HALLOWELL EMC
Hallowell Engineering & Manufacturing Corporation

MicroVent-II

Dual Mode Veterinary Ventilator
IPPV / HFOV

Operating Manual

info@hallowell.com www.hallowell.com P. 413.445.4263 F. 413.496.9254 35 Downing Industrial Park, Pittsfield, MA 01201

USER/OWNER RESPONSIBILITY

PLEASE READ THIS MANUAL BEFORE OPERATING YOUR MICROVENT 1

This **Hallowell EMC** equipment is designed to function, as specified in this manual when operated and maintained in accordance with supplied instructions. This equipment must be periodically checked, maintained and components repaired and replaced when necessary for equipment to operate reliably. Parts that have failed, in whole or in part, exhibit excessive wear, are contaminated, or are otherwise at the end of their useful life, should not be used and should be replaced immediately with parts supplied by **Hallowell EMC** or parts which are approved by **Hallowell EMC**. Equipment that is not functioning correctly should not be used. This equipment and any of its accessories or component parts should not be modified.

The user/owner of this equipment shall have the sole responsibility and liability for any damage or injury to patients or property (including the equipment itself) resulting from operation not in accordance with that described in this manual or with maintenance not in accordance with authorized maintenance instructions, unauthorized repair or modification of the equipment or accessories, or from the use of components or accessories that have either been damaged or not authorized for use with this equipment by **Hallowell EMC**.

WARNINGS AND CAUTIONS

Personnel operating the MicroVent-II must become thoroughly familiar with the instruction manual prior to using the device with patients.

- **DO NOT** remove the back cover of the MicroVent-II. Refer all servicing to an authorized service technician.

- **DANGER** - Possible explosion hazard if the unit is used in the presence of flammable anesthetics.

- Before using the MicroVent-II check that all connections are correct, verify that there is no leak in the system and that the unit is functioning properly.

- Any problems arising from an improperly functioning scavenging system is solely the user's responsibility.

- **OPENING THE UNIT BY UNAUTHORIZED PERSONNEL AUTOMATICALLY VOIDS ALL WARRANTIES AND SPECIFICATIONS. THE PREVENTION OF TAMPERING WITH THE UNIT IS EXCLUSIVELY THE USER'S RESPONSIBILITY: THE MANUFACTURER ASSUMES NO LIABILITY FOR ANY MALFUNCTION OR FAILURE OF THE MICROVENT 1 IF THE UNIT'S SEAL IS BROKEN.**

WARRANTY

The **Hallowell EMC MicroVent-II Veterinary Ventilator** is covered under the warranty expressed on the warranty card attached to the unit at the time of sale to the end user, which reads as follows:

HALLOWELL EMC

ONE YEAR LIMITED WARRANTY

This unit is warranted by **HALLOWELL EMC** to be free of defects in material and workmanship for a period of 1 (one) full year from invoice date of original purchase.

This warranty does not cover unit damaged by abuse or where unit is operated outside the normal operating conditions. The defective part will be repaired or replaced at our option when sent postage prepaid, insured to **HALLOWELL EMC** accompanied by a copy of original invoice. **HALLOWELL EMC** shall not be responsible for any other incidental, contingent or consequential charges or damages.

All conditions of this warranty become null and void should a **VOID** seal be broken.

*THE WARRANTY STATED HEREIN (INCLUDING ITS LIMITATIONS) IS THE ONLY WARRANTY MADE BY **HALLOWELL EMC** AND IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. **HALLOWELL EMC** SHALL NOT BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND.*

Prices, terms, and product specifications are subject to change without notice.

RECEIVING PROCEDURES

1. Inspect carton for signs of damage.

2. Remove all components from the shipping carton. Retain and store both original-shipping cartons for use in the event that the unit has to be shipped. (See "Returning For Service").

3. Inspect the MicroVent-II and accessories for any signs of damage that may have occurred during shipping. If damage has occurred save the shipping container and immediately report damage to Hallowell or the related dealer you purchased the unit through.

Packed by _____ Date ____/____/____ MicroVent-II SN_____

Recv'd by _____ Date ____/____/____ SN verified as _____

The serial number is located on the back of the unit.

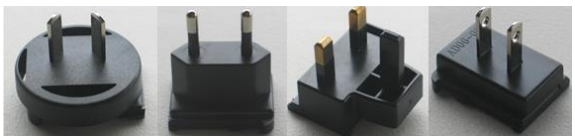
4. Check the items against the packing slip and report discrepancies immediately.

All MicroVent-II shipments include the following:

- **Hallowell EMC MicroVent-II Controller**

- MicroVent-II Power Adapter (PN 090A0276) with **ONE** of the following plugs:
  - US PN 070A0736
  - EURO PN 070A0737
  - UK PN 070A0738
  - AUS PN 070A0739

US EURO UK AUS



- Warranty Card (DOCA5967C)

- Operating Manual (DOCA3662B)

- One 6 mm endotracheal adapter (152A1264)

- One vaporizer bypass tube with quick connectors (000A3798)

Numerous other optional parts may have been shipped with your order also. Please refer to the packing slip for details.

5. **Please** complete and return the enclosed Warranty Registration card.

Preparation and Setup

Set the MicroVent-II on your work surface. If you **DO NOT** plan to use inhalant anesthetics, the unit is shipped with the vaporizer bypass tube, PN 000A3798, seen in the photo to the right, you need not make any changes to this setup. Skip to connection number 3 below.

If you **DO** plan on using inhalant anesthetics continue this setup procedure by making the changes and connections described below:

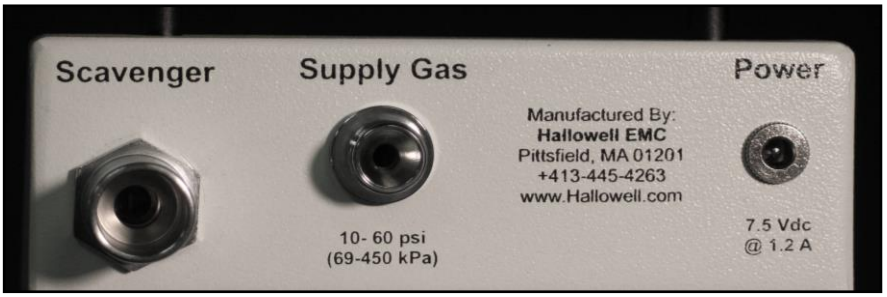
Place the vaporizer of your choice on the work surface to the right of the MicroVent-II. Cut and remove the tubing from the quick connectors on each end of the ventilator bypass tube seen above.

The connections to be made are:

- ✓ On the right-side panel
  1. **TO** the **VAPORIZER**
  2. **FROM** the **VAPORIZER**

The two quick connections are of different sizes. The larger connector should be connected to the inlet of your vaporizer. The smaller should be connected to the outlet of your vaporizer. The hose barbs on these quick connectors are for 1/4" (6 mm) tubing. It is recommended that you connect these quick connects permanently to the correct fitting that attaches to your vaporizer. For cage mount vaporizers use an appropriate length of 1/4" ID tubing, not supplied, and connect the larger quick connect to an FS-2A vaporizer inlet connector and the smaller quick connect to an FS-2 vaporizer outlet connector.

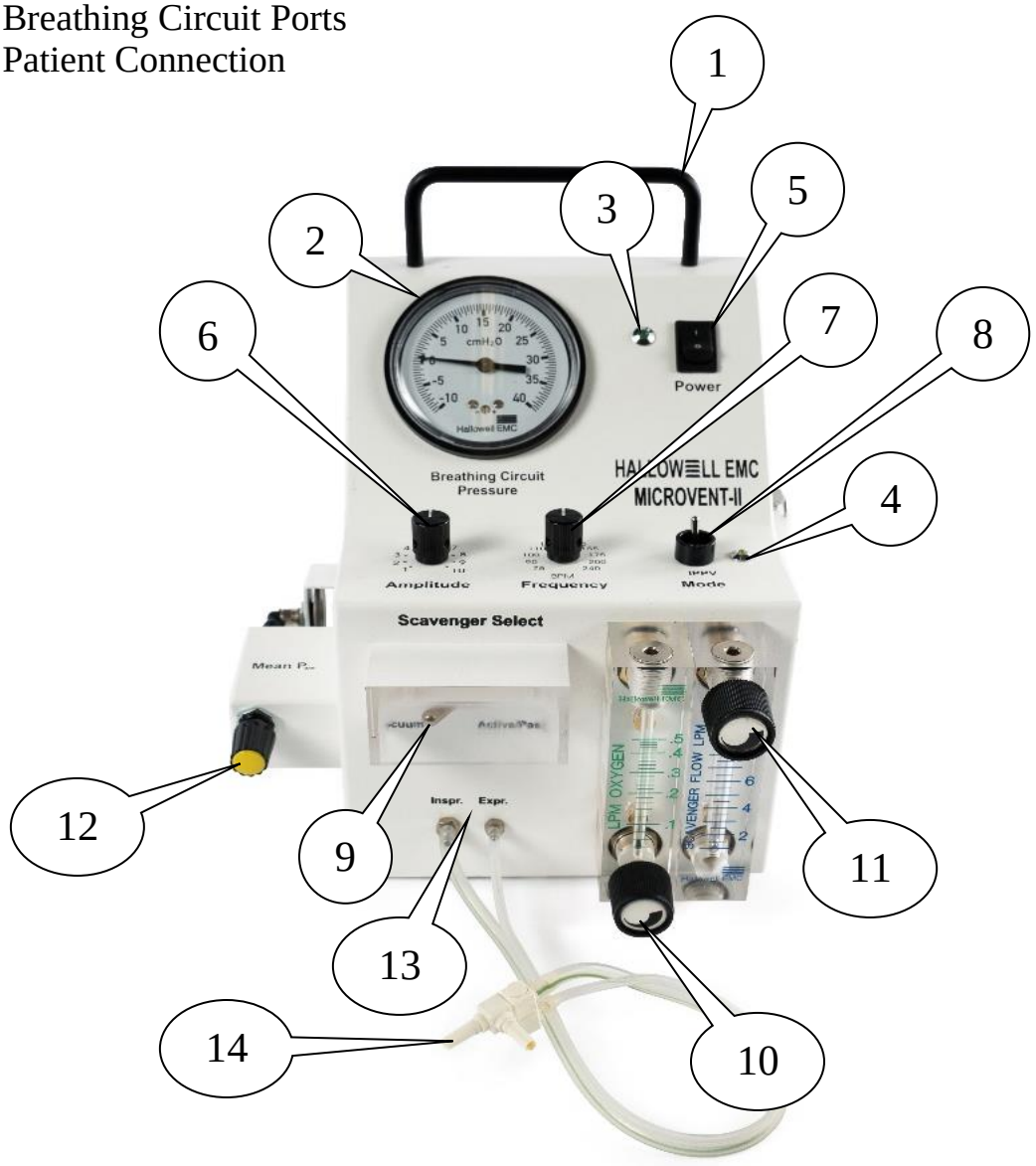
- ✓ In the rear:
  3. **SCAVENGER**
  4. **SUPPLY GAS**
  5. Electrical **POWER**



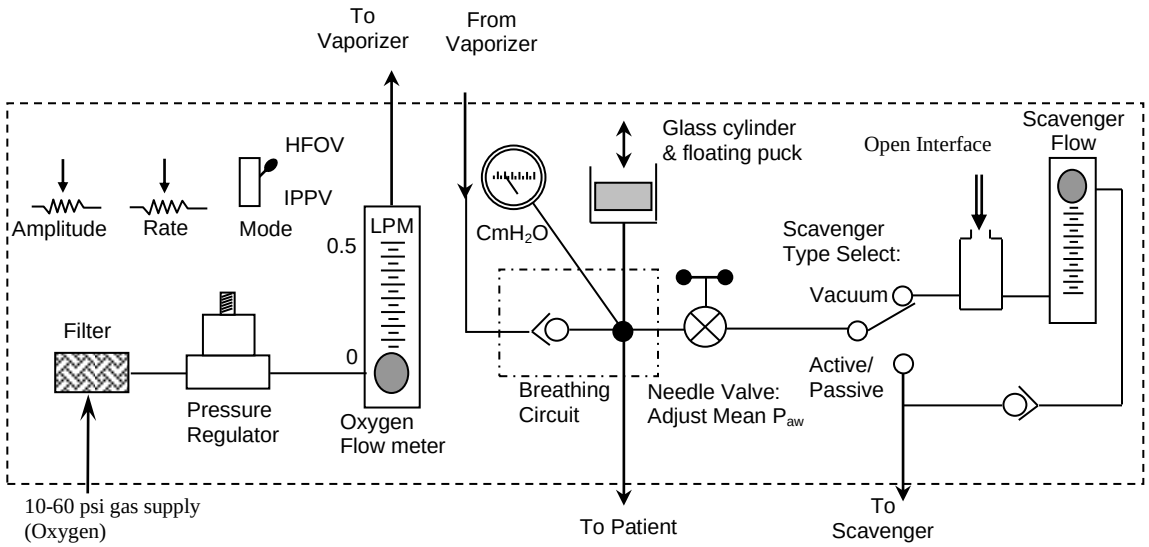
The supply gas connection in the rear is a standard male DISS O_2 connector and should be connected to a 50-psi gas source. The scavenging port will accept either the 19mm scavenger tubing for connection to a standard active or passive scavenging system or a 15mm ET adapter which can be used as a reducer to a smaller tube size if you're connecting the device directly to a vacuum system. A 15mm x 6mm ET tube adapter PN 152A1264 is supplied for this purpose. The electrical power inlet is a low voltage connector for accepting power from the AC adapter provided. AC adapters are available with US (standard), UK, EURO or AUS plug configurations and will accommodate voltages from 100 – 240 VAC at 47 – 63 Hz.

Controls:

1. Handle
2. Breathing Circuit Pressure Manometer
3. Power Indicator
4. Frequency Indicator
5. Power Switch
6. Amplitude
7. Frequency
8. IPPV / HFOV Mode Switch
9. Scavenger Select Switch
10. Oxygen flowmeter
11. Vacuum Scavenging Flowmeter
12. Mean Airway Pressure Adjustment
13. Breathing Circuit Ports
14. Patient Connection



Pneumatic Schematic:



Functional description:

The MicroVent-II is a dual mode ventilator. It will operate to deliver standard intermittent positive pressure ventilation (IPPV) or it will operate to deliver high frequency oscillatory ventilation (HFOV). The entire breathing system has a volume of less than 1cc. There are just four parameters to control, **Oxygen flow** (10), **Frequency** (7) (breaths per minute), **Amplitude** (6) (tidal volume) and Mean Airway Pressure (12) (**Mean P_{aw}**). In operation a small flow of fresh gas, in the range of 50-100ml/min or as low a flow as you are comfortable putting through your vaporizer, is set. This gas can be oxygen as provided by the built-in flowmeter (10) or any mixture of gases you provide from an external source. This gas may flow through an anesthetic vaporizer if you desire using gas anesthetics, then on to the breathing system where it passes the patient connection (14), flows through an open needle valve (12) and on to your scavenging system as required. The animal may breathe spontaneously from this stream of gas as it passes the patient connection at all times. The needle valve (12) is used to adjust Mean P_{aw} as seen on the pressure manometer (2). As the valve is closed, gas flow is restricted causing pressure in the breathing system and thus in the animal's lungs to increase. This Mean P_{aw} will maintain the expanded lungs permitting continuous gas exchange with a minimum of atelactatic alveoli.

The breathing system is also connected to a glass cylinder containing a floating puck, which is set in motion as per the settings for frequency (7) and amplitude (6). In IPPV mode the frequency selectable ranges from 75 to 240 breaths per minute (BPM). The tidal volume (TV) deliverable is from zero to 10ml. This does not limit the usefulness of the MicroVent-II to extremely small animals. A switch (8) to HFOV mode changes the frequency range to 750 to 2400 "breaths" or more accurately cycles per minute. The "tidal volume" during HFOV is generally an order of magnitude less than it would be during IPPV and is now used to set up an oscillation of the molecules of gas from the breathing system down to the alveoli.

Gas exchange during HFOV is accomplished via several mechanisms. Traditional convective or bulk flow occurs in the proximal airways close to the endotracheal tube. The oscillation setup in the system helps promote the molecular diffusion of the different gasses in the system. There is a gradient in the partial pressures of oxygen and anesthetic gas in the system from a peak where the fresh gas flows past the patient connection to a low in the alveoli where the concentrations have been decreased by patient uptake. There is also a gradient in the partial pressure of carbon dioxide in the system from a high in the alveoli to a low in the fresh gas stream. Oxygen and anesthetic molecules continually migrate toward the alveoli while carbon dioxide continually migrates toward the fresh gas stream as they all seek to come into equilibrium within the system. Turbulences produced by bulk flow, Taylor dispersions, pendelluft flows, asymmetric velocity profiles between the center and the edges of the airway lumens and cardiogenic mixing are some of the other known mechanisms of gas exchange

The oscillations are superimposed on the set Mean P_{aw}, "all" the alveoli are held open in virtually a steady state as the frequency is very high and volume of the oscillations is minuscule. The animal now only vibrates slightly; actually, it is more like a hum. No longer do you have the gross movement of the respiratory cycle so distracting to the microsurgeon.

In addition, depending on the amplitude of each cycle and the set mean P_{aw}, a value of resulting continuous positive airway pressure, CPAP, can be set and observed on the pressure manometer (2). This feature naturally allows and virtually assures that the operator will be implementing lung protective strategies as described by Amato and Ranieri, et al. The alveoli are no longer collapsing on expiration then snapping open again as they expand with each breath. This condition has been shown to cause damage to the alveolar epithelium and endothelium.

For convenience also incorporated into the MicroVent 1 is a system that allows it to be directly connected to any type of scavenging system, direct vacuum, an active or a passive system. Placing the **Scavenger Select** switch (8) in the **Active/Passive** position directs the waste gasses directly to the rear scavenging port where you can connect a charcoal canister, a length of tube to a fume hood or through the wall to the outdoors or to an active system that already has a scavenging interface valve in place. Switching to the **Vacuum** position directs the gasses into an internal open interface system allowing you to connect a vacuum line directly to the scavenging port with the 6mm endotracheal tube adapter provided. In this case the scavenging flow rate is then adjusted with the flowmeter on the front panel. It must be set to a flow rate greater than the fresh gas flow rate as provided by the oxygen flowmeter (10) or the externally set flow you are providing.

Functionality test:

- With the unit turned off, ensure that the Mean P_{aw} adjusting needle valve is fully open, fully CCW.
- Open the oxygen flowmeter valve to verify the existence of a supply of oxygen. Set the flow rate to 0.2 lpm.
- Occlude or place a test lung on the patient connection.
- Slowly turn the Mean P_{aw} CW to increase the Mean P_{aw} to 10 cmH_2O.
- Set the Amplitude to 5 , Frequency to 100 and the Mode to IPPV.
- Turn the unit on. After a delay of 1-2 seconds the puck within the glass housing should start oscillating as evidenced by the fluctuations observed on the Breathing Circuit Pressure gauge.
- Increase and decrease the amplitude and frequency controls, observe that the controls have the desired effects.
- Switch to HFOV mode and repeat the step above.
- Turn the unit and O2 flow off.

If the MicroVent-II does not perform as described above, DO NOT use the unit. Resolve the discrepancy or remove the unit for service.

Operating the MicroVent-II with a patient

1. Always start with the MicroVent **Power** off 2. Set the **Mode** to IPPV 3. Open the **Mean P_{aw}** control completely (fully CCW) 4. Set the fresh gas flow desired 5. Connect the patient 6. Increase the **Mean P_{aw}** to the desired level 7. Set the **Frequency** 8. Set the **Amplitude** to "1"	9. Turn the MicroVent **Power** on 10. Observe the frequency light flashing in time with each breath or cycle 11. Increase the **Amplitude** adjusting it and the **Mean P_{aw}** to obtain the desired peak inspiratory and PEEP pressures. 12. If desired switch **Mode** to HFOV and adjust as required

Cleaning and Maintenance

Use no alcohol on or near any plastic parts. Clean only with a damp cloth and mild detergent. Do not allow moisture to enter the glass puck assembly. Under normal operation the flow of gas flowing through the breathing system will carry any moisture from the patient away.

A replacement breathing circuit is available through part number 200A3586B.

RETURNING FOR SERVICE

If the MicroVent-II has a problem, which cannot be resolved with the use of this manual, please call your dealer or **Hallowell EMC** immediately for assistance.

If **Hallowell EMC** determines that it is necessary to have the MicroVent-II returned to us for service, we will provide you with a RETURN AUTHORIZATION NUMBER.

Please seal the unit in a plastic bag to prevent contamination from packing materials.

Use a box of sufficient size to allow for at least 3" of cushioning material such as bubble wrap or foam around the unit. Double boxing the unit provides the best protection. Careful packing is essential. See the Warranty.

Specifications:

OPERATIONAL CHARACTERISTICS	
Frequency	
IPPV mode	75 – 240 BPM
HFOV mode	750 – 2400 Cycles per minute
Amplitude	0-10 ml
I:E Ratio	1:1 (preset)
Supply Gas	Oxygen
Supply Gas Pressure	10-60 psig [69 – 450 kPa]
Controls	
Mode Selection	IPPV / HFOV
Frequency	75 – 240 bpm or 750 – 2400
Amplitude	1 – 10
Mean P_{airway}	5 turn needle valve
Oxygen Flow	0 – 1 LPM
Vacuum Scavenging Flow	0 – 10 LPM
Indicators	
Power On	Front Panel-mounted green LED
Breathing Circuit Pressure	- 10 to + 40 cmH_2O compound gauge
PHYSICAL	
Unit Weight	6 lbs.
Dimensions	9"W x 9"D x 9"H [228mm W x 228mm D x 228mm H]
Power Requirements	100 – 240 Vac, 47 – 63 Hz @ 0.4 A