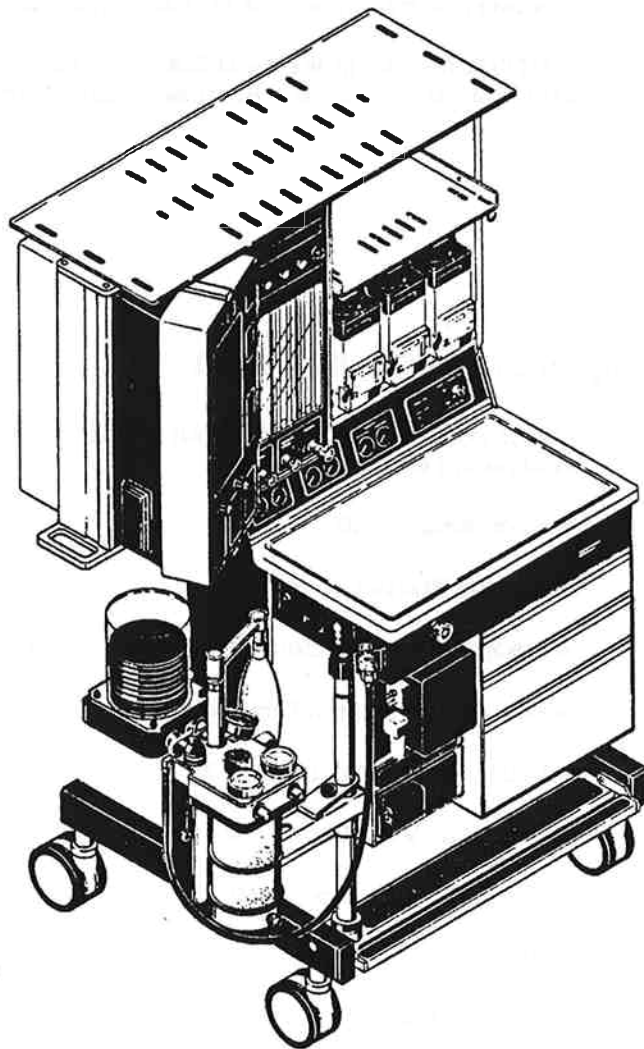




## Modulus CD Anesthesia System Operation and Maintenance Manual **Operating the System**

Display Pod Software Version 2.x

Ventilator Software Version 1.x



# User Responsibility

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This Product will perform in conformity with the description thereof contained in this operating manual and accompanying labels and/or inserts, when assembled, operated, maintained and repaired in accordance with the instructions provided. This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated should be replaced immediately. Should such repair or replacement become necessary, Ohmeda recommends that a telephonic or written request for service advice be made to the nearest Ohmeda Regional Service Center. This Product or any of its parts should not be repaired other than in accordance with written instructions provided by Ohmeda and by Ohmeda trained personnel. The Product must not be altered without the prior written approval of Ohmeda's Safety Department. The user of this Product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than Ohmeda.



**CAUTION:** Federal law in U.S.A. and Canada restricts this device to sale or on the order of a licensed medical practitioner.

## Number of pages in each section

Please confirm that you have all of this manual's pages. All pages in this volume are dated 05/31/90.

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# Notes

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# Introduction

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## Introduction

Thank you for selecting the Ohmeda Modulus CD Anesthesia System. The Ohmeda Modulus CD System features integrated, centrally-controlled monitoring; a vaporizer-interlock system; a back-up battery for temporary, continued basic monitoring and ventilation during power failures; extensive storage space on two shelves and in three drawers; and the Ohmeda Link® 25 Proportional Limiting System, which helps to ensure that any oxygen/nitrous-oxide mixture will contain a minimum of about 25 percent oxygen.

Also included in this system is an electronic anesthesia ventilator that includes many of the same features as other Ohmeda 7800-series ventilators. These instruments are electronically-controlled, pneumatically-driven ventilators that feature adjustable, automatic high-pressure relief.

The Ohmeda Modulus CD Anesthesia System uses a display pod to consolidate the displays and controls for the monitors used with the system. These devices include the system's built-in monitors, which provide O<sub>2</sub>, airway pressure, volume, CO<sub>2</sub>, agent, SpO<sub>2</sub>, and Non-Invasive Blood Pressure monitoring, and can also include certain optional monitors. In the Ohmeda Modulus CD Anesthesia System, the integrated monitors provide processed information to the display pod, which lets you control how the information will appear. The display pod lets you set the modes and control the functions of the system's monitors. This system also provides a single location from which to set, view, and silence monitor and system alarms.

## How to use this manual

This manual is designed both as a guide for you to follow when you are learning to operate the Ohmeda Modulus CD Anesthesia System, and as a reference tool for you to use once you are familiar with the system. To help you quickly and easily find information, we have divided the manual into a booklet and two volumes: this volume, which is volume one, "Operating the System," and two additional volumes, volume two, "Reference," and the booklet, "Setting Up"

### Setting Up

The booklet called "Setting Up" tells you how to unpack and set up the system, how to connect the monitor probes, adapters, and cuffs, how to use the shelves, and how to make the gas cylinder and pipeline connections. Also refer to "Setting Up" whenever you have to install or reposition a device such as a vaporizer or absorber.

### Operating the System

This volume, "Operating the System," tells you how to use the Ohmeda Modulus CD Anesthesia System once it is installed. First, in "Preoperative Checkout Procedures," it tells you how to make sure the system is functioning correctly. Then it tells you how to prepare the system, how to switch it on, how to set the operating limits, how to store data, and how to make adjustments once the case is underway. Finally it tells you how to respond to alarms, how to troubleshoot system problems, and how to shut the system down when the case is over.

# Introduction

## Reference

The other volume, "Reference," provides information that, although important to your understanding of the system, will not usually be needed during cases. "Reference" first explains what the Ohmeda Modulus CD Anesthesia System's controls and devices do. Then, in "Theory of Operation," it explains how the system works. "Theory of Operation" also describes the ventilation cycle, the operating principles upon which the system's monitor's are based, and the central display's and ventilator's operating modes. And it tells you how to compensate for losses and gains in the breathing circuit. In "The Alarm System," "Reference" also explains how the display pod's and ventilator's alarm systems work, what each alarm means, and the priorities the system assigns to each alarm.

"Reference" also includes any maintenance, cleaning, calibration, and service procedures that you can perform. It includes the system's specifications, lists of standard and optional accessories, and the manual's appendix.

Although this manual has been organized so that this one volume—"Operating the System"—contains much of the information you'll need to run the Ohmeda Modulus CD Anesthesia System, do not attempt to use the system by reading just this volume.



**WARNING:** Before using the Ohmeda Modulus CD Anesthesia System, familiarize yourself with it by reading through this entire manual. As with all medical equipment, attempting to use this system without a thorough understanding of its operation may result in injury to the patient.

What warning and caution statements in this manual indicate

Warnings alert you to conditions or actions that may cause harm to humans. Cautions alert you to conditions or actions that may result in damage to equipment. No matter which part of the manual you are using, you should always be familiar with the cautions and warnings that appear throughout this volume, and in "Setting Up" and "Reference."

Before using the system on a patient, perform the preoperative setup procedures described in "Operating the System."

Read the user responsibility statement; it describes what is expected of you to maintain the system. Read the warranty; it describes Ohmeda's responsibility in case of a functional defect.

The display pod functions as the front-panel controls and displays for the system's integrated monitors. Each type of monitor is described in depth in its own section of "Reference."

Some of the sections in this manual apply only when the Ohmeda Modulus CD Anesthesia System is used with the Ohmeda GMS Absorber™; if you plan to use this system with other anesthesia system components, consult Ohmeda for more information.

Keep this manual with the Ohmeda Modulus CD Anesthesia System for answering questions that arise about the system's operation, maintenance or, if necessary, repair.

What the manual's typefaces mean

Throughout this manual we have provided step-by-step instructions to simplify operation of the system. To further clarify the instructions, we have used different typefaces to distinguish between the different kinds of keys you will press, and to identify messages that appear on the display pod's and ventilator's screens.

# Introduction

Messages from the system, which are displayed on the display pod's screens, are represented by a typeface that simulates the messages' actual appearance. For example, a "disk near full" message will look like this:

## Disk Near Full

Messages that are displayed on the ventilator's screen are represented by a dot-matrix typeface that simulates the messages' actual appearance. A "low oxygen" alarm message will look like this:

LOW OXYGEN!

In addition, the system's push-button keys are represented in a typeface similar to the one printed on the keys themselves. For example, an instruction to use the manual setup key will read:



What the manual's symbols mean

In the left column, across from each warning or caution, we have placed an "attention, read accompanying documents" symbol to alert you to the presence of these important statements. The attention symbol looks like this:



When the attention symbol appears in front of text that is printed on the system itself, it means that the text is elaborated upon in this manual.

We have also used—both in the manual and on the system itself—symbols to represent some common terms. These symbols include:

$T_{IP}$  inspiratory pause

$T_I$  inspiratory time

$P_{AW}$  airway pressure

$\dot{V}_E$  minute volume

$V_T$  tidal volume

What we mean by "left side" and "right side"

We have used, in this manual, the terms "left side" or "right side" to refer to locations of devices as you face the anesthesia machine. For example, the common-gas outlet, which—when you face the front of anesthesia machine—is on your left, is said to be on the system's left side. And the AC-electrical outlets, which—as you face the back of the anesthesia machine—are on your right, are said to be on the system's right side.

Use the foldout as study aid

At the back of the reference volume is an oversized page that includes a large illustration of the complete system, the display pod, and the ventilator's front panel. These illustrations are intended to be used as a visual aid when you are studying this manual away from the actual Ohmeda Modulus CD Anesthesia System. Fold out this page to see the illustrations as you read the text of the manual.

# Notes

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# 1/Getting Started

## In this section

Supplies you should have on hand before you start 1-1

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Powering on the system 1-3

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## Supplies you should have on hand before you start

To use the Ohmeda Modulus CD Anesthesia System you will need monitoring accessories that are appropriate for the particular patient in your upcoming case. You will need anesthetic agent that corresponds to the kinds of vaporizers installed in your system. You should have adequately filled backup gas cylinders installed. A proper breathing circuit must be correctly connected to the system. And if you plan to permanently record data you will need diskettes or printer paper.

### NIBP accessories

To compensate for differences in patient and cuff size, the NIBP monitor uses two modes. These modes are selected through the display pod's setup page (see "4/Using the Display Pod"). One mode is for adult and pediatric use, the other is for neonates. You must use the correct type of cuff for the mode you select; if the mode and cuff type are mismatched, the system may display incorrect blood pressures. You will need:

- two-lumen hose
- A cuff that is the size appropriate for your patient



**WARNING:** If the NIBP mode is not appropriate for the size cuff that is installed on the patient, the system may display inaccurate blood pressure values.

### SpO<sub>2</sub> monitoring

Four kinds of probes can be used with the system's built-in oximeter. The probe you select will depend on the size and condition of your patient (see "Deciding which probe to use" in "3/Making the Patient Connections"). We recommend that you have all of the kinds of probes you may need on hand before you start a case. The SpO<sub>2</sub> probes are:

- finger probe
- Flex probe
- ear probe
- Flex II Flex probe (for neonates and children)

### Volume monitoring

The volume monitor requires just two devices, which should already be installed in your breathing system. These devices are:

- volume sensor cartridge
- volume sensor clip

### Oxygen monitoring

If you are using an Ohmeda GMS Absorber, the oxygen sensor and cartridge should have been installed in the absorber during the procedures described in "Setting Up." Unless you are using an absorber other

# 1/Getting Started

than the Ohmeda GMS Absorber, you will not need any additional devices. The oxygen monitoring accessories are:

- oxygen sensor
- oxygen sensor cartridge (installed in the sensor)
- for any non-Ohmeda GMS Absorber, 22-mm tee manifold (stock number 0212-0763-100)

## Airway pressure monitoring

If you are using an Ohmeda GMS Absorber, the only external device required for pressure monitoring is a tube, which should have been connected to the ventilator during the procedures described in "Setting Up." The airway pressure monitoring accessories are:

- pressure sensing tube (stock number 6026-0000-014)
- pressure-sensing tee for non-Ohmeda Absorbers (stock number 6050-0000-456)

## Respiratory gas monitor

A sample line connects the respiratory gas module to a patient circuit adapter that is inserted into the breathing circuit. You should also have extra sample filters available in case the module's filter becomes clogged. The respiratory gas monitor accessories are:

- sample lines (package of 10, stock number 6026-0000-009)
- breathing circuit adapter, elbows, package of 10 (stock number 6027-0000-020)
- breathing circuit adapter, straight, package of 10 (stock number 6027-0000-019)
- filter cartridge, package of 5 (stock number 6050-0001-379)

## Storing data

If you plan to store data acquired during the case, you will need:

- one *pre-formatted* diskette for every nine hours (18 hours if you use the 1.44-meg format) of data that is collected (see "1/Working with Data" in "Reference").
- If you plan to use a printer, you should have plenty of paper loaded into the printer you have selected.

## Setting up the system

Before attempting to use the Ohmeda Modulus CD Anesthesia System, it must have been prepared as described in the booklet "Setting Up," which should be stored behind the last divider in "Reference." Once the system has been properly set up, plug its power cord into a hospital-grade outlet. Do not actually power on the system until you read "Powering on the system."

If you must move the system, be sure to release the foot-operated brake first. Then, once you have relocated the system, apply the brake again to help prevent the system from moving.



**CAUTION:** The brake is intended only to help prevent the stationary system from moving. It is not designed to stop the system if the system is in motion. Attempting to use the brake to stop the system may damage the brake.



# 1/Getting Started

## Powering on the system

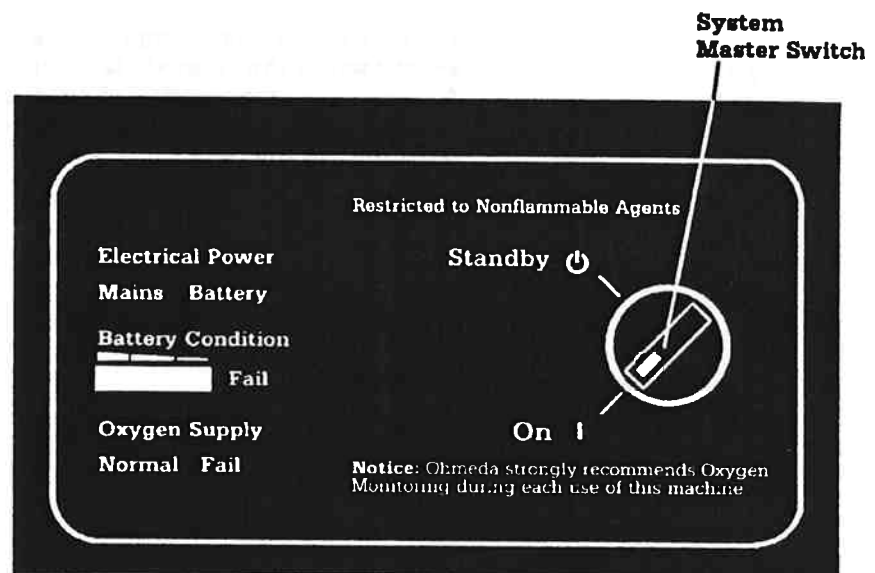
A two-position system master switch located to the right of the pressure gauges controls electrical and pneumatic power to the system. When the switch is in its first position, "standby," both electrical and pneumatic power are off. In the second position, "on," both electrical and pneumatic power are on.

Just left of the switch is the system's indicator panel, which provides information about the status of the system's electrical supply, battery condition, and oxygen supply.

Standby

When the switch is set to "standby": the panel's indicator lights are off; gas is not supplied to the flow-control circuits; electrical power is not supplied to the monitors, display pod, or ventilator; but AC power is provided to the AC outlets on the back of the anesthesia machine and the backup battery is charging.

**Figure 1-1**  
The system  
master switch



When the switch is set to "on": the "normal" indicator is lighted; gas is supplied to the machine's circuits; and electrical power is provided to the monitors and the AC outlets.

If the switch is set to "on" and the anesthesia machine's DC power supply fails, either because of an electronic failure or because the anesthesia system's AC power is lost, the "mains" indicator will go out and the "battery" indicator will be lighted. When the "battery" indicator is lighted, the system is powered by its built-in backup battery, which is designed to temporarily provide power to let the ventilator, oximeter, and oxygen, volume, and airway-pressure monitors continue operating.

When you switch the system on, the display pod will automatically start loading its operating software, which is stored in the display pod's memory. If, however, the contents of memory are lost, you must use the "system software" disk to reload the operating software. (See "The display pod's powerup sequence" in "4/Using the Display Pod.")

# 1/Getting Started

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To power the system on

1. Turn all the gas flow control knobs completely clockwise.
2. Set the vaporizers to off.
3. Move the mechanical ventilation switch to off.
4. Move the system master switch to on.

The system starts its powerup sequence.

## Using the on-screen preoperative checklist

When you power on the Ohmeda Modulus CD Anesthesia System it will display the first page of a series of preoperative checklist pages. These checklists consolidate the procedures that are described in the next section, "2/Preoperative Checkout Procedures." Do not use the Ohmeda Modulus CD Anesthesia System until you have performed the preoperative checkout procedures.



**WARNING:** Always complete the preoperative checkout procedures before using the Ohmeda Modulus CD Anesthesia System on a patient. Perform the preoperative checkout procedures before each case, and use the actual room, pipeline supply, and electrical supply that will be used during the case.

## 2/Preoperative Checkout Procedures

### In this section

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### Visual and electrical checkout

#### Before starting the preoperative checkout procedures



**WARNING:** Always complete the following preoperative checkout procedures before using the Ohmeda Modulus CD Anesthesia System on a patient. Perform these checkout procedures before each case, and use the actual room, pipeline supply, and electrical supply that will be used during the case.



**WARNING:** Ensure that all hoses, tubing, and other circuit connections are made properly before using this anesthesia system. Failure to do so may result in patient injury. Refer to the operation manuals for these devices.

## 2/Preoperative Checkout Procedures

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This section—"Preoperative Checkout Procedures"—describes the minimum checks that should be made before the Ohmeda Modulus CD Anesthesia System is used on a patient. If the system does not pass all of the steps in these procedures, consult "8/Troubleshooting Guide." Do not use the system if it does not function correctly, as described in the preoperative checkout procedures; instead call a qualified service representative.

In addition to the procedures listed here, individual preoperative checklists for this system and its options and accessories are included both in the system's binder, at the front, and in the system's on-screen checklists. Before each case review these checklists, which are intended only to serve as reminders of the complete checkout procedures listed in the operation-and-maintenance manuals for the devices. Always complete the checkout procedures for all the devices in the system. Before starting the preoperative checkout procedures, visually check the system for damage and misconnections.

1. Check the system's machine identification number.
2. Make sure the machine has a valid inspection sticker.
3. Make sure the breathing system is complete, undamaged, and contains adequate CO<sub>2</sub> absorbent.
4. Check for damage:
  - Cylinder yokes
  - Pipeline inlets
  - Flowmeters and flow control valves
  - Pressure gauges
  - Vaporizers
  - Monitors and cables
  - All hoses and tubing
5. Check that the cylinders are properly installed.
6. Check that the vaporizers are properly installed.
7. Check that the cylinder wrench is available.

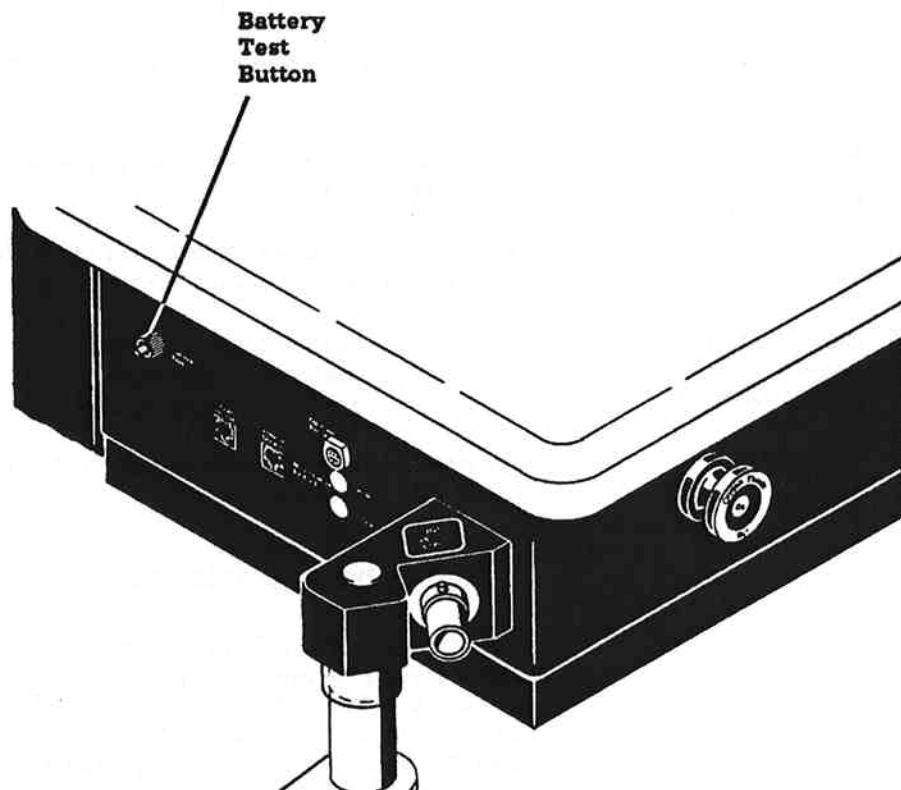
### Checking the battery

Pressing the battery test button, which is on the patient interface panel, momentarily connects the system's built-in backup battery to the battery condition meter on the master switch panel. Before each case—while the system's master switch is on—press the battery test button to test the system's backup battery.

When you press the battery test button, either a colored bar or "fail" will be lighted to indicate the backup battery's condition, unless the battery is completely discharged. When the battery is fully charged, the left-most green-indicator bar will be lighted. As the battery becomes progressively weaker, the lighted bar will move from green, to yellow, and then to red. When the battery is almost completely discharged, the system will flash the red "fail" indicator. If the battery is completely discharged, the system will switch itself off. Do not start to use the system unless the battery is completely charged.

## 2/Preoperative Checkout Procedures

**Figure 2-1**  
Location of the  
battery test  
button



To test the  
battery

Press the battery test button, which is on the patient interface panel.

The battery condition indicator, which is to the left of the anesthesia system's master switch, must light a green bar, indicating that the battery is in good condition. If a yellow or red bar or the "fail" indicator is lighted, or if the system switches itself off, have trained service personnel replace the battery.



**WARNING:** Do not use the anesthesia system if the backup battery is not in good condition. If the backup battery does not function correctly, the anesthesia system's backup power will not function correctly, which may result in a loss of both mechanical ventilation and the ventilator's integrated monitoring if the system's primary power source is removed.

### Pneumatic checkout

#### Checking the vaporizers' mounting

Mixing models  
of vaporizers

You may combine Ohmeda Tec 5 and Ohmeda Tec 4 vaporizers on the manifold that is incorporated into the Ohmeda Modulus CD Anesthesia System. The interlock system used in both Ohmeda Tec 5 and Ohmeda Tec 4 vaporizers prevents simultaneous operation of these devices.

## 2/Preoperative Checkout Procedures



**WARNING:** Do not attempt to mix Ohmeda Tec 3 vaporizers with Ohmeda Tec 4 or Tec 5 vaporizers on the manifold. The safety interlock will not prevent a mixture of Ohmeda Tec 3 vaporizers with Ohmeda Tec 4 or Tec 5 vaporizers from operating simultaneously.

Make sure the vaporizers are locked in place

Check that the interlock rods are in alignment



1. Make sure that the tops of the vaporizers are parallel to the top edge of the manifold. Remount any vaporizers that are out of line.
2. Check the vaporizers' locking knobs to ensure that the vaporizers are locked in place.
3. Attempt to lift each vaporizer off of the manifold. Remount any vaporizer that is not securely locked in place.
4. Attempt to turn on more than one vaporizer at a time. Try every combination that is possible with your system. If more than one vaporizer can be turned on at a time, reseal the vaporizers on the manifold.

**WARNING:** Do not use the system if more than one vaporizer can be turned on at a time.

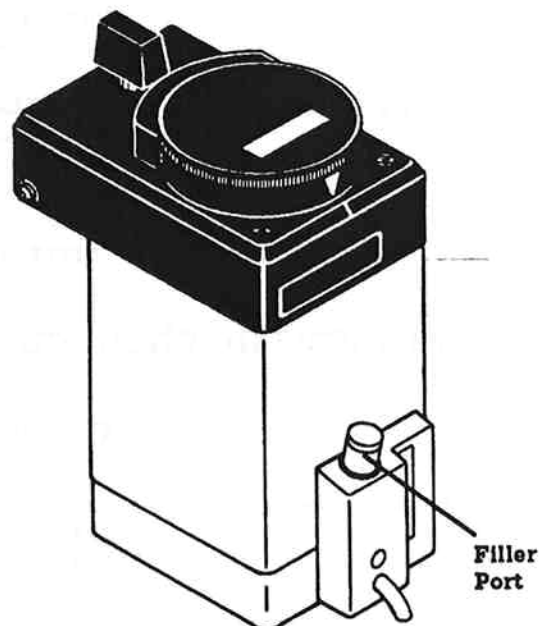
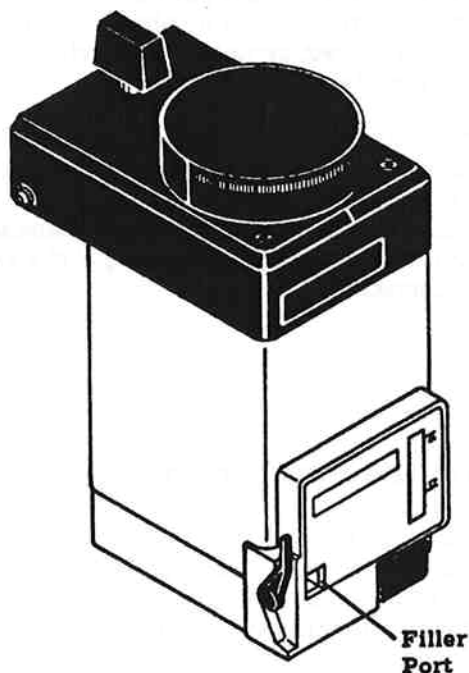
### Filling the vaporizers

Your Ohmeda Tec 5 Continuous Flow Vaporizers were built with one of two optional systems for introducing agent into the vaporizers. You will either use a keyed bottle adapter to inject agent through the vaporizer's keyed filler port, or you will pour agent into the vaporizer's funnel-fill port. Using the keyed port helps assure that the correct agent will be introduced to the vaporizer.

A sight glass on each vaporizer indicates the level of agent in the vaporizer.

**Figure 2-2**  
Vaporizer  
with keyed  
filler port

**Figure 2-3**  
Vaporizer  
with funnel  
filler port



## 2/Preoperative Checkout Procedures



**WARNING:** A vaporizer is calibrated and labeled for one agent only. Do not introduce any other than the designated agent into the vaporizer.



**WARNING:** If a vaporizer is filled with the wrong agent, draining will not eliminate the agent, because the wick will have absorbed some of the agent. Do not use the vaporizer until the wick has been thoroughly cleaned and dried by trained service personnel.



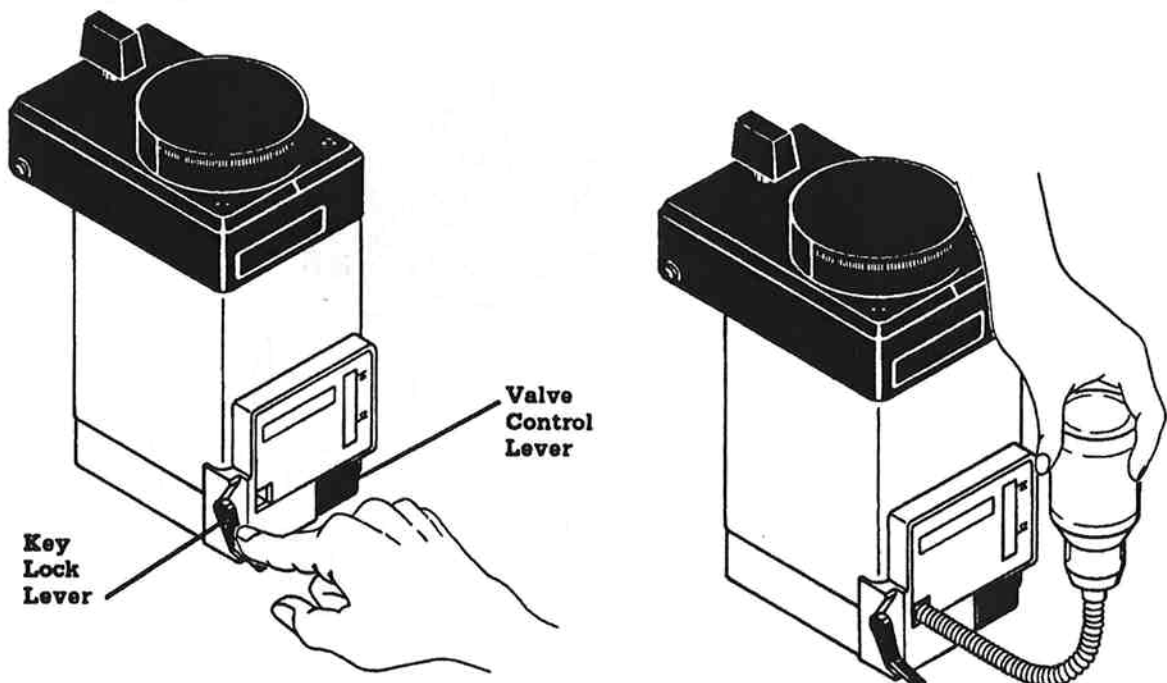
**CAUTION:** The vaporizers must be completely upright for the sight glass to properly indicate agent levels.

To add agent through the keyed filler port

1. Switch off the vaporizer.
2. A lever is on the left side of the vaporizer's filler port, which is on the front of the vaporizer. Pull this key-lock lever down as far as it will go.
3. A second lever, which is on the right side of the filler port, controls the valve through which agent enters the vaporizer. Make sure that this valve-control lever is pushed flush with the port.
4. Remove the cap of the agent bottle.
5. Insert a keyed bottle adapter into the bottle.

**Figure 2-4**  
Opening a  
vaporizer's  
keyed filler port

**Figure 2-5**  
Inserting a  
keyed bottle  
adapter

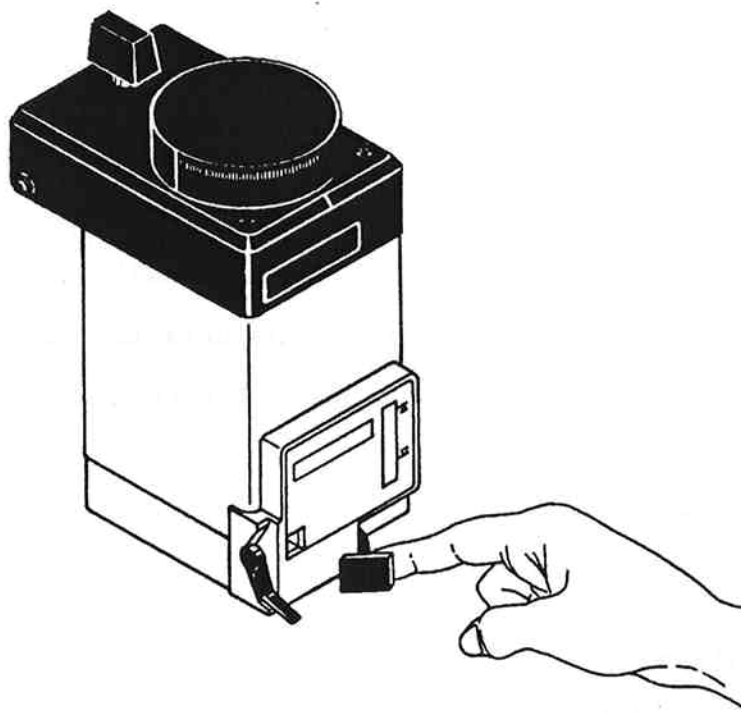


## 2/Preoperative Checkout Procedures

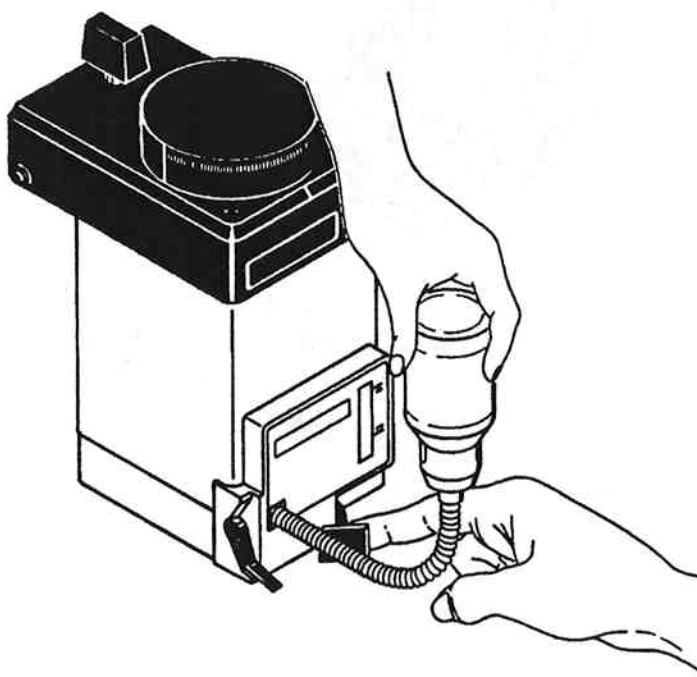
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6. Turn the adapter clockwise until it is secure.
7. While you keep the agent bottle below the level of the filler port:
  - a. Insert the bottle's adapter tube into the vaporizer's filler port.
  - b. Lift the key-lock lever, which is on the port's side, until the adapter is locked in place.

**Figure 2-6**  
Opening  
the valve



**Figure 2-7**  
Filling a vaporizer  
through its  
keyed filler port





## 2/Preoperative Checkout Procedures

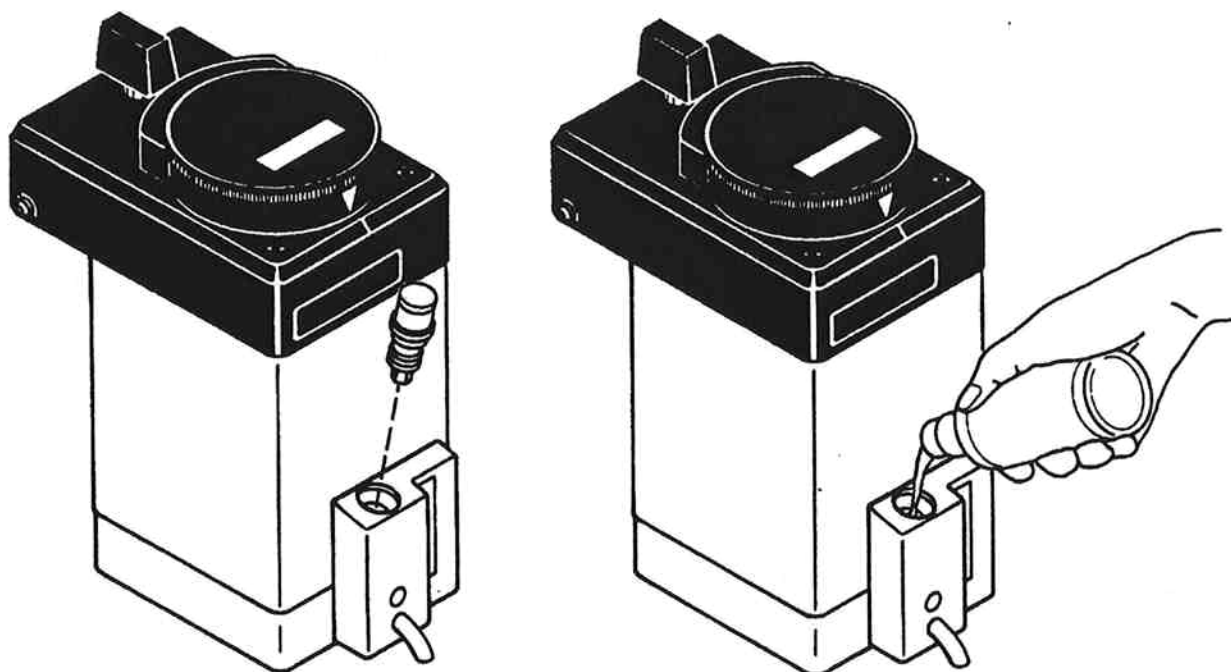
8. Lift the agent bottle until it is tilted downward and is above the filler port. Wait five seconds.
9. Slowly pull the valve-control lever, which is on the right side of the port, until the valve is open. The vaporizer should fill in less than a minute.
10. Once agent has reached the line on the sight glass, push the valve-control lever until it is again flush with the port.
11. Lower the bottle below the filler port.
12. Wait until any agent remaining in the tube has drained back into the bottle, then pull down on the key-lock lever to release the adapter.
13. Remove the adapter tube from the port.
14. Lift the key-lock lever until it is in its top-most position.

To add agent through the funnel-fill port

1. Switch off the vaporizer.
2. A funnel-cap/valve is on top of the filler port. Turn this cap counter-clockwise until you can remove it, exposing the built-in funnel in the port.

**Figure 2-8**  
Removing  
the funnel cap

**Figure 2-9**  
Filling a  
vaporizer  
through its  
funnel port



## 2/Preoperative Checkout Procedures

3. While touching the valve's stem with the agent bottle's lip, gradually pour the correct agent directly into the port until agent has almost reached the line on the sight glass. You must pour slowly to allow time for the vaporizer's wick to absorb agent.
4. Replace and tighten the funnel cap.



**WARNING:** Incomplete sealing of the vaporizer's funnel cap will result in loss of gases. To help prevent such loss, make sure the cap-sealing O-ring is in good condition and the funnel cap is securely tightened before using the vaporizer.

### Checking the gas flow controls

1. Turn all of the flow control valve knobs completely clockwise to close the flow control valves. Do not over-tighten the valves.
2. Either connect the pipeline supplies or slowly open the cylinder valves.



**WARNING:** Open the cylinder valves s-l-o-w-l-y to avoid damaging the regulators.

3. Turn the system master switch to on.

The oxygen flowmeter should show about 50 ml/min. The other flowmeters should show no gas flow.

4. This step tests the function of the Ohmeda Link 25 Proportion Limiting Control System when the nitrous oxide knob is adjusted. During these tests use only the nitrous-oxide flow-control valve; perform the checks from low to high flows; and do not overshoot any setting. If you do overshoot a setting, repeat this section starting at step one.

Set the N<sub>2</sub>O flow control valve so that flow reads (in ml/min):

The O<sub>2</sub> flow must then read (in ml/min):

	Minimum	Maximum
150	40	not applicable
300	79	not applicable
600	158	not applicable
900	236	366
1500	394	611
3000	788	1222
6000	1577	2445
9000	2365	3669
12,000	3153	4891

## 2/Preoperative Checkout Procedures

5. This step tests the function of the Ohmeda Link 25 Proportion Limiting Control System when the oxygen flow knob is adjusted. During these tests use only the oxygen flow control valve. Be careful not to overshoot any setting. If you do overshoot a setting, repeat this step starting at "a." Perform these checks from high to low flows.

Set the O<sub>2</sub> flow control valve so that flow reads (in ml/min):

The N<sub>2</sub>O flow must then read (in ml/min):

	Minimum	Maximum
3000	7358	11,414
1000	2453	3804
500	1226	1902
300	736	1141

- a. Increase the oxygen flow to 6000 ml/min.
- b. Reduce the oxygen flow to 3000 ml/min.



**WARNING:** Do not use the anesthesia system if the Ohmeda Link 25 Proportion Limiting Control System does not operate within permitted ranges. Using an incorrectly operating control system may result in incorrect gas mixtures, and injury to the patient.

6. Adjust all of the gas flows to midscale. While you are turning the flowmeter knobs, the flowmeter floats must move smoothly.
7. Shut off the oxygen supply either by closing the oxygen cylinder valve, or by disconnecting the oxygen pipeline supply. As pressure bleeds off:
  - The oxygen-supply failure alarm must continuously sound.
  - The green, oxygen-supply indicator labeled "normal" must extinguish.
  - The red, oxygen-supply indicator labeled "fail" must flash.
  - All gas flow must fall to zero, with oxygen being the last gas to stop flowing.
8. Turn all of the flow control valve knobs completely clockwise to close the flow control valves. Do not over-tighten the valves.
9. Either reconnect the oxygen pipeline supply or slowly open the oxygen cylinder valve. Once the oxygen supply is restored:
  - The oxygen supply alarm must be silenced.
  - The red, oxygen supply indicator labeled "fail" must extinguish.
  - The green, oxygen supply indicator labeled "normal" must light.

## 2/Preoperative Checkout Procedures

### Leak testing checkout

#### Checking the pipeline and reserve cylinder supply

1. Make sure a gas cylinder or cylinder yoke plug is properly and securely mounted in each cylinder hanger yoke.
2. Disconnect the pipeline supply hose from the wall outlet.
3. Move the system master switch to standby.
4. Open the flow control valves by turning their knobs fully counter-clockwise.



**WARNING:** Open the cylinder valves s-l-o-w-l-y to avoid damaging the regulators.

5. Open each cylinder valve and check the cylinder pressure gauges to verify that the cylinder supplies are adequate. Make a note of all the cylinder pressures.
6. If you are using a second oxygen or nitrous oxide yoke:
  - a. Close the first cylinder.
  - b. Press the oxygen flush button to release the pressure from the first cylinder.
  - c. Open the second cylinder and check its pressure.
7. Check that none of the flowmeters indicate gas flow.
8. Close all of the cylinder valves and note the value on each cylinder pressure gauge. The gauges must show less than a 100 psig (690 kPa) pressure drop in a five minute period. If the pressure drops more than 100 psig in less than five minutes, the high-pressure circuit has an unacceptable leak.

If the circuit is leaking excessively

- a. Defective cylinder gaskets or loose tee handles can cause such leaks. Replace the gasket and tighten the tee handle.
- b. Repeat the leak check. If the circuit still leaks, do not use the system for clinical applications. Call a qualified service representative for repairs.
9. Check the anesthesia machine to hospital pipeline connections.
  - a. Turn the system master switch to on.
  - b. Open all of the flow control valves to return the cylinder pressure gauges to zero.
  - c. Turn the system master switch to standby.
  - d. Close all of the flow control valves.

## 2/Preoperative Checkout Procedures

- e. Connect the hospital O<sub>2</sub> pipeline hose to the system's O<sub>2</sub> pipeline inlet. Ensure that the O<sub>2</sub> pipeline supply pressure, which should be about 50 psig (345 kPa), is indicated on the O<sub>2</sub> pipeline pressure gauge only.
- f. Turn the system master switch to on.
- g. Fully open all of the flow control valves.
- h. Ensure that only the O<sub>2</sub> flowmeter indicates flow.
- i. Close all of the flow control valves.
- j. Connect the hospital N<sub>2</sub>O pipeline hose to the system's N<sub>2</sub>O pipeline inlet. Ensure that the N<sub>2</sub>O pipeline supply pressure, which should be about 50 psig (345 kPa), is indicated on the N<sub>2</sub>O pipeline pressure gauge only.
- k. Fully open the N<sub>2</sub>O and the third-gas flow control valves. As you open the N<sub>2</sub>O flow control valve, the Ohmeda Link 25 Proportion Limiting Control System will engage, increasing the O<sub>2</sub> flow. Refer to "Checking the gas flow controls" to check the correct O<sub>2</sub> flow when the N<sub>2</sub>O flow control valve is opened.
- l. Ensure that the N<sub>2</sub>O flowmeter indicates flow.
- m. Ensure that the third-gas flowmeter indicates zero flow.
- n. Close all of the flow control valves.
- o. Disconnect the N<sub>2</sub>O pipeline supply from the system.
- p. Fully open the N<sub>2</sub>O flow control valve to return the N<sub>2</sub>O pressure gauge to zero.
- q. Close all of the flow control valves.
- r. If your system includes pipeline air, connect the hospital air pipeline supply to the system's air pipeline inlet. Ensure that the air pipeline supply pressure, which should be about 50 psig (345 kPa), is indicated on the air pipeline pressure gauge only.
- s. Fully open the N<sub>2</sub>O and, air flow control valves. As you open the N<sub>2</sub>O flow control valve, the Ohmeda Link 25 Proportion Limiting Control System will engage, increasing the O<sub>2</sub> flow.
- t. Ensure that the N<sub>2</sub>O flowmeter indicates zero flow.
- u. Close all of the flow control valves.

### Checking the low pressure gas circuitry

Before performing this test, check the pipeline supply pressure as described in the previous section.



**WARNING:** Leaking gases and vapors (downstream of the flow control valves and Oxygen Flush valve) may deprive the patient of metabolic gases and anesthetic agent and may pollute the atmosphere. Tests that detect such leaks must be performed frequently. If detected, leakage must be reduced to an acceptable level.

## 2/Preoperative Checkout Procedures

A low-pressure leak-testing device is included with all Ohmeda Modulus CD Anesthesia Systems. Store this device, which should always be kept with the system, in one of the drawers. Perform the low-pressure leak test with the cylinders installed.

The leak-testing device must be in good condition to reliably perform the low-pressure circuit leak test. At least once every six months test the device's ability to produce a partial vacuum of 65-mm hg or greater.

To check the leak-testing device's vacuum production

1. Connect the device to a suitable vacuum gauge.
2. Squeeze and release the bulb to obtain progressively greater displacements. Replace the leak testing device if—while the bulb is still deformed—the device produces a partial vacuum less than 65-mm hg.

To check the low pressure gas circuitry

1. Check the condition of the low pressure leak-testing device.
  - a. Seal the device's inlet connector and squeeze the bulb until it collapses.
  - b. Release the bulb and check the time it takes to reinflate.
  - c. Replace the leak testing device if reinflation occurs in less than one minute.
2. Turn the system master switch to "standby," if it is not on standby already.
3. Switch off the vaporizer.
4. Open each gas supply either by slowly opening the cylinder valves or by connecting the pipeline hoses.
5. Fully open all of the flow control valves.
6. Disconnect the gas supply tubing from the common gas outlet.
7. Attach the leak testing device to the common gas outlet.
8. Repeatedly squeeze and release the hand bulb until it collapses and remains collapsed. Once the bulb stays closed, check how long it takes to reinflate. If the hand bulb reinflates in less than 30 seconds, the low-pressure circuit has an unacceptable leak.

**Figure 2-10**  
The low-pressure leak-testing device



## 2/Preoperative Checkout Procedures

9. For each mounted vaporizer:
  - a. Make sure the vaporizer is properly mounted and that the filler and drain valves are closed tightly.
  - b. Turn the vaporizer concentration control dial to one percent.
  - c. Repeat step eight. If the circuit does not pass the test, the leak is in the vaporizer. Remove leaking vaporizers from service.
  - d. Switch off the vaporizer.
10. Remove the low pressure leak testing device from the common gas outlet.
11. Close all of the flow control valves.
12. Move the system master switch to on.
13. Purge the circuit with a flow of 1 l/min oxygen flow for one minute.
14. Move the system master switch to standby.



Checking the ventilator's circuit

**WARNING:** Do not use the anesthesia system after performing the low-pressure leak test until the vaporizer circuits have been purged with oxygen. Using a system that has not been purged with oxygen may result in incorrect gas mixtures, and injury to the patient.

See "Testing the ventilator circuit" in "Final preparation" for information about checking the ventilator's circuit.

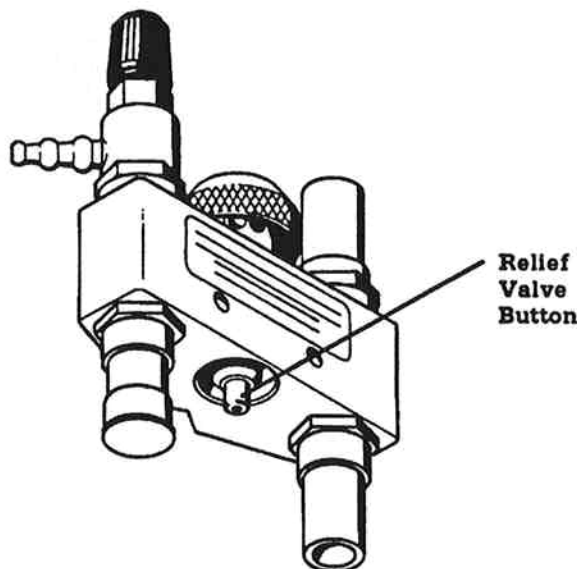
## Breathing circuit checkout

### Testing the scavenging interface relief valve

The relief valve button, which is on the assembly's underside, must freely move up and down. If the button does not move freely, the relief valve is malfunctioning; do not use the assembly if the relief valve button indicates a malfunction.

To test the valve, reach under the assembly and push up, then release, the button. The button must immediately drop back to its lower position.

**Figure 2-11**  
Testing the scavenging interface valve



## 2/Preoperative Checkout Procedures

### Testing the breathing system

Before each case, test the breathing system, which, as throughout this manual, includes the ventilator's bellows assembly and the Ohmeda GMS Absorber. If your system includes other components, consult the literature for those devices, and consider their effect on the performance of the entire breathing system.

General  
breathing  
system checks

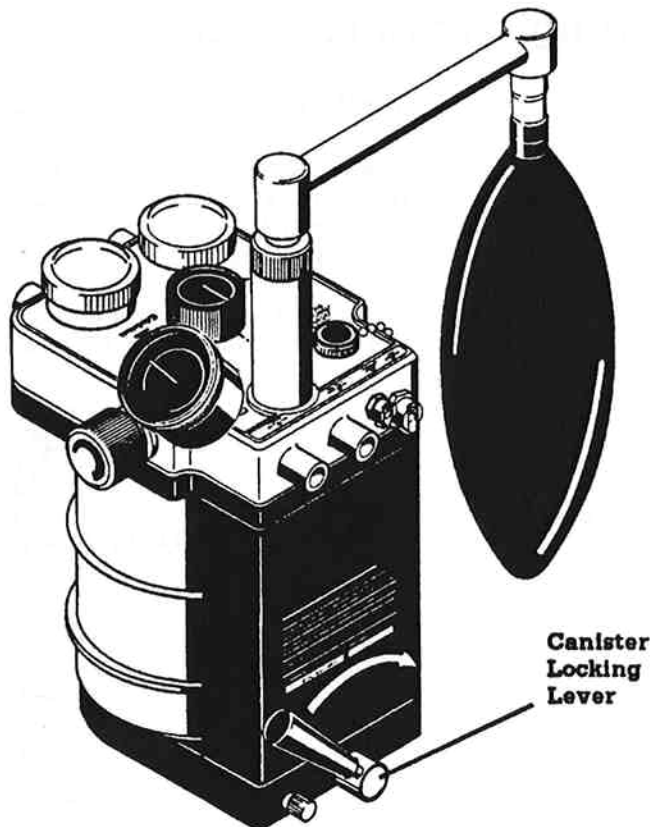


1. Verify that any absorber condensate has been drained and that the drain is completely closed.

**CAUTION:** Be sure to tighten the drain plug after draining condensate from the absorber base. Always perform the preoperative checkout procedures after draining condensate.

2. Verify that the capacity of the absorbent is adequate for the case.
3. Verify that the canisters are properly seated and that the canister locking lever is in the "lock" position.
4. Verify that the Ohmeda GMS Absorber's pressure gauge is zeroed when the system is open to atmosphere.

**Figure 2-12**  
The Ohmeda  
GMS Absorber's  
locking lever



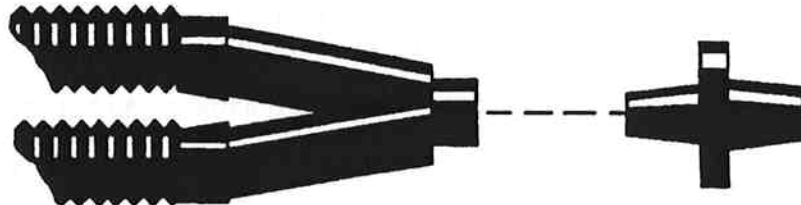


## 2/Preoperative Checkout Procedures

### Testing the absorber for leaks

1. Turn the bag/APL-ventilator switch to the "ventilator" position.
2. Attach a breathing bag to the breathing bag port.
3. Attach a patient circuit to the inhalation and exhalation ports.
4. Occlude the "Y" connector of the patient circuit.

**Figure 2-13**  
Occluding the  
"Y" connector



**WARNING:** When occluding the breathing system for test purposes, use only the approved test plug. Objects in the breathing system can interrupt or disrupt the delivery of breathing-system gases, possibly resulting in injury to the patient. Before using the breathing system on a patient, always check the breathing system components for foreign objects.

5. Press the oxygen flush button.

The bellows must not move. Any movement indicates unacceptable cross-leakage between the bag/APL and ventilator circuits.

6. Turn the bag/APL-ventilator switch to the "bag/APL" position.
7. Remove the breathing bag.
8. Occlude the breathing bag port.
9. Close the APL valve by turning the APL valve knob completely clockwise.
10. Set the anesthesia machine for an oxygen flow of 200 ml/min.
11. Watch the absorber's pressure gauge. Press the oxygen flush button briefly to pressurize the breathing system to just under 40 cm H<sub>2</sub>O. Continue to watch the pressure gauge. The 200 ml/min oxygen flow should raise the breathing system's pressure to at least 40 cm H<sub>2</sub>O. If it does, the leakage of the bag/APL circuit is less than or equal to 200 ml/min at 40 cm H<sub>2</sub>O.

## 2/Preoperative Checkout Procedures

### Testing the APL valve

1. Turn the APL valve completely clockwise.
2. Increase the oxygen flow to 3.0 l/min. The pressure on the absorber's pressure gauge should increase to between 65 cm H<sub>2</sub>O and 80 cm H<sub>2</sub>O. This checks the maximum pressure limit in the bag/APL circuit.
3. Slowly turn the APL valve knob counterclockwise in quarter-turn increments. The pressure should drop, then stabilize, with each turn of the knob. This checks the adjustable pressure limiting function of the valve.
4. The APL valve knob should now be fully clockwise. Remove the occlusion from the breathing bag port.
5. Connect a breathing bag to the breathing bag port (use the bag that you are planning to use in your next case). The 3.0 l/min flow should fill the breathing bag to capacity. The pressure should stabilize between 1.0 cm H<sub>2</sub>O and 7.0 cm H<sub>2</sub>O. This ensures both that the breathing bag will fill for spontaneous breathing with the APL valve completely open and that positive pressure in the circuit will be limited.

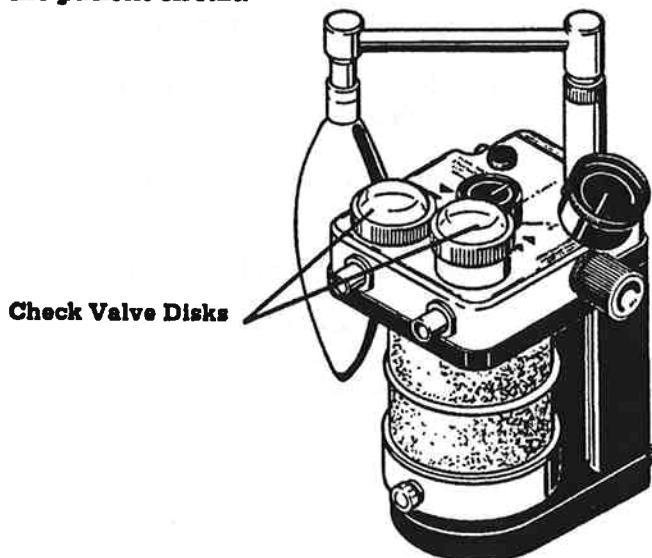
### Testing the check valve's disk movement

1. Rotate the APL valve knob one-half turn clockwise.
2. Press the flush button to fill the breathing bag.
3. Squeeze and release the breathing bag. The check valve disks should flutter with each contraction and expansion of the breathing bag.
4. Remove any occlusions that you have added to the system.



**WARNING:** When the bag/APL-ventilator switch is in the bag/APL position, patient circuit pressure of up to approximately 75 cm H<sub>2</sub>O can occur if the APL Valve is turned fully clockwise. When the switch is placed in the Vent position, the maximum circuit pressure may be different from the APL setting and could be as high as the maximum driving pressure of the ventilator if no additional pressure relief is in the patient circuit.

**Figure 2-14**  
The absorber's  
check valve  
disks



## 2/Preoperative Checkout Procedures

### Monitors

#### Checking the NIBP module

1. Verify proper hose connections from the NIBP Module to the NIBP cuff.
2. Verify that the system is set to the desired high and low NIBP alarm limits.
3. Verify that the system is set to the proper NIBP interval.
4. Take an NIBP reading.

#### Checking the Respiratory Gas Module

1. Inspect all of the accessories of the RGM monitor for damage. Replace broken or damaged accessories with Ohmeda replacement accessories.
2. Inspect the exterior of the RGM monitor for damage. Check the connectors. Replace broken or damaged parts with Ohmeda replacement parts.
3. Check that all patient connections are made.
4. Perform the calibration procedure for zero and span. (See "Calibrating the CO<sub>2</sub>, N<sub>2</sub>O, and agent monitors" in "5/Maintaining and Calibrating the System" of "Reference.")

### Final preparation

#### Testing the low and high oxygen alarms

1. Ensure that the ventilator's mechanical ventilation switch is in the off position.
2. Power on the anesthesia system.
3. Remove the oxygen sensor from the absorber. Let the sensor sit in room air at least three minutes before you move to the next step.
4. Use the display pod to set the low FiO<sub>2</sub> alarm limit to 18 percent.

The pod displays: FiO<sub>2</sub> 18

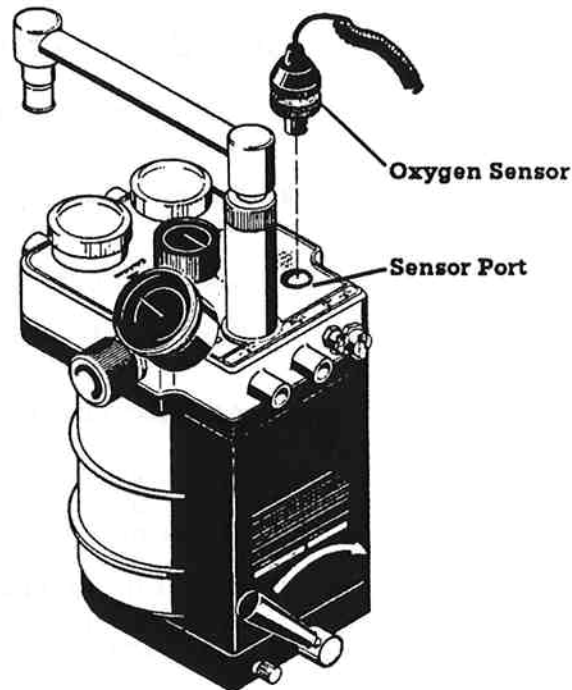
5. Use the display pod to set the high O<sub>2</sub> alarm limit to 40 percent.

The pod displays: FiO<sub>2</sub> 40  
18

6. Use the display pod to adjust the O<sub>2</sub> Calibration until the O<sub>2</sub> (%) display reads 21 percent.

## 2/Preoperative Checkout Procedures

**Figure 2-15**  
Removing the  
oxygen sensor  
from the  
absorber



7. Use the display pod to readjust the low  $\text{FiO}_2$  alarm limit to 22 percent.

The pod displays:  $\text{FiO}_2$   $\frac{40}{22}$

Within ten seconds the display pod will sound a tone and display:

**Low  $\text{FiO}_2$**

8. Now use the display pod to readjust the low  $\text{FiO}_2$  alarm limit to 18 percent.

The pod displays:  $\text{FiO}_2$   $\frac{40}{18}$

Because you have resolved the alarm condition, the system will cancel the low  $\text{FiO}_2$  alarm within ten seconds.

9. Use the display pod to readjust the high  $\text{FiO}_2$  alarm limit to 20 percent.

The pod displays:  $\text{FiO}_2$   $\frac{20}{18}$

Within ten seconds the system will sound a tone and display:

**High  $\text{FiO}_2$**

10. Now use the display pod to readjust the high oxygen alarm limit to 40 percent.

The pod displays:  $\text{FiO}_2$   $\frac{40}{18}$

Because you have resolved the alarm condition, the system will cancel the high  $\text{FiO}_2$  alarm within ten seconds.

## 2/Preoperative Checkout Procedures

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11. Return the oxygen sensor to the absorber socket.
12. Perform the oxygen sensor calibration, as described in "Calibrating the oxygen sensor" in "5/Maintaining and Calibrating the System" of "Reference," at least once a month. If you don't know when the sensor was last calibrated, do it now.

### Testing the low minute volume, reverse flow, and apnea alarms

1. Add a breathing bag to the patient circuit at the "Y" connector.

**Figure 2-16**  
Adding a  
breathing bag  
at the patient  
circuit's "Y"  
connector



2. Set the tidal volume to 500 milliliters.  
The ventilator displays: SET TV = 500 ML
3. Set the rate to 10 breaths per minute.  
The ventilator displays: SET RATE = 10/min
4. Set the inspiratory flow to 30 liters per minute.  
The ventilator displays: I:E=1:5.0
5. Set the inspiratory pressure limit to 40 cm H<sub>2</sub>O.  
The ventilator displays: P<sub>MAX</sub>=40 SUST=xx
6. Make sure that the ventilator's inspiratory pause function is off.
7. Use the display pod to select  $\dot{V}_T$  as the ventilation alarm source.

## 2/Preoperative Checkout Procedures

8. Use the display pod to set the low  $\dot{V}_E$  alarm limit to 0.0 l/min.

The pod displays:  $\dot{V}_E$  .0

9. Use the display pod to set the high  $\dot{V}_E$  alarm limit to 10.0 l/min.

The pod displays:  $\dot{V}_E$  10  
                              .0

- 10. Set the anesthesia system's oxygen flow to 2 l/min.**

11. Ensure that the volume sensor cartridge is on the exhalation port of the absorber. Make sure that the arrows on the sensor clip point toward the absorber.

- 12. Move the absorber's bag-to-ventilator switch to the ventilator position.**

- 13. Use the anesthesia machine's oxygen flush button to fill the bellows.**

14. Switch on mechanical ventilation and wait 40 seconds. The displayed  $\dot{V}_E$  should be between 3.3 liters and 4.3 liters assuming that your system:

- includes an adult bellows
- includes 60" patient tubes
- does not include a humidifier
- has a peak inspiratory pressure off 15 cm H<sub>2</sub>O

(If your system's components and peak inspiratory pressure are different than this, see "Tidal volume compensation" in "3/Theory of Operation" in "Reference" to calculate the compliance factor of your system. Then use this factor to calculate the expected minute volume.)

- 15. Use the display pod to readjust the low  $\dot{V}_E$  alarm to 9.9 l/min.**

The pod displays:  $\dot{V}_E$  10  
9.9

The system also sounds three descending tones that repeat every 15 seconds and displays: LOW VE.

- 16. Use the display pod to readjust the low  $\dot{V}_T$  alarm to 0.0 l/min.**

The pod displays:  $\dot{V}_E$  10  
.0

**The system cancels the alarm.**

- 17. Use the display pod to readjust the high  $\dot{V}_E$  alarm to 0.1 l/min.**

The pod displays:  $\dot{V}_E$  0.1  
0

The system also sounds three descending tones that repeat every 15 seconds and displays: High Vt.

## 2/Preoperative Checkout Procedures

18. Use the display pod to readjust the high  $\dot{V}_E$  alarm to 10 l/min.

The pod displays:  $\dot{V}_E \begin{array}{|c|} \hline 10 \\ \hline .0 \\ \hline \end{array}$

**The system cancels the alarm.**

- 19. Remove the volume sensor clip from the volume sensor cartridge.**

**After 30 seconds the system flashes the red warning indicator, sounds three ascending tones once and displays: Apnea-Vol.**

**After a total of 60 seconds the system sounds six ascending tones once.**

**After a total of 90 seconds the system sounds nine ascending tones once.**

After a total of 120 seconds the system sounds nine ascending tones that repeat every five seconds.

- Put the cartridge back onto the anesthesia system's common gas outlet. Make sure the arrows on the sensor clip must point toward the common gas outlet.

After one ventilation cycle the system removes the apnea alarm and displays  $\dot{V}_E$  data.

- 21. Make sure the "rev alarm off" message is not displayed on the display pod. If it is, use the ventilator's setup page to activate reverse flow detection.**

- 22. Remove the volume-sensor clip from the volume-sensor cartridge, then reinstall the clip backwards on the cartridge.**

**The system sounds three descending tones every 15 seconds, flashes the yellow caution indicator, and displays: Reverse Flow.**

- 23. Remove the volume-sensor clip from the volume-sensor cartridge, then properly reinstall the clip on the cartridge so that the arrows point toward the absorber.**

**The system clears the reverse flow alarm.**

- 24. Return the volume sensor assembly to the breathing system.**

### Testing the high-, low-, and sustained-pressure alarms

1. Set the tidal volume to 500 milliliters.

The ventilator displays: SET TV = 500 ML

- 2. Set the rate to ten breaths per minute.**

The ventilator displays: SET RATE = 10/MIN

3. Set the inspiratory flow to 30 liters per minute (I:E 1:5).

The ventilator displays: I:E = 1:5.0

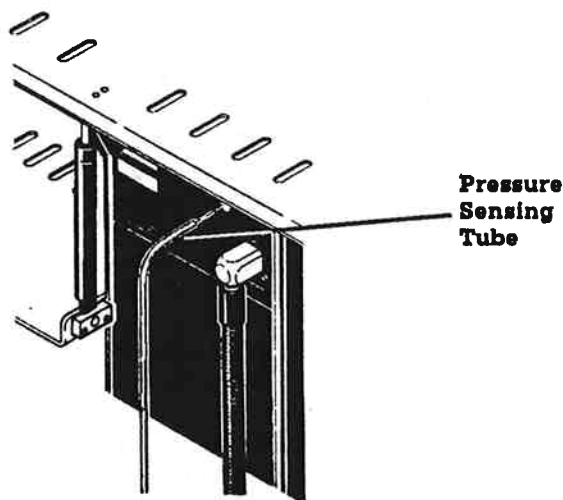
## 2/Preoperative Checkout Procedures

4. Set the inspiratory pressure limit to 40 cm H<sub>2</sub>O.

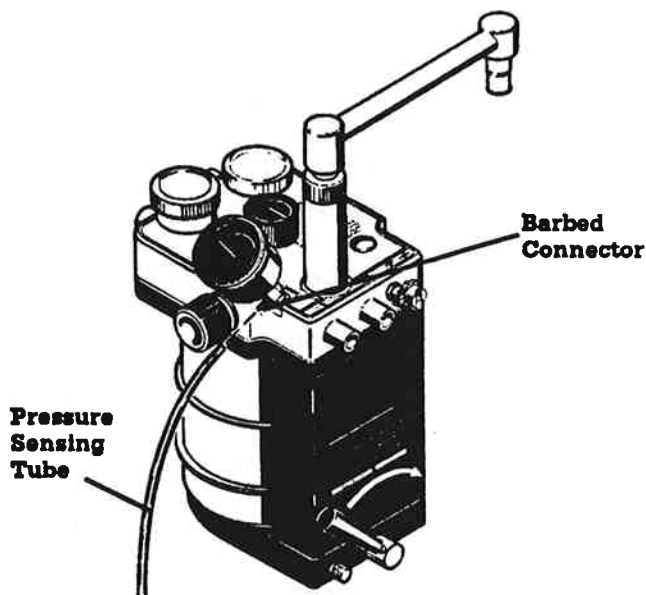
The ventilator displays: P<sub>MAX</sub>=40 SUST=XX

5. Make sure the pressure sensing tube is securely connected between the control module's connector marked "connect to inspiratory side of breathing circuit" and the distal-sensing tee on the inspiratory side of the breathing system. This tee is the barbed connector mounted under the pressure gauge on the absorber. If you're using a device other than an Ohmeda GMS Absorber, the tube may connect to an in-line sensing tee in the inspiratory side of the patient breathing system, as shown in "Monitoring locations on non-Ohmeda GMS Absorbers" in the appendix of "Setting Up."
6. Connect the common gas outlet to the absorber.
7. Set the anesthesia machine's oxygen flow to 2 l/min.
8. Move the bag/APL-Ventilator switch to "ventilator."
9. Open the breathing system at the "Y" connector. (See figure 2-19.)

**Figure 2-17**  
The pressure sensing tube's connection to the control module



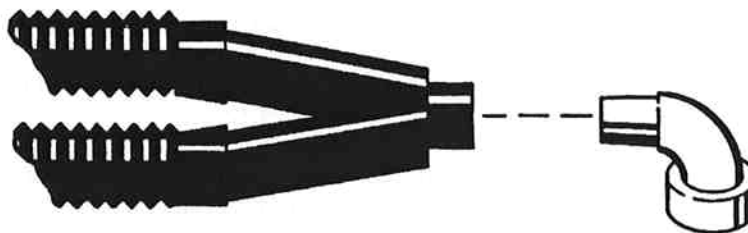
**Figure 2-18**  
The pressure sensing tube's connection to the absorber





## 2/Preoperative Checkout Procedures

**Figure 2-19**  
Opening the  
patient circuit  
at the "Y"  
connector



10. Move the mechanical ventilation switch to on. After 30 seconds of ventilation the system will sound six ascending tones, flash the red warning indicator, and display the low airway pressure warning.

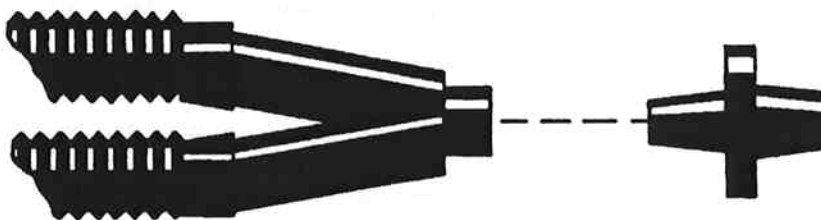
The system displays: **LOW PAW**

11. Move the mechanical ventilation switch to off. Within five seconds the system will cancel the low airway pressure warning.
12. Occlude the patient end of the "Y" connector.



**WARNING:** When occluding the breathing system for test purposes, do not use any object small enough to slip completely into the system. Objects in the breathing system can interrupt or disrupt the delivery of breathing-system gases, possibly resulting in injury to the patient. Before using the breathing system on a patient, always check the breathing system components for foreign objects.

**Figure 2-20**  
Occluding the  
patient circuit  
at the "Y"  
connector



13. Wait for the bellows to inflate. When the bellows are completely extended, move the mechanical ventilation switch to on. Within ten seconds the system will sound three descending tones, flash the yellow caution indicator, and display ventilator pressure limited alarm.

The system displays: **Vent Pressure Limited**

14. Move the mechanical ventilation switch to off. Within five seconds the system will clear the ventilator pressure limited alarm.

## 2/Preoperative Checkout Procedures

15. Turn the APL valve fully clockwise.
16. Connect a three-liter bag to the bag arm.
17. Use the display pod to set the sustained airway pressure alarm limit to 20 cm H<sub>2</sub>O.
18. Move the bag/APL-ventilator switch to bag/APL. (Do not remove the occlusion from the "Y" connector yet.)
19. Press the oxygen flush button until the system pressure (as shown on the absorber's pressure gauge) reaches at least 20 cm H<sub>2</sub>O. Then wait 15 seconds more. Because the pressure still exceeds 20 cm H<sub>2</sub>O, the system sounds the sustained airway pressure alarm.

The system displays: Sustained PAW

20. Slowly open the APL valve to release the pressure in the system. The system will silence the sustained airway pressure alarm when the pressure falls below 20 cm H<sub>2</sub>O.
21. Remove the occlusion from the "Y" connector.
22. Set the absorber's bag/APL-ventilator switch to the position you want to use.

### Testing the anesthesia machine electrical alarms

1. Move the system master switch to on.
2. Unplug the power cord.

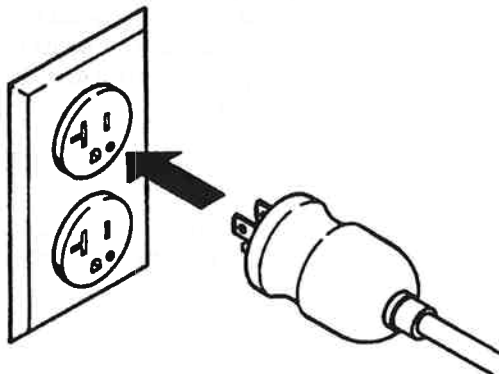
The electrical disconnect/failure alarm must activate briefly, the green "mains" indicator must go out, a battery indicator bar must light, and the red "battery" electrical power indicator must flash.

3. Check that the ventilator displays "pod link fail."
4. Plug in the power cord and observe that: the "battery" indicator stops flashing and the tone is silenced; the battery indicator bar is extinguished; and the "mains" electrical power indicator is lit.

### Checking the system's connections

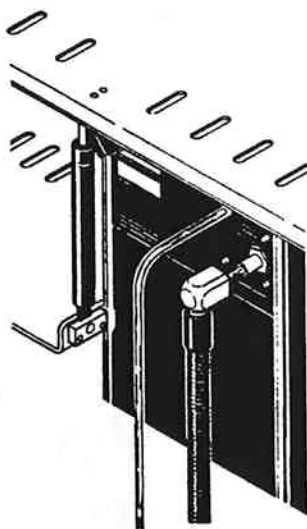
Before you use the system on a patient, check that all of the system's connections are correct and secure.

**Figure 2-21**  
The anesthesia system's electrical power cord must be plugged into a grounded, hospital-grade receptacle.

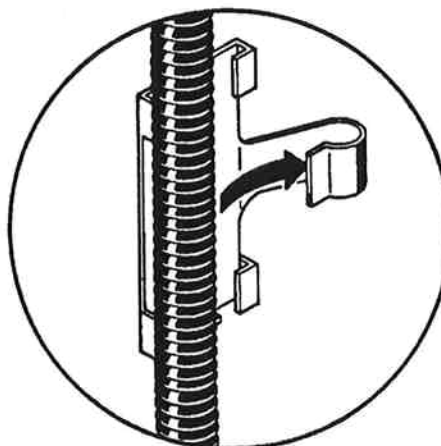


## 2/Preoperative Checkout Procedures

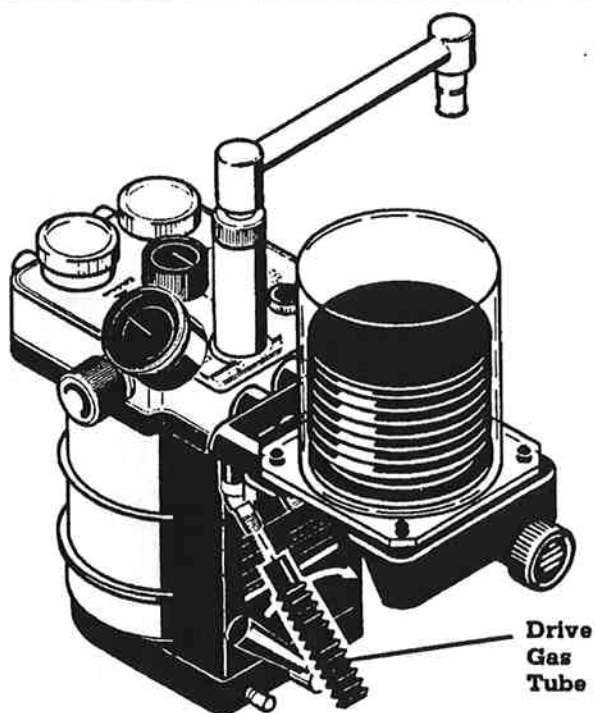
**Figure 2-22**  
One end of the 17-mm corrugated tube must be connected to the 90-degree adapter labeled "connect to bellows ass'y inlet" on the control module.



**Figure 2-23**  
This 17-mm corrugated tube must be connected to the bracket on the anesthesia system's side.



**Figure 2-24**  
The other end of this 17-mm corrugated tube must be connected to the absorber interface manifold's 17-mm, barbed connector.

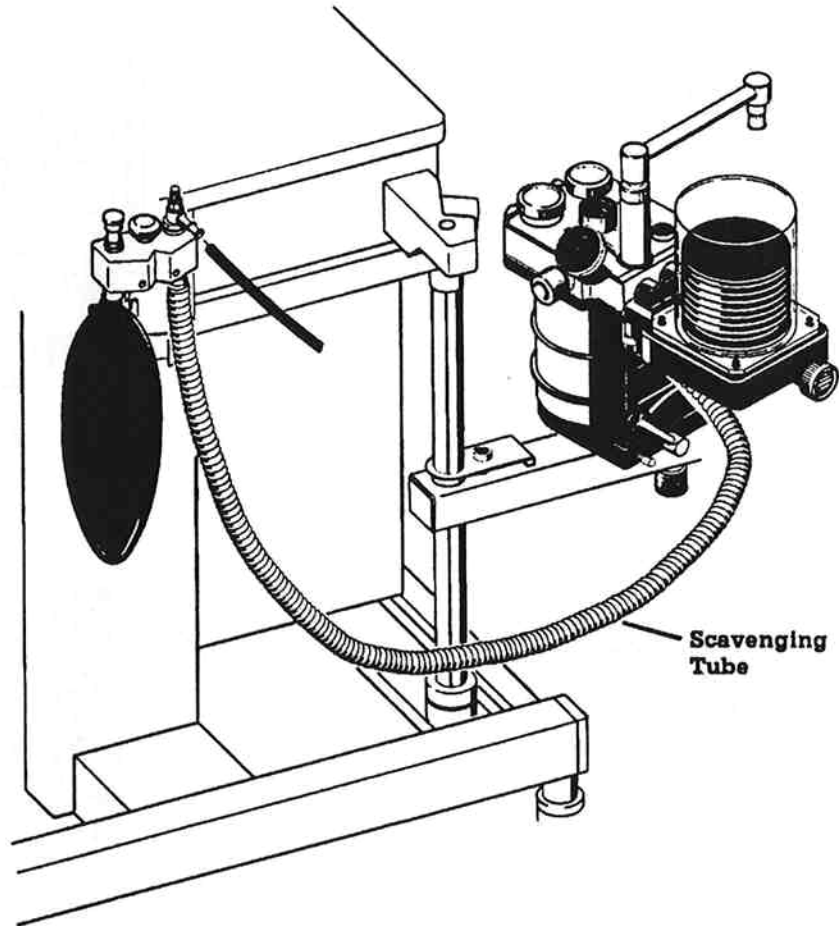


## 2/Preoperative Checkout Procedures

**Figure 2-25**

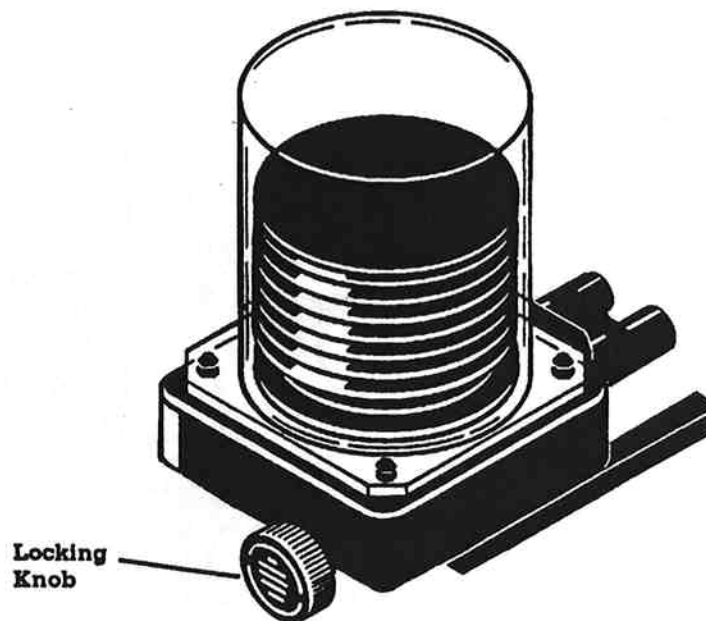
One end of the 19-mm-diameter, corrugated tube must be connected to the absorber interface manifold's 19-mm, barbed connector.

The other end of this 19-mm-diameter tube must be connected to a gas scavenging system.



**Figure 2-26**

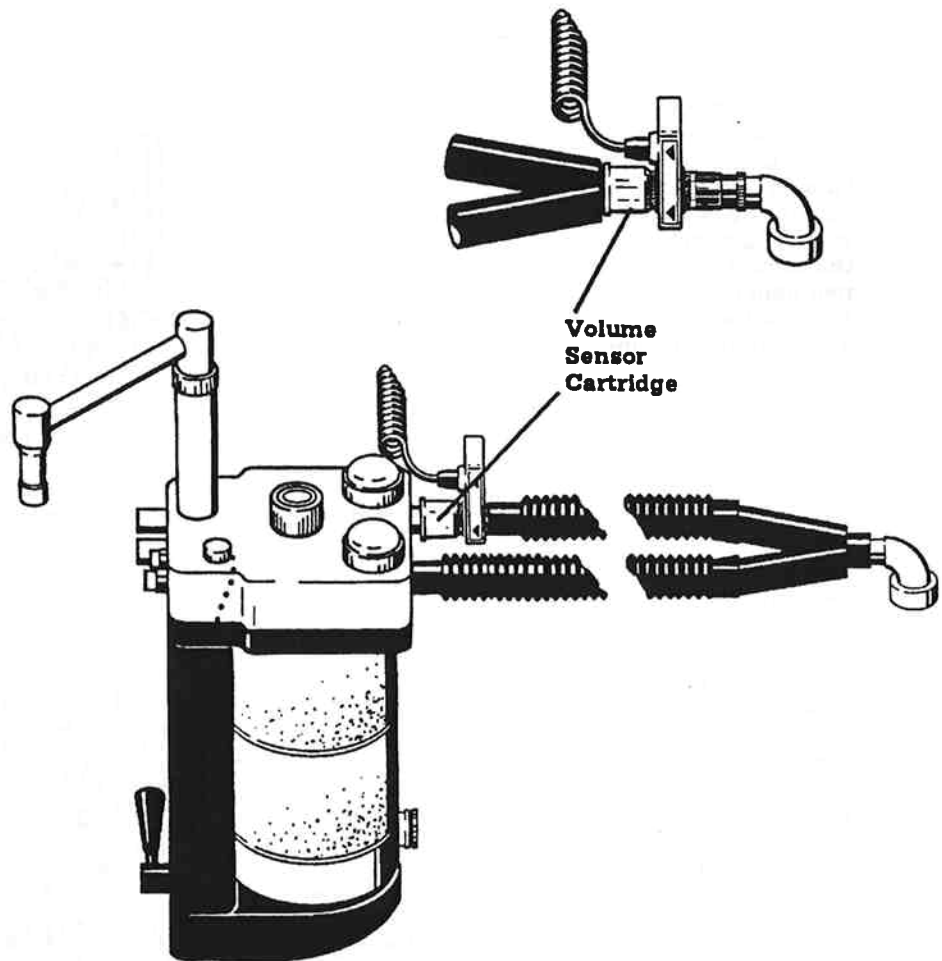
The Bellows Assembly's locking knob must be turned fully clockwise.



## 2/Preoperative Checkout Procedures

**Figure 2-27**

The volume sensor cartridge must be correctly inserted in the breathing system. The cartridge must be clear and free of any obstructions.



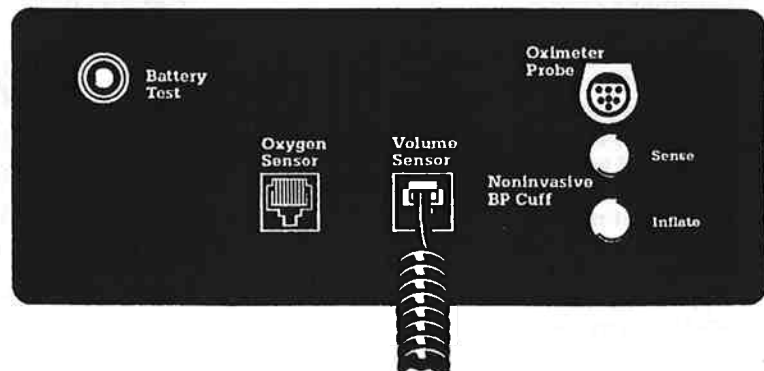
**Figure 2-28**

The volume sensor clip must be attached to the volume sensor cartridge. The arrows on the clip must point in the direction of gas flow in the breathing system.



**Figure 2-29**

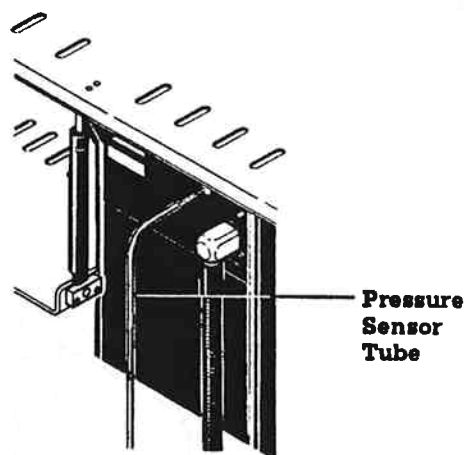
The volume sensor clip's electrical cord must be plugged into the receptacle marked "volume sensor" on the anesthesia system's patient interface panel.



## 2/Preoperative Checkout Procedures

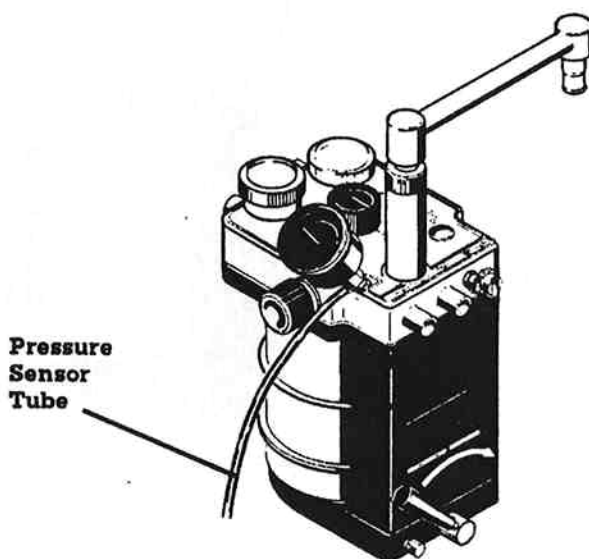
**Figure 2-30**

One end of the clear,  $\frac{1}{8}$ -inch pressure sensor tube must connect to the barbed connector labeled "connect to inspiratory limb of breathing circuit" on the control module's rear panel. This tube must be free of obstructions and kinks.



**Figure 2-31**

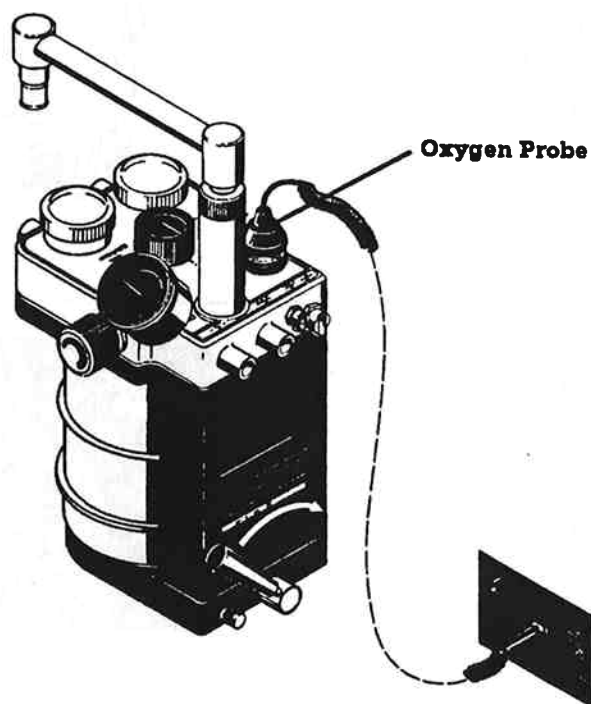
The other end of the pressure sensor tube must connect to the barbed connector mounted under the pressure gauge on the absorber. (If you're using a non-GMS absorber, the tube may connect to an in-line sensing tee in the inspiratory side of the breathing system.)



**Figure 2-32**

The oxygen sensor's electrical cord must be connected to the receptacle labeled "oxygen sensor" on the anesthesia system's patient interface panel.

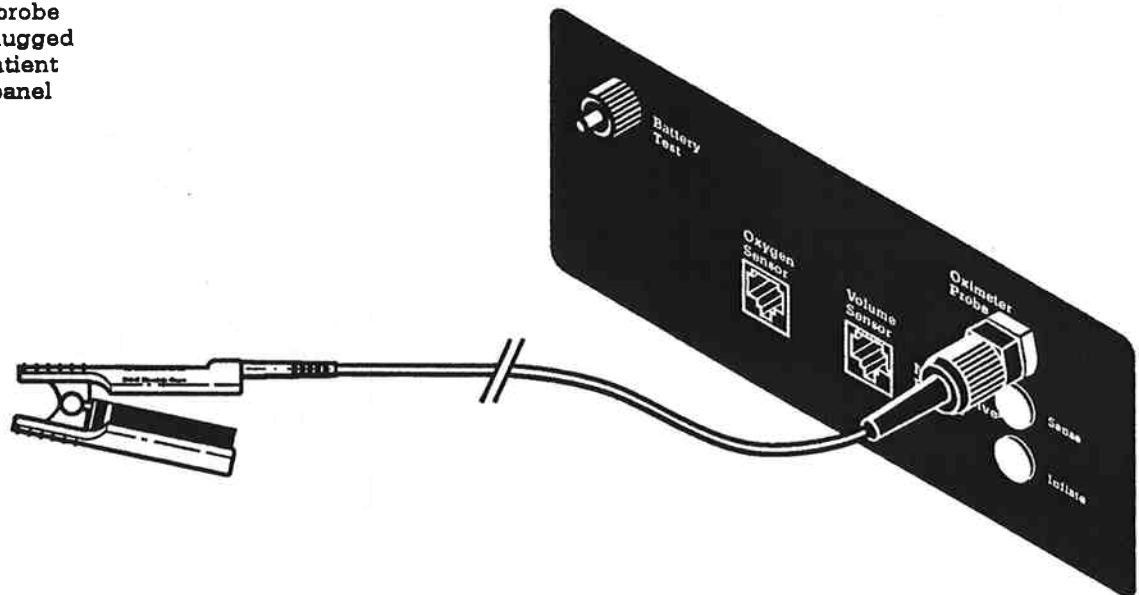
The oxygen sensor must be in the absorber's oxygen sensor port, which is labeled "oxygen sensor." To prevent leaks, the sensor must fit in the port snugly. (If you're using a non-GMS absorber, the sensor may be inserted into in-line sensing tee in the inspiratory side of the breathing system.)



## 2/Preoperative Checkout Procedures

**Figure 2-33**

The  $\text{SpO}_2$  probe must be plugged into the patient interface panel

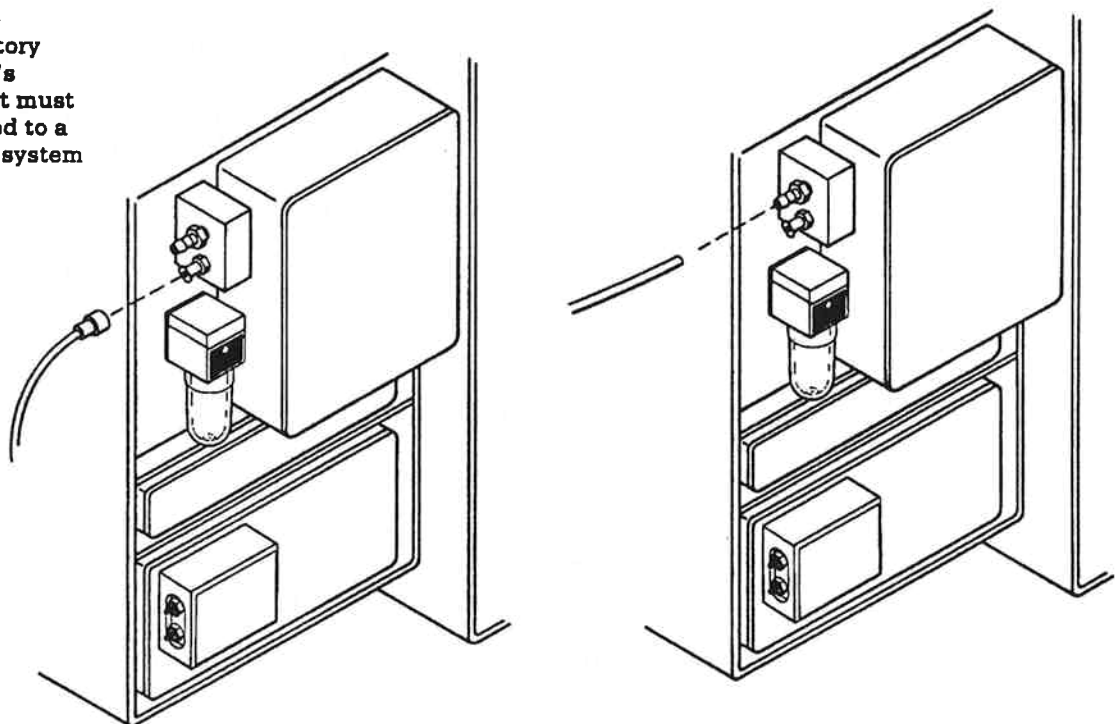


**Figure 2-34**

The respiratory gas module's sample line must be connected to the monitor's sample inlet and to a patient circuit adapter

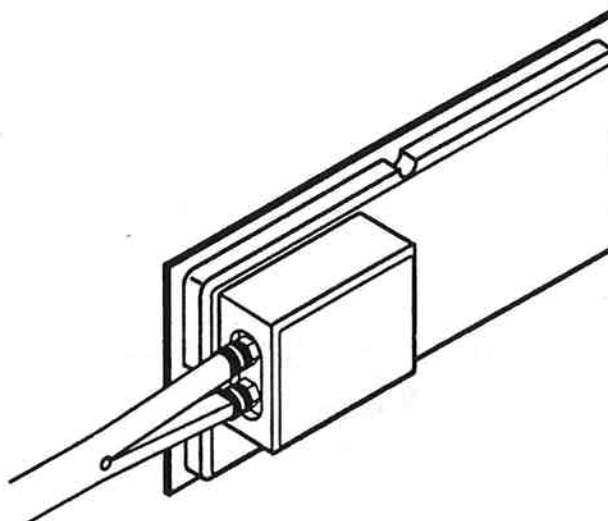
**Figure 2-35**

The respiratory gas module's exhaust port must be connected to a scavenging system




## 2/Preoperative Checkout Procedures

**Figure 2-36**  
An NIBP must  
be connected  
to the NIBP  
front panel



### Checking the backup mode

1. Move the display pod's power interrupt switch to off.
2. Check that the ventilator displays both "pod link failure" and the backup mode within 30 seconds.
3. Press:  (on the ventilator)
4. Calibrate the oxygen sensor:
  - a. Remove the oxygen sensor from the absorber socket to expose the sensor to room air.
  - b. Move the ventilator's mechanical ventilation switch to off.
  - c. Press and continue to hold down the alarm silence button, then press the inspiratory pause button. Release both buttons.

The ventilator displays:

7850 REV xx.xx /0

ENGLISH

- d. Press:  (on the ventilator)

The ventilator displays:

FLOW KNOB TO SET

REV FLOW ALM ON (or OFF)

(If the reverse flow alarm is set to off, change it to on.)



## 2/Preoperative Checkout Procedures

- e. Press: 

The ventilator displays:

FLOW KNOB TO SET

CONTRAST: xx

- f. Press: 

The audio alarm sounds continuously and the ventilator displays:

FLOW KNOB TO SET

AUDIO VOLUME: xx

- g. Press: 

The ventilator displays:

FLOW KNOB TO SET

O<sub>2</sub> CAL: xxx

- h. Make sure that the oxygen sensor has been exposed to room air for at least three minutes. Then use the flow knob to adjust O<sub>2</sub> Cal until the display reads 21 percent. Once you have set O<sub>2</sub> to 21, pause for a few seconds.

- Press: 

The ventilator beeps once and displays:

CHECK SETTINGS!

- i. Reinstall the oxygen sensor into the absorber.
5. Add a breathing bag to the patient circuit at the "Y" connector.

**Figure 2-37**  
Adding a  
breathing bag  
at the patient  
circuit's "Y"  
connector



## 2/Preoperative Checkout Procedures

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6. Set the tidal volume to 500 milliliters.

The ventilator displays: SET TV = 500 ML

7. Set the rate to rate to 10 breaths per minute.

The ventilator displays: SET RATE = 10/min

8. Set the inspiratory flow to 30 liters per minute.

The ventilator displays: I:E=1:5.0

9. Set the inspiratory pressure limit to 40 cm H<sub>2</sub>O.

The ventilator displays: P<sub>MAX</sub>=40 SUST=20

10. Make sure inspiratory pause is off.

11. Set the anesthesia system's oxygen flow to 2 l/min.

12. Move the absorber's bag-to-ventilator switch to the ventilator position.

13. Use the anesthesia machine's oxygen flush button to fill the bellows.

14. Ensure that the volume sensor cartridge is on the exhalation port of the absorber. Make sure that the arrows on the sensor clip point toward the absorber.

15. Switch on mechanical ventilation and wait for the ventilator to complete at least two ventilation cycles.

The ventilator displays dashes in place of the  $\dot{V}_E$  data.

After 30 seconds the ventilator flashes the yellow LED, sounds the warble tone once, and displays: APNEA 31 SEC.

Thirty seconds later the tone warbles twice and the ventilator displays: APNEA 60 SEC.

Thirty seconds later the tone warbles three times and the ventilator displays: APNEA 90 SEC.

Thirty seconds later the ventilator displays "APNEA 120 SEC."

Then the tone warbles continuously, the ventilator flash the red LED, and the ventilator displays: APNEA \*\*\*

16. Put the volume sensor clip back on the volume cartridge. Make sure the arrows on the sensor clip point toward the common gas outlet.

After one more breath the ventilator clears the apnea alarm.

17. Remove the volume sensor clip from the volume sensor cartridge. Reinstall the clip on the cartridge so that the arrows on the clip point away from the absorber.

The ventilator sounds a continuous tone, flashes the yellow LED, and displays: REVERSE FLOW!

## 2/Preoperative Checkout Procedures

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18. Remove the volume-sensor clip from the volume-sensor cartridge, then properly reinstall the clip on the cartridge so that the arrows point toward the absorber.

After two breaths the ventilator clears the reverse flow alarm.

19. Open the breathing system at the "Y" connector.
20. Make sure that mechanical ventilation is on.

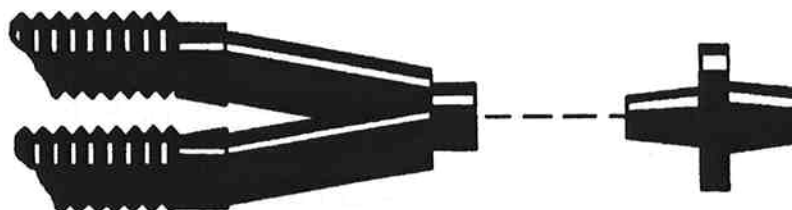
After 20 seconds of ventilation the ventilator sounds the warble tone once per ventilation cycle, flashes the red LED, and displays: LOW PRESSURE!

21. Occlude the patient end of the "Y" connector.



**WARNING:** When occluding the breathing system for test purposes, do not use any object small enough to slip completely into the system. Objects in the breathing system can interrupt or disrupt the delivery of breathing-system gases, possibly resulting in injury to the patient. Before using the breathing system on a patient, always check the breathing system components for foreign objects.

**Figure 2-38**  
Occluding the  
patient circuit  
at the "Y"  
connector



- 
22. Wait for the bellows to inflate. When the bellows are completely extended, move the mechanical ventilation switch to on.

With each breath the ventilator warbles once, flashes the red LED, and display: HIGH PRESSURE!

23. Move the mechanical ventilation switch to off.

Within ten seconds the ventilator clears the high pressure alarm.

24. Turn the APL valve fully clockwise.
25. Connect a three-liter bag to the bag arm.
26. Use the inspiratory pressure limit knob to set the sustained pressure limit to 20 cm H<sub>2</sub>O.  
  
The ventilator displays: P<sub>MAX</sub>=40 SUST=20
27. Move the bag/APL-ventilator switch to bag/APL. (Do not remove the occlusion from the "Y" connector yet.)

## 2/Preoperative Checkout Procedures

28. Press the oxygen flush button until the system pressure (as shown on the absorber's pressure gauge) reaches at least 20 cm H<sub>2</sub>O. Then wait 15 seconds more. Because the pressure still exceeds 20 cm H<sub>2</sub>O, the ventilator sounds a continuous warbling tone, lights the red LED, and displays: SUSTAINED PRES!.
29. Slowly open the APL valve to release the pressure in the system. The ventilator will silence the sustained pressure alarm when the pressure falls below 20 cm H<sub>2</sub>O. (If this test takes more than 30 seconds to complete, an apnea alarm will be triggered.)
30. Remove the occlusion from the "Y" connector.
31. Set the absorber's bag/APL-ventilator switch to the position you want to use.
32. Connect an SpO<sub>2</sub> finger probe to the patient interface panel.
33. Put the finger probe on your finger.

The SpO<sub>2</sub> reading should be within normal range.

34. Move the display pod's power interrupt switch to on.

### Checking the display pod

1. Breathe into the respiratory gas monitor's sample tube.

A CO<sub>2</sub> waveform appears on the display pod.

2. Press: 

The system displays the digital values of the alarm limits.

3. Use the left knob to select the upper systolic alarm limit.

The pod displays: Sys   
XX

4. Press: 

The alert zone is displayed and the alert zone key's indicator is lighted.

5. Press: 

The alert zone limit page is displayed on the lower screen.

6. Use the right knob to select "tight," then "medium," then "wide." Note that the zone widths change as the selection changes.

7. Press: 

The numeric page is displayed on upper screen.

## 2/Preoperative Checkout Procedures

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8. Press: 

The polygon page is displayed on upper screen.

9. Press: 

The analog page is displayed on upper screen.

10. Press: 

The primary display page is displayed on lower screen.

11. Press: 

The graphic trend page is displayed on lower screen.

12. Press: 

The digital trend page is displayed on lower screen.

13. Press: 

The PAW and CO<sub>2</sub> page is displayed on lower screen.

14. Press: 

The first checklist page is displayed on lower screen.

# Notes

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# 3/Making the Patient Connections

## In this section

- Fitting the NIBP cuff 3-1
- Making the respiratory gas module to patient connections 3-3
  - Connecting the sample tube 3-3
- Making the SpO<sub>2</sub> connections 3-3
  - Deciding which probe to use 3-3
  - Connecting and disconnecting probes 3-5
  - Attaching a finger probe 3-5
  - Attaching an ear probe 3-6
  - Attaching a flex probe to an adult 3-7
  - Removing a Flex Probe from an adult 3-10
  - Attaching a Flex II Probe (for neonates and pediatrics) 3-11



**WARNING:** Always perform the preoperative checkout procedures before connecting the system to a patient.

## Fitting the NIBP cuff

### Cuff application guidelines

When using the NIBP monitor on some pediatric patients in the adult/ped mode, you may experience an alarm condition with no blood pressure readings displayed. This condition is more likely to occur when you are required to use an infant-size cuff.

In the adult/ped mode, the NIBP module inflates the cuff at a faster rate than in the neonatal mode. When used with a small size cuff, in the adult/ped mode the pump can inflate the cuff in less than 1.5 seconds, resulting in an alarm condition. In the neonatal mode, the monitor inflates the cuff at a slower rate.

- When using a child-size cuff, set the monitor to the Adult/Ped mode initially. If you experience the above condition, reset the monitor to the neonatal mode.
- When using an infant-size cuff, set the monitor to the neonatal mode to avoid the above condition.



**WARNING:** If the NIBP mode and cuff type are mismatched, the system may display incorrect blood pressures.

Match the cuff size to the patient's arm size; too small a cuff can lead to too tight a fit, resulting in an alarm condition.

### Attaching the cuff

Select a cuff that has a width-to-limb circumference ratio of 0.4:1. On most cuffs, an index line falls within a marked area if the cuff is the correct size for the limb.

1. Ensure that the hose is properly attached to the NIBP module's panel.
2. Squeeze all the air out of the cuff and firmly wrap it around the free limb of the patient as close to heart elevation as possible.

### 3/Making the Patient Connections



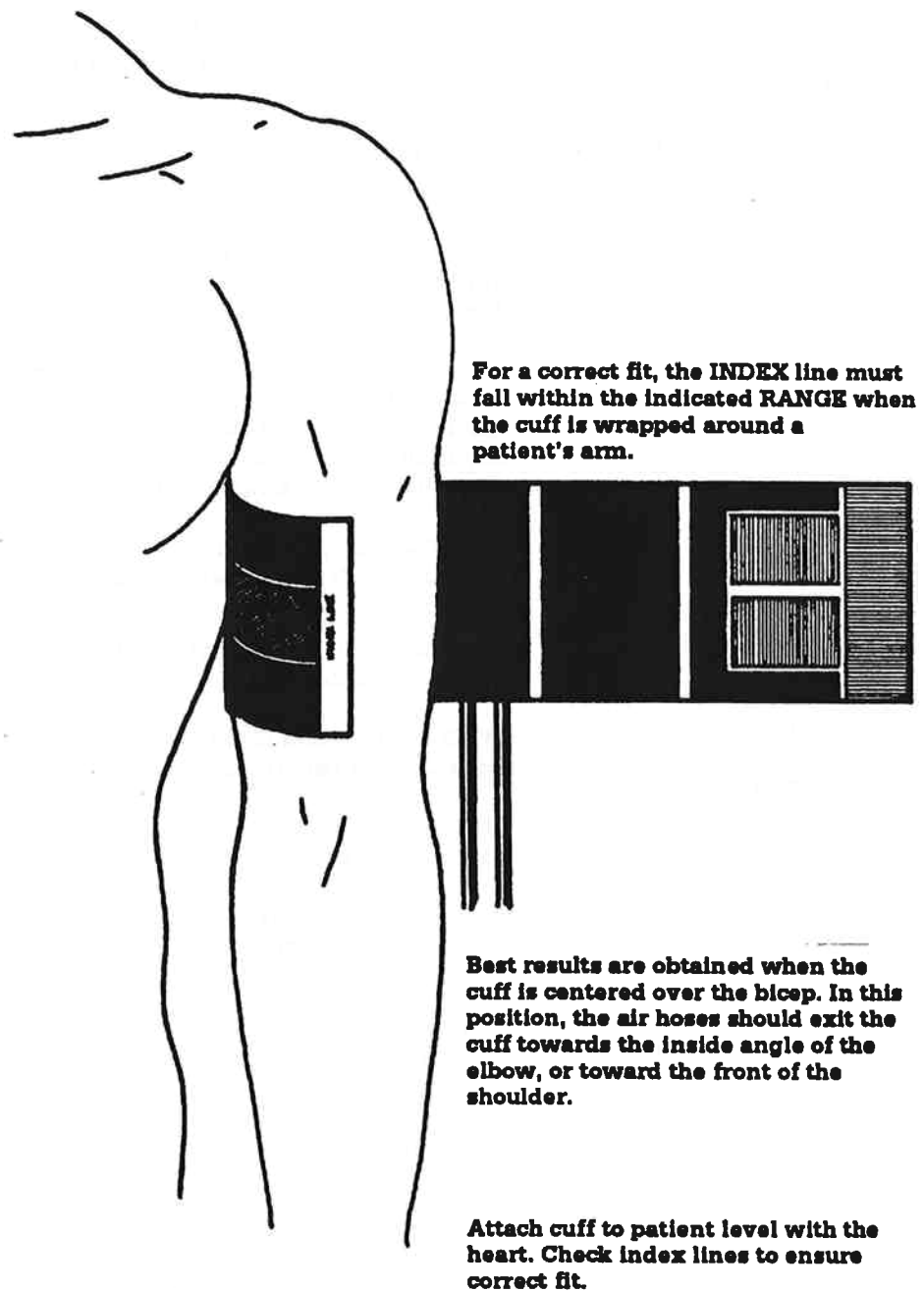
**WARNING:** Do not attach the cuff to a limb being used for fluid infusion. Cuff inflation will block the infusion, possibly causing harm to the patient.



**WARNING:** Do not attach the SpO<sub>2</sub> probe to the same limb as the blood pressure cuff. Inflating the cuff will stop the flow of blood, which may cause the system to sound SpO<sub>2</sub> alarms or to indicate incorrect SpO<sub>2</sub> values.

3. Route the hose from the cuff to the NIBP module so that it does not kink, tangle, or limit access to the patient.

**Figure 3-1**  
Preparing the  
patient





## 3/Making the Patient Connections

### Making the respiratory gas module to patient connections

#### Connecting the sample tube

1. Connect one end of the sample tube's Luer connector to the connector labeled "sample inlet" on the respiratory gas module's interface panel. Ensure that the sample inlet connection is secure.
2. Attach the sample tube to the Luer fitting of the patient circuit adapter. Ensure that the sample tube fits securely into the patient circuit adapter.
3. Place the patient circuit adapter at the proximal end of the patient circuit.
4. Ensure that the sample tube assembly is in good condition. If not, replace with a new sample tube assembly. Some purging may occur if the sample tube assembly is changed while the monitor is in operation.



**CAUTION:** Empty the fluid trap before each use or whenever the trap is more than half full. Failure to empty the trap may allow it to fill while monitoring a patient and cause the monitor to stop sampling gas.

5. Make sure a good filter is in place on the module's interface panel.
6. Ensure that the sample exhaust is connected to the gas scavenging system or returned to the patient circuit.

### Making the SpO<sub>2</sub> connections

Ear, finger, or flex probes connect the patient to the patient interface panel, which routes the patient signals to the oximeter module.



**CAUTION:** SpO<sub>2</sub> data is not collected when electrosurgical interference is detected. If long periods of interference exist, the values of the SpO<sub>2</sub> and Pulse Rate displays are shown as dashes.



**CAUTION:** Avoid storing the monitor and probes at temperatures outside the following range: -20°C to 60°C (-4°F to 140°F).



**CAUTION:** Do not expose the SpO<sub>2</sub> probe detector to strong ambient light while it is being used to monitor a patient. A poor signal may result.



**WARNING:** The SpO<sub>2</sub> probe provides electrical isolation. Do not use cracked or broken probes.

#### Deciding which probe to use

##### Finger Probe

The finger probe is recommended for routine monitoring. It is also preferred when the patient has a very small ear lobe or poor blood circulation.

### 3/Making the Patient Connections



Flex probe

**CAUTION:** Do not attach an SpO<sub>2</sub> probe to a limb having an inflated blood pressure cuff. Valid data will not be received. Attach a probe to the limb opposite the site used for the blood pressure cuff.

The Flex probe is recommended for

- long term monitoring,
- probe sites that are difficult to reach with the ear or finger probes and
- transport monitoring situations.



Ear probe

**WARNING:** When attaching the probe to the patient, apply as little pressure as possible to the probe site. This is particularly important in neonatal applications.

**WARNING:** Patient condition may require changing the probe site periodically. This should diminish the possibility of pressure necrosis of the probe site.

The ear probe is recommended for use:

- during surgical procedures when the hand is not accessible,
- when significant hand or finger motion is expected.



Flex II Probe

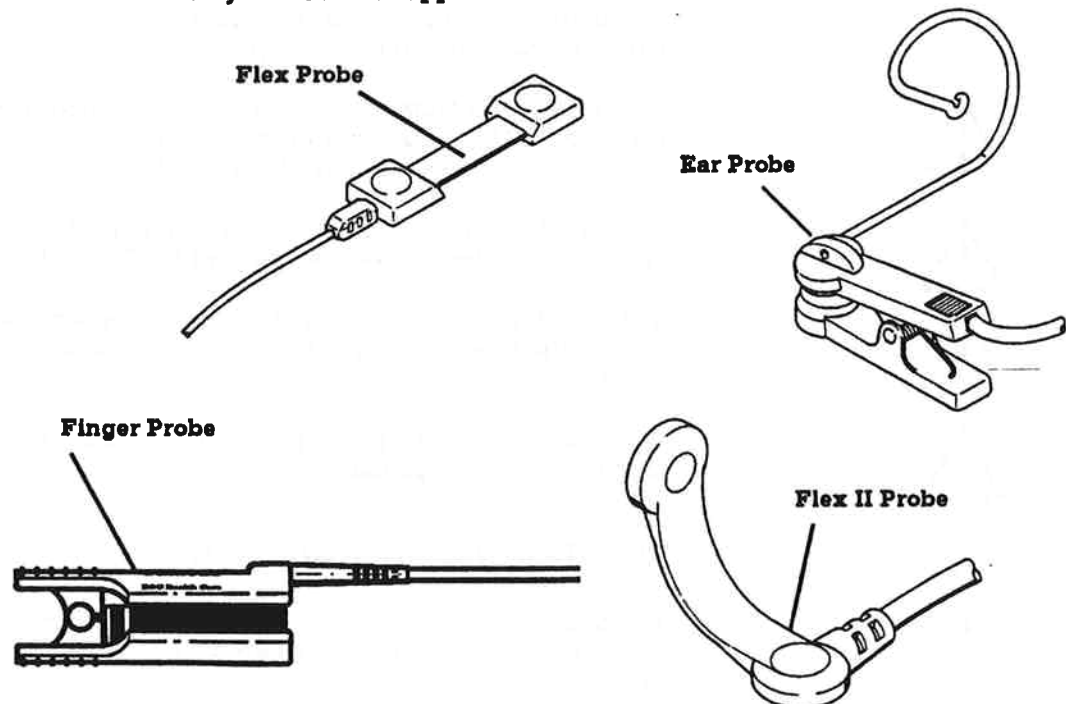


**WARNING:** The ear probe should be moved periodically to the opposite ear if it is used for long term monitoring.

The Flex II probe is recommended for use on neonates and pediatrics.

**WARNING:** LEDs (Light Emitting Diodes) in the probe generate a small amount of heat as a by-product of light emission. Although producing a minimal rise in temperature, the probe site should be checked periodically, at least every two to four hours in long-term monitoring, particularly in neonatal applications.

**Figure 3-2**  
SpO<sub>2</sub> probes



# 3/Making the Patient Connections

## Connecting and disconnecting probes

Connecting  
a probe



Grasp the probe plug with the probe locking clip facing up and insert it into the socket labeled "oximeter probe" on the patient interface panel. The probe locking clip should "click" as you seat the plug into the socket.

**WARNING:** Use only the SpO<sub>2</sub> probes supplied by Ohmeda. Check the Identification Number/Serial Number Tag which is located on the cable near the connector. The model number must read: MOD 8123-00X or 8121-00X (X represents a digit from 1 through 7).

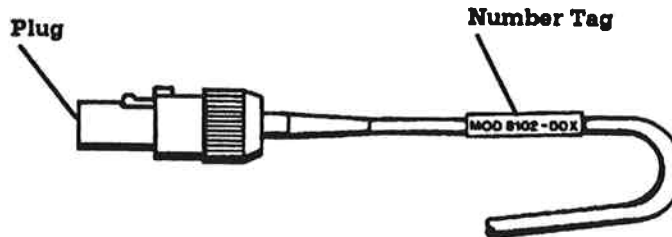
Disconnecting  
a probe



Grasp the probe plug with your thumb on the probe locking clip. Push down on the locking clip with the thumb and pull the probe plug from the connector.

**CAUTION:** Do not apply tension to the probe cable. Probe damage may result.

**Figure 3-3**  
SpO<sub>2</sub> locking  
clip, plug, and  
number tag



## Attaching a finger probe

Remove from the patient's fingers any nail polish, artificial nails, or long nails, any of which may diminish light levels and result in a poor signal. Remove fingernail polish before using the finger probe. If the fingers have artificial or long fingernails that can't be removed, use an ear probe.

Proper coverage of the photodetector is essential. Use the finger that best covers the photodetector and seats properly in the probe lower-half housing.

Clean the probe surface before and after use on each patient. (See "5/Maintaining and Calibrating the System" in "Reference.")

To attach the finger probe, insert the patient's finger into the probe housing until it touches the raised finger stop on the inside lower half of the probe. Be certain that the surface of the finger covers the detector window inside the lower half of the probe. The hand should be relaxed. See figure 3-4 for the correct attachment of the finger probe.

To additionally secure the probe on the finger, wind a piece of tape, such as 3M Transpore<sup>®</sup> Tape, once around the finger and the strain relief.

\*Registered trademark of 3M, St. Paul, MN 55144

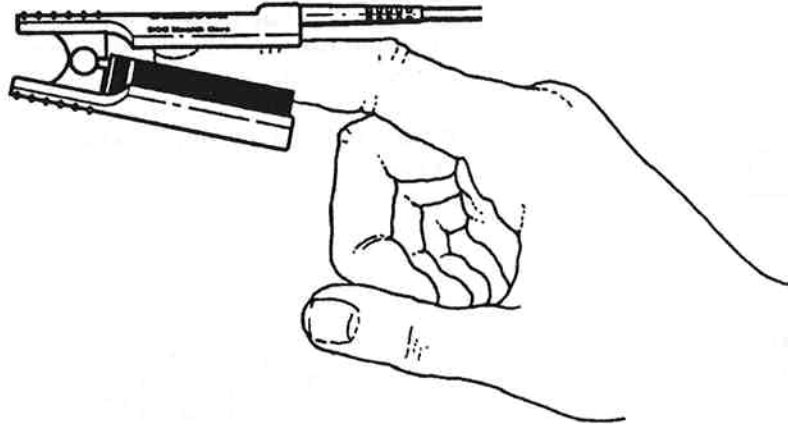
# 3/Making the Patient Connections



**WARNING:** Do not cut off blood circulation.

To determine if the probe is attached correctly and if the display data is verifiable, see "SpO<sub>2</sub> Signal and data validity" in "6/Starting Operation."

**Figure 3-4**  
Attaching a  
finger probe



## Attaching an ear probe

Clean the probe surface before and after use on each patient. (See "5/Maintaining and Calibrating the System" in "Reference.")

Massage the ear lobe with an isopropyl alcohol (70%) pad or rubefacient cream for 20 to 30 seconds to increase perfusion. Rubefacient cream is an agent that causes a reddening of the skin by producing local vasodilation. Such agents can be purchased over-the-counter and should contain 10 percent to 30 percent methyl salicylate and two percent to 10 percent methol. Strong vasodilator cream such as nitroglycerin paste is *not* recommended.

Refer to figure 3-6 for correct placement of the ear probe.

Center the probe on the fleshy part of the ear lobe. To avoid poor signal results, be certain that the detector window is fully covered by the lobe tissue and is not exposed to room light.

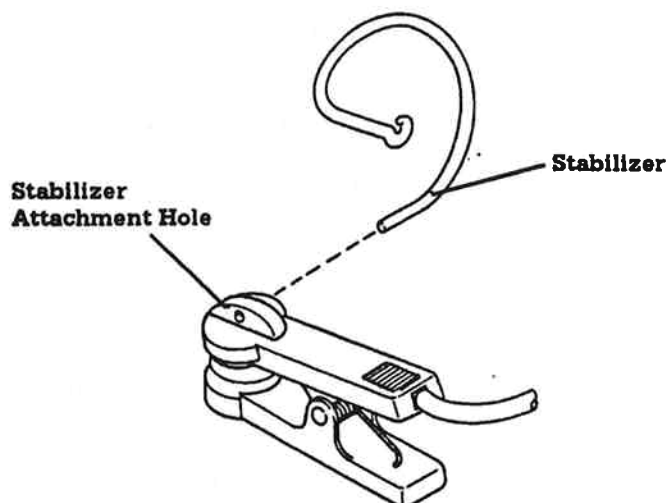
The ear probe should not be positioned where cartilage is present nor should it press against the side of the head.

Use the ear probe stabilizer to position and secure the probe on the patient. Insert the ear probe stabilizer into the hole on the ear probe housing. Then place the ear probe and stabilizer on the ear.

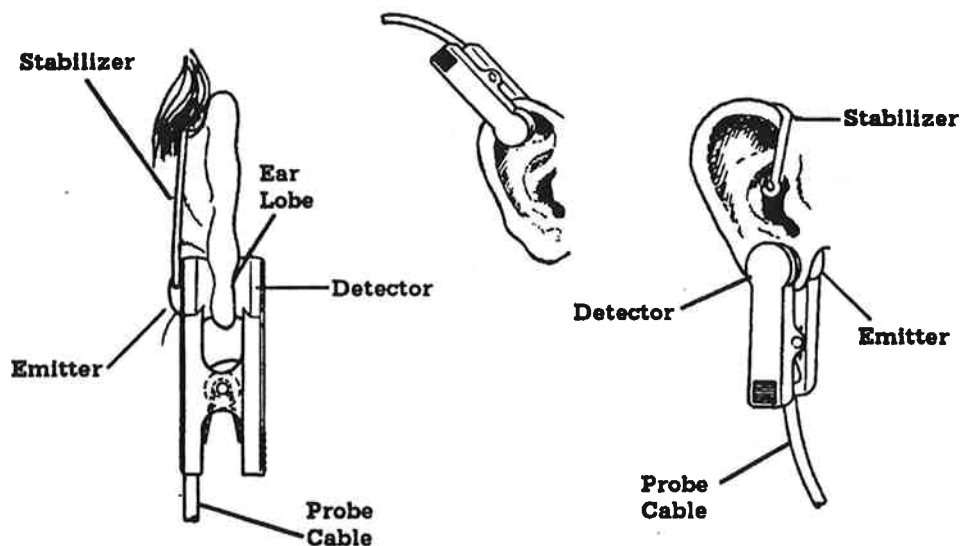
To determine if the probe is attached correctly and if the display data is verifiable, see "SpO<sub>2</sub> Signal and data validity" in "6/Starting Operation."

### 3/Making the Patient Connections

**Figure 3-5**  
Attaching the  
stabilizer to  
the ear probe



**Figure 3-6**  
Placement of  
the ear probe  
on the ear lobe



#### Attaching a flex probe to an adult

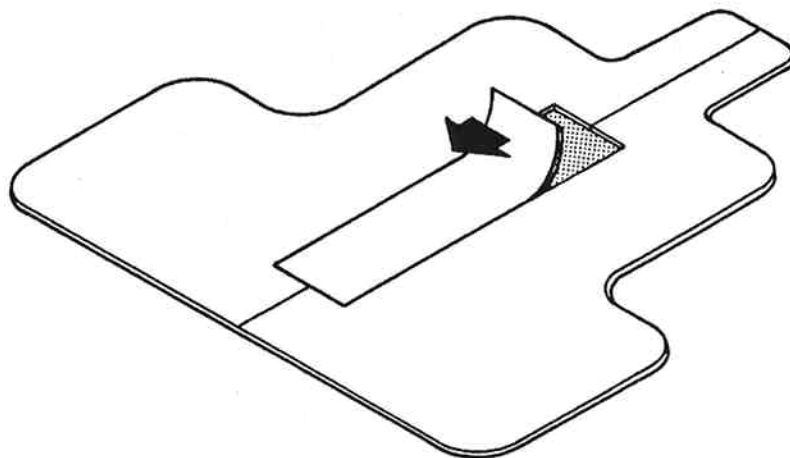
The suggested probe site is a finger. Proper coverage of the Flex Probe detector is essential. Use the finger that best covers the detector.

1. Clean the surface of the probe before and after each use. (See "Cleaning and sterilization," in "5/Maintaining and Calibrating the System" of "Reference").
2. Remove the center strip of protective paper from the disposable adhesive wrap.
3. Gently flatten the flex probe if necessary. Place the probe back side on the center of the wrap with the probe emitter end towards the tab. Press the probe firmly onto the adhesive surface.
4. Remove the remaining protective paper from the wrap.

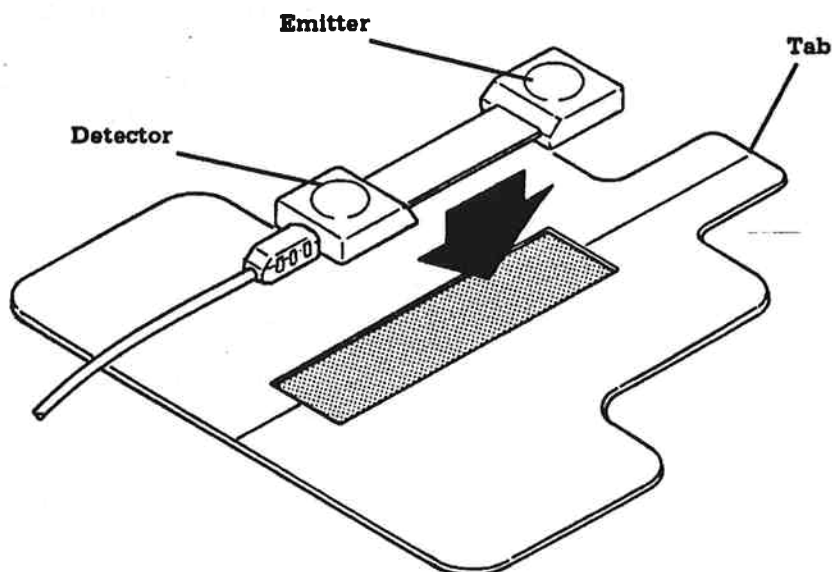
### 3/Making the Patient Connections

5. Center the probe emitter (the end without the cable) over the finger-nail. Secure the wrap tab onto the finger.
6. Curving the Flex Probe around the end of the finger, place the detector flush against the finger pad. Ensure that the probe cable comes out at the bottom of the finger. Check that the detector and emitter blocks are directly opposite each other and have good contact with the finger.
7. Pinch the wrap down on the sides of the finger. Do not fold the sides down. This may cause an overly tight wrap, which could result in a poor signal.
8. Alternately wrap the bottom sides of the adhesive wrap over the top of the finger (nail side).
9. To determine if the probe is attached correctly and if the display data is verifiable, see "SpO<sub>2</sub> Signal and data validity" in "6/Starting Operation."

**Figure 3-7**  
Removing the  
center strip  
from the flex  
probe's adhesive  
wrap

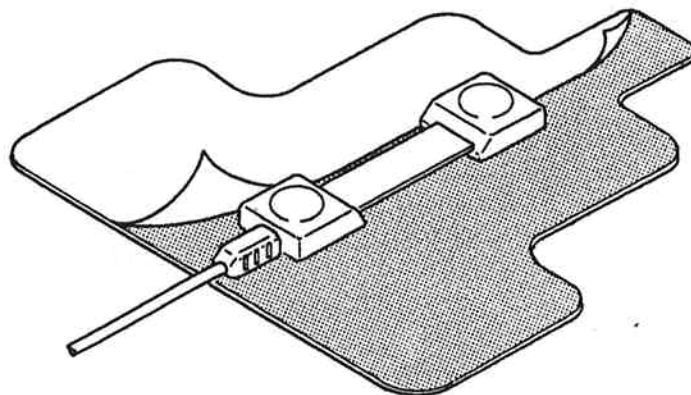


**Figure 3-8**  
Placing the  
SpO<sub>2</sub> flex probe  
on adhesive  
wrap

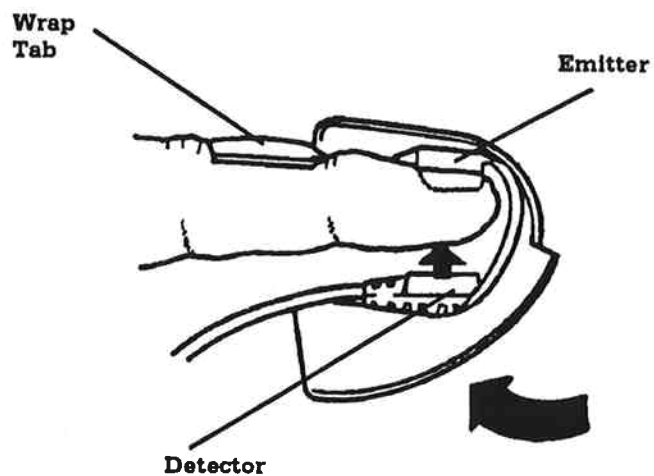


### 3/Making the Patient Connections

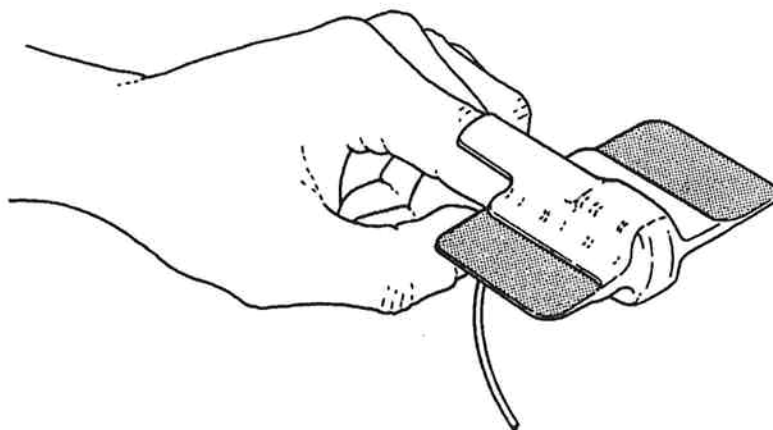
**Figure 3-9**  
A SpO<sub>2</sub> Flex  
probe mounted  
on adhesive  
wrap



**Figure 3-10**  
Placement of  
a SpO<sub>2</sub> Flex  
probe on a  
finger

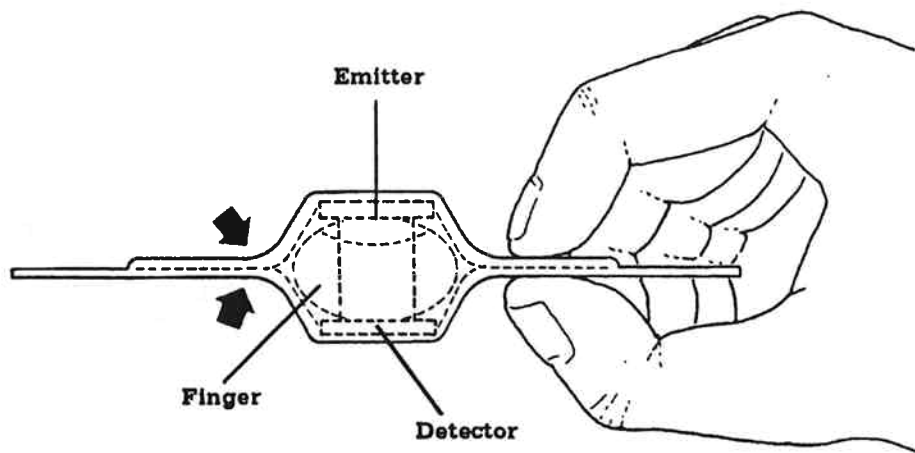


**Figure 3-11**  
SpO<sub>2</sub> probe  
adhesive wrap  
pinched on  
finger sides



### 3/Making the Patient Connections

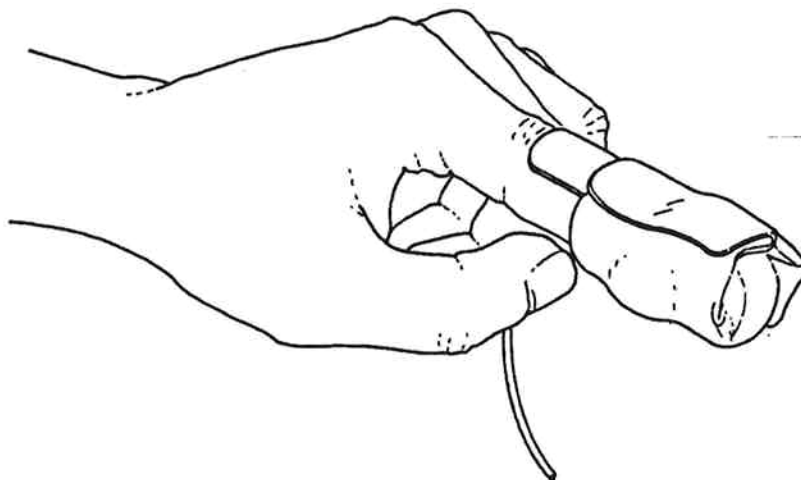
**Figure 3-12**  
End view of  
SpO<sub>2</sub> flex probe  
and wrap  
around finger



#### Removing a Flex Probe from an adult

1. Unfold the sides of the disposable adhesive wrap.
2. Lift the wrap tab off the finger.
3. Loosen and gently pull the probe and wrap from the finger.
4. Unfold the wrap.
5. To prolong the Flex Probe's life, use the following technique to remove it from the disposable adhesive wrap. Grasp the emitter block and gently pull the probe from the wrap. Do not pull on the cable when separating the probe from the wrap.
6. The adhesive wrap is intended for only a single use. Apply the probe to a new adhesive wrap with each successive use.

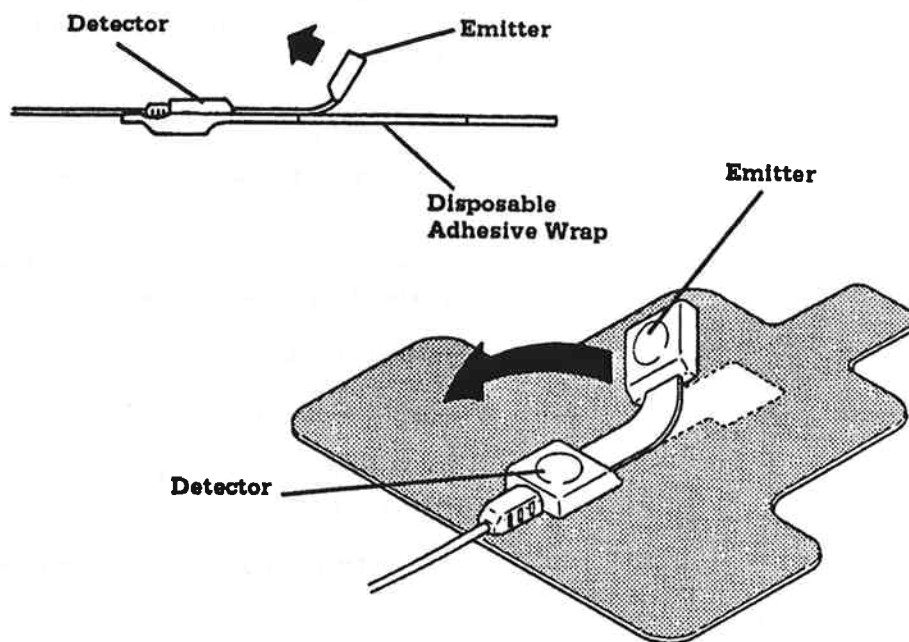
**Figure 3-13**  
SpO<sub>2</sub> Flex probe  
wrapped on a  
finger





### 3/Making the Patient Connections

**Figure 3-14**  
Removing SpO<sub>2</sub>  
Flex probe from  
adhesive wrap



#### Attaching a Flex II Probe (for neonates and pediatrics)

The Flex Probe is a reusable probe designed for use with neonates or pediatrics.

The probe site choice will vary depending on the size of the infant and the site availability. Any site producing a verifiable signal can be used. Some suggestions are the palm, sole of the foot, ankle, calf, and forearm. Additional sites in larger patients are the big toe, thumb, and outer aspect of the foot near the little toe.

Important:

When attaching the probe to the patient, apply as little pressure as possible to the probe site. This is particularly important in neonatal applications.



**WARNING:** Patient condition may require changing the probe site periodically. This should diminish the possibility of pressure necrosis of the probe site.



**WARNING:** Exercise extreme care to ensure continued circulation distal to the probe site after application.



**WARNING:** LEDs (Light Emitting Diodes) in the probe generate a small amount of heat as a by-product of light emission. Although producing a minimal rise in temperature, the probe site should be checked periodically, at least every two to four hours in long term monitoring, particularly in neonatal applications.

### 3/Making the Patient Connections

To attach  
the probe

1. Clean the probe surface before and after each use. (See "Cleaning and sterilization," in "5/Maintaining and Calibrating the System" of "Reference.")
2. Place the probe detector on the bottom of the foot. The detector should be flush against the probe site and fully covered. Optional adhesive disks can be used; see the instructions on adhesive disks in step 4.
3. Place the probe emitter on top of the foot. The probe emitter and the probe detector should be opposite each other.

When using the foot as a probe site, the signal strength is best when the probe is placed close to the toes. With extremely small feet, place the probe toward the heel of the foot for good coverage.

4. Select a piece of wrap and apply it once around the foot to hold the probe in place.

**WARNING:** When using a Flex probe, do not cut off circulation.

The adhesive disk is an optional item for use with the Ohmeda Pulse Oximeter probes. It facilitates easy, initial placement and a flush patient/probe interface.

**WARNING:** Where patient skin is fragile or sensitive to adhesive tape, do not use the adhesive disks.



If you want to use  
adhesive disks

- a. Remove adhesive disks from the holder.
  - b. Place one disk on the probe emitter.
  - c. Place another disk on the probe detector.
  - d. Make sure the colored disk tab does not cover the emitter or the detector surfaces.
  - e. Remove the protective paper cover from the disks before mounting the probe at the site.
5. The probe can be further isolated from patient motion by taping the probe cable to the patient surface three to six inches from the probe head.

**WARNING:** Exercise extreme care to ensure continued circulation distal to the probe site after application.

**CAUTION:** Do not apply tension to the probe cable. Probe damage may result.

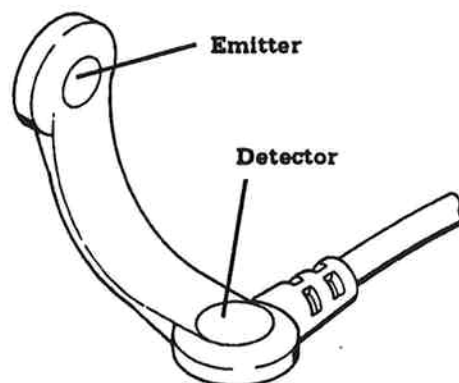
6. To determine if the probe is attached correctly and if the data is verifiable, see "SpO<sub>2</sub> Signal and data validity" in "6/Starting Operation."

After monitoring, remove the wrap, probe, and the adhesive disks if they were used. The adhesive disks are intended for one-time use only; apply new adhesive disks to the probe with each use.

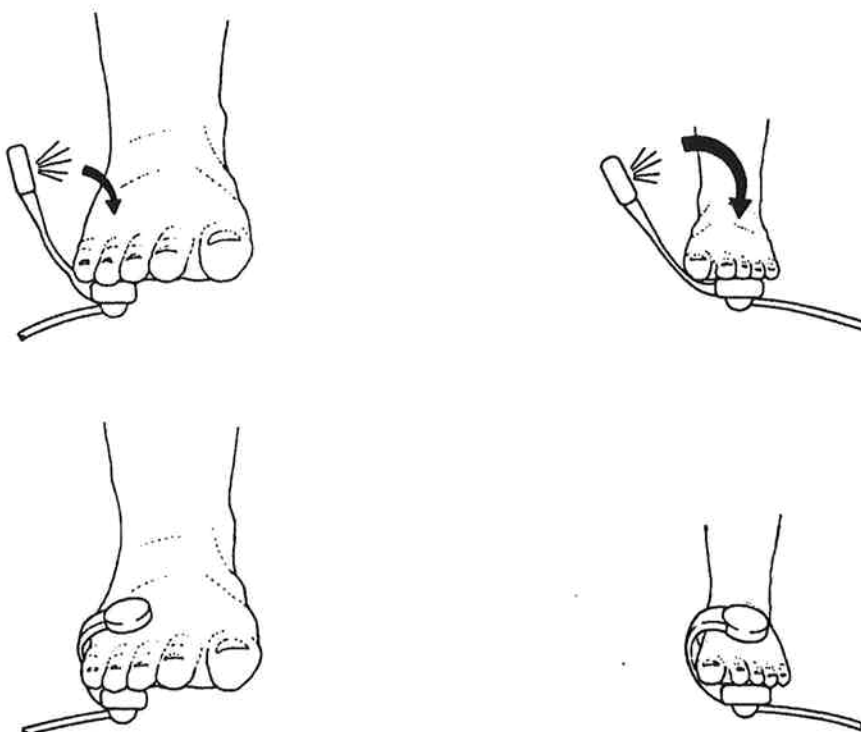


### 3/Making the Patient Connections

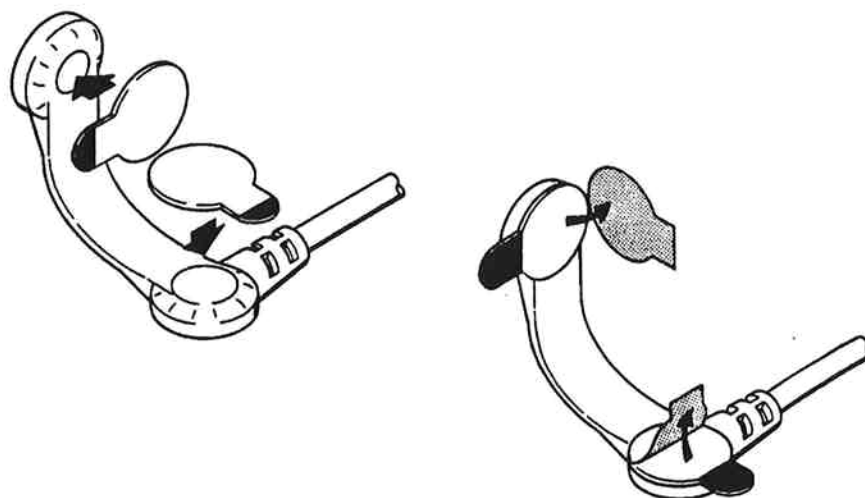
**Figure 3-15**  
Flex Probe,  
emitter and  
detector



**Figure 3-16**  
Flex Probe  
applications



**Figure 3-17**  
Applying  
adhesive disks  
to the Flex probe



# Notes

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# 4/Using the Display Pod

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## The display pod's powerup sequence

**Figure 4-1**  
The display  
pod



## 4/Using the Display Pod

The normal  
startup  
sequence

When you switch on the Ohmeda Modulus CD Anesthesia System, it will display:

### Ohmeda Modulus® CD Anesthesia System



Software Version xx.xx

Self test in progress —> Please Wait

Once the system has completed its internal tests, it will display the first of the preoperative checklist screens. (See the next section to use the preoperative checklist.)

If any of these tests cannot be successfully completed, the system will display an error message. Write down the number of any error messages the system displays. These error messages are used by service personnel when troubleshooting the system.

If the system  
does not display  
the display's  
normal startup  
screen or if it fails  
a powerup test

Because the Ohmeda Modulus CD Anesthesia System's operating software is stored in the system's electronic memory, normally you shouldn't have to have the system software disk in the disk drive to start up the system. It is possible, although rare, for the information stored in RAM-disk memory to be corrupted.

To reload the  
system  
software

If the system does not display the powerup screen, followed by the preoperative checklist, you must use the "system" software disk to reload the operating software.

1. Move the system master switch to standby. (Whenever you switch the system standby, then on, always leave the system in standby for at least five seconds.)
2. Insert the disk labeled "system" into disk drive one, which is on the side of the display pod.

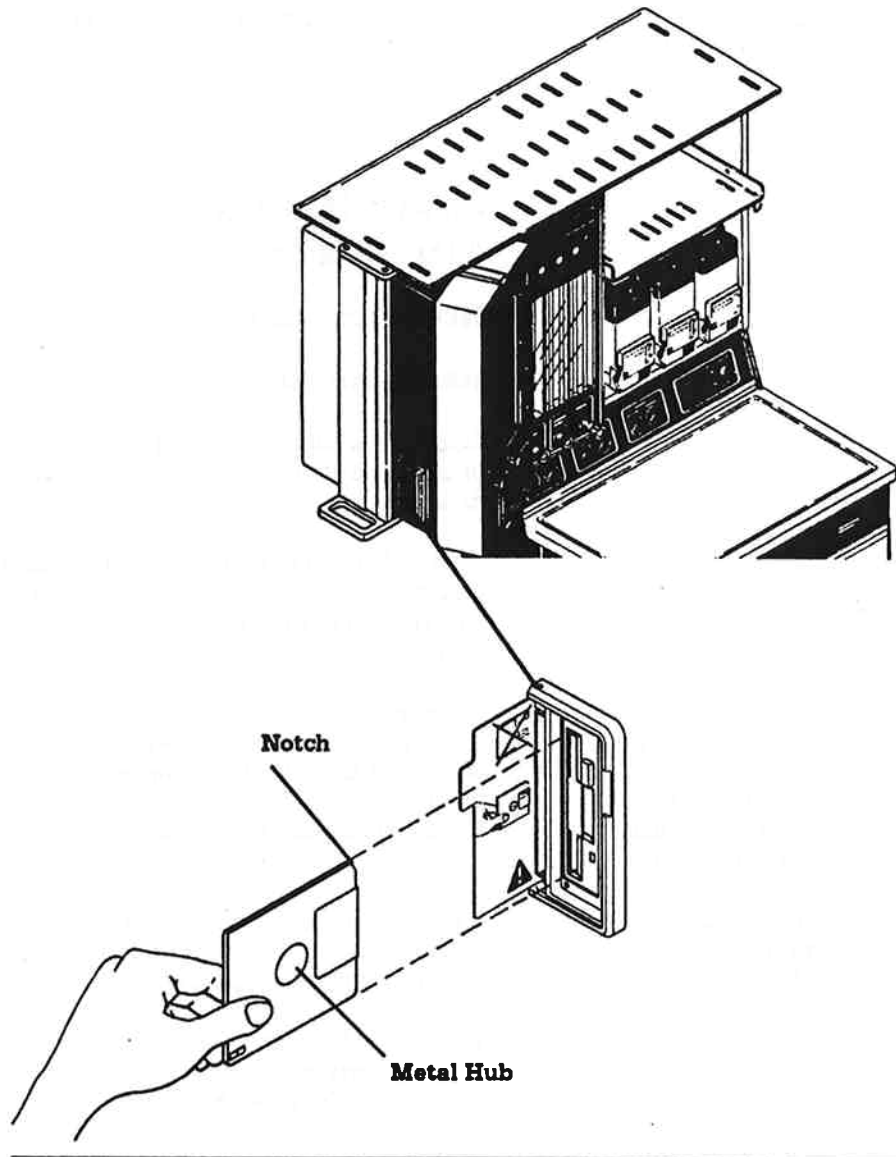


**CAUTION:** When inserting a disk, make sure that the bottom of the disk—the part with the metal hub—faces the front of the gas machine. If the disk does not go into the disk drive smoothly, check to make sure both that the disk is oriented correctly and that another disk is not in the drive. Do not force the disk into the disk drive. Forcing a disk into the disk drive may damage the drive.

3. Move the system master switch to on. Loading the operating software from disk will take about three minutes.
4. After using the system, remove the system disk; this will make starting the system faster next time. If, next time you use it, the system will not start without the system disk in the disk drive, see "Rebuilding the display pod's RAM disk" in "5/Maintaining and Calibrating the System" in "Reference."

## 4/Using the Display Pod

**Figure 4-2**  
Inserting the system  
software diskette



### Selecting the display pod's functions

Selecting any of the system's functions is usually as simple as pressing the key for that function. For example, to display the ventilation page, just press:



The system will then display the ventilation information on the lower screen.

Certain functions, however, require a preexisting condition before you can select them. Before you can select the polygon display, for example, the alert zones must be active. If you attempt to select a function that requires a preexisting condition, the system will display a message reminding you of the preexisting condition that is needed.



## 4/Using the Display Pod

Moving from  
function  
to function

Keys on the display pod are grouped by function. The "upper display format" keys, for example, control the way information is displayed on the top screen. The "lower display selection" keys control the information that is presented on the lower screen. Some other keys, such as "alarm silence" and "alert zones," affect only certain information displayed on certain screens. And some keys, such as "hold" don't affect the displays at all. To exit a displayed function, just press any other key that controls a function that is displayed on the same screen. For example, to exit the ventilation function, you could press "primary display," since the primary display appears on the lower screen. Pressing "numeric," however, would have no effect on the lower screen since the numeric display appears on the upper screen.

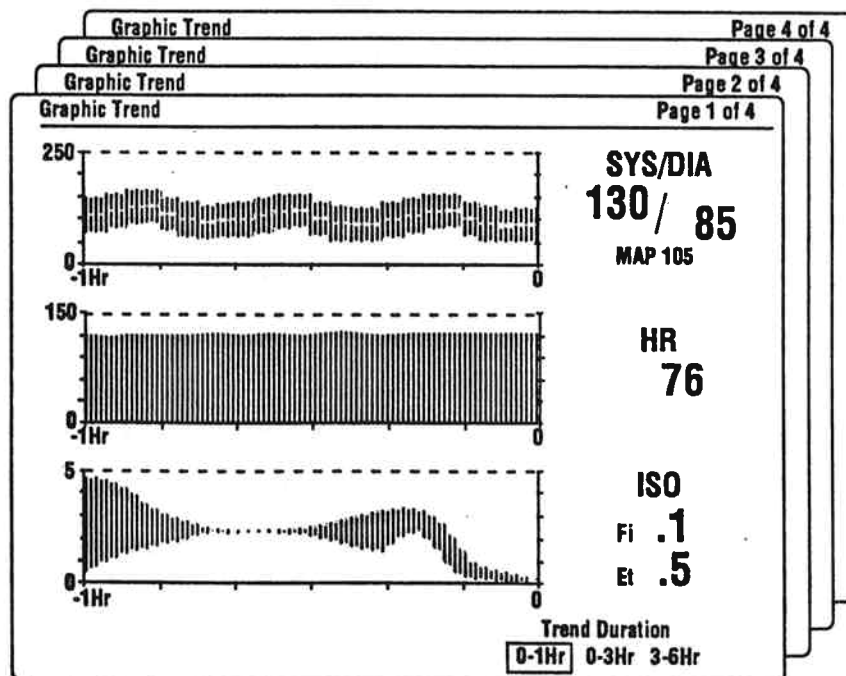
Moving from  
page to  
page within  
a function

Some of the system's functions have more than one display—or "page"—associated with them. Functions that include more than one page are labeled with both the number of pages and the current page. The second page of a four-page function, for example, will read "2 of 4" at the top of the display. Keys that control these functions are marked with a special "folded corner" symbol, which is at the upper-right corner of the keys. To move from page to page in a function that is controlled by one of these keys, press the key again. Each press of the key will move you to the next page. When you reach the final page in the series, pressing the key again will return you to the first page.

Keys that  
control  
multi-page  
functions

- Manual (setup)
- Graphic trend
- Digital trend
- Checklists
- Help

**Figure 4-3**  
Series of pages



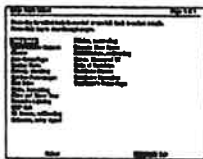
# 4/Using the Display Pod

**Figure 4-4**  
"Multi-page" key



**CAUTION:** Do not use sharp objects to push the display pod's keys. Sharp objects may puncture the pod's front panel, and may cause the display pod to malfunction.

## To get on-screen help



You can use the system's help key to display information about what the system's keys do, what the system's displays mean, and other topics pertaining to the system's operation. The information displayed on the help pages is intended as a quick reference guide to the system, not as a substitute for the in-depth descriptions included in this manual.

To get help

1. Press:



The system displays the help page, which includes a list of topics.

If the system displays "insert system disk," put the system disk into the disk drive and press "help" again.

2. If you want information about a specific key, press that key. The system will then display a page of information about that key. If the help system includes more information about the topic, the top of the page will read "1 of 2." To move to the next page, press "help" again.

If you want information about one of the topics that is listed on the screen, use the left knob to highlight the topic, then press "help" again.

3. To return to the original help page to get information on another topic,

- a. Press any key except "help."

- b. press:



The system again displays the first help page.

To exit the help page

There are three ways to exit help pages.

- If you are still on the first help page, use the left knob to highlight "exit help," then press the help key.
- If you are on any other help page, press any key except "help."
- On any page, wait two minutes without pressing a key. The system will automatically return to the screen that was displayed before you selected help.

# 4/Using the Display Pod

## Using the on-screen preoperative checklists

Whenever you power on the system, it will display the preoperative checklists. These checklists are intended only to guide you through the complete checkout procedure described in "Preoperative Checkout Procedures."

When you first press "checklist" the system will display a table of contents for the checklists. Repeatedly press "checklist" to move from each page of the checklists to the next. Once you have completely checked the system, press a key in the lower display group to exit the checklist.

## Using the display pod's setup pages



Manual setup  
page variables

System variables, such as screen brightness and alarm audio volume, that are not normally set during a case are adjusted through the manual setup pages. These variables include:

- Agent selected to be measured
- Alarm audio volume
- Pulse audio volume
- Display brightness
- Ventilation alarm source (tidal volume or expired volume)
- Respiratory rate alarm source (automatic, volume monitor, or CO<sub>2</sub> monitor)
- NIBP patient mode (adult/pediatric or neonatal)
- SpO<sub>2</sub>/NIBP interface (automatic, on, or off)
- SpO<sub>2</sub> response timing (3, 6, or 12 per second periods)
- Alarm limit display (on demand or continuous)
- Printer logging interval
- Time and date

In addition to the variables set in the manual setup page, the auto-setup page sets:

Auto setup  
page variables

- Alarm limits
- Zone widths
- Trend durations

You can set these variables either individually through the two manual setup pages or as preset groups through the auto-setup page. In the manual setup pages you will use the display pod knobs to step through and adjust any of the variable settings you want to change. In the auto-setup page you will use the left knob to choose one of twelve preset groups of variables. For example, group one might set the anesthetic agent to halothane, the ventilation alarm source to tidal volume, and the blood pressure alarm source to diastolic, while group two might set the agent to enflurane, the ventilation alarm to end tidal, and the blood pressure alarm to mean average pressure; the variables set in these groups can be adjusted by authorized, trained personnel.

# 4/Using the Display Pod

## Using the manual setup pages



The default settings

Pressing "setup" displays the first of the two manual setup pages, which let you set variables not normally adjusted during a case. Although the following procedure describes setting all of the variables in the order they appear on the setup pages, you can set any number of variables in any order. When you are ready to implement the changes you've made and exit the setup page, press any key.

When you first power on the system, before you use the manual or auto setup pages to set the system's operating parameters, the system uses a set of default settings for these parameters. In the following instructions, the default settings are shown in *italics*.

Select the first setup page

1. Press: 

The system displays setup page one. If you do not want to set all of the setup page variables, skip to those you do want to set.

Choose an agent to measure

2. Use the left knob to highlight "anesthetic agent."
3. Use the right knob to move the cursor from "agent?" to "iso," "enf," or "hal."

This tells the respiratory gas monitor to measure either isoflurane, enflurane, or halothane.

Set the alarms' audio volume

4. Use the left knob to highlight "alarm volume."
5. Use the right knob to move the cursor to an alarm volume level from one to seven. (The default is "3.")

As you move the cursor, the system sounds the alarm volume that will be used for the display-pod warning alarms.

Set the pulse audio volume

6. Use the left knob to highlight "pulse volume."
7. Use the right knob to move the cursor to "off" or a pulse volume level from two to seven. (The default is "4.")

As you move the cursor the system sounds the pulse volume that the display pod will use. Move the select cursor off of "pulse volume" to silence the tone.

Set the display brightness

8. Use the left knob to highlight "display brightness."
9. Use the right knob to move the cursor to a brightness level from one to seven. (The default is "4.")

As you move the cursor the system displays the brightness level that will be used. To prolong the lives of the display pod's CRTs, set the brightness to the lowest level that you find comfortable in the ambient light with which in the system will be used.

## 4/Using the Display Pod

Choose a source  
for the ventilation  
alarms

10. Use the left knob to highlight "vent alarm source."

11. Use the right knob to move the cursor to "VT" or "VE."

This determines whether tidal volume or minute volume will be used both to trigger ventilation alarms and as the ventilation reading shown on the display pod.

Choose a source  
for the respiratory  
rate display

12. Use the left knob to highlight "RR source" (respiratory rate display source).

13. Use the right knob to move the cursor to "auto," "vol mon," or "CO<sub>2</sub> mon."

Choosing "auto" tells the system to attempt to use the volume monitor as the source, but to use the CO<sub>2</sub> monitor if the volume monitor isn't providing an acceptable signal.

Move to the  
second setup  
page

14. Press:



The system displays setup page two.

Choose the  
NIBP monitor's  
patient mode

15. Use the left knob to highlight "NIBP patient mode."

16. Use the right knob to move the cursor to "adult/ped," or "neonatal."

This setting determines both the maximum inflation pressure the NIBP monitor will use and the set of NIBP alarm limits the system will use. It also changes the blood pressure trend scale.

Choose the  
SpO<sub>2</sub>/NIBP  
interface

17. Use the left knob to highlight "SpO<sub>2</sub>/NIBP interface."

18. Use the right knob to move the cursor to "auto," "on," or "off."

Choosing "auto" tells the system to determine if the SpO<sub>2</sub> probe is on the same limb as the NIBP cuff. Then (if the system determines that the cuff and probe are on the same limb) certain oximeter-related alarms are silenced while the cuff is inflated. Choosing "on" silences most oximeter-related alarms while the cuff is inflated, whether or not the cuff and probe are on the same limb. Choosing "off" tells the system not to silence the oximeter-related alarms when the cuff is inflated.

Choose the SpO<sub>2</sub>  
response time

19. Use the left knob to highlight "SpO<sub>2</sub> response."

20. Use the right knob to move the cursor to "3," "6," or "12."

The number you choose sets the period in seconds over which the system averages the SpO<sub>2</sub> readings, which are used for both the heart rate and SpO<sub>2</sub> displays. Longer periods increase the number of measurements that are used to determine the displayed values, but decrease the frequency at which the values are updated.

## 4/Using the Display Pod

Display the alarm limits either continuously or on demand

21. Use the left knob to highlight "alarm limit display."
22. Use the right knob to move the cursor to "on demand" or "continuously."

"On demand" means that the alarm limits are displayed only when you are adjusting them.

Set the printer logging interval

23. Use the left knob to highlight "printer logging interval."
24. Use the right knob to move the cursor to "20s," "1 min," "3 min," or "5 min."

This sets the intervals at which data is sent to the printer port.

Set the real-time clock and calendar

25. Use the left knob to highlight "hour," "minute," "month," "day," or "year."

26. Use the right knob to set the time and date.

Exit the manual setup page.

27. Press any other key or wait 15 seconds without making an adjustment.

The system exits the manual setup page and stores any changes you made.

### Using the auto-setup page



The auto-setup page lets you quickly and easily modify all of the setup page variables as well as the alarm limits, the zone widths, and the trend durations. Rather than set these variables individually, as on the manual-setup, trend, and alarm pages, on the auto-setup page you can choose one of twelve predetermined groups of settings, which can be customized by authorized, trained personnel. (See "Programming the auto-setup page configuration sets" in "5/Maintaining and Calibrating the System" of "Reference.")

On the auto setup page is a list that can contain as many as fourteen names. "Ohmeda default" will usually appear at the top of the list. Selecting "Ohmeda default" sets the auto-setup page variables to the system default values (see "System default settings" in the appendix of "Reference").

Listed under "Ohmeda default" will always be twelve slots for customized variable group names, which should be set only by authorized personnel. Your institution should determine which settings are most appropriate for each variable group. These groups of settings and their names should then be used consistently throughout your institution. Your institution might, for example, name one group "Ob-Gyn," name another "Cardiac," and assign appropriate groups of settings for these type of procedures. Your authorized personnel would then install these names and groups of settings on all of the Ohmeda Modulus CD Anesthesia Systems in your facility.

Worksheets and dates

To provide a record of these settings, worksheets are provided in the reference volume's appendix. Next to each name on the list is a date that indicates when each setting group was customized. Before selecting any group, check its date against the date on its worksheet. If these dates do not match, do not select that group.

## 4/Using the Display Pod

Check the  
printer

1. Make sure the printer cable connects from the system's serial communication port to the printer. (See "1/Working with Data" in "Reference" for instructions on connecting a printer.)
2. Before switching on the printer, check your paper supply and set the paper so the printer will start printing at the top of the page. (Many types of printers can be damaged if—while the printer is powered—you use the platen knob to advance the paper. Whenever you manually advance your printer's paper, either switch off the printer, or take the printer "off line" (most printers have an "on line" button), then press the "line feed" button (which most printers also have). Refer to your printer's manual to find the best way to load and advance paper.

Prepare the  
printer

3. Switch on your printer. If the paper is not correctly aligned with the top of the page, take the printer "off line," then press the "line feed" button to advance the paper to the top of the page
4. Make sure your printer is on line. (Your printer's "on-line" indicator should be lighted.)

Set the interval  
at which data  
will print

5. If you have already set the printer logging interval, or if you want to use the default interval of three minutes, skip to step 6.

a. Press:



The system displays the first manual setup page.

b. Press:



The system displays the second manual setup page.

c. Use the left knob to highlight "printer logging interval."

d. The system can send sets of data at intervals of 20 seconds, one minute, three minutes, or five minutes. Use the right knob to highlight either "20 sec," "1 min," "3 min," or "5 min."

Display the  
printer  
instructions

6. Press:



The system displays:

Turn on printer and check paper supply.

Align printer head to top of page.

Set Printer Logging Interval on page 2 of Manual Setup.

Press Printer Logging On/Off key again to start logging.

7. Press:



Because the system keys printing to even intervals on the real-time clock, the system may not start printing right away. When the system clock coincides with the interval you selected the system will start printing.

## 4/Using the Display Pod

To print a "snapshot" of the current patient data

8. Normally the values the system prints are averaged over a 20-second period. To immediately print a set of unaveraged values,

press:



The system prints "event number x" followed by the measured data and the time at which you pressed "event marker." Then, when the next normal interval occurs, the system continues logging averaged data.

### Logging data to a disk

When you use disk logging, an alphanumeric representation of the system settings and displayed measured data is stored on a formatted 3.5 inch disk. The system stores this data as a tab delimited ASCII text file. (See "1/Working with Data" in "Reference" for details on disk logging and formatting disks.) Data is stored at 20-second intervals and whenever the NIBP completes a measurement cycle.

### Beginning data logging

1. If the system boot disk is in the disk drive that is located on the side of the display pod, remove it and store it in a safe place.
2. Insert a formatted 3.5 inch disk that is not write-protected into the disk drive. Insert the disk so that its notched corner is up and enters the disk drive first and the back of the disk (the side with the metal hub) is toward the front of the anesthesia machine. (See "1/Working with Data" in "Reference.")

Insert a formatted disk

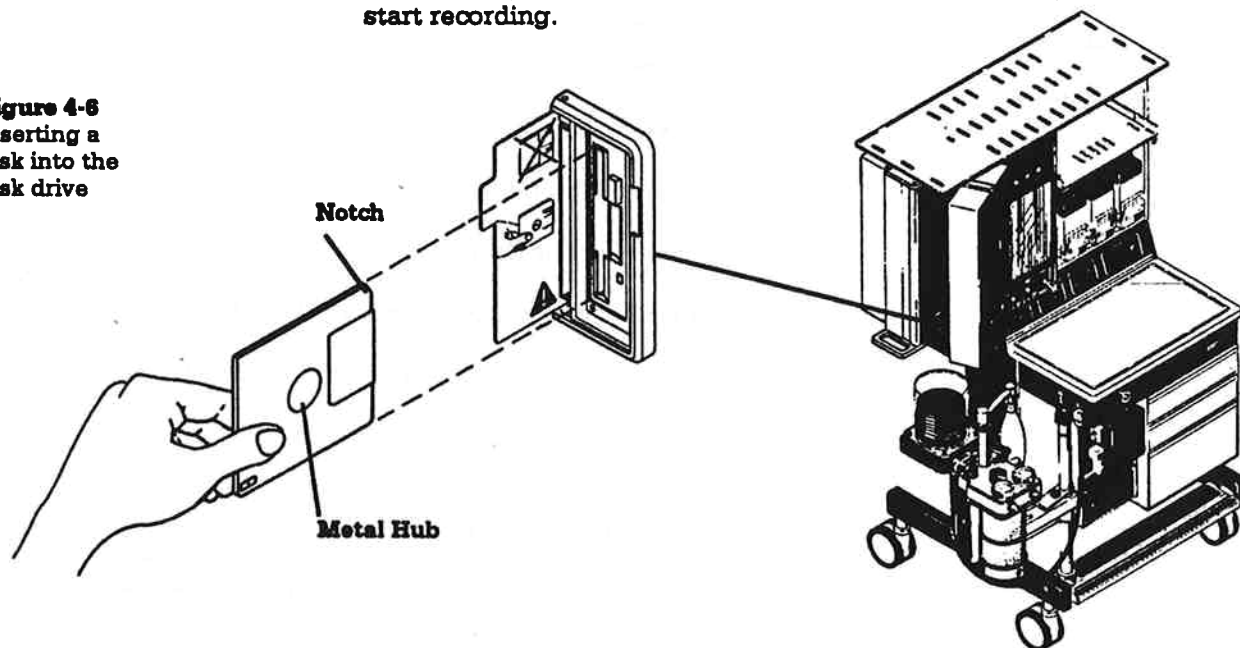
Start logging data

3. Press:



Because the system keys data storage to even 20-second intervals on the real-time clock, the system may not start recording right away. When the system clock reaches an even interval, the system will start recording.

**Figure 4-6**  
Inserting a disk into the disk drive





## 4/Using the Display Pod

To store a "snapshot" of the current measured data

- 4 Normally the values the system stores are averaged over a 20-second period. To immediately store a set of unaveraged values,

press:



The system stores "Event Number x" and the measured data and time at which you pressed "event marker." Then, when the next normal interval occurs, the system continues printing averaged data.

### During data logging to disk

To remind you that it is logging data to disk, the system lights the green LED that is on the "disk logging on/off" button. If, after you press "disk logging," a condition occurs that prevents the system from properly storing data on the disk, the system will extinguish the green LED and—to help you solve the problem—will also display a message on the upper screen. For example, if you haven't placed a disk in the disk drive, the system will display "disk drive empty, install formatted disk."

If the system displays:

**Remove System  
Disk Replace With  
Formatted Disk**

A disk that contains the system's operating program is in the disk drive. Remove the system disk and store it in a safe place. Insert a formatted disk into the disk drive.

**Disk Not Formatted  
Replace With  
Formatted Disk**

The disk in the disk drive is either not formatted or is not formatted correctly. Most disks are sold unformatted; you must format these disks to either the standard IBM®\* 720k or 1.44 meg convention. (See "1/Working with Data" in "Reference.") Insert a formatted disk into the disk drive.

**Disk Full**

The disk in the disk drive cannot hold any more data. (Typically a disk will last for about nine hours of data logging.) Remove the disk, move its write-protect tab to the "read only" position (see "1/Working with Data" in "Reference."), and store the disk in a safe place. Insert a new, formatted disk into the disk drive, then press "disk logging on/off."

**Disk Drive Empty  
Install Formatted Disk**

Insert a formatted disk into the disk drive.

**Disk Write  
Protected Install  
Formatted Disk**

The write-protect tab on the disk is in the read only position. This sliding tab's position tells the system whether it is allowed to write data onto the disk. Remove the disk from the drive and slide the tab to the "write" position.

**Disk Near Full**

The disk has 50 kilobytes or less space left. (Typically a new disk will last for about nine hours of data logging. Fifty kilobytes will last about thirty-five minutes.) Press "disk logging on/off" to stop data logging. Remove the disk, move its write-protect tab to the "read only position" (see "1/Working with Data" in "Reference"), and store the disk in a safe place. Insert a new, formatted disk into the disk drive, then press "disk logging on/off" to restart logging (the system will start a new file).

**Disk Write Fail**

The disk is damaged in such a way that the system cannot write to it. Remove and discard the bad disk. Insert a new, formatted disk into the disk drive, then press "disk logging on/off" to restart logging (the system will start a new file).

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## 4/Using the Display Pod

### Stopping disk logging

Removing a disk from the disk drive while data logging is on can result in both damage to the disk and the loss of data that is on the disk.



**CAUTION:** To avoid damaging disks and losing data, always properly stop data logging and ensure that the disk drive's light is off before removing the disk from the disk drive.

If you want to remove a disk while the "disk logging on/off" button's green LED is lighted (indicating that the system is storing data on the disk), or if you just want to stop data logging,

press:

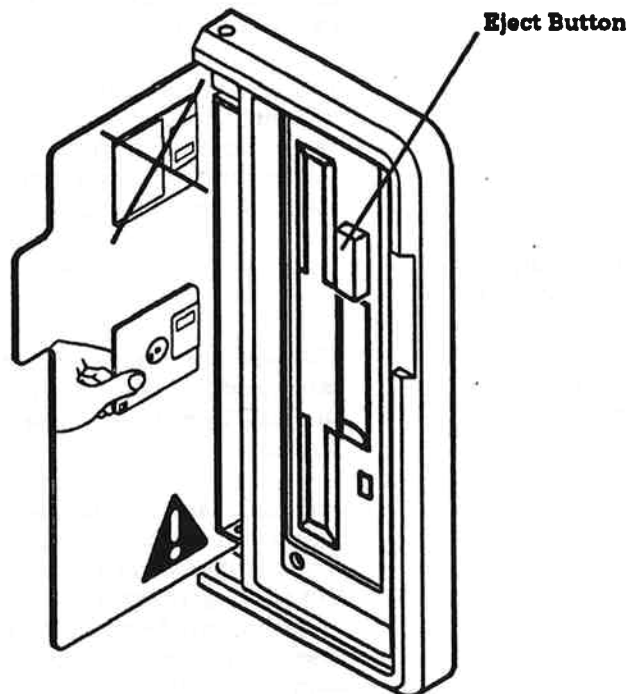


The system extinguishes the "disk logging on/off" button's green LED.

To remove a  
disk

To eject a disk from the disk drive (after making sure that data logging is off), open the disk drive's cover, then press the button at the top of the drive.

**Figure 4-7**  
Disk drive's  
eject button



# 5/Using the Ventilator

## In this section

Using the ventilator's setup page 5-1

If the display pod is functioning 5-1

If the display pod is not functioning 5-3

Setting the inspiratory pressure limit 5-5

Additional alarms controlled by the ventilator's front panel 5-6

Using the backup mode 5-7

## Using the ventilator's setup page

In the setup page the ventilator's front panel controls are used to set parameters not normally adjusted during a case, such as the ventilator's screen contrast and the audio setting. If the display pod is not functioning, the ventilator's setup page will also control the oxygen sensor's calibration.

When you first enter the setup page, the ventilator displays its model number, the set drive gas ("O" for oxygen and "A" for air), the version number of the software it is using and the language selected (because the ventilator's software also accommodates languages other than English). The ventilator then lets you adjust the status of reverse flow detection, the screen's contrast, the alarm volume, and, if the display pod is not functioning, the oxygen sensor's calibration. These parameter settings are saved even when the system is off. To adjust the setup parameters, turn the flow dial. To move from one parameter to the next, press the alarm silence button.

To exit the setup page, either repeatedly press the ventilator's alarm silence button to move through all the steps or, before you reach the final setup page step, move the mechanical ventilation switch to on. When the ventilator exits the setup page, it will first store any changes you've made, then it will exit the setup page and begin normal operation. As the ventilator exits the setup page it will beep once and display "check settings." Although you must press the inspiratory pause button to begin using the setup page, the ventilator maintains the inspiratory pause function's original state.

### If the display pod is functioning

1. Move the mechanical ventilation switch to off.
2. If the anesthesia system's master switch is in standby, switch it on.

**Figure 5-1**  
The ventilator's  
setup page



## 5/Using the Ventilator

3. Press and continue to hold down the alarm silence button, then press the inspiratory pause button. Release both buttons.

The ventilator displays:

7850 REV xx.xx /O

ENGLISH



**WARNING:** Pay attention to the model, software revision number, drive gas, language, and altitude setting shown on the setup page. If the language displayed is other than "English," if the model is other than "7850," or if the drive gas abbreviation is other than "/O" (for oxygen) have an Ohmeda-trained service representative reset the ventilator. Other languages, models, and drive gases have associated operating parameters that are not described in this manual.

4. Press:  (on the ventilator).

The ventilator displays:

FLOW KNOB TO SET

REV FLOW ALM ON or OFF

Setting the  
reverse flow  
alarm status



5. If you are are using the volume sensor at the proximal end of the "Y" connector in the patient breathing system, you may want to disable the reverse flow alarm, which, in that position, can be triggered by normal breathing. See "5/Making the Monitoring Connections" in "Setting Up" for information about installing the volume sensor.

**WARNING:** Do not disable the reverse flow alarm if the sensor is mounted in the distal position of the expiratory limb; in this position the alarm provides valuable information about possible breathing-system malfunctions.

To disable the reverse flow alarm, turn the flow knob clockwise until the display changes to off. When you are ready to move to the next step,

Press: 

The ventilator displays:

FLOW KNOB TO

SET CONTRAST: xx

Setting the  
screen contrast

6. If you want to adjust the LCD screen's contrast, turn the flow dial. As you turn the dial, the ventilator will show a one-to-ten scale that indicates the screen contrast that will be used during normal operation. For best results, set the room lighting to the level that will be used while you are operating the ventilator. When you are ready to move to the next step,

## 5/Using the Ventilator



The ventilator displays:

FLOW KNOB TO SET

AUDIO VOLUME: xx

Setting the  
audio volume

7. If you want to adjust the audio volume level, turn the flow dial. The displayed number represents, on a scale of one to ten, the current volume level, which is also sounding. As you turn the dial, the ventilator will change the tone's volume and the displayed number to indicate the level that will be used during normal operation. When you are ready to move to the next step,



The ventilator silences the alarm and displays:

CHECK SETTINGS!

Any changes you selected are implemented (the inspiratory pause button retains the state it was in when you selected the setup page).

### If the display pod is not functioning

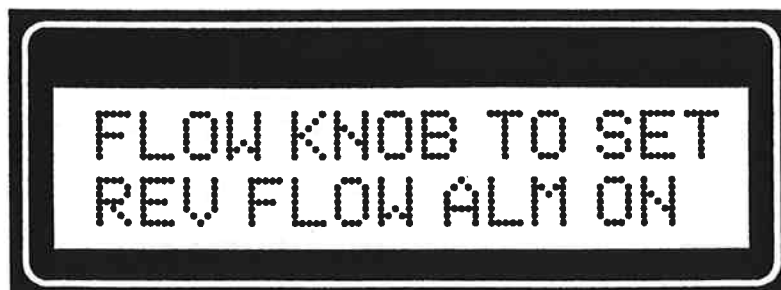
1. Move the mechanical ventilation switch to off.
2. If the anesthesia system's master switch is in standby, switch it on.
3. Press and continue to hold down the alarm silence button, then press the inspiratory pause button. Release both buttons.

The ventilator displays:

7850 REV xx.xx /0

ENGLISH

**Figure 5-2**  
The ventilator's  
setup page



## 5/Using the Ventilator



**WARNING:** Pay attention to the model, software revision number, drive gas, language, and altitude setting shown on the setup page. If the language displayed is other than "English," if the model is other than "7850," or if the drive gas abbreviation is other than "/O" (for oxygen) have an Ohmeda-trained service representative reset the ventilator. Other languages, models, and drive gases have associated operating parameters that are not described in this manual.

4. Press:  (on the ventilator).

The ventilator displays:

FLOW KNOB TO SET

REV FLOW ALM ON or OFF

Setting the  
reverse flow  
alarm status

5. If you are are using the volume sensor at the proximal end of the "Y" connector in the patient breathing system, you may want to disable the reverse flow alarm, which, in that position, can be triggered by normal breathing. See "5/Making the Monitoring Connections" in "Setting Up" for information about installing the volume sensor.



**WARNING:** Do not disable the reverse flow alarm if the sensor is mounted in the distal position of the expiratory limb; in this position the alarm provides valuable information about possible breathing-system malfunctions.

To disable the reverse flow alarm, turn the flow knob clockwise until the display changes to off. When you are ready to move to the next step,

Press: 

The ventilator displays:

FLOW KNOB TO

SET CONTRAST: xx

Setting the  
screen contrast

6. If you want to adjust the LCD screen's contrast, turn the flow dial. As you turn the dial, the ventilator will show a one-to-ten scale that indicates the screen contrast that will be used during normal operation. For best results, set the room lighting to the level that will be used while you are operating the ventilator. When you are ready to move to the next step,

Press: 

The audio alarm sounds continuously and the ventilator displays:

FLOW KNOB TO SET

AUDIO VOLUME: xx

# 5/Using the Ventilator

Setting the  
audio volume

7. If you want to adjust the audio volume level, turn the flow dial. The displayed number represents, on a scale of one to ten, the current volume level, which is also sounding. As you turn the dial, the ventilator will change the tone's volume and the displayed number to indicate the level that will be used during normal operation. When you are ready to move to the next step,

Press:



The ventilator silences the alarm and displays:

FLOW KNOB TO SET

O2 CAL: xxx

Setting the  
O<sub>2</sub> calibration

8. Do not touch the flow knob unless you are prepared to properly calibrate the oxygen sensor. If you want to adjust the sensor's calibration, see "5/Maintaining and Calibrating the System" in "Reference."

Press:



The ventilator beeps once, enters the monitoring mode, and displays:

CHECK SETTINGS!

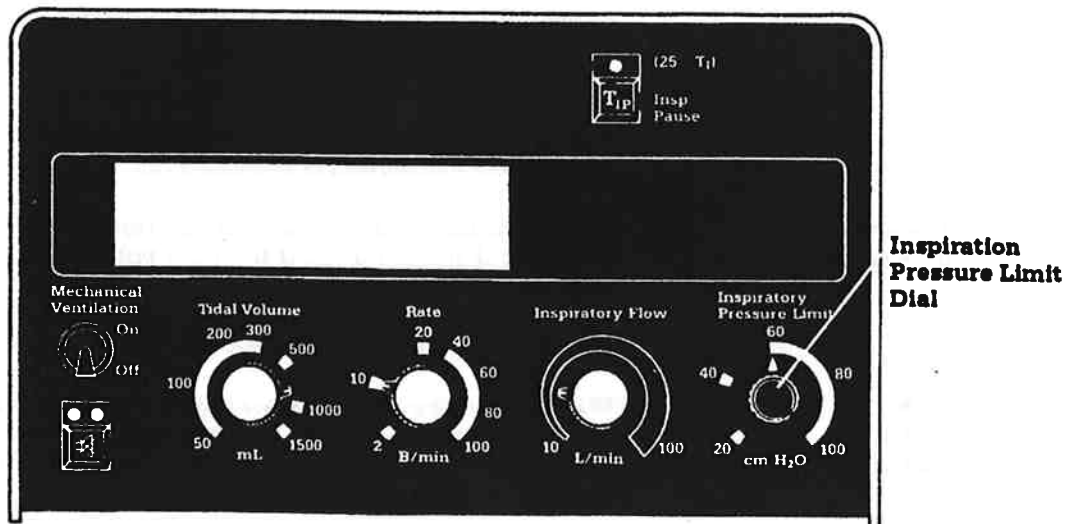
Any changes you selected are implemented (the inspiratory pause retains the state it was in when you selected the setup page).

## Setting the inspiratory pressure limit

Use the ventilator's inspiratory pressure limit dial to set the inspiratory pressure limit. Press the inspiratory pressure limit dial as you turn it.

Anytime you change the value of the inspiratory pressure alarm's set points, the system will display the new limit in two places: on the ventilator's screen and as a "U"-shaped symbol on the display pod's analog display.

**Figure 5-3**  
The inspiratory  
pressure limit  
dial



# 5/Using the Ventilator

To set the  
inspiratory  
pressure limit

1. If the anesthesia system is in standby, move the mechanical ventilation switch to off before moving the system master switch to on.
2. Switch on the anesthesia system, if it is not on already.
3. Use the inspiratory pressure limit dial to set the inspiratory pressure limit.

As you push and turn the inspiratory pressure limit dial, the ventilator will display the maximum pressure limit setting. However, unlike the other three control dials, just touching this dial will not generate a display.

The ventilator will display a reminder if you set the inspired pressure limit to more than 60 cm H<sub>2</sub>O. This pressure limit message is not displayed during mechanical ventilation. And if the inspiratory pressure limit is exceeded, the display pod will display a ventilator-pressure-limited message.

## Additional alarms controlled by the ventilator's front panel

In addition to the ventilation-related alarms set by the display pod, the system also sets trigger points for three alarms based on the positions of other front panel controls. These alarms are the low pressure alarm, the reverse flow alarm, and apnea alarm threshold, which is linked to the tidal volume setting.

The low  
pressure  
alarm

The low pressure alarm activates if the airway pressure fails to change by a value the ventilator sets. This level of change depends on the setting of the inspiratory flow dial.

The ventilator generates a low pressure alarm if the peak airway pressure fails to change during a set period by a value that varies proportionally to the setting of the inspiratory flow dial. The amount of pressure change required to prevent an alarm from triggering will vary between 4 cm H<sub>2</sub>O to 9 cm H<sub>2</sub>O to correspond to the inspiratory range of 10 liters per minute to 100 liters per minute. This change is measured at a point 50 milliseconds after the peak airway pressure and at the end of mechanical exhalation. For example, if the inspiratory flow is set to 30 l/min, the low pressure alarm will activate if the airway pressure change isn't at least 5.1 cm H<sub>2</sub>O. But if the inspiratory flow is set to 80 l/min, the airway pressure must change by at least 7.9 cm H<sub>2</sub>O to keep the alarm from activating.

Unlike the other alarms, the low pressure alarm is active only when mechanical ventilation is switched on.

The reverse  
flow alarm

The threshold at which the system triggers the reverse flow alarm is tied to the tidal volume level. If the tidal volume dial is set to 300 ml or more, an alarm will activate if the ventilator senses 100 ml or more reverse flow. If the tidal volume dial is set to less than 300 ml, 20 ml or more reverse flow will trigger an alarm.



**WARNING:** The reverse flow alarm can function correctly only if reverse flow detection is enabled and the volume sensor cartridge is working correctly and is properly placed in the distal position of the expiratory limb of the breathing system.



## 5/Using the Ventilator

### The apnea alarm

The volume threshold required to start or reset the apnea timer is also tied to the setting of the tidal volume dial. For tidal volume settings between 180 ml and 400 ml, the threshold varies linearly from 20 ml to 100 ml. For settings below 180 ml, the threshold is always 20 ml. And for settings above 400 ml, the threshold is always 100 ml. If, however, mechanical ventilation is off, the threshold required to reset the apnea timer is 20 ml.

## Using the backup mode

When the display pod isn't functioning—whether during the pod's normal boot-up sequence, or because of either an AC power failure or a system failure—the system uses the backup mode to display certain extra information on the ventilator's screen. Normally, if the display pod fails, the system will automatically transfer this information to the ventilator. Certain types of failures, however, will prevent the system from sending information to the ventilator. During these types of failures, you must move the display pod's power interrupt switch to off to manually send the backup-mode information to the ventilator. Even if the backup-mode information is transferred automatically, you should still move the display pod's power interrupt switch to off to clear the display pod's screens and help ensure reliable operation of the backup mode.

The backup mode displays data from the oxygen, SpO<sub>2</sub>, and volume monitors. It also displays and sounds certain related alarms. These alarms do not use the trigger points you set on the display pod. Instead the backup mode uses a fixed set of trigger points. (See "The backup mode" in "3/Theory of Operation" and "Additional alarms shown on ventilator's screen in the backup mode" in "4/The Alarm System" (both in "Reference") for more information about the alarms used in the backup mode.)

### Apnea alarms

Unlike during normal operation, in the backup mode the apnea alarm that is based on volume measurements cannot be disabled. Because the respiratory gas monitor is not active in the backup mode, the apnea-CO<sub>2</sub> alarm is not used in the backup mode.

### If the display pod is not functioning

During normal operation the display pod sets the low-minute-volume, low-oxygen, and high-oxygen alarms. If, however, the display pod fails, the ventilator will use default settings for these alarms. If the display pod isn't working, the ventilator also displays the SpO<sub>2</sub> readings, heart rate, and low SpO<sub>2</sub> alarm status. The settings are:

- High oxygen: Off
- Low oxygen: 18 percent
- Low minute volume: Off
- Low SpO<sub>2</sub>: 90

### If "pod link failure" is displayed

1. Press  (on the ventilator)

The system enters the backup mode

### If the display pod fails but the system doesn't switch to the backup mode

1. Move the "display pod interrupt switch" to off. The ventilator should enter the backup mode and display (within a few seconds):

POD LINK FAILURE!

2. Press  (on the ventilator)

# Notes

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# 6/Starting Operation

## In this section

- Setting the gas flow 6-1
- Adjusting the flowtubes' backlighting 6-2
- Setting the vaporizers 6-3
- Setting the ventilation parameters, beginning ventilation 6-4
- Adjusting the scavenging interface needle valve 6-6
- Starting monitoring 6-7
  - Starting NIBP measurements 6-7
  - Over-pressure release 6-8
  - SpO<sub>2</sub> signal and data validity 6-8

## Setting the gas flow

Each gas included on your anesthesia machine is controlled by a single flow control valve. These flow control valves, which are above the pressure gauges and below the flowmeters, are marked with the symbols for the gases they control, and are color coded to match the backgrounds of the corresponding pressure gauges and flowmeters. So that you can identify it by touch, the knob for oxygen is fluted. The knobs for nitrous oxide and any other gas are etched with a finer, cross-hatch pattern.

The Ohmeda Link 25 Proportion Limiting Control System connects the oxygen and nitrous-oxide flow-control valves. This system is designed both to ensure that any oxygen/nitrous-oxide mixture includes a minimum of about 25-percent oxygen, and to help prevent the oxygen flow from dropping below 50 ml/min.

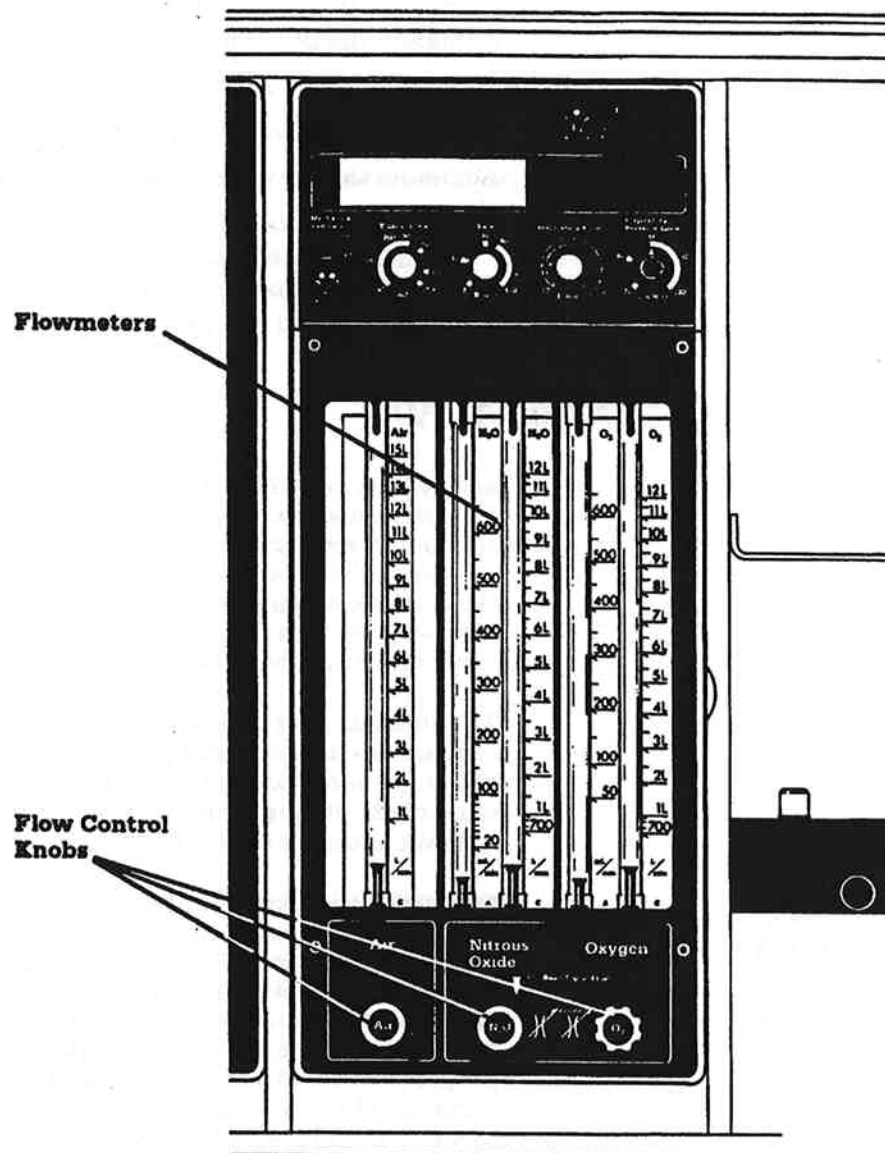


**WARNING:** The Ohmeda Link 25 Proportion Limiting Control System helps ensure only that oxygen/nitrous-oxide mixtures will have a minimum (nominal 25 percent) oxygen concentration. Hypoxic mixtures may be delivered if gases other than oxygen, nitrous oxide or air are used, or when operating at low oxygen flow rates. When using carbon dioxide, helium or nitrogen as an additional gas, make sure the proportions of all gases are carefully adjusted in accordance with accepted clinical practice. Gas mixtures within the breathing system must be monitored when using these gases.

Flowmeters for each gas included in your system are mounted directly above the corresponding flow control valves. The backgrounds of these flowmeters are color coded to match the pressure gauges and control valves. When you are using a flowmeter, read across the top of the meter's float, which is inside the flowmeter's tube, to the scale to the immediate right of the float.

## 6/Starting Operation

**Figure 6-1**  
The flow control  
knobs and  
flowmeters



To set the gas  
flow

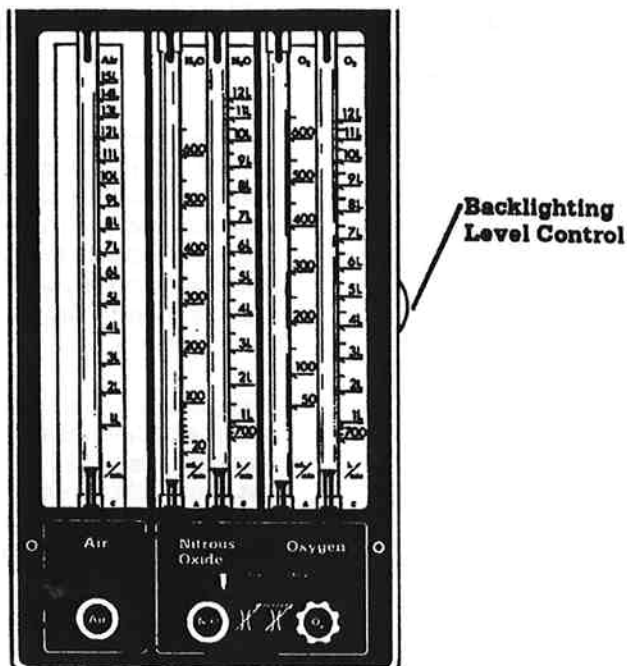
1. Switch the system on as described in "Powering on the system" in "2/Preoperative Checkout Procedures." Do not set the gas flow while the system is in standby.
2. Turn the control knob for the gas whose level you want to set. Read across the top of the flowmeters' floats.

### Adjusting the flowtubes' backlighting

The flowtubes' backlighting level control is at the right of the flowtubes. Adjust the control for a level you find comfortable. If the system's AC power is lost and you must operate using the system's backup batteries, adjust the flowtubes' backlighting to the lowest acceptable level to conserve power.

## 6/Starting Operation

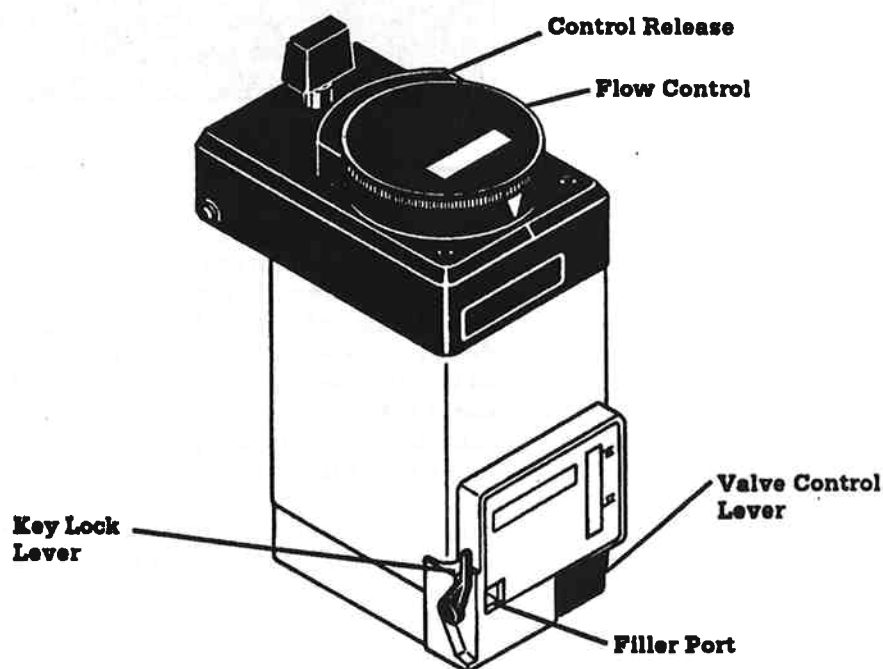
**Figure 6-2**  
The flowtubes'  
backlighting  
level control



### Setting the vaporizers

1. Check that the vaporizers are securely installed, as described in "Checking the vaporizer" in "2/Preoperative Checklists."
2. Check the agent level shown in the vaporizer's sight glass. If the agent is below the fill line, fill the vaporizer as described in "Filling the vaporizers" in "2/Preoperative Checkout Procedures."
3. Set the carrier gas flow.
4. Squeeze the vaporizer's control release and turn the dial to the setting you want to use.

**Figure 6-3**  
Vaporizer  
controls



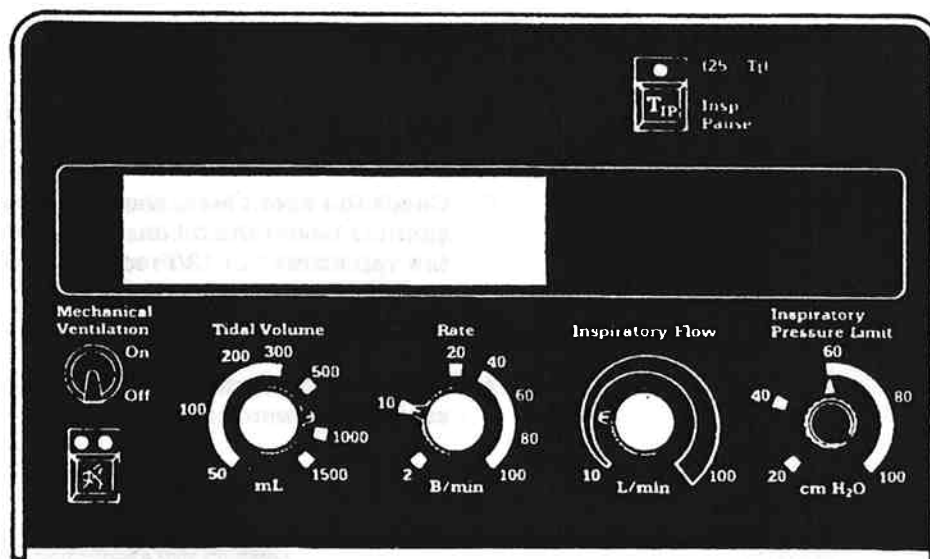
## 6/Starting Operation

### Setting the ventilation parameters, beginning ventilation

Set the ventilation parameters before moving the mechanical ventilation switch to on. Because we recommend that you set the ventilator's controls starting on the left and moving to the right, these instructions describe setting the ventilator's controls from left to right. You can, however, adjust the front panel dials in any order and independently. If you do adjust either the tidal volume dial or rate dial without also adjusting the inspiratory flow dial, touch the inspiratory flow dial to check the new I:E ratio.

It is possible to adjust the controls for a combination of settings that will result in a level the ventilator cannot deliver. If the combination of settings results in a level the ventilator is not designed to deliver, a "vent set error" alarm will be displayed. (See "Computing the ventilator's control range" in "3/Theory of Operation" in "Reference" for a description of the range of control settings.)

**Figure 6-4**  
The control  
module's  
front panel



The measured tidal volume indicated on the screen may be different than the level you set on the tidal volume dial. Under pressure gases compress and certain breathing system components expand, which results in some loss of tidal volume in the breathing system. Also, any fresh gas introduced to the system will be measured by the volume sensor in addition to the gas the bellows assembly delivers. (For instructions on calculating these breathing system losses and gains, see "Tidal volume compensation" in "3/Theory of Operation" in "Reference" for a description of the range of control settings.)

You don't, however, have to manually calculate the compliance effect to compensate for compliance losses. With the volume sensor correctly

# 6/Starting Operation

To set the ventilation parameters and begin mechanical ventilation

connected in the breathing system, adjust the tidal volume dial until the tidal-volume reading on the system's screen indicates the volume you want your patient to receive.

1. Before connecting the ventilator to a patient, perform the preoperative checkout procedures described in "2/Preoperative Checkout Procedures."
2. While the mechanical ventilation switch is off, set the inspiratory pressure limit. (See "Setting the inspiratory pressure limit" in "5/Using the Ventilator.")
3. Use the tidal volume dial to set the tidal volume.

The tidal volume dial lets you set the tidal volume from 50 milliliters to 1500 milliliters. As you turn the dial, the ventilator will display the tidal volume setting. To check the tidal volume setting without changing its value, just touch the dial; the ventilator will then display the current tidal volume setting.

4. Use the rate dial to set the mechanical breath rate.

Turning the rate dial changes the breath rate used for mechanical ventilation and displays the rate. The rate's range is two breaths per minute to 100 breaths per minute in whole number increments. Touching the rate dial will display the current rate on the screen.

5. Use the inspiratory flow dial to set the inspiratory flow rate. (The position of the inspiratory flow dial also sets the low pressure alarm's trigger point.)

The inspiratory flow dial lets you set the inspiratory flow rate, which is continuously variable from 10 liters per minute to 100 liters per minute. Whenever you adjust or just touch the inspiratory flow dial, the ventilator will display the current I:E ratio, which the ventilator calculates based on the set inspiratory flow, tidal volume, breath rate, and the status of the inspiratory pause function. Adjusting any of these parameters will change the I:E ratio; to check the current I:E ratio, touch the inspiratory flow dial.

6. Move the absorber's Bag/APL-Ventilator switch to "ventilator."
7. Use the anesthesia system's oxygen flush valve to fill the bellows.
8. To start mechanical ventilation, move the mechanical ventilation switch to on.

Always switch on the anesthesia system and set the control module's front panel controls before switching on the ventilator.



**WARNING:** Switching on the ventilator before setting the controls may result in inappropriate ventilation of the patient and may trip alarms that relate to mechanical ventilation.

9. Once the ventilator is mechanically ventilating the patient, check the tidal volume. (See "3/Theory of Operation" in "Reference" for information about tidal volume compensation.) If necessary, adjust the front panel controls to modify the ventilator's operating parameters. You can adjust any of the front panel controls while the ventilator is on.

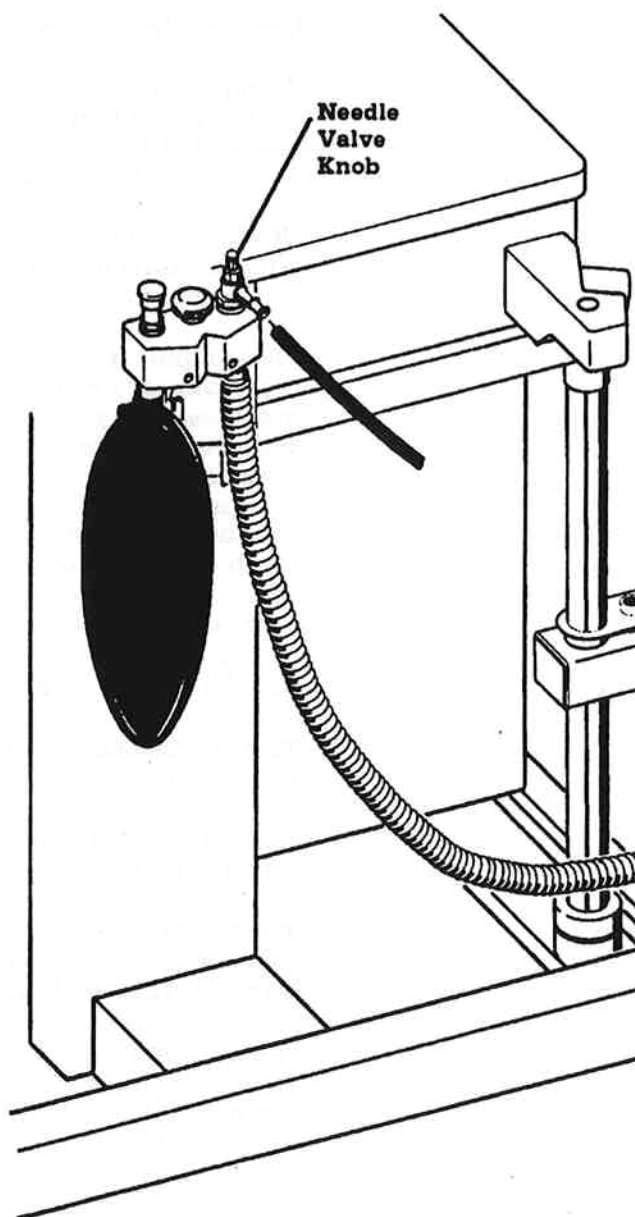
## 6/Starting Operation

### Adjusting the scavenging interface needle valve

When you are using the Ohmeda waste gas scavenging interface valve assembly with a high-vacuum disposal system, you must adjust the assembly's needle valve to prevent the reservoir bag from filling to capacity.

1. Set the gas flow as described in "Setting the gas flow."
2. Adjust the assembly's needle valve so the reservoir bag oscillates between half-full and completely collapsed during each normal breathing cycle.
3. If the vacuum level for your scavenging system changes, readjust the assembly's needle valve.

**Figure 6-5**  
Adjusting the  
scavenging  
interface valve





# 6/Starting Operation

## Starting monitoring

Switching from  
standby to  
monitoring

Until the system senses data from the patient, certain monitors, such as CO<sub>2</sub> monitor, will be in standby. Other monitors, such as the oxygen monitor, will start immediately. And one monitor, the NIBP module, must be started manually.

- CO<sub>2</sub> and agent monitoring will start when the system senses changes in the level of CO<sub>2</sub> that indicate two breaths within a 30-second period. (See "3/Theory of Operation" in "Reference" for more information about breath detection.)
- Volume monitoring will start when the system senses changes in volume that indicate two breaths within a 30-second period.
- SpO<sub>2</sub> monitoring will start when the system has sensed 30 seconds of continuous SpO<sub>2</sub> data.
- NIBP monitoring must be started manually
- Oxygen monitoring will start immediately
- Airway pressure monitoring will start immediately

## Starting NIBP measurements

The displayed blood pressures indicate the patient's condition at the time of the last measurement. Depending on the interval setting, up to 20 minutes can elapse between blood pressure measurement cycles. During this time a patient's condition can change.



**WARNING:** The patient alarm determinations are not continuous but are updated each time a blood pressure measurement is made. Set shorter intervals for more frequent updating of the alarms and displays.

Compensating  
for cuff  
placement

Add 1.8 mm Hg (0.24 kPa) to the displayed readings for each inch that the center of the cuff is located above the heart level of the patient. Subtract 1.8 mm Hg (0.24 kPa) from the displayed readings for each inch that the cuff is located below the heart level of the patient.

To start the  
NIBP monitor

1. Before starting the NIBP module, connect the cuff to the patient interface panel as described in "3/Making the Patient Connections."
2. Make sure you have selected a mode—whether adult/pediatric or neonate—you want to use. You can use either the manual-setup or auto-setup page to select an NIBP mode.
3. Make sure you have set the high and low blood pressure alarm limits to match the patient's expected condition.
4. Select a measurement interval.

a. Press:



The system displays page two of the setup page. NIBP interval is highlighted.

- b. Use the set knob to set the interval within the range of one minute to 20 minutes.

## 6/Starting Operation

- c. To exit the setup page, either wait 15 seconds without using a display-pod control, or press one of the lower display selection keys.

5. To begin NIBP measurements, press:



The system automatically determines the systolic, diastolic, and mean arterial pressures. The system will continue to take readings at the interval you selected until you intervene by pressing "hold" or "stat," or until an alarm condition develops.

While a measurement cycle is in progress, the displayed pressure values are from the previous measurement.

If the patient's blood pressure has risen significantly from the last reading, the monitor will detect this condition and pump the cuff up to a pressure high enough to occlude the artery.

If no NIBP  
measurements  
are displayed

If, for 20 seconds, the system does not receive any blood pressure data, whether because the monitor is in "hold" or for any other reason, the display pod will replace the NIBP data with dashes. If the monitor is unable to determine blood pressure, refer to "8/Troubleshooting Guide."

Suspending  
monitor  
operations

6. To suspend monitor operations indefinitely,

press:



### Over-pressure release

The NIBP module contains a system to limit maximum cuff pressure. If pressure in the cuff rises to approximately 270 mm Hg, the over-pressure switch opens, interrupting power to the module. When pressure in the system has dropped sufficiently, the module again turns on and enters the hold mode. If the cause of the over-pressure has not been corrected, the module will continue to switch off whenever a measurement cycle is initiated. In the neonatal mode, the system limits pressure to 235 mm Hg.

A kink in the connecting hose, or squeezing the patient cuff while it is inflated, can cause the system pressure to rise above 270 mm Hg when the pump turns on. This can result in the NIBP module briefly switching off.

### SpO<sub>2</sub> signal and data validity

SpO<sub>2</sub> monitoring will start automatically when the system senses 30 seconds of continuous SpO<sub>2</sub> data.

Five oximeter indicators are useful in determining that the probe is correctly attached to the patient and that the data is verifiable. They are:

- The signal strength indicator shows a strong signal.
- The plethysmographic waveform is strong.
- SpO<sub>2</sub> numeric value is shown on the display pod and is stable.
- The SpO<sub>2</sub> beep sounds with every heart beat.
- Heart rate is shown on the display pod.

## 6/Starting Operation

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Observe all five indicators simultaneously when you are verifying signal strength.

### Signal strength bargraph

The signal strength bargraph indicates the quality of the signal from the SpO<sub>2</sub> probe.

The alarm message "low quality SpO<sub>2</sub> signal" appears on the display pod (or ventilator's screen in the backup mode) when the signal is questionable. Check that the probe is properly attached to the patient. A remedy may be to perfuse (massage) the probe site and reapply the probe, or to select an alternate probe site.

Very dark pigmentation or a large distance between the probe emitter and detector can reduce the signal strength and result in a poor signal. If the signal strength is half-scale or less, a probe site with a shorter distance between the emitter and the detector might be a possible solution.

### Plethysmographic waveform

You should be able to easily identify the plethysmographic waveform. Although the waveform shape may vary from patient to patient, under normal conditions it corresponds to the arterial pressure waveform.

Figure 6-6 shows a good waveform, which should be a useful guideline in finding a probe placement that generates the fewest noise spikes.

If noise is on the waveform because of poor probe placement, the detector may not be flush with the probe site. Check that the probe is secured and that the tissue sample is not too thick.

Heart rate, determined from the plethysmographic waveform, can be disrupted by a cough or other hemodynamic pressure disturbances. Noise spikes in the waveform indicate motion at the probe site.

### SpO<sub>2</sub> numeric display

The stability of the SpO<sub>2</sub> readings can be used as an indicator of signal validity. Although stability is a relative term, by judging the rate of changes in the signal, one can get a good feeling for which are artifactual and which are physiological.

The stability of readings over time varies according to which sweep rate is selected. In the slower mode, readings have a tendency to be more stable because the signal averaging is done over a longer period of time: six seconds in the slow mode as compared to three seconds in the fast mode.

### SpO<sub>2</sub> beep

An SpO<sub>2</sub> beep tone, whose pitch is proportional to the SpO<sub>2</sub> value, occurs with each beat of the heart.

## 6/Starting Operation

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**Figure 6-6**  
Typical valid  
plethysmographic  
waveform



**Figure 6-7**  
Noisy  
plethysmographic  
waveform



# 7/Responding to Alarms

## In this section

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Using the alarm silence keys 7-1

Responding to display pod alarms 7-1

Responding to alarms displayed on the ventilator's screen in the backup mode 7-19

Responding to alarms displayed on the system master switch panel 7-26

## How to respond to any alarm

These sections describe alarm messages the system may display and the associated alarms. Although we have provided recommendations on how to resolve messages directly related to the system's operation, only the clinician can determine what to do when an alarm relates to the patient's condition. The first step when any alarm sounds is to check the patient. Then, to resolve the alarm, follow the steps listed below, or, if more appropriate, make other decisions based on your own clinical experience.

## Using the alarm silence keys

Both the display pod's and the ventilator's alarm silence keys look like this:



The display  
pod's alarm  
silence key

Press the display pod's alarm silence key to silence—either permanently or temporarily, depending on the type of alarm—any display pod alarm that is sounding. Warnings are silenced for 120 seconds, after which reminder tones sound every 30 seconds. When an alarm is sounding, either the warning or caution indicator will flash. Pressing "alarm silence" will make the alarm stop flashing, although the message will still be displayed to remind you that the alarm condition still exists.

The ventilator's  
alarm silence  
key

Except for when the setup mode is active, the ventilator's alarm silence button is used only if the display pod is not functioning, either because of an AC power failure, or because of a system error. To silence an audible ventilator alarm, press the alarm silence button. If that alarm condition continues, the alarm will sound again in 30 seconds. If, however, a new alarm condition occurs, its audible alarm will sound immediately. Five types of alarms can be silenced permanently, even if the alarm conditions continue. These permanently silenceable alarms include power failure, oxygen sensor failure, low battery, ventilator failure, and volume sensor failure.

## Responding to display pod alarms

For complete descriptions of display pod alarms see "4/The Alarm System" in "Reference."

# 7/Responding to Alarms

## Agt Mon Fail xx

If the system does not receive a proper signal from its built-in respiratory gas monitor, it will sound an "agt mon fail xx" alarm.

1. Connect the patient to a stand-alone respiratory gas monitor.
2. See "Troubleshooting respiratory gas monitor failure messages" in "8/Troubleshooting Guide."
3. Remove the respiratory gas module for servicing. (See "Removing the respiratory gas module" in "6/Service Procedures" of "Reference.")

## APNEA-CO<sub>2</sub>

If for 30 seconds, based on the CO<sub>2</sub> level in the patient sample, the system does not sense a breath, it will sound an "apnea-CO<sub>2</sub>" alarm.

1. Check the patient.
2. If you stopped CO<sub>2</sub> monitoring intentionally, press "alarm standby" to put the CO<sub>2</sub> monitor in standby.
3. Check for disconnections in the patient breathing system.
4. Make sure the respiratory gas monitor's sample line is connected to the patient circuit adapter.
5. Make sure the respiratory gas monitor's sample line is connected to the sensor port on the respiratory gas monitor's interface panel.
6. Check for occlusions in the respiratory gas monitor's sample line.
7. Replace the respiratory gas monitor's filter. (See "Replacing the respiratory gas monitor's filter" in "5/Maintaining and Calibrating the System" of "Reference.")

## Apnea-CO<sub>2</sub> Off

If "CO<sub>2</sub>/agt mon off" has been selected on the alarm standby page, the "apnea-CO<sub>2</sub> off" message will be displayed. To enable the apnea-CO<sub>2</sub> alarm:

To enable the  
apnea-CO<sub>2</sub>  
alarm

1. Press:



The system displays the alarm standby page.

2. Use the select knob to highlight "CO<sub>2</sub> monitor."
3. Use the set knob to highlight "active."
4. To exit the alarm standby page, press any key. Or wait for a few seconds without pressing a key; the system will automatically return to the original display.

## APNEA-Vol

If for 30 seconds the system doesn't detect enough volume in the breathing system, an apnea volume alarm will be generated.

1. Check the patient.
2. If you stopped volume monitoring intentionally, press "alarm standby" to put the volume monitor in standby.
3. Check for disconnections in the patient breathing system.

## 7/Responding to Alarms

4. Check for excessive moisture in the volume sensor cartridge.
5. Check for excessive moisture in the absorber's check valves.
6. Make sure the volume sensor clip is connected securely to the volume sensor cartridge.
7. Make sure the arrows on the volume sensor clip point in the direction of flow.
8. Make sure the volume sensor clip is plugged into the patient interface panel.
9. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too slowly or not at all (See "Replacing the volume sensor" in "5/Maintaining and Calibrating the System" of "Reference.")
10. Replace the volume sensor clip.

### Apnea-Vol Off

If "volume mon off" has been selected on the alarm standby page, the "volume off" message will be displayed. To enable the apnea-volume alarm:

To enable the apnea-volume alarm

1. Press:



The system displays the alarm standby page.

2. Use the select knob to highlight "volume monitor."
3. Use the set knob to highlight "active."
4. To exit the alarm standby page, press any key. Or wait for a few seconds without pressing a key; the system will automatically return to the original display.

### Cal CO<sub>2</sub>/Agt Mon

The respiratory gas module uses two types of calibrations: a "zero" (or baseline) calibration, which it performs automatically, and a "span" calibration, which must be performed manually.

1. Calibrate the respiratory gas monitor as described in "5/Maintaining and calibrating the System" of "Reference."

### Check NIBP Cuff

If the system does not receive an adequate signal from the NIBP cuff, or if inflation takes too long, both of which can happen if the cuff is installed incorrectly, the system will generate a "check NIBP cuff" advisory.

1. Make sure the NIBP cuff is installed correctly on the patient.
2. Replace the NIBP cuff.

### CO<sub>2</sub> Mon Stby

When you first switch on the system or when you select "CO<sub>2</sub> standby" from the alarm standby page, the "CO<sub>2</sub> standby" message will be displayed. Once the system—using the CO<sub>2</sub> monitor—senses two breaths, it will remove the "CO<sub>2</sub> mon stby" message and will start the apnea-CO<sub>2</sub> alarm timer.

## 7/Responding to Alarms

If, after a patient is connected to the breathing system, "apnea-CO<sub>2</sub> standby" is continuously displayed:

1. Check the patient.
2. Check for disconnections in the patient breathing system.
3. Make sure the respiratory gas monitor's sample line is connected to the patient circuit adapter.
4. Make sure the respiratory gas monitor's sample line is connected to the sensor port on the respiratory gas monitor's interface panel.
5. Check for occlusions in the respiratory gas monitor's sample line.
6. Replace the respiratory gas monitor's filter. (See "Replacing the respiratory gas monitor's filter" in "5/Maintaining and Calibrating the System" in "Reference.")

**CO<sub>2</sub>/Agt Bottle Full**

The respiratory gas module uses a water trap to remove liquids from the patient sample. When the water trap, which is located on the respiratory gas module panel, is full, the system sounds a "CO<sub>2</sub>/agt bottle full" alarm.

1. Empty the water trap. (See "Checking the collecting bottle" in 5/Making the Monitoring Connections" of "Getting Started.")
2. If a bright light is shining on the respiratory gas monitor, reposition the system.

**CO<sub>2</sub>/Agt Fail xx**

If the respiratory gas module is not providing CO<sub>2</sub> and agent signals to the display pod, the system will display a "CO<sub>2</sub>/agent fail" alarm.

1. Replace the respiratory gas module (see "Removing the respiratory gas module" in "6/Service Procedures" of "Reference") or connect the patient to stand-alone CO<sub>2</sub> and agent monitors.

**CO<sub>2</sub>/Agt Filter Blocked**

A filter on the respiratory gas module's front panel is designed to protect the module's internal components. If this filter becomes blocked, the system will sound a "CO<sub>2</sub>/agt filter blocked" alarm.

1. Replace the respiratory gas monitor's filter. (See "Replacing the respiratory gas monitor's filter" in "5/Maintaining and Calibrating the System" of "Reference.")
2. Check the sample line for obstructions or kinks.
3. Replace the sample line.

**CO<sub>2</sub>/Agt Line Blocked**

If the line that delivers the patient sample to the respiratory gas module becomes clogged or kinked, the system will sound a "CO<sub>2</sub>/agt line blocked" alarm.

1. Check the sample line for obstructions or kinks.
2. Replace the sample line.
3. Replace the respiratory gas monitor's filter. (See "Replacing the respiratory gas monitor's filter" in "5/Maintaining and Calibrating the System" of "Reference.")



# 7/Responding to Alarms

## CO<sub>2</sub>/Agt Purge

If the system senses that excessive moisture has accumulated in the respiratory gas module's sample line, it will automatically purge the line. While the line is being purged, no CO<sub>2</sub> or agent data will be acquired and the system will display the "CO<sub>2</sub>/agt purge" alarm.

1. Wait for the system to automatically remove the sample line purge message. This should take less than a minute.
2. Replace the sample line.

## CO<sub>2</sub>/Agt Sensor Wet

The respiratory gas monitor uses a photosensitive detector. If this detector become saturated with moisture, the system will sound an alarm. If this alarm sounds, the agent and CO<sub>2</sub> sensing and alarms will not function correctly, if at all.

1. Replace the respiratory gas module.
2. Call a trained service representative to repair the respiratory gas module.

## CO<sub>2</sub>/Agt Warmup

After the respiratory gas monitor is switched on, it must warm up for a few minutes. During this warm-up period, the system will display "CO<sub>2</sub>/agt warmup" to remind you that no agent, N<sub>2</sub>O, or CO<sub>2</sub> data is being generated.

1. Wait for the respiratory gas module to warm up.

## CO<sub>2</sub>/Agt Zeroing

Periodically the system and respiratory gas module will perform an automatic zero calibration procedure. During this auto-zero calibration, the system will not collect CO<sub>2</sub>-and-agent patient data, and the "CO<sub>2</sub>/agt zeroing" message will be displayed. No response is required when this message is displayed; the system will remove the message once the auto-zeroing has been completed.

## Disk Drive Empty — Install Formatted Disk

1. Insert a formatted disk into the disk drive.

## Disk Full

The disk in the disk drive cannot hold any more data.

1. Remove the disk, move its write-protect tab to the "read only" position (see "1/Working with Data" in "Reference"), and store the disk in a safe place.
2. Insert a new, formatted disk into the disk drive.

3. Press:



## Disk Near Full

The disk has 50 kilobytes or less space left. (Typically a new 720k disk will last for about nine hours of data logging. Fifty kilobytes will last about 35 minutes.)

1. To stop disk logging,



2. Remove the disk from the drive.

## 7/Responding to Alarms

3. Slide the disk's tab to the "read only" position. (See "Preparing disks" in "1/Working with Data" of "Reference.")
4. Store the disk in a safe place.
5. Insert a new, formatted disk into the disk drive
6. To restart logging (the system will start a new case file),



**Disk Not  
Formatted —  
Replace With  
Formatted Disk**

The disk in the disk drive is either not formatted or is not formatted correctly. Most disks are sold unformatted; you must format these disks to either the standard IBM® 1.44-meg or 720k convention. (See "Preparing disks" in "1/Working with Data" of "Reference.")

1. Insert a formatted disk into the disk drive.

**Disk Write Fail**

The disk is damaged in such a way that the system cannot write to it.

1. Press "disk logging on/off" to stop data logging.
2. Remove and discard the bad disk.
3. Insert a new, formatted disk into the disk drive
4. Press "disk logging on/off" to restart logging (the system will start a new file).

**Disk Write  
Protected —Install  
Formatted Disk**

The write-protect tab on the disk is in the read only position. This sliding tab's position tells the system whether it is allowed to write data onto the disk.

1. Remove the disk from the drive.
2. Slide the disk's tab to the "write" position. (See "Preparing disks" in "1/Working with Data" of "Reference.")
3. Reinstall the disk into the disk drive.

**Drive Circuit  
Open**

"Drive circuit open" is one of the ventilator's failure messages. It may indicate either an exhalation valve failure or a disconnection in the drive circuit. When this message is displayed the ventilator will attempt to continue mechanical ventilation.

During certain ventilator failure alarms, whose causes may be transitory, the ventilator will continuously attempt to reset its circuits for correct operation. If the ventilator successfully resets its circuits, the system will remove the alarm message and resume normal operation.

1. Check for disconnections in the ventilator's drive circuit.
2. Make sure that the absorber's Bag/APL-Ventilator valve is in the "vent" position.
3. Check the patient.
4. Ventilate the patient manually.
5. Switch to a stand-alone ventilator.
6. Connect stand-alone oxygen, airway-pressure, and volume monitors to the circuit.

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# 7/Responding to Alarms

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## HIGH EI AGENT

If the system detects a level of agent in the expired breath that is higher than the limit you set, the system will generate a "high Et agent" alarm.

1. Check the patient.
2. Check the vaporizer setting.
3. Check the high end-tidal agent alarm limit. Is it set correctly?

## High EtCO<sub>2</sub>

If the system detects a level of CO<sub>2</sub> in the expired breath that is higher than the limit you set, the system will generate a "high EtCO<sub>2</sub>" alarm.

1. Check the patient.
2. Check the absorbent in the absorber. It may be saturated. (See "When to change absorbent" in "5/Maintaining and Calibrating the System" of "Reference.")
3. Check the ventilator settings.
4. Check the high end-tidal CO<sub>2</sub> alarm limit. Is it set correctly?

## HIGH FI AGENT

If the system detects a level of agent in the inspired breath that is higher than the limit you set, the system will generate a "high Fi agent" alarm.

1. Check the patient.
2. Check the vaporizer setting.
3. Check the high inspired-agent alarm limit. Is it set correctly?

## High FiO<sub>2</sub>

If the system detects a level of O<sub>2</sub> in the inspired breath that is higher than the limit you set, the system will generate a "high FiO<sub>2</sub>" alarm.

1. Check the patient.
2. Check the oxygen flowmeter's setting.
3. Check the FiO<sub>2</sub> alarm limit. Is it set correctly?

## HIGH HR

If the system detects a heart rate that is higher than the limit you set, it will generate a "high HR" alarm.

1. Check the patient.
2. Make sure that the SpO<sub>2</sub> probe is properly installed on the patient. (See "Making the SpO<sub>2</sub> connections" in "3/Making the Patient Connections.")
3. Check for interference in the SpO<sub>2</sub> signal.
4. Check the high heart rate alarm limit. Is it set correctly?

## HIGH PAW

If the system detects a peak airway pressure that is higher than the limit you set, it will generate a high PAW alarm.

1. Check the patient.
2. Check for a blockage in the patient breathing system.

## 7/Responding to Alarms

3. Check for moisture in the sensing line that connects the absorber to the ventilator's control module.
4. Check for kinks in the pressure sensing line.
5. Check the high pressure alarm limit. Is it set correctly?

### HIGH SpO<sub>2</sub>

If the system detects SpO<sub>2</sub> that is higher than the limit you set, it will generate a "high SpO<sub>2</sub>" alarm.

1. Check the patient.
2. Make sure that the SpO<sub>2</sub> probe is properly installed on the patient. (See "Making the SpO<sub>2</sub> connections" in "3/Making the Patient Connections.")
3. Check the high SpO<sub>2</sub> alarm limit. Is it set correctly?
4. Replace the SpO<sub>2</sub> probe.

### HIGH SYS BP

If systolic blood pressure has been selected as the blood pressure alarm source (see "Preparing the alarm system" in "4/Using the Display Pod") and the system detects systolic blood pressure higher than the limit you set, the system will generate a "high systolic blood pressure" alarm.

1. Check the patient.
2. Check the high systolic blood-pressure alarm limit. Is it set correctly?

### High V<sub>E</sub>

If the system senses that the minute volume is higher than the level you set, it will generate a high minute volume alarm.

1. Check the patient.
2. Check the high minute volume alarm limit. Is it set correctly?
3. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too rapidly.
4. Replace the volume sensor clip.

### High V<sub>T</sub>

If the system senses that the tidal volume is higher than the level you set, it will generate a high tidal volume alarm.

1. Check the patient.
2. Check the high tidal volume alarm limit. Is it set correctly?
3. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too rapidly.
4. Replace the volume sensor clip.

### Insp Pause On

Pressing the ventilator's inspiratory pause button adds an inspiratory pause—an inflation hold—to the inspiratory cycle. When the inspiratory pause function is active, the ventilator adds an inspiratory pause equal to 25 percent of the set inspiratory time. The system then calculates and displays the new I:E ratio. To remind you that inspiratory pause is on, the system displays the "insp pause on" message.

## 7/Responding to Alarms


To disable the inspiratory pause, press the inspiratory pause button again. The system will remove the "insp pause on" message and the ventilator will display the corrected I:E ratio.

You can continue to adjust the ventilator's front panel controls even when the inspiratory pause function is active. If, while the function is on, you adjust a front panel control, the system takes the inspiratory pause formula into account when it calculates and displays a new I:E ratio.

### Invalid Cal

If the system senses that the oxygen sensor or respiratory gas module was not calibrated properly, the system will display an invalid calibration message.

1. To determine the cause of the message,

press:  (In the calibration group.)

The system displays the name of the monitor whose calibration is invalid and it displays an invalid calibration message next to the name.

If "invalid cal" is displayed for the oxygen monitor

1. Repeat the oxygen sensor calibration.
2. Replace the oxygen sensor cartridge. (See "5/Maintaining and Calibrating the System" of "Reference.")

If "invalid cal" is displayed for the respiratory gas module

1. Repeat the respiratory gas module calibration.
2. Replace the respiratory gas module's filter. (See "5/Maintaining and Calibrating the System" of "Reference.")

### LOW FiO<sub>2</sub>

If the system detects a level of O<sub>2</sub> in the inspired breath that is lower than the limit you set, it will generate a "low FiO<sub>2</sub>" alarm.

1. Check the patient.
2. Check the oxygen flowmeter's setting.
3. Check the low FiO<sub>2</sub> alarm limit. Is it set correctly?

### LOW HR

If the system detects a heart rate that is lower than the limit you set, it will generate a "low HR" alarm.

1. Check the patient.
2. Check for interference in the SpO<sub>2</sub> signal.
3. Make sure that the SpO<sub>2</sub> probe is properly installed on the patient. (See "Making the SpO<sub>2</sub> connections" in "2/Making the Patient Connections.")
4. Check the low heart rate alarm limit. Is it set correctly?

# 7/Responding to Alarms

## LOW P<sub>AW</sub>

The system will generate a low pressure alarm if, for at least 20 seconds, the airway pressure fails to change by an amount that is determined by the ventilator's inspiratory flow control setting. Unlike the other alarms, the low pressure alarm is active only when mechanical ventilation is switched on.

1. Check the patient.
2. Check the breathing system for leaks or disconnections.
3. Check for leaks or disconnections in the sensing tube that connects the absorber to the barbed connector on the ventilator control module's rear panel.
4. Check for kinks in the pressure sensing line.
5. Is the patient breathing spontaneously? During mechanical ventilation spontaneous breathing may trip this alarm.

## LOW SpO<sub>2</sub>

If the system detects SpO<sub>2</sub> that is lower than the limit you set, it will generate a low SpO<sub>2</sub> alarm.

1. Check the patient.
2. Check the oxygen supply.
3. Make sure that the SpO<sub>2</sub> probe is properly installed on the patient. (See "Making the SpO<sub>2</sub> connections" in "3/Making the Patient Connections.")
4. Check the low SpO<sub>2</sub> alarm limit. Is it set correctly?
5. Replace the SpO<sub>2</sub> probe.

## LOW SYS BP

If systolic blood pressure has been selected as the blood pressure alarm source (see "Preparing the alarm system" in "4/Using the Display Pod") and the system detects systolic blood pressure lower than the limit you set, the system will generate a "low sys BP" alarm.

1. Check the patient.
2. Check the low systolic blood-pressure alarm limit. Is it set correctly?

## LOW V<sub>E</sub>

If the system senses that the minute volume is less than the level you set, the system will generate a "low minute vol" alarm.

1. Check the patient.
2. Check the low-minute-volume alarm limit. Is it set correctly?
3. Check for breathing tube disconnections.
4. Check for excessive moisture in the volume sensor cartridge.
5. Check for excessive moisture in the absorber's check valves.
6. Make sure the volume sensor clip is connected securely to the volume sensor cartridge.
7. Make sure the arrows on the volume sensor clip point in the direction of flow.

# 7/Responding to Alarms

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8. Make sure the volume sensor clip is plugged into the patient interface panel.
9. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too slowly or not at all.
10. Replace the volume sensor clip.

## Low $V_T$

If tidal volume has been selected as an alarm source (see "Preparing the alarm system" in "4/Using the Display Pod") and the system senses that the tidal volume is lower than the level you set, it will generate a low tidal volume alarm.

1. Check the patient.
2. Check the low- $V_T$  alarm limit. Is it set correctly?
3. Check for breathing tube disconnections.
4. Check for excessive moisture in the volume sensor cartridge.
5. Check for excessive moisture in the absorber's check valves.
6. Make sure the volume sensor clip is connected securely to the volume sensor cartridge.
7. Make sure the arrows on the volume sensor clip point in the direction of flow.
8. Make sure the volume sensor clip is plugged into the patient interface panel.
9. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too slowly or not at all.
10. Replace the volume sensor clip.

## Low Et AGENT

If the system detects a level of agent in the expired breath that is lower than the limit you set, the system will generate a "low Et agent" alarm.

1. Check the patient.
2. Check the vaporizer setting.
3. Check the low end-tidal agent alarm limit. Is it set correctly?

## Low EtCO<sub>2</sub>

If the system detects a level of CO<sub>2</sub> in the expired breath that is lower than the limit you set, the system will generate a "low EtCO<sub>2</sub>" alarm.

1. Check the patient.
2. Check the low end-tidal CO<sub>2</sub> alarm limit. Is it set correctly?
3. Check the ventilator's settings.

# 7/Responding to Alarms

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## LOW FI AGENT

If the system detects a level of agent in the inspired breath that is lower than the limit you set, it will generate a "low Fi agent" alarm.

1. Check the patient.
2. Check the vaporizer setting.
3. Check the low inspired-agent alarm limit. Is it set correctly?

## Low Supply Pressure

If the ventilator supply gas pressure is less than 22 psig (152 kPa), the system will generate a "low supply pressure" alarm.

1. Check the oxygen supply pressure.
2. Check the patient.
3. Switch to oxygen cylinder use, if necessary.

## NIBP Mode Conflict

If the NIBP mode that the module sets automatically doesn't match the NIBP mode you set on the display pod, the system will generate an "NIBP mode conflict" message.

1. Use the manual setup page to match the NIBP mode to the cuff size.
2. Make sure you are using the correct hose type and length.

## NIBP Mon Fail xx

If the NIBP module detects an NIBP fault and sends an appropriate signal to the display pod, the system will display an "NIBP" alarm.

1. Connect the patient to a stand-alone NIBP monitor.
2. See "Troubleshooting NIBP failure messages" in "8/Troubleshooting Guide."
3. Remove the NIBP module for servicing. (See "Removing the NIBP module" in "6/Service Procedures" of "Reference.")

## NIBP Motion

If problems with the NIBP signal cause invalid data, the system will display an "NIBP motion" advisory. These problems can include: too many blood pressure pulses, slow deflation, or a large artifact.

1. Reposition the arm upon which the NIBP cuff is installed.
2. Make sure that the NIBP hose is routed securely.
3. Check to see if the NIBP hose is pinched.
4. Make sure that excessive pressure is not being placed on the cuff.

## No Agt Selected

If "agent?" is selected as the agent the system should measure; the "no agt selected" message will be displayed. Selecting an agent will remove the message.

## No SpO<sub>2</sub> Probe

If the system does not receive a signal from the SpO<sub>2</sub> probe, it will assume that the SpO<sub>2</sub> probe is not connected to the patient interface panel and it will display the "no SpO<sub>2</sub> probe" alarm.

1. Plug the SpO<sub>2</sub> probe into the patient interface panel.
2. Replace the SpO<sub>2</sub> probe.



# 7/Responding to Alarms

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## No O<sub>2</sub> Pressure

If the oxygen supply pressure at the pipeline input of the anesthesia machine drops below 27 psig (186 kPa), the system will sound the oxygen supply alarm continuously, light the oxygen supply "fail" indicator (which is on the system's master switch panel), and display "no O<sub>2</sub> pressure." The oxygen supply failure alarm also will sound briefly when you switch on the system.

1. Open the reserve oxygen cylinder.
2. Switch off mechanical ventilation until the oxygen supply is restored.
3. Switch to the Bag/APL mode and use manual ventilation.
4. Check the oxygen pipeline gauge.
5. Check the oxygen pipeline for disconnections.

## O<sub>2</sub> Mon Fail 50

If the oxygen monitor, which is located in the ventilator's control module, can't be calibrated from the display pod's calibration page, the system will generate an "O<sub>2</sub> mon fail" alarm.

1. Connect the patient to a stand-alone oxygen monitor.
2. After the case, remove the ventilator's control module for servicing. (See "6/Service Procedures" of "Reference.")

## O<sub>2</sub> Sensor/ Supply Fail

If the system detects less than five percent oxygen, it will generate an alarm. An alarm will also be generated if the sensor isn't connected correctly or if the sensor is broken.

1. Check the oxygen supply.
2. Check the patient.
3. Make sure the oxygen sensor is plugged into the patient interface panel.
4. Check the oxygen-sensor cartridge's surface for excessive moisture.
5. Has the oxygen sensor been left unplugged from the patient interface panel? If it has, or if the control module has been left disconnected from the panel, an oxide coating may have built up on the sensor's surface. Connecting the sensor to the patient interface panel will eventually remove this coating. However, up to twelve hours may be required to free the sensor's surface of oxide build-up.
6. Replace the oxygen-sensor cartridge. It may be worn out. (See "Replacing the oxygen sensor cartridge" in "5/Maintaining and Calibrating the System" of "Reference.")

## PAw Fail 50

If the pressure monitor, which is located in the ventilator's control module, won't accept the sustained pressure setting from the display pod, the system will generate a "PAw mon fail" alarm.

1. Connect the patient to a stand-alone airway-pressure monitor.
2. After the case, remove the ventilator's control module for servicing. (See "6/Service Procedures" of "Reference.")

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## **Remove System Disk—Replace With Formatted Disk**

The disk that contains the system's operating program is still in the disk drive.

1. Remove the system disk and store it in a safe place.
2. Insert a formatted disk into the disk drive. (See "1/Working with Data" in "Reference.")

## **Reposition Cuff**

If the NIBP monitor cannot generate valid data because the pressure pulses are too weak, as can happen when the NIBP cuff is positioned incorrectly, the system will generate a "reposition cuff" advisory.

1. Reposition the arm upon which the NIBP cuff is installed.
2. Make sure that the NIBP hose is routed securely.
3. Check to see if the NIBP hose is pinched.
4. Make sure that excessive pressure is not being placed on the cuff.

## **Reselect Agent**

Failure of communications between the display pod and the respiratory gas module can result in the display pod being set to measure a different agent than the module. If this condition occurs, no agent data will be generated and the system will display "reselect agent."

1. Use the display pod's manual setup page to select the agent measured by the respiratory gas monitor.

## **Reselect Sust Paw**

Failure of communications between the display pod and the ventilator's control module can result in the display pod being set to a different sustained airway pressure limit than the ventilator. If this condition occurs, the system will display "reselect sust PAW."

1. Use the display pod's alarm limits function to reset the sustained PAW.

## **Restart System XXXX**

During normal operation the display pod's computer may experience minor or major problems in its operation. Many of these errors will cause the system to display "restart system" followed by a three- or four-digit error number. Some of these errors will cause the system to enter the backup mode, while other will let the display pod continue operation. Although the display pod will continue working in spite of certain errors, these errors can indicate such problems as invalid data or an improperly functioning alarm system.

1. Make a note of the error number.
2. Restart the display pod as soon as possible.
3. See "Display pod error messages" in "8/Troubleshooting Guide."

## **Rev Alarm Off**

Reverse flow detection can be disabled or enabled on the ventilator's setup page. To remind you when the reverse flow alarm is disabled, the system displays the "rev alarm off" message.

1. If you do not want to use reverse flow detection, no action is necessary. If you do want to use reverse flow detection, use the ventilator's setup page to enable the reverse flow alarm.

## **Reverse Flow**

The level of reverse flow that will trigger a reverse flow alarm depends on the tidal volume you set on the ventilator. If you set the tidal volume

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control for less than 300 ml, then 20 ml or more reverse flow will trigger an alarm. However, if you set the tidal volume control for 300 ml or more, the ventilator will allow up to 100 ml of reverse flow before triggering an alarm.

Reverse flow conditions will be detected only when the volume sensor is correctly placed at the distal position of the expiratory limb of the breathing system. If the volume sensor is located at the proximal position, a reverse-flow condition will occur each time the patient inhales and the reverse flow alarm will activate for each breath.

1. Check the patient.
2. Make sure the volume sensor assembly is in the expiratory limb of the patient breathing system. If the sensor is in the expiratory limb, check the exhalation valve; its disk may be sticking.
3. Make sure the arrows on the volume sensor clip point in the direction of flow.
4. To disable the reverse flow alarm, select "reverse alarm: off" from the manual setup page. (See "Using the display pod's setup page" in "4/Using the Display Pod.")

### **SIMULATED DATA**

Programs have been written for the Ohmeda Modulus CD Anesthesia System that simulate the use of the system. When the system is running one of these programs, it displays "simulated data" to indicate that no actual patient data is being displayed.

1. Remove the data simulation disk from the disk drive.
2. Restart the display pod immediately.

### **SpO<sub>2</sub> Ambient Light**

If the SpO<sub>2</sub> probe's detector receives more light than its emitter can generate, the system will sound an "SpO<sub>2</sub> ambient light detected" alarm.

1. Make sure the SpO<sub>2</sub> probe is correctly installed on the patient.
2. Shield the SpO<sub>2</sub> probe from ambient light.
3. Replace the SpO<sub>2</sub> probe.

### **SpO<sub>2</sub> Interference**

Certain operating-room devices, such as electrosurgical equipment, can generate electrical noise that can interfere with the signal that the SpO<sub>2</sub> probe generates. If electrical noise reaches a level that prevents the SpO<sub>2</sub> monitor from functioning correctly, the system will sound an "SpO<sub>2</sub> interference" alarm. The system does not collect SpO<sub>2</sub> data while this alarm is displayed.

1. Remove or reposition any leads that are draped on the system, particularly on the SpO<sub>2</sub> probe lead.
2. Reorient the SpO<sub>2</sub> probe lead.
3. Reorient the complete system.
4. Wait until electrosurgery has stopped.

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## SpO<sub>2</sub> Light Low

If the SpO<sub>2</sub> probe's detector does not receive sufficient light from its emitter, the system will sound an "SpO<sub>2</sub> light low" alarm.

1. Check for a condition that is blocking the transmission of light from the probe's emitter to its detector.
  - a. Check for fingernail polish.
  - b. Check for dirt or blood on the skin or fingernail.
  - c. Check for dirt or blood on the probe.
  - d. If the probe is in an area of dark pigmentation, move it to a lighter area.
2. Realign the SpO<sub>2</sub> probe.
3. Replace the SpO<sub>2</sub> probe.

## SpO<sub>2</sub> Low Quality

Low perfusion can result in a low quality SpO<sub>2</sub> signal that will cause the SpO<sub>2</sub> and pulse readings to be unreliable.

1. Check for a condition that is blocking the transmission of light from the probe's emitter to its detector.
  - a. Check for fingernail polish.
  - b. Check for dirt or blood on the skin or fingernail.
  - c. Check for dirt or blood on the probe.
  - d. If the probe is in an area of dark pigmentation, move it to a lighter area.
2. Realign the SpO<sub>2</sub> probe.
3. Replace the SpO<sub>2</sub> probe.

## SpO<sub>2</sub> Mon Fail xx

If the system does not receive a proper signal from its SpO<sub>2</sub> module, it will sound a "SpO<sub>2</sub> mon failure" alarm.

1. Connect the patient to a stand-alone oximeter.
2. See "Troubleshooting SpO<sub>2</sub> failure messages" in "8/Troubleshooting Guide."
3. Remove the SpO<sub>2</sub> module for servicing. (See "Removing the SpO<sub>2</sub> module" in "6/Service Procedures" of "Reference.")

## SpO<sub>2</sub> Mon Off

If you select "SpO<sub>2</sub> monitor off" from the alarm standby page, the "SpO<sub>2</sub> mon off" message will be displayed, which means that the system will not display SpO<sub>2</sub> data or sound alarms that are based on SpO<sub>2</sub> monitor readings.

1. Use the alarm standby page to select "active" for the SpO<sub>2</sub> monitor.

## SpO<sub>2</sub> Mon Stby

When the system is powered on, it will automatically put the SpO<sub>2</sub> monitor in standby. You can also use the alarm standby page to manually put the SpO<sub>2</sub> monitor in standby. Once it has sensed SpO<sub>2</sub> data continuously for 30 seconds, the system will make the SpO<sub>2</sub> monitor active (and so it will remove the "SpO<sub>2</sub> mon stdby" message).

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1. When the system senses SpO<sub>2</sub> data for at least 30 seconds, it will remove the SpO<sub>2</sub> monitor standby message.
2. Make sure the SpO<sub>2</sub> probe is connected to the patient interface panel.
3. Use the alarm standby page to select "active" for the SpO<sub>2</sub> monitor.

## SpO<sub>2</sub> PROBE OFF

If the system senses that the SpO<sub>2</sub> probe is not in place on a patient, it will sound an "SpO<sub>2</sub> probe off" alarm.

1. Make sure the SpO<sub>2</sub> probe is correctly installed on the patient.
2. If you do not want to use the SpO<sub>2</sub> monitor, use the alarm standby page to place the SpO<sub>2</sub> monitor in standby. (See "Using alarm standby" in "4/Using the Display Pod.")
3. Replace the SpO<sub>2</sub> probe.

## SUB ATMOS P<sub>AW</sub>

If the system detects airway pressure of less than -10 centimeters of water, it will generate a subatmospheric pressure alarm.

1. Check for inadvertent vacuum hook-ups to the patient breathing system.
2. Check for kinks or occlusions in the breathing system.
3. The inspiratory check valve in the absorber may be stuck. Check the inspiratory check valve.
4. Is the patient breathing spontaneously? During mechanical ventilation spontaneous breathing may trip this alarm.
5. Check the gas-scavenging system for excessive vacuum.

## SUSTAINED P<sub>AW</sub>

Anytime the sustained airway pressure exceeds—for 15 seconds or more—the sustained pressure limit you set, the system will generate a sustained pressure alarm.

1. Check the patient.
2. Check for kinks or blockages in the breathing tubes.
3. Check to make sure the absorber's Bag/APL-Ventilator Valve is in the correct position.

## Vent Fail xx

The system generates a "ventilator failure" message and an appropriate number for certain types of electronic and mechanical failures that the ventilator can experience. The number in the ventilator failure message—such as "vent fail 8"—corresponds to the specific type of failure that has occurred, in this case a gas inlet valve failure.

Although the oxygen, volume, and airway pressure monitors, which are built into the ventilator, may continue to operate, mechanical ventilation is disabled when ventilator failure messages—except the messages for ventilator failures six, seven, and eight—are displayed; do not attempt to use the ventilator while a ventilator failure message is displayed.

During certain ventilator failure alarms, whose causes may be transitory, the ventilator will continuously attempt to reset its circuits for correct

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operation. If the ventilator successfully resets its circuits, the system will remove the alarm message and resume normal operation.

Refer to "Troubleshooting ventilator failure messages" in "8/Troubleshooting Guide" for more information about ventilator failure messages.

**If the ventilator failure 4 (supply gas pressure more than 30 psig) alarm activates**

1. Have the ventilator supply gas regulator checked.

**Vent DIP 1 Fail**

The ventilator has a service mode that is used by service personnel only. This mode is selected by a switch inside the ventilator. If the switch is set so that the ventilator is left in this mode during normal operation, the system will display the "vent DIP 1 fail" message.

1. Have the ventilator's control module serviced immediately. Do not attempt to use the control module.

**Vent Pressure Limited**

The position of the ventilator's inspiratory pressure limit dial can prevent the ventilator from fully implementing its front panel settings. If this condition exists, the system will display the "vent pressure limited" message.

1. Adjust the ventilator's inspiratory pressure limit dial.

**Vent Setup On**

When the ventilator's setup page is selected, the system displays "vent setup on."

1. Repeatedly press "alarm silence" on the ventilator to exit the ventilator's setup page.

**Vol Mon Stby**

When you first switch on the system or when you select "volume monitor standby" from the alarm standby page, the "volume monitor standby" message will be displayed. Once the system—using the volume monitor—senses two breaths within a 30-second period, it will remove the "volume monitor standby" message and will start the apnea-volume alarm timer.

If, after a patient is connected to the breathing system, "volume monitor standby" is continuously displayed:

1. Check the patient.
2. Check for disconnections in the patient breathing system.
3. Check for excessive moisture in the volume sensor cartridge.
4. Check for excessive moisture in the absorber's check valves.
5. Make sure the volume sensor clip is connected securely to the volume sensor cartridge.
6. Make sure the arrows on the volume sensor clip point in the direction of flow.
7. Make sure the volume sensor clip is plugged into the patient interface panel.

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8. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too slowly or not at all. (See "Replacing the volume sensor" in "5/Maintaining and Calibrating the System" of "Reference.")
9. Replace the volume sensor clip.

### Vol Sensor Fail

Two basic kinds of conditions can cause a "volume sensor failure" message. If the system senses that little or no current is flowing through the volume sensor clip, it will assume that the sensor is broken and will send the message.

1. Check the patient
2. Make sure the volume sensor is plugged into the patient interface panel.
3. Replace the volume sensor clip.

## Responding to alarms displayed on the ventilator's screen in the backup mode

If the display pod fails (and the system enters the backup mode), certain of the Ohmeda Modulus CD Anesthesia System's alarms will be displayed on the ventilator's screen. These alarms include low oxygen, low minute volume, and low SpO<sub>2</sub>.

For complete descriptions of alarms see "4/The Alarm System" in "Reference."

### APNEA xxx SEC

If for 30 seconds the ventilator doesn't detect enough volume in the breathing system, an apnea alarm will be generated. The alarm message will indicate the number of seconds that have passed since flow was last detected. The tone will warble once at 30 seconds, twice at 60 seconds, and three times at 90 seconds. At 120 seconds the tone will warble continuously and the screen will display only "apnea \*\*."

Since the ventilator uses the volume-sensing circuits to determine if an apnea condition exists, problems with the volume sensor cartridge or clip can trigger an apnea alarm, as can disconnections in the breathing system.



**WARNING:** If you remove the sensor clip from the volume sensor cartridge before switching on the anesthesia system, the apnea alarms will be inoperative. Do not use the ventilator without the sensor clip properly attached to the volume sensor cartridge.

1. Check the patient.
2. Check for disconnections in the patient breathing system.
3. Check for excessive moisture in the volume sensor cartridge.
4. Check for excessive moisture in the absorber's check valves.
5. Make sure the volume sensor clip is connected securely to the volume sensor cartridge.
6. Make sure the arrows on the volume sensor clip point in the direction of flow.

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7. Make sure the volume sensor clip is plugged into the patient interface panel.
8. Replace the volume sensor cartridge. It may be worn out if its rotor is turning too slowly or not at all. (See "Checking the volume sensor" in "5/Maintaining and Calibrating the System" in "Reference.")
9. Replace the volume sensor clip.

CHECK O2  
PROBE!  
alternating  
with  
CHECK GAS  
SUPPLY

If the ventilator doesn't detect at least five percent oxygen, it will assume that the oxygen sensor has failed, and it will generate an alarm. An alarm will also be generated if the sensor isn't connected correctly, if the sensor is broken, or if no oxygen is in the area of the sensor.

1. Check the oxygen supply.
2. Check the patient.
3. Make sure the oxygen sensor is plugged into the patient interface panel.
4. Check the oxygen-sensor cartridge's surface for excessive moisture.
5. Has the oxygen sensor been left unplugged from the patient interface panel? If it has, or if the control module has been left disconnected from the panel, an oxide coating may have built up on the sensor's surface. Connecting the sensor to the patient interface panel will eventually remove this coating. However, up to twelve hours may be required to free the sensor's surface of oxide build-up.
6. Replace the oxygen-sensor cartridge. It may be worn out. (See "Replacing the oxygen sensor cartridge" in "5/Maintaining and Calibrating the System" of "Reference.")

DRIVE CKT.  
OPEN!

"Drive circuit open" is one of the ventilator's failure messages. It may indicate either an exhalation valve failure or a disconnection or occlusion in the drive circuit. When this message is displayed the ventilator will attempt to continue mechanical ventilation. The ventilator will also attempt to continue to send signals to the display pod from the ventilator's built-in monitors, which generate the system's oxygen, airway-pressure, and volume monitoring.

During certain ventilator failure alarms, whose causes may be transitory, the ventilator will continuously attempt to reset its circuits for correct operation. If the ventilator successfully resets its circuits, the system will remove the alarm message and resume normal operation.

1. Check for disconnections in the ventilator's drive circuit.
2. Check for occlusions in the ventilator's drive circuit.
3. Check the patient.
4. Ventilate the patient manually.
5. Switch to a stand-alone ventilator.
6. Connect stand-alone oxygen, airway-pressure, and volume monitors to the circuit.



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## HIGH PRESSURE!

If the ventilator detects airway pressure higher than the limit you set using the inspiratory pressure limit dial, the ventilator will generate a high pressure alarm.

1. Check the patient.
2. Check for a blockage in the patient breathing system.
3. Check the inspiratory pressure limit dial. Is it set correctly?
4. Check for moisture in the sensing line that connects the absorber to the ventilator's control module.
5. Check for kinks in the pressure sensing line.

## LOW OXYGEN!

If the ventilator detects an oxygen concentration lower than 18 percent, the ventilator will generate a low oxygen alarm.

1. Check the patient.
2. Check the anesthesia system's flowmeter settings. Are they set correctly?
3. Check the anesthesia system's pressure gauges.
4. Check the oxygen supply.
5. Check the oxygen sensor assembly for damage.
6. Make sure the oxygen sensor is inserted securely into the absorber oxygen sensor port.
7. Make sure the oxygen sensor is plugged into the patient interface panel.
8. Check the oxygen-sensor cartridge's surface for excessive moisture.
9. Has the oxygen sensor been left unplugged from the patient interface panel? If it has, or if the ventilator's control module has been left disconnected from the panel, an oxide coating may have built up on the sensor's surface. Connecting the sensor through the patient interface panel to the control module will eventually remove this coating. However, up to 12 hours may be required to free the sensor's surface of oxide build-up.
10. Replace the oxygen-sensor cartridge. It may be worn out.

## LOW PRESSURE!

The ventilator will generate a low pressure alarm if, for at least 20 seconds, the airway pressure fails to change by a value that varies proportionally to the setting of the inspiratory flow dial. Unlike the other alarms, the low pressure alarm is active only when mechanical ventilation is switched on.

1. Check the patient.
2. Check the breathing system for leaks or disconnections.
3. Check for leaks or disconnections in the sensing tube that connects the absorber to the barbed connector on the control module's rear panel.

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4. Check for kinks in the pressure-sensing line.
5. Is the patient breathing spontaneously? During mechanical ventilation spontaneous breathing may trip this alarm.

### LOW SpO<sub>2</sub>

If the system detects SpO<sub>2</sub> that is less than 90, the ventilator will generate a low SpO<sub>2</sub> alarm. (This non-adjustable limit of 90 is the default setting for the backup mode.)

1. Check the patient.
2. Make sure that the SpO<sub>2</sub> probe is properly installed on the patient. (See "Making the SpO<sub>2</sub> connections" in "3/Making the Patient Connections.")
3. Replace the SpO<sub>2</sub> probe.

### LOW SUPPLY PRES!

If the ventilator supply gas pressure is less than 22 psig, the ventilator generates a low supply pressure alarm.

1. Check the oxygen-supply pressure.
2. Check the patient.
3. Switch to oxygen cylinder use, if necessary.

### MAX PRES= xxx

Anytime you adjust the inspiratory pressure limit dial, the ventilator will briefly display the pressure limit in centimeters of water. If, however, mechanical ventilation is off and the inspiratory pressure limit is set to more than 60, the ventilator will also light the yellow alarm LED and will continually display the "max pres=xxx" message. During mechanical ventilation this reminder is disabled.

### NO SpO<sub>2</sub> PROBE!

When the oximeter does not receive a signal from the SpO<sub>2</sub> probe, it assumes that the SpO<sub>2</sub> probe is not connected to either the patient or patient interface panel, so the ventilator displays the "no SpO<sub>2</sub> probe" alarm.

1. Plug the SpO<sub>2</sub> probe into the patient interface panel.
2. Make sure the SpO<sub>2</sub> probe is on the patient.
3. Replace the SpO<sub>2</sub> probe.

### O<sub>2</sub> CAL ERROR!

Some oxygen sensor cartridges can generate signals that are out of the system's normal range. Such cartridges may appear to calibrate correctly. The "O<sub>2</sub> cal Error" alarm is intended to warn you that the oxygen sensor is not properly calibrated. In most cases it is possible to compensate for the extra output of these cartridges by repeating the oxygen-sensor calibration one or more times.

1. Repeat the oxygen sensor calibration procedure.
2. Replace the oxygen sensor cartridge, then repeat the oxygen sensor calibration procedure.

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### POD LINK FAILURE

The ventilator is not receiving data from the display pod so the system has entered the backup mode.

1. To permanently silence the alarm,

press:  (on the ventilator)

### POOR SpO<sub>2</sub> SGNL!

Low perfusion can result in a low quality SpO<sub>2</sub> signal that will cause the SpO<sub>2</sub> and pulse readings to be unreliable. If the oximeter detects such a signal, the ventilator will sound a "poor SpO<sub>2</sub> signal" alarm.

1. Check for a condition that is blocking the transmission of light from the probe's emitter to its detector.
  - a. Check for fingernail polish.
  - b. Check for dirt or blood on the skin or fingernail.
  - c. Check for dirt or blood on the probe.
  - d. If the probe is in an area of dark pigmentation, move it to a lighter area.
2. Realign the SpO<sub>2</sub> probe.
3. Replace the SpO<sub>2</sub> probe.

### POWER FAIL!

If the voltage from the anesthesia system drops below a preset threshold, the ventilator will generate a "power fail" alarm.

1. Begin manual ventilation.
2. Switch to an alternative ventilator.
3. After the case, leave the anesthesia system plugged into a working AC outlet for at least 24 hours to recharge the battery; then test the battery as described in "Checking the battery" in "2/Preoperative Checkout Procedures."

### REV FLOW ALM OFF

Reverse flow detection can be disabled or enabled on the ventilator's setup page. To remind you when the reverse flow alarm is disabled, in the backup mode the ventilator displays the "rev flow alm off" message.

1. If you do not want to use reverse flow detection, no action is necessary. If you do want to use reverse flow detection, use the ventilator's setup page to enable the reverse flow alarm.

### REVERSE FLOW!

In the backup mode, if the ventilator senses an unacceptable level of reverse flow in the patient breathing system, it will generate an alarm. The level of reverse flow that will trigger a reverse flow alarm depends on the tidal volume you set. If you set the tidal volume control for less than 300 ml, then 20 ml or more reverse flow will trigger an alarm. However, if you set the tidal volume control for 300 ml or more, the ventilator will allow up to 100 ml of reverse flow before triggering an alarm.

The reverse flow alarm is intended to warn you of inadvertent reverse flow conditions, such as those caused by a defective or sticking exhalation check valve. These kinds of conditions will be detected only when the volume sensor is correctly placed at the distal position of the expiratory limb of the breathing system. If you place the volume sensor at the

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proximal end of the "Y" connector, volume monitoring will still function. However, when the volume sensor is located at the proximal position, a reverse-flow condition will occur each time the patient inhales and the reverse flow alarm will activate for each breath. To disable the reverse flow alarm in the backup mode, select "reverse alarm: off" from the ventilator's setup page (See "Using the ventilator's setup page" in "5/Using the Ventilator.")

1. Check the patient.
2. Make sure the volume sensor assembly is in the expiratory limb of the patient breathing system. If the sensor is in the expiratory limb, check the exhalation valve; its disk may be sticking.
3. Make sure the arrows on the volume sensor clip point toward the absorber.

### SOFTWARE ERROR!

During normal operation the ventilator's computer may experience minor or major problems in its operation. Although the ventilator will continue working in spite of certain errors, these errors can indicate such problems as invalid data or an improperly functioning alarm system.

1. Recycle the system's power as soon as possible.
2. After the case, have the ventilator checked by service personnel.

### SPO2 FAIL xx

If the system does not receive a proper signal from its built-in SpO<sub>2</sub> monitor, the ventilator will sound an "SpO<sub>2</sub> fail xx" alarm.

1. Connect the patient to a stand-alone oximeter.
2. After the case remove the SpO<sub>2</sub> module for servicing. (See "Removing the SpO<sub>2</sub> module" in "6/Service Procedures" of "Reference.")

### SUB-ATMOS. PRES!

If the ventilator detects airway pressure of less than -10 centimeters of water, it will generate a subatmospheric pressure alarm.

1. Check for inadvertent vacuum hook-ups to the patient breathing system.
2. Check for kinks or occlusions in the breathing system.
3. The inspiratory check valve in the absorber may be stuck. Check the inspiratory check valve.
4. Is the patient breathing spontaneously? During mechanical ventilation spontaneous breathing may trip this alarm.
5. Check the gas-scavenging system for excessive vacuum.

### SUSTAINED PRES!

The ventilator sets the sustained pressure limit to correspond to the inspiratory pressure limit dial setting. For inspiratory pressure limits of 20 cm H<sub>2</sub>O to 60 cm H<sub>2</sub>O, the ventilator sets the sustained pressure limit to one half the inspiratory pressure limit. Any inspiratory pressure limit setting of more than 60 cm H<sub>2</sub>O will result in a sustained pressure limit of 30 cm H<sub>2</sub>O. Anytime the sustained airway pressure exceeds—for 15 seconds or more—the sustained pressure limit set by the inspiratory pressure limit dial, the ventilator will generate a sustained pressure alarm.

1. Check the patient.

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2. Check for kinks or blockages in the breathing tubes.
3. Check to make sure the absorber's Bag/APL-Ventilator switch is in the correct position.

VENT FAIL xx!

The number in the ventilator failure message—such as “vent fail 8”—will correspond to the specific type of failure that has occurred, in this case a gas inlet valve failure. If a ventilator failure alarm does occur, pressing the alarm silence button will permanently silence the alarm tone, although the yellow LED and alarm message will remain on, and the ventilator may not function.

Although the ventilator's monitors may continue to operate, mechanical ventilation is disabled when ventilator failure messages—except the messages for ventilator failures six and eight—are displayed; do not attempt to use the ventilator while a ventilator failure message is displayed.

During certain ventilator failure alarms, whose causes may be transitory, the ventilator will continuously attempt to reset its circuits for correct operation. If the ventilator successfully resets its circuits, it will remove the alarm message and resume normal operation.



**WARNING:** The use of electrosurgical units or other devices that radiate high-intensity electrical fields can affect the operation of the ventilator and monitors attached to the patient. Maintain as much distance as possible between the electrosurgical leads and the cables to the flow and oxygen sensors. Do not drape the electrosurgical leads across the absorber or the anesthesia machine. Do not let the electrosurgical leads rest on any surface of the anesthesia system. Constant surveillance of all monitoring and life support equipment is mandatory whenever electrosurgical devices are in operation, on, or in the vicinity of the patient.



**WARNING:** Ventilator failure messages indicate that a problem exists in the ventilator. Do not attempt to use the ventilator while a ventilator failure message is displayed.

If the ventilator failure 4 (supply gas pressure more than 30 psig) alarm activates

1. Have the ventilator supply gas regulator checked.

Refer to “8/Troubleshooting Guide,” for more information about ventilator failure messages.

VENT SET  
ERROR!

If you attempt to set the inspiratory-flow, tidal-volume and rate controls to a combination that results in a level the ventilator is not designed to deliver, the ventilator will continue to use the most recent acceptable settings, and will generate a ventilator setting error alarm.

1. Readjust the ventilator's controls within the ventilator's operating limits.

VOL MON  
STANDBY!

When the mechanical ventilation switch is off, pressing the alarm silence button cancels and resets the apnea alarm; the volume monitor standby message will be displayed and the alarm will not sound again even if these alarm conditions continue. Once the ventilator senses another breath, the alarm timers and sensor circuits will again be activated and any alarm condition that occurs can again trigger an appropriate alarm.

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### VOL SENSOR FAIL!

If the ventilator senses that little or no current is flowing through the volume sensor clip, which can happen if the volume sensor clip is broken, disconnected, or connected incorrectly, it will send the "vol sensor fail" message.

1. Make sure that the volume sensor clip is connected correctly to the patient interface panel.
2. Replace the volume sensor clip.

— — — — for  
the tidal volume  
reading

If during mechanical ventilation the system does not sense any volume for two consecutive breaths, the system assumes the volume sensor is disconnected or damaged. However, the system does not send a volume sensor failure message. Instead it displays, on the top line, dashes in place of the tidal volume reading.

1. Check the connections between the volume sensor cartridge and the sensor clip.
2. Check for obstructions in the volume-sensor cartridge that may be preventing the cartridge vanes from spinning.

??? is displayed  
in place of  $\dot{V}_T$ ,  
 $V_T$ , or rate  
readings

If you set a control combination the volume monitor cannot measure, or if—in the monitoring mode—breathing occurs that the monitor cannot measure, the ventilator will display question marks in place of the  $\dot{V}_T$ ,  $V_T$ , and rate readings.

1. Adjust the ventilator controls within the limits of the instrument.

### If the alarm silence key will not silence the alarm

Certain electronic failures may be so significant as to cause the system to lose the ability to generate ventilator failure messages even though the ventilator has failed. If such a serious failure occurs, the alarm silence button will not silence the alarm. Do not attempt to use the ventilator if this type of failure occurs.



**WARNING:** Do not attempt to use the ventilator if the alarm silence button will not silence alarms.

1. Ventilate the patient manually.
2. Switch to a functioning system.

## Responding to alarms displayed on the system master switch panel

For complete descriptions of anesthesia machine alarms see "4/The Alarm System" in "Reference."

"Battery"  
indicator flashing  
(electrical  
disconnect/  
failure)

If the anesthesia machine's AC power supply fails or is disconnected, the system will sound a warbling, intermittent alarm and will flash the "battery" indicator to the left of the system master switch.

1. Continue normal operation; the backup battery will allow you to continue for about one hour with mechanical ventilation. To extend the operating time, discontinue mechanical ventilation.

## **7/Responding to Alarms**

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2. Make sure that the system's power cord has not been disconnected.
3. Check the circuit breaker that is on the back of the display pod. Reset it if it has been tripped.
4. Resolve the cause of the power failure.

**"Fail" indicator  
flashing (oxygen  
supply failure)**

If the oxygen supply pressure drops below 27 psig (186 kPa), the system will sound the oxygen supply alarm continuously and light the oxygen supply "fail" indicator. The oxygen supply failure alarm also will sound briefly when you switch on the system.

1. Open the reserve oxygen cylinder.
2. Switch off mechanical ventilation until the oxygen supply is restored.
3. Switch to the Bag/APL mode and use manual ventilation.
4. Check the oxygen pipeline gauge.
5. Check the oxygen pipeline for disconnections.

# Notes

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# 8/Troubleshooting Guide

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## Troubleshooting the system

Symptom	Possible Cause	Recommended Action
System won't power on when connected to functional AC outlet.	Master switch is set to standby.	Move master switch to on.
	Pod interrupt switch off.	Move pod interrupt switch to on
No gas flow	Master switch is set to standby.	Move master switch to on.
	O <sub>2</sub> supply pressure too low.	Check and repair the oxygen supply.
	Supply hose disconnected.	Connect supply hose.
	Kinks in supply hose.	Remove kinks from supply hose.
Electrical/disconnect failure alarm activates	System power cord unplugged.	Plug in power cord.
	Circuit breaker tripped.	Reset circuit breaker
	System's DC power supply has failed.	Call service personnel.
O <sub>2</sub> supply failure alarm activates.	O <sub>2</sub> supply pressure too low.	Check and repair the oxygen supply.
	Cylinder empty.	Replace cylinder.
	Supply hose disconnected.	Connect supply hose.
	Kinks in supply hose.	Remove kinks from supply hose.

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Symptom	Possible Cause	Recommended Action
Excessive high pressure circuit leak	Yoke gate loose.	Tighten yoke tee handle.
	Cylinder gasket leaking.	Replace cylinder gasket(s).
	Unused cylinder yoke is unplugged.	Install yoke plug in unused cylinder yoke.
Excessive low pressure circuit leak	Vaporizer filler or drain valve loose.	Tighten vaporizer filler and drain valves.
	Vaporizer mounted improperly.	Ensure proper vaporizer mounting.
Cannot make a connection to the absorber at one of the anti-disconnect fittings.	Release tab engaged.	Depress the release tab button on the female fitting and try again.
"Battery fail" message displayed.	Not user serviceable.	Call service personnel.

## Troubleshooting the ventilator

### Ventilator problems

Symptom	Possible Cause	Recommended Action
Ventilator in backup mode and no display on the screen. No alarms sounding. Ventilator screen's backlighting off.	System power has failed and backup battery is completely discharged.	After the power is restored, leave the system plugged in for at least 24 hours to recharge battery.
Bellows does not expand during ventilation or tends to collapse	Leak in the breathing system.	Check breathing system hoses and connections.
	Bellows not installed properly.	Check bellows to base attachment.
	Tear or leak in bellows.	Check the entire surface of the bellows. Pay close attention to the angles in the convolutions.
	Insufficient fresh gas flow.	Check that settings on flowmeters are adequate.
Bellows distended or slips off the base.	Incorrect scavenging system pressure.	Check the scavenging system for vacuum or high pressure.
Low pressure alarm sounds continuously.	Leaks in pressure sensing tube.	Replace pressure sensing tube.
	Circuit disconnected.	Reconnect circuit.
	Circuit occluded.	Clear circuit.

# 8/Troubleshooting Guide

Symptom	Possible Cause	Recommended Action
Volume readings are consistently low.	Low oxygen supply pressure.	Check, and repair, the oxygen supply.
	Failed volume sensor cartridge.	Replace the volume sensor cartridge.
	Breathing system leak.	Find and repair leaks.
System sounds alarms at incorrect pressures.	Liquid in pressure sensing tube.	Drain the sensing tube.
	Pressure sensing tube disconnected.	Reconnect the tube.
	Kink in pressure sensing tube.	Replace the tube.
Alarms sound without apparent cause and cannot be silenced.	Certain electronic failures may be so significant as to cause the system to lose the ability to generate ventilator failure messages even though the ventilator has failed. If such a serious failure occurs, the alarm silence button will not silence the alarm.	Do not use the ventilator. Contact trained service personnel.
Reverse flow alarm is activated. (While the volume sensor is in the distal position of the expiratory limb of the breathing circuit.)	Expiratory check valve on absorber is functioning incorrectly.	Replace check valve disk.
Reverse flow alarm is activated during every breath.	If the volume sensor is located in the proximal end of the "Y" connector in the patient circuit, the alarm may sound for each breath.	Either locate sensor in the distal position of the expiratory limb, or use the ventilator's setup page to disable the reverse flow alarm. (see "Using the setup pages" in "5/Using the Ventilator.")
	Volume sensor cartridge is connected backwards to sensor clip.	Correctly connect the clip to the volume cartridge. (See "Checking the volume sensor" in "5/Maintaining and Calibrating the System" of "Reference.")

## Ventilator failure messages

Ventilator failure messages can indicate anything from a defective IC chip to excessive pressure in the ventilator's driving gas supply. All messages indicate problems that can cause the ventilator to shut down. However, some ventilator problems may not generate any ventilator failure message, even though the ventilator may not be functioning correctly.

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**WARNING:** Do not attempt to use the ventilator while a ventilator failure message is displayed. Even if no ventilator failure message is displayed, do not use the ventilator if you suspect a malfunction has occurred.

Some ventilator failure alarm conditions may be caused by transitory electrical interference that devices such as electrocautery instruments can generate. Although the ventilator will disable mechanical ventilation during most ventilator failure alarms, during certain of these alarms, whose causes may be transitory, the ventilator will continuously attempt to reset its circuits for correct operation. If the ventilator successfully resets its circuits, it will remove the alarm message and will resume normal operation.



**WARNING:** The use of electrosurgical units or other devices that radiate high-intensity electrical fields can affect the operation of the ventilator and monitors attached to the patient. Maintain as much distance as possible between the electrosurgical leads and the cables to the flow and oxygen sensors. Do not drape the electrosurgical leads across the absorber or the anesthesia machine. Do not let the electrosurgical leads rest on any surface of the anesthesia system. Constant surveillance of all monitoring and life support equipment is mandatory whenever electrosurgical devices are in operation, on, or in the vicinity of the patient.

Except for "vent fail 4" none of the causes of ventilator failure messages are user serviceable. If your ventilator displays a ventilator failure message other than "vent fail 4" please note the failure number, any other symptoms, and any corrective actions you took, then call trained service personnel.

Ventilator Failure	Possible Cause
VENT FAIL 0!	Electronic Failure
VENT FAIL 1!	Electronic Failure
VENT FAIL 2!	Electronic Failure
VENT FAIL 3!	Electronic Failure
VENT FAIL 4!	Supply gas pressure more than 30 psig
VENT FAIL 5!	Not Used
VENT FAIL 6!	Servo Valve Failure
VENT FAIL 7!	Not Used
VENT FAIL 8!	Gas inlet valve failure
VENT. FAIL 9!	Electronic Failure
VENT. FAIL 10!	Electronic Failure
VENT. FAIL 11!	Reference voltage incorrect
VENT. FAIL 12!	RAM table values incorrect
DRIVE CKT. OPEN!	Exhalation Valve Failure or Bag/APL switch in wrong position

# 8/Troubleshooting Guide

## Troubleshooting the display pod

### Display pod problems

Symptom	Possible Cause	Recommended Action
No display, no lights on display pod	Display pod interrupt switch off	Move display pod interrupt switch to on
	Circuit breaker tripped	Reset circuit breaker
Display very dim	Display brightness set to minimum level on manual setup page	Adjust display brightness
Normal screens displayed but no activity on screens, LEDs, or data	System software error	Use system disk to restart system

### Display pod error messages

During normal operation the display pod's computer may experience minor or major problems in its operation. Many of these errors will cause the system to display "restart system" followed by a three- or four-digit error number. Some of these errors will cause the system to enter the backup mode, while other will let the display pod continue operation. Although the display pod will continue working in spite of certain errors, these errors can indicate such problems as invalid data or an improperly functioning alarm system.

If the "restart system" message is displayed, make a note of the error number, then check the list below; follow the recommended action, if one is listed. Some errors do not appear on the list at all. If your system displays an error that does not appear on the list, restart the display pod as soon as possible.

Error Number	Possible Cause	Action
-4095	RAM disk is unformatted.	Format the RAM disk as described in "6/Service Procedures" of "Reference."
-4094	Data on RAM disk is lost.	Format the RAM disk as described in "6/Service Procedures" of "Reference."
-4093	Error reading RAM disk.	Restart the display pod. If problem persists, reformat the RAM disk as described in "6/Service Procedures" of "Reference."
-4092, -4091	RAM disk is improperly formatted.	Format the RAM disk as described in "6/Service Procedures" of "Reference."
-401, -112	Bad disk used to start system (can be either system disk or RAM disk problem).	If system disk was in the disk drive when the system was started (and the error occurred), replace the system disk. Otherwise, reformat the RAM disk as described in "6/Service Procedures" of "Reference."

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Error Number	Possible Cause	Action
-111, -110, -109	System error	Insert the system disk, then restart the display pod. If the problem is still present, replace the system disk.
-108	Software or hardware error	Insert the system disk, and restart the display pod.
-105	Bad disk used to start system (can be either system disk or RAM disk problem).	If system disk was in the disk drive when the system was started (and the error occurred), replace the system disk. Otherwise, reformat the RAM disk as described in "6/Service Procedures" of "Reference."
-103	Software error	Insert the system disk, then restart the display pod. If the problem is still present, replace the system disk.
-102	Software missing from system load disk.	Insert the system disk, then restart the display pod. If the problem is still present, replace the system disk.
122	Too many alarms for alarm display area. (Some alarms are not displayed.)	Reduce the number of alarm conditions. As a precaution, restart the display pod.
124	Alarms may be invalid or missing.	Restart the display pod at earliest opportunity.
301	Too many alarms to manipulate. (Some alarms are not displayed.)	Reduce the number of alarm conditions. As a precaution, restart the display pod.
302	One or more alarm conditions are not being displayed or are being displayed incorrectly.	Restart display pod.
303, 304, 305	Too many alarms for software to manipulate or display. One or more alarms are not being processed or displayed.	Reduce the number of alarm conditions. As a precaution, restart the display pod.
306	Invalid attributes for an alarm. One or more alarms may not be displayed.	Restart display pod: alarms may be unreliable.
307, 308	One or more alarms may not be classified or handled correctly.	Restart display pod: alarms may be unreliable.
309	Invalid attributes for an alarm. One or more alarms may not be displayed.	Restart display pod: alarms may be unreliable.
500, 501, 701	Too many alarm conditions to handle.	Reduce the number of alarm conditions. As a precaution, restart the display pod. Functional reliability of alarm setting should not be affected.

# 8/Troubleshooting Guide

Error Number	Possible Cause	Action
903, 904, 905	Auto setup "save configuration" failure.	Restart the display pod. Until the display pod is restarted, using "save configuration" will probably cause the error to recur. If, after restarting, the problem persists, reformat the RAM disk as described in "6/Service Procedures" of "Reference."
906	Invalid cursor position during the editing of a configuration file name. Software corruption likely.	Restart display pod. Enter Auto Setup after restarting to verify that all configuration names are still correct.
907	Unable to open auto setup configuration file. Possible RAM disk corruption.	Restart the display pod. Until the display pod is restarted, using "save configuration" will probably cause the error to recur. If, after restarting, the problem persists, reformat the RAM disk as described in "6/Service Procedures" of "Reference."
908	Configuration file access failure detected. Software corruption likely. Configuration file data corruption possible.	Restart display pod. Avoid using auto setup and save configuration until the display pod is restarted. Enter Auto Setup after restarting to verify that all configuration names and settings are still correct.
911	Failure trying to save a system configuration in Save Configuration mode. Corrupted or incompatible version of software likely.	Restart display pod. Do not use "save configuration" until the display pod is restarted. Do not trust the current system settings. Set the system configuration manually (using manual setup page, alarm limits, alert zone widths, trend durations). After restarting, try to save the configuration again. If this fails, restart the display pod with the system disk. If this fails, reformat the RAM disk as described in "6/Service Procedures" of "Reference."
1701, 1702	Software error.	No action is necessary.
1901, 1902	System unable to access calibration date.	No action is necessary. The system will attempt to store a new calibration date when a calibration occurs. If this is unsuccessful, use the system disk to restart the system.
1903	Software error.	Use the system disk to restart the system.
1904	Improper calibration date.	No action is necessary. The system will attempt to store a new calibration date when a calibration occurs. If this is unsuccessful, use the system disk to restart the system.
2100	Software error.	No action is necessary.
2101, 2102, 2125, 2126, 2127, 2128, 2129, 2130, 2301, 2302, 2303, 2700, 2701	Software error.	No action is necessary.

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Error Number	Possible Cause	Action
3285, 3286, 3287, 3288, 3289, 3290, 3292, 3293, 3301, 3302, 3304, 3305	Alarm data manipulation error.	Restart display pod: alarms are not functioning correctly.
3309	Too many alarms for system to track.	Reduce the number of alarm conditions. As a precaution, restart the display pod.
3501, 3502, 3503, 3504, 3505, 3506, 3507, 3508, 3509, 3510	Software error.	No action is necessary.
3511	Software error when reading the current low alert limit for one of the display pod parameters	No action is necessary. The default low alert limit is used.
3512	Software error when reading the current high alert limit for one of the display pod parameters	No action is necessary. The default high alert limit is used.
3701	Front panel switch not read correctly.	Continue to use the system, but pay careful attention switch-related behavior. Make sure you get what you expect when you press a switch.
3710, 3711	Software operating in an invalid state.	Restart the display pod. Until system is restarted, keep a close eye on the behavior of the system immediately after a front panel switch is pressed. Make sure you get what you expect when you press a switch.
3901, 3902, 3903, 3904, 3905, 3906, 3907, 3908, 3909, 3910, 3911, 3912, 3913	Software error.	No action is necessary. Default setting is used.
5300, 5701, 5702, 5703, 5900, 5901	Software error.	No action is necessary.
6101, 6102	Software error.	No action is necessary. The default setting is used.
6103	Software error.	No action is necessary.
6301	Software may run out of memory.	Continue operation, but watch for other error messages.
6500	Software error.	No action is necessary.



## 8/Troubleshooting Guide

Error Number	Possible Cause	Action
6706	Access to help file failed.	Exit "help" application. Restart display pod.
6707	Access to help file failed.	Do not use "help" Restart display pod from system disk.

## Troubleshooting the NIBP

### NIBP problems

Symptom	Possible cause	Recommended action
The monitor is unable to determine the pressure readings	The cuff used may be the wrong size for the patient.	Use a cuff size that is best suited for the patient (see "3/Making the Patient Connections"). Cuffs of various sizes are available as optional accessories. (See 8/Accessories and Optional Parts of "Reference.")
	Leaks in the hose or hose connections can result in false readings or needless alarms. An air leak is indicated when the pump keeps trying to inflate or reinflate the cuff.	Ensure that all the hose connections are tight; replace the air hose if a leak is indicated. (See "2/Preoperative Checkout Procedures" for a leak test.)

### NIBP failure messages

Failure message	Possible cause	Recommended action
NIBP Mon Fail 0	RAM or ROM failure	Restart system. If failure recurs, replace module.
NIBP Mon Fail 1	Pressure transducer failure	Restart system. If failure recurs, replace module.
NIBP Mon Fail 50	Communication failure	Restart system. If failure recurs, replace module.
NIBP Mon Fail 99	Display pod not receiving data	Restart system. If failure recurs, replace module.

## Troubleshooting the respiratory gas module

### Respiratory gas module problems

Symptom	Possible cause	Recommended action
Monitor consistently shows lower CO <sub>2</sub>	Air leak in gas sample system or sample line blocked.	Ensure that the sample tube assembly is attached securely to the sample inlet connector. Do not over tighten the connection.

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Symptom	Possible cause	Recommended action
Frequent purging	Condensed moisture in sample line.	None. Monitor purging to clear sample line.
	Sample line occluded.	Check sample line for sharp bends or for a kinked line.
Frequent purging followed by message "CO <sub>2</sub> /agt line blocked"	Purging system cannot clear blocked line.	Replace sample tube. If problem persists, remove monitor from use.
"CO <sub>2</sub> /agt filter blocked"	The sample filter cartridge is occluded and must be replaced.	Replace the patient sample filter cartridge, which is above fluid trap.
Invalid span	Leak in sampling system	Check sample tube connections. Make sure cannister is not empty. Ensure that there are leaks in the calibration reservoir bag.

### Respiratory gas module failure messages

All respiratory gas module failure messages—such as "CO<sub>2</sub>/agt fail 5"—indicate conditions that will cause the respiratory gas module to produce invalid data; so CO<sub>2</sub> and agent data is not displayed during these types of failures. Certain types of respiratory gas module failures can be corrected by such simple measures as replacing the module's sample filter. Other types of failures, however, require replacing the module, as described in "6/Service Procedure" of "Reference."

Failure message	Possible cause	Recommended action
CO <sub>2</sub> /Agt Fail 0	ROM checksum failure	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 1	RAM failure	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 2	Central processor failure	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 3	No analog output	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 4	No vacuum	Replace module.
CO <sub>2</sub> /Agt Fail 5	No gas flow	Replace module.
CO <sub>2</sub> /Agt Fail 6	Monitor overheated	Check for obstructions near the system's fans. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 7	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 8	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 9	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 10	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 11	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fail 12	Software error	Restart system. If failure recurs, replace module.

## 8/Troubleshooting Guide

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Failure message	Possible cause	Recommended action
CO <sub>2</sub> /Agt Fall 13	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fall 14	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fall 15	Software error	Restart system. If failure recurs, replace module.
CO <sub>2</sub> /Agt Fall 16	Gas analyzer inoperative	Replace module.
CO <sub>2</sub> /Agt Fall 17	Module's filter blocked	Replace filter as described in "5/Maintaining and Calibrating the System" of "Reference."
CO <sub>2</sub> /Agt Fall 18	Gas analyzer needs calibration.	Calibrate monitor as described in "5/Maintaining and Calibrating the System" of "Reference."
CO <sub>2</sub> /Agt Fall 19	Gas analyzer O <sub>2</sub> needs calibration.	Calibrate monitor as described in "5/Maintaining and Calibrating the System" of "Reference."
CO <sub>2</sub> /Agt Fall 20	Monitor's barometer needs recalibration.	Replace module.
CO <sub>2</sub> /Agt Fall 99	Display pod not receiving respiratory gas monitor data.	Replace module.

### SpO<sub>2</sub> failure messages

Failure message	Possible cause	Recommended action
SpO <sub>2</sub> Fall 0	Module or probe hardware failure	Replace probe. Restart system. If error recurs, replace module.
SpO <sub>2</sub> Fall 1	Module can't identify probe.	Replace probe. Restart system. If error recurs, replace module.
SpO <sub>2</sub> Fall 99	Display pod not receiving SpO <sub>2</sub> monitor data.	Replace module.

# Notes

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## 9/Shutting Down the System

After using  
the Ohmeda  
Modulus CD  
Anesthesia  
System

1. Stop disk logging and printer logging.
2. Make sure vaporizers are switched off.
3. Remove the patient circuit from the absorber.
4. Close all of the flow controls.
5. Disconnect all of the pipeline supplies.
6. Open the cylinder valves.
7. Fully open the flow control valve for air or the third gas, if installed.
8. Fully open the flow control valve for nitrous oxide.
9. Fully open the flow control valve for oxygen.
10. Close the third gas's cylinder valve. Before moving to the next step, wait until the float in the flowmeter for the third gas drops to the bottom of its tube.
11. Close the nitrous-oxide cylinder valve. Before moving to the next step, wait until the float in the nitrous-oxide flowmeter drops to the bottom of its tube.
12. Close the oxygen cylinder valve. The low pressure alarm will sound. Before moving to the next step, wait until the float in the oxygen flowmeter drops to the bottom of its tube.
13. Move the system master switch to standby.
14. Close all of the flow control valves.

# Notes

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**Bold page numbers indicate  
"Reference" volume entries**

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A Division of The BOC Group Inc

## Regional Service Offices

**Eastern Region**  
Ohmeda  
Fort Lee Executive Park  
One Executive Drive  
Fort Lee NJ 07024  
USA  
Tel 800 922 0443  
Tel 201 947 6100

**Midwestern Region**  
Ohmeda  
2101 S Arlington Heights Rd  
Suite 145  
Arlington Heights IL 60005  
USA  
Tel 800 372 5867  
Tel 708 364 7090

**Pacific Region**  
Ohmeda  
5635 W Las Positas Blvd  
Suite 406  
Pleasanton CA 94588  
USA  
Tel 800 227 2054  
Tel 415 463 2133

**Southeastern Region**  
Ohmeda  
4565 Winters Chapel Rd  
Atlanta GA 30360  
USA  
Tel 800 241 4300  
Tel 404 449 7990

**Southwestern Region**  
Ohmeda  
831 Greenview Drive  
Grand Prairie TX 75050  
USA  
Tel 800 433 5070  
Tel 800 772 5420

**International**  
UK, Europe, Africa and  
Middle East  
Ohmeda  
Ohmeda House  
71 Great North Road  
Hatfield AL95EN  
Hertfordshire  
England  
Tel 707 263570  
Fax 707 260065/707 260191  
Telex 915128

**Latin America, Caribbean**  
Ohmeda  
10700 N Kendall Dr  
Suite 301  
Miami FL 33176  
USA  
Tel 305 596 0800  
Fax 305 596 9216  
Telex 441258/6812092

**Southeast Asia**  
Ohmeda  
78 Shenton Way  
#09 03  
Singapore 0207  
Tel 65 222 6028  
Fax 65 222 0725  
Telex RS 35276

## Service and Distribution Center

Ohmeda  
7750 The Bluffs NW  
Austell GA 30001  
USA  
Tel 800 999 6277  
Tel 404 739 4774

## Technical Support

Ohmeda  
Ohmeda Drive  
PO Box 7550  
Madison WI 53707  
USA  
Tel 800 345 2700

## Canada Service Centre

Ohmeda  
5865 McLaughlin Road  
Mississauga Ontario L5R 1B8  
Canada  
Tel 416 568 9533  
Fax 416 568 9799

In the USA, please call Customer Service at 800 345 2700 for additional information or to place an order.



A BOC Health Care  
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1202 0119 000  
05 90 0 19 04 06  
Printed in USA  
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