

ENMET Corporation
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ISA-40M Oxygen Monitor
For MRI Scanner Applications
For P/N's

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|------------------|------------------|
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| 04615-002 | 04615-102 |
| 04615-003 | 04615-103 |
| 04615-004 | 04615-104 |

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1.0 Introduction

The **ISA-40M** system is designed to monitor the oxygen content of atmospheres in the vicinity of MRI (Nuclear Magnetic Resonance) equipment. Air contains 20.9% oxygen by volume; if oxygen in the air is displaced by a liquid cryogen (such as nitrogen) leak in MRI equipment, the oxygen deficient atmosphere could become hazardous to human life. To minimize the effects of magnetic fields generated by MRI equipment, LED's and brass hardware are used in the **ISA-40M**.

The **ISA-40M** system employs galvanic micro-fuel cells as oxygen detection transducers. The output current of each cell increases or decreases according to the partial pressure of oxygen in the surrounding air, which corresponds to the oxygen content. The system monitors the oxygen content continuously, and if the oxygen content at any sensor location drops to the alarm point (usually 18.0% by volume), the instrument provides audio and visual alarms at the control unit. An audio alarm also occurs at the sensor location. Internal relay contacts can be used to activate additional alarm signals and/or external equipment. Oxygen content from 16% to 26% by volume is constantly displayed by meters on the control unit. The **ISA-40M** system is an alarm device which minimizes the risk of harm or death to personnel by warning them of a hazardous oxygen deficient atmosphere with enough time for them to take action.

An **ISA-40M** system consists of a number of identical channels of oxygen deficiency detection. Each circuit cell combination makes up a separate channel. **ISA-40M-2** has two identical circuits with related oxygen cells; likewise, an **ISA-40M-4** has four channels. If the cell is enclosed in a remote sensor, each cell can be located in a separate area up to 1000 feet from the instrument enclosure. The cells are connected to the control unit electrically by wire or cable. Each plug-in circuit board contains the circuitry for two channels. **ISA-40M** instruments described in this manual can contain up to 4 channels. This particular manual is for the **ISA-40M-1** through the **ISA-40M-4**.

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

1.1 Unpack

Unpack the **ISA-40M** 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-40M** is received as ordered. If there are accessories on the order, verify 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-40M** is serialized. These numbers are on tags on the equipment and are on record in an **ENMET** database.

2.0 Features

See figure 1 for location of features

| Feature | Description |
|--------------------|---|
| Meter | A Oxygen (O2) concentration meter. The scale is marked in percent by volume O2. |
| Audio Alarm(Horn) | Audio alarm (2900 Hz ,95 dB at 2 ft.). The audio alarm is on when the unit is in alarm. |
| Gain Potentiometer | |
| Visual Alarms | LED, Red: Visual alarm (steady light). When this LED is on, power to the unit is on and the unit is in high alarm. LED, Green: When this is on, the unit is operating and is not in alarm. When this LED is off, the unit is in alarm OR power to the unit has been interrupted. |
| Relay Reset Button | |

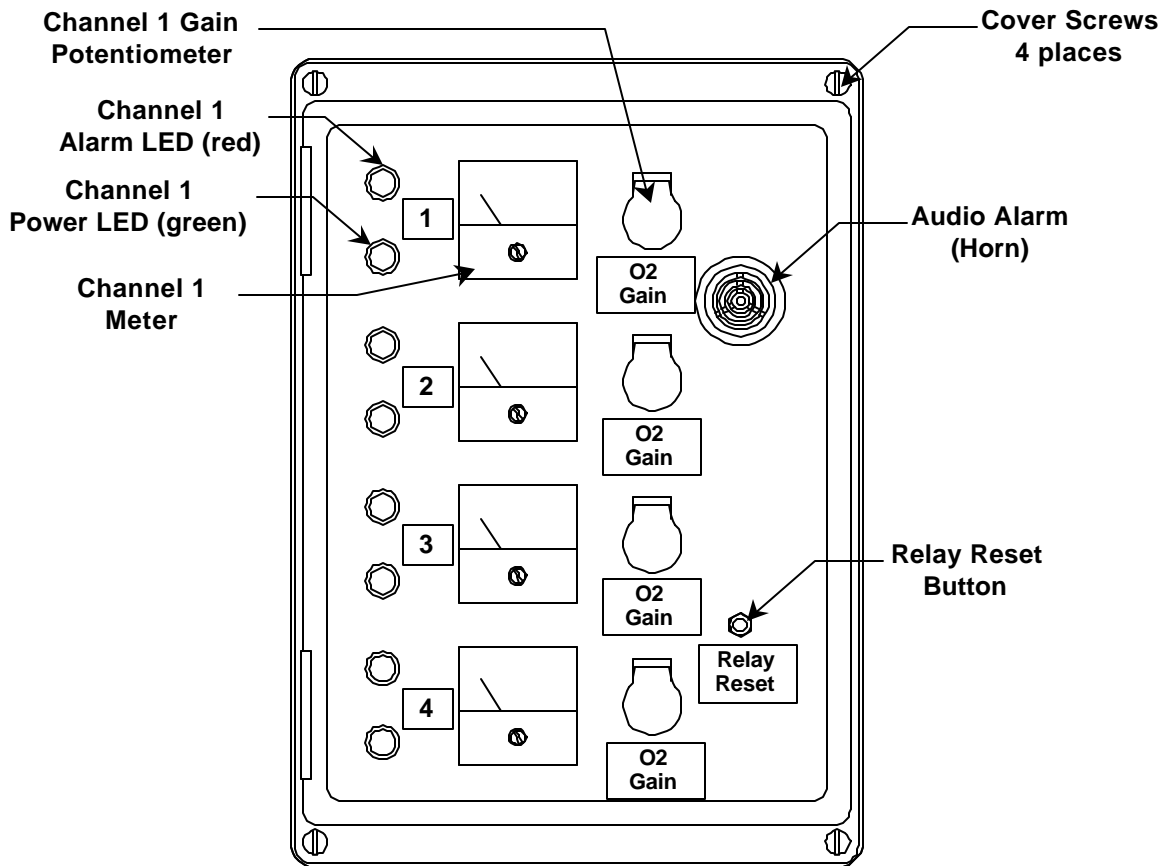


Figure 1: ISA-40M Control Unit Exterior

3.0 Installation

WARNING: This equipment is not for use in hazardous combustible atmospheres as defined by the national electrical code. Use in such atmospheres may result in property damage, injury or death

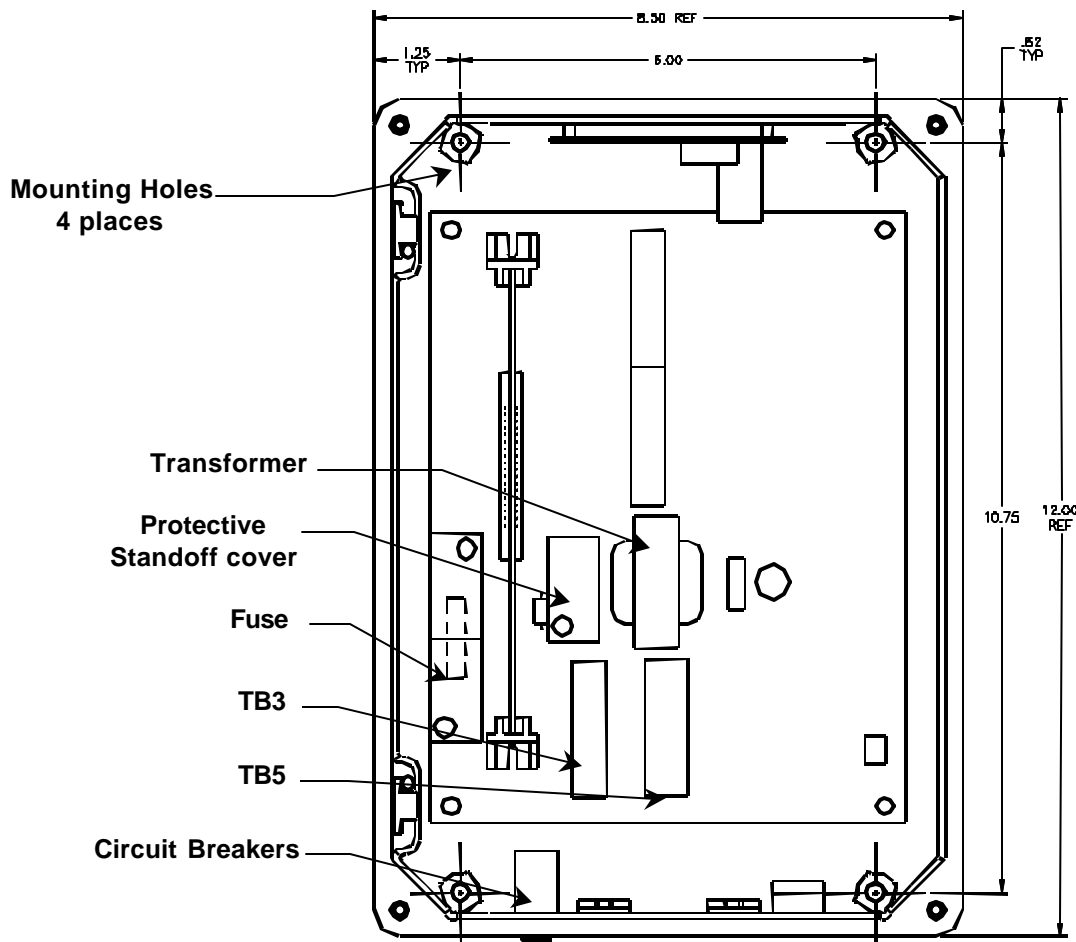


Figure 2: Mounting Dimensions

3.1 Control Unit Mounting and Power Hook-up

Use an appropriate fitting for conduit when supplying power to the unit.

1. Choose a suitable location for mounting the electronics control unit. See Figure 2 for mounting dimensions. NOTE: All dimensions are given in inches.
2. Apply 110 VAC and/or 12 VDC power to the appropriate terminals on TB5 and TB3. Refer to the Wiring Information table. Both 110 VAC and 12 VDC power can be applied together; the 12 VDC is standby power source; DC current will flow only when the AC power is interrupted.

Table 1: Power Supply Wiring

| Power supply | ISA-40M Control Unit connection |
|-----------------|---------------------------------|
| 110 VAC HOT | TB5 HOT |
| 110 VAC NEUTRAL | TB5 NEUT |
| AC ground | TB5 GND |
| 12 VDC | TB3-3 + VDC |
| DC ground | TB3-1 or TB3-2 |

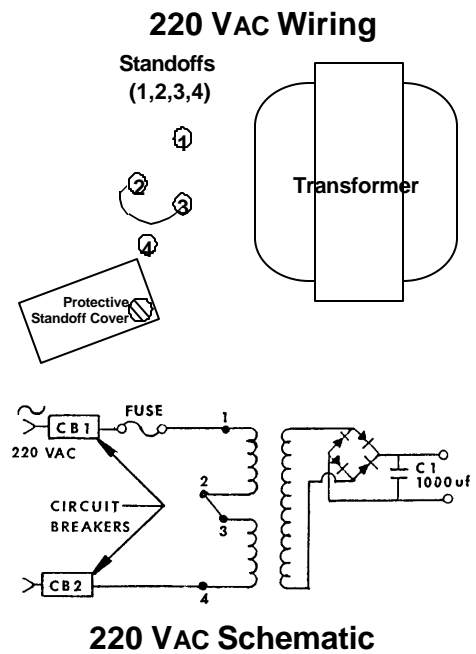
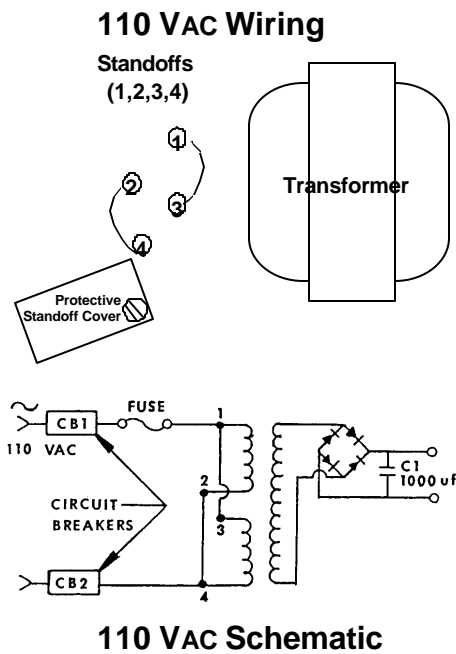
3.1.1 Converting to 220 Vac Power

The input of the transformer must be changed in order to accommodate 220 VAC power. This is accomplished by changing the wiring between four standoffs located under a protective cover next to the transformer, shown in Figure 1. The wiring configurations and the power supply schematics are shown in Figure 5.

To change power supply wiring of transformer from 110 VAC to 220 VAC, resolder the transformer standoff leads to the appropriate configuration shown below. The materials required for this are a flathead screwdriver a soldering iron, 18 gauge (or larger) insulated wire and 60% tin/40% lead resin sore solder.

CAUTION: This procedure should be performed only by personnel with electrical repair experience.

1. Disconnect power from control unit.
2. Remove instrument circuit board to access transformer standoffs on motherboard.
3. Unscrew the cover-retaining screw and rotate protective standoff cover until standoffs are exposed.
4. Unsolder one lead at a time and then resolder to desired configuration (shown below).
5. Wipe up and remove excess solder.
6. Rotate protective cover over standoffs and tighten screws and replace circuit board.



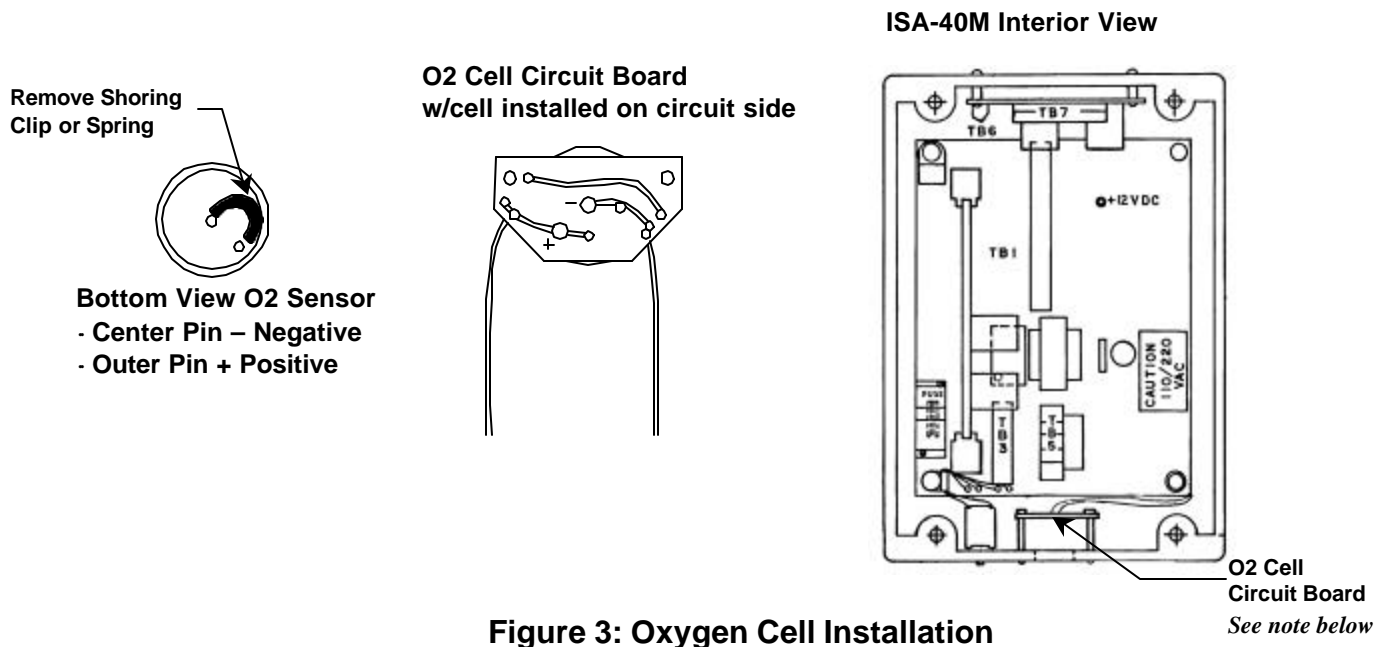


Figure 3: Oxygen Cell Installation

3.2 Oxygen Cell Installation

WARNING: *The transducer cell must be installed and the oxygen monitor must be operational prior to using cryogen with the MRI equipment magnet. If the monitor is not operational, there is a risk of asphyxiation should a leak occur.*

3.2.1 Oxygen Cell Installation Inside of Control Unit

The oxygen detection transducer cell is mounted inside the unit. The cell is packaged in a nitrogen filled plastic bag to prevent depletion of useful life before installation. Do not open or puncture the bag before installation to insure best performance of cell.

1. Remove 4 cover screws to open the control unit and remove screws to remove cell circuit board. See Figure 1 & 3.
2. Carefully remove the cell from the package.
3. Remove the metal shorting clip (or spring) from cell pins. See Figure 3.
4. Plug the cell into the component side of the cell circuit board; center pin to center hole. See Figure 3. Place the board in the enclosure and replace the screws to secure the cell and circuit board.
5. Wait at least four hours for the cell to stabilize before setting the gain. The cell needs time to adjust to oxygen in air, since it has been packaged in pure nitrogen.
6. The life expectancy of oxygen cells is about 14 months; warranty is six months. Remove the cell serial number tag from the plastic bag, and stick it to the inside of the enclosure. In case of cell warranty problems, refer to this serial number.

NOTE: If all channels are used with remote sensor assembly, remove the O2 Cell Circuit Board from the interior of the **ISA-40M**. Reference Table 2 channel 1.

3.2.2 Remote Sensor Assembly Wiring

See Figure 4 for location of terminal blocks.

Table 2: Remote Sensor Assembly Wiring

| Channel | Signal | Control Unit Connection | Sensor Connection |
|---------|-----------------|-------------------------|-------------------|
| 1 | Oxygen Cell (-) | TB1 - 1 O2 - | TBS - 3 |
| 1 | Oxygen Cell (+) | TB1 - 1 O2 + | TBS - 4 |
| 2 | Oxygen Cell (-) | TB1 - 2 O2 - | TBS - 3 |
| 2 | Oxygen Cell (+) | TB1 - 2 O2 + | TBS - 4 |
| 3 | Oxygen Cell (-) | TB2 - 3 O2 - | TBS - 3 |
| 3 | Oxygen Cell (+) | TB2 - 3 O2 + | TBS - 4 |
| 4 | Oxygen Cell (-) | TB2 - 4 O2 - | TBS - 3 |
| 4 | Oxygen Cell (+) | TB2 - 4 O2 + | TBS - 4 |

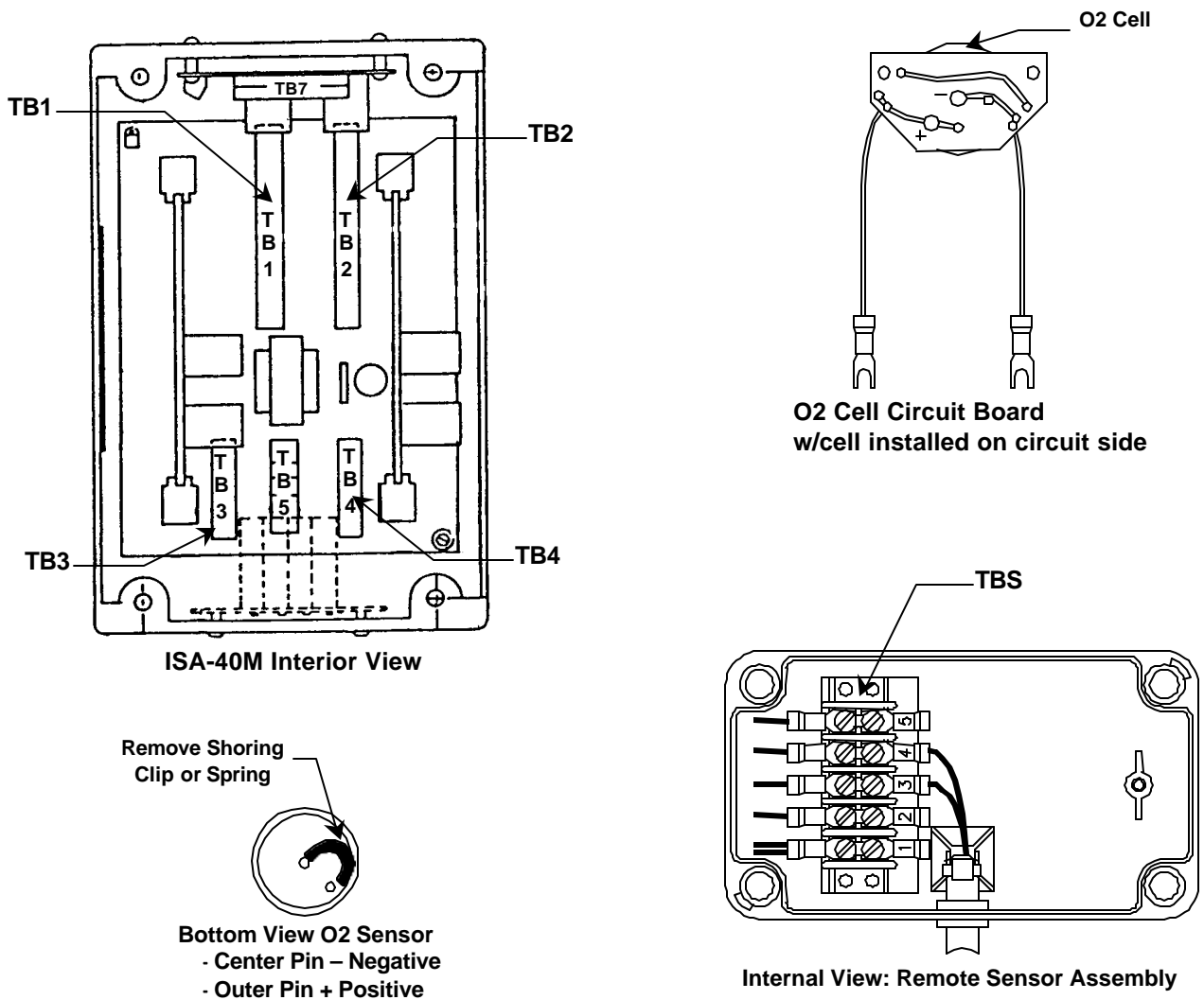


Figure 4: Interior View of Sensor Assembly

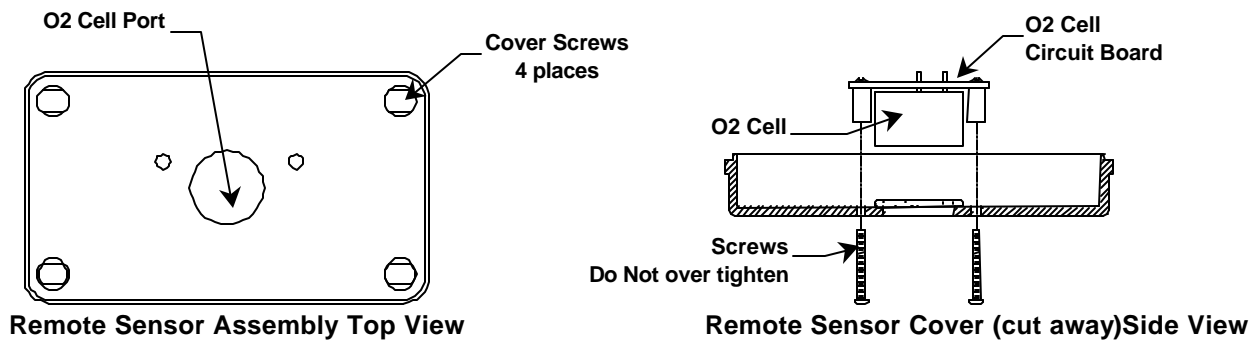


Figure 5: Remote Sensor Oxygen Cell Installation (Optional)

3.2.2 Oxygen Cell Installation for Remote Sensors

For some **ISA-40M** systems, single channel systems, and all multichannel systems, remote sensors are connected to the control unit via wiring. To connect these assemblies to the control unit, see the Wiring Information table on the previous pages. The transducer cells are each packaged in a nitrogen filled plastic bag to prevent depletion of useful life before installation.

1. Open the control unit by removing the four screws on the display face corners. See Figure 1
2. Choose an appropriate location for mounting the oxygen sensor assembly. Remember that the sensor should be situated so that oxygen deficient air reaches the sensor before such air affects persons in the area.
3. Mount the assembly. There are 4 holes in the assembly enclosure used for mounting.
4. Supply shielded sensor wiring from the control unit to the remote sensor.
 - 2 insulated conductors, 18 gauge wire or larger.
 - If cable is run through screen room walls, supply appropriate RF filters.
 - Connect wire to terminals indicated in Table 2, remote sensor assembly wiring.
5. Remove screws in sensor assembly to remove oxygen cell mounting and cell circuit board. See Figure 5.
6. Carefully remove the cell from the package.
7. Remove the metal shorting clip(or spring) from the cell. See Figure 4.
8. Plug the cell into the component side of the cell circuit board in the oxygen sensor assembly; insert the center pin of the cell into the center hole of the circuit board. Place the cell in position in the top of the assembly enclosure and replace the screws to secure the cell in place.

CAUTION: Do not tighten screws too much; doing so can damage the components on the cell circuit board.

9. Wait at least 4 hours for the cell to stabilize; it must adjust to its new environment since it was packaged in pure nitrogen.
10. Remove the cell serial number tag from the plastic oxygen cell package and retain. This is a warranty record (up to six months from date of shipment from **ENMET**).

3.2.3 Oxygen Gain Adjustment

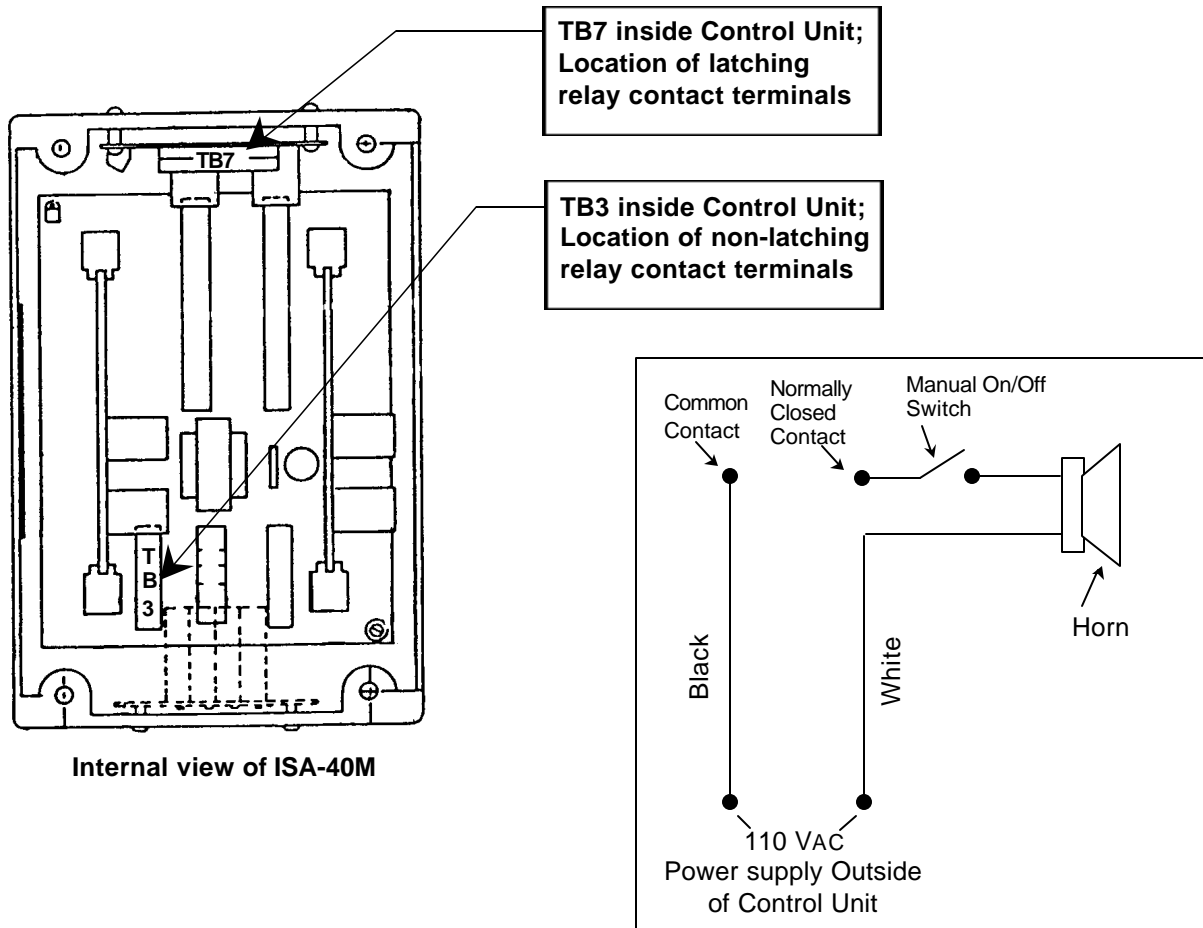
1. Four hours or more after installing the oxygen cell, use a screwdriver to turn the oxygen gain adjust, on the front of the control unit enclosure. Turn it clockwise (increase) and counterclockwise (decrease) to see that the alarm goes on and off as the meter needle passes the alarm level.
2. Expose each oxygen cell to fresh air for 5 minutes. Use cylinders of 20.9% oxygen in nitrogen if necessary to guarantee oxygen content. See section 8.2.
3. After 5 minutes of clean air, adjust the oxygen gain so the meter reads 20.9%.

3.2.4 Circuit board Removal

The plug in circuit board assemblies cannot be plugged in backward because of a polarizing key in the edge connector. It is not good practice to remove and replace the circuit card assemblies while power is applied to the unit.

3.3 Relay Outputs

Relay contacts can be used to activate other alarm signals or equipment away from the control unit enclosure when there is an alarm condition and when the AC or DC power is interrupted. The contacts supplied are dry, with a rating of 2 Amp continuous, 5 Amp surge. Do not overload the **ISA-40M** power supply by connecting it through the relay contacts to an inappropriate load. See Wiring Information Tables 3 & 4 and Sections 3.3.1 and 3.3.2 and the Figure 6 Utilizing Relay Contacts.



Suggested wiring configuration for utilizing relay contacts (manual on/off switch is suggested; user supplied component)

Figure 6: Utilizing the Relay contacts

3.3.1 Non-Latching Relays

There is one non-latching, single pole relay per channel. These relays furnish normally open, normally closed, and common terminals, which are available on TB3 and TB4; refer to the motherboard drawing. These relays are fail-safe; the power off position and the alarm position of the contacts are identical. Contact positions are given for the power off, alarm condition.

Table 3: Non-Latching Relay Wiring
Non-powered, alarm positions are given

| Channel | Terminal Position | Contact |
|---------|-------------------|-----------------|
| 1 | TB3 – 1NC | Normally closed |
| 1 | TB3 – 1NO | Normally open |
| 1 | TB3 – 1COM | Common |
| 2 | TB3 – 2NC | Normally closed |
| 2 | TB3 – 2NO | Normally open |
| 2 | TB3 – 2COM | Common |
| 3 | TB4 – 3NC | Normally closed |
| 3 | TB4 – 3NO | Normally open |
| 3 | TB4 – 3COM | Common |
| 4 | TB4 – 4NC | Normally closed |
| 4 | TB4 – 4NO | Normally open |
| 4 | TB4 – 4COM | Common |

3.3.2 Latching Relays

Latching relays are available on TB7, the terminal strip located on the auxiliary relay circuit assembly located on the upper surface of the control unit enclosure. These relays, once triggered by an alarm condition, remain latched in the alarm position until released by an operator, who activates the relay release pushbutton switch on the front of the enclosure. This switch releases all latched relays together. These relays are not failsafe; the power off position of the contacts is opposite from the latched alarm position. The contact positions given are for the power off, non-alarm condition

Table 4: Latching Relay Wiring
Contacts are in non-powered, non-alarm position

| Channel | Terminal Position | Contact |
|---------|-------------------|-----------------|
| 1 | TB7 – 1 | Normally closed |
| 1 | TB7 – 2 | Normally open |
| 1 | TB7 – 3 | Common |
| 2 | TB7 – 4 | Normally closed |
| 2 | TB7 – 5 | Normally open |
| 2 | TB7 – 6 | Common |
| 3 | TB7 – 7 | Normally closed |
| 3 | TB7 – 8 | Normally open |
| 3 | TB7 – 9 | Common |
| 4 | TB7 – 10 | Normally closed |
| 4 | TB7 – 11 | Normally open |
| 4 | TB7 – 12 | Common |

4.0 Operation

Install and power the unit as previously described in section 3.0 through 3.3.3.

The green LED on each channel is an indication that power is on and the unit is not in alarm. The red LED indicates alarm, which is usually set at an oxygen content of 18.0%. The green LED goes out when the red LED goes on. If no LEDs are on, power has been interrupted.

The meter, one per channel, gives a visual indication of oxygen content at the location of the sensor for that channel. The meter scale reads from 16% to 26% oxygen by volume and is linear. The percentage of oxygen for fresh air, 20.9%, is the center point on the scale. The alarm point is typically 18.0% oxygen. Do not work in a space where the indicated oxygen content is less than 16%. Follow your organization's policy and procedures in an alarm situation.

The audio alarm mounted on the front of the control unit enclosure activates when any one or more channels is in alarm. In order to meet stringent safety requirements, the horn cannot be turned off during maintenance.

4.1 Rough Test

An oxygen alarm can be triggered to verify the alarm point by exhaling over the cell. If the **ISA-40M** includes a remote sensor, two people are required to verify the alarm point, one at the sensor assembly and the other at the control unit.

1. The individual at the sensor assembly inhales and holds his breath for 5 - 15 seconds.
2. Then he exhales slowly through the sintered screen in the cell enclosure.
3. The individual at the control unit observes that the alarm triggers at the alarm point, usually 18.0%.
4. A pressurized cylinder containing a mixture of 17.0% oxygen in nitrogen can be used with an appropriate calibration assembly to trigger the alarm. See section 8.2.

4.2 Precautions Regarding the Cell

Do not expose the oxygen cell to temperatures below 32°F (0°C) or above 130°F (55°C).

Never adjust the oxygen cell in an area where an oxygen deficiency may exist. Always adjust the oxygen cell in fresh air. Use bottled air if necessary.

Avoid exposure to toxic gas environments.

4.3 Atmospheric Pressure Variations

The galvanic oxygen deficiency transducer cell current output is directly proportional to the partial pressure of the oxygen in the atmosphere surrounding the cell. The partial pressure of oxygen is a function of the percent by volume of oxygen in the air and the air pressure. Air pressure varies as natural weather systems move through the area, causing changes in barometric pressure as well as oxygen content. The barometric pressure changes cause a relatively small change in oxygen content indication; for example, if the gain is set to give an oxygen content meter indication of 20.9% oxygen when the barometric pressure is 29.9 inches of mercury, normal variations of barometric pressure cause variations in meter readings of + or - 0.25%, from 20.65% oxygen by volume to 21.15% oxygen by volume. If the gain is set during a normal high pressure weather cycle, the variation is 0.50% downscale; conversely, if the gain is set during a normal low, the variation is upscale. This response to atmospheric pressure is not distressing when understood. The variation of the alarm point by + or - 0.25% is not significant when the liberal safety factor between the alarm point, usually 18.0%, and the point at which oxygen deficiency first emphatically affects human performance, approximately 16.0%, is taken into consideration

4.4 Temperature Variations

The cell output is temperature dependent; consequently, the cell is temperature compensated by means of a thermistor resistor network on the circuit board in the sensor assembly. Significant changes in temperature cause erratic initial readings, as the cell and thermistor do not track due to the difference in their locations and thermal masses. This phenomenon is significant in portable instruments, but usually does not affect the operation of permanent systems.

5.0 Maintenance

5.1 Cell Aging

The output of the cell decreases with cell usage. The change is very small during the operational life of the cell, 12-14 months, and is compensated by changing the gain to cause the meter reading to be 20.9% in fresh air. Gain reset and rough test (Sections 3.2.3 and 4.1) should be accomplished every 4 – 6 weeks.

NOTE: When adjusting the gain, if the air at the sensor locations is suspected to be depleted in oxygen, bottled air and a calibrator should be used; see section 8.2.

5.2 Cell End-of-Life

When the electrodes in the transducer cell are finally depleted, the cell output terminates rather quickly. The first indication that this is occurring is generally an inability to adjust the gain to yield a 20.9% reading in fresh air. Then the cell output decreases until the channel is constantly in alarm. To install a new cell, follow the procedures given in sections 3.2.1 and 3.2.2. If installing a cell in a remote sensor assembly with audio alarm, disconnect the ground side of the sensor assembly audio alarm during this process to avoid spurious alarms while changing the cell; reconnect it when done.

5.3 Circuit Alignment

Each **ISA-40M** system is aligned at the factory; however, due to prolonged use, oxygen cell replacement and assorted other circumstances, it may become necessary to realign the circuitry. If the unit is in constant alarm, the oxygen micro fuel cell has probably expired. Proceed to the cell replacement section 5.2, then come back to this one. The procedure for realignment is not difficult, but be aware that any deviation from the procedure described below voids the warranty. If you have any doubts about the procedure, contact **ENMET** personnel.

The only tools necessary are a digital voltmeter and a small screwdriver. This procedure is given for an S-2 oxygen cell, **ENMET** P/N 67013-008 as furnished as a replacement cell; this cell has a grey label. Refer to Figure 7 for test point and potentiometer locations.

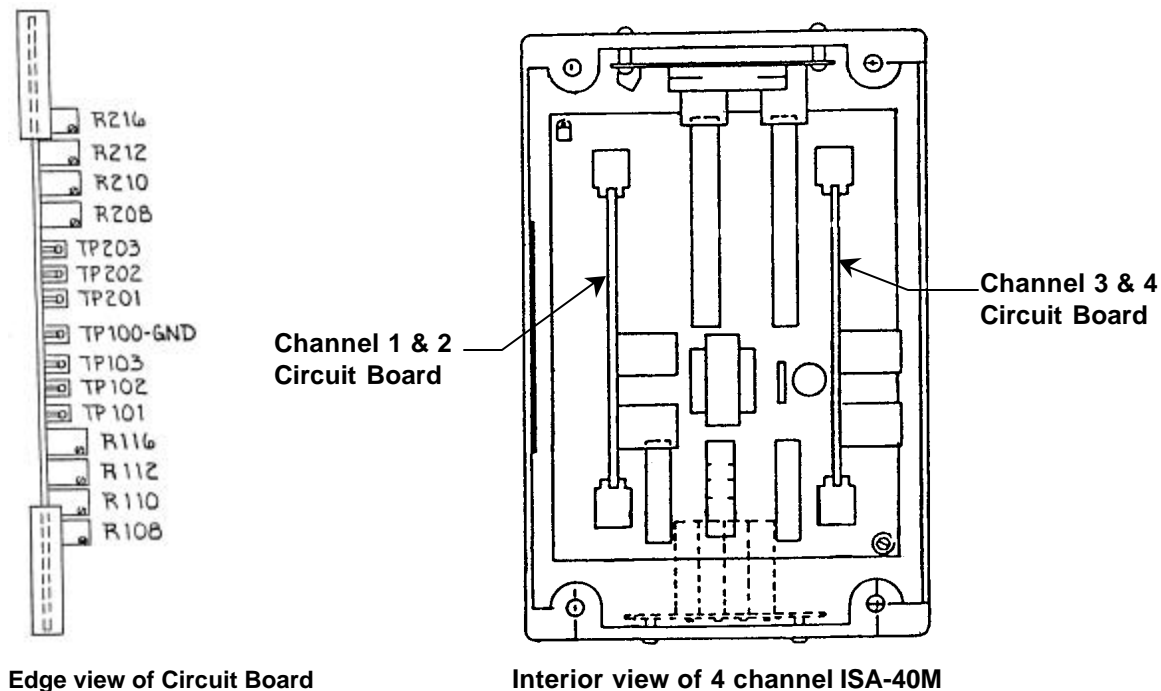


Figure 7: Location of Circuit Boards, Test points and Potentiometers

1. Null adjust:

- a) Disconnect the oxygen cell from the circuit by disconnecting leads at TB1 or TB2 as shown below:

| Channel | Disconnect Terminal Positions |
|---------|-----------------------------------|
| 1 | TB1 – 1 O2 (+) and TB1 – 1 O2 (-) |
| 2 | TB1 – 2 O2 (+) and TB1 – 2 O2 (-) |
| 3 | TB2 – 3 O2 (+) and TB2 – 3 O2 (-) |
| 4 | TB2 – 4 O2 (+) and TB2 – 4 O2 (-) |

- b) Check the null voltage for the channel. Connect the voltmeter leads to the appropriate test points, shown below:

| Channel | Test points | On Circuit Board |
|---------|----------------------|--------------------------|
| 1 | TP101 (-), TP102 (+) | For channel(s) 1 (and 2) |
| 2 | TP201 (-), TP202 (+) | For channels 1 and 2 |
| 3 | TP101 (-), TP102 (+) | For channel(s) 3 (and 4) |
| 4 | TP201 (-), TP202 (+) | For channels 3 and 4 |

- c) Adjust the appropriate null adjust potentiometer, shown below, so the voltage between the points is 0.00 VDC:

| Channel | Potentiometer | On Circuit Board |
|---------|---------------|--------------------------|
| 1 | R108 | For channel(s) 1 (and 2) |
| 2 | R208 | For channels 1 and 2 |
| 3 | R108 | For channel(s) 3 (and 4) |
| 4 | R208 | For channels 3 and 4 |

2. Low Level Set Adjust:

- a) Reconnect the oxygen cell by reconnecting the leads removed in step 2 a).
 b) Make sure the oxygen cell is properly connected by measuring the voltage between the cell leads; this voltage must be between 0.043 and 0.09 VDC.
 c) Measure the Low Level Set voltage for the channel by connecting the voltmeter leads to the appropriate test points, shown below:

| Channel | Test point | On Circuit Board |
|---------|----------------------|--------------------------|
| 1 | TP101 (-), TP103 (+) | For channel(s) 1 (and 2) |
| 2 | TP201 (-), TP203 (+) | For channels 1 and 2 |
| 3 | TP101 (-), TP103 (+) | For channel(s) 3 (and 4) |
| 4 | TP201 (-), TP203 (+) | For channels 3 and 4 |

- d) Adjust appropriate low level set potentiometer, R112 or R212, so the voltage between the test points is 1.03 VDC.

| Channel | Potentiometer | On Circuit Board |
|---------|---------------|--------------------------|
| 1 | R112 | For channel(s) 1 (and 2) |
| 2 | R212 | For channels 1 and 2 |
| 3 | R112 | For channel(s) 3 (and 4) |
| 4 | R212 | For channels 3 and 4 |

3. Full Scale Adjustment:

- a) Place voltmeter leads at the appropriate positions, shown below, to adjust the full scale voltage:

| Channel | Test point | On Circuit Board |
|---------|----------------------|--------------------------|
| 1 | TP101 (-), TP102 (+) | For channel(s) 1 (and 2) |
| 2 | TP201 (-), TP202 (+) | For channels 1 and 2 |
| 3 | TP101 (-), TP102 (+) | For channel(s) 3 (and 4) |
| 4 | TP201 (-), TP202 (+) | For channels 3 and 4 |

- b) Adjust the appropriate oxygen gain potentiometer on the front panel of the control unit so the voltage between the test points is 1.55 VDC.

- c) Adjust the appropriate meter gain potentiometer, shown below, so the channel's meter reads full scale (26% oxygen on most meters). Adjust this pot. Counterclockwise to increase, clockwise to decrease meter reading.

| Channel | Potentiometer | On Circuit Board |
|---------|---------------|--------------------------|
| 1 | R110 | For channel(s) 1 (and 2) |
| 2 | R210 | For channels 1 and 2 |
| 3 | R110 | For channel(s) 3 (and 4) |
| 4 | R210 | For channels 3 and 4 |

- d) Remove the voltmeter leads from the test points.

4. Alarm Set Adjust:

- a) Adjust the oxygen gain potentiometer for the particular channel until the meter reads at the appropriate alarm point (usually 18.0%).
- b) Adjust the appropriate alarm point adjust potentiometer, indicated below, counterclockwise until the oxygen circuit just barely goes into alarm. The red oxygen deficiency LED should just activate as you adjust this potentiometer. If LED is on before the potentiometer adjustment, adjust this potentiometer clockwise until the LED is off, then readjust counterclockwise until the LED just barely activates:

| Channel | Potentiometer | On Circuit Board |
|---------|---------------|--------------------------|
| 1 | R116 | For channel(s) 1 (and 2) |
| 2 | R216 | For channels 1 and 2 |
| 3 | R116 | For channel(s) 3 (and 4) |
| 4 | R216 | For channels 3 and 4 |

- c) Using the oxygen gain potentiometer on the front of the control unit for the channel you are working on, adjust the channel's oxygen meter up so that the channel comes out of alarm. Then adjust down again slowly until to verify that the unit goes into alarm.
- d) Expose the channel's oxygen cell to clean, fresh air for 5 minutes. Using the oxygen gain potentiometer, adjust the meter to read 20.9%.
IMPORTANT: The oxygen sensor *MUST* be in clean, fresh air for this adjustment. If there is any possibility that oxygen deficient air is near the sensor, supply bottled 20.9% oxygen to the sensor for a couple of minutes, then adjust gain.
- e) If possible, exhale all your breath over the oxygen cell. The meter reading should drop and the oxygen alarm should come on at the predetermined alarm point (usually 18.0% oxygen by volume).
- f) If the oxygen alarm does not come on at this point, repeat the entire procedure checking terminal connections, test points, and voltage settings very carefully. If it still does not alarm, contact your local authorized **ENMET** service center.

5. The oxygen circuit alignment is now complete.

5.4 Circuit Breakers / Fuse

ISA-40M instruments above serial number 2568 are equipped with two circuit breakers and a fuse in the AC power supply wiring. The circuit breakers are rated at 1 amp, and the fuse is rated at 50 milliamps (slow blow).

When the fuse or a circuit breaker opens the circuit, the power supply to the **ISA-40M** is interrupted. All LEDs on the front of the instrument are off. First, check to see if one or both circuit breakers have released their reset button. If so, press in the reset button. If not, visually check the fuse for a broken element, then test the fuse electrically for continuity. If the fuse element is broken (visual indication) or cracked (electrical indication), replace it with the same fuse (see section 7.1 for part number). If, after resetting a circuit breaker or replacing the fuse, the same component opens the circuit again within a short period of time, do not attempt to reset or replace the component again; have the instrument and power supply inspected to determine the source of the overload.

CAUTION: The fuse for the **ISA-40M** is a "slow blow" fuse. If this fuse requires replacement, the exact replacement is required (see section 7.1 for part number). Any other type voids the electrical certification. Note also that if the replacement fuse is not a "slow blow" fuse, the replacement fuse will blow as soon as the instrument is supplied with power.

6.0 ISA-40M Specifications

| Control Unit Specifications | |
|-----------------------------|--|
| Power | 110 VAC (or 220 VAC if transformer standouts are reconfigured), 50/60 Hz, and/or 12 VDC, 20 watts max. (5 watts per channel) |
| Alarm | Horn and red LEDs on Control Unit. |
| Sensor Lifetime | Approximately 14 months. Warranted for 6 months from date of shipment. |
| Electronics | Low power, all solid state, utilizing integrated circuits. |
| Dimensions | 12" high x 8" wide x 7" deep |
| Weight | 20 lbs. |
| Enclosure | NEMA-4X Fiberglass |
| Oxygen Cell Specifications | |
| Application | General. Intermediate life and response time. |
| Response Time | 90% in 15 seconds, at 25°C (typical) |
| Output | Nominal (in air at 25°C) $175 \pm 5\mu\text{A}$ At 0% Oxygen less than $2.0\mu\text{A}$ Linearity error (0 – 100% Oxygen) less than 0.5% |
| Operating Temp. Range | 32°F to 125°F |
| ENMET Warranty | 6 months form shipment |
| Size | 1.25" diameter by 0.80" long |
| Weight | 26 grams |
| Expected Life | Up to 14 months in air |

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

7.0 Service Information

7.1 Replacement Part Numbers

A full set of replacement part numbers and prices are a part of the documentation which accompanied the order. A partial list of the most likely parts needed to maintain the equipment is as follows:

| ENMET Part Number | Description |
|--------------------------|--|
| 67013-008 | Oxygen Cell, S2, that has a grey label; The p/n is for the packaged cell as furnished for a replacement |
| 03296-209 | 24 liter, 240 psi cylinder of 20.9% oxygen in nitrogen |
| 03296-170 | 24 liter, 240 psi cylinder of 17% oxygen in nitrogen |
| 63001-002 | 14 VDC lamp |
| 03600-002 | Assembly, Calibrator |
| 04537-005 | Circuit board, one channel |
| 04537-007 | Circuit board, two channel |
| 64002-050 | Fuse, 0.05 Amp, 5x20 slow blow |
| 66017-009 | Sensor cable, specify length |

7.2 Return 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.

There is a Repair Return Form on the last page of this manual. This form can be copied or used as needed.

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/RPS surface and are not insured 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.

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.