Evaluation of the Red Jacket Automatic Line Leak Detector for Hourly Monitoring Monthly Monitoring and Line Tightness Testing

(PPM 4000, RLM 9000, RLM 10,000, ST 1401L, and ST 1801L)

Volume 1. Final Report

PREPARED FOR:

Marley Pump

a United Dominion Company

Revised April 1994

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5800 Foxridge Drive
Mission, Kansas 66202

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Preface

The forms contained in this report are based on data collected using the EPA protocol "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 Leak Detection Test Center which is operated by Ken Wilcox Associates. The report was prepared by Dr. Wilcox.

This report has been revised from a November 1992 version to include monthly monitoring and the location of the functional element in the discharge line. Volume I contains the revised Final Report. Volume II has not been changed. The evaluation meets the requirements of the U.S. Environmental Protection Agency for Pipeline Leak Detection Systems.

Questions should be directed to Mr. Klaus Jarr, Red Jacket Electronics, at (913) 831-5700.

H. Kendall Wilcox

H. Kendall Wilcox, PhD
KEN WILCOX ASSOCIATES

Revised: April 12, 1994

ATTACHMENT A

EPA FORMS FOR THE RED JACKET
AUTOMATIC LINE LEAK DETECTORS
HOURLY MONITORING

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*

System Name: Red Jacket Automatic Line Leak Detectors (PPM 4000, RLM 9000, RLM 10,000, ST 1401L, and ST 1801L) - Hourly Monitoring

Version of System:

Manufacturer Name: Marley Pump - a United Dominion Company

5800 Foxridge Drive
(street address)
Mission, Kansas 66202
(city, state, zip code)
(913) 831-5700
(telephone number)

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 %.

* These forms have been updated to include new models.

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 0.097 gal/h (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 64 tests were conducted on nonleaking line(s) between 1/22/91 (date) and 3/12/91 (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, 75 ft long and constructed of fiberglass (fiberglass, steel, or other).

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

Answer questions 10 and 11 if Option 3 or 4 was used.

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 (time after completition of circulation and start of test)
( ) 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 ΔT(°F)**
1	4	$\Delta T < -25$
4	10	$-25 \leq \Delta T < -15$
5	11	$-15 \leq \Delta T < -5$
5	10	$-5 \leq \Delta T < +5$
5	15	$+5 \leq \Delta T < +15$
4	10	$+15 \leq \Delta T < +25$
1	4	$\Delta T > 25$

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

**ΔT 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.[1]
( ) 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 ave 7.5 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

Test No.	ΔT (°F)	Induced Leak Rate (gal/h @ 10 psi)	Measured Leak Rate (gal/h)
1	+12.2	3.25	Leak
2	+12.2	3.0	Leak
3	+12.2	2.75	Leak

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:	0.02 deg F	2 %	10
Accuracy:	0.1 deg F	2 %	10
Minimum Detectable Quantity:	N/A	1 mL	10
Response Time:	2 min	N/A	10

Threshold is exceeded when the flow rate due to a leak exceeds 0.097 gal/h.

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 150 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)

[1] The PPM 4000 will alert the operator when trapped vapor is present.

- 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 _approx. 2_ min
- 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, President
(name of person performing evaluation)

H. Kendall Wilcox
(signature)

September 16, 1991 (rev. April 1994)
(date)

(816) 795-7997
(telephone number)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

19401 E. 40 Highway
(street address)

Independence, Missouri 64055
(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: Red Jacket Automatic Line Leak Detectors (PPM 4000, RLM 9000, RLM 10,000, ST1401L, and ST 1801L) - Hourly Monitoring

Date: February 19, 1991 (rev. April 1994)

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
   ( ) waste oil
   (X) other (specify) methanol, ethanol, and their blends with gasoline.
   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) Contact manufacturer for other applications.

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.
   ( ) 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?

   ( ) yes (X) no

General Features of the System

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

   (X) 0.1 gal/h Line Tightness Test
   (X) 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.)

   (X) displays or prints a message
   (X) triggers an alarm
   (X) alerts the operator
   (X) shuts down the dispensing system

9. What quantity or quantities are measured by the system? (Please list.)
   pressure (psi) and time

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

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

11. Does the system measure and report the quantity?
    ( ) yes ( ) 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?

( ) operating pressure of line
( ) 150% of operating pressure
(X) a specific test pressure of between 10 to 5 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.)

2 min (single test)
_____ 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?

(X) yes ( ) no

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

(X) yes ( ) no (operator is alerted)

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 (operator is alerted)

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?

( ) manually
( ) by strip chart
( ) by computer
(X) 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
(X) automatically done with a microprocessor

Detection Criterion

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

gal/hr (in the units used by the measurement system)
0.097 gal/hr (in gal/h)

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?

(X) never
( ) before each test
( ) weekly
( ) monthly
( ) semi-annually
( ) 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	1.0	0	0.097
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

Specialized Test Facility, Operational Storage Tank System, or Computer Simulation	
Inside diameter of pipeline (in.)	3 in
Length of pipeline (tank to dispenser) (ft)	75 ft
Volume of product in line during testing (gal)	27.55 gal
Type of material (fiberglass, steel, other[1])	fiberglass
Type of product in tank and pipeline (gasoline, diesel, other[2])	gasoline
Was a mechanical line leak detector present? (yes or no)	no
Was trapped vapor present? (yes or no)	in 3 of 64 tests
Bulk Modulus (B) (psi)	30,760
B/V_o (psi/ml)	-0.295
Storage tank capacity (gal)	560 gal

[1]Specify type of construction material.
[2]Specify type of product for each tank.

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.

ATTACHMENT B

EPA FORMS FOR THE RED JACKET
AUTOMATIC LINE LEAK DETECTORS
MONTHLY MONITORING

Results of the Performance Evaluation
Conducted According to EPA Test Procedures

Pipeline Leak Detection System
Used as a
Monthly 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 a monthly 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*

System Name: Red Jacket Automatic Line Leak Detectors (PPM 4000, RLM 9000, RLM 10,000, ST 1401L, and ST 1801L) - Monthly Monitoring

Version of System: _____

Manufacturer Name: Marley Pump - a United Dominion Company

5800 Foxridge Drive
(street address)

Mission, Kansas 66202
(city, state, zip code)

(913) 831-5700
(telephone number)

Evaluation Results

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

   The EPA regulation for a monthly monitoring test requires that the system be capable of detecting a leak as small as 0.2 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 0.2 gal/h defined at a pipeline pressure of 20 psi in this evaluation is 100 %.

* These forms have been updated to include new models.

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 _0.1_ (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 __54__ tests were conducted on nonleaking line(s) between _1/22/91_ (date) and _2/15/91_ (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, __75__ ft long and constructed of _fiberglass_ (fiberglass, steel, or other).

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

Answer questions 10 and 11 if Option 3 or 4 was used.

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 (time after completition of circulation and start of test)
( ) 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 $\Delta T(°F)$**
1	3	$\Delta T < -25$
4	8	$-25 \leq \Delta T < -15$
5	10	$-15 \leq \Delta T < -5$
5	11	$-5 \leq \Delta T < +5$
5	12	$+5 \leq \Delta T < +15$
4	8	$+15 \leq \Delta T < +25$
1	2	$\Delta T > 25$

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

**ΔT 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.[1]
( ) 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 ave 7.5 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

Test No.	ΔT (°F)	Induced Leak Rate (gal/h @ 20 psi)	Measured Leak Rate (gal/h)
1	+3.09	0.23	leak detected
2	+7.72	0.115[2]	tight[2]
3	+4.03	0	tight

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:	0.02 deg F	2 %	10
Accuracy:	0.1 deg F	2 %	10
Minimum Detectable Quantity:	N/A	1 mL	10
Response Time:	2 min	N/A	10

Threshold is exceeded when the flow rate due to a leak exceeds 0.1 gal/h.

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 150 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)

[1] The PPM 4000 will alert the operator when trapped vapor is present.

[2] Vendors standard level test protocol does not claim to detect 0.115 gph leaks

- 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 0.17 to 3 h
- 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, President
(name of person performing evaluation)

H Kendall Wilcox
(signature)

February 19, 1991 (rev. April 1994)
(date)

(816) 795-7997
(telephone number)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

19401 E. 40 Highway
(street address)

Independence, Missouri 64055
(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: Red Jacket Automatic Line Leak Detectors (PPM 4000, RLM 9000, RLM 10,000, ST 1401L and ST 1801L) - Line Tightness Test

Date: February 19, 1991 (rev. April 1994)

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
   ( ) waste oil
   (X) other (specify) methanol, ethanol, and their blends with gasoline. 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) Contact manufacturer for other applications.

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.
   ( ) 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?

   ( ) yes (X) no

General Features of the System

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

   (X) 0.1 gal/h Line Tightness Test
   (X) 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.)

   (X) displays or prints a message
   (X) triggers an alarm
   (X) alerts the operator
   (X) shuts down the dispensing system

9. What quantity or quantities are measured by the system? (Please list.)
   pressure (psi) and time
   _____
   _____

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

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

11. Does the system measure and report the quantity?
    ( ) yes ( ) 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?

( ) operating pressure of line
( ) 150% of operating pressure
(X) a specific test pressure of between 10 to 5 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.)

0.17 to 3 h (single test)
_____ 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?

(X) yes ( ) no

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

(X) yes ( ) no (operator is alerted)

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 (operator is alerted)

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?

( ) manually
( ) by strip chart
( ) by computer
(X) 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
(X) automatically done with a microprocessor

Detection Criterion

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

gal/hr (in the units used by the measurement system)
0.2 gal/hr (in gal/h)

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?

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

Attachment 2

Summary of Performance Estimates

Pipeline Leak Detection System
Used as an
Monthly 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	0.2	1.0	0	0.1
EPA Standard	0.2	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

Specialized Test Facility, Operational Storage Tank System, or Computer Simulation	
Inside diameter of pipeline (in.)	3 in
Length of pipeline (tank to dispenser) (ft)	75 ft
Volume of product in line during testing (gal)	27.55 gal
Type of material (fiberglass, steel, other[1])	fiberglass
Type of product in tank and pipeline (gasoline, diesel, other[2])	gasoline
Was a mechanical line leak detector present? (yes or no)	no
Was trapped vapor present? (yes or no)	in 3 of 54 tests
Bulk Modulus (B) (psi)	30,760
B/V_o (psi/ml)	-0.295
Storage tank capacity (gal)	560 gal

[1]Specify type of construction material.
[2]Specify type of product for each tank.

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.

ATTACHMENT C

EPA FORMS FOR THE RED JACKET AUTOMATIC LINE LEAK DETECTORS LINE TIGHTNESS TESTING

Results of the Performance Evaluation
Conducted According to EPA Test Procedures

Pipeline Leak Detection System
Used as a
Line Tightness 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 a line tightness 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*

System Name: Red Jacket Automatic Line Leak Detectors (PPM 4000, RLM 9000, RLM 10,000, ST 1401L, and ST 1801L) - Annual Line Tightness Test

Version of System:

Manufacturer Name: Marley Pump - a United Dominion Company

5800 Foxridge Drive
(street address)
Mission, Kansas 66202
(city, state, zip code)
(913) 831-5700
(telephone number)

Evaluation Results

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

   The EPA regulation for a line tightness test requires that the system be capable of detecting a leak as small as 0.1 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 0.1 gal/h defined at a pipeline pressure of 45 psi in this evaluation is 100 %.

* These forms have been updated to include new models.

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 __0..047__ (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 __8/27/92__ (date) and __10/16/92__ (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, __75__ ft long and constructed of __fiberglass__ (fiberglass, steel, or other).

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

Answer questions 10 and 11 if Option 3 or 4 was used.

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 (time after completition of circulation and start of test)
( ) 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 ΔT(°F)**
1	2	$\Delta T < -25$
4	8	$-25 \leq \Delta T < -15$
5	10	$-15 \leq \Delta T < -5$
5	10	$-5 \leq \Delta T < +5$
5	12	$+5 \leq \Delta T < +15$
4	9	$+15 \leq \Delta T < +25$
1	2	$\Delta T > 25$

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

**ΔT 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.[1]
( ) 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 nominal 10 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

Test No.	ΔT (°F)	Induced Leak Rate (gal/h @ 20 psi)	Measured Leak Rate (gal/h)
1	+3.09	0.23	leak
2	+7.72	0.115	leak
3	+4.03	0	tight

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:	0.02 deg F	2 %	10
Accuracy:	0.1 deg F	2 %	10
Minimum Detectable Quantity:	N/A	1 mL	10
Response Time:	2 min	N/A	10

Threshold is exceeded when the flow rate due to a leak exceeds 0.047 gal/h.

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 150 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)

[1] The PPM 4000 will alert the operator when trapped vapor is present.

- 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 150 to 300 min.
- 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, President
(name of person performing evaluation)

H. Kendall Wilcox
(signature)

November 10, 1992 (rev. April 1994
(date)

(816) 795-7997
(telephone number)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

19401 E. 40 Highway
(street address)

Independence, Missouri 64055
(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: Red Jacket Automatic Line Leak Detectors (PPM 4000, RLM 9000, RLM 10,000, ST 1401L and ST 1801L) - Line Tightness Test

Date: November 5, 1992 (rev. April 1994)

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
   ( ) waste oil
   (X) other (specify) methanol, ethanol, and their blends with gasoline.
   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) Contact manufacturer for other applications.

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.)
( ) 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?

( ) yes (X) no

General Features of the System

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

(X) 0.1 gal/h Line Tightness Test
(X) 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 system records and displays day, date, and time of positive test

9. What quantity or quantities are measured by the system? (Please list.)
pressure (psi) and time

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

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

11. Does the system measure and report the quantity?
( ) yes ( ) 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?

( ) operating pressure of line
( ) 150% of operating pressure
(X) a specific test pressure of between 10 to 5 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.)

2.5 to 6 h (single test)
_____ 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?

(X) yes ( ) no

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

(X) yes ( ) no (operator is alerted)

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

( ) yes (X) no

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

( ) yes (X) no (operator is alerted)

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?

( ) manually
( ) by strip chart
( ) by computer
(X) 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
(X) automatically done with a microprocessor

Detection Criterion

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

gal/hr (in the units used by the measurement system)
0.047 gal/hr (in gal/h)

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?

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

Attachment 2

Summary of Performance Estimates

Pipeline Leak Detection System
Used as a
Line Tightness 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	0.1	1.0	0	0.047
EPA Standard	0.1	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 0.10 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

Specialized Test Facility, Operational Storage Tank System, or Computer Simulation	
Inside diameter of pipeline (in.)	3 in
Length of pipeline (tank to dispenser) (ft)	75 ft
Volume of product in line during testing (gal)	27.55 gal
Type of material (fiberglass, steel, other[1])	fiberglass
Type of product in tank and pipeline (gasoline, diesel, other[2])	gasoline
Was a mechanical line leak detector present? (yes or no)	no
Was trapped vapor present? (yes or no)	in 3 of 53 tests
Bulk Modulus (B) (psi)	30,760
B/V_o (psi/ml)	-0.295
Storage tank capacity (gal)	560 gal

[1]Specify type of construction material.
[2]Specify type of product for each tank.

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.