ENMET **Corporation**
PO Box 979
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ISA – 44RALE-OD
ISA – 44RAHE-OD
ISA – 44E-OD

Operation and Maintenance Manual

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MCN-226; 04/03/00

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1.0 Introduction

At many industrial facilities, hazards in the work atmosphere require workers to utilize respiratory air lines for protection. Compressors usually provide the air supply for these respiratory air lines. If the compressor or the air it uses contains carbon monoxide or is oxygen deficient, the health and safety of workers using this air are endangered. To protect the worker from these situations, the federal Occupational Safety and Health Administration (OSHA) requires monitoring of compressor supplied breathing air for carbon monoxide content and has established minimum oxygen requirements for supplied respiratory air.

When respiratory air lines are located in potentially combustible atmospheres, the equipment used to monitor carbon monoxide or oxygen deficiency must be protected so that it cannot ignite the surrounding atmosphere. For these applications, the ISA-44RALE-OD, housed in an explosion proof enclosure, safely monitors compressed air lines of 50 - 250 psi (pounds per square inch) for both carbon monoxide (CO) and oxygen deficiency when these air lines are located in Class I, Group C, D and Class II, Groups E, F, and G hazardous atmospheres as defined by the National Electrical Code.

Consisting of a sampling head assembly, sensor housings and an explosion proof control unit, the ISA-44RALE-OD monitor displays approximate CO and oxygen concentrations on separate meters, activating alarm circuitry when the carbon monoxide content or oxygen deficiency level of compressor air reaches calibrated alarm levels. When alarm circuitry activates, visual alarms (LED's) on the display plate of the monitor activate, indicating a potentially hazardous level of CO or oxygen deficiency. A factory installed audio alarm (horn) is available as an option. Activating concurrently with the visual alarms. Relay circuitry inside the ISA-44RALE-OD control unit is available to activate auxiliary alarm systems and other equipment. All alarm circuitry automatically resets when the carbon monoxide or oxygen deficiency hazard diminishes beyond the calibrated alarm points of the monitor.

The ISA-44RALE-OD also comes in a modified version for high pressure (300 - 5000 psi) compressed air lines. This is the ISA-44RAHE-OD, which includes a special high pressure regulator on the sample head assembly. Except for the high pressure regulator, operation of the ISA-44RAHE-OD is identical to that of the ISA-44RALE-OD. This manual includes all necessary procedures for correct operation of the ISA-44RAHE-OD.

Do not use the ISA-44RALE-OD in combustible atmospheres other than Class I, Group C,D or Class II, Groups E,F and G (as defined by the National Electrical Code). Disregarding this warning voids the instrument warranty and initiates a situation of great potential danger to the user.

The ISA-44E-OD is an ambient air monitor.

NOTE: *All specifications stated in this manual may change without notice.*

1.1 Unpack

Unpack the **ISA-44RALE-OD** and examine it for shipping damage. If such damage is observed, notify both ***ENMET*** customer service personnel and the commercial carrier involved immediately.

Regarding Damaged Shipments

NOTE: **It is your responsibility to follow these instructions. If they are not followed, the carrier will not honor any claims for damage.**

- ❑ This shipment was carefully inspected, verified and properly packaged at our company and delivered to the carrier in good condition.
- ❑ When it was picked up by the carrier at ***ENMET***, it legally became your company's property.
- ❑ If your shipment arrives damaged:
  - Keep the items, packing material, and carton "As Is." Within 5 days of receipt, notify the carrier's local office and request immediate inspection of the carton and the contents.
  - After the inspection and after you have received written acknowledgment of the damage from the carrier, contact ***ENMET*** Customer Service for return authorization and further instructions. Have your Purchase Order and Sales Order numbers available.
- ❑ ***ENMET*** either repairs or replaces damaged equipment and invoices the carrier to the extent of the liability coverage, usually $100.00. Repair or replacement charges above that value are your company's responsibility.
- ❑ The shipping company may offer optional insurance coverage. ***ENMET*** only insures shipments with the shipping company when asked to do so in writing by our customer. If you need your shipments insured, please forward a written request to ***ENMET*** Customer Service.

Regarding Shortages

If there are any shortages or questions regarding this shipment, please notify ***ENMET*** Customer Service within 5 days of receipt at the following address:

ENMET Corporation
680 Fairfield Court
Ann Arbor, MI 48108
734-761-1270 734-761-3220 Fax

1.2 Check Order

Check, the contents of the shipment against the purchase order. Verify that the **ISA-44RALE-OD** is received as ordered. Each **ISA-44RALE-OD** is labeled with its target gas. If there are accessories on the order, ascertain that they are present. Check the contents of calibration kits. Notify ***ENMET*** customer service personnel of any discrepancy immediately.

1.3 Serial Numbers

Each **ISA-44RALE-OD** is serialized. These numbers are on tags on the equipment and are on record in an ***ENMET*** database.

1.2 Operation Principles Explained ISA-44RALE-OD and ISA-44E-OD

Connected to the control unit by conduit, two separate sensor enclosures house two different sensing elements: a metallic oxide semiconductor (MOS) sensor for carbon monoxide detection, and an electrochemical cell (oxygen cell) for oxygen detection. Each sensor is connected to its own circuit board, alarm LED's, meter and relay circuitry; together, these components constitute a channel. The CO and oxygen channels monitor a continuous pressure regulated and humidified air sample for CO and oxygen content.

The MOS sensor, a nonlinear device, detects carbon monoxide via an oxidation process. Inside the sensor, a ceramic element is heated electronically to certain temperatures. When carbon monoxide is present in the monitored air, an oxidation reaction occurs on this ceramic surface, reducing its electronic resistance. Therefore, an electronic signal is transmitted through the conduit to the control unit, where CO channel circuitry analyses the signal, and the meter displays an approximate CO concentration.

Over time, the MOS sensor becomes contaminated, making its response to CO gas inaccurate. To clear the sensor, a Purge/Operate/Horn off switch has been installed on the outside of the control unit. When switched to the PURGE position, this switch heats the sensor to very high temperatures, clearing off contaminants in the process.

The electrochemical sensor (oxygen cell), a linear device, monitors the partial pressure of oxygen in the air. As the air sample passes through the sample head assembly and over the cell, oxygen in this air diffuses through a thin, selective membrane on the surface of the oxygen cell. This generates an electrochemical reaction inside the cell, producing a small electrical current proportional to the partial pressure of oxygen. The current signal is transmitted to the control unit, where oxygen channel circuitry analyses the signal and the meter indicates the oxygen content of the sampled air.

The ISA-44RALE-OD operates continuously on single phase 110 VAC. Because the instrument should be on at all times, it does not have an on/off switch.

The ISA-44E-OD uses the same principles as the ISA-44RALE-OD. However, by changing the type of MOS sensor, the type of gas monitored changes. Also, depending on the type of gas monitoring required, a purge switch may or may not be required.

1.3 Calibration Explained for the ISA-44RALE-OD

The alarm settings of the ISA-44RALE-OD are adjusted and set (calibrated) at the factory to respond within specified time limits to certain concentrations of gas. These concentrations are shown on the red calibration stickers on the display plate of the instrument. Unless otherwise specified, the ISA-44RALE-OD has two alarm settings for carbon monoxide (10 and 20 ppm CO) and one for oxygen (19.5% oxygen by volume). The terms "ppm" and "% oxygen by volume" are described below.

Often used to indicate toxic gas concentrations, the term "ppm" refers to "parts per million". This term describes the concentration of a gas as a proportion of the total volume of an atmosphere. The concentration 20 ppm CO indicates that out of a sample of air divided into one million parts (volumetric units) of equal volume, 20 parts (units) are comprised of carbon monoxide gas, and the remainder is comprised of clean air.

Most commonly used in the safety industry to describe the oxygen content of an atmosphere, the term "% oxygen by volume" describes the amount of oxygen measured as a percent of the total atmosphere in a space. For example, fresh, clean air is approximately 20.9% oxygen by volume, indicating that just over one-fifth of the total atmospheric volume is comprised of oxygen.

NOTE: That this is only a relative measurement; it does not indicate the exact volume of oxygen. For example, at high altitudes the air is much less dense; therefore, even though 20.9% of the atmosphere may be oxygen, the thinner atmosphere means that there is actually less oxygen than in denser sea level air.

The alarm levels of the ISA-44RALE-OD are set to meet certain OSHA requires that compressed breathing air meet at least the specifications of grade D respiratory air as described by the Compressed Gas Association (CGA).

Table 1: Grade D Breathing Air

Grade D Breathing Air	
Oxygen	19.5% - 23.5% By Volume
Carbon monoxide	10 ppm
Hydrocarbons	Maximum 5 Mg/M3
Odor	Free of pronounced odor
Carbon dioxide	Maximum 1000 ppm

The standard alarm levels of the ISA-44RALE-OD (10, 20 ppm CO, and 19.5% oxygen by volume) monitor compressed air for the maximum allowable concentration of CO and the minimum allowable concentration of oxygen. The 10 ppm alarm indicates the maximum allowable level CO (as established by OSHA) is present. The 20 ppm CO alarm alerts the use to higher concentrations of gas, which, if significantly above 50 ppm, could threaten the safety of the worker. The 19.5% oxygen by volume alarm indicates that the oxygen content of the compressed air has fallen below the minimum requirement for grade D air. If the oxygen level continues to fall, the health and safety of the worker are endangered. At approximately 16% by volume, the senses and perceptivity of exposed workers are affected. At 14%, degradation of the senses is serious. At 10% the worker quickly becomes unconscious, and his life is in serious danger. Atmospheres containing 5% or less oxygen by volume are instantly fatal.

1.4 Special Characteristics

Special enclosures and circuitry protect the instrument from becoming a potential source of ignition. The ISA-44RALE-OD is housed in an explosion proof enclosure for Class I, Group C, D and Class II, Groups E, F, and G atmospheres. This means that when the ISA-44RALE-OD is used properly in one of these environments, if combustible gas from the area is ignited inside the control unit or MOS sensor assembly, the explosion would be completely contained within either unit. In addition, an intrinsic safety barrier protects the oxygen cell and circuit against possible ignition. Acting as a fuse, this barrier prevents a surge of electrical power from reaching the oxygen cell, so the cell will not explode or burn. A surge of electricity will break the circuit connection inside the barrier, so the barrier must be replaced if this should occur.

1.5 Calibration Explained for the ISA-44E-OD

The oxygen portion of this unit is the same as for the ISA-44RALE-OD. The gas portion of this unit will change depending on the end users criteria. As in the ISA-44RALE-OD the alarm points are preset at the factory and calibration information can be found labeled on the face plate of the unit.

CAUTION: If the covers of either the control unit or the MOS sensor enclosure are removed, the enclosures are no longer explosion proof.

2.0 Features of ISA-44RALE-OD / ISA-44E-OD

Control Unit: See Figure 1

Feature	Description
Control Unit Enclosure	Explosion Proof for Class I, Group C,D and Class II Groups E, F, and G atmospheres.
Display Plate	Round plate inside control unit enclosure. Houses alarm LEDs, meters and provides access to gas and oxygen channel circuitry.

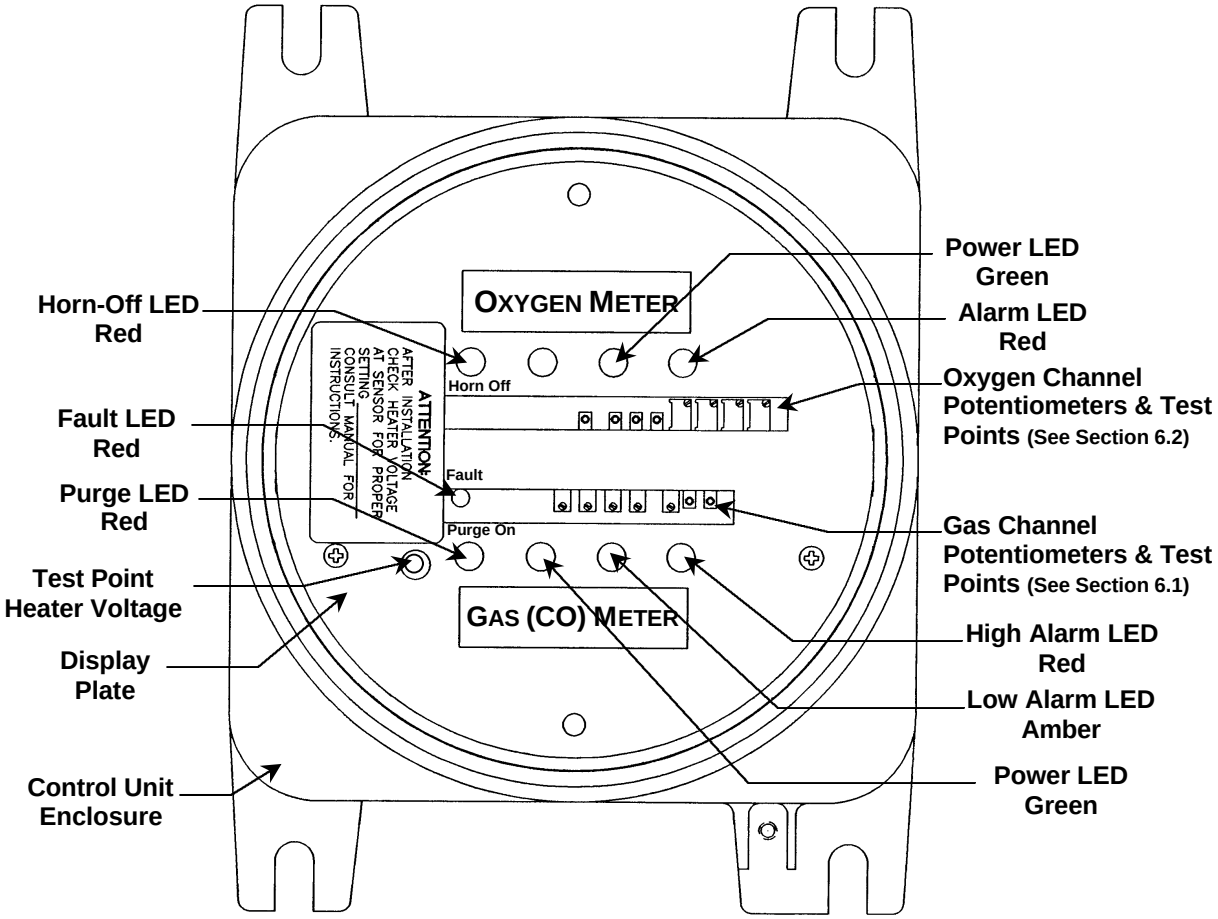

Figure 1: Features ISA-44E-OD Control Unit Display Plate

Oxygen Channel:

Feature	Description
Meter	Indicates percent by volume oxygen in sampled air. Linear scale.
Power LED	This green LED indicates that the oxygen channel is in non-alarm, operating condition. This gives positive indication that the channel is operating.
Alarm LED	This red LED indicates that the oxygen content of respiratory air contains less than 19.5% oxygen by volume. See section 4.3 Oxygen Alarm State.
Horn-Off LED	This orange LED is not actually part of the oxygen channel, although it is located next to the oxygen channel LED's. It is activated when the Purge/Operate/Horn-off switch is set to the "Horn-Off" position, indicating that the factory installed horn is disengaged and thus will not activate during oxygen or gas alarms.

Gas Monitoring Channel:

Meter	Indicates level of gas. This meter is not a linear device. Do not infer exact readings from unmarked points on the scale.
Fault LED	This red LED indicates sensor fault for the gas channel. See description of sensor fault condition in section 4.3 Sensor Fault Alarm State.
Power LED	This green LED indicates a non-alarm operating condition for the gas channel. This provides positive indication that the channel is operating.
Low Alarm LED	This amber LED indicates low alarm condition for the gas channel.
High Alarm LED	This red LED indicates high alarm condition for the gas channel.
Purge LED	This orange LED indicates that the Purge/Operate/Horn-off Switch has been set to PURGE, which increases the sensor heater voltage to clear off contaminants from the surface of the MOS sensor. NOTE: During purging, the MOS sensor does not monitor the gas content of the sampled air.

All Channels: See figure 1

Potentiometers / Test Points	These are small components located directly on the circuit board of each channel. A small screw in each potentiometer adjusts circuit voltages to affect the response of the instrument. The test points are used together with a voltmeter to check the potentiometer voltage adjustments. *Do not adjust the potentiometers except during calibration procedures* (see section 6.0).

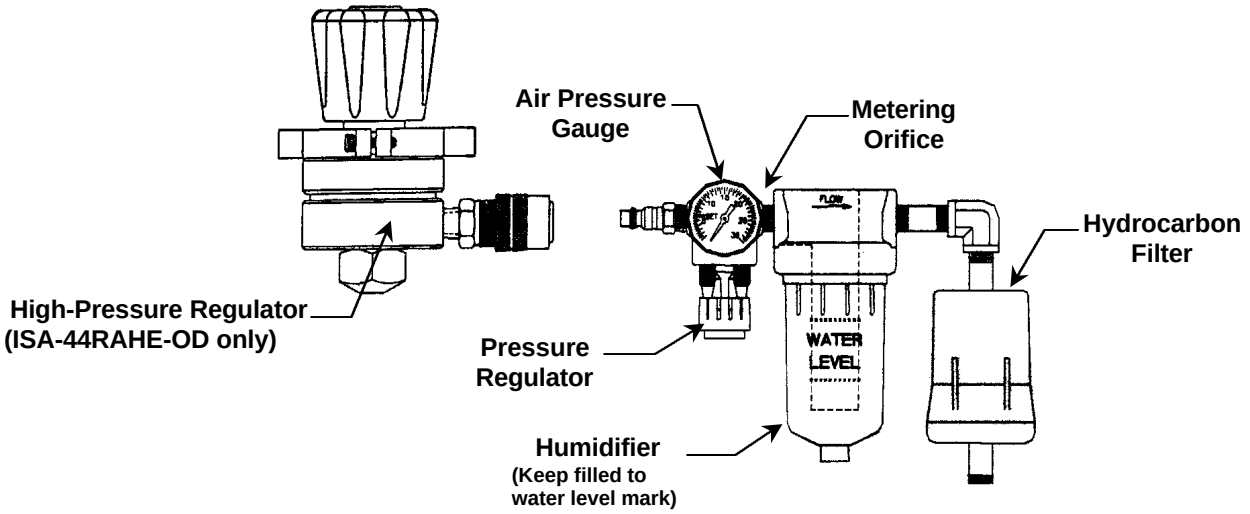

Figure 2: Features Sample Head Assembly

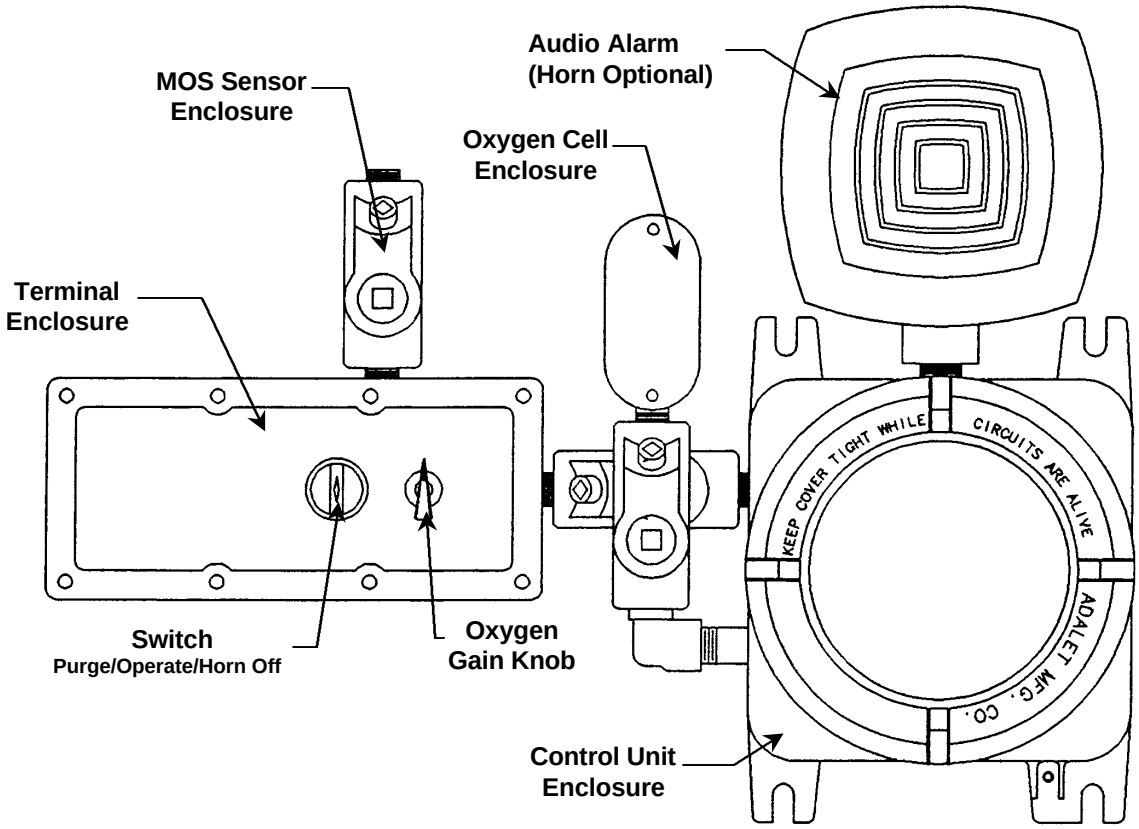

Figure 3: Features Terminal Enclosure with Sensors & Control Unit

Sample Head Assembly see figure 2

Feature	Description
Sample Head Assembly	This assembly includes an inlet orifice, regulator, air pressure gauge and humidifier. This assembly pressure regulates and humidifies the compressed air for the sensors.
High-Pressure Regulator (ISA-44RAHE-OD only)	This device regulates high-pressure air (300 - 5000 PSI) for the sample head assembly. This device must be used when monitoring very high-pressure air. The high-pressure regulator is part of the ISA-44RAHE-OD and is not included with ISA-44RALE-OD.

Terminal Enclosure: See figure 3

Terminal Enclosure	This enclosure supports the Purge/Operate/Horn-off switch on the outside and houses all user terminal connections on the inside. The Wiring Table describes these terminal connections.
MOS Sensor Enclosure	This explosion-proof enclosure houses the MOS sensor. Air flows through the sample head assembly into this enclosure so the MOS sensor can monitor the CO content of the compressed air.
Oxygen Cell Enclosure	This enclosure houses the oxygen cell. Air flows through the sample head assembly into this enclosure so the oxygen cell can monitor the oxygen content of the compressed air.
Switch Purge/Operate/Horn-off	This switch is located on the terminal enclosure. In the PURGE position, this switch increases the MOS sensor heater voltage to clear off contaminants from the sensor surface and silences horn if supplied. In the OPERATE position, this switch sets the MOS sensor to normal operation for monitoring CO and the horn circuit is active if supplied. The HORN-OFF position is included only on instruments with a factory-installed horn (option). When in the HORN-OFF position, the switch silences the horn during testing or calibration procedures. **IMPORTANT**: While the switch is set to PURGE, the MOS sensor does not monitor target gases accurately.
Oxygen Gain Knob	Located on the terminal enclosure. This knob is actually a gain potentiometer for the oxygen channel. It is adjusted periodically during operation and calibration.
Relay contact connections	Located on terminal blocks inside the terminal enclosure. See Wiring Information table 3. All of these relays are non-latching; they change state upon alarm and reset when the channel comes out of alarm. The oxygen channel has one set of relay contacts for its one alarm point. The gas channel has two sets of relay contacts, one for each alarm point (high and low). Relay contacts are in alarm position when the corresponding channel is in alarm. Relay contacts are also in alarm position when the power to a channel is interrupted. Relay contacts automatically reset when the gas or oxygen hazard diminishes beyond the alarm point.
Audio Alarm (Horn-Optional)	A factory-installed horn activates during certain alarms; see section 4.3. This horn is optional; it is not included on all ISA-44RALE-OD / ISA-44E-OD instruments.

3.0 Installation and Warm-up

WARNING*: *Area must be declassified during installation.

When installing the ISA-44RALE-OD/ISA-44E-OD, remember that the instrument is not explosion proof when the instrument or sensor enclosure covers are removed. Make certain that the surrounding atmosphere has been declassified when you install the ISA-44RALE-OD/ISA-44E-OD. Use a portable gas detector or flush the area with clean, fresh air.

NOTE: There is no on/off switch for the ISA-44RALE-OD/ISA-44E-OD. The instrument is designed to operate continuously 24 hours a day.

When choosing a location for the instrument, several things must be taken into consideration. The unit should be in such a position that appropriate personnel are notified when the unit goes into alarm. The ISA-44RALE-OD should be located so that the respiratory air reaches the sensors before it reaches the workers. In addition, the sampling point of the sample head assembly should not be located at a low spot in the compressed air line; water often condenses in compressed air lines and drains to low points in the line (ISA-44RALE-OD only). Water will damage the regulators and sensors of the ISA-44RALE-OD; the only water that should contact the sample head assembly is in the humidifier (bubbler). Finally, the instrument requires that air pass over the MOS sensor at all times.

CAUTION: Since the ISA-44RALE-OD operates 24 hours a day, if the air supply to the MOS sensor is cut off, it will overheat and/or become highly inaccurate.

3.1 Sensor Location for ISA-44E-OD

Gases have different densities. Some are heavier than air and concentrate at the bottom of a space. Some are lighter than air and gather at the top. Consider the density of the gas you want the sensor to detect when you install the sensor.

Table 2: Sensor Location

Heavier than Air	Sensor Location
bottle liquefied petroleum propane butane gasoline trichloreothylene vaporized hydrocarbons	Interior wall, 18 - 24" from the floor. NOT directly above or beside gas ovens, heaters, windows, vents, doorways.
Lighter than Air	**Sensor Location**
natural gas	Locate near ceiling. NOT directly above appliances where it is subject to direct exposure to heat or steam.
Same Density as Air	**Sensor Location**
carbon monoxide	Locate 4 - 6 feet above the floor. NOT in direct air currents of windows, doors or vents.

If you have a problem involving the locations of a unit, please contact your distributor or ***ENMET*** personnel. A technician will analyze the problem and recommend a location.

The ISA-44RALE-OD/ISA-44E-OD operates on 110 VAC. (220v optional)

NOTE: If the ISA-44RALE-OD/ISA-44E-OD is ordered with a horn from the factory, the unit will include a third position on the Purge/Operate/Horn-off switch (HORN-OFF) to silence the horn during testing or calibration. If the user installs his own horn, the switch on the instrument has only two positions (PURGE/OPERATE [optional]), so the user must install a separate switch to silence the horn during testing.

PRECAUTIONS:

- ♦ Do not drill holes in the enclosures to mount them.
- ♦ Use caution with compressed air lines and gas cylinders. High air pressure can cause personal injury, especially to eyes and ears.
- ♦ Be sure to follow all instructions.
- ♦ If instrument does not respond as indicated, contact **ENMET** personnel.
- ♦ Follow all electrical codes to meet requirements for explosion-proof rating.
- ♦ Do not blow cigarette smoke on a sensor.

MATERIALS: ISA-44RALE-OD

- ❑ Appropriate hardware to hook-up air line to sample head assembly. Assembly has Hansen #10 (½" NPT) Push-type plug; uses Hansen series 1000 brass coupler or equivalent.
- ❑ Mounting tools and hardware
- ❑ 110 VAC
- ❑ Power supply line (supply explosion proof fitting for conduit entry into control unit)

PROCEDURE:

WARNING*: *Area must be declassified during installation.

1. Before installation, flush the area with clean air or test the area with a portable gas detector to make sure the atmosphere is not combustible. Then mount the control unit with appropriate hardware.
2. Remove the bolts on top of the terminal enclosure and remove the cover to access the terminal blocks inside.
3. Attach power line (make sure it is not live; power should be applied only at step 8 of this procedure) to the appropriate terminals in the terminal enclosure. See Wiring information given in Table 3. Use an explosion proof fitting when connecting this wiring to the enclosure. See Wiring Information table for connections.
4. If the relay contacts are to be used, utilize the appropriate terminals given in the wiring table.

ISA-44RALE-OD

5. Attach the sample head assembly to the compressed air line. Adjust the knob on the air pressure regulator until the air pressure gauge reads between 5 and 10 PSI.
6. Unscrew the bottom of the humidifier (bubbler) of the sample head assembly, and fill the bubbler to the mark with clean water. Reinstall bottle.
7. Make sure clean air from the compressed air line flows continuously through the sample head assembly (through bubbler and over the sensors). If you suspect contaminated air in your line, use bottled air. Do not operate the instrument without air flowing through the sample head assembly. If you apply compressed air to the sample head, and air does not flow, the orifice may be plugged. Replace it by unscrewing the regulator and then unscrewing the orifice from the humidifier (bubbler). See Section 8.0 for replacement part numbers.
8. Unscrew the cover of the oxygen cell housing. Remove the oxygen cell from its protective package. Using wire cutters, clip off approximately ½ of each pin on the back of the new cell. Plug the cell into the circuit board and place the cell into the clips. Take precaution not to damage the thermsistor on the circuit board. Replace cover.
9. Apply 110 VAC power to the appropriate terminals in the terminal enclosure if supplied or the terminal plate in the control unit.
   NOTE: If applicable, turn HORN off.
10. Set the Purge/Operate/Horn-off switch to PURGE (if applicable).

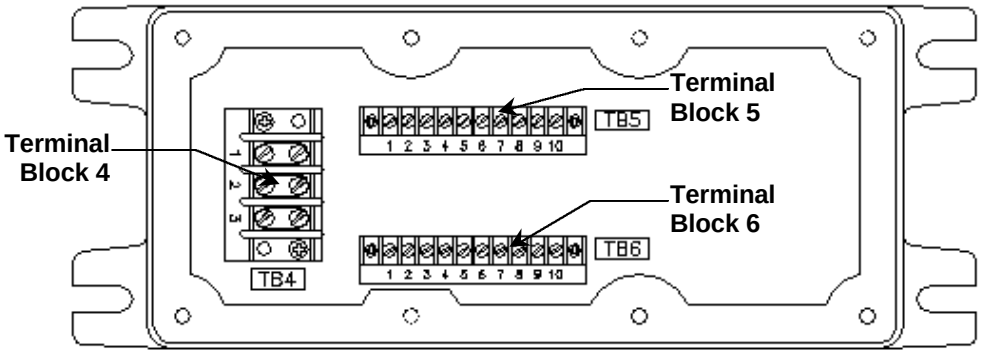

Figure 4: Interior Terminal Enclosure

Table 3: Wiring Information Terminal Enclosure

For ISA-44RALE-OD / ISA-44E-OD (when Purge and Horn are supplied)

Terminal Enclosure Connection	Signal
TB5-6	MOS Sensor Ground
TB5-7	MOS Sensor Heater
TB5-8	MOS Sensor Signal
TB5-2	CO High Alarm Relay, Common
TB5-1	CO High Alarm Relay, Normally Open
TB6-1	CO High Alarm Relay, Normally Closed
TB5-5	CO Low Alarm Relay, Common
TB5-4	CO Low Alarm Relay, Normally Open
TB5-3	CO Low Alarm Relay, Normally Closed
TB6-2	Oxygen Alarm Relay, Common
TB6-3	Oxygen Alarm Relay, Normally Open
TB4-1	AC Ground
TB4-2	110 VAC (black)
TB4-3	110 VAC (white)

NOTE: The terms "normally open" and "normally closed" correspond to the de-energized positions of the relay contacts. The relays are energized during normal (non-alarm) channel operation, so the "normally open" position is closed and the "normally closed" position is open during non-alarm channel operation. The relays are de-energized during alarms or when power to the channel is interrupted.

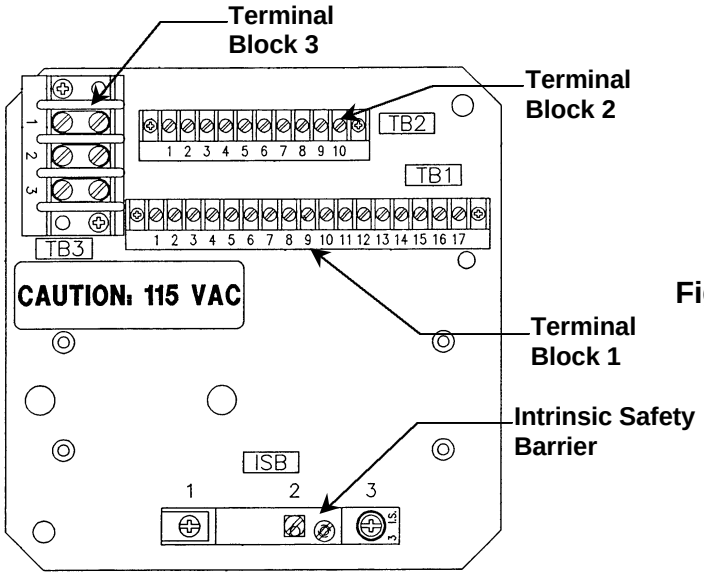

Figure 5: View of Terminal Plate

Table 4: Wiring Information Terminal Plate

For ISA-44RALE-OD/ISA-44E-OD (when Purge and Horn are supplied)

Terminal Plate Connection	Signal
TB3-1	Chassis GND (Green)
TB3-2	110 VAC High (Black)
TB3-3	110 VAC Low (White)
TB1-1	Not Used
TB1-2	Horn 110 VAC High (Black)
TB1-3	Horn 110 VAC Low (White)
TB1-4	12 VDC Positive
TB1-5	12 VDC Negtive
TB1-6	Gas Sensor GND (Brown)
TB1-7	Gas Sensor High (Orange)
TB1-8	Gas sensor Signal (Blue)
TB1-9	High Gas Alarm Relay, Common
TB1-10	High Gas Alarm Relay, Normally Open
TB1-11	High Gas Alarm Relay, Normally Closed
TB1-12	Low Gas Alarm Relay, Common
TB1-13	Low Gas Alarm Relay, Normally Open
TB1-14	Low Gas Alarm Relay, Normally Closed
TB1-15	Oxygen Sensor Negative (Green)
TB1-16	Oxygen Sensor Positive (Orange)
TB1-17	Oxygen Alarm Relay, Common
TB2-1	Oxygen Alarm Relay, Normally Open
TB2-2	Oxygen Alarm Relay, Normally Closed

4.0 Operation

4.1 Operation of the ISA-44RALE-OD

The ISA-44RALE-OD should operate continuously 24 hours a day, 7 days a week. Power to the instrument should not be turned off frequently; doing so will affect instrument accuracy.

During operation, air must flow continuously over the sensors. Failure to provide the sensor with a continuous air flow results in an inaccurate instrument, possible false alarms, and contaminated or burned out sensors.

PROCEDURE:

1. Keep the unit on power.
2. Make sure that air is flowing continuously over the sensors and that the bubbler has sufficient clean water. Adjust the pressure regulator so the pressure gauge reads between 5 and 10 PSI.
3. Set the Purge/Operate/Horn-off switch to OPERATE.
4. Whenever an alarm activates, take action immediately.
5. Every few weeks, supply clean air to the sample head assembly (use bottled 20.9% oxygen if necessary) and adjust the oxygen gain potentiometer so that the oxygen meter reads 20.9.

CAUTION: When making this adjustment, it is imperative that air containing 20.9% oxygen (oxygen content of fresh air) be supplied to the sample head assembly.

***WARNING*:** Any other adjustments of the oxygen gain potentiometer, either accidental or otherwise, will result in inaccurate oxygen detection, a situation of great potential danger to workers utilizing the supplied air.

6. Calibrate the gas channel once every 3 months. If either channel fails a Rough Test (section 5.0), that channel must be calibrated. See section 6.0 for calibration procedures.

4.3 Operating Alarm Conditions

Any spontaneous alarm on any channel, not triggered by initial warm-up or rough test, should be considered a potentially serious gas alarm situation. Do not ignore any alarm condition. *Take action.*

Precautions

- ♦ Do not blow dense clouds of cigarette smoke on a sensor to trigger an alarm.
- ♦ Do not squirt pure gases or liquid hydrocarbons, such as butane, propane, gasoline, etc., directly on the sensor element.
- ♦ Do not use strong cleaning agents, waxes, paints, lacquers, etc., near a sensor. Most of these contain flammable hydrocarbons that may trigger the alarm.

Normal operating condition:

Condition	Signals	Indication
Non-alarm operation	Green LED's for both gas and oxygen channels are on.	Unit is operating. Gas content of air is below the gas channel low alarm point. Oxygen content is above the oxygen channel alarm point.

This is the normal operating condition for the ISA-44E-OD instrument. If on the ISA-44RALE-OD air is bubbling through the sample head assembly humidifier, the signals listed above give positive indication that the unit is operating and is not in alarm.

Alarm State:

Condition	Signals	Indication
Power Interruption	No LED's are on.	Power to the instrument has been interrupted.

When all the LED's on the display plate are off, the power has been interrupted. The relay contacts are in alarm state, but will not engage auxiliary equipment unless such equipment is connected to a separate power source which is still operating.

Oxygen Alarm State:

Condition	Signals	Indication
Oxygen Deficiency Alarm	Oxygen channel green LED is off, red LED is on, meter shows 19.5% oxygen by volume or less. Oxygen channel relay contacts in alarm state. Horn (optional) is on.	Less than 19.5% oxygen by volume in the monitored, air.

An oxygen alarm is indicated by the red LED of the oxygen channel on the display plate. This indicates that there is less than the minimum oxygen requirement of grade D air (19.5% oxygen by volume) in the monitored air. If the oxygen content of the air subsequently rises above the 19.5% by volume alarm point. The red LED will turn off, the green LED will come on, and the relays will automatically reset. If the ISA-44RALE-OD/ISA-44E-OD is equipped with a factory installed audio alarm (horn), it will activate during the oxygen alarm.

***WARNING*:** If the Oxygen Deficiency Alarm signals are on, and the oxygen meter is at bottom scale, it is possible that the oxygen concentration of the compressor air is low enough to cause serious injury or even quick death. Take action.

NOTE: Sometimes an oxygen alarm indicates a depleted oxygen cell, an "open" I.S. barrier, or a bad connection. See sections 7.1 and 7.3 for explanation.

Low-level Gas Alarm State:

Condition	Signals	Indication
Low level Gas Alarm	Gas channel green LED is off, amber LED is on, meter shows low alarm concentration of gas or higher. Gas channel relay contacts in alarm state.	Presence of at least the low alarm concentration of gas in the monitored air.

A low-level gas alarm is shown by the amber LED of the gas channel on the display plate. In addition, the meter will show at least the low-alarm concentration. These signals indicate that there is at least the low-alarm concentration of gas present in the respiratory airline or in the ambient air. If the gas content of the air subsequently falls below the low alarm point, the amber LED will turn off, the green LED will turn on, and the low alarm CO channel relay contacts reset.

High-level Gas Alarm State:

Condition	Signals	Indication
High Gas Alarm	Gas channel green LED is off, amber LED is on, red LED is on, meter shows high gas alarm concentration or higher. Gas channel low and high alarm relays change state. Horn (optional) is on.	Presence of at least the high gas alarm concentration in the monitored air.

A high-level gas alarm concentration is indicated by simultaneous amber and red alarm LEDs. This indicates that there is at least the high alarm concentration of gas present in the respiratory air or ambient air. The meter helps to identify the approximate concentration present. If the gas concentration in the respiratory air falls below the high-level gas alarm concentration, the red LED turns off, and the high-level gas alarm relay contact automatically reset. However, the amber LED and relay contacts will remain in alarm position until the gas concentration falls below the low-level gas alarm point. If the ISA-44RALE-OD/ISA-44E-OD is equipped with a horn, it will activate during the high gas alarm.

***WARNING*:** If High Gas Alarm signals activate, and the meter indicates a full-scale reading, it is possible that the gas content is high enough to cause serious injury or even death. Take action.

Combination Alarm State:

Condition	Signals	Indication
Combination Alarm	See below	See below

A combination alarm is an oxygen alarm together with either a low or high gas alarm. Signals for both alarms will be on. Indicates both oxygen and carbon monoxide hazards.

Sensor Fault Alarm State:

Condition	Signals	Indication
Sensor Fault	Red LED on gas channel is on. Horn (optional) is on. High relays change state.	Problems with MOS sensor.

A sensor fault alarm indicates a problem with the MOS sensor or circuitry. The sensor heater voltage must be checked (section 6.1 or section 7.5). Never use the ISA-44RALE-OD/ISA-44E-OD if the sensor fault alarm is on.

5.0 Rough Test

5.1 ISA-44RALE-OD

The rough test is performed weekly after the instrument has been installed and is operating. The test verifies the alarm capability of the instrument in response to gas and oxygen deficiency. If the alarms do not activate as defined in the procedure outlined below, the ISA-44RALE-OD has failed this test and must be recalibrated. The rough test can also be used as a quick check out for ISA-RALE-OD instruments which have been shut off.

MATERIALS:

- ❑ cylinder of 75 ppm CO
- ❑ cylinder of 17.0% oxygen
- ❑ ***ENMET*** calibration fixture (***ENMET*** part no. 03605-001)
- ❑ clean water

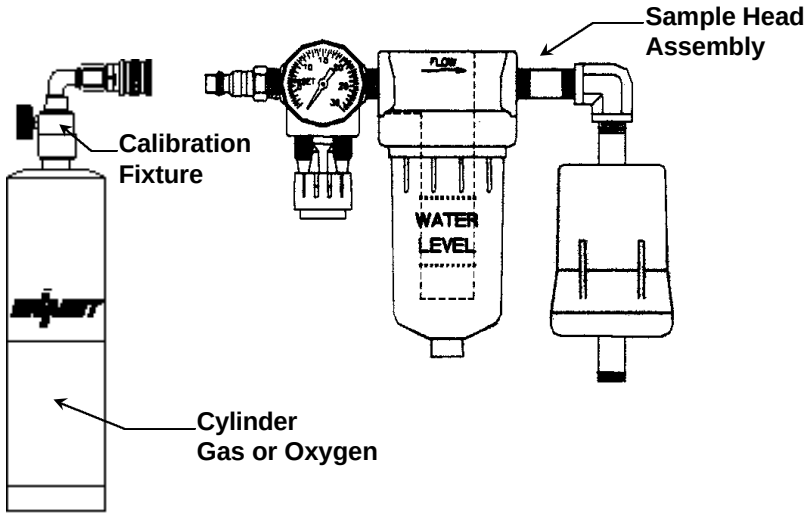

Figure 6: Calibration Fixture with Sample Head Assembly

PROCEDURE:

1. Insure the humidifier on the sample head assembly has clean water up to the fill mark.
2. Set the Purge/Operate/Horn-off switch to the PURGE position. Allow the instrument to purge for ½ hour.
3. After ½ hour, set the Purge/Operate/Horn-off switch to OPERATE and allow the MOS sensor to stabilize for 10 minutes.

NOTE: When switch is set to OPERATE after PURGE, the CO channel may go into alarm while the sensor is stabilizing.

4. After 10 minutes, attach the calibration fixture to the cylinder of 75 ppm CO. Make sure the valve on the calibration fixture is in the off position. Take all necessary precautions to prevent unrestricted release of pressurized air from the compressed air line.
5. Attach the quick release fitting of the calibration fixture to the air inlet of the sample head assembly. To do this, pull back the metal collar of the quick release fitting, put the fitting over the air inlet, and release the collar.
6. Slowly open the valve of the calibration fixture so that gas just starts to bubble through the humidifier of the sample head assembly. Continue to slowly open the regulator until the air flow meter of the sample head assembly reads between 5 and 10 PSI.

7. While the gas is flowing through the sample head assembly, the carbon monoxide channel meter inside the control unit should indicate an increasing level of CO. When the meter reaches the low alarm point range (+ or - 2 meter needle widths of the low alarm point) the amber CO alarm LED should be on. When the meter reaches the high alarm point range (+ or - 2 meter needle widths of the high alarm point), the red CO alarm LED should be on. When the meter reaches full scale, the CO channel rough test is complete.
8. Shut off the valve of the calibration fixture. Do not remove the fixture until the air flow meter on the sample head assembly reads zero. If you remove the fixture before this, back pressure may shoot water onto the sensor and cause damage.
9. When the pressure gauge of the sample head assembly reads zero, remove the calibration fixture from the air inlet of the sample head assembly. To do this, hold the calibration fixture in place, pull back on the metal collar of the quick release fitting and carefully remove the calibration fixture from the air inlet.
10. Remove the calibration fixture from the cylinder of 75 ppm CO, and attach it to the cylinder of 17.0% oxygen.
11. Using the O2 gain control knob adjust the O2 reading to 20.9.
12. Repeat steps 5-6.
13. Watch the meter and red alarm LED of the oxygen channel. The red oxygen alarm LED should activate between 19.6 and 19.4% oxygen. If the instrument is equipped with a factory installed horn, it will also activate.

NOTE: The CO sensor may respond when the 17% O2 is applied. This in normal.

14. Repeat steps 8 and 9.
15. Reconnect the sample head assembly to the compressed air line. Rough test is complete. If instrument passes Rough Test, instrument is ready for operation. If instrument fails Rough Test, proceed to calibration section 6.0.

5.2 Rough Test ISA-44E-OD

This test simulates a gas alarm condition to verify the unit's response capability.

1. Hold a butane lighter near the sensor cover.
2. Very briefly depress the lever, without striking the flint, to squirt some butane vapors, to trigger the alarm.

NOTE: This method is best for units set primarily for hydrocarbon responses. Many units which are set to respond to toxic gases or vapors require calibration gas to verify the response capability. See section 6.3.1 routine gas test.

6.0 Calibration

Calibration is essentially an adjustment of the circuitry affecting the instrument response to particular concentrations of gas or oxygen. Utilizing controlled concentrations of these gases, the user exposes the sensors to these gases and then adjusts the appropriate potentiometers to set alarm points, full scale readings or other responses.

Potentiometers are the most essential components in calibration located directly on the circuit boards of the ISA-44RALE-OD, potentiometers change resistances in circuits, altering certain voltages. This affects the response of the instrument. Potentiometers are adjusted by turning a small screw in the potentiometer. Since there is always a short lag time between an adjustment and its affect on the circuit, always wait a few seconds after making an adjustment to see how much the voltage has been affected.

When using controlled concentrations of gas to calibrate the instrument, do not expose the sensors to this gas if it is flowing directly from compressed air cylinders. Such gas is extremely dry and will not provide accurate calibration. The gas must be humidified by flowing through the bubbler on the ISA-44RALE-OD sample head assembly. Also, do not gas set in a background of pure inert gas, such as argon or nitrogen. The MOS sensor will pick up the background gas and render an inaccurate reading. Appropriate calibration gases are available from ***ENMET***.

The oxygen portion of this unit is the same as for the ISA-44RALE-OD. The gas portion of this unit will change depending on the end users criteria. As in the ISA-44RALE-OD the alarm points are preset at the factory and calibration information can be found labeled on the display plate of the unit.

CAUTION: If the covers of either the control unit or the MOS sensor enclosure are removed, the enclosures are no longer explosion proof.

6.1 CO Channel Calibration

MATERIALS:

- ❑ cylinder of 20 ppm CO (high level alarm concentration)
- ❑ cylinder of 19.5% oxygen (oxygen alarm concentration)
- ❑ small screwdriver
- ❑ digital voltmeter
- ❑ ***ENMET*** calibration fixture (***ENMET*** part no. 03605-001)

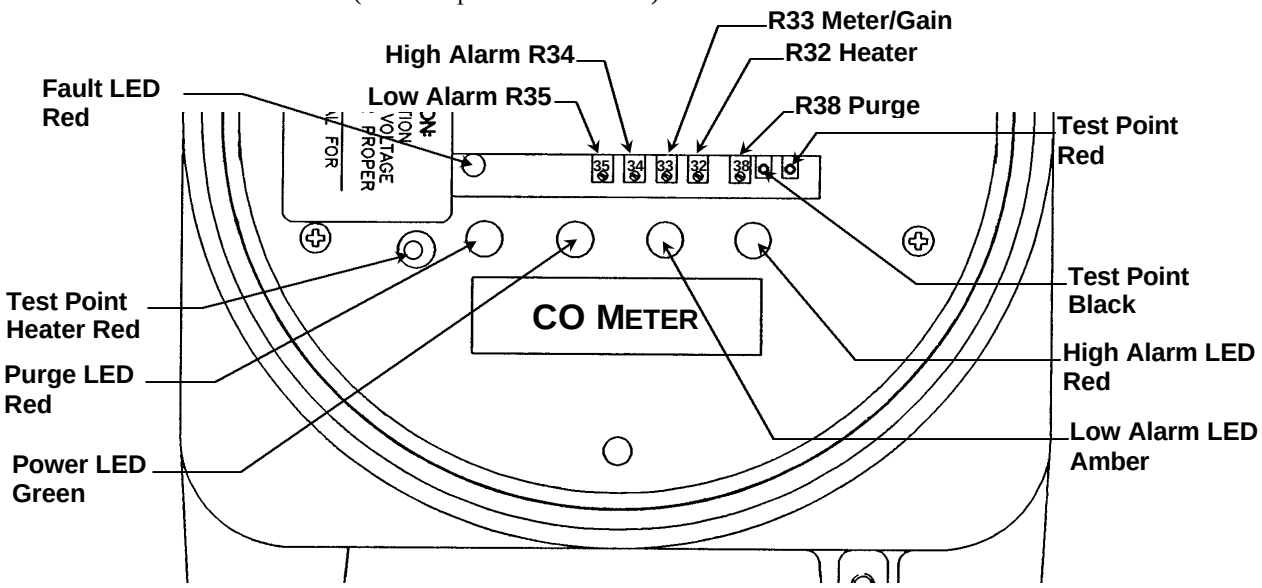

Figure 7: Control Unit CO Channel

PROCEDURE:

WARNING*: *Area must be declassified during this procedure.

1. If necessary, unscrew the clear plastic bottle of the humidifier and fill to the line with clean water. Replace bottle onto humidifier.
2. Attach the calibration fixture to high-level CO alarm gas (20 ppm CO).
3. Remove the sample head assembly from the compressed air line, and attach the quick release fitting of the calibration fixture to the inlet of the sample head assembly. To do this, pull back the metal collar of the quick release fitting, fit the calibration fixture over the sample head assembly air inlet, and release the collar.
4. Slowly open the valve of the calibration fixture until the gauge on the sample head assembly reaches 5 to 10 PSI.
5. Allow the gas to flow over the sensor for 5 to 7 minutes.
6. After 5 - 7 minutes, adjust the meter/gain potentiometer R33 (on CO channel circuit board) until the reading on the CO meter of the display plate corresponds to the concentration of the low alarm point.
7. While the gas is still flowing, slowly adjust the low level alarm set potentiometer R35 (on CO channel circuit board) until the amber alarm LED just barely activates. Be precise; you are setting the low alarm point. If the low alarm LED is already on, adjust potentiometer R35 until the channel comes out of alarm, then readjust very slowly until the alarm LED just barely triggers.
8. Adjust R33 gain potentiometer just until the high alarm point is reached.
9. If the LED did not activate, adjust R34 (on CO channel circuit board) until the LED just activates.
10. Using the regulator on the calibration fixture, turn off the gas. Wait until the pressure gauge on the sample head assembly reads zero, then remove the calibration fixture and gas. Reattach sample head to air line. Meter should go down. CO channel calibration complete.

CAUTION: If sensor fails to respond correctly or fails to clear follow steps a and b below.

a. Place the Purge/Operate/Horn-off switch to PURGE. Measure purge voltage across TB4-7 (+) and TB4-6 (-) inside the terminal enclosure. Voltage should be 1.65 VDC within a 0.03 VDC range. If necessary, adjust potentiometer R38 (on CO channel circuit board, located on display plate) until the required voltage is obtained. Place the Purge/Operate/Horn-off switch to OPERATE, typically the voltage should be .83 ± .03. Verify the voltage listed on the label located on the instrument display plate. Return switch to PURGE and let run for 10 minutes.

b. When purging is complete, set the Purge/Operate/Horn-off switch to OPERATE and allow one half hour for the MOS sensor to stabilize. Repeat steps 3 – 10. If unit still does not operate properly, the sensor may need to be replaced.

6.2 Oxygen Channel Calibration

CAUTION: Enclosures are not explosion proof when the covers are removed. Check the surrounding atmosphere for combustible gases and vapors before performing calibration procedures.

NOTE: This procedure is only necessary if the oxygen channel is not responding accurately or if the channel fails the rough test.

NOTE: Check oxygen cell output, measure the voltage between the cell lead. This should be between 0.043 VDC and 0.09 VDC. If it is not, replace the sensor. See section 7.1 and perform a rough test see section 5.0.

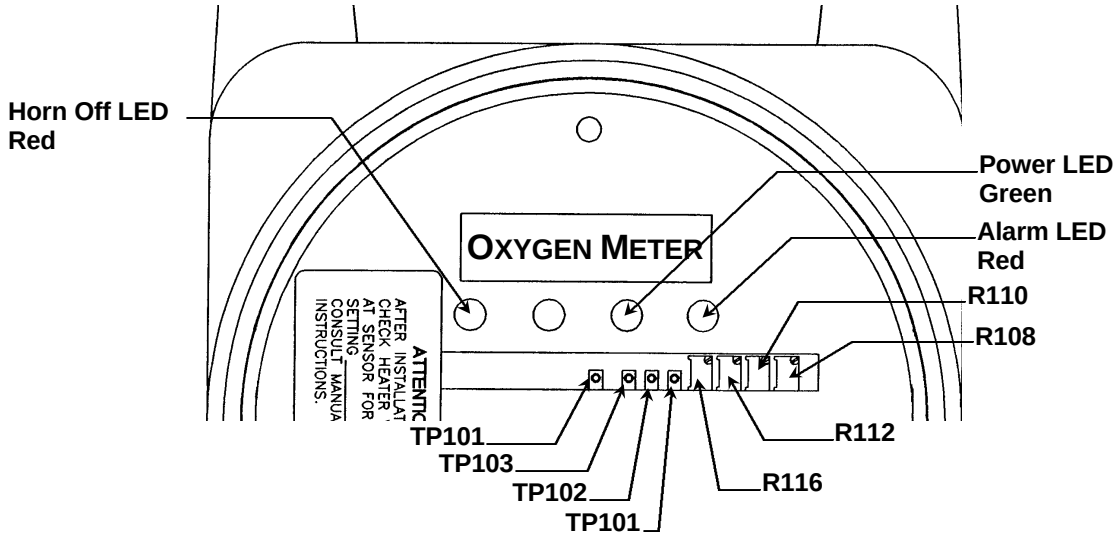

Figure 8: Control Unit Oxygen Channel

PROCEDURE:

1. Set the Purge/Operate/Horn-off switch to HORN-OFF. Open the oxygen cell housing. Remove the cell from the circuit board (do not touch the screen on the cell).

2. Connect the negative voltmeter lead to TP101 and the positive voltmeter lead to TP102 (on the oxygen channel circuit board in the display plate).

3. Adjust the null adjust potentiometer R108 (on oxygen channel circuit board) so the voltmeter shows 0.00 VDC between test points TP101 and TP102.

4. LOW LEVEL SET ADJUST:

a) Reconnect the oxygen cell.

b) To check oxygen cell output, measure the voltage between the cell lead. This should be between 0.043 VDC and 0.09 VDC.

c) Connect the negative lead of the voltmeter to TP101 and the positive lead to TP103 in the main circuit board of the monitor.

d) Adjust the low level set potentiometer, R112, to give .766 VDC between TP101 and TP103.

5. FULL SCALE ADJUSTMENT:

a) Leave the negative lead of the voltmeter at TP101 and connect the positive lead to TP102 on the main circuit board.

b) Adjust the gain potentiometer on the Control unit to give 1.24 VDC between TP101 and TP102.

c) Adjust the meter full scale potentiometer R110 so the meter on the front panel reads full scale, 26% (adjust this pot. counterclockwise to increase, clockwise to decrease.

d) Remove the voltmeter leads from the test points.

6. ALARM SET ADJUST:

a) Adjust the oxygen gain potentiometer on the control unit to predetermined alarm point (19.5%) on the oxygen meter.

b) Adjust the alarm point adjust potentiometer, R116, counterclockwise until the oxygen circuit just goes into alarm. The red oxygen deficiency LED should just activate. NOTE: If the alarm LED is on before you begin the potentiometer adjustment, adjust this pot. clockwise until the LED is off, then readjust counterclockwise until the LED just activates.

c) Adjust the oxygen gain potentiometer down so that the oxygen circuit comes out of alarm. Then adjust up again slowly until the unit goes into alarm.

d) Adjust the oxygen gain potentiometer so that the meter reads 20.9%.

7. The oxygen circuit alignment is now complete. Turn the horn back on.

6.3 Routine Gas Test and Recalibration ISA-44E-OD

Test and/or recalibrate the ISA-44E-OD periodically and whenever a sensor receives severe handling.

Use only the equipment listed. Follow the test and calibration procedures carefully.

MATERIALS:

- ❑ one 17ℓ (propane torch size) cylinder high-level alarm calibration gas with air used as background gas, such as 10% LEL methane in air.

NOTE: Gas should be identical (or equivalent) to that used to calibrate the unit, unless you want to recalibrate to a new gas or different concentration. Do not use inert gases, such as nitrogen or argon.

- ❑ gas calibration fixture (regulator, sensor cover, tubing, humidifier/flowmeter; ***ENMET*** part no. 03700-001).
- ❑ small screwdriver (for adjusting potentiometers)
- ❑ water

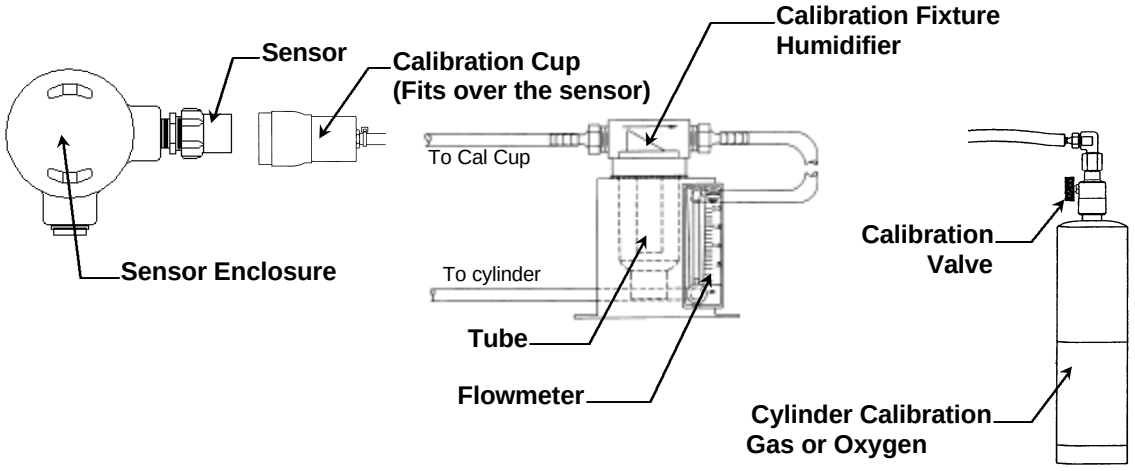

Figure 9: Calibration Adapter ISA-44E-OD

6.3.1 Routine Gas Test

PROCEDURE:

NOTE: Units without PURGE skip steps 2, 4 & 5

1. Make sure the instrument has been in continuous operation for at least 24 hours.
2. After 24 hours, PURGE for at least 20 minutes.
3. Turn Horn off.
4. Turn PURGE off (after 20 minute purge).
5. Wait one hour to let the sensor stabilize.
6. Fill the humidifier bottle of the gas calibration fixture about half way with tap water; be sure the center tube of the humidifier extends into the water.
7. Attach the calibration fixture to the high-level calibration gas. Set the humidifier/flowmeter upright on a level surface.
8. Open the regulator valve slowly and adjust the flow rate. Allow a steady stream to flow through the flowmeter at a rate of 0.9 - 1.1 scfh (standard cubic feet/hour). Do not open the valve all the way. This causes calibration errors and quickly uses up gas.
9. Firmly place the plastic cap over the sensor.
10. Let gas flow over the sensor until verify that the alarm triggers (amber light). Use the Table 5 for approximate lengths of time to alarm.

Table 5: Routine Gas Test Timetable

Gas of Vapor	Minutes
20 ppm CO	5 to 7
50 ppm CO	5
100 ppm CO	3
200 ppm CO	2
10% LEL methane	1 to 2
20% LEL methane	1 to 2
20% LEL propane	1 to 2
100 ppm vinyl chloride	1 to 2
Typical hydrocarbon vapors	1 to 2

11. After you verify the alarm response, turn the gas off and remove the calibration fixture from the gas cylinder.
12. Using low-level calibration gas, repeat steps 8, 9 & 10 to verify the low-level alarm (amber light).
13. Follow the above steps for each channel.
14. Remove the calibration assembly from the gas cylinder.
15. Turn the Horn back on.

NOTE: If this test fails to trigger the alarms and cause appropriate meter reading, and no other electrical or mechanical malfunction is apparent, recalibrate the device (section 6.0).

6.3.2 Recalibration Procedure

Recalibration involves verifying and/or setting the sensor voltage. If the sensor is located 10 feet or more from the control unit, sensor voltage specified in this procedure must be measured initially across the brown and orange wires inside the sensor assembly (you may have already done this during installation).

Once the voltage has been set correctly at the sensor, then measure the corresponding voltage across the heater (positive; red) and ground (negative; black) test points on the display plate of the unit. Record this voltage (you have probably already done this during installation). Now whenever the sensor voltage must be corrected, all you need to do is adjust the voltage so that you gain your recorded voltage across these test points. If the sensor assembly is closer than 10 feet from the unit, simply measure the sensor voltage specified in this procedure across the heater and ground test points on the display plate of the unit.

PROCEDURE: Recalibration

1. Purge in clean air.

NOTE: For units without PURGE, allow 15 minutes for the sensor to recover and stabilize.

2. After the purge, turn PURGE off and wait one hour for the sensor to stabilize.
3. Repeat steps 6-10 in the Test Procedure (Section 6.3.1).
4. After the proper time exposure to the calibration gas, adjust the meter/gain adjust pot. (R33..see Fig.7) until the meter reading corresponds to the low-level gas concentration. For example, 35 ppm CO calibration gas requires a meter reading of 35 ppm CO.
5. Next, adjust the high-level alarm set pot. (R34) until the alarm just barely triggers.

NOTE: Begin this adjustment from a non-alarm condition.

6. Repeat step 5 slowly to verify the alarm adjustment. Leave the pot. next to the alarm point on the alarm side.
7. Turn off the calibration gas.
8. Turn the Horn back on.

6.3.3 Precautions

- It is necessary to have at least ten percent (10%) relative humidity content, or greater, in the test gas for accurate testing and calibration. The water in the humidifier bottle provides this humidity.
- All units factory calibrated to alarm below 300 ppm for any gas in moist air may take up to five minutes to generate the alarm in a static environment containing the specified gas concentration.
- Do not adjust for an instantaneous alarm when the test gas is first released; do not let gas flow at a high rate. If you do, the calibration will be inaccurate and the sensor will be overly sensitive.
- When using gas other than ***ENMET*** calibration gas: do not use test gases with 100% nitrogen as background gas; do not use totally dry gases directly from large high pressure cylinders.

7.0 Replacement Procedures

7.1 Sensor Replacement ISA-44RALE-OD

The sensors require replacement whenever the specified voltages cannot be obtained or when calibration fails. Whenever a sensor is replaced, the corresponding ISA-44RALE-OD channel must be recalibrated.

NOTE: If the MOS sensor is replaced, a whole new MOS sensor assembly must be obtained, for the MOS sensor is permanently cemented into the MOS sensor assembly.

NOTE: One indication that the oxygen cell has depleted is an increasingly frequent need for oxygen gain adjustment as described in section 6.0 calibration. When installing a new oxygen sensor you must trim the pins.

The oxygen cell must be replaced whenever the oxygen meter cannot be set to 20.9% oxygen using the oxygen gain potentiometer while the oxygen cell is exposed to clean air. As the cell nears the end of its life, it becomes depleted more and more quickly until the oxygen channel is constantly in alarm condition. Such an alarm cannot be defeated even if the oxygen gain is adjusted. In addition, if the oxygen cell is removed from the circuit, the meter immediately falls to the bottom of the scale and the oxygen alarm activates.

MATERIALS:

- ❑ wire cutter
- ❑ wrench
- ❑ flat headed screwdriver
- ❑ sensing element replacement
  (MOS sensor assembly, ***ENMET*** part no. 03037-109; oxygen cell part no. 67013-008).

CAUTION: Keep the oxygen cell in its package until approximately 4 hours before installation, when it should be removed from its package and allowed to adjust to the environment for 4 hours, record the cell serial number for warranty reference.

PROCEDURE:

1. Turn off the power for the instrument, and remove the compressed air line from the sample head assembly.

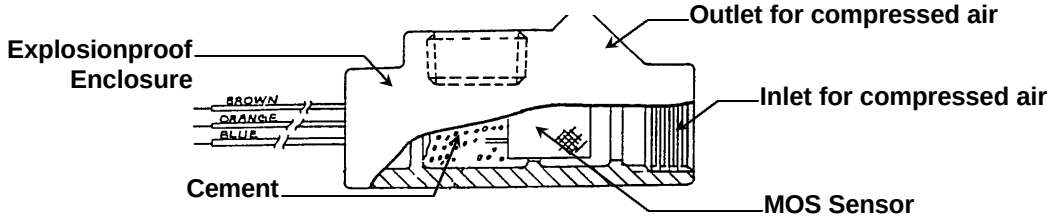

Figure 10: MOS Sensor Assembly, Cut Away View

2. MOS SENSOR:
If terminal enclosure is supplied with unit remove terminal enclosure cover disconnect sensor assembly. Then unscrew the MOS sensor assembly from the terminal enclosure. Screw the new assembly onto the terminal enclosure and connect to correct terminals, see table 3 in section 3.0.

If terminal enclosure in not supplied, remove the tubing leading to the oxygen cell housing from the junction between the sample head assembly and the MOS sensor assembly. Inside the control unit, remove the display plate, and disconnect the MOS sensor wires from TB1-6, TB1-7 and TB1-8. Then unscrew the MOS sensor assembly from the conduit junction to the control unit, and pull the assembly and wires out. Feed the wires of the new assembly through the conduit. the conduit. Connect the wires to TB1-6 (brown), TB1-7 (orange) and TB1-8 (blue). Replace the tubing leading to the oxygen cell housing.

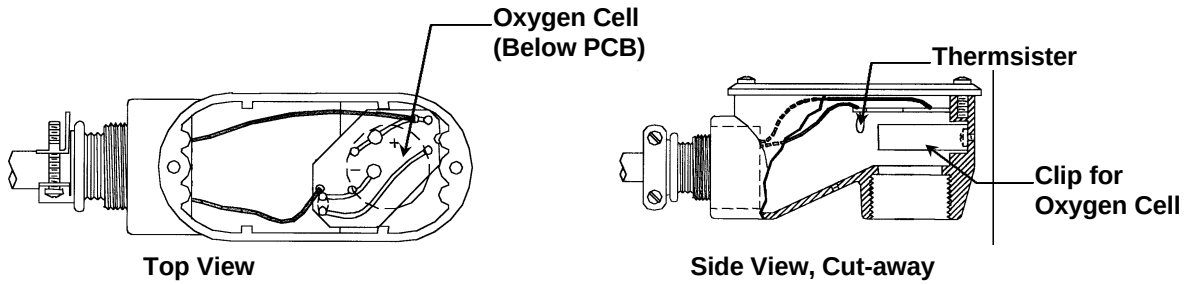

Figure 11: Oxygen Cell Enclosure

3. OXYGEN CELL:
Remove the two screws on the top of the oxygen cell enclosure. Pull the circuit board off the old oxygen cell, and remove the oxygen cell. Using the wire cutters, clip off approximately ½ of each pin on the back of the new cell. Put the new cell into the clip of the enclosure, put the cell circuit board on it. Take precaution not to damage the thermsistor on the circuit board. Replace cover.

4. If the MOS sensor is replaced, recalibrate the CO channel. If the oxygen cell is replaced, recalibrate the oxygen channel. If both sensing elements are replaced, recalibrate both channels.

5. Replace enclosure covers. Sensor replacement is complete.

7.2 LED Replacement

The LED's (light emitting diodes) and colored lenses should last for the life of the instrument. However, if one should break or burn out, replacement is simple.

MATERIALS:

- ❑ Resin-core solder
- ❑ soldering iron
- ❑ shrink tubing for wire
- ❑ replacement LED or lens (see section 8.0 for part numbers)

PROCEDURE:

1. Remove the display plate.

2. Pull the LED out from the plastic lens. Remove the shrink tubing which covers the solder connection between the LED and the wiring.

3. Note which wire is connected to the negative lead of the LED (the flattened area of a small lip around the base of the LED is on the side of the negative lead). Unsolder the old LED. Solder the new LED to the wiring. When the LED is soldered in, put shrink tubing over the connection, and apply heat to shrink.

4. If the lens requires replacement, pop the old one out through the front of the display plate. Push the new one in from the front of the display plate until it snaps into place.

5. Push the LED up into the lens until it snaps into place.

6. Replacement is complete.

7.3 Intrinsic Safety Barrier Replacement

If the oxygen channel encounters a significant power surge, the Intrinsic Safety Barrier will open (similar to a fuse). An open I. S. barrier essentially sets the oxygen channel in alarm. This alarm condition differs from a regular oxygen alarm in that the oxygen meter immediately falls to the bottom of the scale, the channel remains in alarm even if clean, oxygen sufficient air is supplied to the oxygen cell, and there is no meter response to adjustments of the oxygen gain potentiometer.

Note that a similar alarm condition occurs if the oxygen cell has reached the end of its life, the oxygen cell is removed from the circuit, or if there is a bad connection in the oxygen channel circuitry. To determine whether or not the problem is an intrinsic safety barrier, disconnect the power to the unit and declassify the area, then remove the display plate and circuitry from the control unit (do not disconnect anything). At the bottom of the control unit is a mounting plate, on which the I.S. barrier is attached. Check for electrical continuity across terminals 1 and 3 of the I.S. barrier. If there is not continuity, the barrier has opened and must be replaced. If there is continuity, the problem involves some other component or circuitry.

7.4 Sensor Hook-Up and Replacement for ISA-44E-OD

MOS sensors connect to the control unit with three conductors. Two conductors supply heater current to the sensor. The third conductor is a signal wire. Size of heater wire depends on the distance between the particular sensor and the control unit. For a distance of 250-1000 feet, 16 gauge wire is recommended.

Sensor wires correspond to the normal wire code (orange=heater; brown=ground; blue=signal).

NOTE: After you mount and install the ISA-44E-OD you ***MUST*** adjust the sensor heater voltage (see section 7.5).

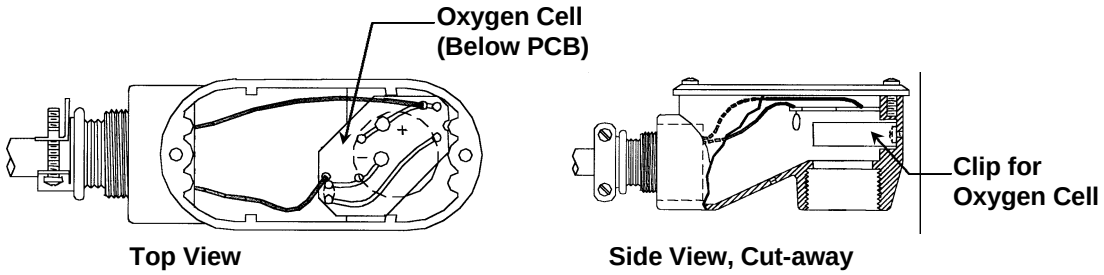

Figure 12A: Oxygen Cell Enclosure

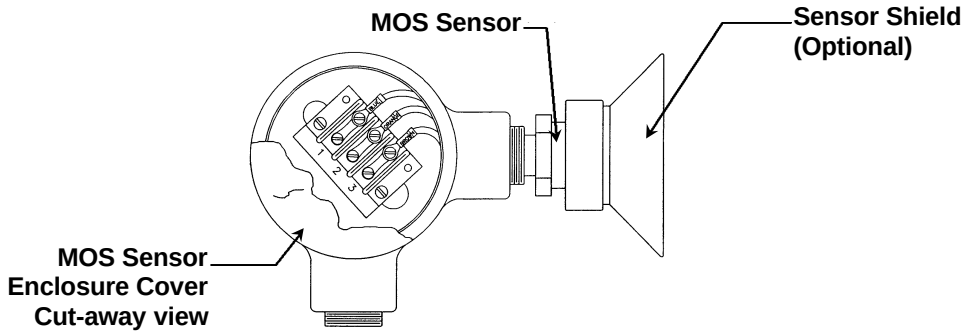

Figure 12B: MOS Sensor Enclosure

7.5 Sensor Heater Voltage

Heating the sensor promotes the oxidation reaction on the sensor element surface. The temperature to which the sensor element is heated determines the selectivity of the equipment to certain gases.

The heater voltage is specified and labeled on the display plate of the instrument. Channels with PURGE switches have two voltages specified; one is for heater voltage, one is for PURGE voltage.

NOTE: Do not increase any sensor voltage to values greater than those given on the unit. Too high voltage can damage the sensor heater winding, making sensor replacement necessary.

If the sensor is located 10 feet or more from the control unit, you must initially measure the sensor voltage specified in this procedure across the brown and orange wires inside the sensor assembly. Once the voltage has been set correctly at the sensor, then measure the corresponding voltage across the heater (positive; red) and ground (negative; black) test points on the display plate of the unit. Record this voltage. Now whenever the sensor voltage must be corrected, all you need to do is adjust the voltage so that you gain your recorded voltage across these test points. If the sensor assembly is closer than 10 feet from the unit, simply measure the sensor voltage specified in this procedure across the heater and ground test points on the display plate of the unit.

MATERIALS:

- ❑ voltmeter with + or - 0.05% accuracy (digital is best)
- ❑ small screwdriver

PROCEDURE: Instruments with PURGE Switch

1. With PURGE switch on, adjust the purge adjust pot. (R38...see Fig. 7) to the purge voltage specified on the enclosure.
2. Turn the PURGE switch off.
3. Now adjust the heater adjust potentiometer (R32) to the specified voltage.

PROCEDURE: Instruments without PURGE Switch

1. Adjust the heater adjust potentiometer (R32) to the required voltage.

NOTE: Sometimes, if a sensor is located a great distance from the control unit, the heater adjust may not (by itself) be able to bring the voltage to the required reading. If not, then adjust the purge adjust pot. (R38) to arrive at the necessary voltage.

7.6 Sensor Assembly Replacement

Replace the sensor assembly if either of the following conditions occur.

- ♦ Fault Condition: The red fault LED indicates a fault in sensor continuity. Either the sensor is bad and needs to be replaced, or there is an open wire somewhere between the sensor assembly and the control unit.
- ♦ Gross Sensor Contamination: Close exposure to an open gas flame, dipping the sensor in lacquer, or continuous exposure to heavy concentrations of industrial vapors will grossly contaminate a sensor. A grossly contaminated sensor causes a continuous alarm and the meter to drift slowly upscale.

PROCEDURE: Sensor Replacement

1. Obtain a new sensor assembly. Make sure the sensor type is identical to your original sensor.
2. Disconnect the orange, brown and blue sensor wires.
3. Unscrew the assembly from the sensor enclosure.
4. Replace the bad sensor with the good sensor and reconnect the wires.
5. Set the sensor heater voltage(s).
6. Recalibrate the instrument.

8.0 Replacement Part Numbers

Description	*ENMET* Part Number
Gas Cylinder 20 ppm Carbon Monoxide	03219-020
Gas Cylinder 50 ppm Carbon Monoxide	03219-050
Gas Cylinder 17.0% Oxygen	03296-170
Gas Cylinder 19.5% Oxygen	03296-195
Gas Cylinder 20.9% Oxygen	03296-209
Humidifier	03406-001
Intrinsic Safety Barrier	64011-000
LED, Red	52005-001
LED, Amber	52005-002
LED, Green	52005-003
LED, Orange	52005-004
Lens, Red	62032-001
Lens, Amber	62032-002
Lens, Green	62032-003
Lens ,Clear	62032-004
MOS Sensor Assembly	03415-001
Oxygen Cell, S-2	67013-008
Regulator, for 50 – 250 psi air line	03406-002
Regulator, for 300 – 5000 psi line	03427-000

9.0 Specifications

Power	110 VAC shingle phase, 10 – 15 Watts
Dimensions (Control Unit)	Approximately 11.5" h x 6.25" w x 9.2" d
Weight	Approximately 42 lbs.
Relay Current	5 Amps non-inductive surge 2 Amps steady
Sensor Life	3 years – MOS Sensor 10 months – Oxygen Cell (6 months Warranty)
Safety Rating	The ISA-44RALE-OD and ISA-44RAHE-OD are safe to use in atmospheres rated Class I, Group C, D or Class II, Groups E, F and G as defined by the National Electrical Code.

NOTE: *All specifications stated in this manual may change without notice.*

10.0 WARRANTY

ENMET warrants new instruments to be free from defects in workmanship and material under normal use for a period of one year from date of shipment from ***ENMET***. The warranty covers both parts and labor excluding instrument calibration and expendable parts such as calibration gas, filters, batteries, etc... Equipment believed to be defective should be returned to ***ENMET*** within the warranty period (transportation prepaid) for inspection. If the evaluation by ***ENMET*** confirms that the product is defective, it will be repaired or replaced at no charge, within the stated limitations, and returned prepaid to any location in the United States by the most economical means, e.g. Surface UPS/RPS. If an expedient means of transportation is requested during the warranty period, the customer is responsible for the difference between the most economical means and the expedient mode. ***ENMET*** shall not be liable for any loss or damage caused by the improper use of the product. The purchaser indemnifies and saves harmless the company with respect to any loss or damages that may arise through the use by the purchaser or others of this equipment.

This warranty is expressly given in lieu of all other warranties, either expressed or implied, including that of merchantability, and all other obligations or liabilities of ***ENMET*** which may arise in connection with this equipment. ***ENMET*** neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than that which is set forth herein.

NOTE: When returning an instrument to the factory for service:

Be sure to include paperwork.

A purchase order, return address and telephone number will assist in the expedient repair and return of your unit.

Include any specific instructions.

For warranty service, include date of purchase

If you require an estimate, please contact ***ENMET*** Corporation.