



# Evaluation of the Caldwell Systems Tank Manager Liquid Sensor

## Final Report

PREPARED FOR:  
**Caldwell Systems Corporation**

**November 9, 1998**



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# **Evaluation of the Caldwell Systems Tank Manager Liquid Sensor**

**Final Report**

**PREPARED FOR:**

**Caldwell Systems Corporation  
600 South Sunset Street, Unit D  
Longmont, Colorado 80501**

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## Preface

This report presents the results of an independent third-party evaluation of the Tank Manager Liquid Sensor that was conducted by Ken Wilcox Associates, Inc. (KWA) using the test procedures described in the standard protocol "Alternative Test Procedures for Evaluating Leak Detection Methods: Evaluation of Liquid Level Sensors", September 1996. The official results of this evaluation are contained in Attachment A of this report on the EPA Results forms. All work was conducted by Ken Wilcox Associates, Inc. at the Fuels Management Research Center (FMRC) in Grain Valley, Missouri.

Although every effort was made to assure that this testing meets the requirements for Alternative Testing as described by the federal EPA, Ken Wilcox Associates, Inc. makes no claims that the evaluation will be accepted by any or all regulatory agencies. The test procedures are listed with the EPA's National Workgroup on Leak Detection Evaluations (NWGLDE)<sup>1</sup> and meet the federal EPA requirements for Alternate Test Protocols as described in the forward to all of the standard EPA protocols for evaluating leak detection methods.<sup>2</sup> Attachment B contains a full copy of the evaluation procedures.

The results of this evaluation apply to the Caldwell Systems Tank Manager Liquid Sensor. This report was prepared by Mr. Jeffrey K. Wilcox, Ken Wilcox Associates, Inc. Technical questions regarding this evaluation should be directed to Mr. Joe Caldwell, Caldwell Systems Corporation at (303) 684-8436.

KEN WILCOX ASSOCIATES, INC



Jeffrey K. Wilcox, Engineer

Approved:



H. Kendall Wilcox, Ph.D., President  
November 9, 1998

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<sup>1</sup> In 1994, the EPA established the National Work Group for Leak Detection Evaluations which consists of a group of State and Federal Regulators that review leak detection evaluations, new evaluation protocols, and other issues affecting the leak detection and underground storage tank industry.

<sup>2</sup> "Standard Test Procedures for Evaluating Leak Detection Methods," EPA/530 UST-90/001-7, March to October 1990. Seven different procedures were developed for different leak detection methods and released between March and October 1990.

## **Attachment A**

### **Official Results Forms for the Caldwell Systems Tank Manager Liquid Sensor**

# 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.

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### Method Description

Name Tank Manager Liquid Sensor

Version number(s) TMLIQ

Vendor Caldwell Systems Corporation  
(Name of Manufacturer)

600 South Sunset Street, Unit D  
(Address)

Longmont,                      Colorado                      80501                      (303) 684-8436  
(City)                                      (State)                                      (Zip Code)                                      (Phone)

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### 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.

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**Sensor Name:** Tank Manager Liquid Sensor

**Version Number(s):** TMLIQ

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### 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.

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**Table 1. Tank Manager Liquid Sensor in Horizontal Position**

Parameter	Product		
	Water	Gasoline	Diesel
Threshold - Lower Detection Limit (inches)	0.955	0.506	0.510
Precision - Standard Deviation (inches)	0.0986	0.0210	0.0247
Detection Time (seconds)	< 1	< 1	< 1
Fall Time (seconds)	< 1	< 1	< 1

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**Table 2. Tank Manager Liquid Sensor in Vertical Position**

Parameter	Product		
	Water	Gasoline	Diesel
Threshold - Lower Detection Limit (inches)	3.650	3.370	2.990
Precision - Standard Deviation (inches)	0.1720	0.0873	0.0417
Detection Time (seconds)	< 1	< 1	< 1
Fall Time (seconds)	< 1	< 1	< 1

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**Sensor Name:** Tank Manager Liquid Sensor

**Version Number(s):** TMLIQ

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Specificity - This sensor will alarm when liquid is present from one end of the sensor to the other. The sensor consists of a hollow tube in which an ultrasonic sound pulse is transmitted. The sound pulse travels to the opposite end of the sensor and returns a reflection that is detected by the Tank Manager Controller. No reflection is generated if the cavity is dry.

Additional Limitations or Considerations - \_\_\_\_\_

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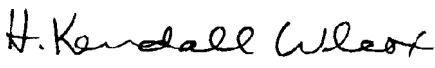
**> Safety Disclaimer: This test procedure only addresses the issue of the methods ability to respond to liquids. It does not test the equipment for safety hazards.**

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### 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)

  
(signature)

November 9, 1998  
(date)

Ken Wilcox Associates, Inc.  
(organization performing evaluation)

Grain Valley, MO 64029  
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