Cardell® 9500HD

Veterinary Vital Signs Monitor

User's Manual

MIDMARK®

For Veterinary Use Only
003-2407-00 (Rev A)

Table of Contents

SECTION 1 - PREFACE

1.1 General

Welcome and thank you for choosing the Cardell® Model 9500HD portable multi-parameter veterinary monitor. The 9500HD continuously monitors and displays the following physiological parameters: ECG waveforms, arterial blood oxygen saturation of arterial hemoglobin (SpO_2), pulse rate, respiration rate, systolic (SYS), diastolic (DIA) and mean arterial pressure (MAP) and temperature. With the addition of the optional Capnostat Mainstream CO_2 probe, one can also measure end-tidal CO_2 as well as inspired CO_2.

This operator's manual contains detailed information about the performance specifications, operation and maintenance of 9500HD. It is designed for use by qualified veterinary personnel. Before using the patient monitor, please read this manual carefully and thoroughly in order to use the monitor safely and correctly.

This manual is an integral part of the product and describes its intended use. It should always be kept close to the equipment. Observance of the manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

1.2 Product Support

1.2.1 Warranty

Please fill in the product warranty card carefully and mail it to our service center. We will keep it for future reference. After unpacking the system, keep the packing materials for future return for service if necessary. The manufacturer shall be responsible for the safety, reliability, and performance of the monitor. The warranty applies if the product is used according to the operator's manual instruction.

The warranty does not apply if the product:

- has been damaged from improper operation (misuse).
- has been damaged because of improper connection to other equipment.
- has been damaged by accident.
- has been modified without written authorization of the Company.
- has had the serial number removed or defaced.

1.2.2 After-sale service

To obtain service or product support, please contact Midmark in Tampa, Florida at **800-643-6275** or visit the website at www.Midmark.com. Have the following information available:

- model and serial number of the equipment
- date of purchase and distributor name

1.3 Important Information

- The manufacturer's quality management system complies with the international standards ISO 9001 and EN 46001 and has the certificate issued by TUVps.

- Manufacturer address: Midmark, 10008 N. Dale Mabry Hwy, Suite 110, Tampa, FL 33618.

- **Phone**: 800-643-6275 **Fax:** 813-264-6218

SECTION 2 - SAFETY

2.1 Safety Notice

2.1.1 Intended Use

The Cardell® 9500HD series monitor is used to provide continuous monitoring, display and recording of physiological parameters, such as: ECG, non-invasive blood pressure, SpO_2, CO_2, respiration, and temperature.

2.1.2 Application Environment

This device is for use by trained veterinary personnel in veterinary centers. The device is to be used on one patient at a time.

2.1.3 Operator Requirements

Only veterinary personnel who have read the Operator's Manual should use this monitor.

2.1.4 Terminology

The terms danger, warning, and caution are used throughout this manual to point out hazards and to designate a degree or level of seriousness. Familiarize yourself with their definitions and significance.

DANGER is defined as a source of potential injury to a person.

WARNING indicates a potential hazard or unsafe practice which, if not avoided, could result in death or serious injury.

CAUTION indicates a potential hazard or unsafe practice which, if not avoided, could result in minor personal injury or product /property damage.

NOTE provides application tips or other useful information to assure that you get the most from your equipment.

2.1.5 Monitor Safety

The safety statements presented in this chapter refer to the equipment in general and in most cases, apply to all aspects of the monitor. There are additional safety statements in the parameter chapters, which are specific to that monitored parameter.

The order in which safety statements are presented in no way implies order of importance.

There are no dangers that refer to the equipment in general. Specific “Danger” statements may be given in the respective sections of this manual.

2.2 Safety Requirements

The following warnings and cautions must be read and understood before operation of the patient monitor.

2.2.1 WARNINGS:

- 9500 HD veterinary monitor is not intended to be used as an apnea monitor.
- 9500 HD veterinary monitor is not intended to be used during MRI or CT scan.
- Please do not rely on the alarm functions of the patient monitor. The alarm limits may have been improperly set or the alarm may have been disabled.
- Alarm functions of the patient monitor must be checked regularly.
- Before putting the system into operation, visually inspect all connecting cables for signs of damage. Damaged cables and connectors must be replaced immediately.
- When several devices are used on the same patient, leakage current may increase and lead to danger to the patient. Before using, please consult a professional to do a leakage current test and make sure the leakage current is within safety limits.
- When a defibrillator is used, make sure patient will not touch the ground, metal or other conductor or device. During defibrillation, never touch the patient, table or the device.
- Before using on another patient, make sure previous monitoring data is cleared.

2.2.2 CAUTION:

- Use properly grounded power sockets and ensure adequate grounding. If there is any doubt about the grounding, please use battery operation.
- Check accessories on regular basis and discard damaged accessories properly.
- To ensure patient’s safety and performance of the product, use only the manufacturer recommended accessories.
- Service parts must be in conformity with IEC 60601 standards. The system configuration of monitor must be in conformity with IEC 60601-1-1 medical electric standard, otherwise, it will reduce the safety of monitor.
- Even while not being used, the battery may also discharge. Check battery level every month.
- The ECG cable socket is for connecting ECG lead wires only. Please do not connect it to any other signal source. Pay attention to the color label and marks of ECG lead wires.
- Please clean the monitor and accessories according to instructions. Always unplug the power cord before cleaning.
- EMC — The device is in conformity with the requirements of IEC 60601-1-2 and related EMC standards. But when electromagnetic power is extremely high, it may cause interference. Please ensure any device close to the monitor meets the related EMC requirements. Do not use cell phone or personal telecommunication devices next to the monitor.

- Unknown EMI may be caused by radio transmitters or TVs. Please remove the patient monitor or add shielding materials.
- INSTRUCTIONS FOR USE – For continued safe use of this equipment, it is necessary that the instructions are followed. However, instructions listed in this manual in no way supersede established medical practices concerning patient care.
- Loss of data — When the device accidentally loses data, please keep patient under close attention until the device returns to normal.
- Other devices connecting to the device should meet IEC standards (for example, data processing device should meet IEC 950 and medical device should meet IEC60601-1) and the whole system should meet the latest version of IEC60601-1-1 standards.
- Plastic bags and other packaging materials should be disposed of in accordance with related regulations.
- After the device or the accessories are at the end of their life cycle, please dispose of them according to local laws and regulations.

2.3 Safety Symbols

NOTE: Some symbols may not appear on all equipment.


BF Applied Part: F-type applied part (floating/insulated) complying with the specified requirements of IEC 60601-1 Medical Standards to provide a higher degree of protection against electric shock than that provided by Type B applied parts.


Type CF Applied Part: F-type applied part (floating/insulated) complying with the specified requirements of IEC 60601-1 Medical Standards to provide a higher degree of protection against electric shock than that provided by Type BF applied parts.


Attention: Consult accompanying documents


Fuse


Equipotentiality


Power ON/OFF


Alternating Current


Earth connector

SECTION 3 - CONTROLS AND CONNECTORS

3.1 Installation and Connection

Environment Requirements:

To ensure electric installation safety, the environment should be reasonably dust free, without corrosive or combustible gas, or extreme temperature or humidity.

Keep a space for the patient monitor at least 5cm from the wall to ensure good air ventilation.

If the patient monitor is installed in a cabinet, please make sure there is enough space to facilitate service.

Extreme temperature can affect the accuracy of the monitor and damage accessories or circuits.

Please ensure that water does not condense in the patient monitor when using the device. For instance, when the monitor is transferred between buildings, there is a risk of condensation because of exposure to humidity and combined with a difference in temperature.

WARNING: Never use the veterinary monitor in an environment with combustible anesthetic gases.

Power Supply Requirements:

Power Supply Input: AC 110-230V, 50/60Hz
Input Power: ≤90VA

Shock Protection:

The 9500HD multi-parameter monitor is a Class I device in conformity with IEC60601/EN60601 requirements with protective grounding (through three pin power plug).

WARNING: To turn off the AC power, please unplug the power cord from power socket or unplug the power cord from the AC power receptacle on the monitor.

The On/Off button will not turn off the AC power of the patient monitor.

Patient Grounding:
The equipotential or grounding cable may be yellow or yellow and green.

During heart or head check, in order to eliminate the potential difference between different equipment, the monitor has a special cable to connect to the grounding system. The grounding cable should be used when using high electrical output equipment such as a

defibrillator or electric cautery or any equipment that may cause interference with the monitor.

Connect the small *end of the grounding cable to the grounding connector on the monitor.* This is the small metal peg on the back of the monitor. The large end of the grounding cable should be connected to any metal surface or copper pipes.

Combination of Equipment:

Both medical and non-medical equipment must comply with IEC60601-1-1 standard.

CAUTION: The use of several machines together can increase the current leakage which risks injury to patient and medical personnel.

Unpacking:

After confirming the outside packing is intact, please open the box and inspect the contents:

Patient Monitor Main Unit
Power Cord
Operator's Manual

In addition, you should have all the accessories and optional parts (See Appendix 4).

If any damage is found during shipping, please keep the package and contact Midmark immediately.

3.2 Before Monitoring

Before monitoring patient, please check the following:

Check if there is any mechanical damage.
Check the external connections.
Check if the patient monitor is in good working condition.

WARNING: If anything is found abnormal or mechanical damage is suspected, please do not use the monitor, and contact Midmark as soon as possible.

Step 1: Turn the monitor on, and the system will start a self-test. If the self-test is successful, you can start monitoring the patient. If changes are to be made in the operation or settings, see the operation procedures in the Operator's Manual.

Step 2: Make sure the monitor is connected to the patient with the appropriate accessories.

Step 3: After connections are in place, there should be waveform or data on the screen, otherwise:

a. Check the connections to the patient.
b. Check the connections to the monitor.

3.3 Front Panel

The front panel of 9500HD multi-parameter patient monitor is as shown in fig.3-1:

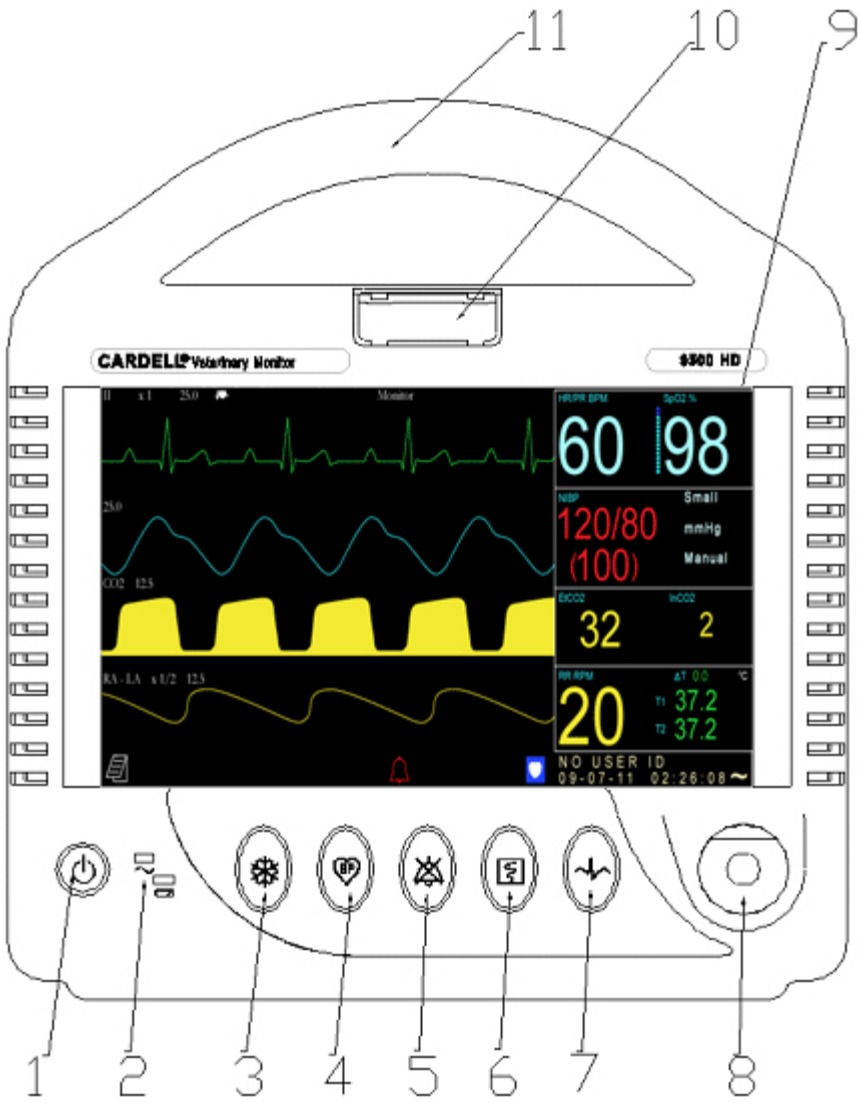
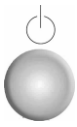


Fig. 3-1 9500HD Front Panel



(1) Power Switch: When the monitor is connected to the wall socket or there is enough battery power, press this button, and the patient monitor will turn on or off. After the patient monitor is turned off, the battery continues to charge.

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(2) Power indicator: AC indicator. When the monitor is connected to the wall socket, whether the patient monitor is turned on or not, the yellow

indicator will remain on. When the patient monitor is turned on and working, the indicator becomes green.

(3) Freeze/Restore: When the waveform is sweeping across the screen, press this button to freeze the waveform. Press the button again to unfreeze the waveform sweep.

(4) Start/Stop BP: Press this button to start blood pressure measurement; press it again to stop blood pressure measurement.

(5) Silence: Press this button to enable /disable the alarm sound.

(6) Start/Stop Printing: Press this button to start printing. Press it again to stop printing. If not pressed after being activated, the monitor will print 90 seconds and automatically stop (except when using the alarm-triggered print setting).

(7) ECG Menu: Press this button to enter the ECG menu.

(8) Knob:
To access the menu, rotate the knob and the required item will appear at the bottom of the screen. When the cursor points to a certain function, press the knob to select it. Then rotate the knob to change the item. When finished, press the knob again to confirm the selection.

(9) Display Screen: Color TFT LCD, displaying waveforms, menus, alarm status and physiological measurement data.

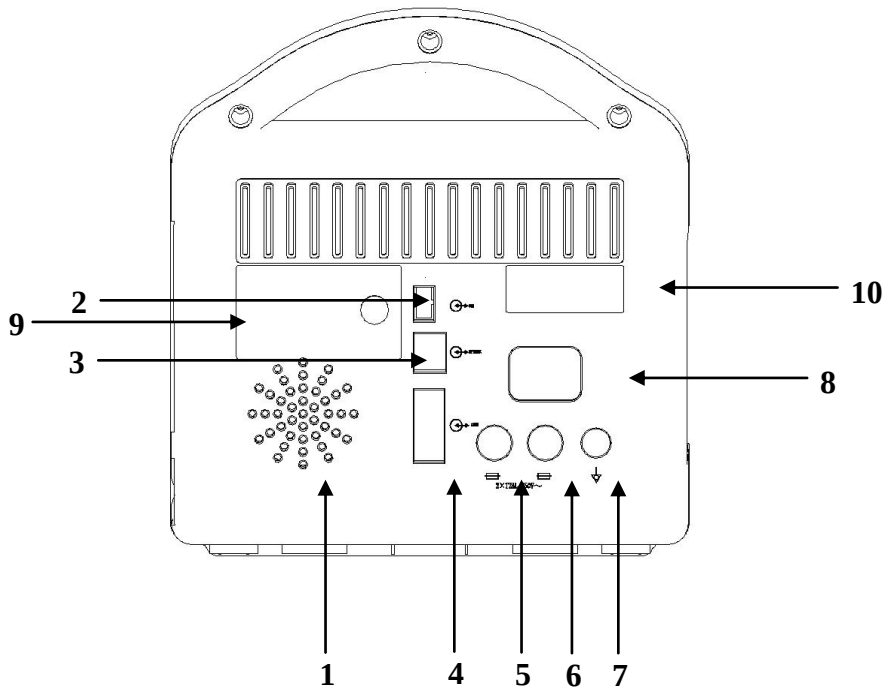
(10) Alarm Indicator: Red/Yellow dual-color alarm indicator.

- The red LED flashes during an emergency alarm (life is endangered).
- The yellow LED flashes during a warning alarm.
- The yellow LED stays on during an alerting alarm.

(11) Handle

3.4 Rear Panel

The rear panel of 9500HD multi-parameter patient monitor is as shown in Fig.3.2:



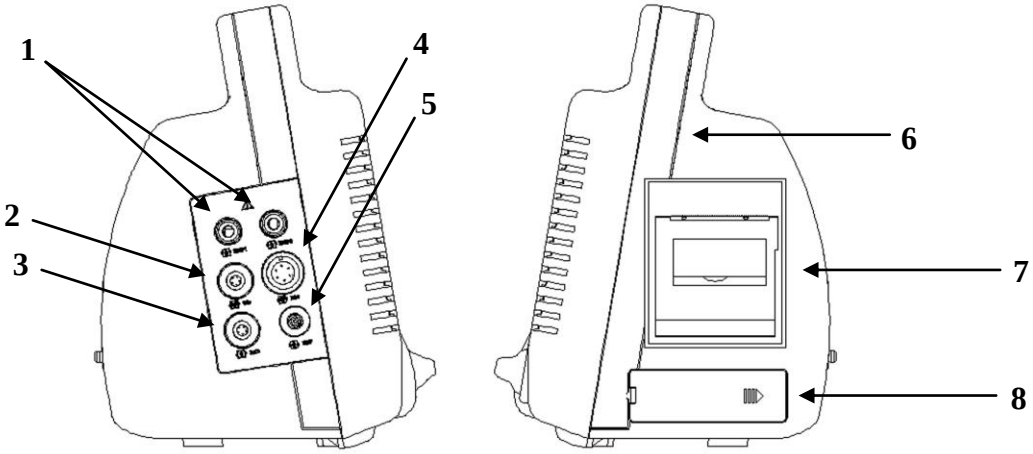
9500HD patient monitor rear panel (Fig. 3.2).

1. Fan (for heat dissipation)
2. Reserved
3. Reserved
4. RS422 (for connecting to PC or central station monitoring system – Model 9503 only).
5. FUSE 1
6. FUSE 2
7. Equipotentiality
8. Power inlet
9. Label (Contact information)
10. Label (Model + Serial No.)

WARNING: Other equipment connected to the device should be certified according to IEC standards (i.e. IEC 950 for data-processing equipment, IEC 60601-1 for medical equipment and IEC 60601-1-1 for whole system).

3.5 Side Panels

Side panels
(Fig.3-4)



1. TEMP1/2: Receptacles for temperature probe extension cables
2. ET CO_2: Receptacle for optional Capnostat Mainstream CO_2 probe
3. SpO_2: Receptacle for SpO_2 extension cable
4. ECG/RESP: Receptacle for ECG cable
5. NIBP: Receptacle for NIBP inflation hose
6. Cardell® Blue Racing Stripe
7. Built-in 3-channel printer
8. Rechargeable Battery compartment

3.6 Power

AC Power:

When AC power is used, the 9500HD may be turned on at any time. Before plugging it into AC power, compare the resident power output with the requirements of the device. On the rear panel, you can see the power supply requirements.

After confirming all cables are properly connected, press the power button on the front panel. The system will start a self-test which lasts about 15 seconds. If the power indicator on the front panel is green, it indicates that the device is in normal working condition and can be used for vital signs monitoring, communication, and battery charging.

When the device is plugged in to AC power and turned off, the power indicator on the front panel is yellow, showing the monitor is in standby condition and the battery is being charged.

Battery Power:

When AC power is shut off, the 9500HD monitor can still work with the internal battery. Before use, the battery must be charged. Whenever the device is plugged into AC power, the battery will automatically be charged. The battery should be charged for at least for 8 hours before it becomes full. To ensure battery is fully charged, it is recommended to plug the device in AC power even when the device is not used.

A fully charged battery can support the device continuously working for 1.5-2 hours. The frequency of NIBP measurement and printing may accelerate the consumption of battery power. When the battery power is almost depleted, the battery mark at the lower right corner of the screen will flash, an audible alarm is emitted. This alerts the user to plug the device into AC power as soon as possible.

WARNING:

- Even when the device is not working, the battery power will be discharged slowly.
- When the device is being stored for a long time, make sure the battery is full.
- Check the battery status and recharge at least once a month.

3.7 Keys and Buttons

The buttons of the device are divided into two types:

Function keys:


Waveform freeze/unfreeze key

Start/Stop blood pressure measurement


Alarm Silence


Printer Start/Stop


ECG menu key


Knob: Located at the lower right of the front panel, it can be used to move left or right through a menu, to change menu selections, and to confirm the selection by pressing it.

3.8 Menu Setup

(1) Rotate the knob to highlight the menu item and press the knob to confirm the selection and enter the sub-menu.
(2) After entering the sub-menu, rotate the knob to highlight the selected menu and press the knob to confirm the selection.
(3) Then rotate the knob again to select the desired item.
(4) When finished, press the knob to confirm the selection and validate the setup.
(5) Rotate the knob to point to the BACK icon and press the knob to return to the original screen.

NOTE: After 30 seconds of inactivity, the menu on the screen will disappear, and the full screen monitoring interface will resume.

3.9 Printing

Recorder
The device uses a built-in 3-channel thermal array recorder

Manually controlled printing

Press the printing start/stop key  on the front panel to print the physiological parameters, history data and monitoring waveforms. Press the key again to stop printing.

Alarm triggered printing:

While the alarm triggered printing function is turned ON, whenever there is an alarm, the recorder will automatically print the data and waveform of 2 seconds or 5 seconds before the alarm. The user may also set the print duration to last 8 seconds, 16 seconds or 32 seconds after the alarm. Alternatively, the user may press the print start/stop key to stop printing  .

Print Header:

The Report header includes date, time, printing speed, and parameter values. Each time a waveform is printed, the above contents will also be printed.

Printing Paper:

The printing paper width is 50mm. The paper should be kept in a cool and dry place, away from direct sunlight, high temperature and humidity. For long-term storage (>5 yrs), it is recommended to make a photocopy.

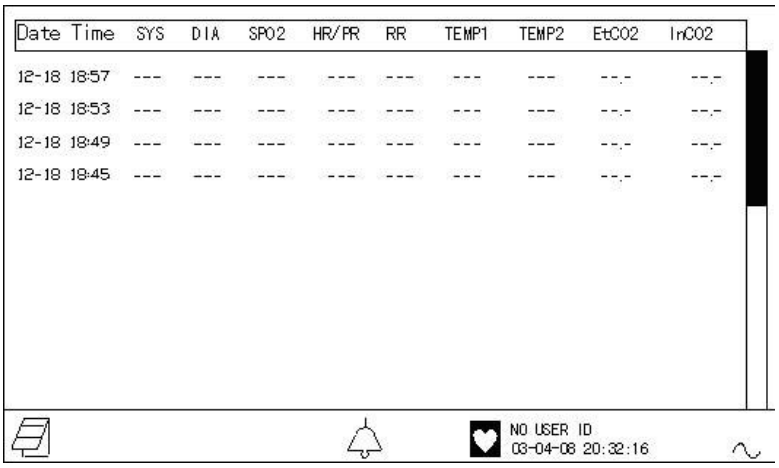
Installing Paper:

To install the paper roll in the printer first lift the smoke-colored latch on the printer compartment. Place the roll of paper between the two round tabs of the paper holder with the paper coming off of the bottom of the roll. Pull enough paper from the roll so it hangs over the door when closed (Do not thread paper under black bar). You are now ready to print.

3.10 Display Screen

(Fig.3-5)

In the figure above, we can see the waveforms of ECG 1, ET CO_2, SpO_2, RESP and the data for ECG1, SpO_2, NIBP, RESP, and TEMP. Press the knob to enter the tabular history screen in Fig.3-6.



(Fig.3-6)

In the figure above, we can see columns for a date/time stamp, and corresponding parameter values, including systolic blood pressure, diastolic blood pressure, SpO_2%, HR/PR, respiration rate, temperature 1, temperature 2, end-tidal CO_2, and inspired CO_2.

The system stores up to 600 sets of history data. On each screen there are 10 sets of data. On the right side of the readings, there is a scroll bar indicating the current location of observation.

Menu Box

(Fig.3-7)

The Menu box uses dynamic popup and exit modes.

When there is no menu on the screen, rotate the knob or press the ECG menu button to activate the menu display. When the menu is displayed on the screen, press the ECG menu button to exit from the menu. When there is no activity for 30 seconds, the menu will disappear automatically and return to the original monitoring screen.

Parameter Box

(Fig.3-8)

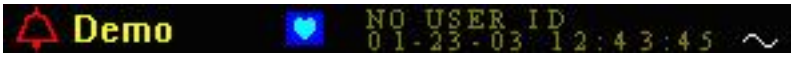
The monitor displays the following parameter values in real time: heart rate/pulse rate, SpO_2%, Diastolic/Systolic/Mean non-invasive blood pressure (NIBP), ET CO_2, IN CO_2, respiration rate, temperature 1&2, and the temperature difference.

ECG measurement includes 3 modes: "Monitoring/Surgical/Diagnosis". The user may select different modes for different applications. The ECG mode label is displayed on the display channel in small font.

The NIBP unit can be displayed as either mmHg or kPa. The NIBP area will display the cuff setting as "Small or Large", referring to whether the vinyl small animal cuffs are being used or if the nylon (SV8 or SV10) large animal cuffs are being used.

The NIBP measurement mode can be selected between "Manual/Auto/Stat", which is displayed on the right side of screen.

Status Box



(Fig.3-9)

In the Status Box, you can see battery power status, alarm status and patient ID number.

(1) Alarm status: A symbol is used to indicate the alarm status.

(2) Battery power status: The more the segments in the battery symbol, the more the power in the battery.

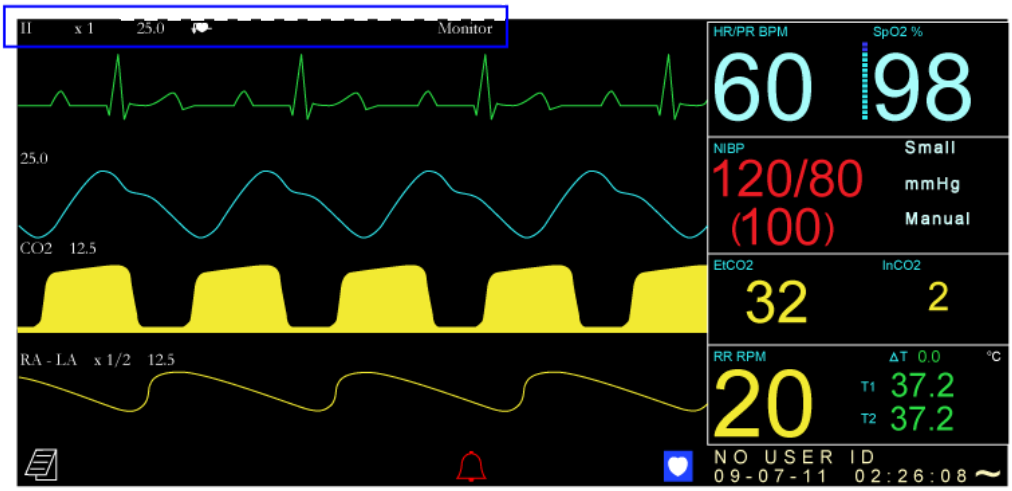
a) When the battery power is low, the battery symbol will flash. Please connect the patient monitor to AC power as soon as possible.

b) When there is no segment in the battery indicator, the symbol will become red, indicating that the battery power is used up. If the patient monitor is not connected to AC power within 3 minutes, the monitor will be turned off automatically.

c) When the battery symbol changes to "~", it indicates the device is connected to AC power.

(3) ID: shows patient's ID number.

Waveform Status



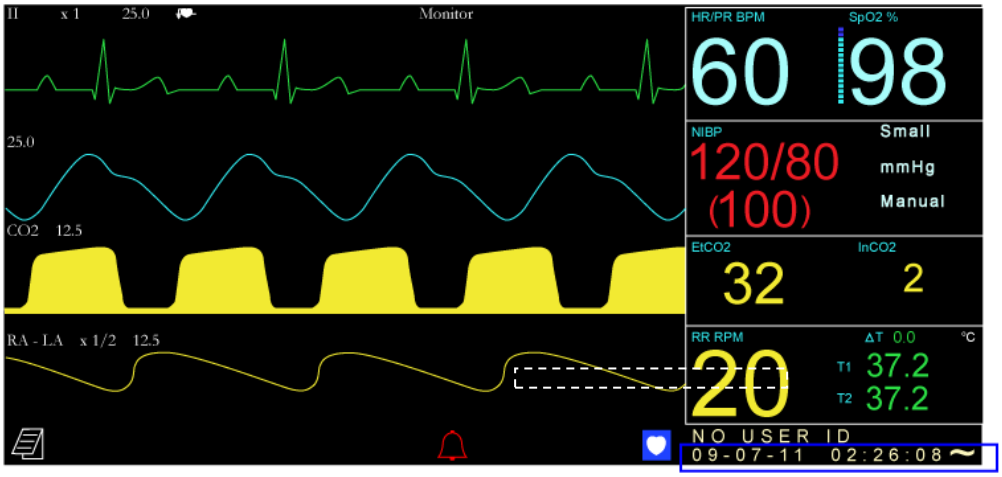
(Fig.3-10)

Waveform speed: The waveform displayed is physiological waveform and the speed unit is mm/s. The waveform can be displayed in speeds of 12.5, 25 or 50mm/s.

ECG Leads: I, II, III, V, avL, avR, avF

RESP Leads: RA-LA, RA-LL, LA-RL, LL-RL

Time Display Area



(Fig.3-11)

The current monitoring time is displayed as YY-MM-DD HH: MM: SS at the bottom right.

SECTION 4 - ALARM SETUP

4.1 General Information

Alarms are designed to give an alert when the monitoring results are abnormal. It is rendered with audible sounds, visual LED indicators, and flashing readings. Alarms have three degrees: Emergency (5 beeps), Warning (3 beeps), Alert (1 beep).

Emergency Alarm: Asystole, SYS-DIA is too low, Apnea Alarm;
Warning Alarm: Parameter values exceed set limits; equipment alarms
Alert Alarm: Low battery power.

Warning alarm equipment conditions are as follows**:**

Lead off
Loose cuff
Probe off
Air leakage
Wrong position
Over pressure
Range exceeded
Other error

When sensors or probes are unplugged, the screen will display “Probe off” or “No sensor” and alarm.

NOTE: When “Asystole” is displayed on the screen, please check for the ECG Gain of the relative channel to see if it is too low to detect heart rate. If so, user can switch the ECG lead or change the source channel for the alarm.

In order to control the alarm function, the alarm on/off and alarm tone can be set up in the alarm setup menu.

4.2 Alarm ON/OFF

Press the Silence key on the front panel of the patient monitor to silence the alarm for a certain period of time. There are three alarm types:


Alarm sound: ON


Alarm sound: OFF (turning off the sound forever can only be set up in each item setup separately, for example, in ECG menu).


01:00
Silence the alarm sound for 1 minute. The time is counted down. But when new alarm event occurs, the alarm sound can be activated automatically.


02:00
Silence the alarm tone for 2 minutes. The time is counted down. But when new alarm event occurs, the alarm sound can be activated automatically.

NOTE: Press the Silence key on the front panel and at the same time, pay attention to the time display at the lower part of the status area until the desired time duration of silence is reached. The alarm for different parameters may be turned off/on in the parameter setup menus.

During the set silence period, the occurrence of a new alarm event will trigger a new alarm, and the silence setup becomes invalid.

The low battery power alarm is not controlled by silence key. The monitor will begin alerting the user to connect the monitor to AC power supply whenever the battery power is low.

WARNING: When the alarm is turned off, there will be no alarm sound, so the user should pay close attention to the patient. The alarm can be turned ON again by pressing the silence key directly.

4.3 Alarm Setup

4.3.1 Alarm ON/OFF Setup:

Rotate the knob to enter each parameter menu to turn the alarm sound ON/OFF.

4.3.2 Alarm Limits Setup

Alarm limits include upper and lower limits that are user adjustable.

The alarm setup for each parameter can be found in the respective parameter setup menus. In the main menu, rotate the knob to select the parameter and press the knob to confirm. Rotate the knob again to look for the soft key and press the knob. The original alarm reading turns into yellow. Now turn the knob left or right, you may increase or decrease the limit until desired limit is obtained. Then press the knob to confirm.

In the NIBP setup menu, there is SYS-DIA Alarm limit, with range from 0 to 40mmHg. The system default is 20 mmHg and will be saved after power off. If the monitor detects that the difference between the SYS and DIA values are lower than this limit, the system will give an emergency alarm.

NOTE: After parameter alarm limits are set, they will remain in the system after power off until next setup.

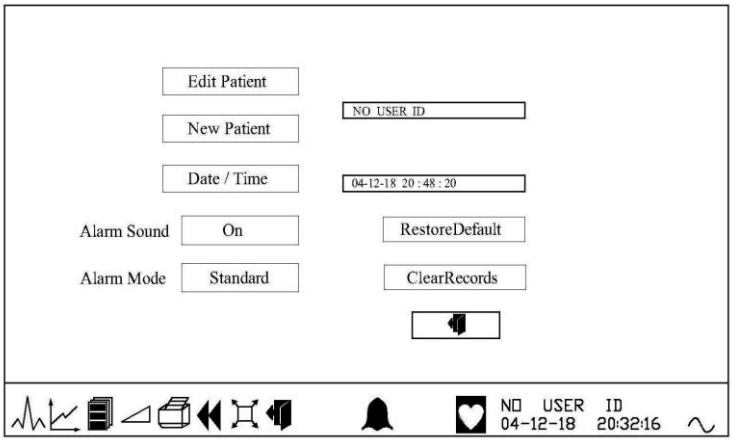
4.3.3 Alarm volume and brightness setup

The alarm volume and display brightness can be set in  section of the main menu.

4.3.4 Default Alarm Limit

The monitor includes default alarm limits recommended by a member of the American College of Veterinary Anesthesia for general veterinary practice. To return to the factory alarm setting, i.e., default alarm limits, follow these steps:

Rotate knob to 
Press knob to confirm, then choose Restore Default in the following fig.:



(Alarm Limits Default Setup)

The following default alarm limits were set in the factory before delivery:

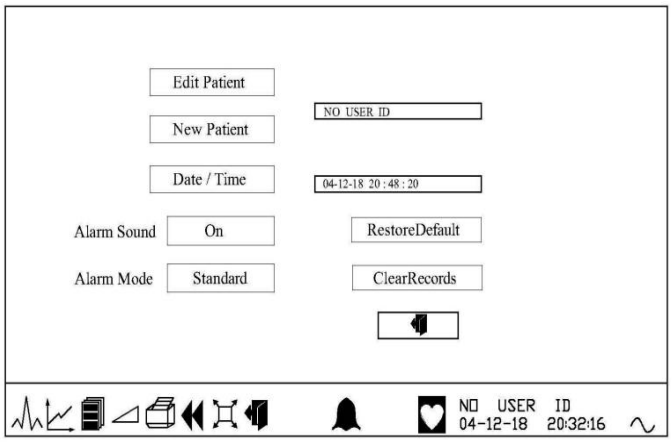
The default alarm limits of the patient monitor are as follows:

Parameter	**High**	**Low**
HR/PR (bpm)	180	50
SpO_2 (%)	100	90
NIBP SYS (mmHg)	160	70
NIBP DIA (mmHg)	100	40
SYS-DIA (mmHg)	20	20
Resp (bpm)	55	5
Temp (℃)	40	36
Et CO_2 (mmHg)	60	20
In CO_2 (mmHg)	10	0

4.3.5 Alarm Mode Setup

9500HD has both a standard alarm mode and an auto alarm mode that can be set as shown in the following fig.:

Rotate knob to 
Press knob to confirm, then enter the following fig.:



(Alarm Mode Setup)

Standard Alarm Mode:

When an abnormal event occurs, while in the Standard Alarm Mode, the alarm will sound in the sequence of priority.

Automatic Alarm Mode:

When an abnormal event occurs, while in Automatic Alarm mode, the monitor's will alarm for 30 seconds then stop, but the visual alarm will continue. For instance, if BP value or Temp exceeds the set limits, the monitor will alarm for 30 seconds and stop, but the visual alarm will continue. However, if Heart rate/Pulse rate, SpO_2 value or respiration rate is abnormal (exceeds the alarm limits), and the alarm is on, the monitor will give real-time audible and visual alarm.

SECTION 5 - Setting up the Monitor

5.1 Display Setup

5.1.1 Display Setup Procedures

(1) Press on front panel
(2) Rotate the Menu Knob until the item to be set is highlighted, and press the Knob to select
(3) Rotate the knob to change the selection options, and press knob to confirm selection
(4) Return to the previous menu after setup is complete

5.1.2 ECG Waveform Speed

The ECG waveform speed can be changed, and is displayed on the top of screen. 12.5mm/s, 25mm/s, 50mm/s are options, and the default sweep speed is 25mm/s.

5.1.3 Respiration Waveform Speed

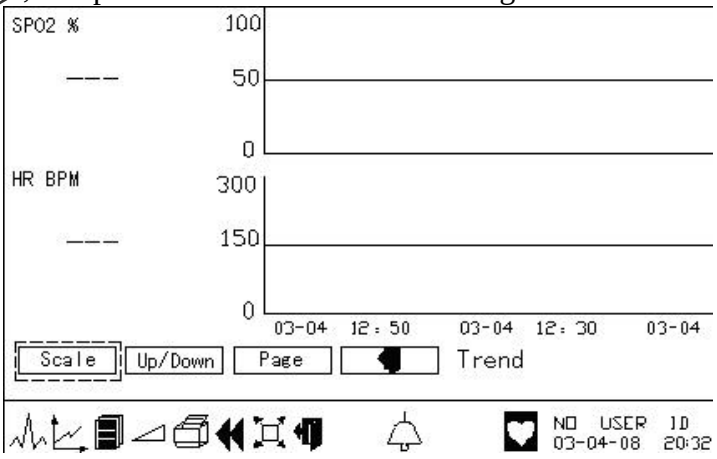
6.25/12.5/25.0 mm/s are options

5.1.4 Waveform Mode

Standard: Single line waveform
Enhanced: Bold line waveform

5.2 Trend Display

Rotate knob to , and press knob to enter the following interface:



The monitor can store up to 48-hours of trend data. Each screen displays two parameters' trend graphs of up to 48 hours. X scale is for monitoring time, Y scale is for the corresponding parameter value. The right end is the current time.

The menu functions are as follows:
Scale: To move the scale and view a different time.

Up/Down: To view different parameters.

Page: To observe trend curve of the previous or the next page.

5.3 Demo Mode

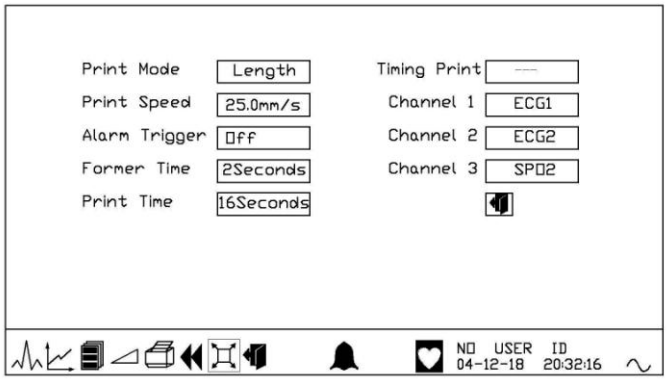
For the purpose of training, the device provides a Demo mode function.

CAUTION: Never try to use demo mode while monitoring patients.

To enter Demo mode:
Step1: Press the power (on/off) button for 2-3 seconds.
Step2: Press the power button twice quickly before entering the monitor interface. Then "Demo mode" will appear on the upper left corner of the screen.
Step 3: Power off the monitor to exit.

5.4 Printing Setup

In *Printing Setup*, the user needs to select print mode, print speed, print channel, timing print/former time/alarm triggered printing "On/Off" and print time.



The monitor is used to print history data or three channels of monitoring waveforms.

Print Mode: "Track/ Length/ Data"
Print Speed: 12.5/25.0mm/s
Alarm Trigger: On/Off
Former Time: 2Seconds/5Seconds
Print Time: 8Seconds/16Seconds/32Seconds

Timing Print: 15Minutes/30Minutes/1Hour/4Hours/8Hours/12Hours/---
Print Channel: When selecting a waveform to print, the monitor will print the waveform in the currently selected printing channel.

Channel 1: ECG1, RESP, SpO_2, CO_2 waveforms
Channel 2: ECG1, RESP, SpO_2, CO_2 waveforms
Channel 3: ECG2, RESP, SpO_2, CO_2 waveforms

NOTE: Do not select the same waveform for Channels 1, 2, and 3.

When an alarm occurs, the monitor will automatically activate the printer to print out the waveform 5 seconds before the alarm if alarm triggered printing is set to ON.

Alarm triggered printing can be set On or Off.

If the alarm triggered printing is set to OFF, then the monitor will not activate the printing automatically.

NOTE: Alarm triggered printing prints only the waveform.

5.6 System Setup

System setup includes patient ID, time, date, alarm tone, alarm mode and default setting.

5.6.1 System setup procedures

(1) Rotate the knob to enter "System Setup"  .
(2) Select to item to be set.
(3) Setup the item.
(4) Press "Back"  to exit.

5.6.2 Patient ID

The monitor displays patient's ID on the main window.

Edit Patient: To change the patient's ID.

New Patient: If you input a new patient's ID, the original patient's ID will be deleted.

5.6.3 Set Time

The monitor displays the date/time. Each time the machine is turned on, the system will display the current date and time in the time status box.

Rotate the knob left or right to change the hour, minute and second. The system time will not be updated until you press the knob to confirm the change.

5.6.4 Alarm Mode: "Auto/Standard"

See section 4.3 for description

5.6.5 Alarm Sound: "ON/OFF"

WARNING: When the alarm is turned off, please pay close attention to the patient.

5.6.6 Restore Default

Return to the default setting.

NOTE: When there is a sudden power failure, please turn off the machine immediately. Do not turn on the machine until the power supply resumes. The system will maintain the original configuration. That is, after the patient monitor is turned on again, the configuration set before power off will remain.

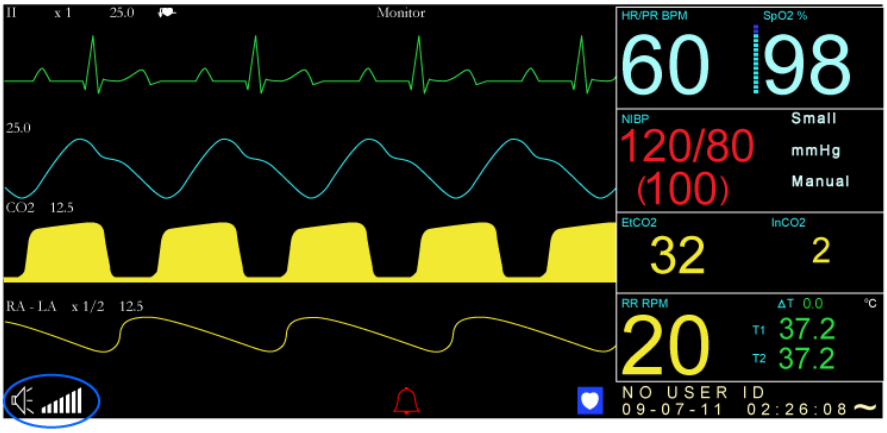
5.7 Volume and Brightness Setup

5.7.1 Setup Procedures

Step 1: Enter "System Setup".

Step 2: Click the icon  in the lower left corner to enter "Volume and Brightness Setup".

5.7.2 Interface Setup:



(Volume Setup Interface)

(Alarm Volume Setup Interface)

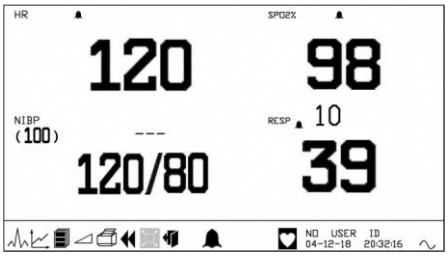
(Brightness Setup Interface)

5.8 Big Font

5.8.1 Setup procedures

Step 1: Rotate the knob to enter “Big Font ” 
Step 2: Press the knob to confirm it.
Step 3: Press the knob again to exit.

The display can be set up in big front mode as shown in the following figure, which is convenient for observing the screen from a long distance.



(Big Font Interface)

SECTION 6 - ECG MONITORING

6.1 General Information

The Cardell® 9500HD Monitor records heart rate with electrode clips attached to the patient. Electrodes detect signals caused by changes of electrical conduction in the heart during the cardiac cycle. Heart rate is computed on a beat-to-beat basis using the R-R interval of the QRS complex. It is necessary to make sufficient preparations before monitoring in order to get accurate readings.

6.2 Patient Cable

The patient cables consist of the main cable (connected to the patient monitor) and the lead wires (connected to the patient).

WARNING: At ECG receptacle, you can see  label, which indicates that the signal input part is highly insulated and defibrillator-proof. In addition, it is guaranteed that the monitor will not be damaged during defibrillation and HF surgical operation.

CAUTION: Use only electrodes, ECG cable and leadwires recommended by Midmark.

6.3 Animal Preparation and Lead Contact

Accurate electrode placement is very important for obtaining a clear quality ECG trace. Sites where leads are attached to the body must be properly prepared to optimize contact. Dogs and cats have enough electrolyte material on their skin and hair so that merely moistening lead sites with 70% isopropyl alcohol is appropriate. This will usually be sufficient for ECG recording/monitoring for a short time, 30 to 60 minutes, depending upon the relative humidity. For monitoring during longer periods, an electrode paste should be used. It is best to first wet the hair at the lead attachment site with alcohol; then place paste on the moistened hair and skin. It is important that the paste be in direct contact with skin. For patients with dense undercoat, rub paste with fingers to assure that it has made contact with skin. Crocodile clips are supplied with this monitor and they must opened wide enough to firmly but gently grasp the skin.

6.4 Attaching ECG Electrodes

6.4.1 Leadwires and Color

Table 6-1: 5-Lead Color and Coding

USA Standard	International Standard
LA = black (Left Foreleg)	L = yellow (Left Foreleg)
RA = white (Right Foreleg)	R = red (Right Foreleg)
RL = green (Right Hind Leg)	N = black (Right Hind Leg)
LL = red (Left Hind Leg)	F = green (Left Hind Leg)
V = brown (explore)	C = white (common)

Table 6-2: 3-Lead Color and Coding

USA Standard	International Standard
LA = black (Left Foreleg)	L = yellow (Left Foreleg)
RA = white (Right Foreleg)	R = red (Right Foreleg)
LL = red (Left Hind Leg)	F = green (Left Hind Leg)

6.4.2 Lead placement

Figure 6-1: 5-Lead Placement

For a 5 lead system, four limb leads can be applied (**RA, LA, RL, and LL)** with the exploring lead (**brown**) used for diagnostic purposes as needed. Otherwise, the exploring lead may be left unplugged. Refer to Figure 6-1 and Table 6-1 for more information.

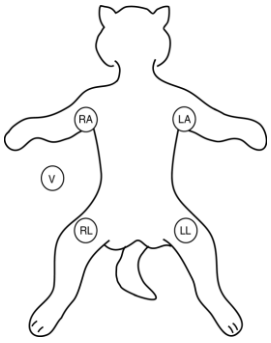
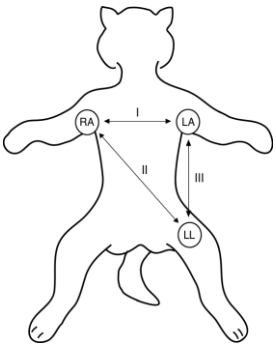


Figure 6-2: 3-Lead Placement

For a 3 lead system, leads should be attached just below the elbow on the front leg and just above the stifle on the hind leg. The following lead sequence should be applied for a 3 lead system: Right Foreleg **(RA-white)**; Left Foreleg **(LA-black)**; Left Hind Leg **(LL-red)**. Refer to Figure 6-2 and Table 6-2 for more information.



6.4.3 POSITIONING ANESTHETIZED PATIENTS

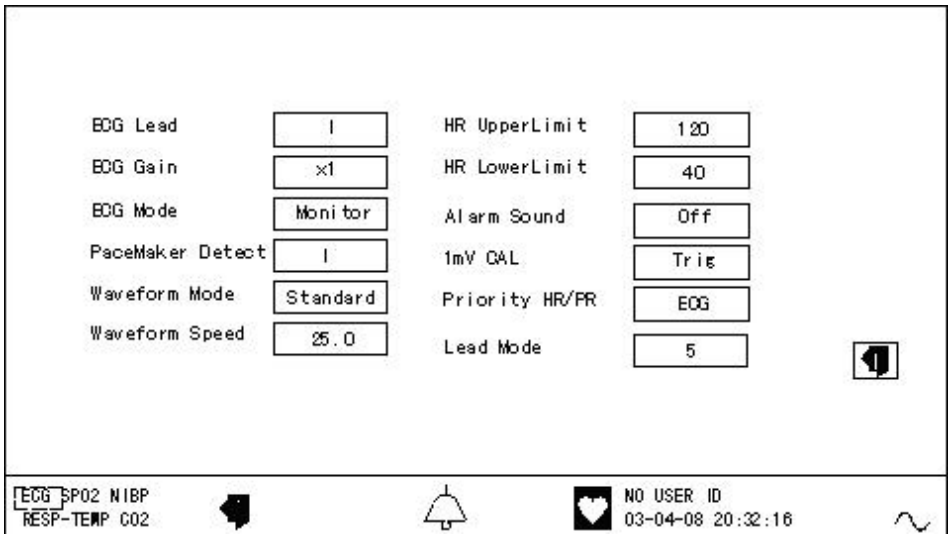
For ECG monitoring during anesthesia, it is most important to position patients properly on the table for the procedure. If standard lead placement as described below is not possible, leads should be attached to the body where they will be least subject to movement and away from the surgical site. It is preferable to view an upright QRS complex for monitoring ECG. A heart base to apex lead arrangement will be best if the negative lead is placed at the base (point of right shoulder at thoracic inlet) and the positive lead at the apex (low on caudal left thorax). Standard right forelimb lead is negative and standard left hind leg is positive in lead two; so if these leads are properly placed and the machine is set to Lead II, an upright complex should be the result.

6.4.4 POSITIONING CONSCIOUS PATIENTS

Standard position for recording diagnostic ECG in dogs is right lateral recumbency. Diagnostic tracings can be obtained in cats in either right lateral or sternal position. Limbs should be perpendicular to the spine and parallel with their opposite member. For awake cats and dogs, it is best to have the patient held by a veterinary technician or veterinary assistant. One lead should be applied first to determine comfort level and adjustment made as needed. Then the other clamps can be placed in position. It is important that the patient be kept still. A moving patient may cause clips to saw into skin tissue leading to discomfort and change in position of electrodes.

6.5 ECG Setup

6.5.1 Rotate the knob to , press knob to confirm. Then choose ECG 1 or ECG 2.



User may select and confirm by rotating and pressing the knob.

ECG Lead: Select different leads to display different ECG waveforms of a patient.
ECG Gain: Select different waveform gain. User may select x1/4, x1/2, x1, x2, x4 or Auto.

ECG Mode: surgical, monitoring, diagnosis

HR Source: ECG1 or ECG 2

PaceMaker Detect: I/II/III/V/Off

Waveform Mode: Standard/Enhanced

Waveform Speed: Waveform speed options: 12.5/25.0/50.0mm/s

HR UpperLimit: HR alarm upper limit range is from the lower limit to 300bpm

HR LowerLimit: HR alarm lower limit range is from 15bpm to the upper limit.

Alarm Sound: On /Off

1mV CAL: When it is pressed, a 1mV square wave will be displayed on the ECG waveform for user calibration.

Priority HR/PR: ECG/ SpO_2.

6.5.2 ECG Setup Procedures

Rotate the knob to select and press the knob to confirm.
For example:
(1) Rotate the knob to highlight “Lead”.
(2) Press the knob and select the desired item.
(3) Press the knob to confirm.
(4) After setup, rotate the knob to the EXIT icon (the last one), press the knob and exit.

6.5.3 ECG Gain

To change the ECG waveform amplitude, user may select x4, x2, x1, x1/2, x1/4 and Auto. The selected gain is displayed above the waveform channel.

CAUTION: When Auto is selected, ECG waveform height is not calibration significant.

6.5.4 Work Mode

The Monitoring/Surgical/Diagnosis mode gives the user three levels of filters to accommodate different circumstances.

Diagnosis mode: Displays the original ECG waveform unfiltered.
Monitoring mode: Filters out low-level interference.

Surgical mode: When there is a high degree of interference and the ECG waveform is significantly distorted (in an operating room, for example). It is not calibration significant.

6.5.5 HR source

User may select ECG1 or ECG 2
ECG 1: to detect heart rate based on ECG 1 signals
ECG 2: to detect heart rate based on ECG 2 signals

6.5.6 Waveform mode

Standard: Display waveform with single line
Enhanced: Display waveform with double line (bold)

6.5.7 Waveform speed

Select ECG waveform display speed. User may select 12.5/25.0/50.0 mm/s according to the specific needs.

6.5.8 Alarm sound On/Off: To turn on or off the ECG alarm sound.

6.5.9 Calibration: Display waveform amplitude when the input signal is 1mV

6.5.10 Sound priority: To select ECG/ SpO_2
ECG: Respond to the heart rate signal
SpO_2: Respond to the pulse rate signal

6.6 Alarm Setup

ECG monitoring alarms include parameters out of limit alarms and abnormal status alarms. When the monitored parameters are out of the preset limits, the monitor will give an audible and visible alarm.

6.6.1 Alarm Limit Setup
Different parameters have different alarm limits. For different patients, different limits may be required.
(1) Rotate the knob in ECG menu
(2) Enter the alarm limit setup menu
(3) Select the alarm limit of the corresponding parameter.

WARNING: The default alarm limits are designed as general guidelines and for convenience so that values can be reset automatically to common starting points, but these should be adjusted with each patient according to their individual circumstances.

6.6.2 Parameter Adjustment Range

Parameter	Adjustment Range
HR	15-300 bpm

6.6.3 Abnormal Status Alarm

Abnormal Status alarm includes “Asystole” and “lead off”.

CAUTION: When ECG amplitude is too low, it may result in inaccurate heart rate or pseudo asystole. We suggest when ECG waveform is too low, change the lead, and adjust to the ECG lead which has maximum amplitude. Otherwise, the monitor may give “Asystole” alarm.

6.7 Precautions

WARNING: When using defibrillator, make sure the electrode and patient cable are not in contact with metal or other conductor surface or grounding devices. During defibrillation, do not touch patient, table or instrument.

WARNING: Ensure conductive parts including electrodes of the patient cable do not come into contact with any conductive surfaces.

WARNING: Do not use the patient monitor during MRI or CT scan.

CAUTION: Leads and cables should be away from patient’s neck.

6.8 Cleaning and Maintenance

CAUTION: Please always obey the detailed instructions supplied together with the transducer, which are more updated than the information here. The following instructions shall be treated as general guidance when there is no specific method. When the cable is found worn out or damaged, please replace the cable at once.

6.8.1 ECG cable cleaning

In order to keep the cable dust-free, please clean it with clean cloth with soapy water or a mild detergent.

6.8.2 ECG cable disinfection

In order to avoid long-term damage to the cable, we recommend that you only disinfect the cable when it's necessary according to your hospital regulations.

CAUTION: Do not autoclave the cable.

6.9 Troubleshooting

6.9.1 Inaccurate Heart Rate

(1) check patient's ECG signal
   a. check /adjust lead placement
   b. check/clean the patient's skin
   c. check/replace ECG electrodes
(2) check if ECG waveform amplitude is normal.

6.9.2 No ECG waveform

After leadwires are connected but there is no ECG waveform and the screen shows "lead off" or "no signal received".

(1) Check if the electrodes are in good contact with the patient and if the leadwires are open.
(2) Check all the external connections of the ECG leadwires.
(3) Check the ECG electrodes. Prolonged placement of electrodes may result in polarized voltage and the electrodes should be replaced.
(4) If "no signal received" is displayed on the ECG channel, then the ECG module has communication problem with the main unit. Turn off the machine and turn it on again. If problem still remains, contact Midmark.

6.9.3 ECG baseline shift

ECG scan baseline is not stable on the display.

(1) Check if the working environment is too humid and if the machine has moisture inside. If yes, keep the machine on for 24 hours and keep the ambient environment dry.
(2) Check the electrode quality and whether the skin is clean where the electrode is placed.

SECTION 7 - NIBP MONITORING

7.1 General Information

The 9500HD uses oscillometric principles to calculate the systolic, diastolic, and mean arterial pressure (MAP) values. The MAP is calculated as the lowest cuff pressure that provides the maximum cuff oscillations. Therefore, MAP is the largest signal received and is the most accurate reading using oscillometric methods. Systolic pressure is calculated as the cuff pressure at which an increase in cuff oscillations is perceived. The diastolic pressure is the cuff pressure when oscillations are no longer decreasing as pressure is released from the cuff. Special veterinary specific algorithms have been designed to ensure reliable and accurate measurements from kittens to horses.

NOTE: See **Appendix 5** for a listing of validation studies on the Cardell® blood pressure and Nellcor pulse oximetry technology.

The patient monitor first inflates the cuff to a pressure of around 20mmHg higher than the systolic pressure, then, slowly deflates the cuff. When the cuff pressure is higher than systolic pressure, the artery is blocked and there are small amplitude oscillometric waveforms. When the cuff pressure is equal to the systolic pressure, the oscillometric amplitude will increase. With the decrease of the cuff pressure, the oscillometric amplitude increases. When the cuff pressure reaches a certain value, the oscillometric amplitude reaches a maximum value, and then the cuff pressure is mean arterial pressure. It uses the changes of the oscillometric amplitude under different cuff pressures to identify mean pressure and calculate the systolic and diastolic pressure.

WARNING: There is a label  below the NIBP receptacle, indicating that the signal input is insulated and defibrillator proof.

7.2 Cuff Placement

CAUTION: Only accessories recommended by Midmark should be used.

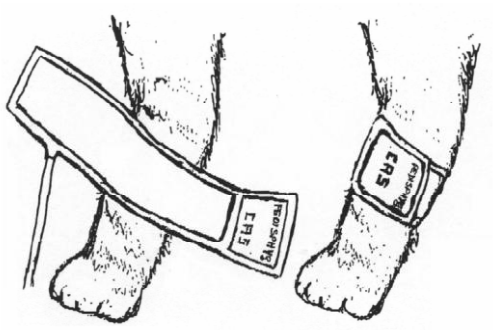
NOTE: Place the patient on a padded surface to provide comfort, and warmth. Shivering will inhibit the monitor from making a determination.

Cuff placement for a cat

A cat may be left in its owner's lap to keep it calm. Measurements are best done in an area of the hospital away from noise and bright lights. The animal may be held so that the front limbs are free for cuff placement. In conscious patients, the tail may be the most appropriate location for placement of the cuff. Cats may be most comfortable in sternal recumbency making the tail a more preferable site. For the median artery on the foreleg, place the cuff

around the forelimb, between the elbow and carpus. It is not necessary to center the cuff over the artery which is on the medial side of the leg because of the fully encircling bladder design. Hair need not be clipped except when heavily matted. In cats less than five (5) pounds when measurements are difficult to obtain, place the cuff around the leg above the elbow to obtain measurements from the brachial artery. Measurements from the coccygeal artery may be used by placing the cuff around the base of the tail but not in anesthetized patients.

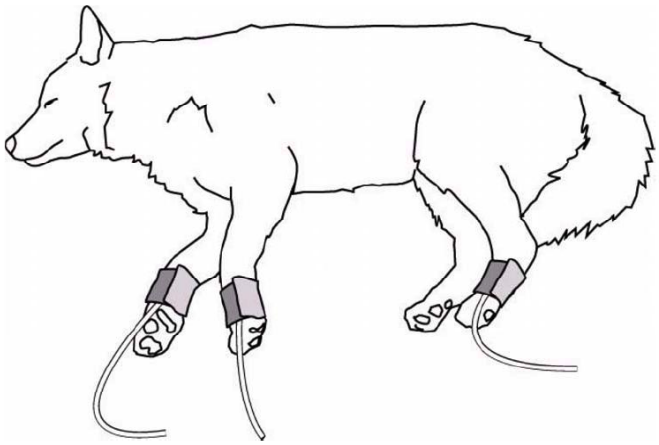
Cat Cuff Placement



Cuff placement for a dog

For measurements in dogs, it is preferable to use the right lateral, sternal or dorsal recumbent positions. That is not a problem in anesthetized patients, but it may be difficult to get large dogs to cooperate for proper positioning. If the dog is in a sitting position, place the front paw on the operator's knee and take measurements from the metacarpus. Sites for cuff placement are the metacarpus, metatarsus and anterior tibial. In anesthetized patients, most surgeries are done on the posterior part of the body so the metacarpal area of the forelimb is most convenient. In situations where this is not possible, the cuff should be wrapped around the metatarsus just proximal to the tarsal pad or around the hind leg just distal to the hock. The tail site should not be used for cuff placement during anesthesia. It is not necessary to center the cuff over the artery because of the fully encircling bladder design. If the hair over the artery site is too thick or matted for good contact, it should be clipped.

NOTE: Use metacarpus or metatarsus.



NOTE: To achieve the most accurate readings, it is important to keep the cuff on a horizontal plane with the heart.

Large animals
A large animal such as a horse should be in a stock, standing still, or lying down. For horses and cows, the cuff can be wrapped around the base of the tail using the coccygeal artery on the ventral surface.

WARNING: When monitoring over an extended period of time, or at frequent intervals, periodically observe the patient's limb to make sure that the circulation is not impaired for a prolonged period of time.

Cuff size selections
The widest cuff that can be placed on the patient, without extending beyond the joint, should be selected. Appropriate sized cuffs may be selected based on published guidelines that cuff width should be 40 – 60% of limb circumference. The cuff should be wrapped for a snug fit. Overlapping the cuff will not affect measurement results. Make sure the hook and loop sections of the cuff are fully engaged when it is wrapped around the limb. If not fully engaged, the cuff will detach during bladder inflation. If that happens, select the next size bigger cuff. Adhesive tape or other material should not be used to secure the cuff. Use the following table as a guide to select the correct size.

Small Animal Cuff Selection

Reorder Number	Bladder Size (Width)	Limb Circumference Range
SV1	2.0 cm	3-6 cm
SV2	2.5 cm	4-8 cm
SV3	3.5 cm	6-11 cm
SV4	4.0 cm	7-13 cm
SV5	5.0 cm	8-15 cm
SV600 (kit)	Includes all of the above	

Large Animal Cuff Selection

Cuff Model Number	Bladder Size (Width)	Limb Circumference Range
SV8	8 cm	13 – 20 cm
SV10	10.2 cm	18 – 26 cm

References:
Pedersen KM, Butler MA, Ersboll AK, Pedersen HD (2002). Evaluation of an oscillometric blood pressure monitor for use in anesthetized cats. JAVMA 221: 646-650.
Sawyer DC, Guikema AH, Siegel EM (2004). Evaluation of a new oscillometric blood pressure monitor in isoflurane anesthetized dogs. Vet Anaesth Analg 31: 27 – 39.

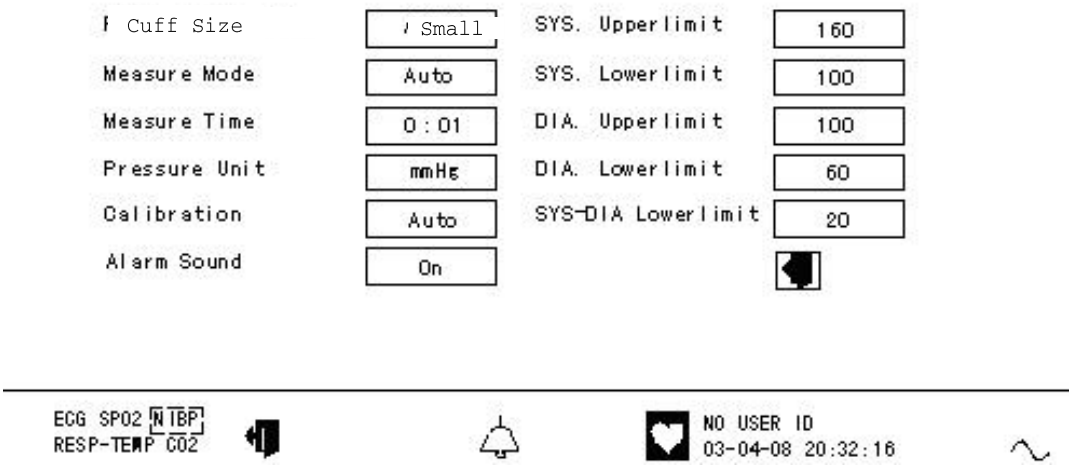
NOTE: For species specific reference values, see **Appendix 2**.

7.3 NIBP Setup

NIBP setup includes: patient mode, measurement mode, and auto measurement time interval, NIBP measurement scale, pressure compensation, alarm limit and alarm sound on or off.

7.3.1 Enter NIBP setup

Rotate the knob to  and press knob to confirm. Rotate to NIBP, press knob to confirm. Users can rotate the knob to select items shown in the following figure and press the knob to confirm:



Select cuff size: Large/Small
Select measurement mode: Manual, Auto and Stat
Select time interval for auto NIBP measurement
Change NIBP measurement scale: mmHg or kPa
Pressure Compensation: Auto pressure compensation method
Alarm limit: adjust alarm upper and lower limits
Alarm On/Off: Turn on or off NIBP alarm sound.

7.3.2 Operation

Method: Rotate the knob to select the desired function then confirm by pressing the knob.

7.3.2.1 Select cuff size
The current cuff size is displayed near the blood pressure value on the screen. Large or small can be selected, corresponding to the type of cuff selected for your patient. When using one

of the two large nylon cuffs (SV8 or SV10), select “Large.” Otherwise, the cuff size should be set to “Small,” corresponding to the white cuffs, sizes SV1-SV5.

CAUTION: Before measurement, make sure you have chosen the right cuff size on the monitor.

7.3.2.2 Select measurement mode: MANU, AUTO, STAT.

NOTE: The current NIBP Measurement Mode will display to the upper right of the NIBP parameter.

----Manual (MANU)

Press NIBP Start/Stop button on the front panel and the NIBP measurement will start immediately.

NOTE: During an NIBP measurement, if the NIBP Start/Stop button is pressed again, the measurement will be stopped immediately.

CAUTION: The initial inflation pressure is 150 mmHg.

----Automatic (AUTO)

The patient monitor will inflate the cuff at the start of each automatic measurement cycle.

NOTE: Anytime during NIBP measurement, pressing the NIBP Start/Stop button will stop the NIBP measurement immediately.

NOTE: In Auto mode, if no NIBP value can be measured, the auto measurement will be stopped automatically.

----STAT

Continuously measure patient’s NIBP for 5 minutes. The mode is mainly used to closely monitor a patient’s blood pressure changes in emergency situations.

During the STAT measurement, press the NIBP Start/Stop button on the front panel, and the measurement will immediately stop.

7.3.3 Select time interval

Select time interval in AUTO (displays behind the mode). Adjustable ranges in minutes are 1-10', 15', 30', 60', 90', 120', 180', 240', 480'. The time interval means the time between the last NIBP measurement start to the next NIBP measurement start.

7.3.4 Change NIBP measurement scale: Use this to change the NIBP measurement scale between mmHg and kPa.

NOTE: The measurement scale is shown in the parameter display.

7.3.5 Alarm Limits: Adjust alarm limits.

7.3.6 Alarm Sound On/Off: Turn the alarm sound on or off.

7.3.7 Alarm for abnormal status:

The Alarm trigger when the following abnormal events occur and messages will be displayed in the NIBP parameter area: "Cuff loose", "Cuff not connected", "Cuff position error", "Overpressure protection", "Measurement out of limits" or "Measurement error". Take the following steps after seeing the messages:

1. Cuff is too loose, not connected or applied to a wrong position
If the NIBP parameter area displays "Cuff loose" or "Cuff not connected" or "Cuff position error", please check the position of the cuff first, and check whether the inflation hose is damaged.

2. Overpressure Protection
If the NIBP parameter area displays "Overpressure protection," it indicates that the internal inflation circuit results in an NIBP measurement failure. Please contact Midmark for service.

3. Measurement Pressure out of Limit
If the NIBP parameter area displays "Measurement Pressure out of limit", it is because the patient's blood pressure is extremely high and out of the measurement range of the patient monitor. Calm the patient down and perform the measurement again.

4. Measurement Error
If the NIBP parameter area displays "Measurement Error", it may be the result of a system self-test error, the patient being over excited, trembling or air leakage. Calm the patient down and perform the measurement again. If the message persists, please contact Midmark.

7.4 Precautions

The following circumstances may affect the measurement results:

(1) patient motion
(2) rapid change in pressure
(3) shock or hypothermia

WARNINGS:

1. Make sure there is no other pressure on the cuff.
2. Wrong cuff size may result in inaccurate measurements.
3. Make sure monitor is set to Large/Small corresponding to cuff used.
4. To ensure the patient's safety, never use cuff on the same limb where an infusion is going on.
5. Do not measure SpO_2 or other parameters on the same limb where blood pressure is measured.
7. Do not apply cuff on an injured limb.
8. Do not measure a patient's blood pressure continuously or repetitively for a long time.
10. Use only accessories recommended by the manufacturer.
11. Remove the cuff after turning the power off.

7.5 Preparations

1、Use cuffs of proper sizes
2、Ensure the cuff has been completely deflated
3、Place the cuff on the patient's limb
4、Install the cuff hose to the NIBP connector of the patient monitor
5、Make sure there is no block between the monitor and the hose
6、Set blood pressure measurement correctly in the setup menu
7、The cuff on the patient's limb should be at the same level as the heart
8、Press the blood pressure start key and start measuring blood pressure

7.6 Maintenance

CUFFS

Prior to each patient use, inspect the blood pressure cuff and its hose for damage.

NOTE: We do not recommend submersion of the cuff. Liquid should not be permitted to enter the cuff bladder because instrument damage may occur. The cuff should be allowed to thoroughly dry before use.

REUSABLE (NYLON) CUFFS

As necessary, for normal cleaning with mild detergents / dilute bleach solution (1-2%), wipe the cuff with the cleaning solution, rinse with water and dry.

DISPOSABLE (VINYL) CUFFS

In certain situations, the cuff may become soiled during its use. In these situations a water-based detergent is suitable for wiping the cuff.

As necessary, the preferred method for cleaning the cuff is to wipe it down with a damp, soapy cloth. A damp, detergent-free cloth should then be used to rinse the cuff.

SECTION 8 - SpO_2 MONITORING

8.1 General Information

The 9500HD continuously monitors and displays arterial blood oxygen saturation (SpO_2) and pulse rate. The monitor beeps with each pulse beat. It allows you to choose alarm limits and audible tone volumes. You can select the high and low alarm limits for SpO_2 and pulse rate, and independently choose the volume for alarm and pulse beep tones.

The 9500HD determines SpO_2 and pulse rate by passing two wavelengths of light, one red (660nm) and the other infrared (940nm), through body tissue to a photo detector. Pulse identification is accomplished by using plethysmographic techniques, and oxygen saturation measurements are determined using spectrophotometric oximetry principles. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the sensor placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues.

The monitor processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SpO_2) to identify the pulse and calculate oxygen saturation. Oxygen saturation calculations can be performed because blood saturated with oxygen predictably absorbs less red light than oxygen depleted blood.

Since measurement of SpO_2 depends on a pulsating vascular bed, any condition that restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SpO_2 readings.

CAUTION: SpO_2 sensors are fragile and should be handled with great care.

8.2 Sensor Placement

WARNING: Use only Nellcor® veterinary oxygen sensors. Use of other oxygen sensors may cause improper performance.

INSTRUCTIONS FOR USE

NOTE: Reusable sensors may be used on the same site for a maximum of four (4) hours, provided the site is inspected routinely to ensure skin integrity and correct positioning. Because individual skin condition affects the ability of the skin to tolerate sensor placement, it may be necessary to change the sensor site more frequently with some patients.

1) Select a sensor and clip that is appropriate for the patient. There are two (2) sizes of VetSat veterinary sensor clips: model VSC-S (small), and model VSC-L (large).
2) Clean the VetSat sensor and clip separately before and after each use.
3) Open the clip by pressing with the thumb and forefinger.

4) Slide one of the sensor's alignment buttons along the clip slot until the sensor pad is fully engaged in the clip.
5) Slide the second sensor button along the other clip slot until the second sensor pad is fully engaged in its side of the clip.

NOTE: Check that the VetSat optical sensor pads are facing each other.

6) The sensor is now ready to be applied to the patient. The preferred sensor application site for canine, feline and equine animals is on the tongue, with the sensor's optical components positioned on the center of the tongue. Alternatively, the sensor and clip may be applied to the animal's lip, toe, ear, prepuce, or vulva.

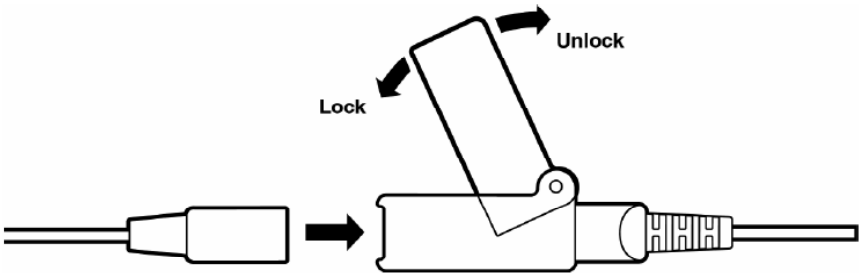
NOTE: If the sensor does not track the pulse reliably, it may be incorrectly positioned, or the sensor site may be too thick, thin, or deeply pigmented to permit appropriate light transmission. If any of these situations occur, reposition the sensor or try another sensor site. If the sensor site is covered with fur, try shaving the site and reapplying the sensor.

7) Be sure that the sensor cable is positioned along the side of the animal's face and body to avoid entanglement with the animal.

WARNING: Do not use supplemental tape to adhere the clip and sensor directly to the site; this can restrict blood flow and cause inaccurate measurements. For best results, secure the sensor cable independently from the sensor.

8) Connect the sensor assembly to the Interface Cable:
   a) Place the plastic hinged cover in the unlocked position (perpendicular to the connector).
   b) Connect the sensor assembly to the Interface Cable.
   c) Lock the plastic hinged cover to prevent accidental cable disconnection.

Figure 10: **Sensor to Interface Cable**



9) Plug the Interface Cable into the SpO_2 connector on the side panel of the monitor. Push the cable in until you hear an audible "click".

WARNING: The  indicates that the SpO_2 sensor connector is insulated and defibrillation proof which can ensure patient and monitor safety during defibrillation and electrosurgery.

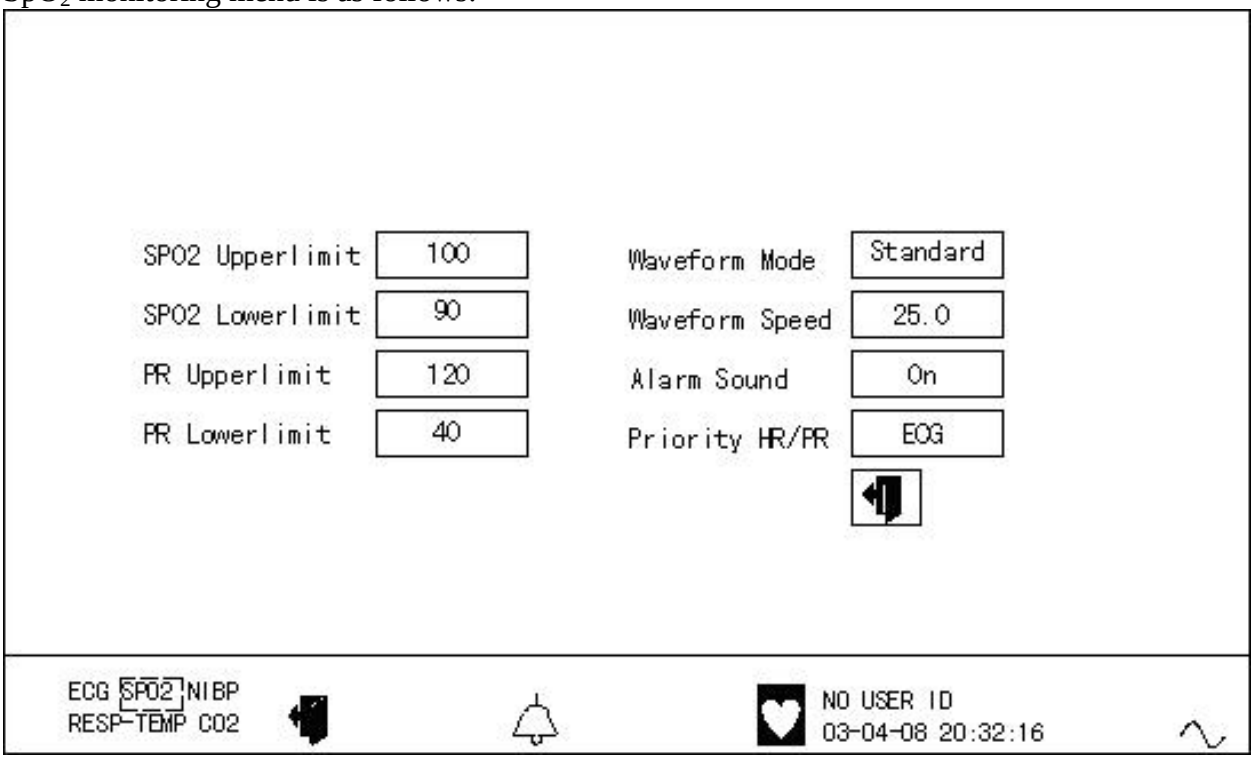
10) Press the ON/STANDBY pushbutton to turn “ON” the monitor.

11) Verify that the sensor is properly positioned by observing at least ten seconds of a continuous pleth waveform being displayed across the screen. When a valid signal is detected, the monitor displays the % SpO_2 and Pulse Rate values. Should the perfusion light be at a low level, reposition the sensor or try a different sensor. If normal operation cannot be achieved, call a Midmark, Inc. representative for assistance.

NOTE: In addition to the V-SAT sensor and clips that are included with the monitor, there is an optional reflectance sensor, the MAXFAST-1, that can be used on the base of the tail. This is mainly used as an alternative when head/neck/dental procedures are being performed.

8.3 Menu Setup

SpO_2 monitoring menu is as follows:



Menu setup: alarm limits, waveform mode, waveform speed, alarm sound On/off, sound priority.

Alarm limit setup: To set the alarm limits.

PR Display Mode: To select pulse rate to be displayed on the same screen.

Waveform Mode: To select the waveform mode.

Waveform Speed: To select the waveform sweep speed.

Alarm Sound On/Off: To turn On or Off the alarm sound.

Priority HR/PR: To select Heart Rate /Pulse Rate Sound Priority

SpO_2 Setup

Rotate the knob to  then confirm. Choose SpO_2 and press the knob to confirm.

Waveform mode: To select Standard or Enhanced

Standard: single line of waveform
Enhanced: bold line of waveform

Waveform speed: To select 12.5mm/s, 25.0mm/s, 50.0mm/s waveform sweep speed.

Alarm sound On/Off: To select On/Off

On: To turn on SpO_2 alarm sound.
Off: To turn off SpO_2 alarm sound.

Sound Priority: To select ECG/ SpO_2

ECG: Heart rate sound corresponding to heart rate signal.
SpO_2: Pulse rate sound corresponding to pulse rate signal.

8.4 Alarm Setup

The SpO_2 alarm is for parameter out of limit or abnormal status. When the parameter exceeds the limit, the monitor will give both visual and audio alarms.

Alarm Range:

Parameter	Range
SpO_2 upper limit	lower limit to 100%
SpO_2 lower limit	0 to upper limit
Pulse rate upper limit	Lower limit to 250 (bpm)
Pulse rate lower limit	30 to upper limit

WARNING: If the SpO_2 upper limit is set to 100%, then, it is equivalent to no alarm limit.

Abnormal Status Alarm: "Probe Off" alarm

8.5 Preparation for Monitoring

(1) Select the proper size sensor.
(2) Apply the sensor to a proper position on the patient. If possible, keep the sensor at the same level of the patient's heart.

WARNINGS:
- Do not apply the SpO_2 sensor to an extremity where there is arterial catheter, blood pressure cuff or injection tube.
- Make sure the light emitting part and light detecting part face each other.
- Make sure the sensor is applied to a region of arterial blood flow.
- Make sure there is no extreme motion.
- Make sure skin where the sensor is applied is neither too thick nor too thin.
- Make sure there is no strong ambient light coming into the sensor. Cover the site with opaque material.

(3) Plug the sensor into the SpO_2 connector on the patient monitor.
(4) Set the upper and lower limits of SpO_2.

CAUTION: Handle the sensor and the wiring with care. There are sensitive electrical parts in the sensor that can be damaged by negligent treatment. Keep the wiring away from pointed things. Normal wear-and-tear caused by patient motion or sensor cleaning will limit the life of the probe. Longevity can be extended by careful treatment.

WARNING: During prolonged monitoring, check and change the sensor position regularly in order to avoid damage to the patient's skin. Special patients need special treatment.

SENSOR REMOVAL

CAUTION: For the comfort of the patient and to avoid damaging the sensor, do not pull on the cable when removing the sensor and clip from the sensor site, but rather, unclip the sensor and remove from placement site.

When SpO_2 monitoring is completed, remove the sensor from the patient.
To remove the sensor and clip from the patient, press the clip open and remove. When the probe is removed from the patient, the message "SpO_2 Probe OFF" is displayed and an audible alarm sounds, indicating a connection has been lost. To acknowledge the alarm, press the SILENCE/RESET pushbutton. The monitor silences the audible and visual alarms and the message "SpO_2 Probe OFF" remains on the display.

To remove the sensor from the clip, grasp the end of each sensor pad and pull it through to the inside of the clip. The sensor should pop out of the clip easily. DO NOT pull on the cable.

8.6 Precautions

WARNING: Prolonged use or the patient's condition may require changing the sensor site periodically. Change sensor site and check skin integrity, circulatory status, and correct alignment every 2~3 hours. If there is any change, move the sensor to another site.

CAUTION: Clean the sensor surface with 70% ethanol before and after use. But do not immerse it totally into the liquid.

CAUTION: Do not autoclave, ethylene oxide sterilize or radiate the sensor.

8.6 Cleaning and Maintenance

CAUTION: Do not autoclave the sensor.

8.6.1 Clean the sensor:

(1) Clean the sensor with a soft cloth moistened in mild soap solution, saline (1%) or one of the following solutions: Microzid (pure), Mucocit (4%), Incidin (10%), Cidex (pure), Sporicidin (1:16), Mucaso (3%), Buraton (pure), alcohol (pure), Alconox (1:84), Cetylcide (1:63).

(2) Clean the sensor surface with soft cloth and let it dry completely.

(3) Wipe the receiving part and flashing part of the sensor with soft cloth immersed in the detergent or alcohol.

(4) Check the sensor and cable each time before use. If any damage is found, please replace them immediately.

8.6.2 Clean the cable

(1) Clean the cable surface with soap water or alcohol. Do not let liquid enter the connecting parts.
(2) Dry it with clean cloth.

CAUTION: Do not immerse the cable or sensor in any liquid or let the liquid enter into the connectors.

8.7 Troubleshooting

8.7.1 No SpO_2 data

Failure Phenomenon:
During monitoring process, there is no SpO_2 waveform or data.

Inspection Method:
Check if there the red light on the sensor is on.

Solution:
If there is no red light inside the sensor, the wiring connectors may have become loose, or the wire inside the cable may have grown frayed over time. Try it on your finger or earlobe, and if no reading is obtained, it may indicate that the V-SAT sensor must be replaced.
If "No signal received" is displayed on the screen, then there is a communication problem between the SpO_2 module and the host. Turn off the machine and turn it on again. If the problem still remains, consult Midmark.

CAUTION: Certain drugs, including alpha-2s, are vaso-constrictive, and may cause difficulty in obtaining readings on patient extremities. Moving the sensor further back on the patient's tongue, or exploring alternate sites (lip, ear, toe webbing, prepuce, vulva), may restore the readings.

8.7.2 Intermittent SpO_2 value

Failure Phenomenon:
When patient SpO2 is measured, the SpO_2 value is not continuous.

Inspection method:
(1) Patient motion
(2) SpO_2 extension cable connection or V-SAT sensor.

Solution:
Keep the patient as still as possible. Value loss caused by patient motion can be considered normal.

SECTION 9 - RESPIRATION and TEMPERATURE MONITORING

9.1 General Information

The monitor provides two respiration monitoring methods: thoracic impedance (indirect) and through the optional Capnostat mainstream CO_2 probe (direct).

NOTE: If the patient is intubated, direct respiration monitoring through the CO_2 sample line is recommended. If you choose to monitor respiration using the thoracic impedance method, place the ECG electrodes on the patient's trunk for more reliable readings.

A continuous temperature monitor is used to measure a patient's core body temperature during the administration of general anesthesia, detection and treatment of hyperthermia, post-surgical recovery, and other various cases that may require constant body temperature monitoring.

The monitor will display continuous electronic temperature readings or the core body temperature via either a rectal/esophageal probe or skin temperature with an external probe.

Temperature monitoring provides numerical information only - no waveform. As with other parameters, data is displayed in the temperature parameter window on the right side of the screen.

WARNING: TEMP socket is labeled with  , showing the signal input part is insulated and defibrillation proof.

9.2 Temperature Monitoring

(1) Select temperature probe.

WARNING: Skin-surface and rectal probes are not exchangeable.

(2) Probe may be used either in the esophagus or the rectum of the patient.

CAUTION: To avoid cross-contamination, we suggest you label the probe with tape indicating which way it's been used.

(3) Insert the temperature probe into the temperature socket in the side panel.

WARNING: Connect temperature probe with patient and insert the other end of the cable into the temperature socket of the monitor completely. The screen will display the temperature reading.

(4) Set temperature alarm limits.

WARNING: Before performing temperature measurement, do not get the temperature probe close to a heat source. If it has been close to a heat source, then let it cool down for 5 minutes before performing measurement.

(5) Start to monitor patient's temperature.

CAUTION: It takes 10 seconds for the patient monitor to display stable reading.

CAUTION: The patient monitor performs an auto temperature calibration every hour. Should the "Temperature calibration error" message appear, please contact Midmark.

WARNING: When temperature probe is not connected or temperature probe falls off, the monitor will stop the measurement and display "----" in the parameter area, but without an audible alarm. It is recommended to check the connection of the temperature probe regularly.

If you use disposable temperature probe, please do not try to disinfect and reuse it. Do deal with it appropriately.

9.3 Respiration Monitoring

The monitor provides two respiration monitoring methods: thoracic impedance (indirect) and through the optional Capnostat mainstream CO_2 probe (direct).

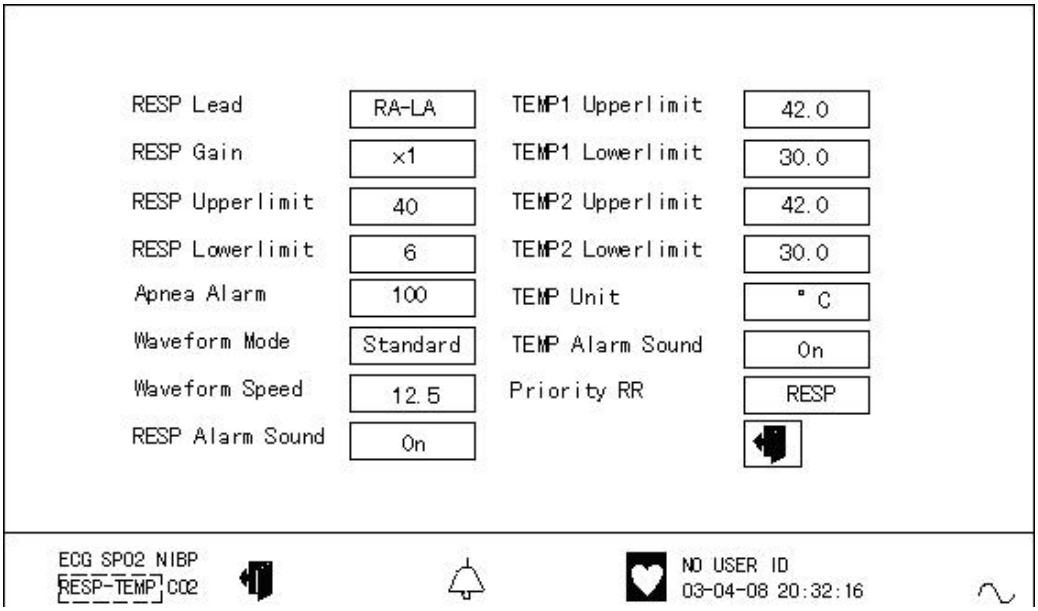
(1) Place electrodes in proper positions
(2) Select proper respiration lead combination
(3) Set respiration alarm limits

NOTE: Electrodes must be placed in proper positions.

CAUTION: Patient motion may result in a respiration measurement error.

9.4 Menu Setup:

The respiration-temperature setup menu is as depicted in the following figure:



RESP Lead: Select proper lead combination:

RA-LA
RA-LL
RA-RL
LL-RL

RESP Gain: Change respiration waveform amplitude: x0.5, x1.0, x2.0.

Apnea Alarm: Alarm On/Off, Alarm time: 5-120s.Within the specified time, if there is no respiration waveform, apnea alarm will be activated. The priority is "High". Select ---: Turn off apnea alarm function.

Waveform Mode: Standard, Enhanced

Standard: Waveform in single line
Enhanced: Waveform in bold line

Waveform Speed: 6.25mm/s, 12.5mm/s, 25.0mm/s

RESP Alarm Sound: On/Off

TEMP Unit: Change the temperature unit.

TEMP Alarm Sound: On/Off

Priority RR: To set the priority of respiration measurement between indirect impedance ("RESP") or direct measurement with CO_2 ("CO_2").

9.5 Alarm Setup:

The respiration-temperature alarm includes a parameter out-of-limit alarm and an abnormal status alarm. When the parameter is out of limit, the monitor will give an alarm sound automatically, and the value displayed on the screen flashes at the same time.

Set up alarm limits:
Different parameters have different limits

WARNING: Alarm limits should be adjusted based on an individual patient's condition.

Parameter Range:

Parameter	Adjustment Range
Respiration upper limit	Low limit to 150 bpm
Respiration lower limit	0 to upper limit
Temp 1 upper limit	Lower limit to 50
Temp 1 lower limit	0 to upper limit
Temp 2 upper limit	Lower limit to 50
Temp 2 lower limit	0 to upper limit

Alarm for abnormal status: "Temperature self test error", "electrode off"

NOTE: When there is an alarm for temperature self test error, please contact Midmark for service.

SECTION 10 – CO_2 monitoring (Optional)

10.1 General Information

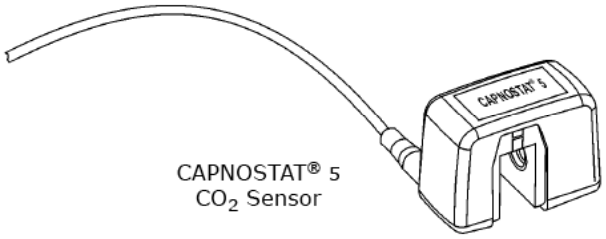
The 9500HD includes the capability to monitor end-tidal CO_2 using the optional Capnostat® CO_2 sensor. This measures CO_2 by using the infrared absorption technique, which has endured and evolved in the clinical setting for over two decades and remains the most popular and versatile technique today.

The principle is based on the fact that CO_2 molecules absorb infrared (IR) light energy of specific wavelengths, with the amount of energy absorbed being directly related to the CO_2 concentration. When an IR beam is passed through a gas sample containing CO_2, the electronic signal from the photodector (which measures the remaining light energy) can be obtained. This signal is then compared to the energy of the IR source and calibrated to accurately reflect CO_2 concentration in the sample. To calibrate, the photodetector's response to a known concentration of CO_2 is stored in the monitor's memory. A reference channel accounts for optical changes in the sensor, allowing the system to remain in calibration without user intervention.

NOTE: CO_2 monitoring is NOT available in Model 9503, which is designed to allow communication with a PC through the serial port. This is facilitated with optional software and will allow remote viewing, control and history/trend archival.

10.2 Capnostat® Sensor

The CAPNOSTAT 5 CO_2 Sensor is a rugged, solid-state, mainstream sensor. It is factory calibrated and does not require further calibration.



10.2.1 Sensor Connections

Connecting the CAPNOSTAT® 5 CO_2 Sensor to the Host System

1. Insert the CAPNOSTAT 5 CO_2 Sensor connector into the receptacle of the 9500HD as shown in Figure 1.
2. Make sure the arrows on the connector are at the top of the connector and line up the two keys of the connector with the receptacle and insert.
3. To remove the connector, grasp the body portion of the connector back and remove.

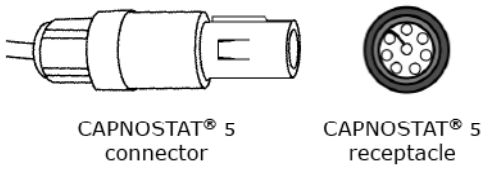
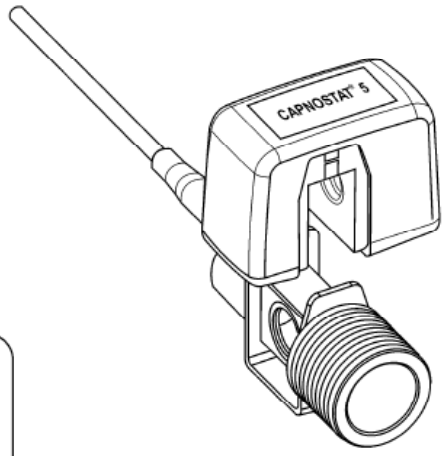
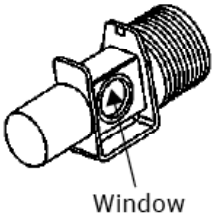


Figure 1

NOTE: Do not remove by pulling cable.

Shown below is the CAPNOSTAT 5 CO_2 Sensor connection to a Respironics Novametrix CO_2 adapter

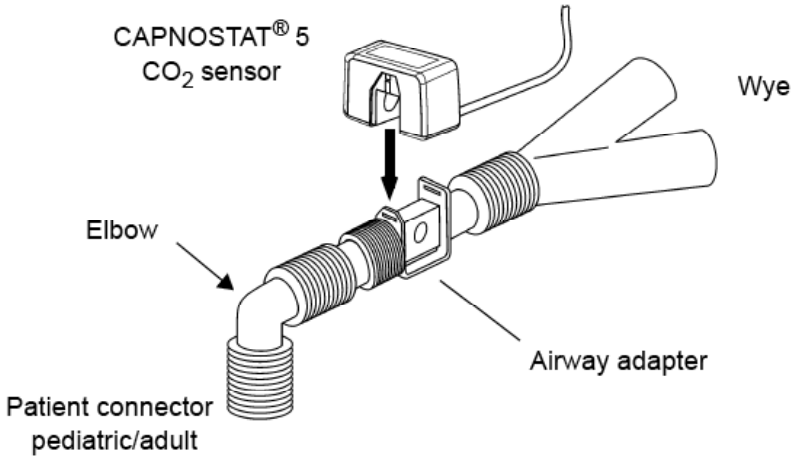




Connect:
Slides on.
Clicks into place.

Remove:
Slides off.

Shown below is the CAPNOSTAT 5 CO_2 Sensor with a patient circuit:

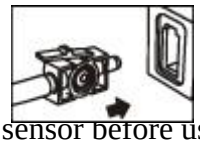


10.3 LoFlo CO_2 Sensor - Sidestream

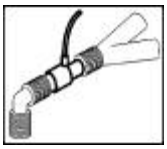
For Sidestream CO_2, the LoFlo CO_2 sensor is provided for your use.

Connecting the LoFlo CO_2 Sensor to the Monitor:

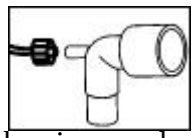
1. Plug the sensor cable into the monitor's CO_2 input receptacle.
2. Wait two minutes to allow the sensor to warm up.
3. Connect the airway adapter or sample line to the sensor. It will click into place when seated correctly.



4. Make sure to Zero your sensor before use. (See section 9.4.)
5. For intubated patients requiring an airway adapter, install the airway adapter at the proximal end of the circuit, between the elbow and the ventilator Y-section.



6. For intubated patients with an integrated airway adapter in the breathing circuit, connect the mail luer connector on the straight sample line to the female port on the airway adapter.

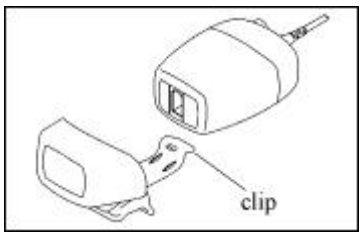


WARNING: Always connect the airway adapter to the sensor before inserting the airway adapter into the breathing circuit. In reverse, always remove the airway adapter from the breathing circuit before removing the sensor.

Using the Sidestream Sensor Holder:

The sidestream sensor holder can be used to clamp the sensor onto an IV pole or a shelf.

1. Push the sensor into the holder until it clicks into position.
2. Clamp the holder onto an IV pole, a shelf, or another appropriate location.
3. To remove the sensor from the holder, release the clip and pull the sensor out of the holder.



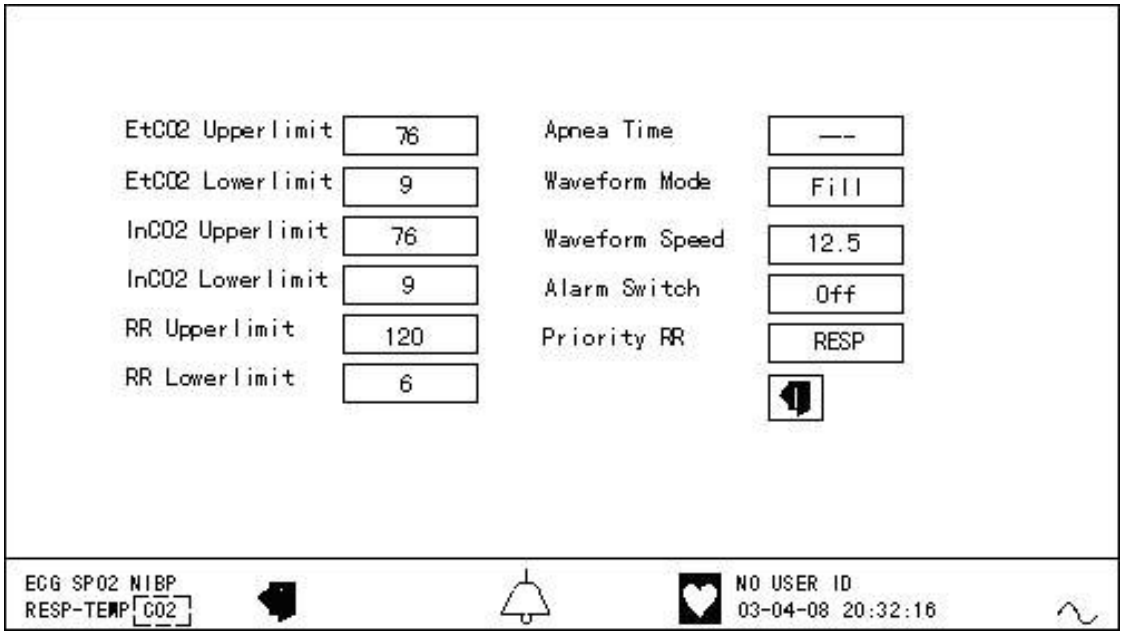
Removing Exhaust Gases from the System:

WARNING: Regarding Anesthetics: When using the sidestream CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, to avoid exposing the veterinary staff to anesthetics.

Use an exhaust tube to remove the sample gas to a scavenging system. Attach it to the sidestream sensor at the outlet connector.

10.4 Menu Setup

The CO_2 setup menu is as depicted in the following figure:



Apnea Time: Alarm time: 5-120s.Within the specified time, if there is no respiration detected, the apnea alarm will be activated. The priority is “High”. Select ---: Turn off apnea alarm function.

Waveform Mode: Standard, Enhanced, Fill
Standard: Waveform in single line
Enhanced: Waveform in bold line
Fill: Waveform filled in

Waveform Speed: 6.25mm/s, 12.5mm/s, 25.0mm/s

Alarm Switch: On/Off

Priority RR: To set the priority of respiration measurement between indirect impedance ("RESP") or direct measurement with CO_2 ("CO_2").

10.5 Alarm Setup

The CO_2 alarm is for parameter out of limit or abnormal status. When the parameter exceeds the limit, the monitor will give both visual and audio alarms.

Alarm Range:

Parameter	Range
$ETCO_2$ upper limit	lower limit to 100mmHg
$ETCO_2$ lower limit	0 to upper limit
$INCO_2$ upper limit	Lower limit to 100mmHg
$INCO_2$ lower limit	0 to upper limit

WARNING: Alarm limits should be adjusted based on an individual patient's condition.

10.6 Cleaning & Maintenance

10.6.1 CAPNOSTAT 5 CO_2 Sensor

Cleaning the outside of the CAPNOSTAT 5 CO_2 Sensor:

• Use a cloth dampened with isopropyl alcohol 70%, a 10% aqueous solution of sodium hypochlorite (bleach), disinfectant spray cleaner such as Steris Coverage® Spray HB, ammonia, or mild soap.

• Wipe down with a clean water-dampened cloth to rinse and dry before use. Make certain that the sensor windows are clean and dry before reuse.

10.6.2 Airway Adapters

• Clean by rinsing in a warm soapy solution followed by soaking in a liquid disinfectant such as
isopropyl alcohol 70%, a 10% aqueous solution of sodium hypochlorite (bleach), a gluteraldehyde 2.4% solution such as Cidex®, Steris System 1® or ammonia. It should then be rinsed out with sterile water and dried.

• May be disinfected using the methods listed below:

Immerse and soak in Cidex® or equivalent 2.4 gluteraldehyde solution for a 10 hour soak.

Immerse and soak in Perasafe® or equivalent peracetic acid .26% solution for a 10 minutes.

Cidex® OPA - follow the manufacturer's instructions for use.

• Before reusing the adapter, ensure the windows are dry, residue free and that the adapter has not been damaged during handling or the cleaning/disinfecting process.

CAUTION: DO NOT insert any object, such as a brush, into the CAPNOSTAT 5 CO_2 airway adapter. Irreparable damage may occur to the CO_2 windows.

SECTION 11 - Cleaning and Maintenance

11.1 Cleaning

WARNING: Do not, under any circumstances, perform any testing or maintenance on the monitor while the monitor is being used to monitor a patient. The monitor must be turned "OFF". Unplug the monitor from the AC power source and remove the internal battery.

CAUTION: Do not open the monitor to clean or repair it. Contact Midmark for service needs.

CAUTION: Disconnect all accessories from the monitor before cleaning. Do not immerse any part of the electrical connector of the cable or accessories in the cleaning or disinfection solution at any time. Do not use an abrasive cloth or cleaner on the accessories.

Immersing the patient cable or lead wires in any liquid may result in moisture entering. This may cause internal damage and reduce the product life. Alcohol and organic solvents may cause stiffness and brittleness.

THE MONITOR

On a daily basis, examine the monitor's case for damage and check the AC power cord for bent or broken prongs, cracks or fraying. Neither the monitor nor the power cord should be used if damaged. If any damage is noted, contact the appropriate service personnel.

CAUTION: Do not spray or pour any water or cleaning solution directly onto the monitor.

As needed, clean the monitor using a soft cloth dampened with a mild dishwashing detergent solution and gently rub the soiled area until clean. Use a clean soft cloth to dry the monitor. Do not use abrasive cleaners on the monitor. Do not use either isopropyl alcohol or solvent to clean the monitor. Use of these cleaners can cause damage to the monitor's surface. Do not immerse the monitor or power cord in the cleaning solution.

When necessary, the monitor surfaces may be disinfected using a soft cloth saturated with a 10% (1:10) solution of chlorine bleach in tap water. When all of the surfaces have been disinfected, wipe the entire surface of the monitor using a soft cloth dampened with fresh water to remove any trace amounts of residue and/or fumes.

NOTE: Thoroughly wipe off any excess cleaning solutions. Care should be taken to prevent water or cleaning solution to run into connector openings or crevices.

THE DISPLAY

CAUTION: Use care when cleaning the display. Do not use a paper towel to clean the display as this may cause scratches.

Occasionally, as needed, clean the display window using a soft, lint-free cloth sprayed with an alcohol free glass cleaner. Do not use either isopropyl alcohol or solvent to clean the display. Use of these cleaners can cause damage to the display. The use of paper towels is not recommended as it may scratch the surface.

PATIENT CABLE AND LEADWIRES

Prior to each patient use, inspect the patient cable and leadwires for damage. As necessary, clean the patient cable and leadwires using a soft cloth dampened with a germicidal solution.

CUFFS

Prior to each patient use, inspect the blood pressure cuff and its hose for damage.

REUSABLE (NYLON) CUFFS

As necessary, for normal cleaning with mild detergents / dilute bleach solution (1-2%), wipe the cuff with the cleaning solution, rinse with water and dry.

NOTE: Midmark does not recommend submersion of the cuff. Liquid should not be permitted to enter the cuff bladder because instrument damage may occur. The cuff should be allowed to thoroughly dry before use.

DISPOSABLE (VINYL) CUFFS

In certain situations, the cuff may become soiled during its use. In these situations a water-based detergent is suitable for wiping the cuff.

As necessary, the preferred method for cleaning the cuff is to wipe it down with a damp, soapy cloth. A damp, detergent-free cloth should then be used to rinse the cuff.

NOTE: Midmark does not recommend submersion of the cuff. Liquid should not be permitted to enter the cuff bladder because instrument damage may occur. The cuff should be allowed to thoroughly dry before use.

PNEUMATIC TUBING

Prior to each patient use, inspect the NIBP Inflation Hose for proper connection, cracks and kinks. As necessary, clean the pneumatic tubing using a soft cloth dampened with a germicidal solution.

CO_2 CONSUMABLES

Capnostat airway adapters are intended for single patient use in human medicine, but in the veterinary setting, may be reused as long as any moisture is allowed to dry between uses. It is estimated that with fairly regular use, the adapters should be replaced every 60 to 90 days. Refer to the manufacturer's instructions enclosed with each sensor for more information.

SpO_2 INTERCONNECTABLE

Prior to each patient use, inspect the SpO_2 Interconnect cable for damage. As necessary clean the cable using a soft cloth dampened with a germicidal solution.

SENSOR AND CLIPS

CAUTION: To avoid damage to the VetSat sensor, remove it from the clip before cleaning either piece.

CAUTION: Do not sterilize the sensor or clips by irradiation, steam or ethylene oxide. Do not immerse the sensors in water or cleaning solution.

When necessary, the sensor may be surface-cleaned by wiping it with an agent such as 70% Isopropyl Alcohol.

The clip may be cleaned by either wiping it with, or soaking it for ten (10) minutes in, 70% Isopropyl Alcohol. If the clip is soaked, be sure to rinse it with water and air-dry it prior to use on the next patient.

After each cleaning and prior to each use, inspect the sensor and cable for fraying, cracking, breakage, or other damage. Inspect the clip for cracking or breakage, or loss of spring tension that would allow slippage or movement of the sensor from its proper position.

NOTE: If defects are noted, do not use the sensor or clip.

Refer to the Directions For Use pamphlet enclosed with the sensor for more information.

TEMPERATURE PROBES

As necessary, the probes should be cleaned with a mild detergent and water to remove excess bioburden. When necessary, the probes may be disinfected using a soft cloth saturated with a 10% (1:10) solution of chlorine bleach in tap water or 70% isopropyl alcohol. When all of the surfaces have been disinfected, wipe the entire surface of the monitor using a soft cloth dampened with fresh water to remove any trace amounts of residue and/or fumes.

11.2 System Calibration

Besides the routine cleaning of the monitor and accessories outlined in the previous section, and replacement of accessories due to normal wear and tear, calibration of the monitor should not be necessary during the warranty period.

If the monitor is in need of repair, it must be referred to the appropriate service personnel. Service performed by unauthorized personnel could be detrimental to the monitor and may void the warranty. For service, contact Midmark, Inc.

APPENDIX 1 - SPECIFICATIONS

I. Safety:

Standard: IEC60601-1-1
Type: Class I, with internal power supply
Protection: BF, CF
Category: Continuous operation non AP/APG common device

II. Power Supply Requirements:

Input power supply: AC110-230V, 50Hz/60Hz
Input power: </= 90VA
Fuse: T2.0AL, 250V fuse, two in the back panel.
Battery: 12V/2.3AH, charging time >/=8 hours, battery powered working time: >/=1.5 hours
Charging mode: Continuous charging when being plugged into power (with overcharge protection).
Discharge protection: Device is automatically turned off when battery power is almost used up.

III. Performances:

ECG
Heart Rate Measurement and Alarm Range: 15-300bpm
Accuracy: +/-1bpm
Heart Rate Average: 8 beats
Pacemaker suppression on pulse rate: Amp: +/-2mV to +/-9mV
Range: 0.2ms to 2.0ms
Connector: AAMI 6-1 pin
Lead Selection: I, II, III, V, aVR, aVL, aVF
Lead Off Alarm: Visual and audible
Input: 5-lead ECG cable
QRS Indicator: Visual and audible
Sweep Speed: 12.5 /25 /50mm/s
Amplitude Selection: x1/4, x1/2, x1, x2, x4
Trend: 2 hours – 4 hours -, 8 hours, -24 hours and -48 hours
Patient Isolation: 4000V 50Hz 60 seconds
Leakage current: <10uA
Frequency Response:
Monitoring: 0.5 to 35Hz (+0.4dB, 3.0dB)
Surgical: 0.5 to 25 Hz (+0.4dB, 3.0dB)
Patient Drive Current: <10uA
Enclosure Leakage Current: <0.1mA
Heart Rate Alarm Time: Less than 7 seconds
Aspect Ratio: 0.24~0.6sec/mV
Defibrillation Protection: 5kV test
Recovery Time after Defibrillation: Less than 5 seconds.

Pulse Oximetry (SpO_2) - Nellcor
Measurement and Alarm Range: 0-100%
SpO_2 Average: 8 beat average
Accuracy: +/-2% (70-100%), +/-3% (50-69%)
SpO_2 Pulse Rate Range: 30-300bpm
SpO_2 Pulse Rate Average: 8 seconds
SpO_2 Pulse Rate Accuracy: +/-3% ±1 digit
Refresh Time: Approx. 2 seconds
Pulse Sound: Pulse sound indication
Sensor Type: Nellcor V-SAT digital lingual sensor provided with small and large clip

Non-invasive Blood Pressure (NIBP) – Cardell®
Measurement Method: Oscillometric
Parameters: Systolic, Diastolic, Mean, Pulse
Unit: mmHg or kPa
Operation Mode: Auto, Manual, STAT
Measurement and Alarm Range: 20-265mmHg
Cuff Pressure Range: 0-280mmHg
Initial Cuff Inflation Pressure: 150+/-10mmHg
Deflation Pressure: 30mmHg (4.0kPa) higher than last systolic pressure.
Auto Cycle Time: 1s, 10s, 15, 30s, 60s, 90s, 120s, 180, 240s, 480s

End-tidal CO_2 – Respironics (Optional)
Method: Mainstream Capnography
Principle of Operation: Non-dispersive infrared (NDIR) single beam optics, dual wavelength, no moving parts
Initialization time: Displayed in less than 15 seconds, full specifications within 2 minutes
Measurement range: 1-150mmHg, 1 to 19.7%, 1 to 20 kPa (at 760mmHg)
Rise time: Less than 60 ms.
CO_2 Resolution: 0.1mmHg 0 to 69 mmHg
0.25 mmHg 70 to 150 mmHg
CO_2 Accuracy: 0-40 mmHg ±2 mmHg
41-70mmHg ±5% of reading
71-100mmHg ±8% of reading
101-150mmHg ±10% of reading
Respiration range: 0 to 150 Breaths/minute
Respiration accuracy: ±1 breath.
Calibration: No routine user calibration required.

Temperature (2-channel)
Measurement and Alarm Limit: 0-50
Probe: Skin surface or rectal /esophageal)
Unit: Celsius/Fahrenheit
Accuracy: +/-0.1
Resolution: 0.1
Refresh time: Approx. 1 second

Respiration
Measurement Mode: Thoracic Impedance (indirect) or through Capnography (direct)
Respiration Rate and Alarm Range: 0-150brpm +/-2brpm
Waveform Display Speed: 6.25, 12.5 and 25mm/s
Refresh time: Approx. 2 seconds

IV. Display:

Display type: Color TFT LCD
Size: 7 inch
Matrix: 480 (H) x 234 (V) pixels
Display channel: 4

V. Recorder:

Type: 3-channel thermal recorder
Printing mode: real-time or alarm triggered printing of text and graphic
Resolution: Vertical (400dpi), Horizontal (800dpi)
Printing channel: 3
Printing speed: Auto/12.5/25.0 mm/s

VI. Physical Specifications:

Net weight: 3.5kg
Gross weight: 5.5kg
Dimensions: 190x230x160mm

VII. Environmental Requirements:

Temperature:
Working: 10-40
Storage and transportation: -20 to +60

Relative humidity:
Working: </=80% (non-condensing)
Storage and transportation: </= 95% (non-condensing)

Barometric pressure:
Working: 86 to 106 kPa
Storage and transportation: 50 to 106 kPa

Specifications are subject to change without prior notice.

APPENDIX 2 – BP REFERENCE VALUES

Which Blood Pressure is Normal in Dogs or Cats?[1]

It is essential to know the reference range of blood pressure in a given species in order to properly evaluate the animal's blood pressure and detect hypertension or hypotension. When using different measurement techniques (oscillometry or direct blood pressure measurements), one must also remember that methodological factors influence results. Therefore, technique-specific reference values should be known. Species-specific, breed-specific, and individual differences in normal blood pressure ranges can be observed. The most accurate assessments are made by comparing different blood pressure readings over time using serial measurements made at regular intervals (at least once yearly). This makes it possible to detect the initial signs of related disease (e.g. cardiovascular and renal disease) more sensitively and at an earlier stage. The normal values for dogs and cats are not identical.

FELINE NORMAL VALUES

The blood pressure values for cats are not breed-specific. However, the most sensitive way to detect changes in feline blood pressure is also by comparing individual blood pressure readings taken over time.

Normal feline blood pressure: **124/84**

Feline Reference Values		
Systolic (mmHg)	Diastolic (mmHg)	
125 ± 11	89 ± 9	Brown et al, 1997
123 ± 14	88 ± 15	Curtet, 2001
125 ± 12	86 ± 15	Weber et al, 2002

Other investigators have reported comparable reference values:

CANINE NORMAL VALUES

The normal values for dogs are breed-specific. Those for Golden Retrievers, Labradors and giant breeds tend to be lower than the overall average and those for greyhounds and in general racing hounds tend to be higher. The table that follows lists the normal values for common dog breeds using oscillometric blood pressure monitors.

Average canine blood pressure: 133/75

This figure was calculated as the mean of 1782 oscillometric measurement in clinically healthy dogs of different breeds. The overall average is therefore serves as a point of reference only. The individual or at least breed-specific value must be known to most accurately determine whether a given patient's blood pressure deviates from normal.

Breed	Systolic (mmHg)	Diastolic (mmHg)	Pulse Rate
Labrador Retriever	118 ± 17	66 ± 13	99 ± 19
Golden Retriever	122 ± 14	70 ± 11	95 ± 15
Great Pyrenees	120 ± 16	66 ± 6	95 ± 15
Yorkshire Terrier	121 ± 12	69 ± 13	120 ± 14
West Highland	126 ± 6	83 ± 7	112 ± 13
Border Collie	131 ± 14	75 ± 12	101 ± 21
King Charles Spaniel	131 ± 16	72 ± 14	124 ± 24
German Shepherd	132 ± 13	75 ± 10	108 ± 23
Terrier	136 ± 16	76 ± 12	104 ± 16
Bullterrier	134 ± 12	77 ± 17	122 ± 6
Chihuahua	134 ± 9	84 ± 12	109 ± 12
Miniature Breeds	136 ± 13	74 ± 17	117 ± 13
Pomeranian	136 ± 12	76 ± 13	131 ± 14
Beagle	140 ± 15	79 ± 13	104 ± 16
Dachshund	142 ± 10	85 ± 15	98 ± 17
Saluki	143 ± 16	88 ± 10	98 ± 22
Greyhound	149 ± 20	87 ± 16	114 ± 28
Pointer	145 ± 17	83 ± 15	102 ± 14

GUIDELINES[1]

Mean Arterial Pressure (MAP): Minimum to adequately perfuse all peripheral tissue beds: 60-70 mmHg.
Hypertension: Suspect with systolic pressure greater than 150 mmHg; affirmed when above 160 170 mmHg; also affirmed in cats when diastolic pressure is above 100 mmHg.
Hypotension: During anesthesia, generally maintain systolic pressure above 80 mmHg.

1 Info per Dr. Donald Sawyer, Michigan State University

APPENDIX 3 – DEAD SPACE

Cause, Effect, & Control in Small Animal Anesthesia
Robert M. Stein, D.V.M.. DAAPM
Founder **www.VASG.org**

Dead space is an often misunderstood and overlooked aspect of veterinary anesthesia patient management. Dead space is always present as a component of the patient's airway and, to a variable degree, as a component of the anesthetic system. Ignoring the harmful consequences of system dead space can lead to potentially fatal patient outcomes. This is especially worrisome when managing small patients.

There are three different types of dead space: anatomic, alveolar, and mechanical (equipment). Dead space ventilation involves that component of the respiratory gases that does not participate in gas exchange. Simply said, there is no patient benefit from dead space ventilation. If mechanical dead space volume equals or exceeds alveolar ventilation volume the patient will not be able to clear carbon dioxide at all. Ideally, your goal should be to minimize dead space through proper patient planning and to detect excess dead space consequences through end-tidal CO_2 monitoring.

Anatomic dead space is comprised of the upper airway structures that do not participate in gas exchange. This includes the gases in the nasal passages, nasopharynx, larynx, trachea, and in the larger airways. **Alveolar dead space** represents those alveoli that are ventilated with fresh gas but not perfused by the pulmonary circulation. **Mechanical or equipment dead space** is made up of any portion of the endotracheal tube extending beyond the patient's incisors, patient monitor adaptors (ET CO_2, apnea alert, etc.), any adaptors used to facilitate patient/system positioning (right-angle or swivel adaptors used to reduce the risk of tracheal trauma during patient rotation), the pace within a mask not occupied by the patient's nose, humidification management exchangers (HME), and the "Y" piece (defined as the terminal end of an F circuit or noncircle system and the inhalation/exhalation hose connector in a circle system).

Exhausted soda lime or malfunctioning one-way valves can also contribute to increasing mechanical dead space. Dead space also increases in a non-rebreathing system when fresh gas flows are inadequate or when certain defects are present in the system (for instance, when the center tube of a Bain system or F circuit is cracked or broken). These dead space contributors can all be controlled through proper system inspection and maintenance.

Mechanical dead space gas is the first gas inhaled at the beginning of the each respiratory cycle. As the mechanical dead space volume increases, ***less*** fresh gas moves into the patient's alveoli, limiting gas exchange.

Anesthetic System							
	Norman Elbow	Jackson-Rees	Bain	Ped circle	Adult circle	Adult F	Ped F
Dead space	<1 ml	3 ml	4 ml	4 ml	8 ml	8 ml	15 ml

Adaptors					
	ET tube	Monitor - ped	Monitor - adult	Positional	Heat & Moisture Exchanger (HME)
Dead Space	2 ml	2 ml	7 ml	8 ml	2.5 to 90 ml

The consequences of excessive mechanical dead space can be substantial and, potentially, fatal. As dead space volume from any cause increases, effective alveolar ventilation decreases. In patients breathing 100% oxygen there may be negligible initial effect on arterial oxygen tension. Arterial CO_2, however, can reach impressive levels. It is possible to have an end-tidal CO_2 level greater than 110 mmHg in patients with a normal pulse oximeter reading.

- Increased arterial CO_2 causes:
  - Respiratory acidosis
  - Sympathetic stimulation
  - Cardiac arrhythmias
    - A mix of sympathetic stimulation and hypoxemic effects
  - Variable peripheral vasoconstriction (sympathetic effect) followed by peripheral vasodilation as a direct effect on peripheral vessels
  - CNS depressant effect and, eventually narcosis
    - Pa CO_2 levels above 100 mmHg have an anesthetic effect
  - Increased cerebral blood flow and intracranial pressure
  - Tachypnea and an increased work of breathing which can negatively impact a debilitated patient
- Arterial O2 levels may eventually decrease enough to cause hypoxemia, especially in a patient breathing room air
- Inadequate ventilation interferes with adjustments in anesthetic levels

Controlling mechanical dead space is a simple matter.

- Mechanical dead space is most concerning for patients under 6 kg body weight
  - Minimize the connectors attached to the endotracheal tube, particularly in small patients.
    - For example, in a 6 kg patient under anesthesia the patient's alveolar ventilation volume would be 31.5 ml. Using a pediatric F circuit with adult ET CO_2 monitor and right angle adaptor (or apnea alert adaptor) could create 30 ml of mechanical dead space; effectively eliminating 95% of normal spontaneous alveolar ventilation.
- Make sure you regularly inspect all anesthetic machines and systems paying particular attention to valve function and inner hose integrity
- Make sure that the ET tube is not excessively long
- Select your anesthetic system carefully
  - Do **not** use a pediatric F circuit as a substitute for conventional pediatric circle hoses or a noncircle system
- Using no more than one monitor adaptor
  - Make sure it is a pediatric, low volume adaptor for smaller patients to avoid any significant impact on total mechanical dead space
- Avoid the use of positional (right angle) adaptors in smaller patients
- Avoid maintaining anesthesia with a facemask

Simply put, anesthetized patients should have their end-tidal CO_2 monitored for maximal patient safety.

APPENDIX 4 - ACCESSORIES

The following items are included in the standard monitor kit and can be reordered from your distributor or directly from Midmark using the associated reorder codes.

Reorder #	Description	incl
SV-1	2.0 cm bp cuff, for limb circumference 3-6cm (white vinyl fabric)	1
SV-2	2.5 cm bp cuff, for limb circumference 4-8cm (white vinyl fabric)	2
SV-3	3.5 cm bp cuff, for limb circumference 6-11cm (white vinyl fabric)	3
SV-4	4.0 cm bp cuff, for limb circumference 7-13cm (white vinyl fabric)	3
SV-5	5.0 cm bp cuff, for limb circumference 8-15cm (white vinyl fabric)	2
SV-8	8.0 cm bp cuff, for limb circumference 13-20cm (white vinyl fabric)	1
SV-10	10.2cm bp cuff, for limb circumference 18-26cm (white vinyl fabric)	1
NIBP-Tube	6’ bp inflation hose with Quick Disconnect	1
~~ECG-C~~	MAX-12/9500 ECG Cable	1
ECG-L3	MAX-12/9500 ECG 3-lead wire set	1
ECG-A	MAX-12/9500 ECG banana clips	3
V-SAT	6’ Nellcor SpO2 lingual sensor and clips (large and small)	1
NEL-EXT	10’ Nellcor extension cable	1
590004	MAX-1/MAX-12/9500 Flexible Esophageal/Rectal Temp probe	1
Paper4F	HD Printer paper with gridlines (4 rolls/tube)	1
PC-US	MAX-12/9500 Power cord (USA)	1
Battery7C	MAX-12/9500 rechargeable sealed lead acid battery	1

The following are optional accessories for use with the 9500HD series:

Reorder #	Description
C-Stat 5	Capnostat Mainstream CO2 probe (incl. airway adapters 6063 & 6312)
6063-00	CO2 Small animal airway adapter (<5cc dead space)
6312-00	CO2 Exotic animal airway adapter (<1cc dead space)
LoFlo	LoFlo Sidestream CO2 module (incl. sampling lines 3473INF & 3473ADU)
3473INF-00	LoFlo airway adapter w/filter – small/neonate
3473ADU-00	LoFlo airway adapter w/filter – adult/pediatric
SV600	Package of 5 Cardell small animal cuffs (1 of each size)
MaxFast-1	Nellcor MaxFast Reflectance sensor & posey wrap
8008-002	9500HD Rolling Stand w/basket and mounting plate
9A465002	9500 Mount for Matrx VMS Plus anesthesia machine
9A465004	9500 Pole mount
EP-S	MAX-12/9500 series small esophageal probe (ecg, temp, resp.)
EP-L	MAX-12/9500 series large esophageal probe (ecg, temp, resp.)
EP-XS	MAX-12/9500 series extra small esophageal probe (ecg, temp, resp.)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