



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

Mail Code 5401G

November 29, 1995

OFFICE OF SOLID WASTE AND EMERGENCY
RESPONSE

MEMORANDUM

SUBJECT: *List of Leak Detection Evaluations*

FROM: Lisa C. Lund, Acting Director /s/
Office of Underground Storage Tanks

TO: All Interested Parties

The purpose of this cover memo is to transmit the attached list and to provide additional information about its appropriate use and about EPA's involvement with it.

The List and Its Use

The List of Leak Detection Evaluations is based on reviews by an **independent** work group consisting of state and EPA UST program staff, and therefore is not an EPA list. Furthermore, neither EPA nor the work group approve or will approve leak detection systems.

Approval or acceptance of systems is the responsibility of the implementing agency -- in most cases the state environmental agency, which should be contacted regarding the approval or acceptance of leak detection systems in a particular area. The evaluations must have been performed by an independent third party, in accordance with EPA or equivalent test procedures, and with leak rates blind to the evaluator.

The List is divided into parts. The **Summary** section categorizes leak detection system evaluations by type of system. The **Specification** section is in alphabetical order by name of the vendor. The **Under Review** section lists evaluations about which the work group has received some information, and is either reviewing or has requested additional information needed to clarify the evaluation. The **Glossary** section provides definitions of terminology used in the List, which should help everyone better understand the information presented in the Specifications section. **Listing of an evaluation as "under review" in no way implies that the evaluation does or does not meet the review criteria.**

Neither EPA nor the work group approve or will approve leak detection systems. Approval or acceptance of systems is the responsibility of the implementing agency. Please contact your implementing agency UST program to determine which leak detection systems are approved or acceptable for use in your area.

The List includes evaluations that followed either an EPA protocol, a national voluntary consensus standard, or a non-EPA procedure developed by an independent third party. Please note that multiple evaluations may exist for one system, and therefore there may be multiple listings for that system.

We believe that the List will be of great benefit to the entire UST community. However, please remember that it has inherent limitations. It is based on evaluations, which are one-time events, often conducted in a lab setting according to protocols that do not test all aspects of a system. Therefore, appearance on the List does not mean that a particular system will work or comply with regulations at any particular site. For these reasons, the List cannot be the final word; decision-makers should make up their own minds based on all available sources of information.

Distribution

The attached List is the first edition and follows a draft that was widely distributed by this office in January. The work group has indicated that the List will be updated periodically, as new evaluations and information are reviewed. The most recent version is available for downloading in electronic form (Microsoft Word 6.0 and WordPerfect 5.2) from EPA's "CLU-IN" -- electronic bulletin board at no charge. [Go into the "UST/LUST" Special Interest Group, then go to File Directory 11.] You can access CLU-IN by modem at (301) 589-8366, with settings 8-N-1 or reach the system operator at (301) 589-8368.

OUST plans to distribute paper revisions of the List about every six months. Because of the large size of the document, to save paper and expense, we will limit distribution. We will send paper copies to vendors, associations, EPA UST offices, state UST offices, and others who request it. We will send only one copy to each organization at each location. EPA Region 10 is no longer updating the list it previously maintained.

Additional information

If you have an evaluation to submit, or if you have comments about the contents of the List, please see the attached August 1, 1996 memorandum from the work group's chair for guidance. As was the case for the draft List, comments regarding a particular listing should be made to the appropriate team leader for that type of evaluation. Comments and new information are welcomed.

I hope that this package is helpful to you. If you would like to make changes to the address information on your envelope, please forward them to David Wiley of my staff, Mail Code 5402W or fax number (703) 603-7178.

Attachments:

*April 26, 1995 Johnson memo, with attachments

*Disclaimer

*List of Leak Detection Evaluations

cc: State UST Contacts
UST/LUST Regional Program Managers
Region 10 Operations Offices' UST/LUST Contacts
Vendors appearing on List of Leak Detection Evaluations
Anthony Tafuri, NRMRL Edison
Members of Work Group on Leak Detection Evaluations

cc (cover only):

Steve Crimardo, ASTSWMO
Larry Brill, Region 1
Stanley Siegel, Region 2
John Humphries, Region 3
Mary Kay Lynch, Region 4
Willie Harris, Region 5
Willie Kelley, Region 6
Bill Pedicinno, Region 7
Steve Tuber, Region 8
Laura Yoshii, Region 9
Lauris Davies, Region 10
David Lloyd, OGC
Kathy Nam, OGC
OUST Management Team, via LAN

ADEM

ALABAMA

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT



April 26, 1995

MEMORANDUM

TO: Vendors of Leak Detection Equipment/Procedures

FROM: Curt D. Johnson, Chairperson

RE: National Leak Detection Work Group's Draft List of Third-Party Evaluated Leak Detection Equipment/Procedures

By now, all of you should have received a copy of our work group's draft list. If you have not received a copy, please contact Lillian Shelton at (703) 308-8859 and she will send you a copy.

The draft list cover letter dated January 17, 1995 from Lisa Lund states that comments on the draft list were due March 1, 1995. This may be sent to either the appropriate work group team leader (see attached member and team list) or to me at the Montgomery letterhead address. We are currently on schedule to provide the first edition list late this summer.

All new evaluations and/or protocols to be evaluated by the work group need to be sent to **my attention** at the letterhead address. To enable the work group to properly review the third-party tests, **three (3) copies** of all applicable information indicated in the enclosed "Leak Detection Equipment Review - Document List" must be included. Because the EPA Region 10 list will no longer be updated and because Mr. Harold Scott of Region 10 has left the work group, third party tests should no longer be sent to Region 10 EPA.

Since the draft list was sent out, the list has been referred to as the "EPA work group list of approved leak detection equipment". The work group and EPA are concerned that similar statements may begin to appear in sales literature distributed by vendors. We request that you do not refer to the list in this way for the following reasons.

1. **This is not an EPA or EPA work group list.** This draft list was prepared by an **independent** work group consisting of state and EPA members.
2. **Neither EPA nor the work group approve leak detection equipment or procedures.** The draft list does not include "approved" leak detection equipment/procedures. It includes leak detection equipment/procedures that the work group reviewed and confirmed, were third-party tested in accordance with either an EPA or other acceptable test protocol, and the test confirmed that the equipment/procedures meet EPA performance standards. Approval or acceptance of leak detection equipment and procedures is the responsibility of the implementing agency, which in most cases is the state environmental agency.

We plan to send only one copy per company per location in the future. If you received more than 1 copy at your location, or if this letter needs to be forwarded, please notify me of the proper person to send future correspondence.

The trial posting of the draft documents on EPA's "CLU-IN" electronic bulletin board was successful and the draft list can currently be accessed. We plan to post the first edition list as well. For more information on CLU-IN, please call (703) 308-8885 or dial into CLU-IN at (301) 589-8366 with your modem set at 8,N,1.

Enclosure: Work Group Members, Work Group Teams, Leak Detection Equipment Review-Document List

WORK GROUP MEMBERS

MEMBER	ADDRESS	PHONE/FAX/E-MAIL
Curt D. Johnson	Alabama Department of Environmental Management PO Box 301463 Montgomery, AL 36130-1463	(334) 271-7986 Fax (334) 270-5612
Mike Kadri	Michigan Department of Natural Resources UST Division PO Box 30157 Lansing, MI 48909-7657	(517) 335-7204 Fax (517) 335-2245
Beth DeHaas	Maine Department of Environmental Protection Statehouse Station No. 17 Augusta, ME 04333	(207) 287-2651 Fax (207) 287-7826
Russ Brauksieck	New York State Department of Environmental Conservation 50 Wolf Rd., Room 360 Albany, NY 12233-3750	(518) 457-4351 Fax (518) 457-4332
David Wiley	USEPA 401 M St. Southwest 5402G Washington, DC 20460	(703) 308-8877 Fax (703) 308-8505
Lamar Bradley	Tennessee Department of Environment and Conservation UST Division, 4th Floor L and C Tower 401 Church St. Nashville, TN 37243-1541	(615) 532-0952 (615) 532-0945 Fax (615) 532-0938
Randy Nelson	USEPA Region 7 RCRA/STPG Branch 726 Minnesota Avenue Kansas City, KS 66101	(913) 551-7220 Fax (913) 551-7947
Thomas Springer	Oklahoma Corporation Commission Fuel Division PO Box 52000-2000 Oklahoma City, OK 73152-2000	(405) 522-5265 Fax (405) 521-6576
Ellen Van Duzee	USEPA Idaho Operations 1435 N. Orchard St. Boise, ID 83706	(208) 334-9507 Fax (208) 334-1231
Shahla Farahnak	California State Water Resource Control Board Division of Clean Water Program PO Box 944212 Sacramento, CA 94244-2120	(916) 227-4350 Fax (916) 227-4349

WORK GROUP TEAMS

TEAM	LEADER	MEMBERS
Volumetric	Beth DeHaas	Brauksieck
Non-Volumetric	Shahla Farahnak	Springer
ATG	Ellen Van Duzee	Brauksieck
SIR	Lamar Bradley	DeHaas Kadri
Vapor/Liquid	David Wiley	Van Duzee
Pipeline	Mike Kadri	Farahnak Springer
Other	Randy Nelson	See New Protocol Team List Below
List	Curt Johnson	Wiley

NEW PROTOCOLS

NEW PROTOCOLS and third-party tests of those protocols will be reviewed by the following sub-team members:	
PROTOCOL	MEMBERS
Liquid Point Sensor	David Wiley
Cable Sensors	David Wiley, Mike Kadri
Continuous ATG	Shahla Farahnak, Mike Kadri
Large Tank ATG	Shahla Farahnak, Ellen Van Duzee, Russ Brauksieck
Large Tank Volumetric	Shahla Farahnak, Russ Brauksieck, Beth DeHass
Vapor/Radian	David Wiley
Maintaining Pressure or Vacuum on Doublewalled Tanks	Tom Springer, Mike Kadri
Large Pipeline	Mike Kadri, Tom Springer

LEAK DETECTION EQUIPMENT REVIEW - DOCUMENT LIST

This information lists the documentation required for review of third-party evaluation of underground storage tank and line leak detection equipment or test methods.

1. A complete third-party evaluation report, including:
 - a. Details of the evaluation procedure if the EPA standard procedure was not used for the evaluation. If the EPA evaluation procedure was used, list any deviations or modifications to the procedure.
 - b. Complete set of all the EPA required attachment sheets.
 - c. Individual test logs and/or field notes.
 - d. Statistical calculations and any applicable graphs or charts generated during the evaluation.
 - e. A statement from the evaluator confirming that all equipment at the test site was properly maintained and calibrated to the level of accuracy necessary for a valid evaluation.
2. An outline of the manufacturer's operating procedures for the equipment/method. The summary procedure must be dated and include a revision number, if applicable. A copy of the summary procedure must be provided to the third-party evaluator for enclosure in the report. Also required is a statement from the manufacturer confirming the use of the submitted procedure during the evaluation.
3. Complete installation/operations manual for the equipment/method.
4. A sample of the test report (including field work-sheets) which will be submitted to the owner/local implementing agency.
5. Outline of the test procedures in high groundwater areas. These procedures should be reviewed for adequacy by the third-party evaluator and a statement to that effect should be included with the report.
6. Outline of the test procedures for manifold tank systems. These procedures should be reviewed for adequacy by the third-party evaluator and a statement to that effect should be included with the report.
7. An affidavit from the manufacturer confirming that there are no mutual financial interests between the equipment manufacturer and the third-party evaluator.
8. A resume, including all applicable formal training and experience, from personnel who conducted the evaluation.
9. Equipment calibration procedures and manufacturer recommended schedule of calibration.

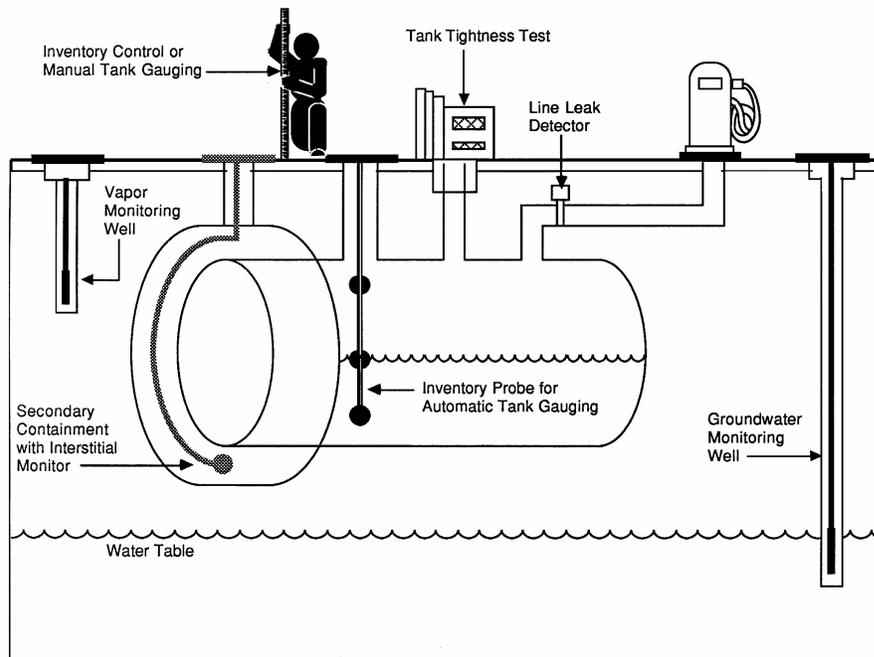
Leak Detection Equipment Review - Document List (Continued)

- 10. The name, address, and phone number of the technical personnel serving as the manufacturer's representative for the response to the regulatory agency questions on the equipment or test method.
- 11. Correspondence letters from state agencies who have reviewed the equipment/method.
- 12. Following documentation for all permanently-installed leak detection equipment:
 - a. A list of installers authorized by the manufacturer to install the leak detection equipment.
 - b. A list of service personnel authorized by the manufacturer to conduct the annual functional test (required for all leak detection equipment).
 - c. An outline of the maintenance procedure (including a list of the parts or functions of the system to be checked, calibrated, or programmed) for the annual functional test by authorized service personnel.
 - d. An outline (1-2 pages) "Equipment Check Guidelines for Inspectors" prepared by the manufacturer. This summary should guide local agency inspectors on proper field procedures to follow when inspecting equipment for proper operation, for attempting to access the stored history (for alarms or failed tests) to determine compliance with state requirements.
 - e. A sample of the reports generated and/or printed by the equipment (for all equipment models), and an explanation of the items in the report, if not self-explanatory.
 - f. Information on how the control panel modules connected to the various probes are labeled. The information on the panel should be directly comparable to the equipment name, model/part/probe number which will be included in the committee's list. If necessary, a permanent label containing that information should be affixed to the panel.
- 13. Following documentation for the methods using tracer analysis:
 - a. Name and certification of the laboratory analyzing vapor samples.
 - b. Quality Assurance Manual of the laboratory.
 - c. Method and amount of tracer injection.
 - d. Vapor sample collection method and chain of custody records.
 - e. Third-party certification for capability of the test-method to detect leaks from the ullage portion of the tank.

FIRST EDITION

LIST OF LEAK DETECTION EVALUATIONS FOR UNDERGROUND STORAGE TANK (UST) SYSTEMS

November 8, 1995



DISCLAIMER

This list of Leak Detection Evaluations was prepared by a work group consisting of State and EPA members and is limited to evaluations of leak detection equipment and procedures, or systems, that the work group has completed review of, and that were conducted by an independent third-party evaluator with leak rates blind to the vendor. This list includes evaluations conducted in accordance with either EPA Standard Test Procedures for Evaluating Leak Detection Methods (EPA/530/UST-90/004X) or other acceptable protocols. The list includes an Under Review category, for evaluations which the work group's review could not be finalized prior to publication. THE LISTING OF SYSTEM EVALUATIONS AS "UNDER REVIEW" IN NO WAY IMPLIES THAT THE EVALUATIONS DO OR DO NOT MEET THE CRITERIA FOR WHICH EVALUATIONS ARE REVIEWED.

SUMMARY SECTION FOR NATIONAL LIST**AUTOMATIC ELECTRONIC LINE LEAK DETECTORS**

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Campo/Miller, Inc.	LS300 and LS300 N/C	3 gph/2.36 gph
	LS300-120 and LS300-120 XLC	3 gph/2.36 gph
	LS300-120 PLUS and LS300-120 PLUS A/S	3 gph/2.36 gph
	LS300-120 PLUS, AL; LS300-120 PLUS, AL, A/S and LS300-120 PLUS AL, LSI	3 gph/1.5 gph
	LS300-120 PLUS, AL; LS300-120 PLUS, AL, A/S and LS300-120 PLUS AL,LSI	0.2 gph/0.1 gph
	LS300-120 PLUS, AL; LS300-120 PLUS, AL, A/S and LS300-120 PLUS AL,LSI	0.1 gph/0.05 gph
Control Engineers	Line Leak Detector Model LLP2	3.0 gph/1.88 gph
	Line Leak Detector Model LLP2	0.1 gph/0.05 gph
Emco Electronics, Tuthill Corp.	EECO System LLD (Q0011) - Hourly Monitoring Test	3.0 gph/2.0 gph
	EECO System LLD (Q0011) - Monthly Monitoring Test	0.2 gph/0.1293 gph
	EECO System LLD (Q0011) - Line Tightness Test	0.1 gph/0.0793 gph
	EECO System LLD Flexible Pipelines - Hourly Monitoring	3.0 gph/2.0 gph
	EECO System LLD Flexible Pipelines - Line Tightness Test	0.1 gph/0.0793 gph
Gilbarco Environmental Products	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	3.0 gph/1.88gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	3.0 gph/2.4 gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	3.0 gph/1.5 gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	0.2 gph/0.1 gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	0.2 gph/0.1 gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	0.1 gph/0.05 gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	0.1 gph/0.04gph
	Environmental Management Console (EMC) with Line Leak Detector, Series PA02630000501	0.1 gph/0.079 gph

AUTOMATIC ELECTRONIC LINE LEAK DETECTORS (Continued)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Gilbarco Environmental Products	Environmental Management Console (EMC)with Line Leak Detector, Series PA02630000501 For Flexible Pipelines	3.0 gph/1.5 gph
	Environmental Management Console (EMC)with Line Leak Detector, Series PA02630000501 For Flexible Pipelines	0.2 gph/0.1 gph
	Environmental Management Console (EMC)with Line Leak Detector, Series PA02630000501 For Flexible Pipelines	0.1 gph/0.079 gph
Hasstech	LineTite Pipeline Leak Monitor	3.0 gph/2.0 gph
	LineTite Pipeline Leak Monitor	0.1 gph/0.062 gph
Marley Pump Co.	Red Jacket PPM 4000, RLM 9000, RLM 10000, ST 1401L, and ST1801L	3.0 gph/2.0 gph
	Red Jacket PPM 4000, RLM 9000, RLM 10000, ST 1401L, and ST1801L	0.2 gph/0.1 gph
	Red Jacket PPM 4000, RLM 9000, RLM 10000, ST 1401L, and ST1801L	0.1 gph/0.047 gph
Ronan Engineering Co.	Ronan X-76 Automatic Line Leak Detector Version X-76 DM-4 Microprocessor and JT-H2 Line Pressure Sensor	3.0 gph/0.831 gph
	Ronan X-76 Automatic Line Leak Detector Version X-76 DM-4 Microprocessor and JT-H2 Line Pressure Sensor	0.1 gph/0.066 gph
Tidel Engineering, Inc.	LIPSPC-301-0730-001/LIP-301-0729-001 Line Integrity Probe and Submersible Pump Controller	3.0 gph/2.0 gph
	LIPS PC-301-0730-001/LIP-301-0729-001 Line Integrity Probe and Submersible Pump Controller	0.1 gph/0.06 gph
Veeder-Root	TLS-350 Line Leak Detector, Series 8475	3.0 gph/2.4 gph
	TLS-350 Line Leak Detector, Series 8475	3.0 gph/1.5 gph
	TLS-350 Line Leak Detector, Series 8475	0.2 gph/0.1 gph
	TLS-350 Line Leak Detector, Series 8475	0.2 gph/0.1 gph
	TLS-350 Line Leak Detector, Series 8475	0.1 gph/0.04 gph
	TLS-350 Line Leak Detector, Series 8475	0.1 gph/0.079 gph
	TLS-350 Line Leak Detector for Flexible Pipelines, Series 8475	3.0 gph/1.5 gph
	TLS-350 Line Leak Detector for Flexible Pipelines, Series 8475	0.2 gph/0.1 gph
	TLS-350 Line Leak Detector for Flexible Pipelines, Series 8475	0.1 gph/0.079 gph
	TLS Line Leak Detector, Series 8484	3.0 gph/1.88 gph
	TLS Line Leak Detector, Series 8484	0.1 gph/0.05 gph

AUTOMATIC MECHANICAL LINE LEAK DETECTORS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
FE Petro, Inc.	STP-MLD-E Line (Flexline) Leak Detector	3.0 gph/2.0 gph
	STP-MLD Pipeline Leak Detector	3.0 gph/2.0 gph
	STP-MLD-D Pipeline Leak Detector	3.0 gph/2.0 gph
Marley Pump Co.	Red Jacket DLD and XLD	3.0 gph/2.0 gph
	Red Jacket FX1/FX2	3.0 gph/2.0 gph
	Red Jacket FX1/FX2 Flexline	3.0 gph/2.0 gph
	Red Jacket FX2/FX2-D and Bigflo	3.0 gph/2.0 gph
	Red Jacket XLP	3.0 gph/2.0 gph
	Red Jacket XLP for Flexible Lines	3.0 gph/2.0 gph
Tokheim Corp.	Tokheim Pressure Monitor, Models PM 101 and 585A-PM	3.0 gph/2.25 gph
Vaporless Manufacturing	Vaporless LD 2000 and LD 2000S	3.0 gph/1.7 gph
	Vaporless LD 2000E and LD 2000E-S	3.0 gph/2.0 gph
	Vaporless LD 2000T and LD 2000T-S	3.0 gph/2.5 gph
	Vaporless LD 3000 and LD 3000S	3.0 gph/2.0 gph

AUTOMATIC TANK GAUGING SYSTEMS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Alert Technologies, Inc.	Alert Model 2000 In-Tank Mass Measurement Probe System	0.2 gph/0.1 gph
Andover Controls Corp.	Andover Infinity CX9000, CX9200, and CMX240	0.1 gph/0.05 gph
	Andover InfinityCX9000, CX9200, and CMX240	0.2 gph/0.1 gph
	Versions AC8+/AC256+ (Magnetostrictive Probe)	0.2 gph/0.1 gph
Arizona Instrument Corp.	Encompass MTS IPAM #17-903 (Magnetostrictive Probe #17-9300)	0.2 gph/0.1 gph
	Encompass USF IPAM #17-901 (Ultrasonic Probe #17-9100)	0.2 gph/0.1 gph
EBW	Auto-Stik II and Auto-Stik Jr.	0.2 gph/0.1 gph
	Auto-Stik II and Auto-Stik Jr.	0.1 gph/0.05 gph
Egemin Naamloze Vennootschap	E'SPI III	0.2 gph/0.075 gph
	E'SPI IV	0.2 gph/0.1 gph
Emco Electronics, Tuthill Corp.	EECO System TLM (0.2 gph Precision Test)	0.2 gph/0.1 gph
	EECO System TLM (0.1 gph Precision Test)	0.1 gph/0.05 gph
	EECO System TLM (0.2 gph Quick Test)	0.2 gph/0.1 gph
	EECO System TLM (0.1 gph Quick Test)	0.1 gph/0.05 gph
Engineered Systems, Inc.	Image II	0.2 gph/0.1 gph
Environment and Safety	EASI Level-Tru	0.2 gph/0.1 gph
Gasboy International	Gasboy TMS 500	0.2 gph/0.1 gph
Gilbarco Environmental Products	EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2, 3, 2.1, and 3.1, PAO238000XXXX Capacitance Probe	0.2 gph/0.1 gph
	EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2.1, 3.1, PAO264XXX0000 Capacitance Probe	0.2 gph/0.126 gph
	EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2.1, 3.1, PAO264XXX0000 Capacitance Probe	0.1 gph/0.071 gph
	EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2.1, 3.1, PAO265XXX0000 Magnetostrictive Probe	0.2 gph/0.093 gph
	EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2.1, 3.1, PAO265XXX0000 Magnetostrictive Probe	0.1 gph/0.071 gph
INCON Environmental	TS 1000(Magnetostrictive Probe)	0.2 gph/0.1 gph
	TS 2000(Magnetostrictive Probe)	0.2 gph/0.058 gph
Keekor Environmental Products	TankTite Leak Detection Kernel Version 1.0 with Keeprobe K7 Magnetostrictive Tank Gauge	0.2 gph/0.1 gph

AUTOMATIC TANK GAUGING SYSTEMS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Marley Pump Co.	Sonic Technology (ST) 1400-1800 Series Tank Monitoring System (Ultrasonic Transducer) ATG Automatic Tank Gauging Monitor, LLM Series Liquid Level Monitor, FMS Fuel Management Monitor	0.2 gph/0.1 gph
	Sonic Technology (ST) 1400-1800 Series Tank Monitoring System (Ultrasonic Transducer) ATG Automatic Tank Gauging Monitor, LLM Series Liquid Level Monitor, FMS Fuel Management Monitor	0.1 gph/0.05 gph
	Red Jacket ATM System, Ver. RLM 5000, 5001, and 9000	0.2 gph/0.1 gph
Patriot Sensors and Controls Corp.	7021 Digital Tank Gauge	0.2 gph/0.1 gph
	7021 Digital Tank Gauge	0.1 gph/0.05 gph
Petro Vend, Inc.	Petrosonic III, Version 4.05 Model 613 (4 inch) Magnetostrictive Probe	0.20 gph/0.10 gph
	Site Sentinel Model II and III Model 613 (2 inch) Magnetostrictive Probe	0.20 gph/0.10 gph
	Site Sentinel Model II and III Model 613 (4 inch) Magnetostrictive Probe	0.20 gph/0.10gph
	Site Sentinel Model II and III Model 613 (4 inch) Magnetostrictive Probe	0.10 gph/0.06 gph
Ronan Engineering Co.	X-76 ETM and X-76 ETM-4X	0.2 gph/0.1 gph
	X-76 ETM and X-76 ETM-4X	0.1 gph/0.05 gph
Tidel Engineering, Inc.	Tidel Environmental Monitoring System, EMS 2000, 3000, and 3500 Series Probes #401-0009 and #401-0010	0.2 gph/0.05 gph
	Tidel Environmental Monitoring System, EMS 2000, 3000, and 3500 Series Probes #401-0021 and #401-0022	0.2 gph/0.1 gph
Universal Sensors and Devices, Inc.	TICS-1000	0.2 gph/0.1 gph
Veeder-Root	TLS-200/200i/300/400 UST ATGS with 7842 Digital Sensing Capacitance Probe	0.2 gph/0.1 gph
	TLS-200/200i/300/400 UST ATGS with 8472 Digital Sensing Capacitance Probe	0.2 gph/0.126 gph
	TLS-200/200i/300/400 UST ATGS with 8472 Digital Sensing Capacitance Probe	0.1 gph/0.071 gph
	TLS-200/200i/250/250i/300/350/400 UST ATGS with 8473 Digital Sensing Magnetostrictive Probe	0.2 gph/0.093 gph
	TLS-200/200i/250/250i/300/350/400 UST ATGS with 8473 Digital Sensing Magnetostrictive Probe	0.1 gph/0.071 gph
	Veeder-Root 3000 Tank Level Module – version TLP2 Normal/Rapid Test Mode - Magnetostrictive Probe	0.2 gph/0.1 gph
	Veeder-Root 3000 Tank Level Module – version TLP2 Normal/Rapid Test Mode - Magnetostrictive Probe	0.1 gph/0.05 gph

DOUBLE WALLED TANK TIGHTNESS TESTS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Fluid Containment, Inc. (formerly O/C Tanks Corp.)	Hydrostatic Precision Tank Test for DWT-Type II Tanks	0.1 gph/0.05 gph without dispensing and 0.7 gph with dispensing
Xerxes Corp.	Xerxes Trucheck Hydrostatic Monitoring System	0.1 gph/0.05 gph

LINE TIGHTNESS TEST METHODS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Hasstech	AcuRite	0.1 gph/0.01 gph
Heath Consultants, Inc.	Petro Tite Line Tester	0.1 gph/0.01 gph
Horner Creative Products	EZY-Chek Manual Line Leak Detector	0.1 gph/0.05 gph
	EZY-Chek II Automatic Line Leak Detector	0.1 gph/0.05 gph
Lab One Analytical, Inc.	Search	0.05 gph/Detection of tracer chemical.
NDE Environmental Corp.	Proline Test Series III, Version 1.0	0.1 gph/0.05 gph
	PTK-88	0.1 gph/0.05 gph
Tanknology Corp. International	TLD-1	0.1 gph/0.05 gph
Tracer Research Corp.	Tracer Tight Line Test	0.1 gph/Detection of tracer chemical.
Western Environmental Resources	Model PLT-100R	0.1 gph/0.05 gph

LIQUID-PHASE INTERSTITIAL DETECTORS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>OPERATING PRINCIPLE</u>
Arizona Instrument Corp.	Soil Sentry Liquid 330(17-330-A/17-330-B), TLM-830, ENCOMPASS APAM Probes 17-141A, 17-142A, 17-143A, 17-144A	refraction
Emco Electronics, Tuthill Corp.	EECO system, Leak Sensor II, Leak Sensor Jr. Thermistor and Proximity probes	thermal conductivity, proximity switch
Gilbarco Environmental Products	PA02590XXX000	float switch
	PA02591144000	float switch
	PA02592000000	float switch
Marley Pump Co.	Red Jacket PPM 4000 with Optical Liquid Discrimination Sensor	optical sensor
Omntec/Electro Levels	L-LL-R-1, LS-ASC, PDS-ASC, PDWS-1, PDWF-1	all: refractive index of liquids; PDS-ASC, PDWS-1, and PDWF-1 also electrical conductivity
PermAlert	PAL-AT Models AT20C, AT50C, AT40K PHL Hydrocarbon Sensor	electrical conductivity
	TankWatch Models PHM10, PHMS Combination Hydrocarbon/Water Probe	electrical conductivity
	TankWatch Models PHM10, PHMS Hydrocarbon Probe	electrical conductivity
Petro Vend, Inc.	Petrosentry IV, Petrosentry VIII, SiteSentinel Liquid Sensor	thermal conductivity
	Petrosentry IV, Petrosentry VIII, SiteSentinel Universal Reservoir Sensor	float switch
	Petrosentry IV, Petrosentry VIII, SiteSentinel Universal Sump Sensor	float switch
Pneumercator Company, Inc.	LDE 700, LDE 740, LDE 9000 Sensor Probe Models 9-901, 9-902, 9-903	capacitance
Tidel Engineering, Inc.	EMS-3500 with Monitoring Well Probes Part 301-0642	magnetic switch/float and hydrocarbon sensitive polymer
	EMS-3500 with Liquid Discriminatory Probes Part 301-0635	Electrical conductivity/ hydrocarbon sensitive polymer
	EMS-3500 Tidel Detector No. 301-0752-001	float switch
Universal Sensors and Devices, Inc.	Leak Alert System Models LAL-100, LA-01, LA-02, LA-04, LA-X4, LA-08, CATLAS Liquid Sensor LALS-1	thermal conductivity
Veeder-Root	TLS-350 Discriminating Interstitial Liquid Sensor	capacitance change/ultrasonic
	TLS-350 Dispenser Pan Sensors and Containment Sump Sensors	electrical conductivity/ultrasonic
	TLS-350 Dual and Single Stage Hydrostatic Sensors	float switch
	TLS-250i, TLS 250i Plus, ILS 250, ILS 350, TLS-350 Interstitial Liquid Sensor for Fiberglass Tanks (0794390-401)	float switch
	TLS-250, TLS 250i Plus, ILS 250, ILS 350, TLS-350 Interstitial Liquid Sensor for Steel Tanks (0794390-420)	float switch

LIQUID-PHASE INTERSTITIAL DETECTORS (Continued)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>OPERATING PRINCIPLE</u>
Veeder-Root	TLS-250i, TLS 250i Plus, ILS 250, ILS 350, TLS-350 Liquid Sensor for Sumps (0794390-206)	float switch
	TLS-350 Solid-State Pan/Sump Sensor (794380-321, -351), Piping Sump Sensor (794380-208), Micro Sensor (794380-340)	product permeable/ultrasonic/float switch

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTORS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>OPERATING PRINCIPLE</u>
Advanced Tank Technology, Inc.	Leak Tracer Dye (LTD), LTD Systems, Inc.	product solubility - color development
Agar Corp.	LEAKWISE Groundwater Monitor ID-220 Series Hydrocarbon on Water Detector System	radio frequency (RF) attenuation
FCI Environmental, Inc.	Analog Hydrocarbon Probe AHP-100	fiber optic chemical sensor
	Digital Hydrocarbon Probe DHP-100	fiber optic chemical sensor
Gilbarco Environmental Products	Environmental Management Console (EMC) Groundwater Sensor, series PA02700XX0001	electrical conductivity
IMO Industries Inc., Gems Sensors Division	Gems Smartwell Portable Monitor model WPM-535 with Groundwater Probe model WP-535	conductive polymer
In-Situ, Inc.	Leak Detection Systems, KW-140 / KW-240 Monitors with Type 1 Sensor	product soluble
	Leak Detection Systems, KW-140 / KW-240 Monitors with Type 2 Sensor	product soluble
Mallory Controls	Pollulert Probes MD221G/T, MD221G/TRA	electrical conductivity
	Pollulert Probes MD241R, MD241RRA, MD241G, MD241GRA	electrical conductivity
One Plus Corp.	Leak Edge Models 100-3001, 100-4001	product permeable
PermAlert	PAL-AT Models AT20C, AT50C, AT40K AGW Sensor Cable	impedance change
	PAL-AT Models AT20C, AT50C, AT40K with PHFW Hydrocarbon Probe and Type 1 Sensor	product soluble
	PAL-AT Models AT20C, AT50C, AT40K with PHFW Hydrocarbon Probe and Type 2 Sensor	product soluble
	PAL-AT Models AT20C, AT50C, AT40K TFH Hydrocarbon Sensor Cable	impedance change
Petro Vend, Inc.	SiteSentinel 30-3206, -3207, -3210 Sensors	product permeable
Raychem Corp.	TraceTek Alarm and Locator Modules TT502 Fuel Sensing Cable	electrical conductivity
Tidel Engineering, Inc.	EMS-3500with Monitoring Well Probes Part 301-0641	conductivity via resistor ladder network
	EMS-3500with Sheen Probes Part 301-0687	electrical conductivity/hydrocarbon sensitive polymer
	EMS-3500 Tidel Detector No. 301-0762	electrical conductivity/hydrocarbon sensitive polymer
	Tidel Detector No. 301-0324-001 and 301-0325-001	electrical conductivity
	Tidel Detector No. 301-0326-001 and 301-0326-002	electrical conductivity
Veeder-Root	350 Series UST Monitoring Systems: Models ILS-350, TLS-350, TLS-350R Groundwater Sensor (794380-621, -622, -624)	electrical conductivity

NON-VOLUMETRIC TANK TIGHTNESS TEST METHODS (TRACER)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Lab One Analytical, Inc.	Search	0.05 gph/Detection of tracer chemical.
Tracer Research Corp.	Tracer Tight	0.1 gph/ Detection of tracer chemical.

NON-VOLUMETRIC TANK TIGHTNESS TEST METHODS (ULLAGE)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Alert Technologies, Inc.	Alert Ullage System Model 1050 (1.5 psi and -1.0 psi)	0.1 gph/ Ultrasonic signal when the tank is under pressure or vacuum is compared to background signal (prior to pressurization).
	Alert Ullage System Model 1050 X (-1.5 psi)	0.1 gph/ Ultrasonic signal when the tank is under vacuum is compared to background signal (prior to vacuum).
NDE Environmental Corp.	UTS-4T Ullage Test	0.1 gph/Make-up gas flow rate into ullage exceeding 0.275 cubic feet/hour.
	UST Ullage Test - Version ProEco U2	0.1 gph/Pressure decay trend not to exceed ± 0.016 psi/hr.
	U3 Ullage Test (Vacuum or Pressure)	0.1 gph/A leak is declared if the noise signal detected is different from the baseline. (Baseline is the noise signal before pressure or vacuum is applied to tank.)
Triangle Environmental, Inc.	TEI Ullage Test, Version 1.00	0.1 gph/An increase in the acoustical noise level of the tank under vacuum due to air or water ingress indicates a leak.
USTest	UST 2000/U (2.0 psi and -1.0 psi))	0.1 gph/A substantial increase in the noise signal (under vacuum or pressure) over the background signal (no pressure or vacuum applied) in the frequency interval of 10 kHz to 20 kHz is declared a leak.

NON-VOLUMETRIC TANK TIGHTNESS TEST METHODS (VACUUM)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Horner Creative Products	EZY 3	0.1 gph/ A leak is declared when the pressure decay is more than 1 inch water column pressure (inch H ₂ O) for non-volatile products and 10% of the lower determined pressure for volatile products. A leak is also declared if any water incursion is detected.
Tanknology Corp. International	VacuTect	0.1 gph/ A leak is declared if any air or water incursion is detected. Sonic emission of air ingress in the ullage area (above product level); sonic emission of bubbles formed by air ingress in product-filled portion of the tank; accumulation of water in bottom of tank from water ingress.
Triangle Environmental, Inc.	TEI System 5000, Version 1.0	0.1 gph/ A leak is declared if the acoustical noise level of the tank under vacuum is greater than the calibrated noise level (which is taken without vacuum).

STATISTICAL INVENTORY RECONCILIATION TEST METHODS (QUALITATIVE)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Entropy Limited	Precision Tank Inventory Control System, Version 90	0.1 gph/0.04 gph
Horner Creative Products	SIR PRO 1 Version 1.0	0.2 gph/0.1 gph
	SIR PRO 1 Version 2.0	0.1 gph/0.05 gph
Syscorp, Inc.	Store Vision Version E.2	0.2 gph/0.0834 gph
USTMAN Industries, Inc.	YES SIR 90	0.2 gph/0.1 gph

STATISTICAL INVENTORY RECONCILIATION TEST METHODS (QUANTITATIVE)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Computerizing, Inc.	Computank V. 3.0	0.1 gph/0.05 gph
Entropy Limited	Precision Tank Inventory Control System Rev. 90	0.1 gph/0.05 gph
Environmental Management Technologies	SIRTECH	0.1 gph/0.05 gph
EnviroQuest Technologies Limited	Enviro Tite SIR (also known as SIRAS 99.6)	0.1 gph/0.05 gph
	SIRAS Software System, Version 2.0	0.1 gph/0.05 gph
	SIRAS Software System, Version 2.8.3	0.2 gph/0.1 gph
Simmons Sirvey Corp.	SIR 5.7	0.1 gph/0.05 gph
S.I.R. International, Inc.	Mitchell's SIR Program v.2.6 12-13-91	0.1 gph/0.05 gph
Sir Phoenix, Inc.	SIR PHOENIX	0.1 gph/0.05 gph
USTMAN Industries, Inc.	USTMAN SIR 1.91	0.1 gph/0.1 gph
	USTMAN SIR Version 94.1	0.1 gph/0.05 gph
Warren Rogers Associates, Inc.	WRA Statistical Inventory Analysis, Version 5.1	0.1 gph/0.05 gph

VOLUMETRIC TANK TIGHTNESS TEST METHODS (OVERFILL)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Hasstech	Leak Computer Tank Test System	0.1 gph/0.05 gph
Heath Consultants, Inc.	Petro Comp	0.1 gph/0.05 gph
Heath Consultants, Inc.	Petro Tite II	0.1 gph/0.05 gph
Horner Creative Products	Horner EZY-Chek I	0.1 gph/0.05 gph
	Horner EZY-Chek II	0.1 gph/0.05 gph
Ibex Industries	Ibex Precision Test System	0.1 gph/0.05 gph
Leak Detection Systems, Inc.	Tank Auditor, Version RTD V.2.16	0.1 gph/0.05 gph
Schuster Instruments	Tel-A-Leak 1	0.1 gph/0.05 gph
Soiltest, Inc.	Soiltest Ainlay Tank 'Tegrity' Tester, S-3	0.1 gph/0.05 gph
Tank Automation, Inc.	Automated Precision Tank Testing System (APTT System) R-2	0.1 gph/0.05 gph
Western Environmental Resources	AES System II	0.1 gph/0.05 gph
	AES System II - (Large Tanks)	0.1 gph/0.05 gph

VOLUMETRIC TANK TIGHTNESS TEST METHODS (UNDERFILL)

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>LEAK RATE/THRESHOLD</u>
Alert Technologies, Inc.	Alert Model 1000	0.1 gph for 2 hr test and 0.2 gph for 4 hr test/0.05 gph
Hasstech	Leak Computer Tank Test System	0.1 gph/0.05 gph
Horner Creative Products	Horner EZY-Chek II	0.1 gph/0.05 gph
NDE Environmental Corp.	Computerized VPLT Testing System	0.1 gph/0.05 gph
	Sure Test - Assured Tight System, Series IV	0.1 gph/0.05 gph
Triangle Environmental, Inc.	TEI System 4000, Version 1.0	0.1 gph/0.05 gph
USTest	UST 2000/LL	0.1 gph/0.05 gph
	UST 2000/P	0.1 gph/0.05 gph

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTORS

<u>VENDOR</u>	<u>EQUIPMENT NAME</u>	<u>OPERATING PRINCIPLE</u>
Arizona Instrument Corp.	Soil Sentry Twelve-X	metal oxide semiconductor
	Soil Sentry Twelve-X	metal oxide semiconductor
Environmental Fuel Systems, Inc.	Fuel Finder Version IV	adsorption sampling
FCI Environmental, Inc.	Analog Hydrocarbon Probe AHP-100	fiber optic
	Digital Hydrocarbon Probe DHP-100	fiber optic
FDR Services, Inc.	GasPak Vapor Monitoring System	product permeable detector
Gilbarco Environmental Products	PA0266000000	adsistor
Mallory Controls	Pollulert Probes MD221V, MD221VRA, MD210V, MD210VRA	adsistor
Mine Safety Appliances	Tankgard Version: P/N 481532 S/N 03095	metal oxide semiconductor
	Tankgard VIII Version: P/N 488803 S/N 00389	metal oxide semiconductor
Petro Vend, Inc.	SiteSentinel Smart Module and Vapor Sensor	metal oxide semiconductor
	Petrosentry TLD III	metal oxide semiconductor
Tidel Engineering, Inc.	EMS-3000 301-0328-001, 301-0330-001	adsistor
	EMS-3500 Vapor Sensor Probe Part No. 301-0634	adsistor
Tracer Research Corp.	Tracer Tight	chromatographic (looks for chemical tracer)
Universal Sensors and Devices, Inc.	Leak Alert System Models LAL-100, LA-01, LA-02, LA-04, LA-X4, LA-08, CATLAS LAVS-1 MOS Vapor Sensor	metal oxide semiconductor
Veeder-Root	ILS 350, TLS-350 Adsistor Vapor Probes	adsistor
Warrick Controls, Inc.	Model 5700 Meter PVP-2 Sensor	adsistor

SPECIFICATION SECTION

ALPHABETICAL BY COMPANY,
THEN BY TEST METHOD,
NEXT BY EQUIPMENT MODEL,
FINALLY BY LEAK RATE

Advanced Tank Technology, Inc.

**Leak Tracer Dye (LTD)
LTD Systems, Inc.**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: intermittent
Operating principle: product solubility - color development

Test Results:

	synthetic <u>gasoline</u>	commercial <u>gasoline</u>
Accuracy (%)	100 (above 8 ppm)	100 (above 23 ppm)
Detection time (min:sec)	<00:01	<00:01
Fall time (min:sec)	N/A*	N/A
Lower detection limit (cm)	<0.32	<0.32

*See glossary.

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, JP-4 jet fuel, synthetic gasoline, toluene, xylene(s).

Manufacturer's specifications:

LTD develops color in alcohols, ketones, solvents, and PCBs as well as petroleum products.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
The detector is not reusable, and must be replaced after contact with hydrocarbons.

Advanced Tank Technology, Inc.
820 N. Sylvania
Fort Worth, TX 76111
Tel: (817) 831-3246

Evaluator: Scientific Information Services
Tel: Not Available

Date of Evaluation: 02/02/93

Agar Corp.

LEAKWISE Groundwater Monitor
ID-220 Series Hydrocarbon on Water Detector System

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: radio frequency (RF) attenuation

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	<00:01	<00:01
Fall time (min:sec)	<00:01	<00:01
Lower detection limits (cm)		
"Standard" setting	0.16	0.32
"Sensitive" setting	0.03	0.03

Specificity Results:

Activated: commercial gasoline, synthetic gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, xylene(s), water.

Manufacturer's specifications:

Operating range:

- Resolution : 0.5 mm of hydrocarbon on water or brine
- Variation : water fluctuation of +/- 1 meter standard (larger variations optional)
- Oil thickness : 0.3 - 25 mm optional (higher ranges available)
- Temperature : 0 - 70 degrees C (higher available)

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
This detector is reusable.
Color coded signal lights indicate the presence of air, water, and hydrocarbon liquid when activated (yellow, green, and red, respectively).

Agar Corp.
P.O. Box 802127
Houston, TX 77280-2127
Tel: (713) 464-4451

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 11/15/91

Alert Technologies, Inc.**Alert Model 2000 In-Tank Mass Measurement Probe System****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D=95.4\%$ and $P_{FA}=4.6\%$ (calculated based on a one-hour test).
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, waste oil, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to tank and test data collection must be 15 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test must be acquired and recorded by computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during test.
- Temperature:** Displacer probe measures mass of product and is immune to product temperature changes.
Therefore, no temperature measurements are required with this ATGS.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.175 inch (0.27 inch for waste oil).
Minimum change in water level that can be detected is 0.088 inch (0.031 inch for waste oil).
- Calibration:** Mass measurement probe and water sensor must be checked and calibrated if necessary in accordance with manufacturer's instructions.
This is a battery operated system and does not automatically generate a hard copy of the leak test result. However, a hard copy of the results can be obtained by transfer of data to another unit (see manufacturer's instructions for further details).
This system is not equipped with any alarms (e.g. high water alarm, or failed leak test alarm).
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment only tests the portion of the tank containing product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).
2000-X model (which was certified for use on tanks up to 30,000 gal capacity) and 2000-XB model (which was certified for use on tanks up to 72,948 gallons) are still under review.

Alert Technologies, Inc.
5400 NewPort Dr., Suite 13
Rolling Meadows, IL 60008
Tel: (708) 392-0060

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 03/11/91

Alert Technologies, Inc.**Alert Ullage System Model 1050 (1.5 psi and -1.0 psi)****NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)**

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Ultrasonic signal when the tank is under pressure or vacuum is compared to background signal (prior to pressurization).
A leak is declared if the ratio exceeds 1.5 for either 12 kHz or 25 kHz frequency band.
- Applicability:** Gasoline, diesel, aviation fuel, heavy fuel oils (#2 through #6), waste oil, and solvents.
- Capacity:** The maximum ullage volume is 6,000 gallons.
- Waiting time:** There is no waiting time after product delivery if the test is conducted after an underfilled tank tightness test.
- Test Period:** The minimum data collection time is 5 minutes.
The test data must be acquired and recorded by a computer.
- Test Pressure:** A net pressure of 1.5 psi (or -1.0 psi) in the ullage of the tank is maintained.
Tank system must be able to maintain pressure or vacuum with a loss of less than 0.4 psig.
- Groundwater:** Depth to groundwater in must be determined. If water table is present outside the ullage portion of the tank, vacuum-ullage test must not be used; Pressure-ullage test must be done under a net outward pressure of 1.5 psi.
- Calibration:** Equipment is calibrated before each test.
- Comments:** This test method only tests the ullage portion of the tank, the product-filled portion of the tank must be tested with an underfilled test method.
Vibration due to nearby equipment or dripping condensation may interfere with this test method.
When testing with vacuum, this test method may not be effective in some backfill because some backfill (such as clay) may plug a hole in the tank.
Manifold tanks are isolated prior to the test.
During the third-party evaluation, unleaded gasoline was used.
During the third-party evaluation, microphone was located 25 feet away from the leak simulator.

Alert Technologies, Inc.
5400 Newport Dr., Suite 13
Rolling Meadows, IL 60008
Tel: (708) 392-0060

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/15/92

Alert Technologies, Inc.

Alert Ullage System Model 1050 X (-1.5 psi)

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Ultrasonic signal when the tank is under vacuum is compared to background signal (prior to vacuum).
A leak is declared if the ratio exceeds 1.5 for either 12 kHz or 25 kHz frequency band.
- Applicability:** Gasoline, diesel, aviation fuel, heavy fuel oils (#2 through #6), waste oil, and solvents.
- Capacity:** The maximum ullage volume is 24,000 gallons.
- Waiting time:** There is no waiting time after product delivery if the test is conducted after an underfilled tank tightness test.
- Test Period:** The minimum data collection time is 5 minutes.
The test data must be acquired and recorded by a computer.
- Test Pressure:** A net pressure of 1.5 psi (or -1.0 psi) in the ullage of the tank is maintained.
Tank system must be able to maintain pressure or vacuum with a loss of less than 0.4 psig.
- Groundwater:** Depth to groundwater in must be determined. If water table is present outside the ullage portion of the tank, vacuum-ullage test must not be used; Pressure-ullage test must be done under a net outward pressure of 1.5 psi.
- Calibration:** Equipment is calibrated before each test.
- Comments:** This test method only tests the ullage portion of the tank, the product-filled portion of the tank must be tested with an underfilled test method.
Vibration due to nearby equipment or dripping condensation may interfere with this test method.
When testing with vacuum, this test method may not be effective in some backfill because some backfill (such as clay) may plug a hole in the tank.
Manifold tanks are isolated prior to the test.
During the third-party evaluation, #4 fuel oil was used.
During the third-party evaluation, microphone was located 25 feet away from the leak simulator.

Alert Technologies, Inc.
5400 NewPort Dr., Suite 13
Rolling Meadows, IL 60008
Tel: (708) 392-0060

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/28/94

Alert Technologies, Inc.

Alert Model 1000

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=98.2\%$ and $P_{FA}=1.8\%$ for 2 hr test and $P_D=99.8\%$ and $P_{FA}=0.2\%$ for 4 hr test.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, waste oil, solvent, and other compatible products.
- Capacity:** The maximum tank capacity is 30,000 gallons.
This equipment is capable of testing a tank at product levels from 20 to 95% full.
- Waiting time:** Minimum waiting time between delivery and the beginning of the test data collection must be at least 1 hour.
Minimum waiting time after dispensing is 1 minute.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours to achieve P_D of 99.8% and P_{FA} of 0.2% and 2 hours to achieve P_D of 98.2% and P_{FA} of 1.8%.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from the data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during test.
- Temperature:** Temperature is not measured because this system is based on mass measurement which is not affected by temperature.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide a minimum of 2 psi net pressure on the bottom of the tank.
- Calibration:** The load cell must be calibrated before each test.
- Comments:** This system was not evaluated using manifold tank systems.
This system tests only the portion of tank containing product.
As product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).

Alert Technologies, Inc.
5400 NewPort Dr., Suite 13
Rolling Meadows, IL 60008
Tel: (708) 392-0060

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 04/26/91

Andover Controls Corp.

**Andover Infinity
CX9000, CX9200, and CMX240**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99.9\%$ and $P_{FA} <0.1\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvents and other compatible products with known coefficients of expansion and density.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and the test data collection must be 6 hours.
Minimum waiting time after dispensing is 3 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data is acquired and recorded by a computer.
Leak rate is calculated as the average of subsets of all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 3 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.35 inches.
Minimum detectable change in water level is 0.003 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Andover Controls Corp.
300 Brickstone Square
Andover, MA 01810
Tel: (508) 470-0555

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 05/24/93

Andover Controls Corp.

Andover Infinity CX9000, CX9200, and CMX240

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=97.6\%$ and $P_{FA}=2.4\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvents and other compatible products with known coefficients of expansion and density.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and the data collection must be 6 hours.
Minimum waiting time after dispensing must be 3 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data is acquired and recorded by a computer.
Leak rate is calculated as the average of subsets of all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 3 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.35 inches.
Minimum detectable change in water level is 0.003 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Andover Controls Corp.
300 Brickstone Square
Andover, MA 01810
Tel: (508) 470-0555

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 05/24/93

Andover Controls Corp.

**Versions AC8+/AC256+
(Magnetostrictive Probe)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99.5\%$ and $P_{FA}=0.5\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 6 hours.
Minimum waiting time after normal pumping must be 4 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data is acquired and recorded by a computer.
Leak rate is calculated as the difference between first and last data collected, divided by elapsed time between first and last volume changes observed.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 3 Resistance Temperature Detectors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.99 inches.
Minimum detectable change in water level is 0.01 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Andover Controls Corp.
300 Brickstone Square
Andover, MA 01810
Tel: (508) 470-0555

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/03/92

Arizona Instrument Corp.

**Encompass MTS IPAM #17-903
(Magnetostrictive Probe #17-9300)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 97.80\%$ and $P_{FA} = 2.20\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, solvents, waste oil, and other products which are compatible with the probe.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** The minimum waiting period between delivery to the tank and test data collection must be 3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.29 inches.
Minimum change in water level that can be detected is 0.0034 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Encompass software provides for remote access capabilities.

Arizona Instrument Corp.
4114 E. Wood St.
Phoenix, AZ 85040-1941
Tel: (800) 528-7411

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/22/94

Arizona Instrument Corp.

**Encompass USF IPAM #17-901
(Ultrasonic Probe #17-9100)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 99.94\%$ and $P_{FA} = 2.06\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, solvents, waste oil, and other products which are compatible with the probe.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** The minimum waiting period between delivery to the tank and test data collection must be 3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A single sensor measures change in ultrasonic wave velocity to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.86 inches.
Minimum change in water level that can be detected is 0.012 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Encompass software provides for remote access capabilities.

Arizona Instrument Corp.
4114 E. Wood St.
Phoenix, AZ 85040-1941
Tel: (800) 528-7411

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/22/94

Arizona Instrument Corp.

Soil Sentry Liquid 330(17-330-A/17-330-B), TLM-830, ENCOMPASS APAM
Probes 17-141A, 17-142A, 17-143A, 17-144A

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: refraction

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>	<u>#2 diesel</u>	<u>water</u>
Accuracy (%)	100	100	N/D**	N/D
Detection time (min:sec)	00:03	00:03	N/D	N/D
Fall time (hr:min:sec)	Manual reset	Manual reset	N/D	N/D
Lower detection limits (cm)				
17-141A	0.25	0.28	0.15	0.1
17-142A	0.25	0.30	0.18	0.18
17-143A	0.03	0.15	0.03	0.13
17-144A	0.28	0.30	0.30	0.15

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, synthetic gasoline, toluene*, xylene(s), water.

*Only 17-143A was tested with toluene.

** See glossary

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring.

The detectors are listed as interstitial due to intended use.

Evaluation followed a combination of EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors," and EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Non-Volumetric Tank Tightness Testing Methods," March 1990.

These detectors are reusable.

Although ENCOMPASS APAM (Accessory Probe Access Module) was not included in evaluations, the probes perform in the same manner when connected to any one of these three systems, according to the manufacturer.

Arizona Instrument Corp.
 4114 E. Wood St.
 Phoenix, AZ 85040-1941
 Tel: (800)528-7411

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Dates of Evaluation: 12/29/92 and 01/08/93

Arizona Instrument Corp.**Soil Sentry Twelve-X****VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: quantitative
 Sampling frequency: continuous
 Operating principle: metal oxide semiconductor

Test Results:

	commercial gasoline	synthetic gasoline	JP-4	JP-5
Accuracy* (%)	170	120	120	N/D***
Bias (%) _x	60	8.0	1.8	N/D
Precision* (%)	6.3	7.7	18	N/D
Detection time (min:sec)	12:20	12:27	12:33	N/D
Fall time (min:sec)	11:53	11:53	11:55	N/D
Lower detection limit (ppm)	150	140	60	92

* For tests conducted with 1000 ppm of test gas.

** Testing was done using a JP-5 jet fuel concentration of 90 ppm in humidified air.

*** See glossary.

Specificity Results (%):

Commercial gasoline	170
n-hexane	110
JP-4 jet fuel	90
synthetic gasoline	110
toluene	43
xylene(s)	22

Manufacturer's specifications:

Calibration is recommended on an annual basis, or whenever the sensor or the main printed circuit board is replaced.

Comments:

Test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Please note that the following specification sheet is a separate evaluation for this same system.

Arizona Instrument Corp.
 4114 E. Wood St.
 Phoenix, AZ 85040-1941
 Tel: (800)528-7411

Evaluator: Radian Corp.
 Tel: (512) 454-4797

Dates of Evaluation: 12/28/90 and 04/17/91

Arizona Instrument Corp.

Soil Sentry Twelve-X

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
Sampling frequency: continuous
Operating principle: metal oxide semiconductor

Test Results:

Table with 3 columns: Test Results, diesel fuel *, JP-8*. Rows include Accuracy (%), Bias, Precision, Detection time (min), Fall time (min), and Lower detection limit.

* A limited number of tests were conducted to determine the response of the system to diesel and JP-8.
** See glossary.

Specificity Results:

Activated: diesel fuel, JP -8.

Manufacturer's specifications:

Calibration is recommended on an annual basis, or whenever the sensor or the main printed circuit board is replaced.

Comments:

Test procedures used were modified from EPA's "Standard Test Procedures for Evaluation Leak Detection Methods: Vapor-Phase Out-of-Tank Product Detectors," March 1990, and Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 6, 1990. Please note that the previous specification sheet is a separate evaluation for this same system.

Arizona Instrument Corp.
4114 E. Wood St.
Phoenix, AZ 85040-1941
Tel: (800)528-7411

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/16/92

Campo/Miller, Inc.

LS300 and LS300 N/C

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3 gph with $P_D = 96.2\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 2.36 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, fuel oils #4 and #6, waste oil, kerosene, and solvents.
- Specification:** System is installed on pressurized fiberglass and/or steel piping.
The piping system must not exceed 35.36 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
There is no waiting time between last dispensing and testing.
- Test Period:** Minimum data collection time is 10 seconds.
Test data is acquired and recorded by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system will energize an indicator light, trigger an audible alarm, and shut down the dispensing system.
- Calibration:** Manufacturer recommends a weekly self check, activated by the operator, and a full functional test every 30 days, estimated to take 5 minutes to perform.

Campo/Miller, Inc.
P. O. Box 1809
Porterville, CA 93258
Tel: (209) 781-6862

Evaluator: Jetronix Engineering Laboratories
Tel: (213) 377-4668
Rev. by Ken Wilcox Associates
Tel: (816) 443-2494
Date of Evaluation: 06/01/91, Rev. 09/09/94

Campo/Miller, Inc.

LS300-120 and LS300-120 XLC

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3 gph with $P_D = 96.2\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 2.36 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, fuel oils #4 and #6, waste oil, kerosene, and solvents.
- Specification:** System is installed on pressurized fiberglass and/or steel piping.
The piping system must not exceed 35.36 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
There is no waiting time between last dispensing and testing.
- Test Period:** Minimum data collection time is 10 seconds, but can be adjusted between 10 and 150 seconds depending on the bulk modulus of the piping system.
Test data is acquired and recorded by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the pipeline is leaking. If a leak is declared, this system will energize an indicator light, trigger an audible alarm, and shut down the dispensing system.
- Calibration:** Manufacturer recommends a weekly self check, activated by the operator, and a full functional test every 30 days, estimated to take 5 minutes to perform.

Campo/Miller, Inc.
P. O. Box 1809
Porterville, CA 93258
Tel: (209) 781-6862

Evaluator: Jetronix Engineering Laboratories
Tel: (213) 377-4668
Rev. by Ken Wilcox Associates
Tel: (816) 443-2494
Date of Evaluation: 06/01/91, Rev. 09/09/94

Campo/Miller, Inc.

LS300-120 PLUS and LS300-120 PLUS A/S

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3 gph with $P_D = 96.2\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 2.36 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, fuel oils #4 and #6, waste oil, kerosene, and solvents.
- Specification:** System is installed on pressurized fiberglass and/or steel piping.
The piping system must not exceed 35.36 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
There is no waiting time between last dispensing and testing.
- Test Period:** Minimum data collection time is 10 seconds, but can be adjusted between 10 and 150 seconds depending on the bulk modulus of the piping system.
Test data is acquired and recorded by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the pipeline is leaking. If a leak is declared, this system will energize an indicator light, trigger an audible alarm, and shut down the dispensing system.
- Calibration:** System must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Campo/Miller, Inc.
P. O. Box 1809
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Tel: (209) 781-6862

Evaluator: Jetronix Engineering Laboratories
Tel: (213) 377-4668
Rev. by Ken Wilcox Associates
Tel: (816) 443-2494
Date of Evaluation: 06/01/91, Rev. 09/09/94

Campo/Miller, Inc.

LS300-120 PLUS, AL; LS300-120 PLUS, AL, A/S and LS300-120 PLUS AL, LSI

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 1.5 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, fuel oils #4 and #6, waste oil, kerosene, and solvents.
- Specification:** System is installed on pressurized fiberglass and/or steel piping.
The piping system must not exceed 163 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
There is no waiting time between last dispensing and testing.
- Test Period:** Minimum data collection time is 10 minutes.
Test data is acquired and recorded by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line every 45 minutes.
It uses a preset threshold and conducts 3 tests to determine whether the pipeline is leaking.
If a leak is declared, this system will energize an indicator light, trigger an audible alarm, and shut down the dispensing system.
- Calibration:** System must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Campo/Miller, Inc.
P. O. Box 1809
Porterville, CA 93258
Tel: (209) 781-6862

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 06/23/95

Campo/Miller, Inc.

LS300-120 PLUS, AL; LS300-120 PLUS, AL, A/S and LS300-120 PLUS AL, LSI

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, fuel oils #4 and #6, waste oil, kerosene, and solvents.
- Specification:** System is installed on pressurized fiberglass and/or steel piping.
The piping system must not exceed 163 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
The waiting time between last dispensing and testing is 3 hours.
- Test Period:** Minimum data collection time is 25 minutes.
Test data is acquired and recorded by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line when the pump has been idle for 3 hours.
It uses a preset threshold and conducts 3 tests to determine whether the pipeline is leaking.
If a leak is declared, this system will energize an indicator light, trigger an audible alarm, and shut down the dispensing system.
- Calibration:** System must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Campo/Miller, Inc.
P. O. Box 1809
Porterville, CA 93258
Tel: (209) 781-6862

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 06/23/95

Campo/Miller, Inc.

LS300-120 PLUS, AL; LS300-120 PLUS, AL, A/S and LS300-120 PLUS AL, LSI

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, fuel oils #4 and #6, waste oil, kerosene, and solvents.
- Specification:** System is installed on pressurized fiberglass and/or steel piping.
The piping system must not exceed 163 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
The waiting time between last dispensing and testing is 6 hours.
- Test Period:** Minimum data collection time is 34 minutes.
Test data is acquired and recorded by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line when the pump is off for 6 hours.
It uses a preset threshold and conducts 3 tests to determine whether the pipeline is leaking.
If a leak is declared, this system will energize an indicator light, trigger an audible alarm, and shut down the dispensing system.
- Calibration:** System must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Campo/Miller, Inc.
P. O. Box 1809
Porterville, CA 93258
Tel: (209) 781-6862

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 06/23/95

Computerizing, Inc.

Computank V. 3.0

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99.5\%$ and $P_{FA}=2\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity is 18,000 gallons.
- Data Requirement:** Minimum of 30 days of usable product level and flow through data are required.
- Comments:** Of the 41 data sets presented for evaluation, only 24 were analyzed. Seventeen data sets were not analyzed. The median monthly throughput for tanks used in this evaluation was 2,340 gallons. Leak rates of 0.05, 0.1, and 0.2 gph were used in this evaluation. Data sets used in this evaluation were supplied by the evaluator. This evaluation did not include data from manifolded tanks.

Computerizing, Inc.
PO Box 99
Scottsboro, AL 35768
Tel: (205) 259-1805

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 09/17/92

Control Engineers

**Line Leak Detector
Model LLP2**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 1.88 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 89 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** No waiting time between product delivery and testing.
No waiting time between last dispensing and testing.
- Test Period:** Data collection time (response time) is about 10 seconds.
Test data must be acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** This equipment is no longer produced by Control Engineers.

Control Engineers
P. O. Box 9037
Houma, LA 70361
Tel: (504) 872-4541

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 07/18/94

Control Engineers

Line Leak Detector Model LLP2

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Specification:** System is installed on pressurized fiberglass and steel pipelines.
The piping system volume must not exceed 89 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between dispensing of product through the piping and testing is 15 minutes.
- Test Period:** Minimum data collection time is 30 minutes.
Test data must be acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** This equipment is no longer produced by Control Engineers.

Control Engineers
P. O. Box 9037
Houma, LA 70361
Tel: (504) 872-4541

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 07/18/94

EBW, INC.

Auto-Stik II and Auto-Stik Jr.

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99.9\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, and solvents, and other compatible products with known coefficients of expansion and densities.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** The minimum waiting period between delivery and testing is 6 hours.
The minimum waiting period between dispensing and testing is 6 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from average of subsets of all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 5 thermistors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.49 inches.
Minimum detectable water level change is 0.0052 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Auto Stik Jr. is used with up to 4 magnetostrictive probes and can handle up to 8 input sensors.
Auto Stik II is used with up to 16 magnetostrictive probes and can handle up to 64 input sensors.

EBW, INC.
2814 McCracken Ave.
Muskegon, MI 49443
Tel: (800) 475-5151

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/20/93

EBW, INC.

Auto-Stik II and Auto-Stik Jr.

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=98.3\%$ and $P_{FA}=1.7\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, and solvents, and other compatible products with known coefficients of expansion and densities.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 6 hours.
Minimum waiting time after dispensing is 2 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from average of subsets of all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 5 thermistors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.49 inches.
Minimum detectable water level change is 0.0052 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tank systems.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Auto Stik Jr. is used with up to 4 magnetostrictive probes and can handle up to 8 input sensors.
Auto Stik II is used with up to 16 magnetostrictive probes and can handle up to 64 input sensors.

EBW, INC.
2814 McCracken Ave.
Muskegon, MI 49443
Tel: (800) 475-5151

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/20/93

Egemin Naamloze Vennootschap**E'SPI III****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D=97.9\%$ and $P_{FA}=1.1\%$.
- Leak Threshold:** 0.075 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 7 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** Minimum data collection time must be 5.5 hours.
The test data must be acquired and recorded by a computer.
Leak rate is calculated from average of subsets of all collected data.
There must be no dispensing or product delivery during test.
- Temperature:** A single moving quartz crystal temperature sensor must be used to determine the average temperature for the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.253 inches.
Minimum change in water level that can be detected is 0.029 inches.
- Calibration:** Temperature sensor and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tanks.
This equipment only tests the portion of the tank that contains product.
As product level is lowered, leak rate in a leaking tank decreases (due to lower head pressure).

Egemin Naamloze Vennootschap
Bredabaan 1201 - 2900
Schoten, Belgium
Tel: 011-32-3-03/645 27 90

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 12/21/90

Egemin Naamloze Vennootschap

E'SPI IV

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=97.2\%$ and $P_{FA}=0.3\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours and 15 minutes.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from average of subsets of all collected data.
There must be no dispensing or product delivery during test.
- Temperature:** A minimum of 5 temperature sensors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.253 inches.
Minimum change in water level that can be detected is 0.029 inches.
- Calibration:** Temperature sensor and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifold tanks.
This equipment only tests the portion of the tank that contains product.
As product level is lowered, leak rate in a leaking tank decreases (due to lower head pressure).

Egemin Naamloze Vennootschap
Bredabaan 1201 - 2900
Schoten, Belgium
Tel: 011-32-3-03/645 2790

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 12/21/90

Emco Electronics, Tuthill Corp.

EECO System LLD (Q0011) – Hourly Monitoring Test

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Specification:** System is installed on pressurized fiberglass and steel piping. The piping system volume must not exceed 67.4 gallons. Tests are conducted at operating pressure.
- Waiting Time:** No waiting time between last delivery and data collection.
No waiting time between dispensing and data collection.
- Test Period:** Data collection time for the test is at least 2 minutes.
Test data acquired and recorded by a microprocessor.
Calculations are automatically done with the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, the system shuts down the dispensing system, displays and prints a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Emco Electronics, Tuthill Corp.
114 MacKenan Dr.
Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/31/93

Emco Electronics, Tuthill Corp.

EECO System LLD (Q0011) – Monthly Monitoring

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 0.1293 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 67.4 gallons.
Tests are conducted at operating pressure.
- Waiting Time:** No waiting time between last delivery and data collection.
Waiting time after dispensing is 0 to 87 minutes.
- Test Period:** Data collection time for the test is at least 9 minutes.
Test data acquired and recorded by a microprocessor.
Calculations are automatically done with the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, the system shuts down the dispensing system, displays and prints a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Emco Electronics, Tuthill Corp.
114 MacKenan Dr.
Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 07/18/94

Emco Electronics, Tuthill Corp.

EECO System LLD (Q0011) – Line Tightness Test

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D = 100\%$ and $P_{FA} = 0\%$
- Leak Threshold:** 0.0793 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 67.4 gallons.
Tests are conducted at operating pressure.
- Waiting Time:** No waiting time between last delivery and data collection.
Waiting time after dispensing is 0 to 2.8 hours.
- Test Period:** Data collection time for the test is at least 31 minutes.
Test data acquired and recorded by a microprocessor.
Calculations are automatically done with the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is declared, the system shuts down the dispensing system, displays and prints a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Emco Electronics, Tuthill Corp.
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Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/31/93

Emco Electronics, Tuthill Corp.

EECO System LLD Flexible Pipelines – Hourly Monitoring Test

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D = 100\%$ and $P_{FA} = 0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Specification:** System is installed on flexible pipelines.
The flexible pipeline system volume must not exceed 49.6 gallons.
Tests are conducted at operating pressure.
- Waiting Time:** No waiting time between last delivery and data collection.
No waiting time between dispensing and data collection.
- Test Period:** Data collection time for the test is at least 11.4 minutes.
Test data acquired and recorded by a microprocessor.
Calculations are automatically done with the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, the system shuts down the dispensing system, displays and prints a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Emco Electronics, Tuthill Corp.
114 MacKenan Dr.
Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 07/18/94

Emco Electronics, Tuthill Corp.

EECO System LLD Flexible Pipelines – Line Tightness Test

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D = 100\%$ and $P_{FA} = 0\%$
- Leak Threshold:** 0.0793 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Specification:** System may be installed on flexible pipelines.
The flexible pipeline system volume must not exceed 49,6 gallons.
Tests are conducted at an average pressure of 10 psi.
- Waiting Time:** No waiting time between last delivery and data collection.
Waiting time between last dispensing and data collection must be at least 14 minutes.
- Test Period:** Data collection time for the test is at least 9 hours.
Test data acquired and recorded by a microprocessor.
Calculations are automatically done with the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is declared, the system shuts down the dispensing system, displays and prints a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Emco Electronics, Tuthill Corp.
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Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 07/18/94

Emco Electronics, Tuthill Corp.

**EECO System TLM
(0.2 gph Precision Test)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 99.1\%$ and $P_{FA} = 0.9\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvents, waste oil, and other substances determined to be compatible with probe.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and the test data collection must be 6 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 1.9 hours.
Test data is acquired and recorded by the microprocessor.
Microprocessor automatically determines test time based on tank size and product level.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.66 inches.
Minimum detectable change in water level is 0.039 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
A magnetostrictive probe measures changes in product volume.

Emco Electronics, Tuthill Corp.
114 MacKenan Dr.
Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/23/93

Emco Electronics, Tuthill Corp.

**EECO System TLM
(0.1 gph Precision Test)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D = 99\%$ and $P_{FA} = 1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4, solvents, waste oil, and other substances determined to be compatible with probe.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and the test data collection must be 6 hours.
There must be no product delivery during the test waiting time.
There is no minimum waiting time after dispensing.
- Test Period:** Minimum data collection time must be 3.75 hours.
During the evaluation, test duration averaged 3.75 hours at 95% full and 5.97 hours at 50% full.
Test data is acquired and recorded by a microprocessor.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.66 inches.
Minimum detectable change in water level is 0.039 inches.
- Calibration:** Temperature sensors and probe must be checked regularly and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
A magnetostrictive probe is used to measure changes in product volume.

Emco Electronics, Tuthill Corp.
114 MacKenan Dr.
Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 02/08/94

Emco Electronics, Tuthill Corp.

**EECO System TLM
(0.2 gph Quick Test)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 95.4\%$ and $P_{FA} = 4.6\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvents, waste oil, and other substances determined to be compatible with probe.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be at least 1 hour and can range up to 6 hours depending upon tank conditions.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** Minimum data collection time must be 53 minutes.
Test data is acquired and recorded by the microprocessor.
Microprocessor automatically determines test time based on tank size and product level.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.66 inches.
Minimum detectable change in water level that can be detected is 0.039 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
A magnetostrictive probe measures changes in product volume.

Emco Electronics, Tuthill Corp.
114 MacKenan Dr.
Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/23/93

Emco Electronics, Tuthill Corp.

**EEO System TLM
(0.1 gph Quick Test)**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D = 96\%$ and $P_{FA} = 4\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4, solvents, waste oil, and other substances determined to be compatible with probe.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and the test data collection must be 6 hours.
There must be no product delivery during the test waiting time.
There is no minimum waiting time after dispensing.
- Test Period:** The minimum data collection time is 1 hour and 44 minutes.
During the evaluation, test duration averaged 2.76 hours at 50% full and 1.73 hours at 95% full.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.66 inches.
Minimum detectable change in water level is 0.039 inches.
- Calibration:** Temperature sensors and probe must be checked regularly and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment tests only the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
A magnetostrictive probe is used to measure changes in product volume.

Emco Electronics, Tuthill Corp.
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Cary, NC 27511
Tel: (800) 342-6125

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 02/15/94

Emco Electronics, Tuthill Corp.

EECO system, Leak Sensor II, Leak Sensor Jr. Thermistor and Proximity probes

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: thermal conductivity, proximity switch

Test Results:

	EECO system		Leak Sensor II		Leak Sensor Jr.	
	commercial gasoline	synthetic gasoline	commercial gasoline	synthetic gasoline	commercial gasoline	synthetic gasoline
Accuracy (%)	100	100	100	100	100	100
Detection time (sec)	<5	<5	<5	<5	<5	<5
Fall time (sec)	manual reset	manual reset	manual reset	manual reset	manual reset	manual reset
Lower detection limits (cm)						
Thermistor	1.22	1.12	1.14	1.14	1.24	1.19
Proximity	0.97	1.04	1.12	1.17	1.12	1.17

Specificity Results:

Activated: commercial gasoline, diesel fuel, synthetic gasoline, jet-A fuel, n-hexane, toluene, xylene(s), water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring.

The test procedures used were modified from EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors," March 1990 and "Standard Test Procedures for Non-Volumetric Tank Tightness Test Methods," March 1990. Detectors are reusable.

Systems alarm if either water or product leaks into the interstitial space.

Emco Electronics, Tuthill Corp.
 114 MacKenan Dr.
 Cary, NC 27511
 Tel: (800) 342-6125

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Date of Evaluation: 11/09/92

Engineered Systems, Inc.

Image II

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 96.6\%$ and $P_{FA} = 3.4\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 90% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from average of subsets of all collected data.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored hazardous product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.83 inches.
Minimum detectable change in water level is 0.0116 inches.
- Calibration:** Temperature sensors and probe must be checked regularly and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Engineered Systems Inc.
2001 W. Campus Dr.
Tempe, AZ 85282
Tel: (602) 438-1362

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 08/20/93

Entropy Limited

Precision Tank Inventory Control System, Version 90

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUALITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=97.9\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.04 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4.
- Capacity:** Maximum tank capacity is 15,000 gallons.
- Data Requirement:** Minimum of 64 days of product level and flow through data.
- Comments:** Of 120 data sets submitted for analysis, 13 were not evaluated and 16 were inconclusive.
The median monthly throughput for tanks used in this evaluation was 42,835 gallons per month.
This evaluation did not include data from manifold tanks.
Data sets used in this evaluation were supplied by the evaluator.

Entropy Limited
S. Great Rd.
Lincoln, MA 01773
Tel: (617) 256-8901

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 04/02/91

Entropy Limited

Precision Tank Inventory Control System Rev. 90

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99.5\%$ and $P_{FA}<0.5\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4.
- Capacity:** Maximum single tank capacity is 21,000 gallons. Maximum total capacity for tanks in a manifolded system shall not exceed 60,000 gallons.
- Data Requirement:** Minimum of 30 days of product level and flow through data.
- Comments:** 32% of the data sets used in this evaluation were from manifold tanks. 89% of the manifolded tanks had manually stuck data. A maximum of three tanks were included in the manifolded systems used in this evaluation. The largest single tank capacity was 20,000 gallons. Of 56 data sets presented for evaluation, 6 were not analyzed due to unusable data. There were no inconclusives. The median monthly throughput of tanks used in this evaluation was 52,207 gallons. Leak rates ranging from 0.0497 to 0.203 gph were used in evaluation. Data sets used in the evaluation were supplied by the evaluator.

Entropy Limited
S. Great Rd.
Lincoln, MA 01773
Tel: (617) 256-8901

Evaluator: Simpson, Gumpertz and Heger, Inc.
Tel: (617) 643-2000

Date of Evaluation: 11/30/93

Environment and Safety

EASI Level-Tru

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=95.4\%$ and $P_{FA}=4.6\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, antifreeze, brake fluid, transmission fluid, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 4.1 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3.6 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data collected over the entire range of the test period.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 resistance temperature detectors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.896 inches.
Minimum detectable change in water level is 0.023 inches.
- Calibration:** Temperature sensors and probe must be checked regularly and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
System is currently undergoing 3rd party certification for 0.1 gph leak rate.

Environment and Safety, Inc.
2075 O'Toole Ave.
San Jose, CA 95131
Tel: (408) 954-9081

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 04/11/91

Environmental Fuel Systems, Inc.

**Fuel Finder
Version IV**

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
 Sampling frequency: intermittent
 Operating principle: adsorption sampling

Test Results:

	<u>benzene</u>	<u>2-methylbutane</u>
Accuracy (%) [Avg. Reading]	106.8 [1647 ppm]	122.7 [1380 ppm]
Bias (%)	64.5	38.2
Precision (%)	22.3	53.2
Detection time (min:sec)	N/A*	N/A
Fall time (min:sec)	N/A	N/A
Lower detection limit (ppm)	77	116

* See glossary.

Specificity Results:

Percentages:

benzene	147.7
n-butane	90.7
n-hexane	55.7
isobutane	51.1
2-methylpentane	143.7
toluene	66.5

Environmental Fuel Systems, Inc.
 P.O. Box 1899
 Bandera, TX 78003
 Tel: (800) 375-7747

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 04/20/93

Environmental Management Technologies

SIRTECH

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4.
- Capacity:** Maximum tank capacity is 18,000 gallons.
- Data Requirement:** Vendor requires 90 days of product level and flow through data before making the first evaluation. Following the first evaluation, subsequent evaluations are made based on 30 days of data.
- Comments:** Of the 41 data sets presented for evaluation, 5 were inconclusive. The median monthly throughput for tanks used in this evaluation was 14,600 gallons. Leak rates of 0.05, 0.1, and 0.2gph were used in this evaluation. Data sets used in this evaluation were supplied by the vendor. This evaluation did not include data from manifolded tanks.

Environmental Management Technologies
P.P. Box 2791
Murfreesboro, TN 37133
Tel: (615) 895-2872

Evaluator: Nathan Adams, Middle TN State Univ.
Tel: (615) 898-2644

Date of Evaluation: 11/05/92

EnviroQuest Technologies Limited

**Enviro Tite SIR
(also known as SIRAS 99.6)**

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99.6\%$ and $P_{FA}=0.4\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum UST capacity shall not exceed 18,000 gallons.
- Data Requirement:** Minimum of 31 days to make an SIR evaluation at least 95% confidence at the rate of 0.1 gph and vendor recommends 45 to 60 days for greater confidence.
- Comments:** Of the 41 data sets presented for evaluation, 5 were not analyzed due to unusable data.
The median monthly throughput for tanks used in this evaluation was 16,700 gallons.
Leak rates ranging from 0.0500 to 0.2043 were used in the evaluation.
Data sets used in this evaluation were supplied by the evaluator.
This evaluation did not include data from manifolded tanks.

Watson Systems, Inc.
4501 Madison
Kansas City, MO 64111
Tel: (816) 756-0774

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 04/03/92

EnviroQuest Technologies Limited

SIRAS Software System, Version 2.0

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D = 99.3\%$ and $P_{FA} = 0.7\%$
Version 2.0 is designed to meet annual test requirements.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum single tank capacity shall not exceed 30,000 gallons.
Maximum total capacity for tanks in a manifolded system shall not exceed 60,000 gallons.
- Data Requirement:** Minimum 30 days of usable product level and flow through data are required.
- Comments:** 27% of the data sets used in this evaluation were from manifolded tanks.
A maximum of 4 tanks were included in the manifolded systems used in the evaluation.
The largest individual tank in this evaluation was 30,000 gallons.
Of the 56 data sets presented for evaluation, 6 were not analyzed due to unusable data.
The median monthly throughput for tanks used in this evaluation was 73,518 gallons.
Leak rates ranging from 0.0458 to 0.2500 were used in the evaluation.
Data sets used in this evaluation were supplied by the evaluator.
Over 50% of the data from large manifolded tanks was collected by automatic tank gauges.

Watson Systems, Inc.
4501 Madison
Kansas City, MO 64111
Tel: (816) 756-0774

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/23/93

EnviroQuest Technologies Limited

SIRAS Software System, Version 2.8.3

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.2 gph with $P_D = 99.999\%$ and $P_{FA} = 0.01\%$.
Version 2.8.3 is designed to meet monthly monitoring requirements.
- Leak Threshold:** 0.1 gph (a leak is declared when the calculated leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum single tank capacity shall not exceed 30,000 gallons.
Maximum total capacity for tanks in a manifolded system shall not exceed 60,000 gallons.
- Data Requirement:** Minimum of 30 days of usable product level and flow through data are required.
- Comments:** 27% of the data sets used in this evaluation were from manifolded tanks.
A maximum of 4 tanks were included in the manifolded systems used in the evaluation.
The largest individual tank in this evaluation was 30,000 gallons.
Of the 56 data sets presented for evaluation, 6 were not analyzed due to unusable data.
The median monthly throughput for tanks used in this evaluation was 73,518 gallons.
Leak rates ranging from 0.0458 to 0.2500 were used in the evaluation.
Data sets used in this evaluation were supplied by the evaluator.
Over 50% of the data from large manifolded tanks was collected by automatic tank gauges.

Watson Systems, Inc.
4501 Madison
Kansas City, MO 64111
Tel: (816) 756-0774

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/23/93

FCI Environmental, Inc.

Analog Hydrocarbon Probe AHP -100

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: fiber optic chemical sensor

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min)	<8	<8
Fall time (min)	<5	<5
Lower detection limit (cm)	<0.01	<0.01

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
The detector is reusable.

FCI Environmental, Inc.
1181 Grier Dr., Bldg. B
Las Vegas, NV 89119
Tel: (800) 510-3627

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 01/15/94

FCI Environmental, Inc.

Digital Hydrocarbon Probe DHP-100

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: fiber optic chemical sensor

Test Results:

Table with 3 columns: Test Results, commercial gasoline, synthetic gasoline. Rows include Accuracy (%), Detection time (min), Fall time (min), and Lower detection limit (cm).

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm. The detector is reusable.

FCI Environmental, Inc.
1181 Grier Dr., Bldg. B
Las Vegas, NV 89119
Tel: (800) 510-3627

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 01/15/94

FCI Environmental, Inc.

Analog Hydrocarbon Probe AHP -100

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
 Sampling frequency: continuous
 Operating principle: fiber optic

Test Results:

	EPA March 1990 protocol			Radian June 1990 protocol	
	<u>xylene</u>	<u>benzene</u>	<u>2-methylbutane</u>	<u>unleaded gasoline</u>	<u>synthetic gasoline</u>
Relative accuracy* (%)	2	35	N/R**	12	22
Bias (%)	1	-23	N/R	-7	-2
Precision (%)	1	11	N/R	4	15
Detection time (min)	<1	<1	N/R	<1	<1
Fall time (min)	<1	<1	N/R	<1	<1
Lower Detect. Limit (ppm)	84	519	N/R	137	220

* Relative accuracy is a function of systematic error, or bias, and random error, or precision. Smaller values indicate better accuracy.

** See glossary.

Lower detection limit for other fuels (ppm):

<u>diesel</u>	<u>JP-4</u>	<u>JP-8</u>	<u>synthetic gasoline</u>	<u>p-xylene</u>	<u>kerosene</u>	<u>unleaded gasoline</u>
1.01	3.08	2.22	3.43	2.60	2.18	2.02

Specificity Results (%) (corrected for sensitivity differences):

	EPA March 1990 protocol		Radian June 1990 protocol	
	benzene	76	unleaded gasoline	93
toluene	96	synthetic gasoline	98	
p-xylene	101	JP-4 jet fuel	105	
synthetic gasoline	100	n-hexane	N/R	
trimethylbenzene	107	xylene	103	
methane	N/R			
butane	N/R			
2-methylbutane	N/R			
pentane	N/R			

Comments:

The test procedures used were taken from EPA's "Standard Test Procedures for Evaluation Leak Detection Methods: Vapor-Phase Out-of-Tank Product Detectors," March 1990, and Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 6, 1990.

FCI Environmental, Inc.
 1181 Grier Dr., Bldg. B
 Las Vegas, NV 89119
 Tel: (800) 510-3627

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Date of Evaluation: 03/07/94 and 12/05/94

FCI Environmental, Inc.

Digital Hydrocarbon Probe DHP-100

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
 Sampling frequency: continuous
 Operating principle: fiber optic

Test Results:

	EPA March 1990 protocol			Radian June 1990 protocol	
	<u>xylene</u>	<u>benzene</u>	<u>2-methylbutane</u>	<u>unleaded gasoline</u>	<u>synthetic gasoline</u>
Relative accuracy* (%)	0	17	N/R**	18	29
Bias (%)	0	-9	N/R	1	-12
Precision (%)	0	11	N/R	9	10
Detection time (min)	<1	<1	N/R	<1	<1
Fall time (min)	<1	<1	N/R	<1	<1
Lower Detect. Limit (ppm)	45	280	N/R	73	118

* Relative accuracy is a function of systematic error, or bias, and random error, or precision. Smaller values indicate better accuracy.

** See glossary.

Specificity Results (%) (corrected for sensitivity differences):

	EPA March 1990 protocol		Radian June 1990 protocol	
	benzene	89	unleaded gasoline	101
toluene	97	synthetic gasoline	88	
p-xylene	100	JP-4 jet fuel	109	
synthetic gasoline	92	n-hexane	108	
trimethylbenzene	104	xylene	N/R	
methane	N/R			
butane	N/R			
2-methylbutane	N/R			
pentane	N/R			

Comments:

The test procedures used were taken from EPA's "Standard Test Procedures for Evaluation Leak Detection Methods: Vapor-Phase Out-of-Tank Product Detectors," March 1990, and Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 6, 1990.

FCI Environmental, Inc.
 1181 Grier Dr., Bldg. B
 Las Vegas, NV 89119
 Tel: (800) 510-3627

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Date of Evaluation: 03/07/94

FDR Services, Inc.

GasPak Vapor Monitoring System

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
 Sampling frequency: intermittent
 Operating principle: product permeable detector

Test Results: (averages of multiple concentrations)

	<u>benzene</u>	<u>heptane, 3-methyl</u>	<u>hexane</u>	<u>Iso-octane</u>	<u>pentane, 2,4-dimethyl</u>	<u>pentane, 2,3,4-trimethyl</u>	<u>toluene</u>	<u>m-xylene</u>
Accuracy (%)	103	102	107	103	105	104	104	99
Bias (%)	-1	1	2	1	1	1	1	-6
Precision (%)	2	2	4	2	3	3	3	4
Lower detection limit (ppm)	1	1	1	1	3	1	1	4
Specificity (%)	100	100	102	101	101	100	100	94

Specificity Results: See results above.

Comments:

Test procedures used were modified from EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Vapor-Phase Out-of-Tank Product Detectors," March 1990.

Detection and fall times were not measured.

Each cartridge is used once, then replaced by another.

GasPak is produced and analyzed by Fayette Environmental Services, Inc., with exclusive marketing and implementation rights assigned to Fuel Detection and Remediation, Inc.

FDR Services, Inc.
 4230 LBJ Freeway, Suite 215
 Dallas, TX 75244
 Tel: (214)506-0588

Evaluator: David G. Bray, Ph.D.
 University of Missouri - Columbia
 Tel: (573) 882-2439
 Date of Evaluation: 07/27/94

FE Petro, Inc.

STP-MLD-E Line (Flexline) Leak Detector

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and some solvents.
- Specification:** System is installed on flexible line.
The piping system volume must not exceed 49.6 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
No waiting time between last dispensing of product through the pipeline and the start of data collection for the test.
- Test Period:** Average data collection time is 3 minutes.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, this system restricts fuel flow to dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Enviroflex line with a bulk modulus of 1,280 was used during the third-party evaluation.

FE Petro, Inc.
P.O. Box 139
McFarland, WI 53558
Tel: (608) 838-8786

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 03/24/94

FE Petro, Inc.

STP-MLD Pipeline Leak Detector

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4 and some solvents.
- Specification:** System can test fiberglass and steel pipelines.
The piping system volume must not exceed 129.14 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
No waiting time between last dispensing of product through the pipeline and the start of data collection for the test.
- Test Period:** Data collection time for the test is less than 30 seconds.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, this system restricts fuel flow to dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

FE Petro, Inc.
P.O. Box 139
McFarland, WI 53558
Tel: (608) 838-8786

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 07/01/92

FE Petro, Inc.

STP-MLD-D Pipeline Leak Detector

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Diesel
- Specification:** System is installed on steel and fiberglass (rigid) pipelines.
The piping system (rigid) volume must not exceed 341 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
No waiting time between last dispensing of product through the pipeline and the start of data collection for the test.
- Test Period:** Average data collection time is 1 minute.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, this system restricts fuel flow to dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

FE Petro, Inc.
P.O. Box 139
McFarland, WI 53558
Tel: (608) 838-8786

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 04/30/94

**Fluid Containment, Inc.
(formerly O/C Tanks Corp.)**

Hydrostatic Precision Tank Test for DWT-Type II Tanks

DOUBLE WALLED TANK TIGHTNESS TEST

- Certification:** Leak rate of 0.1 gph with $P_D=99.9\%$ and $P_{FA}=1.2\%$ without dispensing.
Leak rate of 0.1 gph with $P_D=95\%$ and $P_{FA}=5.0\%$ with dispensing.
- Leak Threshold:** 0.05 gph without dispensing and 0.07 gph with dispensing (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** The maximum tank capacity is 30,000 gallons.
The tank may be tested from zero to 100% full.
The maximum tank diameter must be 10 feet.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 24 hours.
Minimum waiting time between "topping off" the annular space with liquid and test data collection must be 3 hours.
There must be no product delivery during the waiting time.
- Test Period:** The minimum data collection time must be at least 4 hours.
A leak is not declared unless the threshold is exceeded in two tests, separated by at least 8 hours which are performed without dispensing and without changes in the water table.
- Other Limitations:** Volume of trapped vapor must not exceed 20 gallons.
The change in barometric pressure must be less than 0.04 psia over the 4-hour test period.
The annular space is at least 100% full with either water or antifreeze.
If the groundwater is above the bottom of the tank, and no product is being dispensed during test, the total change in groundwater elevation during test must be less than 1.5 inches per hour.
If the groundwater is below the bottom of the tank or not changing during a test, the total change in product level during a test must be less than 0.75 inch per hour.

Fluid Containment, Inc.
Route 20, Box 1380
Conroe, TX 77301
Tel: (409) 756-7731

Evaluator: Vista Research
Tel: (415) 966-1171

Date of Evaluation: 05/15/91

Gasboy International

Gasboy TMS 500

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 99.91\%$ and $P_{FA} = 0.09\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of five resistance temperature detectors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.04 inches.
Minimum detectable change in water level is 0.011 inches.
- Calibration:** Temperature sensors and probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
This system is no longer being manufactured although product support is still available.
Gasboy International was formerly called William M. Wilson's Sons.

Gasboy International
P.O. Box 309
Lansdale, PA 19446
Tel: (215) 855-4631

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 05/10/91

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.88 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 89 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing is 16 minutes.
- Test Period:** The minimum data collection time is 28.8 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the following 2 specification sheets are separate evaluations for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.,
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/07/91

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.4 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time is 13.9 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the previous and following specification sheets are separate evaluations for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.,
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/20/91

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.5 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 128 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time is 14 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the 2 previous specification sheets are separate evaluations for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 04/12/93

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time (response time) for the test must be 0.75 to 8.85 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the following specification sheet is a separate evaluation for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/20/91

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 128 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time is 6 minutes.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the previous specification sheet is a separate evaluation for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 04/12/93

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 89 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing is 2.5 hours.
- Test Period:** The minimum data collection time is 0.3 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the following 2 specification sheets are separate evaluations for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/07/91

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.04 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time is 13.87 minutes.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the previous and following specification sheets are separate evaluations for this same system at the same leak rate.

Gilbarco Environmental Products
7300 W. Friendly Ave.
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Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/20/91

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.079 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 128 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting time between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time is 14 minutes.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.
- Comments:** Please note that the 2 previous specification sheets are separate evaluations for this same system at the same leak rate.

Gilbarco Environmental Products
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Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 04/12/93

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501
For Flexible Pipelines**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.5 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 158.4 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time is 1 minute.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.

Gilbarco Environmental Products
7300 W. Friendly Ave.,
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501
For Flexible Pipelines**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=96\%$ and $P_{FA}=4\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 158.4 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline.
- Waiting Time:** There is no waiting time between delivery of the product to the tank and the start of data collection.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time (response time) for the test must be 0.75 to 8.85 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.

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Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Gilbarco Environmental Products

**Environmental Management Console (EMC)
with Line Leak Detector, Series PA02630000501
For Flexible Pipelines**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.079 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 158.4 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline.
- Waiting Time:** There is no waiting time between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time must be 1.2 to 12.9 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.

Gilbarco Environmental Products
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Evaluator: Ken Wilcox Associates, Inc.
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Gilbarco Environmental Products

EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2, 3, 2.1, and 3.1, PAO238000XXXX Capacitance Probe

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 8.3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 5 hours.
Test data must be acquired and recorded by a microprocessor within the monitoring console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A temperature averaging probe (thermistor) must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.40 inches.
Minimum detectable water level change is 0.040 inches.
- Calibration:** The in-tank probe with temperature and water sensor is self-calibrating but occasional system checks may be required in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Capacitance probes do not work with oxygenated fuels.

Gilbarco Environmental Products
7300 W. Friendly Ave.
Greensboro, NC 27420
Tel: (910) 547-5000

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Gilbarco Environmental Products

**EMC Environmental Management Console, EMC Basic Monitoring System Tank Monitor 2.1, 3.1,
PAO264XXX0000
Capacitance Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99\%$ and $P_{FA}=0.2\%$.
- Leak Threshold:** 0.126 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 8.3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data must be acquired and recorded by a microprocessor within the monitoring console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.52 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** The in-tank probe with temperature and water sensor is self-calibrating but occasional system checks may be required in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Capacitance probes do not work with oxygenated fuels.

Gilbarco Environmental Products
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Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Gilbarco Environmental Products

**EMC Environmental Management Console EMC Basic Monitoring System Tank Monitor 2.1, 3.1,
PAO264XXX0000
Capacitance Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.071 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must at least 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 8.25 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a microprocessor within the monitoring console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.52 inches.
Minimum detectable water level change is 0.027 inches.
- Calibration:** The in-tank probe with temperature and water sensor is self-calibrating but occasional system checks may be required in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Capacitance probes do not work with oxygenated fuels.

Gilbarco Environmental Products
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Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Gilbarco Environmental Products

**EMC Environmental Management Console EMC Basic Monitoring System Tank Monitor 2.1, 3.1,
PAO265XXX0000
Magnetostrictive Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.093 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 8.3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data must be acquired and recorded by a microprocessor within the monitoring console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors are used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.544 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** The in-tank probe with temperature and water sensor is self-calibrating but occasional system checks may be required in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Gilbarco Environmental Products
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Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Gilbarco Environmental Products

**EMC Environmental Management Console EMC Basic Monitoring System Tank Monitor 2.1, 3.1,
PAO265XXX0000
Magnetostrictive Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.069 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be at least 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.25 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a microprocessor within the monitoring console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors are used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.544 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** The in-tank probe with temperature and water sensor is self-calibrating but occasional system checks may be required in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Gilbarco Environmental Products
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Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 03/14/95

Gilbarco Environmental Products

PA02590XXX000

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: float switch

Test Results: *

	commercial	commercial
	<u>gasoline</u>	<u>gasoline</u>
Accuracy (%)	100	100
Response time (min)	3.66	3.45
Recovery time (min)	<1	<1
Product activation height (cm)	1.28	1.27
Lower detection limit (cm)	1.84	1.65

*At a flow rate of 0.19 gal/hr in 7.6 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Gilbarco Environmental Products
7300 W. Friendly Ave.
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Tel: (910) 547-5000

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 07/17/92

Gilbarco Environmental Products

PA02591144000

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: float switch

Test Results:

	commercial <u>gasoline</u>	commercial <u>gasoline</u>
Accuracy (%)	100	100
Response time (min)	6.00	6.51
Recovery time (min)	<1	<1
Product activation height (cm)	3.67	3.62
Lower detection limit (cm)	4.05	4.17

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Gilbarco Environmental Products
7300 W. Friendly Ave.
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Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 07/17/92

Gilbarco Environmental Products

PA0259200000

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: float switch

Test Results:

	commercial	commercial
	<u>gasoline</u>	<u>gasoline</u>
Accuracy (%)	100	100
Response time (min)	8.19	8.49
Recovery time (min)	<1	<1
Product activation height (cm)	4.12	3.95
Lower detection limit (cm)	4.67	4.36

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Gilbarco Environmental Products
7300 W. Friendly Ave.
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Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 07/17/92

Gilbarco Environmental Products**Environmental Management Console (EMC)
Groundwater Sensor, series PA02700XX0001****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	08:55	06:18
Fall time (min:sec)	54:50	26:02
Lower detection limit (cm)	0.02	0.02

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Calibration:

Sensor must be checked annually for operability or in accordance with manufacturer's instructions and calibrated/replaced if necessary.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 This detector is reusable.

Gilbarco Environmental Products
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 Greensboro, NC 27420
 Tel: (910) 547-5000

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 11/20/91

Gilbarco Environmental Products**PA0266000000****VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: adsistor

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>	<u>JP-4</u>
Accuracy (%)	100	0	100
Detection time (min:sec)	7:46	N/A*	17:01
Fall time (min:sec)	2:38	N/A	3:05
Lower detection limit (ppm)	500	>1000	500

*See glossary.

Specificity Results:

Activated: commercial gasoline, JP-4 jet fuel.

No Response: n-hexane, synthetic gasoline, toluene, xylene(s).

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Gilbarco Environmental Products
 7300 W. Friendly Ave.
 Greensboro, NC 27420
 Tel: (910) 547-5000

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 07/24/92

Hasstech

LineTite Pipeline Leak Monitor

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Specification:** System can be installed on pressurized fiberglass, steel, and flexible pipelines. The rigid piping system volume must not exceed 341 gallons. The flexible piping system volume must not exceed 49.6 gallons. Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting period between product delivery and testing. There is no waiting period between last dispensing and testing.
- Test Period:** Minimum data collection time (response time) is 1 minute. This is a single test consisting of multiple cycles of data acquisition with 1-24 minutes waiting time between each cycle. Test data must be acquired and recorded by a permanently installed microprocessor. Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line. It uses a preset threshold and a single test to determine whether the pipeline is leaking. If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.

Hasstech
6985 Flanders Dr.
San Diego, CA 92121
Tel: (619) 457-5880

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Dates of Evaluation: 10/15/91 and 04/10/94

Hasstech

LineTite Pipeline Leak Monitor

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.062 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Specification:** System is installed on pressurized fiberglass, steel, and flexible pipelines.
The rigid piping system volume must not exceed 341 gallons.
The flexible piping system volume must not exceed 49.6 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting period between product delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** Minimum data collection time (response time) is 50 minutes.
This is a single test consisting of multiple cycles of data acquisition with 30 minutes waiting time between each cycle.
Test data is acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line. It uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with the manufacturer's instructions.

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Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Dates of Evaluation: 10/15/91 and 04/10/94

Hasstech

AcuRite

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.01 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 75 gallons.
Tests are conducted at 150% of the line operating pressure.
The mechanical line leak detector must be removed from the piping system being tested.
- Waiting Time:** Minimum waiting period between product delivery and testing is 6 hours.
Minimum waiting period between last dispensing and testing is 30 minutes.
- Test Period:** The minimum data collection time must be 30 minutes.
Test data must be acquired and recorded manually.
Manual calculations are performed by the tester on site.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

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Evaluator: Lamar University
Tel: (409) 880-8788

Date of Evaluation: 03/25/91

Hasstech

Leak Computer Tank Test System

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL) (Edison Lab Protocol)

- Certification:** Leak rate of 0.1 gph with $P_D=95\%$ and $P_{FA}=5\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, solvents, waste oil, and other liquids compatible with the probes.
- Capacity:** The maximum tank capacity is 12,000 gallons.
Tank must be at least 100% full.
- Waiting Time:** The test data must be acquired and recorded by a computer that calculates a leak rate every minute, and determines waiting time for satisfactory data (the test is finished when the standard deviation of 30 sequential leak rates is less than half of the last leak rate determined).
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 70 minutes.
Test data is acquired and recorded by computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or delivery of product during the test.
- Temperature:** A minimum of 7 temperature sensors (thermistors) must be used to determine the average temperature of the stored product.
- Groundwater:** If the groundwater level is not determined, the tank must pass a two level test with at least a 3 foot difference in product level.
If the groundwater level can be determined, a single level test can be conducted provided a net pressure difference of at least 1 psi exists between the groundwater and the product at the bottom of the tank.
- Calibration:** Level sensor must be calibrated before each test.
Temperature sensors must be checked annually and calibrated if necessary.
- Comments:** This equipment was evaluated at the EPA Edison Risk Reduction Engineering Laboratory prior to the standard protocols being written.
This equipment was not evaluated using manifolded tanks.

Hasstech
6985 Flanders Dr.
San Diego, CA 92121
Tel: (619) 457-5880

Evaluator: U.S. EPA Risk Reduction Engineering Laboratory
Tel: (201) 321-6631

Date of Evaluation: 11/88

Hasstech

Leak Computer Tank Test System

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

Certification:	Leak rate of 0.1 gph with $P_D > 99\%$ and $P_{FA} < 1.0\%$.
Leak Threshold:	0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
Applicability:	Gasoline, diesel, aviation fuel, fuel oils #4 and #6, waste oil, and solvents. Other liquids may be tested after consultation with the manufacturer.
Capacity:	The maximum tank capacity is 15,000 gallons. Tank must be at least 90% full.
Waiting Time:	The test data must be acquired and recorded by a computer that calculates a leak rate every minute, and determines waiting time for satisfactory data (the test is finished when the standard deviation of 30 sequential leak rates is less than half of the last leak rate determined). There must be no dispensing or product delivery during the test waiting time.
Test Period:	The minimum data collection time must be 70 minutes. Test data is acquired and recorded by computer. Leak rate is calculated from data determined to be valid by statistical analysis. There must be no dispensing or product delivery during the test.
Temperature:	A minimum of 7 temperature sensors (thermistors) must be used to determine the average temperature of the stored product.
Groundwater:	Depth of the water table in the backfill must be determined and if it is above the bottom of the tank, product level must be raised to provide a minimum of 1 psi net pressure on the bottom of the tank.
Calibration:	Level sensor must be calibrated before each test. Temperature sensors must be checked annually and calibrated if necessary.
Comments:	This equipment was not evaluated using manifolded tanks. This equipment only tests the portion of the tank that contains product.

Hasstech
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San Diego, CA 92121
Tel: (619) 457-5880

Evaluator: Law Engineering Industrial Services
Tel: (800) 672-6601

Date of Evaluation: 04/17/91

Heath Consultants, Inc.

Petro Tite Line Tester

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=99.99\%$ and $P_{FA}=0.37\%$.
- Leak Threshold:** 0.01 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 129 gallons.
Tests are conducted at 150% of the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system being tested.
- Waiting Time:** There is no minimum waiting period between product delivery and testing.
There is no minimum waiting period between last dispensing and testing.
- Test Period:** Minimum data collection time is 1 hour (four 15 minute readings).
A one-hour pretest at or above the test pressure is conducted to eliminate the effects of pipe deflection/stretch on the results.
Test data is acquired and recorded manually.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Heath Consultants, Inc.
9030 Monroe Rd.
Houston, TX 77061
Tel: (713) 947 9292

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/11/91

Heath Consultants, Inc.

Petro Comp

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=0.98\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, solvents, alcohols and water.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 100% full.
An automatic product leveler must be used to maintain a constant product level during the test.
- Waiting Time:** There is no minimum waiting time between product delivery and test data collection.
The product must be mixed continuously throughout the test.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours after the completion of the high level circulation.
The test data must be acquired and recorded by a computer after the completion of the high level circulation.
Leak rate is calculated based on cumulative volume change during low level test (generally based on one hour average volume change).
There must be no dispensing or product delivery during the test.
- Temperature:** A single sensor is used to determine the temperature of the stored product.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide a net pressure of 4 psi on the bottom of the tank.
- Calibration:** Temperature sensor is self calibrating.
Level sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.

Heath Consultants, Inc.
9030 Monroe Rd.
Houston, TX 77061
Tel: (713) 947-9292

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/15/90

Heath Consultants, Inc.

Petro Tite II

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 100% full.
An automatic product leveler must be used to maintain a constant product level during the test.
- Waiting Time:** There is no minimum waiting time between product delivery and test data collection.
The product must be mixed continuously throughout the test.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data is acquired and recorded manually.
Leak rate is calculated based on cumulative volume change during low level test (generally based on one hour average volume change).
There must be no dispensing or product delivery during the test.
- Temperature:** A single DTS-2000 digital sensor is used to determine the temperature of the stored product.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide a net pressure of 4 psi on the bottom of the tank.
- Calibration:** Sensors calibration must be checked at each use and the DTS -2000 recertified a minimum of once every 3 years.
- Comments:** This equipment was not evaluated using manifolded tanks.

Heath Consultants, Inc.
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Houston, TX 77061
Tel: (713) 947-9292

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 11/01/90

Horner Creative Products

EZY-Chek Manual Line Leak Detector

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=98.0\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and waste oil.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 129 gallons.
Tests are conducted at 150% of the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
Waiting time between last dispensing of product through the pipeline system and the start of data collection is zero hours.
- Test Period:** The minimum data collection time for the test must be one and a half hours.
Data must be collected every 15 minutes.
Data collection period consists of a monitor mode and test mode.
Data must be collected in the monitor mode until two consecutive records are within 0.01 gallon of each other.
Four data points must be taken in the test mode for a final gph result.
Test data is acquired and recorded manually.
Manual calculations performed by the operator on site.
- Calibration:** No temperature sensors used.
No calibration required.
Equipment must be checked annually in accordance with manufacturer's instructions.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 07/09/92

Horner Creative Products

EZY-Chek II Automatic Line Leak Detector

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=99.0\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and waste oil.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 129 gallons.
Tests are conducted at 150% of the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
Waiting time between last dispensing of product through the pipeline system and the start of data collection is zero hours.
- Test Period:** The minimum data collection time for the test must be 2 hours.
Data must be collected every 30 seconds.
Data collection period consists of a monitor mode and test mode.
Data must be collected in the monitor mode until two consecutive 15-minute records are within 0.01gallon of each other.
An additional 15-minute monitor mode is required before start of the test mode.
Data must be collected in the test mode for 67 minutes for a final gph result.
Test data is acquired and recorded by a microprocessor.
Calculations are automatically done with a microprocessor.
- Calibration:** Sensors are calibrated before each test.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 07/13/92

Horner Creative Products**EZY 3****NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (VACUUM)**

Certification:	Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
Leak Threshold:	A leak is declared if the pressure decay is more than 1 inch water column pressure (inch H_2O) for non-volatile products and 10% of the lower determined pressure for volatile products. A leak is also declared if any water incursion is detected.
Applicability:	Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, solvents, and waste oil.
Capacity:	The maximum tank capacity is 12,000 gallons if groundwater is not present. Larger tanks may be tested if groundwater is present and a negative pressure of 1.0 to 1.7 psi can be maintained at the bottom of the tank. For gasoline, the ullage volume must be between 800 and 2,500 gallons. For diesel, the ullage volume must be between 500 and 1,500 gallons.
Waiting Time:	There is no waiting time after product delivery to the tank.
Test Period:	The minimum total test time for gasoline is 2.5 hours (1.5 hours vapor equilibrium recirculation time plus one hour of data collection time). The minimum total test time for diesel and less volatile products is 1.5 hours (0.5 hours vapor equilibrium recirculation time plus one hour of data collection). The vapor equilibrium recirculation time is the time required to apply a vacuum and to saturate the ullage with vapors. Test data is acquired and recorded manually.
Water Sensor:	A water sensor must be used to detect water incursion and must be calibrated for every test. The minimum detectable water level for the sensor is 0.014 inches. The minimum detectable change in water level is 0.0095 inches. The minimum water level in the tank must be adjusted to 0.014 inches before sensor calibration begins. The minimum data collection time for the water sensor is 1 hour. The actual water incursion test time depends on the tank size and must be calculated in accordance with the manufacturer's instructions.
Groundwater:	Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, water sensor must be used and test time must be extended to allow sufficient time to detect incursion of water into the tank.
Vacuum:	The minimum vacuum at bottom of the tank must be 1.0 to 1.7 psi below atmospheric pressure. The maximum negative pressure at the top of the tank shall not exceed 4.0 psi.
Comments:	This test method may not be effective in some backfill because some backfill (such as clay) may plug a hole in the tank. This test method was not evaluated using manifolded tanks. If the soil is saturated with product, this test method may not detect air or water incursion. A well point in backfill may help identify presence of this condition. During the third-party certification, gasoline and diesel was used.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Dates of Evaluation: 08/23/94 and 02/08/95

Horner Creative Products

SIR PRO 1 Version 1.0

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUALITATIVE)

- Certification:** Leak rate of 0.2 gph with $P_D=100\%$ and $P_{FA}=0\%$.
Version 1.0 is designed to meet monthly monitoring requirements.
- Leak Threshold:** 0.1 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity may not exceed 18,000 gallons.
- Data Requirement:** A minimum of 30 days of product level and flow through data.
- Comments:** Of the 120 data sets presented for evaluation, 10 were inconclusive.
The median monthly throughput for tanks used in this evaluation was 13,640 gallons.
This evaluation did not include data from manifolded tanks.
Data sets used in this evaluation were supplied by the evaluator.
A single leak rate of 0.2 gph was used in this evaluation.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: Petro Works
Tel: (913) 681-9379

Date of Evaluation: 04/07/93

Horner Creative Products

SIR PRO 1 Version 2.0

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUALITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
Version 2.0 is designed to meet annual test requirements.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity may not exceed 18,000 gallons.
- Data Requirement:** A minimum of 30 days of product level and flow through data.
- Comments:** Of the 120 data sets presented for evaluation, 9 were inconclusive.
The median monthly throughput for tanks used in this evaluation was 11,828 gallons.
This evaluation did not include data from manifolded tanks.
Data sets used in this evaluation were supplied by the evaluator.
A single leak rate of 0.1 gph was used in this evaluation.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: Petro Works
Tel: (913) 681-9379

Date of Evaluation: 04/07/93

Horner Creative Products

Horner EZY-Chek I

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and waste oil.
- Capacity:** The maximum tank capacity is 12,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 6 hours.
Minimum waiting time between "topping off" and test data collection must be 3 hours.
Total minimum waiting time is 6 hours.
There must be no product dispensing or delivery during the test waiting time.
- Test Period:** Minimum data collection time must be 1.5 hours (30 minute monitor period, 60 minute test period).
Data collection must continue until data meets manufacturer's stop test criteria.
Volume data is collected and recorded by a strip chart recorder.
Leak rate is calculated from data of last 1 hour of test period.
There must be no dispensing or product delivery during the test.
- Temperature:** Temperature data is collected by a resistance temperature detector (RTD) and displayed on a LCD readout.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide 2-4 psi net pressure on the bottom of the tank during the test.
Groundwater level must be stable prior to and during the test.
- Calibration:** Level sensors must be calibrated before each test.
- Comments:** This equipment was not evaluated using manifolded tanks.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: W. A. Kibbe and Associates
Tel: (517) 797-2425

Date of Evaluation: 10/03/90

Horner Creative Products

Horner EZY-Chek II

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99.95\%$ and $P_{FA}=0.05\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and waste oil.
- Capacity:** The maximum tank capacity is 12,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 6 hours.
Minimum waiting time between "topping off" and test data collection must be 3 hours.
Total minimum waiting time is 6 hours.
There must be no product delivery or dispensing during the test waiting time.
- Test Period:** The minimum data collection time must be one hour and forty minutes (33 minutes monitor mode and 67 minutes test mode).
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data of last 67 minutes of test period.
At the conclusion of the test mode, data must be checked for the manufacturer's stop test criteria. If data do not meet the criteria, data collection must continue.
There must be no dispensing or product delivery during the test.
- Temperature:** Temperature data is collected by a resistance temperature detector (RTD).
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide 2-4 psi net pressure on the bottom of the tank during the test.
Groundwater level must be stable prior to and during the test.
- Calibration:** Load cell must be calibrated before each use.
- Comments:** This equipment was not evaluated using manifolded tanks.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: W. A. Kibbe and Associates
Tel: (517) 797-2425

Date of Evaluation: 09/18/90

Horner Creative Products

Horner EZY-Chek II

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=95.79\%$ and $P_{FA}=4.21\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, waste oil, and solvents.
- Capacity:** The maximum tank capacity is 12,000 gallons.
The tank must be between 98 and 100% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 8 hours.
There must be no product dispensing or delivery during the test waiting time.
- Test Period:** Minimum data collection time must be one hour and forty minutes (33 minutes monitor mode and 67 minutes test mode).
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data of last 67 minutes of test period.
There must be no product delivery or dispensing during the test.
At the conclusion of the test mode, data must be checked for the manufacturer's stop test criteria. If data do not meet the criteria, data collection must continue.
- Temperature:** Temperature data is collected by a resistance temperature detector (RTD).
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide 1 psi net pressure on the bottom of the tank during the test. If this cannot be accomplished, then the tank cannot be tested using this method.
- Calibration:** Load cell must be calibrated before each use.
- Comments:** This equipment was not evaluated using manifolded tanks.

Horner Creative Products
212 Morton St.
Bay City, MI 48706
Tel: (517) 893-3360

Evaluator: W. A. Kibbe and Associates
Tel: (517) 797-2425

Date of Evaluation: 06/25/90

Ibex Industries

Ibex Precision Test System

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99.5\%$ and $P_{FA}=0.5\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, and solvent.
- Capacity:** The maximum tank capacity is 18,000 gallons.
The tank must be between 92% and 100% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 12 hours.
Minimum waiting time between "topping off" and test data collection must be 3 hours.
There must be no product dispensing or delivery during the waiting time.
- Test Period:** The minimum data collection time must be 1 hour.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 6 temperature sensors must be used to determine the average temperature of the stored product.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide 2-4 psi net pressure on the bottom of the tank.
- Calibration:** Level sensors must be calibrated before each test.
Temperature sensors must be calibrated semi-annually.
- Comments:** This equipment was not evaluated using manifolded tanks.
This system only tests the portion of the tank containing product.

Ibex Industries
22014 S. Union Ave., Suite 103
Bakersfield, CA 93307
Tel: (805) 835-8910

Evaluator: Applied Research Center
Tel: (805) 664-2173

Date of Evaluation: 01/18/91

IMO Industries Inc., Gems Sensors Division

**Gems Smartwell Portable Monitor model WPM-535
with Groundwater Probe model WP-535**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: intermittent
Operating principle: conductive polymer

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	09:31	07:05
Fall time (min:sec)	55:42	17:04
Lower detection limit (cm)	0.04	0.08

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Comments:

*Although sensor is a polymer strip which is mounted in the monitoring well, the monitor is a hand held unit which is typically connected to sensor periodically - hence the "intermittent" designation.

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm. This detector is reusable.

IMO Industries Inc., Gems Sensors Division
Cowles Rd.
Plainville, CT 06062-1198
Tel: (203) 747-3000

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 04/22/93

INCON Environmental**TS 1000 Magnetostrictive Probe****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D=99.9\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, waste oil, motor oil, and solvents with known coefficients of expansion.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 4 hours.
Minimum waiting time between last dispensing and test data collection must be 2 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 5 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.04 inches.
Minimum detectable water level change is 0.011 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

INCON Environmental
P.O. Box 638
Saco, ME 04072
Tel: (800) 872-3455

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/05/92

INCON Environmental

TS 2000 Magnetostrictive Probe

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99.9\%$ and $P_{FA}=0.5\%$.
- Leak Threshold:** 0.058 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, waste oil, and solvents with known coefficients of expansion.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
Minimum waiting time between last dispensing and test data collection must be 2 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no product delivery during the test.
- Temperature:** A minimum of 5 temperature sensors must be used to determine the average temperature of the hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.04 inches.
Minimum detectable water level change is 0.011 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

INCON Environmental
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Saco, ME 04072
Tel: (800) 872-3455

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 05/10/91

In-Situ, Inc.**Leak Detection Systems,
KW-140 / KW-240 Monitors with Type 1 Sensor****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: product soluble

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	00:24	00:09
Fall time (min:sec)	N/A*	N/A
Lower detection limit (cm)	0.01	0.01

*See Glossary

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's Specification:

Type 1 sensor is recommended by manufacturer for detecting liquid and vapor gasoline, alcohol-blend fuels, and JP4 in wet or dry monitor wells.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 This detector is not reusable, and must be replaced after contact with hydrocarbons.

In-Situ, Inc.
 210 S. Third St.
 Laramie, WY 82070-0920
 Tel: (307) 742-8213

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 07/29/91

In-Situ, Inc.**Leak Detection Systems,
KW-140 / KW-240 Monitors with Type 2 Sensor****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: product soluble

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	14:39	08:45
Fall time (min:sec)	N/A*	N/A
Lower detection limit (cm)	0.01	0.01

*See Glossary

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's Specification:

Type 2 sensor is recommended by manufacturer for detecting diesel, heating oil (No. 1 and 2), A2M, JP4, JP5, gasoline, and alcohol blend fuels in wet monitoring wells only.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 This detector is not reusable, and must be replaced after contact with hydrocarbons.

In-Situ, Inc.
 210 S. Third St.
 Laramie, WY 82070-0920
 Tel: (307) 742-8213

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 07/29/91

Keekor Environmental Products

TankTite Leak Detection Kernel Version 1.0 with Keeprobe K7 Magnetostrictive Tank Gauge

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=95.4\%$ and $P_{FA}=4.6\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4 and #6, solvents, and waste oil.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 90% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.1 hours.
Minimum waiting time after a maximum dispensing rate of 50 gallons per minute is 15 minutes.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated as the average of subsets of all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.41 inches.
Minimum change in water level that can be detected is 0.0013 inches.
- Calibration:** Execution of Probe Check diagnostic routine is recommended prior to leak detect tests to ensure sensor is fully operational and in calibration.
Annual preventative maintenance should be performed per manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Keekor Environmental Products
14806 N. 74th St.
Scottsdale, AZ 85260
Tel: (602) 443-0001

Evaluator: Arizona State University
Tel: (602) 965-3185

Date of Evaluation: 10/25/94

Lab One Analytical, Inc.

Search

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.05 gph with $P_D=97.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Detection of tracer chemical.
- Applicability:** All fluid petroleum products and any other fluid which the tracer is compatible.
- Waiting Time:** Waiting period after injection of the tracer into the tank is between one to four weeks. For very large fuel systems, several days or weeks may be required to circulate tracer labeled fuel through all parts of the system. Under these circumstances the waiting period begins after the tracer reaches the pipeline being tested.
- Tracer Dosage:** Dosage of tracer is a factor of tank size and the frequency of tank refills according to manufacturer's recommendations. If the tank system does not operate on a daily basis, another line test method must be used.
- Permeability:** Soil permeability must be sufficient for transport of tracer through the backfill. Soil permeability is checked by measuring the vacuum readings at sampling locations. The vacuum reading must be 10 inches of mercury or less.
- Probe:** Radius of influence of each probe is 10 feet. Locating the pipelines should be done according to the manufacturer's operating procedures for pipeline test results to be valid.
- Comments:** Presence of frozen, saturated soil above the bottom of the tank may limit the effectiveness of this test method. Presence of groundwater above the bottom of the tank may limit the effectiveness of this test method (e.g. when applied to tanks containing water-miscible products or products whose specific gravity is greater than one).

Lab One Analytical, Inc.
12329 E. 60th St.
Tulsa, OK 74146
Tel: (918) 250-1013

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 01/30/95

Lab One Analytical, Inc.

Search

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (TRACER)

- Certification:** Leak rate of 0.05 gph with $P_D=97\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Detection of tracer chemical.
- Applicability:** All fluid petroleum products and any other fluid which the tracer is compatible.
- Capacity:** This test method is not limited by tank capacity, however only portions of the tank system within 10 feet of sample collection point are tested.
- Waiting Time:** Waiting period after injection of the tracer into the tank is 7 to 14 days.
- Tracer Dosage:** Dosage of tracer is a factor of tank size and number of tank refills according to manufacturer's recommendations.
- Permeability:** Soil permeability must be sufficient for transport of tracer through the backfill. Soil permeability is checked by measuring the vacuum readings at sampling locations.
The vacuum reading must be 10 inches of mercury or less.
- Probe:** Radius of influence of each probe is 10 feet. Probes must be placed such that all possible locations and orientations are within the circle of influence. Locating the pipelines should be done according to the manufacturer's operating procedures for pipeline test results to be valid.
- Groundwater:** Depth to the water table present in the backfill must be determined before addition of the tracer to the tank.
If the water table is above the bottom of the tank, throughout the first three days following addition of the tracer, the product level must be maintained above the water table such that the hydrostatic pressure of the product will exceed that of the water table by 0.33 psi.
- Comments:** Presence of frozen, saturated soil above bottom of tank may limit the effectiveness of this test method.
Presence of groundwater above the bottom of the tank may limit the effectiveness of this test method (e.g. when applied to tanks containing water-miscible products or products whose specific gravity is greater than one).

Lab One Analytical, Inc.
12329 E. 60th St.
Tulsa, OK 74146
Tel: (918) 250-1013

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 01/30/95

Leak Detection Systems, Inc.

Tank Auditor, Version RTD V.2.16

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99.98\%$ and $P_{FA}=0.02\%$.
- Leak Threshold:** 0.05 gph if groundwater presence is determined(a leak is declared if the output of the measurement system exceeds this threshold).
If using 2 level testing, the level is changed by 3 feet between the two tests and if the net change between the two tests is greater than 0.02 gph, a leak is declared.
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, waste oil, and other liquids that flow under ambient conditions.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection is variable, dependent on site conditions, but must not be less than 6 hours.
Minimum waiting time between "topping off" and test data collection must be 1 hour.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 1 hour.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A temperature averaging probe must be used to determine the average temperature of the stored product.
- Groundwater:** If depth to the water table is determined and it is above the bottom of the tank, the product level must be adjusted to provide height differential of 3 feet between the product and water in the backfill.
If depth to the water table is not determined, 2 tests must be performed with a level change of at least 3 feet between tests.
- Calibration:** The temperature and level sensors must be calibrated before each test.
- Comments:** This equipment was not evaluated using manifolded tanks.
The evaluation of this equipment did not include a field evaluation of the groundwater compensation by two level testing.

Leak Detection Systems, Inc.
106 Longwater Dr.
Norwell, MA 02061
Tel: (617) 878-7766

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 11/29/91

Mallory Controls

Pollulert Probes MD221G/T, MD221G/TRA

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>	jet fuel <u>(JP-4)</u>
Accuracy (%)	100	100	100
Detection time (sec)	4	7	2
Fall time (sec)	3	4	4
Lower detection limit (cm)	0.08-0.32	0.08-0.32	0.08-0.32

Specificity Results:

Activated: commercial gasoline, toluene, n-hexane, diesel fuel, jet-A fuel, JP-4 jet fuel, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 Evaluation was conducted on probe FD221G/TRA which has identical performance to probes listed, according to manufacturer.
 Probes beginning with "MD" have identical performance as older probes beginning with "FD" according to manufacturer.
 The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Liquid-Phase ASTM-Formatted Methods," June 29, 1990.

Mallory Controls
 2831 Waterfront Pkwy. E. Dr.
 Indianapolis, IN 46214
 Tel: (800) 343-2126

Evaluator: Radian Corp.
 Tel: (512) 454-4797

Date of Evaluation: 07/08/91

Mallory Controls**Pollulert Probes MD241R, MD241RRA, MD241G, MD241GRA****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>	jet fuel <u>(JP-4)</u>
Accuracy (%)	100	100	100
Detection time (sec)	2	2	1
Fall time (sec)	1	2	2
Lower detection limit (cm)	0.16-0.32	0.16-0.32	0.16-0.32

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, JP-4 jet fuel, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 Evaluation was conducted on probe FD241R which has identical performance to probes listed, according to manufacturer.
 Probes beginning with "MD" have identical performance as older probes beginning with "FD" according to manufacturer.
 The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Liquid-Phase ASTM-Formatted Methods," June 29, 1990.

Mallory Controls
 2831 Waterfront Pkwy. E. Dr.
 Indianapolis, IN 46214
 Tel: (800) 343-2126

Evaluator: Radian Corp.
 Tel: (512) 454-4797

Date of Evaluation: 07/08/91

Mallory Controls

Pollulert Probes MD221V, MD221VRA, MD210V, MD210VRA

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: adsistor

Test Results:

	<u>commercial gasoline</u>	<u>synthetic gasoline</u>	<u>JP-4</u>
Accuracy (%)	100	100	100
Detection time (sec)	91	65	86
Fall time (min:sec)	5:39	4:23	9:38
Lower detection limit (ppm)	10 to 100	10 to 500	10 to 50

Specificity Results:

Activated: commercial gasoline, JP-4 jet fuel, synthetic gasoline, toluene, xylene(s).

Not Activated: n-hexane.

Comments:

Evaluation was conducted on probe FD221V which has identical performance to probes listed, according to manufacturer.

Probes beginning with "MD" have identical performance as older probes beginning with "FD" according to manufacturer.

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Mallory Controls
 2831 Waterfront Pkwy. E. Dr.
 Indianapolis, IN 46214
 Tel: (800) 343-2126

Evaluator: Radian Corp.
 Tel: (512) 454-4797

Date of Evaluation: 07/08/91

Marley Pump Co.

Red Jacket PPM 4000, RLM 9000, RLM 10000, ST 1401L, and ST1801L

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 55.1 gallons.
Tests are conducted at 5-10 psi.
- Waiting Time:** There is no waiting period between product delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The minimum data collection time (response time) for the test is 1 minute.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
This system records and displays day, date, time of positive test.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/11/91, Rev. 04/94

Marley Pump Co.

Red Jacket PPM 4000, RLM 9000, RLM 10000, ST 1401L, and ST1801L

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 55.1 gallons.
Tests are conducted at 5-10 psi.
- Waiting Time:** There is no waiting period between product delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The minimum data collection time is 10 minutes.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
This system records and displays day, date, time of positive test.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/11/91, Rev. 04/94

Marley Pump Co.

Red Jacket PPM 4000, RLM 9000, RLM 10000, ST 1401L, and ST1801L

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.047 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuels, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 55.1 gallons.
Tests are conducted at 5-10 psi.
- Waiting Time:** There is no waiting period between product delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The minimum data collection time must be 2.5 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
This system records and displays day, date, time of positive test.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/11/91, Rev. 04/94

Marley Pump Co.

Red Jacket DLD and XLD

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 129 gallons.
Tests are conducted at 8-12 psi.
- Waiting Time:** There is no waiting period between product delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The minimum test time (response time) is 6 seconds.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is detected, this system restricts fuel flow to dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/21/90

Marley Pump Co.

Red Jacket FX1/FX2

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and some solvents.
- Specification:** System is installed on pressurized fiberglass or steel piping.
The piping system volume must not exceed 158 gallons.
Tests are conducted at 8-12 psi.
- Waiting Time:** There is no waiting period between delivery and testing.
There is no waiting period between last dispensing and testing.
Stabilization time up to 45 minutes after dispensing may be required when temperature extremes are present.
- Test Period:** The test time (response time) is less than 5 minutes.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is detected, this system restricts flow to the dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/14/94

Marley Pump Co.

Red Jacket FX1/FX2 Flexline

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and some solvents.
- Specification:** System is installed on pressurized flexible pipelines.
The piping system volume must not exceed 49 gallons.
- Waiting Time:** There is no waiting period between delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The test time (response time) is less than 3 minutes.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, this system restricts flow to the dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Enviroflex pipeline was used during this evaluation which had a bulk modulus of 1,280 psi.
In order for the leak detector to have adequate test, time delays must be integrated into the electronic dispensing equipment or retrofitted in the junction box.
Without this delay, the nozzles cannot be guaranteed being closed for sufficient time to allow the leak detector to compile its line test and provide uninterrupted service.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/22/94

Marley Pump Co.

Red Jacket FX2/FX2-D and Bigflo

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel.
- Specification:** System is installed on pressurized fiberglass or steel piping.
The piping system volume must not exceed 362 gallons.
Tests are conducted at 8-12 psi.
- Waiting Time:** There is no waiting period between delivery and testing.
There is no waiting period between last dispensing and testing.
Stabilization time up to 45 minutes after dispensing may be required when temperature extremes are present.
- Test Period:** The minimum test time (response time) is 3 minutes.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is detected, this system restricts flow to the dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Dates of Evaluation: 3/15/94 and 6/1/94

Marley Pump Co.

Red Jacket XLP

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 129 gallons.
Tests are conducted at 15-22 psi.
- Waiting Time:** There is no waiting period between delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The minimum test time (response time) is 6 seconds.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is detected, this system restricts fuel flow to dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/21/90

Marley Pump Co.

Red Jacket XLP for Flexible Lines

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 48.9 gallons.
Tests are conducted at operating pressure.
- Waiting Time:** There is no waiting period between delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** The minimum test time (response time) is less than 3 minutes.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is detected, this system restricts fuel flow to dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 04/19/93

Marley Pump Co.

**Sonic Technology (ST) 1400-1800 Series Tank Monitoring System (Ultrasonic Transducer)
 ATG Automatic Tank Gauging Monitor, LLM Series Liquid Level Monitor
 FMS Fuel Management Monitor**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 18,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 10 hours.
There is no minimum waiting time after dispensing.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2.35 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A variable number of temperature sensors spaced at approximately six-inch intervals are used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.112 inches.
Minimum detectable water level change is 0.011 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
This system was previously known as the LT1 Automatic Product Level Monitor and was manufactured by Level Tech, Inc. (purchased by Marley 9/91).

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: ADA Technologies
Tel: (303) 792-5615

Date of Evaluation: 09/30/92

Marley Pump Co.

**Sonic Technology (ST) 1400-1800 Series Tank Monitoring System (Ultrasonic Transducer)
ATG Automatic Tank Gauging Monitor, LLM Series Liquid Level Monitor,
FMS Fuel Management Monitor**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99.9\%$ and $P_{FA}=0.01\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, and some solvents.
- Capacity:** The maximum tank capacity is 18,000 gallons.
The tank must be 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 12 hours.
There is no minimum waiting time after dispensing.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2.35 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A variable number of temperature sensors spaced at approximately six-inch intervals are used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.112 inches.
Minimum detectable water level change is 0.011 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
This system was previously known as the LT1 Automatic Product Level Monitor and was manufactured by Level Tech, Inc. (purchased by Marley 9/91).

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: ADA Technologies, Inc.
Tel: (303) 792-5615

Date of Evaluation: 09/25/92

Marley Pump Co.

**Red Jacket ATM System,
Version RLM 5000, 5001, and 9000**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from all data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 temperature sensors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.04 inches.
Minimum detectable water level change is 0.011 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Marley Pump Co.
5800 Foxridge Dr.
Mission, KS 66202
Tel: (913) 813-5700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 04/02/91

Marley Pump Co.

Red Jacket PPM 4000 with Optical Liquid Discrimination Sensor

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: optical sensor

Test Results: *

	unleaded commercial <u>gasoline</u>	synthetic <u>fuel</u>	diesel <u>fuel</u>	home heating <u>oil #2</u>	<u>water</u>
Accuracy (%)	100	100	100	100	100
Response time (min)	2.19	2.20	1.93	2.23	2.81
Recovery time (min)	< 1	< 1	< 1	< 1	< 1
Product activation height (cm)	1.08	1.10	1.03	1.07	1.20
Lower detection limit (cm)	0.30	N/D**	N/D	N/D	N/D

*At a flow rate of 0.13 gal/hr in a 4.8 cm diameter test chamber.

** See glossary.

Specificity Results:

Activated: unleaded commercial gasoline, synthetic fuel, diesel fuel, home heating oil #2, water.

Manufacturer's specifications:

Manufacturer's instructions do not specify procedures or schedules for maintenance or calibration.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The detectors are listed as interstitial due to intended use.

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

The evaluation lists all PPM, RLM, and ST models, including the Multiplexer Unit; however, evaluation procedures were done with PPM 4000.

Marley Pump Co.
 9650 Alden Rd.
 Lenexa, KS 66215
 Tel: (913) 541-2985

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 04/28/92

Mine Safety Appliances

Tankgard
Version: P/N 481532 S/N 03095

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
Sampling frequency: continuous
Operating principle: metal oxide semiconductor

Test Results:

	<u>benzene</u>	<u>2-methylbutane</u>
Accuracy (%)	100	100
Detection time (sec)	5	16
Fall time (min:sec)	04:12	04:42
Lower detection limit (ppm)	12.5	12.5

Specificity Results:

Activated (100%): benzene, n-butane, n-hexane, 2-methylpentane, toluene, isobutane.

Manufacturer's specifications:

Maximum Wire Distance: 500 ft using 18 AWG
Response Time: 30 seconds
Recover Time: 1 minute maximum
Sensor Life: 2 year warranty

Mine Safety Appliances
P. O. Box 427
Pittsburgh, PA 15230
Tel: (412) 776-8600

Evaluator: Carnegie Mellon Research Institution
Tel: (412) 268-3495

Date of Evaluation: 03/26/91

Mine Safety Appliances

Tankgard VIII
Version: P/N 488803 S/N 00389

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
Sampling frequency: continuous
Operating principle: metal oxide semiconductor

Test Results:

	<u>benzene</u>	<u>2-methylbutane</u>
Accuracy (%)	100	100
Detection time (sec)	5	16
Fall time (min:sec)	04:12	04:42
Lower detection limit (ppm)	12.5	12.5

Specificity Results:

Activated (100%): benzene, n-butane, n-hexane, 2-methylpentane, toluene, isobutane.

Manufacturer's specifications:

Maximum Wire Distance: 500 ft using 18 AWG.
Response Time: 30 seconds.
Recover Time: 1 minute maximum.
Sensor Life: 2 year warranty.

Mine Safety Appliances
P. O. Box 427
Pittsburgh, PA 15230
Tel: (412) 776-8600

Evaluator: Carnegie Mellon Research Institution
Tel: (412) 268-3495

Date of Evaluation: 03/28/91

NDE Environmental Corp.

Proline Test Series III, Version 1.0

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=99.0\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4 and #6, and solvents.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at 150% of the line operating pressure.
Mechanical line leak detector must be removed from the pipeline system being tested.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
Minimum waiting time between last dispensing and testing is one hour.
- Test Period:** The minimum data collection time for the test must be one hour.
Pipe deflection, vapor pockets, and large temperature differences may produce inconsistent readings, testing to continue until stable conditions are present.
Test data must be acquired and recorded manually.
Manual calculations are performed by the operator on site.
- Calibration:** Sensors must be calibrated before each test.

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/30/91

NDE Environmental Corp.

PTK-88

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=99.8\%$ and $P_{FA}=1.3\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, and solvent.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 40 gallons.
Tests are conducted at 150% of the line operating pressure.
Mechanical line leak detector must be removed from the pipeline system being tested.
- Waiting Time:** There is no minimum waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing is one hour.
- Test Period:** The minimum data collection time must be 10 minutes per cycle.
Test data is acquired and recorded manually.
Manual calculations are performed by the operator on site.
- Calibration:** Sensors must be calibrated before each test.

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 02/14/91

NDE Environmental Corp.

UTS-4T Ullage Test

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)

- Certification:** Leak rate of 0.1 gph with $P_D=95.24\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Make-up gas flow rate into ullage exceeding 0.275 cubic feet/hour.
- Applicability:** Gasoline, diesel, aviation fuel, heavy fuel oils #4, and solvents.
- Capacity:** Maximum ullage volume is 7,500 gallons.
- Waiting time:** At least 2 hours between the end of adding the product and the start of data collection.
- Test Period:** Data collection time is at least 30 minutes.
Test data is acquired and recorded manually.
- Test Pressure:** The pressure in the ullage portion of the tank is increased such that the net pressure at the bottom of tank (sum of ullage pressure and product head) does not exceed 5.0 psi. It is maintained for a minimum of 5 minutes per 1,000 gallons of ullage. At the conclusion of this stabilization period, the ullage pressure is reduced by 0.5 psi for the remainder of the test.
- Temperature:** Temperature of the ullage must be monitored, and the rate of change of ullage temperature must not exceed manufacturer's tabulated values.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the product level, the net outward pressure must exceed 1 psi throughout the ullage.
- Comments:** The product portion of the tank must be tested using a volumetric underfilled test. This test method was third-party certified using #2 diesel fuels as the test product. This test method was third-party certified using manifolded tanks.

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 12/04/92

NDE Environmental Corp.

UST Ullage Test - Version ProEco U2

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)

- Certification:** Leak rate of 0.1 gph with $P_D=95.24\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Pressure decay trend not to exceed ± 0.016 psi/hr
- Applicability:** Gasoline, diesel, aviation fuel, heavy fuel oils (#2 through #6), and solvents
- Capacity:** Maximum ullage volume is 10,260 gallons.
- Waiting time:** At least 2 hours between the end of adding the product and the start of data collection.
- Test Period:** Data collection time is at least 30 minutes (after data trend has been established).
- Test Pressure:** During the test, a total of 4.0 psi pressure at the bottom of the tank is applied.
- Temperature:** Temperature of the ullage portion of the tank is monitored during the test. A correction factor is applied to account for temperature changes. The correction factor is not applicable for ullage temperature changes greater than 5 degrees F (test must not be conducted).
- Groundwater:** Depth to the water table present in the backfill must be determined. If it is above the product level, the ullage test pressure is maintained at a minimum of 1.0 psi higher than the pressure exerted by the water table.
- Comments:** The product portion of the tank must be tested using a volumetric underfilled test. This test method was third-party certified using #2 diesel fuel as the test product. This test method was third-party certified using manifolded tanks.

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: ADA Technologies, Inc.
Tel: (303) 792-5615

Date of Evaluation: 04/10/92

NDE Environmental Corp.**U3 Ullage Test (Vacuum or Pressure)****NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)**

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** A leak is declared if the noise signal detected is different from the baseline. (Baseline is the noise signal before pressure or vacuum is applied to the tank.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #2 and #6, solvents and waste oil.
- Capacity:** Maximum ullage volume is 16,500 gallons.
- Waiting Time:** There is no waiting time required after product delivery to the tank.
- Test Period:** The data collection time (determination of background noise and a leak) is a few minutes.
After the desired pressure has been reached, the tank should be allowed to settle for ten minutes.
Test period also depends on background noise at the site and on the size of the leak.
- Test Pressure:** A vacuum blower to produce a vacuum of 1 psi in the ullage portion is used. Or, a nitrogen pressure of 4 psi at the tank bottom is applied.
- Temperature:** Acoustic signal is independent of product temperature.
- Groundwater:** Depth to the water table present in the backfill must be determined. If it is above the product level, a vacuum test should not be used. The pressure test may only be used if the ullage test pressure is maintained at a minimum of 1.0 psi higher than the pressure exerted by the water table. If this requires more than 5 psi at tank bottom, then the ullage test should not be used.
- Comments:** This test method tests only the ullage portion on the tank; the product portion of the tank must be tested with an underfilled test method.
This test method was third-party certified using #2 diesel fuel as the test product. During the third-party testing, the microphone was 25 feet away from the leak source. Excess background noise can be a factor in the test result. If background noise is too high, the test is inconclusive.
Noise signals are tape recorded (not digitally recorded).
This test method was not third-party certified with manifolded tanks.
When testing with vacuum, this test method may not be effective in some backfill because some particles (such as clay) may plug holes in the tank.
If soil is saturated with product, this test will not detect air or water ingress.

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 01/15/93

NDE Environmental Corp.

Computerized VPLT Testing System

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99.9\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, solvents, waste oil, and other products.
- Capacity:** The maximum tank capacity is 18,000 gallons.
The tank must contain at least 24 inches of product.
- Waiting Time:** The waiting time between product delivery to the tank and test data collection must be long enough to ensure a temperature change of less than 0.09 degrees F/hour, typically at least 2 hours.
There is no waiting time after dispensing.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from average over data window.
There must be no dispensing or product delivery during the test.
- Temperature:** Typically 5 thermistors are used to determine the average temperature of the stored product. A minimum of one is required.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, the product level in the tank is adjusted to provide minimum of 1 psi pressure differential, positive or negative, on the bottom of the tank during the test.
- Calibration:** Sensors must be checked annually and calibrated if necessary.
- Comments:** The equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: Ken Wilcox Assoc.
Tel: (816) 443-2494

Date of Evaluation: 02/15/93

NDE Environmental Corp.

Sure Test - Assured Tight System, Series IV

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99.99\%$ and $P_{FA}=0.005\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, solvents, and waste oil.
- Capacity:** The maximum tank capacity is 18,000 gallons.
The tank being tested must be between 11% and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
There is no minimum waiting time after dispensing.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from average of subsets of all collected data.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 12 inches of product must be present for the temperature probes to operate properly.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, the product level in the tank is adjusted to provide minimum of 1 psi net pressure on the bottom of the tank during the test. There must be at least 37 inches of gasoline in a tank to create 1 psi net pressure on the bottom.
- Calibration:** Temperature probes and floats must be checked for proper operation prior to each test.
- Comments:** The equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

NDE Environmental Corp.
8906 Wall St., Suite 306
Austin, TX 78754
Tel: (800) 800-4633

Evaluator: ADA Technologies
Tel: (303) 792-5615

Date of Evaluation: 09/09/92

Omntec/Electro Levels**L-LL-R-1, LS-ASC, PDS-ASC, PDWS-1, PDWF-1****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: all: refractive index of liquids; PDS-ASC, PDWS-1, and PDWF-1: also electrical conductivity

Test Results:

	L-LL-R-1 (low level)			L-LL-R-1 (high level)		
	<u>water</u>	<u>gasoline</u>	<u>diesel</u>	<u>water</u>	<u>gasoline</u>	<u>diesel</u>
Accuracy (%)	100	100	100	100	100	100
Detection time (sec)	< 1	< 1	< 1	< 1	< 1	< 1
Fall time (sec)	< 1	< 1	< 1	< 1	< 1	< 1
Lower detection limit (cm)	6.45	6.63	6.53	21.7	21.7	21.8

	PDWS-1			PDWF-1		
	<u>water</u>	<u>gasoline</u>	<u>diesel</u>	<u>water</u>	<u>gasoline</u>	<u>diesel</u>
Accuracy (%)	100	100	100	100	100	100
Detection time (sec)	< 1	< 1	< 1	< 1	< 1	< 1
Fall time (sec)	< 1	< 1	< 1	< 1	< 1	< 1
Lower detection limit (cm)	1.63	1.93	1.85	1.02	1.60	1.67

	PDS-ASC/LS-ASC		
	<u>water</u>	<u>gasoline</u>	<u>diesel</u>
Accuracy (%)	100	100	100
Detection time (sec)	< 1	< 1	< 1
Fall time (sec)	< 1	< 1	< 1
Lower detection limit (cm)	1.42	2.24	2.11

Specificity Results:

Activated: commercial gasoline, synthetic gasoline, diesel fuel, jet-A fuel, n-hexane, toluene, xylene(s), water.

Manufacturer's specifications:

LS and PD series responds to any liquid with an index of refraction different than air. PD series responds to any conducting liquid.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring.

The detectors are listed as interstitial due to intended use.

The test procedures used were modified from EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors," March 1990, and EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Non-Volumetric Tank Tightness Test Methods," March 1990.

Detectors are reusable.

Omntec/Electro Levels
 1993 Pond Rd.
 Ronkonkoma, NY 11779
 Tel: (516) 467-5787

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Date of Evaluation: 06/12/93

One Plus Corp.

**Leak Edge
Models 100-3001, 100-4001**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: product permeable

Test Results:

	commercial	synthetic
	<u>gasoline</u>	<u>gasoline</u>
Accuracy (%)	100	100
Detection time (hr:min:sec)	00:05:41	00:05:14
Fall time (hr:min:sec)	00:30:39	00:18:36
Lower detection limit (cm)	0.02	0.02

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's specifications:

Operating temperatures: Sensor is -40 degrees C to 74 degrees C; Monitor Module is -20 degrees C to 49 degrees C.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
This detector is reusable.

One Plus Corp.
1955 Shermer Rd., Suite 100
Northbrook, IL 60062
Tel: (708) 498-0955

Evaluator: Underwriters Laboratories Inc.
Tel: (847) 272-8800

Date of Evaluation: 12/17/91

Patriot Sensors and Controls Corp.

7021 Digital Tank Gauge

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 99.96\%$ and $P_{FA} = 0.044\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, waste oil, solvents, and other substances with specific gravity >0.6 and a viscosity <1500 cp.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50% to 95% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 2 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data must be acquired and recorded by the 7021 controller (computer).
Leak rate is calculated from data determined to be statistical valid.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 1 resistance temperature detector must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.947 inches.
Minimum detectable water level change is 0.0254 inches.
- Calibration:** Temperature sensors and probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment tests only that portion of the tank which contains product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).
This equipment was originally manufactured by MagneTek (Patriot's predecessor).
Change in product volume is measured using a magnetostrictive probe.
This system may also be used to test at a minimum product height of 18 inches or a 14% full tank, whichever is higher, if the leak rate is set at 0.1 gallons per hour.
This threshold is calculated based on $P_D = 95\%$ and $P_{FA} = 5\%$.

Patriot Sensors and Controls Corp.
1080 N. Crooks Rd.
Clawson, MI 48017-1097
Tel: (810) 435-0700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/07/91

Patriot Sensors and Controls Corp.

7021 Digital Tank Gauge

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D = 95.34\%$ and $P_{FA} = 4.66\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, waste oil, solvents, and other substances with specific gravity >0.6 and a viscosity <1500 cp.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50% to 95% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 8 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data must be acquired and recorded by the 7021 controller (computer).
Leak rate is calculated from data determined to be statistical valid.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 1 resistance temperature detector must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.947 inches.
Minimum detectable water level change is 0.0254 inches.
- Calibration:** Temperature sensors and probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank which contains product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).
This equipment was originally manufactured by MagneTek (Patriot's predecessor).
Change in product volume is measured using a magnetostrictive probe.

Patriot Sensors and Controls Corp.
1080 N. Crooks Rd.
Clawson, MI 48017-1097
Tel: (810) 435-0700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/07/91

PermAlert

**PAL-AT Models AT20C, AT50C, AT40K
PHL Hydrocarbon Sensor**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: electrical conductivity

Test Results: *

	commercial
	<u>gasoline</u>
Accuracy (%)	100
Response time (min)	1.13
Recovery time (min)	8.83
Product activation height (cm)	0.53
Lower detection limit (cm)	0.38

*At a flow rate of 0.13 gal/hr in a 4.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2.
Not activated: water.

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

PermAlert
7720 N. Lehigh Ave.
Niles, IL 60714-3491
Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 02/05/92

PermAlert

**TankWatch Models PHM10, PHMS
Combination Hydrocarbon/Water Probe**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: electrical conductivity

Test Results: *

	commercial <u>gasoline</u>	<u>water</u>
Accuracy (%)	100	100
Response time (min)	0.30	<1
Recovery time (min)	1.97	1.68
Product activation height (cm)	0.18	0.80
Lower detection limit (cm)	0.56	1.93

*At a flow rate of 0.13 gal/hr in a 4.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2.

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

PermAlert
7720 N. Lehigh Ave.
Niles, IL 60714-3491
Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 06/16/92

PermAlert

**TankWatch Models PHM10, PHMS
Hydrocarbon Probe**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: electrical conductivity

Test Results: *

	commercial
	<u>gasoline</u>
Accuracy (%)	100
Response time (min)	0.25
Recovery time (min)	2.33
Product activation height (cm)	0.17
Lower detection limit (cm)	0.38

*At a flow rate of 0.14 gal/hr in a 4.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2.
Not activated: water.

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

PermAlert
7720 N. Lehigh Ave.
Niles, IL 60714-3491
Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 06/16/92

PermAlert**PAL-AT Models AT20C, AT50C, AT40K
AGW Sensor Cable****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative for presence of product
quantitative for location
Sampling frequency: continuous
Operating principle: impedance change

Test Results: *

	commercial gasoline		
	1/3 MER** <u>1348 ft.</u>	2/3 MER <u>2644 ft.</u>	MER <u>3982 ft.</u>
Accuracy (%)	100	100	100
Response time (min)	9.92	6.25	21.28
Recovery time (min)	1.0	1.0	1.0
Product activation height (cm)	2.03	1.13	5.00
Detection length (cm)	116.3	64.8	286.1
Lower detection limits (cm)			
Product activation height	N/D***	N/D	5.1
Detection length	N/D	N/D	295.6

*At a flow rate of 0.14 gal/hr in test chamber.

**MER is Maximum Effective Range, the longest length of sensor cables and /or jumper cables that can be connected to form a leak detection network.

*** See glossary.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. System can monitor interstitial spaces.

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Cable Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Evaluation also covered quantitative leak location.

PermAlert
7720 N. Lehigh Ave.
Niles, IL 60714-3491
Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 01/17/92

PermAlert**PAL-AT Models AT20C, AT50C, AT40K
with PHFW Hydrocarbon Probe and Type 1 Sensor****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: product soluble

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	00:24	00:09
Fall time (min:sec)	N/A*	N/A
Lower detection limit (cm)	0.01	0.01

* See glossary.

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's specifications:

Operating temperature range is 0 degrees F to 90 degrees F.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 The sensor filament must be replaced after contact with hydrocarbons.

PermAlert
 7720 N. Lehigh Ave.
 Niles, IL 60714-3491
 Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 09/15/92

PermAlert**PAL-AT Models AT20C, AT50C, AT40K
with PHFW Hydrocarbon Probe and Type 2 Sensor****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: product soluble

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	14:39	08:45
Fall time (min:sec)	N/A*	N/A
Lower detection limit (cm)	0.01	0.01

* See glossary.

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's specifications:

Operating temperature range is 0 degrees F to 90 degrees F.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
 This detector is not reusable.
 The sensor filament must be replaced after contact with hydrocarbons.

PermAlert
 7720 N. Lehigh Ave.
 Niles, IL 60714-3491
 Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 09/15/92

PermAlert

**PAL-AT Models AT20C, AT50C, AT40K
TFH Hydrocarbon Sensor Cable**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative for presence of product
 quantitative for location
 Sampling frequency: continuous
 Operating principle: impedance change

Test Results: *

	commercial gasoline		
	1/3 MER**	2/3 MER	MER
	<u>1368 ft.</u>	<u>2685 ft.</u>	<u>4046 ft.</u>
Accuracy (%)	100	100	100
Response time (min)	3.40	7.48	16.21
Recovery time (min)	>60	>60	>60
Product activation height (cm)	0.65	1.33	3.53
Detection length (cm)	27.7	56.8	150.4
Lower detection limits (cm)			
Product act. height	N/D***	N/D	3.6
Detection length	N/D	N/D	152.9

*At a flow rate of 0.16 gal/hr in test chamber.

**MER is Maximum Effective Range, the longest length of sensor cables and /or jumper cables that can be connected to form a leak detection network.

** See glossary.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2.

Not Activated: water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. System can monitor interstitial spaces.

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Cable Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Evaluation also covered quantitative leak location.

PermAlert
 7720 N. Lehigh Ave.
 Niles, IL 60714-3491
 Tel: (708) 966-2190

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 02/11/92

Petro Vend, Inc.

Petrosonic III Version 4.05 Model 613 (4 inch) Magnetostrictive Probe

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99.07\%$ and $P_{FA}=0.93\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, and solvents
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 12 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data is acquired and recorded by computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no product delivery during the test waiting time.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.92 inches.
Minimum detectable change in water level is 0.02 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Petrosonic III version 4.04 is an older model Tank Gauging System, and is no longer being marketed.

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Underwriters Laboratories, Inc.,
Tel: (847) 272-8800

Date of Evaluation: 11/04/94

Petro Vend, Inc.

Site Sentinel Model II and III, Model 613 (2 inch) Magnetostrictive Probe

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=96.55\%$ and $P_{FA}=3.45\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, and solvents
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 12 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data is acquired and recorded by computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 2.47 inches.
Minimum detectable change in water level is 0.037 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Underwriters Laboratories, Inc.,
Tel: (847) 272-8800

Date of Evaluation: 11/04/94

Petro Vend, Inc.

Site Sentinel Model II and III, Model 613 (4 inch) Magnetostrictive Probe

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99.82\%$ and $P_{FA}=0.18\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, and solvents
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 12 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data is acquired and recorded by computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.92 inches.
Minimum detectable change in water level is 0.02 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Underwriters Laboratories, Inc.,
Tel: (847) 272-8800

Date of Evaluation: 11/04/94

Petro Vend, Inc.

Site Sentinel Model II and III, Model 613 (4 inch) Magnetostrictive Probe

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99.95\%$ and $P_{FA}=0.35\%$.
- Leak Threshold:** 0.06 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, and solvents
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be at least 90% full.
- Waiting Time:** Minimum waiting time between delivery to the tank and test data collection must be 12 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data is acquired and recorded by computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 Resistance Temperature Detectors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.92 inches.
Minimum detectable change in water level is 0.02 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Underwriters Laboratories, Inc.,
Tel: (847) 272-8800

Date of Evaluation: 11/04/94

Petro Vend, Inc.

**Petroentry IV, Petroentry VIII, SiteSentinel
Liquid Sensor**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: thermal conductivity

Test Results: *

	commercial
	<u>gasoline</u>
Accuracy (%)	100
Response time (min)	0.51
Recovery time (min)	<1
Product activation height (cm)	0.35
Lower detection limit (cm)	0.76

*At a flow rate of 0.14 gal/hr in a 4.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 10/15/92

Petro Vend, Inc.

**Petro Sentry IV, Petro Sentry VIII, Site Sentinel
Universal Reservoir Sensor**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: float switch

Test Results: *

	<u>50 wt% Ethylene glycol in water</u>		<u>30 wt% Calcium chloride in water</u>	
	<u>Up</u>	<u>Down</u>	<u>Up</u>	<u>Down</u>
Accuracy (%)	100	100	100	100
Response time (min)	19.62	16.86	17.77	15.91
Recovery time (min)	<1	<1	<1	<1
Product activation height (cm)	20.9	5.90	20.5	5.95

*At a flow rate of 0.21 gal/hr in test chamber.

Specificity Results:

Not applicable

Comments:

This point sensor is intended to monitor the level of either ethylene glycol or calcium chloride solutions in the interstitial or annular space of a double-walled tank, by triggering an alarm if any significant gain or loss of solution occurs.

Evaluation was performed using procedures from Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991, modified to accommodate the intended purpose.

Petro Vend, Inc.
 6900 Santa Fe Dr.
 Hodgkins, IL 60525-9909
 Tel: (708) 485-4200

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 10/15/92

Petro Vend, Inc.

**Petroentry IV, Petroentry VIII, SiteSentinel
Universal Sump Sensor**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: float switch

Test Results: *

	commercial
	<u>gasoline</u>
Accuracy (%)	100
Response time (min)	8.32
Recovery time (min)	<1
Product activation height (cm)	3.37
Lower detection limit (cm)	3.97

*At a flow rate of 0.20 gal/hr in a 7.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 10/15/92

Petro Vend, Inc.

**SiteSentinel
30-3206, -3207, -3210 Sensors**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: product permeable

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (hr:min:sec)	00:01:41	00:05:14
Fall time (hr:min:sec)	07:28:44	00:18:36
Lower detection limit (cm)	0.02	0.02

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's specifications:

Conductive polymer.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.

This detector is reusable.

The third party evaluators identified these sensors as identical to One Plus Corporation's Models 100-3001 and 100-4001 Leak Edge Hydrocarbon Leak Monitor System. The evaluation was abbreviated and used some data from the One Plus system evaluation.

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Underwriters Laboratories, Inc.
Tel: (847) 272-8800

Date of Evaluation: 12/10/92

Petro Vend, Inc.

**SiteSentinel
Smart Module and Vapor Sensor**

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: metal oxide semiconductor

Test Results:

	commercial gasoline	synthetic gasoline	JP-4
Accuracy* (%)	100	100	100
Detection time (min:sec)	00:05	00:07	00:10
Fall time (min:sec)	06:30	03:35	04:26
Lower detection limit (ppm)	10	10	10

*For tests conducted with 1000 ppm of test gas.

Specificity Results:

Activated: commercial gasoline, synthetic gasoline, JP-4 jet fuel, n-hexane, toluene, xylene(s).

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 04/16/92

Petro Vend, Inc.

Petroentry TLD III

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: metal oxide semiconductor

Test Results:

	<u>benzene</u>	<u>2-methylbutane</u>
Accuracy (%)	100	100
Detection time (min:sec)	00:05	00:16
Fall time (min:sec)	04:12	00:42
Lower detection limit (ppm)	12.5	12.5

Specificity Results:

Activated: benzene, n-butane, n-hexane, isobutane, 2-methylpentane, toluene.

Manufacturer's specifications:

Maximum Wire Distance: 500 ft using 18 AWG

Petro Vend, Inc.
6900 Santa Fe Dr.
Hodgkins, IL 60525-9909
Tel: (708) 485-4200

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 03/26/91

Pneumercator Company, Inc.

**LDE 700, LDE 740, LDE 9000
Sensor Probe Models 9-901, 9-902, 9-903**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: capacitance

Test Results:

	commercial	synthetic
	<u>gasoline</u>	<u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	<00:01	<00:01
Fall time (hr:min:sec)	Manual reset	Manual reset
Lower detection limit (cm)		
9-901	0.32	0.36
9-902	0.36	0.34
9-903	0.76	0.74

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s), water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. This system is listed as interstitial. Evaluation followed a combination of EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors" and EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Non-Volumetric Tank Tightness Testing Methods." The detector is reusable.

Pneumercator Company, Inc.
120 Finn Court
Farmingdale, NY 11735
Tel: (516) 293-8450

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/14/93

Raychem Corp.**TraceTek Alarm and Locator Modules
TT502 Fuel Sensing Cable****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative for presence of product
quantitative for location

Sampling frequency: continuous

Operating principle: electrical conductivity

Test Results: *

	commercial gasoline		
	1/3 MER** <u>334 m</u>	2/3 MER <u>665 m</u>	MER <u>995 m</u>
Accuracy (%)	100	100	100
Response time (min)	22.11	17.13	19.42
Recovery time (min)	N/A***	N/A	N/A
Product activation height (cm)	1.53	1.53	1.53
Detection length (cm)	61	61	61
Lower detection limits (cm)			
Product act. height	N/D***	N/D	0.77
Detection length	N/D	N/D	10

*At a flow rate of 0.17 gal/hr in test chamber.

**MER is Maximum Effective Range, the longest length of sensor cables and /or jumper cables that can be connected to form a leak detection network.

** See glossary.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2.

Not Activated: water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party

Evaluation of Leak Detection Methods: Cable Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Evaluation also covered quantitative leak location.

Raychem Corp.
300 Constitution Dr.
Menlo Park, CA 94025-1164
Tel: (415) 361-3333

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 05/15/92

Ronan Engineering Co.

**Ronan X-76 Automatic Line Leak Detector
Version X-76 DM-4 Microprocessor and JT-H2 Line Pressure Sensor**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.831 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvent, and waste oil.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 45 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
No waiting time between last dispensing of the product through the pipeline and the start of data collection for the test.
- Test Period:** The minimum data collection time (response time) for the test must be 20 seconds.
Test data must be acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Ronan Engineering Co.
21200 Oxnard St.
Woodland Hills, CA 91367
Tel: (818) 883-5211

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 10/04/91

Ronan Engineering Co.

**Ronan X-76 Automatic Line Leak Detector
Version X-76 DM-4 Microprocessor and JT-H2 Line Pressure Sensor**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.066 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvent, and waste oil.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 45 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
Waiting time between last dispensing of the product through the pipeline and the start of data collection for the test must be 2 hours.
- Test Period:** The minimum data collection time (response time) for the test must be 20 minutes.
Test data must be acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Ronan Engineering Co.
21200 Oxnard St.
Woodland Hills, CA 91367
Tel: (818) 883-5211

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 10/04/91

Ronan Engineering Co.**X-76 ETM and X-76 ETM-4X****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D = 99.96\%$ and $P_{FA} = 0.044\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, waste oil, and other substances with specific gravity >0.60 and a viscosity <1500 cp.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full if the system leak threshold is set at 0.1 gph.
This system may also be used to test at a minimum product height of 12 inches or a 14% full tank, whichever is higher, if the leak threshold is set at 0.049 gph.
This threshold is calculated based on $P_D = 95\%$ and $P_{FA} = 5\%$.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 2 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data must be acquired and recorded by computer.
Leak rate is calculated from data determined to be statistically valid.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 1 resistance temperature detector must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.947 inches.
Minimum detectable water level change is 0.0254 inches.
- Calibration:** Temperature sensors and probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Change in product volume is measured using magnetostrictive probe.
X76ETM-4X console has different housing which allows it to be mounted outside.

Ronan Engineering Co.
21200 Oxnard St.
Woodland Hills, CA 91367
Tel: (818) 883-5211

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/07/91

Ronan Engineering Co.

X-76 ETM and X-76 ETM-4X

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D = 95.34\%$ and $P_{FA} = 4.66\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, waste oil, and other substances with specific gravity >0.60 and a viscosity <1500 cp.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours.
Test data must be acquired and recorded by computer.
Leak rate is calculated from data determined to be statistically valid.
There must be no dispensing or product delivery during the test.
- Temperature:** Minimum of 1 resistance temperature detector must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.947 inches.
Minimum detectable water level change is 0.0254 inches.
- Calibration:** Temperature sensors and probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Change in product volume is measured using magnetostrictive probe.
X76ETM-4X console has different housing which allows it to be mounted outside.

Ronan Engineering Co.
21200 Oxnard St.
Woodland Hills, CA 91367
Tel: (818) 883-5211

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 11/21/91

Schuster Instruments

Tel-A-Leak 1

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99.86\%$ and $P_{FA}=0.14\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and waste oil.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
Minimum waiting time between "topping off" and test data collection must be 1 hour.
There must be no dispensing or product delivery during the test waiting period.
- Test Period:** The minimum data collection time must be 1 hour.
Test data is acquired and recorded manually and by a computer.
Leak rate calculated from average of the last 10 consecutive 6 minute readings.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 10 temperature sensors must be used to determine the average temperature of the stored product.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide 2-4 psi net pressure on the bottom of the tank during the test.
- Calibration:** Temperature and level sensors must be checked annually and calibrated annually.
- Comments:** This system was not evaluated using manifolded tanks.

Schuster Instruments
211 E. Grove St.
Kawkawlin, MI 48631
Tel: (517) 684-6638

Evaluator: W. A. Kibbe and Associates
Tel: (517) 797-2425

Date of Evaluation: 11/26/90

Simmons Sirvey Corp.

SIR 5.7

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99.0\%$ and $P_{FA}=1.0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Motor vehicle fuels.
- Capacity:** Maximum tank capacity is 18,000 gallons.
- Data Requirement:** Minimum of 30 days of product level and flow through data.
- Comments:** All 41 data sets were analyzed with conclusive results.
The median monthly throughput for tanks used in the evaluation was 7,000 gallons.
Leak rates ranging from 0.05 to 0.2 gph were used in evaluation.
Data sets used in this evaluation were supplied by the evaluator.
This evaluation did not include data from manifolded tanks.

Simmons Sirvey Corp.
9550 Forest Lane, Ste. 720
Dallas, TX 75243-5934
Tel: (800) 848-8378

Evaluator: S.S.G. Associates
Tel: (601) 234-1179

Date of Evaluation: 12/15/92

S.I.R. International, Inc.

Mitchell's SIR Program v.2.6 12-13-91

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=98\%$ and $P_{FA}=2\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum UST capacity shall not exceed 18,000 gallons.
- Data Requirement:** Minimum of 32 days of product level and flow through data.
- Comments:** Of the 41 data sets presented for evaluation, only 24 "best" analyses were returned. 17 data sets were not analyzed. The median monthly throughput for tanks used in this evaluation was 6,313 gallons. Leak rates of 0.049 to 0.21 gph were used in the evaluation. Data sets used in this evaluation were supplied by the evaluator. This evaluation did not include data from manifolded tanks.

S.I.R. International, Inc.
11210 Steeplecrest Dr., Suite 120
Houston, TX 77065
Tel: (713) 897-0224

Evaluator: Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 01/27/92

Sir Phoenix, Inc.

SIR PHOENIX

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99.0\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity is 18,000 gallons.
- Data Requirement:** Vendor requires 90 days of product level and flow through data before making the first evaluation.
Following the first evaluation, subsequent evaluations are made based on 30 days of data.
- Comments:** Of the 41 data sets presented for evaluation, 5 were inconclusive.
The median monthly throughput of tanks used in the evaluation was 14,600 gallons.
Leak rates of 0.05, 0.1, and 0.2 gph were used in this evaluation.
Data sets used in the evaluation were supplied by the vendor.
This evaluation did not include data from manifolded tanks.

Sir Phoenix, Inc.
P.O. Box 588
Lawrenceburg, TN 38464
Tel: (615) 762-3300

Evaluator: Nathan Adams, Middle TN State Univ.
Tel: (615) 898-2644

Date of Evaluation: 11/05/92

Soiltest, Inc.

Soiltest Ainlay Tank 'Tegrity' Tester, S-3

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 10 hours.
Minimum waiting time between "topping off" and test data collection must be 2 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 1.5 hour.
Test data is acquired and recorded manually and by a strip chart recorder.
Leak rate is calculated from data of last 1.5 hours of test period.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 3 thermistors must be used to determine the average temperature of the stored product.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide 2-4 psi net pressure on the bottom of the tank during the test.
- Calibration:** Level sensors must be calibrated before each test.
Temperature sensors must be checked annually and calibrated if necessary.
- Comments:** This system was not evaluated using manifolded tanks.

Soiltest, Inc.
86 Albrecht Dr., P. O. Box 8004
Lake Bluff, IL 60044-8004
Tel: (800) 323-1242

Evaluator: Law Engineering Industrial Services
Tel: (800) 672-6601

Date of Evaluation: 11/28/90

Syscorp, Inc.

Store Vision Version E.2

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUALITATIVE)

- Certification:** Leak rate of 0.2 gph with $P_D=95.7\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.0834 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity is 12,000 gallons.
- Data Requirement:** Minimum of 29 days of product level and flow through data are required.
- Comments:** Of the 120 data sets presented for evaluation, 32 were inconclusive. The median monthly throughput for tanks evaluated was 8,097 gallons. A single leak rate of 0.2 gph was used in this evaluation. Data sets used in this evaluation were supplied by the evaluator. This evaluation did not include data from manifolded tanks.

Syscorp, Inc.
1513 Huffman Rd., Suite 202
Birmingham, AL 35215
Tel: (205) 853-0004

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/30/93

Tank Automation, Inc.

**Automated Precision Tank Testing System (APTT System)
R-2**

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, fuel oil #6, solvents, waste oil, and other compatible products.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time between product delivery and test data collection must be 10.5 hours.
Minimum waiting time between "topping off" and test data collection must be 2.5 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 1 hour.
Test data must be acquired and recorded manually for level measurement and by computer for temperature measurement.
Leak rate is calculated from 1 hour test period.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 10 thermistors must be used to determine the average temperature of the stored product.
- Groundwater:** Groundwater presence is checked to a depth of 5 feet and test is performed at product level of 66 inches above grade to ensure a minimum 1 psi pressure at bottom of tank.
- Calibration:** Temperature and level sensors are checked annually and calibrated if necessary.
- Comments:** This system was not evaluated using manifolded tanks.

Tank Automation, Inc.
P.O. Box 1395
Wall, NJ 07719
Tel: (908) 280-2233

Evaluator: Wildwood Engineering
Tel: Not Available

Date of Evaluation: 11/14/90

Tanknology Corp. International

TLD-1

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=99.5\%$ and $P_{FA}=0.5\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 50 gallons.
Tests are conducted at 150% of the line operating pressure.
Mechanical line leak detector must be removed from the pipeline system being tested.
- Waiting Time:** Testing may begin immediately after the test equipment is installed in the line.
Test may not be ended until the pass/fail criteria set by the manufacturer has been met.
- Test Period:** The data collection time for the test is 30 minutes to 6 hours.
Pipe deflection, vapor pockets, and large temperature differences may produce inconsistent readings, testing to continue until stable conditions are present.
Test data is acquired and recorded manually.

Tanknology Corp.
5255 Hollister
Houston, TX 77040
Tel: (800)888-8563

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/29/91

Tanknology Corp. International**VacuTect****NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (VACUUM)**

Certification:	Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
Leak Threshold:	A leak is declared if any air or water incursion is detected: Sonic emission of air ingress in the ullage area (above product level); sonic emission of bubbles by air ingress in product-filled portion of the tank; accumulation of water in bottom of tank from water ingress.
Applicability:	Gasoline, diesel, aviation fuel, fuel oil #4, and waste oil.
Capacity:	The maximum tank capacity is 75,000 gallons. The microphone should be located within 60 feet from any possible leak source. The test is generally conducted at 60-90% product level range. The test may be performed at lower product levels (minimum 5% product in the tank) if the total ullage volume does not exceed 20,000 gallons.
Test Period:	The minimum data collection time to declare a tank tight (after vacuum is reached) is 1 hour if the backfill is dry (no water is detected in backfill prior to or at the conclusion of the test). There is no specified minimum test time to declare a tank "non-tight". If water is present in the backfill, the minimum test time for declaring a tank tight is calculated based on the tank size, amount of water present in the tank prior to the test, tank tilt, type of water sensor and its location. Manufacturer's time charts should be checked for appropriate test times. When the test relies on detection of water ingress, the minimum test time to declare a tank tight (if the measurements are taken at the low end of the tank) is: 4 hours for the printed circuit board water sensor (test time may be shorter for tanks smaller than 1500 gallons) and 1 hour for the magnetostrictive water sensor. When water is present in the backfill, an inclinometer must be used to determine and record tank tilt. Tank tilt may also be determined by taking readings at both ends of the tank. Water sensor should always be used at the low end of the tank. If the water measurements are not taken at the low end of the tank, extended test times may be required to detect any water ingress.
Water Sensor:	A water sensor (at the low point of the tank) is used to detect water ingress. Magnetostrictive sensor: minimum detectable water level is 0.017 inches, minimum detectable water level change is 0.001 inches. Printed circuit board sensor: minimum detectable water level is 0.022 inches, minimum detectable water level change is 0.016 inch. Water miscible products limit the effectiveness of water ingress detection.
Groundwater:	Depth to water table present in the backfill must be determined, and if it is above the bottom of the tank, test time must be extended to allow sufficient time to detect 0.1 gph incursion of water into the tank.
Vacuum:	The minimum vacuum at the bottom of the tank must be greater -0.5 psi.
Comments:	This test method may not be effective in some backfill because some backfill (such as clay) may plug a hole in the tank. This test method was not evaluated using manifolded tanks. If the soil is saturated with product, this test method may not detect air or water incursion. A well point in the backfill may help identify presence of this condition. During the third-party certification, gasoline, diesel, and JP-4 were used.

Tanknology Corp.
5255 Hollister
Houston, TX 77040
Tel: (800) 888-8563

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Dates of Evaluation: 09/08/92, 02/20/92, 1/18/94
and 10/28/91

Tidel Engineering, Inc.

**LIPSPC-301-0730-001/LIP-301-0729-001
Line Integrity Probe and Submersible Pump Controller**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel.
- Specification:** System is installed on pressurized fiberglass and steel pipelines.
The piping system volume must not exceed 129 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
No waiting time between last dispensing of the product through the pipeline and the start of data collection for the test.
- Test Period:** The minimum data collection time (response time) for the test is 1 minute.
Test data must be acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/02/93

Tidel Engineering, Inc.

**LIPSPC-301-0730-001/LIP-301-0729-001
Line Integrity Probe and Submersible Pump Controller**

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.06 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel.
- Specification:** System is installed on pressurized fiberglass and steel pipelines.
The piping system volume must not exceed 129 gallons.
Tests are conducted at the line operating pressure.
- Waiting Time:** No waiting time between last delivery of the product to the tank and the start of data collection.
No waiting time between last dispensing of the product through the pipeline and the start of data collection for the test.
- Test Period:** The minimum data collection time (response time) for the test is 1.5 hours.
Test data must be acquired and recorded by a permanently installed microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm and shuts down the dispensing system.
- Calibration:** Sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/02/93

Tidel Engineering, Inc.

**Tidel Environmental Monitoring System, EMS 2000, 3000, and 3500 Series
Probes #401-0009 and #401-0010**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 96.2\%$ and $P_{FA} = 3\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 2 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data is acquired and recorded by the microprocessor contained within the EMS console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 temperature sensors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor is used to detect water incursion.
Minimum water level detectable in the tank is 1.48 inches.
Minimum detectable water level change is 0.035 inches.
- Calibration:** Temperature sensors and ultrasonic probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
EMS 2000 and 3000 Series are no longer manufactured by Tidel.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 06/07/93

Tidel Engineering, Inc.

Tidel Environmental Monitoring System, EMS 2000, 3000, and 3500 Series
Probes #401-0021 and #401-0022

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 99.91\%$ and $P_{FA} = 0.09\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 2 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data is acquired and recorded by the microprocessor contained within the EMS console.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 temperature sensors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor is used to detect water incursion.
Minimum water level detectable in the tank is 1.48 inches.
Minimum detectable water level change is 0.035 inches.
- Calibration:** Temperature sensors and ultrasonic probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
EMS 2000 and 3000 Series are no longer manufactured by Tidel.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 06/07/93

Tidel Engineering, Inc.**EMS-3500
With Monitoring Well Probes Part 301-0642****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: magnetic switch/float and hydrocarbon sensitive polymer

Test Results: *

	commercial gasoline	water	
		<u>low</u>	<u>high</u>
Accuracy (%)	100	100	100
Response time (min)	6.39	4.76	4.12**
Recovery time (min)	>60	<1	<1
Product activation height (cm)	2.27	4.31	19.22
Lower detection limit (cm)	2.32	4.31	N/A***

* At a flow rate of 0.89 gal/hr in test chamber of diameter 12.6 cm.

** Larger test chamber and flow rate of 1.51 gal/hr.

*** See glossary.

Specificity Results:

Activated at 2.27 cm height: diesel fuel, synthetic fuel, home heating oil #2.

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party

Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems":

Final Report - November 11, 1991.

In addition, the probe was tested to determine its capability of detecting hydrocarbons floating on water.

A Lower Detection Limit thickness of 0.04 cm was detected on average in 16 minutes 41 seconds, with the recovery time averaging 12 minutes, 55 seconds.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 02/17/93

Tidel Engineering, Inc.**EMS-3500
Liquid Discriminatory Probes Part 301-0635****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity/hydrocarbon sensitive polymer

Test Results: *

	<u>commercial gasoline</u>	<u>water</u>
Accuracy (%)	100	100
Response time (min)	3.59	0.96
Recovery time (min)	13.18	<1
Product activation height (cm)	1.76	0.49
Lower detection limit (cm)	4.19	1.52

* At a flow rate of 0.04 gal/hr in a 2.54 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel (at liquid height of 1.78 cm), synthetic fuel (at 2.30 cm), home heating oil #2 (at 2.30 cm).

Comments:

The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party

Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems":
 Final Report - November 11, 1991.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 01/29/93

Tidel Engineering, Inc.**EMS-3500
Tidel Detector No. 301-0752-001****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: float switch

Test Results: *

	<u>50 wt% Ethylene glycol in water</u>		<u>30 wt% Calcium chloride in water</u>	
	<u>up</u>	<u>down</u>	<u>up</u>	<u>down</u>
Accuracy (%)	100	100	100	100
Response time (min)	21.91	30.10	22.27	31.08
Recovery time (min)	<1	<1	<1	<1
Product activation height (cm)	28.92	2.75	28.82	2.48

* At a flow rate of 0.26 gal/hr in test chamber.

Specificity Results:

Not applicable

Comments:

This point sensor is intended to monitor the level of either ethylene glycol or calcium chloride solutions in the interstitial or annular space of a double-walled tank, by triggering an alarm if any significant gain or loss of solution occurs.

Evaluation was performed using procedures from Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991, modified to accommodate the intended purpose.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 04/20/93

Tidel Engineering, Inc.

EMS-3500
with Monitoring Well Probes Part 301-0641

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: conductivity via resistor ladder network

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	00:04	00:07
Fall time (min:sec)	<01:00	<01:00
Lower detection limit (cm)	0.32	0.32

Specificity Results:

Activated (100%): commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, JP -4 jet fuel, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 02/02/93

Tidel Engineering, Inc.**EMS-3500
With Sheen Probes Part 301-0687****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity/hydrocarbon sensitive polymer

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	07:45	03:35
Fall time (min:sec)	18:01	16:57
Lower detection limit (cm)	0.02	0.04

Specificity Results:

Activated (100%): commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, JP-4 jet fuel, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 01/31/93

Tidel Engineering, Inc.

**EMS-3500
Tidel Detector No. 301-0762**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: electrical conductivity/hydrocarbon sensitive polymer

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	9:31	7:05
Fall time (min:sec)	55:42	17:04
Lower detection limit (cm)	0.04	0.08

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Manufacturer's specifications:

Groundwater probe used to detect free floating hydrocarbons in monitoring wells.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 03/18/93

Tidel Engineering, Inc.**Tidel Detector No. 301-0324-001 and 301-0325-001****LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity

Test Results:

	jet fuel (JP-4)	commercial gasoline	synthetic gasoline
Accuracy (%)	100	100	100
Detection time (sec)	1	2	2
Fall time (sec)	2	1	2
Lower detection limit (cm)	0.16-0.32	0.16-0.32	0.16-0.32

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, JP-4 jet fuel, synthetic gasoline, xylene(s).

Manufacturer's specifications:Detector No.301-0324-001

Application: Liquid sensor, water, used in 4" monitoring well.
 Sensor: Magnetism and conductivity pins.
 Detection Range: 1/8" floating product on groundwater or 1.5" free product.

Detector No.301-0325-001

Application: Liquid sensor, water or hydrocarbon used in reservoir, sump or pipeline trench.
 Sensor: Magnetism and conductivity pins.
 Detection Range: 1/8" floating product on groundwater or 1.5" free product.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Radian Corp.
 Tel: (512) 454-4797

Date of Evaluation: 07/08/91

Tidel Engineering, Inc.

Tidel Detector No. 301-0326-001 and 301-0326-002

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: electrical conductivity

Test Results:

	commercial gasoline	synthetic gasoline	jet fuel (JP-4)
Accuracy (%)	100	100	100
Detection time (sec)	4	7	2
Fall time (sec)	3	4	4
Lower detection limit (cm)	0.08-0.32	0.08-0.32	0.08-0.32

Specificity Results:

Activated: commercial gasoline, toluene, n-hexane, diesel fuel, jet-A fuel, JP-4 jet fuel, synthetic gasoline, xylene(s).

Manufacturer's specifications:

Detector No.301-0326-001

Application: Liquid sensor, water, used in 2" monitoring well.
 Sensor: Magnetism and conductivity pins.
 Detection Range: 1/8" floating product on groundwater or 2.5" free product.

Detector No.301-0326-002

Application: Liquid sensor, water, used in annulus of double wall steel tanks.
 Sensor: Magnetism and conductivity pins.
 Detection Range: 1/8" floating product on groundwater or 2.5" free product.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Radian Corp.
 Tel: (512) 454-4797

Date of Evaluation: 07/08/91

Tidel Engineering, Inc.

EMS-3000
301-0328-001, 301-0330-001

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: adsistor

Test Results:

	commercial gasoline	synthetic gasoline	JP-4
Accuracy (%)	100	100	100
Detection time (sec)	91	65	86
Fall time (min:sec)	5:39	4:23	9:38
Lower detection limit (ppm)	10 to 100	10 to 500	10 to 50

Specificity Results:

Activated: commercial gasoline, JP-4 jet fuel, synthetic gasoline, toluene, xylene(s)
Not Activated: n-hexane.

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Tidel Engineering, Inc.
2615 E. Belt Line Rd.
Carrollton, TX 75006
Tel: (800) 678-7577

Evaluator: Radian Corp.
Tel: (512) 454-4797

Date of Evaluation: 07/08/91

Tidel Engineering, Inc.

EMS-3500
Vapor Sensor Probe Part No. 301-0634

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: adsistor

Test Results:

	commercial gasoline	synthetic gasoline	JP-4
Accuracy* (%)	100	100	100
Detection time* (min:sec)	2:46	1:41	1:50
Fall time* (hr:min:sec)	>1:00:00**	>1:00:00**	>1:00:00**
Lower detection limit (ppm)	100	500	100

* For tests conducted with 1000 ppm of test gas.

** The vapor sensor probe was recalibrated when it did not recover after 1 hour, from exposure to test vapors.

Specificity Results:

Activated: commercial gasoline, JP-4 jet fuel, synthetic gasoline, n-hexane, toluene, xylene(s).

Manufacturer's specifications:

Vapor sensor probe for use in normally dry monitoring wells to detect hydrocarbon vapors.

Can be used in monitoring wells up to 20 feet deep.

The probe will alarm if it comes in contact with water and must be removed immediately to prevent damage to probe.

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Tidel Engineering, Inc.
 2615 E. Belt Line Rd.
 Carrollton, TX 75006
 Tel: (800) 678-7577

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 03/18/93

Tokheim Corp.

Tokheim Pressure Monitor, Models PM 101 and 585A-PM

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.25 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and alcohols.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 78 gallons.
Tests are conducted at 150% operating pressure.
- Waiting Time:** There is no waiting period between product delivery and testing.
There is no waiting period between last dispensing and testing.
- Test Period:** Minimum test time (response time) must be 4 seconds.
- System Features:** This system is permanently installed on the piping and automatically tests the line.
It uses a preset threshold and a single test to determine whether the piping is leaking.
If a leak is detected, this system restricts flow to the dispenser.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Tokheim Corporation no longer manufactures this system.

Tokheim Corp.
10501 Corporate Dr.
Fort Wayne, IN 46801-0360
Tel: (219) 423-2552

Evaluator: Vista Research
Tel: (415) 966-1171

Date of Evaluation: 11/02/90

Tracer Research Corp.

Tracer Tight Line Test

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0.0\%$.
- Leak Threshold:** Detection of tracer chemical.
- Applicability:** All fluid petroleum products and any other fluid which the tracer is compatible.
- Waiting Time:** Waiting period after injection of the tracer into the tank is on average 2 weeks, but must be no less than 1 week, and no more than 4 weeks.
For very large systems, several days or weeks may be required to circulate tracer-labeled fuel through all parts of the system.
Under these circumstances the 1 week waiting period begins after the tracer reaches the pipeline being tested.
- Tracer Dosage:** Dosage of tracer is a factor of tank size and the frequency of tank refills according to manufacturer's recommendations.
Tracer labeled product should be circulated through the piping before the test period begins.
Pressurized piping must be brought up to operating pressure or caused to operate on a daily basis.
- Permeability:** Soil permeability must be greater than 1 Darcy.
Soil permeability must be sufficient for transport of tracer through the backfill.
- Probe:** Radius of influence of each probe is 10 feet.
Locating the pipelines should be done according to the manufacturer's operating procedures for pipeline test results to be valid.
- Comments:** Presence of frozen, saturated soil (frozen groundwater) surrounding the pipeline may reduce the effectiveness of this test method.
Presence of groundwater surrounding piping may also reduce the effectiveness of This test method (e.g. when applied to tanks containing water-miscible products or products whose specific gravity is greater than one).

Tracer Research Corp.
3755 N. Business Center Dr.
Tucson, AZ 85705
Tel: (800) 989-9929

Evaluator: Ken Wilcox Associates (1991)
Tel: (816) 443-2494
Control Strategies Engineering (1992)
Tel: (602) 682-8726
Dates of Evaluation: 10/04/91 and 05/92

Tracer Research Corp.

Tracer Tight

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (TRACER)

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** Detection of tracer chemical.
- Applicability:** All fluid petroleum products and any other fluid which the tracer is compatible.
- Capacity:** This test method is not limited by tank capacity, however only portions of the tank system within 10 feet of sample collection point are tested.
- Waiting Time:** Waiting period after injection of the tracer into the tank is 7 to 30 days (generally two weeks).
- Tracer Dosage:** Dosage of tracer is a factor of tank size and the frequency of tank refills according to manufacturer's recommendations.
- Permeability:** Soil permeability must be greater than 1 Darcy.
Soil permeability must be sufficient for transport of tracer through the backfill.
- Probe:** Radius of influence of each probe is 10 feet. Probes must be placed such that all possible locations and orientations are within the circle of influence.
- Groundwater:** Depth to the water table present in the backfill must be determined. In order for a leak below the water table to be indicated by the release of the tracer compound, the hydrostatic pressure of product in the tank must exceed the hydrostatic pressure of the water table.
This is done by maintaining the product level at least 6 inches over the water table for a minimum of 17 hours during the first three days following the addition of the tracer compound to the tank system.
In high groundwater situations, this method may be supplemented with measurement of water ingress, at the discretion of the regulatory agency.
- Comments:** Presence of frozen, saturated soil above bottom of tank may limit the effectiveness of this test method.
Presence of groundwater above the bottom of the tank may also limit the effectiveness of this test method (e.g. when applied to tanks containing water-miscible products or products whose specific gravity is greater than one).
- Probe:** Radius of influence of each probe is 10 feet. Probes must be placed such that all possible locations and orientations are within the circle of influence.

Tracer Research Corp.
3755 N. Business Center Dr.
Tucson, AZ 85705
Tel: (800) 989-9929

Evaluator: Ken Wilcox Associates (1990)
Tel: (816) 443-2494
Control Strategies Engineering (1992)
Tel: (602) 682-8726
Dates of Evaluation: 10/04/90 and 05/92

Tracer Research Corp.

Tracer Tight

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
 Sampling frequency: intermittent
 Operating principle: chromatographic (looks for chemical tracer)

Test Results:Hydrocarbon detector (GC/FID)

	<u>xylene</u>	<u>benzene</u>	<u>2-methylbutane</u>	<u>gasoline</u>	<u>Tracers</u>
Accuracy (%)	<20	<20	<20	<20	N/R*
Bias (%)	0	0	0	0	N/R
Detection time (min)	<0.01	<0.01	<0.01	<0.01	N/R
Fall time (min)	<0.01	<0.01	<0.01	<0.01	N/R
Lower detection limit (ppm)	20	20	20	20	N/R

Tracer Detector

	<u>xylene</u>	<u>benzene</u>	<u>2-methylbutane</u>	<u>gasoline</u>	<u>Tracers</u>
Accuracy (%)	N/R	N/R	N/R	N/R	<20
Bias (%)	N/R	N/R	N/R	N/R	0
Detection time (min)	N/R	N/R	N/R	N/R	<0.01
Fall time (min)	N/R	N/R	N/R	N/R	<0.01
Lower detection limit (ppm)	N/R	N/R	N/R	N/R	10 ⁻⁵

* See glossary.

Specificity Results:

See above.

Manufacturer's specifications:

Soil permeability at the site must exceed 1 Darcy.

Comments:

Test results based on EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Non-Volumetric Tank Tightness Testing Methods," March 1990 and "recognized national standard of GC/FID hydrocarbon measurements."

The method utilizes a chromatographic measurement of a vapor sample collected monthly from the site. Hydrocarbon vapors and the added chemical tracer can be measured independently.

During the evaluations, the tracer chemical was declared 159 out of 161 trials.

The system evaluation included detectors, analytical procedures, sample containers, sampling procedures, sampling equipment, monitoring well materials and installations, and tracer mobility.

Tracer Research Corp.
 3755 N. Business Center Dr.
 Tucson, AZ 85705
 Tel: (800)989-9929

Evaluator: Control Strategies Engineering
 Tel: (602) 682-8726

Date of Evaluation: 05/05/92

Triangle Environmental, Inc.

TEI Model LT-3, Version 1.0

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=100.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oils #4 and #6, solvents, and waste oil.
- Specification:** System tests fiberglass and/or steel piping.
The piping system volume must not exceed 80 gallons.
Tests are conducted at 150% of the line operating pressure.
- Waiting Time:** There is no minimum waiting time between delivery of product and the start of data collection.
Minimum waiting time between last dispensing of product through the pipeline system and the start of data collection must be at least 15 minutes.
- Temperature:** Product temperature change per hour should be less than 4 degrees F.
- Test Period:** The minimum data collection time must be 15 minutes.
Test data is acquired and recorded manually.
Manual calculations are performed by the operator on site.
- Calibration:** Sensors must be checked annually and calibrated semi-annually in accordance with manufacturer's instructions.

Triangle Environmental, Inc.
172 W. Verdugo Ave.
Burbank, CA 91502-2132
Tel: (818) 840-7020

Evaluator: United States Testing Company
Tel: (213) 723-7181

Date of Evaluation: 03/03/92

Triangle Environmental, Inc.

TEI Ullage Test, Version 1.00

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** An increase in the acoustic noise level of the tank under vacuum is detected due to air or water ingress indicates a leak.
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and light liquids.
- Capacity:** The maximum ullage volume is 15,000 gallons.
The microphone should be located within 24 feet of all points of the ullage portion of the tank.
- Waiting Time:** There is no waiting time if the test is conducted after the underfilled tank test.
- Test Period:** The data collection time is 1 minute.
- Test Pressure:** Vacuum of 1 psi is maintained in the ullage portion of the tank.
If the vacuum cannot be maintained, see manufacturer's instructions.
- Temperature:** Acoustic signal is independent of product temperature.
- Groundwater:** Depth to groundwater table present in the backfill must be determined, and if it is above the product level, vacuum pressure must be adequate to detect an ingress of water.
- Comments:** This test method was third-party certified using unleaded gasoline as the test product.
Manifolded tanks are identified and isolated prior to the test.
During the third-party testing, the microphone was 24 feet away from the leak source.
Headphones are used during the test to listen for the signal of air ingress.
Noise signals are tape recorded.
Test method may not be effective in some backfill because some particles (such as clay) may plug a hole in the tank.
If the soil is saturated with product, this test will not detect air or water ingress.

Triangle Environmental, Inc.
172 W. Verdugo Ave.
Burbank, CA 91502-2132
Tel: (818) 840-7020

Evaluator: United States Testing Co. Inc.
Tel: (213) 723-7181

Date of Evaluation: 05/05/93

Triangle Environmental, Inc.

TEI System 5000, Version 1.0

NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (VACUUM)

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** A leak is declared if the acoustic noise level of the tank under vacuum is greater than the calibrated noise level (which is taken without vacuum).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil #4, solvents, and light liquids.
- Capacity:** The maximum tank capacity is 20,000 gallons.
The tank must be at least 14% full.
The microphone should be located within 24 feet of all points on the tank.
- Waiting Time:** There is no waiting time after product delivery to the tank.
- Test Period:** The data collection time is 1 minute.
- Test Pressure:** Vacuum of 1 psi is maintained at the bottom of the tank.
If the vacuum cannot be maintained, see manufacturer's instructions.
- Temperature:** Acoustic signal is independent of product temperature.
- Groundwater:** Depth of the groundwater table in the backfill must be determined.
This method cannot be used if the groundwater is above the bottom of the tank.
- Comments:** This test method was third-party certified using unleaded gasoline as the test product.
During the third-party testing, the microphone was 24 feet away from the leak source.
Headphones are used during the test to listen for the signal of air ingress.
Noise signals are tape recorded (not digitally recorded).
Manifolded tanks are identified and isolated prior to the test.
This test method cannot be used if the backfill is not porous.
This test method may not be effective in some backfill because some particles (such as clay) may plug a hole in the tank.
If the soil is saturated with product, this test will not detect air or water ingress.

Triangle Environmental, Inc.
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Burbank, CA 91502-2132
Tel: (818) 840-7020

Evaluator: United States Testing Co., Inc.
Tel: (213) 723-7181

Date of Evaluation: 02/04/93

Triangle Environmental, Inc.

TEI System 4000, Version 1.00

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=4.8\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, fuel oil, waste oil, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
Tank must be between 50 and 100% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time is determined by computer.
The average data collection time during the evaluation was four hours.
Leak rate is calculated from data of last 2 hours of test period.
Test data is acquired and recorded by computer.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 3 thermistors must be used to determine the average temperature of the stored product.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide a net pressure of at least 1 psi on the bottom of the tank.
- Calibration:** Sensors must be calibrated before each test.
- Comments:** This equipment was not evaluated using manifolded tanks.
This system tests only the portion of the tank containing product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
T.E.I. System 4000 may also be used as an overfilled test method.

Triangle Environmental, Inc.
172 W. Verdugo Ave.
Burbank, CA 91502-2132
Tel: (818) 840-7020

Evaluator: United States Testing Company, Inc.
Tel: (213) 723-7181

Date of Evaluation: 04/02/91

Universal Sensors and Devices, Inc.

TICS-1000

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D = 96.6\%$ and $P_{FA} = 3.4\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold.)
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 90% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8 hours.
There is no minimal waiting time after dispensing
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6 hours.
Test data is acquired and recorded by a microprocessor.
Leak rate is calculated from average of subsets of all collected data.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 resistance temperature detectors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.83 inches.
Minimum detectable water level change is 0.0116 inches.
- Calibration:** Temperature sensors and probes must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests that portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Universal Sensors and Devices, Inc.
9205 Alabama Ave., Unit C
Chatsworth, CA 91311
Tel: (818) 988-7121

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/20/93

Universal Sensors and Devices, Inc.

Leak Alert System Models LAL-100, LA-01, LA-02, LA-04, LA-X4, LA-08, CATLAS
Liquid Sensor LALS-1

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: thermal conductivity

Test Results: *

	commercial
	<u>gasoline</u>
Accuracy (%)	100
Response time (min)	1.24
Recovery time (min)	<1
Product activation height (cm)	0.61
Lower detection limit (cm)	0.76

* At a flow rate of 0.04 gal/hr in a 2.6 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Universal Sensors and Devices, Inc.
9205 Alabama Ave., Unit C
Chatsworth, CA 91311
Tel: (818) 988-7121

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 06/01/94

Universal Sensors and Devices, Inc.**Leak Alert System Models LAL-100, LA-01, LA-02, LA-04, LA-X4, LA-08, CATLAS
LAVS-1 MOS Vapor Sensor****VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: metal oxide semiconductor

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>	<u>JP-4</u>
Accuracy (%)	100	100	100
Detection time (min:sec)	00:31	00:40	00:42
Fall time (min:sec)	4:43	4:25	4:30
Lower detection limit (ppm)	100	N/D*	N/D

* See glossary.

Specificity Results:

Activated: commercial gasoline, synthetic gasoline, JP-4 jet fuel, n-hexane, toluene, xylene(s).

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Universal Sensors and Devices, Inc.
 9205 Alabama Ave., Unit C
 Chatsworth, CA 91311
 Tel: (818) 988-7121

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 06/01/94

USTest**UST 2000/U (2.0 psi and -1.0psi)****NON-VOLUMETRIC TANK TIGHTNESS TEST METHOD (ULLAGE)**

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** A substantial increase in the noise signal (under vacuum or pressure) over the background signal (no pressurization or vacuum applied) in the frequency interval of 10 kHz to 20 kHz, is declared as a leak.
- Applicability:** Gasoline, diesel, and aviation fuel, fuel oils (#2 through #6), solvents, waste oil. Equipment is not in contact with the product.
- Capacity:** Ullage volume of 7,550 gallons or less for +2.0 psig and 5,250 gallons or less for -1.0 psig test.
- Waiting Time:** There is no waiting time if the test is conducted after an underfilled tank tightness test.
- Test Period:** Minimum data collection time (includes collection of background information) is 15 minutes.
- Test Pressure:** Tests are done at a net of +2.0 psi (pressure) or -1.0 psi (vacuum) in the ullage portion of the tank.
- Groundwater:** Depth to the groundwater table present in the backfill must be determined. If it is above the product level, the test under vacuum must not be conducted. Net outward pressure throughout the ullage must exceed 2.0 psi.
- Calibration:** Test equipment is checked by the tester before each test.
- Comments:** This is an ullage test only; the portion of the tank that contains product must be tested with an underfilled test method.
 During the third-party certification, unleaded gasoline was the test product.
 During the third-party certification, the microphone was less than 8.5 feet from the leak source.
 Surrounding acoustical noise can interfere with the test result.
 If the background noise is above a certain threshold, the test is inconclusive.
 Vibration due to nearby equipment or dripping condensation can interfere with this test.
 This equipment is not third-party certified using manifolded tanks.

USTest
 P.O. Box 53835
 Lafayette, LA 70505
 Tel: (318) 981-9421

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Date of Evaluation: 03/24/92

USTest

UST 2000/LL

VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=98.12\%$ and $P_{FA}=1.88\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel. Water, kerosene, and other liquids may be tested in consultation with the manufacturer.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be at least 15% full.
There must be at least 20 inches and not more than 67 inches of product in the tank.
- Waiting Time:** Minimum waiting period between delivery and test data collection is usually between 3 to 12 hours.
Testing may begin when the rate of product temperature change does not exceed 0.1 degrees F per hour.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data is acquired and recorded by a computer, which does a regression analysis to determine the leak rate.
An ultrasonic device is used to measure changes in product level.
There must be no dispensing or product delivery during the test.
- Temperature:** Change in temperature is determined via a measurement of the change in the speed of sound.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide a net pressure of at least +/-1.0psi on the bottom of the tank.
- Calibration:** The temperature sensors and probes must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This system tests only the portion of the tank containing product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).

USTest
P.O. Box 53835
Lafayette, LA 70505
Tel: (318) 981-9421

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 06/09/94

USTest**UST 2000/P****VOLUMETRIC TANK TIGHTNESS TEST METHOD (UNDERFILL)**

- Certification:** Leak rate of 0.1 gph with $P_D=99.9\%$ and $P_{FA}=0.1\%$ for tanks up to 15,000 gallons, and leak rate of 0.1 gph with $P_D=99.7\%$ and $P_{FA}=0.3\%$ for tanks up to 45,000 gallons.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel. Water, kerosene, and other liquids may be tested in consultation with the manufacturer.
- Capacity:** The maximum tank capacity is 45,000 gallons.
The tank must be at least 78.6% full.
- Waiting Time:** Minimum waiting period for tanks up to 45,000 gallons must be determined from the manufacturer's chart of Wait Time versus Tank Volume, and this chart must be included in the tank test report.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time for tanks between 10,000 and 45,000 gallons is determined from the manufacturer's chart of Differential Volume versus Test Duration. The line labeled $P_D = 99.9\%$ must be used. This chart must be included in the tank test report.
Test data is acquired and recorded by a computer, which does a regression analysis to determine the leak rate.
There must be no dispensing or product delivery during the test.
- Temperature:** Change in temperature is determined via a measurement of the change in the speed of sound.
- Groundwater:** Depth to the water table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide a net pressure of at least 1.0 psi on the bottom of the tank.
- Comments:** This equipment was not evaluated using manifolded tanks.
This system tests only the portion of the tank containing product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).

USTest
P.O. Box 53835
Lafayette, LA 70505
Tel: (318) 981-9421

Evaluators: Midwest Research Institute
Tel: (816) 753-7600
and Ken Wilcox Associates
Tel: (816) 443-2494
Dates of Evaluation: 12/05/90 (1000-10000 gallons),
and 08/04/92 (10000-45000 gallons)

USTMAN Industries, Inc.

USTMAN SIR 1.91

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=98.4\%$ and $P_{FA}=1.6\%$.
- Leak Threshold:** 0.1 gph (a leak is declared when a continuous loss exceeding the threshold at the 5% level of significance is detected).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity is 18,000 gallons.
- Data Requirement:** Minimum of 42 days of product level and flow through data is required.
- Comments:** Of the 41 data sets submitted for analysis, four data sets were not analyzed, 7 were inconclusive.
This evaluation did not include data sets from manifolded tanks.
The median monthly throughput for tanks used in this evaluation was 10,978 gallons.
Leak rates ranging from 0.048 to 0.201 gph were used in the evaluation.
Data sets used in this evaluation were supplied by the evaluator.

USTMAN Industries Inc.
12265 W. Bayaud Ave., Suite 110
Lakewood, CO 80228
Tel: (303) 986-8011

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 10/31/91

USTMAN Industries, Inc.

USTMAN SIR Version 94.1

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D \geq 99\%$ and $P_{FA} \leq 1.0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity of 30,000 gallons.
- Data Requirement:** Minimum of 30 days of product level and flow through data.
- Comments:** All 53 data sets presented for evaluation were evaluated with conclusive results. The median monthly throughput of tanks used in this evaluation was 25,408 gallons. Leak rates of 0.05, 0.1, and 0.2 gph were used in the evaluation. Data sets used in this evaluation were supplied by the evaluator and some data sets used an USTMAN SIR 1.91 (0.1 gph) analysis as documentation that tanks in this evaluation were tight. This evaluation included some data from manifolded tanks.

USTMAN Industries Inc.
12265 W. Bayaud Ave., Suite 110
Lakewood, CO 80228
Tel: (303) 986-8011

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 03/31/94

USTMAN Industries, Inc.

YES SIR 90

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUALITATIVE)

- Certification:** Leak rate of 0.2 gph with $P_D=96.3\%$ and $P_{FA}=3.9\%$.
- Leak Threshold:** 0.1 gph (a leak is declared when a consistent loss exceeding the threshold that is statistically significant from zero at the 5% confidence level is detected).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity is 15,000 gallons.
- Data Requirement:** Minimum of 35 days of product level and flow through data.
- Comments:** Of the 120 data sets evaluated by the method, 15 were inconclusive. This evaluation did not include data sets from manifolded tanks. The median monthly throughput for tanks used in this evaluation was 15,867 gallons. Data sets used in this evaluation were supplied by the evaluator.

USTMAN Industries Inc.
12265 W. Bayaud Ave., Suite 110
Lakewood, CO 80228
Tel: (303) 986-8011

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 12/17/90

Vaporless Manufacturing

Vaporless LD 2000 and LD 2000S

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.7 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and solvent.
- Specification:** System is installed on pressurized fiberglass or steel piping. The piping system volume must not exceed 129 gallons. Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting period between last dispensing and testing. There is no waiting period between product delivery and testing.
- Test Period:** The minimum test time (response time) is 5 seconds.
- System Features:** This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, the LD 2000 will restrict fuel flow to dispenser, and the LD 2000S will shut off the pump.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Vaporless Manufacturing
9234 E. Valley Rd., Suite C
Prescott Valley, AZ 86314
Tel: (602) 775-5191

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 11/19/90

Vaporless Manufacturing

Vaporless LD 2000E and LD 2000E-S

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

Certification:	Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
Leak Threshold:	2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
Applicability:	Gasoline, diesel, aviation fuel and solvent.
Specification:	System is installed on flexible piping. The piping system volume must not exceed 59.6 gallons. Tests are conducted at the line operating pressure.
Waiting Time:	There is no waiting period between last dispensing and testing. There is no waiting period between product delivery and testing.
Test Period:	The minimum test time (response time) is 30 seconds.
System Features:	This system is permanently installed on the piping and automatically tests the line. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, the LD 2000E will restrict fuel flow to dispenser, and the LD 2000E-S will shut off the pump.
Calibration:	Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
Comments:	Enviroflex piping with a bulk modulus of 1,352 psi was used during the third-party evaluation.

Vaporless Manufacturing
9234 E. Valley Rd., Suite C
Prescott Valley, AZ 86314
Tel: (602) 775-5191

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/11/92

Vaporless Manufacturing

Vaporless LD 2000T and LD 2000T-S

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

Certification:	Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
Leak Threshold:	2.5 gph (a leak is declared if the output of the measurement system exceeds this threshold).
Applicability:	Gasoline, diesel, aviation fuel and solvent.
Specification:	System is installed on pressurized fiberglass or steel piping. The piping system volume must not exceed 129 gallons. Tests are conducted at the line operating pressure.
Waiting Time:	There is no waiting period between last dispensing and testing. There is no waiting period between product delivery and testing.
Test Period:	The minimum test time (response time) is 1 minute.
System Features:	This system is permanently installed on the piping and automatically tests the line. "T" stands for shortened check valve to fit the Tokiem pump. It uses a preset threshold and a single test to determine whether the piping is leaking. If a leak is detected, the LD 2000T will restrict fuel flow to dispenser, and the LD 2000T-S will shut off the pump.
Calibration:	Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Vaporless Manufacturing
9234 E. Valley Rd., Suite C
Prescott Valley, AZ 86314
Tel: (602) 775-5191

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 07/13/93

Vaporless Manufacturing

Vaporless LD 3000 and LD 3000S

AUTOMATIC MECHANICAL LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.0 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel and solvent.
- Specification:** System is installed on pressurized steel and fiberglass piping. The piping system volume must not exceed 320 gallons. Tests are conducted at the line operating pressure.
- Waiting Time:** There is no waiting period between last dispensing and testing.
- Test Period:** The minimum test time (response time) is 9 seconds.
- System Features:** This system is permanently installed on the piping and automatically tests the line when the pump is activated. If a leak is detected, the LD 3000 will restrict fuel flow to dispenser, and the LD 3000S will shut off the pump.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Vaporless Manufacturing
9234 E. Valley Rd., Suite C
Prescott Valley, AZ 86314
Tel: (602) 775-5191

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/20/93

Veeder-Root

TLS-350 Line Leak Detector, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 2.4 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time (response time) is 13.9 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Please note that the following specification sheet is a separate evaluation for this same system at the same leak rate.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/20/91

Veeder-Root

TLS-350 Line Leak Detector, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.5 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 128 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** The minimum data collection time (response time) is 14 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Please note that the previous specification sheet is a separate evaluation for this same system at the same leak rate.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 04/12/93

Veeder-Root

TLS-350 Line Leak Detector, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=100.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.10 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 6 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Please note that the following specification sheet is a separate evaluation for this same system at the same leak rate.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/20/91

Veeder-Root

TLS-350 Line Leak Detector, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=100.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.10 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 128 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 6 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Please note that the previous specification sheet is a separate evaluation for this same system at the same leak rate.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 04/12/93

Veeder-Root

TLS-350 Line Leak Detector, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.04 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 41 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 14 minutes.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Please note that the following specification sheet is a separate evaluation for this same system at the same leak rate.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 09/20/91

Veeder-Root

TLS-350 Line Leak Detector, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.079 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 128 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 14 minutes.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** Please note that the previous specification sheet is a separate evaluation for this same system at the same leak rate.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Veeder-Root**TLS-350 Line Leak Detector for Flexible Pipelines, Series 8475****AUTOMATIC ELECTRONIC LINE LEAK DETECTOR**

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.5 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 158.4 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 1 minute.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, and triggers an alarm.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Veeder-Root

TLS-350 Line Leak Detector for Flexible Pipelines, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.2 gph with $P_D=96\%$ and $P_{FA}=4\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 158.4 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 0.75 to 8.85 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Veeder-Root

TLS-350 Line Leak Detector for Flexible Pipelines, Series 8475

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.079 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized flexible piping.
The piping system volume must not exceed 158.4 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing depends on volume of product and temperature gradient which is determined by the system's computer.
- Test Period:** Minimum data collection time (response time) is 1.2 to 12.9 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 08/04/93

Veeder-Root

TLS Line Leak Detector, Series 8484

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 3.0 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 1.88 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 89 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing is 16 minutes.
- Test Period:** Minimum data collection time (response time) is 28.8 seconds.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/07/91

Veeder-Root

TLS Line Leak Detector, Series 8484

AUTOMATIC ELECTRONIC LINE LEAK DETECTOR

- Certification:** Leak rate of 0.1 gph with $P_D=100.0\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvent.
- Specification:** System is installed on pressurized fiberglass and steel piping.
The piping system volume must not exceed 89 gallons.
Tests are conducted at the line operating pressure.
The mechanical line leak detector must be removed from the pipeline system.
- Waiting Time:** There is no waiting period between product delivery and testing.
Minimum waiting period between last dispensing and testing is 2.5 hours.
- Test Period:** Minimum data collection time (response time) is 0.3 hours.
Test data must be acquired and recorded by a microprocessor.
Calculations are automatically done by the microprocessor.
- System Features:** This system is permanently installed on the pipeline and automatically tests the line.
Uses a preset threshold and a single test to determine whether the pipeline is leaking.
If a leak is declared, this system displays a message, triggers an alarm, and shuts down the dispensing system.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 08/07/91

Veeder-Root

**TLS-200/200i/300/400 UST ATGS
with 7842 Digital Sensing Capacitance Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.2 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 5 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A temperature-averaging probe must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.40 inches.
Minimum change in water level that can be detected is 0.040 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Capacitance probes do not work with oxygenated fuels.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Veeder-Root**TLS-200/200i/300/400 UST ATGS
with 8472 Digital Sensing Capacitance Probe****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D=99\%$ and $P_{FA}=0.2\%$.
- Leak Threshold:** 0.126 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.3 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored hazardous substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.52 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Capacitance probes do not work with oxygenated fuels.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Veeder-Root

**TLS-200/200i/300/400 UST ATGS
with 8472 Digital Sensing Capacitance Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.071 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.25 hours.
Minimum waiting time after dispensing is 30 minutes.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 1.52 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).
Capacitance probes do not work with oxygenated fuels.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Veeder-Root**TLS-200/200i/250/250i/300/350/400 UST ATGS
with 8473 Digital Sensing Magnetostrictive Probe****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D=99\%$ and $P_{FA}=0.1\%$.
- Leak Threshold:** 0.093 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and solvents.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50 and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.3 hours.
There must be no product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 2 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.544 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered the leak rate in a leaking tank decreases (due to lower head pressure).

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/14/93

Veeder-Root

**TLS-200/200i/250/250i/300/350/400 UST ATGS
with 8473 Digital Sensing Magnetostrictive Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.071 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, solvents, and waste oil. Other liquids may be tested after consultation with the manufacturer.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 8.25 hours.
Minimum waiting time after dispensing is 30 minutes.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 3 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated as the difference between the first and last data collected.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored product.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.544 inches.
Minimum change in water level that can be detected is 0.027 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank that contains product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 03/14/95

Veeder-Root**Veeder-Root 3000 Tank Level Module – version TLP2
Normal/Rapid Test Mode – Magnetostrictive Probe****AUTOMATIC TANK GAUGING SYSTEM**

- Certification:** Leak rate of 0.2 gph with $P_D=95.0\%$ and $P_{FA}=0.1\%$ in normal test mode and $P_D=95.0\%$ and $P_{FA}=5.0\%$ in rapid test mode.
- Leak Threshold:** 0.1 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be between 50% and 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours and 40 minutes.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 4 hours for normal test mode and 1.2 hours for rapid test mode.
Test data must be acquired and recorded by a microprocessor.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.49 inches.
Minimum detectable change in water level is 0.05 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank which contains product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).
This system was formerly called CEI 3000 and was manufactured by Control Engineers.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/27/92

Veeder-Root

**Veeder-Root 3000 Tank Level Module – version TLP2
Normal/Rapid Test Mode – Magnetostrictive Probe**

AUTOMATIC TANK GAUGING SYSTEM

- Certification:** Leak rate of 0.1 gph with $P_D=99.2\%$ and $P_{FA}=0.08\%$ in normal test mode and $P_D=95.0\%$ and $P_{FA}=5.0\%$ in rapid test mode.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, and aviation fuel.
- Capacity:** The maximum tank capacity is 15,000 gallons.
The tank must be 95% full.
- Waiting Time:** Minimum waiting time between product delivery to the tank and test data collection must be 6 hours and 40 minutes.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time must be 6.38 hours for normal test mode and 2.67 hours for rapid test mode.
Test data must be acquired and recorded by a microprocessor.
Leak rate is calculated from data determined to be valid by statistical analysis.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 thermistors must be used to determine the average temperature of the stored substance.
- Water Sensor:** A water sensor must be used to detect water incursion.
Minimum water level detectable in the tank is 0.49 inches.
Minimum detectable change in water level is 0.05 inches.
- Calibration:** Temperature sensors and probe must be checked and calibrated in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.
This equipment only tests the portion of the tank which contains product.
As the product level is lowered, the leak rate in a leaking tank decreases (due to lower head pressure).
This system was formerly called CEI 3000 and was manufactured by Control Engineers.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Midwest Research Institute
Tel: (816) 753-7600

Date of Evaluation: 05/21/92

Veeder-Root**TLS-350 Discriminating Interstitial Liquid Sensor****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: capacitance change / ultrasonic

Test Results: *

	commercial <u>gasoline</u>	<u>water</u>
Accuracy (%)	100	100
Response time (min)	0.46	1.36
Recovery time (min)	<1	<1
Product activation height (cm)	0.23	0.69

* At a flow rate of 0.94 gal/hr in 14.4 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel (at liquid height of 0.37 cm), synthetic fuel (at 0.35 cm), home heating oil #2 (at 0.43 cm).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The detectors are listed as interstitial due to intended use. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Veeder-Root
 125 Powder Forest Dr.
 Simsbury, CT 06070-2003
 Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 06/30/93

Veeder-Root

TLS-350

Dispenser Pan Sensors and Containment Sump Sensors

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: electrical conductivity / ultrasonic

Test Results: *

	commercial gasoline	water	
		low	high
Accuracy (%)	100	100	100
Response time (min)	6.59	4.60	5.00
Recovery time (min)	17.17	<1	<1
Product activation height (cm)	3.40	2.45	20.3

* At a flow rate of 0.17 gal/hr in a 6.0 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel (at liquid height of 4.75 cm), synthetic fuel (at 2.58 cm), home heating oil #2 (at 4.67 cm).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 05/26/93

Veeder-Root**TLS-350
Dual and Single Stage Hydrostatic Sensors****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: float switch

Test Results: *

	50 wt% Ethylene glycol in water		30 wt% Calcium chloride in water	
	<u>up</u>	<u>down</u>	<u>up</u>	<u>down</u>
Accuracy (%)	100	100	100	100
Response time (min)	22.52	35.75	20.46	37.07
Recovery time (min)	<1	<1	<1	<1
Product activation height (cm)	33.1	3.9	32.2	4.0

* At a flow rate of 0.33 gal/hr in a test chamber of 7.8 cm diameter.

Specificity Results:

Not applicable

Comments:

This point sensor is intended to monitor the level of either ethylene glycol or calcium chloride solutions in the interstitial or annular space of a double-walled tank, by triggering an alarm if any significant gain or loss of solution occurs.

Evaluation was performed using procedures from Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991 modified to accommodate the intended purpose.

Veeder-Root
 125 Powder Forest Dr.
 Simsbury, CT 06070-2003
 Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 12/07/92

Veeder-Root**TLS-250i, TLS 250i Plus, ILS 250, ILS 350, TLS-350
Interstitial Liquid Sensor for Fiberglass Tanks (0794390-401)****LIQUID-PHASE INTERSTITIAL DETECTOR****Detector:**

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: float switch

Test Results: *

	commercial gasoline**	synthetic gasoline***
Accuracy (%)	100	100
Response time (min)	3.66	3.45
Recovery time (min)	<1	<1
Product activation height (cm)	1.28	1.27
Lower detection limit (cm)	1.84	1.65

* At a flow rate of 0.19 gal/hr in 7.6 cm diameter test chamber.

** TLS-250, TLS 250i Plus, ILS 250

*** ILS 350, TLS-350

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Veeder-Root
 125 Powder Forest Dr.
 Simsbury, CT 06070-2003
 Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 07/17/92

Veeder-Root

**TLS-250, TLS 250i Plus, ILS 250, ILS 350, TLS-350
Interstitial Liquid Sensor for Steel Tanks (0794390-420)**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: float switch

Test Results:

	commercial gasoline*	commercial gasoline**
Accuracy (%)	100	100
Response time (min)	6.00	6.51
Recovery time (min)	<1	<1
Product activation height (cm)	3.67	3.62
Lower detection limit (cm)	4.05	4.17

* TLS-250, TLS 250i Plus, ILS 250, at a flow rate of 0.13 gal/hr in 4.8 cm diameter test chamber.

** ILS 350, TLS-350, at a flow rate of 0.12 gal/hr in 4.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 07/17/92

Veeder-Root

**TLS-250i, TLS 250i Plus, ILS 250, ILS 350, TLS-350
Liquid Sensor for Sumps (0794390-206)**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: float switch

Test Results:

	commercial <u>gasoline</u>	commercial <u>gasoline</u> **
Accuracy (%)	100	100
Response time (min)	8.19	8.49
Recovery time (min)	<1	<1
Product activation height (cm)	4.12	3.95
Lower detection limit (cm)	4.67	4.36

* TLS-250, TLS 250i Plus, ILS 250, at a flow rate of 0.15 gal/hr in 5.8 cm diameter test chamber.

** ILS 350, TLS-350, at a flow rate of 0.14 gal/hr in 5.8 cm diameter test chamber.

Specificity Results:

Activated: diesel fuel, synthetic fuel, home heating oil #2, water.

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were those in Carnegie Mellon Research Institute's "Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems": Final Report - November 11, 1991.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 07/17/92

Veeder-Root

**TLS-350
Solid-State Pan/Sump Sensor (794380-321, -351), Piping Sump Sensor (794380-208),
Micro Sensor (794380-340)**

LIQUID-PHASE INTERSTITIAL DETECTOR

Detector:

Output type: qualitative
 Sampling frequency: continuous
 Operating principle: product permeable / ultrasonic / float switch

Test Results:

	<u>gasoline</u>	<u>diesel</u>	<u>water</u>
<u>Piping Sump Sensor (794380-208)</u>			
Min. product level (cm)	3.51	3.40	3.03
Precision	0.011	0.011	0.011
Detection time (sec)	<1	<1	<1
<u>Solid-State Pan/Sump Sensor (794380-321, -351)</u>			
Min. product thickness (cm)	2.60	2.50	2.60
Precision	0.010	0.010	0.010
Detection time (sec)	<1	<1	<1
<u>Micro Sensor (794380-340)</u>			
Min. product thickness (cm)	0.51	0.46	0.48
Precision	0.011	0.007	0.007
Detection time (sec)	<1	<1	<1

Specificity Results (%):

commercial gasoline 100
 diesel fuel 100
 water 100

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm, for groundwater monitoring. The test procedures used were modified by the evaluator from those in EPA's "Standard Test Procedures for Evaluation Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors," March 1990.

Veeder-Root
 125 Powder Forest Dr.
 Simsbury, CT 06070-2003
 Tel: (203) 651-2700

Evaluator: Ken Wilcox Associates
 Tel: (816) 443-2494

Date of Evaluation: 10/20/94

Veeder-Root

**350 Series UST Monitoring Systems: Models ILS-350, TLS-350, TLS-350R
Groundwater Sensor (794380-621, -622, -624)**

LIQUID-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: electrical conductivity

Test Results:

	commercial	synthetic
	<u>gasoline</u>	<u>gasoline</u>
Accuracy (%)	100	100
Detection time (min:sec)	08:55	06:18
Fall time (min:sec)	54:50	26:02
Lower detection limit (cm)	0.02	0.02

Specificity Results:

Activated: commercial gasoline, n-hexane, diesel fuel, jet-A fuel, toluene, synthetic gasoline, xylene(s).

Comments:

EPA and many states require detection of 1/8 inch of product, which is 0.32 cm.
This detector is reusable.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495
Dates of Evaluation: 11/20/91 (TLS-350) and
07/28/92

Veeder-Root

**ILS 350, TLS-350
Adsistor Vapor Probes**

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: qualitative
Sampling frequency: continuous
Operating principle: adsistor

Test Results:

	commercial <u>gasoline</u>	synthetic <u>gasoline</u>	JP-4 <u>jet fuel</u>
Accuracy (%)	100	0	100
Detection time (min:sec)	7:46	N/A*	17:01
Fall time (min:sec)	2:38	N/A	3:05
Lower detection limit (ppm)	500	>1000	500

*See Glossary.

Specificity Results:

Activated: commercial gasoline, JP-4 jet fuel

Not Activated: n-hexane, synthetic gasoline, toluene, xylene(s).

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Veeder-Root
125 Powder Forest Dr.
Simsbury, CT 06070-2003
Tel: (203) 651-2700

Evaluator: Carnegie Mellon Research Institute
Tel: (412) 268-3495

Date of Evaluation: 07/24/92

Warren Rogers Associates, Inc.

WRA Statistical Inventory Analysis, Version 5.1

STATISTICAL INVENTORY RECONCILIATION TEST METHOD (QUANTITATIVE)

- Certification:** Leak rate of 0.1 gph with $P_D=99.98\%$ and $P_{FA}=0.02\%$.
- Leak Threshold:** 0.05 gph (a leak is declared when leak rate exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** Maximum tank capacity is 18,000 gallons.
- Data Requirement:** Minimum 30 days of product level and flow through data.
- Comments:** All 41 data sets were analyzed with conclusive results.
The median monthly throughput for tanks used in the evaluation was 1,000 gallons.
Leak rates of 0.05, 0.1, and 0.20 gph were used in this evaluation.
A portion of the data used in the evaluation was supplied by the vendor.
This evaluation did not include data from manifolded tanks.

Warren Rogers Associates, Inc.
747 Aquidneck Ave.
Middletown, RI 02840
Tel: (401) 846-4747

Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 12/18/90

Warrick Controls, Inc.

**Model 5700 Meter
PVP-2 Sensor**

VAPOR-PHASE OUT-OF-TANK PRODUCT DETECTOR

Detector:

Output type: quantitative
 Sampling frequency: continuous
 Operating principle: adsistor

Test Results:

	commercial gasoline	synthetic gasoline	JP-4
Accuracy (%)	25.4	-100.0	157.1
Bias (%)	14.4	-100.0	108.3
Precision (%)	7.6	N/D*	20.4
Detection time (min)	>60	N/A*	>60
Fall time (min)	38	N/A	>60
Lower detection limit (ppm)	1353.3	N/D	N/D

* See glossary.

Specificity Results:

Not Activated: commercial gasoline, synthetic gasoline, JP-4 jet fuel, n-hexane, toluene, xylene(s).

Comments:

The test procedures used were those in Radian Corporation's draft report "Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted Methods," June 29, 1990.

Warrick Controls, Inc.
 4237 Normandy Court
 Royal Oak, MI 48073
 Tel: (810) 549-4900

Evaluator: Carnegie Mellon Research Institute
 Tel: (412) 268-3495

Date of Evaluation: 09/10/91

Western Environmental Resources

Model PLT-100R

LINE TIGHTNESS TEST METHOD

- Certification:** Leak rate of 0.1 gph with $P_D=100\%$ and $P_{FA}=0\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, waste oil, and solvents.
- Specification:** System tests fiberglass and steel piping.
The piping system volume must not exceed 80 gallons.
Tests are conducted at 150% of the line operating pressure.
Mechanical line leak detector must be removed from the piping system being tested.
- Waiting Time:** There is no waiting period between delivery and testing.
Minimum waiting time between last dispensing and testing is 1 hour.
- Test Period:** The minimum data collection time must be 30 minutes.
Test data must be acquired and recorded manually.
Two tests with zero time between the tests are required before a leak can be declared.
- Calibration:** Equipment must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.

Western Environmental Resources
PO Box 37
Bakersfield, CA 93302
Tel: (805) 326-0173

Evaluator: Vista Research
Tel: (415) 966-1171

Date of Evaluation: 11/21/90

Western Environmental Resources

AES System II

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=97.7\%$ and $P_{FA}=2.3\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, waste oil, and solvents.
- Capacity:** Maximum tank capacity is 15,000 gallons.
The tank must be at least 100% full.
- Waiting Time:** Waiting period between delivery and the beginning of the test is included in the waiting period after "topping off".
Waiting time between "topping off" and beginning the test is computer-dictated by real-time analysis of level and temperature data.
Waiting time is generally 4 to 12 hours.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time is 2 hours (two one-hour tests).
Test data must be acquired and recorded by a computer.
Leak rate is calculated from the data of last 1.5 hours of test period.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 5 temperature sensors must be used to determine the average temperature of the stored hazardous substance.
- Groundwater:** Depth to the groundwater table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide minimum 2 psi net pressure on the bottom of the tank during the test.
- Calibration:** Level sensors must be calibrated before each test in accordance with manufacturer's instructions.
Temperature sensor must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.

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Evaluator: Vista Research
Tel: (415) 966-1171

Date of Evaluation: 12/20/90

Western Environmental Resources

AES System II - (Large Tanks)

VOLUMETRIC TANK TIGHTNESS TEST METHOD (OVERFILL)

- Certification:** Leak rate of 0.1 gph with $P_D=98.9\%$ and $P_{FA}=1.1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, fuel oil, waste oil, and solvents.
- Capacity:** Maximum tank capacity is 75,000 gallons.
The tank must be 100% full.
- Waiting Time:** Minimum waiting time after adding any substantial amount of product to the tank is 24 hours.
Waiting time between "topping off" and beginning the test is computer-dictated by real-time analysis of level and temperature data and must be at least 1 hour.
There must be no dispensing or product delivery during the test waiting time.
- Test Period:** The minimum data collection time is 4 hours.
Test data must be acquired and recorded by a computer.
Leak rate is calculated from the data of 3 hours of test period.
There must be no dispensing or product delivery during the test.
- Temperature:** A minimum of 12 thermistors must be used to determine the average temperature of the stored hazardous substance.
- Groundwater:** Depth to the groundwater table present in the backfill must be determined, and if it is above the bottom of the tank, product level must be adjusted to provide minimum 2 psi net pressure on the bottom of the tank during the test.
- Calibration:** Level sensors must be calibrated before each test in accordance with manufacturer's instructions.
Temperature sensors must be checked annually and calibrated if necessary in accordance with manufacturer's instructions.
- Comments:** This equipment was not evaluated using manifolded tanks.

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Evaluator: Ken Wilcox Associates
Tel: (816) 443-2494

Date of Evaluation: 02/28/92

Xerxes Corp.

Xerxes Trucheck Hydrostatic Monitoring System

DOUBLE WALLED TANK TIGHTNESS TEST

- Certification:** Leak rate of 0.1 gph with $P_D=99\%$ and $P_{FA}=1\%$.
- Leak Threshold:** 0.05 gph (a leak is declared if the output of the measurement system exceeds this threshold).
- Applicability:** Gasoline, diesel, aviation fuel, and fuel oil #4.
- Capacity:** The maximum tank capacity is 30,000 gallons.
Tank may be tested from 0 to 100% full.
- Waiting Time:** There is no waiting time between product delivery and test data collection.
- Test Period:** The minimum data collection time must be 10 hours.
- Groundwater:** Groundwater depth must be determined before and after the test.
When groundwater level is above the bottom of the tank but below the top, the test should be repeated if the groundwater level increases by more than 7 inches during test.
When groundwater is above the tank, the test should be repeated if groundwater level increases by more than 5 inches.

Xerxes Corp.
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Evaluator: Robert Plunkett, Ph.D.
Tel: (612) 338-0945

Date of Evaluation: 01/07/93

UNDER REVIEW (Listed alphabetically by Manufacturer's name)

<u>Test Method</u>	<u>Vendor</u>	<u>Equipment Model</u>	<u>Evaluator/Date of Evaluation</u>
Automatic Tank Gauge (0.1 and 0.2 gph)	Alert Technologies	2000X and 2000XB	Ken Wilcox Associates 02/28/94 and 06/22/94
Continuous ATG	Alert Technologies	3000 and 4000	Ken Wilcox Associates 02/20/92
Liquid Phase Product Detector	Armstrong Monitoring	Alertmaster 5100: AMC-5007	Environment Canada 12/03/92
Vapor Phase Product Detector	Armstrong Monitoring	Alertmaster 5100: AMC F4000	Environment Canada 12/03/92
Line Tightness Test Method	Campo/Miller, Inc.	PL400	Jetronix Radio Engineering Laboratories 05/16/91
Liquid Phase Product Detector	EBW	LS-30A, LS-3A, LS-7	Ken Wilcox Associates 04/20/93
Liquid Phase Product Detector	EBW	LS-5, LS-10, LS-15, LS-20, LS-35	Ken Wilcox Associates 07/05/94
Automatic Tank Gauge (0.1 and 0.2 gph)	ENRAF B.V. Delft Instruments	STIC 818	Ken Wilcox Associates 01/02/94
Volumetric Tank Tightness Test (Large Tanks)	HassTech	Leak Computer	Ken Wilcox Associates 07/11/92
Volumetric Tank Tightness Test (Overfill)	Heath Consultants	Quick Chek 2000	Midwest Research Institute 03/12/90
Vapor-Phase Product Detector	HNU	DL-101; HW-101; ISPI-101; PI-101	Carnegie Mellon Research Institute 11/28/91, 02/05/92, 03/05/92
Statistical Inventory Reconciliation	Horner Creative Products	SIR Pro 1 V 3.0 (quantitative)	Ken Wilcox Associates 05/31/95
Statistical Inventory Reconciliation	Horner Creative Products	SIR Pro 1 V 4.0 (quantitative)	Ken Wilcox Associates 05/25/95
Automatic Tank Gauge (0.1 gph)	INCON Environmental	TS 1000	Ken Wilcox Associates 08/05/92
Automatic Tank Gauge (0.1 gph)	INCON Environmental	TS 2000	Ken Wilcox Associates 05/10/91
Continuous Automatic Tank Gauge	INCON Environmental	SCALD (Applies to Incon Controller Models TS 1000, TS 2000, TS 1001, TS 2001 Sensor Model TS-DLP)	Ken Wilcox Associates 09/14/95
Liquid Phase Product Detector	Mallory Controls	Pollulert Probes MD210; MD210RA; MD221TJ; MD221TJRA	Radian Corp. 07/08/91
Continuous Automatic Tank Gauge	Marley Pump	ST1400-1800, ATG, FMS, LLM	ADA Technologies 10/12/92
Vapor-Phase Product Detector	Mine Safety Appliances	Tank-Check	Carnegie Mellon Research Institute 05/31/91

UNDER REVIEW (Listed alphabetically by Manufacturer's name)

<u>Test Method</u>	<u>Vendor</u>	<u>Equipment Model</u>	<u>Evaluator/Date of Evaluation</u>
Volumetric Tank Tightness Test (Overfill) Large Tank	NDE Environmental Corp.	Computerized VPLT	Vista Research 06/17/91
Statistical Inventory Reconciliation (Quantitative)	Practical Tank Management	Tank Management System 10	Ken Wilcox Associates 12/02/91
Statistical Inventory Reconciliation (0.2 gph)	Precision Tank Service, Inc.	Total SIR 1.0	Ken Wilcox Associates 07/18/95
Statistical Inventory Reconciliation (0.2 gph)	SIR International, Inc.	Mitchell's SIR Program (Version 2.7)	Ken Wilcox Associates 06/8/95
Statistical Inventory Reconciliation (0.1 gph)	SIR International, Inc.	Mitchell's SIR Program (Version 2.6)	Ken Wilcox Associates 06/8/95
Statistical Inventory Reconciliation (Qualitative)	Southeastern Liquid Analyzers	Tank Chek 4.0	Petro Works 06/03/93
Automatic Tank Gauge (0.1 gph)	Tidel Engineering, Inc.	EMS 2000, 3000, 3500 Probes 0009 and 0010, 0021, 0022	Ken Wilcox Associates 02/10/93
Liquid Phase Product Detector	Tidel Engineering, Inc.	EMS 3000: 301-0327-001; 301-0329-001	Radian Corp. 07/08/91
Statistical Inventory Reconciliation (0.2 gph)	Triangle Environmental, Inc.	TRI SIR (Version 1.01)	Ken Wilcox Associates 08/23/95
Continuous Automatic Tank Gauge	Veeder-Root	TLS 300/400 with CSLD	Midwest Research Institute 09/04/92
Statistical Inventory Reconciliation (0.1 gph)	Warren Rogers Assoc.	SIRA Version 5.2	Ken Wilcox Associates 02/17/95
Volumetric Tank Tightness Test	Western Environmental Resources	AES Version 2 Underfill Test	Vista Research, Inc. 07/08/91

GLOSSARY

Accuracy:

The degree to which the measured leak rate agrees with the induced leak rate on the average. If a method is accurate, it has a very small or zero bias.

Activated:

Refers to the state of a qualitative detector's response when indicating the presence of product.

Continuous Detector:

Detectors that operate continuously and are always present and are never turned off.

Detection time:

The sum of rise time and lag time.

Fall time:

The elapsed time after a detector has responded to a test hydrocarbon and is removed and has recovered to 95% of its original baseline level or there is no detectable signal output.

False Alarm:

Declaring a tank to be leaking when in fact it is tight.

Induced Leak Rate:

The actual leak rate, in gal/h, used during the evaluation against which the results from a given test device will be compared.

Intermittent Detector:

Detectors that monitor on a regular basis. An intermittent detector may be a hand held device that is portable or a permanently installed device that is used to periodically test for the presence of product.

Lag Time:

The elapsed time from the detector's first contact with test product to the first detectable signal.

Leak threshold:

This is the measured leak rate at which the test method declares the tank to be leaking. This leak rate will always be less than or equal to the leak rate requirement for the various release detection (RD) methods given in 40 CFR § 280 Subpart D-Release Detection. (Please note that some states and other regulatory authorities may have different requirements). The minimum threshold for declaring a leak is experimentally determined from the results of the evaluation of the RD method.

Manifolded Tanks:

Manifolded tanks are those tanks that are connected by piping that allow the tank system to function as a single tank. A typical manifolded tank system usually consists of two tanks connected by a siphon tube that permits the product in the tanks to be at the same level while product is being pumped out of only one tank.

Measured Leak Rate:

A positive number in gal/h, measured by the test device that indicates the amount of product leaking out of the tank. A negative number would indicate that something was being added to the tank. The performance of a method is based on how well the measured leak rate compares to the actual induced leak rate.

N/A:

Not Applicable

Nominal Leak Rate:

The set or target leak rate to be achieved as closely as possible during the evaluation of a leak detection method. It is a positive number expressed in gph (gal/h).

N/D:

Not Determined

N/R:

No Response

Precision:

The degree of agreement of repeated measurements of the same parameter. Precision estimates reflect random error and are not affected by bias.

Probability of Detection, P(D):

The probability of detecting a leak of a given size and is usually expressed as a percentage.

Probability of False Alarm, P(FA):

The probability of declaring a tank to be leaking when it is tight. It is usually expressed as a percentage.

Probe:

A component of a detection system that must come into contact with product before product can be detected or measured.

Qualitative Responses:

The type of detector response that indicates only the presence or absence of product without determining the specific product concentration or thickness.

Quantitative Response:

A type of detector response that quantifies the concentration or thickness of product present.

Resolution:

The resolution of a measurement system is the smallest change in the quantity being measured which the system is capable of detecting.

Response Time:

A general term that refers to the more specific terms of lag time, rise time, and fall time.

Rise Time:

The elapsed time from a detector's first detectable signal in response to the presence of product to an output that is 95% of full scale for a quantitative detector or activated for a qualitative detector.

Specificity:

Specificity applies to vapor and liquid sensors and lists products or components of products that these sensors can detect. Specificity for quantitative sensors is the ratio of sensor output, or measured concentration, to the actual concentration of hydrocarbon test gas expressed as a percentage. Specificity for qualitative sensors is reported as activated if the sensor responds within 24 hours. Otherwise, specificity is reported as inactivated.

Ullage Test:

An ullage test tests the un-wetted portion of the tank, or that portion of the tank that is not in contact with product. These tests can use a variety of physical phenomena including acoustical signals and pressure gain or loss in the ullage space of a sealed system.