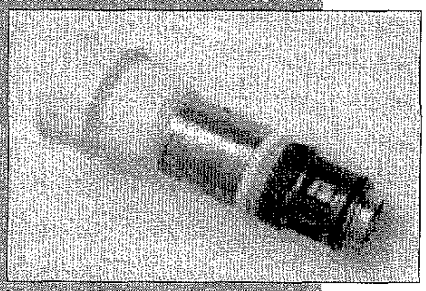
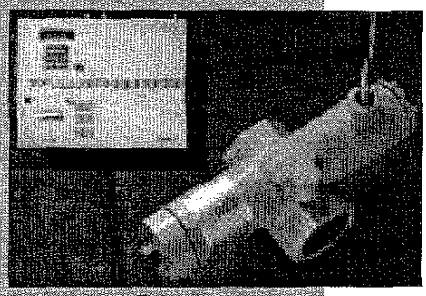
by Jeff K. Wilcox, M.E.S.

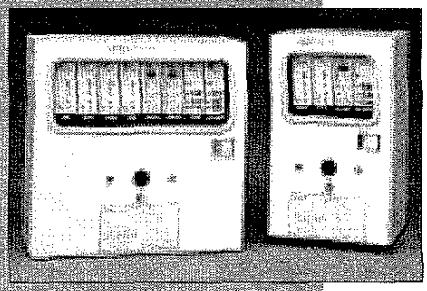
Third Party Testing Results of Pipeline Leak Detectors



Courtesy of FE Petro, Inc.



Courtesy of Linco Electronics

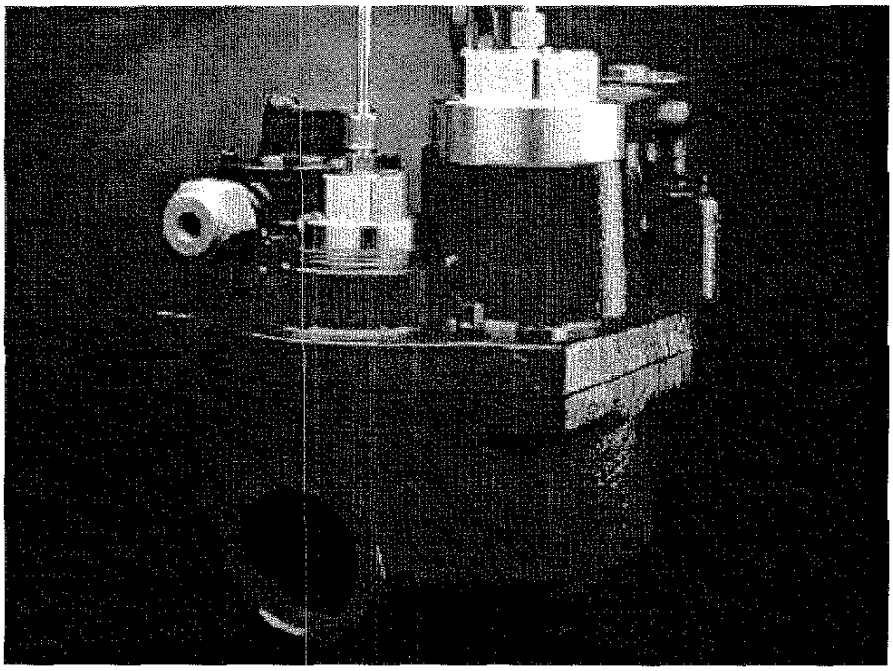


Courtesy of Tuthill Engineering Company

THIS ARTICLE PROVIDES AN OVERVIEW OF THE TESTING RESULTS FOR **89** PIPELINE LEAK DETECTORS listed in a recently published EPA report on third-party testing of line leak detection equipment. These detectors are:

- Automatic electronic pipeline leak detectors (52 systems)
- Automatic mechanical pipeline leak detectors (18 systems)
- Large diameter pipeline leak detectors (7 systems)
- Line tightness test (11 systems)
- Trace chemical test (1 system)

Column headings for each type of system vary, depending on the type of information provided in the listing. If all of the information in a column for a particular category is identical, the data is generally presented under "Common Characteristics." Following is an explanation of the information in each column.



Right Courtesy of Veeder-Root Company

Jeff K. Wilcox, M.E.S. *is an environmental engineer for Ken Wilcox Associates, Inc. (KWA). Most of the methods on the list of the National Work Group on Leak Detection Evaluations were evaluated by KWA. Since 1990, KWA has evaluated some 200 different leak detection methods.*

Table 1 Automatic Electronic Line

Manufacturer	Model	Certified Leak Rate (gph)	P_d %	P_{fa} %	Leak Threshold (gph)	Certified for (Note 10)
Campo/Miller, Inc.	LS300 and N/C	3.000	96.2	0	2.360	g,d,a,4,6,w,k,s
Reader Response #32	LS300-120 and 120 XLC	3.000	96.2	0	2.360	g,d,a,4,6,w,k,s
	LS300-120+ and A/S	3.000	96.2	0	2.360	g,d,a,4,6,w,k,s
	LS300-120+ AL; AL-A/S and AL-LSI	3.000	100.0	0	1.500	g,d,a,4,6,w,k,s
	LS300-120+ AL; AL-A/S and AL-LSI	0.200	100.0	0	0.100	g,d,a,4,6,w,k,s
	LS300-120+ AL; AL-A/S and AL-LSI	0.100	100.0	0	0.050	g,d,a,4,6,w,k,s
Control Engineers	LLP2	3.000	100.0	0	1.880	g,d,a
Reader Response #33	LLP2	0.100	100.0	0	0.050	g,d,a
EBW, Inc.	Electronic leak detection	3.000	100.0	0	1.500	g,d,a,4,6,w,k,s
Reader Response #34	Electronic leak detection	0.200	100.0	0	0.100	g,d,a,4,6,w,k,s
	Electronic leak detection	0.100	100.0	0	0.050	g,d,a,4,6,w,k,s
Emco Electronics	EECO (Q0011)	3.000	100.0	0	2.000	g,d,a,4
Reader Response #35	EECO (Q0011)	0.200	100.0	0	0.1293	g,d,a,4
	EECO (Q0011)	0.100	100.0	0	0.0793	g,d,a,4
	EECO (Flexible)	3.000	100.0	0	2.000	g,d,a,4
	EECO (Flexible)	0.100	100.0	0	0.0793	g,d,a,4
Gilbarco	LLD Series PA02630000501	3.000	100.0	0	1.500	g,d,a,s
Reader Response #36	LLD Series PA02630000501	0.200	100.0	0	0.100	g,d,a,s
	LLD Series PA02630000501	0.100	100.0	0	0.079	g,d,a,s
	LLD Series PA02630000501 (Flexible)	3.000	100.0	0	1.500	g,d,a,s
	LLD Series PA02630000501 (Flexible)	0.200	96.0	1.0	0.100	g,d,a,s
	LLD Series PA02630000501 (Flexible)	0.100	100.0	0	0.079	g,d,a,s
Hasstech, Inc.	LineTite Pipeline Leak Monitor	3.000	100.0	0	2.000	g,d,a
Reader Response #37	LineTite Pipeline Leak Monitor	0.100	100.0	0	0.062	g,d,a
	LineTite Pipeline Leak Monitor (Flexible)	3.000	100.0	0	2.000	g,d,a
	LineTite Pipeline Leak Monitor (Flexible)	0.100	100.0	0	0.062	g,d,a
	LineTite II, Model 2001J	3.000	100.0	0	2.500	g,d,a,4
	LineTite II, Model 2001J	0.100	100.0	0	0.050	g,d,a,4

A. Manufacturer. The name of the primary system manufacturer or, in cases of "private labeled" systems, the vendor. (For more information, circle the Reader Response number on *PE&T's* postage-paid Reader Response postcard or contact the manufacturer directly.)

B. Model. Most automatic electronic leak detector models are listed more than once because they were evaluated to perform multiple EPA prescribed tests (i.e., hourly, monthly, annual). Leak detectors with different model numbers may be combined in a listing if the model numbers indicate consoles and do not affect performance, or indicate optional manual or automatic operation.

C. Certified leak rate. Certified leak rates are the minimum standards established by the US EPA. These rates are: hourly test—3.0 gph; monthly test—0.2 gph; annual test—0.1. State requirements may be different.

D. Probability of Detection (P_d). Probability of detection is a measure of the reliability of a system to

Table 1 Cont.

Piping Materials	Test Pressure	Maximum Volume (gals.)	Waiting Time After Dispensing	Test Period After Setup	Actions if Leak is Declared	Notes	Page
FRP, steel	Operating	35.36	None	10 sec.	d,l,a	1	54
FRP, steel	Operating	35.36	None	10-150 sec.	d,l,a	1, 2	55
FRP, steel	Operating	35.36	None	10-150 sec.	d,l,a	2	56
FRP, steel	Operating	163.00	None	10 min.	d,l,a	3	57
FRP, steel	Operating	163.00	3 hrs.	25 min.	d,l,a	4	58
FRP, steel	Operating	163.00	6 hrs.	34 min.	d,l,a	4	59
FRP, steel	Operating	89.00	None	10 sec.	d,l,a	5	61
FRP, steel	Operating	89.00	15 min.	30 min.	d,l,a	5	62
FRP, steel	Operating	163.00	None	10 min.	d,l,a	3	Note 12
FRP, steel	Operating	163.00	3 hrs.	25 min.	d,l,a	4	Note 12
FRP, steel	Operating	163.00	6 hrs.	34 min.	d,l,a	4	Note 12
FRP, steel	Operating	67.40	None	2 min.	d,m,a		73
FRP, steel	Operating	67.40	0-87 min.	9 min.	d,m,a		74
FRP, steel	Operating	67.40	0-168 min.	31 min.	d,m,a		75
Flexible	Operating	49.60	None	11.4 min.	d,m,a		76
Flexible	10 psi	49.60	14 min.	9 hrs.	d,m,a		77
FRP, steel	Operating	128.00	Note 6	14 sec.	d,m,a,	7	98
FRP, steel	Operating	128.00	Note 6	6 min.	d,m,a	7	99
FRP, steel	Operating	128.00	Note 6	14 min.	d,m,a	7	100
Flexible	Operating	158.40	Note 6	1 min.	d,m,a	7	101
Flexible	Operating	158.40	Note 6	45-531 min.	d,m,a	7	102
Flexible	Operating	158.40	Note 6	1.2 - 12.9 hrs.	d,m,a	7	103
FRP, steel	Operating	341.00	None	1-26 min.	d,m,a	6, 7	114
FRP, steel	Operating	341.00	None	1.5 - 12.5 hrs.	d,m,a	6, 7	115
Flexible	Operating	49.60	None	1-6 min.	d,m,a	6, 7	116
Flexible	Operating	49.60	None	2.3-5.0 hrs.	d,m,a	6, 7	117
FRP, steel	Operating	172.00	None	1-6 min.	d,m,a	6, 7	Not in report
FRP, steel	Operating	172.00	None	2.16 hrs.	d,m,a	6, 7	Not in report

Continued on page 20

detect an existing leak. The detection system must be capable of doing so at least 95 percent or more of the time to be acceptable.

E. Probability of false alarm (P_{fa}). The probability of false alarm is the other side of the same coin; this is the probability that the system will erroneously detect a leak in a tight system. This value must be 5 percent or less for the equipment to qualify.

F. Leak threshold. The leak threshold is "the value used during the test to determine whether the piping passed or failed the test." This value is set by each system manufacturer to meet EPA criteria. It requires a balance between (1) a high sensitivity to finding a leak at the risk of causing a false alarm (a low threshold) and (2) less sensitivity with less chance of causing a false alarm (a high threshold). A more complete definition involves delving into the statistical operations required in the evaluation process. (We will be addressing the test protocols and procedures in more depth in a future article for our mathematically inclined readers.)

Table 1 Cont.

Automatic Electronic Line

Manufacturer	Model	Certified Leak Rate (gph)	Pd %	Pfa %	Leak Threshold (gph)	Certified for (Note 10)
INCON	TS-LLD Line Leak Detector	3.000	100.0	0	1.500	g,d,a,4
Reader Response #38	TS-LLD Line Leak Detector	0.200	100.0	0	0.100	g,d,a,4
	TS-LLD Line Leak Detector	0.100	100.0	0	0.050	g,d,a,4
	TS-LLD Line Leak Detector (Flexible)	3.000	100.0	0	1.500	g,d,a,4
	TS-LLD Line Leak Detector (Flexible)	0.200	100.0	0	0.100	g,d,a,4
	TS-LLD Line Leak Detector (Flexible)	0.100	100.0	0	0.050	g,d,a,4
Marley	PPM 4000, RLM 9000, RLM 10000, ST 1401L, ST 1801L	3.000	100.0	0	2.000	g,d,a,s,
Reader Response #39	PPM 4000, RLM 9000, RLM 10000, ST 1401L, ST 1801L	0.200	100.0	0	0.100	g,d,a,s
	PPM 4000, RLM 9000, RLM 10000, ST 1401L, ST 1801L	0.100	100.0	0	0.047	g,d,a,s
Ronan	X-76 DM-4 Microprocessor and JT-H2	3.000	100.0	0	0.831	g,d,a,4,6,w,s,
Reader Response #40	X-76 DM-4 Microprocessor and JT-H2	0.100	100.0	0	0.066	g,d,a,4,6,w,s,
Tidel	LIPSPC-301-0730-001 and LIP-301-0729-001	3.000	100.0	0	2.000	g,d,a
Reader Response #41	LIPSPC-301-0730-001 and LIP-301-0729-001	0.100	100.0	0	0.060	g,d,a
Veeder-Root, Inc.	TLS-350, Series 8475 (VLLD)	3.000	100.0	0	1.500	g,d,a,s
Reader Response #42	TLS-350, Series 8475 (VLLD)	0.200	100.0	0	0.100	g,d,a,s
	TLS-350, Series 8475 (VLLD)	0.100	100.0	0	0.079	g,d,a,s
	TLS-350, Series 8475 (Flexible) (VLLD)	3.000	100.0	0	1.500	g,d,a,s
	TLS-350, Series 8475 (Flexible) (VLLD)	0.200	96.0	4.0	0.100	g,d,a,s
	TLS-350, Series 8475 (Flexible) (VLLD)	0.100	100.0	0	0.079	g,d,a,s
	TLS Series 8484 (PLLD)	3.000	100.0	0	1.880	g,d,a,s
	TLS Series 8484 (PLLD)	0.100	100.0	0	0.050	g,d,a,s
	Series 8494 (WPLLD)	3.000	100.0	0	2.500	g,d,a,s
	Series 8494 (WPLLD)	0.200	100.0	0	0.170	g,d,a,s
	Series 8494 (WPLLD)	0.100	100.0	0	0.090	g,d,a,s

Common Characteristics:
All systems share the following common characteristics:
- They acquire and process data by microprocessor.
- They are all permanently installed in the piping network.
- Requirements for annual calibration checks may be satisfied by successful periodic self-checking.
- They have the leak threshold preset in the microprocessor.
- They do not require a waiting time between delivery and testing.
- They require only one test. (See Notes 3 and 4 for exceptions.)

Certified for:
a = Aviation Fuel
d = Diesel (Note 10)
g = Gasoline
k = Kerosene
s = Solvents
w = Waste Oil
4 = #4 Fuel Oil
6 = #6 Fuel Oil

Pd = Probability of detection
Pfa = Probability of false alarm
≤ = Equal to or less than

Actions if leak is declared:
a = Alarm
d = Dispenser shutdown
l = Light
p = Power to pump interrupted
m = Message

G. Certified for. This column refers to the liquid products for which the systems are certified. Acceptable products are determined by the manufacturer and the third-party evaluator. The EPA considers any system meeting the other EPA criteria to be suitable for use with any regulated product. Industry standards of practice, manufacturers' instructions and fire codes require that all equipment that is part of an UST or AST system be compatible with the product stored and handled.

H. Piping materials. Leak detection systems designed for use with steel and FRP piping may not work with flexible piping. Others have been modified specifically for flexible (hose-type) piping systems that "balloon," or stretch, when pressurized. Ballooning may

Leak Detectors

Table 1 Cont.

Piping Materials	Test Pressure	Maximum Volume (gals.)	Waiting Time After Dispensing	Test Period After Setup	Actions if Leak is Declared	Notes	Page
FRP, steel	Operating	163.00	None	3 min.	d,m,l,	11	138
FRP, steel	Operating	163.00	None	50-480 min.	d,m,l,	8, 11	139
FRP, steel	Operating	163.00	8 hrs.	40 min.	d,m,l,	11	140
Flexible	Operating	49.60	None	3 min.	d,m,l,	11	141
Flexible	Operating	49.60	None	2.35 hrs.	d,m,l,	8, 11	142
Flexible	Operating	49.60	8 hrs.	50 min.	d,m,l,	11	143
FRP, steel	5-10 psi	55.10	None	1 min.	d,m,a	9	157
FRP, steel	5-10 psi	55.10	None	10 min.	d,m,a	9	158
FRP, steel	5-10 psi	55.10	None	2.5 hrs.	d,m,a	9	159
FRP, steel	Operating	45.00	None	20 sec.	d,m,a	7	214
FRP, steel	Operating	45.00	2 hrs.	20 min.	d,m,a	7	215
FRP, steel	Operating	129.00	None	1 min.	d,m,a		229
FRP, steel	Operating	129.00	None	1.5 hrs.	d,m,a		230
FRP, steel	Operating	128.00	Note 6	14 sec.	d,m,a	7	273
FRP, steel	Operating	128.00	Note 6	6 min.	d,m,a	7	274
FRP, steel	Operating	128.00	Note 6	14 min.	d,m,a	7	275
Flexible	Operating	158.40	Note 6	1 min.	m,a	7	276
Flexible	Operating	158.40	Note 6	.75-8.85 hrs.	d,m,a	7	277
Flexible	Operating	158.40	Note 6	1.2-12.9 hrs.	d,m,a	7	278
FRP, steel	Operating	89.00	16 min.	28.8 sec.	d,m,a	7	279
FRP, steel	Operating	89.00	150 min.	18 min.	d,m,a	7	280
FRP, steel	≤ 50psi	100.00	None	2 sec.	m,a	7	281
FRP, steel	≤ 50psi	100.00	15 min.	45 min.	d,m,a	7	282
FRP, steel	≤ 50psi	100.00	None	2 hrs.	m,a	7	283

Notes

1. Calibrate weekly and monthly.
2. Test period is adjustable.
3. Three tests are performed automatically every 45 minutes.
4. Three tests are performed.
5. No longer manufactured.
6. Waiting time depends on volume of product and temperature gradient.
7. May not be used in piping equipped with mechanical leak detectors.
8. Automatic shut off if last passed test was more than 28 days.
9. System displays the date and time of last passed test.
10. Systems certified for diesel may also be suitable for #2 Fuel Oil.
11. Utilize existing STP pump wiring and FM communications to console.
12. Not from source report. System uses an evaluated system in its proprietary electronic gauge console.

Source: *List of Leak Detection Evaluations for the Underground Storage Tank Systems*, Third Edition, April 18, 1997.

otherwise be misread as a leak, resulting in a false alarm. While FRP piping and systems using flexible connectors are somewhat flexible, they are not considered "flexible" in the EPA listings.

Piping materials are not specified by EPA. As far as the Agency is concerned, any system meeting its standard criteria is acceptable for use with any type of piping. Again, industry standards of practice require all equipment that is part of an UST or AST system be compatible with the product stored and handled.

I. **Test pressure.** Most evaluation tests are performed at normal operating pressure. Since leak rates

Continued on page 36

Table 2

Automatic Mechanical

(All systems have a certified leak rate of 3.0 gph with

Manufacturer	Model	Leak Threshold (gph)	Certified for	Piping Materials	Test Pressure
FE Petro Inc.	STP-MLD	2.00	g,d,a,4,s*	FRP, steel	Operating
Reader Response #43	STP-MLD-D	2.00	d	FRP, steel	Operating
	STP-MLD-E (Flexible)	2.00	g,d,a,s*	Flexible	Operating
Marley	Red Jacket DLD and XLD	2.00	g,d,a,s	FRP, steel	8-12 psi
Reader Response #44	Red Jacket FX1/FX2	2.00	g,d,a,s*	FRP, steel	8-12 psi
	Red Jacket FX1/FX2 (Flexible)	2.00	g,d,a,s*	Flexible	None stated
	Red Jacket FX2/FX2-D and Bigflo	2.00	g,d	FRP, steel	8-12 psi
	Red Jacket XLP	2.00	g,d,a,s	FRP, steel	15-22 psi
	Red Jacket XLP (Flexible)	2.00	g,d,a,s	Flexible	Operating
Tokheim Corp.	PM 101 and 585A-PM	2.25	g,d,al	FRP, steel	1.5 x operating
Reader Response #45					
Vaporless	LD 2000	1.70	g,d,a,s	FRP, steel	Operating
Reader Response #46	LD 2000S	1.70	g,d,a,s	FRP, steel	Operating
	LD 2000E	2.00	g,d,a,s	Flexible	Operating
	LD 2000E-S	2.00	g,d,a,s	Flexible	Operating
	LD 2000T	2.50	g,d,a,s	FRP, steel	Operating
	LD 2000T-S	2.50	g,d,a,s	FRP, steel	Operating
	LD 3000	2.00	g,d,a,s	FRP, steel	Operating
	LD 3000S	2.00	g,d,a,s	FRP, steel	Operating

Common Characteristics of All Systems
- Certified leak rate of 3.0 gph with a Pd of 100% and a Pfa of 0.
- Are all permanently installed in the piping network.
- Checked annually and calibrated in necessary. (See Note 5.)
- Have a preset leak threshold. (See Note 4.)
- Make a single test to determine lightness. (See Note 4.)
- Do not require a waiting time between delivery and testing. (See Notes 3 and 4.)

Certified for:
al = Alcohol
a = Aviation Fuel
d = Diesel (Note 7)
g = Gasoline
s = Solvents
s* = Some Solvents
4 = #4 Fuel Oil

Pd = Probability of detection

Pfa = Probability of false alarm

≤ = Equal to or less than

Actions if leak is declared:
r = Restricts flow to dispenser

p = Power to pump interrupted

An Overview of Evaluations of Leak Detection Systems

The federal underground storage tank (UST) regulations (40 CFR 280) require that most UST systems in use today be provided with one or more means of detecting leaks in tanks and piping. The EPA regulation established performance standards for leak detection methods and required proof that they could be met. The Agency then published standard test procedures for evaluating all the leak detection methods that were available when the regulations were issued in 1988. The tables in this article summarize most piping evaluations that were performed since the EPA regulations went into effect. The information in the tables was compiled during the last four years by the National Work Group on Leak Detection Evaluations (NWGLDE).

EPA began evaluating leak detection methods back in 1986 with the "Edison Project." The Agency evaluated the performance of 19 volumetric tank tightness testing systems submitted for consideration. Subsequent evaluations became the responsibility of vendors, and were extended to cover other methods such as pipeline leak detectors, non-volumetric tank tightness testing, out-of-tank vapor and liquid monitoring and statistical inventory reconciliation.

Beginning in 1990, EPA Region 10 published a series of lists of leak detection methods that had been evaluated, and the listed performance appeared to meet the Agency's criteria. Also, in 1990, several states began to independently examine the data from these tests, and discovered that some of the tests were not performed in accordance with the EPA standard test procedures. In some cases, the system evaluated was tested by the vendors rather than by an independent third-party laboratory. While this so-called "first-party" testing is permitted by the EPA, the combination of the two factors—the use of first-party tests and the lack of compliance with EPA test protocols on some tests—caused the credibility of all leak detection method evaluations to become suspect.

In an attempt to reverse this loss of faith in the system, I suggested to EPA that a work group be formed to review third party (not first party) test data to ensure that the tests were indeed per-

Line Leak Detection

Table 2 Cont.

a Pd of 100% and a Pfa of 0.)

Maximum Volume (gallons)	Waiting Time After Dispensing	Test Period After Setup	Actions if Leak is Declared	Notes	Page
129.14	None	< 30 seconds	r		93
341.00	None	1 minutes	r		94
49.60	None	3 minutes	r	1	95
129.00	None	6 seconds	r		160
158.00	Note 3	< 5 minutes	r		161
49.00	None	< 3 minutes	r	1	162
362.00	Note 3	3 minutes	r		163
129.00	None	6 seconds	r		164
48.90	None	< 3 minutes	r		165
78.00	None	4 seconds	r	5, 6	248
129.00	None	5 seconds	r		269
129.00	None	5 seconds	p		269
59.60	None	30 seconds	r	2	270
59.60	None	30 seconds	p	2	270
129.00	None	1 minute	r		271
129.00	None	1 minute	p		271
320.00	None	9 seconds	r	4	272
320.00	None	9 seconds	p	4	272

Notes

1. Bulk modulus of 1280 psi.
2. Bulk modulus of 1352 psi.
3. Waiting time of up to 45 minutes after dispensing may be required when temperature extremes are present.
4. Presetting leak threshold, number of tests, and waiting time between delivery and testing are not mentioned in listing.
5. Checked semi-annually and calibrated if necessary.
6. No longer manufactured.
7. System certified for diesel may also be suitable for #2 Fuel Oil.

Source: *List of Leak Detection Evaluations for the Underground Storage Tank Systems*, Third Edition, April 18, 1997.

Required by EPA

by Curt Johnson

formed in accordance with EPA and other acceptable protocols. Because several states were already doing this on their own (including my state), it seemed logical for us to all work together. The NWGLDE was formed soon after, in 1993. It consists of volunteers from seven states and two EPA offices who perform a comprehensive review of third-party tests of UST and piping leak detection methods to ensure that: (1) these tests are run in accordance with EPA or other acceptable test protocols; and (2) the test data does, in fact, support the results of the evaluation.

The NWGLDE's impact was felt almost immediately as vendors and evaluators have since performed only third-party tests, and performed them with the knowledge that the work group would scrutinize their work. As a result, those who purchase and those who regulate UST leak detection equipment now have a higher level of confidence in the third-party test results that are presented in the current work group list.

It is important to understand that the NWGLDE list is prepared by an independent work group comprised of state and US EPA and UST program staff. The list includes only leak detection methods that have been properly third-party evaluated according to an EPA evaluation procedure or another acceptable procedure (such as an ASTM standard or one developed by an independent third party evaluator). The primary function of the work group is to determine whether a leak detection method has been evaluated according to an acceptable evaluation procedure. Although the NWGLDE list may be a useful tool for locating potential vendors, this list is not comprehensive, and being included on the list does not guarantee that the leak detection method works. Also, some test results were submitted to the work group after the document went to print and, thus, do not appear on the current edition of the list.

Curt Johnson works for the Alabama Department of Environmental Management (ADEM) and is Chair of the National Work Group of Leak Detection Evaluations (NWGLDE).