

EVALUATION OF THE RED JACKET  
OPTICAL LIQUID  
DISCRIMINATION SENSOR

EPA EVALUATION FORM

PREPARED FOR  
MARLEY PUMP COMPANY  
5800 FOXRIDGE DRIVE  
MISSION, KANSAS 66202

APRIL 1992

# Results of Third Party Standard Evaluation

## Point Sensor Liquid Contact Product Detectors

This form documents the performance of the point sensor liquid contact leak detection system described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the Third Party Procedures developed according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors."<sup>1</sup>

Tank owners using this leak detection system should keep this form on file to prove compliance with the federal regulations. Tank owners should check with state and local agencies to verify that this form satisfies their requirements.

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### Method Description

Name Models PPM 4000, PPM 2000, PPM3000, RLM9000, RLM9001, RLM5001, & Multiplexer unit

Version Red Jacket PPM 4000 with Optical Liquid Discrimination Sensor

Vendor The Marley Pump Company

9650 Alden Road

(street address)

Lenexa,

Kansas

66215

(913) 541-2985

(city)

(state)

(zip)

(phone)

Detector output type:  X  Qualitative

Detector operating principle:   Electrical Conductivity   Capacitance Change

Interface Probe   Product Permeable   Product Soluble   Thermal Conductivity

Pressure Switch   Magnetic Switch  X  Other  Optical Sensor

Detector sampling frequency:   Intermittent  X  Continuous

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### Evaluation Results

The detector described above was tested for its ability to detect test liquids in contact with the point sensor. The following parameters were determined:

- Detection Accuracy - The measure of sensor response to the presence of liquids.
- Response Time - Amount of time the detector must be exposed to liquid before it responds.
- Recovery Time - Amount of time that passes before the detector returns to its baseline reading after the test liquid is removed.
- Lower Detection Limit - The smallest liquid concentration that the detector can reliably detect.
- Product Activation Height - The height of liquid to cause sensor activation.
- Specificity - Indicates the level of response, of the detector, to several different liquids.

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<sup>1</sup> Carnegie Mellon Research Institute. Test Procedures for Third Party Evaluation of Leak Detection Methods: Point Sensor Liquid Contact Leak Detection Systems: Final Report - November 11, 1991.

Liquid Contact Product Detector Red Jacket Models PPM 4000 PPM 2000, PPM3000, RLM9000,

RLM9001, RLM5001, & Multiplexer unit

Version Red Jacket PPM 4000 with Optical Liquid Discrimination Sensor

### Evaluation Results (continued)

#### > Compiled Test Results for Qualitative Detector

Test Product Flow Rate: 0.13 ± .003 gal/hr.

	Detection Accuracy	Product Activation Height	Response Time at a Flow Rate of 0.13 ± .003 gal/hr	Recovery Time
<b>Accuracy and Response Time</b>  Regular Unleaded Commercial Gasoline (6 tests)	100%	0.43 ± 0.02 in (1.08 ± 0.04 cm)	2.19 ± 0.13 min	less than 1 min.
<b>Specificity</b>  Synthetic Fuel (3 tests)	100%	[102%]* 0.43 ± 0.04 in (1.10 ± 0.10 cm)	2.20 ± 0.21 min	less than 1 min.
Diesel Fuel (3 tests)	100%	[95.4%]* 0.41 ± 0.02 in (1.03 ± 0.06 cm)	1.93 ± 0.14 min	less than 1 min.
Home Heating Oil #2 (3 tests)	100%	[98.5%]* 0.42 ± 0.02 in (1.07 ± 0.06 cm)	2.23 ± 0.23 min	less than 1 min.
Water (3 tests)	100%	[111%]* 0.47 ± 0.04 in (1.20 ± 0.10 cm)	2.81 ± 0.13 min	less than 1 min.

\* Specificity Reference: Regular Unleaded Commercial Gasoline

Test Fuel	Product Activation Height - Calculated Lower Detection Limit for 95% / 5% Condition
Regular Unleaded Commercial Gasoline	0.12 in (30 cm)

> **Safety disclaimer:** This test procedure only addresses the issue of the method's ability to detect the presence of liquid product. It does not test the equipment for safety hazards.

### Certification of Results

I certify that the point sensor liquid contact product detector was operated according to the vendor's instructions and that the evaluation was performed according to the Third Party Procedures developed according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors."<sup>1</sup> I also certify that the results presented above are those obtained during the evaluation.

Marc Portnoff  
(printed name)

*Marc Portnoff*  
(signature)

April 28, 1992  
(date)

Carnegie Mellon Research Institute \*\*  
(organization performing evaluation)

Pittsburgh, PA 15213  
(city, state, zip)

(412) 268-3495  
(phone number)

\*\* Consultant to the Manufacturer

**Test Procedures for Evaluating Leak Detection Methods:  
Liquid Contact Point Sensors - Out of Tank Product Detectors**

November 1991

**Test Results for  
The Marley Pump Company  
Red Jacket PPM 4000 Monitor with  
Optical Liquid Discrimination Sensor (OLDS)**

**April 1992**

Monitor: Marley Red Jacket PPM 4000

OLDS Probe Dimensions = 2.0 x 1.5 cm

Test Chamber Diameter = 4.8 cm

**The Detection System described above was tested for its ability to detect test liquids in contact with the point sensor. The following parameters were determined:**

- Detection Accuracy - The measure of sensor response to the presence of liquids.
- Response Time - Amount of time the detector must be exposed to liquid before it responds.
- Recovery Time - Amount of time that passes before the detector returns to its baseline reading after the test liquid is removed.
- Lower Detection Limit - The smallest liquid concentration that the detector can reliably detect.
- Minimum Sensitive Height - The minimum sensor length required to be in contact with the liquid product to cause sensor activation.
- Product Activation Height - The height of liquid to cause sensor activation.
- Specificity - Indicates the level of response, of the detector, to several different liquids.

**ACCURACY AND RESPONSE**

Monitor = PPM 4000

Sensor = OLDS

Probe Dimensions =  $2.049 \pm 0.004$  cm by  $1.533 \pm .005$ cm

NA=not applicable

NR=no response

**Minimum Sensitive Height = 1 in (25 mm) + 20% = 30 mm****TEST PRODUCT = UNLEADED GASOLINE****Test Distance = 25 ft**

Trial#	Probe#	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	1	19.0	1.98	<1	1.0	8.1	16
2	1	18.8	2.27	<1	1.1	7.9	18
3	1	18.8	2.32	<1	1.1	8.2	19
4	2	19.4	2.10	<1	1.1	8.1	17
5	2	19.6	2.27	<1	1.1	7.9	18
6	2	19.6	2.18	<1	1.1	7.8	17
<b>Average</b>			<b>2.19</b>	<b>&lt;1</b>	<b>1.08</b>	<b>8.0</b>	<b>18</b>
<b>Std. Dev.</b>			<b>0.13</b>	<b>NA</b>	<b>0.04</b>	<b>0.1</b>	<b>1</b>

<b>Detection Accuracy (%)</b>	<b>100.0</b>
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<b>Calculated Lower Detection Limit</b>
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<b>Product Activation Height (cm)</b>	<b>0.30</b>
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**SPECIFICITY**

Monitor = PPM 4000  
 Sensor = OLDS  
 Probe Dimensions =  $2.049 \pm 0.004$  cm by  $1.533 \pm .005$ cm

NA=not applicable  
 NR=no response

**Minimum Sensitive Height = 1 in (25 mm) + 20% = 30 mm**

**TEST PRODUCT = Water**

**Test Distance = 25 ft**

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	2	20.1	2.83	<1	1.2	8.48	24
2	2	20.0	2.93	<1	1.3	8.19	24
3	1	19.9	2.68	<1	1.1	7.84	21
<b>Average</b>			<b>2.81</b>	<b>&lt;1</b>	<b>1.20</b>	<b>8.2</b>	<b>23</b>
<b>Std. Dev.</b>			<b>0.13</b>	<b>NA</b>	<b>0.10</b>	<b>0.3</b>	<b>2</b>

**Detection Accuracy (%) 100.0**

**Specificity Calculations**  
**Product Activation Height (%) 110.8**

**TEST PRODUCT = HEATING OIL**

**Test Distance = 25 ft**

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	2	22.4	2.23	<1	1.1	7.6	17
2	1	22.4	2.00	<1	1.0	8.0	16
3	2	22.5	2.45	<1	1.1	7.8	19
<b>Average</b>			<b>2.23</b>	<b>&lt;1</b>	<b>1.07</b>	<b>7.8</b>	<b>17</b>
<b>Std. Dev.</b>			<b>0.23</b>	<b>NA</b>	<b>0.06</b>	<b>0.2</b>	<b>2</b>

**Detection Accuracy (%) 100.0**

**Specificity Calculations**  
**Product Activation Height (%) 98.5**

**SPECIFICITY (cont.)**

Monitor = PPM 4000  
 Sensor = OLDS  
 Probe Dimensions =  $2.049 \pm 0.004$  cm by  $1.533 \pm .005$ cm

NA=not applicable  
 NR=no response

**Minimum Sensitive Height = 1 in (25 mm) + 20% = 30 mm**

**TEST PRODUCT = DIESEL FUEL**

**Test Distance = 25 ft**

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	1	22.7	2.07	<1	1.1	7.7	16
2	2	22.7	1.92	<1	1.0	7.8	15
3	1	22.7	1.80	<1	1.0	7.8	14
<b>Average</b>			<b>1.93</b>	<b>&lt;1</b>	<b>1.03</b>	<b>7.8</b>	<b>15</b>
<b>Std. Dev.</b>			<b>0.14</b>	<b>NA</b>	<b>0.06</b>	<b>0.0</b>	<b>1</b>

**Detection Accuracy (%) 100.0**

**Specificity Calculations**

**Product Activation Height (%) 95.4**

**TEST PRODUCT = SYNTHETIC GASOLINE**

**Test Distance = 25 ft**

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	1	20.4	2.27	<1	1.1	7.9	18
2	1	20.3	1.97	<1	1.0	7.6	15
3	2	20.3	2.37	<1	1.2	8.0	19
<b>Average</b>			<b>2.20</b>	<b>&lt;1</b>	<b>1.10</b>	<b>7.9</b>	<b>17</b>
<b>Std. Dev.</b>			<b>0.21</b>	<b>NA</b>	<b>0.10</b>	<b>0.2</b>	<b>2</b>

**Detection Accuracy (%) 100.0**

**Specificity Calculations**

**Product Activation Height (%) 101.5**