ENMET Corporation
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# ISA-50M / ISA-50M-2
# DUAL LOW ALARM
# OXYGEN MONITOR

80015-104
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## FIGURES, ILLUSTRATIONS

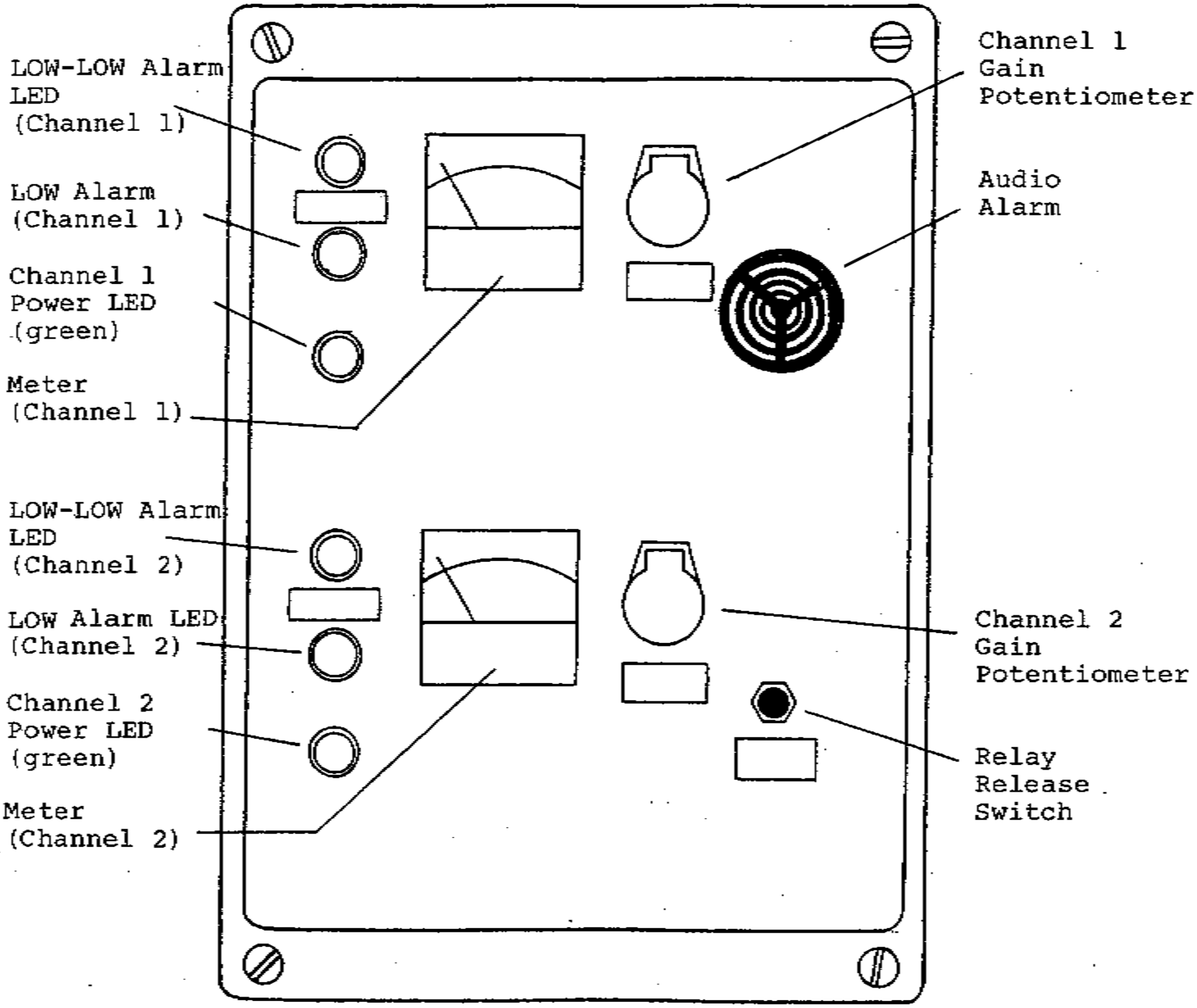



FIGURE 1: The ISA-50M Control Unit

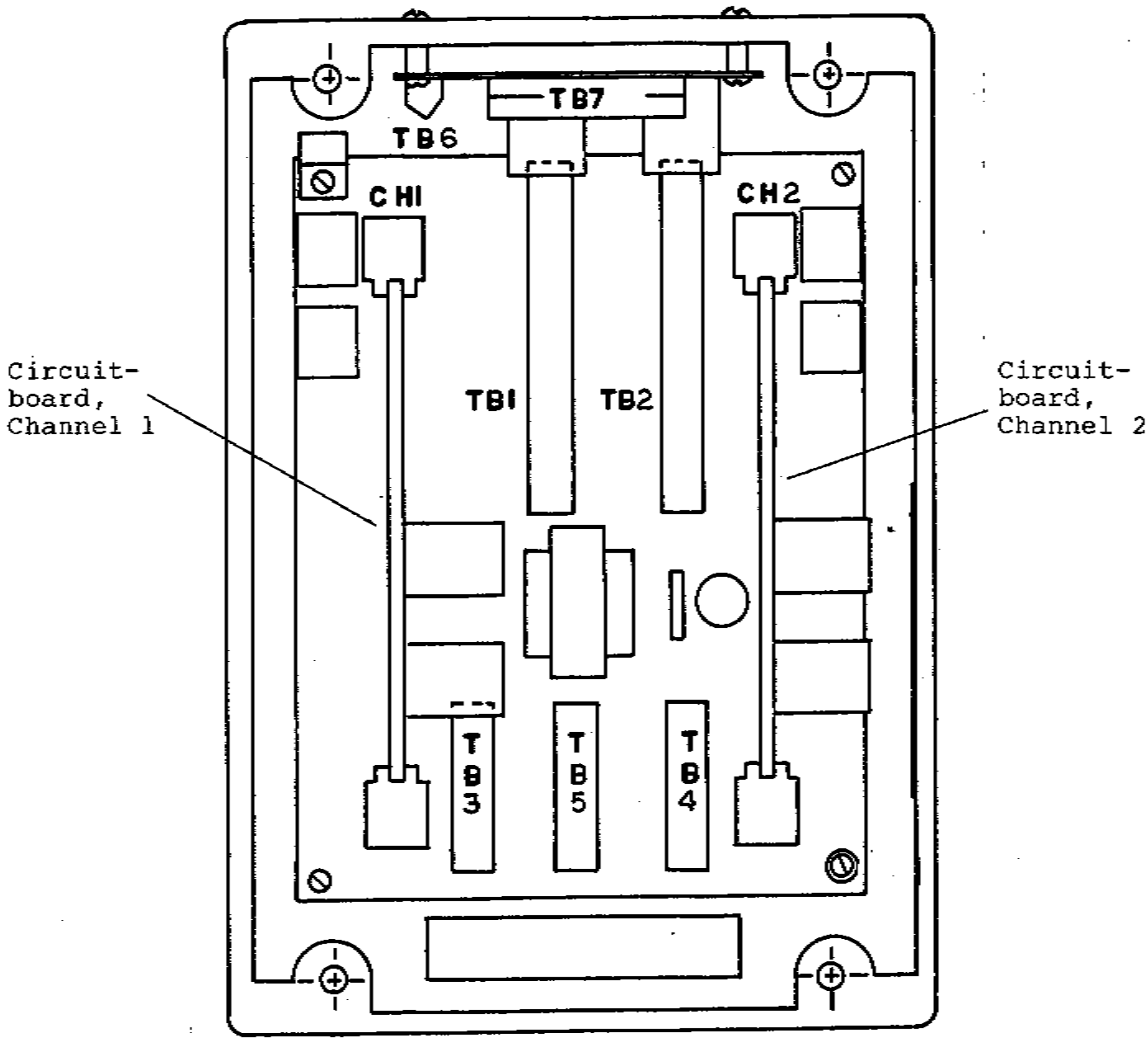
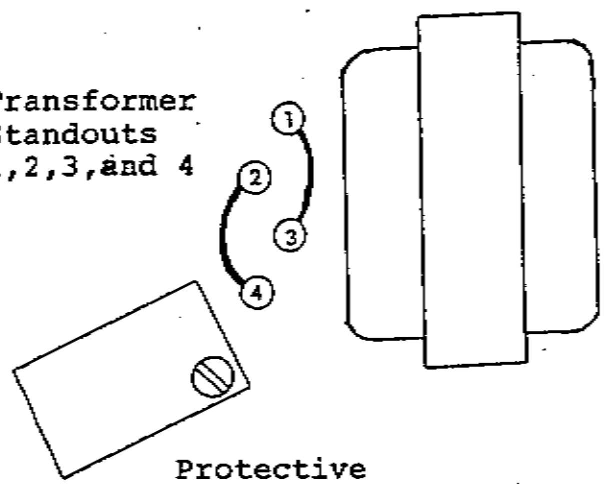


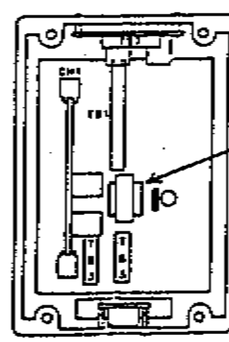

FIGURE 2: Internal View of ISA-50M Control Unit

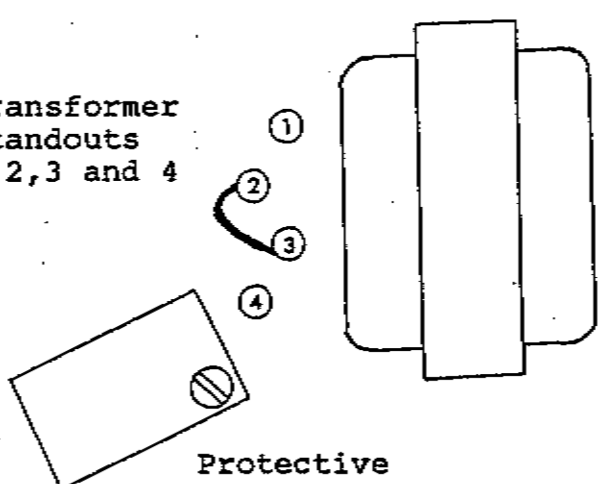
FIGURE 3: 110 VAC and 220 VAC Wiring Configurations

To change wiring from 110 Vac to 220 Vac, resolder the transformer standout 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 core solder. CAUTION: This procedure should be performed only by personnel with electrical repair experience.

1. Disconnect power from control unit.
2. Remove instrument circuitboard to access transformer standouts on motherboard.
3. Unscrew cover-retaining screw and rotate standout Protective cover until standouts are exposed.
4. Unsolder one lead at a time and resolder to desired configuration.
5. Wipe up and remove excess solder.
6. Rotate protective cover over standouts and tighten screw.
7. Replace circuitboard.



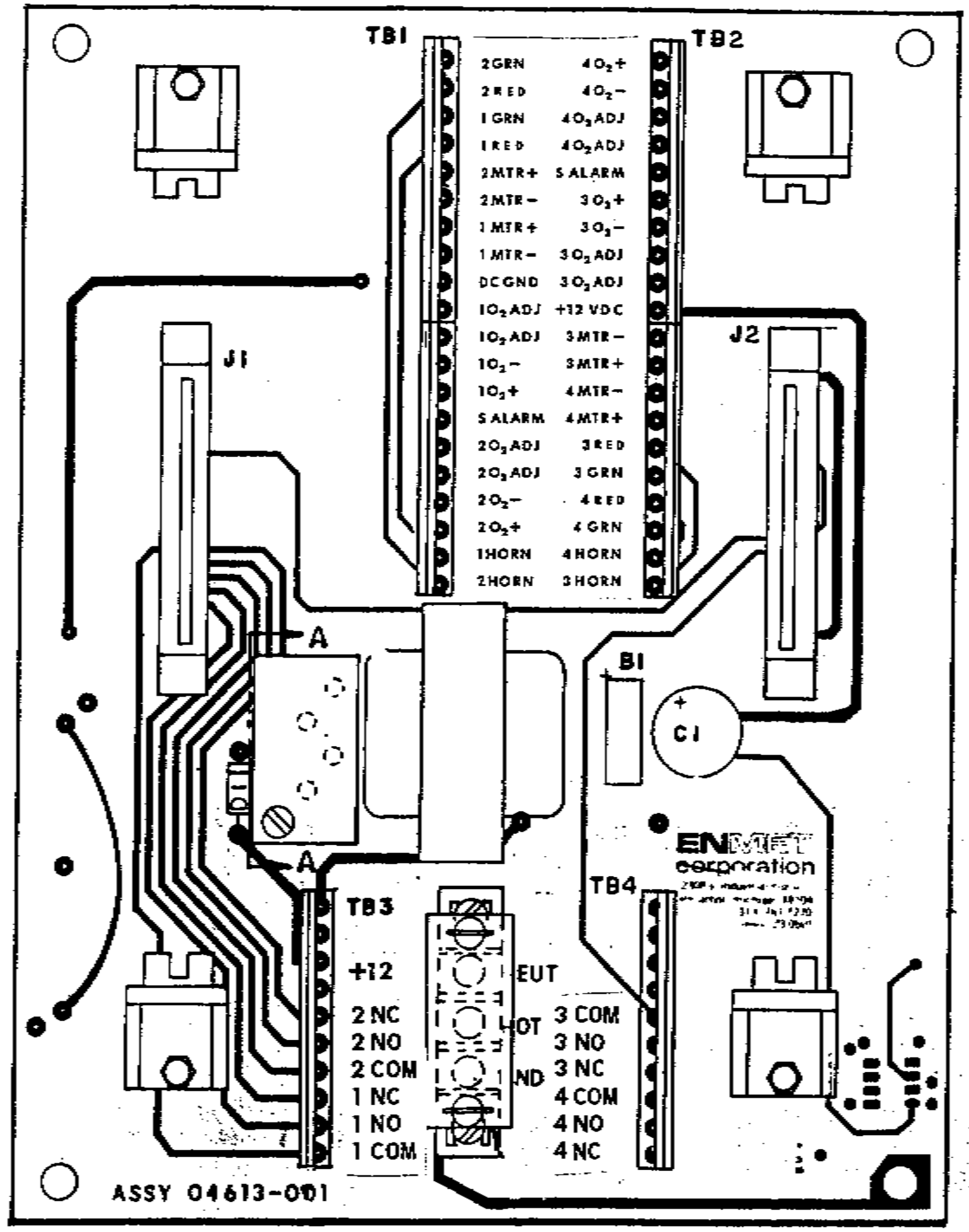
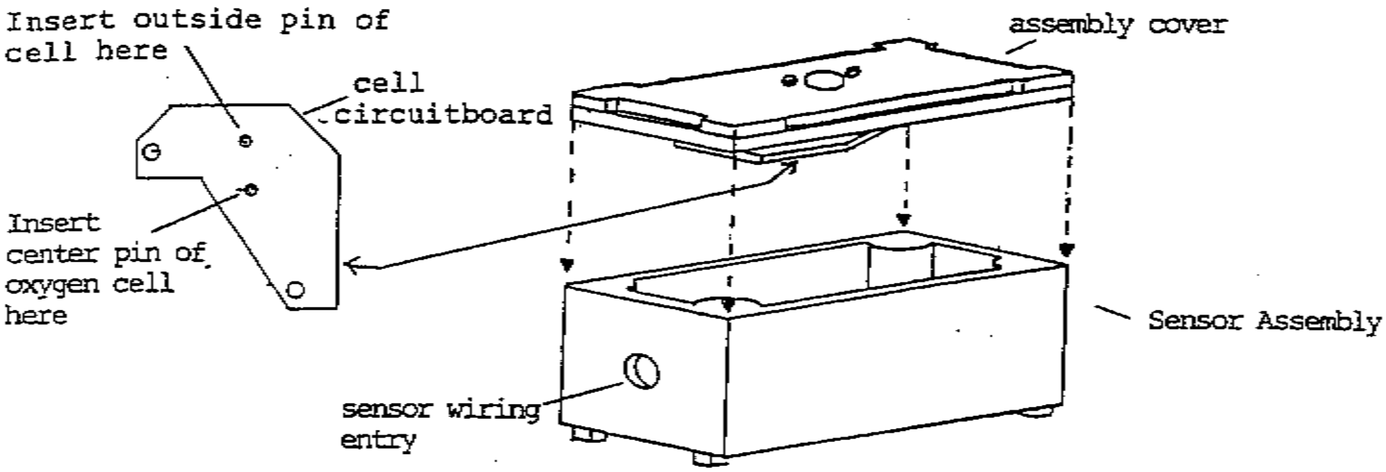
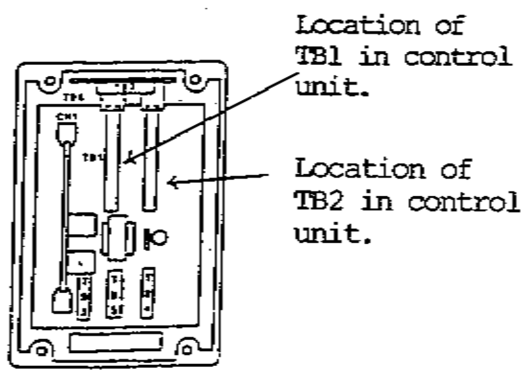


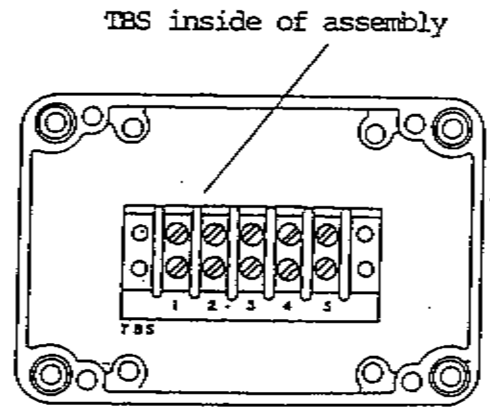

FIGURE 4: ISA-50M-2 Motherboard (Note: TB7 is shown in Fig. 2. TB7 is located on the inside of the top wall fo the enclosure on a relay circuitbaord).

NOTE: This motherboard is very similar to motherboards used in some other ENMET instruments. Therefore, please follow carefully the wiring instructions in this manual, as the terminal designations on the motherboard do not necessarily imply their function. For example, $2O_2$+ is <u>not</u> the + connection for channel 2 oxygen cell.

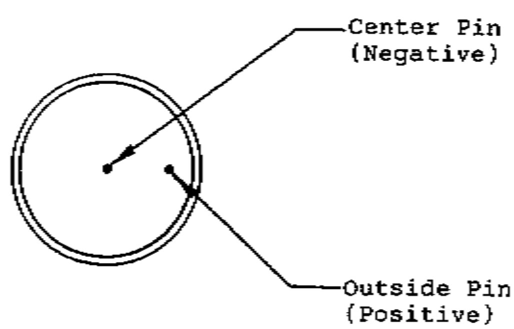
FIGURE 5: Oxygen Sensor Assembly Installation



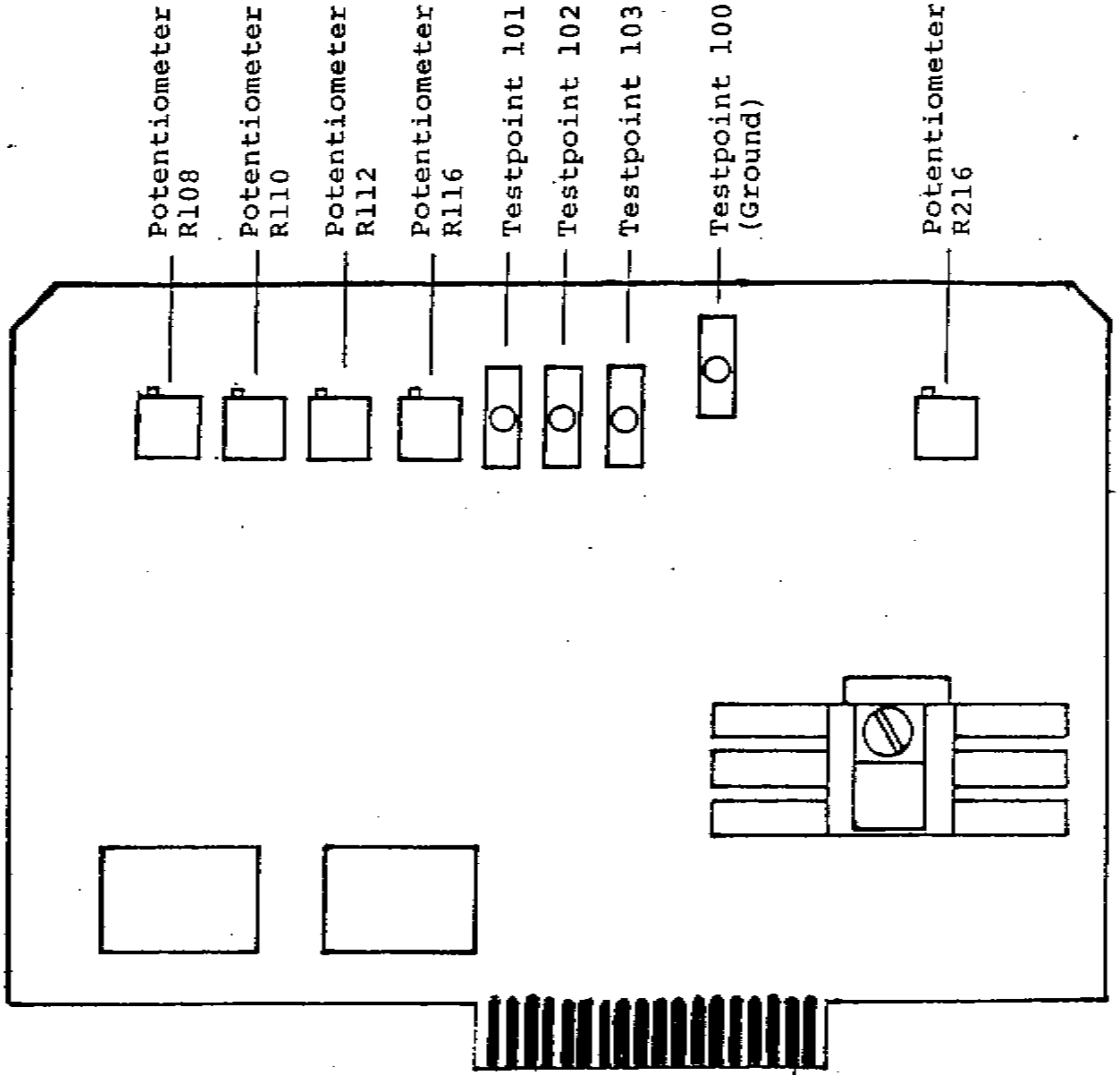




OXYGEN CELL

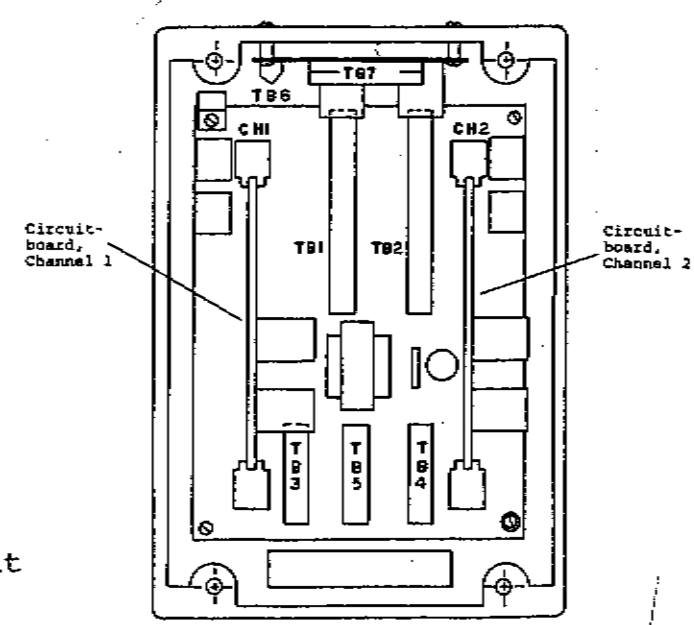



BOTTOM VIEW




Circuitboard

FIGURE 6: CIRCUITBOARD FOR ONE CHANNEL SHOWING LOCATION OF POTENTIOMETERS, TESTPOINTS




Location of circuitboards in control unit

# 1.0 UNDERSTANDING THE ISA-50M

## 1.1 Introduction

The ISA-50M is designed specifically for use with NMR (nuclear magnetic resonance) imaging systems. In order to create the high conductivity required in NMR systems, cryogenic gases such as liquid nitrogen and helium are used to supercool the magnetic components. Such gases, if released into ambient air, can quickly evaporate and displace available oxygen. If oxygen is displaced significantly, exposed individuals could be in danger of suffocating. To guard against this hazard, the ISA-50M monitors the concentration of oxygen in an area and activates alarm signals if the oxygen content falls below preset alarm points.

The ISA-50M and ISA-50M-2 dual-alarm oxygen deficiency monitors from ENMET consist of one and two remote sensors (respectively) and a control unit. Sensors are permanently mounted at strategic locations to analyze the oxygen content of ambient air. At the control unit, the meter indicates oxygen concentrations between 16-26% by volume (standard). Audio and visual alarm signals on the control unit activate when the oxygen content at the sensor location falls below either of two preset alarm points (LOW and LOW-LOW). Service relay contacts, which change state concurrently upon activation of the alarm signals, can be used to activate auxiliary equipment in the event of an oxygen deficiency alarm.

The ISA-50M is designed to be installed within the NMR system area. Much of the hardware in the ISA-50M is brass. Alarm LEDs are used instead of lamps to ensure longer life. The incoming power supply is filtered to minimize RF interference.

Before using your ISA-50M, read through this instruction manual completely. Following all the procedures set forth herein will maximize the usefulness and lifetime of your instrument.

## 1.2 Operating Principles

The ISA-50M and ISA-50M-2 described in this manual have 1 and 2 channels of detection, respectively. A channel includes a sensor, its associated circuitry in the control unit, and a set of alarm signals on the front of the control unit (a meter and three indicator LEDs). The audio alarm activates during any alarm condition. Since there is only one set of alarm LEDs and meter for each channel, alarm signals quickly identify the location of the potential oxygen hazard.

An electrochemical fuel cell (oxygen cell) is the sensing element of the ISA-50M system. Oxygen in the atmosphere surrounding the

## 1.2 Operating Principles (continued)

sensor diffuses through a thin membrane on the surface of the cell screen. This induces an electrochemical reaction within the cell to produce a small electrical current proportional to the partial pressure of oxygen in the air. This current signal is transmitted via cable (user-supplied) to the control unit, where sensor electronics analyze and translate the signal into an approximate oxygen concentration. After approximately 14 months, the oxygen cell becomes depleted and must be replaced.

## 1.3 Oxygen Concentrations Explained

Clean, fresh air contains approximately 20.9% by volume oxygen. The term "20.9% by volume oxygen" means that oxygen comprises 20.9%, or just over 1/5, of the total atmospheric volume of an area. If the oxygen content of an area decreases significantly from this level, the atmosphere can become hazardous to humans.

Directly affecting exposed persons, oxygen deficiency occurs when the oxygen content of an area falls below the normal 20.9% by volume concentration. If the oxygen content of the area decreases to 16% by volume, the senses and perceptivity of exposed persons are affected. At 14%, degradation of the senses is serious. At 10% oxygen by volume the individual quickly becomes unconscious, and his or her life is in serious danger. Atmospheres containing 5% or less are instantly fatal.

The concentration 19.5% by volume oxygen has been established by OSHA (Occupational Safety and Health Association) as the minimum requirement for oxygen levels in a workplace. Each ISA-50M dual alarm oxygen deficiency monitor is calibrated to activate alarm signals at two factory-set alarm points; LOW and LOW-LOW. Usually, one is set at 19.5%. However, the alarm points can be adjusted by recalibrating the unit (see section 4.0).

## 1.4 An Important Note About the Oxygen Cell

The galvanic oxygen deficiency transducer cell (oxygen 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 plus

1.4 <u>An Important Note About the Oxygen Cell</u> (cont.)

or minus approximately 0.25%. If the gain is set during a normal high pressure weather cycle, the variation is 0.5% oxygen by volume 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 0.25% is not significant when the liberal safety factor between a normal oxygen deficiency alarm point of 19.5% and the point at which oxygen deficiency first emphatically affects human performance, approximately 16.0% by volume, is taken into consideration.

# 2.0 USING THE ISA-50

## 2.1 Instrument Description

### 2.1.1 ISA-50M Control Unit, External Components

| | |
|---|---|
| CONTROL UNIT ENCLOSURE | A NEMA-4X fiberglass enclosure. |
| CHANNEL COMPONENTS | On the front of the control unit, each channel includes one green LED, two alarm LEDs, a meter and a gain potentiometer. The function of each component is outlined below. |
| Power LEDs (green) | When this LED is on, it indicates that power is being supplied to the channel and a safe oxygen concentration is present at the sensor. The Power LED is off during alarms or power failures. |
| Alarm LEDs | These LEDs activate when the oxygen concentration at the sensor falls below the corresponding alarm point (either LOW or LOW-LOW). The factory-set alarm point for each Alarm LED is indicated on an orange sticker next to the Alarm LED. |
| Meter | This linear scale meter indicates the oxygen concentration at the sensor. The standard meter scale indicates oxygen concentrations of 16-26% by volume. |
| Gain Potentiometer | The Gain Potentiometer is periodically adjusted to set the meter to 20.9% when the sensor is exposed to clean, fresh air. This is done to compensate the circuit as the oxygen cell becomes depleted and its current output drops. |
| AUDIO ALARM | The Audio Alarm emits a high-pitched tone during any oxygen deficiency alarm. In order to meet important safety requirements, it is not possible to switch off the Audio Alarm. |
| RELAY RELEASE SWITCH | This push-button switch resets the Alarm LEDs and latching relays (inside the control unit) following an alarm. |

## 2.0 USING THE ISA-50

### 2.1.2 ISA-50M Control Unit, Internal Components

**MOTHERBOARD**

The motherboard has connections for power, sensor and relay wiring and provides the mounting interface for the circuitboard.

**CIRCUITBOARD**

The circuitboard contains the basic circuitry required for operating one channel of ISA-50M oxygen detection. During calibration procedures, certain components on the circuitboard (potentiometers and testpoints) are used to adjust the response of the instrument.

**TERMINAL BLOCKS**

Located inside the control unit, the terminal blocks (identified as TB1, TB3, etc.) contain wiring connection points for sensor wiring, power supply wiring, relay hook-ups, etc.

**SERVICE RELAYS**

One set of latching and one set of non-latching relay contacts correspond to each alarm point. Relay contacts change state when the corresponding alarm signals activate. Latching relays remain in alarm position until reset with the Relay Release switch (on front of control unit) following an alarm. Non-latching relays release automatically when the oxygen hazard at the sensor dissipates beyond the corresponding alarm point. Terminals for hooking up to latching and non-latching relay contacts are available on certain terminal blocks inside the control unit.

### 2.1.3 ISA-50M Sensor

**SENSOR ASSEMBLY**

Each channel has its own sensor. The sensor enclosure is constructed of heavy plastic and protects the oxygen cell and oxygen cell circuitry. The sensor assembly includes a terminal block inside for sensor wiring connections (Fig. 5).

## 2.0 USING THE ISA-50

### 2.2 Operating, Alarm Conditions for a Channel

| Condition | Signals | Indication |
|---|---|---|
| Unit Operating (no alarms) | Green LED for channel is on. | Power is being supplied to the channel. Oxygen concentration at channel's sensor is above oxygen deficiency alarm points. |

When the green LED for a channel is on, it indicates safe oxygen levels at the sensor, and gives positive indication that the channel is operating.

| Condition | Signals | Indication |
|---|---|---|
| LOW Alarm (oxygen deficiency alarm) | Green LED for channel is off. LOW Alarm LED is on. Corresponding relay contacts change state. | Oxygen concentration at channel's sensor is at or below LOW Alarm concentration. |

This alarm alerts the user to potential hazards involving oxygen deficiency. The LOW Alarm LED activates to indicate that oxygen concentration at sensor is at or below LOW Alarm oxygen deficiency alarm point concentration. Service relay contacts change state for corresponding alarm condition. If oxygen concentration (as shown on meter) rises above LOW Alarm concentration, green Power LED activates. When green LED comes on, corresponding LOW Alarm relay contacts either reset automatically (non-latching relays) or can be reset with the relay release switch (for latching relays) on the front of the control unit. LOW Alarm LED must be reset using relay release switch.

| Condition | Signals | Indication |
|---|---|---|
| LOW-LOW Alarm (oxygen deficiency alarm) | Green LED for channel is off. LOW Alarm LED is on. LOW-LOW Alarm LED is on. Audio Alarm is on. Corresponding relay contacts change state. | Oxygen concentration at channel's sensor is at or below the LOW-LOW alarm concentration. |

2.2 Operating, Alarm Conditions for a Channel (continued)

This alarm alerts the user to potential hazards involving oxygen deficiency. The LOW-LOW Alarm LED activates to indicate that oxygen concentration at sensor is at or below the LOW-LOW oxygen deficiency alarm point. Service relay contacts change state for corresponding alarm condition. If oxygen concentration (as shown on meter) rises above LOW-LOW Alarm concentration, corresponding LOW-LOW Alarm relay contacts either reset automatically (non-latching relays) or can be reset with the relay release button (for latching relays) on the front of the control unit. LOW-LOW Alarm LED must be reset using the relay release button.

**CAUTION: WHEN CHANNEL IS IN LOW-LOW ALARM, AND METER IS AT BOTTOM OF SCALE, IT IS POSSIBLE THAT OXYGEN CONCENTRATION OF AREA IS LOW ENOUGH TO CAUSE SERIOUS INJURY OR EVEN QUICK DEATH.**

| Condition | Signals | Indication |
|---|---|---|
| Power to the channel is interrupted. | None of the LEDs for for the channel are on.<br>Non-latching relays are in alarm position. | The channel is not operating, so exposed persons are vulnerable to oxygen deficiency hazards. |

This condition indicates that the channel (or instrument) is no longer functioning. Personnel should take appropriate action. If the problem is not a power outage at the facility, call your ENMET-authorized service center for repair instructions. NOTE: Although the non-latching service relays are in alarm position, they will not engage the auxiliary equipment to which they are connected unless an operating power source has been connected to the auxiliary equipment.

## 2.3 Installation

There are a number of prerequisites that must be accommodated when choosing a location for the ISA-50M. Locate the control unit so that appropriate personnel are notified when the alarms activate. Do not locate sensors more than 1000 ft. from the control unit. Do not locate the sensor where large-scale temperature changes can occur, for example, near doors, windows, etc.

**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.**

When choosing a location for a sensor, carefully consider the nature of the application. For example, if the monitor is to protect against oxygen displacement by a heavier-than-air gas, mount the sensor somewhere between 3-5 feet off the ground so that the sensor detects the oxygen change before the oxygen-deficient air reaches the breathing height for workers.

Normally, the ISA-50M is connected to a 110 Vac power source. If the transformer standout connections are changed (see Fig. 3), the instrument may be connected to a 220 Vac power source. The unit can also be connected to 12 vdc power. If both 110 Vac and 12 Vdc are connected, current flows from the ac source; dc current flows when the ac power is interrupted.

Auxiliary equipment (alarms, etc.) can be connected to service relays in the instrument. The standard relays (single pole, double throw) are 2 amp continuous, 5 amp surge dry contact. On special order, 10 amp relays (double pole, double throw) are available. Notice that auxiliary equipment connected to these relays will not activate during power interruptions if the auxiliary equipment runs on power from the ISA-50M unit. Also notice that the alarm and power-interrupt positions of the non-latching relay contacts are identical; alarm and power interrupt position of latching relay contacts are opposite.

The ISA-50M has been shipped without the oxygen cell installed in the sensor housing; it is to be installed during these installation procedures. The cell is kept in an airtight package during shipping to prevent its depletion. Do not open this package until you are ready to install the cell. The cell should be removed from its protective package, and its metal shorting clip carefully removed approximately 4 hours before installation.

MATERIALS

- 110 vac power source (unless unit is reconfigured to accept 220 Vac power; see Fig. 3)
- Mounting hardware and tools (user-supplied)
- Sufficient cable or wire in conduit for the following:

    power supply wiring (do not run through same conduit as sensor wiring)
    sensor wiring (2-conductor, 16 gauge; up to 1000 ft.)
    auxiliary equipment wiring (to relay contacts)

2.3 Installation (continued)

-- Drill for creating cable or wiring entries in control unit enclosure

-- Strain-relief fittings for cable or conduit entries in control unit, sensor assembly enclosures. If entry is to be made watertight, use watertight fittings.

-- Fresh, clean air at the sensor (supply bottled 20.9% oxygen, ENMET p/n 03296-209 and calibration assy. 03600-002, if such air is not available at sensor location).

**CAUTION NEVER ADJUST UNIT TO 20.9% OXYGEN WHEN CELL IS IN OXYGEN-DEFICIENT AIR OR DANGEROUS MISCALIBRATION COULD RESULT.**

-- Digital voltmeter

PROCEDURE:

1. After determining appropriate locations for the control unit and sensor housing, mount these components securely. The control unit mounting holes are accessible from the inside.

2. Locate TB5 inside the control unit (see Fig. 4), which contains the power hook-up terminals. Drill an appropriate cable or conduit entry in the control unit. Place a strain-relief fitting in the entry, supply wiring, and hook up to appropriate terminals, shown below.

   **CAUTION: MAKE SURE POWER SUPPLY WIRING IS NOT LIVE; SUPPLY POWER ONLY WHEN YOU REACH STEP 5 OF THIS PROCEDURE.**

| 110 Vac | 12 vdc |
|---|---|
| TB5-AC Neutral | TB3-2 -- DC Ground |
| TB5-AC Hot | TB3-3 -- + 12 Vdc |
| TB5-AC Gnd | |

3. Connect sensor assembly to the control unit in accordance with the chart below. TBS is the 5-position terminal block inside the sensor assembly; TB1 and TB2 positions are located the motherboard inside the control unit. In addition, supply a strain-relief fitting for the cable entry in the sensor assembly enclosure.

2.3 <u>Installation</u> (continued)

| From | To |
|---|---|
| TBS-3 (Channel 1 sensor assembly, green wire)..... | TB1-1 02 - |
| TBS-4 (Channel 1 sensor assembly, orange wire).... | TB1-1 02 + |
| TBS-3 (Channel 2 sensor assembly, green wire)..... | TB2-3 02 - |
| TBS-4 (Channel 2 sensor assembly, orange wire).... | TB2-3 02 + |

4. If the service relay contacts are to be used, locate TB3 and TB7 inside the control unit. TB3 contains non-latching relay connections; TB7 contains latching relay connections. Drill a cable or conduit entry in an appropriate location in the control unit enclosure, and connect up to the terminals described below. Include strain-relief fitting in the cable entry.

Non-latching Relays
(Alarm and Power-Interrupt Position)

TB3-1 NC.......Channel 1 LOW Alarm, Normally Closed
TB3-1 NO.......Channel 1 LOW Alarm, Normally Open
TB3-1 COM......Channel 1 LOW Alarm, Common

TB3-2 NC.......Channel 1 LOW-LOW Alarm, Normally Closed
TB3-2 NO.......Channel 1 LOW-LOW Alarm, Normally Open
TB3-2 COM......Channel 1 LOW-LOW Alarm, Common

TB4-3 NC.......Channel 2 LOW Alarm, Normally Closed
TB4-3 NO.......Channel 2 LOW Alarm, Normally Open
TB4-3 COM......Channel 2 LOW Alarm, Common

TB4-4 NC.......Channel 2 LOW-LOW Alarm, Normally Closed
TB4-4 NO.......Channel 2 LOW-LOW Alarm, Normally Open
TB4-4 COM......Channel 2 LOW-LOW Alarm, Common

Latching Relays
(Non-alarm and Power-Interrupt Position)

TB7-C1.........Channel 1 LOW Alarm, Common
TB7-NO1........Channel 1 LOW Alarm, Normally Open
TB7-NC1........Channel 1 LOW Alarm, Normally Closed

TB7-C2.........Channel 1 LOW-LOW Alarm, Common
TB7-NO2........Channel 1 LOW-LOW Alarm, Normally Open
TB7-NC2........Channel 1 LOW-LOW Alarm, Normally Closed

TB7-C3.........Channel 2 LOW Alarm, Common
TB7-NO3........Channel 2 LOW Alarm, Normally Open
TB7-NC3........Channel 2 LOW Alarm, Normally Closed
TB7-C4.........Channel 2 LOW-LOW Alarm, Common
TB7-NO4........Channel 2 LOW-LOW Alarm, Normally Open

2.3 Installation (continued)

TB7-NC4........Channel 2 LOW-LOW Alarm, Normally Closed

5. Apply 110 vac power to your ISA-50M. The alarm LEDs on the control unit activate; this is normal.

6. At the sensor enclosure, remove the four corner screws on the housing and lift off the cover. Unscrew the standoffs holding the sensor circuitboard in place. Making sure the oxygen cell has been out of its shipping package, and has had its metal shorting clip removed, for four hours, plug it into its circuitboard inside the sensor assembly (center pin of cell into center hole of circuitboard), and gently replace the circuitboard and standoffs. Do not screw in tightly; the circuitboard can be damaged by doing so. The oxygen cell screen faces the sintered steel disk in the enclosure.

7. Wait 5 minutes.

8. Using your voltmeter, check the voltage across the pins of the oxygen cell while it is plugged into the sensor circuitboard. Connect negative voltmeter lead to the center pin of the cell, and the positive lead to the outside pin of the cell. Voltage must be between .043 and .09 vdc.

9. Replace sensor enclosure cover onto sensor enclosure.

10. Expose sensor to clean, fresh air (or bottled 20.9% oxygen, if necessary) for 2-3 minutes.

    **CAUTION: DO NOT ADJUST INSTRUMENT IF OXYGEN CELL IS IN AN OXGEN-DEFICIENT ATMOSPHERE.**

11. Adjust oxygen gain potentiometer on front of control unit (clockwise to increase, counterclockwise to decrease) so oxygen meter reads 20.9% while sensor is exposed to clean, fresh air.

12. Installation is complete. Proceed to section 3.0 and perform a Rough Test for the instrument.

## 2.4 Operation

The ISA-50M operates continuously, requiring very little maintenance. For the most part, you need only monitor the ISA-50M for alarms (see section 2.2 for description of alarm conditions). Once every 4-6 weeks you must perform an oxygen gain adjustment (see below) to compensate for depletion of the oxygen cell. Cell depletion occurs very slowly; only after several weeks is depletion significant enough to require circuitry adjustment.

OXYGEN GAIN ADJUSTMENT

1. Supply clean, fresh air or a low flow of bottled 20.9% oxygen to the sensor for 2-3 minutes.

2. While sensor is exposed to this air, adjust Gain Potentiometer (clockwise to increase, counterclockwise to decrease) so oxygen meter reads at 20.9%.
3. If meter cannot be adjusted to 20.9%, oxygen cell must be replaced. See section 5.2.

## 2.5 Precautions

Do not expose the oxygen cell to temperatures below 32 degrees F or above 130 degrees F.

Never adjust the instrument to read 20.9% when the cell is in an oxygen-deficient environment. Always supply clean, fresh air to the sensor for this; use bottled air (20.9% oxygen) if necessary.

Avoid cell exposure to toxic gas environments. Toxic gas can degrade the cell.

The sintered steel disk in the sensor assembly is water-permeable (that is, water can soak through it). When mounting the assembly in an area where water could contact the disk, be sure mounting is accomplished in such a way that water contact with the disk is minimized.

## 3.0 ROUGH TEST

This test should be performed upon installation and approximately every 4-6 weeks. Test should only be performed following an Oxygen Gain Adjustment (see section 2.4).

The Rough Test is a simple check-out procedure designed to test quickly the functional aspects of the system. By exposing the sensor to low oxygen concentrations, the user can easily identify whether or not the alarms are functional and activate at proper levels. If the instrument does not respond as outlined in the procedure below, the channel must be recalibrated (section 4.0).

If the sensor is located far from the control unit, two people are required for this procedure; one applies the gas at the sensor, the other observes instrument response at the control unit.

MATERIALS (optional; low oxygen concentrations can be supplied by the user's own breath)

- -- cylinder of compressed air with oxygen concentration below the lower oxygen deficiency alarm point for the instrument (see Section 5.3 for ordering information).
- -- calibration assembly (ENMET part no. 03600-002) to apply bottled oxygen concentration to sensor.

PROCEDURE

1. At the sensor, one person holds their breath for fifteen seconds, exhales slowly all their breath over the sintered steel disk in the sensor enclosure, then places a hand over the disk.

   OR

   Expose the sensor to a low flow of bottled air containing an oxygen concentration lower than the lower alarm point of the instrument.

2. The person at the control unit observes the movement of the meter, checking to see that the LOW Alarm and LOW-LOW Alarm LEDs and audio alarm activate when the meter reaches the corresponding oxygen alarm concentrations.

3. If alarm LEDs activate at proper levels, test is complete. If alarm LEDs do not activate at proper levels, recalibrate the instrument (see section 4.0).

## 4.0 CALIBRATION

A channel must be recalibrated whenever it fails the Rough Test. If a channel does not respond to these calibration procedures, check to see if it requires a new oxygen cell (see step 6 of this procedure). If a new cell is not required, contact ENMET or your authorized ENMET service center.

Calibration is essentially channel circuitry realignment. After circuit voltages have been checked and, if necessary, adjusted, the alarm points are set and the oxygen cell is exposed to 20.9% oxygen. The alarm points are checked by exposing the oxygen cell to low concentrations of oxygen and observing the alarm LEDs and meter of the channel to see if they activate at the correct concentrations.

During the calibration procedures, potentiometers are adjusted to affect the response of the instrument. When adjusting these components, wait a few seconds between adjustments; there is a short lag time between any adjustment of a potentiometer and its effect on the circuit.

IMPORTANT: It is imperative that air with an oxygen concentration of 20.9% (clean, fresh air or bottled 20.9% oxygen) be supplied to the sensor where required in these procedures. Adjusting an instrument in oxygen-deficient air results in a dangerously miscalibrated instrument.

IMPORTANT: When making potentiometer adjustments on channel circuit boards, make sure the potentiometers you adjust correspond to the channel on which you are working.

### MATERIALS

-- small screwdriver

-- digital voltmeter

-- clean, fresh air or bottled 20.9% oxygen by volume (ENMET part no. 03296-209; calibration assembly for cylinder of 20.9% oxygen--ENMET part no. 03600-002)

PROCEDURE: Calibration of One Channel. This procedure is given for an S-2 cell, ENMET P/N 67013-008 as furnished as a replacement cell; this cell has a grey label.

4.0 CALIBRATION (continued)

1. At the sensor, remove the screws on the cover of the sensor enclosure, lift off the lid. Remove the cell circuit board by unscrewing the circuitboard standoffs. Pull the oxygen cell out of its circuitboard. ISA-50M alarms will activate; this is normal.

2. Set a digital voltmeter to measure 0-5.0 vdc. Inside the ISA-50M control unit, connect the negative lead of the voltmeter to TP101 and the positive lead to TP102 of the channel's circuitboard (see Fig. 6).

3. With the small screwdriver, adjust the screw in potentiometer R108 until the voltmeter reads 0.00 vdc between TP101 and TP102 (see Fig. 6 for location of potentiometer).

4. Plug the oxygen cell into its circuitboard (center pin of cell into center hole of circuitboard), and gently screw the circuitboard back into place. Do not screw in tightly; the circuitboard can be damaged by doing so. The oxygen cell screen faces the sintered steel disk in the enclosure.

5. Wait 5 minutes.

6. Using your voltmeter, check the voltage across the pins of the oxygen cell while it is plugged into the sensor circuitboard. Connect negative voltmeter lead to to the center pin of the cell, and the positive lead to the outside pin of the cell. Voltage must be between .043 and .09 Vdc. If voltage is not within this range, cell must be replaced (see section 5.2).

7. Replace sensor enclosure cover onto sensor enclosure.

8. Back at the control unit, connect the negative lead of the voltmeter to TP101 and the positive lead to TP103 on the circuitboard. Adjust potentiometer R112 on the circuitboard until the voltmeter reads 1.03 vdc between TP101 and TP103.

9. Leave the negative lead of the voltmeter at TP101 and connect the positive lead to TP102. On the front panel of the control unit, adjust the oxygen gain potentiometer until the voltmeter reads 1.55 vdc between TP101 and TP102. Then adjust potentiometer R110 on the circuitboard (counterclockwise to increase, clockwise to decrease) until the oxygen meter on the front panel of the control unit reads at the full scale mark.

10. Remove the voltmeter leads from the testpoints.

11. On the front panel of the control unit, adjust the oxygen

gain potentiometer until the oxygen meter reads at the LOW Alarm concentration.

12. Adjust potentiometer R116 on the circuit board counterclockwise until the LOW Alarm LED on the front of the control unit just barely activates. If LOW Alarm LED is on before you begin this potentiometer adjustment, adjust Gain Potentiometer (on front of control unit) to bring meter upscale so green LED activates. Press Relay Release Switch. Now adjust R216 clockwise so that when you set the meter at LOW Alarm concentration, the LOW Alarm LED will not activate. Using Gain Potentiometer, set meter at LOW Alarm concentration. Now adjust potentiometer R116 counterclockwise until the LOW Alarm LED just activates.
13. On the front panel of the control unit, adjust the oxygen gain potentiometer until the oxygen meter reads at the LOW-LOW Alarm concentration.
14. Adjust potentiometer R216 on the circuit board counterclockwise until the LOW-LOW Alarm LED on the front of the control unit just activates. If LOW-LOW Alarm LED is on before you begin this potentiometer adjustment, adjust Gain Potentiometer (on front of control unit) to bring meter upscale so green LED activates. Press Relay Release Switch. Now adjust R216 clockwise so that when you set the meter at LOW-LOW Alarm concentration, the LOW-LOW Alarm LED will not activate. Using Gain Potentiometer, set meter at LOW-LOW Alarm concentration. Now adjust potentiometer R116 counterclockwise until the LOW-LOW Alarm LED just barely activates. The audio alarm also activates.
15. Adjust Gain Potentiometer on front of control unit so oxygen meter reads at 20.9. Press Relay Release Switch. Then adjust gain pot. slowly downward to verify that alarm LEDs activate when meter indicates corresponding alarm concentrations.
16. Expose sensor to clean, fresh air (or bottled 20.9% oxygen, if necessary) for 2-3 minutes.
17. Adjust gain potentiometer on front of control unit to set meter to 20.9% while sensor is exposed to clean, fresh air.
18. Calibration is complete. Proceed to section 3.0 and perform a Rough Test for the channel.

## 5.0 REPLACEMENT PROCEDURES

### 5.1 LED Replacement

1. Obtain appropriate colored LED (see section 5.3 Part Numbers).

2. Unscrew collar from around LED.

3. Unplug burned-out lamp.

4. Plug in new lamp and replace collar. NOTE: Leads on LED are offset; LED plugs into socket only one way.

### 5.2 Oxygen Cell Replacement

Whenever the oxygen cell is replaced, the channel must pass a Rough Test before it is ready for operation (see section 3.0 ROUGH TEST).

The oxygen cell is shipped in an airtight, nitrogen-filled package to prevent its depletion during shipment. Do not open the package until 4 hours before you are ready to use the cell. The cell must adapt to temperature, air pressure, etc. of its operating environment for 4 hours before it is ready for operation.

1. Prior to installation, open the oxygen cell package, carefully remove the metal shorting clip, and set the cell face down somewhere in its operating environment where it will not be disturbed. Allow it to adjust to the environment for four hours.

2. Remove the 4 corner screws on the sensor enclosure and remove the enclosure cover (refer back to Fig. 5 in manual).

3. Remove cell circuitboard by unscrewing the standoffs which hold it in place. Remove the oxygen cell.

4. Making sure the oxygen cell has been out of its package for four hours, plug the new oxygen cell into the circuitboard, and gently replace the circuitboard standoffs. Do not replace standoff screws tightly; circuitboard components can be damaged. Replace cover of sensor enclosure.

5. Wait 5 minutes for the cell to adjust to the circuit.

5.2 <u>Oxygen Cell Replacement</u> (continued)

6. Expose the cell to clean, fresh air (or 20.9% oxygen) for 2-3 minutes. While cell is still exposed to this air, adjust the Gain Potentiometer on the front of the instrument so the oxygen meter reads at 20.9.

7. Proceed to section 3.0 for a Rough Test.

5.3 <u>Part Numbers</u>

$O_2$ Cell, S-2, as furnished for replacement...67013-008
20.9% oxygen (24 liter, 300 psi cylinder)....03296-209
17.0% oxygen (24 liter, 300 psi cylinder)....03296-170
Circuitboard for one channel.................04537-002
LED Base ...................................62034-000
LED, red....................................62034-001
LED, green..................................62034-002
LED, amber..................................62034-003

## 6.0 SPECIFICATIONS

Control Unit Dimensions................12" h x 8" w x 7" d

Control Unit Enclosure Construction.....NEMA-4X fiberglass

Power...................................110 Vac

Electronics.............................all solid state

Standard system relays..................2 amp continuous, 5 amp surge (single pole, double throw, dry contacts)

Oxygen Cell.............................electrochemical fuel cell.

operating temperature..............32-112 degrees F.

lifetime...........................approximately 14 months. Warranted for 6 months from date of shipment.

## 7.0 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; however, oxygen cells are limited to a warranty period of six (6) months from date of shipment from ENMET. 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. 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.

Material shipped to ENMET for warranty evaluation must be packed so it is not damaged in shipping. This applies particularly to oxygen cells, which must be packed so that the connector pins cannot damage the membranes of adjacent cells, and cells cannot be damaged by the movement of other cells or items in the shipment. We strongly suggest that oxygen cell pins be protected with a small piece of styrofoam, that individual cells be placed in small plastic bags, and that adequate packing material be used to constrain the movement of the cells and other items during shipment. Material damaged in shipment is not covered by warranty.

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.