



USER MANUAL

RAS-4 Rodent Anesthesia System™

For research use only.
Not for use in diagnostic procedures.



Preface

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Content

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Proper Equipment Operation

WARNINGS



- *To reduce the risk of electric shock, do not remove the cover. No user serviceable parts are inside. Refer to qualified service personnel if help is required.*

- *Use this product only in the manner described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.*

AVERTISSEMENTS



- *Pour réduire le risque de choc électrique, ne pas retirer le couvercle. Ce produit ne contient aucune pièce pouvant être réparée par l'utilisateur. Au besoin, confier l'appareil à un réparateur qualifié.*
- *Ce produit ne doit être utilisé que comme décrit dans ce manuel. Si cet appareil est utilisé d'une manière autre que celle spécifiée par le fabricant, la protection fournie par l'appareil peut être entravée.*

Contact Us

If you have a question about a product that is not answered in this manual or if you need assistance regarding this product, please contact the Revvity Customer Care Center:

Telephone: +1.800.762.4000

Fax: +1.203.944.4904

www.revvity.com/contact-us

Before you call, have the following information available for the technical representative:

- Product serial number

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This device complies with 2004/108/EC. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

KC

This device complies with MSIP (Ministry of Science, ICT, and Future Planning) EMC Registration requirements. This instrument is registered as a Class A instrument for business use only. Product seller and user should notice that this equipment is not for household use.

A급 기기 (업무용 정보통신기기)

이 기기는 업무용으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 만약 잘못판매 또는 구입하였을 때에는 가정용으로 교환하시기 바랍니다.

CE

This device complies with all CE rules and requirements.

NOTE



Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

REMARQUE



Tout changement ou modification apporté à cet instrument non expressément approuvé par l'entité responsable de la conformité peut annuler l'autorisation d'opérer l'appareil accordée à l'utilisateur.

Table of Symbols

Table 1 contains symbols that identify particularly important information and alert you to the presence of hazards. These symbols may appear in this manual and/or on the product it describes.

Table 1. Important Symbols

Symbol Symbole	Description Description
	DANGER: An imminently hazardous situation, which, if not avoided, will result in death or serious injury. DANGER: Situation présentant un danger imminent qui, s'il n'est pas éliminé, peut entraîner des blessures graves, voire la mort.
	WARNING: Caution, risk of danger. Refer to the User's documentation. (ISO 7000-0434B) AVERTISSEMENT: Attention, danger potentiel. Se reporter à la documentation de l'utilisateur.
	NOTE: A cautionary statement; an operating tip or maintenance suggestion; may result in instrument damage if not followed. REMARQUE: Énoncé indiquant une précaution à prendre, un conseil de fonctionnement ou une suggestion d'entretien; son non-respect peut provoquer des dommages à l'instrument.
	Hazardous voltage; risk of electric shock. (IEC 60417-6042) Tension dangereuse; risque de blessure par électrocution.
	Biological risks. (ISO 7000-0659) Risques biologiques.
	Risk of poison. (ISO 3864) Risque d'empoisonnement.
	Risk of explosion. (ISO 3864) Risque d'explosion.
	Hazardous fumes. Émanations dangereuses.
	Risk of fire. (ISO 3864) Risque d'incendie.

Table 1. Important Symbols (continued)

Symbol Symbole	Description Description
	Risk of eye injury; wear safety glasses. Risque de lésion oculaire; porter des lunettes de sécurité.
	Protective ground symbol. (IEC 60417-5019) Symbole de terre de protection.
	Ground symbol. (IEC 60417-5017) Symbole de terre.
	Fuse. (IEC 60417-5016) Fusible.
	Alternating current. (IEC 60417-5032) Courant alternatif.
	On (power). (IEC 60417-5007) Marche (alimentation).
	Off (power). (IEC 60417-5008) Arrêt (alimentation).
	Korean Certification Mark. Marque coréenne de certification.
	CE compliance mark. Marque de conformité CE.
	WEEE symbol. Do not dispose of as unsorted municipal waste. See the Revvity website (www.revvity.com) for more information.
	Signifies that the unit has passed safety tests for grounding, power line transience, and current leakage. Signifie que l'appareil a réussi les tests de sécurité pour la mise à la terre, le courant transitoire de ligne d'alimentation et la perte de courant.
	Input. Entrée.
	Output. Sortie.

Table 1. Important Symbols (continued)

Symbol Symbole	Description Description
Equipment labels are color coded: Les étiquettes de l'appareil sont codées couleur:	Yellow Caution, risk of danger Red Stop Blue Mandatory action Green Safe condition or information Jaune Attention, danger potentiel Rouge Arrêter Bleu Intervention obligatoire Vert Condition sûre ou informations de sécurité

Table of Contents

Preface	1
Introduction.....	8
Principle of Operation.....	9
Instrument Safety	10
Required Training.....	10
Chemical and Biological Safety	10
Electrical Safety	11
Mechanical Safety	11
Hardware Reference	12
Chassis	13
Anesthetic Controls/Delivery	14
Exhaust Controls	15
Connections	15
Anesthesia Outputs, O2 Supply, and Power Input.....	15
Vacuum and Chamber Exhaust Outputs	17
Waste Gas Out Connection	18
Induction Chamber	18
System Accessories	19
Specifications	21
Chassis.....	21
Anesthetic Delivery	21
Exhaust System	22
Environmental.....	22
Electrical.....	22
Operation	23
Unpacking the System.....	24
Installing the RAS-4	25
Flow Charts	29
Gas Flow Chart.....	29
Exhaust Flow Chart	29
Turning ON the Main Power	30
Anesthesia Parameters	32
Turning ON the Anesthesia Delivery Ports	33
Adjustable Flow Circuits.....	33
Pre-set Flow Circuits.....	33
FMT Connector	34
Using the Exhaust System	35
Using the Individual Vacuum Channels	35
Chamber Scavenging	36
Shutting Down the System	36
Vaporizer Filling Procedure - Warnings	37
Filling the Vaporizer	38

Draining the Vaporizer	43
Maintenance	45
Cleaning the Induction Chamber	46
Cleaning the System	46
Tubing	46
Lubricants	46
Annual Preventative Maintenance	46
Calibration	46
Replacing the Vaporizer	47
Removing the Vaporizer	47
Installing the Vaporizer	49
Troubleshooting	50
Leaks or Reduced Flow	50
Change in the Time Required for Animal Induction	50
Rodent is waking up from anesthesia early	50
Green LED doesn't illuminate	50
Consumable Parts	51
Tubing	51
Isoflurane	51
Index	52
Revvity Product Warranty	55

Introduction

This manual includes instructions for unpacking, operating, and maintaining the Rodent Anesthesia System.

NOTE



- *The RAS-4 Rodent Anesthesia System is for research use only. Not for use in diagnostic procedures.*
- *Personnel operating the Rodent Anesthesia System must be thoroughly familiar with the instruction manual and equipment operation prior to use.*
- *Tampering with the anesthesia system components by unauthorized personnel voids all warranties and specifications. The prevention of tampering with the anesthesia system is the sole responsibility of the user or owner.*
- *Revvity assumes no liability for any malfunction, failure, damage or loss to either equipment or life. Always adhere to proper Diameter Index Safety System (DISS) hose connections. Failure to comply will void your warranty and could compromise patient safety. Only use the included power converter supplied with this system. Do not substitute.*

Principle of Operation

The RAS-4 Rodent Anesthesia System is supplied with oxygen via conductive hose from the oxygen source. This could be a large or small tank in close proximity to the work area or piped-in from a central supply location. In all circumstances, the supply pressure should be between 50-60 PSI.

Oxygen flows through an internal regulator to the precision vaporizer, where it picks up anesthetic vapor. The gas mixture is then channeled to the independent circuits.

Anesthetic gas is only distributed into an imaging system when that circuit's switch is activated. The CPC connector on the side delivers a 1000 cc/min flow when properly connected to an FMT Imaging System.

Imaging system(s) and/or induction chamber are connected to the flow outlets as needed.

The RAS-4 system can be connected, and has been tested with the IVIS Lumina, IVIS Spectrum, IVIS Quantum, and FMT platforms.

Three vacuum circuits are included to provide measured vacuum flow to each channel. A dedicated 30 mm port is present for capturing the waste gas from the Vented Induction Chamber.

All waste gas scavenging is accomplished via the 30 mm port on the top of the system. Gas may be directed to a suitable scavenging system or a VaporGuard® canister.

Instrument Safety

The following safety information about the Rodent Anesthesia System is included in this documentation. Read and review all safety information before operating the Rodent Anesthesia System.

- [Required Training on page 10](#)
- [Chemical and Biological Safety on page 10](#)
- [Electrical Safety on page 11](#)
- [Mechanical Safety on page 11](#)

Required Training

Ensure that all personnel involved with the operation of the instrument have:

- Received instruction in general safety practices for laboratories.
- Received instruction in specific safety practices for the instrument.
- Read and understood all related MSDSs.

WARNING



Use this product only in the manner described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Chemical and Biological Safety

WARNING



In some applications, chemicals or samples used with the Rodent Anesthesia System are potentially hazardous and can cause illness.

WARNING



Some of the chemicals used with the Rodent Anesthesia system are flammable.

- Read and understand the material safety data sheet (MSDS) provided by the chemical manufacturer before you store, handle, or work with any chemical or hazardous material.

Chemical and Biological Safety (Continued)

- Minimize contact with and inhalation of chemicals and chemical wastes.
- Wear appropriate personal protective equipment when handling chemicals or samples (e.g., safety glasses, gloves, or clothing). For additional safety guidelines consult the MSDS.
- Handle all samples using good laboratory practices to prevent biohazards.
- Do not leave chemical containers open. Use only with adequate ventilation, including a fume hood, if necessary.
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the chemical manufacturer's cleanup procedures as recommended on the MSDS.
- Dispose of chemical or infectious waste in accordance with good laboratory practices and local, state/provincial, or national environmental and health regulations.
- After emptying waste containers, seal the waste containers appropriately.
- Comply with all local, state/provincial, or national laws and regulations related to chemical and waste storage, handling, and disposal.

Electrical Safety

The wall outlet or the power cable connector on the side of the instrument should be accessible after the system's installation to enable trained service personnel to safely disconnect power from the system during servicing.

Mechanical Safety

Procedures which could result in injury may be performed only by operators who have been warned of the potential hazards and have received adequate training in performing the procedures in the safest possible manner.

Hardware Reference

This section identifies and describes the Rodent Anesthesia System hardware. It also lists the Rodent Anesthesia System technical specifications.

This section contains the following information:

- [Chassis on page 13](#)
- [Anesthetic Controls/Delivery on page 14](#)
- [Exhaust Controls on page 15](#)
- [Connections on page 15](#)
 - [Anesthesia Outputs, O2 Supply, and Power Input on page 15](#)
 - [Vacuum and Chamber Exhaust Outputs on page 17](#)
 - [Waste Gas Out Connection on page 18](#)
- [Induction Chamber on page 18](#)
- [System Accessories on page 19](#)
- [Specifications on page 21](#)

Chassis

Frame and faceplate of the chassis is Aircraft Aluminum construction with powder-coat paint. Unit may be bench mount, wall mount, or attached to the optional mobile frame.

The chassis encloses the pressure regulator, which drops the supply pressure to 6 PSI for the anesthetic delivery, and the air pumps and blowers, which perform the scavenging functions.



Figure 1. Chassis

Anesthetic Controls/Delivery

The anesthesia controls allow for initializing and monitoring the system, and is capable of delivering anesthesia to the four independent channels at varying flow rates, as required.

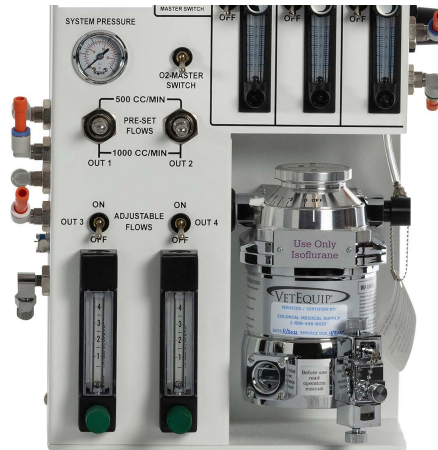


Figure 2. Anesthetic Delivery Controls

Table 2. Anesthesia Controls/Delivery Components	
Part	Description
System Pressure Gauge	Reads pressure in the system, and is useful for knowing when the vaporizer is properly pressurized (6 PSI is normal).
O2 Master Switch	Controls the system oxygen activation.
Pre-set Flows - Out 1 & 2	Two pre-set flows of 500 cc/min and 1000 cc/min including toggle switches (center position is OFF).
Adjustable Flows - Out 3 & 4	Two served by a 0-4 LPM flowmeter including ON/OFF switches to allow flow rates to be pre-set and toggled with each switch.
Internal Regulator	Regulates internal pressure to 6 PSI for steady delivery despite changes in use patterns.
Isoflurane Vaporizer	Variable by-pass, temperature compensated with pin-indexed fill port.
Internal Manifold	Manages flow delivery to the pre-set flow circuits.

Exhaust Controls

The exhaust controls allow for initializing the evacuation system and is capable of providing measured vacuum flow to the three channels.

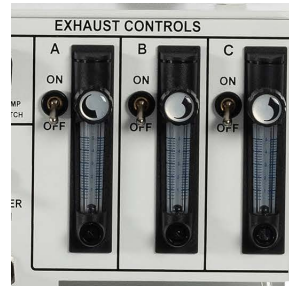


Figure 3. Exhaust Controls

Table 3. Exhaust Controls Components	
Part	Description
Vacuum Pump Master Switch	Controls the activation of the vacuum pump and exhaust blower.
Adjustable Vacuums A, B, & C	Three 0-5 LPM flowmeters are attached to the vacuum pump to measure and direct flow to specific evacuation ports as required. ON/OFF switches are included to allow flow rates to be pre-set and toggled with the switch.

Connections

Anesthesia Outputs, O2 Supply, and Power Input

The Anesthesia Output connections are used to connect the system/deliver anesthesia to the imaging system(s) and/or induction chamber. The FMT anesthesia output is specific to a FMT Imaging System. The oxygen supply input delivers the necessary oxygen to the vaporizer in order to create anesthetic gas. The power input is needed to run the vacuum pump and exhaust blower.

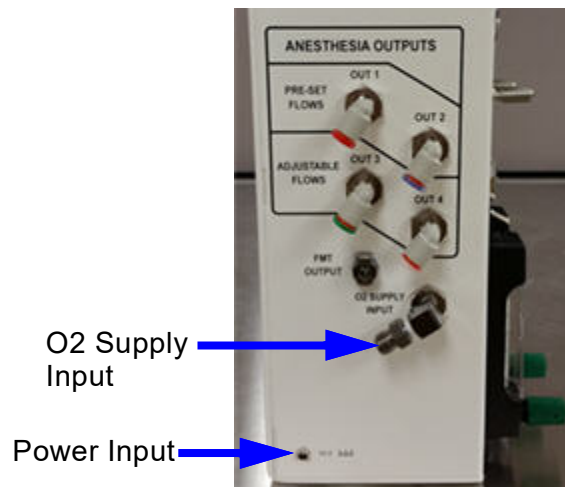


Figure 4. Anesthesia Outputs Connections

Table 4. Anesthesia Output Components	
Part	Description
Pre-set Flows - Out 1	Swivel-type connector with push-to-fit 3/8" OD, red sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
Pre-set Flows - Out 2	Swivel-type connector with push-to-fit 3/8" OD, blue sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
Adjustable Flows - Out 3	Swivel-type connector with push-to-fit 3/8" OD, green sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
Adjustable Flows - Out 4	Swivel-type connector with push-to-fit 3/8" OD, clear sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
FMT Output	A dedicated FMT connection with 1000 cc/min pre-set flow. CPC female connector.
O2 Supply Input	Standard Oxygen DISS Male inlet port.
12 VDC Input	2.1 mm female inlet connection.

Vacuum and Chamber Exhaust Outputs

The vacuum and chamber exhaust connections connect the system to imaging system(s) and induction chamber respectively.



Figure 5. Vacuum and Chamber Exhaust Outputs

Table 5. Vacuum and Chamber Exhaust Outputs	
Part	Description
Vac A	Swivel-type connector with push-to-fit 3/8" OD, red sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
Vac B	Swivel-type connector with push-to-fit 3/8" OD, blue sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
Vac C	Swivel-type connector with push-to-fit 3/8" OD, green sleeve, connection. Tubing can be engaged and released at will; zero leakage fittings.
Chamber Exhaust	30 mm OD x 22 mm ID fitting for universal acceptance of current standard evacuation.14 CFM exhaust blower, powered by the 12 VDC inlet, allows proper scavenging for the induction chamber. It is separate from the vacuum pump and dedicated to the chamber only.

Waste Gas Out Connection

This port collects all waste gas from the imaging system(s) and/or induction chamber. Gas may be directed to the included VaporGuard XL-R canister or to a suitable scavenging system.



Figure 6. Waste Gas Out Connection

Table 6. Was Gas Out Connection	
Part	Description
Waste Gas Out	30 mm OD x 22 mm ID fitting for universal acceptance of current standard evacuation.

Induction Chamber

The induction chamber is used to anesthetize the rodent(s) prior to placing them in an appropriate animal handling system.



Figure 7. Induction Chamber

Table 7. Induction Chamber	
Part	Description
Induction Chamber	Oversized 2.5 L chamber, vented style. Anesthesia inlet connection is to be paired with the chamber-to-tubing adapter and the corresponding tubing. Exhaust outlet connection is a 30 mm OD x 22 mm ID fitting for universal acceptance of current standard evacuation.

System Accessories

The system accessories are used to power the system, and form connections between the anesthesia unit, imaging system(s), and induction chamber.



Figure 8. System Accessories

Table 8. System Accessories	
Part	Description
Standard 10' oxygen hose, color coded, reinforced with DISS female fittings on each end	Connects the O2 Supply Input to an appropriate oxygen supply output.
12 V power converter with multiple socket connections to create a universal fit for worldwide, universal connection	Powers the system and offers various connections to accommodate a universal fit. Connects the 12 VDC input to the wall outlet, using the appropriate socket connection.
Four (4) semi transparent, colored, 6' long, 1/4" ID tubes for fresh gas delivery	Connects the anesthesia outputs to the imaging system(s) and/or induction chamber. Tubing should be connected to match the corresponding color of the sleeve in each connector.
Three (3) opaque, colored, 6' long, 1/4" ID tubes for vacuum collection	Connects the vacuum outputs to the imaging system(s). Tubing should be connected to match the corresponding color of the sleeve in each connector.
One (1) black, 6' long Anprolene, 1/4" ID tube with male CPC connector for FMT	Connects the FMT Output to an FMT Imaging Cassette.

Table 8. System Accessories

Part	Description
Transparent, 6' long, 30 mm diameter smooth bore tubing for chamber evacuation	Connects the Chamber Exhaust to the exhaust outlet of the induction chamber.
Two (2) VaporGuard XL-R canisters	Refillable filters (can also be used as disposable) containing carbon for waste gas scavenging. Connects directly into the Waste Gas Out port.
Four (4) SMC port plugs	Plugs unused Anesthesia and Vacuum Outputs to prevent accidental anesthesia leakage.

NOTE

All colored tubing is of urethane construction to eliminate breakdown during use.

Specifications

This section lists the technical specifications for the RAS-4 Rodent Anesthesia System. Technical specifications are subject to change without notice.

Specifications for components in this section:

- [Chassis on page 21](#)
- [Anesthetic Delivery on page 21](#)
- [Exhaust System on page 22](#)
- [Environmental on page 22](#)
- [Electrical on page 22](#)

Chassis

Carrying handle	8.5" (22 cm)
Size (H x W x L)	18" (46 cm) x 14" (35cm) x 25" (64 cm)
Weight	31 lbs (14 kg)

Anesthetic Delivery

Inlet pressure	50-60 PSI
Internal regulator	Up to 6 PSI
Pressure gauge	0-15 PSI
Circuits (4 total)	• Two served by a 0-4 LPM flowmeter, including ON/OFF switch. • Two with pre-set flows of 500 cc/min and 1000 cc/min, including a toggle switch.
Dedicated FMT quick connect outlet	1000 cc/min pre-set flow
Isoflurane Vaporizer	Variable by-pass, temperature compensated with pin-indexed fill port

Exhaust System

Vacuum pump	9 LPM, 12 VDC, 0.86 A, 10.3 W
Circuits (3 total)	Served by a 0-5 LPM flowmeter, including ON/OFF switch
Exhaust Blower	14 CFM, 12 VDC, 0.90 A, 10.8 W

Environmental

Operating Temperature	59° to 78°F (15° to 25°C) ^a
Operating Humidity	0-80% relative humidity, noncondensing
Storage Temperature	59° to 78°F (15° to 25°C)
Storage Humidity	0-80% relative humidity, noncondensing
Pollution Degree	2
Altitude	Up to 2000m (6560ft.)
Indoor Use Only	

a. Ambient temperature should not vary more than 4°F (2°C) over 24 hours.

Electrical

One clean, grounded AC power outlet for the instrument must be located within 6 feet (2 m) of the location. Unit is supplied with a 12V power transformer and multiple socket connections.

Input Voltage	100 to 240 VAC ($\pm 10\%$), 500 W, 50/60 Hz System does not have transient over voltage protection.
Output Voltage	12 V, 2.5 A

Operation

This section includes the following general instructions for using the RAS-4 Rodent Anesthesia System:

- [Unpacking the System on page 24](#)
- [Installing the RAS-4 on page 25](#)
- [Flow Charts on page 29](#)
- [Turning ON the Main Power on page 30](#)
- [Anesthesia Parameters on page 32](#)
- [Turning ON the Anesthesia Delivery Ports on page 33](#)
- [Using the Exhaust System on page 35](#)
- [Shutting Down the System on page 36](#)
- [Vaporizer Filling Procedure - Warnings on page 37](#)
- [Filling the Vaporizer on page 38](#)
- [Draining the Vaporizer on page 43](#)

Unpacking the System

- 1 Examine the shipping carton for signs of external damage.



Figure 9. RAS-4 Shipping Container

- 2 Unpack all items. Retain and store the original shipping cartons and materials in case the RAS-4 system needs to be reshipped.
- 3 Inspect the anesthesia system and accessories for signs of damage that may have occurred during shipping. If damage is discovered, immediately file a claim with the carrier and notify Revvity Customer Care (see [page 2](#)).



Figure 10. RAS-4 System and Components

- 4 Compare the quantities received to quantities shown on the packing list. Immediately report any discrepancies to Revvity Customer Care (see [page 2](#)).

Installing the RAS-4

- 1 Place the RAS-4 in the desired location.

NOTE



This system is able to be placed on a bench top, wall mounted, or attached to an optional Mobile Frame.

- 2 Connect the oxygen supply to the O2 Supply Input Port on the left hand side of the machine. The inlet supply pressure should be between 50-60 PSI.

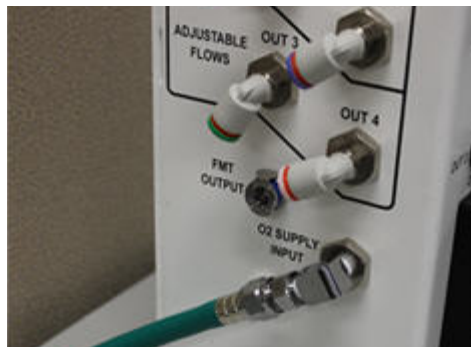


Figure 11. O2 Supply Input

WARNING



Use only oxygen regulated to 50-60 PSI as the carrier gas. Always adhere to proper Diameter Index Safety System (DISS) hose connections. Failure to comply will void your warranty and could compromise user and/or patient safety.

NOTE



Tubing connections are as necessary, with one input to each source. Insert SMC Port Plugs into the unused Anesthesia and Vacuum Outputs, as necessary.

NOTE



It is suggested to pair the tubing to match the color of the sleeve in each connector.

Installing the RAS-4 (Continued)

- 3 Connect the red, transparent tubing to the Out 1 port. Connect the other end to the desired Gas In port or Gas Inlet port of the desired instrument or insert an anesthesia port plug into Out 1.
- 4 Connect the blue, transparent tubing to the Out 2 port. Connect the other end of the desired Gas In port of the second instrument or insert an anesthesia port plug into Out 2.
- 5 Connect the green, transparent tubing to the Out 3 port. Connect the other end to the Gas In port of the third instrument or insert an anesthesia port plug into Out 3.
- 6 Connect the clear, transparent tubing to the Out 4 port. Connect the chamber adapter to the end of the clear, transparent tubing.

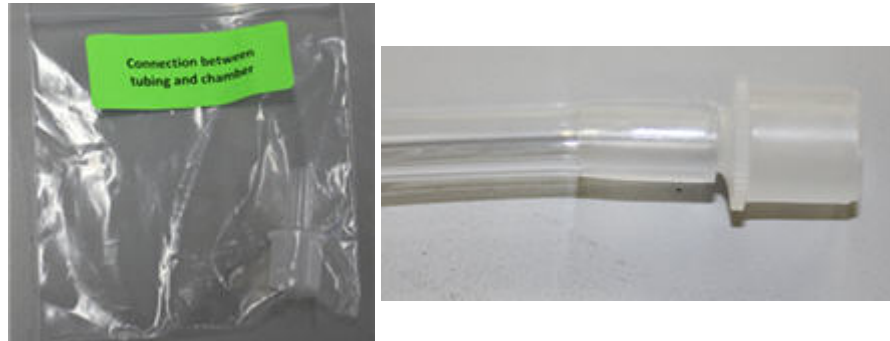


Figure 12. Connection Between Tubing and Chamber Adapter

- 7 Connect the clear, transparent tubing and chamber adapter to the induction chamber.

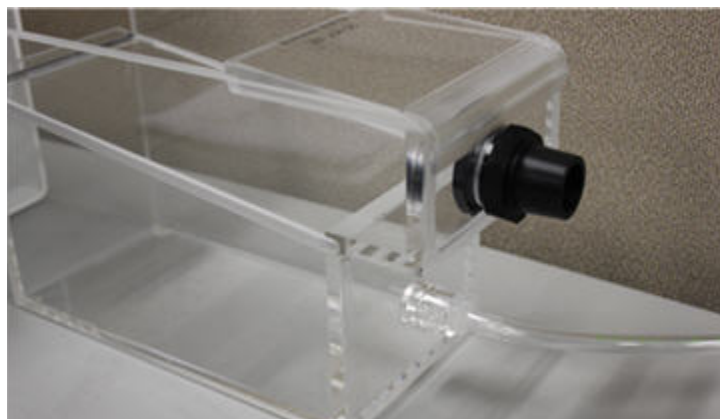


Figure 13. O2 Induction Chamber Input

Installing the RAS-4 (Continued)

- 8 Connect the black tubing to the FMT Output. Connect the other end to the Gas In port on the back of an FMT instrument.

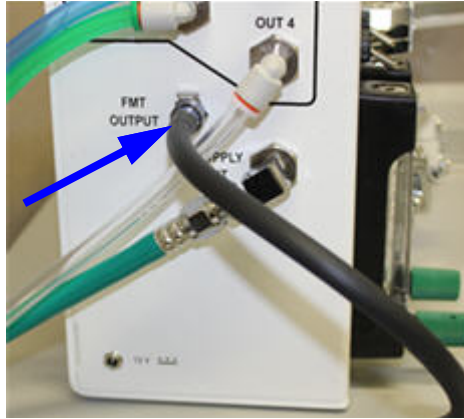


Figure 14. FMT Output Connection

- 9 Using the opaque, colored tubing, form a connection between the Vacuum Outputs and imaging system(s), or plug the port using the SMC port plugs, as required.

NOTE



It is suggested to pair the tubing to match the color of the sleeve in each connector, and the colored input tubing color.

- 10 Using the transparent, smooth bore 30 mm tubing, form a connection between the Chamber Exhaust and the exhaust outlet of the induction chamber.



Figure 15. Chamber Exhaust Connections

Installing the RAS-4 (Continued)

- 11 Mount one of the VaporGuard XL-R canisters into the Waste Gas Out port or to a suitable scavenging system.



Figure 16. VaporGuard XL-R Canister Mounted

WARNING



Verify all connections have been secured before turning ON the system.

Flow Charts

Gas Flow Chart

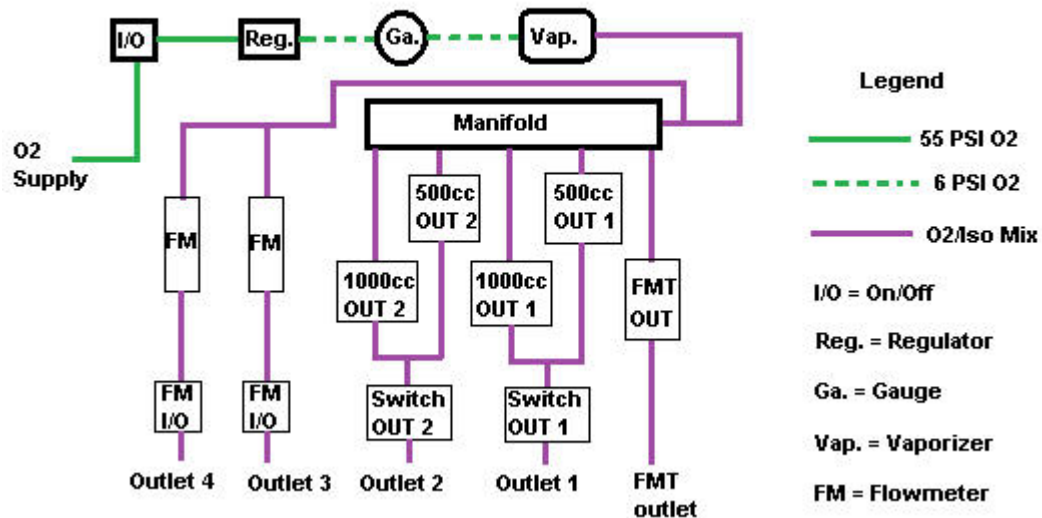


Figure 17. Gas Flow Chart

Exhaust Flow Chart

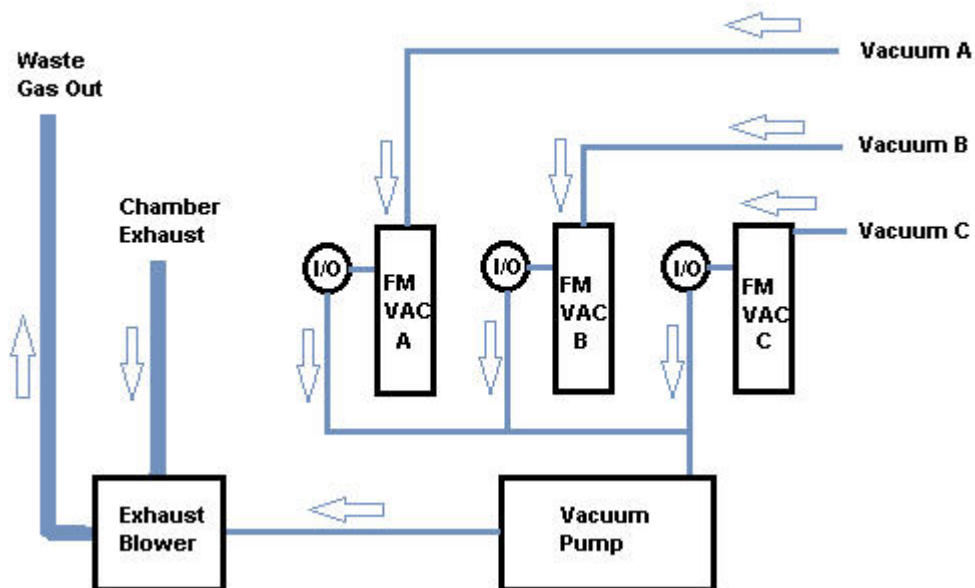


Figure 18. Exhaust Flow Chart

Turning ON the Main Power

- 1 Attach the appropriate plug assembly to the power transformer to match the power receptacle in your lab.

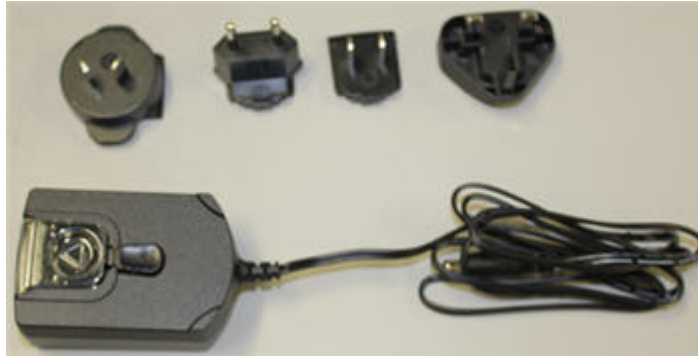


Figure 19. Power Assembly

- 2 Connect the included transformer to the 12 VDC female port on the left hand side of the system. Only use the plug assembly that was supplied with the system.

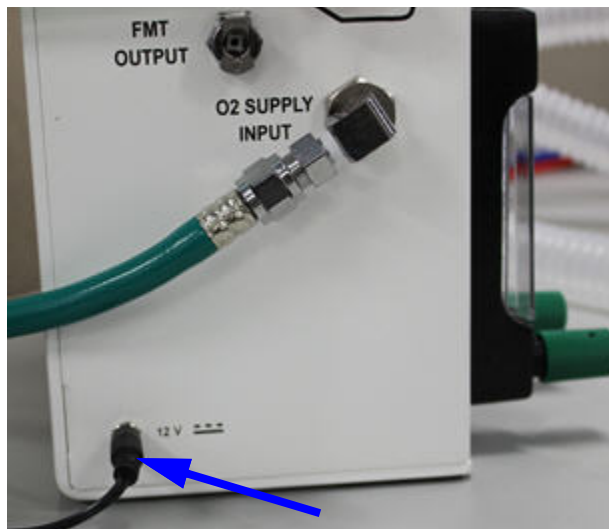


Figure 20. 12V Power Input

WARNING



- Use only the power converter supplied with the RAS-4 Rodent Anesthesia System. Do not substitute. If the correct power converter was not provided, contact Revvity Customer Care ([page 2](#)) to order a replacement.
- Use only a properly grounded power outlet when connecting the system to power.

Turning ON the Main Power (Continued)

- 3 On the front of the machine, turn the O2 Master Switch to the ON position (up). When the switch is activated, pressure will be indicated by the System Pressure gauge. The pressure should be 6 PSI +/- 0.5 PSI.

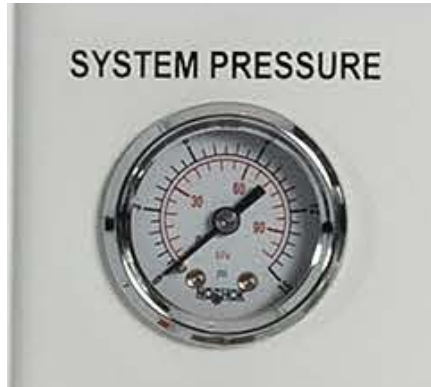


Figure 21. System Pressure Gauge

WARNING



If the System Pressure gauge is not in the 6PSI +/- 0.5PSI range, do NOT use the RAS-4 system. Contact Revvity Customer Care ([page 2](#)) for assistance.

Anesthesia Parameters

Anesthesia delivery can be performed with a compatible Revvity Imaging instrument, or the induction chamber.

Most mice and rats are able to be successfully anesthetized using the following parameters.

NOTE



Anesthesia amounts will differ based on mouse or rat variables. Use the parameters below only as a baseline.

Table 9. General Mouse Anesthesia Parameters

Induction Chamber	Flowrate	1000 cc/min
	Vacuum	5 LPM with full Vacuum ON
	Concentration	2.5%
Instrument	Flowrate	1000 cc/min
	Vacuum	5 LPM with full Vacuum ON
	Concentration	2.5%

Table 10. General Rat Anesthesia Parameters

Induction Chamber	Flowrate	1000 cc/min
	Vacuum	5 LPM with full Vacuum ON
	Concentration	3%
Instrument	Flowrate	1000 cc/min
	Vacuum	5 LPM with full Vacuum ON
	Concentration	3%

Turning ON the Anesthesia Delivery Ports

Four separate anesthesia delivery ports supply oxygen and anesthetic to your animals:

- [Adjustable Flow Circuits](#) (2)
- [Pre-set Flow Circuits](#) (2)

Adjustable Flow Circuits

Two circuits incorporate a flowmeter and an ON/OFF switch.

To use the flowmeter circuits:

- 1 Turn the corresponding switch to the ON position (up).

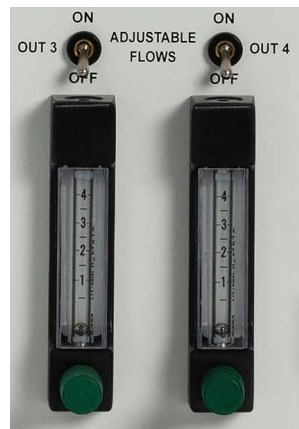


Figure 22. Adjustable Flows Controls

- 2 Rotate the flow control knob counter-clockwise to increase the flow.
- 3 Measure flow at the center of the bobbin (ball). You may flip the switch to the OFF position (down) to immediately stop the flow, or rotate the flow control clockwise to decrease the flow.

Pre-set Flow Circuits

Two additional circuits deliver flow to corresponding ports. The circuits are pre-set flow devices with no corresponding flowmeters.

To deliver 500 cc/min or 1000 cc/min to a pre-set flow circuit:

- 1 Flip the switch to the up position to deliver a pre-set flow of 500 cc/min. This rate will flow regardless of downstream restriction or resistance. This is especially useful in imaging systems where tubing runs are long, or perhaps restricted by smaller diameter tubing.

Pre-set Flow Circuits (Continued)

- 2 Return the switch to the center position to stop the flow to that circuit.



Figure 23. Pre-set Flows Switches - Center Position

- 3 Flip the switch to the down position to deliver a pre-set flow of 1000 cc/min.
- 4 Return the switch to the center position to stop the flow to that circuit.

FMT Connector

A port for an FMT Imaging Cassette is incorporated into the system. This port uses a standard CPC fitting and can be connected to the FMT constantly. The port will deliver 1000 cc/min of gas mixture when the cassette is engaged in the FMT system. When the cassette is removed from the FMT, all flow ceases.

NOTE



Any vacuum port may be used to scavenge any circuit in use. You do not have to dedicate one vacuum port for an individual circuit. You may find it easier to do so, but the design of the system is to take advantage of various scenarios where things change and where flexibility is paramount. Colored tubing and connector sleeves are supplied to assist in circuit identification. Turning on all of the vacuum ports will distribute the scavenging capabilities across all of the used ports. Turn the scavenging ports off if they are not in use.

Using the Exhaust System

Two separate components create evacuation within the Rodent Anesthesia System: the vacuum pump and the exhaust blower. Both are controlled by a single switch located on the front panel indicated by the Vacuum Pump Master Switch.

- 1 Turn the Vacuum Pump Master Switch to the ON position. A green LED illuminates and you should hear the action of the vacuum pump and exhaust blower.
- 2 The pump and blower scavenge the waste gas from the individual anesthesia circuits and from the induction chamber. All the gas is collected and vacated out of a single 30 mm port at the top of the unit. This port should be connected to a carbon filter, a hood, or other suitable collection device.

Using the Individual Vacuum Channels

Three flowmeters above the vaporizer are connected to a vacuum pump. To use a vacuum channel:

- 1 Turn the corresponding switch to the ON position (up).
- 2 Rotate the flow control knob counter-clockwise to adjust the volume of vacuum in the channel. ON/OFF switches are included to allow flow rates to be pre-set and only toggled with the switch.

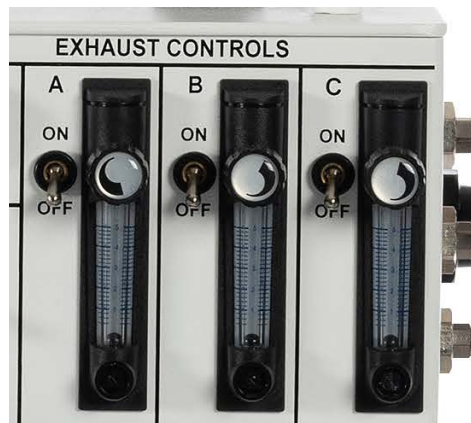


Figure 24. Exhaust Controls

- 3 Always monitor your settings to assure the proper vacuum is present. The different vacuum ports are marked to make identification of ports easier to follow, similarly with the anesthesia ports.

Chamber Scavenging

The system uses Rodent's Zero Pollution Vented Induction Chambers. An exhaust fan is present, generating 12 CFM flow. The exhaust flow to this port is constant as long as the Vacuum Pump Master Switch is activated and the green LED is illuminated. There is no adjustment necessary for the exhaust blower. Animals may be introduced and removed from the induction chamber while fresh gas is flowing

Shutting Down the System

To shut down the system:

- 1 Rotate the Vaporizer to the OFF position.



Figure 25. Vaporizer in the OFF Position

- 2 Turn each individual circuit switch to the OFF position (down).

WARNING



If all circuits are not switched OFF, unintended use of oxygen and isoflurane may occur. Exposure to high concentrations of waste anesthetic gases are potentially hazardous and can cause illness.

- 3 Turn OFF the O2 Master Switch to stop all supply gases to the system.
- 4 Turn OFF the Vacuum Pump Master Switch. The green LED turns off.

Vaporizer Filling Procedure - Warnings

WARNING



Do not fill the vaporizer with liquid isoflurane agent while the RAS-4 system is pressurized with the oxygen supply. Prior to refilling, turn off the oxygen supply and turn the pre-set flow Out 1 and 2 to 1000 cc/min, and Out 3 and 4 to the ON position. Flow has stopped when the rotameter ball is at the bottom of the indicator tubes for Out 3 and 4. When the flow has stopped, refill the vaporizer.

WARNING



Do not fill the vaporizer unless the vaporizer dial control is in the OFF position. Do not turn the dial ON during filling, or turn on any of the oxygen supply valves.

WARNING



Use only isoflurane. Do not use any anesthetic gas other than isoflurane. Operating the RAS-4 system with other anesthesia agents may result in serious injury.

WARNING



Failure to appropriately ventilate the area around the RAS-4 system may expose users to waste anesthesia gas. It is recommended that appropriate personal monitoring equipment be used in accordance with the guidelines established by the user's safety committee or organization. When draining the vaporizer of isoflurane, use a properly marked and chemically resistant storage container, and follow draining procedures provided in the vaporizer manufacturer's manual.

WARNING



Use the RAS-4 only in the upright position.

Filling the Vaporizer

The RAS-4 system is equipped with a key-filled vaporizer. A key-filled vaporizer requires a specially configured bottle adapter that only fits an isoflurane bottle. In addition, the vaporizer fill port is designed to accept only the unique key of the isoflurane bottle adapter. Other bottle adapters are made for other anesthetic agents, and should never be used or modified to fit the RAS-4 isoflurane vaporizer. In addition to preventing filling the vaporizer with the wrong anesthetic agent, the key-filled system reduces exposure to the agent during the filling procedure. The RAS-4 system is supplied with the correct isoflurane bottle adapter.

NOTE



If a different agent is desired, contact Revvity Customer Care ([page 2](#)) for assistance.

WARNING



*The vaporizer on the Rodent Anesthesia System is specific to the system and **MUST NOT** be used as a component on any other anesthesia system or device.*

Filling the Vaporizer (Continued)

The vaporizer uses oxygen that is pressurized up to 6 PSI. Before removing the cap to refill the vaporizer the internal pressure must be relieved.

- 1 Review the warnings in [Vaporizer Filling Procedure - Warnings on page 37](#) on how to fill the pressurized vaporizer using only isoflurane in the vaporizer, and the other safety warnings.
- 2 Make sure that the oxygen is turned off at the source or supply regulator.



Figure 26. Oxygen Regulator

- 3 Turn the dial of the vaporizer to any point within the delivery range of the vaporizer, 0-5%.
- 4 Use the flowmeters or pre-set switches to bleed residual oxygen from the system. Turn any or all to 1000 cc/min and wait for flow to cease.
- 5 Ensure the System Pressure gauge reads zero (0).

WARNING



Do NOT fill the vaporizer port if the System Pressure gauge reads any number other than 0. Any pressure within the system may result in agent being violently expelled from the fill port, splashing liquid agent on the clothes, skin or eyes, and resulting in gross pollution of the room. If this occurs, vacate the room immediately and seek first aid and medical attention as needed.

Filling the Vaporizer (Continued)

- 6 Set the Vaporizer to the OFF position.



Figure 27. Vaporizer

- 7 Switch the O2 Master Switch to the OFF position (down).



Figure 28. O2 Master Switch

NOTE



The key-filled system requires three keyed elements. The isoflurane bottle is equipped with a special collar that only permits an isoflurane bottle adapter to screw on. The fill and drain ports on the vaporizer only accept the special key that is unique to the isoflurane bottle adapter (Figure 29).



Figure 29. Isoflurane Bottle Adapter

Filling the Vaporizer (Continued)

NOTE



Perform [step 8](#) under a laboratory fume hood or in accordance with your organization's procedures for handling anesthetic agents.

- 8 Remove the cap and seal from the isoflurane bottle and make sure that the bottle neck is not chipped or damaged. Fit the keyways of the bottle adapter to the keys of the bottle collar. Screw them together until fully tightened. The bottle is ready for filling the vaporizer.
- 9 Confirm that the RAS-4 system is completely depressurized and that the vaporizer is in the OFF position. Turn the top retaining screw on the vaporizer filling unit counter-clockwise. Position the RAS-4 system so that the front legs are set one inch (1") from the edge of the work bench. Remove the dummy filler plug.
- 10 Hold the bottle upright, but below the filler socket, and bend the adapter so that its end is horizontal. The two holes on the key should be facing downwards. Insert the key into the filler socket port.
- 11 After inserting the key, turn the top retaining screw clockwise to tighten it and seal the filler adapter in the vaporizer filler socket ([Figure 30](#)).



Figure 30. Bottle Adapter Key

- 12 Raise the bottle above the level of the filler socket without kinking the adapter tube. A steady stream of bubbles should emerge from the adapter inner tube within two seconds. If this does not occur, remove the bottle and adapter from the vaporizer, and see [step a](#).

Draining the Vaporizer

- 1 Draining the key-filled vaporizer also uses the keyed bottle adapter. Before draining the vaporizer, make sure that the oxygen is off at the source, the vaporizer is set to OFF, and the RAS-4 system has been depressurized. (For more details, see [step 2](#) to [step 4](#) of [Filling the Vaporizer on page 38](#).)

WARNING



To access the bottom retaining screw, the RAS-4 may need to be tilted back and supported to gain clearance. The RAS-4 system is heavy, so make sure that your fingers are not in danger when propping up the module.

- 2 Fit the bottle adapter onto an empty isoflurane bottle. Prop up the front of the RAS-4 with small books or similar objects, if necessary.
- 3 Insert the bottle adapter with its two holes facing upwards into the drain socket ([Figure 32](#)). Tighten the bottom retaining screw.



Figure 32. Draining the Vaporizer

- 4 Verify the bottle is below the level of the drain socket and the tube is not kinked. Remove the prop under the RAS-4 so that the vaporizer is level and can properly drain.

WARNING



Make sure that the vaporizer has been depressurized.

- 5 For draining purposes (and to allow air to vent), unscrew the top retaining screw and remove the dummy filler plug from the filler socket.

Draining the Vaporizer (Continued)

- 6 Open the front drain valve screw by turning it counter-clockwise. Allow the vaporizer to drain.



Figure 33. Drain Valve Screw

- 7 If it is not possible to complete the draining process, close the drain valve, loosen the bottom retaining screw, then remove the bottle and adapter from the vaporizer drain socket.

WARNING



Perform the procedure in [step 8](#) under a laboratory fume hood or in accordance with your organization's procedures for handling anesthetic agents.

- 8 Remove the adapter from the bottle. Carefully shake the adapter two or three times to clear the tube, then reassemble and repeat [step 2](#) to [step 6](#).
- 9 When draining is complete, close the drain valve (clockwise), loosen the bottom retaining screw (prop up the RAS-4 system if necessary) and remove bottle and adapter. Replace the dummy filler plug in the fill socket and fully tighten the top retaining screw in a clockwise direction.

Maintenance

This section includes procedures that are to be performed periodically, either to make the RAS-4 system run better, or to protect components from damage.

The equipment must be periodically checked, calibrated, maintained and/or, components repaired or replaced when necessary for equipment to operate reliably. Parts that have failed in whole or in part, exhibit excess wear, are contaminated, or are otherwise unfit for use, should be immediately discarded and replaced. To maintain the warranty, replacement parts must be installed or supplied only by Revvity qualified service personnel. If replacements are needed, contact Revvity Customer Care (see [page 2](#)).

The following sections are included in this manual:

- [Cleaning the Induction Chamber on page 46](#)
- [Cleaning the System on page 46](#)
- [Tubing on page 46](#)
- [Lubricants on page 46](#)
- [Annual Preventative Maintenance on page 46](#)
- [Calibration on page 46](#)
- [Replacing the Vaporizer on page 47](#)

Cleaning the Induction Chamber

- Do not use alcohol or ammonia on the chamber.
- Use warm water and soap for initial cleaning.
- Nolvasan solution or Clidox diluted to manufacturer's recommendations may be used as a disinfectant.
- Check daily for condition of gasket and replace as needed. If replacement is needed, contact Revvity Customer Care (see [page 2](#)).

Cleaning the System

- Do not use harsh or abrasive cleaners.
- Wipe with a damp cloth to clean.
- The RAS-4 is coated with a baked-on finish that will withstand most cleaning/disinfectant solutions. If a solution is to be used, it is recommended you initially test its effect on an inconspicuous spot of the finish.

Tubing

These products are disposable and will deteriorate with age and use. They should be inspected prior to each use for kinks, holes and general wear. Contact Revvity Customer Care if replacement is needed (see [page 2](#)).

Lubricants

DO NOT USE PETROLEUM BASED LUBRICANTS. If you must use a lubricant, use only a silicone-based product.

Annual Preventative Maintenance

Annual preventive maintenance and certification is recommended to ensure proper operation.

Calibration

Calibration procedures should only be performed by an authorized service center or third party company. Revvity does not provide Calibration Services.

Replacing the Vaporizer

The vaporizer may need to be changed when the vaporizer is no longer delivering within the expected parameters. Below are the instructions to replace the vaporizer.

Tools needed

- 5mm Allen wrench
- Channel lock pliers

Removing the Vaporizer

- 1 Shut down the system,
- 2 Perform the draining procedure, see [Draining the Vaporizer on page 43](#).
- 3 Disconnect the slip fit Output tubing using the channel lock pliers.



Figure 34. Vaporizer Output

- 4 Remove the two rear bolts with a 5mm Allen wrench (see [Figure 35](#)).

NOTE



Use care when removing the screws. Do not drop the vaporizer or spacer. Do not pull the vaporizer as tubing is still connected.

Removing the Vaporizer (Continued)



Figure 35. Vaporizer Bolts

- 5** Remove the slip fit input fitting from the vaporizer using the channel lock pliers.



Figure 36. Vaporizer Input

- 6** Remove the old vaporizer.



Figure 37. Vaporizer Removed

Installing the Vaporizer

- 1 Attach the slip fit fittings for the input to the new vaporizer.
- 2 Place the spacer with the holes to the top, and run the bolts through the spacer.

NOTE



The bolts must be placed in adjacent holes.

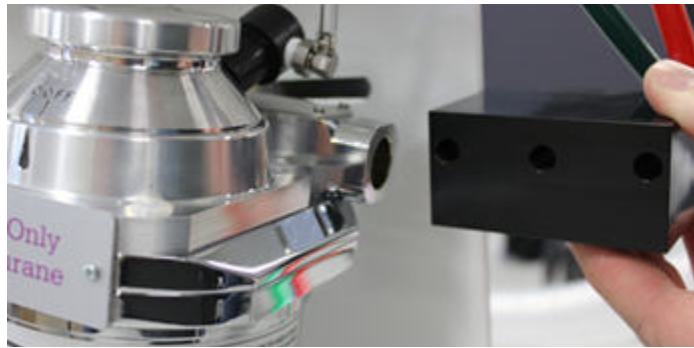


Figure 38. Vaporizer Spacer

- 3 Press the vaporizer against the spacer and thread the bolts.
- 4 Verify the bottom of the vaporizer is parallel to the unit.
- 5 Hand tighten the bolts.
- 6 Connect the Slip Fit output tubing to the vaporizer.

Troubleshooting

Below are possible troubleshooting causes and solutions.

Leaks or Reduced Flow

If, at anytime, an isoflurane leak occurs within the RAS-4 system, turn OFF the oxygen supply immediately and contact Revvity Customer Care.

You can repair leaks in other external parts of the system, such as the tubing or connections. Use a suitable leak detection agent.

If the flow is reduced, but no leaks are heard or detected, make sure that the tubing is not kinked or obstructed. Tighten fittings or replace cracked or damaged tubing as needed.

For suspected leaks indicated by reduced flows, isolate parts of the system in order to determine the location of the possible leak or obstruction. Check areas that are frequently handled, such as the connections to the manifold, or kinked hoses leading to the Induction Chamber/imaging system.

Change in the Time Required for Animal Induction

Changes in the usual time required to anesthetize animals, assuming that all the flows are normal and no leaks are detected, may indicate the need for vaporizer repair or other RAS-4 system service, contact Revvity Customer Care ([page 2](#)).

Rodent is waking up from anesthesia early

Possible Cause	Solution
The rodent was not exposed to anesthesia long enough.	Allow the anesthesia to wear off before anesthetizing the rodent.
The rodent has been out of anesthesia longer than expected.	Re-anesthetize the rodent.
Isoflurane may be leaking and the rodent is not receiving enough anesthesia.	Turn OFF all gas flow immediately. • Verify all tubing connections are secure. • Verify isoflurane is flowing properly.
The Vaporizer is out of calibration.	Remove the Vaporizer using Replacing the Vaporizer on page 47 , and send for calibration.

Green LED doesn't illuminate

Possible Cause	Solution
Power might be disconnected.	Verify all power connections are secure.

Consumable Parts

This section includes consumable parts that can be ordered from Revvity.

Description	Part Number
VaporGuard XL-R canister, refillable	CLS148220
VetEquip Disposable Charcoal filter	CLS148221
Induction Chamber	CLS148208
Vaporizer	CLS148206
Power Plug, Switching Power supply, 12V	CLS148209
Power Pack Adapters, multi-national (4)	CLS148211

Tubing

Description	Part Number
Standard 10' oxygen hose, color coded, reinforced with DISS female fittings on each end	CLS148222
Transparent, 6' long, 30 mm diameter smooth bore tubing for chamber evacuation	CLS148223
Kit - Red Tubing 10ft, Coupler	CLS148229
Kit - Green Tubing, 10ft, Coupler	CLS148233
Kit - Blue Tubing, 10ft, Coupler	CLS148234
Kit - Clear Tubing, 10ft, Coupler	CLS148235
Kit - Tubing Extension	CLS148227
Induction Chamber Tubing Adapter	CLS148224
22mm Adapter, Chamber inlet fitting	CLS148225
Black, 6' long Anprolene, 1/4" ID tube with male CPC connector for FMT	CLS148219
SMC Port Plug	CLS148226

Isoflurane

Isoflurane can be purchased through Veterinary Equipment suppliers.

Index

A		I	
Anesthetic Delivery	14	Induction Chamber	18
Specifications	21	Cleaning	46
Turning ON the Ports	33	Instrument safety	10
C		L	
Calibration	46	Lubricants	
Chassis	13	Maintenance	46
Specifications	21	M	
Chemical Safety	10	Main Power	
Connections	15	Turn ON	30
Controls		Maintenance	
Anesthesia	14	Annual	46
Exhaust System	15	Induction Chamber	46
Customer Support plans	2	Lubricants	46
D		Replacing the Vaporizer	47
Delivery		System Cleaning	46
Anesthetic	14	Tubing	46
Draining the Vaporizer	43	Mechanical	
E		Safety	11
Electrical Safety	11	Mechanical Safety	11
Electrical Specifications	22	MSDS	10
Environmental Specifications	22	P	
Exhaust System	15, 35	Preventative Maintenance	
Specifications	22	Annual	46
F		Calibration	46
Filling the Vaporizer	38	Principle of Operation	9
H		S	
Hardware		Safety	10, 11
Anesthetic Delivery	14	Chemical	10
Chassis	13	Electrical	11
Connections	15	instrument	10
Draining the Vaporizer	43	Mechanical	11
Exhaust Controls	15	Training Required	10
Exhaust System	35	Service plans	2
Filling the Vaporizer	38	Shut Down	
Induction Chamber	18	System	36
System Accessories	19	Specifications	21
Turning ON the Main Power	30	Anesthetic Delivery	21
Unpacking the System	24	Chassis	21
High Voltage	11	Electrical	22
		Environmental	22
		Exhaust System	22
		Support plans	2

System	
Cleaning	46
Exhaust	15
Shut Down	36
Unpacking	24
System Accessories	19
T	
Training Required	10
Tubing	
Maintenance	46
V	
Vaporizer	
Draining	43
Filling	38
Replacement	47
Voltage	11
W	
Waste Disposal	10

Revvity Product Warranty

For a period of one (1) year following installation, the RAS-4 system will perform in material conformance with its published specifications at the time of sale. Parts replaced during a warranty repair may be retained by Revvity, and will be warranted for the longer of the remaining term of the original warranty period, or thirty (30) days from date of replacement. Revvity's sole obligation, and Customer's sole remedy under this warranty, is to correct or replace, at Revvity's option, any non-conforming components of the RAS-4 system at Revvity's expense, including parts, labor and travel expenses related to maintenance and corrective service, during such one (1) year warranty period.

No coverage or benefits shall be provided under this Limited Warranty if any of the following conditions apply:

- a** The RAS-4 Rodent Anesthesia System has been subjected to abnormal use, abnormal conditions, unauthorized modifications (e.g., unauthorized installation of hardware or software), unauthorized repair or servicing, misuse, neglect, abuse, accident, alteration, any use inconsistent with, or in contradiction to, the instructions in this manual, or other acts which are not the fault or responsibility of Revvity.
- b** Revvity was not advised in writing by the Customer of the alleged defect or malfunction of the System within thirty (30) days after discovery of the alleged defect.

If a problem develops during the Limited Warranty period, Customer must contact Revvity Customer Care for assistance.

THE FOREGOING LIMITED WARRANTY IS CUSTOMER'S SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. REVVITY SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF ANTICIPATED BENEFITS OR PROFITS, LOSS OF SAVINGS OR REVENUE, PUNITIVE DAMAGES, LOSS OF USE OF THE SYSTEM OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF ANY SUBSTITUTE EQUIPMENT OR FACILITIES, DOWNTIME, THE CLAIMS OF ANY THIRD PARTIES, INCLUDING CUSTOMERS, AND INJURY TO PROPERTY, RESULTING FROM THE PURCHASE OR USE OF THE RAS-4 RODENT ANESTHESIA SYSTEM OR ARISING FROM BREACH OF THE WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, STRICT TORT, OR ANY OTHER LEGAL OR EQUITABLE THEORY, EVEN IF REVVITY KNEW OF THE LIKELIHOOD OF SUCH DAMAGES. REVVITY SHALL NOT BE LIABLE FOR DELAY IN RENDERING SERVICE UNDER THE LIMITED WARRANTY, OR FOR LOSS OF USE DURING THE PERIOD THAT THE RAS-4 RODENT ANESTHESIA SYSTEM IS BEING REPAIRED. REVVITY'S LIMIT OF LIABILITY UNDER THE LIMITED WARRANTY SHALL BE THE PURCHASE PRICE OF THE RAS-4 SYSTEM. REVVITY SHALL NOT BE LIABLE FOR ANY OTHER LOSSES OR DAMAGES.

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