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Certification Reports

Results of U.S. E.P.A. Standard Evaluations

FX1V AND FX2V - Leak Detectors

VEEDER-ROOT

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Evaluation of the Veeder-Root Fx1V and Fx2V Leak Detectors Installed in the Big Flow or Packer/Manifold on Rigid and Flexible Pipelines

Final Report

PREPARED FOR

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November 21, 2005

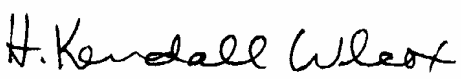
Preface

This report was prepared for Veeder-Root by Ken Wilcox Associates, Inc. This report presents the results of an independent performance evaluation of the Big Flow leak detector using a Red Jacket Fx2V mechanical leak detector as the pilot valve. Testing was conducted with gasoline on both rigid and flexible pipelines. The results in this report can be applied to the Veeder-Root Fx1V and Fx2V.

The purpose of the current testing was to demonstrate that the Big Flow system performs adequately when tested on larger piping including both rigid, flexible, and a combination of both types of pipelines. Testing for this evaluation was performed in accordance with the federal EPA "Standard Test Procedures for Evaluating Leak Detection Methods: "Pipeline Leak Detection Systems", EPA/530/UST-90/010, September, 1990."

The work was conducted at the Fuels Management Research Center which is operated by Ken Wilcox Associates, Inc. This report was prepared by Dr. Ken Wilcox and the laboratory testing conducted by Craig Wilcox. Questions regarding this evaluation should be directed to Mr. Alex Abri, Veeder-Root, at (800) 323-1799

KEN WILCOX ASSOCIATES, INC.



H. Kendall Wilcox, Ph.D.
President
November 21, 2005

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Appendix A – EPA Forms for the Evaluation of the Veeder-Root Fx1V and Fx2V Leak Detectors Installed in the Big Flow or Packer/Manifold on Rigid Pipelines

Appendix B – EPA Forms for the Evaluation of the Veeder-Root Fx1V and Fx2V Leak Detectors Installed in the Big Flow or Packer/Manifold on Flexible Pipelines

1.0 Introduction

The federal Environmental Protection Agency (EPA) has provided a series of documents that describe the procedures which are to be used to verify that leak detection equipment meets the performance requirements of the Federal Register.[1] At the minimum, a leak detector that 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. 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%.

This report presents the results of an evaluation of the performance of the Veeder-Root Big Flow Pipeline Leak Detection System using an FX2V mechanical leak detector as the pilot valve. Two types of pipe line configurations were used during this evaluation: testing on rigid pipe only; and testing on flexline only. Complete sets of 53 tests were conducted for each pipeline configuration, thus meeting all of the requirements for a full EPA evaluation according to the standard EPA procedures for pipeline leak detectors.[2]

1 CFR 280.4

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

2.0 Overview of Evaluation Procedures

The Big Flow adapter was installed in the pipline system at the KWA Test Facility. A 1.5 H.P. pump motor delivered fuel to the Big Flow unit and from there out to the two pipeline configurations that were used in the evaluation. The flow of temperature-conditioned fuel was passed through both segments of the line simultaneously. At the end of the circulation, the appropriate segment was valved off and a zero leak and a 3 gal/h test were conducted. The second segment was then valved off and the tests repeated.

The temperature of the product in the pipeline tank was varied relative to the surrounding soil temperature. Product was circulated through the line and leaks were induced at rates equivalent to 3 gal/hr at 10 psig as specified in the EPA protocol.[3] The induced leak rates were established during the circulation period either by adjusting the flow of fuel through a flow meter set to 3.0 gal/h at a pressure of 10 psig or as a nonleak condition. The submerged turbine (STP) was turned off at the dispenser end of the line and a test was automatically initiated. Testing continued until an alarm occurred or the controller indicated a pass condition had occurred.

The test results reported by the Veeder-Root system were compared to the leak conditions that were introduced into the line. A total of 53 tests were conducted on each of the pipeline configurations. This evaluation consisted of one leak test and one tight test conducted at each of the temperature differential extremes indicated in Table 1. In addition 3 tests were conducted with vapor in the lines as specified in the protocol.

Table 1. Summary of Temperature Conditions Used in the Evaluation

Minimum Number of Conditions Required	Number of Conditions Used	Range of dT (°F)*
1	2	dT < -25
4	8	-25 = dT < -15
5	10	-15 = dT < -5
5	10	-5 = dT < +5
5	10	+5 = dT < +15
4	8	+15 = dT < +25
1	2	dT > 25
Total = 25	Total = 25 tight + 25 leaks	-----

* ?T is the difference between the temperature of the product dispensed through the pipeline for over an hour prior to the conduct of a test and the average temperature of the backfill and soil surrounding the pipe.

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

Briefly summarized, the test procedures were as follows:

1. Product was conditioned in the pipeline tank to the required temperature. The soil temperature was monitored at distances of 2, 4, and 12 inches from the pipeline to determine proper temperature differentials.
2. Product was circulated through the both legs of the pipeline (rigid and flexible) at a combined rate of approximately 30 gal/min for one hour.
3. After valving off the segments of interest, a leak was induced in the line equivalent to 3.0 gal/hr at 10 psig.
4. The submerged pump dispenser switch was shut off and the pressure was reduced to zero.
5. The pump was authorized and the test was automatically conducted by the MLD.
6. This process was repeated for both rigid and flexible pipeline configurations at the end of each circulation.
7. This process was repeated for each of the temperature differentials shown in Table 1.

Since the test times were less than 15 minutes, the protocol allows for conducting 3 tests for each circulation. In this case the test times were less than one minute so that 3 tests could be conducted on each line for each circulation. The entire process of conducting the six tests was usually less than 10 minutes.

3.0 Description of the Testing Location

The Veeder-Root system was evaluated at the Fuels Management Research Center located in Grain Valley, Missouri, which is operated by Ken Wilcox Associates, Inc. Two different pipeline configurations were tested during the evaluation. A summary of the two configurations is provided in Table 2.

Table 2. Description of Pipelines Used in This Evaluation

Line Description	Length of Each Pipe Segment (ft)				
	3.125" dia FRP	4" dia FRP	3" dia Flex	Total Gal.	Bulk Modulus (psi)
Flex Line	30*	0	130	47.7*	8,360
Rigid Line	150	200	0	208.4	34,458

* The National Workgroup does not allow volume of rigid line to be included in flex line volume for purposes of calculating maximum line size.

The flex line tests were conducted on a 3-inch diameter by 130 ft. long flexible line containing unleaded gasoline. There was also a 30-foot long section of rigid line that is 3.125 inches in diameter coming from the STP to the beginning of the flexline. Although the total volume of the line was 59.7 gallons, the National Workgroup on Leak Detection Evaluations (NWGLDE) allows only the inclusion of the volume of the flexible line in the calculations for maximum line volume for the flex line. The line size has accordingly been limited to just the volume of the flex line, which is 47.7 gallons. The bulk modulus, which is a measure of the "stretch" which occurs when the line is pressurized, was 8,360 psi.

The rigid tests were conducted on a 4-inch diameter by 200 ft. long FRP segment also containing gasoline. An additional 3.125-inch diameter for 30 ft of FRP pipe connected to the STP at the beginning of the 4-inch diameter FRP pipe and an additional 150 ft of 3.125-inch diameter FRP pipe followed the 4-inch diameter pipe leading back to the storage tank. The total volume of the line was 208.4 gallons. The bulk modulus was 34,458 psi.

The conditioned product was contained in a 600 gallon steel tank, which was equipped with a standard 1.5 H.P. Red Jacket submersible pump. Product was heated or cooled in the tank by circulating glycol and product through an external heat exchanger. RTD's were located at 2 inches, 4 inches and 12 inches from the line as specified by the EPA protocol. A single temperature probe 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.

4.0 Test Results and Discussion

Testing for this evaluation was conducted using procedures specified in the EPA protocol. The results of the evaluation have been calculated using Section 7.4 of the EPA procedures for systems that do not report a leak rate. The results of the data analysis have been summarized in Table 3.

Calculation of P_{FA} and P_D

A total of 50 tests without vapor in the line were conducted for the Hourly Testing mode, which consisted of 25 leak tests and 25 tight tests. Three tests were conducted with vapor in the line, but the results of these tests were not included in the performance calculations. There were no missed detections or false alarms observed for any of the 50 tests. The P_D of a 3.0 gal/hr leak was calculated to be 100% with a confidence interval from 100 to 86.7% and the P_{FA} on tight line was calculated to be 0% with a confidence interval of zero to 13.3%. When a leak was present in the line, test times were all 1 minute or less. When a leak was not present in the line, test times were also all1 minute or less.

Maximum Line Size

The EPA allows for line leak detectors to be used on lines up to twice the size that they were evaluated on. During this testing, the Veeder-Root system was evaluated on a FRP line consisting of a total of 180 ft of 3.125 inch diameter FRP and 200 ft of 4 inch diameter FRP with a total volume of 208.4 gallons. It was also evaluated on a flexible line that was 130 feet in length by 3-inches in diameter plus 30-feet in length by 3.125-inches in diameter. While the total volume of the line as tested was 59.7 gallons, only the volume of the flex line by itself was included in the calculations for the maximum line size. If the EPA protocol limitations are applied to the Veeder-Root system, the results of this evaluation would apply to rigid lines with a total volume of up to 416.7 gallons and flexible pipelines having a maximum volume of 95.4 gallons.

Waiting Times

Waiting times after the delivery of product, after product is circulated through the line or after pumping has stopped are not necessary before valid tests can be conducted. All of the tests were conducted immediately after product circulation through the pipeline was stopped.

Table 3. Performance Parameters for the Veeder-Root Pipeline Leak Detector for the Rigid and Flexible Pipeline Tests Using the EPA Protocol

Parameter	Rigid Value	Flex Value
Probability of False Alarm (P_{FA}) Of a 3.0 gal/hr leak (Hourly	0%	0 %
Confidence Interval for Probability of False Alarm (Hourly P_{FA})	86.7% to 100%	86.7% to 100%
Probability of Detection (P_D) of a 3.0 gal/hr leak (Hourly)	100%	100%
Confidence Interval for Probability of False Alarm (Hourly P_{FA})	0% to 13.3%	0% to 13.3%
Maximum Line Size	416.7 gal	95.4 gal
Waiting Time After Delivery of Product Before Conducting a Test	None	None
Waiting Time After Product Circulation Through Line Before Conducting a Test	None	None
Hourly Test Times with 3.0 gal/hr Leak	Range: 0 to 1 minutes	
Hourly Test Times without Leak	Range: 0 to 1 minutes	

* Volume of flexible section of line only

5.0 Conclusions

The following conclusions are based on the data collected during this evaluation.

1. The Veeder-Root Fx1V and Fx2V Leak Detectors meet the US federal performance requirements for hourly monitoring when Installed in the Big Flow or Packer/Manifold on rigid and flexible Pipelines.
2. The maximum size lines that the system can be installed on are 416.7 gallons for rigid lines and 95.4 gallons for flexible lines.
3. No stabilization times are needed after dispensing of product through the line have been completed.

Appendix A.

EPA Forms for Evaluation of the Veeder-Root Fx1V and Fx2V Leak Detectors Installed in the Big Flow or Packer/Manifold on Rigid Pipelines

Results of the Performance Evaluation
Conducted According to EPA Test Procedures

Pipeline Leak Detection System
Used as an
Hourly Monitoring Test

This form summarizes the results of an evaluation to determine whether the pipeline leak detection system named below and described in Attachment 1 complies with federal regulations for conducting an hourly monitoring test. The evaluation was conducted according to the United States Environmental Protection Agency's (EPA's) evaluation procedure, specified in *Standard Test Procedures for Evaluating Leak Detection Methods: Pipeline Leak Detection Systems.* The full evaluation report includes seven attachments.

Tank system owners who use this pipeline leak detection system should keep this form on file to show compliance with the federal regulations. Tank system owners should check with state and local agencies to make sure this form satisfies the requirements of these agencies.

System Evaluated

Name Veeder-Root Fx2V installed in the Big Flow or Packer/Manifold

Version number(s) Rigid Lines (applies to Fx1V also)

Vendor Veeder-Root
(Name of Manufacturer)

125 Powder Forest Drive, P.O. Box 2003
(Address)

Simsbury,	CT	06070-7684	(800) 323-1799
(City)	(State)	(Zip Code)	(Phone)

Evaluation Results

1. The performance of this system
   (X) meets or exceeds
   ( ) does not meet
   the federal standards established by the EPA regulation for hourly monitoring tests.

   The EPA regulation for an hourly monitoring test requires that the system be capable of detecting a leak as small as 3 gal/h with a probability of detection (P_D) of 95% and a probability of false alarm (P_{FA}) of 5%.

2. The estimated P_{FA} in this evaluation is 0 % with a confidence interval from 0 % to 13.3 %

   The estimated P_D against a leak rate of 3 gal/h defined at a pipeline pressure of 10 psi in this evaluation is 100 %. With a confidence interval from 86.7 % to 100 %..

Criterion for Declaring a Leak

3. This system
   (X) uses a preset threshold
   ( ) measures and reports the output quantity and compares it to a predetermined threshold to determine whether the pipeline is leaking.

4. This system
   (X) uses a single test
   ( ) uses a multiple-test sequence consisting of _____ tests (specify number of tests required) separated by _____ hours (specify the time interval between tests) to determine whether the pipeline is leaking.

5. This system declares a leak if the output of the measurement system exceeds a threshold of 1.5 gal/h @ 10 psi (specify flow rate in gal/h) in 1 out of 1 tests (specify, for example, 1 out of 2, 2 out of 3). If more detail is required, please specify in the space provided.

Evaluation Approach

6. There are five options for collecting the data used in evaluating the performance of this system. This system was evaluated

   (X) at a special test facility (Option 1)
   ( ) at one or more instrumented operational storage tank facilities (Option 2)
   ( ) at five or more operational storage tank facilities verified to be tight (Option 3)
   ( ) at 10 or more operational storage tank facilities (Option 4)
   ( ) with an experimentally validated computer simulation (Option 5)

7. A total of 53 tests were conducted on nonleaking line(s) between 25 May 05 (date) and 7 June 05 (date). A description of the pipeline configuration used in the evaluation is summarized in Attachment 3.

Answer questions 8 and 9 if Option 1, 2, or 5 was used.

8. The two sections of pipeline used in the evaluation were 3.125 and 4 in. in diameter, 180 and 200 ft long and constructed of FRP (fiberglass, steel, or other).

9. A mechanical line leak detector
   (X) was
   ( ) was not
   present in the pipeline system.

Answer questions 10 and 11 if Option 3 or 4 was used. NOT APPLICABLE

10. The evaluation was conducted on _____ (how many) pipeline systems ranging in diameter from _____ in. to _____ in., ranging in length from _____ ft to _____ ft, and constructed of _____ (specify materials).

11. A mechanical line leak detector
    ( ) was
    ( ) was not
    present in the majority of the pipeline systems used in the evaluation.

12. Please specify how much time elapsed between the delivery of product and the start of the data collection:
    (X) 0 to 6 h
    ( ) 6 to 12 h
    ( ) 12 to 24 h
    ( ) 24 h or more

Temperature Conditions

This system was evaluated under the range of temperature conditions specified in Table 1. The difference between the temperature of the product circulated through the pipeline for 1 h or more and the average temperature of the backfill and soil between 2 and 12 in. from the pipeline is summarized in Table 1. If Option 1, 2 or 5 was used, a more detailed summary of the product temperature conditions generated for the evaluation is presented in Attachment 4. If Option 3 or 4 was used, no artificial temperature conditions were generated.

Table 1. Summary of Temperature Conditions Used in the Evaluation

Minimum Number of Conditions Required	Number of Conditions Used*	Range of dT(°F)**
1	2	dT < -25
4	8	-25 ≤ dT < -15
5	10	-15 ≤ dT < -5
5	10	-5 ≤ dT < +5
5	10	+5 ≤ dT < +15
4	8	+15 ≤ dT < +25
1	2	dT > 25

*This column should be filled out only if Option 1, 2, or 5 was used.

**? T is the difference between the temperature of the product dispensed through the pipeline for over an hour prior to the conduct of a test and the average temperature of the backfill and soil surrounding the pipe.

Data Used to Make Performance Estimates

13. The induced leak rate and the test results used to estimate the performance of this system are summarized in Attachment 5. Were any test runs removed from the data set?

    (X) no
    ( ) yes

    If yes, please specify the reason and include with Attachment 5. (If more than one test was removed, specify each reason separately.)

Sensitivity to Trapped Vapor

14. (X) According to the vendor, this system can be used even if trapped vapor is present in the pipeline during a test.
( ) According to the vendor, this system *should not be used* if trapped vapor is present in the pipeline.

15. The sensitivity of this system to trapped vapor is indicated by the test results summarized in Table 2. These tests were conducted at 28 psi with 110 ml of vapor trapped in the line at a pressure of 0 psi. The data and test conditions are reported in Attachment 6.

Table 2. Summary of the Results of Trapped Vapor Tests (see Attachment 6 for additional tests)

Test No.	dT (°F)	Induced Leak Rate (gal/h @ 10 psi)	Measured Leak Rate (gal/h)
51	-7.7	3	Leak detected
52	-7.7	0	Tight
53	-7.7	3	Leak detected

Performance Characteristics of the Instrumentation

16. State below the performance characteristics of the primary measurement system used to collect the data. (Please specify the units, for example, gallons, inches.)

Quantity Measured:	Temperature	Volume	Time (ms)
Resolution:	0.01 deg F	1%	10
Precision:	0.03 deg F	2%	10
Accuracy:	0.10 deg F	4%	10
Minimum Detectable Quantity:	0.04 deg F	1%	10
Response Time:	2 min	N/A	10

Threshold is exceeded when the flow rate due to a leak exceeds 1.5 gal/h. (@10 psi)

Application of the System

17. This leak detection system is intended to test pipeline systems that are associated with underground storage tank facilities, that contain petroleum or other chemical products, that are typically constructed of fiberglass or steel, and that typically measure 2 or 3 in. in diameter and 350 ft or less in length. The performance estimates are valid when:

- the system that was evaluated has not been substantially changed by subsequent modifications
- the manufacturer's instructions for using the system are followed
- the mechanical line leak detector
(X) is present in
( ) has been removed from
the pipeline (check both if appropriate)

the waiting time between the last delivery of product to the underground storage tank and the start of data collection for the test is 0 h

- the waiting time between the last dispensing of product through the pipeline system and the start of data collection for the test is 0 h
- the total data collection time for the test is variable min (depends on line characteristics)
- the volume of the product in the pipeline is less than twice the volume of the product in the pipeline system using in the evaluation, unless separate written justification for testing larger pipeline systems is presented by the manufacturer, concurred with by the evaluator, and attached to this evaluation as Attachment 8
- please give any other limitations specified by the vendor or determined during the evaluation.

Disclaimer: *This test procedure only addresses the issue of the system's ability to detect leaks in pipelines. It does not test the equipment for safety hazards or assess the operational functionality, reliability or maintainability of the equipment.*

Attachments

Attachment 1 - Description of the System Evaluated

Attachment 2 - Summary of the Performance of the System Evaluated

Attachment 3 - Summary of the Configuration of the Pipeline System(s) Used in the Evaluation

Attachment 4 - Data Sheet Summarizing Product Temperature Conditions Used in the Evaluation

Attachment 5 - Data Sheet Summarizing the Test Results and the Leak Rates Used in the Evaluation

Attachment 6 - Data Sheet Summarizing the Test Results and the Trapped Vapor Tests

Attachment 7 - Data Sheet Summarizing the Test Results Used to Check the Relationship Supplied by the Manufacturer for Combining the Signal and Noise

Certification of Results

I certify that the pipeline leak detection system was operated according to the vendor's instructions. I also certify that the evaluation was performed according to the procedure specified by the EPA and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox
(name of person performing evaluation)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

H. Kendall Wilcox
(signature)

1125 Valley Ridge Drive
(street address)

November 21, 2005
(date)

Grain Valley, MO 64039
(city, state, zip)

(816) 443-2494
(telephone number)

Attachment 1

Description

Pipeline Leak Detection System

This form provides supporting information on the operating principles of the leak detection system or on how the equipment works. This form is to be filled out by the evaluating organization with assistance from the manufacturer before the start of the evaluation.

Describe the important features of the system as indicated below. A detailed description is not required, nor is it necessary to reveal proprietary features of the system.

To minimize the time required to complete this form, the most frequently expected answers to the questions have been provided. For those answers that are dependent on site conditions, please give answers that apply in "typical" conditions. Please write in any additional information about the system that you believe is important.

Check all appropriate boxes for each question. Check more than one box per question if it applies. If 'Other' is checked, please complete the space provided to specify or briefly describe the matter. If necessary, use all the white space next to a question to complete a description.

System Name and Version: Veeder-Root Fx2V Installed in Big Flow or Packer/Manifold
Date: November 21, 2005

Applicability of the System

1. With what products can this system be used? (Check all applicable responses.)

   (X) gasoline
   (X) diesel
   (X) aviation fuel
   ( ) fuel oil #4
   ( ) fuel oil #6
   (X) solvent (Contact manufacturer for solvent applications)
   ( ) waste oil
   (X) other (specify) Contact manufacturer for other hydrocarbon applications.

2. What types of pipelines can be tested? (Check all applicable responses.)

   (X) fiberglass
   (X) steel
   (X) other (specify) any rigid piping

3. Can this leak detection system be used to test double-wall pipeline systems?

   (X) yes ( ) no

4. What is the nominal diameter of a pipeline that can be tested with this system?

   (X) 1 in. or less
   (X) between 1 and 3 in.
   (X) between 3 and 6 in. Contact manufacturer for application to lines greater than 3 in.
   (X) between 6 and 10 in.
   ( ) other

5. The system can be used on pipelines pressurized to 50 psi.
   The safe maximum operating pressure for this system is 50 psi.

6. Does the system conduct a test while a mechanical line leak detector is in place in the pipeline?

   (X) yes ( ) no

General Features of the System

7. What type of test is the system conducting? (Check all applicable responses.)

   ( ) 0.1 gal/h Line Tightness Test
   ( ) 0.2 gal/h Monthly Monitoring Test
   (X) 3 gal/h Hourly Test

8. Is the system permanently installed on the pipeline?
   (X) yes ( ) no

   Does the system test the line automatically?
   (X) yes ( ) no

   If a leak is declared, what does the system do? (Check all applicable responses.)

   ( ) displays or prints a message
   ( ) triggers an alarm
   ( ) alerts the operator
   ( ) shuts down the dispensing system
   (X) other (Restricts flow of fuel to vehicle)

9. What quantity or quantities are measured by the system? (Please list.)
   Volume
   Time

10. Does the system use a preset threshold that is automatically activated or that automatically turns on an alarm?

    ( ) yes (If yes, skip question 11.)
    (X) no (If no, answer question 11.)

11. Does the system measure and report the quantity?
    ( ) yes (X) no

If so, is the output quantity converted to flow rate in gallons per hour?
( ) yes ( ) no

12. What is the specified line pressure during a test?

(X) operating pressure of line
( ) 150% of operating pressure
( ) a specific test pressure of _____ psi

Test Protocol

13. What is the minimum waiting period required between a delivery of product to an underground storage tank and the start of the data collection for a pipeline leak detection test?

(X) no waiting period
( ) less than 15 min
( ) 15 min to 1 h
( ) 1 to 5 h
( ) 6 to 12 h
( ) 12 to 24 h
( ) greater than 24 h
( ) variable (Briefly explain.)

14. What is the minimum waiting period required between the last dispensing of product through the pipeline and the start of the data collection for a pipeline leak detection test?

(X) no waiting period
( ) less than 15 min
( ) 15 min to 1 h
( ) 1 to 4 h
( ) 4 to 8 h
( ) greater than 8 h
( ) variable (Briefly explain.) _____

15. What is the minimum amount of time necessary to set up equipment and complete a leak detection test? (Include setup time, waiting time and data collection time. If a multiple-test sequence is used, give the amount of time necessary to complete the first test as well as the total amount of time necessary to complete the entire sequence.)

N/A h (single test) (unit is permanently installed in the line)
_____ h (multiple test)

16. Does the system compensate for those pressure or volume changes of the product in the pipeline that are due to temperature changes?

( ) yes (X) no

17. Is there a special test to check the pipeline for trapped vapor?

( ) yes (X) no

18. Can a test be performed with trapped vapor in the pipeline?

(X) yes* ( ) no

19. If trapped vapor is found in the pipeline, is it removed before a test is performed?

( ) yes (X) no

20. Are deviations from this protocol acceptable?

( ) yes (X) no

If yes, briefly specify:

21. Are elements of the test procedure determined by on-site personnel?

( ) yes (X) no

If yes, which ones? (Check all applicable responses.)

( ) waiting period between filling the tank and the beginning of data collection for the test
( ) length of test
( ) determination of the presence of vapor pockets
( ) determination of "outlier" (or anomalous) data that may be discarded
( ) other (Describe briefly.)

Data Acquisition

22. How are the test data acquired and recorded?

(X) manually
( ) by strip chart
( ) by computer
( ) by microprocessor

23. Certain calculations are necessary to reduce and analyze the data. How are these calculations done?

( ) manual calculations by the operator on site
( ) interactive computer program used by the operator
( ) automatically done with a computer program
( ) automatically done with a microprocessor
(X) no calculations – this is a mechanical system

Detection Criterion

24. What threshold is used to determine whether the pipeline is leaking?

gal/hr (in the units used by the measurement system)
1.5 @ 10 psi (in gal/h) at operating pressure

25. Is a multiple-test sequence used to determine whether the pipeline is leaking?

( ) yes (If yes, answer the three questions below)
(X) no (If no, skip the three questions below)

How many tests are conducted?
How many tests are required before a leak can be declared?
What is the time between tests?
(Enter 0 if the tests are conducted one after the other.)

Calibration

26. How frequently are the sensor systems calibrated?

( ) never
( ) before each test
( ) weekly
( ) monthly
( ) semi-annually
(X) yearly or less frequently

Attachment 2

Summary of Performance Estimates
Pipeline Leak Detection System
Used as an
Hourly Monitoring Test

Complete this page if the pipeline leak detection system has been evaluated as an hourly test. Please complete the first table. Completion of the last three tables is optional. (The last three tables present the performance of the system for different combinations of thresholds, probabilities of false alarm, and probabilities of detection. They are useful for comparing the performance of this system to that of other systems.)

Performance of the Pipeline Leak Detection System as Evaluated

Description	Leak Rate (gal/h)	P_D	P_{FA}	Threshold (gal/h)
Evaluated System	3	100	0	1.5 @ 10 psi
EPA Standard	3	0.95	0.05	N/A

Probability of False Alarm as a Function of Threshold

Threshold (gal/h)	Probability of False Alarm
Not determined	0.10
	0.075
	0.05
	0.05

Probability of Detection as a Function of Threshold for a Leak Rate of 3.0 gal/h

Threshold (gal/h)	Probability of Detection
Not determined	0.95
	0.90
	0.80
	0.50

Smallest Leak Rate that Can be Detected with the Specified Probability of Detection and Probability of False Alarm

Leak Rate (gal/h)	Probability of Detection	Probability of False Alarm
Not determined	0.95	0.10
	0.95	0.075
	0.95	0.05
	0.90	0.05
	0.80	0.05
	0.50	0.05

Attachment 3

Summary of the Configuration of the Pipeline System(s) Used in the Evaluation

Pipeline Leak Detection System
Options 1, 2, and 5

Rigid Pipeline

Specialized Test Facility, Operational Storage Tank System, or Computer Simulation	
Inside diameter of pipeline (in.)[1]	4 in. / 3 1/8 in.
Length of pipeline (tank to dispenser) (ft) [1]	200 ft. / 180 ft.
Volume of product in line during testing (gal) [1]	130.6/ 71.8 = 208.4 gal
Type of material (fiberglass, steel, other[2])	FRP
Type of product in tank and pipeline (gasoline, diesel, other[3])	Gasoline
Was a mechanical line leak detector present? (yes or no)	Yes
Was trapped vapor present? (yes or no)	Yes (in 3 tests)
Bulk Modulus (B) (psi)	34,458
B/V_o (psi/ml)	0.0450
Storage tank capacity (gal)	600 gal

[3]Piping consisted of 150 feet of FRP pipe with 3 1/8 in. inside diameter connected to the pump and 200 feet of FRP pipe with 4 in. inside diameter; dimensions and volumes are for each section.
[2]Specify type of construction material. Note: two sections as indicated.
[3]Specify type of product for each tank.

Attachment 4

Veeder-Root Fx2Vi n Big Flow or Packer/Manifold

Data Sheet Summarizing the Product Temperature Conditions Used in the Evaluation

Hourly Testing on Rigid Pipelines - 3.0 gal/hr leak tests

Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Nominal Product Temperature Before Circulation Was Started	Time Circulation Started	Time Circulation Ended	Duration of Circulation	Time of Temperature Measurements	T(TB)	T(1)	T(2)	T(3)	T(G)	T(TB)-T(G)	Temperature Test Matrix Category
	(D-M-Y)	(deg F)	(local military)	(local military)	(h-min)	(local military)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(Table 5.1)
1	25-May-05	65.3	930	1030	1	930	65.3	64.7	64.6	64.7	64.7	0.6	-5 to +5
2	25-May-05	65.3	930	1030	1	930	65.3	64.7	64.6	64.7	64.7	0.6	-5 to +5
3	25-May-05	65.3	930	1030	1	930	65.3	64.7	64.6	64.7	64.7	0.6	-5 to +5
4	25-May-05	66.9	1055	1155	1	1055	66.9	64.7	64.7	64.7	64.7	2.2	-5 to +5
5	25-May-05	66.9	1055	1155	1	1055	66.9	64.7	64.7	64.7	64.7	2.2	-5 to +5
6	25-May-05	66.9	1055	1155	1	1055	66.9	64.7	64.7	64.7	64.7	2.2	-5 to +5
7	25-May-05	68.4	1330	1430	1	1330	68.4	64.8	64.7	64.8	64.8	3.6	-5 to +5
8	25-May-05	68.4	1330	1430	1	1330	68.4	64.8	64.7	64.8	64.8	3.6	-5 to +5
9	25-May-05	68.4	1330	1430	1	1330	68.4	64.8	64.7	64.8	64.8	3.6	-5 to +5
10	25-May-05	69.1	1500	1600	1	1500	69.1	65	64.8	64.7	64.8	4.3	-5 to +5
11	26-May-05	76.1	955	1055	1	955	76.1	65.1	65.1	65	65	11.1	+5 to +15
12	26-May-05	76.1	955	1055	1	955	76.1	65.1	65.1	65	65	11.1	+5 to +15
13	26-May-05	76.1	955	1055	1	955	76.1	65.1	65.1	65	65	11.1	+5 to +15
14	26-May-05	78.2	1132	1232	1	1132	78.2	65.5	65.2	65	65.1	13.1	+5 to +15
15	26-May-05	78.2	1132	1232	1	1132	78.2	65.5	65.2	65	65.1	13.1	+5 to +15
16	26-May-05	78.2	1132	1232	1	1132	78.2	65.5	65.2	65	65.1	13.1	+5 to +15
17	26-May-05	80	1405	1505	1	1405	80	65.8	65.3	65.2	65.3	14.7	+5 to +15
18	26-May-05	80	1405	1505	1	1405	80	65.8	65.3	65.2	65.3	14.7	+5 to +15
19	26-May-05	80	1405	1505	1	1405	80	65.8	65.3	65.2	65.3	14.7	+5 to +15
20	26-May-05	77.4	1547	1647	1	1547	77.4	66.4	65.7	65.3	65.5	11.9	+5 to +15
21	27-May-05	83.3	1011	1111	1	1011	83.3	66	65.6	65.5	65.6	17.7	+15 to +25
22	27-May-05	83.3	1011	1111	1	1011	83.3	66	65.6	65.5	65.6	17.7	+15 to +25
23	27-May-05	83.3	1011	1111	1	1011	83.3	66	65.6	65.5	65.6	17.7	+15 to +25
24	27-May-05	87.2	1122	1222	1	1122	87.2	67.3	66.1	65.8	66	21.2	+15 to +25
25	27-May-05	87.2	1122	1222	1	1122	87.2	67.3	66.1	65.8	66	21.2	+15 to +25
26	27-May-05	87.2	1122	1222	1	1122	87.2	67.3	66.1	65.8	66	21.2	+15 to +25
27	31-May-05	92.9	1300	1400	1	1300	92.9	66.9	66.8	66.9	66.9	26	>+25
28	31-May-05	92.9	1300	1400	1	1300	92.9	66.9	66.8	66.9	66.9	26	>+25

Data Sheet Summarizing the Product Temperature Conditions Used in the Evaluation

Hourly Testing on Rigid Pipelines - 3.0 gal/hr leak tests

Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Nominal Product Temperature Before Circulation Was Started	Time Circulation Started	Time Circulation Ended	Duration of Circulation	Time of Temperature Measurements	T(TB)	T(1)	T(2)	T(3)	T(G)	T(TB)-T(G)	Temperature Test Matrix Category
	(D-M-Y)	(deg F)	(local military)	(local military)	(h-min)	(local military)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(Table 5.1)
29	31-May-05	88.9	1440	1540	1	1440	88.9	69.9	67.8	67.1	67.6	21.3	+15 to +25
30	31-May-05	88.9	1440	1540	1	1440	88.9	69.9	67.8	67.1	67.6	21.3	+15 to +25
31	1-Jun-05	60.5	1610	1710	1	1610	60.5	71.4	68.9	67.4	68.1	-7.6	-5 to -15
32	1-Jun-05	60.5	1610	1710	1	1610	60.5	71.4	68.9	67.4	68.1	-7.6	-5 to -15
33	1-Jun-05	60.5	1610	1710	1	1610	60.5	71.4	68.9	67.4	68.1	-7.6	-5 to -15
34	2-Jun-05	51.6	1050	1150	1	1050	51.6	67.3	67.3	67.3	67.3	-15.7	-15 to -25
35	2-Jun-05	51.6	1050	1150	1	1050	51.6	67.3	67.3	67.3	67.3	-15.7	-15 to -25
36	2-Jun-05	51.6	1050	1150	1	1050	51.6	67.3	67.3	67.3	67.3	-15.7	-15 to -25
37	2-Jun-05	48.4	1310	1410	1	1310	48.4	63.6	66.8	67.3	66.8	-18.4	-15 to -25
38	2-Jun-05	48.4	1310	1410	1	1310	48.4	63.6	66.8	67.3	66.8	-18.4	-15 to -25
39	2-Jun-05	48.4	1310	1410	1	1310	48.4	63.6	66.8	67.3	66.8	-18.4	-15 to -25
40	2-Jun-05	39.9	1445	1545	1	1445	39.9	61.6	66.4	67.2	66.4	-26.5	<-25
41	2-Jun-05	39.9	1445	1545	1	1445	39.9	61.6	66.4	67.2	66.4	-26.5	<-25
42	2-Jun-05	46.8	1610	1710	1	1610	46.8	60.7	65.9	67.1	66.1	-19.3	-15 to -25
43	2-Jun-05	46.8	1610	1710	1	1610	46.8	60.7	65.9	67.1	66.1	-19.3	-15 to -25
44	6-Jun-05	57.8	1033	1133	1	1033	57.8	67.1	67.3	67.3	67.3	-9.5	-5 to -15
45	6-Jun-05	57.8	1033	1133	1	1033	57.8	67.1	67.3	67.3	67.3	-9.5	-5 to -15
46	6-Jun-05	57.8	1033	1133	1	1033	57.8	67.1	67.3	67.3	67.3	-9.5	-5 to -15
47	6-Jun-05	60.1	1150	1250	1	1150	60.1	66.8	67.2	67.2	67.2	-7.1	-5 to -15
48	6-Jun-05	60.1	1150	1250	1	1150	60.1	66.8	67.2	67.2	67.2	-7.1	-5 to -15
49	6-Jun-05	60.1	1150	1250	1	1150	60.1	66.8	67.2	67.2	67.2	-7.1	-5 to -15
50	7-Jun-05	59.6	1055	1155	1	1055	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15

Attachment 5

Hourly Testing on Rigid Pipelines - 3.0 gal/hr leak tests

Data Sheet Summarizing the Test Results and the Leak Rates Used in the Evaluation

Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Induced Leak Rate	Time between End of Circulation and Start of Data Collection for Test	Time Data Collection Began	Time Data Collection Ended	Measured Test Result	Was Threshold Exceeded?
	(D-M-Y)	(gal/h)	(h-min)	(local military)	(local military)	(leak or tight)	(yes or no)
1	25-May-05	3.0	6	10:36	10:37	3.0	yes
2	25-May-05	0.0	7	10:37	10:37	0.0	no
3	25-May-05	3.0	8	10:38	10:39	3.0	yes
4	25-May-05	0.0	5	12:00	12:00	0.0	no
5	25-May-05	3.0	6	12:01	12:02	3.0	yes
6	25-May-05	0.0	7	12:02	12:02	0.0	no
7	25-May-05	3.0	8	14:38	14:38	3.0	yes
8	25-May-05	0.0	9	14:39	14:39	0.0	no
9	25-May-05	3.0	10	14:40	14:41	3.0	yes
10	25-May-05	0.0	5	16:05	16:05	0.0	no
11	26-May-05	3.0	6	11:01	11:01	3.0	yes
12	26-May-05	0.0	7	11:02	11:02	0.0	no
13	26-May-05	3.0	8	11:03	11:04	3.0	yes
14	26-May-05	0.0	6	12:38	12:38	0.0	no
15	26-May-05	3.0	7	12:39	12:40	3.0	yes
16	26-May-05	0.0	8	12:40	12:40	0.0	no
17	26-May-05	0.0	6	15:11	15:11	0.0	no
18	26-May-05	3.0	7	15:12	15:13	3.0	yes
19	26-May-05	0.0	8	15:13	15:13	0.0	no
20	26-May-05	3.0	7	16:54	16:55	3.0	yes
21	27-May-05	3.0	7	11:18	11:19	3.0	yes
22	27-May-05	0.0	8	11:19	11:19	0.0	no
23	27-May-05	3.0	8	11:19	11:20	3.0	yes
24	27-May-05	0.0	5	12:27	12:27	0.0	no
25	27-May-05	3.0	6	12:28	12:29	3.0	yes
26	27-May-05	0.0	7	12:29	12:29	0.0	no
27	31-May-05	0.0	5	14:05	14:05	0.0	no
28	31-May-05	3.0	6	14:06	14:07	3.0	yes
29	31-May-05	0.0	5	15:45	15:45	0.0	no
30	31-May-05	3.0	5	15:45	15:46	3.0	yes
31	1-Jun-05	3.0	5	17:15	17:16	3.0	yes
32	1-Jun-05	0.0	6	17:16	17:16	0.0	no
33	1-Jun-05	3.0	7	17:17	17:18	3.0	yes
34	2-Jun-05	3.0	7	11:57	11:58	3.0	yes
35	2-Jun-05	0.0	8	11:58	11:58	0.0	no

Attachment 5

Hourly Testing on Rigid Pipelines - 3.0 gal/hr leak tests

Data Sheet Summarizing the Test Results and the Leak Rates Used in the Evaluation

Pipeline Leak Detection System

Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Induced Leak Rate	Time between End of Circulation and Start of Data Collection for Test	Time Data Collection Began	Time Data Collection Ended	Measured Test Result	Was Threshold Exceeded?
	(D-M-Y)	(gal/h)	(h-min)	(local military)	(local military)	(leak or tight)	(yes or no)
36	2-Jun-05	3.0	9	11:59	12:00	3.0	yes
37	2-Jun-05	0.0	5	14:15	14:15	0.0	no
38	2-Jun-05	3.0	6	14:16	14:17	3.0	yes
39	2-Jun-05	0.0	7	14:17	14:17	0.0	no
40	2-Jun-05	0.0	15	16:00	16:00	0.0	no
41	2-Jun-05	3.0	17	16:02	16:03	3.0	yes
42	2-Jun-05	0.0	3	17:13	17:13	0.0	no
43	2-Jun-05	3.0	3	17:13	17:14	3.0	yes
44	6-Jun-05	0.0	5	10:38	10:38	0.0	no
45	6-Jun-05	3.0	6	10:39	10:40	3.0	yes
46	6-Jun-05	0.0	7	10:40	10:40	0.0	no
47	6-Jun-05	3.0	6	11:56	11:57	3.0	yes
48	6-Jun-05	0.0	7	11:57	11:57	0.0	no
49	6-Jun-05	3.0	8	11:58	11:59	3.0	yes
50	7-Jun-05	0.0	7	10:59	10:59	0.0	no

Attachment 6

Data Sheet Summarizing the Test Results and the Trapped Vapor Tests

Pipeline Leak Detection System
Options 1 and 5
Hourly Testing on Rigid Pipelines - 3.0 gal/hr leak tests
Summary of Temperature Conditions

Test No. (Based on Temperature Condition)	Date Test Began	Nominal Product Temperature Before Circulation Was Started	Time Circulation Started	Time Circulation Ended	Duration of Circulation	Time of Temperature Measurements	T(TB)	T(1)	T(2)	T(3)	T(G)	T(TB)-T(G)	Temperature Test Matrix Category
	(D-M-Y)	(deg F)	(local military)	(local military)	(h-min)	(local military)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(Table 5.1)
51	07-Jun-05	59.60	0955	1055	1	0955	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15
52	07-Jun-05	59.60	0955	1055	1	0955	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15
53	07=Jun-05	59.60	0955	1055	1	0955	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15

Summary of Leak Rates

Test No.	Date Test Began	Pipeline Pressure	Induced Leak Rate	Time between End of Circulation and Start of Data Collection for Test	Time Data Collection Began	Time Data Collection Ended	Measured Test Result	Was Threshold Exceeded?
	(D-M-Y)	(psi)	(gal/h)	(h-min)	(local military)	(local military)	(leak or tight)	(yes or no)
51	07-Jun-05	30	3.0	0:05	1100	1101	Leak	yes
52	07-Jun-05	30	0.0	0:06	1101	1102	Tight	no
53	07-Jun-05	30	3.0	0:07	1103	1104	Leak	Yes

Attachment 7

Data Sheet Summarizing the Test Results Used to Check the Relationship Supplied by the Manufacturer for Combining the Signal and Noise

Pipeline Leak Detection System
Options 1 and 5

NOT APPLICABLE TO THIS EVALUATION

First Check		
Test No.	Actual Leak Rate* (gal/h)	Measured Leak Rate (gal/h)
1		
2		
3		
4		
5		
6		

* Recommended leak rates for monthly monitoring tests and line tightness tests: 0.0, 0.05, 0.10, 0.20, 0.30 and 0.40 gal/h. Recommended leak rates for hourly tests: 0.0, 2.0, 2.5, 3.0, 3.5, and 4.0 gal/h.

Second Check		
Test No.	Actual Leak Rate* (gal/h)	Measured Leak Rate (gal/h)
A		
B		
C		
A + B*		

* A + B is the summation of the results of Tests A and B using the manufacturer's relationship for combining the signal and the noise.

Appendix B

EPA Forms for Evaluation of the Veeder-Root Fx1V and Fx2V Leak Detectors Installed in the Big Flow or Packer/Manifold on Flexible Pipelines

Results of the Performance Evaluation
Conducted According to EPA Test Procedures

Pipeline Leak Detection System
Used as an
Hourly Monitoring Test

This form summarizes the results of an evaluation to determine whether the pipeline leak detection system named below and described in Attachment 1 complies with federal regulations for conducting an hourly monitoring test. The evaluation was conducted according to the United States Environmental Protection Agency's (EPA's) evaluation procedure, specified in *Standard Test Procedures for Evaluating Leak Detection Methods: Pipeline Leak Detection Systems.* The full evaluation report includes seven attachments.

Tank system owners who use this pipeline leak detection system should keep this form on file to show compliance with the federal regulations. Tank system owners should check with state and local agencies to make sure this form satisfies the requirements of these agencies.

System Evaluated

Name Veeder-Root Fx2V installed in the Big Flow or Packer/Manifold

Version number(s) Flexible Lines (applies to Fx1V also)

Vendor Veeder-Root
(Name of Manufacturer)

125 Powder Forest Drive, P.O. Box 2003
(Address)

Simsbury,	CT	06070-7684	(800) 323-1799
(City)	(State)	(Zip Code)	(Phone)

Evaluation Results

1. The performance of this system
   (X) meets or exceeds
   ( ) does not meet
   the federal standards established by the EPA regulation for hourly monitoring tests.

   The EPA regulation for an hourly monitoring test requires that the system be capable of detecting a leak as small as 3 gal/h with a probability of detection (P_D) of 95% and a probability of false alarm (P_{FA}) of 5%.

2. The estimated P_{FA} in this evaluation is 0 % and the estimated P_D against a leak rate of 3 gal/h defined at a pipeline pressure of 10 psi in this evaluation is 100 %.

Criterion for Declaring a Leak

3. This system
   (X) uses a preset threshold
   ( ) measures and reports the output quantity and compares it to a predetermined threshold to determine whether the pipeline is leaking.

4. This system
   (X) uses a single test
   ( ) uses a multiple-test sequence consisting of _____ tests (specify number of tests required) separated by _____ hours (specify the time interval between tests) to determine whether the pipeline is leaking.

5. This system declares a leak if the output of the measurement system exceeds a threshold of 1.5 gal/h @ 10 psi (specify flow rate in gal/h) in 1 out of 1 tests (specify, for example, 1 out of 2, 2 out of 3). If more detail is required, please specify in the space provided.

Evaluation Approach

6. There are five options for collecting the data used in evaluating the performance of this system. This system was evaluated

   (X) at a special test facility (Option 1)
   ( ) at one or more instrumented operational storage tank facilities (Option 2)
   ( ) at five or more operational storage tank facilities verified to be tight (Option 3)
   ( ) at 10 or more operational storage tank facilities (Option 4)
   ( ) with an experimentally validated computer simulation (Option 5)

7. A total of 53 tests were conducted on nonleaking line(s) between 25 May 05 (date) and 7 June 05 (date). A description of the pipeline configuration used in the evaluation is summarized in Attachment 3.

Answer questions 8 and 9 if Option 1, 2, or 5 was used.

8. The pipeline used in the evaluation was 3 in. in diameter, 130 ft long and constructed of flexible materials (fiberglass, steel, or other)plus a section 3.125 in. in diameter, 30 ft long and constructed of FRP.

9. A mechanical line leak detector
   (X) was
   ( ) was not
   present in the pipeline system.

Answer questions 10 and 11 if Option 3 or 4 was used. NOT APPLICABLE

10. The evaluation was conducted on _____ (how many) pipeline systems ranging in diameter from _____ in. to _____ in., ranging in length from _____ ft to _____ ft, and constructed of _____ (specify materials).

11. A mechanical line leak detector
    ( ) was
    ( ) was not
    present in the majority of the pipeline systems used in the evaluation.

12. Please specify how much time elapsed between the delivery of product and the start of the data collection:
    (X) 0 to 6 h
    ( ) 6 to 12 h
    ( ) 12 to 24 h
    ( ) 24 h or more

Temperature Conditions

This system was evaluated under the range of temperature conditions specified in Table 1. The difference between the temperature of the product circulated through the pipeline for 1 h or more and the average temperature of the backfill and soil between 2 and 12 in. from the pipeline is summarized in Table 1. If Option 1, 2 or 5 was used, a more detailed summary of the product temperature conditions generated for the evaluation is presented in Attachment 4. If Option 3 or 4 was used, no artificial temperature conditions were generated.

Table 1. Summary of Temperature Conditions Used in the Evaluation

Minimum Number of Conditions Required	Number of Conditions Used*	Range of dT(°F)**
1	2	dT < -25
4	8	-25 ≤ dT < -15
5	10	-15 ≤ dT < -5
5	10	-5 ≤ dT < +5
5	10	+5 ≤ dT < +15
4	8	+15 ≤ dT < +25
1	2	dT > 25

*This column should be filled out only if Option 1, 2, or 5 was used.

**? T is the difference between the temperature of the product dispensed through the pipeline for over an hour prior to the conduct of a test and the average temperature of the backfill and soil surrounding the pipe.

Data Used to Make Performance Estimates

13. The induced leak rate and the test results used to estimate the performance of this system are summarized in Attachment 5. Were any test runs removed from the data set?

    (X) no
    ( ) yes

    If yes, please specify the reason and include with Attachment 5. (If more than one test was removed, specify each reason separately.)

Sensitivity to Trapped Vapor

14. (X) According to the vendor, this system can be used even if trapped vapor is present in the pipeline during a test.
( ) According to the vendor, this system *should not be used* if trapped vapor is present in the pipeline.

15. The sensitivity of this system to trapped vapor is indicated by the test results summarized in Table 2. These tests were conducted at 28 psi with 110 ml of vapor trapped in the line at a pressure of 0 psi. The data and test conditions are reported in Attachment 6.

Table 2. Summary of the Results of Trapped Vapor Tests (see Attachment 6 for additional tests)

Test No.	dT (°F)	Induced Leak Rate (gal/h @ 10 psi)	Measured Leak Rate (gal/h)
51	-7.7	3	Leak detected
52	-7.7	0	Tight
53	-7.7	3	Leak detected

Performance Characteristics of the Instrumentation

16. State below the performance characteristics of the primary measurement system used to collect the data. (Please specify the units, for example, gallons, inches.)

Quantity Measured:	Temperature	Volume	Time (ms)
Resolution:	0.01 deg F	1%	10
Precision:	0.03 deg F	2%	10
Accuracy:	0.10 deg F	4%	10
Minimum Detectable Quantity:	0.04 deg F	1%	10
Response Time:	2 min	N/A	10

Threshold is exceeded when the flow rate due to a leak exceeds 1.5 gal/h. (@10 psi)

Application of the System

17. This leak detection system is intended to test pipeline systems that are associated with underground storage tank facilities, that contain petroleum or other chemical products, that are typically constructed of fiberglass or steel, and that typically measure 2 or 3 in. in diameter and 350 ft or less in length. The performance estimates are valid when:

- the system that was evaluated has not been substantially changed by subsequent modifications
- the manufacturer's instructions for using the system are followed
- the mechanical line leak detector
( ) is present in
(X) has been removed from
the pipeline (check both if appropriate)

- the waiting time between the last delivery of product to the underground storage tank and the start of data collection for the test is 0 h

- the waiting time between the last dispensing of product through the pipeline system and the start of data collection for the test is 0 h

- the total data collection time for the test is variable min (depends on line characteristics)

- the volume of the product in the pipeline is less than twice the volume of the product in the pipeline system using in the evaluation, unless separate written justification for testing larger pipeline systems is presented by the manufacturer, concurred with by the evaluator, and attached to this evaluation as Attachment 8

- please give any other limitations specified by the vendor or determined during the evaluation.

Disclaimer: *This test procedure only addresses the issue of the system's ability to detect leaks in pipelines. It does not test the equipment for safety hazards or assess the operational functionality, reliability or maintainability of the equipment.*

Attachments

Attachment 1 - Description of the System Evaluated

Attachment 2 - Summary of the Performance of the System Evaluated

Attachment 3 - Summary of the Configuration of the Pipeline System(s) Used in the Evaluation

Attachment 4 - Data Sheet Summarizing Product Temperature Conditions Used in the Evaluation

Attachment 5 - Data Sheet Summarizing the Test Results and the Leak Rates Used in the Evaluation

Attachment 6 - Data Sheet Summarizing the Test Results and the Trapped Vapor Tests

Attachment 7 - Data Sheet Summarizing the Test Results Used to Check the Relationship Supplied by the Manufacturer for Combining the Signal and Noise

Certification of Results

I certify that the pipeline leak detection system was operated according to the vendor's instructions. I also certify that the evaluation was performed according to the procedure specified by the EPA and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox
(name of person performing evaluation)

H. Kendall Wilcox
(signature)

November 21, 2005
(date)

(816) 443-2494
(telephone number)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

1125 Valley Ridge Drive
(street address)

Grain Valley, MO 64039
(city, state, zip)

Attachment 1

Description

Pipeline Leak Detection System

This form provides supporting information on the operating principles of the leak detection system or on how the equipment works. This form is to be filled out by the evaluating organization with assistance from the manufacturer before the start of the evaluation.

Describe the important features of the system as indicated below. A detailed description is not required, nor is it necessary to reveal proprietary features of the system.

To minimize the time required to complete this form, the most frequently expected answers to the questions have been provided. For those answers that are dependent on site conditions, please give answers that apply in "typical" conditions. Please write in any additional information about the system that you believe is important.

Check all appropriate boxes for each question. Check more than one box per question if it applies. If 'Other' is checked, please complete the space provided to specify or briefly describe the matter. If necessary, use all the white space next to a question to complete a description.

System Name and Version: Veeder-Root Fx2V installed in the Big Flow or Packer/Manifold

Date November 21, 2005

Applicability of the System

1. With what products can this system be used? (Check all applicable responses.)

   (X) gasoline
   (X) diesel
   (X) aviation fuel
   ( ) fuel oil #4
   ( ) fuel oil #6
   (X) solvent (Contact manufacturer for solvent applications)
   ( ) waste oil
   (X) other (specify) Contact manufacturer for other hydrocarbon applications.

2. What types of pipelines can be tested? (Check all applicable responses.)

   (X) fiberglass
   (X) steel
   (X) other (specify) any flexible piping

3. Can this leak detection system be used to test double-wall pipeline systems?

   (X) yes ( ) no

4. What is the nominal diameter of a pipeline that can be tested with this system?

(X) 1 in. or less
(X) between 1 and 3 in.
(X) between 3 and 6 in. Contact manufacturer for application to lines greater than 3 in.
(X) between 6 and 10 in.
( ) other

5. The system can be used on pipelines pressurized to 50 psi.
The safe maximum operating pressure for this system is 50 psi.

6. Does the system conduct a test while a mechanical line leak detector is in place in the pipeline?

(X) yes ( ) no

General Features of the System

7. What type of test is the system conducting? (Check all applicable responses.)

( ) 0.1 gal/h Line Tightness Test
( ) 0.2 gal/h Monthly Monitoring Test
(X) 3 gal/h Hourly Test

8. Is the system permanently installed on the pipeline?

(X) yes ( ) no

Does the system test the line automatically?

(X) yes ( ) no

If a leak is declared, what does the system do? (Check all applicable responses.)

( ) displays or prints a message
( ) triggers an alarm
( ) alerts the operator
( ) shuts down the dispensing system
(X) other (Restricts flow of fuel to vehicle)

9. What quantity or quantities are measured by the system? (Please list.)
Volume
Time

10. Does the system use a preset threshold that is automatically activated or that automatically turns on an alarm?

( ) yes (If yes, skip question 11.)
(X) no (If no, answer question 11.)

11. Does the system measure and report the quantity?
( ) yes (X) no

If so, is the output quantity converted to flow rate in gallons per hour?
( ) yes ( ) no

12. What is the specified line pressure during a test?

(X) operating pressure of line
( ) 150% of operating pressure
( ) a specific test pressure of _____ psi

Test Protocol

13. What is the minimum waiting period required between a delivery of product to an underground storage tank and the start of the data collection for a pipeline leak detection test?

(X) no waiting period
( ) less than 15 min
( ) 15 min to 1 h
( ) 1 to 5 h
( ) 6 to 12 h
( ) 12 to 24 h
( ) greater than 24 h
( ) variable (Briefly explain.)

14. What is the minimum waiting period required between the last dispensing of product through the pipeline and the start of the data collection for a pipeline leak detection test?

(X) no waiting period
( ) less than 15 min
( ) 15 min to 1 h
( ) 1 to 4 h
( ) 4 to 8 h
( ) greater than 8 h
( ) variable (Briefly explain.) _____

15. What is the minimum amount of time necessary to set up equipment and complete a leak detection test? (Include setup time, waiting time and data collection time. If a multiple-test sequence is used, give the amount of time necessary to complete the first test as well as the total amount of time necessary to complete the entire sequence.)

__N/A__ h (single test) (unit is permanently installed in the line)
_____ h (multiple test)

16. Does the system compensate for those pressure or volume changes of the product in the pipeline that are due to temperature changes?

( ) yes (X) no

17. Is there a special test to check the pipeline for trapped vapor?

( ) yes (X) no

18. Can a test be performed with trapped vapor in the pipeline?

(X) yes ( ) no

19. If trapped vapor is found in the pipeline, is it removed before a test is performed?

( ) yes (X) no

20. Are deviations from this protocol acceptable?

( ) yes (X) no

If yes, briefly specify:

21. Are elements of the test procedure determined by on-site personnel?

( ) yes (X) no

If yes, which ones? (Check all applicable responses.)

( ) waiting period between filling the tank and the beginning of data collection for the test
( ) length of test
( ) determination of the presence of vapor pockets
( ) determination of "outlier" (or anomalous) data that may be discarded
( ) other (Describe briefly.)

Data Acquisition

22. How are the test data acquired and recorded?

(X) manually
( ) by strip chart
( ) by computer
( ) by microprocessor

23. Certain calculations are necessary to reduce and analyze the data. How are these calculations done?

( ) manual calculations by the operator on site
( ) interactive computer program used by the operator
( ) automatically done with a computer program
( ) automatically done with a microprocessor
(X) no calculations – this is a mechanical system

Detection Criterion

24. What threshold is used to determine whether the pipeline is leaking?

gal/hr (in the units used by the measurement system)
1.5 @ 10 psi (in gal/h) at operating pressure

25. Is a multiple-test sequence used to determine whether the pipeline is leaking?

( ) yes (If yes, answer the three questions below)
(X) no (If no, skip the three questions below)

How many tests are conducted?
How many tests are required before a leak can be declared?
What is the time between tests?
(Enter 0 if the tests are conducted one after the other.)

Calibration

26. How frequently are the sensor systems calibrated?

( ) never
( ) before each test
( ) weekly
( ) monthly
( ) semi-annually
(X) yearly or less frequently

Attachment 2

Summary of Performance Estimates
Pipeline Leak Detection System
Used as an
Hourly Monitoring Test

Complete this page if the pipeline leak detection system has been evaluated as an hourly test. Please complete the first table. Completion of the last three tables is optional. (The last three tables present the performance of the system for different combinations of thresholds, probabilities of false alarm, and probabilities of detection. They are useful for comparing the performance of this system to that of other systems.)

Performance of the Pipeline Leak Detection System as Evaluated

Description	Leak Rate (gal/h)	P_D	P_{FA}	Threshold (gal/h)
Evaluated System	3	100	0	1.5 @ 10 psi
EPA Standard	3	0.95	0.05	N/A

Probability of False Alarm as a Function of Threshold

Threshold (gal/h)	Probability of False Alarm
Not determined	0.10
	0.075
	0.05
	0.05

Probability of Detection as a Function of Threshold for a Leak Rate of 3.0 gal/h

Threshold (gal/h)	Probability of Detection
Not determined	0.95
	0.90
	0.80
	0.50

Smallest Leak Rate that Can be Detected with the Specified Probability of Detection and Probability of False Alarm

Leak Rate (gal/h)	Probability of Detection	Probability of False Alarm
Not determined	0.95	0.10
	0.95	0.075
	0.95	0.05
	0.90	0.05
	0.80	0.05
	0.50	0.05

Attachment 3

Summary of the Configuration of the Pipeline System(s) Used in the Evaluation

Pipeline Leak Detection System
Options 1, 2, and 5

Flexible Pipeline

Specialized Test Facility, Operational Storage Tank System, or Computer Simulation	
Inside diameter of pipeline (in.)[1]	3 in / 3 1/8 in
Length of pipeline (tank to dispenser) (ft) [1]	130 ft. / 30 ft.
Volume of product in line during testing (gal) [1]	47.74 gal*
Type of material (fiberglass, steel, other)	Flex/FRP
Type of product in tank and pipeline (gasoline, diesel, other)	Gasoline
Was a mechanical line leak detector present? (yes or no)	Yes
Was trapped vapor present? (yes or no)	Yes (in 3 tests)
Bulk Modulus (B) (psi)	8360
B/V_o (psi/ml)	0.037
Storage tank capacity (gal)	600 gal

[1] Piping consisted of 30 feet of FRP pipe with 3 1/8 in. inside diameter connected to the pump and 130 feet of flexible pipe with 3 in. inside diameter. The total line volume was 59.4 gallons.

Attachment 4

Data Sheet Summarizing the Product Temperature Conditions Used in the Evaluation

Hourly Testing on Flex Pipelines - 3.0 gal/hr leak tests

Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Nominal Product Temperature Before Circulation Was Started	Time Circulation Started	Time Circulation Ended	Duration of Circulation	Time of Temperature Measurements	T(TB)	T(1)	T(2)	T(3)	T(G)	T(TB)-T(G)	Temperature Test Matrix Category
	(D-M-Y)	(deg F)	(local military)	(local military)	(h-min)	(local military)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(Table 5.1)
1	25-May-05	65.3	930	1030	1	930	65.3	64.7	64.6	64.7	64.7	0.6	-5 to +5
2	25-May-05	65.3	930	1030	1	930	65.3	64.7	64.6	64.7	64.7	0.6	-5 to +5
3	25-May-05	65.3	930	1030	1	930	65.3	64.7	64.6	64.7	64.7	0.6	-5 to +5
4	25-May-05	66.9	1055	1155	1	1055	66.9	64.7	64.7	64.7	64.7	2.2	-5 to +5
5	25-May-05	66.9	1055	1155	1	1055	66.9	64.7	64.7	64.7	64.7	2.2	-5 to +5
6	25-May-05	66.9	1055	1155	1	1055	66.9	64.7	64.7	64.7	64.7	2.2	-5 to +5
7	25-May-05	68.4	1330	1430	1	1330	68.4	64.8	64.7	64.8	64.8	3.6	-5 to +5
8	25-May-05	68.4	1330	1430	1	1330	68.4	64.8	64.7	64.8	64.8	3.6	-5 to +5
9	25-May-05	68.4	1330	1430	1	1330	68.4	64.8	64.7	64.8	64.8	3.6	-5 to +5
10	25-May-05	69.1	1500	1600	1	1500	69.1	65	64.8	64.7	64.8	4.3	-5 to +5
11	26-May-05	76.1	955	1055	1	955	76.1	65.1	65.1	65	65	11.1	+5 to +15
12	26-May-05	76.1	955	1055	1	955	76.1	65.1	65.1	65	65	11.1	+5 to +15
13	26-May-05	76.1	955	1055	1	955	76.1	65.1	65.1	65	65	11.1	+5 to +15
14	26-May-05	78.2	1132	1232	1	1132	78.2	65.5	65.2	65	65.1	13.1	+5 to +15
15	26-May-05	78.2	1132	1232	1	1132	78.2	65.5	65.2	65	65.1	13.1	+5 to +15
16	26-May-05	78.2	1132	1232	1	1132	78.2	65.5	65.2	65	65.1	13.1	+5 to +15
17	26-May-05	80	1405	1505	1	1405	80	65.8	65.3	65.2	65.3	14.7	+5 to +15
18	26-May-05	80	1405	1505	1	1405	80	65.8	65.3	65.2	65.3	14.7	+5 to +15
19	26-May-05	80	1405	1505	1	1405	80	65.8	65.3	65.2	65.3	14.7	+5 to +15
20	26-May-05	77.4	1547	1647	1	1547	77.4	66.4	65.7	65.3	65.5	11.9	+5 to +15
21	27-May-05	83.3	1011	1111	1	1011	83.3	66	65.6	65.5	65.6	17.7	+15 to +25
22	27-May-05	83.3	1011	1111	1	1011	83.3	66	65.6	65.5	65.6	17.7	+15 to +25
23	27-May-05	83.3	1011	1111	1	1011	83.3	66	65.6	65.5	65.6	17.7	+15 to +25
24	27-May-05	87.2	1122	1222	1	1122	87.2	67.3	66.1	65.8	66	21.2	+15 to +25
25	27-May-05	87.2	1122	1222	1	1122	87.2	67.3	66.1	65.8	66	21.2	+15 to +25
26	27-May-05	87.2	1122	1222	1	1122	87.2	67.3	66.1	65.8	66	21.2	+15 to +25
27	31-May-05	92.9	1300	1400	1	1300	92.9	66.9	66.8	66.9	66.9	26	>+25
28	31-May-05	92.9	1300	1400	1	1300	92.9	66.9	66.8	66.9	66.9	26	>+25

Attachment 4

Data Sheet Summarizing the Product Temperature Conditions Used in the Evaluation

Hourly Testing on Flex Pipelines - 3.0 gal/hr leak tests

Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Nominal Product Temperature Before Circulation Was Started	Time Circulation Started	Time Circulation Ended	Duration of Circulation	Time of Temperature Measurements	T(TB)	T(1)	T(2)	T(3)	T(G)	T(TB)-T(G)	Temperature Test Matrix Category
	(D-M-Y)	(deg F)	(local military)	(local military)	(h-min)	(local military)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(Table 5.1)
29	31-May-05	88.9	1440	1540	1	1440	88.9	69.9	67.8	67.1	67.6	21.3	+15 to +25
30	31-May-05	88.9	1440	1540	1	1440	88.9	69.9	67.8	67.1	67.6	21.3	+15 to +25
31	1-Jun-05	60.5	1610	1710	1	1610	60.5	71.4	68.9	67.4	68.1	-7.6	-5 to -15
32	1-Jun-05	60.5	1610	1710	1	1610	60.5	71.4	68.9	67.4	68.1	-7.6	-5 to -15
33	1-Jun-05	60.5	1610	1710	1	1610	60.5	71.4	68.9	67.4	68.1	-7.6	-5 to -15
34	2-Jun-05	51.6	1050	1150	1	1050	51.6	67.3	67.3	67.3	67.3	-15.7	-15 to -25
35	2-Jun-05	51.6	1050	1150	1	1050	51.6	67.3	67.3	67.3	67.3	-15.7	-15 to -25
36	2-Jun-05	51.6	1050	1150	1	1050	51.6	67.3	67.3	67.3	67.3	-15.7	-15 to -25
37	2-Jun-05	48.4	1310	1410	1	1310	48.4	63.6	66.8	67.3	66.8	-18.4	-15 to -25
38	2-Jun-05	48.4	1310	1410	1	1310	48.4	63.6	66.8	67.3	66.8	-18.4	-15 to -25
39	2-Jun-05	48.4	1310	1410	1	1310	48.4	63.6	66.8	67.3	66.8	-18.4	-15 to -25
40	2-Jun-05	39.9	1445	1545	1	1445	39.9	61.6	66.4	67.2	66.4	-26.5	<-25
41	2-Jun-05	39.9	1445	1545	1	1445	39.9	61.6	66.4	67.2	66.4	-26.5	<-25
42	2-Jun-05	46.8	1610	1710	1	1610	46.8	60.7	65.9	67.1	66.1	-19.3	-15 to -25
43	2-Jun-05	46.8	1610	1710	1	1610	46.8	60.7	65.9	67.1	66.1	-19.3	-15 to -25
44	6-Jun-05	57.8	1033	1133	1	1033	57.8	67.1	67.3	67.3	67.3	-9.5	-5 to -15
45	6-Jun-05	57.8	1033	1133	1	1033	57.8	67.1	67.3	67.3	67.3	-9.5	-5 to -15
46	6-Jun-05	57.8	1033	1133	1	1033	57.8	67.1	67.3	67.3	67.3	-9.5	-5 to -15
47	6-Jun-05	60.1	1150	1250	1	1150	60.1	66.8	67.2	67.2	67.2	-7.1	-5 to -15
48	6-Jun-05	60.1	1150	1250	1	1150	60.1	66.8	67.2	67.2	67.2	-7.1	-5 to -15
49	6-Jun-05	60.1	1150	1250	1	1150	60.1	66.8	67.2	67.2	67.2	-7.1	-5 to -15
50	7-Jun-05	59.6	1055	1155	1	1055	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15

Attachment 5

Data Sheet Summarizing the Test Results and the Leak Rates Used in the Evaluation

Hourly Testing on Flex Pipelines - 3.0 gal/hr leak tests
Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Induced Leak Rate	Time between End of Circulation and Start of Data Collection for Test	Time Data Collection Began	Time Data Collection Ended	Measured Test Result	Was Threshold Exceeded?
	(D-M-Y)	(gal/h)	(h-min)	(local military)	(local military)	(leak or tight)	(yes or no)
1	25-May-05	3.0	12	10:42	10:43	3.0	yes
2	25-May-05	0.0	14	10:44	10:44	0.0	no
3	25-May-05	3.0	14	10:44	10:45	3.0	yes
4	25-May-05	0.0	10	12:05	12:05	0.0	no
5	25-May-05	3.0	11	12:06	12:07	3.0	yes
6	25-May-05	0.0	12	12:07	12:07	0.0	no
7	25-May-05	3.0	16	14:46	14:47	3.0	yes
8	25-May-05	0.0	17	14:47	14:47	0.0	no
9	25-May-05	3.0	18	14:48	14:49	3.0	yes
10	25-May-05	0.0	8	16:08	16:08	0.0	no
11	26-May-05	3.0	12	11:07	11:08	3.0	yes
12	26-May-05	0.0	13	11:08	11:08	0.0	no
13	26-May-05	3.0	14	11:09	11:10	3.0	yes
14	26-May-05	0.0	13	12:45	12:45	0.0	no
15	26-May-05	3.0	14	12:46	12:47	3.0	yes
16	26-May-05	0.0	16	12:48	12:48	0.0	no
17	26-May-05	0.0	10	15:15	15:15	0.0	no
18	26-May-05	3.0	11	15:16	15:17	3.0	yes
19	26-May-05	0.0	12	15:17	15:17	0.0	no
20	26-May-05	3.0	14	17:01	17:02	3.0	yes
21	27-May-05	3.0	12	11:23	11:24	3.0	yes
22	27-May-05	0.0	13	11:24	11:24	0.0	no
23	27-May-05	3.0	14	11:25	11:26	3.0	yes
24	27-May-05	0.0	11	12:33	12:33	0.0	no
25	27-May-05	3.0	11	12:33	12:34	3.0	yes
26	27-May-05	0.0	12	12:34	12:34	0.0	no
27	31-May-05	0.0	10	14:10	14:10	0.0	no
28	31-May-05	3.0	10	14:10	14:11	3.0	yes
29	31-May-05	0.0	9	15:49	15:49	0.0	no
30	31-May-05	3.0	10	15:50	15:51	3.0	yes
31	1-Jun-05	3.0	11	17:21	17:22	3.0	yes
32	1-Jun-05	0.0	12	17:22	17:22	0.0	no
33	1-Jun-05	3.0	13	17:22	17:23	3.0	yes
34	2-Jun-05	3.0	14	12:04	12:05	3.0	yes
35	2-Jun-05	0.0	15	12:05	12:05	0.0	no

Attachment 5

Data Sheet Summarizing the Test Results and the Leak Rates Used in the Evaluation

Hourly Testing on Flex Pipelines - 3.0 gal/hr leak tests
Pipeline Leak Detection System
Options 1 and 5

Test No. (Based on Temperature Condition)	Date Test Began	Induced Leak Rate	Time between End of Circulation and Start of Data Collection for Test	Time Data Collection Began	Time Data Collection Ended	Measured Test Result	Was Threshold Exceeded?
	(D-M-Y)	(gal/h)	(h-min)	(local military)	(local military)	(leak or tight)	(yes or no)
36	2-Jun-05	3.0	16	12:06	12:06	3.0	yes
37	2-Jun-05	0.0	11	14:21	14:21	0.0	no
38	2-Jun-05	3.0	12	14:22	14:22	3.0	yes
39	2-Jun-05	0.0	13	14:23	14:23	0.0	no
40	2-Jun-05	0.0	3	15:48	15:48	0.0	no
41	2-Jun-05	3.0	4	15:49	15:50	3.0	yes
42	2-Jun-05	0.0	7	17:17	17:17	0.0	no
43	2-Jun-05	3.0	8	17:18	17:19	3.0	yes
44	6-Jun-05	0.0	11	10:44	10:44	0.0	no
45	6-Jun-05	3.0	12	10:45	10:46	3.0	yes
46	6-Jun-05	0.0	13	10:46	10:46	0.0	no
47	6-Jun-05	3.0	13	12:03	12:04	3.0	yes
48	6-Jun-05	0.0	14	12:04	12:04	0.0	no
49	6-Jun-05	3.0	15	12:05	12:06	3.0	yes
50	7-Jun-05	0.0	10	11:05	11:05	0.0	no

Attachment 6

Data Sheet Summarizing the Test Results and the Trapped Vapor Tests

Pipeline Leak Detection System
Options 1 and 5
Hourly Testing on Flex Pipelines - 3.0 gal/hr leak tests
Summary of Temperature Conditions

Test No. (Based on Temperature Condition)	Date Test Began	Nominal Product Temperature Before Circulation Was Started	Time Circulation Started	Time Circulation Ended	Duration of Circulation	Time of Temperature Measurements	T(TB)	T(1)	T(2)	T(3)	T(G)	T(TB)-T(G)	Temperature Test Matrix Category
	(D-M-Y)	(deg F)	(local military)	(local military)	(h-min)	(local military)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(deg F)	(Table 5.1)
51	07-Jun-05	59.60	0955	1055	1	0955	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15
52	07-Jun-05	59.60	0955	1055	1	0955	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15
53	07-Jun-05	59.60	0955	1055	1	0955	59.6	67.2	67.2	67.3	67.3	-7.7	-5 to -15

Summary of Leak Rates

Test No.	Date Test Began	Pipeline Pressure	Induced Leak Rate	Time between End of Circulation and Start of Data Collection for Test	Time Data Collection Began	Time Data Collection Ended	Measured Test Result	Was Threshold Exceeded?
	(D-M-Y)	(psi)	(gal/h)	(h-min)	(local military)	(local military)	(leak or tight)	(yes or no)
51	07-Jun-05	30	3.0	0:11	1106	1107	Leak	yes
52	07-Jun-05	30	0.0	0:12	1107	1107	Tight	no
53	07-Jun-05	30	3.0	0:13	1108	1109	Leak	yes

Attachment 7

Data Sheet Summarizing the Test Results Used to Check the Relationship Supplied by the Manufacturer for Combining the Signal and Noise

Pipeline Leak Detection System
Options 1 and 5

NOT APPLICABLE TO THIS EVALUATION

First Check		
Test No.	Actual Leak Rate* (gal/h)	Measured Leak Rate (gal/h)
1		
2		
3		
4		
5		
6		

* Recommended leak rates for monthly monitoring tests and line tightness tests: 0.0, 0.05, 0.10, 0.20, 0.30 and 0.40 gal/h. Recommended leak rates for hourly tests: 0.0, 2.0, 2.5, 3.0, 3.5, and 4.0 gal/h.

Second Check		
Test No.	Actual Leak Rate* (gal/h)	Measured Leak Rate (gal/h)
A		
B		
C		
A + B*		

* A + B is the summation of the results of Tests A and B using the manufacturer's relationship for combining the signal and the noise.

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