ensure that there is no absorbent residue on the surface.
- Refill the absorption canister with a new absorbent, making sure not to exceed the Fill Line scale.
- 5) Install the absorption canister back into the bracket and tighten the retaining knob.

#### 7.9.2 Vaporizer emptying

If the anesthesia machine is not in use for a long time, follow the steps below to empty the residual anesthetic in the vaporizer:

- Please operate the device in a well-ventilated place.
- Please wear personal protective equipment (gloves, masks, eye shields, etc.) when operating the equipment, and dispose of potentially hazardous waste in accordance with local laws and regulations.
- Do not mix anesthetic agents with other liquids.



Do not wipe the anesthetic spilled on the surface of the equipment. Otherwise, it may damage the surface. It is recommended to let it evaporate naturally and keep it in a well-ventilated place.

 Ensure that the oxygen source is closed, and the vaporizer scale dial is adjusted to "0" while turning the O<sub>2</sub> flowrate turnknob clockwise to the end.





- 2) Ensure that the equipment is placed in a well-ventilated area.
- 3) Connect the silicone tube to the discharge port of the vaporizer, lift the silicone tube upward, use a screwdriver to loosen the cross screw, and then unscrew the filling cap to balance the internal and external air pressure, then insert the silicone tube into the waste medicine bottle.



Figure 7-2

4) Loosen the sealing cap of the filling port, and then use a screwdriver to loosen the screw at the front end to allow the anesthetic to flow out of the vaporizer.





5) When no anesthetics flow out, tighten the screw at the front end to lock the sealing cap of the filling port.





6) Collect the discharge from the tubing outlet, and dispose of the anesthetic in the waste liquid bottle in accordance with regulations.

## 8-Other Reference Information

#### 8.1 Pressure measurement

 $\label{eq:mmH2} \begin{array}{l} 1 \ atm = 1033 \ cmH_2O = 760 \ mmHg = 760 \ Torr = 1013 \ mb = 14.7 \ psi \\ 1 \ psi = 70.3 \ cmH_2O = 51.7 \ mmHg = 68.9 \ mb = 6.9 \ kPa \\ 1 \ mmHg = 1.36 \ cmH_2O = 1.33 \ mb \\ 1 \ cmH_2O = 0.736 \ mmHg = 0.981 \ mb \end{array}$ 

#### 8.2 Conversion of pressure units

Unit	psi	inchH <sub>2</sub> 0	kPa	millibar	cmH <sub>2</sub> 0	mmHg
psi		27.680	6.8947	68.947	70.308	51.715
inch H <sub>2</sub> 0	3.6127x10 <sup>-2</sup>		0.2491	2.491	2.5400	1.8683
kPa	0.14504	4.0147		10.000	10.1973	7.5006
millibar	0.01450	0.40147	0.100		1.01973	0.75006
cmH <sub>2</sub> 0	1.4223x10 <sup>-2</sup>	0.3937	0.09806	0.9806		0.7355
mmHg	1.9337x10 <sup>-2</sup>	0.53525	0.13332	1.3332	1.3595	-

# 8.3 Minimum alveolar concentration (MAC) reference for common inhalation anesthetic agents

Animal	Halothane	Isoflurane	Sevoflurane
Cat	1.19	1.63	2.58
Dog	0.87	1.3	2.34

Note: MAC is defined as the concentration of anesthetic agent within alveolar gas at normal atmospheric pressure, which results in the disappearance of pain sensitivity in 50% of the animals. The value of MAC is not exactly equal to the set value required for the vaporizer during veterinary anesthesia.

#### 9-Product Warranty

The warranty of this equipment starts from the date of leaving the factory. During the warranty period, the equipment cannot be used normally due to problems such as materials and process defects. RWD undertakes after-sales service such as equipment maintenance and parts replacement.

Any damage caused by improper use or over-range use is not covered by the warranty. If repair or replacement of parts is required, the cost will be borne by the user.

If the reworked equipment was found to have been unauthorised disassembly, RWD will not provide after-sales service such as warranty, free maintenance and parts replacement.

The warranty statement (including its restrictions) is exclusively issued by RWD and covers all other warranties.

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