# IDEXX **VetStat***

## Electrolyte and Blood Gas Analyzer

## Operator's Guide

06-05139-04

IDEXX LABORATORIES

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The VetStat* Electrolyte Blood Gas Analyzer is an electrolyte and blood gas analyzer for veterinary use. This portable analyzer provides fast, accurate results via single-use disposable cassettes using samples of whole blood, plasma or serum. The VetStat analyzer offers an easy-to-use touch-screen platform, convenient veterinary-specific menu options and species-specific reference ranges for canine, feline and equine samples.

The VetStat analyzer is designed to provide rapid results for sodium ($Na^+$), potassium ($K^+$), chloride ($Cl^-$), ionized calcium ($Ca^{++}$), hydrogen ion concentration (pH), partial pressure carbon dioxide ($PCO_2$), partial pressure oxygen ($PO_2$), total hemoglobin concentration (tHb), hemoglobin oxygen saturation ($SO_2$), total carbon dioxide ($tCO_2$), bicarbonate ($HCO_3^-$) and anion gap (AG). The table below provides important information regarding supported sample types, available reporting units and analyzer dynamic ranges for each parameter.

| | Sample Type | | | Available Units | | Dynamic Range |
|---|---|---|---|---|---|---|
| **Parameter** | **Whole Blood** | **Plasma** | **Serum** | **Default** | **Other** | **(Default Units)** |
| $Na^+$ | • | • | • | mmol/L | | 100–180 |
| $K^+$ | • | • | • | mmol/L | | 0.8–10 |
| $Cl^-$ | • | • | • | mmol/L | | 50–160 |
| $Ca^{++}$ | • | • | • | mmol/L | mg/dL | 0.2–3.0 |
| pH | • | • | • | pH units | | 6.6–7.8 |
| $PCO_2$ | • | | | mmHg | kPa | 10–200 |
| $PO_2$ | • | | | mmHg | kPa | 10–700 |
| tHb | • | | | g/dL | mmol/L g/L | 5–25 |
| $SO_2$ | • | | | % | | 60–100 |
| $tCO_2$* | • | | | mmol/L | | 1.0–200.0 |
| $HCO_3^-$* | • | | | mmol/L | | 1.0–200.0 |
| Anion gap* | • | | | mmol/L | | 3–30 |

*These parameters are calculated from parameters measured by the VetStat analyzer.

See “Parameters” in this section for more information on the parameters listed above.

## VetStat Principles of Operations

The VetStat analyzer is a microprocessor-based instrument measuring optical fluorescence from discrete sensors called optical electrodes (optodes).

A disposable, single-use cassette contains all of the elements needed for calibration, sample measurement and waste containment. Specific calibration information from the cassette is read into the analyzer by swiping the cassette package through the bar-code reader. The cassette is then placed into the measurement chamber.

The analyzer warms the cassette to 37.0° ±0.1°C (98.6° ±0.1°F), and performs a calibration verification on the sensors for $PCO_2$ and $PO_2$ by passing a precision calibration gas mixture across the optode sensors. The pH and electrolyte channels are calibrated with precision buffer solution contained in the cassette. The tHb and $SO_2$ channels are factory-calibrated.

When calibration is verified, the analyzer aspirates the blood sample into the cassette and across the optode sensors. After equilibrating with the blood sample, fluorescence emission is then measured. After the measurement, the cassette containing the blood sample is removed from the analyzer and discarded. The analyzer contains no reagents, blood or waste.

During each measurement, light originating from lamps in the analyzer is passed through optical filters so that photons of a specific energy are transmitted to the sensors, causing them to emit fluorescence. The intensity of this emitted light depends upon the partial pressure of oxygen ($PO_2$), partial pressure of carbon dioxide ($PCO_2$), hydrogen ion concentration (pH), and electrolyte concentration ($Na^+$, $K^+$, $Cl^-$, $Ca^{++}$) of the blood in direct contact with the sensors, as described above. The light emitted by the fluorescent sensors is measured by the analyzer after passing through lenses and additional optical components. A filter is used to isolate specific wavelengths of interest from this returning light for measurement by a light detector.

For tHb and $SO_2$, red and infrared light from one LED and two laser diodes is directed via dichroic beamsplitters and optical waveguides onto and through an optically polished window to the blood in the cassette over the $O_2$ sensor. This light is partially absorbed and reflected by the erythrocytes and sensor overcoat and then reflected back up into the instrument, traveling via an optical waveguide to a photodiode. The intensity of light reflected back at each wavelength varies in a well-defined way with the blood *c*tHb and $SO_2$, and is used in their measurement.

The output signal of the detectors is converted by the microprocessor to a numeric readout in conventional units of measure and displayed on the touch screen. Other values commonly used for the assessment of oxygen and acid-base status are calculated from these measured values.

## Parameters[1, 2, 3, 4, 5]

The various parameter descriptions provided in this section are based on current veterinary literature and are provided for general guidance only. As with any diagnosis or treatment, the primary care veterinarian should use clinical discretion with each patient based on a complete evaluation of the patient, including physical presentation and complete laboratory data. Diagnoses and treatment decisions are the ultimate responsibility of the primary care veterinarian.

### Sodium

Sodium is the major cation of extracellular fluid. Its primary functions in the body are to chemically maintain osmotic pressure and acid-base balance, and to transmit nerve impulses. Sodium functions at the cell membrane level by creating an electrical potential between different cell membranes, causing the transmission of nerve impulses and neuromuscular excitability to be maintained. Sodium is involved in some enzyme catalyzed reactions as a cofactor. The body has a strong tendency to maintain a total base content, and only slight changes are found even under pathologic conditions.

Low sodium values (hyponatremia) usually reflect a relative excess of body water rather than a low total body sodium. Reduced sodium levels may be associated with low sodium intake; sodium losses due to vomiting or diarrhea with adequate water and inadequate salt replacement, diuretic overdosage or NaCl-losing nephropathy; osmotic diuresis; metabolic acidosis; adrenocortical insufficiency; congenital adrenal hyperplasia; dilution type due to edema; cardiac failure; hepatic failure; and hypothyroidism.


1. Kaneko JJ, ed. *Clinical Biochemistry of Domestic Animals*. 4th ed. San Diego, CA: Academic Press; 1989.
2. Thrall MA, et al. *Veterinary Hematology and Clinical Chemistry*. Baltimore, MD: Lippincott, Williams and Wilkins; 2004.
3. Pagana KD, Pagana TJ. *Mosby's Manual of Diagnostic and Laboratory Tests*. Boston, MA: Mosby; 1998:133–135.
4. Willard MD, et al. *Small Animal Clinical Diagnosis by Laboratory Methods*. 3rd ed. Philadelphia, PA: WB Saunders; 1999.
5. DiBartola SP. *Fluid, Electrolyte and Acid-Base Disorders in Small Animal Practice*. 3rd ed. Philadelphia, PA: Elsevier; 2006.

Elevated sodium values (hypernatremia) are associated with conditions of water loss in excess of salt loss through profuse sweating, prolonged hyperpnea, severe vomiting or diarrhea, diabetes insipidus or diabetic acidosis, increased renal sodium conservation in hyperaldosteronism, hyperadrenocorticism, inadequate water intake because of coma or hypothalamic diseases, dehydration, or excessive saline therapy.

The sodium value obtained can be used in the diagnosis or monitoring of all disturbances of the water balance, infusion therapies, vomiting, diarrhea, burns, heart and kidney insufficiencies, central or renal diabetes insipidus, endocrine disturbances and primary or secondary cortex insufficiency of the adrenal gland, or other diseases involving electrolyte imbalance.

### Potassium

Potassium is the major cation in the intracellular fluid and functions as the primary buffer within the cell itself. Ninety percent of potassium is concentrated within the cell, and damaged cells release potassium into the blood. Potassium plays an important role in nerve conduction and muscle function, and helps maintain acid-base balance and osmotic pressure.

Elevated potassium levels (hyperkalemia) can be found in hypoadrenocorticism, oligouria, anemia, urinary obstruction, renal failure due to nephritis or shock, metabolic or respiratory acidosis, renal tubular acidosis with the $K^+/H^+$ exchange, and hemolysis of the blood. Low potassium levels (hypokalemia) can be found in excessive loss of potassium through diarrhea or vomiting, inadequate intake of potassium, malabsorption, severe burns and increased secretion of aldosterone. High or low potassium levels may cause changes in muscle irritability, respiration and myocardial function.

The potassium value obtained can be used to monitor electrolyte imbalance in the diagnosis and treatment of infusion therapies, shock, heart or circulatory insufficiency, acid-base imbalance, therapy with diuretics, various kidney problems, diarrhea, hyper- and hypo-function of adrenal cortex, and other diseases involving an electrolyte imbalance.

### Chloride

Chloride is an anion that exists predominantly in extracellular spaces. It maintains cellular integrity through its influence on osmotic pressure. It is also significant in monitoring acid-base balance and water balance. In metabolic acidosis, there is a reciprocal rise in chloride concentration when the bicarbonate concentration drops.

Decreased levels of chloride are found in severe vomiting, severe diarrhea, ulcerative colitis, pyloric obstruction, severe burns, heat exhaustion, diabetic acidosis, Addison's disease, fever and acute infections such as pneumonia. Increased levels are found in dehydration, Cushing's syndrome, hyperventilation, eclampsia, anemia and cardiac decompensation.

### Ionized Calcium

Calcium in blood is distributed as free calcium ions (50%); calcium bound to protein, mostly albumin (40%); and calcium bound to anions such as bicarbonate, citrate, phosphate and lactate (10%). However, only free ionized calcium can be used by the body in such vital processes as muscular contraction, cardiac function, transmission of nerve impulses and blood clotting. The VetStat analyzer measures the ionized portion of the total calcium. In certain disorders, such as pancreatitis and hyperparathyroidism, ionized calcium may be a better indicator for diagnosis than total calcium. Abnormalities in albumin affect the total calcium, but not the ionized calcium.

Elevated calcium (hypercalcemia) may be present in various types of malignancy, renal failure, hyperparathyroidism, hypoadrenocorticism and granulomatous diseases. Hypercalcemia occurs commonly in critically ill patients with abnormalities in acid-base regulation and losses of protein and albumin. Decreased calcium (hypocalcemia) is often noted with eclampsia, hypoparathyroidism, pancreatitis, renal disease, alkalosis and ethylene glycol toxicity.

### pH

The pH value of the blood, serum or plasma may be the single most valuable factor in the evaluation of the acid-base status of a patient. The pH is one of the most tightly controlled parameters in the body and indicates the balance between the renal (kidney), respiratory (lung) and blood buffer systems. The causes of abnormal blood pH values are generally classified as:

- Primary bicarbonate deficit—metabolic acidosis
- Primary bicarbonate excess—metabolic alkalosis
- Primary hypoventilation—respiratory acidosis
- Primary hyperventilation—respiratory alkalosis

An increased pH value (alkalemia) in blood, serum or plasma may occur because of an accumulation of plasma bicarbonate, or a loss of acidic fluids from the body such as from vomiting. Respiratory alkalosis is the result of an increased elimination of $CO_2$ through the lungs because of hyperventilation.

A decreased pH value (acidemia) in blood, serum or plasma may occur because of an increased formation of organic acids, an increased excretion of $H^+$ ions in certain renal disorders, an increased acid intake such as in ethylene glycol poisoning, or a loss of alkaline body fluids. Respiratory acidosis is the result of a decreased alveolar ventilation and may be acute as the result of pulmonary edema, airway obstruction or medication, or may be chronic as the result of obstructive or restrictive respiratory diseases.

### *P*$CO_2$

The partial pressure of carbon dioxide (*P*$CO_2$) in arterial blood is used to assess how well the body eliminates carbon dioxide, a by-product of metabolism. A *P*$CO_2$ value below the normal range is called “respiratory alkalosis” and indicates hypocapnia, a condition caused by increased alveolar ventilation, such as hyperventilation. An arterial *P*$CO_2$ above the normal range is called “respiratory acidosis” and indicates hypercapnia. Hypercapnia is a sign of ventilatory hypoventilation and failure, resulting from cardiac arrest, chronic obstructive lung disease or chronic metabolic acid-base disturbances.

### *P*$O_2$

The partial pressure of oxygen (*P*$O_2$) in arterial blood is used to assess how well the body is able to absorb oxygen in the lungs. Values below the normal arterial *P*$O_2$ (arterial hypoxemia) are usually caused by pulmonary, circulatory or respiratory abnormalities (e.g., bronchial obstruction, vascular problems, decrease in cardiac output, increased oxygen demand, anatomical heart defect, low inspired $O_2$ content). Generally, $O_2$ levels above 100 mmHg do not contribute significantly to the oxygen content since, with normal hemoglobin concentrations, a *P*$O_2$ of 80 to 100 mmHg provides a 97% saturation level (and a level greater than 100% cannot be achieved).

### tHb

Hemoglogin is the main component of erythrocytes and is the primary vehicle for the transportation of oxygen within the bloodstream. In addition to its role in carrying oxygen, hemoglobin is an important component of the buffer system and is responsible for more than 80% of the nonbicarbonate buffering capacity of whole blood.

Decreases in the amount of hemoglobin in the blood can be a result of either decreased concentration of hemoglobin within the erythrocytes, and/or a decreased number of erythrocytes in circulation. Decreases in hemoglobin are most often caused by anemia, or a decrease in the number of erythrocytes in circulation. Anemias are usually classified

as either regenerative or nonregenerative. Regenerative anemia may be caused by blood loss or hemolysis. Nonregenerative anemia may be caused by bone marrow disease, drug reactions, infectious diseases, or secondary to chronic inflammation, or renal disease. Other nonanemia causes of a decrease in hemoglobin include iron deficiency, deficiency of other precursors to hemoglobin, portosystemic shunts and hepatic atrophy.

Increases in the amount of hemoglobin in the blood are most often a result of polycythemia, or an increase in the number of erythrocytes in circulation. Polycythemia is usually classified as either relative or absolute. Relative polycythemia may be caused by splenic contraction, dehydration or hypovolemia. Absolute polycythemia may be caused by living in high altitudes, pulmonary or cardiac disease, primary polycythemia or excessive erythropoietin secretion secondary to renal tumors or rarely other renal conditions.

### $SO_2$

Oxygen saturation ($SO_2$) is the percentage of hemoglobin that has oxygen bound to it. It can also be thought of as the percentage of actual oxygen content of the blood compared to the oxygen carrying ability of the blood. By using the hemoglobin-oxygen dissociation curve, the $SO_2$ can be correlated directly with the partial pressure of oxygen ($PO_2$) of the blood. An arterial oxygen saturation ($S_aO_2$) of greater than 93% is considered normal.

A decreased $SO_2$ usually correlates with a decreased $PO_2$ and is called hypoxemia. Hypoxemia may be caused by a primary lung disease inhibiting oxygen absorption, hypoventilation, circulatory abnormalities, or a decreased atmospheric pressure of oxygen. Alternate forms of hemoglobin that do not carry oxygen (such as methemoglobin, sulfhemoglobin or carboxyhemoglobin) or a decreased affinity of hemoglobin for oxygen may also result in a low $S_aO_2$.

An $SO_2$ result cannot exceed 100% and this is considered to be a normal finding.

### $tCO_2$

$tCO_2$ is the total amount of carbon dioxide measured in the blood sample. $tCO_2$ is composed of:

- Bicarbonate ($HCO_3^-$)
- Carbonic acid ($H_2CO_3$)
- Carbon dioxide ($CO_2$)

The blood buffer system, which plays an important role in the acid-base status of the patient, uses these three forms of carbon dioxide. Because the amounts of $H_2CO_3$ and dissolved $CO_2$ in the blood are so small, $tCO_2$ is an indirect measure of the $HCO_3^-$ ion. When the $CO_2$ content is measured on a serum or plasma sample, room air may affect the partial pressure of the $CO_2$. As a result, $tCO_2$ can be used as a rough guide to acid-base balance.

### $HCO_3^-$

Bicarbonate ($HCO_3^-$) is an important component of the blood buffer system. The bicarbonate and chloride ions play a major role in maintaining electrical neutrality in the extracellular and intracellular fluid. Levels of $HCO_3^-$ are regulated by the kidneys. $HCO_3^-$ increases with alkalosis and decreases with acidosis.

### Anion Gap

The anion gap is an expression of the value of the commonly measured anions subtracted from the value of the commonly measured cations. It is most commonly expressed as the equation:

$$\text{Anion gap} = (Na^+ + K^+) - (Cl^- + HCO_3^-)$$

Increases indicate titrational metabolic acidosis and an increase in unmeasured anions (lactic acid, ketones, salicylic acid, ethylene glycol, and uremic acids such as BUN and creatinine). This is generally associated with decreased bicarbonate ($HCO_3^-$) concentration loss by titration. The anion gap helps clarify mixed acid-base disorders such as concurrent metabolic acidosis and alkalosis.

*These parameters are calculated from parameters measured by the VetStat analyzer.

## Contents

Before you begin installing your VetStat analyzer, take a moment to look over the contents to ensure that you have the following:

- Power supply with power cord
- Battery
- Quality control material (either OPTI* CHECK or VetStat* Control)
- Gas bottle
- Thermal printer paper
- Two standard reference cassettes (SRCs), level 1 and level 3
- Hemoglobin calibration cassette (HbCC)

**NOTE:** The two SRCs and the HbCC are located inside the analyzer's storage compartment.

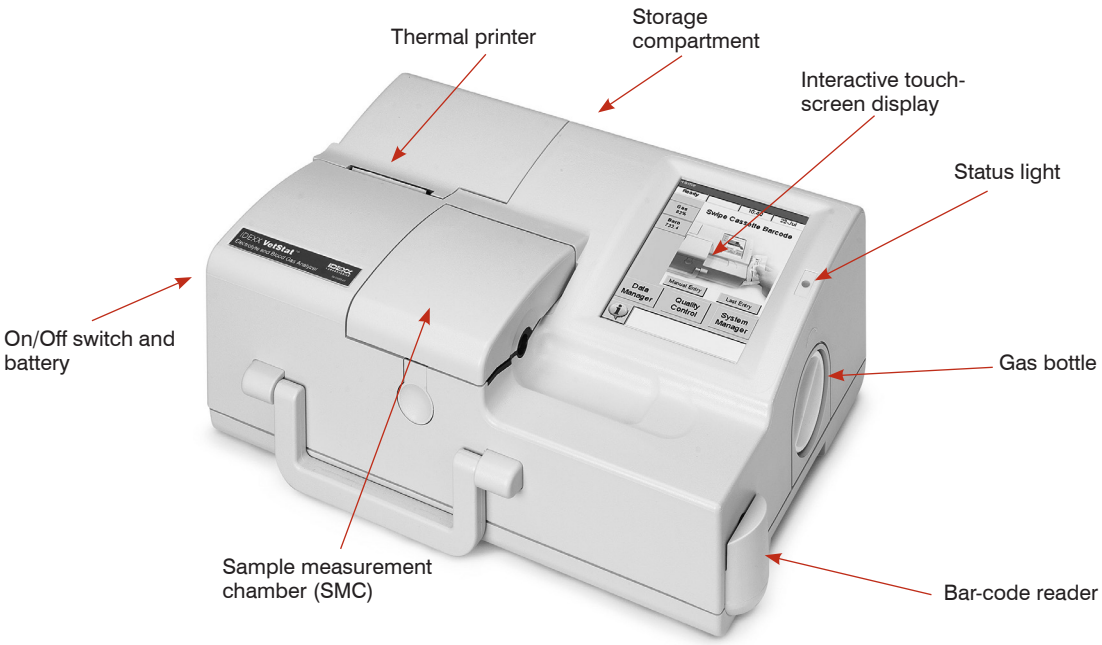



**Figure A-1:** IDEXX VetStat components

## Analyzer Components

Before installing the VetStat analyzer, it is important to familiarize yourself with the analyzer's components (Figure A-1).

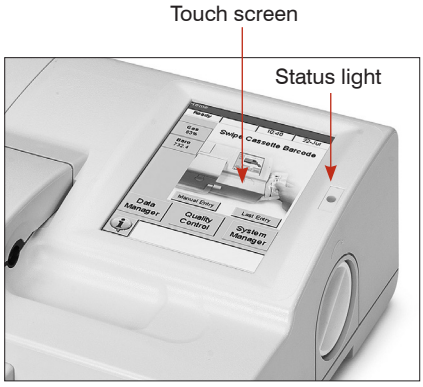



**Figure A-2:** Touch screen and status light

### Interactive Touch-Screen Display

You communicate with the analyzer through a touch screen (Figure A-2).

### Status Light

To the right of the touch screen is a two-color status light (Figure A-2). The status light illuminates when the analyzer is in use, and remains unlit when idle. During operation you will see one of the following:

- **Green Light**—The analyzer is in the process of calibration or measurement; do not open the cover
- **Red Light**—An error has occurred, the analyzer has stopped
- **Blinking Red Light**—The analyzer has encountered a problem and needs operator interaction before it can proceed

### Sample Measurement Chamber (SMC)

Inside the analyzer is the sample measurement chamber (SMC). To open the cover, depress the button (Figure A-3).

LEDs and infrared lasers are located inside the sample measurement chamber.

**NOTE:** To prevent damage to the LEDs, avoid direct contact. See the Cleaning and Maintenance section for instructions on cleaning the SMC.

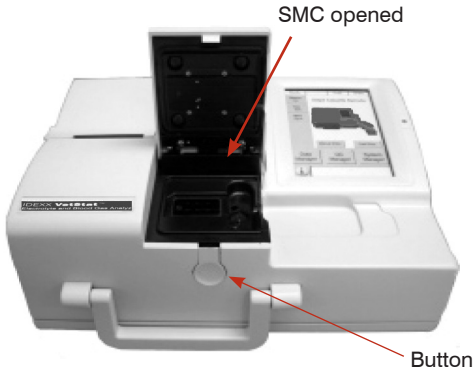



**Figure A-3:** Sample measurement chamber (SMC)

### Gas Bottle

During calibration, the VetStat analyzer uses a precision gas that is completely self-contained in a disposable low-pressure bottle. After swiping the bar code on the gas bottle package insert past the bar-code reader, the bottle is inserted on the right side of the analyzer (Figure A-4).

**NOTE:** When you turn the analyzer on, it performs a gas purge, which uses more gas than a typical sample analysis.

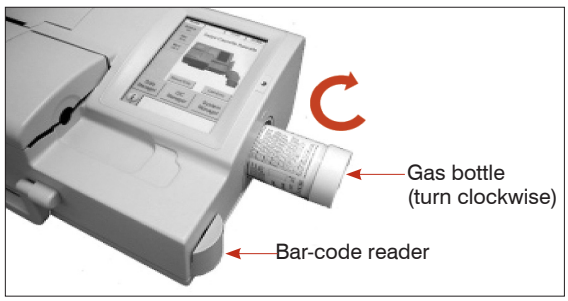



**Figure A-4:** Gas bottle and bar-code reader

### Bar-Code Reader

The bar-code reader, located on the right (Figure A-4), reads quality control ranges, as well as lot and expiration information from sample cassettes, quality control material, standard reference cassettes (SRCs) and gas bottles.

## Thermal Printer

The thermal printer is accessed by raising the door on the top left of the analyzer (Figure A-5). The printer uses heat-sensitive, document-grade paper that is resistant to fading. The analyzer can print patient values, quality control values and calibration values, as well as patient and diagnostic information.

## Peristaltic Pump

Contained within the same compartment as the thermal printer is a peristaltic pump cartridge that is used to transport liquids and gases. All liquids are contained within the VetStat cassette and do not enter the analyzer (Figure A-5).

**NOTE:** The peristaltic pump cartridge is a replaceable item; see the Cleaning and Maintenance section for more information.

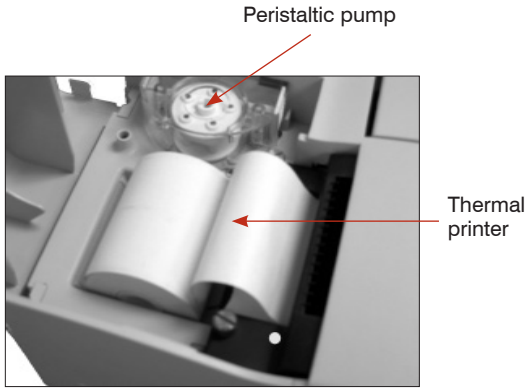



**Figure A-5:** Thermal printer and peristaltic pump

## Model and Serial Numbers

The model and serial numbers are located on an identification plate on the bottom of the analyzer.

## Back of Analyzer

On the back of the analyzer (Figure A-6) are:

- An RS232 interface port
- An Ethernet port
- An LED that indicates the charging status of the battery
- A storage compartment that can hold an extra paper roll, the SRCs, other supplies or accessories
- A compact flash card slot (CF slot) for software upgrades

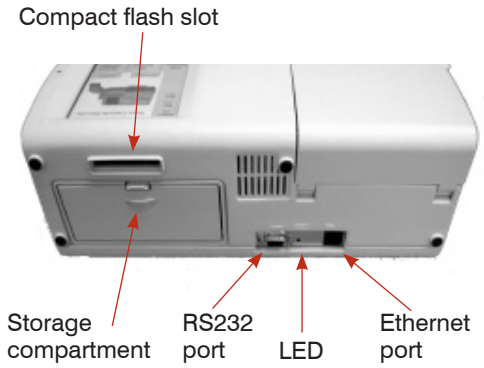



**Figure A-6:** Back of the VetStat analyzer

## Power Connector

On the left side of the analyzer (Figure A-7) is the power connector, where you can connect the VetStat analyzer to an external power supply.

## On/Off Switch

The on/off switch is located on the left next to the power connector.

**NOTE:** Allow a 30-second delay when switching the power on or off.

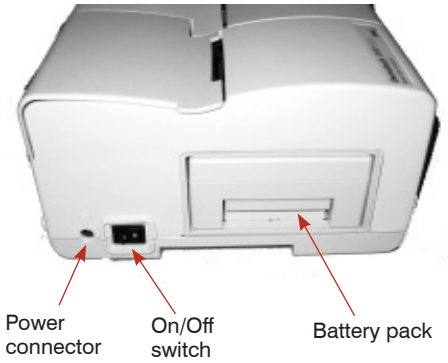



**Figure A-7:** Left of the VetStat analyzer

### Rechargeable Battery Pack

The rechargeable battery pack is located on the left next to the on/off switch. It is removed by squeezing the handle and sliding it out. The battery allows you to operate the VetStat analyzer without having to plug it into an electrical outlet. The battery can be charged in the analyzer or in the optional VetStat battery charger.

### Battery Discharge/Recharge

If you frequently use your VetStat analyzer on battery power, we recommend that the internal NiCad rechargeable battery be deep discharged routinely (e.g., every six months). To do this, disable the Battery Saver mode (see “Setting Up Hardware” in the System Management section) and then leave the analyzer turned on overnight running only on battery power.

A blank touch screen indicates a deep discharged battery. Plug in the external power supply and allow six hours to fully charge the battery. During the charge, the charge status LED located on the back of the VetStat analyzer stays on constantly.

The charge status LED begins flashing four times per second when the charge is complete. It blinks slowly (once every 1.5 seconds) when trickle-charging a depleted battery.

**NOTE:** If you frequently use your VetStat analyzer on battery power, we recommend that you purchase an additional battery and the optional external battery charger, 110 V or 220 V.

## Safety Precautions

For your safety and the proper operation of your equipment, always follow these precautions when working with your VetStat analyzer:

- Keep the analyzer away from all sources of liquids such as sinks and wash basins.
- Keep the analyzer away from explosive gases or vapors.
- Use only the power source supplied with the VetStat analyzer.
- Always handle blood samples and collection devices with care.
- Dispose of the VetStat cassettes according to local regulations.

**WARNING! LASER HAZARD**

The IDEXX VetStat Analyzer is a Class 1 laser product according to the requirements of IEC 60825-1.

The maximum energy output is as follows:

670 nm (LED): 40 microwatts maximum for 400 ms

780 nm (Laser): 40 microwatts maximum for 400 ms

850 nm (Laser): 40 microwatts maximum for 400 ms

**Caution:** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

**WARNING! ELECTRIC SHOCK**

- The analyzer is designed as a conventional device (closed, not waterproof type).
- Do not operate the analyzer in an explosive environment or in the vicinity of explosive anesthetic mixtures containing oxygen or nitrous oxide.
- This analyzer is suitable for continuous operation.
- The power plug must only be plugged into a ground socket. When using an extension cord, make sure that it is of the proper size and is properly grounded.
- Any breakage of the ground lead inside or outside the analyzer, or a loose ground connection, can cause a hazardous condition when operating the analyzer. Intentional disconnection of the grounding is not permitted.
- When replacing the fuses, make sure that they are of the same type and rating as the original fuses. Never use repaired fuses or short-circuit the fuse holders.

All service is subject to the terms of IDEXX's warranty and, after the warranty period, IDEXX's extended maintenance agreement, and must be performed by an authorized IDEXX service technician. For technical support or service, contact IDEXX Technical Support.

## Choosing a Location

Location is important for trouble-free operation of your VetStat analyzer. Choose a site that is convenient for your sampling needs and meets the following physical requirements of the analyzer:

- Grounded electrical outlet, when operated with power supply
- Away from direct sunlight
- Room temperature within 10°–32°C (50°–90°F)
- Maximum relative humidity of 95%
- At least two inches of clearance around the analyzer to allow air to circulate
- Away from strong electromagnetic fields such as those created by electric motors and x-ray equipment
- Away from explosive gases or vapors
- Placed on a hard, flat surface with no obstruction between the surface and the air vents on the bottom of the analyzer (this prevents overheating)

**NOTE:** These requirements also apply when the VetStat analyzer operates on battery power outside a laboratory setting.

## Installing the VetStat Analyzer

Place the analyzer on a secure table top that allows plenty of working space and is convenient to a power connection.

1. Plug in the power supply.
   - Plug the power supply into the receptacle on the left side of the analyzer.
   - Plug the power cord into the power supply.
   - Plug the cord into a grounded electrical outlet.

   **NOTE:** To protect your VetStat analyzer and other electronic devices from damage caused by electrical power spikes, IDEXX recommends the use of a surge protector.
2. Install the battery pack.
   - Push the battery pack into the opening on the left of the VetStat analyzer.

     **NOTE:** The battery needs to be charged for at least six hours before using the VetStat analyzer on battery power. It is charged automatically whenever the analyzer's external power supply is plugged into an electrical outlet.

     **NOTE:** The status LED on the back of the analyzer is always on while the battery is being charged. The LED blinks rapidly (four times per second) when the battery is fully charged. It blinks slowly (once every 1.5 seconds) when charging a depleted battery. (If the VetStat analyzer's power is off, the status LED is also off.)
3. Locate the power switch on the left side of the analyzer and switch it to **on** (Figure B-1). The VetStat analyzer start-up screen displays. Tap **OK**.
4. Install the gas bottle.
   a. When the "Stop! Low Gas. Replace Now." message appears, tap **OK**.
   b. When the "Swipe Bar Code for New Gas Bottle" message appears, swipe the bar code located on the gas bottle's package insert.

      **NOTE:** If the bar code is damaged or unreadable, tap the **Manual** button and enter the bar code using the alphanumeric keypad.
   c. Open the gas bottle by unscrewing its cap.

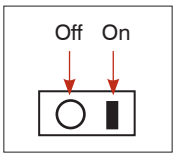



**Figure B-1:** Off/On switch

d. Record the date of installation on the gas bottle for later reference.

**NOTE:** The bar code on the gas bottle package insert contains expiration information. The VetStat analyzer will alert you when the gas is low or two weeks before the expiration of the gas bottle as a reminder to order a replacement.

e. When the “Please Insert Gas Bottle” message appears, insert the gas bottle in its housing and turn it clockwise until it is snug (Figure B-2). Then tap **OK**.

**WARNING:** Do not overtighten the gas bottle because this may cause damage to the VetStat analyzer.

**Figure B-2:** Gas bottle

f. When the “New Gas Bottle?” message appears, tap **Yes**.

**NOTE:** If, after the initial installation, you need to remove a gas bottle and reinstall the same bottle, tap **No** at the “New Gas Bottle?” message. On the next screen, enter the number of weeks the gas bottle has been in use. Refer to the installation date that you recorded on the gas bottle.

5. The VetStat analyzer begins to warm up and performs a gas purge, which is indicated on the status bar at the bottom of the screen. When the warm-up is complete, the Home screen appears (Figure B-3).

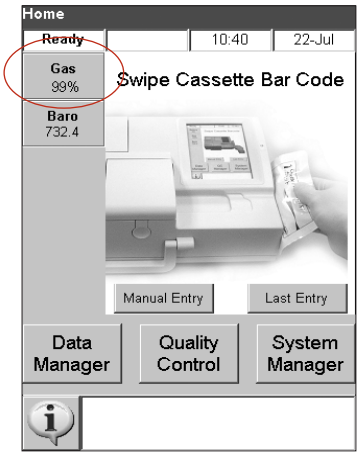



**Figure B-3:** Home screen

**NOTE:** The percentage of gas contained in the bottle is indicated in the upper left of the Home screen. For a new gas bottle, the percentage should be 99%.

6. Install the printer paper.

a. Place the paper into the paper tray.

**NOTE:** Only thermal paper can be used in the VetStat analyzer’s printer.

b. With the analyzer turned on, thread the paper into the feeder slot on the analyzer (Figure B-4).

As soon as the printer detects the paper, it automatically feeds the paper completely through the printer. The red Paper Advance button should only be used when paper is present.

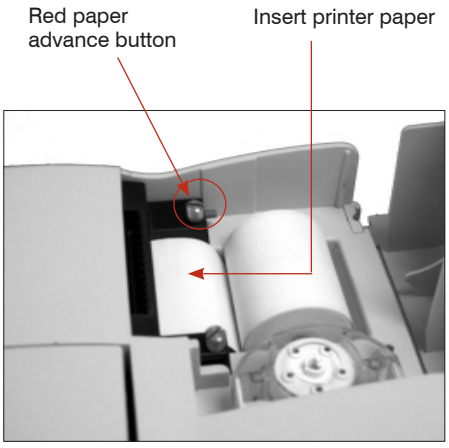



**Figure B-4:** Thermal printer

c. To advance paper after the initial installation, press the red Paper Advance button located on the left side of the printer.

**NOTE:** The red Paper Advance button is only active when the printer detects paper in the printer.

7. Set up the standard reference cassettes (SRCs levels 1 and 3).

   **NOTE:** When you open a new SRC, be sure to scan the bar code on the foil pouch. This enters the lot number and the expiration date into the VetStat database. Do not discard the foil pouch. Each SRC level has its own unique lot number printed on the pouch. The SRC should be stored in its pouch when not in use.

   **NOTE:** The following procedure for programming SRC ranges is identical for all levels.

   a. From the Home screen, tap **System Manager** and then tap **Setup**.

   b. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**.

   c. From the System> Setup screen, tap **SRC** (Figure B-5).

   d. Scan the bar code on the SRC foil pouch using the bar-code reader on the VetStat analyzer.

      - The bar code should face the analyzer.
      - A beep indicates a valid bar code. A red status light indicates an invalid bar code (e.g., SRC expired).

      **NOTE:** If the bar code is damaged or unreadable, you can manually enter the bar code. Tap the **Manual** button to display the alphanumeric keypad. Enter the bar-code information printed on the bar-code label on the foil pouch.

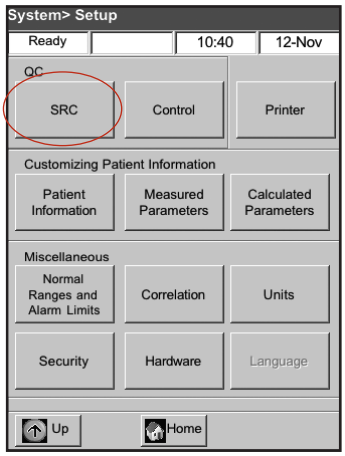



**Figure B-5:** System> Setup screen

   e. If the level, lot number and expiration date are correct, tap **Save**. If they are incorrect, tap the applicable **Edit** button to correct the information.

   f. Repeat steps 7d and 7e for SRC level 3 (and optional SRC level 2, if necessary).

   g. When you are finished scanning and saving the bar codes for the SRCs, tap **Cancel** and then tap **Home**. When the "Data modified. Save data before exiting?" message appears, tap **Yes**.

      **NOTE:** If previous SRC data exists in the database, the following screen messages appear:

      - "Print Previous SRC Data?"—Tap **Yes** if you want to keep a copy of the previous SRC data for your records.
      - "Delete Previous SRC Data?"—Tap **Yes**. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**. The previous SRC data is deleted from the database.

8. Run the SRCs.

   **IMPORTANT:** Before sample testing, you must run the standard reference cassettes (SRCs level 1 and 3) that are supplied with the analyzer.

   a. From the Home screen, tap **Quality Control**, and then tap **SRC**.

   b. Use the alphanumeric keypad to enter your Operator ID, and then tap **OK**.

   c. Press the button to open the sample measurement chamber (SMC) cover.

   d. Examine the SRC level 1 to ensure it is clean and insert it into the chamber. Press down to properly seat the SRC.

e. Close the sample measurement chamber cover.

**NOTE:** If the “Error—Need Setup—QC” message appears, you need to set up the standard reference cassettes before running this procedure. See step 7 for more information.

f. When the “SRC Information Correct?” message appears, verify the cassette’s lot number and level number displayed on the screen, and then tap **Yes** to continue.

g. The analyzer begins the measurement process, which is indicated on the touch screen. During this time (approximately 60 seconds), a progress bar is displayed.

h. When the measurement is complete, the analyzer displays the results.

- The analyzer automatically checks the results against the analyzer’s reference ranges, and stores the results in its internal database.
- For parameters within range, **Pass** is displayed and printed.
- For parameters out of range, or if an internal drift is detected, **Fail** is displayed.

**NOTE:** If the SRC test fails, gently clean the SRC, the optics window and the inside cover of the SMC (see the Cleaning and Maintenance section) and repeat this process. If it fails again, call IDEXX Technical Support.

i. Tap the **Up** button to print the results.

j. Open the sample measurement chamber cover, remove the SRC and close the cover.

**NOTE:** The SRCs are reusable. After removing the SRCs, return them to their foil pouches and store them in the storage compartment located on the back of the VetStat analyzer.

k. Perform the second SRC measurement with SRC level 3 in the same manner (and optional SRC level 2, if necessary).

If both SRC level 1 and level 3 tests pass, the analyzer is ready for diagnostic use.

l. Tap the **Home** button to return to the Home screen.

**IMPORTANT:** When performing an SRC measurement, you may see results for parameters you do not use for patient analysis. It is important that you contact IDEXX Technical Support to report any failing parameters.

9. Set up the quality control materials.

a. From the Home screen, tap **System Manager** and then tap **Setup**.

b. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**.

c. Tap **Control** (Figure B-6).

d. Swipe the 36-digit bar code marked Level 1 SWIPE A supplied with the OPTI CHECK* or VetStat* Control lot.

**NOTE:** The bar-code information is on the quality control package insert. If the bar code is damaged or unreadable, tap **Manual** on the “Swipe Bar Code” message and manually enter the information.

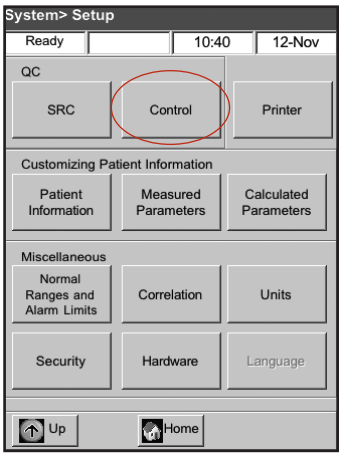



**Figure B-6:** System> Setup screen

e. When the “Swipe Next Bar Code Now” message appears, swipe the second 36-digit bar code marked Level 1 SWIPE B supplied with the same OPTI CHECK or VetStat Control lot.

f. Confirm that the lot and expiration date information that appears on the screen matches the information on the quality control package insert.

g. When you are finished swiping the bar-code information for quality control level 1, A and B, tap **Save**.

h. The “Swipe Bar Code” message appears again. Repeat steps 9d through 9g for quality control levels 2 and 3.

i. When you are finished entering and saving the information for quality control levels 1, 2 and 3, tap **Cancel** and then tap **Home** to return to the Home screen.

10. Run quality control.

a. From the Home screen, tap **Quality Control**, and then tap **Control**.

b. Using the alphanumeric keypad, enter your Operator ID and then tap **OK**.

c. Select the level of control that you are running and tap **Continue**.

d. The lot number and selected level appear on the screen. Tap **Yes** if they are correct.

e. Swipe the bar code on the VetStat sample cassette package being used for quality control.

**NOTE:** If the bar code is damaged or unreadable, tap **Manual** and enter the bar code using the alphanumeric keypad.

f. Open the sample measurement chamber cover by pressing the release button (Figure B-7).

g. Open the sample cassette pouch and remove the sample cassette. Wipe any excess moisture from the cassette with a clean, dry, lint-free cloth.

h. Insert the sample cassette into the chamber. Press down to ensure that it is seated.

i. Close the SMC cover. The analyzer starts to calibrate, as indicated on the screen.

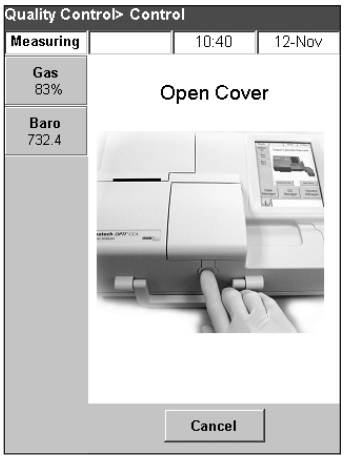



**Figure B-7:** Open SMC cover

**NOTE:** If the sample measurement chamber cover is opened while the status light is green, the cassette calibration will be canceled and the cassette must be discarded.

j. After the calibration is complete:

- Remove a quality control ampule from the box of controls and mix the contents by gently inverting, being careful not to heat it with your hands. Invert the ampule for 10 seconds.
- Gently tap the head of the ampule with your fingernail to remove any liquid.
- Carefully open the ampule by breaking off the top.

**NOTE:** To ensure proper measurement, run the control fluid immediately after opening the ampule.

**NOTE:** Protect your fingers by using gloves or tissue while breaking the ampule.

- Aspirate directly from the ampule, or use a capillary or syringe to withdraw a small amount of control material from the ampule for aspiration.

  **NOTE:** Best results are obtained from direct aspiration from the ampule via the syringe adapter. To accomplish this, hold the ampule at a 45° angle during aspiration and ensure that the red syringe adapter is submerged in the liquid (Figure B-8). Use a new ampule of control material for each analysis.

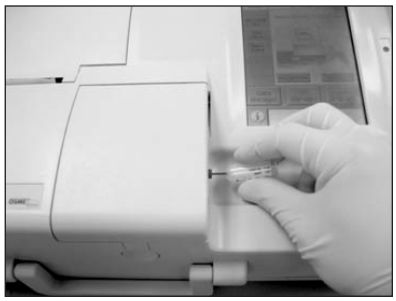


**Figure B-8:** Direct aspiration

  **NOTE:** If a syringe is used, withdraw the ampule contents slowly to minimize agitation and avoid introducing bubbles into the syringe.

k. When the syringe adapter is fully submerged in the control fluid, tap **OK**. The quality control sample is automatically aspirated into the cassette and the measurement starts. The status light is green, indicating that the cover should not be opened. The “Measurement in Process” message appears on the screen with a progress bar. The ampule can be removed 3–5 seconds after the analyzer begins to make a ticking sound.

   Upon completion of the measurement, the results are displayed, and pass or fail status is indicated.

l. Tap **Up** to accept or reject the results.

   - If the results are acceptable, tap **Accept**. The results are stored in the database.
   - If the results are not acceptable, tap **Reject.** Rejected results are not stored in the database.
   - Tap **Review** if you want to view the results again.

   **NOTE:** After you choose to accept or reject the results, the results are automatically printed. Call IDEXX Technical Support to report any failing result.

   **NOTE:** If any of the results are outside of the VetStat’s measurement range (indicated by a **Low** or **High)**, the results cannot be accepted into the database.

m. Open the sample measurement chamber cover, remove the cassette and close the cover.

n. Tap **Up** or **Home** to return to the Home screen.

## Precautions and Warnings

- Use of calibration solutions, calibration gas or optodes that are not supported by IDEXX could void your warranty and extended maintenance agreement support coverage.
- Once used, the sample cassette holds animal body fluids. Handle with appropriate care and dispose of appropriately.
- VetStat cassettes have been validated for use with canine, feline and equine samples.
- For in-vitro diagnostic use only.
- For veterinary use only.

## Sample Cassettes

Customized, single-use, disposable sample cassettes are available for use with the VetStat analyzer (Figure C-1). Each cassette contains a sample fillport and removable syringe adapter (Figure C-2). The syringe adapter projects from the sample fillport and allows a syringe to be easily attached to the cassette. When sampling with a capillary tube, simply remove the syringe adapter from the fillport.

**Figure C-1:** IDEXX VetStat cassette

**NOTE:** The syringe adapter can be removed while the cassette is inside the sample measurement chamber.

**Figure C-2:** Sample fillport and syringe adapter

**IMPORTANT:** The sample must not be injected, and the collection device (a syringe or capillary tube) must be seated firmly into the syringe adapter or sample fillport. The analyzer will automatically aspirate the sample. See the Sample Collection and Handling section for more information on proper sampling technique.

The sample cassettes are stored at room temperature (10°–32°C/50°–90°F) and are packaged in sealed foil pouches. The bar code on the outside of each foil pouch contains lot, expiration and calibration information specific to the cassette.

**NOTE:** Sample cassettes should be disposed of in accordance with local, state and federal regulations.

## Standard Reference Cassettes (SRC)

Standard reference cassettes (SRCs) are used to check the electronics and the optics of the VetStat analyzer. To ensure optimal performance, IDEXX recommends that SRC measurements be confirmed within acceptable ranges once each day that the analyzer is in operation. Three SRC levels are available for the VetStat analyzer; each one tests a different optical range. SRC level 1 and SRC level 3 are provided as part of the initial analyzer shipment because they measure the high and low optical ranges. While it is recommended that you run both SRC level 1 and level 3 on a daily basis, you can alternate between these SRCs each day.

If you are interested in three control levels, the SRC level 2, which measures the middle optical range, is available for purchase from IDEXX.

**The SRCs are packaged in foil pouches that contain the SRC expiration date, lot number and bar code. Do not discard these pouches after opening the SRC cassettes.** To ensure optimal performance of the SRCs, place the SRC inside the foil pouch when it is not in use. Store the SRC pouches in the storage compartment located on the back of the analyzer (Figure C-3).

**NOTE:** The SRC calibrations are separate from the quality control procedure, which is described in the Quality Control section.

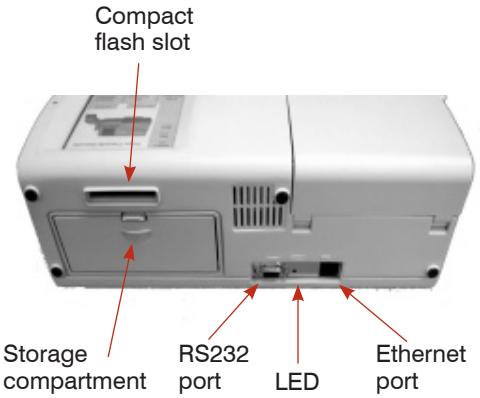



**Figure C-3:** Back of the VetStat analyzer

## Hemoglobin Calibration Cassette (HbCC)

A reusable hemoglobin calibration cassette (HbCC) is provided with the analyzer and is used to calibrate the hemoglobin channel. The HbCC verifies the measurement optics and electronics, and corrects any potential drift. It is important to run the HbCC once every three months.

The HbCC is packaged in a foil pouch that contains the HbCC expiration date and lot number. **Do not discard this pouch after opening the HbCC.** To ensure optimal performance of the HbCC, place the cassette inside the foil pouch when it is not in use. Store the HbCC in the storage compartment located on the back of the analyzer (Figure C-3).

## Other Accessories and Consumables

### Calibration Gas Bottle

**Use:** For the calibration of pH, $PCO_2$ and $PO_2$ in the VetStat analyzer

**Contents:** Each disposable, low-pressure cylinder contains approximately two liters of gas (at less than 145 psi at 21°C)

**Composition:**

| | |
|---|---|
| Oxygen | 14.0 ±0.02% |
| Carbon Dioxide | 6.0 ±0.02% |
| Nitrogen | balance |

**Storage:** Stable when stored at 4°–30°C (39°–86°F) until its expiration date

**Disposal:** Dispose of according to the safety regulations applicable at your facility

**IMPORTANT:** If the analyzer is being shipped via air travel, it is critical that the gas bottle is removed before shipping.

**CAUTION:** The gas bottle is a pressurized bottle. Protect it from sunlight and do not expose it to temperatures exceeding 50°C (122°F). Refer to the package insert for further information on the calibration gas.

### Battery Charger—110 V (Optional)

**Use:** For fast charging of the battery pack for the VetStat analyzer

**Contents:** Each charger contains a power supply with circuitry

**Input Voltage:** 110 VAC, 47–63 Hz

**Storage:** Refer to the package insert

### Battery Charger—220 V (Optional)

**Use:** For fast charging of the battery pack for the VetStat analyzer

**Contents:** Each charger contains a power supply with circuitry

**Input Voltage:** 220 VAC, 47–63 Hz

**Storage:** Refer to the package insert

### External Battery

**Use:** Allows the VetStat analyzer to operate on battery power

**Specifications:** 12 V, 2800 mAh

### Peristaltic Pump

**Use:** Transports liquids and gases

**Storage:** Room temperature

**Specifications:** Replace once per year (see the Cleaning and Maintenance section for more information)

### Quality Control Material

An initial supply of quality control materials are provided with the VetStat analyzer. Additional quality control materials are available for purchase from IDEXX.

**VetStat Control/OPTI CHECK:**

**Use:** Assayed quality control materials that monitor the measurement of pH, $PCO_2$, $PO_2$, sodium, potassium, chloride, ionized calcium, total hemoglobin content and oxygen saturation in the IDEXX VetStat Electrolyte and Blood Gas Analyzer

**Active Ingredients:** Formulated using aqueous organic and carbonate buffers at equilibrium with predetermined levels of oxygen, carbon dioxide, nitrogen, with salts, buffers and polystyrene beads

**Storage:** Store unopened ampules at room temperature (15°–30°C/59°–86°F). Do not use beyond the expiration date. Do not freeze. Refer to the package insert for more information.

## Thermal Paper

**Use:** For the printing of patient, quality control and calibration values, as well as patient and diagnostic information

**Composition:** Thermal, document-grade, resistant to fading

**Storage:** Room temperature

### Changing the Printer Paper

The thermal printer paper supplied by IDEXX contains an indicator strip to alert you when the paper roll needs to be changed.

**To change the paper:**

1. Open the printer cover on the top of the VetStat analyzer.
2. Press the red Paper Advance button to eject any remaining paper (Figure C-4).
3. Remove the old roll.
4. Place the paper into the paper tray.

   **NOTE:** Only thermal paper can be used in the VetStat analyzer's printer.
5. With the VetStat analyzer turned on, thread the paper into the feeder slot on the analyzer (Figure C-4).

   **NOTE:** Do not fold the paper before inserting it into the feeder.

   As soon as the printer detects the paper, it automatically feeds the paper completely through the printer. The red Paper Advance button should be used only if paper is present.
6. To advance paper after the initial installation, press the red Paper Advance button located on the left of the printer.

   **NOTE:** The red Paper Advance button is only active when the printer detects paper in the printer.
7. Close the printer cover and tear off any excess paper.

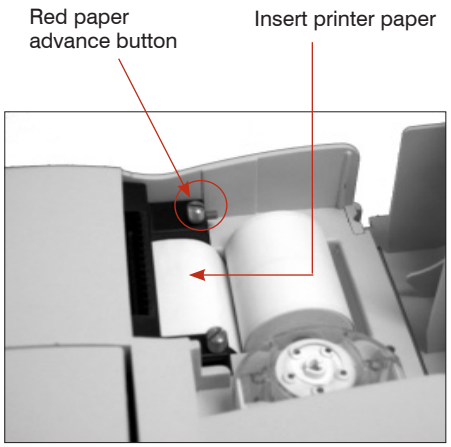



**Figure C-4:** Thermal printer

## Sample Cassettes

Each lot of sample cassettes is calibrated during the manufacturing process. Every sample cassette package is then labeled with a bar code containing this calibration information, as well as its lot number and expiration date.

**NOTE:** See the Cassettes, Consumables and Accessories section for more information on sample cassettes.

The sample cassette's bar code is read by swiping the cassette package through the bar-code reader. The sample cassette is then installed and an automatic calibration verification is performed using a precision gas mixture and the sample cassette's internal storage buffer.

During the calibration and measurement processes, diagnostic tests are automatically performed to ensure correct operation of the analyzer and measurement of the sample cassette. These tests include automatic checks of the sample cassette for temperature control; fluidic control during calibration; proper equilibrium behavior of the sensors during calibration and measurement; automatic detection of bubbles and short sample during aspiration; and automatic detection of low gas, low battery, dirty optics or worn pump conditions.

## Hemoglobin Calibration Cassette (HbCC)

**Calibration of the hemoglobin channel is required every three months.** This calibration is performed using the hemoglobin calibration cassette (HbCC). The hemoglobin calibration verifies the measurement optics and electronics, and corrects any potential drift.

**NOTE:** When the HbCC is scheduled to be run, the standard reference cassettes (SRCs) level 1 and level 3 must be run after the hemoglobin calibration is complete.

### Running the HbCC

1. From the Home screen, tap **Quality Control**, and then tap **HbCC.**
2. Enter the setup ID, **207**, and then tap **OK**.
3. Enter your Operator ID, and then tap **OK**.
4. Use the alphanumeric keypad to enter the lot number of the HbCC (found on the cassette's foil pouch or on the top of the cassette), and tap **OK**.
5. When the "Open Cover" message appears, press the button to open the sample measurement chamber (SMC) cover.
6. When the "Clean Optics and Inside of Cover" message appears, gently clean the optics window and the inside top cover of the sample chamber with a soft lint-free cloth, and then tap **OK**.
7. Gently wipe both sides of the HbCC with a clean, dry, lint-free cloth and examine the cassette to ensure it is clean. Insert the cassette into the chamber and press down to properly seat it.
8. Close the SMC cover. The VetStat analyzer automatically detects the presence of the HbCC and begins the calibration process, which is indicated on the touch screen. During this time (approximately 60 seconds), a progress bar is displayed.
9. When the calibration is complete and the message appears indicating to do so, open the SMC cover, remove the hemoglobin calibration cassette and then close the SMC cover.

   **IMPORTANT:** The HbCC is reusable. After removing the HbCC, return it to its foil pouch and store it in the storage compartment located on the back of the analyzer.
10. The analyzer prints the Hemoglobin Calibration report, showing the previous and new calibration results and calibration factors.

11. After the hemoglobin calibration, the “Delete Old SRC Data and Rescan SRC Bar Codes” message appears. Tap **OK** to delete the current SRC data for each level (Figure D-1).

    **NOTE:** These messages appear only if previous SRC data exist in the database.

    **IMPORTANT:** You must delete and rescan SRC data. SRC and quality control values may be erroneous if this action is not performed.

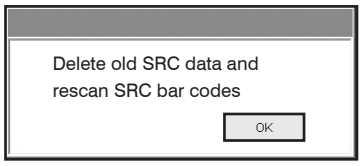



**Figure D-1:** Delete and rescan SRC message

12. The “Setup—QC. Swipe Bar Code” message appears. Before you can continue, you must set up the standard reference cassettes.
    a. Swipe the SRC level 1 bar code.

       **NOTE:** If the bar code is damaged or unreadable, you can manually enter the bar code. Tap the **Manual** button for either the Lot Number field or the Expiration field to display the alphanumeric keypad. Enter the lot or expiration information printed on the bar code.

    b. If the level, lot number and expiration date are correct, tap **Save**.
    c. Repeat steps 12a and 12b for SRC level 3 (and optional SRC level 2, if necessary).
13. When you are finished scanning and saving the bar codes for the SRCs, tap **Cancel** and then tap **Home**. A message appears asking if you want to save the changed data. Tap **Yes**. The Home screen appears.
14. Verify performance by now running SRC measurements.

    **NOTE:** See “Running Standard Reference Cassettes” in this section for more information on running SRCs.

## Standard Reference Cassettes (SRCs)

Standard reference cassettes (SRCs) are used to check the electronics and the optics of the VetStat analyzer. To ensure optimal performance, IDEXX recommends that SRC measurements be confirmed within acceptable ranges once each day that the analyzer is in operation. Three SRC levels are available for the VetStat analyzer; each one tests a different optical range. SRC level 1 and SRC level 3 are provided as part of the initial analyzer shipment because they measure the high and low optical ranges. While it is recommended that you run both SRC level 1 and level 3 on a daily basis, you can alternate between these SRCs each day.

If you are interested in three control levels, the SRC level 2 is available for purchase from IDEXX.

**NOTE:** See the Cassettes, Consumables and Accessories section for more information on SRCs.

These special test cassettes contain a stable optical sensor simulator that is measured by the analyzer in exactly the same manner as other cassettes, and provides assurance that all measured parameters are consistent. The results obtained should fall within the limits supplied with the SRCs.

**IMPORTANT:** On the SRC report, you may see results for parameters that you are not testing on patient samples. It is important that you contact IDEXX Technical Support to report any failing SRC results.

### Running Standard Reference Cassettes

**IMPORTANT:** One SRC level must be run each day the VetStat analyzer is in use. Use the following procedure when running any of the SRC levels (1, 2 or 3).

1. From the Home screen, tap **Quality Control**, and then tap **SRC**.
2. Use the alphanumeric keypad to enter your Operator ID, and then tap **OK**.
3. Press the button to open the sample measurement chamber (SMC) cover.
4. Examine the SRC level 1 to ensure it is clean. Use a clean, dry, lint-free cloth to wipe off the cassette, and then insert it into the chamber. Press down to properly seat the SRC.
5. Close the sample measurement chamber cover.

   **NOTE:** If the "Error—Need Setup—QC" message appears, you need to set up the standard reference cassettes before running this procedure. See "Setting Up the Standard Reference Cassette" in the System Management section.
6. When the "SRC Information Correct?" message appears, verify the cassette's lot number and level number displayed on the screen, and then tap **Yes** to continue.
7. The analyzer begins the measurement process, which is indicated on the touch screen. During this time (approximately 60 seconds), a progress bar is displayed.
8. When the measurement is complete, the analyzer displays the results.
   - The analyzer automatically checks the results against the analyzer's reference ranges, and stores the results in its internal database.
   - For parameters within range, **Pass** is displayed.
   - For parameters out of range, or if an internal drift is detected, **Fail** is displayed.

   **NOTE:** If the SRC test fails, gently clean the SRC, the optics window and the inside cover of the SMC and repeat this process (see the Cleaning and Maintenance section). If it fails again, call IDEXX Technical Support.
9. Tap the **Up** button to print the results.
10. Open the sample measurement chamber cover and remove the SRC.

    **NOTE:** The SRCs are reusable. After removing the SRCs, return them to their foil pouches and store them in the storage compartment located on the back of the analyzer.
11. Close the sample measurement chamber cover.
12. Tap the **Home** button to return to the Home screen.

**IMPORTANT:** When performing an SRC measurement, you may see results for parameters you do not use for patient analysis. It is important that you contact IDEXX Technical Support to report any failing parameters.

## Additional Printing Options for SRC Results

To print SRC reports or SRC statistical information:

1. From the Home screen, tap **Data Manager**.
2. In the Measurement Reports/Statistics section, tap **SRC** (Figure D-2).
3. On the Data>SRC Measurement screen (Figure D-3), select the run (located on the left) that you want to review.
4. Tap the applicable button on the right (Figure D-3):

| Button | Description |
|---|---|
| View | Displays the SRC results |
| Print | Prints the SRC results |
| Delete | Deletes the selected SRC results<br>**NOTE:** The setup password, 207, must be entered before deleting the results. |
| Export | This feature is not currently available. |
| Mark | Allows for multiple SRC runs to be selected at one time |
| All | Selects all SRC run results currently stored in the database |
| Up | Displays the previous page of SRC results |
| Down | Displays the next page of SRC results |
| Statistics | Generates statistics based on all stored data for SRC measurements |

5. Tap **Home** to return to the Home screen.

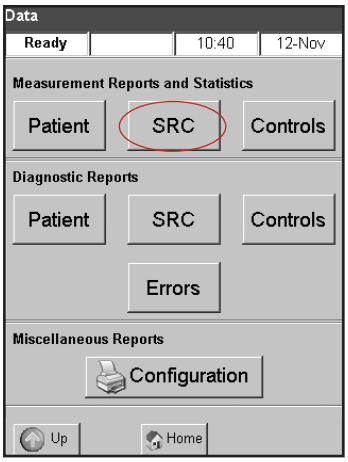



**Figure D-2:** Printing options

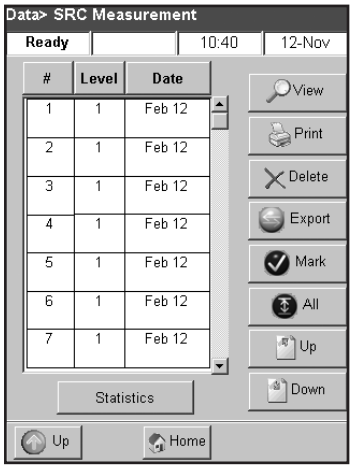



**Figure D-3:** SRC measurements

The purpose of a quality control procedure using the quality control fluid (OPTI CHECK, VetStat* Control) is to ensure reliable patient values over the clinically significant ranges for all the measured parameters.

OPTI CHECK and VetStat Control are used to verify the performance of the VetStat cassettes, electronics and optics.

**NOTE:** The SRCs, which must be run daily, verify only the performance of the analyzer's electronics and optics.

A control measurement can be made using any sample cassette lot or sample cassette type, and any level of the quality control samples (level 1, 2 or 3). It is recommended that you use the most comprehensive cassette available in your inventory. For example, if you have a sample cassette for $Na^+$, $K^+$ and $Cl^-$, as well as a sample cassette for pH, $PCO_2$, $Na^+$, $K^+$ and $Cl^-$, the latter sample cassette should be used for quality control. Policies regarding the measurement of quality control samples are at the discretion of your veterinary practice.

As a minimum, IDEXX recommends that quality control samples—level 1, 2 or 3—be performed:

- When the analyzer is first installed
- Once every four weeks for a routine check
- If you think your results are incorrect

IDEXX recommends that you use a different level of control each month.

## Running Quality Control

1. From the Home screen, tap **Quality Control**, and then tap **Control**.
2. Using the alphanumeric keypad, enter your Operator ID and then tap **OK**.
3. Select the level of control that you are running and tap **Continue**.

   **NOTE:** If the "Need Setup—QC" message appears, you need to set up the quality control material before running this procedure. See "Setting Up the OPTI CHECK or VetStat Quality Control Material" in the System Management section.
4. The lot number and selected level appear on the screen. Tap **Yes** if they are correct.

   **NOTE:** If they are not correct and a new lot of quality control material is being used, make sure the ranges have been entered into the analyzer before running a sample. (See "Setting Up the OPTI CHECK or VetStat Quality Control Material" in the System Management section for more information.) If the password function is enabled, you will be asked for it before deleting the database for the previous lot number.
5. Swipe the bar code on the VetStat sample cassette package (Figure E-1) being used for quality control.

   **NOTE:** If the bar code is damaged or unreadable, tap **Manual** and enter the bar code using the alphanumeric keypad.

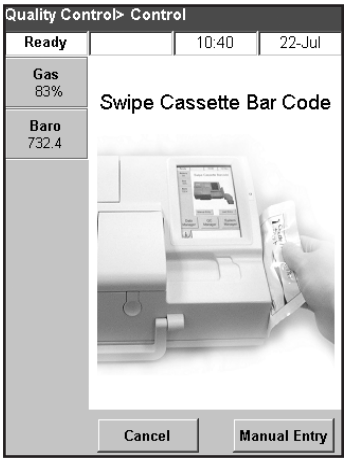



**Figure E-1:** Swipe bar code

6. Open the sample measurement chamber cover by pressing the release button (Figure E-2).
7. Open the sample cassette pouch and remove the sample cassette. Wipe any excess moisture from the cassette with a clean, dry, lint-free cloth.
8. Insert the sample cassette into the chamber. Press down to ensure that it is seated.
9. Close the SMC cover. The analyzer starts to calibrate, as indicated on the screen.

   **NOTE:** If the sample measurement chamber cover is opened while the status light is green, the cassette calibration will be canceled and the cassette must be discarded.

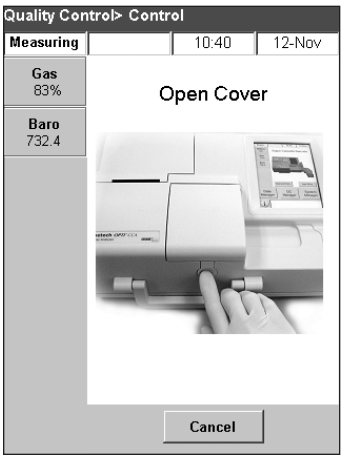



**Figure E-2:** Open SMC cover

10. After the calibration is complete:
    - Remove a quality control ampule from the box of controls and mix the contents by gently inverting, being careful not to heat it with your hands. Invert the ampule for 10 seconds.
    - Gently tap the head of the ampule with your fingernail to remove any liquid.
    - Carefully open the ampule by breaking off the top.

      **NOTE:** To ensure proper measurement, run the control fluid immediately after opening the ampule.

      **NOTE:** Protect your fingers by using gloves or tissue while breaking the ampule.
    - Aspirate directly from the ampule, or use a capillary or syringe to withdraw a small amount of control material from the ampule for aspiration.

      **NOTE:** Best results are obtained from direct aspiration from the ampule via the syringe adapter. To accomplish this, hold the ampule at a 45° angle during aspiration and ensure that the red syringe adapter is submerged in the liquid (Figure E-3). Use a new ampule of control material for each analysis.

      **NOTE:** If a syringe is used, withdraw the ampule contents slowly to minimize agitation and avoid introducing bubbles into the syringe.

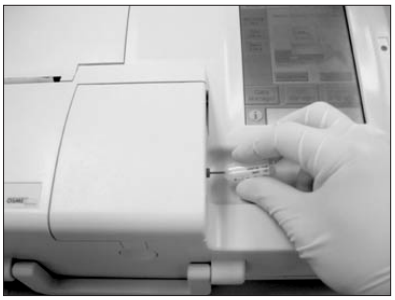


**Figure E-3:** Direct aspiration

11. When the syringe adapter is fully submerged in the control fluid, tap **OK**. The quality control sample is automatically aspirated into the cassette and the measurement starts. The status light is green, indicating that the cover should not be opened. The “Measurement in Process” message appears on the screen with a progress bar. The ampule can be removed 3–5 seconds after the analyzer begins to make a ticking sound.

    Upon completion of the measurement, the results are displayed, and pass or fail status is indicated.

12. Tap **Up** to accept or reject the results.
    - If the results are acceptable, tap **Accept**. The results are stored in the database.
    - If the results are not acceptable, tap **Reject.** Rejected results are not stored in the database.
    - Tap **Review** if you want to view the results again.

    **NOTE:** After you choose to accept or reject the results, the results are automatically printed. Call IDEXX Technical Support to report any failing result.

    **NOTE:** If any of the results are outside the VetStat's measurement range (indicated by a **Low** or **High)**, the results cannot be accepted into the database.
13. Open the sample measurement chamber cover, remove the cassette and close the cover.
14. Tap **Up** or **Home** to return to the Home screen.

## Additional Print Options for Quality Control Results

The VetStat analyzer can print reports containing information on the mean, standard deviation (SD) and coefficient of variation (CV) of stored quality control data.

1. From the Home screen, tap **Data Manager**.
2. In the Measurement Reports/Statistics section, tap **Controls** (Figure E-4).
3. In the Data> Control Measurement screen (Figure E-5), select the run (located on the left side of the screen) that you want to review.
4. Tap the applicable button on the right (Figure E-5):

| Button | Description |
|---|---|
| View | Displays the quality control (QC) results |
| Print | Prints the QC results |
| Delete | Deletes the selected run<br>**NOTE:** The setup password, 207, must be entered before the data can be deleted. |
| Export | This feature is not currently available. |
| Mark | Allows for multiple QC runs to be selected at one time |
| All | Selects all QC run results currently stored in the database |
| Up | Displays the previous page of QC results |
| Down | Displays the next page of QC results |
| Statistics | Generates statistics based on all stored data for QC measurements |

5. Tap **Home** to return to the Home screen.

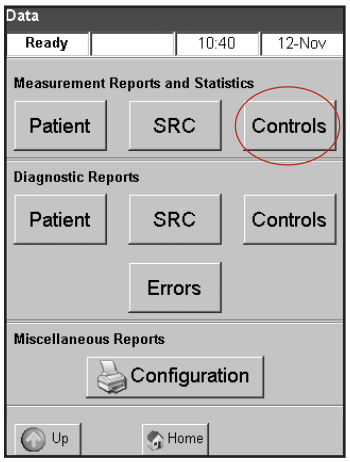



**Figure E-4:** Data screen

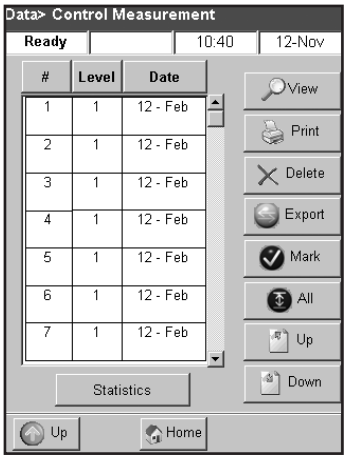



**Figure E-5:** Data> Control Measurement screen

## Anticoagulants

Lithium heparin is the recommended anticoagulant. Reference ranges for the VetStat analyzer have been established based on the use of lithium heparin as the anticoagulant. Anticoagulants such as EDTA, citrate, oxalate, fluoride and sodium heparin may have a significant effect on blood pH and/or electrolyte levels and should not be used.

## Collection Devices

### Syringes

For fast, easy blood collection, IDEXX recommends the Vital Signs lithium-heparin syringe. These syringes contain the recommended anticoagulant, lithium heparin, so there is no need to transfer the sample to a lithium-heparin collection tube. Using this syringe allows you to run the sample immediately after collecting it from the patient.

**NOTE:** There is no need to heparinize the needle when using the Vital Signs lithium-heparin syringe. If you choose a different syringe to collect the patient sample, do not heparinize the syringe with anything other than lithium heparin.

When using a syringe to collect and run samples, mix the specimen thoroughly before analyzing it by gently inverting or rolling the syringe between both hands. Also be sure to expel any air bubbles.

### Capillary Tubes

The recommended capillary tube is the Drummond 200 µL lithium-heparin capillary tube. These tubes are preferred because they are coated with the recommended anticoagulant, lithium heparin, which prevents the sample from clotting while in the tube.

To prevent damage to the cassette, use only capillary tubes with fire-polished ends. Do not pack the capillary tube with clay.

## Sample Volume Requirements

A minimum of 125 µL of sample is required for the analysis. However, to avoid the introduction of air into the sample cassette, syringes and capillary tubes should be filled with a minimum of 200 µL of sample.

## Whole-Blood Samples

Whole-blood samples can be arterial, capillary or venous.

- Arterial blood is needed only when the practitioner is looking for a meaningful interpretation of $PO_2$. $PO_2$ is measured only with the respiratory cassette.
- Capillary samples are acceptable for the evaluation of all parameters except $PO_2$.
- Venous blood is more commonly collected and is acceptable for the evaluation of all parameters except $PO_2$.

## Whole-Blood Collection

To prevent clotting, whole-blood samples require the addition of an anticoagulant. Use only lithium heparin as the anticoagulant (see the Anticoagulants section).

Collect the sample into any of the following:

A. a lithium-heparin syringe (Vital Signs 1mL)

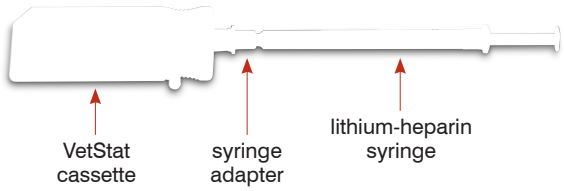
B. a lithium-heparin capillary tube (Drummond 200 µL)

C. an untreated syringe with immediate transfer to a lithium-heparin blood-collection tube

### A. Collection with a Lithium-Heparin Syringe

1. Fill the syringe with a minimum of 200 µL (0.2 cc) of whole blood.
2. Carefully remove the needle from the syringe and roll the syringe between your fingers to mix the sample.
3. Expel any air bubbles.
4. Proceed immediately to analysis. When the analyzer prompts you, place the syringe onto the syringe adapter of the cassette (Figure F-1).

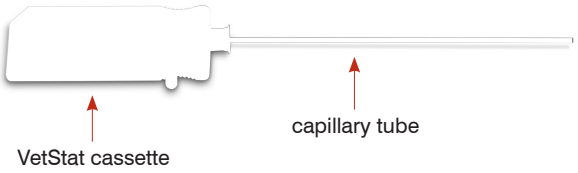
**Figure F-1:** IDEXX VetStat cassette with syringe adapter and syringe attached




### B. Collection with a Lithium-Heparin Capillary Tube

1. Fill the capillary tube with 200 µL (0.2 cc) of whole blood.
2. Roll the capillary tube between your fingers to mix the sample.
3. Expel any air bubbles.
4. Proceed immediately to analysis. When the analyzer prompts you, place the capillary tube into the sample fillport of the cassette (Figure F-2).

**Figure F-2:** IDEXX VetStat cassette with capillary tube attached




**IMPORTANT:** Be sure to remove the syringe adapter from the cassette.

### C. Collection with an Untreated Syringe

1. Fill the syringe with a minimum of 200 µL (0.2 cc) of whole blood.
2. Immediately transfer the whole blood to a lithium-heparin collection tube. To ensure the proper sample-to-lithium-heparin ratio is achieved, be sure to fill the tube to the tube manufacturer's specifications.
3. Cap the tube and gently invert the sample for 30 seconds to ensure it is well mixed.
4. Remove the needle from a clean 1-mL syringe and aspirate a minimum of 200 µL (0.2 cc) of heparinized whole blood from the lithium-heparin tube.

   **NOTE:** Some syringes may not fit appropriately onto the cassette's syringe adapter, which will affect analyzer performance. For this reason, a Becton Dickinson 1-mL syringe is recommended (Figure F-3).

**Figure F-3:** Becton Dickinson 1-mL syringe

5. Expel any air bubbles.

6. Proceed immediately to analysis. When the analyzer prompts you, place the syringe onto the syringe adapter of the cassette. (Figure F-4)

**Figure F-4:** IDEXX VetStat cassette with syringe adapter attached, Becton Dickinson 1-mL syringe

### Whole-Blood Handling

Analyze whole-blood samples immediately (within 5 minutes of collection). If the analysis is delayed, store the sample in an ice batch and analyze it within one hour of collection. Discard the sample if the analysis is delayed for more than one hour from collection.

## Plasma Samples

When collecting plasma samples for use on the VetStat analyzer, use only lithium heparin as the anticoagulant.

### Plasma Sample Collection

1. Fill the untreated syringe with a minimum of 200 $\mu$L (0.2 cc) of whole blood.
2. When using an evacuated tube, allow the sample to draw naturally into the tube by vacuum. When not using an evacuated tube, remove the needle from the syringe and immediately transfer the whole blood to a lithium-heparin collection tube.

   **NOTE:** To ensure the proper sample-to-lithium-heparin ratio is achieved, be sure to fill the tube to the tube manufacturer's specifications.
3. Cap the tube (not applicable if using an evacuated tube) and gently invert the sample for 30 seconds to ensure it is well mixed.
4. Centrifuge the sample for 10 minutes in a standard centrifuge (8,000 rpm) or 120 seconds in a high-speed centrifuge (12,000–16,000 rpm)
5. Remove the needle from a clean 1-mL syringe and aspirate a minimum of 200 $\mu$L (0.2 cc) of plasma from the lithium heparin tube.

   **NOTE:** Some syringes may not fit appropriately onto the cassette's syringe adapter, which will affect analyzer performance. For this reason, a Becton Dickinson 1-mL syringe is recommended (Figure F-3).
6. Expel any air bubbles.
7. Proceed immediately to analysis. When the analyzer prompts you, place the syringe onto the syringe adapter of the cassette. (Figure F-4)

### Plasma Sample Handling

If storage is required, separate the plasma from the cells, tightly cap the sample tube, and store the plasma at 4°–8°C (39°–46°F) for up to 48 hours. If longer storage is required, freeze the plasma. Allow the plasma to return to room temperature prior to analysis. $PO_2$ should not be measured with a plasma sample because the oxygen level will change rapidly when exposed to room air.

## Serum Samples

### Serum Sample Collection

1. Fill an untreated syringe with a minimum of 200 µL (0.2 cc) of whole blood.
2. When using an evacuated tube, allow the sample to draw naturally into the tube by vacuum. When not using an evacuated tube, remove the needle from the syringe and immediately transfer the whole blood to an untreated serum collection tube.
3. Cap the tube (not applicable if using an evacuated tube) and allow the sample to stand for 20 minutes to ensure it is fully clotted.

   **NOTE:** Samples allowed to clot for more than 30 minutes should not be used.
4. Centrifuge the sample for 10 minutes in a standard centrifuge (8,000 rpm) or 120 seconds in a high-speed centrifuge (12,000–16,000 rpm).
5. Remove the needle from a clean 1-mL syringe and aspirate a minimum of 200 µL (0.2 cc) of serum from the serum collection tube.

   **NOTE:** Some syringes may not fit appropriately onto the cassette's syringe adapter, which will affect analyzer performance. For this reason, a Becton Dickinson 1-mL syringe is recommended. (Figure F-3)
6. Expel any air bubbles.
7. Proceed immediately to analysis. When the analyzer prompts you, place the syringe onto the syringe adapter of the cassette. (Figure F-4)

### Serum Sample Handling

If storage is required, separate the serum from the clot, tightly cap the sample tube, and store the serum at 4°–8°C (39°–46°F) for up to 48 hours. If longer storage is required, freeze the serum. Allow the serum to return to room temperature prior to analysis. $PO_2$ should not be measured using a serum sample because the oxygen level will change rapidly when exposed to room air.

## Dilutions

Dilutions are not supported.

Running a patient sample on the VetStat analyzer is simple and fast. Follow the instructions outlined below for whole-blood, plasma and serum sample analysis.

1. Make sure that the VetStat analyzer is at the Home screen.
2. Read the sample cassette information into the analyzer by swiping the bar code across the bar-code reader located at the bottom right of the analyzer.
   - The bar code needs to face the analyzer.
   - A beep and a green status light indicate a valid bar code.
   - If the bar code is damaged or unreadable, tap **Manual** and enter the bar code using the alphanumeric keypad on the touch screen.
3. If requested, enter your Operator ID.
4. Press the cover release button to open the sample measurement chamber (SMC).
5. Insert the sample cassette (Figure G-1):
   - Open the sample cassette foil pouch and remove the cassette.
   - Gently wipe both sides of the cassette with a clean, dry, lint-free cloth to remove excess moisture.
   - Insert the cassette into the SMC. Press down to ensure the cassette is seated.
   - Close the SMC cover.
   - The status light turns green. Do not open the SMC cover while the status light is green because this will cancel the cassette calibration process, and the cassette must then be discarded.

**Figure G-1:** VetStat analyzer with seated sample cassette

6. During the calibration process, enter the patient information by selecting the applicable button.
   - **STAT**—This option is ideal for emergency situations and requires entering only the species before aspirating the patient sample. You can enter the applicable patient information after the sample analysis.
   - **New Patient**—Use this option to enter patient data before the sample analysis.
   - **Last Patient**—Select this option when analyzing the most recent patient entered into the VetStat analyzer. The patient information is automatically entered on the touch screen. After verifying that the information is correct, tap **Finish** to proceed to sample analysis.

   Tap **Finish** when you are done entering the patient information.

   **NOTE:** For more information on entering patient data, see “Patient Data Entry” in this section.
7. When the calibration process is complete, the status light turns off, and the “Mix and Place the Sample” message appears.

   **NOTE:** When using a syringe, mix the syringe sample well by rolling it gently between your hands and inverting it end over end. Be sure to expel any air bubbles before attaching the syringe to the cassette’s syringe adapter.

   **NOTE:** The analyzer retains calibration information for 10 minutes. If the sample is not attached to the cassette within 10 minutes from calibration, the analyzer will display a message to discard the cassette.

8. Attach the sample to the cassette (Figures G-2 and G-3) and tap **OK**. Do not inject the sample. It will automatically be aspirated by the analyzer.

**Figure G-2:** IDEXX VetStat cassette

**Figure G-3:** Sample fillport and syringe adapter

- When using a capillary tube, remove the syringe adapter from the cassette and attach the capillary tube to the cassette fillport.

  **NOTE:** You can remove the syringe adapter while the cassette is in the SMC.

- When using a syringe, attach the syringe to the red syringe adapter and make sure that the syringe adapter is not touching the syringe plunger.

**IMPORTANT:** The sample can be attached at any time during the calibration process. After attaching the sample, tap **OK**. After the cassette calibration, the automatic sample aspiration begins and the measurement process immediately follows.

As the sample is being measured, the "Cassette Measurement in Process. Please wait." message appears. Do not open the SMC cover during the measurement process. The sample can be removed 3–5 seconds after the analyzer begins to make a ticking sound.

9. When the analysis is complete, the results appear on the touch screen and automatically print. Tap **Up** or **Home** to modify patient information or to finalize results. After the results are finalized, the analyzer prompts for the cassette to be removed.
10. Open the SMC cover. Remove the cassette and discard it, following local, state and federal regulations. Close the SMC cover.

## Patient Data Entry

When entering patient information, several patient data screens appear. The screens that appear depend on the type of cassette you are using for patient measurement.

**To enter patient data:**

1. Tap the **STAT**, **New Patient** or **Last Patient** button (Figure G-4).
2. Select the species (Figure G-5).

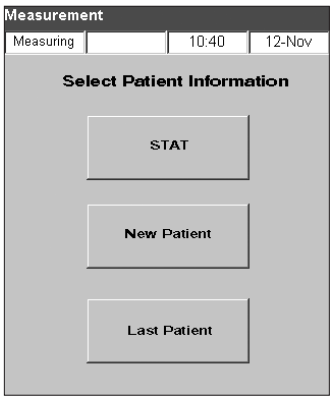



**Figure G-4:** Measurement> Select Patient Information screen

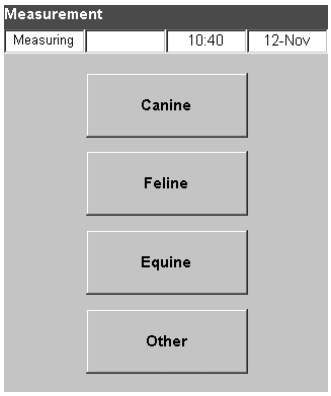



**Figure G-5:** Measurement> Select Patient Species screen

3. Select the patient's gender (Figure G-6).
4. Enter the patient's age (Figure G-7).

   **NOTE:** Enter the patient's age in either years or months. You cannot enter both.
5. Enter the required patient data (Figure G-8).

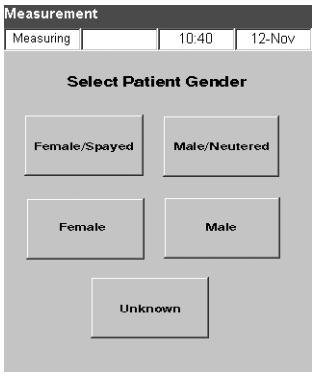



**Figure G-6:** Measurement> Select Patient Gender screen

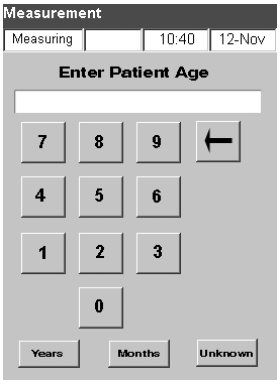



**Figure G-7:** Measurement> Enter Patient Age screen

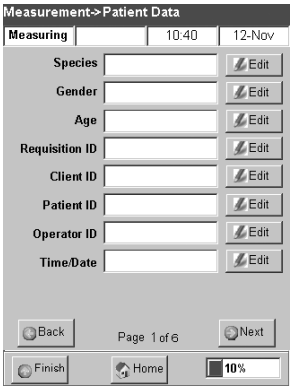



**Figure G-8:** Required patient data

**NOTE:** Patient data entry fields vary depending on which patient data your practice has set up and which type of cassette you are running. The respiratory and fluid therapy cassettes require additional data entry (Figure G-9). See "Customizing Patient Data" in the System Management section for more information.

**Figure G-9:** Measurement> Patient Data Respiratory screens (1–6)

## Additional Options for Patient Reports

The VetStat analyzer's Data Manager screen allows you to:

- Reprint patient results
- View patient results
- Delete patient results

The analyzer's database can store up to 200 patient results, which can be viewed, reprinted or deleted at any time.

**To print, view or delete patient results:**

1. From the Home screen, tap **Data Manager**.
2. In the Measurement Reports/Statistics section, tap **Patient**. A list of patient results appears on the screen.
3. Select the patient data (located on the left of the screen) that you want to review.
4. Tap the applicable button on the right:

| Button | Description |
|---|---|
| View | Displays the patient results |
| Print | Prints the patient results |
| Delete | Deletes the selected patient results |
| Export | This feature is not currently available. |
| Mark | Allows for multiple patient results to be selected at one time |
| All | Selects all patient runs stored in the database |
| Up | Displays the previous page of patient results |
| Down | Displays the next page of patient results |

5. Tap **Home** to return to the Home screen.

Your VetStat analyzer is shipped preset to easily perform sampling operations. Through the touch screen, you can:

- Enter patient data
- Print patient, quality control and calibration reports
- Enter additional information to tailor the analyzer's performance to match the particular needs of your practice

**NOTE:** For safety and security, certain VetStat customization can be protected by a security code. The analyzer's programming or existing parameters can then be changed only by entering the correct security code.

**NOTE:** All of the system settings reside in the analyzer memory, even after the power is turned off.

From the Home screen, you have access to the following VetStat features:

- Data Manager
- Quality Control Manager
- System Manager

## Data Manager

The Data Manager feature allows you to print patient, standard reference cassette (SRC) and quality control information.

- To learn about printing patient information, see "Additional Options for Patient Reports" in the Running a Patient Sample section.
- To learn about printing standard reference cassette information, see "Additional Printing Options for SRC Results" in the Calibration section.
- To learn about printing quality control information, see "Additional Print Options for Quality Control Results" in the Quality Control section.

The Data Manager also contains diagnostic reports for patient information, SRCs, controls and errors, as well as a configuration report. See the Troubleshooting and Diagnostics section for more information on these reports.

## Quality Control

The Quality Control feature allows you to run quality control using OPTI CHECK, VetStat Control, and an SRC or an HbCC.

- To learn about performing quality control using OPTI CHECK or VetStat Control materials, see the Quality Control section.
- To learn about running a standard reference cassette, see "Running Standard Reference Cassettes" in the Calibration section.
- To learn about running an HbCC, see "Running a Hemoglobin Calibration Cassette (HbCC)" in the Calibration section.

## System Manager

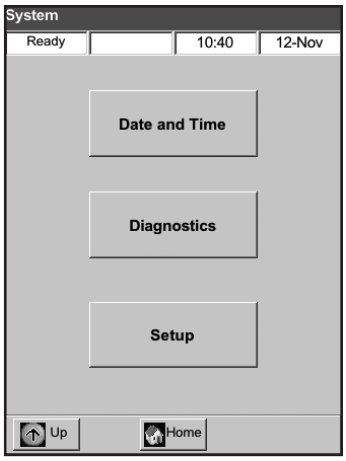


**Figure H-1**: System screen

Within the System Manager feature, there are many options you can use to customize your VetStat analyzer to accommodate your clinic's needs.

Tap the **System Manager** button on the Home screen to access the System screen (Figure H-1), where you can set the date and time, run diagnostics and set up the VetStat analyzer.

### Setting the Date and Time

1. From the Home screen, tap **System Manager** to access the System screen.
2. Tap **Date and Time** to display the Date and Time Settings screen.
   - To select the time format, tap either the **12-hr** or **24-hr** option.
   - To edit the time or date, tap that field's **Edit** button. The alphanumeric keypad appears. Use the keypad to change the date/time settings.
   - Tap **Enable Daylight Saving Time** to turn on the daylight saving time option. A check mark appears in the checkbox.
   - Tap **Automatically Adjust for Daylight Saving Time** to turn this option on. A check mark appears in the checkbox.
3. Tap **Save** to save your settings.
4. Tap **Up** to return to the System screen or tap **Home** to return to the Home screen.

### Performing Diagnostics

The Diagnostics screen contains detailed information that can be useful during troubleshooting. For information on using these features, see the Troubleshooting and Diagnostics section.

### Setting Up the VetStat Analyzer

The Setup screen lets you set up quality control materials, the displays for printed reports and system security. You can also customize several other features from the Setup screen.

**NOTE:** To access the Setup screen, you must enter the setup password: **207**.

### Setting Up the Standard Reference Cassettes (SRCs)

When you open a new SRC, be sure to scan the bar code on the foil pouch. This enters the lot number and the expiration date into the VetStat database. Do not discard the foil pouch. Each SRC level has its own unique lot number printed on the pouch.

The following procedure for programming SRC ranges is identical for all levels.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**.
3. From the System> Setup screen, tap **SRC** (Figure H-2).

4. Scan the bar code on the SRC foil pouch using the bar-code reader on the VetStat analyzer.
   - The bar code should face the analyzer.
   - A beep indicates a valid bar code. A red status light indicates an invalid bar code (e.g., SRC expired).

   **NOTE:** If the bar code is damaged or unreadable, you can manually enter the bar code. Tap the **Manual** button to display an alphanumeric keypad. Enter the bar-code information printed on the bar-code label on the foil pouch.

   **NOTE:** If previous SRC data exists in the database, the following messages appear:
   - "Print Previous SRC Data?"—Tap **Yes** if you want to keep a copy of the previous SRC data for your records.
   - "Delete Previous SRC Data?"—Tap **Yes**. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**. The previous SRC data is deleted from the database.

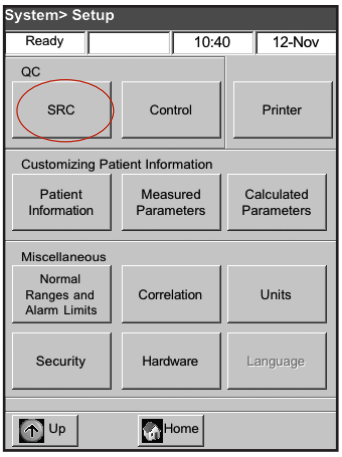



**Figure H-2:** System> Setup screen

5. The new SRC level, lot number and expiration date appear on the touch screen. If they are correct, tap **Save**. If they are incorrect, tap the applicable **Edit** button to correct the information.
6. Repeat steps 4 and 5 for SRC level 3 (and optional SRC level 2, if necessary).
7. When you are finished scanning and saving the bar codes for the SRCs, tap **Cancel** and then tap **Home**.

   **NOTE:** If the "Data modified. Save data before exiting?" message appears, tap **Yes**.

## Setting Up the OPTI CHECK or VetStat Quality Control Materials

Use this procedure to set up the OPTI CHECK and VetStat Control quality control materials.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**.
3. Tap **Control** (Figure H-3).
4. Swipe the 36-digit bar code marked Level 1 SWIPE A supplied with the OPTI CHECK or VetStat Control lot.

   **NOTE:** The bar-code information is on the insert located inside the quality control box. If the bar code is damaged or unreadable, tap **Manual** on the "Swipe Bar Code" message and manually enter the information.
5. When the "Swipe Next Bar Code Now" message appears, swipe the second 36-digit bar code marked Level 1 SWIPE B supplied with the same OPTI CHECK or VetStat Control lot.

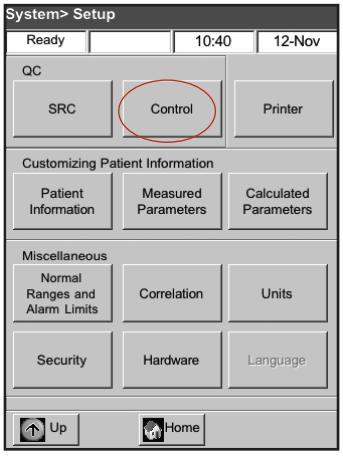



**Figure H-3:** System> Setup screen

6. Confirm that the lot and expiration date information that appears on the screen matches the information on the quality control package insert.
7. When you are finished swiping the bar-code information for quality control level 1, A and B, tap **Save**.
8. The “Swipe Bar Code” message appears again. Repeat steps 4 through 7 for quality control levels 2 and 3.
9. When you are finished entering and saving the information for quality control levels 1, 2 and 3, tap **Cancel** and then tap **Home** to return to the Home screen.
10. The analyzer is now ready to run quality control. See the Quality Control section for instructions.

## Setting Up the Printer

The Printer screen lets you program the printing functions of the VetStat analyzer.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and tap **OK**.
3. From the Setup screen, tap **Printer** (Figure H-4).
4. From the Printer screen (Figure H-5):
   - Tap **Patient Reports** to print patient reports at the end of each measurement.
   - Tap **Calibration Reports** to add a calibration report to each patient report.
   - Tap **1** or **2** to indicate the number of copies to print for the patient report.

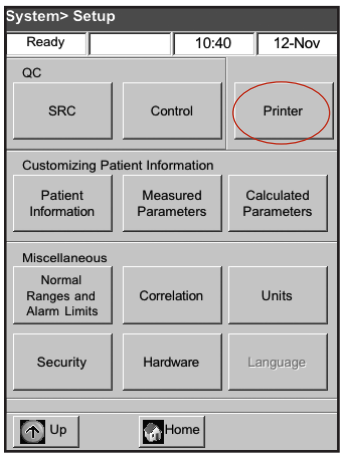



**Figure H-4:** System> Setup screen

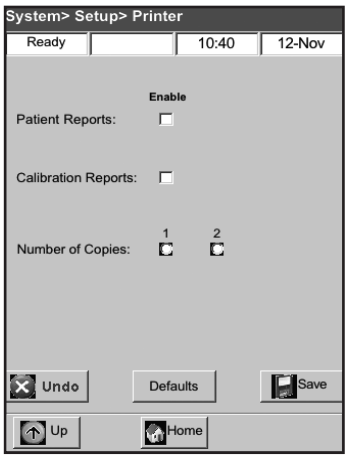



**Figure H-5:** System> Setup> Printer screen

**NOTE:** To return the analyzer to its default settings, tap the **Defaults** button.

5. Tap **Save** to save the printer settings.
6. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

## Customizing Patient Information

The Patient Information feature lets you define which patient information is requested during each measurement and which information is printed.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen, tap **Patient Information** (Figure H-6).
4. On the Info 1 screen, tap the options you want to include in the patient information (Figure H-7): **Patient ID**, **Operator ID**, **Requisition ID**, **Client ID**, **Species** and **Gender**.

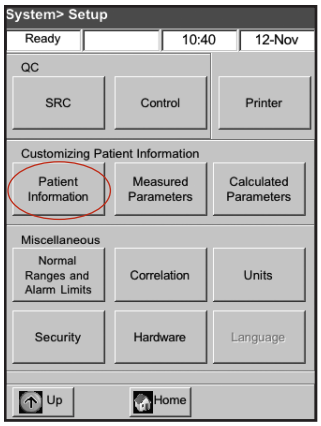



**Figure H-6:** System> Setup screen

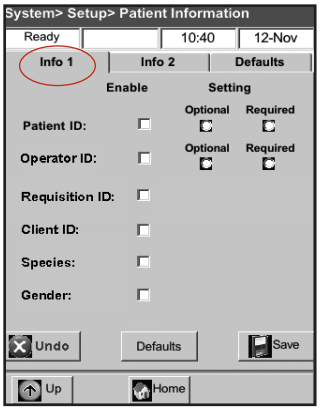



**Figure H-7:** System> Setup> Patient Information> Info 1 screen

5. If you selected Patient ID or Operator ID, tap **Optional** or **Required**. These settings determine whether or not you must enter the patient ID or operator ID when entering patient data.

   **NOTE:** To return the analyzer to its default settings, tap the **Defaults** button.

6. Tap the **Info 2** tab, and then tap each desired option (Figure H-8):

| | |
|---|---|
| Age | Liter Flow |
| Bypass | TVol(VT) |
| Sample Type | PS |
| O2 Mode | PEEP |
| I/E Ratio | Rate (f) |
| Vent Mode | CPAP |
| Pplat | User-Defined Field |
| MVol(VE) | Bilevel Pressure |
| PIP | |

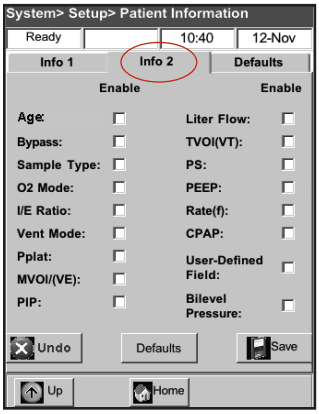



**Figure H-8:** System> Setup> Patient Information> Info 2 screen

7. Tap the **Defaults** tab (Figure H-9) to set your own default values for patient input parameters.

   The VetStat analyzer comes with factory-programmed default values that represent typical values. The default values are printed and used for the calculated parameters unless you change them during a measurement. Best results are obtained when you use measured values. You can change the default values only if the parameter has been enabled. After each measurement, the value is reset to the default value, even after the analyzer has been turned off. The exception is the tHb value, which remains at the selected value until the analyzer is powered off.

   The parameters and their programmed default values are listed below. These values are used in the calculations of various parameters if measured values are not available.

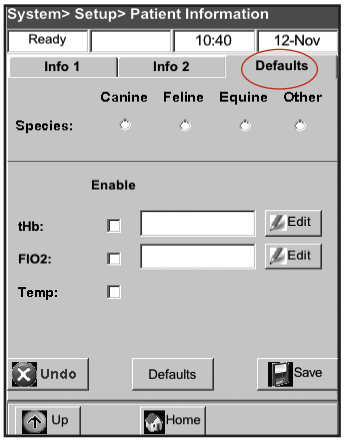



**Figure H-9:** System> Setup> Patient Information> Defaults screen

**Default Parameters**

| | Canine | Feline | Equine | Other |
|---|---|---|---|---|
| **tHb** | 15.0 g/dL | 11.5 g/dL | 11.0 g/dL | 15.0 g/dL |
| **FIO2** | 0.21 | 0.21 | 0.21 | 0.21 |
| **Temp.** | 37.0°C/98.6°F | 37.0°C/98.6°F | 37.0°C/98.6°F | 37.0°C/98.6°F |

For each parameter:

- Tap the parameter to select it. A check mark appears in the **Enable** checkbox.
- Tap **Edit** and use the alphanumeric keypad to change the default value as needed.

  **NOTE:** The default patient temperature cannot be edited.

  **NOTE:** Units for the tHb parameter can be changed by following the instructions found in the System Management section.

  **NOTE:** The default values indicated above are the original factory settings. If out-of-range values are entered, they are automatically flagged as errors and the valid range is shown.

8. Tap **Save** to save your settings.

   **NOTE:** To return the analyzer to its default settings, tap the **Defaults** button.

9. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

## Customizing Measured Parameters

The Measured Parameters screen lets you remove or disable parameters.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen, tap **Measured Parameters** (Figure H-10).
4. Tap **Allow Blanking** (Figure H-11). Parameter blanking turns off the selected parameters and disables the measurement from occurring. It also allows you to prevent a measured parameter from appearing on a printed report after the measurement has occurred.

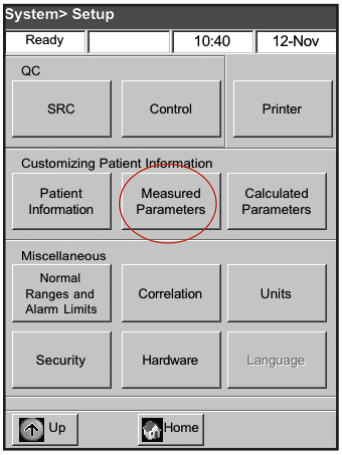



**Figure H-10:** System> Setup screen

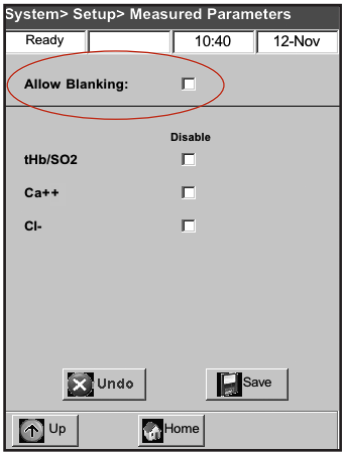



**Figure H-11:** System> Setup> Measured Parameters screen

5. Tap the parameters to be disabled.

   **NOTE:** The disabled parameters are not available during a sample or quality control measurement.

   **NOTE:** This selection disables the applicable parameters and all of their dependent parameters. To enable these parameters at a later time, you must access this screen, tap the parameters you want to enable and then tap **Save**.
6. Tap **Save** to save the settings.
7. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

## Customizing Calculated Parameters

The VetStat analyzer can calculate various parameters using the measured values obtained during sample analysis. There are many different equations used to calculate these parameters. These equations are provided in Appendix C: Calculated Values. Practitioners should refer to this appendix to determine if the methods used to calculate the results are suitable for their practices.

The Calculated Parameters screen lets you specify the parameters that are calculated and reported on the patient report. The report printout order is fixed, but calculated parameters can be included or excluded from the printout.

**To specify the parameters to calculate and report on:**

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen, tap **Calculated Parameters** (Figure H-12).
4. Select the cassette type (Figure H-13).

   - **EI**—Electrolytes
   - **FTI**—Fluid Therapy/Electrolyte 8 Plus
   - **RTI**—Respiratory Therapy
   - **iCa**—Ionized Calcium

   **NOTE:** Each cassette type can have different calculated parameters. In Figure H-13, all available parameters are displayed. When you select a cassette type (e.g., EI–Electrolytes), the parameters specific to that cassette are displayed.

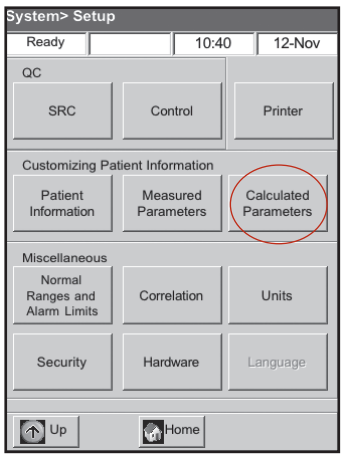



**Figure H-12:** System> Setup screen

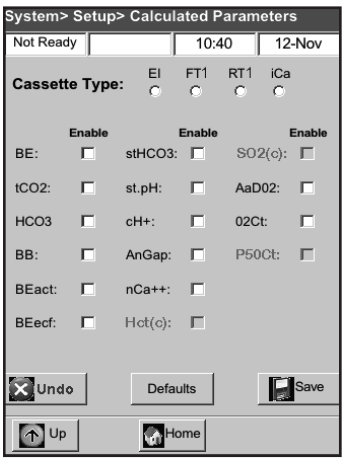



**Figure H-13:** System> Setup> Calculated Parameters screen

5. Select the parameters to be calculated and printed on the patient report, and then tap **Save**.

   **NOTE:** To return the analyzer to its default settings, tap the **Defaults** button.
6. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

   **NOTE:** See Appendix C for definitions of the available calculated parameters.

## Setting Up Normal Ranges/Alarm Limits

The Normal Ranges/Alarm Limits screen provides the normal ranges for canine, feline and equine arterial and venous samples.

**To view the normal ranges for canine, feline and equine:**

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen in the Miscellaneous section, tap **Normal Ranges/Alarm Limits**.
4. On the Limits 1 tab (Figure H-14), tap the name of the range you want to view.
5. Tap the **Limits 2** and **Limits 3** tabs (Figures H-15 and H-16) to view the normal ranges for each species and sample type. (See Appendix A for a list of the normal ranges the VetStat analyzer uses for each species.)
6. Tap **Save** to save your settings.

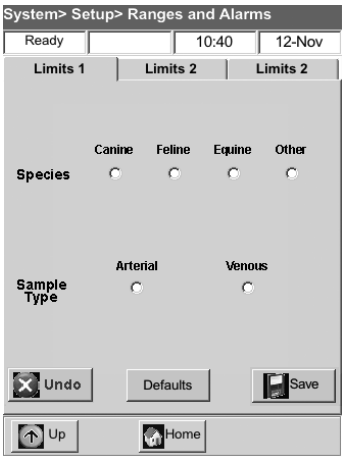



**Figure H-14:** System> Setup> Ranges and Alarms> Limits 1 screen

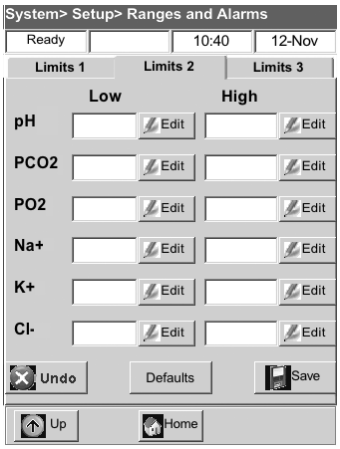



**Figure H-15:** System> Setup> Ranges and Alarms> Limits 2 screen

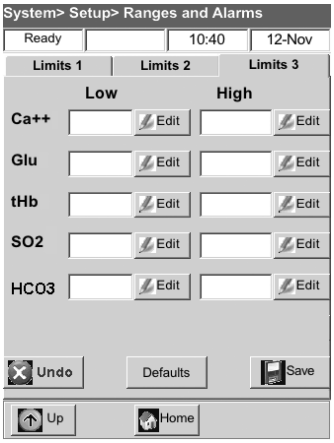



**Figure H-16:** System> Setup> Ranges and Alarms> Limits 3 screen

**NOTE:** To return the analyzer to its default settings, tap the **Defaults** button.

7. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

## Correlation Factors

The Correlation screen is password-protected and can be accessed only with the assistance of an IDEXX Technical Support representative.

## Setting Units

The Units screen lets you change the units of measurement for barometer/partial pressures, temperature, total hemoglobin and output resolution.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen, tap **Units** (Figure H-17).
4. On the Units screen, select the desired unit of measurement (Figure H-18).

   **NOTE:** If you select SI units, the barometric pressure is measured in mbar and the partial pressures in kPa. When Conventional units is selected, the barometric pressure and the partial pressures are indicated in mmHg.

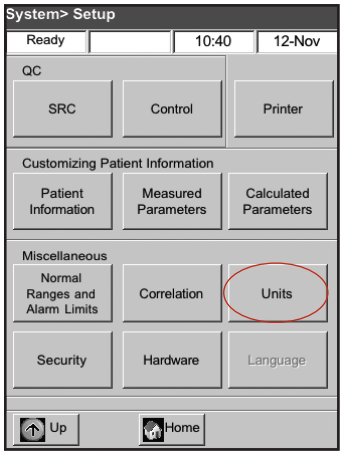



**Figure H-17:** System> Setup screen

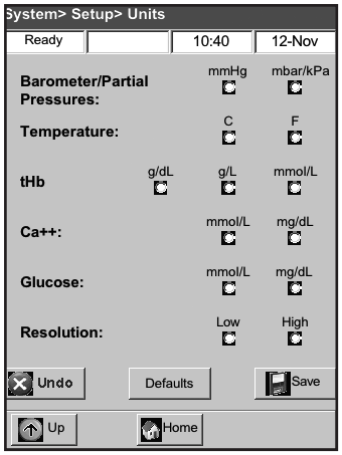



**Figure H-18:** System> Setup> Units screen

Your VetStat analyzer has been factory preset to the following units:

| | |
|---|---|
| Barometer/Partial Pressures: mmHg | Temperature: °C |
| tHb: g/dL | $Ca^{++}$: mmol/L |
| | Resolution: Low |

**NOTE:** When units are changed, the system automatically recalculates related units using the new unit parameter. See Appendix B: Technical Specifications for more information on high and low resolutions.

5. Tap **Save** to save the settings.

   **NOTE:** To return to the original factory settings, tap the **Defaults** button.

6. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

## Setting Up Security

The Security screen allows you to:

- Enable or disable the setup password
- Prevent patient measurements from being run unless quality control has been performed
- Limit access to the analyzer to only properly trained and authorized users

### Changing the System Setup Password

The VetStat analyzer is set to require you to enter the setup password, 207, prior to accessing the Setup screen.

**To change the setup password:**

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen in the Miscellaneous section, tap **Security** (Figure H-19).
4. On the Password tab, tap **Edit** (Figure H-20) and then use the alphanumeric keypad to enter your new setup password. You can enter any number between 0 and 9999.

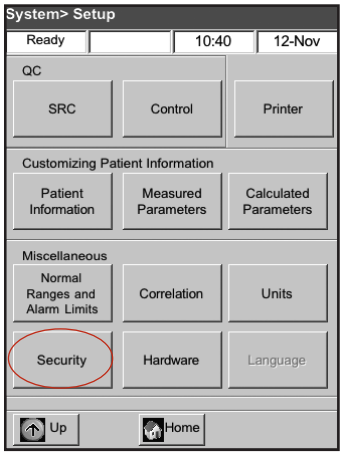



**Figure H-19:** System> Setup screen

**Figure H-20:** System> Setup> Security screen

5. Tap **Save** to save the new setup password and return to the Security screen.

**NOTE:** If you change the setup password, be sure to keep a copy of the new password in a secure place for future reference.

### Setting Quality Control Lockout Requirements

The QC Lockout tab allows you to prevent users from running patient measurements unless the required quality controls have been run.

**NOTE:** The VetStat analyzer is factory-set with lockout options turned off.

**To set quality control lockout requirements:**

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen in the Miscellaneous section, tap **Security**.
4. Tap the **QC Lockout** tab (Figure H-21).
5. Tap the desired quality control lockout options:
   - **SRC Lockout Enable—**This option lets you require that one, two or three SRC levels be run at regular intervals: every eight hours, every 12 hours, every 24 hours or every seven days. If the required number of SRC levels are not run within the specified time frame, patient measurements cannot be run on the VetStat analyzer.

     **NOTE:** The selected time interval begins when this feature is enabled.
   - **Control Lockout Enable—**This option lets you require that one, two or three OPTI CHECK or VetStat quality control materials be run at regular intervals: every eight hours, every 12 hours, every 24 hours or every seven days. If the required number of quality control materials are not run within the specified time frame, patient measurements cannot be run on the VetStat analyzer.
   - **New Lot Lockout Enable—**This option lets you require that quality control materials be run when a new lot of sample cassettes is in use.
6. Tap **Save** to save the quality control lockout settings.
7. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

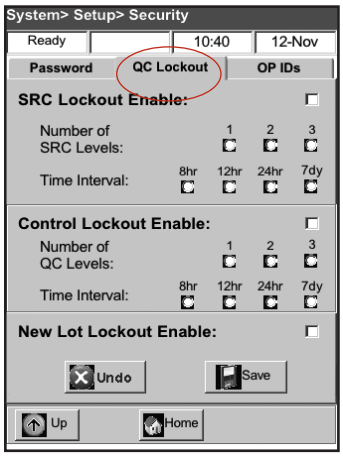



**Figure H-21:** System> Setup> Security screen

### Setting Operator IDs

The VetStat analyzer lets you set up operator IDs to limit access to the analyzer to only properly trained and authorized users.

**To set operator IDs:**

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen in the Miscellaneous section, tap **Security**.

4. Tap the **Op IDs** tab (Figure H-22).
5. Tap the **Secure Operator ID Enable** checkbox to turn on the secure operator ID features.
6. Tap the desired operator ID options:
   - **Add—**This option lets you add operator IDs. IDs can be a maximum of 11 digits. The analyzer can store up to 300 operator IDs and associated personal identification numbers (PINs).

     **NOTE:** The four-digit PIN is required by the operator to access analyzer features. The operator ID is printed on all reports created under this PIN. The PIN maintains security and should be kept private.
   - **Delete—**Lets you delete one or more selected operator IDs.
   - **Clear All—**Deletes all operator IDs stored in the database.
   - **Print—**Prints a list of all operator IDs and their associated PINs.
   - **Up—**Displays the previous page of operator IDs/PINs.
   - **Down—**Displays the next page of operator IDs/PINs.
7. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

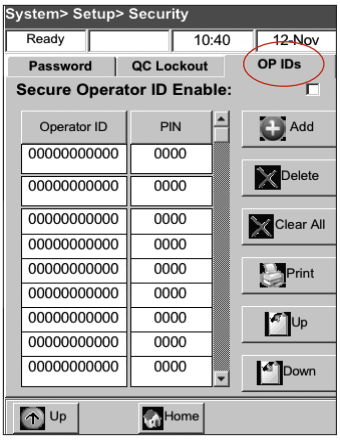



**Figure H-22:** System> Setup> Security screen

## Setting Up Hardware

The Hardware screen lets you adjust the hardware options.

1. From the Home screen, tap **System Manager** and then tap **Setup**.
2. Use the alphanumeric keypad to enter the setup password, **207**, and then tap **OK**.
3. From the Setup screen, tap **Hardware** (Figure H-23).
4. On the Hardware screen, adjust the hardware options as desired (Figure H-24).

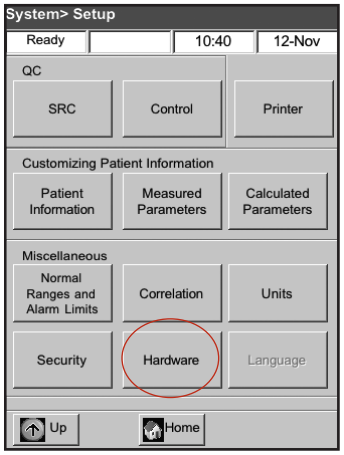



**Figure H-23:** System> Setup screen

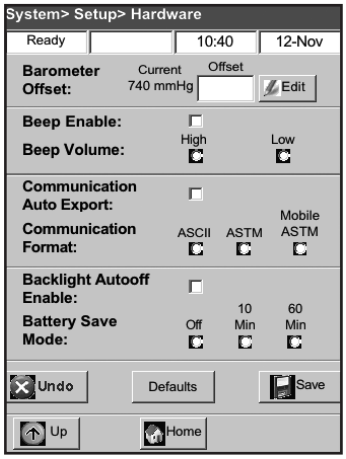



**Figure H-24:** System> Setup> Hardware screen

a. **Barometer Offset—**The offset is the difference between the default barometric pressure and the barometric pressure obtained by your weather station.

   To change the barometric pressure, tap the **Edit** button, enter the new numbers and tap **OK**.

   **NOTE:** Make sure to use the absolute barometric pressure and not the altitude-corrected pressure (check with your local weather service or airport).

   **NOTE:** You can change barometric pressure units from mmHg to mbar (see "Defining Units" in the System Management section).

b. **Beep Enable**/**Beep Volume**

   - Tap the **Beep Enable** checkbox to turn on the VetStat analyzer's audible alarm (beep). A check mark appears in the checkbox.
   - Tap the desired **Beep Volume** option (**High** or **Low**) for the VetStat analyzer's audible alarm.

c. **Communication Auto Export**/**Communication Format**

   This hardware option is not currently available.

d. **Backlight AutoOff Enable**/**Battery Save Mode**

   - Tap the **Backlight AutoOff Enable** checkbox to automatically turn off the VetStat analyzer's backlight when the analyzer goes into standby mode.
   - The **Battery Save Mode** options include **Off**, **10 minutes** or **60 minutes**. If you select **10 minutes** or **60 minutes**, the VetStat analyzer will go into standby mode when not used within that amount of time.

5. Tap **Save** to save the settings.

   **NOTE:** Tap the **Defaults** button to return the VetStat analyzer to its default settings.

6. Tap **Up** to return to the Setup screen or tap **Home** to return to the Home screen.

   **NOTE:** To exit standby and resume normal operation, tap the touch screen.

## Routine Cleaning

The VetStat analyzer is designed to require very little maintenance. Routine cleaning consists of wiping the exterior analyzer surfaces with a soft, damp cloth, using either a 10% bleach solution or isopropyl alcohol.

**NOTE:** Never use strong or abrasive cleaners on the VetStat analyzer. The touch screen can be cleaned using a window cleaner. However, do not spray the window cleaner directly on the touch screen. Spray it onto a dry, clean cloth.

### Cleaning the Bar-Code Reader

**To clean the bar-code reader:**

1. Press in the locking detent located on the bar-code reader guide (Figure I-1).
2. Gently slide the bar-code reader guide up, away from the analyzer.
3. Using a lint-free cloth dampened with isopropyl alcohol or an alcohol prep pad, gently clean the face of the reader.
4. Slide the bar-code reader guide down over the reader until it clicks.

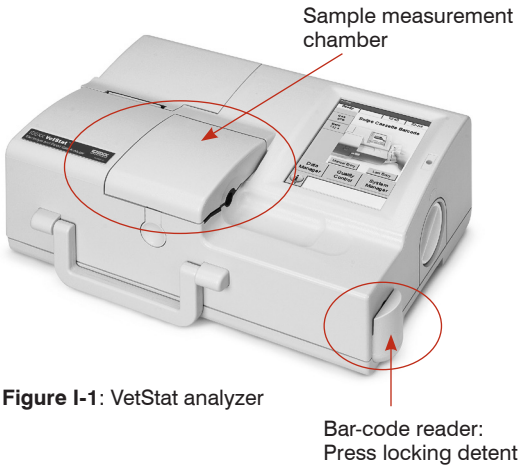



**Figure I-1**: VetStat analyzer

## Weekly Cleaning

The sample measurement chamber (SMC) should be cleaned once a week.

Open the SMC cover (Figure I-1) and clean the optics surface, as well as the underside of the SMC cover, with a lint-free cloth that has been dampened with isopropyl alcohol. A cotton swab can be used to clean the smaller parts of the SMC.

## Annual Maintenance

The peristaltic pump cartridge and gas I/O port seal must be replaced annually to ensure that your VetStat analyzer operates at peak performance.

**To replace the peristaltic pump cartridge and gas I/O port seal:**

1. Turn off the VetStat analyzer and open the printer cover door. The peristaltic pump is located to the right of the printer.
2. Remove the pump by firmly grasping the housing and pulling upward (Figure I-2).
3. Using tweezers or hemostats, carefully pull out the two pump seals and discard them.
4. Insert the new seals, making sure the small diameter holes (flat top) are face down. Ensure that the seals are fully seated.

   **NOTE:** Seals are fully seated when the front seal is flush with the surface and the rear seal is approximately 1/8" (3 mm) below the surface.

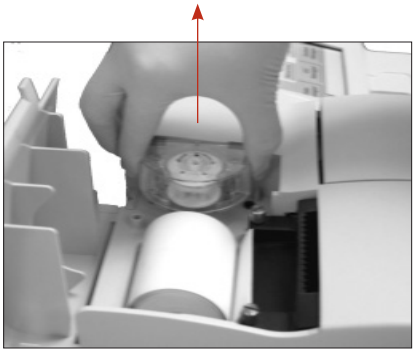


**Figure I-2:** Remove pump cartridge

5. With the nipples facing down, hold the new peristaltic pump cartridge next to the pump motor. Turn the motor shaft by hand so it aligns with the key-way of the pump spool. Then, align the pump cartridge with the motor shaft and push the cartridge down firmly until it is fully seated on the housing (Figure I-3).
6. Press the pump cartridge roller down until it is firmly seated on the shaft of the pump motor (Figure I-4).

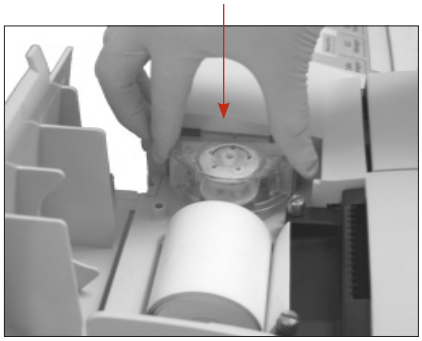


**Figure I-3:** Install the new pump cartridge

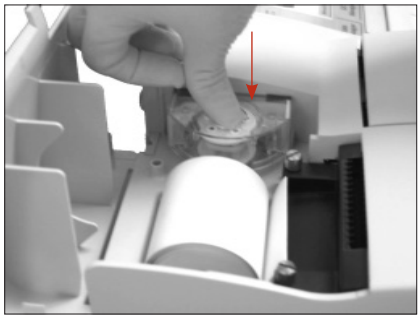


**Figure I-4:** Push down the pump roller

7. Open the SMC cover. Remove the black gas I/O port seal (Figure I-5) by grasping it with a hemostat or tweezers and firmly pulling upward. Discard the old gas I/O port seal.

   **WARNING:** Do not push the hemostat or tweezers down into the port opening as this may cause damage to the analyzer.
8. Install the new gas I/O port seal with the rounded surface pointing up and press it into the recess. When fully seated, the I/O port seal is approximately 1/8" (3 mm) above the surrounding surface.
9. Test the peristaltic pump to ensure correct operation. From the Home screen, tap **System**, tap **Diagnostics** and then tap the **Tests** tab.
10. Tap **Pump** (Figure I-6) to test the pump motor. The pump should rotate smoothly without excessive noise. This diagnostic test automatically steps through all the speeds used during normal operation (50–800 rpm) and then returns to the Diagnostics> Tests tab.

    When the diagnostic test is complete, run one sample in control mode, ensuring that the control measurement passes without errors (see “Running Quality Control” in the Quality Control section).

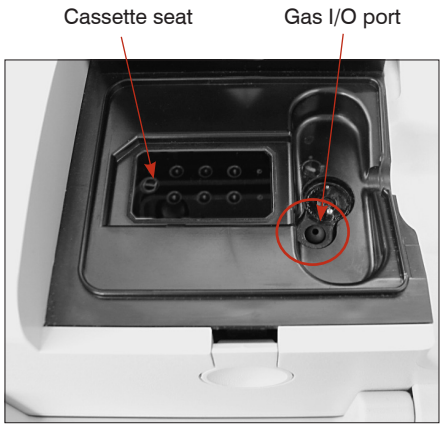



**Figure I-5**: Inside the sample measurement chamber

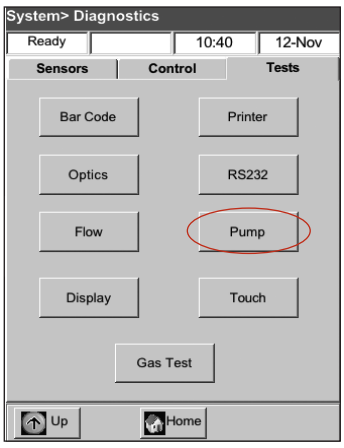



**Figure I-6:** System> Diagnostics> Tests> Pump

## Diagnostics

Your IDEXX VetStat Electrolyte and Blood Gas Analyzer has a number of useful diagnostic programs.

**NOTE:** Many of the diagnostics that can be performed on the VetStat analyzer require the assistance of an IDEXX Technical Support representative.

### Sensors

On the Diagnostics> Sensors tab, you can check the following:

- Temperature
- LEDs
- Battery voltage
- Gas level
- Barometric pressure

**To check system functions on the Sensors tab:**

1. From the Home screen, tap **System Manager** to display the System screen.
2. Tap **Diagnostics** (Figure J-1) and then tap the **Sensors** tab (Figure J-2).

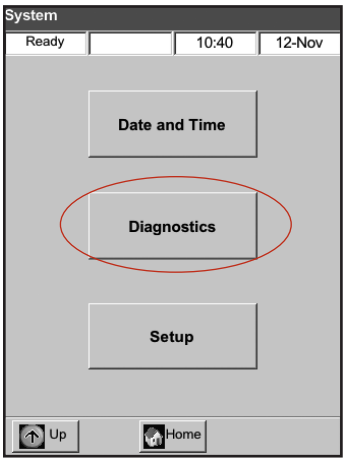



**Figure J-1:** System screen

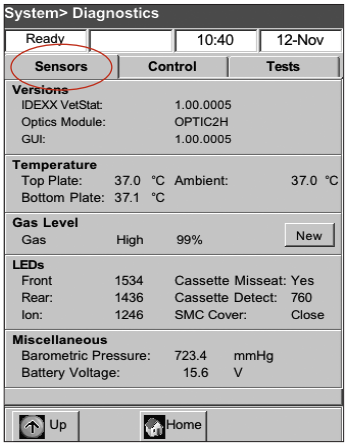



**Figure J-2:** System> Diagnostics> Sensors tab

- **Temperature—**In the Temperature section, you can check the top plate, bottom plate and ambient temperatures.

  **NOTE:** If the top or bottom plate temperatures are out of range, the temperature display changes to red. Normal temperatures are:

  – Top plate: 36.95°–37.05°C

  – Bottom plate: 37.10°–37.2°C

- **Gas Level—**In the Gas Level section, you can check the percentage of gas remaining in the gas bottle. With a new gas bottle in place, the pressure should be approximately 99%; with the bottle removed, the pressure should be 00%.

  **NOTE:** To install a new gas bottle, tap **New** in the Gas Level section. Swipe the bar-code label located on the gas bottle's package insert. Tap **OK** to initiate a gas purge.

- **LEDs—**In the LEDs section, you can view the status of the analyzer's LEDs.

- **Barometric pressure/Battery voltage—**In the Miscellaneous section, you can check the barometric pressure and the battery voltage.
  - If the barometric pressure requires adjustment, see “Setting Up Hardware” in the System Management section.
  - If the battery voltage is below 11.8 V, the battery needs to be recharged or may need to be replaced. Perform the deep-discharge maintenance procedure and recheck (see “Battery Discharge/Recharge” in the Introduction section.)

3. Tap **Home** to return to the Home screen.

## Controls

On the Diagnostics> Control tab, you can check the following:

- Cooling fan
- Valve drive
- Gas valve
- Factory settings

**To check system functions on the Control tab:**

1. From the Home screen, tap **System**.
2. Tap **Diagnostics** (Figure J-1) and then tap the **Control** tab (Figure J-3).
   - **Fan—**To check the cooling fan, tap the **On/Off** button to start the test. When on is selected, you should feel the draft of the fan when you place your hand over the fan on the back of the analyzer.
   - **Gas Valve—**This test should be performed only with the assistance of an IDEXX Technical Support representative. Contact IDEXX Technical Support.
   - **Valve Drive—**This test should be performed only with the assistance of an IDEXX Technical Support representative. Contact IDEXX Technical Support.
   - **FSet (Factory Settings)—**Checking factory settings should be performed only by an IDEXX Technical Support representative. Contact IDEXX Technical Support.
3. Tap **Home** to return to the Home screen.

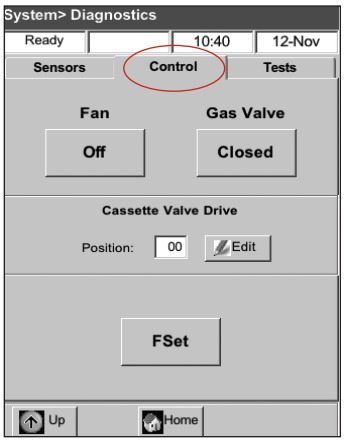



**Figure J-3:** System> Diagnostics> Controls tab

## Tests

On the Diagnostics> Tests tab, you can check the following:

- Bar-code reader
- Optics
- Pump flow
- Display
- Gas test
- Printer
- RS232 interface
- Pump motor
- Touch screen

**To check system functions on the Tests tab:**

1. From the Home screen, tap **System**.
2. Tap **Diagnostics** (Figure J-1) and then tap the **Tests** tab (Figure J-4).

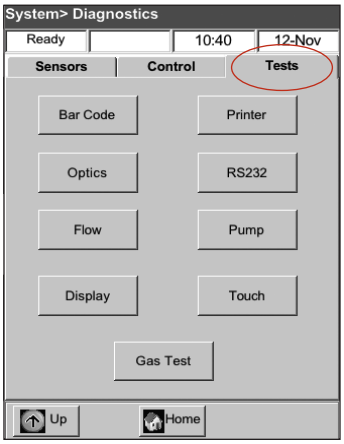



**Figure J-4:** System> Diagnostics> Tests tab

- **Bar-Code Reader—**This test checks that the bar-code reader is functioning properly. Tap **Bar Code** to start the test. Swipe a bar-code label (e.g., from a cassette). The touch screen shows a sequence of numbers. Compare those numbers to the numbers printed on the bar-code label. If the numbers match, the bar-code reader is functioning properly. Tap **OK** to return to the Tests tab.
- **Printer—**This test checks the operation of the printer. Tap **Printer** to start the test. The printer prints a test printout. Verify that the alphanumeric printout is legible and that all of the characters printed properly.

  **NOTE:** If the printout is deficient, you may need to replace the printer. Call IDEXX Technical Support to order a replacement printer. Then, follow these steps:

  – Turn off the VetStat analyzer and disconnect the power source from the wall outlet.
  – Remove the paper roll and the pump cartridge.
  – Unscrew the two thumbscrews holding the printer in place. Then pull the printer up and out toward the paper tray.
  – Disconnect the cable from the receptacle.
  – Install the new printer following these steps in reverse order.

  Contact IDEXX Technical Support for further assistance.
- **Optics—**Checking the analyzer optics should be performed only by an IDEXX Technical Support representative. Contact IDEXX Technical Support for assistance.
- **RS232 Interface—**This test checks the proper functioning of the serial interface and should be performed only by an IDEXX Technical Support representative. Contact IDEXX Technical Support for assistance.
- **Pump Flow—**This test checks the pump cartridge. Tap **Flow** to start the test. Insert a new cassette and then close the SMC cover. When the test is complete, pass/fail results and two flow numbers appear on the screen. The two numbers indicate the actual flow rates clockwise and counter-clockwise. If the flow numbers are 99.99, this part of the test failed and no flow number could be obtained. Discard the cassette and repeat the test, or replace the pump cartridge (see the Cleaning and Maintenance section for more information).

  **NOTE:** The pump flow test can fail the first time it is run, even if the pump cartridge is working correctly. Run the test a second time before replacing the cartridge.
- **Pump Motor—**Tap **Pump** to start the test. The pump motor test automatically steps through all the speeds used during normal operation (50–800 rpm) and then displays the Diagnostics> Tests tab.
- **Display—**This test checks the proper functioning of the analyzer's LEDs. Tap **Display** to start the test. The analyzer display will turn red, then green and then blue.

- **Touch Screen—**This test checks the proper functioning of the analyzer's touch screen. Tap **Touch** to start the test. Touch the screen; a dot should appear in the location you touched. If this does not happen, tap **Calibrate** and follow the instructions. Using a stylus or pointed object, touch the center of the calibration mark as it appears on the screen. When you are finished, tap **Save**.

  **NOTE:** Sharp objects can damage the screen.

- **Gas Test—**This test is designed exclusively for use by an IDEXX Technical Support representative. Contact IDEXX Technical Support to run this test.

3. Tap **Home** to return to the Home screen.

## Measurement and Diagnostics Reports

You can print reports that provide information on the diagnostic and calibration tests that are performed on the VetStat analyzer.

### Patient Measurement Report

The Patient Measurement report is available with results after each measurement.

**To print the Patient Measurement report:**

1. From the Home screen, tap **Data Manager** to display the Data screen.
2. In the Measurement Reports and Statistics section, tap **Patient** (Figure J-5).
3. Select a patient and tap **Print** to print the Patient Measurement report. The printout details the measured signal in millivolts and drifts.
4. Tap **Up** to return to the Data screen.

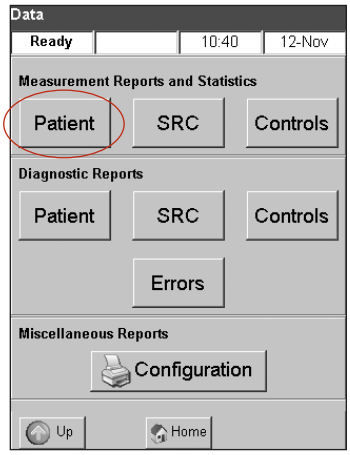



**Figure J-5:** Data screen> Patient button

### SRC Measurement Diagnostics Report

**To print the SRC Measurement Diagnostics report:**

1. From the Home screen, tap **Data Manager** to display the Data screen.
2. In the Measurement Reports and Statistics section, tap **SRC** (Figure J-6).
3. Tap **Print** to print the SRC Measurement Diagnostic report. The printout shows details of measured millivolts signals, as well as the observed drifts in measurement.
4. Tap **Up** to return to the Data screen.

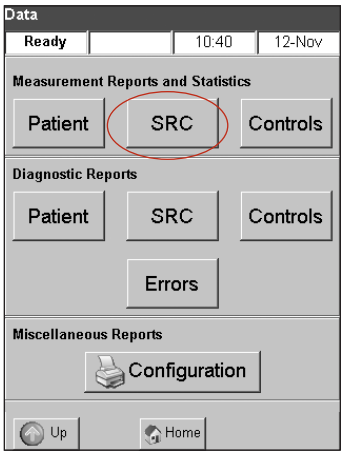



**Figure J-6:** Data screen> SRC button

## Controls Measurement Diagnostics Report

**To print the Controls Measurement Diagnostics report:**

1. From the Home screen, tap **Data Manager** to display the Data screen.
2. In the Measurement Reports and Statistics section, tap **Controls** (Figure J-7).
3. Tap **Print** to print the Controls Measurement Diagnostic report. The printout shows details of measured millivolts signals, as well as the observed drifts in measurement.
4. Tap **Up** to return to the Data screen.

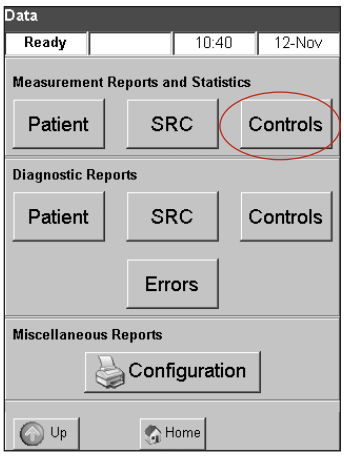



**Figure J-7:** Data screen> Controls button

## Error Report

**To print the Error report:**

1. From the Home screen, tap **Data Manager** to display the Data screen.
2. In the Calibration Reports section, tap **Errors** (Figure J-8).
3. On the Errors screen in the Error Log section:
   - Tap **Print** to print the error messages in the database.
   - Tap **Delete** to delete the error messages from the database. At the “Delete the Error Log?” message, tap **Yes** to delete all error messages.
4. Tap **Up** to return to the Data screen.

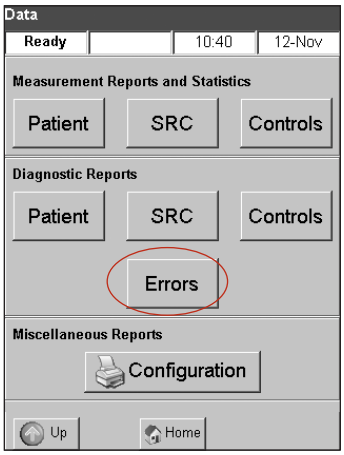



**Figure J-8:** Data screen> Errors button

## Configuration Report

**To print the Configuration report:**

1. From the Home screen, tap **Data Manager** to display the Data screen.
2. In the Configuration Report section, tap **Configuration** (Figure J-9) to print the report. The printout lists all settings defined for the analyzer, including quality control ranges, reference limits, correlation factors, patient information, printout settings, etc.
3. Tap **Up** to return to the Data screen.

   **NOTE:** After initial setup, a configuration report should be printed and kept in a safe place for later reference.

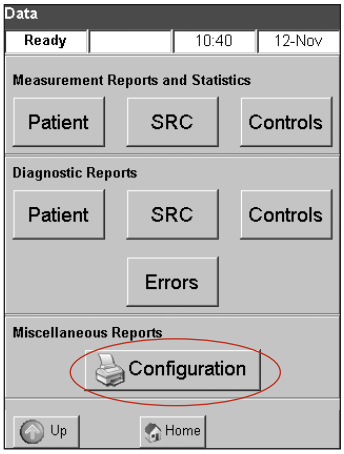



**Figure J-9:** Data screen> Configuration button

## Alert Messages

Your IDEXX VetStat Electrolyte and Blood Gas Analyzer is designed to provide trouble-free service. At times, various alert messages may appear, requiring you to initiate corrective action.

If you need additional assistance, contact IDEXX Technical Support.

| Message | Problem/Action |
|---|---|
| ! Not Ready: Low Gas | The gas pressure is low.<br>• Replace the gas bottle. |
| ! Not Ready: Temperature out of range. | The temperature is out of range.<br>• Wait for the analyzer to reach the correct temperature.<br>• If the analyzer does not become ready within a reasonable time, check the temperature in System> Diagnostics.<br>**Temperature specifications:**<br>Top plate: 36.95°–37.05°C<br>Bottom plate: 37.10°–37.2°C<br>**NOTE:** The cooling fan turns on if the temperature is >31.5°C and turns off if the temperature is <30.5°C. |
| ! Not Ready: Cassette Detect | A cassette detect error has occurred.<br>• Remove the cassette and turn the power off. Wait 30 seconds and turn the power back on.<br>• If the message persists, contact IDEXX Technical Support. |
| ! Not Ready: Low Battery | The battery voltage is low.<br>• Operate the analyzer on AC power and/or recharge the battery. |
| Warning! No sample detected. | Sensors did not detect any sample.<br>• Make sure the sample is properly attached, not clotted and does not contain air bubbles. Wait for the analyzer to recalibrate.<br>• Remix the sample carefully. Tap **OK** to notify the analyzer that the sample is reattached and to reaspirate the sample. |
| Warning! Unstable pH. Check cassette. | Unstable pH (other measured parameter).<br>**NOTE:** This message is a warning. The analyzer will, however, display a result for the parameter.<br>• Remove the cassette and check for aspirated bubbles. If bubbles are visible in the cassette, rerun the sample with a new cassette. |
| Warning! Bad sensor—pH. | The pH (or other measured parameter) sensor is bad.<br>• Tap **Cancel** to stop the measurement.<br>• Tap **OK** to continue the measurement. If you continue, no results will be provided for the bad sensor or any calculated result that uses this measurement. |
| Warning! Low battery. One test remaining. | The battery voltage is low.<br>• Tap **OK** to complete the current test.<br>• Replace the battery or recharge it by plugging the analyzer into the main power supply as soon as possible. |
| Warning! Gas expires soon. | The gas bottle will expire in two weeks.<br>• Tap **OK** to continue. Ensure that a new gas bottle is in inventory or has been ordered. |

| Message | Problem/Action |
|---|---|
| Warning! Low gas. One test remaining. | When the percentage in the gas bottle reaches 4%, this message appears.<br>• Tap **OK** to complete the current test.<br>• Replace the gas bottle at the completion of the test.<br>**NOTE:** You can replace the gas bottle at the next warning, and the VetStat analyzer will automatically perform the necessary one-minute gas purge. Otherwise, use the standard procedure to perform the purge. |
| Warning! Check pump. | The peristaltic pump is becoming worn.<br>• Tap **OK** to continue the measurement.<br>• Perform a pump diagnostic if this warning persists. If the pump diagnostic fails, replace the pump cartridge (see the Cleaning and Maintenance section). |
| Warning! Check pump. Please remove cassette. | The peristaltic pump is becoming worn.<br>• Remove the cassette. Retry with a new cassette.<br>• Change the peristaltic pump cartridge (see the Cleaning and Maintenance section). |
| Warning! Bubble detected. Check cassette. | A bubble was detected at the light gates.<br>• Remove the cassette. Tap **OK** to continue.<br>• Examine the cassette and look for bubbles. If bubbles are visible, rerun the sample using a new cassette. |
| Warning! Hb Cal expires soon. | This message appears only once, before the three-month expiration of the hemoglobin calibration, and acts as a reminder to run the hemoglobin calibrator.<br>• Tap **OK** to continue.<br>• Ensure that an HbCC is in inventory or has been ordered. |
| Warning! Secure Op ID list is full. | The number of secure operator IDs stored in memory equals 300.<br>• Tap **OK** to continue.<br>• To delete previous operator IDs from memory, see “Setting Operator IDs” in the System Management section. |
| Stop! Low battery. Recharge now.<br>*or*<br>Stop! Low battery. Recharge and cycle power. | The battery is low.<br>• Turn the power off, wait 30 seconds and then turn the power back on.<br>• Install a freshly charged battery, recharge for up to six hours before the next sample is run, or operate the analyzer on AC power. |
| Stop! Low gas. Replace now. | The gas cylinder is empty.<br>• Replace the gas cylinder and tap **OK**. |
| Stop! System error. Cycle power for reset. | The analyzer has detected an internal error.<br>• Turn the power off, wait 30 seconds and then turn the power back on.<br>• Discard the cassette. |
| Stop! Memory error. Database deleted. | Patient, quality control and other databases were deleted.<br>• Tap **OK** and the analyzer will reinitialize. |

| Message | Problem/Action |
|---|---|
| Stop! Temperature out of range. | The temperature is out of range during any kind of measurement.<br>• Tap **OK** and continue.<br>• If the error message appears again, check the temperature in System> Diagnostics.<br>**Temperature specifications:**<br>Top plate: 36.95°–37.05°C<br>Bottom plate: 37.10°–37.2°C<br>**NOTE:** The cooling fan turns on if the temperature is >31.5°C and turns off if the temperature is <30.5°C. |
| Error! Bad sensors. Discard cassette. | Two or more measured parameter sensors are bad.<br>• Tap **OK**, discard the cassette and repeat the test with a new cassette. |
| Error! Possible clot. Discard cassette. | A sample error has occurred. This may be due to a clot or to a blockage preventing sample aspiration.<br>• Tap **OK** and discard the cassette. Check the sample for clots. If present, redraw and analyze a new sample. |
| Error! Gas expired. | The gas bottle has expired, or you have used an invalid bar code.<br>• Check the gas bottle label. Make sure the expiration date has not been exceeded. If expired, insert a new gas bottle.<br>• Check the date setting in System> Time and Date. |
| Error! Cassette misseat 1 (or 2). Reinsert. | The cassette was not properly placed into the chamber.<br>• Open the SMC cover, remove and reinsert the cassette, and close the cover. Tap **Cancel** to continue.<br>• Tap **Cancel** and then remove and discard the cassette. Repeat the test with a new cassette.<br>**NOTE:** Be sure to wipe the cassette with a dry, clean, lint-free cloth before inserting it into the SMC.<br>If the message still appears with a different cassette, turn the power off and wait 30 seconds. Then turn the power back on and retry. |
| Error! Cassette misseat 2. Discard cassette.<br>*or*<br>Error! Bad cassette. Discard cassette. | The cassette was not properly placed into the chamber or the cassette is damaged.<br>• Tap **Cancel** and then remove and discard the cassette. Repeat the test with a new cassette. Be sure to wipe the cassette with a dry, clean, lint-free cloth before inserting it into the SMC.<br>• If the message still appears with a different cassette, turn the power off and wait 30 seconds. Then turn the power back on and retry. |
| Error! Bad calibration. Discard cassette. | The analyzer did not calibrate because of internal problems or problems with the cassette.<br>• Tap **Cancel** and then remove and discard the cassette. Repeat the test with a new cassette. Be sure to wipe the cassette dry with a clean, lint-free cloth before inserting it into the SMC.<br>• If the message still appears with a different cassette, turn the power off and wait 30 seconds. Then turn the power back on and retry. |
| Error! Dirty optics. Clean cassette and optics.<br>*or*<br>Error! Dirty optics. Discard cassette. | The optics or the cassette are dirty. The analyzer is unable to calibrate because of dirty optics or a dirty cassette.<br>• Remove the cassette. Wipe the cassette with a dry, clean, lint-free cloth. Inspect the optics on the bottom and top plates. Clean them, if necessary, with isopropyl alcohol. Reinsert the cassette, or discard it and insert a new cassette. Tap **OK** to continue with the test. |

| Message | Problem/Action |
|---|---|
| Error! Calibration expired. Discard cassette. | The cassette has been holding the calibration for more than 10 minutes without a sample being attached.<br>• Tap **OK** and then remove and discard the cassette. |
| Error! Unstable sensors. Discard cassette. | A sample error has occurred. This may be due to a clot or large air bubble if two or more sensors are unstable.<br>• Tap **OK** and then remove and discard the cassette. Check the sample for clots or bubbles. Rerun the test with a new cassette. |
| Error! Short sample. Discard cassette. | The analyzer was not able to aspirate enough contiguous sample fluid to cover the optode sensors after multiple aspiration attempts. If a bubble was detected, the analyzer attempted to restart the aspiration and was not able to aspirate enough sample.<br>• Tap **OK** and then remove and discard the cassette. |
| Error! Invalid bar code. | The bar code is invalid; either the analyzer misread the bar-code label, or the bar-code label is invalid.<br>• Tap **OK** to retry.<br>• If the error message appears again, try entering the bar code manually.<br>• Clean the bar-code reader.<br>– Press in the locking detent located on the bar-code reader guide.<br>– Gently slide the bar-code reader guide up and away from the analyzer.<br>– Using an alcohol prep pad or a lint-free cloth dampened with diluted alcohol, gently wipe the face of the reader clean.<br>– Slide the bar-code reader guide down over the reader until it clicks.<br>– Retry the bar code. |
| Error! Invalid bar code. Check time and date.<br>*or*<br>Error! Expired bar code. Check time and date. | The bar code is invalid; either the analyzer misread the bar-code label, or the product (i.e., gas bottle, cassette or SRC) has expired.<br>• Tap **OK** to retry.<br>• Verify the product expiration date.<br>• If the error message appears again, check the date in System> Time and Date. |
| Error! Invalid bar code. Different QC lot. | The bar code is invalid.<br>• Verify that <Swipe A> and <Swipe B> of the quality control material are from the same level and lot number. Tap **OK** to continue. |
| Error! Invalid tHb calibrator. | The cassette placed in the SMC is invalid.<br>• Verify that the cassette placed in the SMC is a valid hemoglobin calibration cassette (HbCC). Tap **OK** to continue. |
| Error! Invalid QC lot. | The QC lot is invalid.<br>• Tap **OK** to continue.<br>• Configure the quality control material in Setup and retry. (See “Setting Up the OPTI CHECK or VetStat Quality Control Material” in the System Management section.) |
| Error! Invalid SRC. | The SRC type is invalid.<br>• Tap **OK** to continue.<br>• Remove the SRC.<br>• Configure the SRC data in Setup and retry. (See “Setting Up the Standard Reference Cassette (SRC)” in the System Management section.) |

| Message | Problem/Action |
|---|---|
| Error! Expired SRC. Check time and date. | The SRC expiration date has been reached.<br>• Tap **OK** and remove the SRC.<br>• If the error message appears again, check the date in System> Time and Date.<br>• Configure a new SRC in Setup and retry. (See “Setting Up the Standard Reference Cassette (SRC)” in the System Management section.) |
| Error! Setup QC. | A measurement of QC materials, either liquid or SRCs, was attempted prior to setting up.<br>• Tap **OK** to continue.<br>• Configure the SRCs and/or liquid QC material in Setup and retry. (See the System Management section.) |
| Error! Calibration out of range. | This error can occur during Hb calibration, and is triggered when the correction is greater than 10%.<br>• Contact IDEXX Technical Support for assistance. |

# Technical Support

If you have any questions, please contact IDEXX Technical Support toll-free at:

- U.S./Canada **1-800-248-2483**
- Europe **idexx.eu**
- Australia **1300 44 33 99**
- New Zealand **0800 83 85 22**
- Brazil **0800-777-7027**
- Latin America **soportelatam@idexx.com.br**
- China **400-678-6682**
- South Korea **080 7979 133**
- Taiwan **0800 291 018**
- Japan **0120-71-4921**

# Appendix A: Normal Ranges

The normal ranges for canine, feline and equine parameters are:

| Parameter | Units | Canine | | Feline | | Equine | |
|---|---|---|---|---|---|---|---|
| | | Low | High | Low | High | Low | High |
| $Na^+$ [1] | mmol/L | 144 | 160 | 150 | 165 | 133 | 150 |
| $K^+$ [1] | mmol/L | 3.5 | 5.8 | 3.5 | 5.8 | 3.0 | 5.3 |
| $Cl^-$ [1] | mmol/L | 109 | 122 | 112 | 129 | 97 | 109 |
| $Ca^{++}$ [3, 4] | mg/dL | 5.0 | 6.0 | 4.5 | 5.5 | 6.01 | 7.21 |
| $Ca^{++}$ | mmol/L* | 1.25 | 1.50 | 1.13 | 1.38 | 1.50 | 1.79 |
| pH arterial [2, 3] | | 7.36 | 7.44 | 7.36 | 7.44 | 7.35 | 7.47 |
| pH venous [2, 3] | | 7.34 | 7.46 | 7.33 | 7.41 | 7.34 | 7.43 |
| $tCO_2$ arterial [2, 3] | mEq/L | 25.0 | 27.0 | 21.0 | 23.0 | | |
| $tCO_2$ venous [2, 3] | mEq/L | 21.0 | 31.0 | 27.0 | 31.0 | | |
| $HCO_3^-$ arterial [2, 3] | mEq/L | 24.0 | 26.0 | 20.0 | 22.0 | 22.0 | 29.0 |
| $HCO_3^-$ venous [2, 3] | mEq/L | 20.0 | 29.0 | 22.0 | 24.0 | 22.0 | 29.0 |
| $PCO_2$ arterial [2, 3] | mmHg | 36 | 44 | 28 | 32 | 36 | 46 |
| $PCO_2$ venous [2, 3] | mmHg | 32 | 49 | 34 | 38 | 38 | 48 |
| $PO_2$ arterial [2, 3] | mmHg | 90 | 100 | 90 | 100 | 80 | 112 |
| $PO_2$ venous [2, 3] | mmHg | 24 | 48 | 35 | 45 | 37 | 56 |
| tHb [5] | g/dL | 12.0 | 18.0 | 8.0 | 15.0 | 10.0 | 18.0 |
| $SO_2$ [6, 7] | % | 93 | 100 | 93 | 100 | 93 | 100 |

*Conversion to SI units: mg/dL x 0.25 = mmol/L

†Conversion to SI units: mg/dL x 0.0555 = mmol/L

**NOTE:** When selecting **Other** in the Species Selection screen, the normal ranges printed on the patient report are the analyzer's dynamic range. IDEXX does not provide normal ranges for species other than canine, feline and equine.


1. Data on file at IDEXX Laboratories, Inc. Westbrook, ME USA.
2. Willard MD, Tvetden H, Turnwald GH, eds. *Small Animal Clinical Diagnosis by Laboratory Methods*. 3rd ed. Philadelphia, PA: WB Saunders; 1999.
3. Robinson NE. *Current Therapy in Equine Medicine*. 4th ed. Philadelphia, PA: WB Saunders; 1997.
4. Schenck PA, Chew DJ. Hypocalcemia: A Quick Reference. *Vet Clin Small Anim.* 2008; 38(3):455–458.
5. Kahn CM, Line S, eds. *The Merck Veterinary Manual*. 9th ed. Whitehouse Station, NJ Merck; 2005.
6. Bonagura JD. *Kirk's Current Veterinary Therapy XII Small Animal Practice*. Philadelphia, PA: WB Saunders; 1995.
7. White GA, Matthews NS, Walker MA, Slater MR. Pulse Oximetry for Estimation of Oxygenation in Dogs with Experimental Pneumothorax. *JVECC.* 2007; 4(2):69–76.

## Measurement Range and Resolution

| Parameter | Dynamic Range | Low Resolution | High Resolution |
|---|---|---|---|
| $Na^+$ | 100–180 mmol/L | 1 | 0.1 |
| $K^+$ | 0.8–10 mmol/L | 0.1 | 0.01 |
| $Cl^-$ | 50–160 mmol/L | 1 | 0.1 |
| $Ca^{++}$ | 0.2–3.0 mmol/L | 0.01 | |
| pH | 6.6–7.8 pH units | 0.01 | 0.001 |
| $PCO_2$ | 10–200 mmHg | 1 | 0.1 |
| $PO_2$ | 10–700 mmHg | 1 | 0.1 |
| tHb | 5–25 g/dL | 0.1 | |
| $SO_2$ | 60–100% | 1 | 0.1 |

## Barometric Pressure

300 to 800 mmHg

## Operating Altitude

Up to 3048 m (10,000 ft)

## Operating Parameters

Minimum sample size: 125 µL

Sample type: lithium heparinized whole blood, plasma or serum

Sample application: syringe or capillary

Sample input: automatic aspiration

Analysis time: <2 minutes

Ambient temperature range: 10°C–32°C (50°F–90°F)

Relative humidity range: 5%–95% (noncondensing)

## Dimensions and Weight

Width: 14.2 inches

Depth: 9.1 inches

Height: 4.7 inches

Weight: 10 pounds

Weight with battery: 12 pounds

## Default Settings

| Parameter | Default |
|---|---|
| Baro factor | 0.000 |
| Patient ID | On/Opt |
| Operator ID | On/Opt |
| Requisition ID | On/Opt |
| Client ID | On/Opt |
| Age | On |
| Gender | On |
| Species | On |
| Sample type | On |
| tHb | Off |
| $O_2$ Mode | Off |
| $FIO_2$ | Off |
| Vent Mode | Off |
| Tvol | Off |
| MVol | Off |
| PIP | Off |
| Pplat | Off |
| PS | Off |
| PEEP | Off |
| CPAP | Off |
| Rate | Off |
| Liter Flow | Off |

| Parameter | Default |
|---|---|
| I/E Ratio | Off |
| Bi-Level | Off |
| User Def | Off |
| User Def 2 | Off |
| User Def 3 | Off |
| Printouts (Patient) | On, 1 copy |
| Printouts (Calibration) | Off |
| Password | Enabled |
| QC Lockout (SRC Levels) | 0 |
| QC Lockout (QC Levels) | 0 |
| QC Lockout (New Lot) | Off |
| Units | Conventional |
| Temp | Centigrade |
| Time | 24-hour |
| tHb | g/dL |
| $Ca^{++}$ | mmol/L |
| Resolution | Low |
| Communication Format | ASCII |
| Language | English |
| Battery Saver (Auto Off) | Always on |
| Battery Saver (Display) | Always on |
| | |

## Units Used in Measured and Input Parameters for Calculations

| Parameter | Unit | Parameter | Unit |
|---|---|---|---|
| pH | pH-unit | K | mmol/L |
| $PCO_2$ | mmHg | Ca | mmol/L |
| $PO_2$ | mmHg | Cl | mmol/L |
| tHb | g/dL | $SO_2$ | % |
| Na | mmol/L | | |

## Conversion Table for Units[1]

| | |
|---|---|
| $CTO_2$, $O_2CT$, $tCO_2$ | 1 vol% = 1 mL/dL = 0.4464 mmol/L |
| tHb | 1 g/dL = 10 g/L = 0.6206 mmol/L |
| barometric pressure, $PCO_2$, $PO_2$ | 1 mmHg = 1.3333 mbar = 0.1333 kPa |
| ionized calcium ($Ca^{++}$) | 1 mmol/L = 4.008 mg/dL = 2 mEq/L |

## Calculated Parameters and Equations[1, 2, 3, 4, 5, 6, 7]

The IDEXX VetStat Electrolyte and Blood Gas Analyzer can calculate various parameters using the measured values obtained during sample analysis. There are many different equations used to calculate these parameters. These equations are provided below.

**Note:** Calculated parameters, with the exception of $HCO_3^-$, do not have reference ranges.

To specify which parameters the VetStat analyzer will calculate and display in a patient report, see “Calculated Parameters” in the System Management section.

The following calculated parameters have been tested for canine, feline and equine specimens and are verified to provide results that are suitable for veterinary use.

### AG

The anion gap is a calculated parameter used to express the difference in concentrations of major cations and anions in the blood specimen.[1]

$$AG = (Na^+ + K^+) - (Cl^- + HCO_3^-) \quad \text{[mmol/L]}$$

### $BE_{ecf}$

The base excess of extracellular fluid is a quantity that reflects only the nonrespiratory components of acid-base balance (tHb = 5 g/dL).[2]

$$BE_{ecf} = 0.93 \cdot [14.83 \cdot (pH - 7.40) - 24.4 + HCO_3^-] \quad \text{[mmol/L]}$$

**NOTE:** This equation is, as stated in the NCCLS, an approximation. It is not directly derived from the BE equation alone.

### $tCO_2$

Total concentration of $CO_2$ in plasma, the sum of dissolved $CO_2$ and bicarbonate[2]

$$tCO_2 = HCO_3^- + (0.0307 \cdot PCO_2) \quad \text{[mmol/L]}$$

### $HCO_3^-$

Bicarbonate concentration in plasma[2]

$$HCO_3^- = 0.0307 \cdot PCO_2 \cdot 10^{(pH - 6.129)} \quad \text{[mmol/L]}$$

The following calculated parameters require additional information beyond the measured values to calculate a result. In the absence of measured values, for example tHb or $SO_2$, the VetStat analyzer can use default values or measured values from other testing entered through the patient information screens. The analyzer will calculate the result based upon the equations below. The equations are from established and accepted methods in human diagnostics; they have not been derived using veterinary samples.

### $AaDO_2$

The alveolar to arterial oxygen tension gradient ($PAO_2 - PaO_2$) is the difference between the alveolar oxygen tension and the measured oxygen tension of arterial blood.[3]

$$Aa(DO_2) = (PAO_2 - PaO_2) \quad \text{[mmHg]}$$

### $AaDO_2^t$

Alveolar to arterial oxygen tension difference corrected to patient temperature other than the default temperature (37°C) preprogrammed in the VetStat analyzer[3]

$$AaDO_2^t = PAO_2^t - PaO_2^t \quad \text{[mmHg]}$$

*where:*

$$PAO_2^t = (P_{total} - PH_2O^t)\ FIO_2 - PACO_2^t\ [FIO_2 + (1 - FIO_2)/R]$$

*with* $PH_2O^t = 47 \cdot 10^{[0.0237 - 0.0001\ (t - 37)]\ (t - 37)}$

*and* $PACO_2 = PaCO_2$ (alveolar $PCO_2$ = arterial $PCO_2$)

*Apply above equation for* $PAO_2^t \geq PO_2^t$,
*otherwise* $PAO_2^t = PO_2^t$

### BB

The buffer base is the concentration of buffering anions that is available in whole blood to buffer strong acids and consists mainly of protein anions and bicarbonate. Of the protein anions, hemoglobin is the most significant.[4]

$$BB = BE + 41.7 + 0.42 \cdot tHb \quad \text{[mmol/L]}$$

## BE

The base excess of the blood results from a calculation to determine the titratable base of the blood, which in principle is measured by titration of the blood with a strong acid or base to a pH of 7.4 with $PCO_2$ = 40 mmHg at 37°C.[2]

$$BE = (1 - 0.023 \cdot tHb) \cdot [(7.7 + 2.33 \cdot tHb) \cdot (pH - 7.40) - 24.4 + HCO_3^-] \quad [mmol/L]$$

## $BE_{(act)}$

Base excess at actual oxygen saturation[6]

$$BE_{(act)} = (1 - 0.0143 \cdot tHb) \cdot [(1.63 \cdot tHb + 9.5) \cdot (pH - 7.4) - 24.26 + HCO_3^-] - 0.2 \cdot tHb \cdot \left(1 - \frac{SO_2}{100}\right) \quad [mmol/L]$$

## $cH^+$

Concentration (activity) of hydrogen ions in plasma[4]

$$cH^+ = 10^{(9-pH)} \quad [nmol/L]$$

## $cH^{+t}$

Concentration of hydrogen ions corrected to patient temperature other than the default temperature (37°C) preprogrammed into the VetStat analyzer[2]

$$cHt = 10^{(9-pH^t)} \quad [nmol/L]$$

## $nCa^{++}$

The ionized calcium value standardized to pH = 7.40

**For blood:**[2]

$$nCa^{++}\ (pH = 7.4) = Ca^{++} \cdot 10^{0.22 \cdot (pH - 7.4)} \quad [mmol/L]$$

**For plasma or serum:**[2]

$$nCa^{++}\ (pH = 7.4) = Ca^{++} \cdot 10^{0.24 \cdot (pH - 7.4)} \quad [mmol/L]$$

## $O_2Ct$

Oxygen content is the sum of oxygen bound to hemoglobin as $O_2Hb$ and the amount of oxygen dissolved in the plasma. This value is calculated from the measured $O_2Hb$, and tHb if available, and is estimated from the calculated $SO_2$ if the measured $O_2Hb$ is not available and if the calculation of oxygen saturation is selected.[7]

$$O_2Ct = 1.39 \cdot \frac{O_2Hb}{100} \cdot tHb + 0.00314 \cdot PO_2 \quad [vol\%]$$

**NOTE:** If $PO_2$ is not available, $O_2Ct$ is calculated with $PO_2$ = 90 mmHg.

### $PCO_2^t$

$PCO_2$ value corrected to patient temperature other than the default temperature (37°C) preprogrammed into the VetStat analyzer[3]

$$PCO_2^t = PCO_2 \cdot 10^{0.019 \cdot (t - 37)} \quad \text{[mmHg]}$$

### $pH^t$

pH corrected to patient temperature other than the default temperature (37°C) preprogrammed into the VetStat analyzer[3]

$$pH^t = pH - [0.0147 + 0.0065 \cdot (pH - 7.4)] \cdot (t - 37) \quad \text{[pH-unit]}$$

### $PO_2^t$

$PO_2$ value corrected to patient temperature other than the default temperature (37°C) preprogrammed into the VetStat analyzer[4]

$$PO_2^t = PO_2 \cdot 10^{\left[\frac{5.49 \cdot 10^{-11} \cdot PO2^{3.88} + 0.071}{9.72 \cdot 10^{-9} \cdot PO2^{3.88} + 2.30}\right] \cdot (t - 37)} \quad \text{[mmHg]}$$

### $st.HCO_3^-$

Standard bicarbonate of the blood, defined as the plasma bicarbonate concentration in blood that has been equilibrated at 37°C with a gas mixture having a $PCO_2 = 40$ mmHg.[4]

$$st.HCO_3^- = 10^{(st.pH - 6.022)} \quad \text{[mmol/L]}$$

### st.pH

Standard pH of the blood is defined as the pH value of a blood sample that has been equilibrated at 37°C with a gas mixture having a $PCO_2 = 40$ mmHg.[4]

$$st.pH = (0.8262 - 0.01296 \cdot tHb + 0.006942 \cdot BE) \cdot \log(0.025 \cdot PCO_2) + pH \quad \text{[pH-unit]}$$


1. Burtis CA, Ashwood ER, eds. *Tietz Textbook of Clinical Chemistry*, 2nd ed. Philadelphia, PA: WB Saunders; 1994.
2. Constable PD. Clinical assessment of acid-base status: comparison of the Henderson-Hasselbalch and strong ion approaches. *Vet Clin Pathol*. 2000;29(4):115–128.
3. NCCLS. *Definitions of quantities and conventions related to blood pH and gas analysis*, C12-A. 1994.
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5. Zander R. Die korrekte Bestimmung des Base Excess (BE mmol/L) im Blut. *Anesthesiol Intensivmed Notfallmed Schmerzther*. 1995;30(1):36–38.
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## Daily

**SRC Daily Runs**

**Week Ending:**

| SRC | Monday | | | Tuesday | | | Wednesday | | | Thursday | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Level 1** | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |
| **Level 2** | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |
| **Level 3** | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |

| SRC | Friday | | | Saturday | | | Sunday | | |
|---|---|---|---|---|---|---|---|---|---|
| **Level 1** | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |
| **Level 2** | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |
| **Level 3** | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |

## Weekly

**Month:** **Year:**

| | Week 1 | | Week 2 | | Week 3 | | Week 4 | |
|---|---|---|---|---|---|---|---|---|
| Clean SMC | Date | Initials | Date | Initials | Date | Initials | Date | Initials |

**Month:** **Year:**

| | Week 1 | | Week 2 | | Week 3 | | Week 4 | |
|---|---|---|---|---|---|---|---|---|
| Clean SMC | Date | Initials | Date | Initials | Date | Initials | Date | Initials |

**Month:** **Year:**

| | Week 1 | | Week 2 | | Week 3 | | Week 4 | |
|---|---|---|---|---|---|---|---|---|
| Clean SMC | Date | Initials | Date | Initials | Date | Initials | Date | Initials |

**Month:** **Year:**

| | Week 1 | | Week 2 | | Week 3 | | Week 4 | |
|---|---|---|---|---|---|---|---|---|
| Clean SMC | Date | Initials | Date | Initials | Date | Initials | Date | Initials |

## Monthly

**Quality Control Monthly Runs**

**Month:** **Year:**

| | VetStat Control | | | OPTI CHECK | | |
|---|---|---|---|---|---|---|
| Level 1 | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |
| Level 2 | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |
| Level 3 | Pass/Fail | Date | Initials | Pass/Fail | Date | Initials |

## Quarterly

**Year:**

| | Quarter 1 | | Quarter 2 | | Quarter 3 | | Quarter 4 | |
|---|---|---|---|---|---|---|---|---|
| Perform Hb-Calibration | Date | Initials | Date | Initials | Date | Initials | Date | Initials |

## Annually

| | Year: | | Year: | | Year: | | Year: | |
|---|---|---|---|---|---|---|---|---|
| Replace peristaltic pump cartridge | Date | Initials | Date | Initials | Date | Initials | Date | Initials |
| | **Year:** | | **Year:** | | **Year:** | | **Year:** | |
| Change gas I/O port | Date | Initials | Date | Initials | Date | Initials | Date | Initials |

## As Needed

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Clean analyzer surfaces | Date | Initials | Date | Initials | Date | Initials | Date | Initials |
| Change gas bottle | Date | Initials | Date | Initials | Date | Initials | Date | Initials |
| Discharge battery | Date | Initials | Date | Initials | Date | Initials | Date | Initial |