December 29, 2008

To: All Interested Parties

RE: Amendment to EPA ATG and Non Volumetric TTT Protocols for water sensor testing

The NWGLDE was recently asked to consider a change in the number of test replications of the water sensor evaluation required in an existing EPA Protocol, published in March, 1990. The following protocols require an evaluation of a water sensor:

"Standard Test Procedures for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems," EPA/530/UST-90/006, March 1990

"Standard Test Procedures for Evaluating Leak Detection Methods: Non-Volumetric Tank Tightness Testing Methods," EPA/530/UST-90/005, March 1990

Following due consideration, the NWGLDE has decided the information supplied was sufficiently convincing to justify a reduction in the number of replications of the water sensor test from 100 replications to 20 replications. The statistical calculations in Chapter 7 of the above named documents will reflect the smaller number of tests.

Since similar water sensor testing is required in evaluations according to the "Standard Test Procedures for Evaluating Leak Detection Methods: Non-Volumetric Tank Tightness Testing Methods" the reduction in the required number of test replications would apply to equipment evaluated according to that protocol as well.

The following page contains the information supplied to the NWGLDE which formed the basis for the amendment as requested by the evaluator

This amendment to the above named Protocols was officially accepted by the NWGLDE on December 17, 2008.

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A Note on Water Sensor Testing for Determining the Minimum Level Change

The Automatic Tank Gauging Test Protocol[1] has a procedure for testing a probe to determine the minimum water level (or other fluid) change that it can detect reliably. The procedure described there has been interpreted as requiring a total of 100 level change determinations, although requiring this large a number was not intended and is not necessary to reliably determine the capability of the probe to measure an incremental change in fluid level.

While the original basis is probably lost in time, it may have resulted from the thought that when a test was being run to determine the minimum detectable water level, once a measurement of the minimum detectable level was obtained, it would be natural to continue the process to measure incremental changes. Since 20 determinations of the minimum detectable water (or fluid) level were required, if each was continued to give 5 or so level change determinations, then a total sample size of 100 or so would result.

However the number came about, it is not necessary to measure as many as 100 water (or fluid) change increments in order to reliably estimate the performance of the probe in tracking incremental changes. In fact, doing so many is quite tedious and the tedium may result in less accuracy because of getting tired or bored than a more carefully done experiment with fewer determinations.

A carefully done study measuring the increments for 20 changes should be sufficient to determine the capability of the probe to track water (or fluid) level changes. If an experiment with 20 determinations of the level change measurement is done, then the tolerance factor, K, required for the estimation of the MLC (minimum level change) that the sensor can detect becomes 2.784 instead of the value 2.233 based on 100 increments. (This is the value determined and used in Step 7 on page 39 of the protocol. Note that on that page it is noted that a different value of K must be determined if the number of differences obtained is less than 100.)

Ideally, one might want to use different starting levels to make sure that the starting level does not adversely affect the ability to track level changes. If different levels are used, I would recommend at least 10 increments be used with each starting level. Two starting levels would result in 20 increments. The factor of K is based on the degrees of freedom for the pooled standard deviation. A single set of 20 or more measurements can be used to estimate this standard deviation, resulting in n – 1 degrees of freedom (19 if 20 are used, giving a K of 2.784.) If two sets of 10 determinations were used, the degrees of freedom would be 18 and the corresponding K would be 2.819. Other values for K can be found in the *CRC Handbook of Tables for Probability and Statistics*.

In summary, I recommend that a smaller number of water (fluid) change increments be used. I suggest that a set of 20 increments, carefully done, is sufficient, although more can certainly be done and would improve the results slightly. The main improvement results from the smaller value of K being used, but note that it varies only slightly after reaching 15 or more degrees of freedom.

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1 "Standard Test Procedures for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems," EPA/OUST/UST-90/006, March 1990, Section 7.2.2.