Evaluation of the Red Jacket Fx1DV and Fx2DV Installed in the Big-Flo Diaphragm Valve (BFDV) for Hourly Testing on Flexible Pipelines Containing Diesel Fuel

(Addendum to the March 1994 Evaluation)

PREPARED FOR

The Marley Pump Company

(A United Dominion Company)

March 11, 1999

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Preface

The data contained in this report was obtained from the Red Jacket Fx1DV/Fx2DV line leak detector installed in the Red Jacket Big-Flo Diaphragm Valvel (BFDV) on flexible piping containing diesel fuel. This report is to be used in conjunction with the March 15, 1994 evaluation of this system on rigid pipelines containing diesel fuel.[1] Testing was performed in accordance with the EPA Pipeline Leak Detection Test Protocol [2] with the exception of the number of tests performed. The results of this abbreviated testing indicate that Red Jacket system will successfully perform leak detection on flexible pipeline systems containing diesel fuel. All testing was conducted at the Fuels Management Research Center (FMRC) operated by Ken Wilcox Associates, Inc.

This report was prepared by Mr. Jeffrey K. Wilcox, Ken Wilcox Associates, Inc. Questions regarding this addendum should be directed to Mr. Ed Dunning, Marley Pump, at (319) 391-8600.

KEN WILCOX ASSOCIATES, INC.

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President

March 11, 1999

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[1] Evaluation of the Fx1D, Fx2D, Fx1DV, and Fx2DV (Installed in the Big-Flo) for Hourly Testing on Bulk Lines Containing Diesel Fuel, Final Report (includes Addendum for Vented Models Produced after July 30, 1996), Prepared for Marley Pump, March 15, 1994 (Revised July 30, 1996), Ken Wilcox Associates, Inc.

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

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Addendum for Flexible Pipelines with Diesel FX1DV/Fx2DV Installed in the Big-Flo

1.0 Introduction

This report is to be used in conjunction with the March 15, 1994 evaluation of the Red Jacket Fx1D, Fx2D, Fx1DV and Fx2DV with the Big-Flo.[3] The March 15, 1994 evaluation was conducted on a rigid pipeline that was 350 ft. in length by 3 3/8 inches in diameter with a volume of 181 gallons. Testing conducted on the rigid pipeline determined that the Red Jacket system had a probability of detection (P_D) of 100% and a probability of false alarm (P_{FA}) of 0% for Hourly Testing on bulk pipelines containing diesel fuel.

This report contains additional test data for the Red Jacket system that was conducted on a 215 ft, 1.5 inch diameter (internal) flexible pipeline with a capacity of 19.7 gallons. Testing was performed in accordance with the EPA Pipeline Leak Detection Test Protocol [4] with the exception of the number of tests performed. The results of this abbreviated testing indicate that the Red Jacket Fx1DV/Fx2DV line leak detector installed in the Red Jacket Big-Flo Diaphragm Valve (BFDV) will successfully perform hourly testing leak detection on flexible pipeline systems containing diesel fuel.

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[3] Evaluation of the Fx1D, Fx2D, Fx1DV, and Fx2DV (Installed in the Big-Flo) for Hourly Testing on Bulk Lines Containing Diesel Fuel, Final Report (includes Addendum for Vented Models Produced after July 30, 1996), Prepared for Marley Pump, March 15, 1994 (Revised July 30, 1996), Ken Wilcox Associates, Inc.

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

2.0 Background

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

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

The EPA protocol does not require that systems be tested on both rigid and flexible pipelines. However, some federal, state, and local regulators have required additional testing on flexible pipelines for systems that were originally evaluated on rigid pipelines. This addendum has been prepared for Marley Pump to demonstrate the performance of this system on flexible pipelines containing diesel fuel.

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

[6] 40CFR Part 280, Subpart D.

3.0 Description of the Red Jacket System

The Big-Flo leak detector is a diaphragm operated valve which uses a pilot control valve, in this case the Fx1DV or Fx2DV mechanical line leak detector, to detect a leak. The Fx1DV and Fx2DV leak detectors are mechanical systems that incorporate a poppet valve and metering pin. They are designed to operate at lower flow rates than the Big-Flo unit. The pilot leak detector is mounted “piggyback” onto the Big-Flo unit and controls the pressure on one side of the Big-Flo’s control diaphragm. The Big-Flo’s operation is therefore controlled by the operation of the smaller pilot leak detector.

If the pilot detector detects a leak, it will remain in a restricted flow state and allow full pump pressure on one side of the Big-Flo’s control diaphragm. This will keep the control diaphragm closed and restrict the product flow. If the pilot valve is in the fully open position, which occurs when there is no leak greater than its threshold value, the pressure on the control diaphragm will be lower. This pump pressure will then lift the Big-Flo’s poppet which allows normal flow rates.

The model used to collect the data used in this report was the Fx2DV. Both the Fx1DV and Fx2DV that this report is applied to function in the same manner. Both are designed to operate in diesel fuel and contain a 1/4 inch FNPT threaded port in the cap of the leak detector. The Fx2DV also provides a 1/4 inch FNPT port in the body allowing for the “Snap Tap” option.

4.0 Overview of the Evaluation Procedures and the Testing Conditions

Six additional tests were conducted on the Red Jacket system. The test conditions and results for these six tests are provided in Table 1. A brief summary of the test procedures is below.

- Product is heated or cooled in the conditioning tank.
- Product is circulated through the pipeline for 1 hour.
- A leak is introduced into the pipeline either before or immediately after the product circulation ends.
- The leak detector conducts a test and the results are recorded

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

Table 1. Data and Results for Testing Conducted on Flexible Pipelines Containing Diesel Fuel

Test No.	Date Test Began	Time Circulation Started	Time Circulation Ended	Time Data Collection Began	Time Data Collection Ended	Duration of Circulation	Time Between End of Circulation and Start of Data Collection	Duration of Data Collection	T(TB) (Product Temp.)	T(G) (Ground Temp.)	T(TB)-T(G) Temp.) Differential)	Temp. Matrix Category	Induced Leak Rate	Measured Test Result
	mm/dd/yy	hhmm	hhmm	hhmm	hhmm	hhmm	hhmm	hhmm	deg F	deg F	deg F	deg F	gal/h	
1	01/04/99	1819	1919	1919	1920	0100	0000	0001	46.58	42.46	4.12	-5 to +5	3.0	Leak
2	01/04/99	1819	1919	1919	1920	0100	0000	0001	46.58	42.46	4.12	-5 to +5	0	Tight
3	01/05/99	1030	1130	1130	1131	0100	0000	0001	70.16	42.16	28.00	>+25	3.0	Leak
4	01/05/99	1030	1130	1130	1131	0100	0000	0001	70.16	42.16	28.00	>+25	0	Tight
5	01/05/99	1325	1425	1425	1426	0100	0000	0001	17.60	43.54	-25.94	<-25	3.0	Leak
6	01/05/99	1325	1425	1425	1426	0100	0000	0001	17.60	43.54	-25.94	<-25	0	Tight

5.0 Description of the Testing Location

The Red Jacket system was evaluated at the Fuels Management Research Center which is located in Grain Valley, Missouri and operated by Ken Wilcox Associates, Inc. All line tests were conducted with diesel fuel in the pipeline. Testing for this addendum was conducted on a 215 ft. long flexible pipeline with a total volume of 19.7 gallons. The bulk modulus of the flexible pipeline was 4,485 psi.

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

6.0 Test Results

The performance parameters for the Red Jacket system are summarized in Table 2.

Probability of Detection (P_D)
The Red Jacket system was correct in its determination of a leak for all of the leak tests. The estimated P_D of a 3 gal/h leak is 100% with an upper confidence limit of 63 to 100%.

Probability of False Alarm (P_{FA})
The Red Jacket system was correct in its determination of a tight pipeline for all of the tight tests. The estimated P_{FA} is 0% with a lower confidence limit of 0 to 37%.

Time to Conduct a Test
All of the tests were completed in one minute or less.

Maximum Line Size
The EPA protocol allows pipeline leak detection methods to be used on pipelines with up to twice the volume of that used in the evaluation. If the EPA protocol is used to calculate the performance parameters, the Red Jacket system can be used on flexible pipelines up to 39.5 gallons.

Table 2. Summary of the Test Results and Limitations

Parameter	Value
Probability of Detection for a 3 gal/h leak	100%
Confidence Limits	63 to 100%
Probability of False Alarm	0%
Confidence Limits	0 to 37%
Time to Conduct a Test	less than one minute
Maximum Applicable Flexible Line Size	39.5 gallons