

ENMET Corporation
P.O. Box 979
Ann Arbor, MI 48106-0979

**ISA-100-RAL
ISA-100RAL-OD
Operation and Maintenance**

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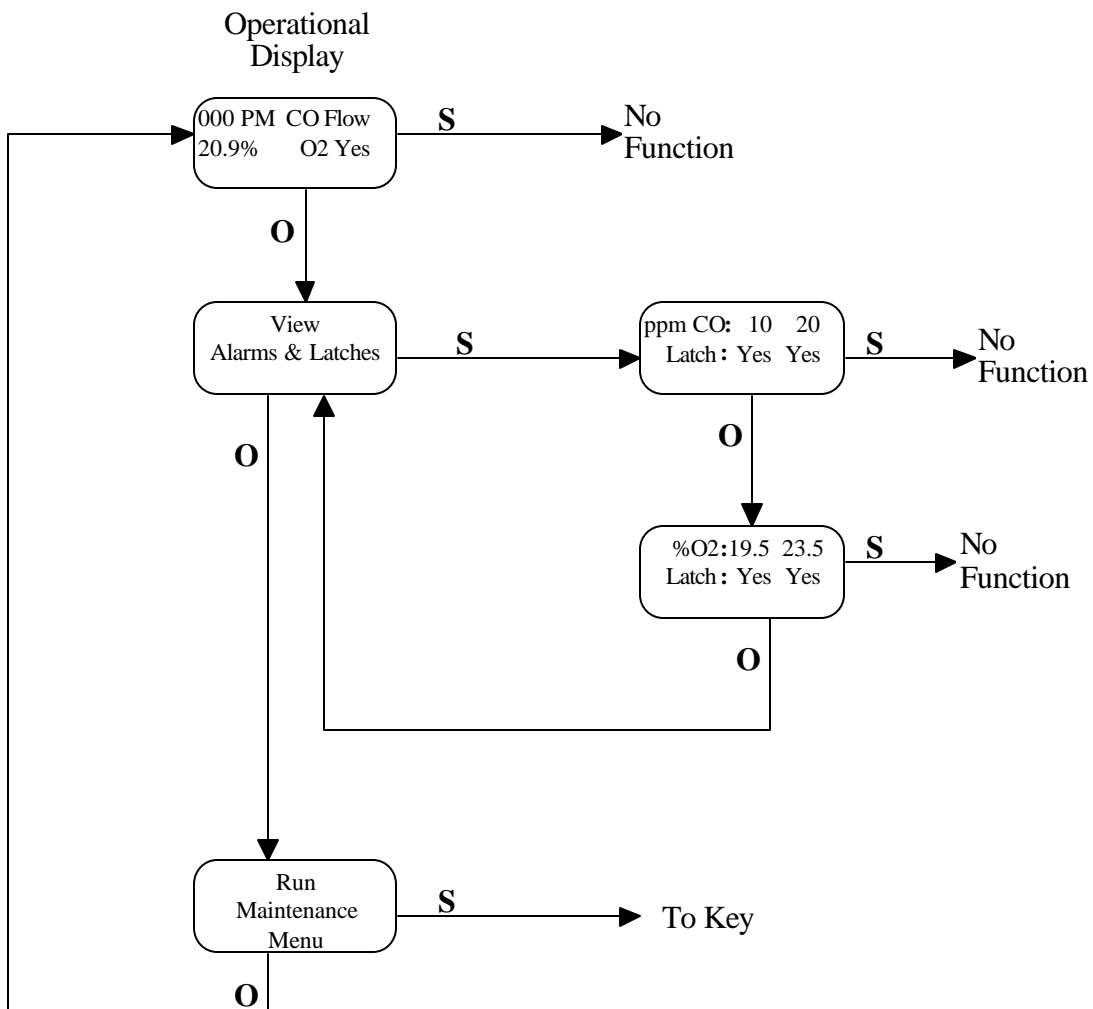
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100 RAL



O = Option
S = Select

Figure 4.2:
Operation Menu Diagram

100 RAL

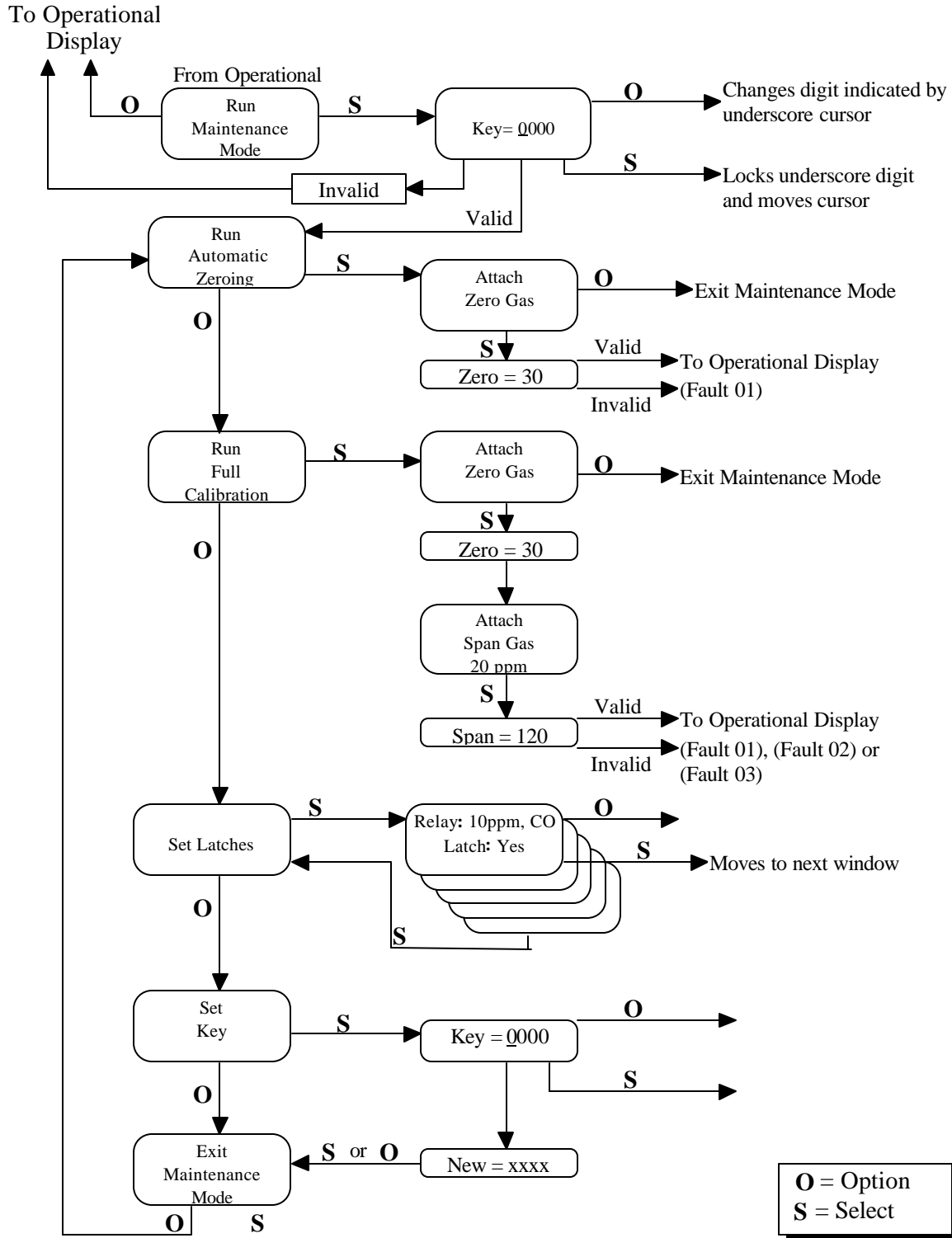


Figure 5.1:
Maintenance Menu Diagram

**Figure 5.2:
Application of Zero and Calibration Gas**

**Figure 5.3:
Sensor Circuit Board**

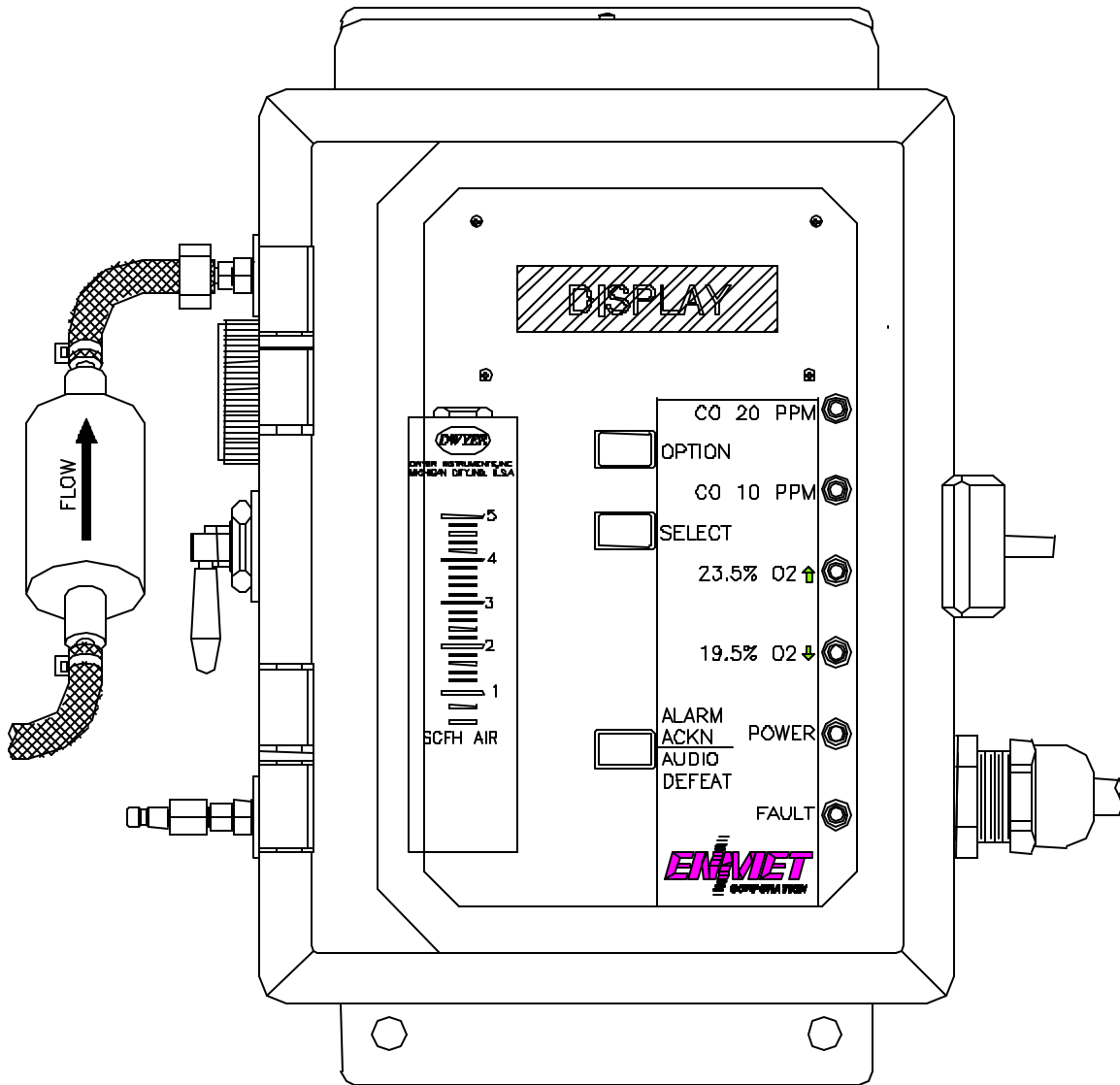


Figure 5.4: ISA-RAL-OD Filter Placement Diagram

1.0 INTRODUCTION

1.1 General Description

The ISA-100RAL and ISA-100RAL-OD are gas detection instruments that monitor compressed breathing air for certain hazards to the user. The ISA-100RAL monitors breathing air for carbon monoxide; the ISA-100RAL-OD monitors breathing air for carbon monoxide and for variations in the oxygen content. In both instruments, a sample of the compressed air is passed over electrochemical sensors, and the resultant electrical outputs are used to evaluate the air for the target gases. Some features of the instruments are as follows:

- * continuous monitoring of the sample air
- * continuous LCD display of gas concentration
- * menu driven operational and maintenance controls
- * menu driven calibration procedure
- * audio and visual alarms indicate unsafe conditions
- * alarm relay contacts available on terminal strips
- * a fault relay and visual fault alarm
- * flowmeter plus low flow fault indication and display
- * alarm acknowledgement capability including audio defeat
- * continuous humidification of dry sample air
- * optional 4-20 ma outputs
- * NEMA-12 packaging

1.2 Upon Receipt

1.2.1 Unpack

Unpack the instrument and examine it for shipping damage. If such damage is observed, notify both ENMET customer service personnel and the commercial carrier involved immediately; save the shipping box and packing material.

1.2.2 Check

Check against the purchase order that the contents of the shipment are as ordered. The ISA-100RAL and the ISA-100RAL-OD look alike; ascertain that the correct instrument is in the shipment. Check the contents of a calibration kit if it was included on the order. Notify ENMET customer service personnel of a discrepancy immediately.

1.3 Serial Number

Each instrument is serialized, and the serial number appears on the shipping documents and on the serial number tag on the side of the enclosure. This number is in the ENMET database along with calibration and shipment information, and identifies the instrument when communicating with ENMET.

1.4 Carbon Monoxide

A description of the toxic effects of carbon monoxide is given in Appendix A, and should be reviewed by the user.

1.5 Expansion Capabilities

Oxygen sensing capability can be added to an ISA-100RAL in the field; consult ENMET customer service personnel for details.

The optional 4-20 ma output feature can also be added in the field.

1.6 Monitoring of High Pressure Air

High pressure air in lines or tanks can be monitored continuously by using a high pressure regulator. A regulator is available from ENMET; see Section 6.0, below. This regulator operates in series with the low pressure regulator supplied with the instrument, and is rated for pressures up to 5000 psig.

2.0 INSTRUMENT FEATURES

2.1 Exterior Features

The exterior of the instrument is shown in Figure 2.1. The exterior features, which are identical for the ISA-100RAL and the ISA-100RAL-OD, are as follows:

ENCLOSURE	A NEMA-12 plastic box, approximately 8x8x6, with a clear hinged front cover.
REGULATOR	At the end of a two foot long hose from the left top of the enclosure is a small air pressure regulator with a gauge. This serves to supply a constant sample air pressure to the instrument, which provides a constant flow rate.
On the left surface of the enclosure:	
SAMPLE AIR PORT	The nipple for the hose leading to the regulator.
SAMPLE-CALIBRATE VALVE	A red-handled ball valve which directs the air from either the sample or the calibrate port. The handle points at the port, sample or calibration, which is providing the air to the instrument.
CALIBRATE PORT	The entrance for the calibration gas. The quick release fitting mates with one on the calibration adapter.
AUDIO ALARM	A loud horn activated by certain alarm conditions.
On the top surface of the enclosure:	
HUMIDIFIER TUBE	Under a black sheetmetal cover, a tube that extracts moisture from the atmosphere and adds it to a dry sample.

On the right surface of the enclosure:

FRONT COVER LATCH A turn-and-lock latch that retains the clear front cover. Provisions exist to lock this latch with an auxiliary padlock if desired.

LINE CORD A cord to supply 110 vac to the equipment.

At the top and bottom of the enclosure:

MOUNTING FLANGES Flanges with holes for mounting the enclosure to a vertical surface.

2.2 Display Panel

The display panel, shown in Figure 2.2, is viewed through the clear front cover of the enclosure, and is accessed by opening the cover. Features are as follows:

DISPLAY A 2 line, 16 character per line, backlit LCD, upon which the numerical values of gas concentrations, and other information, is displayed.

FLOWMETER A flow indicator, located at the output of the sample flow stream, which indicates quantitatively the flow of sample air or calibration gas through the instrument.

LABEL A yellow label upon which is given the switch functions and the alarm levels of the visual alarm lights. This label differs from the ISA-100RAL to the ISA-100RAL-OD, because oxygen alarm levels are given for the latter instrument.

VISUAL ALARMS These are located on the right side of the display panel. They are comprised of a red LED for each alarm level, a green power LED, and a red fault LED. There are two alarm level LEDs on the ISA-100RAL, and four on the ISA-100-RAL-OD.

PUSHBUTTON SWITCHES There are three of these, located to the left of the label; they are small yellow lighted rectangles. They are:

OPTION SWITCH The topmost switch.

SELECT SWITCH Directly under the option switch.

**ALARM ACKNOWLEDGE/
AUDIO DEFEAT** Located near the bottom of the label.

2.3 The Circuit Board

The Display Panel is released by removing the two retaining screws located in diagonal corners. The Circuit Board is accessed by removing the display panel. Features are:

TERMINAL STRIP	This twenty-three position terminal strip is located at the bottom of the Circuit Board. On it are twelve positions for three contacts for each of four alarm relays, and three positions for the contacts of a fault relay. There are also two positions for each of the optional 4-20 ma outputs.
MANIFOLD HOUSING	Sample manifold and sensors are located under this small aluminum housing.

3.0 Installation

3.1 Mounting of Instrument

The instrument should be located near the pipe or tank containing the breathing air, and upstream from where the air is being used, so that the air sample reaches the instrument before the air being sampled reaches the users.

Upright vertical orientation of the instrument is necessary for proper operation. Mount the instrument on an appropriate vertical surface using the mounting flanges provided. The holes in the flanges are 0.31 inch in diameter and form a 4 x 8.75 rectangle. Remove the black humidifier tube cover to access the top mounting flange, then replace the cover.

3.2 Sample Air Supply

Tap the pipe or tank containing the breathing air and use appropriate fittings to mount the regulator. The regulator input threads are 1/4 NPT. A quick release pneumatic connector is supplied at the regulator input, for convenience and for compatibility with a high pressure regulator if one is used. This can be removed and replaced with a 1/4 NPT close nipple if desired. The regulator input air pressure can vary from 60 to 250 psig. Set the regulator at approximately 50 psig, as indicated by the gauge. The flowmeter on the display panel reads approximately two SCFH. The regulator pressure and the flow rate are not critical parameters.

The sample air exits the instrument from two separated ports on the back surface of the enclosure. Take care to not obstruct these exit ports. After mounting the enclosure, they are not accessible.

Be sure that the red calibrate-sample valve handle on the left side of the enclosure is pointed up toward the sample input port.

3.3 Power Supply

Connect the line cord to a source of 110vac power. The input power can vary from 100 to 240 vac, 50/60 hz; if other than 110 vac power is desired, the plug on the line cord must be changed.

Upon supplying power to the instrument, the green power on LED is lit, and the display backlight is lit, and numbers are given on the display. The instrument may go into alarm briefly, but the sensors stabilize quickly. If the instrument persists in alarm, acknowledge the alarm by pressing the ALARM ACKN/AUDIO DEFEAT switch. If alarm persists longer than 30 minutes, call ENMET customer service personnel.

3.4 Outputs

Two types of alarm outputs are available: relay contacts and optional 4-20 ma outputs.

3.4.1 Relay Contacts:

Relay contacts are available for each alarm; these are SPDT, rated at 2.0 amp at 110vac, and may be latching or non-latching as required by the application. They are accessed on the terminal strip at the bottom of the circuit board in the positions given below:

Position	Function	Contact
1	CO, Low Alarm	NC
2	CO, Low Alarm	C
3	CO, Low Alarm	NO
4	O2, Low Alarm	NC
5	O2, Low Alarm	C
6	O2, Low Alarm	NO
7	CO, High Alarm	NC
8	CO, High Alarm	C
9	CO, High Alarm	NO
10	O2, High Alarm	NC
11	O2, High Alarm	C
12	O2, High Alarm	NO

These relay coils are energized when they are in the non-alarm state; the contact conditions given above are for the unenergized state, which is identical to the alarm state. In a ISA-100RAL, there are no O2 relays; in this case, if additional CO alarm relay contacts are desired, relays can be inserted in these positions and programmed as CO relays.

In addition, there is a fault relay, which changes state whenever the instrument is in a fault condition. The contact positions are:

13	Fault	NC
14	Fault	C
15	Fault	NO

The coil of this relay is energized when the instrument is in the non-fault state; the contact conditions given above are for the unenergized state, which is identical to the fault state.

These relay contacts can be used to operate auxiliary alarms or for other functions. Punch a hole in the bottom of the enclosure for a wire exit, and use appropriate cable and fittings to preserve the NEMA-12 rating of the enclosure.

3.4.2 Optional 4-20 ma Outputs:

Optional isolated 4-20 ma outputs are available for data logging or other purposes. After the required components are in place, these outputs are available on the terminal strip in the following positions:

Position	Channel	Function
16	CO	Ground
17	CO	+ 4 to 20 ma
18	O2	Ground
19	O2	+ 4 to 20 ma

Wiring requirements are the same as for the relays.

Positions 20, 21, 22, and 23 on the terminal strip are empty.

3.5 Calibrate

If a calibration kit is available, calibrate the instrument 24 hours after installation. See Section 5.0, Maintenance, for calibration instructions. After calibration, be sure to return to red calibrate-sample valve handle to the up position, pointing toward the sample input port.

4.0 Operation

4.1 Normal Operating Condition

With the instrument installed as described above, and is supplied with uncontaminated air, the POWER green LED is on, the display and the three pushbutton switches are lighted, the flowmeter reads approximately two SCFH, and the information on the display is as shown in Figure 4.1 for the sensor complement on the particular instrument. The red alarm and fault LEDs are not lighted.

4.2 Alarm Set Points

The ISA-100RAL is supplied with two factory set alarm points. They are set at either the USA standard of 10 and 20ppm CO, or the Canadian standard of 5 and 10ppm CO. If alarm set points are not specified on an order, a unit with alarms at 10 and 20ppm CO is supplied. The ISA-100RAL-OD also has oxygen alarms at 19.5% deficiency and 23.5% abundance. See Figure 2.2.

If the CO concentration increases above that of an alarm set point, the associated red LED is lighted, and the associated relay changes state. The audio alarm is activated at the lower alarm set point.

With an ISA-100RAL-OD, if the oxygen content of the sample air exceeds the abundance alarm set point or decreases below the deficiency alarm set point, the audio alarm is activated, the associated red LED is lighted, and the associated relay changes state.

4.3 Alarm Latching

An instrument is shipped with the alarms in the non-latching mode. In the non-latching mode, at the cessation of the condition that causes an alarm, the alarm indications automatically cease and the alarm relay contacts revert to the non-alarm state.

The alarms may be independently configured in the latching mode by use of the maintenance menu. In the latching mode, at the cessation of the condition which causes the alarm, the alarm indications do not cease, and the alarm relay contacts do not revert to the non-alarm state, until the ALARM ACKN/AUDIO DEFEAT switch is pressed. An alarm condition can also be acknowledged by pressing the switch during the alarm condition; then at the cessation of the alarm condition, alarm indications cease and alarm relay contacts revert to the non-alarm condition. After an alarm is acknowledged, alarms in the latching configuration are re-armed to latch at the next alarm condition.

4.4 Audio Defeat

With the alarms in the non-latching configuration, pressing the ALARM ACKN/AUDIO DEFEAT switch during an alarm silences the audio alarm.

With an alarm in the latching configuration, pressing the ALARM ACKN/AUDIO DEFEAT switch during an alarm silences the audio alarm and unlatches the associated relay(s).

4.5 Display

In normal operation without gas concentrations, the display is as shown in Figure 4.1, for the sensor complement on the particular instrument. This position of the display is termed the "operational display".

As explained below, the display can be changed to furnish other information by using the OPTION and SELECT switches.

The concentration of CO is given in PPM (parts per million parts of air), and, with a ISA-100RAL-OD, oxygen concentration is given in per cent by volume. When sample flow is reduced below a limit, the display switches from "Flow yes" to "Flow no".

4.6 Operational Menu

The operational menu allows the user to view alarm set point concentration values and alarm latching configurations, and to enter the maintenance menu with the proper key. The operational menu is accessed with the OPTION and SELECT switches. The operational menu diagram is shown in Figure 4.2, upon which the OPTION switch is indicated with a "O", and the select switch is indicated with a "S".

If the instrument is left at any location in the operational or maintenance menu other than the operational display, with no action for a period of 45 seconds, it reverts back to the operational display.

4.7 Fault Indications

4.7.1 Low Flow Fault:

A sensitive pressure switch is used to furnish a low flow indication. When the sample air pressure drops below 30 psig, the fault light and audio alarm are activated, the fault relay changed state, and the display reads "Flow no".

4.7.2 Other Fault Indications:

Other fault indications are associated with sensor zero and calibration activities, and are described in the maintenance section of this manual.

5.0 Maintenance

5.1 Maintenance Menu

The maintenance menu is accessed with the OPTION and SELECT switches. The maintenance menu diagram is shown in Figure 5.1. From the operational display, press the OPTION switch twice; "run MAINTENANCE MODE" is displayed.

5.1.1 Key:

In the "run MAINTENANCE MODE" position, press the SELECT switch; "Key = 0000" is displayed.

Entrance to the maintenance menu is guarded with a four digit key. The factory default setting of the key is 1270. When a valid numerical key is inserted, the user is allowed to enter the maintenance menu.

In the "Key = 0000" position, the underline cursor is under the left digit. Press the OPTION switch to change the left digit; select the correct digit, then press the SELECT switch, which locks the correct digit in place and moves the cursor one digit to the right. Continue this process until the four digit key is complete. When a valid key is inserted in this manner, the display is transferred to the "run AUTOMATIC ZEROING" portion of the menu. If an invalid key is inserted, "INVALID" is displayed briefly, then the operational display is resumed.

5.1.2 Automatic Zero:

A valid key entry sets the instrument in the "run AUTOMATIC ZEROING" position, which enables the setting of the zero gas concentration point. This is desirable if the zero reference of one of the sensors has drifted over a period of time. For CO, the zero reference point is 0000 ppm CO; in an ISA-100RAL-OD, the zero reference point for oxygen is 20.9% oxygen by volume. Note that the calibration procedure described below also includes setting the zero point. If a full calibration is required, instead of setting just the zero point, press the OPTION switch once; "run FULL CALIBRATION" is displayed. See paragraph 5.1.3, below.

To set the zero point without performing full calibration, from the "run AUTOMATIC ZEROING" position, press the SELECT button; "attach Zero Gas" is displayed. While it is possible to zero the sensor(s) using a sample from a "clean" air line, this entails using the sample as a standard, and is best avoided. The best zero gas for either instrument is a cylinder of 20.9% oxygen in nitrogen with no CO present. This is available in the calibration kit.

Pressing the OPTION switch at this point aborts the procedure and transfers the display to the "exit MAINTENANCE MODE" position.

To continue the procedure, attach a cylinder of zero gas to the Calibration Port using the calibration adapter, as shown in Figure 5.2. Open the cylinder valve, set the regulator at 55 psig, and turn the red handle of the sample-calibrate valve down toward the calibration port. Let the gas flow for about a minute, then press the SELECT switch.

"Zero = 30" is displayed, along with other information. This is a timer that counts down from 30 seconds, at the end of which the procedure is finished. The instrument sets the clean air voltage point for the CO sensor, and, in an ISA-100RAL-OD, sets the 20.9% O₂ point for the oxygen sensor. It then examines the validity of these values; if they are valid, it reverts back to the operational display. If a failure occurs, "(fault-01)" is displayed.

After this procedure is complete, be sure to return the red handle of the sample-calibrate valve to the up position, pointing toward the Sample Port. If the sample-calibrate valve is not switched back to the sample port position, the low flow alarm is activated when the zero gas is removed.

5.1.3 Calibration:

Insertion of a valid key results in the display: "run AUTOMATIC ZEROING". Press the OPTION switch once; "run FULL CALIBRATION" is displayed. Press the SELECT switch; "Attach Zero Gas" is displayed; this is the start of the automatic zero procedure as described in paragraph 5.1.2, above. When this procedure is complete, "Span = 20" is displayed to indicate that the correct span gas for this procedure is 20 ppm CO in a mixture of 20.9% oxygen in nitrogen. **DO NOT USE ANY OTHER THAN THE CORRECT SPAN GAS FOR THIS PROCEDURE.**

Pressing the OPTION switch at this point aborts the procedure and sets the display at the "exit MAINTENANCE MODE" position.

To continue the procedure, press the SELECT switch; "Attach Span Gas" is displayed. Attach the correct span gas to the Calibration Port with the calibration adapter, open the cylinder valve, set the regulator at 55 psig, and turn the red handle of the sample-calibrate valve down toward the Calibration Port. Allow the calibration gas to flow for about a minute, then press the SELECT switch; "Span = 120" is displayed. This is a timer that counts down 120 seconds, at which point the procedure is complete.

After a valid zero and calibration, the instrument reverts to the operational display. After an invalid zero or calibration, "(fault 01)" is displayed for an invalid zero, and "(fault 02)" is displayed for an invalid calibration; "(fault 03)" is displayed for both an invalid zero and an invalid calibration.

After this procedure is complete, return the red handle of the sample-calibrate valve to the up position, pointing toward the Sample Port. If the sample-calibrate valve is not returned to the sample port position, the low flow fault alarm is activated when the calibration gas is removed. The O2 display on the ISA-100RAL-OD may have a slight variance in its reading for oxygen., This is due to pressure changes on the sensor. This variance should correct its self as the sensor readjust to the operation pressure. If it does not the reading can be adjusted by performing an AUTOMATIC ZERO, reference section 5.1.2.

5.1.4 Set Latches:

To latch and unlatch the alarm relays, after inserting a valid key, press the OPTION switch three times; "set LATCHES" is displayed. Press the Select switch; the particular alarm relay and its latch mode is displayed, for example, "Relay: 10ppm CO, Latch: no". Use the OPTION switch to toggle the latch mode between "yes" and "no". Select the desired mode, then press the SELECT switch to step to the next relay. The procedure steps sequentially to all alarm relays in this manner; when complete, it returns to the "set LATCHES" position.

5.1.5 Set the Key:

To set a new key, after inserting a valid key, press the OPTION switch four times; "set KEY" is displayed. Press the SELECT switch; "Key = 0000" is displayed, with the underscore cursor under the left digit. Use the OPTION switch to change the left digit, select the desired digit, and use the SELECT switch to lock the digit in place and move the cursor one digit to the right. When all four digits of the new key have been selected, "new = XXXX" is displayed. Record the new key; without it, the maintenance menu cannot be reentered once it is left. If the key is lost, call ENMET customer service personnel.

From the "new = XXXX" position, press either the OPTION or the SELECT switch; "exit MAINTENANCE MODE" is displayed.

5.1.6 Exit:

From the "exit MAINTENANCE MODE" position, press the SELECT switch to resume the operational display. Or, press the OPTION switch to reenter the maintenance menu at the "run AUTOMATIC ZEROING" position.

5.2 Sensor Replacement

5.2.1 CO Sensor:

A CO sensor must be replaced when it can no longer be calibrated. To replace a sensor, perform the following steps.

- * Turn off the electrical power. The sample air can remain flowing.
- * Open the display panel. Remove the manifold housing from the sensor area.
- * Release the two manifold retention screws and remove the manifold.
- * Remove the old CO sensor, which is the bottommost sensor, and replace it with a new sensor.
- * Replace the manifold. Observe that the flowmeter reading is correct. Turn on the electrical power. Wait at least 30 minutes, then recalibrate the sensor per the instructions in Section 5.1.3.
- * CO sensor: If a fault code is displayed following calibration rerun the calibration procedure section 5.1.3. As the timer is counting down during calibration, a voltage is displayed on the screen beside the timing count. This voltage must be between 0.58 and 0.69. If it is not, adjust this voltage during the last 30 seconds of the calibration interval, using RV2 the bottom potentiometer on the sensor circuit board shown on Figure 5.3. If an adjustment is made, adjust the value to 0.65.
- * Replace the manifold housing, and secure the display panel. An instrument without the manifold housing in place is susceptible to RFI.

5.2.2 O2 Sensor:

An oxygen sensor must be replaced when it can no longer be calibrated in clean air. To replace the sensor, follow the general steps given for the replacement of the CO sensor, but effect a replacement of the oxygen sensor, which is the large sensor in the center position of the manifold. After sensor installation, wait at least 30 minutes for sensor to stabilize before recalibrating, reference section 5.1.3. If a fault code is displayed following calibration rerun the calibration section 5.1.3. While the timer is counting down during calibration, the digital potentiometer setting is displayed on the screen beside the timing count. This setting, which may range between 0 and 256, must be between 100 and 140. If it is not, adjust the setting to 128 using RV1, the upper potentiometer on the sensor circuit board, shown in Figure 5.3. The setting can be adjusted in all but the last 10 seconds of the calibration interval.

5.3 Humidifier Tube

The humidifier tube is used to assure that the CO and oxygen sensors are not subjected to extremely dry air for a long period of time, which would decrease their useful life. Change the humidifier tube when changing a CO sensor at the completion of its useful life. To do so, remove the sheetmetal cover from the top of the enclosure, exposing the humidifier tube. Note the coiled arrangement of the tube. Remove the old tube and replace it with the new one. Replace the sheetmetal cover.

5.4 Flow Control Orifice

A 0.006-inch diameter orifice is used to set the flow rate and to drop the air pressure. It is located at the top of the enclosure where the air enters the humidifier tube. In well maintained air systems, this orifice should not clog. However, if difficulty is experienced in maintaining flow rate with assured inlet pressure, remove air pressure from the equipment and examine this orifice; replace it if necessary.

5.5 Particulate Filter Replacement

On instruments with serial numbers S/N 188 and above, a filter is installed in the air line, as shown in Figure 5.4.

To replace this filter:

- Obtain a new filter
- Note the correct direction of flow, as denoted by the arrow on the filter body
- Remove the old filter
- Replace with the new filter

5.6 Power Supply

The power supply is a small module located on the back surface of the enclosure under the circuit board.

6.0 Replacement Parts and Accessory List

Part Number	Description
67052-028	Power Supply
67016-1106	Oxygen Cell
67020-1200	CO Cell, <i>for instruments S/N 299 and below</i>
67016-1204	CO Cell, <i>for instruments S/N 300 and above</i>
73070-009	Orifice
73108-002	Humidifier Tube
62022-005	Display
03427-000	Regulator Assembly, High Pressure
03407-000	Kit, Calibration ISA-100RAL
03407-001	Kit, Calibration ISA-100RAL-OD
03219-020	Cylinder, 20 ppm CO in air
03296-209	Cylinder, 20.9% oxygen in nitrogen
03700-022	Calibration Adapter
73089-002	Filter, particulate <i>for instruments S/N 188 and above</i>

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 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.

Appendix A

The Characteristics and Effects of Carbon Monoxide

Carbon monoxide is a colorless odorless toxic gas generated by incomplete combustion of a hydrocarbon fuel in air. It may be present where internal combustion engines, furnaces, boilers, and other combustion devices are present. It is toxic when inhaled because of its great affinity to hemoglobin, the oxygen carriers in the red cells of the blood. CO replaces the oxygen normally carried by the hemoglobin, and thus inhibits the delivery of oxygen throughout the body; the victim suffers from oxygen deficiency, and may die from asphyxiation. The symptoms and degree of danger resulting from exposure to CO depend upon the concentration of the gas and the length of exposure; this is shown in Figure 3.2. The ISA-100-RAL instrument is employed to warn the user of the presence of CO, and to facilitate the assessment of the degree of danger that he or she is exposed to.

Based upon knowledge of the effects of CO, the Occupational Safety and Health Authority (OSHA) has set limits on exposure to CO in the workplace. These are 35 ppm (parts CO per million parts air) as an time weighted average for an eight hour day, and a maximum exposure of 200 ppm. For compressed air line applications, OSHA requires Grade D breathing air supplied, using a Compressed Gas Association (CGA) definition (G-7.1). Depending on interpretation of the OSHA respiratory standard, 10 ppm and 20 ppm CO have been used as maximum limits and standard instrument alarm points.

The ISA-100-RAL has two preset alarm setpoints, at 10 ppm and 20 ppm CO, which are adjustable, but cannot be set below 5 ppm or above 100 ppm.

The curves below are for percent carboxalhemoglobin with 50% being the top curve, 5% the bottom. %COHb is a measure of the amount of hemoglobin occupied by CO rather than oxygen. CO effects upon children, adults engaging in physical activity, and smokers, are more pronounced.