THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

TECHNOLOGY TYPE:	**AUTOMATIC TANK GAUGING (ATG) LEAK DETECTION SYSTEMS**
APPLICATION:	**UNDERGROUND STORAGE TANKS**
TECHNOLOGY NAME:	**Standard Water Float**
COMPANY:	**Veeder-Root Company**
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ETV Joint Verification Statement

The U.S. Environmental Protection Agency (EPA) has established the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies. Information and ETV documents are available at www.epa.gov/etv.

ETV works in partnership with recognized standards and testing organizations, with stakeholder groups (consisting of buyers, vendor organizations, and permitters), and with individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field and laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted according to rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Advanced Monitoring Systems (AMS) Center, one of six verification centers under ETV, is operated by Battelle in cooperation with EPA's National Risk Management Research Laboratory. The AMS Center recently evaluated the Standard Water Float manufactured and distributed by Veeder-Root Company for its ability to detect water ingress into an underground storage tank (UST) holding gasoline and gasoline/ethanol blends. The vendor installed the equipment in a Battelle-designed/constructed test vessel and trained Battelle staff on its proper use. Battelle staff conducted the evaluation.

VERIFICATION TEST DESCRIPTION

Testing was performed between September 13 and September 30, 2011. The verification test was designed to evaluate the functionality of the ATG systems when in ethanol-blended fuel service. The test was performed in the interior of an existing research building (JS-20) at Battelle's West Jefferson, OH south campus. The building interior and the exterior area surrounding the building were modified to accommodate a specially-fabricated test vessel and support items. The test vessel was fabricated from a 6-ft diameter piece of a fiberglass storage tank shell which was fitted with glass ends to allow visual observation of the conditions within the vessel during testing. Exterior storage facilities were made available for fuel and waste storage.

The characteristics of independent variables were selected and established during the test runs to determine the response of the dependent variables. Performance parameters were evaluated based on the responses of the dependent variables and used to characterize the functionality of the ATG system. The water ingress tests were focused on the mixing method of water addition into the test vessel. Three test designs were incorporated into the evaluation:

- A continuous water ingress test consisting of two parts:
    - Determination of minimum detection height;
    - Determination of smallest detectable incremental change in height; and
- A quick water dump followed by a fuel dump.

In the first test, a continuous stream of water was introduced into the field test vessel to produce a splash on the surface of the fuel or to not produce a splash by trickling the water along the surface of the fuel filler riser pipe to slowly meet the surface of the fuel. The independent variables and levels for the continuous water ingress test were:

- Fuel ethanol content (three levels): E0 (no ethanol), E15 (15% ethanol), and E85 (up to 85% ethanol);
- Water ingress method/rate (two levels): with splash and without splash; and
- Fuel height (two levels): 25% and 65% full.

The water ingress method/rate was selected to establish conditions that impact the degree of mixing that occurs in a tank using the three ethanol blends. The rate was established to accumulate enough water to generate a technology response within 1 hour. If a response was not observed in 3 hours, the run was terminated. Introducing water with a splash was accomplished by positioning a water tube such that water droplets would free-fall to the fuel surface below. The test condition was maintained until a response in the water detection technology was observed, or terminated after 3 hours if there is no response. Introducing water without a splash was accomplished by positioning the water tube such that surface tension allowed the water to flow along the outside of the fuel filler riser pipe with minimal agitation to the surface of the fuel. The test condition was maintained until a response in the water detection technology was observed, or terminated after 3 hours if there was no response.

Two fuel height levels were specified to establish different splash mixing regimes and diffusion columns. The lower fuel height yielded the greater splash mixing potential, but the shorter diffusion columns through which the water could flow. Conversely, the higher fuel height yielded the lower splash mixing potential, but the higher diffusion column. The fill heights were established to ± 10% of the target height of either 25% or 65%. At 25% and 65% of the height of the test vessel, 170 and 610 gallons, respectively, of fuel were in the test vessel.

To address the second part of the continuous water ingress test, once the water detection technology reacted to the minimum water height, the smallest increment in water height that can be measured was determined. An ingress rate of 200 mL/min was calculated to produce a height increase at the bottom of the tank of approximately 1/16th of an inch in 10 minutes. Readings were taken from the technology, as well as visually, 10 minutes after the increment portion of the run started. Both the technology readings and the manually-measured water levels were recorded. Readings/measurements were taken after ten, 10-minute increments for each replicate of Test 1 (to produce a minimum of 100 measurements).

The last type of test focused on the potential to detect phase separation in an UST. The test was designed to simulate a quick water ingress rate followed by a high degree of mixing such as might occur if a large volume of water was dumped into the tank at a 25% fill height and then fuel was dumped to fill the tank to a 65% fill height. This test was mainly observational in that the test vessel was disturbed quickly with water and fuel and the response of the technology was recorded throughout the test. Three runs of this type were conducted, one for each of the fuel types being evaluated in this verification test. The E0 run was conducted first and used as the baseline for the technology responses to establish the minimum wait time of 30 minutes with E15 and flex fuel.

Battelle staff checked the technology console for status messages continuously until an initial float response was indicated, recorded several instrument parameter values at the time of initial float response and every 10 minutes thereafter during the increment runs, and backed up the collected data each day. No on-site calibrations were performed. Each time that the technology reading was recorded, an independent height measurement was taken from the rulers installed on the glass ends or inside the test vessel.

QA oversight of verification testing was provided by Battelle and EPA. Battelle technical staff conducted a performance evaluation audit, and Battelle QA staff conducted a technical systems audit and a data quality audit of 25% of the test data. An independent technical systems audit was conducted on behalf of EPA. This verification statement, the full report on which it is based, and the Quality Assurance Project Plan (QAPP) for this verification test are available at www.epa.gov/etv.

TECHNOLOGY DESCRIPTION
The following information was provided by the vendor and has not been verified.

The Veeder-Root Standard Water Float is designed to detect and measure the level of water present at the bottom of a fuel storage tank in conjunction with a magnetostrictive level probe and ATG system. The water float, which represents a non-volumetric test technology, is located on the bottom of the tank where water collects as a dense phase in gasoline. As the water depth increases, the float rises and transmits an electronic signal proportional to the level of water in the bottom of the tank. Specific versions of the float are available for use in diesel fuel and (non-ethanol blended) gasoline. These floats are ballasted to have a net density intermediate to that of water and their respective fuels such that they will float at the water-fuel interface. The evaluation was performed using a standard float for use in gasoline.

Information acquired during operation of the water detection technology was transmitted from the float via a 2-conductor signal cable to a data recording and display console. A single console can compile data for several individual floats, and the Veeder-Root TLS-350 was used for this purpose during this verification test. The TLS-350 provides an electronic display and paper print-out of fuel and water heights and volumes, as well as settings for warnings and alarms based on measured heights. The console also generates an electronic data file that can be continuously transferred to a computer for users who want access to the data.

VERIFICATION RESULTS
The Standard Water Float responded to the water ingress when the test fuel was E0 and E15, but showed no response when flex fuel was used as the test fuel. The reason for the no response was that no clear separated dense phase was formed in the flex fuel when water was added to the test vessel. As a result, the performance parameters defined in the QAPP could not be determined for this technology when flex fuel was employed. The following table provides a summary of verification test results for the Veeder-Root Standard Water Float; the calculated performance parameters were determined using the pooled data from the E0 and E15 water ingress runs.

Currently 40 CFR, Section 280.43(a) states water detection technologies should detect "water at the bottom of the tank," which does not address water entrained in the fuel due to increased miscibility with the presence of ethanol. The water sensor, tested according to "EPA's Standard Test Procedures for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems," did not detect water in the test vessel containing either intermediate (E15) or high (E85) ethanol blends if the water was suspended in the product or the water did not reach the bottom of the tank. Because of this, there is not sufficient data to evaluate whether this technology, when used with UST systems containing intermediate or high ethanol blends, would indicate a potential release under every circumstance.

Performance Parameter	Method of Evaluation	Results	
Accuracy (E0 and E15 only)	Comparison to manual measurements	**Bias**	-0.167 inches
Sensitivity (E0 and E15 only)	Comparison to manual measurements	**Tolerance Limit**	0.680 inches
		Minimum Detectable Level Change	0.0596 inches
Precision (E0 and E15 only)	Evaluation of initial response for all runs with responses	**Mean** $(\bar{x})$	0.65 inches
		St Dev.	0.012 inches
		Precision ($\bar{x}$**/ St Dev.)**	53 inches
Ease of use	Operator observations	• Initial installation was completed in ~2 hours by vendor • Operation is automated upon powering; requires no external intervention • Operated unattended except for data downloads • Daily comma-delimited data files are generated automatically and stored in separate data files on an internal hard drive • Normal operations of the console involve following prompts on console screen; however, downloading and data management may be challenging	
Maintenance	Operator observations	• No routine maintenance activities were performed during testing	
Consumables/waste generated	Operator observations	• The technology required no consumables and generated no waste	

Signed by Tracy Stenner 9/26/12
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