OPW
FUEL MANAGEMENT SYSTEMS
A DOVER COMPANY

EECO SYSTEM®

Leak Sensor Jr.
Installation Operation
& Maintenance Manual

Q340-002
October 5, 1995 (Reprint)

TABLE OF CONTENTS

TABLE OF CONTENTS

ILLUSTRATIONS/TABLES

1.0 GENERAL INFORMATION

1.1 FCC NOTICE

WARNING: This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with this instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

WARNING: The Leak Sensor Jr. system is designed to detect liquid and hydrocarbon vapors in a safe and reliable manner when installed as instructed herein. Deviation from these procedures including the installation or use of nonapproved components could result in unsafe conditions or unreliable operation and will void the warranty. Safe installation is the responsibility of the installer and user. Refer to the EMCO WHEATON sales brochure (Q104) for additional system and application information.

1.2 CODES AND STANDARDS

The codes and standards called for or referred to herein are hereby made a part of this manual. The latest edition shall apply. In the event of discrepancies in specification code or standards, the more stringent and/or local codes shall govern.

1.1 NEMA - National Electrical Manufacturers Association

1.2 NEC - National Electrical Code

1.3 IEEE - Institute of Electrical & Electronic Engineers

1.4 ISA - Instrument Society of America

1.5 UL - Underwriters Laboratories

1.6 FM - Factory Mutual Research

Install in accordance with NEC (NFPA 70) and Automotive and Marine Service Station Codes (NFPA 30A) and local codes.

1.3 SPECIFICATIONS

Power:
- Primary 115 VAC, +/- 10 %, 0.5A
- Secondary 12 VAC, 25 VA

Operating Temperature:
- 0 - 50°C (32 - 122°F)

Microprocessor:
- 8749 Micro-controller.

Sensors:
- Refer to Appendix A for sensor types.

Interface Board Types:
- Liquid Proximity Sensor interface board.
- Liquid Thermistor Sensor interface board.
- Vapor Standard Sensor interface board.
- Vapor LVH Sensor interface board.
- Interstitial Space Flood interface board.

Diagnostic Mode:
- Internal (Self diagnostic). Checks complete ALARM path circuit from sensor input barriers to indicators.

Alarm Relay (Standard):
- Relay contacts for connection to external alarm circuit (light, horn, etc.). Maximum ratings of: 5 Amps, 120 VAC (unit has normally open and normally closed contacts).

Relay Alarm Box (Optional):
- Optional alarm relay box contains six separate relays (one for each sensor channel). The contacts are rated for 10 Amps, 250 VAC.

Approvals:
- UL Listed - File MH7630.
- FM approved.
- FCC test for Class A Computing device (Part 15 Subpart J).
- CSA approved.

1.4 QUICK INSTALLATION REFERENCE

PARTS REQUIRED:

1. Circuit Breaker, 15 Amp rating.
2. 14 gauge power wire (black, white, green) - UL Listed.
3. 3/4 inch rigid metal conduit with couplings.
4. 16 gauge stranded sensor wire (colored and black).
5. 1/2 inch rigid metal conduit with couplings and junction boxes.
6. Wire identification markers.

GENERAL INSTALLATION STEPS:

1. Mount Leak Sensor Jr. console (standard box) on wall inside.
2. Install power conduit and wires.
3. Replace power supply cover.
4. Install sensor conduit and wires.
5. Install sensors.
6. Start system and verify operation.

1.5 CONTRACTOR SUPPLIED ITEMS

ITEM	QTY	ITEM	QTY
15 Amp Circuit Breaker	1	N/A	N/A
3/4 " Rigid Metal Conduit	A/R	1/2" Rigid Metal Conduit	A/R
3/4 " Rigid Metal Connector	A/R	1/2" Rigid Metal Connector	A/R
3/4 " Rigid Metal Couplings	A/R	1/2" Rigid Metal Couplings	A/R
3/4 " Rigid Metal Locknut	A/R	1/2" Rigid Metal Locknut	A/R
3/4 " Conduit Bushing	A/R	1/2" Conduit Bushing	A/R
WIRE #14 THWN OR THHN (power wiring)			A/R
WIRE #16 THWN OR THHN STRANDED 26X30 Red (sensor wiring)			A/R
WIRE #16 THWN OR THHN STRANDED 26X30 Black (sensor wiring)			A/R
1/2" MYERS ELEC."SCRUTITE"	P/N ST-1	Conduit Hub	A/R
3/4" MYERS ELEC."SCRUTITE"	P/N ST-2	Conduit Hub	A/R
1/2" THOMAS&BETTS "BULLET"	P/N 370	Conduit Hub	A/R
3/4" THOMAS&BETTS "BULLET"	P/N 371	Conduit Hub	A/R

2.0 SYSTEM DESCRIPTION

2.1 GENERAL DESCRIPTION

The purpose of this EMCO WHEATON Leak Sensor Jr. manual is to instruct the installer and user in the procedures to install, operate, and maintain a safe and reliable leak detection system. The information presented herein is intended for use by qualified installers and trained operators at the user's facility. (Refer to Figure 1 for Typical Leak Sensor Installation).

2.2 SYSTEM CONTROLLER

The Leak Sensor Jr. system controller is a totally automated, micro computer controlled vapor and liquid sensing system. It accepts input from up to four (4) standard sensors, through two sensor interface boards, for monitoring hydrocarbon storage sites for leaks and spills. The system has special input circuits to monitor two (2) switch closure inputs for the connection of non-EMCO WHEATON devices such as pressure or vacuum operated switches or high product switch devices. (See Section 3.3.3).

The system is housed in a metal wall mounted enclosure (standard) for installation in a non-hazardous enclosed area or a NEMA-4 Weather Proof Box (optional) for installation in a non-hazardous unprotected area. Each enclosure includes a Microprocessor/Display circuit board and a Backplane board (contains power supply, input circuits for 2 switch closures, Alarm Relay, and connections for 2 sensor interface boards).

The microcomputer control program continually monitors each sensor channel and activates the audible alarm and corresponding LED to identify any detected problems (alarm condition or system fault). The sensor channel will be identified by an Alarm or Trouble Light on the front display panel.

The audible alarm may be silenced from the front panel without clearing the fault indication LED. The system includes a special monitoring circuit to continually test for open or shorted field sensor wiring.

When installed as instructed herein, the Leak Sensor Jr. system is designed to detect liquid and hydrocarbon vapors in a safe and reliable manner. Deviation from this procedure could result in unsafe conditions or unreliable operation and could void the warranty. Safety is the responsibility of the installer and user. Refer to the EMCO WHEATON sales brochure for additional system and application information.

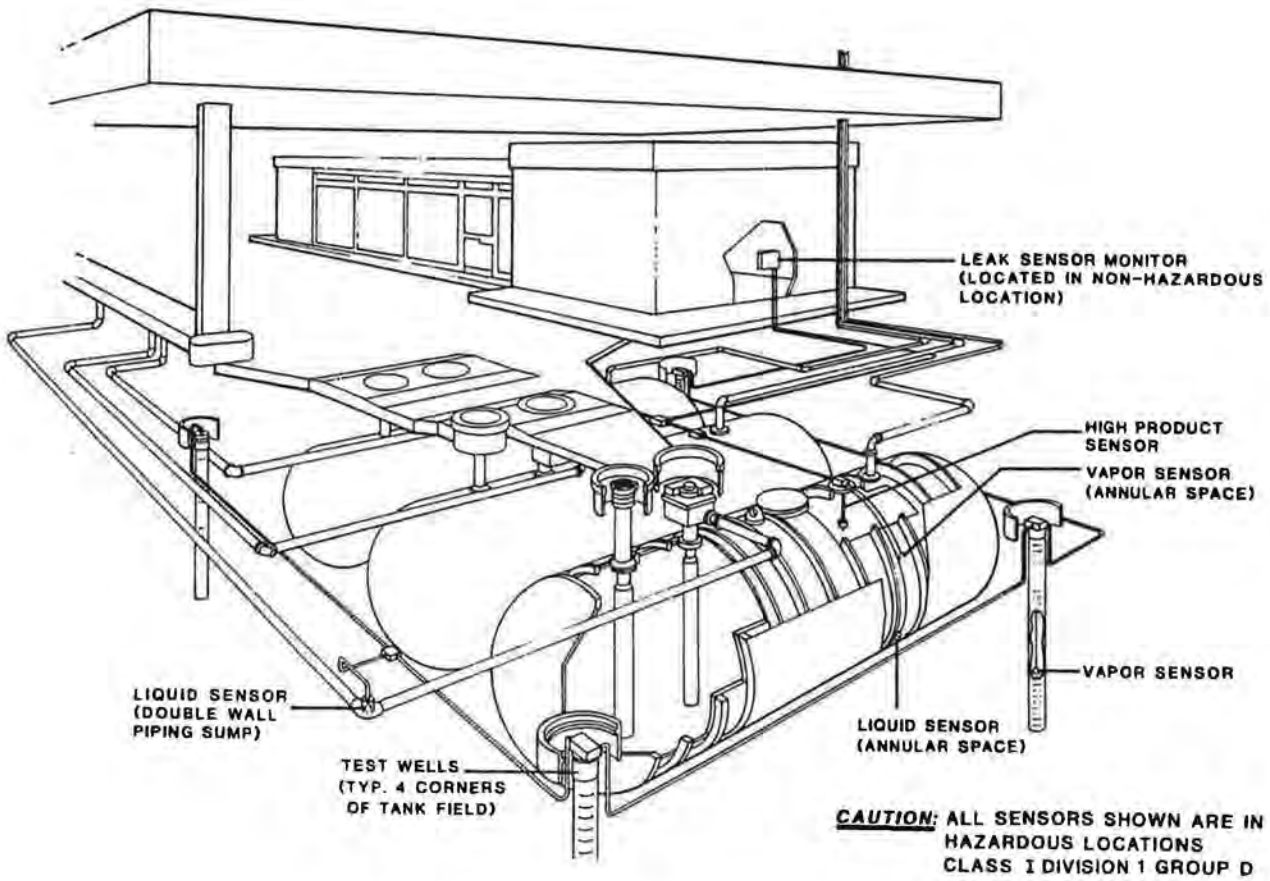


FIGURE 1: TYPICAL INSTALLATION (Drawing Q0340-104-41 Sheet 1)

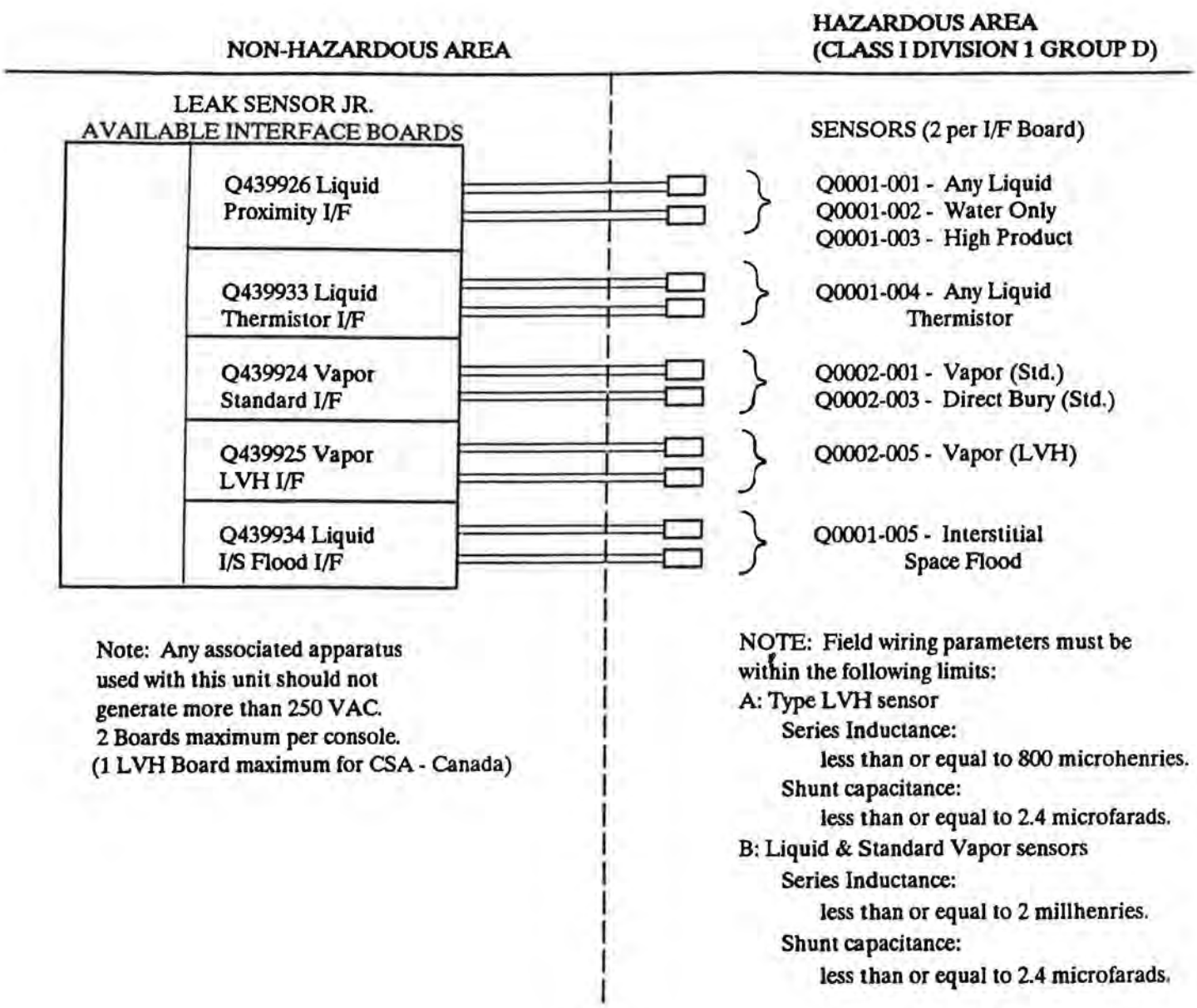


FIGURE 2: LEAK SENSOR JR. INTERFACE TO SENSOR PART NUMBER IDENTIFICATION (Drawing Q0340-104-41 - Sheet 2)

2.3 SENSOR INTERFACE BOARDS

The Leak Sensor Jr. can be configured with two Sensor Interface Boards, using either liquid proximity, liquid thermistor, standard vapor, LVH vapor, or interstitial space flood or a combination of the above. Two sensors (of the same type) may be attached to each interface board. Refer to Figure 2 (Leak Sensor Jr. Interface to Sensor Part Number Identification).

2.4 INDICATOR PANEL (Refer to Figure 3)

Four rows of indicator LEDs are located on the front panel to convey system status to the user.

ROW 1 - 6 ALARM (red) LEDs
A "flashing" LED indicates an "active" alarm condition, while a "steady" LED indicates a transient condition (an alarm that has ceased).

ROW 2 - 6 NORMAL (green) LEDs
A green LED will be "ON" for each "enabled" sensor channel during normal operation.

ROW 3 - 4 TROUBLE (yellow) LEDs

A "flashing" yellow LED indicates detection of a shorted or open sensor circuit while a "steady" LED indicates a transient condition.

ROW 4 - TEST, SILENT, OPERATING

The TEST (red) LED is "ON" during operation of the diagnostic test. The SILENT (red) LED is "ON" if the SILENT button has been pressed. The

OPERATING (green) LED "flashes" during normal operation of the system.

Controls consist of a TEST button to initialize the diagnostic test, a SILENT button to silence the audible alarm (does not clear alarm indication), and a key operated RESET switch to clear alarm indications after an alarm has occurred and has been corrected.

2.5 SENSORS

The sensors used with the Leak Sensor Jr. system are designed to detect the presence of liquids and hydrocarbon vapors when located in observation wells or in the interstitial space of a double wall tank. Refer to Appendix A for further information on the installation and operation of the sensors.

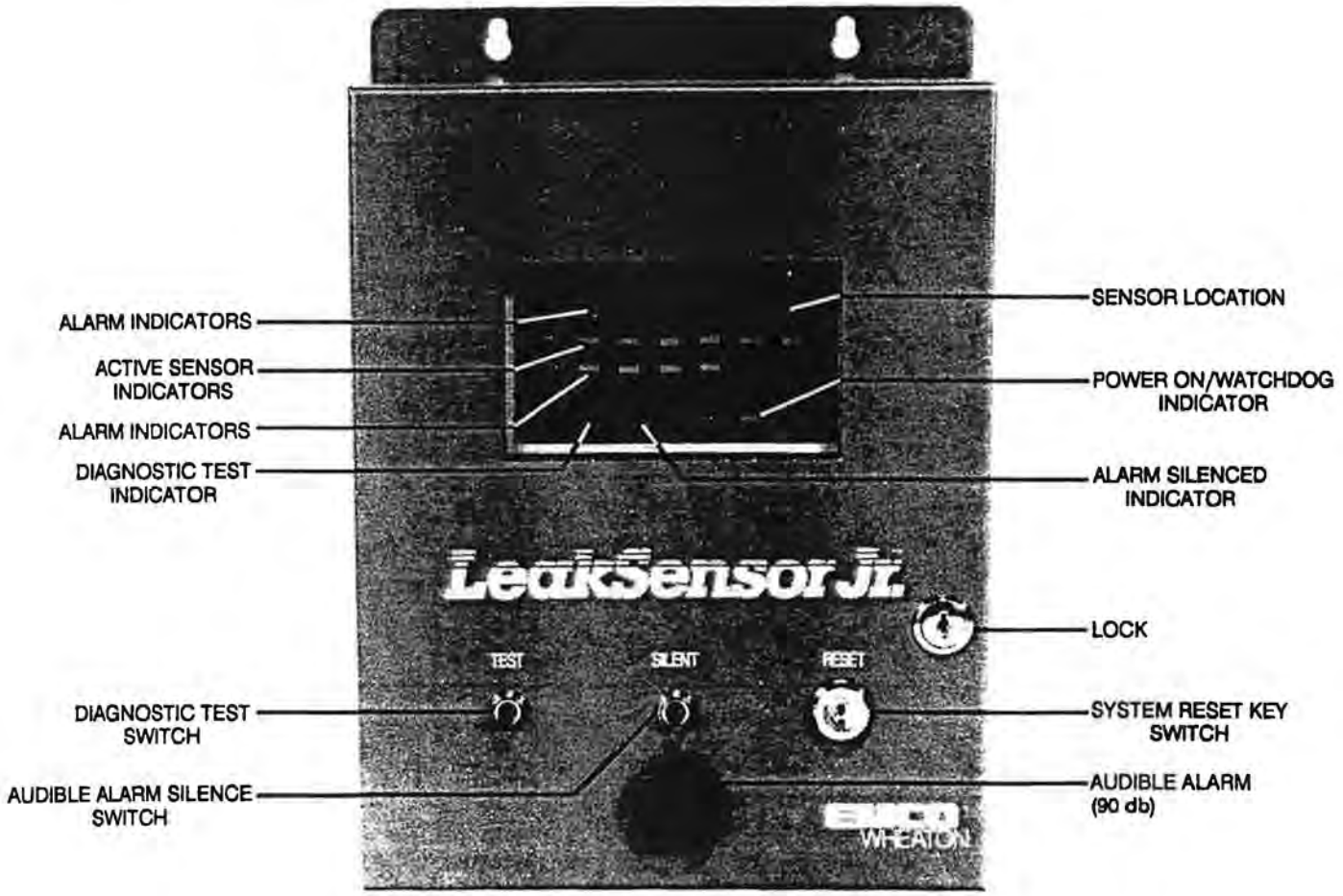


FIGURE 3: LEAK SENSOR JR. FRONT PANEL

3.0 INSTALLATION

3.1 SYSTEM PLANNING

Before starting the installation, the following planning must be completed:

- Read and understand this manual.
- Prepare all site layouts.
- Obtain all necessary permits.
- Specify installation to conform to all local codes/practices.

It is recommended that the user read and understand ANSI/ISA RP126, "Installation of Intrinsically Safe Instrument Systems", in Class I Hazardous Locations.

The Leak Sensor Jr. Controller may be located up to 1500 feet from the sensors using 16 gauge wires. Route all field wiring through rigid steel conduit and fittings approved for intrinsically safe circuits installed in accordance with NEC (NFPA 70) and Automotive and Marine Service Station Code (NFPA 30 A) hazardous locations. The standard Leak Sensor Jr. enclosures are designed to be wall mounted inside a non-hazardous area with 115 VAC power supplied through a dedicated circuit breaker. (The optional NEMA 4 enclosure is weather proof for mounting outdoors, but must be located outside the hazardous area).

3.2 SYSTEM CONFIGURATION

Each of the five Sensor Interface Board types are designed for a specific type of sensor. Two of the same type sensors may be connected to the interface board. Use the diagram below to select the correct sensor and interface board combination.

LEAK SENSOR JR. INTERFACE BOARDS	SENSOR TYPES (2 sensors per I/F board type)	FIELD WIRES
Q439926 Liquid Proximity I/F	Q0001-001 - Any Liquid (Proximity) Q0001-002 - Water Only (Proximity) Q0001-003 - High Product (Proximity)	2 each 2 each 2 each
Q439933 Liquid Thermistor I/F	Q0001-004 - Any Liquid (Thermistor)	3 each
Q439924 Vapor Standard I/F	Q0002-001 - Vapor (Standard) Q0002-003 - Direct Bury (Std. Vapor)	2 each 2 each
Q439925 Vapor LVH I/F	Q0002-005 - Vapor (LVH)	3 each
Q439934 Liquid I/S Flood I/F	Q0001-005 - Interstitial Space Flood	2 each

NOTE: Match the sensor type to the designated board type.

EXAMPLE: One Q0001-001 and one Q0001-003 may be connected to Q439926 I/F
or one Q0002-001 and one Q0002-003 may be connected to Q439924 I/F
or two Q0002-005 may be connected to Q439925 I/F board.

3.3 MECHANICAL/ELECTRICAL INSTALLATION

3.3.1 SYSTEM CONTROLLER

Using the dimensions shown in Figure 4, mount the Leak Sensor Jr. system controller inside a non-hazardous location and positioned where the operator can see the control panel and hear the alarm.

NOTE: Use only listed rigid threaded conduit and listed gasketed weatherproof conduit connectors when installing NEMA 4 boxes. Refer to contractor supplied items listed for approved types.

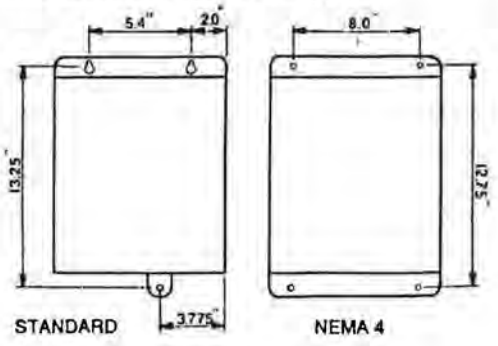


FIGURE 4: MOUNTING DIMENSIONS

Secure the box with #10 screws or appropriate fasteners (3 or 4 required).

WARNING! The Leak Sensor Jr. requires a dedicated circuit breaker and primary power line. Deviation from this requirement may cause improper operation of the system. Power required for this unit is 115 VAC, 60 HZ, single phase 0.5 Amps.

Refer to Figure 5 for the following procedure.

- Remove the knockout located below power supply AC terminals.
- Install 1/2 inch rigid conduit from the controller to the power panel. (Install per NEC and local code).
- Run 3 conductor, universal code (black, white, green), standard gauge wire through the conduit (14 gauge, UL Listed).

WARNING! Do <u>not</u> connect power at this time!

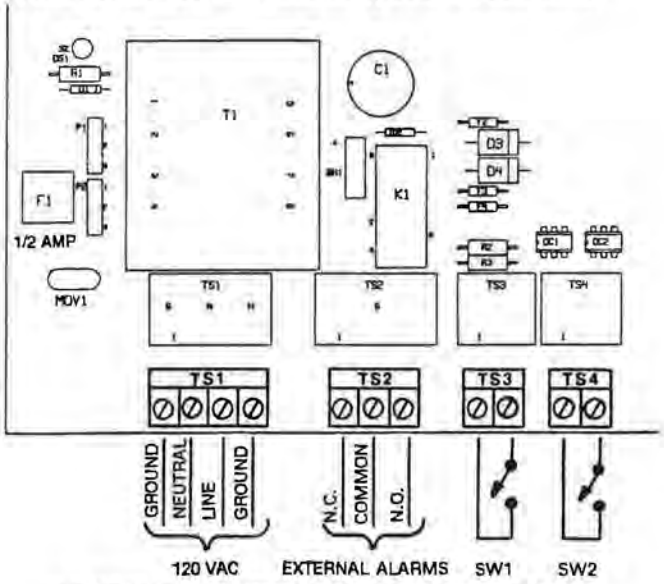


FIGURE 5: EXTERNAL CONNECTIONS

Connect 115 VAC wires to power supply as shown in Figure 5 by securing the ground, neutral, and line wires under the screw lugs of terminals G, N, and L terminals located below the power transformer.

NOTE: Install circuit breaker and connect power wires now BUT leave circuit breaker <u>OFF</u>!

3.3.2 EXTERNAL ALARM RELAY

Connect an external alarm circuit to the Alarm Relay Contact terminals (COMMON, N.O. or N.C) shown in Figure 5. Observe maximum ratings of 5 Amps, 120 V. Activation of the External Alarm may be determined by the placement of jumper P3 on MPU/Display board (refer to Figure 13). Place the jumper to the upper position to allow the external alarm to be silenced with the front panel Silent switch. When jumper P3 is in the lower position, the Silent switch has no affect on the external alarm. (See section 6.0).

3.3.3 SWITCH CLOSURE INPUT

The two "Switch Closure Inputs" are designed to accept devices which operate by closing or opening a set of switch contacts (no voltage). The Leak Sensor Jr. input mode may be changed from Normally Open operation (switch closes upon activation) to Normally Closed operation (switch opens upon activation of the device) by moving the shorting jumper (P1 or P2) from the lower position to the upper position. (Refer to Figure 12).

<u>The Leak Sensor Jr. switch closure inputs are NOT Intrinsically Safe. Any device connected to these inputs must be installed per NEC and Local Codes. Maximum resistance for the "closed" input must not exceed 600 ohms to insure safe and correct system operation.</u>

3.3.4 CONDUIT

Install 1/2 or 3/4 inch rigid conduit from the Leak Sensor Jr. controller enclosure to the tank field. Install per National Electrical Code and local standards.

NOTE: Conduit run must contain <u>only</u> the Leak Sensor Jr. sensor wires to comply with UL certification for Intrinsically Safe Circuits).

3.3.5 SENSOR PLACEMENT

Refer to Appendix A for correct sensor installation.

3.3.6 FIELD WIRING

NOTE: FIELD WIRES FOR INTRINSICALLY SAFE CIRCUITS MAY <u>NOT</u> BE RUN WITH ANY OTHER WIRING.

All sensor wiring must be installed in compliance with the National Electrical Code and Local Code requirements. Install 16 gauge THHN or THWN (stranded

26X30) wires in the conduit for the required sensors. Use black for the sensor Ground (DC common) and colored for the remaining wires. Leave extra wire (approximately 24 inches) at each end. Secure the sensor wires to the appropriate field wires inside the junction box with butt splices.

SENSOR TYPE	WIRES	DESIGNATION
Liquid (Proximity)	2	Signal - White Common - Black
Liquid (Thermistor)	3	Voltage - White Signal - Green Common - Black
Vapor (Standard)	2	Signal - White Common - Black
Vapor (LVH)	3	Voltage - White Signal - Green Common - Black
Interstitial Space Flood	2	Signal - White Common - Black

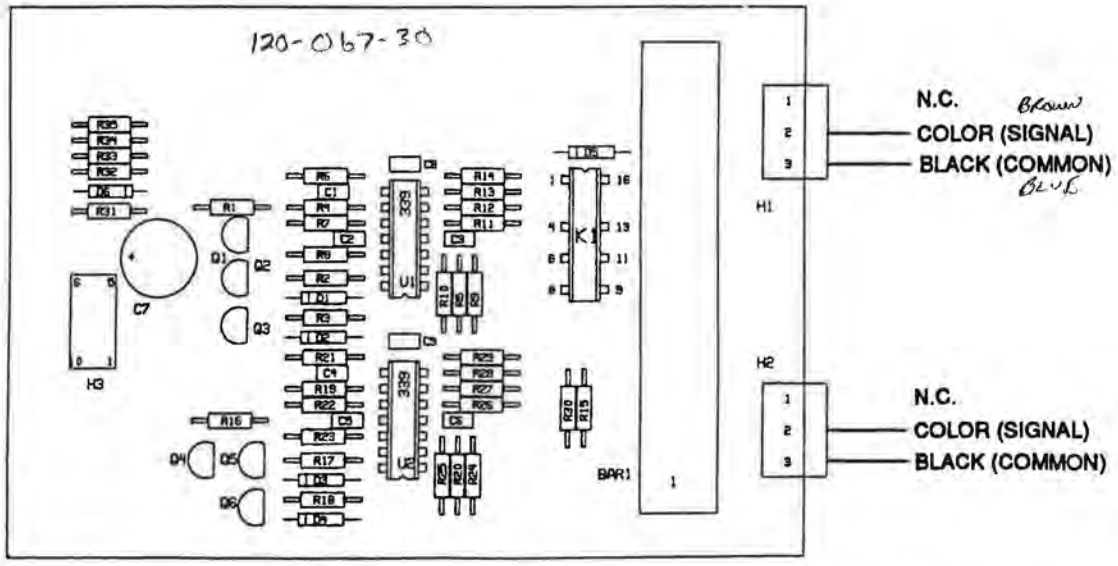


FIGURE 6: LIQUID SENSOR (PROXIMITY) INTERFACE BOARD P/N Q-439926

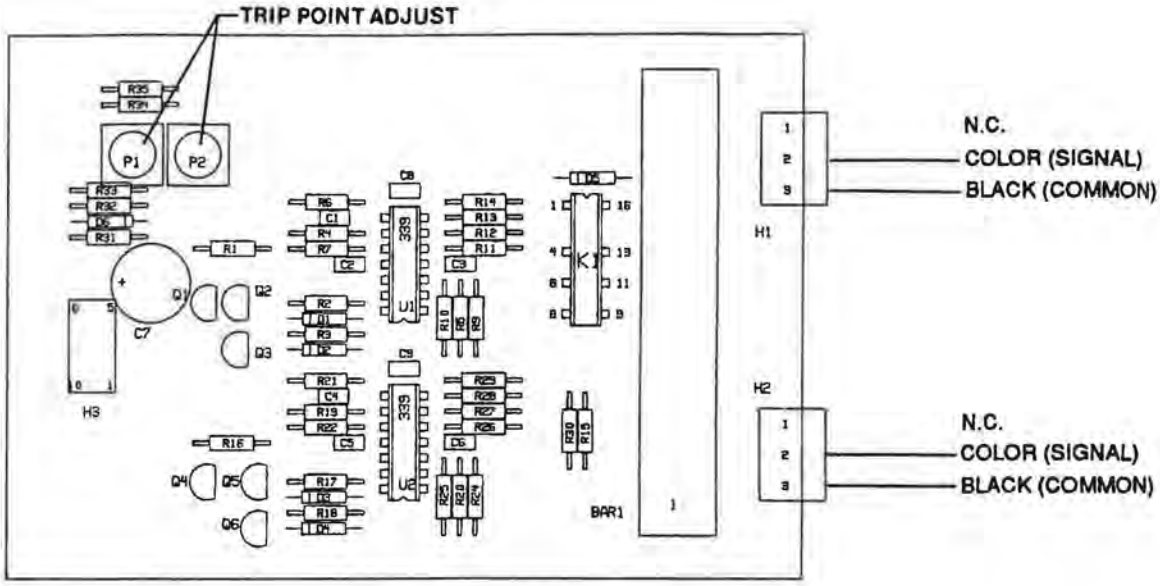


FIGURE 7: STANDARD VAPOR SENSOR INTERFACE BOARD P/N Q-439924

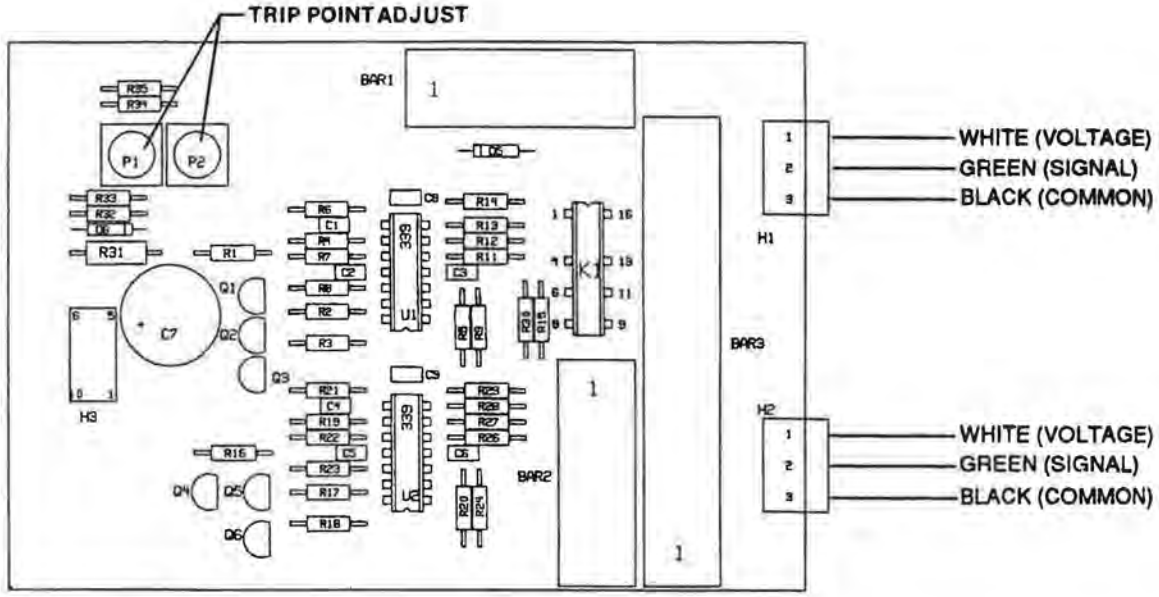


FIGURE 8: LVH VAPOR SENSOR INTERFACE BOARD P/N Q-439925

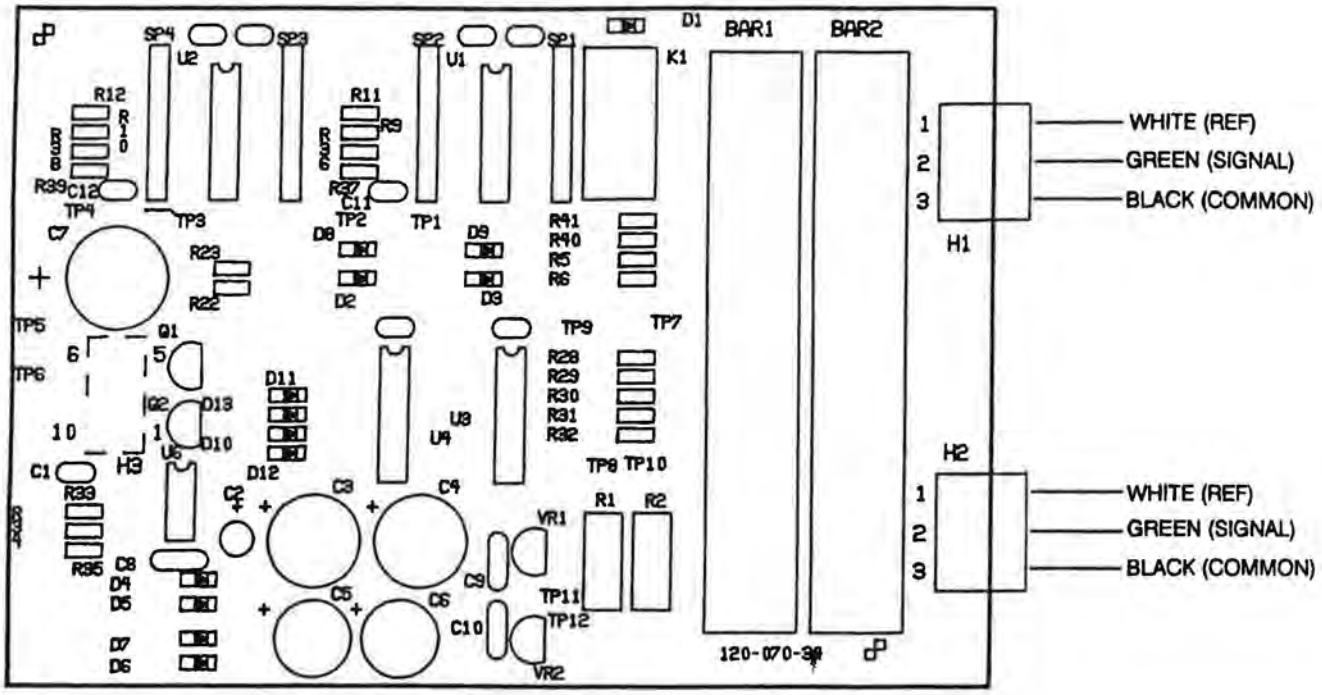


FIGURE 9: LIQUID SENSOR (THERMISTOR) INTERFACE BOARD P/N Q439933

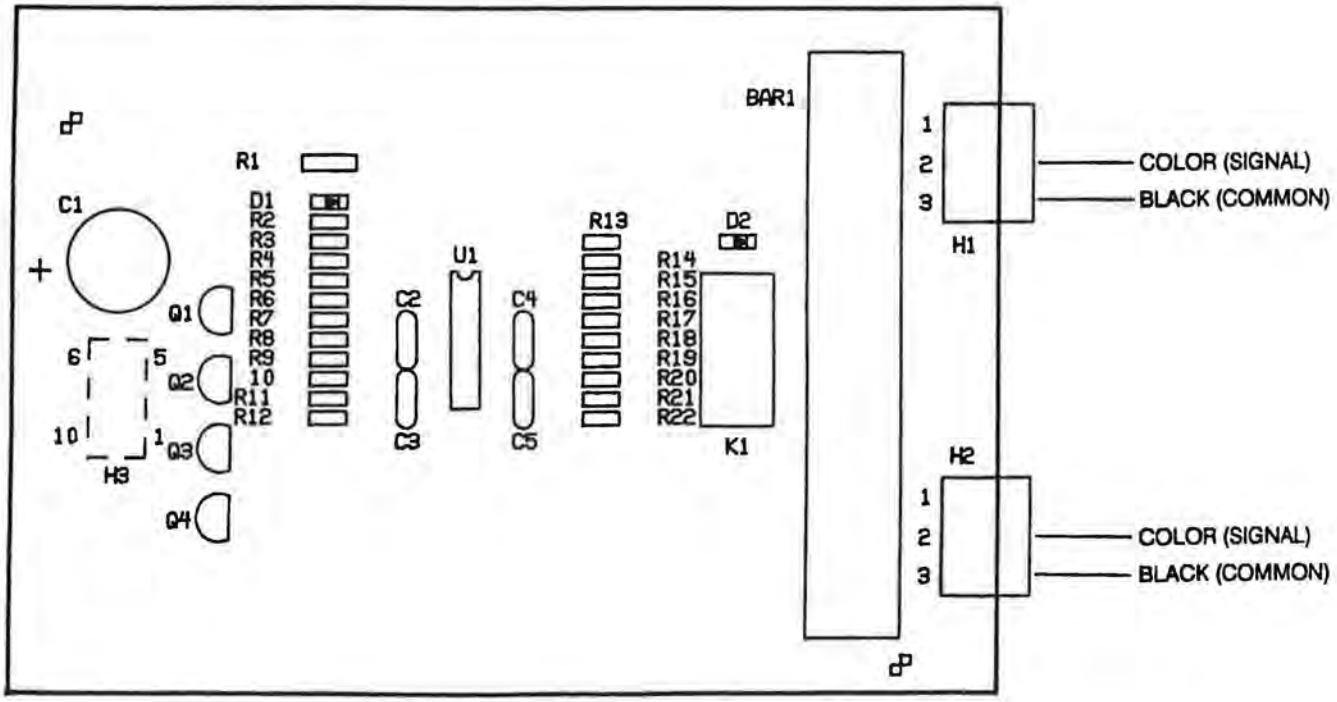


FIGURE 10: INTERSTITIAL SPACE FLOOD SENSOR INTERFACE BOARD P/N Q439934

3.3.7 FIELD WIRING TO INTERFACE CONNECTION

Install the field wires in the interface connector as indicated in the table below. Refer to Figures 6, 7, 8, 9, & 10 for Interface connections.

BOARD P/N	TYPE	NUMBER OF WIRES	CONN.	WIRE LABEL
Q439926	Liquid Proximity	2	H1-1	No Connection
			H1-2	L1-Signal
			H1-3	L1-Common (black)
		2	H2-1	No Connection
			H2-2	L2-Signal
			H2-3	L2-Common (black)
Q439933	Liquid Thermistor	3	H1-1	L1-Voltage
			H1-2	L1-Signal
			H1-3	L1-Common (black)
		3	H2-1	L2-Voltage
			H2-2	L2-Signal
			H2-3	L2-Common (black)
Q439924	Vapor (Standard)	2	H1-1	No Connection
			H1-2	V1-Signal
			H1-3	V1-Common (black)
		2	H2-1	No Connection
			H2-2	V2-Signal
			H2-3	V2-Common (black)
Q439925	Vapor (LVH)	3	H1-1	V1-Voltage
			H1-2	V1-Signal
			H1-3	V1-Common (black)
		3	H2-1	V1-Voltage
			H2-2	V2-Signal
			H2-3	V2-Common (black)
Q439934	Liquid Interstitial Space Flood	2	H1-1	No Connection
			H1-2	L1-Signal
			H1-3	L1-Common (black)
		2	H2-1	No Connection
			H2-2	L2-Signal
			H2-3	L2-Common (black)

CAUTION:

Liquid Sensor wiring polarity MUST be observed. If wired incorrectly, alarm will result.

When the wires have been installed in the supplied connector, plug the connector into the appropriate interface board.

WARNING:

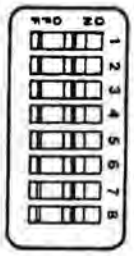
Reinstall the metal cover over the sensor wire connections to secure the Intrinsically Safe area.

3.3.8 ENABLE SENSORS

NOTE: Sensor channel selections are recognized on Power Up and Reset. The sensor channels are shipped from the factory set to the ENABLE position and will be in alarm on any unused channel until start-up procedures are completed and the system reset.

Only switch positions with corresponding sensors attached to the input are placed in the UP position. Refer to Figures 11 and 12.

The Sensor Enable Switches S1 (Refer to Figure 11) are located on the lower right quadrant of the MPU/ Display board. The eight position DIP switch is labeled 1 through 8 (only the first 6 are used). Place the switch corresponding to the sensor channel in the "ON" (up) position. Channels without sensors attached must be in the "OFF" (down) position.



SWITCH POSITION	DISPLAY
BOTTOM BOARD 1	A1
BOTTOM BOARD 2	A2
TOP BOARD 1	B1
TOP BOARD 2	B2
SWITCH 1	S1
SWITCH 2	S2
NOT USED	-
NOT USED	-

FIGURE 11: ENABLE SWITCH

3.3.9 SYSTEM START-UP

1. Check that metal cover has been installed over the field wire connection area.

2. Check earth ground (green wire) to chassis with ohm meter. Resistance should be less than 1 ohm.

3. Connect the circuit breaker per standard practices.

4. Turn circuit breaker on.

5. Install a Do Not Turn Off label on the circuit breaker. The Leak Sensor Jr. is designed for continuous duty.

3.3.10 SYSTEM ADJUSTMENTS

The Leak Sensor Jr. system requires no adjustments except Vapor Sensor trip point level adjustment for background noise (residual vapors). Setting the trip point does NOT turn the sensor OFF, only changes the alarm trip point to a slightly higher setting (less sensitive).

3.3.10.1 STANDARD VAPOR CIRCUIT (Refer to Figure 7)

Locate the Trip Point Adjustments P1 & P2 on the Standard Vapor interface board. Adjust the potentiometer clockwise for the corresponding sensor channel until the red LED on the front panel flashes. Turn the adjustment counterclockwise until the red LED stops flashing, then turn the adjustment screw an additional 10 degrees.

If the adjustment does not cause the red LED to stop flashing, there may be an actual Alarm condition detected by the sensor. This condition may be verified by removing the sensor from the tank or test well and allowing 5 to 10 minutes for the sensor to clear, at which time the red LED will stop flashing.

3.3.10.2 LVH VAPOR CIRCUIT (Refer to Figure 8)

NOTE: Wait approximately 1 hour after power up before making this adjustment. The LVH sensor must warm up prior to normal operation.

Locate the Trip Point Adjustment P1 & P2 on the LVH Vapor interface board. Adjust the potentiometer clockwise for the corresponding sensor channel until the red LED on the front panel flashes. Turn the adjustment counterclockwise until the red LED stops flashing, then turn the adjustment screw an additional 10 degrees.

If the adjustment will not cause the red LED to stop flashing, there may be an actual alarm condition detected by the sensor. This condition may be verified by removing the sensor from the tank or test well and allowing 5 to 10 minutes for the sensor to clear, at which time the red LED will stop flashing.

The LVH Vapor Sensor requires approximately one hour to stabilize after power has been applied or restored following extended power outages and may indicate an alarm condition during this warm up period. Check the site for leaks or spills if the alarm condition does not clear after a reasonable length of time.

This adjustment may be required again after the sensor has adapted to the environment it is placed in. Reset the system with the reset switch.

3.3.11 SYSTEM DIAGNOSTIC
(Runs Automatically At Power-Up)

Close the front cover and press the diagnostic Test switch. All front panel lamps will light simultaneously for 1 second. The MPU activates a relay on each sensor interface board and monitors the "fault" circuit path for a correct level. The green Normal LED flashes during this segment of the test. Any faults detected during the diagnostic test will be indicated by a flashing yellow Trouble LED for the defective channel. Any channel with an "active" alarm or fault condition at the end of the test will be indicated by a flashing red Alarm LED. Successful completion of the diagnostics is indicated by the green Normal LEDs on for all enabled channels and the green Operating LED flashing.

If no problems have been encountered to this time, the installation is complete. Close and secure the front panel.

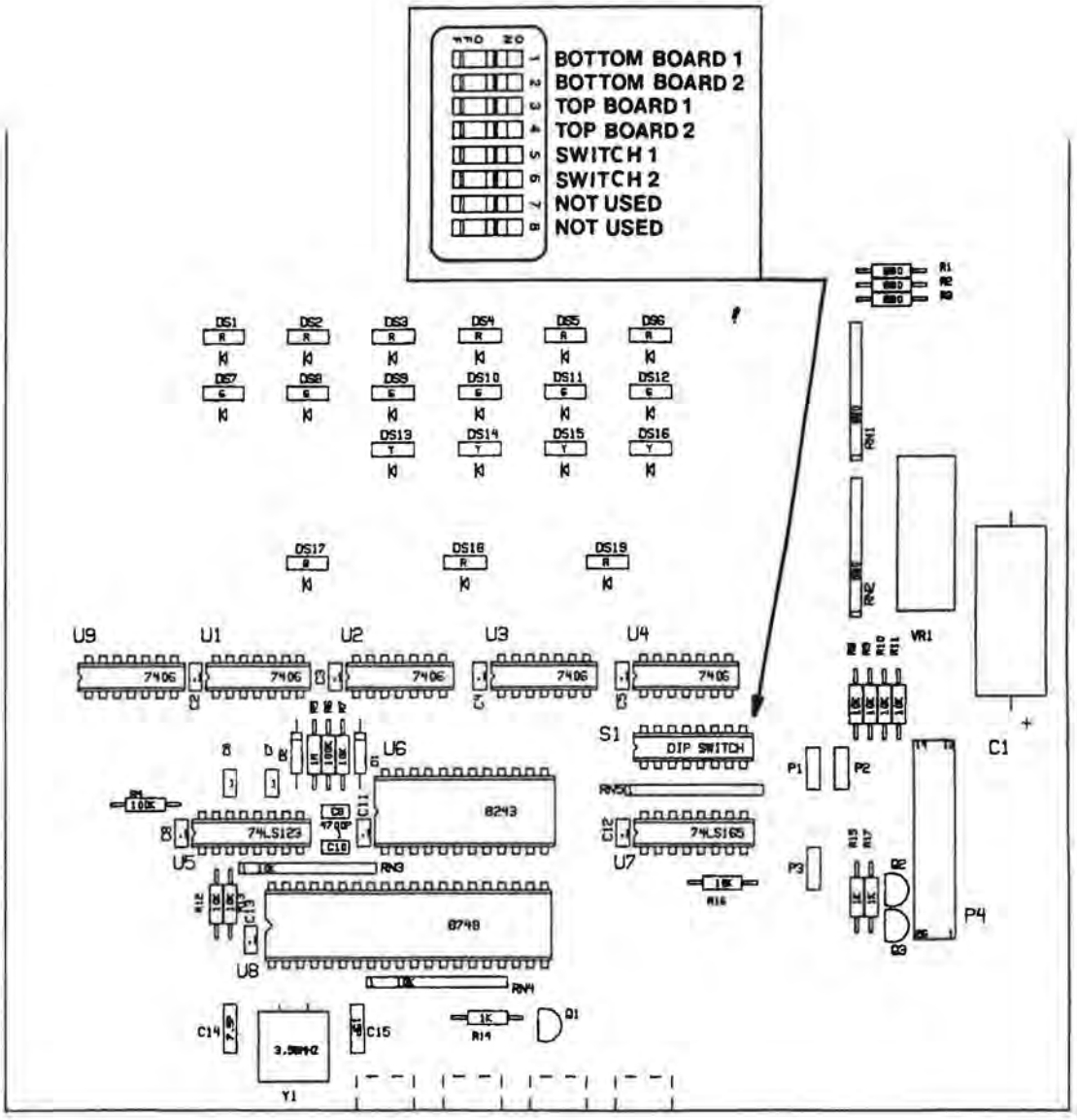


FIGURE - 12: MPU AND DISPLAY BOARD

4.0 OPERATION

The Leak Sensor Jr. is designed to operate continuously after initial installation and check-out for constant 24-hour-a-day monitoring of sensors. The front indicator panel provides status of the sensors and indication of correct operation. Under normal operation, the green light will be flashing (no fault conditions present) and the normal light will be on for each enabled channel.

4.1 DIAGNOSTICS

Internal Diagnostics will run when power is turned on or when the "Test" switch is pressed. This test illuminates all lights on the front panel and sounds the audible alarm for one second to test the lights and alarm. Then a set of relays are activated to test the alarm path of the electronic circuit and blinks all active channel Normal lights to indicate the circuits being tested. The Trouble Light for a channel that does not pass the test will remain lit upon completion of the test.

4.2 ALARM CONDITION

A flashing red Alarm Light and audible alarm indicates detection of a vapor or liquid leak. Trouble in the sensor wiring (either shorted or open) will be indicated by a flashing yellow Trouble Light for the defective channel. The green Normal Light for the channel will be "Off".

An Active Alarm is indicated by a "flashing" LED. A transient condition is indicated with a "steady" LED (not blinking).

4.3 SILENT SWITCH

The audible alarm may be silenced by actuating the Silent switch (located in the center of the front panel). The "Silent" light will be illuminated. Any active Alarm or Trouble indications will not be affected by activation of the Silent switch. Any new alarm condition will cause the audible alarm to sound again and the new alarm channel light to be illuminated.

NOTE: Silencing the audible alarm does not solve the problem! When a problem does exist, after a reset, the Leak Sensor Jr. will return to the alarm condition until the problem has been corrected.

4.4 SYSTEM RESET

The Leak Sensor Jr. can be reset by actuating the reset key switch (located on the front panel). Notify the proper authority if either a red or yellow light is illuminated on the front panel or call EMCO at 1-800-342-6125.

4.5 POWER INTERRUPTIONS

Restoration of power after a power loss at the site has occurred will <u>not</u> cause a problem in the operation of the Leak Sensor Jr. The system will automatically reinitialize, perform the diagnostic test and continue normal operation. A period of time may be required for the type LVH Sensor to return to its' preset operating condition after an extended power outage and may require a system Reset.

5.0 MAINTENANCE

The Leak Sensor Jr. is maintenance free, however it is recommended that a preventive maintenance schedule be performed annually.

5.1 DIAGNOSTICS

Activate the Internal Diagnostics by pressing the TEST switch. Observe the operation for defective LEDs on the front panel. (Refer to Paragraph 4.1).

5.2 SENSORS

Each sensor should be checked for electrical functionality by observing the LED indicators on the front panel during testing ("flashing" LED indicates active alarm condition). For testing any sensor, refer to Appendix A.

6.0 RELAY BOX (OPTIONAL)

The optional relay box provides (6) relays for the external connection of alarms or other devices. Each relay is actuated by it's corresponding sensor channel when an alarm condition is detected. Both normally open and normally closed contacts are available for use with connections via a terminal block. Each relay contact is rated 10 amps, 250VAC. The relay contacts may be used to activate lights on remote control pan-

els, start or stop pumps (observe contact ratings) etc. Refer to Figure 13 when making connections to the relays contacts. (see Section 6.2).

6.1 INSTALLATION (MECHANICAL)

Position the Relay Box as shown in Figure 13. Remove the knockout from the left side of the Leak Sensor Jr. enclosure and connect the enclosures with a length of conduit (maintaining the 10" maximum). Feed the ribbon cable and ground wire through the conduit and connect the ribbon cable to H2 (located on left side of Backplane board). Route the green ground wire down to the power ground terminal (refer to Figure 13).

NOTE: Use only listed rigid threaded conduit, 1 inch trade size only, maximum 10 inches long, with listed gasketed weatherproof conduit connectors when installing this assembly outdoors. Refer to contractor supplied items (see section 1.5) list for approved types.

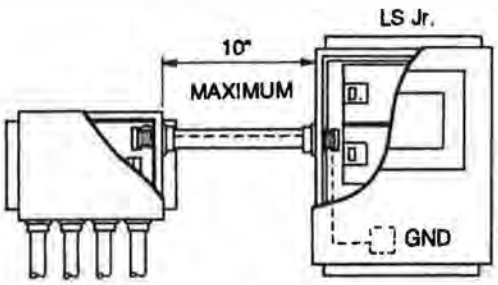


FIGURE 13: RELAY BOX PLACEMENT

6.2 INSTALLATION (ELECTRICAL)

This section describes connection of the external alarm relay (refer to Figure 5) and the optional relay box (refer to Figure 13).

The Leak Sensor Jr. supplies no power through the relay contacts. External circuits must utilize an external power source (115 VAC or battery). Install per NEC and local codes.

6.2.1 NORMALLY OPEN (closes when activated)

Connect external circuit leads to C (common) and N.O. (normally open) terminals. The relay contacts will close when a fault condition is detected and activate the external circuit.

6.2.2 NORMALLY CLOSED (opens whenactivated)

Connect external circuit leads to C (common) and N.C. (normally closed) terminals. The relay contacts will open when a fault condition is detected and activate the external circuit.

RELAY BOX TERMINAL DESIGNATION

SENSOR:	SWITCH 2	SWITCH 1	TOP BOARD SENSOR 2	TOP BOARD SENSOR 1	BOTTOM BOARD SENSOR 2	BOTTOM BOARD SENSOR 1
CONNECTION:	SC2	SC1	B2	B1	A2	A1

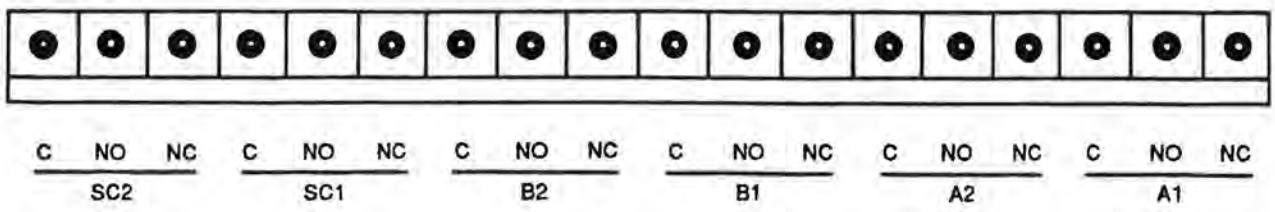


FIGURE 14: RELAY BOX CONNECTION DIAGRAM

7.0 TROUBLESHOOTING

Trouble shooting the system is done by observing the diagnostic test progress and replacement of logic boards.

The Diagnostic test checks the alarm path from the Intrinsic Safety Barrier on each interface board through the MPU and display.

The presence of AC power is indicated by a green LED located next to the power transformer. If the LED is lit, there is power through the input circuit and line fuse.

System operation is indicated by a flashing green LED (operating) on the front panel.

Enabled Channels are indicated by the green LEDs (NORMAL) on the front panel.

Open or shorted field wires or sensors are indicated by yellow LEDs on the front panel.

7.1 START-UP PROBLEMS

7.1.1 AC POWER

LSJr. will not power up (green AC power LED and Operating LED not On).

- Main AC circuit breaker tripped.
- Bad or loose AC connection between AC panel and Leak Sensor Jr.
- Power supply fuse blown.

Test Procedure

Test for 120 VAC with voltmeter at TS1 - N & L (Refer to Figure 5).

- If 1 VAC, check wall mounted breaker and connections to LSJr.

Remove and test fuse with ohmmeter for O Ohms resistance.

- Replace fuse if "open" (High resistance reading on low scale).

7.1.2 DC POWER

Will not power up (green Power Supply LED is On, front panel LEDs not On).

- Interconnect Ribbon Cable not connected.
- 12 VDC missing on Controller Board.
- Defective Controller Board.

Test Procedure

Check if ribbon cable is connected at Backplane board connector H1.

- Reconnect ribbon cable if loose.

Check 12 VDC (minimum) across capacitor C1 on Controller Board (right side).

- If less than 12 VDC, replace Backplane (Power Supply) board.

7.1.3 EXTERNAL ALARM

Continual alarm when power is applied to the system.

- System shows actual alarm.
- Alarm circuit connected to wrong terminals.

Test Procedure

Check front panel for actual alarm indication.

- P3 jumper may be moved to upper position to silence the alarm with the Silent switch while the alarm condition is being corrected.

Check that external alarm circuit is connected to the C & NO terminals.

- If connected to C & NC terminals, move connection to C & NO.

7.1.4 EXTERNAL ALARM WILL NOT ACTIVATE

External alarm circuit not activated during alarm condition.

- P3 jumper missing (controller board).
- External Alarm or wiring defective.

Test Procedure

Check for P3 jumper (Upper = control with Silent Switch, Lower = ON with alarm).

- If missing, place jumper in correct position.

Check External Alarm, place shorting jumper across LSJr. external alarm terminals.

- If External Alarm does not activate, repair or replace external alarm.

7.2 DIAGNOSTIC TEST

7.2.1 LED DISPLAY TEST

LEDs off (one or more) during first half of Test cycle.

- Defective LED

Test Procedure

Observe LED panel as Test switch is pressed; All LEDs should be On for 1 second.

- If any LED is off during this time, replace Controller Board.

7.2.2 SENSOR INTERFACE CIRCUIT TEST

Trouble LED (yellow) flashes and Alarm sounds during second half of Test cycle.

- Defective "Alarm Circuit" path.

Test Procedure

Alarm indication during second half of Test indicates defective circuit.

- Replace Interface Board.

7.3 OPERATIONAL PROBLEMS

7.3.1 CHANNEL ENABLE

No LEDs On (red, green, or yellow) for desired channel, Operating LED is On.

- Sensor channel not Enabled.

Test Procedure

Check setting of S1 for desired channel (should be On).

- If switch is On or changed, activate Reset switch to "read" S1 settings.

Run Diagnostics Test to check LEDs.

7.3.2 FLASH LIQUID ALARM

Flash Liquid Alarm (red LED).

- Sensor is detecting a liquid.
- Wires reversed at interface connector.
- Sensor installed without protective shield.
- Defective sensor.

Test Procedure

Check sensor location for leak or spill.

- Notify proper authorities to correct problem (leak or spill).

Check wire connections for correct installation (Start-Up).

- White (color) to terminal 2, black to terminal 3.

Check liquid sensor for shield installation.

- Position tip of sensor 1/4" inside shield.

Check liquid sensor, remove from location, position in free air.

- If Alarm LED "flashes", substitute with operational sensor, retest.

7.3.3 FLASHING VAPOR ALARM

Flashing Vapor Alarm (red LED).

- Sensor is detecting hydrocarbon vapors.
- Trip Point adjustment required.
- Defective vapor sensor

Test Procedure

Check sensor location for leak or spill.

- Notify proper authorities to correct problem (leak or spill).

Check vapor sensor Alarm Trip Point adjustment (start-up).

- If adjustment cannot be made, proceed to next step.

Check vapor sensor, remove from location, position in free air; Wait 5-10 minutes.

- If Alarm LED flashes, substitute with operational sensor, retest.

7.3.4 FLASHING TROUBLE LED (Liquid & Vapor channels only)

Flashing Trouble LED (yellow).

- Shorted circuit in sensor wires or sensor.
- Open circuit in sensor wires, connections, or sensor.

Test Procedure

Check sensor, wires, and connections for shorted condition.

Check sensor, wires, and connections for open condition.

- Repair connections or replace wiring or sensor as required.

7.3.5 TRANSIENT ALARM CONDITION

Steady Alarm or Trouble LED (not flashing).

- Transient Alarm condition.

Test Procedure

Reset system (Local Codes may require notification of authorities).

Run Diagnostic Test.

- If condition is repeated, correlate transient condition with product delivery, heavy rains, etc.
- If alarm is on vapor channel, check trip point adjustment.

7.3.6 SILENT LED IS ON

Silent LED is On (no alarms indicated).

- Condition indicates Silent Switch was pressed.

Test Procedure

Reset system, Silent LED will go Off.

- If LED remains On, check Silent Switch is not shorted.
- If Silent Switch is good, replace Controller Board.

7.3.7 TOTAL SYSTEM FAILURE

Test, Silent, & Operating LEDs flash and audible alarm beeps at fast rate.

- Microprocessor/Software malfunction.

Test Procedure

This indicates a failure in the MPU circuit.

Check "seating" of Microprocessor (U8).

- With power Off, remove MPU; check pins, and reinstall. Power On.
- If problem persists, replace Controller Board.

7.3.8 DOES NOT DETECT SWITCH CLOSURE INPUT

Switch Closure input not detected.

- Input channel not selected (Normal LEDs Off).
- Shorting jumpers missing from P1/P2.
- Device exceeds 600 Ohms in "closed" position.
- Defective circuit.

Test Procedure

Check Controller Board S1-5&6 (On if input connected).

- If switch setting is changed, Reset the LSJr. to "read" the selection.

Check Controller Board for Shorting Jumper installation (P1 & P2 on controller).

- If missing, install new jumpers and retest.

Test Input Device for less than 600 Ohms in "closed" position.

- If device resistance is greater than 600 Ohms, correct or replace device.

Test LSJr internal circuits. Place P1/P2 jumpers in lower position to simulate a Normally Open mode (alarm on closure), short input terminals, observe Alarm LED.

A. If alarm does not flash, replace Backplane (input circuit fuses blown).

B. If alarm flashes and P1/P2 jumpers were moved from the upper position to perform this test, replace Controller Board (Inverter is defective).

7.3.9 EXTERNAL ALARM

External alarm circuit not activated during alarm condition.

- P3 jumper missing (controller board).
- External alarm or wiring defective.
- Alarm relay circuit defective

Test Procedure

Check for P3 jumper (Upper = control with Silent Switch, Lower = On with alarm).

- If missing, place jumper in correct position.

Check External Alarm, place shorting jumper across LSJr. external alarm terminals.

- If External Alarm does not activate, repair or replace external alarm.

Test relay contacts - C to NC with no alarm (zero Ohms), then C to NO as Test button is pressed (zero Ohms).

- If resistance greater than 10 Ohms, replace Back Plane Board.

APPENDIX A
SENSOR INSTALLATION & TECHNICAL DATA

TABLE OF CONTENTS

Definitions:

NEC - National Electrical Code
LVH - Low Volatile Hydrocarbon
EPA - Environmental Protection Agency

1.0 INTRODUCTION

All sensors available for use with the EMCO Leak Sensor are listed as intrinsically safe when installed as directed in the Installation Manual (P/N Q340-102). Deviation from those procedures including the installation or use of non-approved components could result in unsafe conditions or unreliable operation and will void the warranty. Safe installation is the responsibility of the installer and user.

The sensors used with the EMCO Leak Sensor are divided into two basic sensor types - Liquid and Vapor. The sensor type determines how the sensor is used and where it will be installed. For example, a vapor sensor should be installed above any liquid. Correct placement of the sensor is mandatory for correct and accurate operation.

1.1 LEAK SENSOR APPLICATIONS

Installation of all sensors must use a waterproof junction box and a conduit seal off fitting (required by NEC to prevent explosive vapors from reaching the non-hazardous area). Use the waterproof cord grip provided with each sensor to route sensor wires out of the junction box. Access to the sensor for test and service purposes must be provided (manway is recommended).

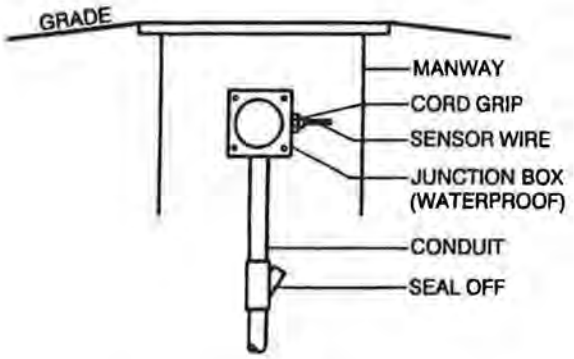


FIGURE 1: GENERAL MANWAY LAYOUT

The Leak Sensor console must be mounted in the non-hazardous area. EYS seal off fittings must be installed and sealed per the National Electrical Code. Per NEC (National Electrical Code), ONLY sensor wires from one console may be run in the conduit. All sensor wires to be connected to that console may be run in the same conduit. If the sensor wires must be routed inside a wire way, they must be enclosed and separated by metal barriers (or enclosed in metal conduit) to maintain separation from all other wiring. **CAUTION:** Wires connecting the intrinsically safe sensor to the Leak Sensor Console must be separated from all other wires by conduit or metal barriers.

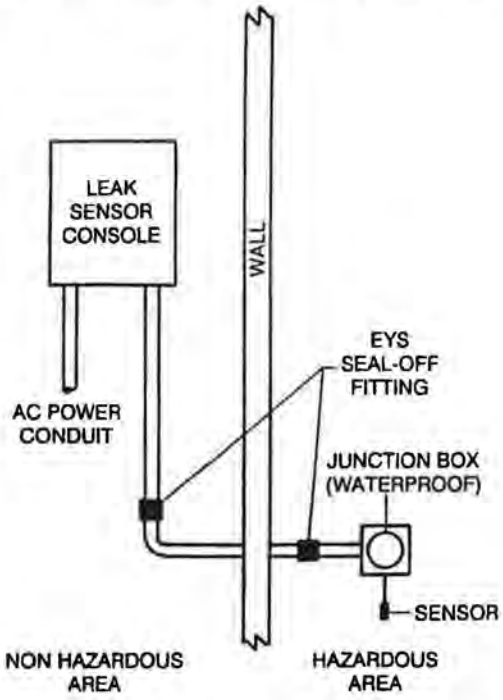


FIGURE 2: GENERAL SYSTEM LAYOUT

The sensors may be used in various applications to detect leaking tanks and pipes to limit contamination. A general guide is provided on the following pages for your use in positioning the sensors. Monitoring well placement at the site should be determined by a site engineer for normal protection.

The sensors for the Leak Sensor are supplied with a compression fitting to enable you to mount the sensor through the monitoring well or an existing cap assembly. Installing the sensor requires putting a 1/2 inch diameter hole through the cap or wall of the well and place the compression assembly as shown in Figure 3. **CAUTION:** Do not use a power drill in the hazardous area. Move the cap assembly to a safe area or use a hand operated drill.

Feed the sensor wire from the inside of the mounted compression fitting to the outside. Measure the desired distance on the wire from the compression fitting to the sensor so that it is positioned at the proper height. Place the sensor in the well and install the cap on the well while holding the wire to prevent "wrap-up" of the sensor wire. Tighten the compression fitting to secure the wire. If you have not purchased caps for your monitoring well, they are available from EMCO WHEATON. (See Figure 4).

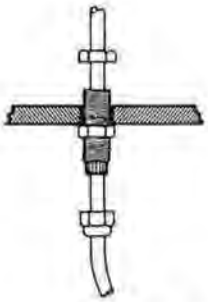


FIGURE 3: COMPRESSION FITTING

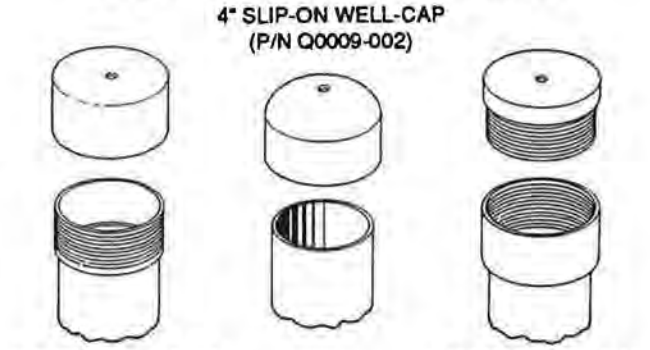


FIGURE 4: WELL CAPS

2.0 TYPICAL SENSOR INSTALLATION

The following diagrams illustrate typical sensor installations. They should not be used as installation drawings as each job site may require a unique layout. Consult the project engineer for appropriate installation details.

2.1 LIQUID SENSOR IN INTERSTITIAL SPACE

PLACEMENT AT 4 OR 8 O'CLOCK:

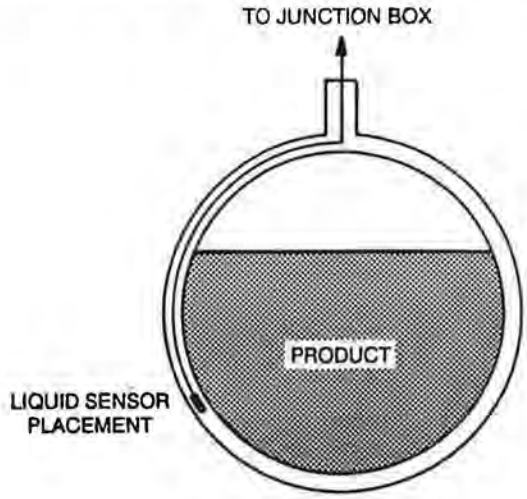
Locate and mark a point on the sensor wire from the sensor, the length determined from the following formula:

Tank Diameter x 1.3 + Riser Length

Example:

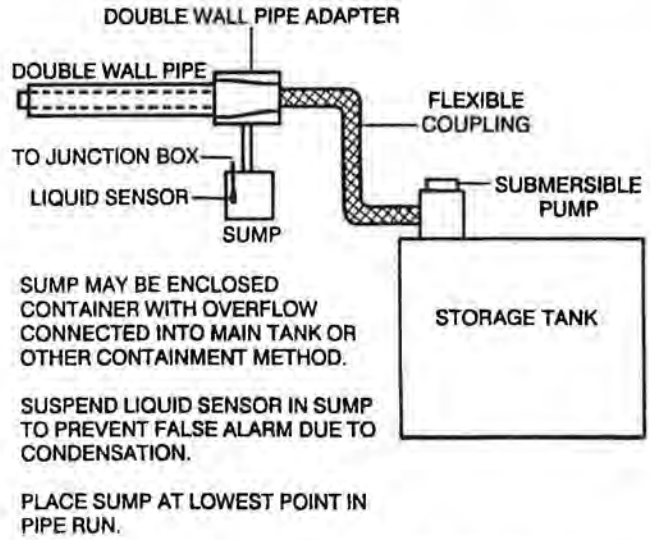
6'-0" diameter	72"
times	x 1.3
equals	=93.6"
plus riser length	+36"
Mark sensor wire at:	129.6" (130")

Attach the pull cord to the sensor and pull it into the tank interstitial space until the mark on the wire is even with the top of the riser.



2.2 LIQUID SENSOR IN PIPING SUMP

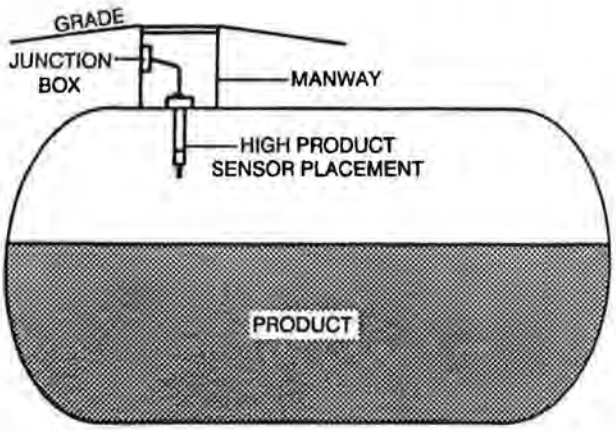
A liquid sensor may be placed in a sump that is connected to a "bell housing adapter" at the lowest point in a double wall pipe run. The sensor should be suspended above the bottom of the sump to eliminate false alarms due to condensation. If the sump is sealed, it may be connected back into the storage tank to prevent contamination to the soil if the pipe leaks. Use of the optional Relay Box will allow control of the pump's power for positive shut off if a leak is detected.



2.3 HIGH PRODUCT LIQUID SENSOR

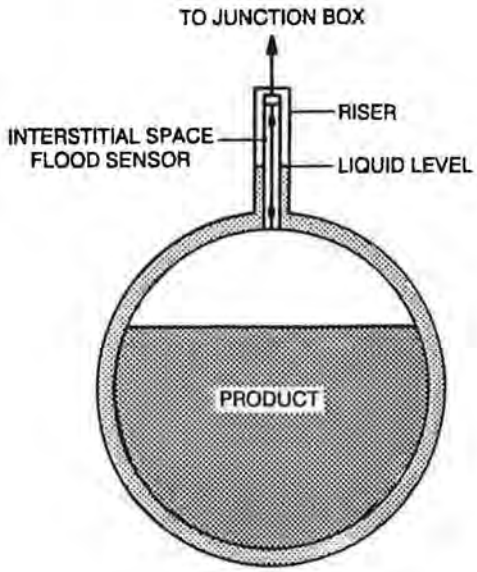
Position the sensor in either 2" or 4" tank openings using bushings. The liquid level at which the sensor activates may be changed by adding 1/2" rigid conduit and couplings for the desired sensor depth. All pipe

joints must be sealed with pipe dope. Refer to the manufacturers' tank chart to determine the length to add to the sensor for the desired alarm level. The EPA states that 90% of the tank capacity is the maximum alarm level.



2.4 INTERSTITIAL SPACE FLOOD LIQUID SENSOR

Position the sensor in a 4" diameter riser that opens into the interstitial space of the tank. Fill the interstitial space with a liquid that is recommended by the tank manufacturer to a point midway between the two sensor floats. This level will allow a +/- 4 inch deviation from the expansion or contraction of the liquid. Changes in this liquid level, caused by leaks in either wall of the tank, will result in an alarm condition by activating the float switches in the sensor.



2.5 VAPOR SENSOR IN INTERSTITIAL SPACE

PLACEMENT AT 3 OR 9 O'CLOCK:

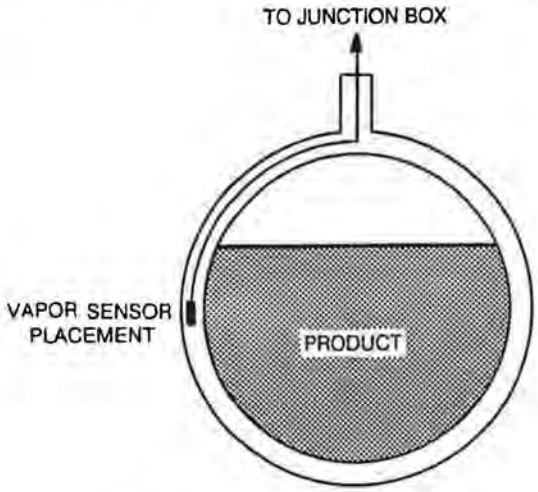
Locate and mark a point on the sensor wire from the sensor, the length determined from the following formula:

Tank Diameter x .7 + Riser Length

Example:

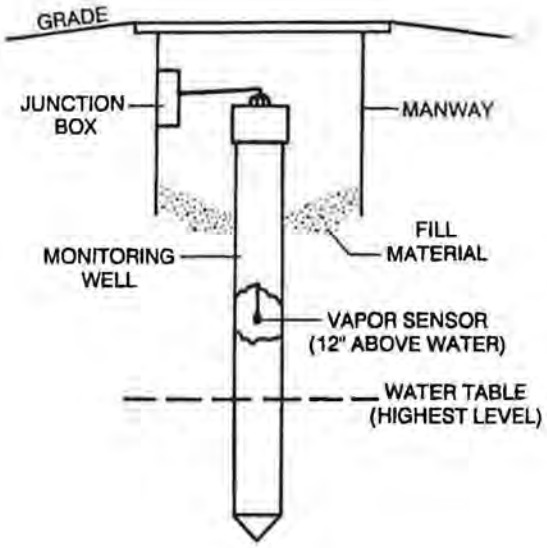
8'-0" diameter	96"
times	x .7
equals	=67"
plus riser length	+36"
Mark sensor wire at:	103"

Position the sensor into the interstitial space until the mark on the sensor wire is even with the top of the riser.



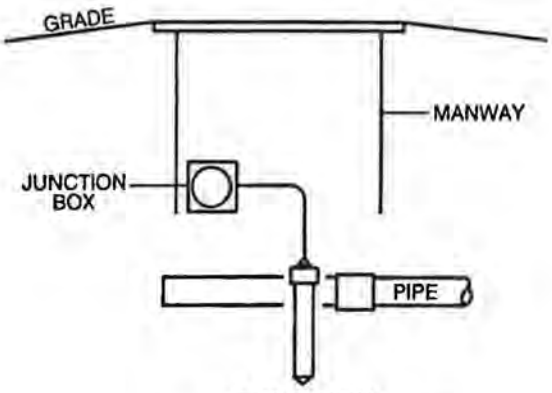
2.6 VAPOR SENSOR IN MONITORING WELL

Position the sensor one foot above the highest level of the water table or as high as necessary to eliminate the possibility of the sensor being under water. Use the cord grip provided with the sensor to seal the wire in the well cap.



2.7 DIRECT BURY STANDARD VAPOR SENSOR

Position the sensor in the gravel fill near pipe connections. For best results, the sensor should be positioned with the top of the sensor level with the top of the pipe. For testing and servicing purposes, the sensor and junction box must be accessible through a manway. Sensors may be placed 20' apart when positioned in pea gravel fill material. (The effective sensing range in pea gravel is a 10' radius).

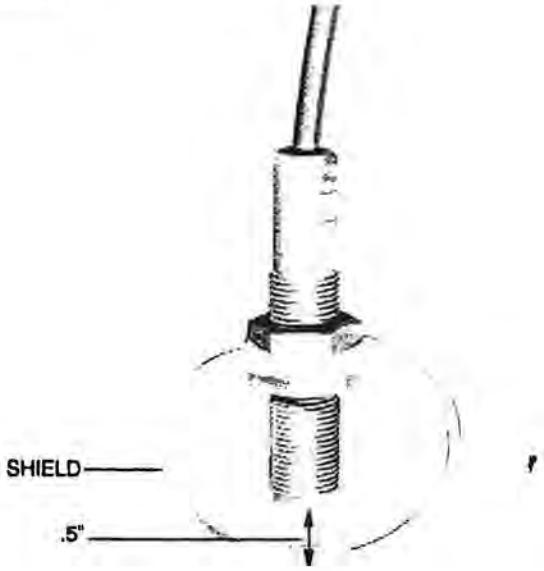


DIRECT BURY
STANDARD VAPOR SENSOR

3.0 LIQUID SENSORS

Two types of liquid sensor technologies are used in the EMCO Electronics Leak Sensors; Proximity and dual Thermistor sensors. The Proximity type will detect liquids and solids that are within 4 mm of the tip and walls of the tank or pipes. The Thermistor liquid sensor detects the presence of liquids and is not affected by solids.

3.1 LIQUID SENSOR - PROXIMITY

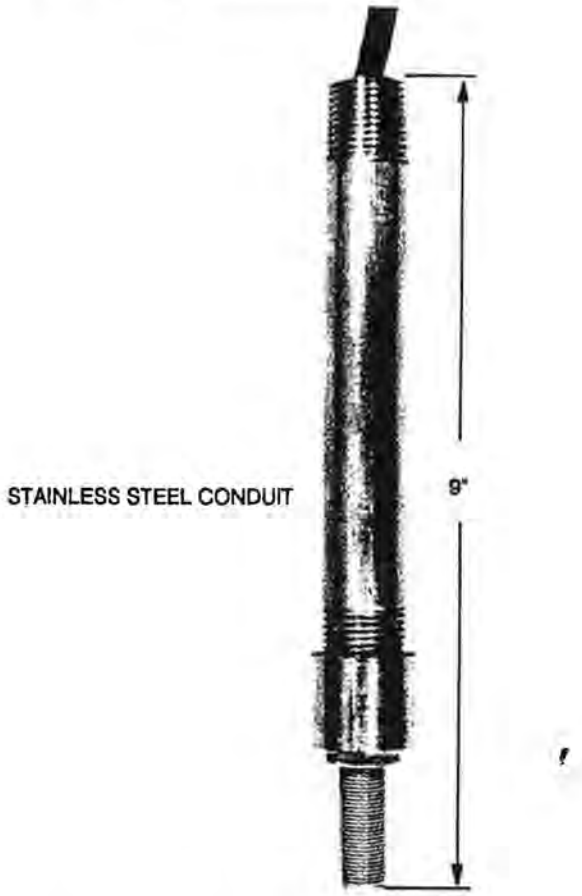


Sensor Type	Liquid - Proximity
Part Number	Q0001-001 (all liquids) & Q0001-002 (water only)
Temperature Range	-25 to 70°C (-13 to 158°F)
Sensor Size	Diameter = 0.5", Length = 2.4"
Minimum Opening	1" Dimension
Number of Wires	2 (Color = Signal, Black = Common)
Wire Length	20' (attached to sensor)

The proximity liquid sensor will detect liquids (and solids) within 4 mm of the sensor tip. The sensor is supplied with a nylon shield to maintain the physical separation between the sensor and the sides of the tank or other solids.

Prior to installing sensor, make sure there is a minimum clearance of 1 inch in the opening where it is to be placed. Install the sensor by attaching a pull cord to the sensor shield, then pulling the sensor into position in the interstitial space of a double wall tank. Refer to the diagram on page 2.

3.2 LIQUID HIGH LEVEL SENSOR - PROXIMITY



Sensor Type	Liquid High Level - Proximity
Part Number	Q0001-003
Temperature Range	-25 to 70°C (-13 to 158°F)
Sensor Size	Diameter = 1.1", Length = 9.0"
Minimum Opening	2" Dimension
Number of Wires	2 (Color = Signal, Black = Common)
Wire Length	20' (attached to sensor)

The liquid high level proximity sensor will detect liquids whenever they touch the tip of the sensor. The sensor assembly incorporates a proximity sensor that is sealed inside a metal housing. The installer must provide a 1/2" to 2" bushing for a 2" tank opening and a 2" to 4" bushing for a 4" tank opening (also available from EMCO Electronics).

Install the sensor by first attaching the waterproof cord grip (1/2" NPT threaded) supplied with the sensor. Place this assembly into the appropriate bushing before installing into tank. The depth of the sensor may be increased by adding 1/2" coupling and 1/2" pipe lengths. Seal all pipe threads with fuel proof pipe dope.

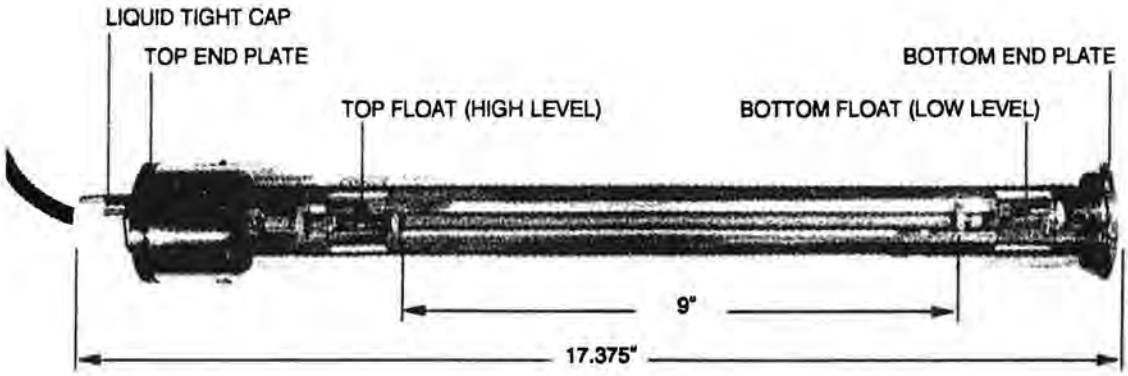
3.3 LIQUID SENSOR - THERMISTOR

Sensor Type	Liquid - Thermistor
Part Number	Q0001-004
Temperature Range	-25 to 70°C (-13 to 158°F)
Sensor Size	Diameter = 0.5", Length = 2.0"
Minimum Opening	.625" Dimension
Number of Wires	3 (White = Ref., Green = Signal, Black = Common)
Wire Length	20' (attached to sensor)

The liquid thermistor sensor detects any liquid when the sensor is covered with the liquid. Due to the small size of this sensor (1/2" x 2"), it can be inserted in most interstitial spaces in double wall tanks. It can also be used in a sump area.

Install the sensor by attaching a nylon pull cord to the sensor end, then pull it into position in the interstitial space of a double wall tank. The minimum clearance required to install this sensor is 5/8".

3.4 LIQUID INTERSTITIAL SPACE FLOOD SENSOR



Sensor Type	Liquid Interstitial Space Flood
Part Number	Q0001-005
Temperature Range	-25 to 70°C (-13 to 158°F)
Sensor Size	Diameter = 2.1", Length = 17.375"
Minimum Opening	3" Dimension
Number of Wires	2 (Color = Signal, Black = Common)
Wire Length	20' (attached to sensor)

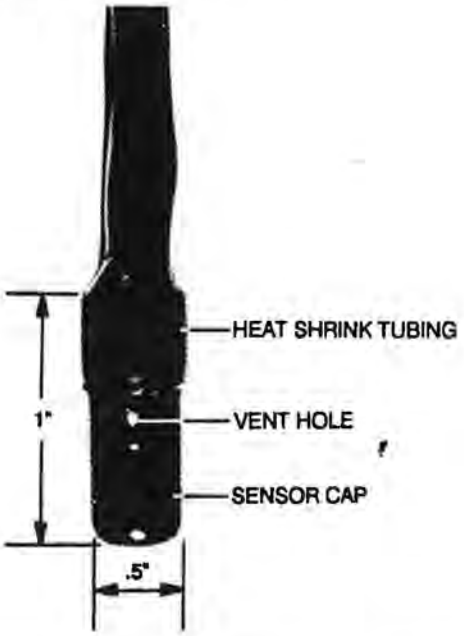
The liquid interstitial space flood sensor will detect both a loss of or increase in liquid level. The sensor requires a 4" riser that is located in an opening to the interstitial area of a double wall tank.

Install the sensor by positioning it inside the 4" riser. The interstitial space is then filled with a liquid solution (consult tank manufacturer for approved liquids) to a point midway on the sensor tube.

4.0 VAPOR SENSORS

Two types of vapor sensor technologies are used in the EMCO Electronics Leak Sensors. The Adsorption (standard vapor) is a cold sensor used in detecting hydrocarbon vapors from gasoline and other highly volatile compounds. The Low Volatile Hydrocarbon (LVH) sensor is a solid state MOS device on which the sensing surface is warmed slightly to enhance detection of lower levels of hydrocarbon vapors such as diesel and fuel oils.

4.1 STANDARD VAPOR SENSOR - ADSORPTION

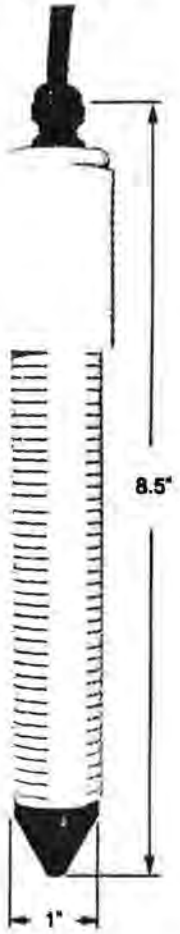


Sensor Type	Standard Vapor - Adsorption
Part Number	Q0002-001
Temperature Range	-20 to 50°C (-4 to 122°F)
Sensor Size	Diameter = 0.5", Length = 1.0"
Minimum Opening	.625" Dimension
Number of Wires	2 (Color = Signal, Black = Common)
Wire Length	20' (attached to sensor)

The standard vapor (adsorption) sensor will detect hydrocarbon vapors wherever a spill or leak has occurred. This would include observation wells and between the walls of a double wall tank. The sensor will increase in resistance as the vapor concentration increases and activates the alarm when a preset level of resistance has been reached.

If installing the sensor between the walls of a double wall tank, refer to Section 2.5 above. If installing the sensor in a observation well, refer to Section 2.6 above. In either installation, do not allow the sensor surface to become contaminated by coming in contact with liquids.

4.2 DIRECT BURY VAPOR SENSOR - ADSORPTION



Sensor Type	Direct Bury Vapor - Adsorption
Part Number	Q0002-003
Temperature Range	-25 to 70°C (-13 to 158°)
Sensor Size	Diameter = 1.0", Length = 8.5"
Minimum Opening	2" Dimension
Number of Wires	2 (Color = Signal, Black = Common)
Wire Length	3.5' (attached to sensor)

The direct bury vapor (adsorption) sensor will detect hydrocarbon vapors wherever a spill or leak (typically in pipe runs) has occurred. The sensor is contained in a PVC assembly which provides an air pocket to protect the it from water and hydrocarbon liquids. The sensor will increase in resistance as the vapor concentration increases and activates the alarm when a preset level of resistance has been reached.

Install the sensor in the gravel fill near pipe connections, achieving the best results with the sensor top level with the pipe. For testing and servicing purposes, the sensor and junction box must be accessible through a manway. Sensors may be placed 20' apart when positioned in pea gravel fill material. (The effective sensing range in pea gravel is a 10' radius).

4.3 LVH VAPOR SENSOR

Sensor Type	LVH Vapor - Low Volatile Hydrocarbon
Part Number	Q0002-005
Temperature Range	-20 to 50°C (-4 to 122°F)
Sensor Size	Diameter = 0.85", Length = 2.5"
Minimum Opening	1.25" Dimension
Number of Wires	3 (White = Voltage, Green = Signal, Black = Common)
Wire Length	20' (attached to sensor)

NOTE: Do not use in FRP tanks. This sensor may give false alarms by detecting uncured FRP resins.

The low volatile hydrocarbon vapor sensor is a solid state MOS device used to detect low level hydrocarbon vapors (diesel and fuel oils) wherever a spill or leak has occurred. This would include observation wells and between the walls of a double wall tank. The sensing surface is "warmed" to enhance detection of low levels of hydrocarbon vapors. Due to this fact, the sensor requires approximately 30 minutes to reach operating temperature after power is turned on. NOTE: If power is lost for extended periods of time, the sensor may be in alarm for a brief period after power is restored.

If installing the sensor between the walls of a double wall tank, refer to Section 2.5 above. If installing the sensor in a observation well, refer to Section 2.6 above.

5.0 HOW TO TEST SENSORS

Each type of sensor must be tested during installation/ start-up and at various intervals as specified by local regulations. Use the following procedures to test the sensors.

5.1 LIQUID SENSORS

Liquid sensors should be tested using the following method:

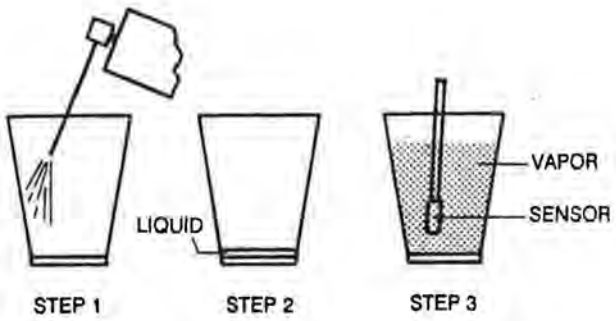
1. Make sure the Leak Sensor console is on and operational.
2. Remove the sensor from the monitoring location.
3. Fill a container with 1" of clean water.
4. Insert the liquid sensor tip into the water.
5. Observe the Leak Sensor front panel for the alarm condition.
6. If the sensor does not respond within 10 minutes, refer to the Trouble Shooting section of your Operation Manual (Q340-102).

5.2 VAPOR SENSORS

Vapor sensors can be safely tested by using low-toxic, non-flammable testing fluid (EMCO P/N Q430-100). The test must be conducted using a container with 4" (minimum) sides and 3" diameter base. **CAUTION:** DO NOT PLACE SENSOR IN TESTING FLUID! If test must be conducted in windy conditions, use a container with a top to prevent vapors from being blown out of the container

Vapor sensors should be tested using the following method:

1. Make sure the Leak Sensor console is on and operational.
2. Remove the sensor from the monitoring location.
3. Prepare the container by spraying a small amount of test liquid (3 second burst) into it. See diagram (Step 1) below.
4. Swirl the liquid for 5 seconds to aid vaporization. See diagram (Step 2) below.
5. Insert the sensor into the vapor near the bottom of the container. See diagram (Step 3) below.
6. Observe the Leak Sensor front panel for the alarm condition.
7. If the sensor does not respond within 10 minutes, refer to the Trouble Shooting section of your Operation Manual (Q340-102).



5.3 STANDARD VAPOR SENSOR RESISTANCE TEST

The standard vapor sensor environment may be checked by measuring sensor resistance with a digital multimeter.

1. Turn off AC power from the console.
2. Locate the sensor wires at the console.
3. Measure the resistance of the sensor.
4. Restore AC power to the console.

The measured resistance of the standard vapor sensor is interpreted as follows:

zero ohms = shorted wires

.5K - 6K = normal background
5K - 8K = high humidity location
9K - 11K = sensor in water
15K - 470K = alarm condition
above 470K = open connection

If the sensor resistance is in the alarm range, one additional test may be performed by lifting the sensor from its normal position for 10 to 20 minutes and then repeat the above checks. Return to normal resistance (.5K - 6K) confirms detection of hydrocarbon vapors in the monitoring site.