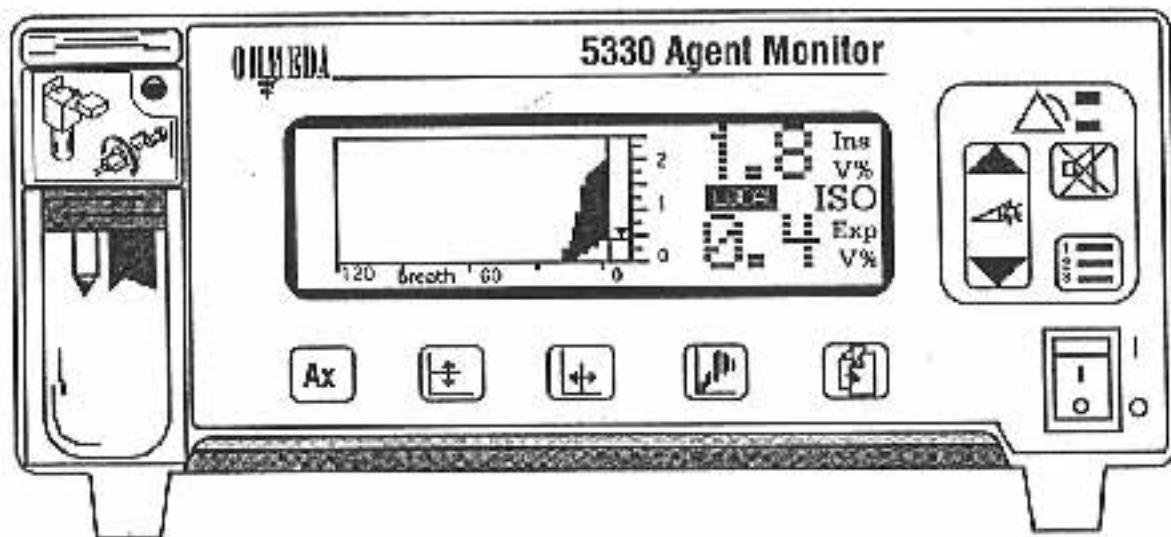


## 5330 Agent Monitor

Operator's Manual  
Software Revision 5 or Higher



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## 1/Overview

This chapter covers the following features in an Ohmeda 5330 Agent Monitor operating with software revision level 5 or higher:

- Main features
- Front panel
- Back panel
- Bottom panel
- Displays
- Patient connections

In addition, there is a complete list of the warnings and cautions you must observe when using the monitor.

## Features

The monitor provides compact, anesthetic agent monitoring for the operating room. Using infrared and microprocessor technology, the monitor

- Measures CO<sub>2</sub> to identify whether the sampled breath is from an Inspiratory (Ins) or an Expiratory (Exp) breath phase.
- Measures and displays the concentration of anesthetic agent on a graphic display panel.

If the monitor is unable to identify the breath phase (for example, when no CO<sub>2</sub> is detected), the data are presented as the maximum (Max) and minimum (Min) concentration detected. If the monitor is unable to detect a breath, the display is updated every 15 seconds.

The monitor features:

- Isollurane, enflurane, halothane, desflurane, and sevoflurane (5-agent monitors only) monitoring
- Disposable water separator filter cartridge
- High resolution display
- Membrane switch control panel
- Trend data collection
- Agent analog output for strip chart recording
- Measurement of inspired and expired anesthetic agents
- Side-stream sampling system to allow the use of a wide variety of sample adapters

- Automatic zeroing and easy calibration procedures
- User-replaceable software cartridge for system upgrades
- RS-232 communication port for input and output to computers or printers
- Multiple language versions
- A menu system for changing the monitor's operating parameters and for service

**Note:** The 5330 Agent Monitor is not approved for monitoring sevoflurane in some countries (including US and Canada). Disregard references in this manual to sevoflurane and SpanC calibration gas if using the 5330 in these countries.

A kit with patient sample lines, airway adapters, scavenger adapters, disposable filter cartridges, and calibration gas was included with the monitor.

## Front panel

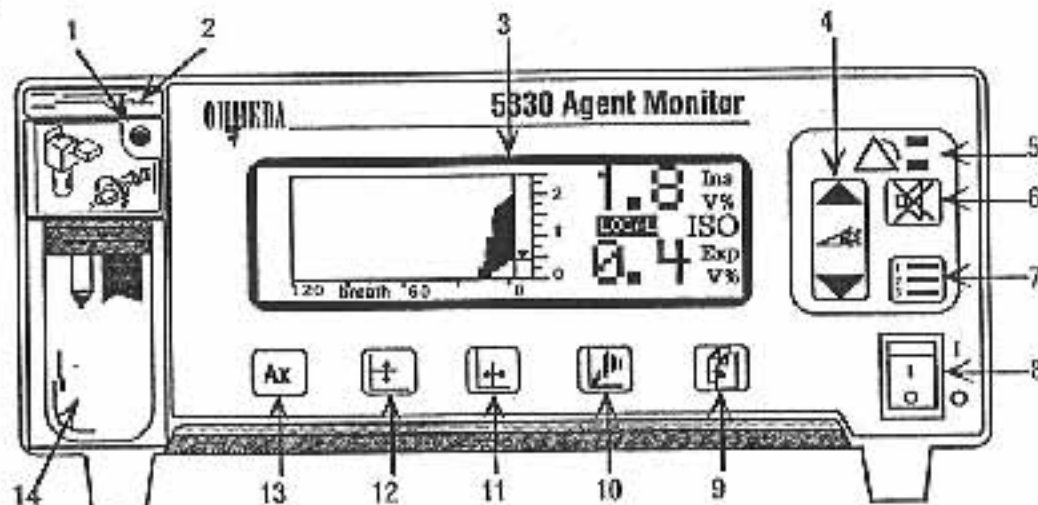


Figure 1-1. Front Panel

- |   |                           |    |                   |
|---|---------------------------|----|-------------------|
| 1 | Sample inlet              | 8  | Power switch      |
| 2 | Water separator cartridge | 9  | Menu/Next         |
| 3 | Graphic display           | 10 | Return to monitor |
| 4 | Up/Down arrows            | 11 | Trend length      |
| 5 | Alarm indicators          | 12 | Trend scale       |
| 6 | Alarm silence             | 13 | Select agent      |
| 7 | Next Parameter            | 14 | Water bottle      |

### 1 Sample inlet

This connects the patient circuit to the monitor using an Ohmeda sample line.

**WARNING: Data validity**—Use only the 96-in. (243.84 cm) length, 0.047-in. (1.2 mm) I.D. sample line supplied with the monitor for gas sampling. A longer sample line may change the operating characteristics (specifications) of the monitor (i.e., degrade the response time).

**2 Water separator cartridge**

This removable cartridge allows gas and vapors, but not liquids, to pass from the sample line into the monitor. See 4/Maintenance and Service for replacement information.

**3 Graphic display**

This graphic display shows agent data, alarm conditions, and configuration information.

**4**

These keys perform two functions depending upon the mode in which the monitor is operating: setup or normal operation.

In Setup mode (menus displayed), press one of these keys to raise or lower the value of a highlighted menu parameter, respectively.

During normal operation (trend graph displayed), you can use these keys to adjust the display contrast.

**5**  **Alarm indicators**

These lights display a flashing red light, a flashing yellow light, or a continuous yellow light depending on the type of alarm. See 2/Operation and Calibration for a description of alarm types.

**6**  **Alarm silence**

Pressing this key once starts a countdown timer and mutes the audible tone for currently active alarms for the time period shown. If a new alarm occurs during the alarm silence period, it reactivates the audible alarm tone automatically.

If you press this key two times within 2 seconds, **all-mute mode** is set—any new alarms occurring during the alarm silence period **will not** reactivate the audible alarm tone.

If you press this key again **after the first 2 seconds** of the alarm silence period, the audible alarm tone is reactivated. This is true for both all-mute and non-all-mute modes.

See 2/Operation and Calibration for a description of alarm types.

**7**  **Next Parameter**

Pressing this key selects the next parameter shown on a menu.






**8 Power switch**

This switch turns the monitor On ( I ) or Off ( O ).

**9**  **Menu/Next**

Pressing this key cycles through the menu pages of either monitor mode or Setup/Service mode.



- 10  Return to Monitor  
From any menu, pressing this key returns the unit to the normal operation mode (trend graph displayed).
- 11  Trend Length  
Pressing this key changes the time axis (amount of trend history) of the trend display.
- 12  Trend Scale  
Pressing this key changes the magnitude axis (maximum value) of the trend display.
- 13  or  Select Agent  
Pressing this key selects the agent to be monitored—changes the internal algorithms and then indicates the selected agent on the display.
- 14 Water bottle  
This bottle collects fluids separated from the patient's aspirated sample. See 4/Maintenance and Service for instructions on how to empty the bottle and, when necessary, how to clean the optical sensor cone.

**CAUTION:** Always empty the water bottle when it is half full or before moving the monitor. Failure to empty this bottle may allow fluid to overflow into the monitor and cause malfunction.

## Back panel

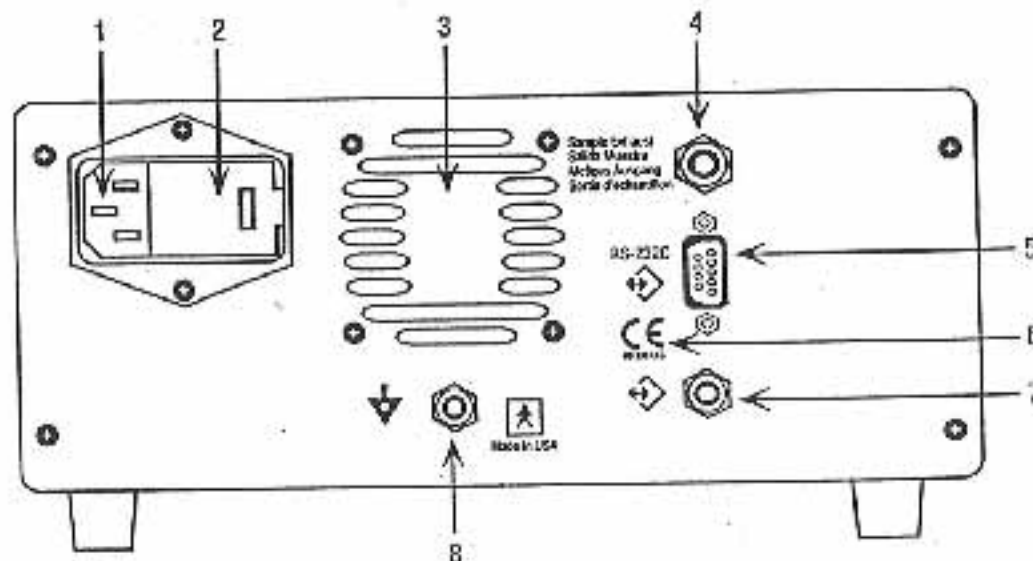


Figure 1-2. Back Panel

- |   |                       |   |                            |
|---|-----------------------|---|----------------------------|
| 1 | Power cord receptacle | 5 | RS-232 connector           |
| 2 | Power control module  | 6 | CE/EMC mark                |
| 3 | Cooling fan           | 7 | Analog output jack         |
| 4 | Sample exhaust        | 8 | External ground connection |



### 1 Power cord receptacle

Plug the power cord that goes to the AC mains power supply in here.

**CAUTION:** Use only the power cord supplied with this monitor. When replacing the power cord, use only the power cord specified for this monitor.

### 2 Power control module

This module, which also contains the power cord receptacle, contains the voltage selector drum (selections of 100 V, 120 V, 220 V, and 240 V) and the power input fuses. After the voltage is properly set and the proper fuses are installed, no further adjustment is required.

To set the voltage to local power or to replace the power fuses, see 4/Maintenance and Service.

**CAUTION:** Always make sure the monitor is set up to operate at the AC power supply line voltage present at the "wall" receptacle before you plug in the power cord.

### 3 Cooling fan

This fan provides constant air circulation to protect the monitor's heat-sensitive electronic components.

**CAUTION:** Do not cover or block the cooling fan. Check the cooling fan intake at the back of the monitor on a weekly basis to be sure there is no blockage.

### 4 Sample exhaust

Connect the sample exhaust line (1/8 in. barbed connector) to a waste gas scavenging system to properly eliminate the gas sample. If a closed circuit is required, return the gas sample to the patient circuit.

**WARNING:** Data validity—The scavenger pressure at the sample exhaust port must not be above or significantly below atmospheric pressure or the monitor readings will be invalid.

### 5 RS-232 connector

The 9-pin RS-232 connector provides input and output to a printer or computer.

### 6 CE mark

If your monitor has this mark, it means that the product conforms with the European Council Directive 89/336/EEC relating to Electromagnetic compatibility when it is used in accordance with the instructions provided in this manual.

**CAUTION:** To prevent improper loading, which upsets the correspondence between the measured voltage and the intended output voltage, connect only a high impedance device (100K  $\Omega$  or higher) to the analog output.

### 7 Analog output jack

The 1/8-in. jack provides a connection for a strip chart recorder.

### B External ground connection

Provides connection to an equipotential grounding system, if available.

## Bottom panel

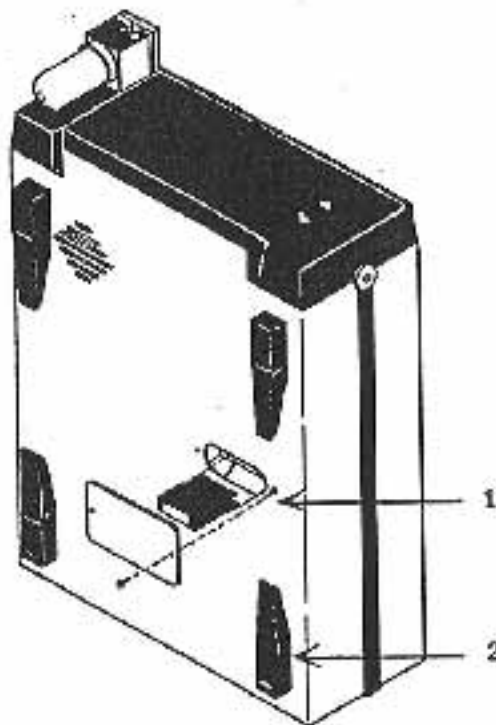


Figure 1-3. Bottom Panel

### 1 Software cartridge

The monitor's program is stored in the software cartridge located under a cover on the bottom panel. See 4/Maintenance and Service for software cartridge replacement instructions.

### 2 Adjustable feet

The adjustable feet allow for several mounting configurations:

- Horizontal - Low or High profile
- Tilt - Front Panel up or down

## Displays

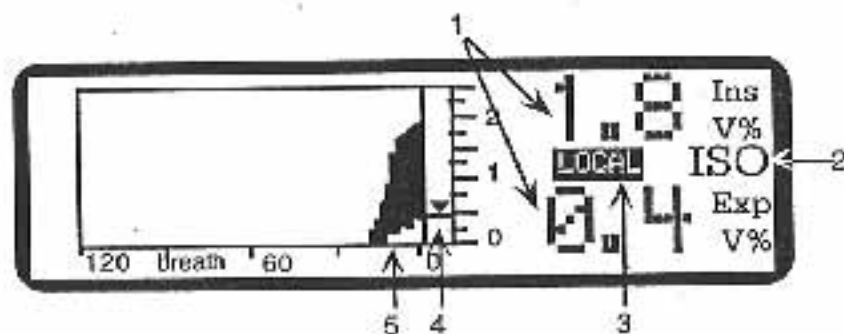


Figure 1-4. Monitor display

- |   |   |   |                           |
|---|---|---|---------------------------|
| 1 | Digital display                                 | 4 | Breath detection bargraph |
| 2 | Agent selected                                  | 5 | Trend display             |
| 3 | Alarm silence timer or agent value compensation |   |                           |

### 1 Digital display

The inspiratory and expiratory (or Max/Min) concentrations of anesthetic agent appear in volume percentages. When monitoring isoflurane, enflurane, or halothane, values larger than 9.9% are indicated by asterisks: \*.\*. When monitoring desflurane, values larger than 24.0% are indicated by asterisks: \*.\*. When the monitor is unable to measure the gas sample (during purge or auto-zero, for example), the digits are replaced with dashes --.

### 2 Agent selected

The type of anesthetic agent selected—**isoflurane (ISO)**, **enflurane (ENF)**, **halothane (HAL)**, **desflurane (DES)**, or **sevoflurane (SEV)** [5-agent monitors only]—appears between the digital values.

**WARNING: Patient safety**—Selecting one agent but delivering another agent or a mixture of agents will cause erroneous readings. These errors may be high or low, depending upon which agent is selected and which agent or mixture of agents is actually delivered.

### 3 Alarm silence timer/Agent value compensation area

When you press the Alarm Silence key, the timer shows the time remaining before the audible alarm will resume in this area. You can select the alarm-silence period—30, 60, 90, or 120 seconds.

If the alarms have not been silenced, this area shows the selected agent value compensation. This compensation is to local-barometer pressure or to sea-level pressure depending on the monitor setting (see 2/Operation and Calibration for more information on pressure compensation).

### 4 Breath detection bargraph

The instantaneous agent concentration is shown at the tip of the triangular arrow head in this bargraph. The bargraph also displays the most recent inspiratory and expiratory (or the Max/Min) values for the most recent breath.

Inspiratory value = - - - (dotted line)

Expiratory value = — (solid line)

### 5 Trend display

The anesthetic agent case history appears as a trend graph. Trend graph time period options range from breath-by-breath to the most recent 20, 60, or 120 minutes. Each time period is displayed as a vertical bar. One end of the bar represents the inspired (or the Maximum) and the other end the expired (or the Minimum) concentration for the same breath or period.

If inspired is greater than expired (for example, during induction), the trend is solid. If inspired is less than expired (for example, during recovery), the trend is crosshatched.

If a breath phase cannot be detected and the monitor is in the Max/Min mode, only the Max and Min values are shown; the space between is left blank.

If the values go off the top of the display, marks are placed along the top edge of the trend graph.

In the breath-by-breath mode, 5-minute time periods are indicated by a vertical bar in the upper portion of the trend display.

Display scales for ISO, ENF, SEV, and HAL are: 0 to 1.25%, 0 to 2.5%, 0 to 5%, and 0 to 10%.

Display scales for DES are: 0 to 1.25%, 0 to 2.5%, 0 to 3.75%, 0 to 5%, 0 to 10%, and 0 to 20%.

## Patient connections

**WARNING: Data validity—DO NOT USE PVC SAMPLE LINE. Using PVC patient sample line may permanently damage the monitor and cause false agent concentration readings.**

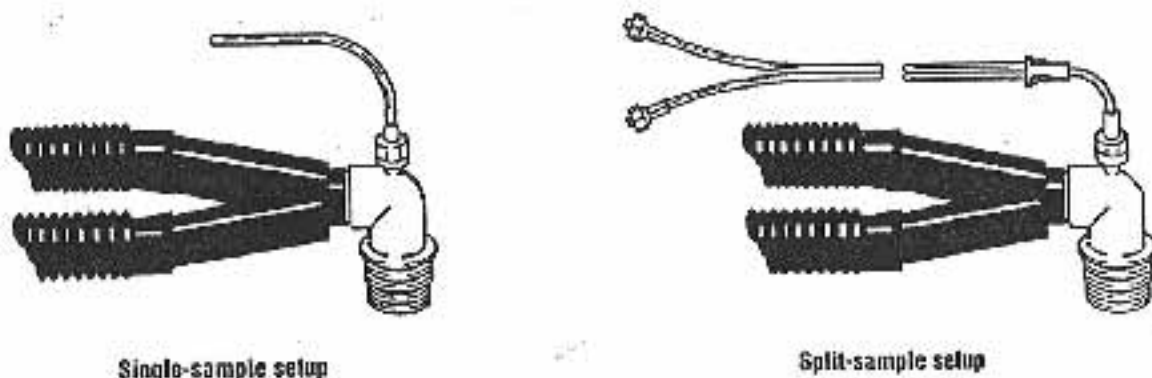


Figure 1-5. Patient circuit adapters

### Single sample inlet – 5330 Agent Monitor only

1. Make sure that the sample line is in good condition. If not, replace it with a new line. Avoid changing the sample line while the monitor is in operation.
2. Connect one end of the single sample line to the connector on the sample inlet.
3. Insert the appropriate patient circuit adapter into the proximal end of the patient circuit. Attach the sample line to the fitting on the patient circuit adapter.
4. Make sure that the sample line is attached to the patient circuit adapter and to the sample inlet connector securely.
5. Make sure that the sample exhaust is connected to a gas scavenging system or returned to the patient circuit.

### Split sample inlet – 5330 and 5200/5210 Capnometer

1. Make sure that the sample line is in good condition. If not, replace it with a new line. Avoid changing the sample line while the monitor is in operation.
2. Connect one of the pair of connectors on the single/dual lumen sample line to the connector on the sample inlet.
3. Connect the other of the pair of connectors to the sample inlet on the 5200/5210 Capnometer.

4. Insert the appropriate patient circuit adapter into the proximal end of the patient circuit. Attach the sample line to the fitting on the patient circuit adapter.
5. Make sure that the sample lines are attached to the patient circuit adapter and to the sample inlet connectors securely.
6. Make sure that the sample exhaust is connected to a gas scavenging system or returned to the patient circuit.

**WARNINGS: Data validity—**

- To prevent inaccurate readings, make sure the water bottle is snugly seated and that the connections between the sample line and the monitor do not leak.
- The scavenger pressure at the sample exhaust port must not be above or significantly below atmospheric pressure or the monitor readings will be invalid.

**CAUTION:** Always empty the water bottle when it is no more than half full or before moving the monitor. Failure to empty this bottle may allow fluid to overflow into the monitor and cause malfunction.

## Precautions

Two types of precautions appear throughout this manual: warnings and cautions.

**Read this section carefully before operating or servicing the monitor.**

## Warnings

A **WARNING** indicates a potentially harmful situation that may cause injury to the patient or operator.

Federal law in the USA and Canada restricts this device to sale by or on the order of a licensed medical practitioner.

**Handle the monitor with care**

Improper handling can cause monitor damage or inaccurate operation.

**Electrical Shock Hazard**

Measure the leakage current whenever an external device is connected to the analog or digital ports. Forward and Reverse Polarity: 100 microamperes maximum.

Do not remove the cover of the 5330 Agent Monitor. Refer servicing to qualified service personnel who are trained in the repair of this equipment. Only competent individuals trained in the repair of this equipment should attempt to service it.

Detailed information for more extensive repairs is included in the service manual solely for the convenience of users having proper knowledge, tools and test equipment and for service representatives trained by Ohmeda.

**Electrical Shock and Flammability Hazard**

Before servicing the monitor, always turn it off and disconnect it from the AC main power supply.



Use the power cord supplied with this monitor only. When replacing the power cord, use only the power cord specified for this monitor.

### **Explosion Hazard**

Do not use the monitor in the presence of flammable anesthetics or other flammable substances.

### **Fire Hazard**

For continued protection against fire hazard, replace only with the same type and rating of fuse.

### **Patient Safety**

Do not, under any circumstances, perform any testing or maintenance on the monitor when it is being used to monitor a patient.

The patient sample line is designed for one-time use. Repeated use of this disposable line may result in cross-contamination of patients and/or instrument malfunctions.

### **Proper Grounding**

For protection against shock hazards, connect this equipment only to a three-wire, grounded, hospital-grade receptacle. The three-connector plug must be inserted into a properly wired three-wire receptacle. Where a two-wire receptacle is encountered, a qualified electrician must replace it with a properly grounded three-wire receptacle in accordance with the governing electrical code.

- Do not, under any circumstances remove the grounding contact from the power plug.
- Do not use extension cords or adapters of any type.

### **Failure of Operation**

If the monitor fails to respond as described, do not use it until the situation has been corrected by trained service personnel.

### **Operator safety**

When handling any component of the patient circuit that comes in contact with the patient's exhalant gas or fluids, wear safety eyeglasses, gloves, mask, and gown.

Small amounts of anesthetic gases are introduced into ambient air during the calibration procedures. Hold the gas canisters below shoulder level and make sure the room is adequately ventilated. Connect the instrument exhaust to a scavenging system.

### **Data validity**

To prevent invalid data due to performance degradation, use only Ohmeda sample lines and cannulae.

Use only the 96-in. (243.84 cm) length, 0.047-in. (1.2 mm) I.D. sample line supplied with the monitor for gas sampling. A longer sample line may change the operating characteristics (specifications) of the monitor (i.e., degrade the response time).

To prevent inaccurate readings, make sure the water bottle is snugly seated and that the connections between the sample line and the circuit adapter and between the sample line and the monitor do not leak.

**Data validity, continued**

The scavenger pressure at the sample exhaust port must not be above nor significantly below atmospheric pressure or the monitor readings will be invalid.

Selecting one agent but delivering another agent or mixture of agents will cause erroneous readings. These errors may be high or low, depending upon which agent is nominally selected and which agent or mixture of agents is actually delivered.

Do not operate the monitor unless it is properly calibrated. Inaccurate readings will result.

To prevent inaccurate patient readings, use only SpanA (6016-0000-104), SpanB (6016-0000-102), and SpanC (5-agent monitors only [6016-0000-100]) gas canisters to calibrate a monitor with software revision level 5 or higher.

Do not spray the calibration gas when the canister temperature is below 50 °F (10 °C). Allow the can to reach room temperature before use. If you accidentally spray gas from a cold canister, discard the canister. The concentration in the remaining gas is too high and will cause a bad calibration.

A high patient blood alcohol content will cause erroneously high agent concentration readings.

If the monitor fails to respond as described in the calibration procedures, do not use the monitor until the malfunction has been corrected.

Perform the preoperative checkout procedure before using the monitor with a patient. If the monitor fails any test, it must be removed from use until it has been repaired and checked for correct operation.

To prevent inaccurate patient readings, do not operate the monitor unless it is properly installed and then calibrated. Calibrate the monitor at least once a month.

Do not use PVC patient sample lines. PVC sample lines may permanently damage the monitor and cause false agent concentration readings.

Use only Ohmeda calibration gases or equivalents:

- SpanA gas (6016-0000-104) consists of 4% isoflurane, 96% argon,  $\pm 0.03\%$ , gravimetric standard.
- SpanB gas (6016-0000-102) consists of 6% halothane, 6% CO<sub>2</sub>, 88% argon,  $\pm 0.03\%$ , gravimetric standard.
- SpanC gas (5-agent monitors only [6016-0000-100]) consists of 1.5% sevoflurane, 98.5% argon,  $\pm 0.03\%$ , gravimetric standard.

**Cautions**

A CAUTION indicates a condition that may lead to equipment damage or malfunction.

**Voltage**

Always make sure the monitor is set up to operate at the AC power supply line voltage present at the "wall" receptacle.



To prevent improper loading, which upsets the correspondence between the measured voltage and the intended output voltage, connect only a high impedance device (100K  $\Omega$  or higher) to the analog output.

### Water bottle

Always empty the water bottle when it is no more than half full or before moving the monitor. Failure to empty the water bottle may allow fluid to overflow into the monitor and cause a malfunction.

### Cleaning

- Do not autoclave, pressure sterilize, or gas sterilize the monitor.
- Do not immerse the monitor in liquid. The electronic circuitry can be short circuited, causing permanent damage.
- Use the cleaning solution sparingly. Excessive solution can flow in the monitor and cause damage to internal components.
- Do not touch, press, or rub the display panel with abrasive cleaning compounds, instruments, brushes, rough-surface materials, or bring it into contact with anything that could scratch the panel.
- Do not use petroleum-based or acetone solutions, or other harsh solvents, to clean the display panel or the instrument. These substances attack the device's materials, and device failure may result.

### Fan

Do not cover or block the cooling fan. Check the cooling fan intake at the back of the monitor on a weekly basis to be sure there is no blockage.

## Symbols and Definitions

The symbols and their meanings found on the 5250 RGM and in this manual are as follows:



89/336/EEC

If your monitor has this mark, this product conforms with European Council Directive 89/336/EEC relating to electromagnetic compatibility when it is used in accordance with the instructions provided in this manual.



Indicates the monitor has type BF patient isolation.

## 2/Operation and Calibration

This chapter contains

- Information about and instructions for accessing and, if desired, changing available system options:
  - The agent to be monitored
  - Trend information appearance
  - Configurable features, such as alarm limits, system parameters, date, time, language, and the altitude compensation parameter
- Procedures for
  - Monitor calibration
  - Preoperative checkout
- General information about the system's alarms

### Agent selection

#### **WARNINGS: Data validity—**

- **Selecting one agent but delivering another agent or mixture of agents will cause erroneous readings. These errors may be high or low, depending upon which agent is nominally selected and which agent or mixture of agents is actually delivered.**
- **A high patient blood alcohol content will cause erroneously high agent concentration readings.**

When you select an agent to be monitored, the system uses that agent's internal algorithm for monitoring and displays its name on the screen. When changing from one agent to another, the new agent's alarm limits are reset for that agent's default limits.

ISO, HAL, ENF, and SEV:	High inspired limit is 5.0 High expired limit is 4.0 Low inspired and expired limits are 0.0
DES:	High inspired limits are 16.0 High expired limits are 14.0 Low inspired and expired limits are 0.0



To change the agent, press Select Agent until the agent name of your choice appears on the display.

## Trend selection

### Trend scale

The trend scale options for ENF, ISO, HAL, and SEV are:

0 to 1.25%	0 to 5%
0 to 2.5%	0 to 10%

The trend scale options for DES are:

0 to 1.25%	0 to 5.0%
0 to 2.50%	0 to 10%
0 to 3.75%	0 to 20%



To change the displayed trend scale, press Trend Scale until the scale you want to use appears.

### Trend length

The trend length options are:

- Breath-by-breath
- 20 minutes
- 60 minutes
- 120 minutes



To change the displayed trend length, press Trend Length until the option you want to use appears.

## Configuration selections

The system has a series of configuration setup and service menus from which you choose the parameters you want to change and then select the setting you want for that parameter.

As shown in Figure 2-1, the first two menus (1/2 and 2/2) are monitor mode screens with alarm and system parameter options. The other five menus (1/, 2/, 3/, 4/, and 5/5) provide setup and service options. As the operator, you may need to use these screens for calibrating; for setting the date, time, and language in which screen information appears; and for setting the altitude compensation.

In general, the steps for accessing these menus, for selecting the menu item you want, and for changing that item are as follows:



1. To access the menus and move to the next one, press Menu/Next.

**Note:** To access the menus in Setup/Service Mode, you must choose the Go to Setup/Service item on the System Param. menu and then press ▲.



2. To select the menu item you want to change, press Next Param.

3. To change the value of the selected item, press ▲ or ▼ to increase or decrease the value, respectively.



4. To return to Monitor Mode, from any menu press Return to Monitor.

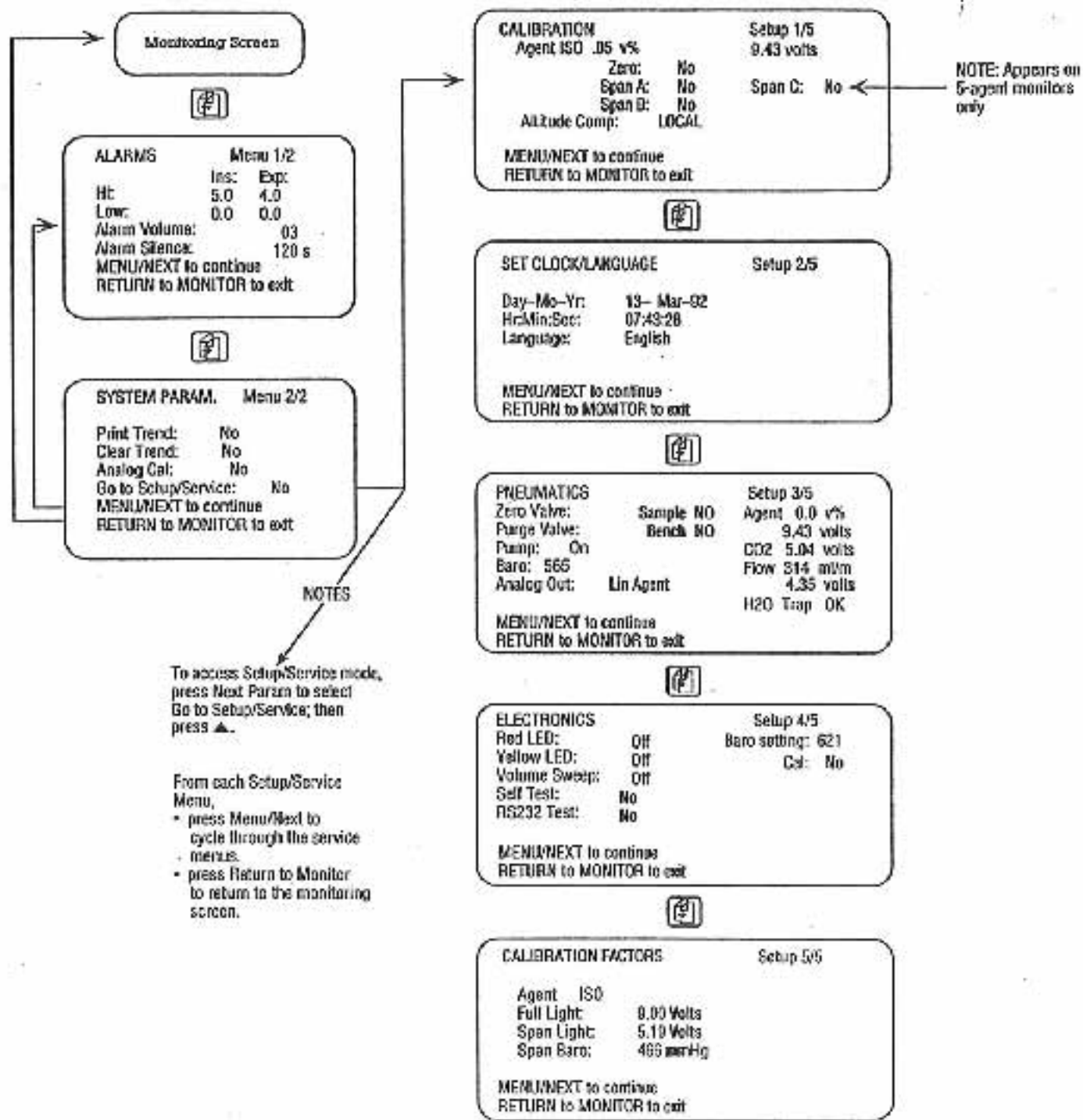


Figure 2-1. Menu system

### Alarms menu

At this menu you have the following choices for adjusting the alarm limit values for the agent being monitored:

High and low inspired and expired: ISO, HAL, ENF, and SEV = 0 to 10%  
DES = 0 to 18%

Alarm volume—01 to 07 (default = 03)

Alarm silence period—30, 60, 90, or 120 seconds (default = 120)

### System parameters menu

At this menu, you press  $\blacktriangle$  to toggle to the "yes" option to

- Clear trend data.
- Print trend data.
- Set the analog output to a calibration signal output from strip chart recorder calibration.
- Access the Setup/Service Mode menus.

### Calibration menu

At this menu,

- Press  $\blacktriangle$  to access the "yes" option to manually calibrate the monitor for

Zero

SpanA

SpanB

SpanC

- Press  $\blacktriangle$  to toggle between sea level (assumed to be 760 mmHg) and local (measured at powerup).

**Ax**

- Press Select Agent to change agents.

For the calibration procedure, see "Calibration" later in this chapter.

For more information on altitude pressure compensation, see "Altitude compensation" later in this chapter.

#### Notes:

- To obtain readings that agree with the vaporizers, use "Sea Level" for all except the Ohmada Tec™ 6, which requires that you use "Local." See your vaporizer manual regarding pressure compensation.
- The % agent displayed in this screen is 0.05% above the volume percent computed by the unit. Subtract 0.05% to obtain the most accurate value possible.

### Set Clock/Language menu

Use this menu to set the correct date and time and to select the desired screen language.



- Press Next Param to select the Day-Mo-Yr and/or Hr:Min:Sec option(s) and to move through the three sections available for each. Press  $\blacktriangle$  or  $\blacktriangledown$  to increase or decrease the values for those items.



- Press Next Param until Language is selected and then press  $\blacktriangle$  to move through the available options—English, French, German, Spanish, and Italian.

## Pneumatics, Electronics, and Calibration Factors menus

These remaining menus are generally for service use only.

## Calibration

### WARNINGS: Data validity—

- Use only Ohmeda calibration gases or equivalents:
  - SpanA gas (6016-0000-104) consists of 4% isoflurane, 96% argon,  $\pm 0.03\%$ , gravimetric standard.
  - SpanB (6016-0000-102) gas consists of 6% halothane, 6% CO<sub>2</sub>, 88% argon,  $\pm 0.03\%$ , gravimetric standard.
  - SpanC (5-agent monitors only [6016-0000-100]) gas consists of 1.5% sevoflurane, 98.5% argon,  $\pm 0.03\%$ , gravimetric standard.
- If the monitor fails to respond as described in the calibration procedure, do not use the monitor until the malfunction has been corrected.

---

### Important:

- You must calibrate the monitor in Calibration Mode.
  - If the message Recalibration recommended appears on the screen, the internal barometer must be calibrated **before** you perform the zero and span calibrations; see "Altitude compensation" later in this chapter.
- 

To assure that the monitor performs correctly, perform the zero and span calibration checks as follows:

- When Recal Required message is flashing.
- Once a month.
- If the monitor's accuracy is suspect.
- After the monitor has been serviced.
- If the monitor is moved to a different altitude or after a severe weather change (barometric pressure changes of more than 50 mmHg).

Two forms of calibration are involved:

- Zero (baseline)  
Periodically the monitor automatically "zeros" to compensate for changes to the baseline.

**WARNING: Patient safety—**To prevent inaccurate patient readings, use only SpanA (6016-0000-104), SpanB (6016-0000-102), and SpanC (5-agent monitors only [6016-0000-100]) gas canisters to calibrate a monitor with software revision level 4 or higher.

- SpanA requires a calibration gas canister with 4% isoflurane, 96% argon,  $\pm 0.03\%$ , gravimetric standard.  
SpanB requires a calibration gas canister with 6% halothane, 6% CO<sub>2</sub>, 88% argon,  $\pm 0.03\%$ , gravimetric standard.



**Note:** Halothane cannot be highly pressurized. As there is not a great deal of gas in the SpanB canister, try to conserve it.

SpanA and SpanB calibration drifts are less than 0.02% in 12 hours. Although the monitor remains in calibration for long periods of time, it is prudent to perform span calibrations periodically.

**SpanC (for use with 5-agent monitors only)** requires a calibration gas canister with 1.5% sevoflurane, 98.5% argon,  $\pm 0.03\%$ , gravimetric standard.

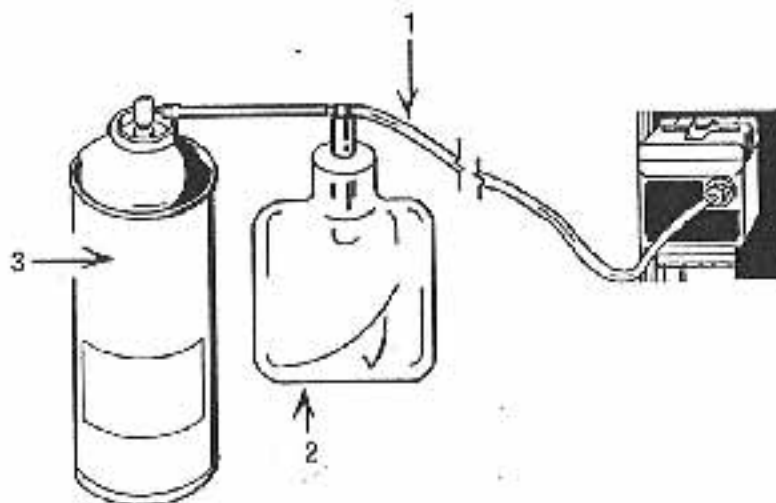


Figure 2-2. Zero and span calibration connections

- 1 Sample line
- 2 Calibration bag
- 3 Calibration gas canister

### Span check

To validate the accuracy of the agent reading:

1. Connect one end of a single-lumen sample line to the sample inlet. Connect the other end to the calibration bag. Connect the bag to the adapter tube provided with the calibration gas canister; see Figure 2-2.

2. Select ISO as the agent.

3. On the display, verify that the altitude compensation parameter is set to Local.

If it is not, follow the procedure under "Altitude compensation" later in this chapter to change it.

4. Using SpanA calibration gases (4% isoflurane, 96% argon), simulate inspiration and expiration by pressing and releasing the valve step on the gas canister three or four times (five seconds on, ten seconds off). Verify that

min agent = 0% (+0.1, -0.0%) and

max agent = 4.0% ( $\pm 0.2\%$ ).

Repeat the check if necessary.



5. **SpanB** calibrates only halothane.

Using **SpanB** calibration gases (6% halothane, 6% CO<sub>2</sub>, 88% argon), repeat step 1 (to connect the gas canister) and then step 4 with **HAL** selected, to verify the inspired and expired agent readings.

inspired agent = 0% and

expired agent = 6.2% ( $\pm 0.3\%$ )

Repeat the check if necessary.

6. **SpanC** calibrates sevoflurane in 5-agent 5330 monitors only.

Using **SpanC** calibration gases (1.5% sevoflurane, 98.5% argon), repeat step 1 (to connect the gas canister) and then step 4 with **SEV** selected. Verify that:

min agent = 0% (+0.1%, -0.0%) and






max agent = 1.5% ( $\pm 0.2\%$ ).

## 7. If you had to change the altitude compensation parameter from Sea level to Local, change it back to the original setting.

## Barometric pressure





The barometric pressure parameter for the monitor must be within  $\pm 5$  mmHg of the local pressure. You may check to see that it is correctly set and if it is not, you can change it.

### Barometric pressure check

1. Power on the monitor and allow time for the Select Agent screen to appear.
2. Select an agent and proceed to the monitoring screen.
-  3. To access the **SYSTEM PARAM** menu, press Menu/Next two times.
-  4. Use Next Param to select Go to Setup/Service and then press  $\blacktriangle$ .
5. Disconnect the sample line, if any, from the sample inlet.
-  6. Press Menu/Next until the **PNEUMATICS** menu appears.
-  7. Press Next Param until the Pump option is selected. To turn the pump off, press  $\blacktriangledown$ .
8. Check that the Baro reading is correct for your area—within  $\pm 5$  mmHg of the local pressure. Compare it to a calibrated barometric pressure gauge.  
If the reading requires adjustment, perform the "Barometric pressure calibration" procedure that follows or contact an Ohmeda service representative in your area.
-  9. To return to normal operation, press Return to Monitor.

### Barometric pressure calibration

1. Follow steps 1 through 5 in the preceding section, "Barometric pressure check."

-  2. Press Menu/Next until the ELECTRONICS menu appears.
-  3. Press Next Param until the Baro setting option is selected.
4. Press ▲ or ▼ to increase or decrease the value so it matches the current barometric pressure as indicated on a calibrated barometric pressure gauge or other such instrument.
-  5. Press Next Param to select the Cal option.
6. To save the new barometric pressure calibration value, press ▲.
-  7. To return to normal operation, press Return to Monitor.

### Zero and span calibration procedure

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**Important:** For maximum accuracy the monitor must always be zero calibrated before it is span calibrated, as described below.

If you perform a barometer calibration, you must do a zero and then SpanA, SpanB, and SpanC (5-agent monitors only) calibrations, in this order, to clear the Recal Required message. Upon calibrating the barometer, the unit sets the recalibration-required flag; if the barometer was invalid at span time then so was the span.

It does not matter which gas you selected during zero or span calibration, although the volume percentage value displayed varies with the agent selected. Do not be concerned if the percentage displayed does not agree with the calibration gas being delivered when the monitor has a different agent selected. The unit "knows" how to use the span information because you must select either SpanA, SpanB, or Span C (5-agent monitors only) regardless of which gas is selected for monitor mode.

---

#### Zero calibration

1. Power on the monitor and allow it to warm up for at least 30 minutes.
-  2. To access the SYSTEM PARAM menu, press Menu/Next two times.
-  3. Use Next Param to select Go to Setup/Service.
4. To access the CALIBRATION menu, press ▲.  
The Zero option is already selected.
5. To zero the monitor, press ▲. The message Manual Zero in Progress appears.

If the zero is successful, after about 10 seconds the CALIBRATION menu reappears; go to SpanA calibration, step 1.

If the zero is unsuccessful, ZERO FAIL appears. If the failure condition persists after repeated attempts, the monitor requires servicing.

**SpanA calibration**

1. To select SpanA, press Next Param. Leave the setting at No.
2. To span the unit for ISO, ENF, and DES, connect the SpanA calibration gas through the calibration bag and the sample line (see Figure 2-2). Do not spray gas yet.

**WARNINGS:**

- **Operator safety**—Small amounts of anesthetic gases are introduced into ambient air during the calibration procedures. Hold the gas canister below shoulder level and make sure the room is adequately ventilated. Connect the instrument exhaust to a scavenging system.
- **Data validity**—
  - Do not spray the calibration gas when the canister temperature is below 50 °F (10 °C). Allow the can to reach room temperature before use. If you accidentally spray gas from a cold canister, **discard the canister**. The concentration in the remaining gas is too high and will cause a bad calibration.
  - To prevent inaccurate patient readings, use only SpanA (6016-0000-104), SpanB (6016-0000-102), and SpanC (5-agent monitors only (6016-0000-100)) gas canisters to calibrate a monitor with software revision level 4 or higher.

3. Wait for the unit to completely empty the cal bag, after which the unit goes into purge. To detect the purge condition, watch the alarm LED; it must be on steady. Note that the unit may alarm almost immediately upon connecting the calibration gas due to high inspired agent—the LED flashes for that alarm and so you must wait for the LED to stop flashing. When the LED is steady, you can be sure the bag is empty of room air or other gases and ready for calibration gases.
4. Introduce the SpanA calibration gas (4% isoflurane, balance argon) by inflating the bag to about 1/2-in. thickness. Maintain 1/3 to 2/3 bag inflation throughout the span. Avoid over-pressurizing the unit during span calibration by making sure the bag is never quite full.
5. Observe the bench voltage; when the voltage display has stabilized to within  $\pm 0.02$  V and the cal bag is not quite full, press ▲.

After about 10 seconds, Span Complete appears on the screen, and then the CALIBRATION menu reappears.

If the span calibration is unsuccessful, INVALID SPAN, MENU/NEXT to Continue appears. Make sure you are using the correct calibration gas canister: SpanA (6016-0000-104). Press ▲ to repeat the span. If still unsuccessful, the monitor requires service.

**Notes:**

- If the agent concentration readings steadily decrease, the calibration gas canister may be depleted. Use a new canister and repeat steps 2 through 5.
- Agent concentration readings in the calibration screen may not agree with calibration gasses being supplied to the monitor. This occurs when the agent selected and the agent being supplied to the unit during calibration are not the same. The volume % displayed is always for the selected agent; this discrepancy does not mean the span was unsuccessful.

With ISO selected, SpanA gas will read about 4.05% on the calibration screen. With any other agent selected, the reading will be higher. This does not affect the span calibration; it affects only the number displayed.

### SpanB calibration

The SpanB gas cannot be highly pressurized because the halothane condenses out at higher pressures.

**Always use the cal bag.** Connect the SpanB calibration gas through the calibration bag and the sample line.

1. Select SpanB. Leave the setting at No.
2. Connect the SpanB calibration gas through the calibration bag and the sample line. Do not spray gas yet.

### WARNINGS:

- **Operator safety**—Small amounts of anesthetic gases are introduced into ambient air during the calibration procedures. Hold the gas canister below shoulder level and make sure the room is adequately ventilated. Connect the instrument exhaust to a scavenging system.
  - **Data validity**—
    - Do not spray the calibration gas when the canister temperature is below 50 °F (10 °C). Allow the can to reach room temperature before use. If you accidentally spray gas from a cold canister, discard the canister. The concentration in the remaining gas is too high and will cause a bad calibration.
    - To prevent inaccurate patient readings, use only SpanA (6016-0000-104), SpanB (6016-0000-102), and SpanC (5-agent monitors only (6016-0000-100)) gas canisters to calibrate a monitor with software revision level 4 or higher.
3. Wait for the unit to completely empty the cal bag and go into purge. Empty the bag every time.

To detect the purge condition, watch the alarm LED; it must be on steady. Note that the unit may alarm almost immediately upon connecting the calibration gas due to high inspired agent—the LED flashes for that alarm and so you must wait for the LED to stop flashing,

When the LED is steady, you can be sure the bag is empty of room air or other gases and ready for calibration gases.

4. Introduce the SpanB calibration gas (6% halothane, 6% CO<sub>2</sub>, balance in argon) by inflating the bag to about 1/2-in. thickness. Maintain 1/3 to 2/3 bag inflation throughout the span. Avoid over-pressurizing the unit during span calibration by making sure the bag is never quite full.
5. Observe the bench voltage; when the voltage display has stabilized to within  $\pm 0.02$  V and the cal bag is not quite full, press ▲.

After about 10 seconds, Span Complete appears on the screen, and then the CALIBRATION menu reappears.


If the span calibration is unsuccessful, INVALID SPAN, MENU/NEXT to Continue appears. Make sure you are using the correct calibration gas canister—SpanB (6016-0000-102). Press ▲ to repeat the span. If still unsuccessful, the monitor requires service.

**Notes:**

- If the agent concentration readings steadily decrease, the calibration gas canister may be depleted. Use a new canister and repeat steps 2 through 5.
- Agent concentration readings in the calibration screen may not agree with calibration gasses being supplied to the monitor.

This occurs when the agent selected and the agent being supplied to the unit during calibration are not the same. The volume % displayed is always for the selected agent; this discrepancy does not mean the span was unsuccessful.

With HAL selected, SpanB gas will read about 6.18% on the calibration screen. With any other agent selected, the reading will be lower. This does not affect the span calibration; it affects only the number displayed.

6. Disconnect the SpanB gas canister from the sample line.
7.  4-agent monitors only: To return to normal operation, press Return to Monitor.

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**Important:** If any portion of the calibration procedure fails and you return to monitoring, the old calibration constants are retained and the message Recal gas analyzer will appear on the monitoring screen until a full calibration has been successfully completed.

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**SpanC calibration (5-agent monitors only)**

**Always** use the cal bag. Connect the SpanC calibration gas through the calibration bag and the sample line.

1. Select SpanC. Leave the setting at No.
2. Connect the SpanC calibration gas through the calibration bag and the sample line. Do not spray gas yet.

**WARNINGS:**

- **Operator safety**—Small amounts of anesthetic gases are introduced into ambient air during the calibration procedures. Hold the gas canister below shoulder level and make sure the room is adequately ventilated. Connect the instrument exhaust to a scavenging system.
  - **Data validity**—
    - Do not spray the calibration gas when the canister temperature is below 50 °F (10 °C). Allow the can to reach room temperature before use. If you accidentally spray gas from a cold canister, discard the canister. The concentration in the remaining gas is too high and will cause a bad calibration.
    - To prevent inaccurate patient readings, use only SpanA (6016-0000-104), SpanB (6016-0000-102), and SpanC (5-agent monitors only (6016-0000-100)) gas canisters to calibrate a monitor with software revision level 4 or higher.
3. Wait for the unit to completely empty the cal bag and go into purge. Empty the bag every time.



To detect the purge condition, watch the alarm LED; it must be on steady. Note that the unit may alarm almost immediately upon connecting the calibration gas due to high inspired agent—the LED flashes for that alarm and so you must wait for the LED to stop flashing.

When the LED is steady, you can be sure the bag is empty of room air or other gases and ready for calibration gases.

4. Introduce the SpanC calibration gas (1.5% sevoflurane, balance in argon) by inflating the bag to about 1/2-in. thickness. Maintain 1/3 to 2/3 bag inflation throughout the span. Avoid over-pressurizing the unit during span calibration by making sure the bag is never quite full.
5. Observe the bench voltage; when the voltage display has stabilized to within  $\pm 0.02$  V and the cal bag is not quite full, press  $\blacktriangle$ .

After about 10 seconds, Span Complete appears on the screen, and then the CALIBRATION menu reappears.

If the span calibration is unsuccessful, INVALID SPAN, MENU/NEXT TO CONTINUE appears. Make sure you are using the correct calibration gas canister—SpanC (6016-0000-100). Press  $\blacktriangle$  to repeat the span. If still unsuccessful, the monitor requires service.

### Notes:

- If the agent concentration readings steadily decrease, the calibration gas canister may be depleted. Use a new canister and repeat steps 2 through 5.
- Agent concentration readings in the calibration screen may not agree with calibration gasses being supplied to the monitor. This occurs when the agent selected and the agent being supplied to the unit during calibration are not the same. The volume % displayed is always for the selected agent; this discrepancy does not mean the span was unsuccessful.

With SEV selected, SpanC gas will read about 1.5 % on the calibration screen. With any other agent selected, the reading will be lower. This does not affect the span calibration; it affects only the number displayed.

6. Disconnect the SpanC gas canister from the sample line.
7. To return to normal operation, press Return to Monitor.



---

**Important:** If any portion of the calibration procedure fails and you return to monitoring, the old calibration constants are retained and the message Recal gas analyzer will appear on the monitoring screen until a full calibration has been successfully completed.

---

## Altitude compensation

**Note:** Changing the selected agent can change the altitude compensation. Always select your agent first.

Most vaporizers do not compensate for altitude. Agent vaporizers (except the Dhmeda Tec 6 vaporizer) are designed to produce the same partial pressure at any altitude. Therefore, at a higher altitude (lower total pressure), a vaporizer will produce a higher concentration in volume percent.

For example, in Los Angeles, California, an accurate vaporizer set at 1% delivers a concentration of 7.6 mmHg/760 mmHg, or 1%. In Denver, Colorado, the same vaporizer set at 1% delivers a concentration of 7.6 mmHg/620 mmHg, or 1.226%.

The 5330 Agent Monitor has an internal parameter to compensate for altitude changes. When that parameter is set to Local, the actual delivered concentration is displayed. When that parameter is set to Sea level, the monitor will change the display to correlate with the vaporizer setting. To correlate with a Toc 6 vaporizer, set the altitude compensation parameter to Local.




Accurate Vaporizer Setting	Agent Partial Pressure	Actual Concentration at 5,000 ft	Monitor Output at 5,000 ft with Local Compensation	Monitor Output at 5,000 ft with Sea Level Compensation
1.0%	7.6 mm Hg	1.2%	1.2%	1.0%
2.0%	15.2 mm Hg	2.4%	2.4%	2.0%
3.0%	22.8 mm Hg	3.6%	3.6%	3.0%
4.0%	30.4 mm Hg	4.9%	4.9%	4.0%
5.0%	38.0 mm Hg	6.1%	6.1%	5.0%

Figure 2-3. Local and sea-level parameter setting effects.

**Important:**

- When you are monitoring ISO, HAL, ENF, or SEV, the monitor can be referenced to Sea level atmospheric pressure, as are vaporizer dials. If this is the setting you've selected, the monitor readings may not match a mass spectrometer or other device that has been referenced to local atmospheric pressure.
- When you are monitoring DES, the monitor must be referenced to Local atmospheric pressure rather than Sea level.

**To change the altitude compensation parameter setting:**

1. Power on the monitor and allow time for the Select Agent screen to appear.
2. Select an agent and proceed to the monitoring screen.
3. To access the SYSTEM PARAM menu, press Menu/Next two times. 
4. Use Next Param to select Go to Setup/Service and then press ▲. 
5. At the CALIBRATION menu, use Next Param to select Altitude Comp.
6. To change from Local to Sea level, or vice versa, press ▲.
7. To return to the monitoring screen, press Return to Monitor and then verify that the correct altitude compensation parameter is displayed. 



## Preoperative checkout

### WARNINGS:

- **Explosion hazard**—Do not use the monitor in the presence of flammable anesthetics or other flammable substances.
- **Data validity**—Perform the preoperative checkout procedure before using the monitor with a patient. If the monitor fails any test, it must be removed from use until it has been repaired and checked for correct operation.
- **Data validity**—To prevent inaccurate patient readings, do not operate the monitor unless it is properly installed and then calibrated. Calibrate the monitor at least once a month.

**CAUTION:** Always make sure the monitor is set to operate at the AC power supply line voltage present at the "wall" receptacle.

1. Connect the power cord to the monitor (back panel) and to the main AC power supply.
2. Empty the water bottle.

**WARNING:** Data validity—To prevent inaccurate readings, make sure the water bottle is snugly sealed and that the connections between the sample line and the circuit adapter and between the sample line and the monitor do not leak.

**CAUTION:** Always empty the water bottle when it is half full or before moving the monitor. Failure to empty this bottle may allow fluid to overflow into the monitor and cause malfunction.



3. Turn on the monitor and allow it to warm up for more than 5 minutes.

During powerup, the monitor performs a series of internal checks. The alarm tone should sound and the red and yellow LEDs should flash. If a problem exists, the monitor displays a message; see 3/Messages and Troubleshooting for complete information.

### WARNINGS: Data validity—

- To prevent invalid data due to performance degradation, use only Ohmeda sample lines and cannulae.
- Use only the 96-in. (243.84 cm) length, 0.047-in. (1.2 mm) I.D. sample line supplied with the monitor for gas sampling. A longer sample line may change the operating characteristics (specifications) of the monitor (i.e., degrade response time).

4. Check that all the patient and exhaust connections are secure.



or



5. To select the agent to be monitored, press Select Agent.



6. To begin monitoring, press Return to Monitor.

7. If this is the first time the monitor is being used for monitoring, or if you have any reason to suspect the accuracy of the readings:
- Perform the "Barometric pressure check" and, if necessary, "Barometric pressure calibration" procedures found earlier in this chapter.
  - Then perform the "Zero and span calibration procedure" also found earlier in this chapter.

## Alarm types

See 3/Messages and Troubleshooting for an alphabetical listing of all alarm messages, their cause(s), and recommended action(s).

Priority/ type	Definition	Visual	Audible	Staging
High	Possibly life-threatening; requires immediate attention	Red LED flashes. Message in trend area.	Three high tones. Automatic reset after alarm condition has cleared.	Audible tone at detection and then every 30 seconds. After 2 minutes, tone sounds every 10 seconds.
Medium	Requires prompt attention.	Yellow LED flashes. Message in trend area.	Three low tones. Automatic reset after alarm condition has cleared.	Audible tone at detection and then every 30 seconds. After 2 minutes, tone sounds every 10 seconds.
Low	Requires operator awareness.	Yellow LED constant. Message in trend area.	One high and one low tone when the condition occurs.	None
System fail	Monitor did not pass internal tests.	Yellow LED constant. Message in trend area.	Continuous tone while condition is present.	None

## 3/Messages and Troubleshooting

Some monitor conditions, such as violation of an alarm limit or problems with the sample line will cause a message to appear in the trend area of the display. Other conditions, such as no power to the monitor, do not generate a message.

Refer to the table that follows for a list of symptoms that may occur followed by an alphabetical listing of messages you may receive; each item includes the possible cause(s) and the recommended action(s).

Symptom/message	Possible cause(s)	Recommended action(s)
Monitor fails to respond when power is turned on.	Monitor is not plugged in.	Plug unit into AC power supply.
	Rear panel fuse is blown.	Replace the fuse; see 4/Maintenance and Troubleshooting.
	Power supply failure.	Unit requires service.
Monitor makes unusual noise (squeaks, chirps) when powered on and won't respond.	Power supply is in a shutdown mode.	Unit requires service.
Electronic interference appears on the screen.	Various: Electrosurgery, MRI (NMR), or other electrical device.	Plug unit into a different power outlet or change unit's location.
Display problems: unreadable; poor contrast; flickers, characters missing, etc.	Loose/faulty connections or damaged display.	Unit requires service.
Keys don't function or function intermittently.	Internal keyboard connector may be disconnected or membrane key panel may be damaged.	Unit requires service.
Monitor does not sense a breath.	Leak in pneumatics system, sample line, water separator assembly, or the pump has failed.	Check sample line, water separator cartridge, and water bottle. Replace as needed. If the problem persists, the unit requires service.
Pump sounds noisy or unusual.	Misaligned, improperly connected, or faulty pump.	Unit requires service.
	Scavaging system disconnected.	Connect monitor exhaust to scavaging system.

### 3/Messages and Troubleshooting

Symptom/message	Possible cause(s)	Recommended action(s)
Sample line plugs often.	Excessively high secretions/liquid in sample. Purging system cannot clear blocked line or water separator cartridge.	Check/replace sample line and/or water separator cartridge. Empty water bottle and clean optical sensor cone. Draw sample off airway circuit from the top instead of the bottom. If problem persists, unit requires service.
Unit spontaneously resets	RECAL REQD message appears.	Calibrate the unit—Baro, Zero, SpanA, SpanB, and SpanC (5-agent monitors only).
	No message appears; power supply may be low.	Unit requires service.
A/D fail	A/D system has failed.	Unit requires service.
Analog fail	Analog system has failed.	Unit requires service.
Autozero (or) Autozeroing	Automatic autozero in process.	No action required.
Bench saturated	Infrared agent bench has become contaminated.	Replace the water separator cartridge and allow the unit to dry out for 24 hours (leave it running in service mode). If the condition persists, unit requires service.
Cal Baro Fail	Unit is unable to zero the pressure sensor, which must be successfully zeroed to assure accuracy.	Unit requires service.
Clearing	Clearing trend memory.	No action required.
CPU fail	CPU system has failed.	Unit requires service.
Hi exp AGENT	Expired agent exceeds the alarm setpoint.	Check patient. Message clears when alarm condition is removed. Make sure alarm setpoint is correct.
Hi insp AGENT	Inspired agent exceeds the alarm setpoint.	Check patient. Message clears when alarm condition is removed. Make sure alarm setpoint is correct.

Symptom/message	Possible cause(s)	Recommended action(s)
INVALID SPAN	Agent channel span failed. Repeated failure may indicate a problem with the calibration gas canister, the pneumatics system, or the infrared agent bench assembly.	Verify that you have the correct calibration gas canisters: SpanA (6016-0000-104), SpanB (6016-0000-102), and SpanC (5-agent monitors only (6016-0000-1000)). RGM gases do not work, Span1 and Span2 gases do not work for software revision 4 or higher, and you must use SpanA for SpanA, SpanB for SpanB, and SpanC for SpanC. Check the expiration date on the gas canister and make sure that it is not empty. Repeat the span calibration procedure; see 2/Operation and Calibration. If the condition persists, unit requires service.
Line blocked	Sample line is blocked.	Replace the sample line.
	Monitor exhaust port is blocked.	Check scavaging system connection. Disconnect briefly to see if the message clears.
Low exp AGENT	Expired agent is below the alarm setpoint.	Check patient. Message clears when alarm condition is removed. Make sure alarm setpoint is correct.
Low insp AGENT	Inspired agent is below the alarm setpoint.	Check patient. Message clears when alarm condition is removed. Make sure alarm setpoint is correct.
Manual Zero in Progress	The user-initiated zero calibration is in progress.	If successful, no action required. If unsuccessful, see recommended action under Zero Fail message.
Recalibration recommended. Cal: 1> Baro 23 Span MENU/NEXT to continue.	The internal barometer needs calibration.	Perform the "Barometric pressure calibration" and "Zero and span calibration" procedures in 2/Operation and Calibration.
No Flow	Tubing or filters are blocked or disconnected, or the pump is bad.	Unit requires service.
No Vacuum	Failure in the pneumatics system.	Unit requires service.

### 3/Messages and Troubleshooting

Symptom/message	Cause(s)	Recommended action(s)
Printing	Occurs if Print Trend is selected on the System Parameters screen.	No action required.
Purging	Condensed moisture is in the sample line.	Monitor is clearing the sample line (a normal operation). No action required.
Ram Fail	RAM system has failed.	Unit requires service.
Recal gas analyzer	Zero/span calibration was not complete or unsuccessful.	Perform the "Zero and span calibration" procedure in 2/Operation and Calibration. Verify barometer calibration. Make sure each of the calibrations (zero, SpanA, SpanB, and SpanC [5-agent monitors only]) completes successfully. If condition persists, unit requires service.
Rom Fail	ROM system has failed.	Unit requires service.
Sample filter blocked	Water separator cartridge is clogged.	Replace the water separator cartridge. If the condition persists, unit requires service.
Sample line blocked	There is no flow through the sample line.	Replace the sample line. If the condition persists, unit requires service.
Span in Progress	Agent channel span calibration is in progress.	No action required.
Water trap full	Water bottle has filled with fluid.	Empty the water bottle and wipe the sensor cone. If the condition persists, unit requires service.
Zero Fail	Agent channel zero calibration failed.	Perform a manual zero calibration; see 2/Operation and Calibration. If the condition persists, unit requires service.



## 4/Maintenance and Service

This chapter contains the following information and instructions:

- **Cleaning**
  - The monitor's exterior surface
  - Sample lines and patient-circuit adapters
  - The water bottle and optical sensor cone
- **Replacing**
  - The water separator cartridge
  - Fuses
  - Software cartridge
- **Selecting the line voltage**
- **Ohmeda's service and repair policy**
- **Accessories list with part numbers**

### **WARNINGS:**

- **Electrical shock hazard**—Do not remove the cover of the 5330 Agent Monitor. Refer servicing to qualified service personnel who are trained in the repair of this equipment. Only competent individuals trained in the repair of this equipment should attempt to service it.
- **Electrical shock and flammability hazard**—Before servicing the monitor, always turn it off and disconnect it from the AC mains power supply.
- **Patient safety**—Do not, under any circumstances, perform any testing or maintenance on the monitor when it is being used to monitor a patient.
- **Operator safety**—When handling any component of the patient circuit that comes in contact with the patient's exhalant gas or fluids, wear safety eyeglasses, gloves, mask, and gown.



## Cleaning procedures

### Monitor exterior

**WARNING: Operator safety**—When handling any component of the patient circuit that comes in contact with the patient's exhalant gas or fluids, wear safety eyeglasses, gloves, mask, and gown.

**CAUTION: Cleaning**—

- Do not autoclave, pressure sterilize, or gas sterilize the monitor.
  - Do not immerse the monitor in liquid. The electronic circuitry can be short circuited, causing permanent damage.
  - Use the cleaning solution sparingly. Excessive solution can flow in the monitor and cause damage to internal components.
  - Do not touch, press, or rub the display panel with abrasive cleaning compounds, instruments, brushes, rough-surface materials, or bring it into contact with anything that could scratch the panel.
  - Do not use petroleum-based or acetone solutions, or other harsh solvents, to clean the display panel or the instrument. These substances attack the device's materials, and device failure may result.
1. Turn off the monitor and unplug it from the AC mains power supply.
  2. Wipe the outer surface of the monitor with a soft cloth dampened with a mild soap and water solution or with 70% isopropyl alcohol.
  3. To clean the display panel, gently wipe it with a cotton swab saturated with 70% isopropyl alcohol.
  4. Allow the monitor's surface to dry completely before connecting it to AC mains power. Do not plug in a wet monitor.

### Sample lines and patient circuit adapters

These items are expendable. To avoid any possibility of cross-contamination of patients, we recommend using new Ohmeda sample lines and circuit adapters for each patient.

### Water bottle and optical sensor cone

The water bottle should not become more than half full at any time and the optical sensor cone must be cleaned and maintained so the monitor can reliably alert the user to a WATER TRAP FULL condition.

1. When the WATER TRAP FULL message appears or when the bottle is more than half full, empty the water bottle.
  - a. Grasp the water bottle firmly and pull straight down.
  - b. Empty the contents in a container designated for patient waste.If the bottle is already empty, the cone needs cleaning.
2. With a clean cloth (alcohol wipe, gauze, tissue, etc.), wipe off the optical sensor cone.
3. To reinstall the water bottle, simply push it firmly back onto the water separator assembly.

## Replacement procedures

### Water separator cartridge

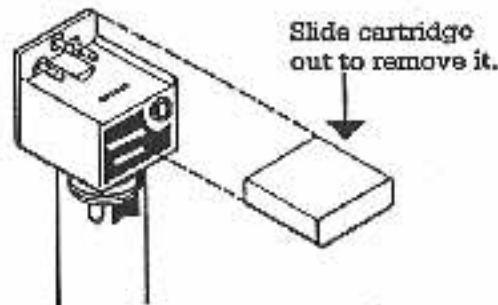


Figure 4-1. Water separator cartridge replacement

1. Pull the cartridge straight out from the water separator assembly. Discard the used cartridge in a receptacle designated for patient waste.
2. Place the new cartridge in position and slide it into place until it seats properly.
3. Check for leaks by occluding the sample line and noting that the monitor purges within 5 seconds.

### Fuses and voltage selection drum

Two fuses and a voltage selection drum are inside the power input module on the back panel. To replace one or both of the fuses and/or to change the line voltage selection for the monitor, follow this procedure.

1. Turn off the monitor and unplug the power cord from the power input module. Note the voltage rating. This rating must match the voltage available at the "wall" receptacle.
2. Using a small straight-blade screwdriver, gently pry open the power input module cover as shown in Figure 4-2.

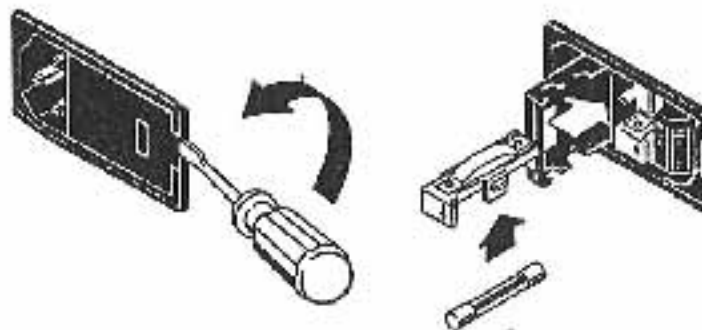


Figure 4-2. Fuse replacement and voltage selection

3. Note that the arrow on the end of the fuse holder(s) points down. Slip the blade of the screwdriver behind the arrow and pull the fuse holder forward. Remove both fuse holders.

**WARNING: Fire hazard**—For continued protection against fire hazard, replace only with the same type and rating of fuse.

4. Remove the blown fuse(s) and replace with a like fuse.
5. Orient the fuse holder(s) with the new fuse(s) in place with the arrow pointing down and slip back into the power input module.
6. Make sure the voltage selection drum is properly seated in the module and that the local line voltage stamped on the drum is facing outward.  
Do not attempt to turn the drum before prying it out.  
If the incorrect voltage is facing outward, gently pry out the drum and reseat it with the correct voltage facing out.
7. Close the power input module cover and snap it in place.
8. Verify that the voltage marking matches the voltage available at the wall receptacle.
9. Reinstall the power cord and test the monitor for proper operation by performing the "Preoperative checkout" in 2/Operation and Calibration.

### Software cartridge

**CAUTION:** Always empty the water bottle when it is half full or before moving the monitor. Failure to empty the water bottle may allow fluid to overflow into the monitor and cause a malfunction.

1. Turn off the monitor and unplug it from the AC mains power supply.
2. Empty the water bottle and disconnect the sample line.
3. Gently place the monitor with the back panel as shown in **Figure 4-3**.

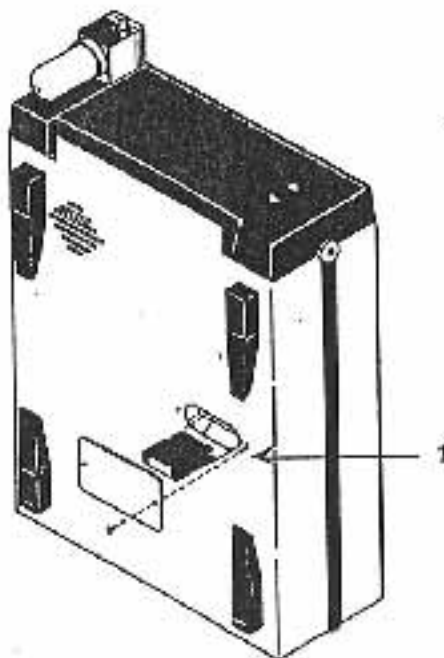


Figure 4-3. Software cartridge replacement

4. Using a Phillips-head screwdriver, remove the two screws and small cover plate from the bottom panel.

5. Grasp the installed software cartridge (Figure 4-3, item 1) and pull it out from the chassis. Note the key orientation.
6. Install the new software cartridge. **Note:** The cartridge is keyed and you can only install it in one direction.
7. Reattach the cover plate and gently turn the monitor right-side up again.

## Service and repair policy

Warranty repair and service must be performed by an Ohmeda Service Representative.

Do not use malfunctioning equipment. Make all necessary repairs, or have the equipment serviced by an Ohmeda Service Representative. Parts listed in the service manual for this product may be repaired or replaced by a competent, trained person who has experience in repairing devices of this nature. After repair, test the equipment to make sure it complies with the manufacturer's published specifications.

**CAUTION:** Only competent individuals trained in the repair of this equipment should attempt to service it.

## Obtaining service

Service, other than what is described in this manual, must be performed by a technically competent individual as described in the service manual for this product.

**WARNING:** Electrical shock hazard—Only Ohmeda-trained service personnel should open the monitor. Refer servicing to qualified service personnel.

**Inside the USA:** Contact Ohmeda Technical Support, which is listed on the back cover, for assistance.

**Outside the USA:** Contact the nearest Ohmeda Representative or office listed on the back cover of this manual.

## Packaging and return procedure

If returning equipment to Ohmeda:

### Everyone:

Please clean the equipment as described in the "Cleaning procedures" section of this chapter. Allow the monitor to dry thoroughly.

Package the equipment securely—in the original shipping container if possible—and enclose the following:

1. A letter describing the problem in detail.
2. Warranty information (a copy of the invoice or other applicable documentation must be included).
3. Purchase order number to cover repairs (if out of warranty), or for tracking purposes if in warranty.
4. "Ship To" and "Bill To" information.

#### **4/Maintenance and Service**

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5. Person (name and telephone/Telex/Fax number, and country) to contact for questions about necessary repairs.

When Ohmeda's warranty is not applicable, repairs are made at Ohmeda's current list price for replacement part(s) plus a labor charge.

**Inside the USA:** First call OSDC for instructions on your specific product and then ship it prepaid to the following address:

Ohmeda Service and Distribution Center  
7750 The Bluffs NW  
Austell, GA 30001

**Outside the USA:** Send to your local authorized service office as shown on the back cover of this manual.

## Accessories

### Standard

Power cord, US/Canada (1).....	0208-0943-300
Sample lines, 8 ft, single lumen (package of 10).....	6026-0000-009
Sample lines, 8 ft, single/dual lumen (package of 10).....	6026-0000-039
ET tube adapters	
Straight tee (package of 10) .....	6027-0000-019
Elbows (package of 10) .....	6027-0000-020
Disposable water separator cartridge (package of 5).....	6050-0001-379
4-Agent Calibration kit:	
SpanA and SpanB cal gas, 1/8-in. tee, calibration bag, TBG .094-in. ID x .150-in. OD, 3/32-in. barb luer.....	6050-0003-557
5-Agent Calibration kit:	
SpanA, SpanB, and SpanC cal gas, 1/8-in. tee, calibration bag, TBG .094-in. ID x .150-in. OD, 3/32-in. barb luer .....	6050-0003-558
SpanA cal gas: 4% isoflurane, 96% argon .....	6016-0000-104
SpanB cal gas: 6% halothane, 6% CO <sub>2</sub> , 88% argon .....	6016-0000-102
SpanC cal gas: 1.5% sevoflurane, 98.5% argon .....	6016-0000-100
5330 Agent Monitor Operator's Manual, Rev 5 or higher, English .....	6050-0004-258
5330 Agent Monitor Service Manual, Rev. 5 or higher, English.....	6050-0004-260

### Optional

Sample lines, 8 ft, single lumen (package of 100).....	6026-0000-037
Disposable water separator cartridge (package of 50).....	6050-0001-669
package of 25 .....	6050-0001-772
package of 5 .....	6050-0001-379
ET tube adapters	
Straight tee (package of 100).....	6027-0000-073
Elbow (package of 100) .....	6027-0000-072
Neonatal adapters	
2.5 mm (package of 10).....	6027-0000-064
3.0 mm (package of 10).....	6027-0000-065
3.5 mm (package of 10).....	6027-0000-066
4.0 mm (package of 10).....	6027-0000-067
4.5 mm (package of 10).....	6027-0000-068
5.0 mm (package of 10).....	6027-0000-069
Water bottle.....	6050-0000-847
Water bottle O-rings .....	6016-0000-032
Lubricant for O-rings .....	0220-0091-300
Scavenge adapter kit	
19 mm tee M/F with 1/8-in. barb and 10 ft of 1/8-in. tubing .....	0237-2124-870
Return adapter kit, sample exhaust to patient circuit tee	
22 mm M/F with 1/8-in. barb .....	6050-0000-002
Fresh gas flow adapter assembly, Modulus II Anesthesia Gas System.....	6050-0000-311
Power cord	
Italy.....	6030-0000-002
Cont. European.....	6030-0000-004
Australian.....	6030-0000-001
U.K.....	6050-0002-259
Fuse kit, 100/120 V and 220/240 V.....	6050-0001-208



## Appendix A/Specifications

**Note:** Unless otherwise indicated, all specifications are based at sea level, are nominal, and are subject to change without notice. All specifications assume a properly calibrated, operational monitor.

### Electromagnetic compatibility

#### Electromagnetic effects

Indications that the system is experiencing electromagnetic interference include variations in the display, instability of readings, or error messages indicating a patient or system problem that cannot be resolved by the instructions found in the Operator's Manual. This interference may be intermittent and careful correlation between the effect and its possible source is important. The system will not display any of these indications if it is used within its intended electromagnetic environment.

#### Environment

Suitable for use in the environment described in IEC 601-1-2.

#### EMC performance

The monitor complies with the requirements of IEC 601-1-2 when tested at 230 V 50 Hz (Electromagnetic compatibility - Requirements and tests). The following basic EMC standards were applied to verify compliance. The IEC 1000 series replaces the IEC 801 series referenced in IEC 601-1-2.

**Emissions:** CISPR 11 Group 1, Class B

**Immunity:** IEC 1000-4-2, 8 kV air, 3 kV contact  
IEC 1000-4-3, 3 V/m  
IEC 1000-4-4, 1 kV power, 500 V I/O  
IEC 1000-4-5, 2 kV line to earth, 1 kV line to line

### General

#### Physical

**Size** 10 in. W x 4 in. H x 16 in. L  
25 cm W x 10 cm H x 40 cm L

**Weight:** < 15 lbs.  
< 7 kg

### Electrical

Power input: 110–240 Vac, 50/60 Hz, 70 watts maximum.  
Two fuses in the power input module—both sides of input power fused:  
100 and 120 Vac use 1A, 3AG fast-acting fuses.  
220 and 240 Vac use 0.8A, 3AG fast-acting fuses.

### Leakage current limits

Power on, forward or reverse polarity,  
50  $\mu$ A maximum at 100/120 Vac or  
100  $\mu$ A maximum at 220-230/240 Vac

Ground wire impedance: < 0.1  $\Omega$

### Analog output

ENF, HAL, ISO, and SEV vol%: 10%  
DES vol%: 20%  
5% voltage linearity tolerance up to 70 mV offset.

### Display

Range: ISO, HAL, ENF, and SEV—0 to 9.9% (analog output 0 to 1 V)  
DES—0 to 24.0% (operating at sea level)  
Analog output rails at 20.0% DES  
Resolution: ISO, HAL, ENF, SEV, and DES—0.1%

Displayed parameter: Agent concentration %

### Accuracy:

ISO, HAL, ENF, and SEV	DES
0 to 1.0% $\pm$ 0.2%	0 to 4.9% $\pm$ 0.2%
1.1 to 6.0% $\pm$ 0.3%	5.0 to 9.9% $\pm$ 0.5%
6.1 to 7.0% $\pm$ 0.35%	10.0 to 18.0% $\pm$ 1.0%
	18.1 to 22 $\pm$ 2.0% (analog output rails at a 20.0% monitor reading) operating at the barometric pressure where the unit was calibrated, between sea level and 7,000 ft (2,134 m) of altitude.

### Response time

600 msec (10–90% step at 280 ml/min)

### Sample flow rate

250 ml/min minimum

### Breath rate

20 breaths per minute maximum for display of inspired and expired values. No limit for display of maximum and minimum values.

### Warmup time

5 minutes; full accuracy in 30 minutes

### Stability

Zero Auto zero  
Span 0.2%/12 hours

**Thermal drift**

Zero DES, ENF, ISO, and SEV— $\pm 0.02\%/^{\circ}\text{C}$   
 HAL— $\pm 0.04\%/^{\circ}\text{C}$   
 Span  $\pm 0.02\%/^{\circ}\text{C}$

**Compensation**

Barometric pressure (within 50 mmHg of barometer at calibration time)

**Environmental**

	Temperature	Humidity	Altitude
Operating	15 to 35 °C 59 to 95 °F	0 to 95% RH, noncondensing	-100 to 10,000 ft. -30 to 3,000 m
Storage	-5 to +50 °C 23 to 122 °F	0 to 95% RH, noncondensing	-100 to 15,000 ft. -30 to 4,500 m

**International Electrotechnical Commission (IEC) classifications**

Type of protection against electric shock: Class I

Degree of protection against electric shock: Type BF

Degree of protection against ingress of liquids: Ordinary

Mode of operation: Continuous

Recommended methods of sterilization or disinfection:

See Chapter 4, Cleaning procedures in the *5330 Operator's Manual* and section 1.4.1 in the *5330 Service Manual*.

Degree of safety of application in the presence of a flammable anesthetic mixed with air, oxygen, and/or nitrous oxide:

Equipment not suitable for use in the presence of a flammable anesthetic mixture with air, oxygen, and/or nitrous oxide.

**Alarms****High and medium priority alarms**

DES		ENF, HAL, ISO, and SEV
(low expired limit +0.2%) to 18.0%	High expired agent	(low expired limit +0.2%) to 10%
(low inspired limit +0.2%) to 18.0%	High inspired agent	(low inspired limit +0.2%) to 10.0%
6.0% to (high expired limit - 0.2%)	Low expired agent	0% to (high expired limit - 0.2%)
0.0 % to (high inspired limit - 0.2%)	Low inspired agent	0% to (high inspired limit - 0.2%)

**Note:** The unit will not allow you to cross-set the alarms' limits; i.e., you cannot set the high expired agent and low expired agent settings at the same value.

**Alarm volume**

01 through 07 (highest). Default: 03

**Alarm silence**

30, 60, 90, 120 seconds. Default: 120

## Appendix B/Communication

The monitor provides connectors for both serial and analog communication.

### Serial—RS-232

**WARNING: Electrical shock hazard—Measure the leakage current whenever an external device is connected to the analog or digital ports. Forward and reverse polarity: 100 microamperes maximum.**

Using the RS-232, DB-9 connector on the rear panel, data communication is as follows:

- 1200 baud
- Odd parity
- 7 bits per character
- 1 stop bit

The DB-9 port connector pin assignments are as follows:

Pin	Function
2	Data transmitted from the monitor
3	Data received into the monitor
7	Ground
9	External input for alarm silencing (falling edge, TTL signal)

The following data is sent to the RS-232 connector at each breath (or every 15 seconds if no breath is detected):

- Inspired agent (in percent)
- Expired agent (in percent)
- Selected agent
- Altitude compensation (local = 0, sea level = 1)

If the breath phase cannot be determined, the data sent changes to:

- Maximum agent (in percent)
- Minimum agent (in percent)
- Selected agent
- Altitude compensation (local = 0, sea level = 1)

Agent percentages reported go up to 10% (30% for DES) but are subject to the same accuracy specifications as displayed agent values.

### Analog—Strip chart calibration

A strip chart recorder can be connected to the analog output jack on the rear panel.

Refer to the instructions for the chart recorder for additional information.

**WARNING: Electrical shock hazard—**Measure the leakage current whenever an external device is connected to the analog or digital ports. Forward and reverse polarity: 100 microamperes maximum.

**CAUTION:** To prevent improper loading, which upsets the correspondence between the measured voltage and the intended output voltage, connect only a high impedance device (100K  $\Omega$  or higher) to the analog port.

1. Plug the chart recorder's analog connector into the analog port on the back of the monitor.
2. Press the Menu/Next key until the SYSTEM PARAM menu appears.
3. Press Next Parm until Analog Cal is selected.
4. To begin analog calibration, press  $\blacktriangle$ .  
A repeating, full-scale (0 to 1 volt), 0.25 Hz trapezoidal wave appears at the analog output; see Figure B-1.
5. Follow the chart recorder instructions and adjust its recording to reflect the voltage levels and the time spans as shown in Figure B-1.
6. Press  $\blacktriangle$  to change the Analog Cal option back to No.
7. To return to normal operation, press Return to Monitor.

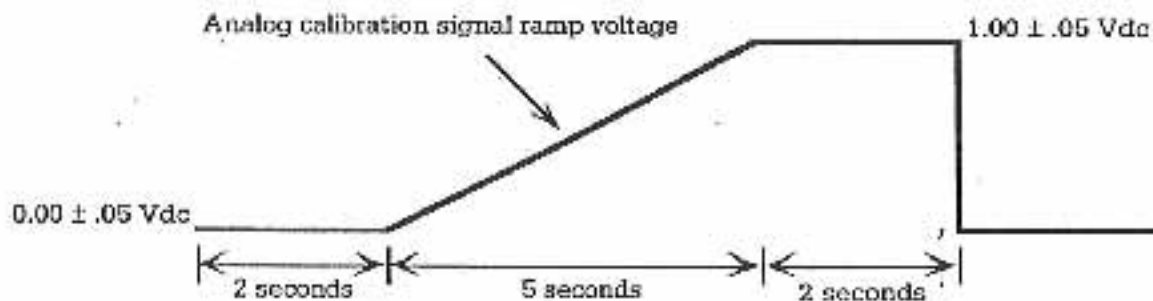


Figure B-1. Analog calibration signal

Output tracks agent concentrations up to 10% (ENF, HAL, ISO, SEV) or 20% (DES) and rails at 1 V for higher concentrations.

## Appendix C/Vaporizer Efficacy Test

You can use the 5330 Agent Monitor to verify the output of agent vaporizers. Follow the procedure for efficacy testing provided with your vaporizer. Keep the following points in mind:

- For vaporizers that provide constant partial pressure of agent over variable barometric pressure (or altitude), set the monitor to Sea Level. (You can change the barometric compensation of the monitor in the CALIBRATION screen, which is the first of the five Setup/Service screens).

The dial on this type of vaporizer is calibrated in volume percent at sea level. In Sea Level mode, the monitor reports the volume percent of agent corrected to sea level barometric pressure. As of September 1993, all Ohmeda vaporizers—except for the Tec 6—operate in this manner. Therefore, set the monitor to Sea Level mode for all except the desflurane vaporizers (Tec 6). The unit is shipped with Sea Level as the default mode when you select ISO, ENF, HAL, or SEV (5-agent monitors only). For these three agents, if the mode is changed, the new mode will be the default on the next powerup. For DES, the unit always powers up with Local as the default.

- For vaporizers that provide constant volume percent of agent over variable barometric pressure (or altitude), the monitor should be set to Local. The dial on this type of vaporizer is calibrated in volume percent at local barometric pressure and therefore the sea level compensation in the monitor is not required (or desired). For efficacy testing of the Tec 6 desflurane vaporizer, set the monitor to Local mode. This is the default mode when DES is selected.
- No matter what device you use to measure vaporizer output, there is some nonzero error in the measurement and the operator (or vaporizer manufacturer) must decide how to handle the tolerance stack up. The 5330 Agent Monitor produces very repeatable results because it provides a digital readout that does not require interpolation. Every user gets the same result (within the tolerances of the monitor).
- Consider the accuracy specification of this monitor (see Appendix A) and those of the vaporizer to determine if the vaporizer is performing within its expected range.

For example: A typical specification for a vaporizer tolerance might be  $\pm 15\%$  of the dial reading, and a tolerance of 5% of reading could be typical of this unit. At 6% halothane, then, this example results in the following test tolerances:

$\pm 15\%$  of 6% = 0.9% of error (max) due to the vaporizer

$\pm 5\%$  of 6% = 0.3% of error (max) due to the monitor

In a worst case scenario (vaporizer and monitor error of the same sign), in this example readings that are between 6.0% - (0.9% + 0.3%) = 4.8% and



## C/Vaporizer Efficacy Test

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$6.0\% + (0.9\% - 0.3\%) = 7.2\%$  could be observed on a good monitor and a good vaporizer. This type of specification would guarantee that good vaporizers are never failed. This could result in some vaporizers passing that are operating outside of their specifications if the vaporizer and monitor errors tend to cancel each other (or are opposite in sign).

For example: If a vaporizer set to 6.0% were actually putting out 7.0% halothane (or 0.1% above the hypothetical specification above) while the unit is reading 0.2% low for a reading of 6.8%, which would pass the 4.8% to 7.2% range, in this example the vaporizer would be operating out of its specification.

- To absolutely guarantee that the vaporizer is operating within specifications—that bad vaporizers are never passed—it would be necessary to subtract the monitor tolerance from the vaporizer tolerance. In the example above with the hypothetical vaporizer and monitor, the pass specification for the vaporizer set to 6% would be  $\pm(0.9 - 0.3)\%$  or  $\pm 0.6\%$ . With that calculation a vaporizer actually putting out 7.0% would fail the  $6.0\% \pm 0.6\%$  range (5.4% to 6.6%) because the properly working (and calibrated) monitor would have to read somewhere between 6.7% and 7.3%.

Always evaluate which type of specification is appropriate (or perhaps some combination) and apply that specification consistently.

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