

LEAK DETECTION/LOCATION SYSTEMS

PAL-AT® • LIQUIDWATCH® • FLUIDWATCH®



PERMALERT

Environmental Specialty Products, Inc.

PAL-AT detects and locates leaks for: Computer Rooms, Jet Fuel Systems, Tank Farms and Clean Rooms.



Why PAL-AT®? *Control the damage and you control costs.*

In most monitoring situations, just knowing that you have a liquid leak is not good enough. You need to know: Where is it? When did it occur? Where did it start? Is there more than one leak? You need accurate information-and you need it now!

The sooner you pinpoint the where and what, the sooner you can begin to control and minimize damage to your facility, the environment and to your balance sheet.

With PAL-AT® you can have this type of information-instantly. PAL-AT is a patented, sophisticated microprocessor system with multi-sensing and remote monitoring capabilities. Its advanced technology provides dependable around the clock surveillance of all monitored areas. And it's the first system to actually help manage your risks and associated costs.

PAL-AT ADVANTAGES

Wet Cable Start Up and

Multiple Leak Location: Because the PAL-AT system uses data specific to the condition of the installed sensor cable, the system's software can incorporate short lengths of wet cable in a reference map. This allows monitoring, even though the cable may be wet due to liquid entering the monitored area during installation, condensation at start up or small leaks in the system. After moisture is detected, a "new" reference map is made to continue to provide leak surveillance. Changes in the cable in relation to the new reference map from additional sections of wet cable (additional or growing leak), will cause PAL-AT to alarm.

Versatility: PAL-AT models can monitor up to eight separate sensing zones each having up to 7,500 feet of sensor cable. Each sensor cable can be integrated with liquid probes and float switches for the monitoring of single and/or double-wall piping and tanks. The PAL-AT system permits cost effective installation of complex systems, with its ability to integrate different cable types and probes, that can monitor for leaks in multiple piping networks, tanks, subfloors, and other sensitive work areas. Hydrocarbon sensing cables can be direct buried for monitoring pipelines and above ground storage tanks.

Extended Range/Low Power/Remote Installation: The extended range systems will allow monitoring of 7,500 feet on a single sensor string. For solar and/or battery applications, reduced power consumption is available to reduce initial costs. A two

sensor circuit unit is available to effectively monitor pipelines. Communications can be direct wire modems, phone, wireless or other means, as desired by the user.

System Archives: Date and time ledgers of all significant operating events, including power failure, cable leak/short/break/fault probe activation, and alarm silencing are stored in permanent memory. The stored documentation is very helpful to the system's operator to establish if clean-up, repairs and other remedial efforts were promptly performed and in compliance with local codes.

Security System: PAL-AT has a multi-level security password

system that requires a security code before accepting commands for advanced system functions. This allows access to control functions, based on the operator's responsibilities.

U.L. Listed/FM Approved and EPA Third Party Tested: The PAL-AT is U.L. listed and FM approved to provide connections for intrinsically safe sensor circuits for use in Class 1, Division 1, Groups C and D hazardous locations when used with PAL-AT cables and probes. The system has been tested by a third party, in accordance with U.S. EPA Guidelines. CE approval is available on request.

Other Features:

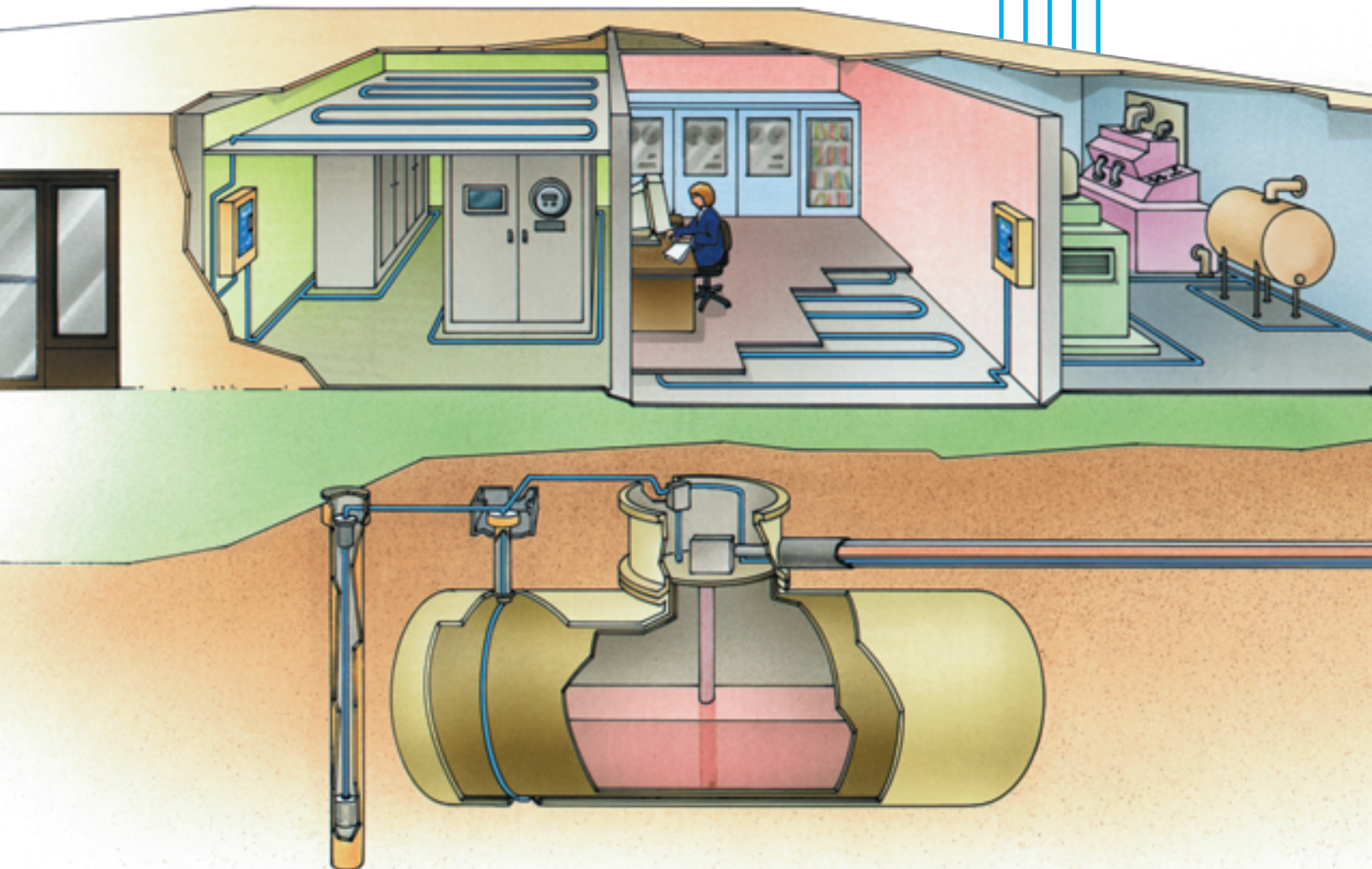
- 2 line X 40 character display, showing status, date, and time.
- Keypad entry of system data and alarm acknowledgement.
- RS232 serial port.
- Remote trouble shooting and control using PALCOM® software via modem.
- Battery back-up of date and time functions.
- Programmable Relays: SPDT, 10A, 250 VAC.
- Automatic restart when power is restored after power loss.
- Available in German.
- Optional NEMA 7 or 4X enclosure.



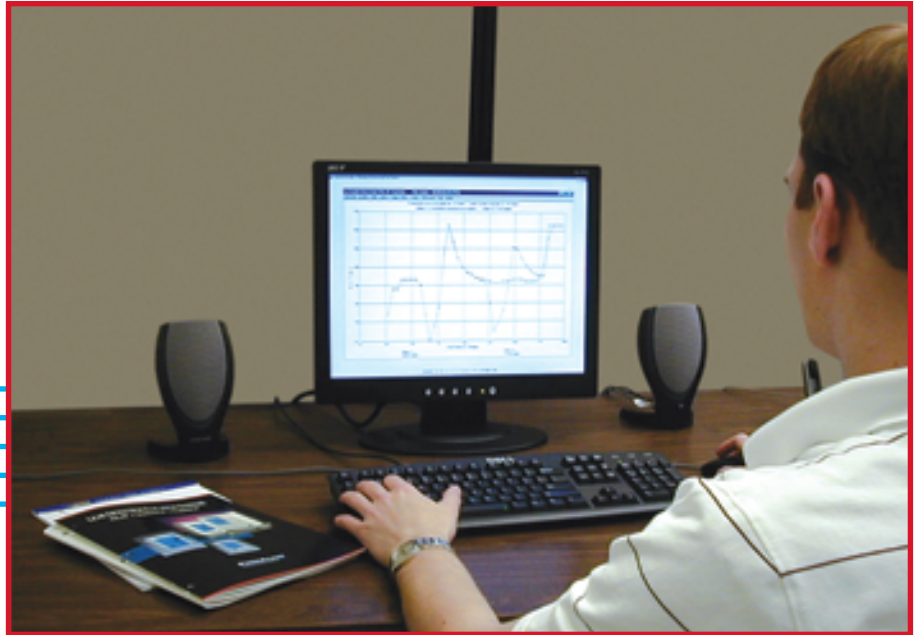
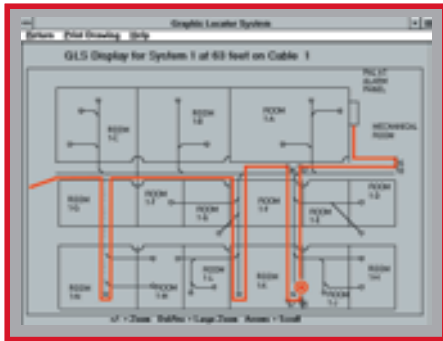
Leak Detection *At Work*

PermAlert leak detection systems provide protection for the following applications:

Wet Benches	POP Sites
Dry Storage	Buried Chilled/Hot Water Lines
Pharmaceutical Manufacturing Areas	Buried Steam Lines
Process Control Rooms	Hospital Operating Rooms
File Storage Areas	Ground Water Monitoring
Sprinkler System Monitoring	Manholes, Electrical/Mechanical
Chemical Storage Areas	Process Drain Lines
Environmental Chambers	Solvent Leak Detection
Microfilm Storage Rooms	Acid Leak Detection
Military Mothballing Facilities	Electrical Vaults
Cable Trays and Tunnels	Laboratories
Microwave Relay Stations	Underground Storage Tanks
Museum Storage	Data Center Storage Areas
Radioactive Liquid Storage	Airport Hydrant Systems
Landfill Leachate Piping Systems	Semiconductor Facilities
Hazardous Chemical Storage	Computer Rooms
Double-Wall Piping	Tank Farms, Above/Below Grade
	Web Hosting Facilities



Centralized Operations with *PALCOM® Network Software*



PALCOM® software, (for Windows® 98/NT/XP) can centrally monitor up to 254 PAL-AT monitoring units. A computer is connected to the PAL-AT units, using either twisted pair wire or modems. The software has the ability to continuously monitor the status and/or remotely operate each PAL-AT.

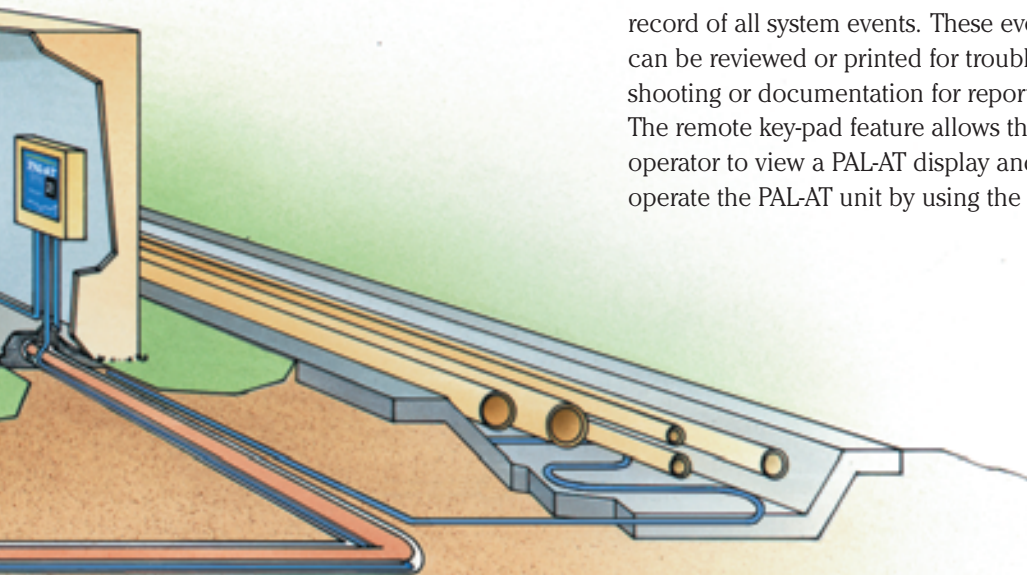
Connecting 254 PAL-ATs to a host computer, allows over 2,000 miles of sensing string to be monitored.

The PALCOM archive feature keeps a record of all system events. These events can be reviewed or printed for troubleshooting or documentation for reports. The remote key-pad feature allows the operator to view a PAL-AT display and operate the PAL-AT unit by using the

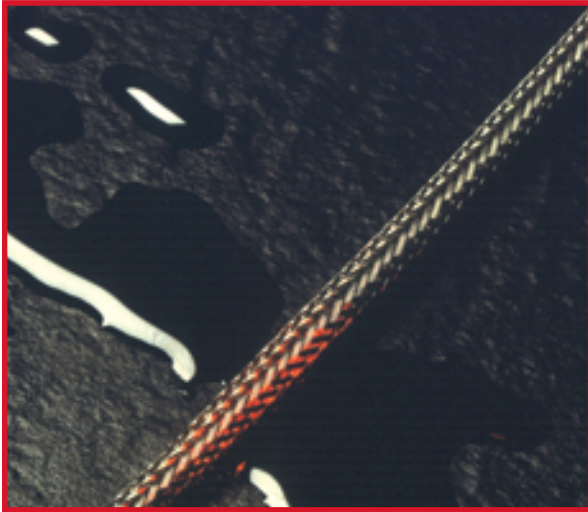
computer. This allows immediate access to the monitoring panel, regardless of its location, to respond to alarms and initiate appropriate action.

By using the graph data feature, the stored reference maps and current condition of the sensor string can be viewed and/or printed. This documentation can be used for compliance records and troubleshooting.

PALCOM has an optional patented Graphic Locator System (GLS), that displays the location of a leak on a CAD drawing. Each PAL-AT system has a drawing created for displaying the location of alarms. This drawing can be printed for maintenance records.

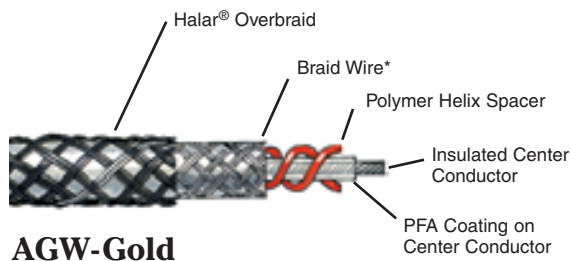


PAL-AT® Sensor Cable



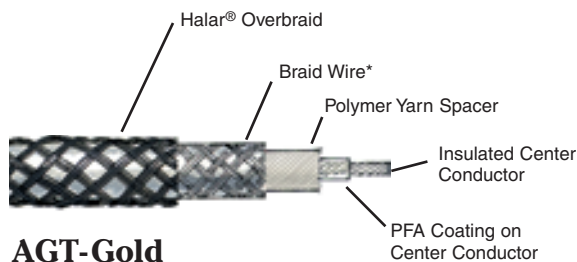
The PAL-AT® sensing string can be made up of any combination of probes and sensor cables. Sensor cables and probes are designed to serve a wide variety of applications.

With PAL-AT's sensor technology, the system is not subject to false alarms caused by dust, or other non-liquid conductive materials that may come in contact with the cable, or from casually stepping on the cable. Several sensor cables are capable of detecting and locating both water based and hydrocarbon liquids and others will detect only hydrocarbons, ignoring water. In most applications, the sensor cable can be dried and reused after a leak is repaired and clean up has been completed. The state-of-the-art "Gold cables" have no exposed metal and are designed for corrosive chemical applications. The length of sensor cable that must be "wetted" with a specific liquid, before an alarm condition occurs, is referred to as the cable sensitivity. Sensitivity is a function of sensor string length and PAL-AT monitoring panel settings.



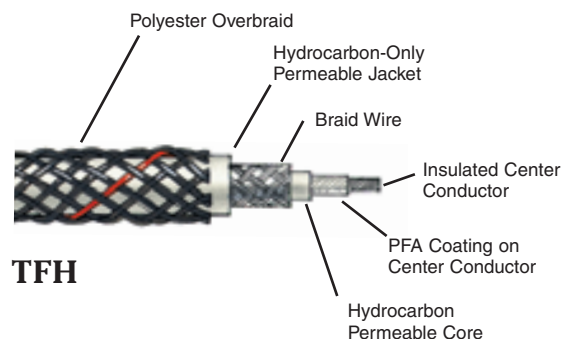
AGW-Gold

AGW-Gold is a quick drying cable, that is chemically resistant and designed to detect highly corrosive liquid leaks, such as acids, bases and solvents. Typical applications are secondary containment pipes, computer rooms, sub-floors of clean rooms and high temperature applications.



AGT-Gold

AGT-Gold is a wicking cable specially designed for the detection of accumulations at a shallow depth of 1/16 inch of liquid. The cable is chemically resistant and designed to detect water, highly corrosive acid, base and solvent leaks in computer rooms, clean room sub-floors, above ground single wall pipes and equipment applications. This cable requires more drying time than AGW-Gold.



TFH

TFH is a wicking cable specifically designed to detect only hydrocarbons. This cable may be direct buried to a maximum depth of 20 feet to locate fuel leaks while ignoring the presence of water. This cable is ideal for monitoring single-wall pipes and tanks.

In addition to sensor cable, PermAlert provides jumper cables. Jumper cable is used to connect the monitoring unit and sensing string or link sensing strings between monitored areas.

* Gold cables have polymer coated braid wire.

PERMALERT Probes



Probes monitor for leaks at specific locations. There are several probes available to monitor for water and/or hydrocarbons that can be connected in series to the sensing string. PermaAlert offers probes for a wide variety of applications with the PAL-AT System or the LiquidWatch System.

PHL probes will only detect hydrocarbon liquid and is typically installed in the interstitial space of double-wall tanks.

PWS probes will detect water-based liquids. PWS and PHL probes are used in tandem to monitor double-wall tanks containing hydrocarbon products for water and hydrocarbon leak detection.

PSTV and PTHL Probes are float switches, designed for installation in a 2" stand pipe on double-wall tanks. It allows monitoring of the interstitial space of a double-wall tank or high/low level of the product in the tank.

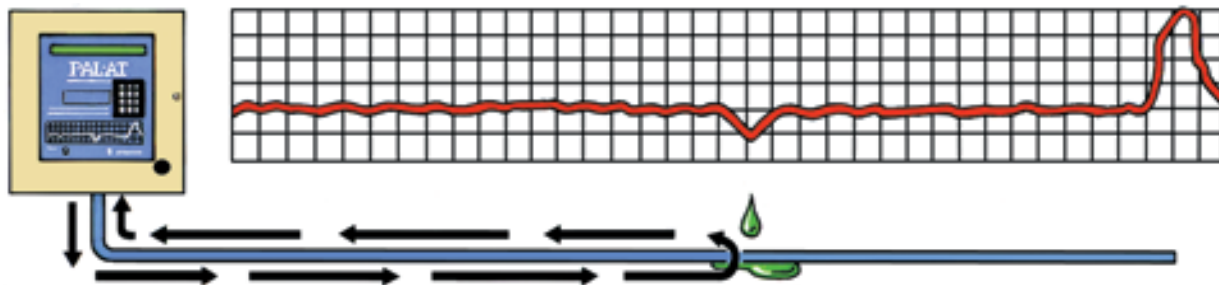
PFS probes are float switches designed to monitor liquids in manholes, sumps, etc. It will detect water-based or hydrocarbon liquids.

PT10 Probe Integrators allow the PAL-AT to monitor any normally closed or normally open switch to activate an alarm condition. These switches can be temperature, pressure or other sensors, as required.

PA10 Probe Adapters allow LiquidWatch to monitor any normally closed or normally open switch to activate an alarm condition.

Switches are available to brine monitoring in double-wall tanks for use with a probe integrator or probe adapter.

How does PAL-AT work?



PAL-AT operates similar to radar by sending out safe energy pulses, two thousand times each second, on the sensor cable. The reflections (echoes) generated by these energy pulses are specific to the condition of the installed sensor cable. These reflections are stored in memory as a reference map. The alarm unit continuously measures the cable reflections and compares them with the values of the reference map stored in memory. Liquids in sufficient quantities to "wet" the sensor cable will alter the cable's impedance at the leak location. This alteration of impedance will change the energy reflected from the cable at this location.

The monitoring unit's microprocessor recognizes the change in energy reflection from the wet portion of cable and enters into alarm. A new reference map with the change can be stored in memory, to allow monitoring to continue.

The PAL-AT locates the point of origin of a leak or cable fault within $\pm 0.1\%$ of the sensor string length or ± 5 feet, whichever is greater. In the alarm mode, the unit activates output relays to facilitate the control of valves or remote alarms (if desired), while providing audio and visual alarms, including a digital display of the distance to the leak origin.

LiquidWatch® Leak Detection Systems

PRODUCT FEATURES

- Sensing of organic liquids (hydrocarbons and solvents) or water within seconds of contact
- Vapor and gases are ignored
- Remote monitoring capability with an RS-232 interface and relays
- UL Listed with Class 1, Division 1, Groups C & D sensor circuits optional
- NEMA 4X Enclosure
- Up to 64 probes and 16 programmable alarm relays available



Specifications

Part 1 - System

1.1 The Discrete Point Monitoring System (D.P.M.S.) shall consist of a monitoring unit, probe module, relay module and probes. The D.P.M.S. shall be capable of detecting liquids in contact with a sensor probe connected to the monitoring panel. It shall not detect vapors or gases.

1.2 When liquid is detected, an audible alarm shall sound and an LCD readout of the probe activation shall be visible on the front display. The D.P.M.S. system shall alarm within one (1) minute or less after contact with liquid.

1.3 The system supplier shall have at least ten (10) years experience in the manufacturing of leak detection systems.

Part 2 - Components

2.1 The standard sensors shall be probes. The probes shall be less than 1 1/4" in diameter and less than 2" long for use with organic or conductive (water-based) liquids. The probe shall be of solid state construction and corrosion resistant housing with no moving parts. The probes shall reset after liquids are removed from the probe. Lead wires shall consist of 24 AWG shielded conductor with color coded insulation.

2.2 The use of other probes such as float switches, ground water monitoring or other devices shall use a dry contact to indicate an alarm condition. Float switch probes shall be resettable after fluids are removed and shall use material of construction suitable for liquids to be sensed for corrosion resistance.

2.3 The monitoring panel shall be modular in design and accept up to sixty-four (64) probes and sixteen (16) programmable alarm relays.

The LCD shall provide indication of the system's status. When a probe alarms the type of alarm (active, short or break) and the probe number shall be indicated. Using the membrane keypad the operator shall be able to program the system and review the history archive. An RS-232 interface port shall be available for use in remote monitoring of the unit using ASCII commands. The enclosure shall be NEMA 4X.

Part 3 - Safety

3.1 The unit must be U.L. Listed and provide connections for intrinsically safe sensor circuits for use in Class 1, Division 1, Groups C & D hazardous locations (where required).

LiquidWatch® Monitoring Units have been engineered to meet a broad range of customer needs. The system can be configured with up to 64 probes and 16 alarm relays. The modular design allows for meeting current needs while allowing for future expansion of the system.

LiquidWatch® employs a 2 line, 20 character backlit LCD with a membrane keypad for operator interface. The probe circuits are supervised and provide alarms for probe active, short and break conditions. Probes can be programmed on a leak alarm to operate one of 16 optional relays for remote alarm indication or operation of a shut down procedure.

LiquidWatch® Monitoring Units are equipped with normally energized 10A, 240 VAC, DPDT relays: 1 common alarm relay and up to 16 programmable relays (in modules of four). The alarm console can be located up to 10,000 feet (3000m) from the probes. The probe modules (8 probes per module) can be mounted remotely to reduce wiring costs.

The patented probes for LiquidWatch® are solid-state design and respond in seconds after contact with organic liquids or water. Hydrocarbon fumes or vapors have no effect, thereby virtually eliminating false alarms.

The LiquidWatch® Monitoring Unit can also monitor any switch (float switch, thermostat, high level switch, dry contact, etc.), using the optional probe adapter.

FluidWatch® Leak Detection Systems

PRODUCT FEATURES

- Senses water based liquids within seconds of contact
- Sensitivity from several inches to several feet
- Durable sensor cable
- Available in three different sensor lengths: 50 ft., 75 ft. and 100 ft.
- Comes in a kit, complete with 25 ft. of jumper cable, sensor cable, cable clips and cable tags
- 120 VAC, 240 VAC or 24 VDC input power



Specifications

Part 1 - System

1.1 FluidWatch Leak Detection System shall consist of an electronic monitoring unit, coaxial water-sensing cable, interconnecting jumper cable, cable clamps and identification tags. All cable connectors shall be factory installed.

The system supplier shall have at least five (5) years experience in the manufacture of the leak detection systems.

Part 2 - Components

2.1 The monitoring unit shall be able to monitor one length of sensing cable. Three (3) LED's shall be visible on the door of the unit indicating System Monitoring (Green), Leak Detected (Red), or Cable Break (Yellow). The unit shall have an audible alarm and be equipped with two (2) normally energized SPDT Form 1C relays having contacts rated for 10 A continuous at 250 VAC. The audible alarm and relays shall be activated in the event of a leak or a continuity fault.

The system shall have two (2) external switches for operator input: test and alarm silence. Internal switches shall select cable sensitivity (high, medium, and low), enable the silence button, enable automatic silence when the cable dries, and select 120/240 VAC operating voltage.

The monitoring unit shall be powered by [120 VAC] [240 VAC] [24 VDC]. It shall be housed in a modified NEMA 4X nonmetallic enclosure with nominal dimensions of 7" x 7" x 3".

2.2 The sensor shall be a coaxial cable consisting of an insulated center conductor, water permeable dielectric core, and outer braid conductor.

The sensing cable shall have the ability to detect the presence of water at any point along the cable's length. The cable shall be easily field repairable, flexible, and carry less than six (6) VAC under normal operating conditions.

The sensing cable shall be available in lengths of 50, 75, and 100 feet. All sensing cable shall be supplied with connectors.

2.3 The system shall include one monitoring unit, one length of sensing cable, one 25-foot jumper cable to connect the sensing cable to the monitoring unit, one cable clamp for every five (5) feet of sensing and jumper cable, and five (5) cable tags.

Part 3 - Installation

3.1 All FluidWatch system components shall be installed in accordance with manufacturer's installation instructions.

3.2 The monitoring unit shall be installed and powered in accordance with NEC and local code requirements.

The FluidWatch® Leak Detection Monitoring Unit is engineered to monitor small areas for water leaks. Typical applications include unmanned equipment rooms, small raised floor areas and small tanks. The system continuously monitors the capacitance of the sensor cable and detects changes. Seconds after the coaxial sensor cable contacts water or water-based liquids, the unit enters into alarm. The sensor cable can be quickly dried in place after the leak is cleaned up and the system is back on-line.

FluidWatch® uses an LED "traffic light" display to indicate status: Green - normal; Yellow - break; and Red - leak. An audible alarm and two (2) 250 VAC, 10 A, SPDT relays activate when either a leak or break occurs. There are two (2) operator buttons, one to test the system and the other to silence the alarm.

Internal jumpers are used to enable alarm silencing, to select cable sensitivity and to enable automatic silencing upon return of the system to normal conditions.

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Environmental Specialty Products, Inc.

PAL-AT® Specification Guide

The leak detection/location system shall consist of microprocessor based monitoring unit(s) capable of continuous monitoring of a sensor string for leaks/faults. The unit shall have a sensing range of (2,000)(5,000) (7,500) feet per cable. The alarm unit(s) shall operate on the principle of pulsed energy reflection and be capable of mapping the entire length of the sensor cable and storing the digitized system map in non-volatile memory. The alarm unit(s) shall provide continuous indications that the sensor cable is being monitored.

After proper acknowledgement of a minor leak, the leak detection/location system shall be capable of monitoring the entire sensing string for additional leaks even if they are smaller than the leaks previously acknowledged. The system shall be capable of accounting for minor installation irregularities, static moisture and puddles (such as condensation) with no loss in accuracy or sensitivity. The system shall locate the point of origin of the first leak or fault within $\pm 0.1\%$ of the sensor string length or ± 5 feet, whichever is greater. The monitoring unit shall report and record, to nonvolatile memory, the type of fault, distance, date, and time of an alarm.

The system manufacturer shall have at least seven years of experience with leak detection/location sensor cable technology and

provide a factory trained representative at two on-site meetings for pre-construction and sensor/electronics installation.

The system shall have multi-level security passwords for access to operating functions with recording of all password entries to nonvolatile memory.

The alarm unit(s) shall be enclosed in a modified NEMA 12 enclosure and have a two line by forty character display providing status and alarm data. The monitoring unit(s) (shall be field connected to an) (shall have a factory mounted) alarm horn. The unit shall be U.L. listed and FM approved to provide connections for intrinsically safe sensor circuits for use in Class 1, Division 1, Groups C and D hazardous locations.

The system shall be tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules and so labeled.

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".
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(s) to automatically resume monitoring, without resetting, upon restoration of power.

The monitoring unit(s) 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 two SPDT output relays, rated for 250 VAC, 10 amps.

The sensor cable, connectors, (probes) and jumpers shall be supplied by the manufacturer of the monitoring unit(s). The cable sensing principle shall provide for continuous monitoring while short lengths of the cable are in contact with liquids, without altering the systems sensitivity and/or accuracy.

Software will be available that allows the manufacturer to remotely or on site interface through the RS-232 serial port for troubleshooting and diagnostics. Software shall have the ability to operate the PAL-AT monitoring units and retrieve each of the stored reference maps and current condition TDR traces. Software shall also be available for the customer to purchase.



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PAL-AT U.S. Patent No. 4,797,621, plus foreign patents
AGT-Gold U.S. Patent No. 5,355,720, plus foreign patents
AGW-Gold U.S. Patent No. 4,910,998 and No. 5,355,720, plus foreign patents

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