Evaluation of the Vaporless LD-2200-Scout Mechanical Line Leak Detector

(Addendum to the November 19, 1990 Performance Evaluation of the Vaporless LD 2000 Line Leak Detector)

Final Report

Prepared For:

Vaporless Manufacturing, Inc.

November 10, 1998

Ken Wilcox Associates, Inc.
1125 Valley Ridge Drive, Grain Valley, MO 64029, USA
Voice (816) 443-2494, Fax (816) 443-2495
E-mail info@kwaleak.com, Web http://www.kwaleak.com

Evaluation of the Vaporless LD-2200-Scout Mechanical Line Leak Detector

(Addendum to the November 19, 1990 Performance Evaluation of the Vaporless LD 2000 Line Leak Detector)

Final Report

Prepared For:

Vaporless Manufacturing, Inc.
8700 East Long Mesa Drive
Prescott Valley, AZ 83614

November 10, 1998

Preface

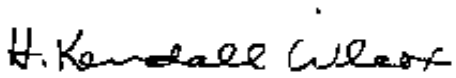
The data contained in this report was obtained from the Vaporless LD-2200-Scout Mechanical Line Leak Detector. This report is to be used in conjunction with the November 19, 1990 evaluation of the Vaporless system.[1] This report contains test data that was collected in October 1998 on rigid and flexible pipelines to verify that the LD-2200-Scout could detect a 3 gal/h leak in the same manner as the original version of the LD-2000. Testing was performed in accordance with the EPA Pipeline Leak Detection Test Protocol[2] with the exception of the number of tests performed. All testing was conducted at the Fuels Management Research Center (FMRC) operated by Ken Wilcox Associates, Inc.

This report was prepared by Mr. Jeffrey K. Wilcox, Ken Wilcox Associates, Inc. Questions regarding this addendum should be directed to Mr. Greg Young, Vaporless Manufacturing, Inc. (800) 367-0185.

KEN WILCOX ASSOCIATES, INC.

Jeffrey K. Wilcox, Engineer

Approved:



H. Kendall Wilcox, Ph.D.
President

November 10, 1998

[1] Performance Evaluation of the Vaporless LD 2000 Line Leak Detector, Final Report, For Vaporless Manufacturing, November 19, 1990, Ken Wilcox Associates, Inc.

[2] "Standard Test Procedures for Evaluating Leak Detection Methods: Pressurized Pipeline Leak Detection Systems", EPA/530/UST-90/010, September, 1990.

Table of Contents

1.0 Introduction

This report contains the results of testing conducted on the LD-2200-Scout. A limited number of tests were conducted which were designed to verify that the LD-2200-Scout could detect a 3 gal/h leak in the same manner as the original LD 2000 mechanical line leak detector. Testing was performed in accordance with the EPA Pipeline Leak Detection Test Protocol[1] with the exception of the number of tests performed [2]

This report is to be used in conjunction with the November 19, 1990 evaluation of the Vaporless LD 2000 mechanical line leak detector.[3] Several evaluations have been conducted on various LD 2000 models to determine performance parameters.[4] The original LD 2000 evaluation (November 19, 1990) was conducted on a rigid pipeline that was 176 ft. in length by 3 3/8 inches in diameter with a volume of 81.5 gallons. The results of the testing determined that the LD 2000 had an estimated probability of detection (P_D) of 100% with an upper confidence interval of 92 to 100% and an estimated probability of false alarm (P_{FA}) of 0% with a lower confidence limit of 0 to 8%.

---

[1] "Standard Test Procedures for Evaluating Leak Detection Methods: Pressurized Pipeline Leak Detection Systems", EPA/530/UST-90/010, September, 1990.

[2] The EPA protocol requires that 50 tests be conducted under various conditions for a full evaluation. This evaluation consisted of 6 tests on a rigid line and 6 tests on a flexible line.

[3] Performance Evaluation of the Vaporless LD 2000 Line Leak Detector, Final Report, For Vaporless Manufacturing, November 19, 1990, Ken Wilcox Associates, Inc.

[4] Three previous evaluations were conducted on versions of the LD-2000 for Hourly Testing. Evaluation reports written by KWA, Inc. for the following models of the LD-2000 are available from Vaporless Manufacturing: LD-2000 and LD-2000S, 11/19/90; LD-2000E and LD-2000E-S, 12/11/92; LD-2000T and LD-2000T-S, 7/13/93

2.0 Background

The federal Environmental Protection Agency (EPA) has provided a series of documents[5] which describe the procedures which are to be used to verify that leak detection equipment meets the performance requirements of the Federal Register.[6] At the minimum, a leak detector which is capable of detecting leaks of 3.0 gallons per hour (gal/hr) or larger on an hourly basis must be installed on all pressurized piping. Other options include the use of equipment which is capable of detecting 0.20 gal/hr on a monthly basis or an annual test capable of detecting leaks of 0.10 gal/hr. The probability of detecting a leak of stated size must be 95% or greater with a probability of a false alarm (declaring a tight line to be leaking) of no more than 5%.

To provide a mechanism for achieving compliance with the requirements for leak detection on pressurized piping, the EPA has developed a test protocol "Standard Test Procedures for Evaluating Leak Detection Methods: Pressurized Pipeline Leak Detection Systems", EPA/530/UST-90/010, September, 1990. Testing conducted for this addendum were evaluated according to the EPA protocol with the exception of the number of tests conducted.

The EPA protocol does not require that systems be tested on both rigid and flexible pipelines. However, some federal, state, and local regulators have required additional testing on flexible pipelines for systems that were originally evaluated on rigid pipelines. This addendum includes the results of testing conducted on flexible piping in response to those regulator's requirements.

---

[5] "Standard Test Procedures for Evaluating Leak Detection Methods," EPA/530 UST-90/001-7, March to October 1990. Seven different procedures were developed for different leak detection methods and released between March and October 1990.

[6] 4OCFR Part 280, Subpart D.

3.0 Overview of the Evaluation Procedures and the Testing Conditions

A total of 12 tests were conducted for this evaluation. Six tests were conducted on the LD-2200-Scout on each type of pipeline (rigid and flexible). The test conditions and results for these tests are provided in Tables 1 and 2. Of the six tests on each line, three leak tests and three tight tests were conducted.

Testing was conducted at rates equivalent to 3 gal/h at 10 psi for Hourly Testing. Testing was conducted at the temperature extremes of ±25 deg F and at neutral. The ±25 deg F temperature differences are the extremes required for EPA certification. If a leak detector is successful at these temperature differences, it would also be expected to pass at less extreme temperature differences.

Table 1. Data and Results for Testing Conducted on Rigid Pipeline

Test No.	Date Test Began	Time Circulation Started	Time Circulation Ended	Time Data Collection Began	Time Data Collection Ended	Duration of Circulation	Time Between End of Circulation and Start of Data Collection	Duration of Data Collection	T(TB) (Product Temp.)	T(G) (Ground Temp.)	T(TB)-T(G) (Temp. Differential)	Temp. Matrix Category	Induced Leak Rate	Measured Test Result
	mm/dd/yy	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**deg F**	**deg F**	**deg F**	**deg F**	**gal/h**	
1	10/16/1998	0900	1000	1035	1035	0100	0035	0000	63.68	64.64	-0.96	+5 to -5	0	Tight
2	10/16/1998	0900	1000	1035	1036	0100	0035	0001	63.68	64.64	-0.96	+5 to -5	3.0	Leak
3	10/16/1998	1120	1220	1220	1220	0100	0000	0000	38.12	64.20	-26.08	< -25	0	Tight
4	10/16/1998	1120	1220	1220	1221	0100	0000	0001	38.12	64.20	-26.08	< -25	3.0	Leak
5	10/16/1998	1610	1710	1710	1710	0100	0000	0000	88.34	63.17	25.17	> +25	0	Tight
6	10/16/1998	1610	1710	1710	1711	0100	0000	0001	88.34	63.17	25.17	> +25	3.0	Leak

Table 1. Data and Results for Testing Conducted on Flexible Pipeline

Test No.	Date Test Began	Time Circulation Started	Time Circulation Ended	Time Data Collection Began	Time Data Collection Ended	Duration of Circulation	Time Between End of Circulation and Start of Data Collection	Duration of Data Collection	T(TB) (Product Temp.)	T(G) (Ground Temp.)	T(TB)-T(G) (Temp. Differential)	Temp. Matrix Category	Induced Leak Rate	Measured Test Result
	mm/dd/yy	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**hhmm**	**deg F**	**deg F**	**deg F**	**deg F**	**gal/h**	
7	10/16/1998	1040	1045	1045	1045	0005	0000	0000	68.00	65.82	2.18	+5 to -5	0	Tight
8	10/16/1998	1040	1045	1045	1046	0005	0000	0001	68.00	65.82	2.18	+5 to -5	3.0	Leak
9	10/16/1998	1230	1330	1330	1330	0100	0000	0000	41.36	66.20	-24.84	< -25	0	Tight
10	10/16/1998	1230	1330	1330	1331	0100	0000	0001	41.36	66.20	-24.84	< -25	3.0	Leak
11	10/16/1998	1505	1605	1605	1607	0100	0000	0002	88.88	65.46	23.42	> +25	0	Tight
12	10/16/1998	1505	1605	1607	1608	0100	0002	0001	88.88	65.46	23.42	> +25	3.0	Leak

4.0 Description of the Testing Location

The Vaporless system was evaluated at the Fuels Management Research Center which is located in Grain Valley, Missouri and operated by Ken Wilcox Associates, Inc. All line tests were conducted using regular unleaded gasoline. Testing for this addendum was conducted on a 200 ft. fiberglass pipeline with a volume of 85 gallons and a 215 ft. flexible pipeline with a total volume of 19.7 gallons. The bulk modulus was 34,443 psi for the rigid line and 4,485 psi for the flexible pipeline.

The LD-2200-Scout was installed by the manufacturer in its usual configuration in a standard Red Jacket pump. The Red Jacket pump was installed in a 600 gallon tank where product was thermally conditioned according to the EPA protocol requirements. Product was heated or cooled in the 600 gallon tank by circulating glycol and product through an external heat exchanger. Soil temperatures were monitored by temperature sensors located at 2 inches, 4 inches and 12 inches from the line as specified by the protocol. A single temperature sensor was located 4 inches from the bottom of the product conditioning tank. The weighted soil temperature and the product tank temperature at the beginning of the test were used to compute the temperature differential between the soil and the product.

5.0 Description of the LD-2200-Scout

The LD-2200-Scout mechanical leak detector incorporates a poppet valve and metering pin. When the pump is activated, fuel is metered into the line to raise the pressure. If the pressure rises above 24 psi, the poppet valve opens and full flow into the line occurs. If the pressure fails to rise above 24 psi, fuel flow in the line is restricted to approximately 2 gal/min.

The LD-2200-Scout mechanical line leak detector is based on the original LD-2000 developed by Vaporless in 1990. Features of the LD-2200-Scout include:

- Drastically reduced piston size of the leak detector making for a much more responsive leak detector, significantly reducing the fuel needed to pass through the metering pin and poppet to allow full flow of the pump.

- Eliminates traditional fuel flow path to the piston allowing the leak detector metering system better isolation from the turbulence and hydraulic effects found in the pump head during pump startup. This fuel flow change also eliminates the mechanical and thermal effects present in the upper half of the pump, allowing the leak detector to only respond to line pressure changes.

- More responsive leak detectors allowing the line to open up for pumping more quickly. When the pump is off, it will reset to leak sense position faster because of the smaller amount of fuel under the piston. Additionally, the leak detector does not have to completely reset to cycle through the leak sense position. If the line pressure falls as low as 5 psi (when the pump is off), the leak detector is forced into the leak sense mode.

- Reduced surface area of the piston results in less exposure to hydraulic line shock, enhancing leak detection performance not only in steel and fiberglass lines but also in flexible piping systems.

- Higher leak sense pressure is possible due to the reduced piston area. The leak detector stays in the fast fill position to a higher pressure, compressing vapor pockets or removing stretch from flexible pipe faster.

- Field adjustment access in cap to adjust sensitivity for wear or field variables such as deep burial or excessive trapped vapor.

6.0 Test Results and Limitations

The performance parameters for the LD-2200-Scout are summarized in Table 3.

Probability of Detection (P_D)

The LD-2200-Scout was correct in its determination of a leak for all of the leak tests. The estimated P_D of a 3 gal/h leak is 100% with an upper confidence limit of 61 to 100%.

Probability of False Alarm (P_{FA})

The LD-2200-Scout was correct in its determination of a tight pipeline for all of the tight tests. The estimated P_{FA} is 0% with a lower confidence limit of 0 to 39%.

Time to Conduct a Test

All of the tests were completed in under one minute with one exception. One of the tests required 20 minutes to complete due to a temperature differential extreme that was present during the test (See Table 1).

Maximum Line Size

The EPA protocol allows pipeline leak detection methods to be used on pipelines with up to twice the volume of that used in the evaluation. If the EPA protocol is used to calculate the performance parameters, the LD-2200-Scout can be used on rigid pipelines up to 170 gallons and flexible pipelines up to 39.5 gallons.

Table 2. Summary of the Test Results and Limitations

Parameter	Value
Probability of Detection for a 3 gal/h leak	100%
Confidence Limits	69 to 100%
Probability of False Alarm	0%
Confidence Limits	0 to 39%
Time to Conduct a Test	< 1 minute to 20 minutes depending on line conditions
Maximum Applicable Rigid Line Size	170 gallons
Maximum Applicable Flexible Line Size	39.5 gallons