

Leak Detection/Location Systems

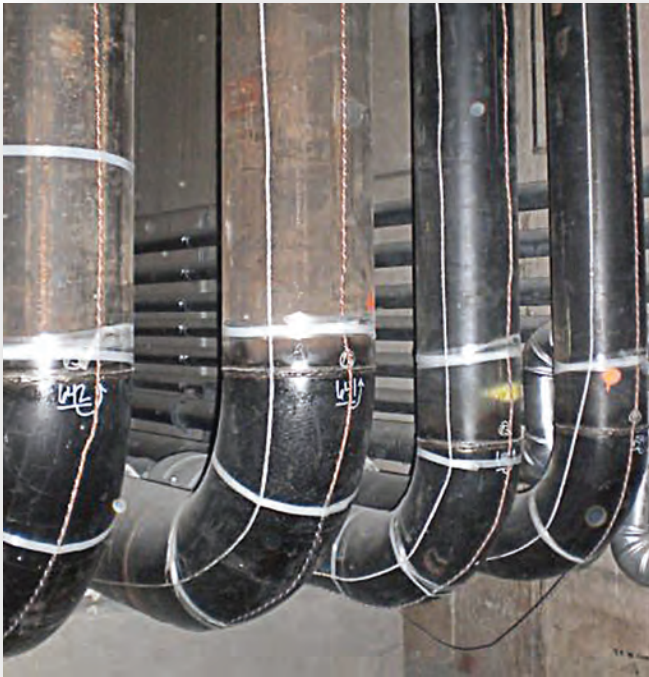
PAL-AT® • LIQUIDWATCH® • FLUIDWATCH®



PERMA ALERT

Enviromental Specialty Products

PAL-AT detects and locates leaks for
Data Centers, Jet Fuel Systems, Tank Farms, Clean Rooms and Other Applications



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, personnel, the environment and to your balance sheet.

With PAL-AT® you can have this type of information instantly. PAL-AT is a sophisticated micro-processor 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 continuous 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 automatically 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 re-alarm. The alarm queue stores the information for retrieval by the BMS, Palcom® or by the operator at the panel.

Versatility: PAL-AT models can monitor up to four separate sensing zones each having up to 7,500 ft [2300 m] of sensor cable. Each sensor cable can be integrated with liquid probes and float switches for the monitoring of sumps, trays, 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 aboveground storage tanks.



Low Power Installation: For solar and/or battery applications, 24 VDC connection and reduced power consumption is available to reduce power supply initial costs. A four sensor circuit unit is available to effectively monitor pipelines. Communications can be via Ethernet, RS-485, RS-232, 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 and probe activation 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.

UL Listed, CE compliance and EPA Third Party Tested:

The optional Zener Barrier Panel is UL (US and Canada), ATEX, IECEx listed to provide connections for intrinsically safe sensor circuits for use in Class I, Division 1, Groups C and D or Zone 0, Group IIB hazardous locations.

Other Features:

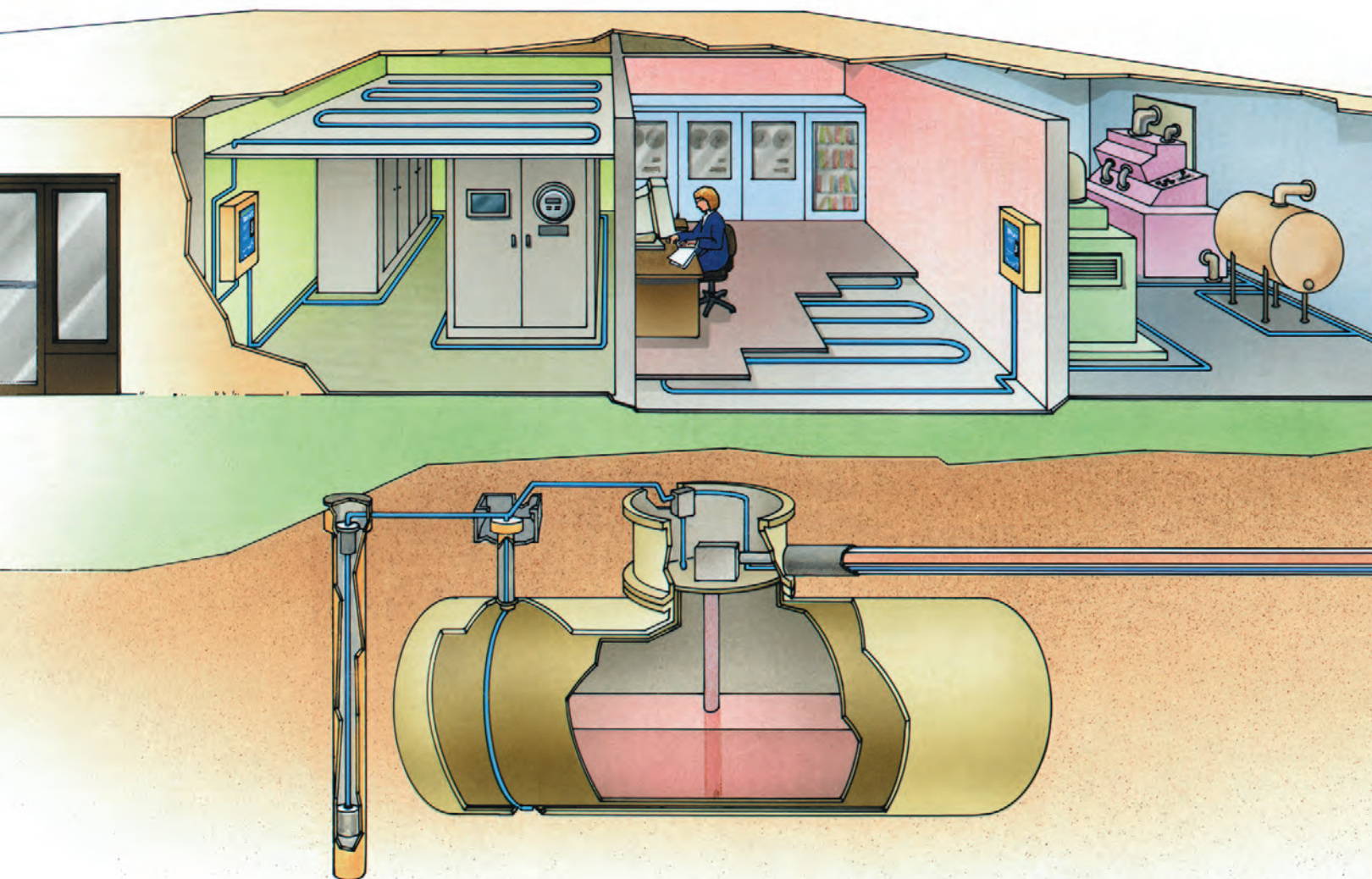
- 2 line X 40 character display, showing status, date and time
- Keypad entry of system data and alarm acknowledgement
- RS232 and RS485 serial ports
- Ethernet connection and Modbus TCP/IP
- Modbus RTU
- Remote trouble shooting and control using PALCOM® software
- Battery back-up of date and time functions
- Programmable Relays: SPDT, 10A, 250 VAC
- Automatic restart when power is restored after power loss
- Available in other languages



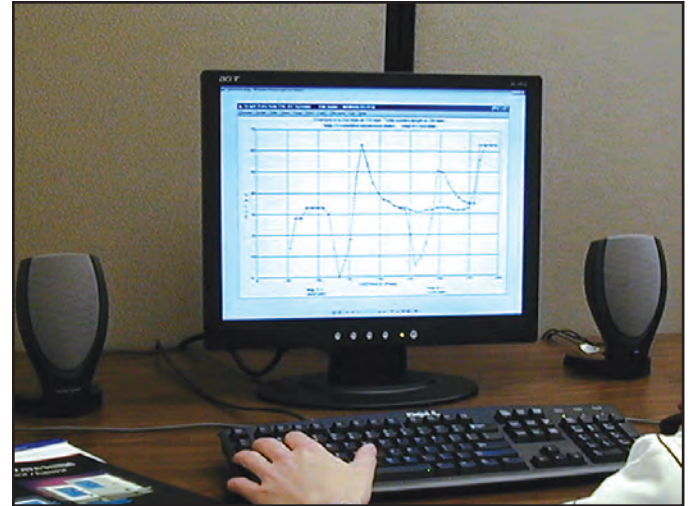
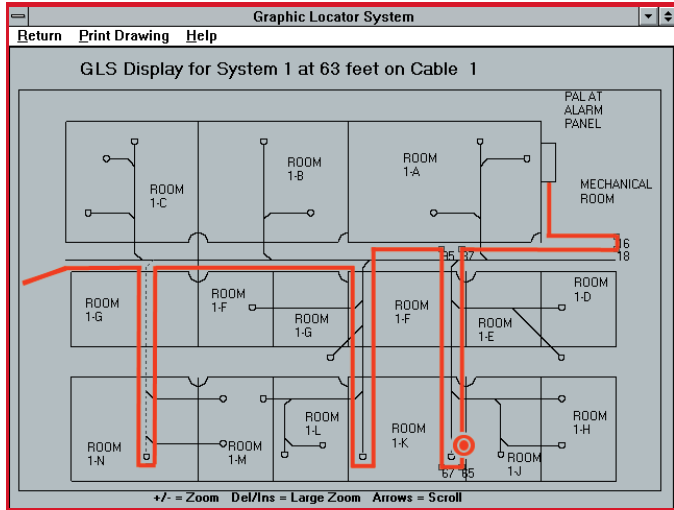
Leak Detection *At Work*

PermAlert leak detection systems provide protection for the following applications:

Wet Benches	Double-Wall Piping
Dry Storage	Buried Chilled/Hot Water Lines
Pharmaceutical Manufacturing	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
Mining Industry	Tank Farms, Above/Below Grade
POP Sites	Web Hosting Facilities



Centralized Operations with *PALCOM® Network Software*

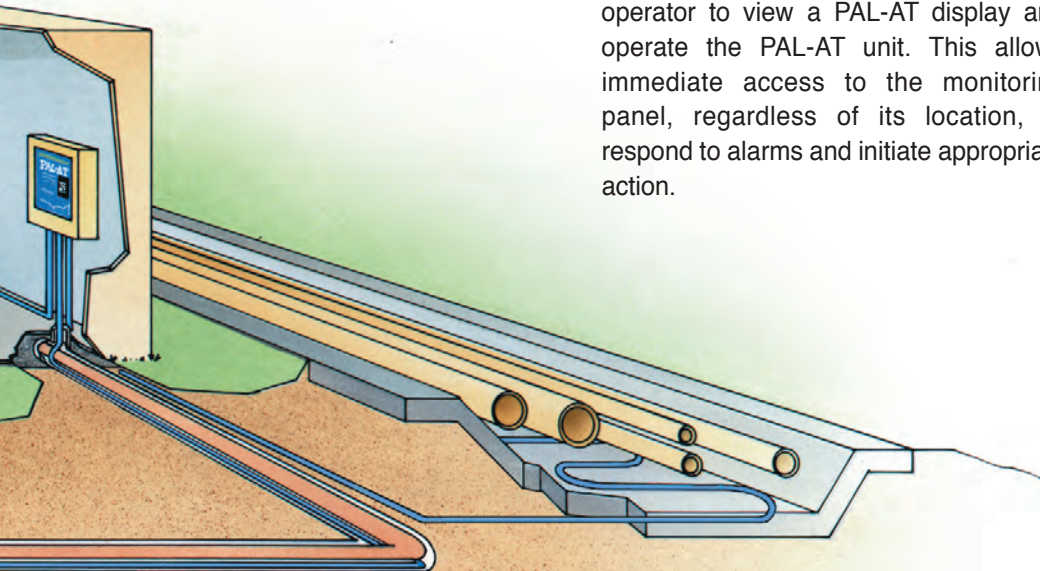


PALCOM® software, (for Windows®), can centrally monitor up to 254 PAL-AT monitoring units. A computer is connected to the PAL-AT units, using either Ethernet, RS-232, RS-485 or phone modems. The software has the ability to continuously monitor the status and/or remotely operate each PAL-AT.

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 keypad feature allows the operator to view a PAL-AT display and operate the PAL-AT unit. 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.

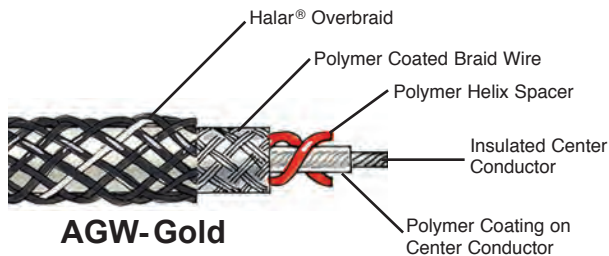
PALCOM has a Graphic Locator System (GLS), that displays the location of a leak on a CAD drawing. Each PAL-AT system has a drawing created for displaying the location of alarms. This drawing can be printed for maintenance records.



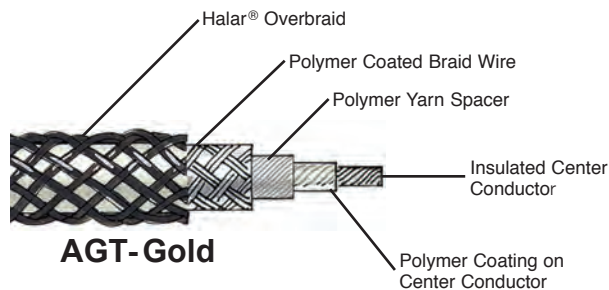
PAL-AT[®] Sensor Cable

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.

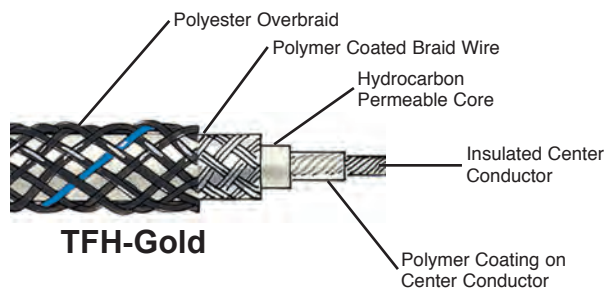
With PAL-AT's sensor technology, the system is not subject to false alarms caused by dust or other non-liquid conductive materials that may come in contact with the cable or from casually stepping on the cable. Several sensor cables are capable of detecting and locating both water-based and hydrocarbon liquids and others will detect only hydrocarbons, ignoring water. In some 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 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 is a wicking cable specially designed for the detection of accumulations at a shallow depth of $\frac{1}{16}$ 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, aboveground single-wall pipes and equipment applications. This cable requires more drying time than AGW-Gold.



TFH-Gold is a wicking cable specifically designed to detect only hydrocarbons. This cable may be direct buried in slotted PVC screen pipe 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.

PERMALERT Probes



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

PHLR Probe will only detect hydrocarbon liquid and is typically installed in the interstitial space of double-wall tanks, sumps, double contained piping or other low points for detecting hydrocarbon leakage.

PWS Probes will detect water-based liquids.

PSTV and PTHL Probes are float switches, designed for installation in a 2" stand pipe on double-wall tanks. They allow monitoring of the interstitial space of a double-wall tank or high/low level of the product in the tank. Special materials are available for specific liquids for chemical compatibility.

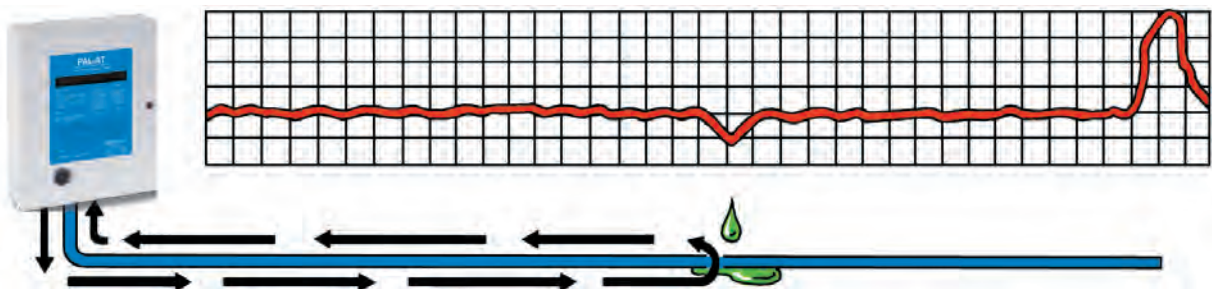
PFS Probe is a float switch designed to monitor liquids in manholes, sumps, etc. It will detect water-based or hydrocarbon liquids. Special materials are available for specific liquids for chemical compatibility.

Speciality Probes: With the use of the PA10 (LiquidWatch) and the PT10 (PAL-AT) our systems can monitor probes that are specially required for given applications providing for greater flexibility in meeting customers requirements.

PT10 Probe Integrator and the PA10 adapter monitor any normally-closed or normally-open switch that indicates an alarm condition. The switches can be temperature, pressure or other sensors, as required.

Examples are reed type float switches in double contained piping and brine monitoring switches in double-wall tanks.

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 recognizes the change in energy reflection from the wet portion of cable and enters into alarm. A new reference map with the change is stored automatically

allowing monitoring to continue. The alarm queue stores the alarm messages and must be cleared by the operator. The system also detects and locates breaks, shorts and probe activations. This allows for fast response to the location of the alarm for repairs or remedial action.

The PAL-AT locates the point of origin of a leak or cable fault within $\pm 0.3\%$ of the sensor string length or ± 6 feet, whichever is greater for water based liquids and $\pm 0.6\%$ of the sensor string or ± 6 feet for hydrocarbon liquids. In the alarm mode, the unit activates output relays to facilitate the control of valves or remote alarms, while providing output to the BMS via Modbus, Palcom, audio and visual alarms, including a digital display of the distance to the leak origin at the panel.

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, cUL Listed with Class I, 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, depending on the 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 PHLR hydrocarbon probe shall be less than 1½" in diameter and less than 2" long for use with organic liquids. The hydrocarbon probe shall reset after the elements are cleaned and/or replaced. The PWS conductivity probe shall be of solid state construction and corrosion resistant housing. The conductivity 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. A Modbus RTU interface shall be available for interface to a BMS system. The enclosure shall be NEMA 4X.

Part 3 - Safety

3.1 The unit must be UL Listed and provide connections for intrinsically safe sensor circuits for use in Class I, 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 sixty-four (64) probes and sixteen (16) alarm relays. The modular design allows for meeting current needs while allowing for future expansion of the system.

LiquidWatch employs a two (2) line, twenty (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 sixteen (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 sixteen (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 PHLR probe for LiquidWatch is solid-state design and responds in seconds after contact with organic liquids. 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 sensor lengths: 10 ft to 100 ft
- Comes in a kit, complete with (if required) 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 ten (10) years experience in the manufacture of the leak detection systems.

Part 2 - Components

2.1 The monitoring unit shall be able to monitor a length of sensing cable. Three (3) LED's shall be visible on the door of the unit indicating System Monitoring (Green), Leak Detection (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 or 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 or special lengths as required up to 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 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 online.

FluidWatch (115/240 volt version) 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.

FluidWatch II System is a low voltage (10-30 V AC/DC) with the status display on the circuit board and three relays (two leak and one fault) for use with CRAC/CRAH units and other applications not requiring an alarm horn.

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 (3,000 ft) [900m], (7,500 ft) [2300m] 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 the detection of a minor leak, the leak detection/location system shall reset itself and continue to monitor the entire sensing string for a growing leak or an additional leak(s) even if they are smaller than the leak(s) 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 $\pm 0.3\%$ of the sensor string length or ± 6 feet, whichever is greater for water-based liquids and $\pm 0.6\%$ of the sensor string length or ± 6 feet, whichever is greater for hydrocarbon based liquids. The monitoring unit shall report and record, to non-volatile memory, the type of fault, distance, date and time of an alarm. The alarm queue will require clearing by an operator after alarms are detected to reset from the alarm mode.

The system manufacturer shall have at least fifteen (15) years of experience with leak detection/location sensor cable technology and provide a factory trained representative at on-site meetings for pre-construction sensor/electronics installation, commissioning and owner training.

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

The alarm unit(s) shall be enclosed in a NEMA 12 enclosure and have a two line by forty character display providing status and alarm data. The monitoring unit(s) shall have a factory mounted alarm horn. The unit shall be UL listed and CE compliant. The optional Zener Barrier Panel will provide connections for intrinsically safe sensor circuits for use in Class I, Division 1, Groups C and D/Zone 0, Group IIB 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 non-volatile memory allowing the unit(s) to automatically resume monitoring, without resetting, upon restoration of power.

The monitoring unit(s) power requirements shall be 110/240 VAC, 50 VA, 50/60 Hz, single phase. Monitoring units shall be equipped with RS-232, RS-485 and Ethernet communication ports and a minimum of three 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 remote or on-site interface through communication ports 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. The software shall be able to have a digital map of the layout of the system and indicate on the map the location of alarms.



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