# BLUEPRINT FOR BREATHING

***Introducing the A.D.S. 2000...***
**An Unprecedented Breakthrough in Anesthesia Delivery**


## MICROPROCESSOR ELECTRONICALLY VENTILATES THE PATIENT IF SPONTANEOUS RESPIRATION DOES NOT OCCUR

- Eliminates need to monitor patients' breathing
- Frees technician for other duties

## AUTOMATICALLY SETS BREATHING PARAMETERS AFTER ENTERING PATIENT'S WEIGHT INTO SYSTEM

- Delivers measured amounts of anesthesia at predetermined intervals
- May be used as a critical care ventilator or anesthesia delivery unit

## ELECTRONICALLY CALCULATES AND DISPLAYS MINUTE VOLUME PER KILOGRAM

- Assures optimum oxygen and $CO_2$ levels
- Eliminates errors associated with conventional ventilation

**ANESTHESIA MADE SIMPLE**

engler engineering corporation

**1-800-445-8581**
1099 East 47th Street • Hialeah, Florida 33013 USA
(305) 688-8581 • FAX (305) 685-7671
Web site: www.englerUSA.com
E-Mail: info@englerUSA.com

# COMPANY PROFILE

Engler Engineering Corporation has been in business since 1964 and occupies an 8000 square foot facility in Hialeah, Florida (USA). We manufacture ultrasonic dental scalers, polishers and combination units including electro surgery equipment and ultrasonic instruments for the veterinary market as well as a microprocessor controlled anesthesia delivery system and a respiratory monitor for veterinary use only.

We also manufacture dental equipment for the human market. Please visit our website www.englerusa.com for more detailed information or call us at the numbers shown below.

Engler Engineering Corp. acquired the exclusive manufacturing and marketing rights of **Dynax** products, including stretchers, animal restraint devices, comfort cots, heating pads, and other products. We also acquired the Alpha-Sonic, Ora-Sonic, and Pro-Sonic line of piezo scalers.

Engler Engineering Corporation's brand name veterinary products proudly include:
**Excelsior,** high speed dental air unit with vacuum / electro-surge / ultrasonic scaler / low speed / high speed / air / water syringe,
**Son - Mate II,** ultrasonic scaler / polisher,
**Sonus II,** ultrasonic dental scaler,
**Poli - X,** micromotor variable speed polisher,
**Drill – Aire**, high speed dental air unit, high speed, air / water syringe,
**Drill – Aire Plus**, high speed dental air unit, high speed, low speed, air / water syringe,
**Scale - Aire Mini,** high speed dental air unit with ultrasonic scaler / high speed / low speed / air / water syringe,
**Scale - Aire,** high speed dental air unit with ultrasonic scaler / high speed / low speed / air / water syringe and compressor / tank,
**Tri - Mate,** ultrasonic scaler / micromotor polisher / electro-surge,
**ADS 2000,** microprocessor controlled anesthesia delivery system / ventilator,
**Sentinel V.R.M**., respiratory monitor.

Engler manufactures the **Sonus V** ultrasonic dental unit for the human market

We manufacture all of the inserts and tips used in the Engler products as well as many others on the market today in the 18K, 25K, and 30K frequency range.

Our repair department has the technical knowledge to repair and maintain most dental devices manufactured by other companies including Shorline.

**Engler Engineering Corporation's (EEC) foreign sales are handled through a large and growing network of dental and veterinary distributors. At the present time we are represented throughout Europe, South and Central America, Canada, Asia, New Zealand, Australia, the Middle East, and most other countries.**

If you have any questions or comments, please contact:

Engler Engineering Corporation
**1099 East 47th Street, Hialeah, Florida 33013**
800-445-8581 – 305-688-8581 – FAX 305-685-7671
**Web site: www.englerusa.com Help site: www.engler411.com**

# TABLE OF CONTENTS

# PARTS LIST

Upon opening the carton the ADS 2000 was shipped in, you will find:

ADS 2000 Unit,

ADS instruction manual,

Instructional DVD,

Breathing Circuit with gas sampling elbow,

Green Oxygen Hose,

“To” Vaporizer Hose,

“From” Vaporizer Hose,

Blue Scavenger Tubing,

Power Adapter,

Mask Adapter,

Test Lung,

Gas sampling hose with Luer lock connectors.

## PLEASE READ VERY CAREFULLY

**Engler Engineering Corporation (EEC) makes every effort to verify that all parts for this device including any optional accessories ordered with it are included in this shipment. It is imperative that you inspect the package and if you find any pieces damaged or missing, you must notify us immediately. Claims for damaged or missing parts will only be accepted within five days of reciept.**

**EEC makes every effort to verify that our devices are built and tested to approved standards. Any modification to the device, hoses or power supply initiated by others nullifies all warranty statements. Engler Engineering Corporation will not be held liable in any way, for any damage, injury or death due to non-authorized service, improper installation, or improper use of this device.**

**Engler Engineering Corporation**
**1099 East 47th Street, Hialeah, Florida 33013**
**800-445-8581 – 305-688-8581 – FAX 305-685-7671**
**E-mail: info@englerusa.com**

# SPECIAL INFORMATION

There are a few special areas of information that must be read and understood prior to operating the ADS 2000.

1. BATTERY BACKUP: The ADS 2000 has an internal battery backup system that allows you to continue your procedures in the event of loss of electrical power. It also protects the unit from electrical spikes that may occur during thunderstorms or brownouts. In addition, it allows you to use it as an emergency ventilator in the field if required. It is suggested that the power supply be plugged in, and connected to the device at all times so you will have full power in the event of an emergency. The battery backup should provide ten to twelve hours of use when fully charged.

2. The red LED on the face of the ADS 2000 will illuminate when the battery requires charging. It will also flash whenever the external gas sampling hose is disconnected from the circuit.

3. The ADS 2000 can be damaged if any liquid or of anesthesia enters it from the vaporizer. It is imperative that you do not overfill the vaporizer and that you have it inspected and certified at least every year. Anesthesia residue found in the ADS 2000 may void the warranty.

   CAUTION: It is important when connecting the vaporizer to ensure that _ The vaporizer is mounted lower than the ADS 2000. This will prevent liquid anesthetic from possibly entering the ADS 2000.

4. This device must be flushed between procedures to ensure proper operation. Failure to flush the device may allow unwanted foreign materials to build up in the hoses and internal parts. This may cause incorrect readings on the display, and / or interfere with the proper flow of gases through the unit. Additionally, the unit may not be able to complete its self-test causing a default which will show as an error on the display. Please refer to page 21 of this manual for the flush procedure.

5. The breathing circuit hoses supplied with the ADS 2000 are “disposable” type hoses and are easily replaceable. It is suggested that they be replaced periodically.

6. The ADS 2000 will shut down the flow of oxygen, sound the alarm and flash the LED, whenever the gas sampling circuit is disconnected. This is an important safety feature for this device. Upon reconnecting the sampling hose, the device will continue to operate with the settings as established.

# INSTALLATION INSTRUCTIONS

1. **Connecting the Oxygen Hose** - On the back panel of the unit there is a port marked "**OXYGEN IN**", connect one end of the **Green Oxygen Hose** to this port and connect the other end of this hose to your **50 PSI** oxygen source. Since the oxygen fittings are universally standard, you may use your own oxygen hose if desired.

CAUTION: IT IS EXTREMELY IMPORTANT THAT THE OXYGEN BE REGULATED TO A PRESSURE OF **50 POUNDS PER SQUARE INCH (PSI)**, FOR THE MINUTE VOLUME PER KILOGRAM DISPLAY TO READ ACCURATELY. PRESSURE OVER 50 PSI MAY DAMAGE INTERNAL PARTS VOIDING THE WARRANTY.

2. **Connecting the Vaporizer Hose** - On the back panel of the unit there is a port marked "**TO VAPORIZER**", connect one end of the non marked silicon hose to this port and connect the other end to your vaporizer inlet port.

3. **Connecting the Vaporizer Hose** - On the back panel of the unit there is a port marked "**FROM VAPORIZER**", connect one end of the blue striped silicon hose to this port and connect the other end to your vaporizer outlet port.

NOTE: The ADS 2000 must be used with a *precision* vaporizer.

4. **Connecting the Scavenger Tubing** - Connect one end of the Blue Scavenger tubing to the "**SCAVENGER OUT**" port on the back of the unit. Connect the other end to either a "passive" or "active" scavenging system. This will help to eliminate all traces of anesthetic gases used in the operating room that could pose a hazard to personnel. The use of a f/air anesthesia gas filter unit or active anesthesia scavenger system is highly recommended. Care must be taken to ensure that the scavenger port is not blocked by improper use of these devices as the animal's ease of expiration depends on the resistance of the scavenger line.

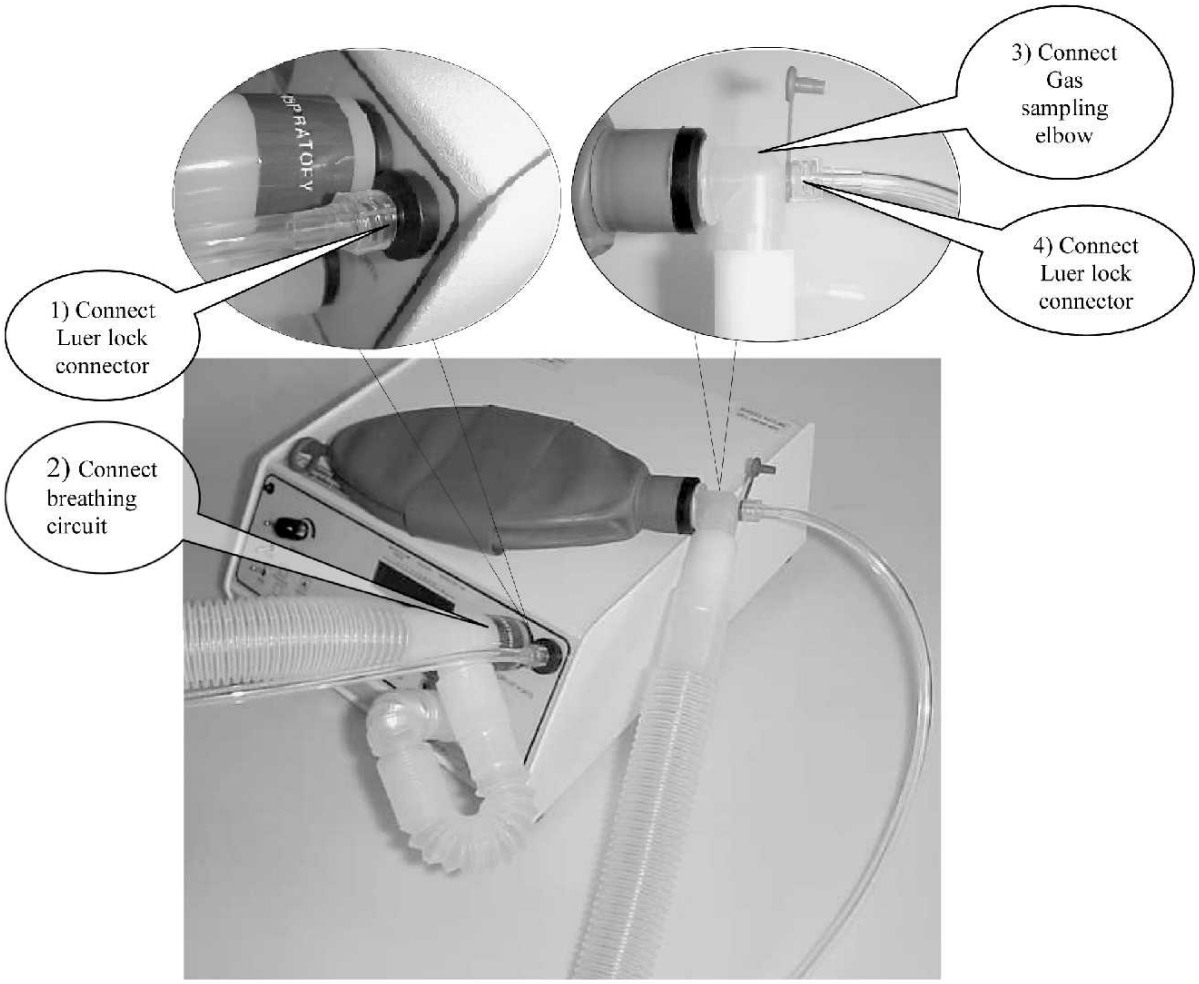
5. **Connecting the Power Adapter** - Connect the small male plug of the power adapter into the back of the ADS 2000 at the 15 VDC @ 1.2 A outlet. Then plug the adapter into an electrical outlet. The supplied power adapter continuously charges the internal battery backup.

NOTE: On a full charge the ADS 2000 has 10 to 12 hours of battery backup for uninterrupted operation during power failure. Complete battery recharging is accomplished in approximately 8 hours.

6. **Connecting the Breathing Circuit** - Connect the two large ends of the breathing circuit to the "BREATHING CIRCUIT" ports on the front panel of the ADS 2000. You may use your own breathing circuit if you desire. The top port (inspiratory) of the ADS 2000 feeds oxygen / anesthesia to the patient. The bottom port (expiratory) is the exhaust. After the lungs have been inflated the internal exhale valve allows the natural elasticity of the animal's lungs to exhale oxygen / anesthesia out through this port.

7. **Connecting the gas sampling system** - To connect the external gas sampling system perform the following steps:

1) Insert the Luer lock connector to the gas sampling input and rotate it clockwise one half turn.
2) Connect the two breathing circuits ends to the breathing circuit ports.
3) Now insert the gas-sampling elbow into the end of the breathing circuit as shown.
4) Insert the Luer lock connector to the gas-sampling elbow and rotate it clockwise one half turn.




Note: You're ADS 2000 unit is fitted with a hose disconnect safety system. In the event that the external sampling hose becomes disconnected, the system will disconnect the gas input to the patient, sound an alarm and flash the red LED on the front left corner of the unit.

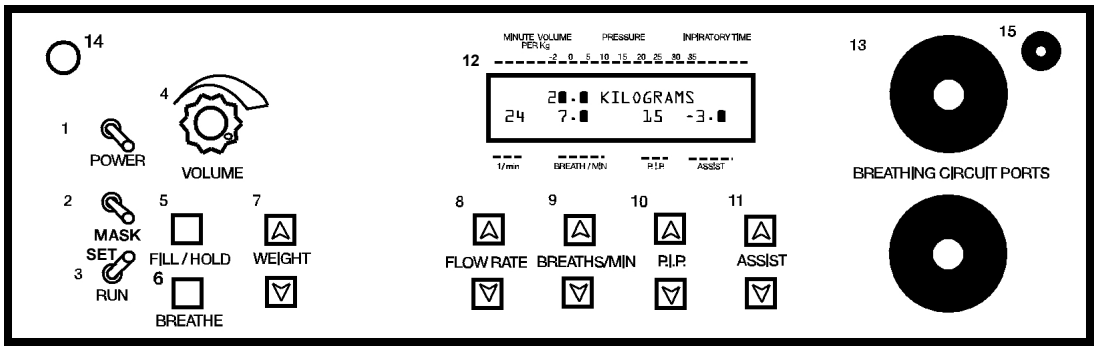
Once the external sampling hose is reconnected, the unit will continue to work at its previous setting.

# GETTING FAMILIAR WITH THE ADS 2000

In order to operate the ADS 2000 properly, you need know its controls.

Front View:

**LCD DISPLAY** - Displays Minute Volume, Inspiratory Time, Proximal Airway Pressure, Flow Rate, Breaths Per Minute, Peak Inspiratory pressure, and Assist Pressure.




**POWER** switch - This switch turns the power to the ADS 2000 **ON** and **OFF**.

**MASK** switch - This switch is used for enabling and disabling the **Mask Mode**

**SET / RUN** Switch - When in the **SET,** this switch allows the operator to enter in the patients' weight. When switched to **RUN** the ADS 2000 begins ventilating the patient.

**VOLUME** Knob - This knob controls the volume of the audible **warning alarm**. We suggest that you start with it turned fully clockwise, i.e. full volume and adjust it as necessary.

**FILL / HOLD** Button - When this button is pressed, the ADS 2000 will fill the lungs of the patient to the indicated peak inspiratory pressure and hold it until the button is released.

**BREATHE** Button - When this button is pressed, the ADS 2000 will initiate a breath to the indicated peak inspiratory pressure to the patient.

**WEIGHT UP / DOWN** Buttons - When the ADS 2000 is in the **SET MODE** these buttons allow the operator to enter the weight of the patient, from below **1.0 Kg**. to **68 Kg**.

**FLOW RATE UP / DOWN** Buttons - Depressing these buttons cause the **FLOW RATE** to increase or decrease, from **0.2 LPM** to **60 LPM**.

**BREATHS PER MINUTE UP / DOWN** Buttons - These buttons control the minimum number of times that the ADS 2000 will breathe per minute, from 1 to 95 B.P.M.

**P.I.P. UP / DOWN** Buttons - These buttons control the **Peak Inspiratory Pressure** in cm of $H_2O$, that the ADS 2000 will deliver to the patient, from **5.0 cm** to **35 cm**./ $H_2O$

**ASSIST UP / DOWN** Buttons - These buttons set the **sensitivity of inspiratory effort** necessary for the ADS 2000 to facilitate an assisted breath, from **–0.3 to 6.0 cm**. / $H_2O$ They also allow the **ASSIST** feature to be turned off.

**BREATHING CIRCUIT PORTS** - Connect the breathing circuit to these ports.

**BATTERY LOW INDICATOR / SAFETY ALARM** - The red led on the front panel of the ADS 2000 is a warning indicator that the battery power is low, and that the unit should be placed on charge immediately. When the unit is first powered up the led will self test by flashing on and then should remain off.

The LED will also flash if the external sampling hose is disconnected.

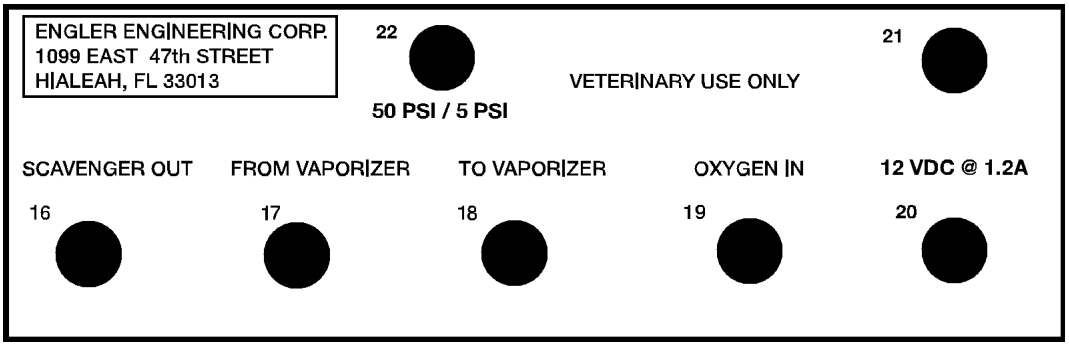
**GAS SAMPLING INPUT** - To connect the Gas Sampling System, insert the **Luer lock** connector to the Gas Sampling input and rotate it clockwise one half turn. The **Luer lock** connector is located at the end of the 1/8" clear tube. Locate the other **Luer lock** connector at the other end of the 1/8" clear tube. Connect it to the Gas Sampling elbow on the Breathing Circuit.

Note: It is imperative that the Gas Sampling Hose stay connected during use.

**Rear View:**

**SCAVENGER OUT** - Connect one end of the blue "**Scavenger**" tubing to this port and connect the other end to a scavenging filter canister or other scavenging device, either active or passive.
**FROM VAPORIZER** - Connect one end of the "**From Vaporizer**" hose to this port and connect the other end to the outlet port of your precision vaporizer.
**TO VAPORIZER** - Connect one end of the "**To Vaporizer**" hose to this port and connect the other end to the inlet port or your precision vaporizer.
**OXYGEN IN** - Connect one end of the green "**Oxygen**" hose to this port and connect the other end to an oxygen source that is set to a pressure of **50 PSI** (pounds per square inch).
**POWER INLET** - Connect your power cord to this port.
**ALARM** - This is the alarm speaker.

**50 PSI / 5 PSI TOGGLE** - This is the manual control to alternate between the **50 PSI** (normal) operating mode and the **5 PSI**, (lab) mode.



# POUNDS TO KILOGRAMS CONVERSION CHART

In order for the ADS 2000 to operate properly, the correct patient weight must be entered. The ADS 2000 requires that the patient's weight be entered in kilograms, therefore if the patients weight in pounds is known then the following formula will help in determining the patients weight in kilograms.

Kg = P x 0.454

Where:

Kg = patient's weight in kilograms

P = patient's weight in pounds

Example: You have a 40 pound patient and need to find out it's weight in kilograms.

Kg = 40 x 0.454

Kg = 18.2 Kilograms or 18 Kilograms

**Conversion from kilograms to pounds**

| Kilograms | Pounds | Kilograms | Pounds |
|---|---|---|---|
| 1 | 2.205 | 35 | 77.160 |
| 2 | 4.409 | 36 | 79.365 |
| 3 | 6.614 | 37 | 81.570 |
| 4 | 8.818 | 38 | 83.774 |
| 5 | 11.023 | 39 | 85.979 |
| 6 | 13.228 | 40 | 88.183 |
| 7 | 15.432 | 41 | 90.388 |
| 8 | 17.637 | 42 | 92.593 |
| 9 | 19.841 | 43 | 94.797 |
| 10 | 22.046 | 44 | 97.002 |
| 11 | 24.250 | 45 | 99.206 |
| 12 | 26.455 | 46 | 101.411 |
| 13 | 28.660 | 47 | 103.616 |
| 14 | 30.864 | 48 | 105.820 |
| 15 | 33.069 | 49 | 108.025 |
| 16 | 35.273 | 50 | 110.229 |
| 17 | 37.478 | 51 | 112.434 |
| 18 | 39.683 | 52 | 114.638 |
| 19 | 41.887 | 53 | 116.843 |
| 20 | 44.092 | 54 | 119.048 |
| 21 | 46.296 | 55 | 121.252 |
| 22 | 48.501 | 56 | 123.457 |
| 23 | 50.705 | 57 | 125.661 |
| 24 | 52.910 | 58 | 127.866 |
| 25 | 55.115 | 59 | 130.071 |
| 26 | 57.319 | 60 | 132.275 |
| 27 | 59.524 | 61 | 134.480 |
| 28 | 61.728 | 62 | 136.684 |
| 29 | 63.933 | 63 | 138.889 |
| 30 | 66.128 | 64 | 141.093 |
| 31 | 68.342 | 65 | 143.298 |
| 32 | 70.547 | 66 | 145.503 |
| 33 | 72.751 | 67 | 147.707 |
| 34 | 74.956 | 68 | 149.912 |

## TURNING ON THE ADS 2000

1. Verify that the oxygen supply hose is connected properly. Open the O2 valve to begin oxygen supply to the ADS 2000. The oxygen supply must be regulated to **50 PSI**. Make sure that the **vaporizer** (if in circuit) is "**OFF**" .

2. Place the "**POWER**" and "**MASK**" switches in the "O" position. Place the "**SET / RUN**" switch into the "**SET**" position. Check that the **Toggle Switch** located at the rear of the unit is set to "**Normal**" **50 PSI**.

3. Place your thumb over the open end of the gas-sampling elbow that is connected to the end of the breathing circuit.

Note: By placing your thumb over the gas-sampling elbow you are creating a closed circuit for the ADS 2000 built in self-test feature.

Note: The gas sampling system hose must be properly connected before the ADS 2000 self-test is initiated.

4. While still holding your thumb over the sampling elbow, place the **Power** switch to "I" or "**On**" . The ADS 2000 will now perform a self-test. This will be indicated by the LCD display as shown in Figure 1. Continue to hold your thumb over the end of the sampling elbow until this test is complete.

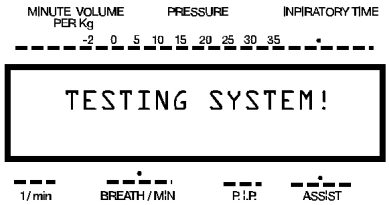



**Fig.1**

5. As shown in Figure 2, at the end of the self-test you will be prompted by one of the following messages in the LCD display.

**Fig.2**

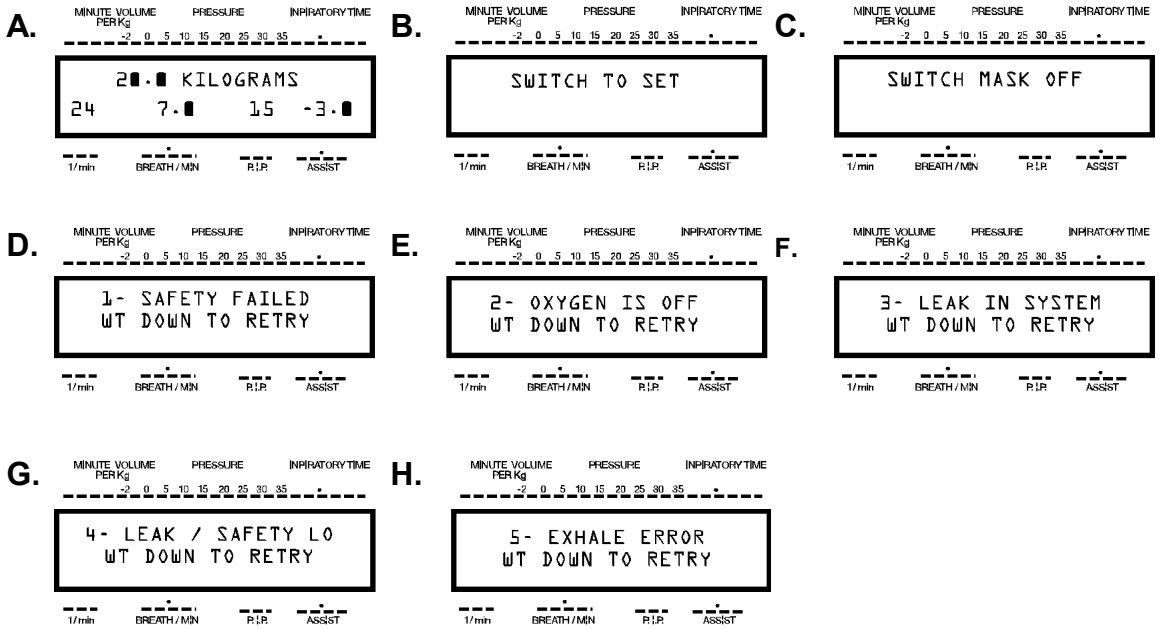
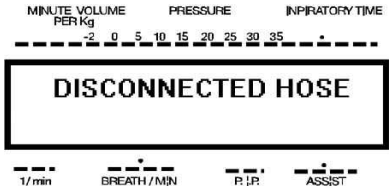


Fig.3




6. When the unit passes self test, the LCD Display will show (fig 2 A), its **Automatic Default** – 20 kilograms. The ADS 2000 has just passed the self-test.

7. If you get readout 2 B. "**SWITCH TO SET**", then place the **SET / RUN** switch to "**SET**". The display will now give readout "A" or "C", if you get readout "A." then proceed to Step 6.

8. If you get readout 2 C. "**SWITCH MASK OFF"** then place the "**MASK**" switch to "O" or "OFF". The display will now give readout "A", proceed to Step 6.

9. If you get any one of the error messages "D" through "H" please refer to **TROUBLESHOOTING THE ADS 2000,** section of this manual, beginning on page 24.

10. If a message as in figure 3 is displayed, a hose from the Breathing Circuit or the **Gas Sampling Circuit** is not connected properly. Re-connect hoses and try again.

The ADS 2000 is ready for operation!

Note: Do not connect TEST LUNG / patient until unit has passed self-test.

## SET MODE

In this section you will learn and set up the parameters of the ADS 2000 in the "**SET MODE**". The "**SET MODE**" is the resting or static mode for the ADS 2000. The "**SET MODE**" is the mode in which you will enter the patients' weight in kilograms and from that input the ADS 2000 will select all of the other parameters for you. Of course, the ADS 2000 will only select values based on an average, if at any time you wish to change any parameter, you may do so at any time.

THE **LCD DISPLAY** in **SET MODE**. Figure 2 A shows the default 20 kilograms display once the self test process is completed.

1. Make sure that the **SET / RUN** switch is in the "**SET MODE**".

2. As shown on figure 2A we can see the following:

   a. Patient default **Weight** is pre-selected at 20 Kilograms.

   b. The default **Flow Rate** is pre-selected to a value of 24 liters per minute.

c. The default number of **Breaths Per Minute** is 7.5

d. The default **Peak Inspiratory Pressure** is pre-selected to a value of 15 cm. of $H_2O$.

e. The **Assist** feature is on and defaults at a pre-selected value of -3.0 cm. of $H_2O$.

Every time you turn the ADS 2000 on, the LCD display should show the **default values** as shown on page 10, indicating a **successful self-test**.

3. To enter a different weight, simply press either the **WEIGHT UP** or **WEIGHT DOWN** buttons on the front of the ADS 2000 while in **Set Mode**, until the upper line of the LCD displays the desired weight.

NOTE: Weight values under 10 Kilograms are set to the nearest 0.5 Kilograms, while weight over 10 Kilograms are set to the nearest 1 Kilogram.

NOTE: It is important to set the unit for the correct weight for each patient so that the **MINUTE VOLUME PER KILOGRAM** value will be calculated correctly.

4. As you select different weight values the ADS 2000 automatically provides default ventilation parameters. At any time before or during a procedure, you can change any of following parameters:

a. **LITERS PER MINUTE** - To adjust the **FLOW RATE** to the patient, simply press the **FLOW RATE UP** or **FLOW RATE DOWN** buttons on the front of the ADS 2000.

b. **BREATHS PER MINUTE** - To adjust the number of **BREATHS PER MINUTE** delivered to the patient, simply press the **BREATHS PER MINUTE UP** or **BREATHS PER MINUTE DOWN** buttons on the front of the ADS 2000.

c. **PEAK INSPIRATORY PRESSURE** - To adjust the Peak Inspiratory Pressure delivered to the patient, press either the **P.I.P. UP** or **P.I.P. DOWN** buttons on the front of the ADS 2000.

d. **ASSIST** - To adjust the amount of inspiratory effort needed to initiate a breath by the patient, press either the **ASSIST UP** or **ASSIST DOWN** buttons on the front of the ADS 2000.

NOTE: To turn the **ASSIST** feature off, press and hold the **ASSIST DOWN** button until the LCD displays "**OFF**" where the **ASSIST** value was located.

# THE LCD DISPLAY in RUN MODE

NOTE: We suggest that you practice with the provided **TEST LUNG**, until you feel confident that you fully understand the proper operation of the ADS 2000. Throughout the manual whenever the word "patient(s)" is used, you will also see the words, "**TEST LUNG"**, this means that you should first familiarize yourself with this function by using the **TEST LUNG** first.

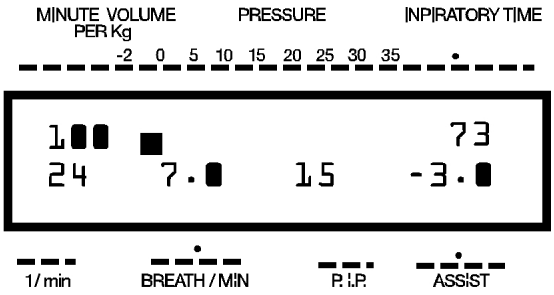
NOTE: When using the **TEST LUNG** you should always keep the vaporizer **OFF.**

1. Now that you have entered in the patients' weight (the **TEST LUNG** simulates a 20 Kilogram patient), you are ready to begin delivering anesthesia or ventilating your patient (**TEST LUNG)**.

2. If you haven't done so already, connect the end of the Breathing Circuit to your patient (**TEST LUNG)**.

3. Place the **SET / RUN** switch to "**RUN**". The patient's (**TEST LUNG)** chest should begin to fill up to the preset **P.I.P**. (Peak Inspiratory Pressure)

**4.** After the patient (**TEST LUNG**) has reached the preset **P.I.P**. the exhale valve will open and the patients' (**TEST LUNG**) chest will exhale (deflate). The LCD display should look similar to the display below.




NOTE: Numbers used in section 5 and 6 of pages 11 and 12 are examples only.

5. The upper line of the LCD readout is now displaying, from left to right, the following information:

a. **Minute Volume Per Kilogram**, (100 in this case). This number will be updated with each breath.

b. **Peak Inspiratory Pressure Graph**, (A square black cursor moving across a white background).

NOTE: The cursor starts at 0 cm. of $H_2O$ and moves up to the selected Peak Inspiratory Pressure (15 cm. of $H_2O$ in this case).

NOTE: A square **BLACK** cursor moving across a **WHITE** background indicates that the breath was initiated by the ADS 2000. Whereas a square **WHITE** cursor moving across a **BLACK** background indicates that the patient initiated the breath.

c. **Inspiratory Time**, (.73 seconds in this case)

6. The bottom line of the LCD readout shows the following parameters:

a. **Flow Rate**, (24 Liters Per Minute in this case).

b. **Breaths Per Minute**, (7 Breaths per minute in this case).

c. **Peak Inspiratory Pressure**, (15 cm. of $H_2O$ in this case).

d. **Assist** (Inspiratory Effort), (-3.0 cm. of $H_2O$ in this case).

7. The ADS 2000 will now wait until either the patient initiates a breath, either by giving an inspiratory effort of equal or greater than the **ASSIST** value (-3.0 in this case), or until it is time for the A.D.S 2000 to give the next breath (computed by the microprocessor), it will then repeat the cycle.

NOTE: If pressure in the system increases between breaths, a built in safety feature will cause the ADS 2000 to allow an "exhale" (pop-off) , i.e. the exhale valve opens to allow pressure to escape. This would happen, for instance, if the surgeon leaned on the patient's chest. It can also happen if the patient tries to exhale after he has already exhaled a tidal volume. You will hear the exhale valve open and close rapidly. *This is normal.*
To **temporarily stop** the ADS during a procedure, place the **SET / RUN** switch to "**SET**". Doing so will hold the current parameters, the current breath will be completed and the machine will stop. **To continue ventilation**, switch back to "**RUN**".

## UNDERSTANDING THE MINUTE VOLUME NUMBER

1. Since **blood gas analysis** is not always available, we provide a **Minute Volume Number** as a guide, to know if you are properly ventilating the patient. A properly ventilated patient should require from 150 to 250 ml. / minute / Kg. The 150 ml. / minute / Kg. number is appropriate for larger patients and the 250 ml. / minute/ Kg. number for smaller patients. **In general, it is better to over ventilate rather than under ventilate a patient.**

NOTE: The Minute Volume per Kilogram number becomes useful after the patient has stabilized. It will require a few breaths for this stabilization to take place, and then you will see the Minute Volume per Kilogram number fluctuate slightly between breaths.

There are two ways to change the **Minute Volume** per Kilogram number:

**a.** Since the **Minute Volume** number is directly proportional to **Breaths Per Minute**, the most direct way to change the **Minute Volume** number is to change the number of **Breaths Per Minute**.

**b.** Changing the **Peak Inspiratory Pressure** (**P.I.P.**) will change the **Tidal Volume** and therefore change **Minute Volume** number as well. Obese patients with low thoracic compliance and patients with restrictive lung conditions will often need a higher **Peak Inspiratory Pressure**. The best method is to observe the “rise and fall” of the chest and adjust the **Peak Inspiratory Pressure** for a "reasonable" amount of filling.

## THE PEAK INSPIRATORY PRESSURE GRAPH

1. The **Peak Inspiratory Pressure** of the patient is indicated by a cursor moving across the middle of the LCD display.

2. The cursor starts at 0 cm. of $H_2O$ and moves up to the selected **Peak Inspiratory Pressure.**

3. A square **BLACK** cursor moving across a **WHITE** background indicates that the breath was initiated by the ADS 2000. Whereas a square **WHITE** cursor moving across a **BLACK** background indicates that the patient initiated the breath, (**ASSIST MODE**).

## THE INSPIRATORY TIME

1. The information in the upper right hand corner of the display shows the **Inspiratory Time** in seconds, e.g., 1.20 and is **updated with each breath**. The exact length of inspiration is not critical, but it should allow an **INSPIRATORY: EXPIRATORY RATIO** of at least 1:2. This means at 10 B**reaths Per Minute**, the inspiratory time should be no longer than two seconds. Generally, intervals of 0.75 to 2 seconds are suggested, the shorter time intervals being best for smaller patients.

2. The easiest way to adjust the **Inspiratory Time** is to adjust the **Flow Rate**, i.e. the higher the F**low Rate** the quicker the lungs will be brought up to the preset **Peak Inspiratory Pressure**, thus a quicker **Inspiratory Time**. Generally set the **Flow Rate** so that the patient's chest rises in a reasonable time.

IMPORTANT: Very short **Inspiratory Times** may indicate a very high **Flow Rate** into a very small patient. Under these circumstances, the narrowness of the tube and the resistance of the trachea and other air passageways will cause the pressure to build up without inflating the lungs. It is usually very obvious when this occurs because the **pressure will rise extremely rapidly**, **but the chest will not fill**. **DO NOT LET THIS CONDITION GO UNCORRECTED**. Lower the **FLOW RATE** to 2 or 4 LPM and let the chest fill more slowly.

Once the chest is filling normally, raise the **FLOW RATE** up to a reasonable **Inspiratory Time**.

3. If the **Inspiratory Time** exceeds 3 seconds, the **ALARM** will sound. This may be due to the **Flow Rate being too low**, but is usually caused by a leak in the system. Most of the time the problem will be a leaking endotracheal tube cuff. This can almost always be detected by carefully listening for a leak during inhalation.

## DISPLAYING TIDAL VOLUME

**Tidal Volume** can be displayed instead of **Minute Volume Per Kilogram** when in **Normal** and **LAB MODE**. This option is always available by pressing **WEIGHT UP** while the **SET / RUN** switch is on **RUN**. This option can also be initiated upon start-up .

In order to have the ADS 2000 display the **Tidal Volume**, press the **Flow Rate** up button while turning the ADS 2000, **ON**.

To exit this mode, press **WEIGHT DOWN** while the **SET / RUN** switch is on **RUN** or turn the ADS 2000 **OFF** and restart the unit.

## UNDERSTANDING FLOW RATE

The **Flow Rate** displayed on the ADS 2000 is an instantaneous value, i.e. if the ADS 2000 was set to 24 LPM and if the unit were to have an inspiratory time of 1 minute, then 24 liters of gas would have been used. In reality, the ADS 2000 only allows gas to flow when a breath is being delivered. In order to determine the "Actual **FLOW RATE**" a simple calculation can be performed.

This calculation is as follows:

$$F_{ave.} = (F_{ins} \times T_{on} \times B) / 60$$

Where:

$F_{ave.}$= Actual Flow Rate

$F_{ins.}$= Flow Rate on LCD Display

$T_{on}$= Inspiratory Time

$B$= Actual Breaths Per Minute

## UNDERSTANDING BREATHS PER MINUTE

1. The **Breaths Per Minute** displayed is the exact **Breaths Per Minute** only when the **Assist** is in the **OFF** setting. If the **Assist** is **ON**, the displayed value is the minimum **Breaths Per Minute**, i.e. the ADS will initiate a breath only if the patient does not do so in the allotted time. The ADS 2000 correctly updates and displays the Minute Volume per Kilogram after each breath, whether the patient or the machine initiated the breath.

**Example 1** If the **Assist** is **OFF** and the **Breaths Per Minute** is set at 6.0, then the patient (**TEST LUNG**) will only have six inspiratory / expiratory cycles each minute.

**Example 2** If in the above case, the **Assist** was in the -2.0 setting and the **Breaths Per Minute** remained at 6.0, and the patient gave a single inspiratory effort of -2.0 cm. of $H_2O$, then the patient will have seven inspiratory / expiratory cycles for that minute.

## HOW TO SET P.I.P.

1. To adjust the **Peak Inspiratory Pressure**, simply depress either the **P.I.P. UP** or **P.I.P. DOWN** buttons on the front of the ADS 2000.

NOTE: To see how the **P.I.P.** setting works using the **Test Lung**, press the **P.I.P. DOWN** button until it displays 5.0, place the **SET / RUN** switch to "**RUN**". The **Test Lung** will begin to fill up to 5.0 cm. $H_2O$ shown on the display. Notice that the **Test Lung** does not inflate as much as it did when the **P.I.P.** was set at 15 cm. H2O.

## UNDERSTANDING ASSIST

1. The default setting for **Assist**, (assisted respiration) is set at -3.0 cm. of $H_2O$. This setting allows for a breath to be initiated by the patient. If you wish to allow the patient to initiate its own breath, use the **Assist** buttons (far right on the display) to set the amount of **NEGATIVE PRESSURE**, (vacuum) the patient has to produce in order to initiate a breath.

2. You would usually select the lowest possible number that does not cause false breaths. When in **Assist MODE** the ADS 2000 will wait for the patient to initiate a breath. If the patient does not **SPONTANEOUSLY INITIATE** a breath, the ADS 2000 will automatically begin the breathing cycle for the patient at the set parameters.

3. If you prefer not to allow the patient to initiate it's own breath, you may do so by pressing the **ASSIST DOWN** button until the display reads "**OFF**".

**This is not recommended**.

## USING THE FILL / HOLD FEATURE

1. **FILL / HOLD** fills the chest to the selected pressure and then maintains that pressure, i.e., it does not allow exhalation until the button is released. **FILL / HOLD** can be used to induce a patient as described below in the section **BUCKING THE ADS**

2. **FILL / HOLD** can also help during closure of thoracotomy incisions. Simply press the **FILL / HOLD** and hold it until the lungs are filled. The lungs will fill to the preset parameter and will remain inflated AT THAT PRESSURE until the button is released. There is some hysteresis, i.e. the pressure is allowed to fall 3 cm. $H_2O$ before the chest is refilled.

**Caution**: Overzealous hyperinflation of previously collapsed areas of the lungs can cause pulmonary damage.

For this reason it is best to inflate the lungs at the lowest possible **P.I.P.** value, (around 10 cm. of $H_2O$) and for the shortest time necessary (a few seconds) when the chest is open.

## RESISTING (BUCKING) THE ADS

1. If the patient is not in a deep enough plane of anesthesia it may attempt to buck the ADS 2000. You will see very short inspiration times and violent attempts to inhale and exhale. There are several practical solutions to this problem.

a. Patient may require additional medication, on doctors orders. (For example intravenous drugs).

b. **SET THE VAPORIZER TO 4 OR 5 PERCENT**. Then press **FILL / HOLD** and keep the button depressed for a second or two. Release, then repeat. Do this until the patient relaxes, then **RESET THE VAPORIZER** and allow the ADS 2000 to take over.

c. Set the **Assist** value to a **more sensitive value** (i.e. a smaller negative number, -2.0 is more sensitive than -4.0), turn the vaporizer to 3 or 4 percent. The patient will usually ventilate himself down. The Minute Volume number may go up for a few breaths.

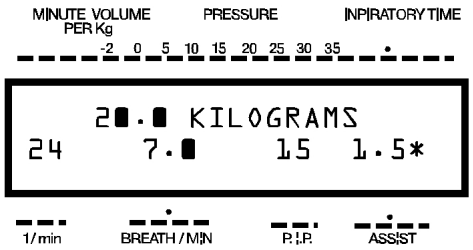
3. Once the patient is stabilized, the settings can be adjusted (if necessary).

# UNDERSTANDING PEEP MODE

1. The ADS 2000 has a built in **PEEP** (**Positive End Expiratory Pressure**) mode. To activate the **PEEP MODE** perform the following:

a. Press the **Assist UP** button until the unit displays "**Entering the PEEP MODE**" and the alarm beeps.

b. As shown below, the LCD display will now show a **PEEP** value instead of an **Assist** number




NOTE: An " * " (asterisk) is displayed as an indication that the ADS 2000 is in the **PEEP MODE**.

NOTE: The **Assist MODE** will not function when the ADS 2000 is in **PEEP MODE**.

NOTE: **PEEP** pressures range from 0 to 9 cm. of $H_2O$. Adjust the **PEEP** pressure by using the **ASSIST UP** and **ASSIST DOWN** buttons.

c. To exit the **PEEP MODE** Press the **ASSIST DOWN** button until the unit displays "**Entering the ASSIST MODE**" and the alarm beeps.

# UNDERSTANDING THE FLUSH MODE

1. To avoid failure of the ADS 2000 it must be flushed after each surgery. This will assist to remove any debris or condensation that may build up.

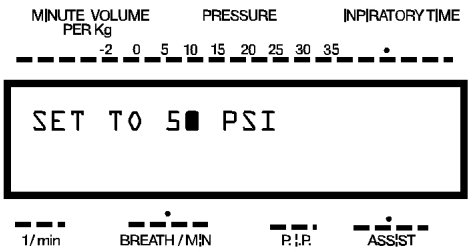
2. To enter the **FLUSH MODE** perform the following:

   a. Turn **OFF** the ADS 2000, turn the vaporizer off, and ensure the **5 PSI / 50 PSI** switch is set to **50 PSI.**

   b. Seal the end of the breathing circuit by placing your thumb over it. Maintain the seal over the end of the breathing circuit until the end of this procedure.

   c. Press the **FILL / HOLD** button and continue holding it down while turning the ADS 2000 **ON** . Continue to hold **FILL / HOLD** button down for 20 – 30 seconds.

   d. The LCD will now look like the display below. The ADS 2000 is now in the FLUSH **MODE** and a full 60 LPM flow of oxygen is passing through the ADS 2000.




   e. To exit this mode, simply release the **FILL / HOLD** button and the unit will go through the usual self-test.

NOTE: As a method of preventative maintenance the **FLUSH MODE** should be done after every procedure. This will insure that the internal hoses and valves are kept clean and dry.

## USING THE BREATHE FEATURE

1. The **BREATHE** button can be pressed at any time between cycles (breaths) to initiate a breath, overriding both timed and assisted respiration.

NOTE: To test the **BREATHE** function, turn the ADS 2000 **ON**, (see page 10) install the **TEST LUNG** onto the end of the breathing circuit, place the **SET / RUN** switch to "**RUN**". When the ADS 2000 is between breaths, press the **BREATHE** button, the **TEST LUNG** will inflate and deflate to the preset parameter.

## USING THE MASK MODE

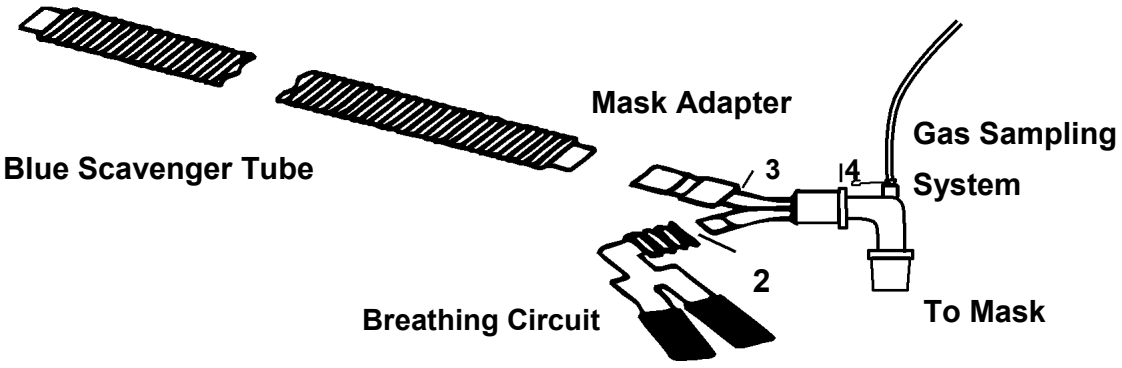
NOTE: Unit must be turned **ON** while in **Normal Mode** (**50 PSI**), then the tubing configuration changed to **Mask Mode**.

1. The **Mask Adapter** consists of the Y piece and the adapter. Masking a patient down requires an adapter, which is supplied with the unit.

2. As shown below, connect the Breathing Circuit to the end of the “Y” piece.

3. Attach the “Blue Scavenger Tubing” to the large adapter that is connected to the “Y” piece.

4. Connect the Gas Sampling Elbow to the large port of the “Y” piece as shown.




5. Set the vaporizer to the desired concentration.

6. Place the "**MASK**" switch **ON** or "**I**". The LCD display will look like Figure 6, and a continuous flow of oxygen with anesthetic gas will flow through the mask at your pre-selected **FLOW RATE**.

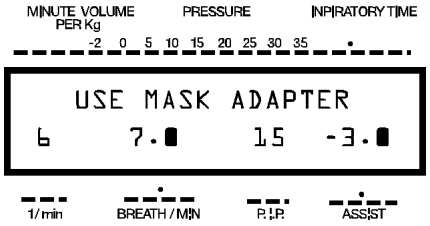



**Figure 6**

# USING A MASK WHILE IN LAB MODE

When using a mask in **Lab Mode** (**5 PSI** low flow) do not use the **Mask Adapter**. Instead, connect the mask directly to the breathing circuit. The blue scavenger tube should be connected to the scavenger port at the back of the unit.

NOTE: An adequate **MASK** flow is calculated as in the formula below:

$$F_{MASK} = 3 \times M_V$$

Where: $F_{MASK}$ = Mask Flow Rate

$M_V$ = Minute Volume per Kilogram

The ADS 2000 automatically selects a **Mask FLOW RATE** of at least 3 times **Minute Volume** based on the patients' weight entered.

NOTE: The scavenger system must be able to hold at least one **Tidal Volume** for the **MASK** function to work properly.

NOTE: In the **MASK Mode** there is a built in pressure safety feature that stops the flow to the patient and causes an audible alarm if the pressure exceeds 35 cm. of $H_2O$. This pressure can build up if the **MASK ADAPTER** is not used, i.e. the mask is connected directly to the Breathing Circuit.

8. To end a **MASK** procedure, simply place the "**MASK**" switch in the **OFF** or "**O**" and put the **5 / 50 PSI Switch** (on the back of the unit) back to **50 PSI**. The ADS 2000 then reverts back to normal operation.

# ENDOTRACHEAL TUBES and the ADS 2000

**1.** The proper function of any ventilator depends on a good seal between the trachea and the tube cuff. Small leaks will cause the **Minute Volume** Per Kilogram to be inaccurate, while larger leaks will not allow the p**eak inspiratory pressure** to be reached in a reasonable time if at all.

**2.** Small tubes should have the adapter on the OUTSIDE, rather than the inside of the tube. When they are on the inside, the adapter narrows the opening significantly and can seriously interfere with respiration. This is, of course, true whether positive pressure ventilation is used or not. In fact, it is even more important for "regular" anesthesia systems.

**3.** The cuff should be tested to be sure there are no leaks. Fill and cap the cuff, then submerge in water to check for leaks.

**4.** A good seal must be made to the patient, but care should be used not to put too much pressure on the trachea since excessive pressure can damage tissue.

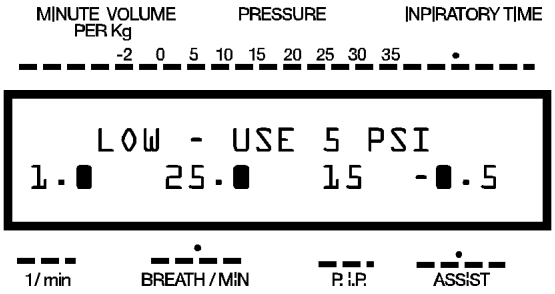
# USING THE ADS 2000 in LAB MODE

In order to facilitate the ventilation of very small patients the ADS 2000 has a low pressure **LAB MODE**. This mode does not have any preset default parameters by weight; therefore it is advised that you have experience operating the ADS 2000 before using this mode. To enter this mode perform the following:

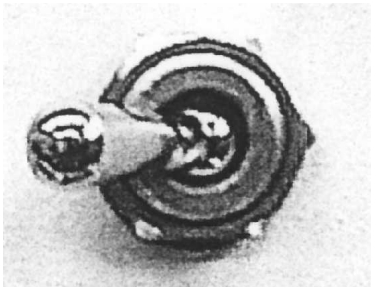
**1.** Turn **ON** the ADS 2000 as usual and allow it to go through the self-test procedure. The LCD should display the initial default of 20 Kilograms.

NOTE: The start-up self-test may show an error if you attempt to start the ADS 2000 with the input pressure set at **5 PSI**, therefore, always start the ADS 2000 in the **NORMAL MODE** at **50 PSI** then set the **50 PSI / 5 PSI** switch to the **5 PSI** setting.

**2.** Now press the **WEIGHT DOWN** button until the LCD displays looks like the example below.




**3.** On the back panel of the ADS 2000 you will find a **TOGGLE SWITCH** to select the pressure - **50 PSI** for normal operation (and to start up self test) and **5 PSI** for **LAB MODE**. Set switch to **5 PSI.**



**50 PSI / 5 PSI**

This A.D.S has an internal regulator for **LAB MODE**.

Always begin operation with an input pressure of **50 PSI**

**4.** In **LAB MODE**, the **Minute Volume** per Kilogram is displayed. **Tidal Volume** is available anytime when pressing **WEIGHT DOWN** while **SET / RUN** switch is on **RUN**.

5. In **LAB MODE** the **FLOW RATES** are adjustable between 0.2 to 6.0 **Liters Per Minute**.

6. The **Breaths Per Minute** in **LAB MODE** are adjustable between 1 and 95.

NOTE: The **Breaths Per Minute** are in increments of

0.5 for 1 - 12 B.P.M.
1.0 for 13 - 50 B.P.M
2.0 for 50 - 70 B.P.M
5.0 for 70 - 95 B.P.M

7. The **MASK** function in **LAB MODE** does not require the use of a **Mask Adapter**.

## USE OF EXTERNAL EQUIPMENT WITH THE ADS 2000

Connecting any external apparatus to the ADS 2000 may adversely affect the operation of the unit. EEC will not be held liable for any damage to the unit, injury or death to the patient if any non-approved equipment is used.

Always test for correct operation on the **Test Lung** prior to using the ADS 2000 on a patient.

# TROUBLESHOOTING the ADS 2000

1. **Check the unit's calibration:**

To enter the **Calibration Mode**, perform the following:

a. Turn **OFF** the ADS 2000, turn the vaporizer off.
b. Disconnect the breathing circuit and the gas sampling system (if available).
c. Disconnect the scavenger hose.
d. Press the **P.I.P. Up** and **Down** buttons at the same time and hold them down while turning **ON** the ADS 2000.
e. A single number will be displayed in the LCD screen; this number must be between 25 and 27 for the unit to function properly. If the calibration number is not between 25 and 27, the unit may require calibration. Contact EEC for instructions. Return, repair and loaner forms are available at engler411.com, click the "repair" tab.

2. The unit must be flushed at the end of each procedure:

To enter the **FLUSH MODE** perform the following:

a. Turn **OFF** the ADS 2000, turn the vaporizer off, and ensure the **5 PSI / 50 PSI** switch is set to **50 PSI**.
b. Place and hold your thumb over the end of the breathing circuit.
c. Press the **FILL / HOLD** button and continue holding it down while turning the ADS 2000 **ON**. Continue to hold the **FILL / HOLD** button down for 20 - 30 seconds.
d. The LCD will display "**SET TO 50 PSI"**. The ADS 2000 is now in the **FLUSH MODE** and a full **60 LPM** flow of oxygen is passing through the ADS 2000.

3. Confirm that oxygen is on and the oxygen line pressure is **50 PSI**.
4. Check for cracks and leaks in the breathing circuit. If any damage is found replace breathing circuit.
5. Ensure that unit is connected to power and that the **Battery Low** LED is not on. If **Battery Low** LED is on, the unit must be charged. Charge overnight for best results.

If the **Battery Low** LED stays on after the unit has been powered you may have one of the following problems:

a. There is no power in the wall socket that you are connecting the unit to.
b. The power adapter is damaged.
c. The battery has expired and needs to be replaced. To have the battery replaced, send the unit to Engler Engineering Corporation. See engler411.com for return, repair, and loaner forms, click the “repair” tab..
d. The female power socket in the back of the ADS 2000 has been damaged. See engler411.com for return, repair, and loaner forms, click the “repair” tab.

6. Make sure that the **Gas Sampling System** is connected properly.

To connect the **Gas Sampling System**, insert the **Luer Lock** connector to the **Gas Sampling** input and rotate it clockwise one half turn. Now insert the **Gas Sampling** elbow into the end of the Breathing Circuit.

7. Inspect the all ADS 2000 hoses periodically to make sure that they are properly connected, and not kinked, cracked, or broken.

## The ADS 2000 and Electro Surgery Units

NOTE: The use of certain types of electro surge cauterizing units can cause severe radio interference resulting in “locking up” the ADS 2000 microprocessor. It is suggested to experiment with the supplied **TEST LUNG** to see which cauterizing units are compatible with the ADS 2000.

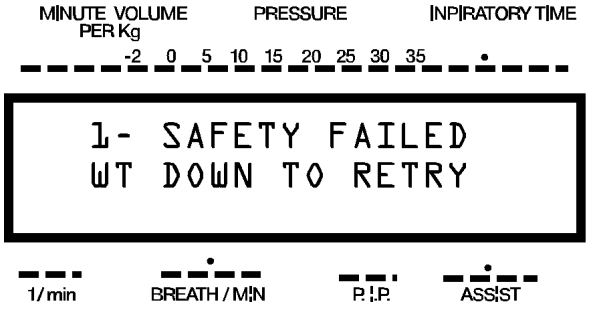
NOTE: The power supply (plug) that is supplied with the ADS 2000 can sometimes act as an antenna for receiving interference from an electro surge unit. Temporarily unplugging the power supply (running in **Battery Mode**) aids in isolating the ADS 2000 from electro surge interference.

Note: Your ADS 2000 unit is fitted with a **Hose Disconnect Safety System**. In the event that the external sampling hose becomes disconnected, the system will **disconnect** the gas input to the patient, **sound** an alarm and **flash** the red light on the front left corner of the unit.
Once the external sampling hose is reconnected, the unit will continue to work properly.

If you encounter any unusual difficulties with the ADS 2000 call EEC at 1-800-445-8581. Do not attempt to repair the A.D.S 2000 on your own. Doing so will invalidate your warranty.

## Issues upon Self-Test

1. If upon **Self-Test** you get the following display:

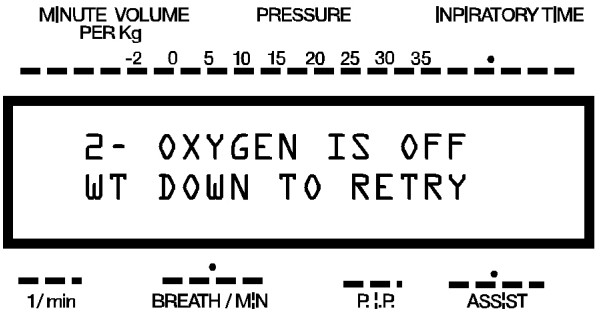



**a.** This indicates that the mechanical **Safety Pop-Off Valve** inside the unit is dirty or it has failed.

**b.** There is debris or condensation trapped inside the unit, perform a **FLUSH** of the unit by following the instructions in the **UNDERSTANDING THE FLUSH MODE** section of this manual. Then Press the **WEIGHT DOWN** button to retry.

**c.** Call EEC's assistance hot line. 1-800-445-8581.

2. If upon **Self-Test** you get the following display:




This may indicate a number of problems. In order to test all internal lines and valves the ADS 2000 attempts to pressurize and then checks for leaks. If it cannot pressurize then it will give the above readout. The causes for the error are as follows:

**a.** No oxygen or very low oxygen pressure. Confirm there is **50 PSI** of oxygen in the Green oxygen hose that runs to the back of the ADS 2000. Press the **WEIGHT DOWN** button to **Retry**.

**b.** The "**To Vaporizer**" and / or "**From Vaporizer**" connectors are loose, check all vaporizer hoses and connections, confirm they are secure and have no leaks. Press the **WEIGHT DOWN** button to **Retry**.

c. The vaporizer has an internal leak. To diagnose this problem connect the "**To Vaporizer**" hose **directly** to the "**From Vaporizer**" hose, and Press the **WEIGHT DOWN** button to **Retry**. If that works, it indicates that the vaporizer is the problem.

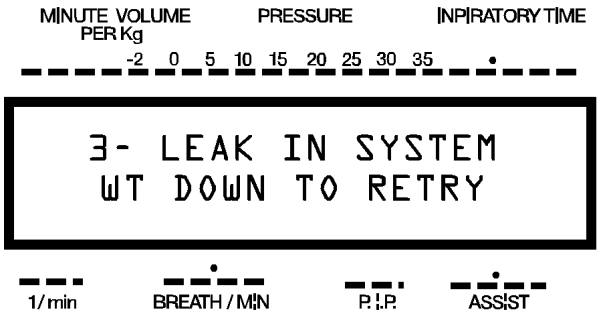
d. You are not placing you thumb over the gas-sampling elbow that is connected to the end of the breathing circuit during start-up. Place your thumb over the end of the gas-sampling elbow and press the **WEIGHT DOWN** button to **Retry**.

e. The **Gas Sampling Hose** is disconnected or not installed properly.

f. **Low Battery** - recharge unit / replace battery.

g. If the problem persists call EEC's assistance hot line. 1-800-445-8581

3. If upon **Self-Test** you get the following display:




This indicates that there is leak somewhere in the system.

a. There is debris or condensation trapped inside the unit, perform a **FLUSH** of the unit by following the instructions in the **UNDERSTANDING THE FLUSH MODE** section of this manual. Then Press the **WEIGHT DOWN** button to **Retry**.

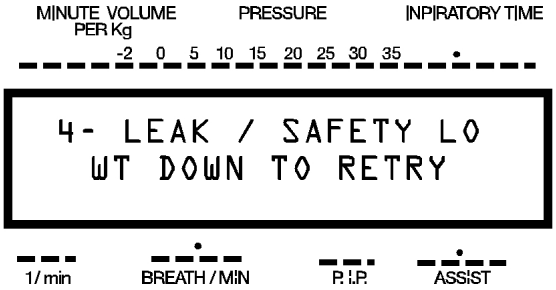
b. One of the hoses may be loose, check all connections and Press the WEIGHT DOWN button to **Retry**.

c. The Breathing Circuit has a leak or cuff is loose, check the Breathing Circuit for leaks, confirm it is securely connected to the **Breathing Circuit Ports** on the front of the unit. Press the **WEIGHT DOWN** button to **Retry**.

d. Vaporizer has a leak or hose(s) connected to vaporizer have come loose.

e. **Pop Off Valve** adjustment needed. This must be completed by EEC as specialized tools and test equipment is required. Call 800-445-8581

**4.** If upon **Self-Test** you get the following display:



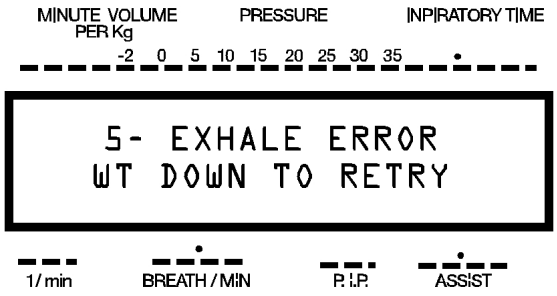

This display indicates that there is a minor leak or the **Safety Pop Off** is releasing at too low a pressure.

a. There is a loose connection to the ADS 2000 or to the vaporizer, check and secure all connections. Press the **WEIGHT DOWN** button to **Retry**.

b. There is debris or condensation trapped inside the unit, perform a **FLUSH** of the unit by following the instructions in the ***UNDERSTANDING THE FLUSH MODE*** section of this manual. Then Press the **WEIGHT DOWN** button to ***R*****etry**.

c. If the problem persists call EEC's assistance hot line. 1-800-445-8581

5. If upon **Self-Test** you get the following display:




This display indicates that there is an obstruction to the **Exhale Valve** or that the **Exhale Valve** did not open. The following can cause this error.

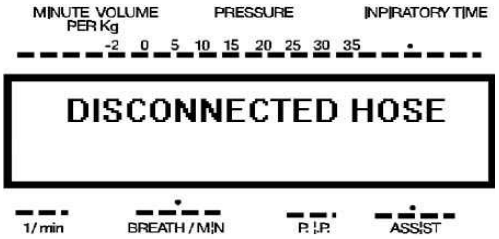
a. There is an obstruction in the scavenging system, check to ensure that a free flow of exhaust gas can pass through the scavenging system. Then Press **WEIGHT DOWN** button to Retry.

b. An active scavenging system is being used and the active scavenger valve is CLOSED or SHUT. Open the active scavenger valve and then Press **WEIGHT DOWN** button to **Retry**.

c. Battery is low – recharge unit / replace battery.

d. If the problem persists call EEC's assistance hot line. 1-800-445-8581

6. If at any point during the procedure you get the following display:




The display indicates that there is a hose disconnected. Typically the Gas Sampling Hose.

a. Inspect all the hoses and re-install any disconnected hoses. After a few seconds the system will automatically go back to normal operation.
b. If the problem persists call EEC's assistance hot line. 1-800-445-8581

## FREQUENTLY ASKED QUESTIONS

Q. The **Flow Rate** indicated on my LCD readout seems to be a very high number, in my rebreathing system I never used flow rates like 32 or 44 liters per minute, is this normal?

A. Absolutely, the LCD readout on the ADS 2000 gives the **Flow Rate** if the unit were left on for an Inspiratory Time of 60 seconds. An example would be as follows; say the ADS 2000 was set to 24 LPM and we let the unit have an inspiratory time of 1 minute, then 24 liters of gas would have been used. In reality, the ADS 2000 only allows gas to flow **when a breath is delivered** for whatever the **Inspiratory Time** is. In order to determine the "**Actual Flow Rate**" a simple calculation can be performed. This calculation is as follows:

$$F_{ave.} = (F_{ins} \times T_{on} \times B) / 60$$

Where:

$F_{ave.}$ = Actual Flow Rate

$F_{ins.}$ = Flow Rate on LCD Display $T_{on}$ = Inspiratory Time

$B$ = Actual Breaths Per Minute

Q. How does the ADS 2000 calculate the Minute Volume per Kilogram?

A. The formula for calculating minute volume is:

$$M_V = (T_V \times B) / W$$

Where: $M_V$ = Minute Volume per Kilogram Tv
= Tidal Volume
B = Breaths Per Minute W
= Weight in Kilograms

The ADS has a microprocessor, which determines this number and updates the display after each inspiration has ended.

Q. What is proper value for the **Minute Volume per Kilogram** number?

A. A properly ventilated patient should require from 150 to 250 ml. / minute / Kg. The 150 ml. / minute / Kg. number is appropriate for larger patients and the 250 ml. / minute / Kg. number for smaller patients.

Q. How do I add additional anesthesia liquid to my vaporizer during a procedure?

To fill the vaporizer during a procedure, place the **SET / RUN** switch to "**SET**", wait for the ADS 2000 to complete the last breath cycle. Fill the vaporizer as usual, then switch back to "**RUN**" to continue.

Q. How do I change my oxygen tank when it is low?

A. As with any anesthesia system, be sure to check your oxygen supply **BEFORE** starting any procedure. To replace the tank, shut off the valve at the top of the oxygen tank, then depressurize the GREEN, "**Oxygen In**" line running to the ADS 2000. The pressure may be released in the line by slightly loosening the GREEN, hose for a few seconds to bleed the line. Connect the regulator to a full tank.

Q. I have just successfully completed several procedures, but when I turn the ADS 2000 back **ON** and it goes through the **SELF-TEST**, the LCD display gives me Error 4 - **LEAK / SAFETY LO**, is this normal?

A. Yes, this error is usually caused by a build up of condensation in the exhale valve of the ADS 2000. To remove this condensation simply perform the following procedure:

a. Turn the ADS 2000 **OFF**.

b. Place and hold your thumb over the end of the **Gas Sampling Elbow** that is connected to the end of the breathing circuit.

c. Press the **FILL / HOLD** button and hold it down while turning the ADS 2000 **ON**.

d. The unit is now in the **FLUSH MODE** and a full 60 LPM flow of oxygen is passing through the ADS 2000.

e. To exit this mode, simply release the **FILL / HOLD** button and the unit will go through the **Self-Test**.

Q. Can I use the ADS 2000 with my **Induction Chamber**?

A. Of course, if you put the ADS 2000 into the **MASK MODE** it will allow a continuous flow of anesthetic gas to flow through the breathing circuit. All you have to do is connect the **Mask Adapter** to the unit as described in the section **USING THE MASK MODE**, but instead of connecting the output to a mask, connect it to your I**nduction Chamber**.

Q. Can I use my **Vaporizer** at the same settings that I am used to using on my rebreathing system?

A. Since the ADS 2000 always delivers a consistent breath, using a measured amount of anesthesia, you may find that you can actually turn your vaporizer settings to about half of what you had been using with your rebreathing system.

Q. Why doesn't the ADS 2000 use a **Lime Canister** or **Breathing Bag**?

A. Since the ADS 2000 is a **Positive Pressure Ventilator** it only allows the oxygen and or anesthetic to flow during the inspiration phase of the respiratory cycle i.e. only for the inspiratory time. Since the ADS 2000 fills up the lungs for each breath there is no need for a breathing bag. The ADS 2000 does not recycle the exhaled gas; it delivers the waste gas to the scavenger system.

Q. What happens if the electronic safety fails?

A. To prevent the over-inflation of the lungs, the ADS 2000 incorporates both an electronic and mechanical safety mechanism (pop-off).

Q. Does the **Gas Sampling System** need to be connected for the unit to work properly?

A. Yes, the **Gas Sampling System** must be connected for the unit to work properly.

Q. How often does my ADS need to be sent back to the manufacturer for service?

A. We recommend sending your ADS with the supplied **Hoses** and **Power Supply** (plug) in for servicing every two years.

Service includes:

- Checking the power adapter and socket.
- Check the battery for voltage retention and leaks.
- Check / replace the pinch valve hose.
- Check ports for proper fit, debris and cleaning.
- Check operation of all switches.
- Check operation and calibration of the pressure sensor.
- Check oxygen manifold for leaks, proper flow and calibration.
- Check pop off for leaks and calibration.
- Check hose integrity
- Provide software upgrade if available.

It is also highly recommended that you send your **vaporizer** to an authorized center at least **once a year** for **calibration and certification** as per the vaporizer manufacturer's recommendations.

## Notice of Conformity

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

o Reorient or relocate the radio / TV receiving antenna
o Increase the separation between the equipment and receiver
o Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
o Consult the dealer or an experienced radio / TV technician for help

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la Classe A est conforme à la norme NMB-003 du Canada.

If you have any questions or comments, please contact:

Engler Engineering Corporation
**1099 East 47th Street, Hialeah, Florida 33013**
800-445-8581 – 305-688-8581 – FAX 305-685-7671
**Web site: www.englerusa.com Help site: www.engler411.com**