Certification Reports

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

Point Sensor - Liquid Contact Product Detectors

Contents:

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Results of Third Party Standard Evaluation

Point Sensor Liquid Contact Product Detectors

This form documents the performance of the cable 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."[1]

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.

Method Description

Name TLS-350/300/300i Series UST Monitoring System

Version with Interstitial Liquid Sensor for Fiberglass Tanks (0794390-401,404,407,409)

Vendor Veeder-Root Environmental Products

125 Powder Forest Drive
(street address)

Simsbury,	CT	06070-2003	(800) 873-3313
(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 (Float Switch)

Detector sampling frequency: ___Intermittent X Continuous

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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[1] 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 TLS-350/300/300i Series UST Monitoring System

Version with Interstitial Liquid Sensor for Fiberglass Tanks (0794390-401,404,407,409)

Evaluation Results (continued)

> Compiled Test Results for Qualitative Detector

Test Product Flow Rate: 0.19 ± 0.010 gal/hr.

	Detection Accuracy	Product Activation Height	Response Time at a Flow Rate of 0.19 ± 0.010 gal/hr	Recovery Time
Accuracy and Response Time Regular Unleaded Commercial Gasoline (6 tests)	100%	0.50 ± 0.02 in (1.27 ± 0.05 cm)	3.45 ± 0.11 min	< 1 min
Specificity Synthetic Fuel (3 tests)	100%	**[100%]*** 0.50 ± 0.02 in (1.27 ± 0.06 cm)	3.89 ± 0.09 min	< 1 min
Diesel Fuel (3 tests)	100%	**[97%]*** 0.49 ± 0.02 in (1.23 ± 0.06 cm)	3.70 ± 0.12 min	< 1 min
Home Heating Oil #2 (3 tests)	100%	**[100%]*** 0.50 ± 0.02 in (1.27 ± 0.06 cm)	3.78 ± 0.07 min	< 1 min
Water (3 tests)	100%	**[92%]*** 0.46 ± 0.02 in (1.17 ± 0.06 cm)	3.25 ± 0.19 min	< 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	0.65 in (1.65 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."[1] I also certify that the results presented above are those obtained during the evaluation.

Margaret Nasta, Ph.D.
(printed name)

Margaret Nasta
(signature)

April 22, 1998
(date)

Carnegie Mellon Research Institute **
(organization performing evaluation)

Pittsburgh, PA 15230
(city, state, zip)

(412) 268-3475
(phone number)

** Consultant to the Manufacturer

Results of Third Party Standard Evaluation

Point Sensor Liquid Contact Product Detectors

This form documents the performance of the cable 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."[1]

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.

Method Description

Name 350 Series UST Monitoring Systems: Models ILS 350 (serial #Beta 013) & TLS 350

Version with Interstitial Liquid Sensor for Fiberglass Tanks (0794390-401)

Vendor Veeder-Root Environmental Products

125 Powder Forest Drive
(street address)

Simsbury, CT 06070-2003 (800) 873-3313
(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 (Float Switch)

Detector sampling frequency: ___Intermittent X Continuous

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.

[1] 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 UST Monitoring System: Models ILS 350 (Beta 013) & TLS 350
Version with Interstitial Liquid Sensor for Fiberglass Tanks (0794390-401)

Evaluation Results (continued)

> Compiled Test Results for Qualitative Detector

Test Product Flow Rate: 0.19 ± 0.010 gal/hr.

	Detection Accuracy	Product Activation Height	Response Time at a Flow Rate of 0.19 ± 0.010 gal/hr	Recovery Time
Accuracy and Response Time Regular Unleaded Commercial Gasoline (6 tests)	100%	0.50 ± 0.02 in (1.27 ± 0.05 cm)	3.45 ± 0.11 min	< 1 min
Specificity Synthetic Fuel (3 tests)	100%	[100%]* 0.50 ± 0.02 in (1.27 ± 0.06 cm)	3.89 ± 0.09 min	< 1 min
Diesel Fuel (3 tests)	100%	[97%]* 0.49 ± 0.02 in (1.23 ± 0.06 cm)	3.70 ± 0.12 min	< 1 min
Home Heating Oil #2 (3 tests)	100%	[100%]* 0.50 ± 0.02 in (1.27 ± 0.06 cm)	3.78 ± 0.07 min	< 1 min
Water (3 tests)	100%	[92%]* 0.46 ± 0.02 in (1.17 ± 0.06 cm)	3.25 ± 0.19 min	< 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	0.65 in (1.65 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."[1] I also certify that the results presented above are those obtained during the evaluation.

Margaret Nasta, Ph.D.
(printed name)

Margaret Nasta
(signature)

July 17, 1992
(date)

Carnegie Mellon Research Institute **
(organization performing evaluation)

Pittsburgh, PA 15213
(city, state, zip)

(412) 268-3475
(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
Veeder-Root UST Monitoring System: Model ILS 350
with Interstitial Liquid Sensor for Fiberglass Tanks 0794390-401
July 1992

Monitor: Veeder-Root UST Monitoring System: Model ILS 350 (serial # Beta 013)		
Probe Size	=	3.45 x 5.65 x 1.90 cm
Test Chamber Diameter	=	7.6 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 = Veeder-Root UST Monitoring System: Model ILS 350
Sensor = Interstitial liquid sensor for fiberglass tanks 0794390-401
Probe Size = 3.45 ± 0.01 (W) X 5.65 ± 0.07 (L) X 1.90 ± 0.05 (H) cm

NA=not applicable
NR=no response

Minimum Sensitive Height = 0.8 in (20 mm) + 20% = 24 mm

TEST PRODUCT = UNLEADED GASOLINE

Test Distance = 12 ft

Trial#	Probe#	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	31	21.0	3.67	< 1	1.3	12.5	46
2	31	21.0	3.43	< 1	1.2	12.8	44
3	31	21.0	3.42	< 1	1.3	12.6	43
4	31	21.0	3.35	< 1	1.2	12.8	43
5	31	21.0	3.42	< 1	1.3	12.9	44
6	31	21.0	3.40	< 1	1.3	12.9	44
Average			**3.45**	**<1**	**1.27**	**12.8**	**44**
Std. Dev.			**0.11**	**NA**	**0.05**	**0.2**	**1**

Detection Accuracy (%)	**100.0**

Calculated Lower Detection Limit	
Product Activation Height (cm)	**1.65**

SPECIFICITY

Monitor = Veeder-Root UST Monitoring System: Model ILS 350
Sensor = Interstitial liquid sensor for fiberglass tanks 0794390-401
Probe Size = 3.45 ± 0.01 (W) X 5.65 ± 0.07 (L) X 1.90 ± 0.05 (H) cm

NA=not applicable
NR=no response

Minimum Sensitive Height = 0.8 in (20 mm) + 20% = 24 mm

TEST PRODUCT = **Water**

Test Distance = 12 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	31	21.0	3.32	< 1	1.2	11.7	39
2	31	21.1	3.03	< 1	1.1	11.9	36
3	31	21.1	3.40	< 1	1.2	11.8	40
Average			**3.25**	**<1**	**1.17**	**11.8**	**38**
Std. Dev.			**0.19**	**NA**	**0.06**	**0.1**	**2**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**92.1**

TEST PRODUCT = **HEATING OIL**

Test Distance = 12 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	31	21.7	3.70	< 1	1.2	11.4	42
2	31	21.7	3.80	< 1	1.3	11.3	43
3	31	21.7	3.83	< 1	1.3	11.0	42
Average			**3.78**	**<1**	**1.27**	**11.2**	**42**
Std. Dev.			**0.07**	**NA**	**0.06**	**0.2**	**1**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**100.0**

SPECIFICITY (cont.)

Monitor = Veeder-Root UST Monitoring System: Model ILS 350
Sensor = Interstitial liquid sensor for fiberglass tanks 0794390-401
Probe Size = 3.45 ± 0.01 (W) X 5.65 ± 0.07 (L) X 1.90 ± 0.05 (H) cm

NA=not applicable
NR=no response

Minimum Sensitive Height = 0.8 in (20 mm) + 20% = 24 mm

TEST PRODUCT = **DIESEL FUEL**

Test Distance = 12 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	31	22.6	3.83	< 1	1.3	11.5	44
2	31	22.6	3.68	< 1	1.2	11.1	41
3	31	22.7	3.60	< 1	1.2	11.7	42
Average			**3.70**	**<1**	**1.23**	**11.4**	**42**
Std. Dev.			**0.12**	**NA**	**0.06**	**0.3**	**2**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**97.4**

TEST PRODUCT = **SYNTHETIC GASOLINE**

Test Distance = 12 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	31	20.6	3.80	< 1	1.2	12.37	47
2	31	20.5	3.98	< 1	1.3	12.06	48
3	31	20.5	3.88	< 1	1.3	11.86	46
Average			**3.89**	**<1**	**1.27**	**12.1**	**47**
Std. Dev.			**0.09**	**NA**	**0.06**	**0.3**	**1**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**100.0**

Results of Third Party Standard Evaluation

Point Sensor Liquid Contact Product Detectors

This form documents the performance of the cable 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."[1]

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.

Method Description

Name TLS-350/300/300i Series UST Monitoring System

Version with Interstitial Liquid Sensor for Steel Tanks (0794390-420)

Vendor Veeder-Root Environmental Products

125 Powder Forest Drive
(street address)

Simsbury,	CT	06070-2003	(800) 873-3313
(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 (Float Switch)

Detector sampling frequency: ___Intermittent X Continuous

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.

[1] 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 TLS-350/300/300i Series UST Monitoring System

Version with Interstitial Liquid Sensor for Steel Tanks (0794390-420)

Evaluation Results (continued)

> Compiled Test Results for Qualitative Detector

Test Product Flow Rate: 0.12 ± 0.003 gal/hr.

	Detection Accuracy	Product Activation Height	Response Time at a Flow Rate of 0.12 ± 0.003 gal/hr	Recovery Time
Accuracy and Response Time Regular Unleaded Commercial Gasoline (6 tests)	100%	1.42 ± 0.03 in (3.62 ± 0.08 cm)	6.51 ± 0.06 min	< 1 min
Specificity Synthetic Fuel (3 tests)	100%	**[104%]*** 1.48 ± 0.02 in (3.77 ± 0.06 cm)	5.85 ± 0.11 min	< 1 min
Diesel Fuel (3 tests)	100%	**[98%]*** 1.39 ± 0.02 in (3.53 ± 0.06 cm)	5.81 ± 0.05 min	< 1 min
Home Heating Oil #2 (3 tests)	100%	**[98%]*** 1.39 ± 0.02 in (3.53 ± 0.06 cm)	5.88 ± 0.06 min	< 1 min
Water (3 tests)	100%	**[87%]*** 1.23 ± 0.02 in (3.13 ± 0.06 cm)	5.48 ± 0.04 min	< 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	1.64 in (4.17 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."[1] I also certify that the results presented above are those obtained during the evaluation.

Margaret Nasta, Ph.D.
(printed name)

Margaret Nasta
(signature)

April 22, 1998
(date)

Carnegie Mellon Research Institute **
(organization performing evaluation)

Pittsburgh, PA 15230
(city, state, zip)

(412) 268-3475
(phone number)

** Consultant to the Manufacturer

Results of Third Party Standard Evaluation

Point Sensor Liquid Contact Product Detectors

This form documents the performance of the cable 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."[1]

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.

Method Description

Name 350 Series UST Monitoring Systems: Models ILS 350 (serial #Beta 013) & TLS 350

Version with Interstitial Liquid Sensor for Steel Tanks (0794390-420)

Vendor Veeder-Root Environmental Products

125 Powder Forest Drive
(street address)

Simsbury,	CT	06070-2003	(800) 873-3313
(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 (Float Switch)

Detector sampling frequency: ___Intermittent X Continuous

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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[1] 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 UST Monitoring System: Models ILS 350 (Beta 013) & TLS 350
Version with Interstitial Liquid Sensor for Steel Tanks (0794390-420)

Evaluation Results (continued)

> Compiled Test Results for Qualitative Detector

Test Product Flow Rate: 0.12 ± 0.003 gal/hr.

	Detection Accuracy	Product Activation Height	Response Time at a Flow Rate of 0.12 ± 0.003 gal/hr	Recovery Time
Accuracy and Response Time				
Regular Unleaded Commercial Gasoline (6 tests)	100%	1.42 ± 0.03 in (3.62 ± 0.08 cm)	6.51 ± 0.06 min	< 1 min
Specificity				
Synthetic Fuel (3 tests)	100%	**[104%]*** 1.48 ± 0.02 in (3.77 ± 0.06 cm)	5.85 ± 0.11 min	< 1 min
Diesel Fuel (3 tests)	100%	**[98%]*** 1.39 ± 0.02 in (3.53 ± 0.06 cm)	5.81 ± 0.05 min	< 1 min
Home Heating Oil #2 (3 tests)	100%	**[98%]*** 1.39 ± 0.02 in (3.53 ± 0.06 cm)	5.88 ± 0.06 min	< 1 min
Water (3 tests)	100%	**[87%]*** 1.23 ± 0.02 in (3.13 ± 0.06 cm)	5.48 ± 0.04 min	< 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	1.64 in (4.17 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."[1] I also certify that the results presented above are those obtained during the evaluation.

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Margaret Nasta
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July 17, 1992
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Pittsburgh, PA 15213
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(412) 268-3475
(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
Veeder-Root UST Monitoring System: Model ILS 350
with Interstitial Liquid Sensor for Steel Tanks 0794390-420
July 1992

Monitor: Veeder-Root UST Monitoring System: Model ILS 350 (serial # Beta 013)		
Probe Diameter	=	3.77 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 = Veeder-Root UST Monitoring System: Model ILS 350
Sensor = Interstitial liquid sensor for steel tanks 0794390-420
Probe Diameter = 3.77 cm; Std. Dev. = 0.01

NA=not applicable
NR=no response

Minimum Sensitive Height = 1.6 in (40 mm) + 20% = 48 mm

TEST PRODUCT = UNLEADED GASOLINE

Test Distance = 16 ft

Trial#	Probe#	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	21	22.1	6.50	< 1	3.5	7.7	50
2	21	22.1	6.50	< 1	3.6	7.8	51
3	21	22.0	6.43	< 1	3.6	7.8	50
4	21	22.0	6.47	< 1	3.6	7.7	50
5	21	22.0	6.60	< 1	3.7	7.6	50
6	21	22.0	6.57	< 1	3.7	7.8	51
Average			**6.51**	**<1**	**3.62**	**7.7**	**50**
Std. Dev.			**0.06**	**NA**	**0.08**	**0.1**	**1**

Detection Accuracy (%)	**100.0**

Calculated Lower Detection Limit	
Product Activation Height (cm)	**4.17**

SPECIFICITY

Monitor = Veeder-Root UST Monitoring System: Model ILS 350
Sensor = Interstitial liquid sensor for steel tanks 0794390-420
Probe Diameter = 3.77 cm; Std. Dev. = 0.01

NA=not applicable
NR=no response

Minimum Sensitive Height = 1.6 in (40 mm) + 20% = 48 mm

TEST PRODUCT = **Water**

Test Distance = 16 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	21	21.2	5.52	< 1	3.1	7.6	42
2	21	21.2	5.45	< 1	3.1	7.5	41
3	21	21.1	5.47	< 1	3.2	7.7	42
Average			**5.48**	**<1**	**3.13**	**7.6**	**42**
Std. Dev.			**0.04**	**NA**	**0.06**	**0.1**	**1**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**86.6**

TEST PRODUCT = **HEATING OIL**

Test Distance = 16 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	21	22.1	5.93	< 1	3.5	7.6	45
2	21	21.9	5.82	< 1	3.5	7.9	46
3	21	21.9	5.90	< 1	3.6	7.8	46
Average			**5.88**	**<1**	**3.53**	**7.8**	**46**
Std. Dev.			**0.06**	**NA**	**0.06**	**0.2**	**1**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**97.7**

SPECIFICITY (cont.)

Monitor = Veeder-Root UST Monitoring System: Model ILS 350
Sensor = Interstitial liquid sensor for steel tanks 0794390-420
Probe Diameter = 3.77 cm; Std. Dev. = 0.01

NA=not applicable
NR=no response

Minimum Sensitive Height = 1.6 in (40 mm) + 20% = 48 mm

TEST PRODUCT = **DIESEL FUEL**

Test Distance = 16 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	21	24.1	5.87	< 1	3.5	7.8	46
2	21	24.3	5.80	< 1	3.6	7.9	46
3	21	23.9	5.77	< 1	3.5	8.0	46
Average			**5.81**	**<1**	**3.53**	**7.9**	**46**
Std. Dev.			**0.05**	**NA**	**0.06**	**0.1**	**0**

Detection Accuracy (%) 100.0

Specificity Calculations
Product Activation Height (%) 97.7

TEST PRODUCT = **SYNTHETIC GASOLINE**

Test Distance = 16 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	21	21.1	5.93	< 1	3.8	8.1	48
2	21	21.1	5.90	< 1	3.8	8.1	48
3	21	21.2	5.73	< 1	3.7	8.0	46
Average			**5.85**	**<1**	**3.77**	**8.1**	**47**
Std. Dev.			**0.11**	**NA**	**0.06**	**0.1**	**1**

Detection Accuracy (%) 100.0

Specificity Calculations
Product Activation Height (%) 104.1

Results of U.S. EPA Standard Evaluation

Liquid-Phase Out-of-Tank Product Detectors

This form documents the performance of the liquid-phase product detector described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors."

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.

Method Description

Name 350 Series UST Monitoring Systems: Models TLS-350 & ILS-350

Version with Groundwater Sensor (Form #794380-621, -622, -624)

Vendor Veeder-Root Environmental Products

125 Powder Forest Drive
(street address)

Simsbury (city) | CT (state) | 06070-2003 (zip) | (203) 651-2700 (phone)

Detector output type: ___Quantitative _X_Qualitative

Detector operating principle: _X_Electrical Conductivity ___Thermal Conductivity

___Interface Probe ___Product Permeable ___Product Soluble ___Other _____

Detector sampling frequency: ___Intermittent _X_Continuous

Evaluation Results

The detector described above was tested for its ability to detect a layer of liquid floating on water. The following parameters were determined:

Accuracy - How closely the product thickness, as measured by the detector, agrees with the actual thickness.

Bias - Whether the method consistently over-estimates or under-estimates product thickness. Not applicable to qualitative detectors.

Precision - Agreement between multiple measurements of the same product thickness. Not applicable to qualitative detectors.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time that passes before the detector returns to its baseline reading after the product is removed.

Lower Detection Limit - The smallest liquid concentration that the detector can reliably detect. To meet federal performance standards, this must be less than 0.32 cm (1/8 inch).

Specificity - Indicates the accuracy of the detector in several different liquids.

Liquid-Phase Product Detector Models TLS-350 & ILS-350 with
Version Groundwater Sensor (Form #794380-621, -622, -624)

Evaluation Results (continued)

> **Compiled Test Results** (for tests conducted with 0.32 cm of floating product)

Test	Commercial Gasoline	Synthetic Gasoline
Accuracy (%)	100	100
Bias* (%)	Not Applicable	Not Applicable
Precision* (%)	Not Applicable	Not Applicable
Detection Time (hh:mm:ss)	00:08:55	00:06:18
Fall Time (hh:mm:ss)	00:54:50	00:26:02
Lower Detection Limit (cm)	0.02	0.02

* Not applicable to qualitative detectors.

> **Specificity Results (%)**

Commercial gasoline	Activated
Synthetic gasoline	Activated
Diesel fuel	Activated
Jet -A jet fuel	Activated
n -Hexane	Activated
Toluene	Activated
Xylene(s)	Activated

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

Certification of Results

I certify that the liquid-phase product detector was operated according to the vendor's instructions and that the evaluation was performed according to the standard EPA test procedure for liquid-phase out-of-tank product detectors except as noted on any attached sheets. I also certify that the results presented above are those obtained during the evaluation.

Marc Portnoff
(printed name)

Marc Portnoff
(signature)

June 30, 1997
(date)

Carnegie Mellon Research Institute *
(organization performing evaluation)

Pittsburgh, PA 15230
(city, state, zip)

412 - 268 - 3495
(phone number)

* Consultant to the Manufacturer

Results of U.S. EPA Standard Evaluation

Vapor-Phase Out-of-Tank Product Detectors

This form documents the performance of the vapor-phase product detector described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Vapor-Phase Out-of-Tank Product Detectors."[1]

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.

Method Description

Name 350 Series UST Monitoring Systems:
Models ILS 350 & TLS 350

Version with Adsistor Vapor Sensor (Form no. 794390-700)

Vendor Veeder-Root Environmental Products 125 Powder Forest Drive
(Street Address)

Simsbury (City) CT (State) 06070-2003 (Zip) (203) 651-2700 (Phone)

Detector output type: ___Quantitative _X_Qualitative

Detector operating principle: ___Metal Oxide Semiconductor _X_Adsistor ___Detector Tube
___Catalytic Gas Sensor ___Combustible Gas Detector ___Photoionization Detector
___Product-Permeable Detector ___IR Detector ___Other_____

Detector sampling frequency: ___Intermittent _X_Continuous

Evaluation Results

The detector described above was tested for its ability to detect known concentrations of test gas. The following parameters were determined:

Accuracy - How closely test gas concentration, as measured by the detector, agrees with the actual gas concentration.

Bias - Whether the method consistently over-estimates or under-estimates gas concentration. Not applicable to qualitative detectors.

Precision - Agreement between multiple measurements of the same gas concentration. Not applicable to qualitative detectors.

Detection Time - Amount of time the detector must be exposed to test gas before it responds.

Fall Time - Amount of time that passes before the detector returns to its baseline reading after test gas is removed.

Lower Detection Limit - The smallest gas concentration that the detector can reliably detect.

Specificity - Indicates the ability of the detector to detect several different test gases.

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[1] Radian Corporation. Development of Procedures to Assess the Performance of External Leak Detection Devices: Vapor-Phase ASTM-Formatted methods. Draft Report. EPA Contract No. 68-03-3409. Work Assignment 22. June 29,1990. [Gas concentrations levels were corrected for laboratory temperature and pressure.]

Vapor-Phase Product Detector Model ILS 350 & TLS 350
Version with Adsistor Vapor Sensor (Form no. 794390-700)

Evaluation Results (continued)

> Accuracy, Response Time, and Lower Detection Limit Results

Test	Commercial Gasoline	Synthetic Gasoline	JP-4 Jet Fuel
Accuracy* (%)	100	0	100
Bias* ◊ (%)	Not Applicable	Not Applicable	Not Applicable
Precision* ◊ (%)	Not Applicable	Not Applicable	Not Applicable
Detection Time* (hh:mm:ss)	00:07:46	Not Applicable	00:17:01
Fall Time* (hh:mm:ss)	00:02:38	Not Applicable	00:03:05
Lower Detection Limit (ppm)	500	> 1000	500

* For tests conducted with 1000 ppm of test gas
◊Not applicable to qualitative detectors.

> Specificity Results (%)

Commercial gasoline	Activated
Synthetic gasoline	No Response
JP-4 Jet Fuel	Activated
n-Hexane	No Response
Toluene	No Response
Xylene(s)	No Response

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

Certification of Results

I certify that the vapor-phase product detector was operated according to the vendor's instructions and that the evaluation was performed according to the standard EPA test procedure for vapor-phase out-of-tank product detectors except as noted on any attached sheets. I also certify that the results presented above are those obtained during the evaluation.

Marc Portnoff
(printed name)

Marc Portnoff
(signature)

June 30, 1997
(date)

Carnegie Mellon Research Institute *
(organization performing evaluation)

Pittsburgh, PA 15230
(city, state, zip)

412 - 268 - 3495
(phone number)

* Consultant to the Manufacturer

Standard Test Procedures for Evaluating Leak Detection Methods:
Vapor-Phase Out of Tank Product Detectors - June 1990

Complete Test Results for
Veeder - Root UST Monitoring System
Models TLS -350, ILS-350
with Adsistor Vapor Probe

July 1992

x0001 Standard Test Method for Accuracy and Response Time (*)

Test Gas	Concentration ppm	Accuracy %	Rise hr:min:sec	Fall hr:min:sec
Unleaded Gasoline	50	0	Not Applicable	Not Applicable
Unleaded Gasoline	500	100	0:20:39	0:02:20
Unleaded Gasoline	1000	100	0:07:46	0:02:38
Synthetic Gasoline	50	--	--	--
Synthetic Gasoline	500	--	--	--
Synthetic Gasoline	1000	0	Not Applicable	Not Applicable
JP-4 Jet Fuel	50	0	Not Applicable	Not Applicable
JP-4 Jet Fuel	500	100	0:17:27	0:03:50
JP-4 Jet Fuel	1000	100	0:17:01	0:03:05

(*) Average of Five Tests

x0003 Standard Test Method for Specificity (**)

Test Gas	Concentration ppm	Accuracy %	Rise hr:min:sec	Fall hr:min:sec
Unleaded Gasoline	500	100	0:16:42	0:02:00
n-Hexane	500	0	Not Applicable	Not Applicable
JP-4 Jet Fuel	500	100	0:33:58	0:03:22
Synthetic Gasoline	500	0	Not Applicable	Not Applicable
Toluene	500	0	Not Applicable	Not Applicable
Xylene	500	0	Not Applicable	Not Applicable

(**) Average of Two Tests

x0006 Standard Test Method for Lower Detection Limit (***)

Test Gas	Concentration ppm	Accuracy %	Rise hr:min:sec	Fall hr:min:sec
Unleaded Gasoline	500	100	0:19:33	0:02:16
Synthetic Gasoline	1000	0	Not Applicable	Not Applicable
JP-4 Jet Fuel	500	100	0:24:20	0:03:44

(***) Average of Six Tests

ILS -350 Monitoring System Serial # Beta 013: TLS -350 Monitoring System Serial # 11014666415001

Carnegie Mellon Research Institute 4400 Fifth Ave. Pittsburgh, PA 15213

Standard Test Procedures for Evaluating Leak Detection Methods: Vapor-Phase Out of Tank Product Detectors - June 1990

Complete Test Results for Veeder - Root UST Monitoring System Models TLS -350, ILS-350 with Adsistor Vapor Probe

July 1992

x0001 Standard Test Method for Accuracy and Response Time

UNLEADED GASOLINE

CHAMBER =21°C			CHAMBER =20°C			CHAMBER = 20°C		
Conc. (ppm)	Rise Time (min)	Fall Time (min)	Conc. (ppm)	Rise Time (min)	Fall Time (min)	Conc. (ppm)	Rise Time (min)	Fall Time (min)
50	NR	NR	500	22.17	2.30	1000	10.78	2.28
50	NR	NR	500	15.22	2.12	1000	7.28	2.92
50	NR	NR	500	20.70	2.97	1000	6.55	2.12
50	NR	NR	500	21.12	2.25	1000	7.57	2.92
50	NR	NR	500	24.08	2.02	1000	6.63	2.90
Average	**NR**	**NR**	**Average**	**20.66**	**2.33**	**Average**	**7.76**	**2.63**

SYNTHETIC GAS

						CHAMBER =20°C		
Conc. (ppm)	Rise Time (min)	Fall Time (min)	Conc. (ppm)	Rise Time (min)	Fall Time (min)	Conc. (ppm)	Rise Time (min)	Fall Time (min)
50			500			1000	NR	NR
50			500			1000	NR	NR
50			500			1000	NR	NR
50			500			1000	NR	NR
50			500			1000	NR	NR
Average			**Average**			**Average**	**NR**	**NR**

JP-4 JET FUEL

CHAMBER =22°C			CHAMBER =22°C			CHAMBER =21°C		
Conc. (ppm)	Rise Time (min)	Fall Time (min)	Conc. (ppm)	Rise Time (min)	Fall Time (min)	Conc. (ppm)	Rise Time (min)	Fall Time (min:sec)
50	NR	NR	500	36.02	4.42	1000	29.87	5.20
50	NR	NR	500	15.88	2.93	1000	24.43	4.22
50	NR	NR	500	17.80	4.32	1000	12.28	2.75
50	NR	NR	500	8.32	4.03	1000	10.22	1.90
50	NR	NR	500	9.22	3.45	1000	8.32	1.37
Average	**NR**	**NR**	**Average**	**17.45**	**3.83**	**Average**	**17.02**	**3.09**

Rise and Fall Time was based on when the buzzer alarmed and reset
NR: No Response after exposure for 1 hour
CHAMBER: Sensor Chamber Temperature

Carnegie Mellon Research Institute 4400 Fifth Ave. Pittsburgh, PA 15213

x0003 Standard Test Method for Specificity

UNLEADED GASOLINE
CHAMBER =21°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	13.98	1.95
500	19.40	2.05
Average	**16.69**	**2.00**

SYNTHETIC GAS
CHAMBER =19°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	NR	NR
500	NR	NR
Average	**NR**	**NR**

JP-4 JET FUEL
CHAMBER =19°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	9.22	3.45
500	58.72	3.28
Average	**33.97**	**3.37**

XYLENE
CHAMBER =19°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	NR	NR
500	NR	NR
Average	**NR**	**NR**

n-HEXANE
CHAMBER =19°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	NR	NR
500	NR	NR
Average	**NR**	**NR**

TOLUNE
CHAMBER =21°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	NR	NR
500	NR	NR
Average	**NR**	**NR**

x0006 Standard Test Method for Lower Detection Limit

UNLEADED GASOLINE
CHAMBER =21°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	22.17	2.30
500	15.22	2.12
500	20.70	2.97
500	21.12	2.25
500	24.08	2.02
500	13.98	1.95
Average	**19.54**	**2.27**

SYNTHETIC GAS
CHAMBER =20°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
1000	NR	NR
1000	NR	NR
1000	NR	NR
1000	NR	NR
1000	NR	NR
1000	NR	NR
Average	**NR**	**NR**

JP-4 JET FUEL
CHAMBER =22°C

Conc. (ppm)	Rise Time (min)	Fall Time (min)
500	36.02	4.42
500	15.88	2.93
500	17.80	4.32
500	8.32	4.03
500	9.22	3.45
500	58.72	3.28
Average	**24.33**	**3.74**

ILS -350 Monitoring System Serial # Beta 013
TLS -350 Monitoring System Serial # 11014666415001

Rise and Fall Time was based on when the buzzer alarmed and reset
NR: No Response after exposure for 1 hour
CHAMBER: Sensor Chamber Temperature

Results of Third Party Standard Evaluation

Point Sensor Liquid Contact Product Detectors

This form documents the performance of the cable 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."[1]

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.

Method Description

Name UST Monitoring System: Model TLS 350 with

Version Solid-State Discriminating Dispenser Pan (794380-320) and Containment Sump Sensors (794380-350)

Vendor Veeder-Root Environmental Products

125 Powder Forest Drive
(street address)

Simsbury, CT 06070-2003 (800) 873-3313
(city) (state) (zip) (phone)

Detector output type: X Qualitative

Detector operating principle: X Electrical Conductivity ___Capacitance Change

___Interface Probe ___Product Permeable ___Product Soluble ___Thermal Conductivity

___Pressure Switch ___Magnetic Switch X Other Ultrasonic

Detector sampling frequency: ___Intermittent X Continuous

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. (see attached memo)
- 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.

[1] 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 UST Monitoring System: Model TLS 350 with

Version Solid-State Discriminating Dispenser Pan (794380-320) and Containment Sump sensors (794380-350)

Evaluation Results (continued)

> Compiled Test Results for Qualitative Detector

Test Product Flow Rate: 0.17 ± .010 gal/hr.

	Detection Accuracy	Product Activation Height	Response Time at a Flow Rate of 0.17 ± .010 gal/hr	Recovery Time
Accuracy and Response Time Regular Unleaded Commercial Gasoline (6 tests)	100%	1.34 ± 0.05 in (3.40 ± 0.13 cm)	6.59 ± 0.22 min	17.17 ± 2.32
Water - Low Level Alarm (6 tests)	100%	[72.0%]* 0.96 ± 0.00 in (2.45 ± 0.01 cm)	4.60 ± 0.13 min	less than 1 min.
Water - High Level Alarm (6 tests)	100%	7.98 ± 0.01 in (20.3 ± 0.0 cm)	5.00 ± 0.14 min	less than 1 min.
Specificity Synthetic Fuel (3 tests)	100%	[76.0%]* 1.02 ± 0.03 in (2.58 ± 0.09 cm)	6.02 ± 0.14 min	greater than 1 hour
Diesel Fuel (3 tests)	100%	[139.7%]* 1.87 ± 0.00 in (4.75 ± 0.00 cm)	44.13 ± 3.52 min	not applicable
Home Heating Oil #2 (3 tests)	100%	[137.3%]* 1.84 ± 0.01 in (4.67 ± 0.03 cm)	44.28 ± 0.40 min	not applicable

*** Specificity Reference: Regular Unleaded Commercial Gasoline**

Test Fuel	Product Activation Height - Calculated Lower Detection Limit for 95% / 5% Condition
Regular Unleaded Commercial Gasoline	0.18 in (0.47 cm)
Water	0.99 in (2.51 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."[1] I also certify that the results presented above are those obtained during the evaluation.

Marc Portnoff
(printed name)

Marc Portnoff
(signature)

June 30, 1997
(date)

Carnegie Mellon Research Institute **
(organization performing evaluation)

Pittsburgh, PA 15230
(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
Veeder-Root UST Monitoring System: Model TLS 350
with Dispenser Pan Sensor
May 1993

Monitor: TLS 350 UST Monitoring System		
Dispenser Pan Sensor Diameter	=	5.4 cm
Test Chamber Diameter	=	6.0 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.
• Designated Starting Point - The initial fluid height. For the testing the upper alarm it was set at 7 inches.

* After a sensor alarmed, the sensor was allowed to air dry per manufacturer's instructions. For either diesel fuel or home heating oil, after a sensor alarmed, the sensor was soaked in coleman fuel for 30 minutes and then allowed to air dry per manufacturer's instructions.

ACCURACY AND RESPONSE

Monitor = Veeder-Root TLS-350
Sensor = Dispenser Pan Sensor
Probe Diameter = 5.417 ± 0.016 cm ; $\alpha = 0.05$

NA=not applicable
NR=no response

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

TEST PRODUCT = UNLEADED GASOLINE

Test Distance = 5 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	20.5	6.70	15.0	3.50	11.5	77.0
2	2	21.4	6.25	14.0	3.30	11.7	73.0
3	3	20.9	6.52	17.0	3.30	11.5	75.0
4	4	21.0	6.53	20.0	3.30	11.3	74.0
5	5	21.9	6.90	19.0	3.60	11.3	78.0
6	1	19.9	6.65	18.0	3.40	11.1	74.0
Average			**6.59**	**17.17**	**3.40**	**11.4**	**75**
Std. Dev.			**0.22**	**2.32**	**0.13**	**0.2**	**2**

Detection Accuracy (%) 100.0

LOWER DETECTION LIMIT

TEST PRODUCT = UNLEADED GASOLINE

Test Distance = 5 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	25.8	6.03	10	0.47	11.1	10.5
2	3	25.6	6.47	12	0.47	11.1	12.0
3	5	24.7	6.18	10	0.47	12.0	11.0
4	6	25.1	6.18	31	0.47	10.6	15.0
5	1	25.0	3.97	23	0.47	12.0	9.0
6	3	24.7	4.27	9	0.47	10.7	10.0
Average			**5.52**	**15.83**	**0.47**	**11.2**	**11**
Std. Dev.			**1.10**	**9.06**	**0.00**	**0.6**	**2**

Detection Accuracy (%) 100.0

Calculated Lower Detection Limit
Product Activation Height (cm) 0.47

ACCURACY AND RESPONSE

Low Level Alarm

Monitor = Veeder-Root TLS-350
Sensor = Dispenser Pan Sensor
Probe Diameter = 5.417 ± 0.016 cm ; $\alpha = 0.05$

NA=not applicable
NR=no response

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

TEST PRODUCT = **Water**

Test Distance = 5 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	24.2	4.62	<1	2.45	11.8	54.5
2	1	24.8	4.55	<1	2.45	11.3	51.3
3	1	24.6	4.42	<1	2.43	11.8	52.0
4	1	25.0	4.72	<1	2.45	11.1	52.2
5	1	24.9	4.52	<1	2.45	11.1	50.3
6	1	24.8	4.78	<1	2.45	11.2	53.8
Average			**4.60**	**<1**	**2.45**	**11.4**	**52**
Std. Dev.			**0.13**	**NA**	**0.01**	**0.3**	**2**

Detection Accuracy (%)	**100.0**

Calculated Lower Detection Limit	
Product Activation Height (cm)	**2.51**

SPECIFICITY

Specificity Calculations	
Product Activation Height (%)	**72.0**

ACCURACY AND RESPONSE

High Level Alarm

Monitor = Veeder-Root TLS-350
Sensor = Dispenser Pan Sensor
Probe Diameter = 5.417 ± 0.016 cm ; $\alpha = 0.05$

NA=not applicable
NR=no response

Minimum Sensitive Height = 8 in (20.3 cm) + 20% = 34.4 cm

TEST PRODUCT = **Water**

Test Distance = 5 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	24.7	4.82	<1	20.3	10.0	48.0
2	1	24.6	5.02	<1	20.3	9.9	49.5
3	1	24.7	5.23	<1	20.3	9.7	51.0
4	1	24.8	5.07	<1	20.3	9.7	49.0
5	1	24.6	4.97	<1	20.3	9.8	48.5
6	1	24.5	4.90	<1	20.3	10.2	50.0
Average			**5.00**	**<1**	**20.3**	**9.9**	**49**
Std. Dev.			**0.14**	**NA**	**0.0**	**0.2**	**1**

Detection Accuracy (%)	**100.0**

(*) For this series of tests, the designated starting point was 7 inches.

SPECIFICITY

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

TEST PRODUCT = **SYNTHETIC GASOLINE**

Test Distance = 5 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	24.4	5.93	19	2.5	9.9	59
2	2	23.9	5.93	>60	2.6	10.1	60
3	3	23.7	6.18	>60	2.7	10.9	67.7
Average			**6.02**	**NA**	**2.58**	**10.3**	**62**
Std. Dev.			**0.14**	**NA**	**0.09**	**0.5**	**5**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**76.0**

SPECIFICITY (cont.)

Monitor = Veeder-Root TLS-350
Sensor = Dispenser Pan Sensor
Probe Diameter = 5.417 ± 0.016 cm ; $\alpha = 0.05$

NA=not applicable
NR=no response

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

TEST PRODUCT = **DIESEL FUEL**

Test Distance = 5 ft

Trial#	Probe #	Liquid Temp. (°C)	Response Time (min)	Recovery Time (min)	Product Activation Height (cm)	Flow Rate (ml/min.)	Liquid Volume (ml)
1	5	24.4	40.48	NA	4.75	10.1	100
2	6	24.1	44.38	NA	4.75	10.0	100
3	2	24.4	47.52	NA	4.75	10.1	100
Average			**44.13**	**NA**	**4.75**	**10.0**	**100**
Std. Dev.			**3.52**	**NA**	**0.00**	**0.1**	**0**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**139.7**

TEST PRODUCT = **HEATING OIL**

Test Distance = 5 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	23.1	44.27	NA	4.65	11.1	100
2	2	24.1	43.88	NA	4.65	11.0	100
3	3	23.3	44.68	NA	4.70	10.9	100
Average			**44.28**	**NA**	**4.67**	**11.0**	**100**
Std. Dev.			**0.40**	**NA**	**0.03**	**0.1**	**0**

Detection Accuracy (%)	**100.0**

Specificity Calculations	
Product Activation Height (%)	**137.3**

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name Discriminating Interstitial Sensor (Used in a non-discriminating mode)

Version number(s) 794380-341

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold (Lower Detection Limit) - The smallest product thickness that the detector can reliably detect.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Sensor Name: Discriminating Interstitial Sensor (Used in a non-discriminating mode)
Version Number(s): 794380-341

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation

	Product		
Parameter	**Water**	**Gasoline**	**Diesel**
Threshold - Lower Detection Limit (inches)	< 0.125	< 0.125	< 0.125
Precision - Standard Deviation (inches)	N/A*	N/A*	N/A*
Detection Time (minutes)	< 1	< 1	< 1
Fall Time (minutes)	< 1	< 1	< 1

* Sensor was tested for its ability to alarm below 0.125 inches.

Specificity -This sensor will respond to any liquid after its threshold is exceeded.

Additional Limitations or Considerations - None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

H. Kendall Wilcox
(signature)

Grain Valley, MO 64029
(city, state, zip)

November 1, 2000
(date)

(816) 443-2494
(phone number)

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name Hydrostatic Brine Sensor

Version number(s) 794380-301 Single point and 794380-303 Dual point sensors for use with the TLS-350 Series, TLS-300 Series, EMC Series, EMC Basic, Red Jacket ProMax and Red Jacket ProPlus

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold Levels – The liquid levels at which alarms are triggered.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation for the Single Point Sensor 794380-301

Parameter	
Threshold Level (inches)	1.74
Precision - Standard Deviation (inches)	0.006
Detection Time (minute)	< 1
Fall Time (minute)	<1

Table 2. Results of the Evaluation for the Dual [pomt Sensor 794380-303

Parameter	**Low Level**	**High Level**
Alarm Level (inches)	1.20	13.13
Precision - Standard Deviation (inches)	0.003	0.007
Detection Time (minute)	< 1	< 1
Fall Time (minute)	< 1	< 1

Specificity – This sensor will respond to any liquid after its threshold is exceeded. This testing was specifically for performance in brine

Additional Limitations or Considerations - None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

H. Kendall Wilcox

(signature)

Grain Valley, MO 64029
(city, state, zip)

February 3, 2003
(date)

(816) 443-2494
(phone number)

Laboratory Data

Veeder Root Hydrostatic Brine Sensor Data

Dual Point Sensor 794380-303

Test #	Low Level ML Added	Low Level Alarm (in)	High Level ML Added	High Level Alarm (in)
1	162	1.187	1581	13.11
2	163	1.195	1580	13.10
3	162	1.187	1580	13.10
4	162	1.187	1580	13.10
5	162	1.187	1579	13.09
6	162	1.187	1579	13.09
Stdev		**0.003**		**0.007**
Mean		**1.189**		**13.097**
Threshold		**1.20**		**13.13**

Single Point Sensor 794380-301

Test #	Low Level ML Added	Low Level Alarm (in)
1	234	1.715
2	234	1.715
3	233	1.708
4	234	1.715
5	233	1.708
6	232	1.701
Stdev		**0.006**
Mean		**1.710**
Threshold		**1.74**

Modified Procedure
Results of U.S. EPA Standard Evaluation
Liquid-Phase Product Detectors

This form documents the performance of the liquid-phase product detector described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's "Standard Test Procedure for Evaluation Leak Detection Methods: Liquid-Phase Out-of-tank Liquid Product Detectors". The modifications to the procedure were made to accommodate the specialized requirements of interstitial monitors.

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 make sure this form satisfies their requirements.

Method Description

Name Discriminating Dispenser Pan Sensor; Containment Sump Sensor

Version number TLS-350/300/300i Series Consoles with Sensor Models: 794380-322; 794380-352

Vendor Veeder Root Environmental Products

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

Simsbury,	CT	06070-2003	(203) 651-2700
(city)	(state)	(zip)	(phone)

Detector output type: ( ) Quantitative (x) Qualitative

Detector operating principle: ( )Electrical Conductivity ( ) Thermal Conductivity ( ) Interface Probe (X) Product Permeable ( ) Product Soluble (X) Other reed switch/float
Detector sampling frequency: ( ) Intermittent (X) Continuous

Evaluation Results

The detectors listed above were tested for their ability to detect a layer of liquid (hydrocarbon or water) in a tank or a sump. The following parameters were determined:

Lower Detection Limit - The smallest product thickness that the detector can reliably detect.

Specificity - Whether or not the sensor responds to various products.

Precision - Agreement between multiple measurements of the same product level

Detection Time - Amount of time the detector must be exposed to product before it responds.

Evaluation Results (continued)

> **Compiled Test Results** (for tests conducted at the lower detection limit)

Test	Gasoline	Water	Diesel
Probability of Detection	100	100	100
Probability of False Alarm	0	0	0
Accuracy (%)	100	100	100
Bias	N/A	N/A	N/A
Precision (%)	*	*	*
Detection Time (hh:mm:ss)	< 00:00:01	< 00:00:01	< 00:00:01
Lower Detection Limit (in)	*	*	*

* SEE ATTACHED TABLES

Specificity Results (%)**

Commercial gasoline	100
Synthetic gasoline	100
Diesel fuel	100
Jet-A jet fuel	100
n-Hexane	100
Toluene	100
Xylene(s)	100
Water	100/ 0**

** The sensors will respond to any liquid except for the polymer strip sensor which will not respond to water.

> **Safety disclaimer: This test procedure only addresses the issue of the interstitial monitors ability to detect leaks. It does not test the equipment for safety hazards.**

Certification of Results

I certify that the interstitial monitor was installed and operated according to the vendor's instructions and that the results presented on this form are those obtained during the evaluation. I also certify that the evaluation was performed using the procedures described in the modified test protocol.

H. Kendall Wilcox, Ph.D., President
(printed name)

H. Kendall Wilcox
(signature)

January 2, 1995 (Revision Dates: April 20, 1998; June 23, 1997)
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, Missouri 64029
(city, state, zip)

(816) 443-2494
(phone number)

Test Results for the Veeder Root Discriminating Pan Sensor (Model Number: 794380-322)

Float Switches

Run No.	High Level Water Height to Alarm (in)	Low Level Water Height to Alarm (in)
1	12.243	1.353
2	12.259	1.337
3	12.254	1.337
4	12.249	1.337
5	12.254	1.332
6	12.254	1.343
Mean (in)	12.252	1.340
Accuracy	100	100
Threshold (in)	12.276	1.372
Precision (Std Dev)	0.005492	0.007333
Detection Time	< 1 second	< 1 second
Fall Time	< 1 second	< 1 second

Polymer Strip

Run No.	Product		
	Water	Unleaded Gasoline	Diesel
	Height to Alarm (in)	Height to Alarm (in)	Height to Alarm (in)
1	No Response	0.005	0.005
2	No Response	0.005	0.005
3	No Response	0.005	0.005
4	No Response	0.005	0.005
5	No Response	0.005	0.005
6	No Response	0.005	0.005
Mean (in)		0.005	0.005
Accuracy		100	100
Threshold (in)		0.005	0.005
Precision (Std Dev)		N/A	N/A
Detection Time		Approx. 10 min.	2 - 12 hrs
Fall Time		N/A	N/A

Test Results for the Discriminating Dispenser Pan and Containment Sump Sensors (Model Number: 794380-352)

Float Switches

Run No.	High Level Water Height to Alarm (in)	Low Level Water Height to Alarm (in)
1	7.622	1.312
2	7.637	1.332
3	7.632	1.322
4	7.632	1.317
5	7.637	1.322
6	7.632	1.322
Mean (in)	7.632	1.321
Accuracy	100	100
Threshold (in)	7.656	1.351
Precision (Std Dev)	0.005477	0.006646
Detection Time	< 1 second	< 1 second
Fall Time	< 1 second	< 1 second

Polymer Strip

Run No.	Product		
	Water	Unleaded Gasoline	Diesel
	Height to Alarm (in)	Height to Alarm (in)	Height to Alarm (in)
1	No Response	0.005	0.005
2	No Response	0.005	0.005
3	No Response	0.005	0.005
4	No Response	0.005	0.005
5	No Response	0.005	0.005
6	No Response	0.005	0.005
Mean (in)		0.005	0.005
Accuracy		100	100
Threshold (in)		0.005	0.005
Precision (Std Dev)		N/A	N/A
Detection Time		Approx. 10 min.	2 - 12 hrs
Fall Time		N/A	N/A

Modified Procedure
Results of U.S. EPA Standard Evaluation
Liquid-Phase Product Detectors

This form documents the performance of the liquid-phase product detector described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's "Standard Test Procedure for Evaluation Leak Detection Methods: Liquid-Phase Out-of-tank Liquid Product Detectors". The modifications to the procedure were made to accommodate the specialized requirements of interstitial monitors.

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 make sure this form satisfies their requirements.

Method Description

Name Solid-State Dispenser Pan/Containment Sump Sensors; Piping Sump Sensors; Micro Sensor

Version number TLS-350/300/300i Series Consoles with Sensor Models: 794380-321; 794380-351; 794380-208; 794380-209; 794380-340

Vendor Veeder Root Environmental Products

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

Simsbury,	CT	06070-2003	(203) 651-2700
(city)	(state)	(zip)	(phone)

Detector output type: ( ) Quantitative (x) Qualitative

Detector operating principle: ( )Electrical Conductivity ( ) Thermal Conductivity ( ) Interface Probe ( ) Product Permeable ( ) Product Soluble (x) Other Ultrasonic and Float Switch
Detector sampling frequency: ( ) Intermittent (x) Continuous

Evaluation Results

The detectors listed above were tested for their ability to detect a layer of liquid (hydrocarbon or water) in a tank or a sump. The following parameters were determined:

Minimum Detectable Product Thickness - The smallest product thickness that the detector can reliably detect.

Precision - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Specificity - Whether or not the sensor responds to various products.

Evaluation Results (continued)

> Compiled Test Results

Solid-State Dispenser Pan/Containment Sump Sensors (Float Switch)

Probe Model	**794380-321/351**		
Product Type	**Gasoline**	**Diesel**	**Water**
Minimum Detectable Product Thickness (in)	1.022	0.983	1.022
Precision	0.010	0.010	0.010
Detection Time (hh:mm:ss)	<00:00:01	<00:00:01	< 00:00:01

Piping Sump Sensors (Float Switch)

Probe Model	**794380-208/209**		
Product Type	**Gasoline**	**Diesel**	**Water**
Minimum Detectable Product Thickness (in)	1.380	1.339	1.193
Precision	0.011	0.011	0.011
Detection Time (hh:mm:ss)	< 00:00:01	< 00:00:01	< 00:00:01

Micro Sensor (Ultrasonic)

Product Sensitive Sensor (liquid)

Probe Model	**794380-340**		
Product Type	**Gasoline**	**Diesel**	**Water**
Minimum Detectable Product Thickness (in)	0.200	0.180	0.189
Precision	0.011	0.007	0.007
Detection Time (hh:mm:ss)	< 00:00:01	<00:00:01	< 00:00:01

> Specificity Results (%)*

Commercial gasoline	100
Diesel fuel	100
Water	100

* These probes are designed to alarm in the presence of any liquid that exceeds the threshold level.

Liquid-Phase Product Detector Solid-State Dispenser Pan/Containment Sump Sensors; Piping Sump Sensors; Micro Sensor
Version number TLS-350/300/300i Series Consoles with Sensor Models: 794380-321; 794380-351; 794380-208; 794380-209; 794380-340

> Safety disclaimer: This test procedure only addresses the issue of the interstitial monitors ability to detect leaks. It does not test the equipment for safety hazards.

Certification of Results

I certify that the interstitial monitor was installed and operated according to the vendor's instructions and that the results presented on this form are those obtained during the evaluation. I also certify that the evaluation was performed using the procedures described in the modified test protocol.

H. Kendall Wilcox, Ph.D., President
(printed name)

H. Kendall Wilcox
(signature)

November 20, 1994 (Revision Dates: April 20, 1998; June 23, 1997)
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, Missouri 64029
(city, state, zip)

(816) 443-2494
(phone number)

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name Position-Sensitive Sensor

Version number(s) 794380-323 Position-Sensitive Single Point Sensor for use with the TLS-350 Series, TLS-300 Series, EMC Series, EMC Basic, Red Jacket ProMax, ILS-350 and Red Jacket ProPlus

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold Levels – The liquid levels at which alarms are triggered.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation for the Position-Sensitive Sensor 794380-323

Parameter	Water	Diesel Fuel	Gasoline	E85
Alarm Level (inches)	1.359	1.449	1.520	1.479
Precision - Standard Deviation (inches)	0.0408	0.00376	0.00377	0.00450
Detection Time (minute)	< 1	< 1	< 1	< 1
Fall Time (minute)	< 1	< 1	< 1	< 1

Specificity – This sensor will respond to any liquid after its threshold is exceeded. This testing included water, diesel fuel, gasoline and E85.

Additional Limitations or Considerations - Sensor alarms if it is raised from the bottom of the containment vessel.

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

H. Kendall Wilcox
(signature)

April 7, 2003 (Rev. Jan 31, 2006)
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, MO 64029
(city, state, zip)

(816) 443-2494
(phone number)

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name Discriminating Interstitial Sensor

Version number(s) 794380-343 for use with the TLS Series 350/350R/Simplicity/PC Monitoring System.

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold (Lower Detection Limit) - The smallest product thickness that the detector can reliably detect.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Sensor Name: Discriminating Interstitial Sensor
Version Number(s): 794380-343

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation

	Product		
Parameter	**Water**	**Gasoline**	**Diesel**
Threshold - Lower Detection Limit (inches)	< 0.1	< 0.1	< 0.1
Precision - Standard Deviation (inches)	N/A*	N/A*	N/A*
Detection Time (minute)	< 1	< 1	< 1
Fall Time (minute)	< 1	< 1	< 1

* Sensor was tested for its ability to alarm below 0.100 inches.

Specificity -This sensor will respond to any liquid after its threshold is exceeded. The sensor is designed to discriminate between fuel and water. Separate fuel and water alarms are triggered depending on if the alarm is caused by fuel or water.

Additional Limitations or Considerations - None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

H. Kendall Wilcox
(signature)

May 10, 2001
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, MO 64029
(city, state, zip)

(816) 443-2494
(phone number)

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name MicroSensor

Version number(s) 794380-344 for use with the TLS Series 350/350R/PC, EMC Series, and Red Jacket Promax Monitoring System.

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold (Lower Detection Limit) - The smallest product thickness that the detector can reliably detect.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation

	Product			
Parameter	**Water**	**Gasoline**	**Diesel**	**E85**
Threshold - Lower Detection Limit (inches)	< 0.1	< 0.1	< 0.1	< 0.1
Precision - Standard Deviation (inches)	N/A*	N/A*	N/A*	N/A*
Detection Time (minute)	< 1	< 1	< 1	< 1
Fall Time (minute)	< 1	< 1	< 1	< 1

* Sensor was tested for its ability to alarm below 0.1 inches.

Specificity - This sensor will respond to any liquid after its threshold is exceeded.

Additional Limitations or Considerations - None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

H. Kendall Wilcox
(signature)

May 10, 2001 (Rev. Feb 2, 2006)
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, MO 64029
(city, state, zip)

(816) 443-2494
(phone number)

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name___ Mag Sump Sensor _____

Version number(s)__ Form no. 857080-xxx For use with TLS-350 series, EMC, EMC-PC, EMC Enhanced, EMC-PC Enhanced, Red Jacket ProMax _____

Vendor__ Veeder-Root _____
(Name of Manufacturer)

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

Simsbury,	CT	06070	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold (Lower Detection Limit) - The smallest product thickness that the detector can reliably detect.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Sensor Name: Mag Sump Sensor
Version Number(s): Form no. 857080-xxx For use with TLS-350 series, EMC,

EMC-PC, EMC Enhanced, EMC-PC Enhanced, Red Jacket ProMax

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation

(See Attached Table for test data.)

Specificity - This is a discriminating sensor. A water warning is produced first followed by a water alarm. If fuel is present, it will alarm either by itself or floating on top of any water that is present in the sump.

Additional Limitations or Considerations – None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

H. Kendall Wilcox
(signature)

Grain Valley, MO 64029
(city, state, zip)

May 17, 2004 (Revised 5/26/05)
(date)

(816) 443-2494
(phone number)

Sensor Name: Mag Sump Sensor

Version Number(s): Form no. 857080-xxx For use with TLS-350 series, EMC, EMC-PC, EMC Enhanced, EMC-PC Enhanced, Red Jacket ProMax

Test Data for Veeder Root Mag Sump Sensor

24" Sump Sensor

Water Only
Water Alarm

Run #	Alarm Height (in)
1	1.640
2	1.640
3	1.609
4	1.609
5	1.599
6	1.589
Mean	1.614
Stdev	0.021254852
Threshold	1.666
Detection Time	~ 10 sec
Fall Time	~ 10 sec

Gasoline Only
Fuel Alarm

Run #	Alarm Height (in)
1	1.374
2	1.374
3	1.394
4	1.394
5	1.312
6	1.363
Mean	1.368
Stdev	0.030233156
Threshold	1.441
Detection Time	~ 10 sec
Fall Time	~ 10 sec

Diesel Only Fuel Alarm

Run #	Alarm Height (in)
1	1.363
2	1.271
3	1.271
4	1.353
5	1.358
6	1.358
Mean	1.329
Stdev	0.045107764
Threshold	1.438
Detection Time	~ 10 sec
Fall Time	~ 10 sec

Gas on 7" Water
Fuel Alarm with Water

Run #	Alarm Height (in)
1	1.076
2	1.122
3	1.128
4	1.112
5	1.122
6	1.138
Mean	1.116
Stdev	0.02135758
Threshold	1.168
Detection Time	~ 10 sec
Fall Time	~ 10 sec

Diesel on 7" Water Fuel
Alarm with Water

Run #	Alarm Height (in)
1	1.056
2	1.107
3	1.138
4	1.102
5	1.117
6	1.087
Mean	1.101
Stdev	0.027961404
Threshold	1.169
Detection Time	~ 10 sec
Fall Time	~ 10 sec

Explanation of Table

This discriminating sensor can identify whether an alarm is due to water or fuel. The following definitions apply to the tables above.

Water only water alarm – When the water reached a depth of slightly more than 1.6 inches an alarm occurred. The Water Alarm threshold is programmable from around 1.7 to 10 inches.

Fuel (gas or diesel) only alarm – If fuel enters a dry sump the fuel sensor will alarm at around 1.3 inches

Fuel alarm with water – If water is present and fuel enters the sump, a fuel alarm will result when the fuel depth reaches 1.0 to 1.2 inches on top of the water. This will occur irrespective of the water depth as long as the water is below the top of the sensor. The Fuel Alarm threshold is not programmable.

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name Interstitial Veeder Root Sensor for Double-walled Tanks – High Alcohol

Version number(s) 794380-345 for use with the TLS Series 350/350R/PC, EMC Series, and Red Jacket ProMax Monitoring System.

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold (Lower Detection Limit) - The smallest product thickness that the detector can reliably detect.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation

	Product			
Parameter	**Water**	**Gasoline**	**Diesel Fuel**	**E85**
Threshold - Lower Detection Limit (inches)	0.152	0.151	0.131	0.164
Precision - Standard Deviation (inches)	0.00708	0.00509	0.00534	0.00708
Detection Time (minute)	< 1	< 1	< 1	< 1
Fall Time (minute)	< 1	< 1	< 1	< 1

* Sensor was tested for its ability to alarm below 0.1 inches.

Specificity - This sensor will respond to any liquid after its threshold is exceeded.

Additional Limitations or Considerations - None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox, Ph.D., President
(printed name)

H. Kendall Wilcox
(signature)

February 2, 2006
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, MO 64029
(city, state, zip)

(816) 443-2494
(phone number)

Method Name and Version: Veeder Root Mag Sump Sensors
Date of Certification: January 16, 2006

Results of Evaluation of Systems Used for Testing of Sump Containment Vessels

This form describes the performance of the leak detection method described below. The evaluation was conducted by a consultant to the manufacturer according to a modification of the Water sensor test procedures described in the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems."

Tank owners using this leak detection system should keep this form on file to provide compliance with the federal regulations. Tank owners should check with State and local agencies to make sure this form satisfies their requirements.

Leak Detection Method Description

Name Magnetostricitive Discriminating Level Indicating Sump Sensor (Mag Sump Sensor)

Version number(s) Sump sensor Form numbers 857080-211, 857080-221, 857080-212 and 857080-222 for use with the TLS-350 Series, EMC Series, EMC Basic, and Red Jacket ProMax

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Results

This Leak Detection Method minimum change in level (MLC) that can be detected by The two probes tested for this evaluation are shown in Table 1.

Table 1. Performance of Veeder Root Mag Sump Probes

Parameter	857080-211, and -221 (12 inch probe)	857080-212, and -222 (24 inch probe)
Standard Deviation (in)	0.00130	0.00213
Minimum Level Change	0.00291	0.00475

Method Name and Version: Veeder Root Mag Sump Sensors
Date of Certification: January 16, 2006

Test Conditions During Evaluation

The evaluation testing was conducted in a 4 inch diameter containment sump with a nominal cross section of 12.56 square inches and a measured level to volume ratio of 0.000125 inches per ml.

Limitations on the Results

The performance estimates above are only valid when:

- The method has not been substantially changed.
- The vendor's instructions for installing and operating the Leak Detection Method are followed.
- Other limitations specified by the vendor or determined during testing:

_____

_____

_____

_____

Procedural Information

State the procedures used to determine when the Containment Sump is stable.

Level is monitored until stable readings are obtained..

State the procedures used to eliminate various types of errors.

Wind/Vibration

Shield from wind.

Water temperature versus surrounding soil and backfill temperature

Not considered

Other

None specified.

Method Name and Version: Veeder Root Mag Sump Sensors
Date of Certification: January 16, 2006

Other Information

Have other evaluations been conducted on this method? ( ) Yes (X) No

If so, please summarize the results or attach a copy of the Results Forms to this document.

> **Safety disclaimer: This test procedure only addresses the issue of the Leak Detection Method's ability to detect leaks. It does not test the equipment for safety hazards.**

Certification of Results

I certify that the Leak Detection Method was installed and operated according to the vendor's instructions and that the results presented on this form are those obtained during the evaluation.

H. Kendall Wilcox	Ken Wilcox Associates, Inc.
(printed name)	(organization performing evaluation)
H. Kendall Wilcox	
(signature)	Grain Valley, MO 64029
	(city, state, zip)
January 16, 2006	816-443-2494
(date)	(phone number)

Results of U.S. EPA Alternative Evaluation

Liquid Level Sensor

This form documents the performance of the liquid level sensor described below. The evaluation was conducted by the equipment manufacturer or a consultant to the manufacturer according to the U.S. EPA's requirements for alternative protocols. The full evaluation report also includes a report describing the method, a description of the evaluation procedures, and a summary of the test data.

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

Method Description

Name Single-Point Mini Hydrostatic Sensor

Version number(s) Form No. 794380-304, for use with ILS-350, TLS 300 Series, TLS-350 Series, EMC Series, EMC Basic, Red Jacket ProMax, and Red Jacket ProPlus

Vendor Veeder-Root
(Name of Manufacturer)

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

Simsbury,	CT	06070-7684	(860) 651-2700
(City)	(State)	(Zip Code)	(Phone)

Evaluation Parameters

The sensors listed above were tested for their abilities to respond to liquids when the sensors are installed in underground storage tank applications. The following parameters were determined from this evaluation.

Threshold (Lower Detection Limit) - The smallest product thickness that the detector can reliably detect.

Precision (standard deviation) - Agreement between multiple measurements of the same product level.

Detection Time - Amount of time the detector must be exposed to product before it responds.

Fall Time - Amount of time before the detector stops responding after being removed from the product.

Specificity - Types of products that the sensor will respond to.

Evaluation Results

Note: If the test data can be presented in a more appropriate manner, the evaluator may select to present the information below in a data table, which can be attached to these forms.

Table 1. Results of the Evaluation

	Product
Parameter	**Brine**
Threshold - Lower Detection Limit (inches)	0.793
Precision - Standard Deviation (inches)	0.00184
Detection Time (seconds)	<15
Fall Time (seconds)	<15

Specificity -This sensor will respond to any liquid after its threshold is exceeded but testing was conducted only with brine

Additional Limitations or Considerations - None

> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.

Certification of Results

I certify that the liquid level sensor was tested under conditions according to the vendor's operating instructions. I also certify that the evaluation was performed using methods described in the attached Alternative EPA Test Procedures for Liquid level sensors, and that the results presented above are those obtained during the evaluation.

H. Kendall Wilcox
(printed name)

H. Kendall Wilcox
(signature)

May 18, 2004
(date)

Ken Wilcox Associates, Inc.
(organization performing evaluation)

Grain Valley, MO 64029
(city, state, zip)

(816) 443-2494

VEEDER-ROOT

For technical support, sales or other assistance, please visit:
www.veeder.com