$\%O_2$ .... corrected reading
DR 90%
$P_{ambient}$ .... 1034 cm H_2O (sea level)
P_{system} .... 1044 cm H_2O (1034 + 10 cm H_2O mean pressure)

$$\%H_2O = 90\% \left(\frac{1034 \text{ cm } H_2O}{1044 \text{ cm } H_2O} \right)$$

$$\%O_2 = 90\% \ (.99)$$

$$\%O_2 = 89\%$$

Therefore: The actual oxygen percentage in the pressurized system is 89% even though the reading displayed is 90%.

3.3 Anesthetic Gases

The Oxygen Sensor has been tested for effectiveness in a wide variety of anesthetic and other commonly encountered medical gases. Gases tested are shown below along with the concentrations at which the tests were conducted. All errors were recorded after two (2) hours of continuous exposure.

The following gases will not damage and have a minimal effect on the performance of the 5500 Oxygen Sensor (see "Warranty Statements").

Gases with equal to or less than a 1 percent oxygen error.

Gas	Anesthetic Level
1. Nitrogen	80%
2. Helium	80%
3. Nitrous Oxide	80%
4. Carbon Dioxide	12%
5. Cyclopropane*	50%
6. Enflurane	7%
7. Diethyl Ether*	20%

> * WARNING: Never use the Oxygen Monitor in the presence of flammable gases.

Gases with equal to or less than a 2 percent oxygen error.

Gas	Anesthetic Level
1. Isoflurane	5%
2. Methoxyflurane	4%
3. Halothane	6%

4.0 Maintenance

4.1 Battery Replacement

(Perform whenever "LO BAT" indicator is displayed)

Remove the four screws in the back of the unit. Then lift off the back case half.

Remove the old battery from the insulator inside the Analyzer and unsnap the connection.

Attach a new 9-volt alkaline battery to the battery snap and place the battery back inside the insulator. NOTE: Units can be used with rechargeable 9V nickel cadmium batteries.

Replace the rear case half and reinstall the case screws.

4.2 Sensor Replacement

Unpack the new No. 5500 Oxygen Sensor and inspect it for any visible signs of damage.

Insert a screwdriver tip into the slot between the sensor and the cable plug and twist it to loosen the sensor. Gently pull the cable plug straight out.

Align the keys inside the new sensor with the keyways on the sensor cable plug and push the plug directly into the sensor until it is fully seated.

4.3 Cleaning

The 5577 Oxygen Analyzer requires very little maintenance. When needed, clean the case using a cloth moistened with an isopropyl alcohol solution. Clean the sensor in the same manner, then wipe it dry with a sterile gauze sponge to remove any residue.

> CAUTION: Do not use liquid sterilizing or cleaning agents on the sensor or sensor cable contacts. These contacts are exposed only when the sensor is disconnected from the cable.

Never autoclave, pasteurize, or gas sterilize the Analyzer or sensor. Severe equipment damage will result.

4.4 Storage

(Clean the case prior to storage.)

Store in a clean, dry area with temperature maintained between -20°C and 70°C (-4°F and 158°F).

If the unit will be stored in excess of 30 days, repack the Analyzer, sensor and sensor cable in their original containers.

$\%O_2$ .... corrected reading
DR 90%
$P_{ambient}$ .... 1034 cm H_2O (sea level)
$P_{\overline{system}}$ .... 1044 cm H_2O (1034 + 10 cm H_2O mean pressure)

$$\%H_2O = 90\% \left(\frac{1034 \text{ cm } H_2O}{1044 \text{ cm } H_2O} \right)$$

$\%O_2 = 90\% \, (.99)$

$\%O_2 = 89\%$

Therefore: The actual oxygen percentage in the pressurized system is 89% even though the reading displayed is 90%.

3.3 Anesthetic Gases

The Oxygen Sensor has been tested for effectiveness in a wide variety of anesthetic and other commonly encountered medical gases. Gases tested are shown below along with the concentrations at which the tests were conducted. All errors were recorded after two (2) hours of continuous exposure.

The following gases will not damage and have a minimal effect on the performance of the 5500 Oxygen Sensor (see "Warranty Statements").

Gases with equal to or less than a 1 percent oxygen error.

Gas	Anesthetic Level
1. Nitrogen	80%
2. Helium	80%
3. Nitrous Oxide	80%
4. Carbon Dioxide	12%
5. Cyclopropane*	50%
6. Enflurane	7%
7. Diethyl Ether*	20%

* WARNING: Never use the Oxygen Monitor in the presence of flammable gases.

Gases with equal to or less than a 2 percent oxygen error.

Gas	Anesthetic Level
1. Isoflurane	5%
2. Methoxyflurane	4%
3. Halothane	6%

4.0 Maintenance

4.1 Battery Replacement

(Perform whenever "LO BAT" indicator is displayed)

Remove the four screws in the back of the unit. Then lift off the back case half.

Remove the old battery from the insulator inside the Analyzer and unsnap the connection.

Attach a new 9-volt alkaline battery to the battery snap and place the battery back inside the insulator. NOTE: Units can be used with rechargeable 9V nickel cadmium batteries.

Replace the rear case half and reinstall the case screws.

4.2 Sensor Replacement

Unpack the new No. 5500 Oxygen Sensor and inspect it for any visible signs of damage.

Insert a screwdriver tip into the slot between the sensor and the cable plug and twist it to loosen the sensor. Gently pull the cable plug straight out.

Align the keys inside the new sensor with the keyways on the sensor cable plug and push the plug directly into the sensor until it is fully seated.

4.3 Cleaning

The 5577 Oxygen Analyzer requires very little maintenance. When needed, clean the case using a cloth moistened with an isopropyl alcohol solution. Clean the sensor in the same manner, then wipe it dry with a sterile gauze sponge to remove any residue.

CAUTION: Do not use liquid sterilizing or cleaning agents on the sensor or sensor cable contacts. These contacts are exposed only when the sensor is disconnected from the cable.

Never autoclave, pasteurize, or gas sterilize the Analyzer or sensor. Severe equipment damage will result.

4.4 Storage

(Clean the case prior to storage.)

Store in a clean, dry area with temperature maintained between -20°C and 70°C (-4°F and 158°F).

If the unit will be stored in excess of 30 days, repack the Analyzer, sensor and sensor cable in their original containers.

VAPOR PRESSURE OF WATER	
Temperature *(degrees Celsius)*	Pressure *(cm H_2O)*
30	43
31	46
32	49
33	51
34	54
35	57
36	61
37	64
38	68
39	71
40	75
41	79
42	84
43	88
44	93
45	98

Figure 7

Excessive condensation on the semipermeable membrane can also cause the sensor readings to drop. If water droplets collect on the membrane surface, the diffusion of oxygen into the sensor will decrease. In "wet side" applications, the sensor should be removed periodically and blotted dry with a sterile gauze sponge. To reduce condensation on the membrane, insert the sensor into the circuit so that it faces downward.

CAUTION: For the unit to function properly, the sensor and sensor cable contacts must be kept dry. These contacts are exposed only when the sensor is removed from the sensor cable.

3.2 Pressurized Systems

The Oxygen Analyzer measures the partial pressure of oxygen (PO_2) within a gas mixture. Partial pressure is the percentage of the total pressure which is exerted by a single gas within a gas mixture. The amount of oxygen which diffuses through the membrane into the sensor is directly proportional to the partial pressure of oxygen in the environment in which the sensor is placed.

When the sensor on a unit calibrated to standard atmospheric pressure is placed in an environment with a higher pressure, an increased amount of oxygen will pass through the membrane causing an increased current flow within the sensor. The actual oxygen percentage has not changed; however, the increased partial pressure of the oxygen is higher. Thus an erroneous reading is displayed as a value greater than the actual.

This problem may be overcome in one of two ways:

1. The unit may be calibrated in the pressurized system.
2. The amount of error may be calculated using this formula:

$$\%O_2 = DR \left(\frac{P_{ambient}}{P_{\overline{system}}} \right)$$

$\%O_2$ = Actual Percent Oxygen

DR = Display Reading (in percent)

$P_{ambient}$ = Ambient Pressure (at which the unit was calibrated)

$P_{\overline{system}}$ = System Pressure (mean system pressure at the sensor)

Example

Correct for the effects of pressure on a unit which was calibrated in dry gas at atmospheric pressure then used in a pressurized system with a mean airway pressure 10 cm H_2O above atmospheric pressure.

3.0 APPLICATIONS

3.1 Humidified Atmospheres
3.2 Pressurized Systems
3.3 Anesthetic Gases

3.1 Humidified Atmospheres

The Oxygen Analyzer will display correct readings at relative humidities from 0% to 100%. However, it is essential that users of the device understand the effect of water vapor on the gas mixture.

When water vapor is introduced into a dry gas mixture, it will exert its own pressure. When 100% oxygen is passed through a humidifier, it will be saturated with water in gaseous form. Because of this, an Oxygen Analyzer which has been calibrated in dry gas will correctly display a reading that is slightly lower when the sensor is placed in a humidified atmosphere.

Conversely, when an Oxygen Analyzer is used in a ventilator circuit and the sensor is placed on the "dry side" prior to humidification of the delivered gas mixture, the reading displayed by the unit will be slightly higher than the actual percent oxygen delivered to the patient. This is due to the water vapor introduced into the system which dilutes the gas mixture after it has been measured.

> CAUTION: Since humidified gases cannot be 100% oxygen, the 5577 Oxygen Analyzer should never be calibrated in an atmosphere which is saturated with water vapor.

The following formula may be used to calculate the actual oxygen percentage compensating for humidification and pressure. (The temperature of the gas mixture is also a variable that must be accounted for in determining the effects of water vapor.)

$$\%\ O_2 = DR\left(\frac{P_{ambient} - P_{H_2O}}{P_{\overline{system}}}\right)$$

$\%\ O_2$ = Actual Percent Oxygen

DR = Display Reading (in percent)

$P_{ambient}$ = Ambient Pressure (at which the unit was calibrated)

$P_{\overline{system}}$ = System Pressure (mean system pressure at the sensor)

P_{H_2O} = Partial Pressure of Water Vapor (at system temperature)

Example

Unit was calibrated in dry gas at atmospheric pressure and then used in a pressurized system with a mean pressure of 10 cm H_2O and saturated with water vapor at 37°C. To compensate for the effects of humidification and pressure:

$\%\ O_2$ .... corrected reading

DR 90%

$P_{ambient}$ .... 1034 cm H_2O (sea level)

$P_{\overline{system}}$ .... 1044 cm H_2O (1034 + 10 cm H_2O mean pressure)

P_{H_2O} .... 64 cm H_2O (see Figure 7)

$$\%O_2 = 90\%\left(\frac{1034\text{ cm }H_2O - 64\text{ cm }H_2O}{1044\text{ cm }H_2O}\right)$$

$$\%O_2 = 90\%\left(\frac{970\text{ cm }H_2O}{1044\text{ cm }H_2O}\right)$$

$\%O_2 = 90\%\ (.93)$

$\%O_2 = 84\%$