

PAL-AT[®]

Leak Detection/Location System

Guide Specification

Part 1 General

1.1 Furnish a complete cable-type leak detection and location system consisting of a micro-processor based monitoring unit, sensor cable, probes, system layout map and auxiliary equipment required to provide continuous monitoring of the sensing string(s) for leaks, shorts, breaks and probe activations. If any of these conditions should occur at any point along the cable, an alarm shall sound, type of condition shall be clearly identified and the location clearly displayed. (Optional:) [The system shall be designed to monitor the sub-floor or raised floor of a computer room or clean room and shall detect all liquids which may be present using a single sensor cable. Systems that can alarm due to build up of dust and dirt are not acceptable] [The system shall monitor the interstitial space of double contained piping, tanks and/or trenches.] [The system shall monitor direct buried hydrocarbon cable.]

1.2 **Manufacturer**

The system shall be the PAL-AT Leak Detection and Location System manufactured by PermAlert, Niles, Illinois, (847) 966-2190. The manufacturer shall have at least 10 years experience in supplying leak detection systems.

1.3 **References**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)
Class No. 3610 - Intrinsically Safe Apparatus and Associated Apparatus

UNDERWRITERS LABORATORIES (UL)
UL 913 - Intrinsically Safe Apparatus and Associated Apparatus

Part 2 Performance

2.1 The Leak Detection System shall locate the point of origin of the first water leak or fault (break/short/probe) within $\pm .1\%$ (.2% for hydrocarbons) of the sensor string length or ± 5 feet, whichever is greater. The system shall identify the type of alarm leak/break/short/probe as well as the location. The system shall be able to monitor (detect and locate) with up to 100 feet of cable wetted without significant inaccuracy in location.

The System shall be evaluated by an independent third party according to the Third Party Procedures developed according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of Tank Product Detectors." The evaluation results shall verify the system manufacturer's claim regarding sensitivity, range and other performance data.

2.2 **Sensing String Length**

The system shall be capable of monitoring up to [15,000] [10,000] [5,000] [2,000] feet of cable per sensor string from a single monitoring unit.



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2.3 **Multiple Leaks**

The system shall be capable of monitoring (detecting and locating) for multiple leaks or additional liquid on the sensor cable.

2.4 **Breaks and Shorts**

The system shall be capable of identifying the location of breaks and shorts on the cable. When either of these faults occur, an alarm shall sound and a display visible on the front of the monitoring unit shall clearly indicate the type of fault, i.e. BREAK or SHORT and display the location of the fault. A Tektronix TDR 1503C or equal shall be furnished to the owner of the continuous monitoring panel cannot locate breaks and shorts or if it cannot furnish a TDR trace to verify cable installation.

2.5 **Liquids Detected**

The system shall be capable of detecting all liquids, including, but not limited to aqueous, hydrocarbon, conductive and nonconductive liquids. (Optional:) [Two cables are to be furnished to detect and differentiate between hydrocarbon/solvents and aqueous liquids.] [Only hydrocarbons are to be detected.]

2.6 **Remote Annunciation**

The system shall provide relays for remote indication of an alarm condition. The relays shall provide indication that no alarm conditions exist, an alarm condition exists but has not yet been acknowledged, and an alarm condition exists and has been acknowledged. Communications shall be available via RS-232 and ASCII communication protocol to allow central point monitoring and control via a remote computer.

2.7 **Archives**

The system shall record significant events in nonvolatile memory. A minimum of 900 events shall be stored. When the memory becomes full, the recorded events shall be deleted from memory on a FIFO basis. Each recorded event shall include the time and date that the event occurred. Archives shall be retrievable through the RS-232 and ASCII communication protocols.

2.8 **System Status**

The system shall continuously provide positive indication that it is monitoring the sensing string and the status of the sensing string. The system clock shall provide the time and date on the LCD of the monitoring panel. The system clock shall be programmable by the user. A time and date indication shall be included for all events recorded in memory.

2.9 **Security**

The system shall have assignable password security to provide for a varying levels of system access. A minimum of 20 passwords shall be available within the system. The system shall not permit unauthorized modifications to the sensing string to be made (i.e. shortening the cable length) without causing an alarm condition.

2.10 **Sensor Types**

The system shall be capable of monitoring sensor cables, probe sensors and switch sensors (such as float switches, pressure switches, etc.) from the same monitoring panel. English language displays shall indicate the status of the sensors.

2.11 **Sensitivity**

The system shall not detect incidental liquid contact that is not at least equivalent to a small puddle, 3 inches in diameter. The sensitivity of the system shall be field adjustable to increase or decrease the amount of wetted cable needed to cause an alarm from several inches to several feet.



Part 3 Products

3.1 **Monitoring Unit**

The monitoring unit shall be microprocessor based and capable of monitoring up to [15,000] [10,000] [5,000] [2,000] feet of sensing string per cable, including sensor cable, probes and jumper cable. The monitoring unit shall indicate when any liquid comes in contact with the sensor cable by sounding an alarm, actuating the 2 output relays, displaying a message stating that a leak has been detected and the location of that leak on the sensing string.

The monitoring unit shall have a green LED on the front panel to indicate the unit is powered. A 2 line by 40 character backlit LCD shall be visible from the front of the unit to provide system data. A red LED on the front panel shall indicate an alarm condition has occurred.

The monitoring unit power requirements shall be 120/240 VAC, 100 VA, 50/60 Hz, single phase. Monitoring units shall be equipped with an RS-232 communication port and a minimum of one common and one per cable SPDT output relay, rated for 250 VAC, 10 amp.

The monitoring unit shall be enclosed in a modified NEMA 12 enclosure. The unit shall be U.L. Listed and FM approved to provide connections for intrinsically safe sensor circuits for use in Class I, Division I, Groups C and D Hazardous Locations. The ability to locate a leak shall not depend on battery backed up functions. In the event of power failure, system conditions and parameters shall be stored in nonvolatile memory allowing the unit to automatically resume monitoring, without resetting, upon restoration of power. An on-off switch shall be provided in the panel for servicing. [Optional: A NEMA 4X outer enclosure shall be furnished with viewing windows for mounting outdoors.] [A NEMA 7 explosion proof enclosure shall be furnished.]

3.2 **Sensor Cable**

The sensor cables shall be suitable for use with the monitoring unit. The sensor cables shall be of coaxial construction consisting of an insulated copper center conductor, a suitable spacer material, and an outer braid.

All sensor center conductors must not be less than 14 AWG for mechanical strength.

All cables must be capable of field installation of connectors by trained technicians. The cable shall be available in lengths up to 1,500 feet in bulk spools. All cables must be field repairable by trained technicians. Cable on flat surfaces shall have hold down clips every 8 feet and cable identification tags every 50 feet.

Part 4 Installation

4.1 **General**

The system shall be installed per the manufacturer's recommended installation procedures. All local, state and federal codes and requirements shall be followed. The system shall be installed by properly trained personnel.

4.2 **Graphic Locator Maps**

A location map shall be provided with the system by the installing contractor indicating the "As Installed" system configuration and sensing string layout. Footage along the cable shall be provided as references to locate leaks. Footage shall be based upon Calibration Points taken per Section 4.3.



4.3 **Calibration Point**

The installing contractor shall be responsible for taking and recording calibration points along the sensing string per the manufacturer's recommended procedures. All cable not in containment piping shall have cable tags every 50 feet.

4.4 **Field Test of System**

Tests shall be performed to demonstrate the ability of the system to detect and locate breaks, shorts and probes on the sensor string. The cable shall be shorted with the alarm and location verified. Leak testing shall be done per the following procedure to verify operation and ability to work with condensation pools of other static moisture.

- A. Wet the sensor cable near the start of the sensor string and acknowledge the detection/location alarm and remap the system.
- B. Wet the sensor cable near the end of the sensor string with the first location still wetted and acknowledge the detection/location alarm and remap the system.
- C. Wet the sensor cable in 3 additional locations between the first and second leak location with each detection/location alarm being acknowledged and all prior leak locations still wetted.

Prepare and submit a report verifying each leak location and detection accuracy. Furnish a history print out of the test results from the panel. Submit TDR traces for each test run to allow verification of wet locations.

4.5 **Field Technical Assistance**

The contractor will provide manufacturer's technical assistance for contractor, training, installation inspection, start up and owner operating and maintenance training. Contractor is to follow all manufacturer's instructions for installation. A time domain reflectometry graph of the cable installation shall be furnished at time of owner training.

[Direct buried hydrocarbon cable only]

4.6 **Direct Buried of Hydrocarbon Sensing Cable**

Hydrocarbon cable is to be buried as detailed on the drawing and as required by the manufacturer. Care shall be taken not to damage the cable. The cable ends shall be sealed to prevent moisture ingress. Backfill material shall be per the manufacturer's instructions. Connectors shall be accessible in junction boxes at grade or in manholes, valve pits or other locations. PVC pipe risers shall be utilized to house cable from below grade to grade. 6" of approved sand shall be placed under the cable and compacted. The cable shall be laid in place with 6" of approved sand placed on top of the cable and then compacted prior to pipe installation. A sample of the sand shall be sent to the leak detection system manufacture for approval.

In locations where the cable is to be covered by concrete or other structures, slotted PVC with a sock shall be used for installation of the sensor cable. Access points shall be installed to make the cable replaceable and serviceable in the field.

The contractor is to comply with all manufacturer's instructions in regards to installation of the system including design requirements.



PALCOM®

Central Point Monitoring System Guide Specification

Part 1 General

1.1 Scope

This specification is intended to encompass the materials, performance and installation requirements for a Central Point Monitoring System (CPMS) for utilization with the installation of single or multiple PAL-AT Leak Detection and Location Systems (PAL-AT's).

1.2 Description

The CPMS shall be based on the PALCOM for Windows™ software package developed by PermAlert Environmental Specialty Products, Inc., Niles, Illinois.

The CPMS shall be capable of providing centrally located monitoring and operation of up to 254 PAL-AT's.

The CPMS shall be interactive with each PAL-AT providing bidirectional communications. The CPMS computer shall receive status information (i.e. leak, break, short, location, etc.) from each PAL-AT and also allow remote operation of each PAL-AT.

The CPMS shall be capable of providing the information in a "user friendly" manner. This includes, but is not limited to, visual display at the computer and printouts.

Part 2 Materials

2.1 Central Point Monitoring Unit

The Central Point Monitoring Unit shall be a computer system, printer, modem and accessories.

The minimum hardware requirements for PALCOM for Windows are as follows:

- Personal computer with Windows® 95/98/NT
- 1 3 1/2" high density disk drive
- 1 Hard disk drive with a minimum of 5MB available memory
- 1 RS-232 serial port
- 1 Parallel printer port

A printer shall be provided along with the necessary cables and accessories to permit it to operate with the selected computer system.

A short haul modem (PermAlert Model SHS-1 or compatible) shall be provided along with the necessary cables, power square and accessories to allow connection and communication to the computer system, if any PAL-AT is direct wired. A phone modem (Model PM-1) shall also be provided for remotely located PAL-AT's.

2.2 Software

The communication software shall be the PALCOM® communication software package for PAL-AT Leak Detection and Location System and shall be supplied by PermAlert, Inc.

2.3 Monitoring Location



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The PAL-ATs shall be supplied as per the "Leak Detection Specification" and shall be configured to communicate with the CPMS.

Modems shall be provided at each PAL-AT for communication with the computer. Short haul modems (Model SHS-2) for hard wired interconnections and phone modems (Model PM-2) for communication via phone lines are acceptable. Selection of modem type(s) shall be based upon configurations of the PAL-AT's and their respective location to the computer.

2.4 **Miscellaneous**

In addition to the above referenced material, the contractor must provide for a dedicated phone line, communication cable, power supply and other materials as may be required to ensure the proper operation of the computer.

A dedicated analog phone line is required, if any phone modems are used.

The communication cable shall be two (2) unshielded twisted pairs, 22 AWG of communication cable quality and construction for hard wired interconnections.

Part 3 **Performances**

The CPMS shall be capable of monitoring up to 254 PAL-AT's from a remote location in either the automatic mode or the manual mode. Selection of the monitoring mode shall be accomplished at the computer via a simple menu selection. The default shall be the automatic mode.

3.1 **Automatic Monitoring**

The Automatic monitoring function shall monitor the status of each PAL-AT in a logical and sequential process. Automatic monitoring shall not rely on the presence of an operator.

Each PAL-AT connected via a direct wired short haul modem shall be continuously monitored in sequential order, i.e. PAL-AT #1, #2, #3.....

Each PAL-AT connected via a phone modem shall be interrogated by the computer at least once per day. In the event that communications cannot be established, an error message shall be entered by PALCOM. If an event occurs at the PAL-AT, the PAL-AT will immediately establish contact with the computer and report the event. If the PAL-AT is unable to establish contact with the computer, the PAL-AT will initiate a recall sequence routine until contact is completed.

The PALCOM software shall display the system identification number, the system status and the cable status on each cable of the PAL-AT. The system identification number is a number from 1 to 254. The cable status will indicate one of the following conditions:

- Cable card not installed
- Cable off line
- Cable normal
- Leak detected at XXX feet
- Break detected at XXX feet
- Short detected at XXX feet
- Probe #X active
- Probe #X reset
- Cable drying at XXX feet
- No end found in cable

The CPMS shall be capable of printing the updated archives from the PAL-ATs it is monitoring. Once updated archives are printed, PALCOM will change the status message from update to one of the other messages.



3.2 **Graphic Locator System**

The CPMS shall have a Graphic Locator System (GLS) with the ability to store and retrieve a CAD drawing of the facility and leak detection routing. Upon updating the archives, the facility drawing shall be able to be viewed on the screen for each alarm condition with a flashing icon at the location of the alarm condition (optional).

3.3 **Manual Menu**

A manual menu shall be provided to allow remote operation of the PAL-AT's keypad, list the PAL-AT's archives and plot traces of cables.

Remote operations of the PAL-AT's keypad (remote keypad) shall allow the CPMS to echo the information on the PAL-AT's LCD on the computer screen. The remote keypad shall also permit actuation of all PAL-AT functions available on the PAL-AT's key pad from the CPMS keyboard.

The CPMS shall be capable of reading a PAL-AT's archives and then listing those archives either on the computer's screen or printing those archives to the printer. A file shall be created in the computer of the archived information. A procedure for creating a permanent record of these archives must be provided.

The CPMS shall be capable of retrieving, displaying and printing digitized map information. A file of this information can be created by the operator for reference.

(Optional):

Using the graphic locator system, the CPMS shall be able to recall the stored CAD drawing of the facility with the operator selecting the system, cable and location where the flashing icon will appear (optional).

Part 4 Installation

The CPMS shall be installed by an authorized contractor who is familiar with the intent of the CPMS and the PALCOM software. Installation shall include computer system setup and configuration, modem installation, communication cable installation/interconnection and software installation/configuration.

The installing contractor shall be capable of performing all the work required or be capable of supervising the work of subcontractors.

All work shall be performed to local codes and requirements. It shall be the contractors responsibility to ensure that all requirements are met.

All work shall be performed per the instructions supplied by PermAlert and in accordance with the PALCOM Operation Manual.

PermAlert shall supply field technical assistance to assist in the setup of the CPMS. A minimum of two (2) days shall be included during the software configuration and setup phase.

4.1 **Training**

The installing contractor shall be responsible for coordinating training by PermAlert for the CPMS operators. Training shall consist of a factory authorized person performing a minimum of four (4) hours of training on the CPMS and the PAL-AT.

