ENMET **Corporation**
PO Box 979
Ann Arbor, MI 48106-0979

ISA-44-2-OD

OPERATION & MAINTENANCE

MANUAL

80003-007
Revised June 1992
MCN-122; 09/01/92
MCN-204; 01/29/01
MCN-295; 09/04/03

Table of Contents

List of Figures and Tables

Reference information:

NOTE: [important information about use of instrument – if not followed may have to redo some steps.]

CAUTION: [affects equipment – if not followed may cause damage to instrument, sensor etc…]

***WARNING*: [affects personnel safety – if not followed may cause bodily injury or death.]**

1.0 Introduction

ENMET model **ISA-44-2-OD** is an all solid-state electronic gas detection system that minimizes the risk of injury or death to people who are exposed to potentially hazardous gas and/or oxygen deficiency in working environments. It continuously monitors for combustible gas, toxic gas, and lack of oxygen. Whenever the situation becomes threatening, alarms are triggered alerting all personnel in potential danger to take proper action. Audio (horn) and visual (lights) alarm signals are calibrated to trigger at both high and low-level gas concentrations.

The unit mounts to a wall or panel and operates continuously from either 110 VAC, 220 VAC, and/or 12 VDC power. It has relay contacts to operate external signals or equipment when the hazardous gas exceeds or the available oxygen falls below the preset alarm level. The unit is often used for monitoring wet wells, where it is calibrated to alarm at significant quantities of methane, hydrogen sulfide, and oxygen deficiency.

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

1.1 Unpack

Unpack the **ISA-44-2-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-44-2-OD** is received as ordered. Each **ISA-44-2-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-44-2-OD** is serialized. These numbers are on tags on the equipment and are on record in an ***ENMET*** database.

1.4 Read Manual

Read this manual carefully and thoroughly.

2.0 Features and Controls of the ISA-44-2-OD

How the ISA-44-2-OD Works

The **ISA-44-2-OD** uses gas-sensitive Metallic Oxide Semiconductor (MOS) sensing elements that react to toxic and combustible gas molecules. An oxidation reaction occurs on the sensor surface when contaminants are present. The oxidation reaction changes the gas sensor's electrical resistance, which then triggers the alarm circuitry when the concentration of gas goes beyond a preset level. Also, an oxygen micro-fuel cell and associated circuitry maintain a steady current indicating the presence of a satisfactory oxygen level. Should there be a lack of oxygen, the current emitted by the micro-fuel cell will decrease accordingly, triggering the alarm in the same manner.

The **ISA-44-2-OD** has two similar circuits (printed circuit assemblies PC1 and PC2, see Figure 2) with related sensors. Each of these circuit-sensor combinations makes up a separate channel of gas detection. The combustible gas detection circuit is on PC2; the toxic gas detection circuit is on PC1. A third circuit-sensor combination on the right-hand side of PC1 comprises the oxygen deficiency channel.

2.1 Standard Calibration

The majority of **ISA-44-2-OD** instruments are furnished with a standard calibration, which is as follows:

Combustible Gas Channel:

Alarm Level	Alarm Threshold
Low Alarm:	10% LEL methane
High Alarm:	20% LEL methane
Meter Full Scale:	50% LEL methane

Toxic Gas Channel:

Alarm Level	Alarm Threshold
Low Alarm:	10 ppm hydrogen sulfide
High Alarm:	20 ppm hydrogen sulfide
Meter Full Scale:	50 ppm hydrogen sulfide

Oxygen Deficiency Channel:

Alarm Level	Alarm Threshold
Alarm:	19.5% oxygen
Meter Scale:	16% to 26% oxygen

This calibration corresponds to one of the major applications of the instrument. Because the instrument may be purchased with many different calibrations, the manual has been written in a general fashion.

2.2 External Features

See **Figure** 1 for the outside front panel of the instrument:

Feature	Description
Power Indictor (Green Light)	When the green light for a channel is on, the unit is operating normally; that is, there is no alarm condition. When this light is off, the channel is in alarm or the power to the channel has been interrupted.
Visual Alarms	Red Light: Visual alarm signal for high-level gas concentration. Relay contacts can also be attached here for activating remote signals. Amber Light: Visual alarm signal for low-level gas concentration. Relay contacts can be hooked up to activate remote signals.
Meters	Two gas concentration meters and one oxygen concentration meter. The scale is marked in parts per million (ppm) for toxic gas detection, percent lower explosive limit (%LEL) for combustible gas, and percentage of oxygen (% oxygen) in air. The "ppm" and "%LEL" meters are non-linear devices; therefore the scales do not express specific gas concentrations for regions between the alarm points. *Do Not* infer exact readings from unmarked regions of these meter scales.
Audio Alarm (Horn)	Audio alarm (2900 Hz,95 dB at 2 ft.). The audio alarm is activated when the unit is in alarm.
Operation Switch	A rotary switch for: ▪ OPERATE – Normal Operation ▪ HORN OFF – Disable Audio Alarm ▪ PURGE ON – (sensor temperature control) Purge ON to clean (purge) sensor surface of absorbed contaminants (sensor hot).
Switch Indicator (Red)	When the light is on, Indicates Operation Switch is not in OPERATE
Oxygen Gain	Allows user to adjust meter reading with a screwdriver. Normal fresh air concentration is 20.9% but the meter will periodically show a variation due to atmospheric conditions. *Do Not* adjust the oxygen gain until the oxygen cell (sensor) has been in fresh air for at least 15 minutes.

NOTE: All monitoring channels work independently. When one alarm is activated, the others are not affected and continue monitoring without further adjustment.

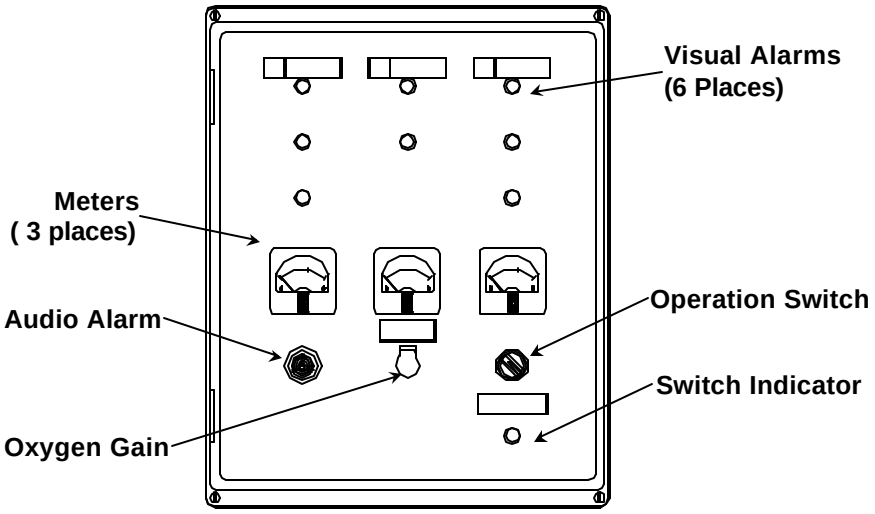


Figure 1: External Features of the ISA-44-2-OD

2.3 Internal Circuitry of the ISA-44-2-OD

See **Figure** 2, 3 and 4 for interior location of **ISA-44-2-OD** circuit boards, terminal blocks, etc.

Feature	Description
Relay Outputs	For both high and low-level alarms (TB1, TB3, TB4). Relays can activate a remote alarm signal when either a hazardous gas or oxygen deficiency level is detected or when the AC or DC power is interrupted. There are five double-pole relays. These furnish normally open, normally closed, and common terminals. Relay current is 5 amps, non-inductive surge, 2 amps steady
Potentiometers	The potentiometers (POT) vary critical circuit resistances, which vary the sensor's sensitivity, and are essential to recalibration procedures. The unit is initially calibrated at the factory. The potentiometers are described below. ▪ **Heater Adjust (R1)** For adjusting the sensor heater operating voltage (see **Section** 3.4). R1 is located on PC1 and PC2. ▪ **Low Level Alarm Set (R2)** For low-level alarm adjustment (recalibration see **Section** 5.2). R2 is located on PC1 and PC2. ▪ **High Level Alarm Set (R3)** For high-level alarm adjustment (recalibration; see **Section** 5.2). R3 is located on PC1 and PC2. ▪ **Meter Adjust (R4)** To adjust and set the meter for the appropriate gas response (recalibration). R4 is located on PC1 and PC2. ▪ **Purge Adjust (R36)** For adjusting the sensor heater purging voltage (toxic gas detection channel only). Located only on PC1. ▪ **Oxygen Alarm Adjust (R52)** For oxygen alarm adjustment (oxygen cell recalibration; see **Section** 5.2.2). R52 is located on PC1. ▪ **Null Adjust, (R44), Full Scale Adjust (R46), Low Level Set (R48)** To adjust and set the meter for the appropriate oxygen response (oxygen cell recalibration). These potentiometers are located on PC1 only.
Power Terminal Block (TB6)	Terminal to connect the unit to voltage source. Use the correct watertight fitting for the cord or conduit when supplying power to unit.
Intrinsic Safety Barrier (IS1)	To electrically isolate the oxygen cell and prevent the accidental application of high voltage to the cell.

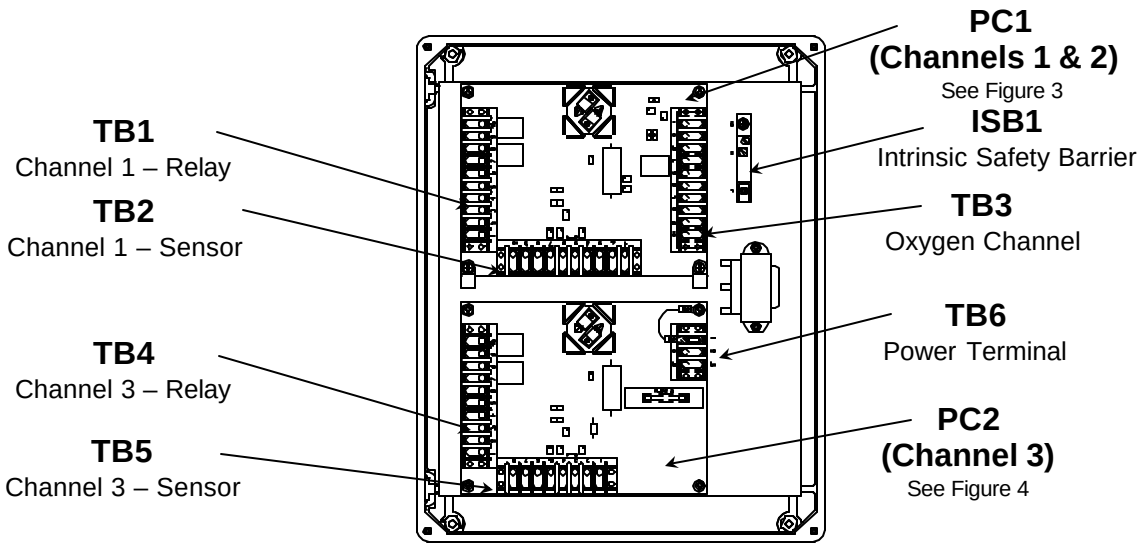


Figure 2: Internal Circuitry Features of the ISA-44-2-OD

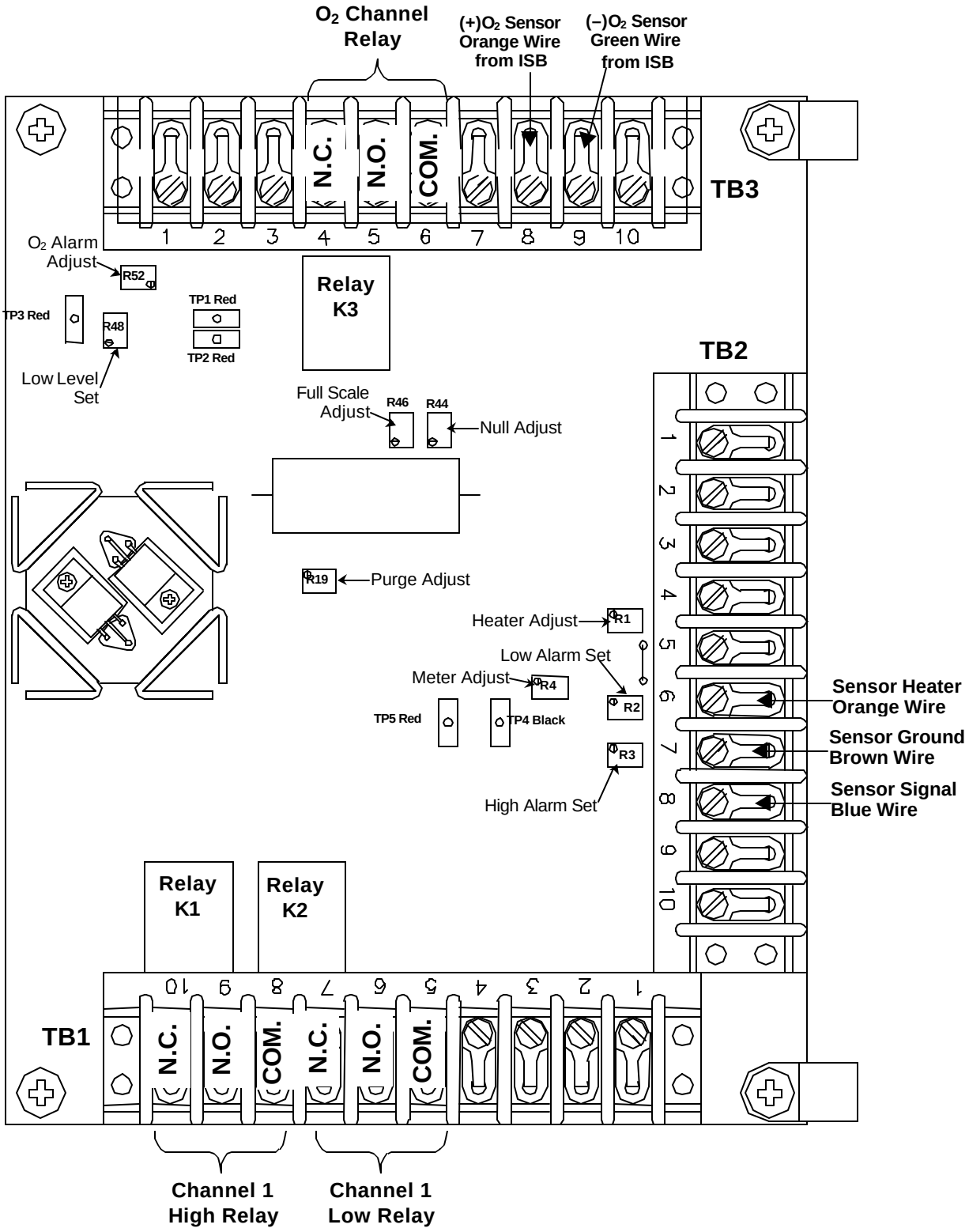


Figure 3: Circuitry PC1 Channels 1 and 2

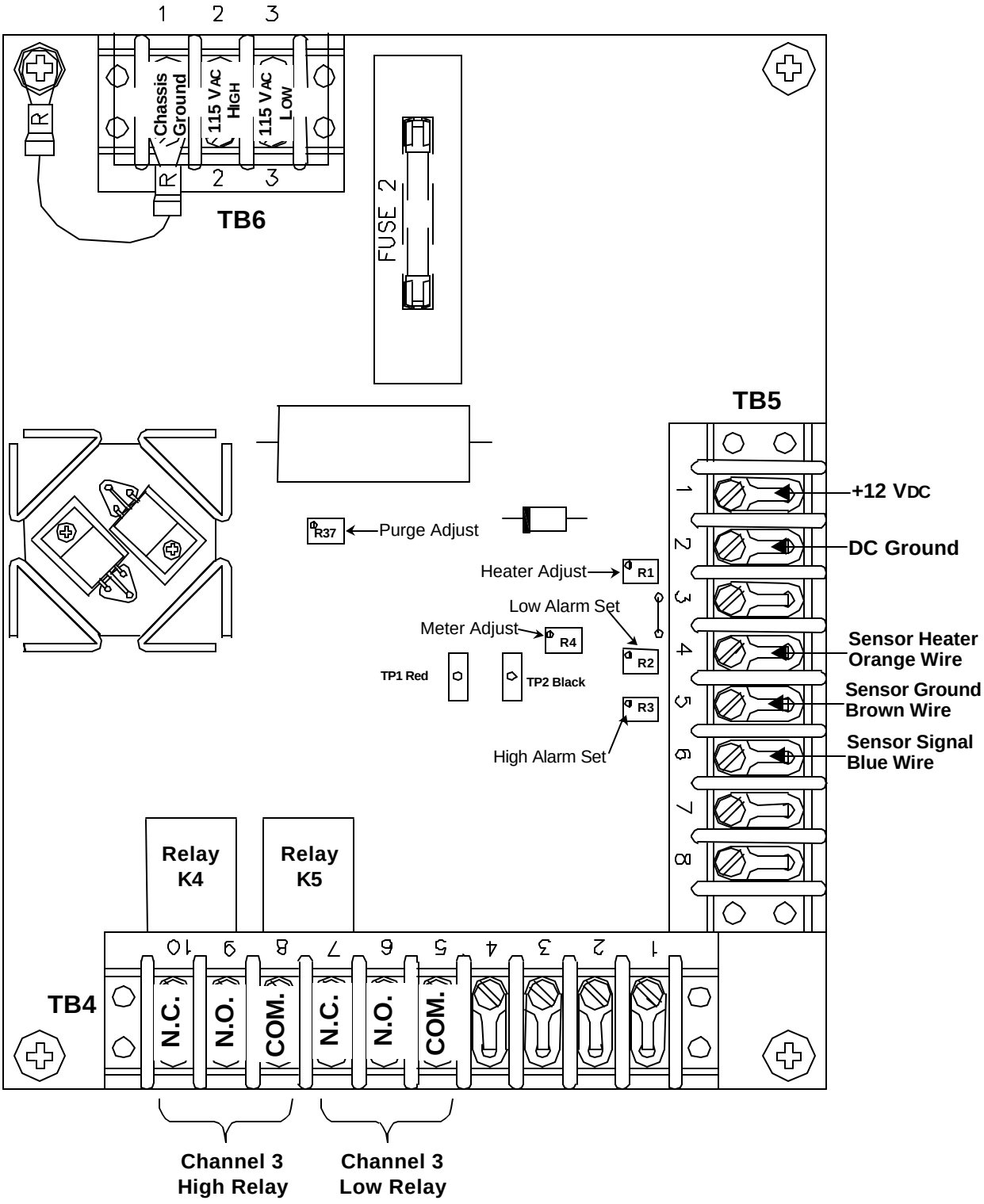


Figure 4: Circuitry PCB 3 Channel 3

3.0 Installation

The **ISA-44-2-OD** is completely oiltight and watertight. Use the correct watertight fitting for the cord or conduit when supplying power to the unit.

3.1 Power Hook-Up and Mounting of Control Unit ISA-44-2-OD

1. Choose a suitable location for mounting the electronics control unit.
2. The OPERATE switch should be in the HORN OFF position.
3. Open the control unit. Remove the terminal strip cover from TB-6 (see **Figure** 2 and 4). Simply pull the cover off the holding prongs.
4. Apply 115 VAC, 220 VAC* and/or 12 VDC power to the proper terminals. Refer to **Figure** 4.
   NOTE: 220 VAC power requires a change in the transformer hook-up by a competent electrician or electronics technician; but this change is best done at ***ENMET***. Both AC and DC power can be applied at the same time. Current will flow from the AC source; DC current (as emergency back-up power) will flow ONLY when the AC power is interrupted.
5. Run the relay contacts through the same watertight fitting as the power cord leads or out a second fitting. Be sure to use watertight fittings that meet NEMA-4X standards. See **Figure** 8 for an example of relay wiring. When the power supply is interrupted, the relays switch to the same position as for the true gas alarm condition and the power lights (green) are off. *Do Not Connect the Unit to Other Voltage Supply Lines*.
6. Replace the terminal strip cover on TB-6. Make sure the cover fits snugly into the prongs.

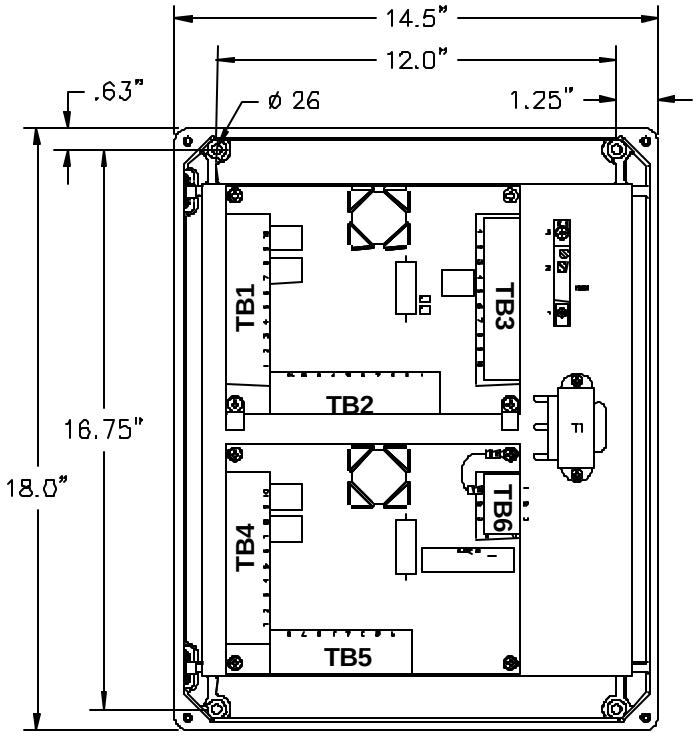


Figure 5: Mounting Dimensions ISA-44-2-OD

3.2 Sensor Location

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. As a guide, consult the gas descriptions below.

Table 1: Heavier than Air

Gas	Sensor Location
Bottled LP (liquefied petroleum)	Interior wall; 18-24" from floor. ▪ DO NOT locate directly above or beside gas appliances (ovens, heaters). ▪ Avoid locating anywhere near a vent or window or near an outside doorway.
Propane	
Butane	
Gasoline	
Trichloroethylene	
Vaporized hydrocarbons	
Hydrogen sulfide	

Table 2: Lighter than Air

Gas	Sensor Location
Natural gas (methane)	Near ceiling. ▪ DO NOT locate directly above appliances where it is subject to direct exposure to heat or steam.
Ammonia	
Hydrogen	

Table 3: Same Density as Air

Gas	Sensor Location
Carbon Monoxide	4-6 feet above the (generally uniform) floor. ▪ DO NOT locate in direct air currents of windows, doors, or vents.

Oxygen

Oxygen deficiency is usually caused by a gas that displaces the air in a space. The oxygen sensor should be located to quickly detect the displacement of air by the gas. If a heavier than-air gas is involved in the application, locate the sensor low in the space being monitored. Conversely, if a lighter-than air gas is involved, locate the sensor high in the space. If there is doubt, call ***ENMET*** we will help you locate the sensor correctly.

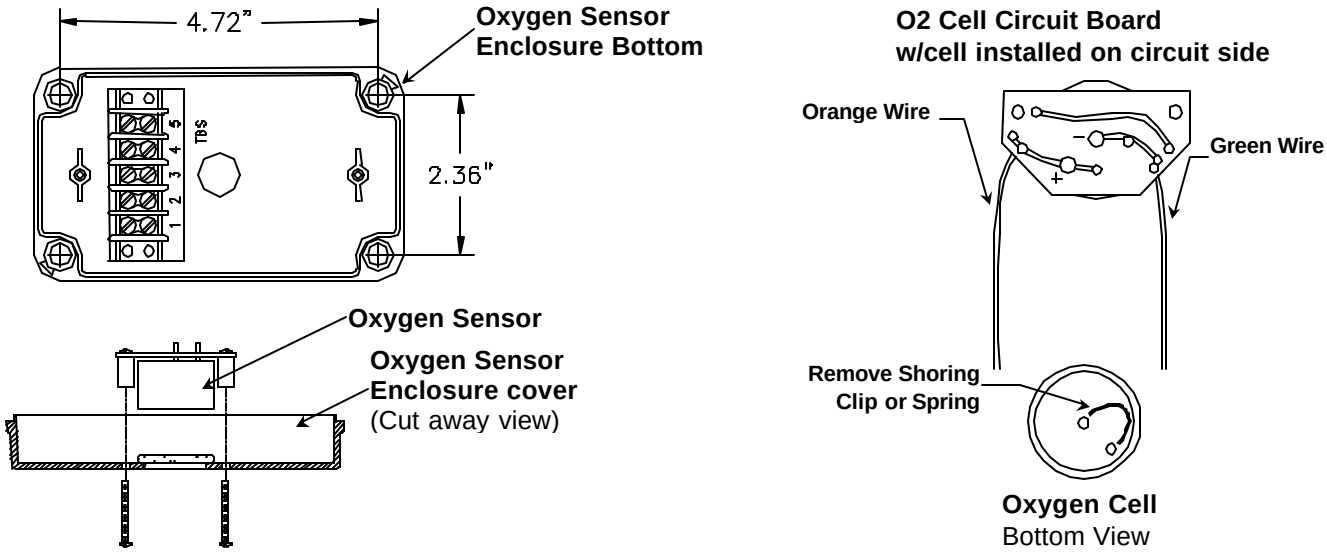


Figure 6: Oxygen Cell Enclosure

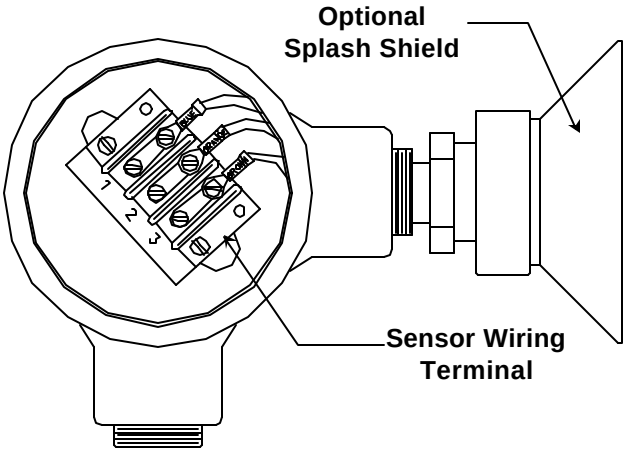
3.3 Sensor Hook-up

The oxygen cell comes packaged in a sealed vapor proof bag. The cell needs to be installed in the remote sensor enclosure after the enclosure has been mounted. See Figure 6. This procedure is the same as the procedure described in **Section** 5.3

The MOS sensor is connected to the **ISA-44-2-OD** control unit with three conductor wiring, use the correct oiltight fitting. 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. See **Table** 4.

Sensor wires correspond to the normal wire code:

orange – heater
brown – heater ground
blue – signal



Sensor Wiring		
FOR 812 / 813 / 814 SENSORS		
Position	**Function**	**Wire Color**
1	Signal	(Blue)
2	Heater	(Orange)
3	Ground	(Brown)

Figure 7: Internal View of Sensor Wiring

NOTE: The three color-coded wiring attachments must be performed by the user when replacing the sensor.

Table 4: Recommended Wire Gauge

Distance from Sensor to Control Unit	Recommended Wire Gauge
250 feet	16 AWG
350 feet	14 AWG
Longer Distances	Contact Factory

CAUTION: After you mount and install the **ISA – 44-2-OD,** you must adjust the sensor heater voltage (see **Section** 3.4).

This equipment is usually permanently installed, with sensor, power, and relay wires run through hard conduit. The enclosure is not punched, so wiring may approach the enclosure from any direction; however, the bottom of the enclosure is the best wiring entrance surface.

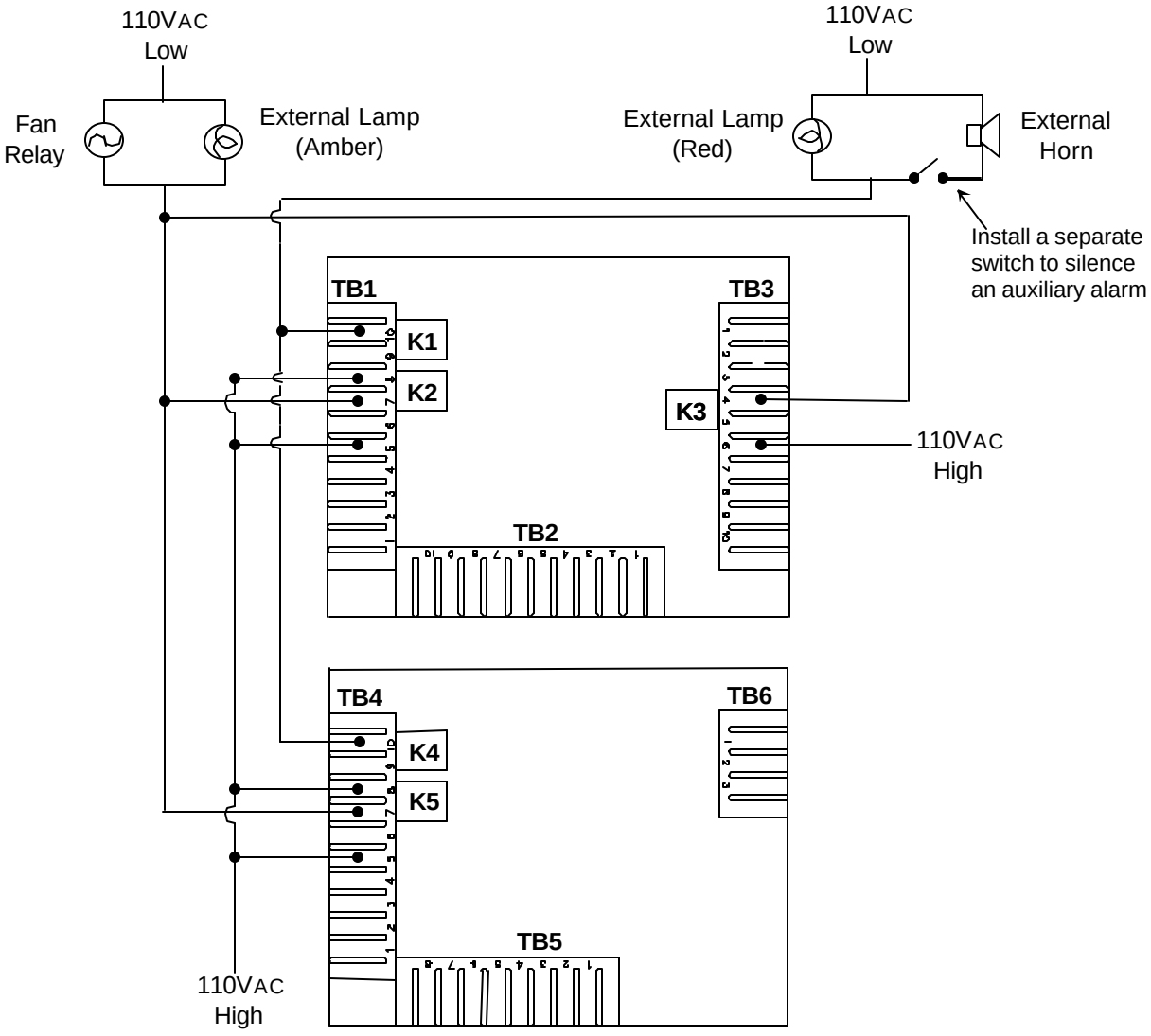
1. The OPERATE switch should be in the HORN OFF position.
2. Insert each set of sensor wires through a conduit; install with a watertight fitting and tighten the fitting by hand. Be sure to leave enough wire inside the enclosure for easy hook-up to terminals. The location of terminals corresponding to each sensor is shown in **Figure** 3, 4 and 7.

Relay Hook-up

See **Figure** 8 for an example of how to use the relay contacts.

Table 5: Relay Function

Relay	Channel	function
K1	1	High Alarm
K2	1	Low Alarm
K3	2	Oxygen
K4	3	High Alarm
K5	3	Low Alarm



CAUTION: Actual wiring will not exit the enclosure at the nearest point. The bottom of the enclosure is the best entrance/exit surface. You must punch holes and use NEMA-4X watertight fittings.

Figure 8: Suggested Relay Hook-Up Configuration

3.4 Sensor Heater Voltage

Heating the sensor promotes the oxidation reaction on the element surface. The temperature to which the sensor element is heated determines the selectivity of the equipment to certain gases. A chart, located inside the instrument front panel, specifies the voltage for each sensor. Refer to **Figures** 3 and 4 for potentiometer locations.

NOTE: Do not increase any sensor voltage to values greater than those given on the chart. Too high voltage can damage the sensor heater winding; and if that happens you have to replace the sensor.

YOU NEED:

- A digital voltmeter with a + or - 0.05% accuracy
- A small screwdriver for adjusting pots.

Measure DC volts across the brown and orange wires in the sensor assembly at the sensor, not at the terminal strip.

EXCEPTION: If your sensor is mounted directly onto the side of the enclosure, then measure DC volts at the terminal strip -- TB1-7 (ground) and TB1-6 (heater).

SENSORS REQUIRING PURGING:

1. Turn the OPERATION switch to PURGE ON and adjust RV38 (purge POT) to the voltage specified on the chart inside the unit.
   NOTE: Adjust this POT clockwise to increase, counterclockwise to decrease the voltage.
2. Turn the OPERATION switch to HORN OFF.
3. Now adjust the sensor heater POT RV32 to the required voltage.
   NOTE: Adjust this POT clockwise to increase, counterclockwise to decrease the voltage.

SENSORS NOT REQUIRING PURGING:

Adjust the sensor heater POT (RV32 see **Figure** 4) 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, RV38, to arrive at the necessary voltage.

NOTE: Once you have set the voltage at the sensor, check and record the voltage across TB1-7 (ground) and TB1-6 (heater). The next time you must check the sensor heater voltage, first check the voltage across TB1-7 and TB1-6. If this voltage has not changed, the sensor heater voltage at the sensor has also not changed. If the voltage across TB1-7 and TB1-6 has changed, you must reset the voltage at the sensor as described in the procedures above.

3.5 Oxygen Cell Adjustment

1. Expose the cell to fresh air for 15 minutes.
2. Adjust the Oxygen Gain Potentiometer (front of enclosure) until the meter reads 20.9% oxygen. This is the normal fresh air concentration. Use a screwdriver to adjust the potentiometer.
3. Turn the HORN back ON.
4. You must adjust the Oxygen cell periodically since atmospheric conditions change. Do this at least every time you run a safety check on your monitoring equipment.

NOTE: Try not to locate the unit in an area where quick temperature changes are likely to occur, like near an outside door. The oxygen cell is sensitive to temperatures, and the circuitry for this cell cannot track rapid changes in temperature. Such a change may cause nuisance alarms, especially for those units calibrated to alarm at a percent near the normal fresh air volume (20.9%). A rapid temperature change is more likely to cause an alarm on a unit calibrated to alarm at 19.5% than one calibrated to alarm at 18.0%.

4.0 Operation

Mount and install the **ISA-44-2-OD** electronics unit and sensors as outlined in the previous **Section**.

NOTE: There is no ON/OFF switch. As a safety device this unit is designed to be powered and ON at all times.

4.1 Warm-Up

1. Turn the switch to PURGE ON (when applicable) or HORN OFF.
2. For 5-30 minutes, after first applying power, the red gas alarm light stays on as the sensor heats and purges (clears) its surface of contaminating molecules that have collected while the sensor was inactive.
3. When the red and amber light turns off, and the green power light comes on, the initial warm-up is complete.
4. Turn the switch to OPERATE.

4.2 Operation Condition

Table 6: Reference, State of Operation of ISA-44-2-OD

Normal operating state	• No alarms • Green light on
Alarm state	• Green light off • Amber light (low level alarm) or • Amber light, Red light and Audio Alarm (high level alarm) • Appropriate relay contacts in alarm position
Sensor fault or disconnected	• Green and red light on together.

Any spontaneous alarm on any channel, not triggered by the initial warm-up or rough test (**Section** 4.4) should be considered a potentially serious gas alarm situation. *TAKE ACTION*. VACate all persons from the affected area. Observe these people for signs of toxic gas poisoning, carbon monoxide poisoning, etc. Open windows or vents where it is feasible; then after the contaminated area is cleared, turn off all gas and electric appliances and gas pilot lights. Check all gas appliances and fixtures for leaking gas, pilot light failures, defective valves, and improper ventilation. Follow your company's prescribed safety procedures in addition to those mentioned above.

4.3.1 Precautions

Do not blow cigarette smoke on a sensor.

Do not squirt pure gases or liquid hydrocarbons, such as butane, propane, gasoline, etc. directly on the sensor.

Do not use a strong cleaning agent, wax or lacquer near a sensor.

4.4 Rough Test

To see that the instrument is capable of alarming, at a quick glance. Do not substitute this procedure for regular calibration with proper equipment.

For hydrocarbon (combustible) responses:
Hold a butane lighter near the sensor cover. Briefly depress the lever, without striking the flint, to squirt some butane vapors. Do not squirt butane vapors directly on the sensor. The alarm should trigger; green power light goes off and the red light and horn activate.

OR

Expose a small amount of rubbing alcohol (methanol) to the atmosphere near the sensor. Waving the cap from an alcohol bottle should be enough. The alarm should trigger.

For toxic gas response:
Follow the methanol test above.

For oxygen deficiency responses:
Exhale normally over the oxygen cell. The clean air you inhale is about 20.9% oxygen and the air you exhale is about 16% oxygen, well below the preset alarm point. The alarm should trigger.

5.0 Maintenance

The **ISA-44-2-OD** hazardous gas and oxygen deficiency monitor is a safety instrument and requires periodic testing and recalibration at regular intervals. Also, check for obvious mechanical damage or malfunctions such as burned out lamps.

Purge the sensor periodically. This interval varies with the amount of contaminants in the atmosphere.

5.1 Routine Gas Test

Perform this test at regular intervals. You decide how often; we recommend that you perform this test at least once every six weeks.

NOTE: The gases should be identical, or equivalent (correlation gas) to those used to initially calibrate the unit, unless you want to recalibrate to a new gas or different concentration. In addition, calibration gases must be in a background of air; do not use gases with an inert gas background (such as nitrogen or argon).

Test

YOU NEED:

- Cylinder of high-level calibration gas with air used as background gas (for example 200 ppm CO in air)
- Calibration fixture (with humidifier/regulator, plastic tubing and calibration cup); ***ENMET*** part # 03700-001
- Clean water
- Small screwdriver

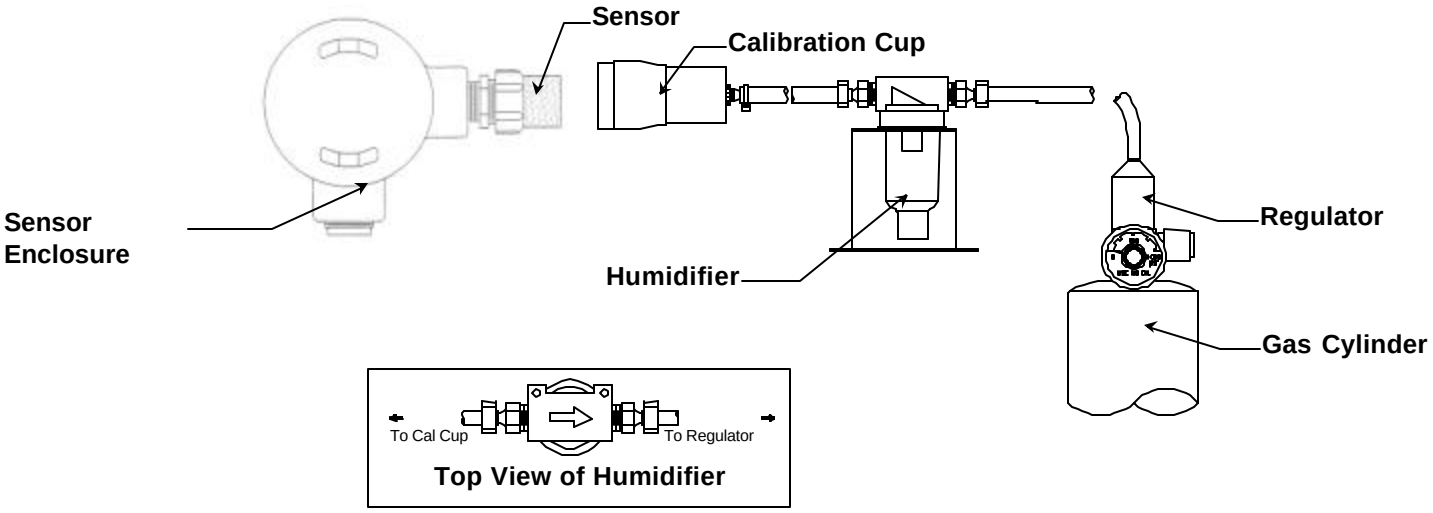


Figure 9: Exposing a Sensor to Test or Calibration Gas

PROCEDURE:

1. The unit must operate continuously for at least 24 hours before this test.
2. After 24 hours, turn the HORN OFF.
3. On units requiring purging, rotate switch to PURGE ON, purge for 20 minutes. After the purge, rotate switch to HORN OFF, wait 20 minutes for the sensor to stabilize.
4. Fill the humidifier bottle with tap water about half-way.
5. Attach the calibration fixture to the high-level gas cylinder. Set humidifier upright on a level surface.
6. Open the valve to allow a steady stream of gas to bubble through the water.

7. Put the cal cup of the calibration fixture over the sensor. Let the gas flow over the sensor until the alarm triggers. Use **Table** 6 for the approximate allowable time period until alarm:

Table 7: Approximate Alarm Time

Gas or Vapor	Time to Alarm
20 ppm CO	5 - 7 minutes
50 ppm CO	5 minutes
200 ppm CO	2 minutes
10% LEL methane	1 minute
20% LEL methane	1 minute
100 ppm vinyl chloride	1 - 2 minutes
typical hydrocarbon vapors	1 - 2 minutes
20% LEL propane	1 minute

8. After you verify the alarm response, turn the gas off and remove the calibration fixture from the gas cylinder.

9. Turn the switch back to OPERATE.

CAUTION: If steps 1 - 10 do not trigger the alarms, and no electrical or mechanical malfunction is apparent, you must recalibrate the instrument.

5.2 Calibration

5.2.1 Toxic Gas Channel # 1

The following procedure is for checking the calibration level and for recalibrating the Carbon Monoxide(CO) Channel of the **ISA-44RAL-OD**. Refer to **Figure** 2 and 4.

Perform A Complete Recalibration Periodically (at least monthly) and:

- When you replace the sensor.
- When the sensor encounters severe conditions (i.e., gross exposure to smoke or liquid hydrocarbon).

MATERIALS

- Cylinders of calibration gas of known CO concentration in air (i.e. 20 ppm and 50 ppm CO in air.). **DO NOT** use CO in an inert carrier gas, such as nitrogen or argon.
- Calibration gas fixture (with quick-disconnect fitting – ***ENMET*** part number 03605-001)
- Small screwdriver (for potentiometer adjustment)
- dc voltmeter

PROCEDURE

1. Turn operation switch to HORN OFF. Be sure humidifier bottle is filled with tap water to Water Level mark.
2. Turn operation switch to PURGE ON. Measure purge voltage across TB-6(+) and TB2-7(-). It should be 1.6 VDC +/- .03 VDC. If not 1.6 VDC +/- .03 VDC, adjust Purge Adjust Potentiometer (see **Figure** 4) until desired reading is shown. Turn operation switch to HORN OFF and measure sensor heater voltage across TB2-6 and TB2-7. It should now read 0.86 VDC +/- .03 VDC. If it is not 0.86 VDC +/- .03 VDC, adjust Heater Adjust Potentiometer (see **Figure** 4) until desired reading is shown.
3. Turn operation switch back to PURGE ON. Purge at least one hour, up to overnight.

REMEMBER: If you suspect contaminated air in your compressor system, use clean bottled air to supply the sensors with a continuous airflow.

4. After purging, turn operation switch to OPERATE. Allow 30 minutes to stabilize.
5. Remove the compressed air line and insert the calibration apparatus (see **Figure** x).
6. Turn operation switch to HORN OFF. Open the regulator on the top of the high-level calibration gas cylinder. This brings the gas into the sampling assembly.
7. Regulate the flow of calibration gas according to the "...SET" mark or between 7 – 12 PSI on the pressure regulator dial.
8. Let the high-level calibration gas flow into the system for 5 minutes. This assures a full and balanced response from the sensor. During this time, the meter should have risen above the low-level alarm point and the amber light should have gone on.
9. With the gas still flowing, adjust the Meter Adjust Potentiometer with a small screwdriver (adjust this pot CCW to increase, CW to decrease meter reading). You want to have the same meter reading as the calibration gas concentration. This sets the alarm point. Refer to **Figure** 4.

Note: Do not adjust for instantaneous alarm when test gas is first released. If you do, the calibration will be inaccurate, and the sensor will be overly sensitive.

10. Adjust the High Level Alarm Set Adjust Potentiometer CCW until the red alarm light is just barely triggered. At this point, verify the audio alarm is operational by turning the operation switch to OPERATE momentarily.

NOTE: If red alarm light is on prior to the potentiometer adjustment, adjust this POT CW until the light deactivates, then readjust CCW until the light just barely activates.

11. Shut off the calibration gas flow (at the regulator on the gas cylinder).
12. Allow pressure to equalize – wait until the pressure meter on the humidifier-regulator assembly reads zero. Remove calibration fixture, and reconnect humidifier-regulator assembly to compressed air line. Allow air to flow over sensor for 10 minutes to clear the sensor.
13. In a similar manner, apply the low level calibration gas for five minutes
14. While the gas is still flowing, adjust the Low Alarm Set Adjust potentiometer CCW until the amber alarm light just activates.

NOTE: If amber light is on prior to POT adjustment, adjust this POT CW until light is off, then readjust CCW until light just activates.

IMPORTANT: The meter may not display the exact low level alarm.

DO NOT change the low level alarm meter reading unless grossly off (four meter needle widths or more). If far off, recalibrate the high alarm, meter reading (step 9).

15. Repeat step 11.

16. Repeat step 12.

17. Reconnect the sample head to the air line.

18. The flow of clean air should clear the unit from its gas alarm state within 3-5 minutes. After 5 minutes, turn the operation switch to OPERATE.

19. Clean compressed air lines will show a meter reading from 0 – 1/3 full scale. Green power light will indicate a clean condition.

20. Carbon Monoxide Detection Channel Calibration is complete.

Verify the operation switch is in the OPERATE position.

5.2.2 Oxygen Channel # 2

This procedure is given in reference to an S-2 cell, which is ***ENMET*** P/N 67013-008 as furnished as a replacement cell.

MATERIALS

- digital voltmeter
- small screwdriver

PROCEDURE

1. Turn OPERATION switch to HORN OFF position.
2. Null Adjust
   a. Disconnect the oxygen cell from the circuit by disconnecting leads at TB3-8 (+) (terminal block 3-position 8) and/or TB3-9 (-). Removing one lead is sufficient to break the circuit. See **Figure** 3.
   b. Connect negative (-) voltmeter lead to TP-1 (test point one) and positive (+) voltmeter lead to TP-2 in the oxygen circuit. These are in the lower right hand corner of the printed circuit board.
   c. Adjust the Null Adjust potentiometer to read 0.00 VDC between TP-1 and TP-2.
3. Low Level Set:
   a. Reconnect the oxygen cell to TB3-9(-) and TB3-8(+).
   b. Make sure the oxygen cell is properly connected by measuring the voltage between TB3-9 and TB3-8. Voltage should read between .043 and .09 VDC. Allow oxygen cell to stabilize for 15 minutes.
   c. Connect negative lead of voltmeter to TP-1 and positive lead to TP-3 in the oxygen circuit.
   d. Adjust the Low Level Set potentiometer to read .766 VDC.
4. Full Scale Adjust:
   a. Leave negative lead of voltmeter at TP-1 and connect positive lead of voltmeter to TP-2 in oxygen circuit.
   b. Adjust oxygen gain potentiometer (on front panel of unit) so the voltmeter reads 1.24 VDC.
   c. Adjust Meter Full Scale Adjust potentiometer on circuit board so the meter on the front panel reads full scale (26%). Adjust this potentiometer cw to increase, ccw to decrease meter reading.
   d. Verify that the oxygen alarm comes on at the predetermined alarm point (19.5%) on the meter. If it does not, repeat steps a. and b. in this Section. If the oxygen alarm still does not come on, repeat the entire recalibration procedure checking terminal connections, testpoints and voltage settings very carefully. Contact your local Authorized ***ENMET*** Service Center if problems persist.
   e. Adjust and leave the oxygen gain potentiometer at a meter reading of 20.9% (setpoint).
5. The oxygen cell calibration is now complete. Turn the operation switch to OPERATE.

5.2.3 Combustible Gas Channel # 3

1. Wait 8 - 10 minutes for the sensor to recover from the test.
2. Repeat steps 3 - 7 as outlined in the test procedure above using the high level calibration gas.
3. With the gas still flowing, adjust the Meter Adjust potentiometer (Ref. **Figure** 4) R33; ccw to increase, cw to decrease meter reading) with a small screwdriver.
   - You want to have the meter pass through the low level alarm point, to verify that the alarm light triggers.
   - If it does not, set the meter to the low alarm point and adjust R35 (low level alarm POT).
   - Then adjust the meter gain POT to pass through the high alarm point, verify that the alarm light triggers at the high alarm point.
   - If it does not, set the meter gain to the high alarm point adjust R34 to trigger the alarm light.
   - Turn the switch to OPERATE for a second to verify the horn is operational. This sets the alarm points.

CAUTION: *DO NOT* adjust for instantaneous alarm when test gas is first released. If you do, the calibration is inaccurate, and the sensor is overly sensitive.

4. Shut off the calibration gas flow at the valve on the gas cylinder.
5. Remove the calibration gas, the flow of clean air should clear the unit from its gas alarm state in less than one minute. After the alarms have cleared, turn the switch to OPERATE.

CAUTION: Do not use calibration gas with inert gases such as argon or nitrogen as a background. The background gas must be "air" or equivalent.

CAUTION: Do not totally dry gases directly from high-pressure cylinders.

5.3 Replacement of Sensors

Gas Sensors

The MOS sensor is durable, it can be purged of contaminants by operating in PURGE for a sufficient length of time and at regular intervals.

Gross contamination usually occurs during unavoidable misuse. Close exposure to an open gas flame, dipping the sensor in a hydrocarbon such as lacquer, or continuous exposure to heavy concentrations of industrial vapors will grossly contaminate a sensor. A grossly contaminated sensor causes a continuous alarm.

If a sensor is bad, replace it.

PROCEDURE:

1. Obtain a new sensor assembly. Make sure the sensor type is identical to your original sensor (019, 030, 812, 813 or 109).
2. Disconnect the orange, brown and blue sensor wires.
3. Unscrew the assembly from the sensor enclosure.
4. Replace the bad sensor and reconnect the wires.
5. Set the sensor heater voltage (See **Section** 3.4).
6. Recalibrate the instrument (See **Section** 5.2).

Oxygen Cell

Replace the cell when you can no longer adjust the Oxygen Gain potentiometer to a meter reading of 21%. At this point, the expired fuel cell will cause the oxygen circuit (channel 2) to be in constant alarm.

1. Obtain a new S-2 oxygen cell, ***ENMET*** P/N 67013-008 as furnished as a replacement cell.
2. Remove the four large screws from the top of the cell enclosure.
3. Remove the two smaller screws that hold the cell board to the inside of the box cover (**Figure** 6). Remove the circuit board and cell.
4. Unplug the old cell. Pull firmly, do not twist.

NOTE: If your unit is an older model, there may not be a circuit board for the oxygen cell in the sensor enclosure. In such a case you will have to carefully unsolder the wires from pins on the old cell and resolder the wires to the new cell (orange to outside pin; green to center pin).

5. Carefully remove the metal shorting clip from the new oxygen cell. Then plug the new cell into the side of the board with the thermistor and resistor, (enter pin of center hold; see **Figure** 6.
6. Replace screws to secure the cell in the enclosure cover.

CAUTION: Do not over tighten the screws; over tightening could cause damage to the oxygen cell.

7. Replace the cover.
8. Wait at least four hours for the cell to stabilize. The cell needs to adjust to oxygen, since it has been packaged in nitrogen.
9. After at least four hours, adjust the Oxygen Gain so the meter reads 20.9%.
10. Verify the alarm point by exhaling over the cell (for about five seconds). The alarm should trigger at the preset level.
11. If you replace the oxygen cell and cannot adjust it to the proper alarm threshold, open the circuit board enclosure and check voltages and make potentiometer adjustments as outlined in **Section** 5.2.2, to recalibrate the oxygen circuit.

5.4 Trouble Shooting

Symptom	Problem/Correction
When first plugged in, the unit alarms for up to 10 - 20 minutes.	If the unit has not been used recently, this is normal. The MOS sensor is cold and/or contaminated. Keep unit ON or PURGE (on units so equipped) overnight with the sensor in fresh air.
Red alarm light stays on continuously, even after allowed to operate (or PURGED) overnight.	Either hazardous gas conditions exist, or there is a contaminated sensor, or a bad circuit. Contact ***ENMET*** for voltage checks.
Oxygen channel is in constant alarm (amber light and horn are on).	Probably a dead fuel cell; replace (see Section 5.3). It can also be a grossly contaminated fuel cell; replace also.
Either green or amber or red lights do not work.	There might be a burned out lamp.
Unit fails to alarm when calibration gas is applied.	Recalibration may be necessary. See section 6.0 If recalibration fails, check sensor voltage, cylinder contents and pressure.
Unit gradually creeps into alarm or sensitive.	Either hazardous gas conditions exist, or too recalibration is necessary. On units requiring purging, rotate to PURGE once a week for one hour to clean sensor surface.
Unit does not operate.	Check the fuse next to TB-6. If the fuse element in the glass tube is cracked or broken, replace it (p/n 64004-001). If this does not correct the problem, contact ***ENMET***

6.0 Replacement Part Numbers

ENMET replacement part numbers:

Description	Part Number
Explosionproof Sensor	03033-109
Explosionproof Sensor	03033-812
Explosionproof Sensor	03033-813
Replacement Oxygen Cell	67013-008
Replacement lens, Red ½″	62012-011
Replacement lens, Green ½″	62012-012
Replacement lens, Amber ½″	62012-013
Replacement Lamp ½″	63001-002
Replacement lens, Red 1″	62012-001
Replacement lens, Green 1″	62012-002
Replacement lens, Amber 1″	62012-003
Replacement, LED Red 1″	52006-003
Replacement, LED Green 1″	52006-001
Replacement, LED Amber 1″	52006-002
Replacement Oxygen Cell, PCB	03258-012
Cylinder of Calibration Gas	Contact ***ENMET*** for part number of target gas for each instrument. See note below.

NOTE: The gases should be identical, or equivalent (correlation gas) to those used to initially calibrate the unit, unless you want to recalibrate to a new gas or different concentration. In addition, calibration gases must be in a background of air; do not use gases with an inert gas background (such as nitrogen or argon).

7.0 Specifications

These are general characteristics; actual specifications will vary according to custom-built features, boxes, etc.

Power	• 115 +/- 10% VAC single phase • 220 VAC single phase, 50-60 Hz, 40 watts • 12 VDC, 40 watts
Relay Current	5 amps, non-inductive surge, 2 amps steady
Sensor Life	Up to 3 years in fresh air
Oxygen	Average 14 months, 6 month warranty
Electronics	Low power, all solid-state with integrated circuits.
Audio Alarm	2900 Hz, 95 dB at 21 feet
Enclosure	NEMA-4X box, watertight, oiltight, corrosion proof (optional NEMA-12 steel or stainless steel box).
Size	18" tall x 14.5" wide x 8" deep
Weight	48 lbs. (including cables, sensor housing, horn, etc.).

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

8.0 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.

There are Return for Repair Instructions and Form on the last pages of this manual. This Form can be copied or used as needed.

Notes:

PO Box 979
680 Fairfield Court
Ann Arbor, Michigan 48106-0979
734.761.1270 Fax 734.761.3220

Returning an Instrument for Repair

ENMET instruments may be returned to the factory or any one of our Field Service Centers for regular repair service or calibration. The ***ENMET*** Repair Department and Field Service Centers also perform warranty service work.

When returning an instrument to the factory or service center for service, paperwork must be included which contains the following information:

- A purchase order number or reference number.
- A contact name with return address, telephone and fax numbers
- Specific instructions regarding desired service or description of the problems being encountered.
- Date of original purchase and copy of packing slip or invoice for warranty consideration.
- If a price estimate is required, please note it accordingly *and be sure to include a* ***fax number***.

Providing the above information assists in the expedient repair and return of your unit.

Failure to provide this information can result in processing delays.

ENMET charges a one hour minimum billing for all approved repairs with additional time billed to the closest tenth of an hour. All instruments sent to ***ENMET*** are subject to a minimum $30 evaluation fee, even if returned unrepaired. Unclaimed instruments that ***ENMET*** has received without appropriate paperwork or attempts to advise repair costs that have been unanswered, after a period of 60 days, may be disposed of or returned unrepaired COD with the evaluation fee.
Service centers may have different rates or terms. Be sure to contact them for this information.

Repaired instruments are returned by UPS/FedEx Ground and are <u>not insured</u> unless otherwise specified. If expedited shipping methods or insurance is required, it must be stated in your paperwork.

Note: Warranty of customer installed components.

If a component is purchased and installed in the field, and fails within the warranty term, it can be returned to ***ENMET*** and will be replaced, free of charge, per ***ENMET***'s returned goods procedure.

If the entire instrument is returned to ***ENMET*** Corporation with the defective item installed, the item will be replaced at no cost, but the instrument will be subject to labor charges at half of the standard rate.

Repair Return Form

Mailing Address:
***ENMET* Corporation**
PO Box 979
Ann Arbor, Michigan 48106

Shipping Address:
***ENMET* Corporation**
Attn: Repair Department
680 Fairfield Court
Ann Arbor, Michigan 48108

Phone Number: **734.761.1270**
FAX Number: **734.761.3220**

Your Mailing Address:

_____

_____

_____

_____

Your Shipping Address:

_____

_____

_____

_____

Contact Name: _____ **Your Phone:** _____

Your PO/Reference Number: _____ **Your FAX:** _____

Payment Terms: ❑ ***COD***
(Check one) ❑ ***VISA / MasterCard***_____ _____
Card number Expiration

Return Shipping Method:

❑ UPS: ❑ Ground ❑ 3 Day Select ❑ Next Day Air ❑ ND Air Saver ❑ 2-Day Air

❑ Federal Express: ❑ Ground ❑ Express Saver ❑ P-1 ❑ Standard ❑ 2-Day Air

❑ FedEx Account number: _____

Would you like *ENMET* to insure the return shipment?

❑ No ❑ Yes **Insurance Amount:** $_____