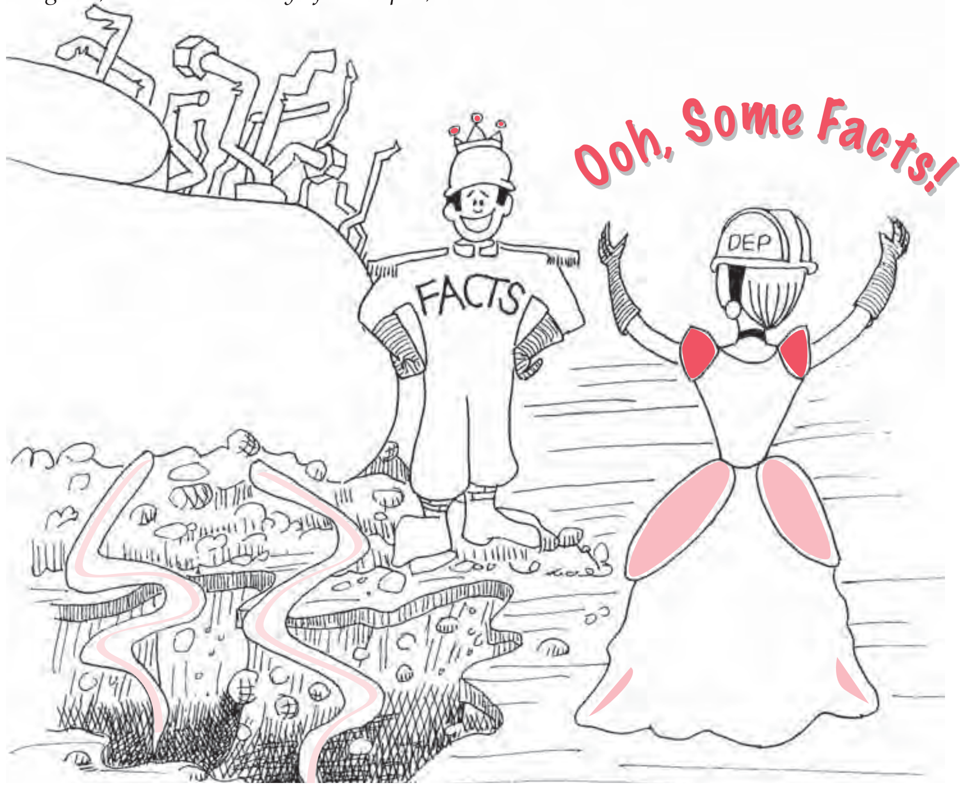
Tank-nically Speaking

by Marcel Moreau

*Marcel Moreau is a nationally recognized petroleum storage specialist whose column, **Tank-nically Speaking**, is a regular feature of* LUSTLine*. As always, we welcome your comments and questions. If there are technical issues that you would like to have Marcel discuss, let him know at* **marcel.moreau@juno.com.**

Someday My Facts Will Come…Part 2

As promised in my March 2011, LUSTLine *article, this follow-up article will take a closer look at what some of the testing statistics generated by Crompco, a leading UST testing company headquartered in Pennsylvania, can tell us about the current state of our UST systems. To provide different viewpoints on the data, I've also enlisted Tom Schruben, an independent environmental risk-management and UST-equipment-failure investigator, and Ed Kubinsky of Crompco, to contribute to this article as well.*



About Our Data

Crompco has been in business for 30 years and operates up and down the East Coast from Florida to Maine, with a strong presence in the Mid-Atlantic states. Unless otherwise stated, the data presented here are a compilation of the testing done by Crompco in Maryland, Pennsylvania, New Jersey, New York, and Massachusetts from January 2004 through August of 2011.

Crompco is primarily in the UST testing business, performing traditional tank and piping tightness testing, sump and spill bucket leak testing, and line leak detector operational testing, and providing annual certification of automatic tank gauges (ATGs) and the various sensors that are plugged into them.

Crompco primarily uses the following equipment and test methods:

- **Tanks:** Estabrook Ezy-3 Locator Plus (a non-volumetric, underfill tank testing methodology)
- **Lines:** Petro-Tite line tester
- **Under-dispenser and tank-top sumps:** hydrostatic testing
- **Spill buckets:** both hydrostatic and vacuum-based methodologies.
- **ATG and associated sensors:** per manufacturer's instructions and regulatory guidance.

Crompco has been using the same testing technologies for a number of years, so this variable is constant. Crompco also has a seasoned team of testers, most with many years of experience, so most of the test data we will be looking at were gathered by a relatively small group of people.

In the interest of preserving some of Crompco's proprietary data, all of the numbers here are presented as percentages. But in all cases, the percentages are based on hundreds to thousands of individual tests, so we can be reasonably confident that the percentages presented here represent accurate trends and are not flukes due to a small sample size.

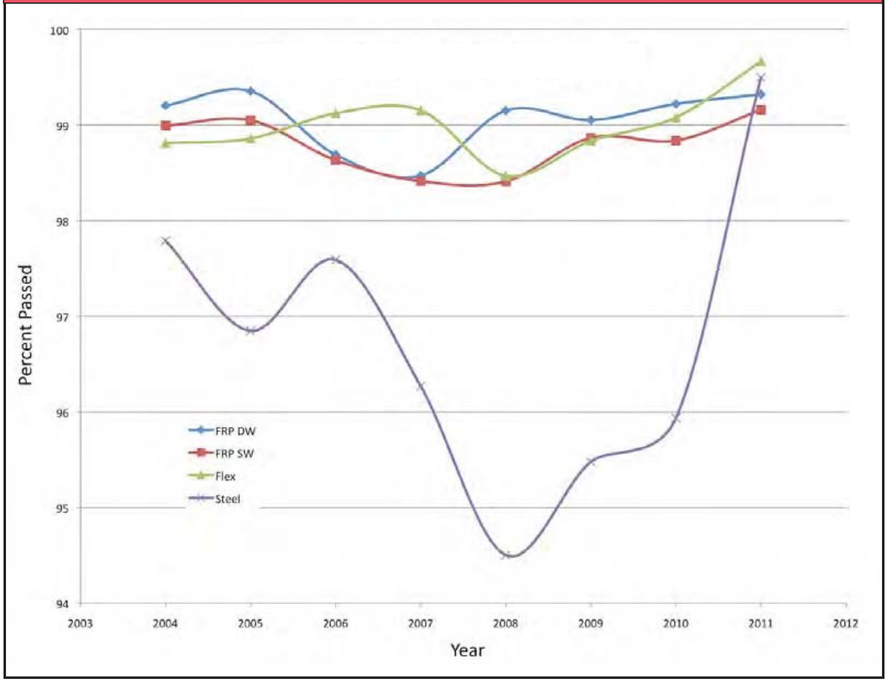
The Facts

Here are some graphs and a brief discussion of what we think might be going on.

Piping

Overall, the piping tightness-testing data (Figure 1) show that all types of piping are performing pretty well. There does not appear to be a significant difference among single- or double-walled fiberglass piping or the flexible piping systems that are in service today. Ed says they still test some of the older yellow Total Containment piping systems, but we made no attempt to sort these out from the flex-pipe category. Remember, these statistics are for passing tests—there was no evaluation of the condition of the pipe. There are, however, some pretty scary looking old flex-pipe systems that still manage to get passing test results. Steel piping systems have a slightly lower passing rate than FRP or flexible pipe, but steel is still doing reasonably well. The dramatic improvement in steel pipe performance in

FIGURE 1. PERCENT PIPING TESTS PASSED



2011 may not be a reliable trend as there have been relatively few tests of steel piping systems conducted in 2011.

Given the prevailing wisdom that leaks today are mostly in piping, the near perfect performance of these piping systems may seem a bit perplexing. Where are the piping leaks?

When reviewing these data, keep the following in mind:

- These piping tightness test results do not include the dispenser components or the submersible pump. This is because most tests are conducted with the ball valve at the submersible pump closed, so any leaks in the submersible pump head will not be "seen" by the test. Likewise, Crompco testers typically run the initial line test with the crash valve open so the dispenser components are tested, but if a leak is found in a dispenser component, the test is re-run with the crash valve closed so the dispenser is no longer included in the test. If the test with the crash valve closed passes, the result is recorded as a pass and would appear as a pass in our data. Crompco reports the leak in the dispenser separately to the owner or operator of the facility. So the leaks that are part of our database are leaks that were found between the ball valve and the crash valve. This would include flexible connectors in fiberglass piping systems and end fittings on flexible piping systems, but not leaks in the submersible pump head or inside the dispenser cabinet.
- Liquid leaks in dispensers and submersible pumps are very often visible when a cover or lid is removed. Most service technicians who observe a leaking filter, meter, flexible connector, or functional element are not going to call in a tightness tester to confirm the leak. As a result, your typical service technician will likely discover a lot more liquid leaks (as opposed to vapor leaks) in the course of a year than your typical tightness tester. The service technician will simply replace the leaking component and there will be no tightness-test results to document the leak—only perhaps a test conducted after the repair to document that the piping is tight. The point here is that we need to look beyond tightness-test data to get a handle on the universe of UST releases. While dispensers and submersible pumps have been largely overlooked by the UST regulations, they are clearly significant contributors to the LUST side of the program.

Tanks

Overall, the tank-testing data (Figure 2) show that all types of tanks are performing pretty well, though not quite as well at the piping. Fiberglass tanks are performing a bit better than steel tanks. Somewhat disturbing is the sudden decrease in the passing rate of double-walled steel tanks, and to a lesser extent the fiberglass tanks. This is true only for 2011 and although we have only partial data for 2011, the number of tanks tested in each category is still significant. These are trends worth keeping an eye on.

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FIGURE 2. PERCENT TANK TESTS PASSED

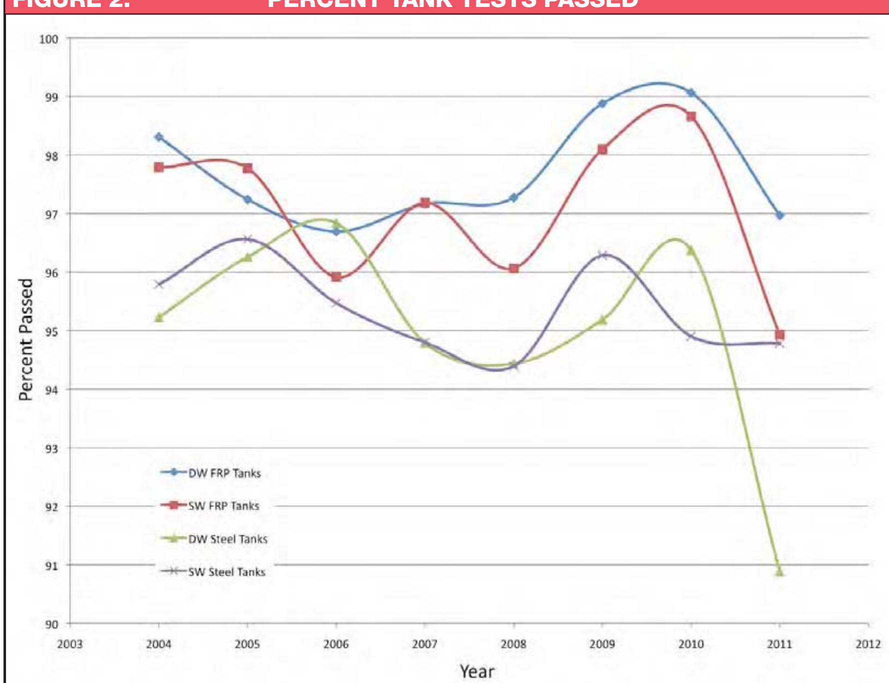

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FIGURE 3. PERCENT SUMP TESTS PASSED

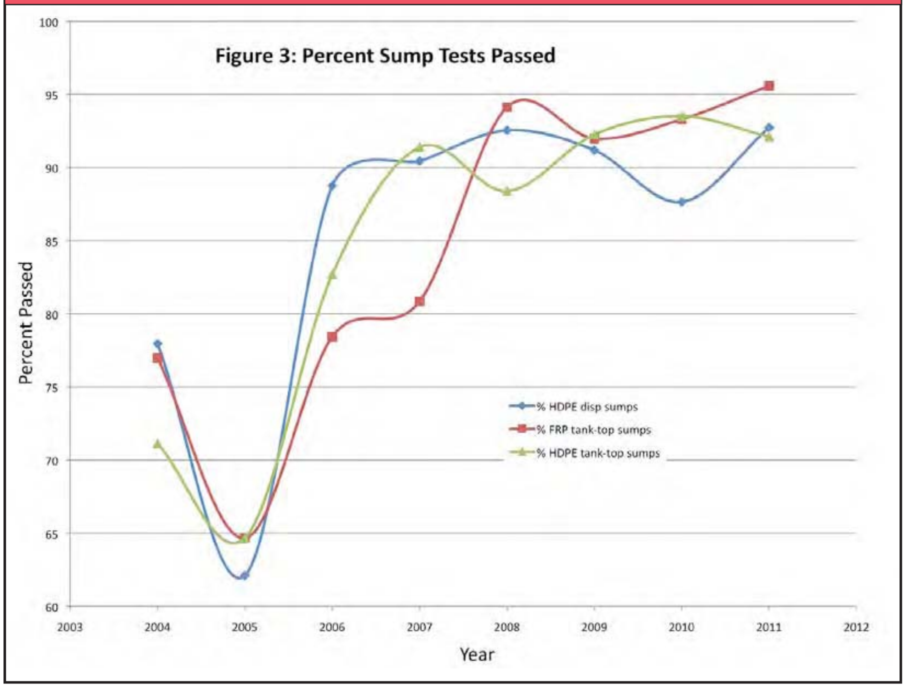
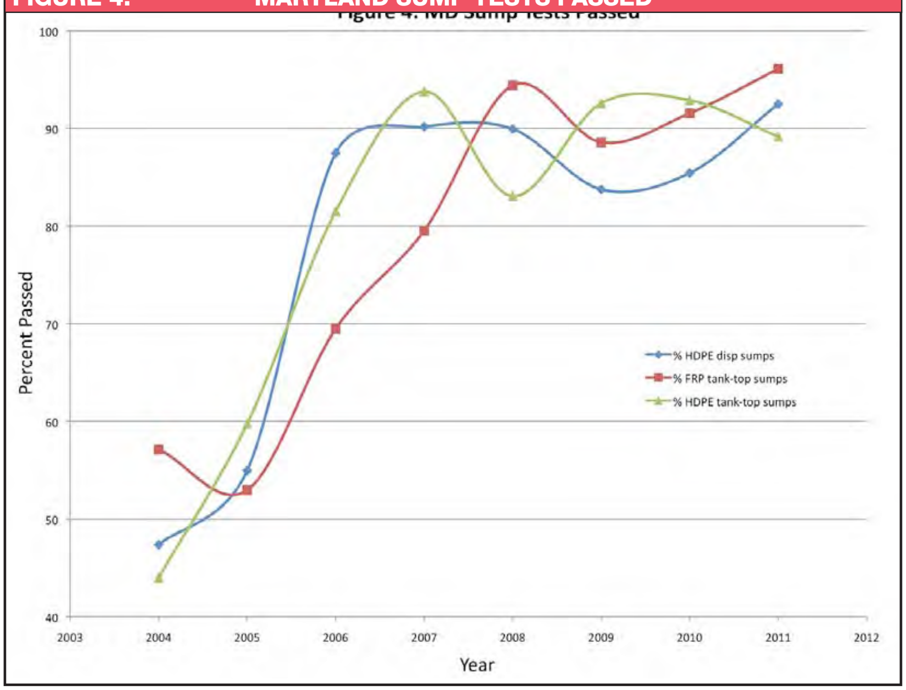


FIGURE 4. MARYLAND SUMP TESTS PASSED



When reviewing these data, keep the following in mind:

- The data we currently have do not indicate whether the tank failed to pass because of either a liquid leak in the bottom of the tank or a vapor leak from a tank-top fitting. This information could likely be gleaned from the data sheets for the tests, but we have not conducted that analysis yet.
- The double-walled tank failures may be underestimated. I know that in Maine, for example, a service technician who finds that the interstitial space of a tank is full of fuel will typically pump out the fuel from the interstitial space and return a week or so later to see if the fuel has returned. If the interstitial space is again full of fuel the tank is generally considered to have failed and a tightness test is not conducted. Maine has documented more than 50 failures of jacketed and double-walled steel tanks over the last five years.
- Maryland requires heating oil and emergency generator tanks to be tested at 15 years of age and every 5 years thereafter. A fair number of these tanks are present in the Maryland data, and our statistics may be skewed a bit by the inclusion of these tanks in our tank-testing statistics.
- The results of these tank tests are encouraging when viewed through a historical lens. Back in the late 1970s, when one of the first regulatory-driven tank-testing programs was conducted in Prince Georges County, Maryland, passing rates for tank tests were 50 percent. When USEPA conducted their tank-testing survey in the mid-1980s, the passing rate was 65 percent. That we are achieving tank-test passing rates generally above 95 percent in recent years is a measure of how far we have come in our quest to improve the integrity of our storage systems. Still, we should keep an eye on these numbers and maybe dig a little deeper to see how today's tanks are failing to be sure that our passing rate isn't slipping as our tank population ages.

Sumps

Keep in mind that a technician may make simple repairs to sump components (e.g., tightening a loose hose clamp) before conducting a test or after a failed test. Some of these passing results (Figure 3) may have initially been "fails" that were repaired and passed when retested. In other words, sumps in the "as found" condition might have a lower passing rate than what is reflected here.

The sump testing trend is encouraging in that it shows that greater numbers of sumps are passing tests over time, an indication that once sumps are made tight, a good many of them will stay tight for a while. The data show little difference in the performance of fiberglass versus high-density polyethylene (HDPE) plastic sumps. This is perhaps an indication that the major issues with sump leaks are associated with the penetration fittings that seal around the piping and electrical conduit that go through the side of the sump walls.

The pronounced decline in passing tests in 2005 is most likely due to a new sump-testing requirement that went into effect in Maryland in that year. Because a large number of the Maryland sumps were being tested for the first time, a large percentage of them failed. The sump-testing data for Maryland only (Figure 4) demonstrate that once the initial leak problems are addressed, sump performance increases substantially over time and levels off to about a 95 percent passing rate after a few years.

Spill Buckets

The trend in spill buckets is similar to the sump trend (Figure 5). There is a high failure rate initially that improves with time as leaky spill buckets are replaced. As this new generation of spill buckets ages, they may begin to fail as well and we should see a decreasing trend in the passing rate over time. If such a trend comes to pass, it would give us an indication of the real-world life expectancy of spill buckets.

Line Leak Detectors

Figure 6 shows the percent of electronic and mechanical line leak detectors (LLDs) that were successfully able to detect a three-gallon per hour leak each year. Overall, the electronic line leak detectors are performing better than the mechanicals, although the performance of the mechanical LLDs is steadily improving. We're not sure what is responsible for the improvement in the passing rate of the mechanical LLDs, but it may be the result of either better procedures for testing LLDs or improvements in the manufacturing of LLDs that have made them more reliable.

The dip in the performance of the electronic LLDs in 2005 and 2006 is likely due to a large increase in the number of electronic LLDs that were tested in MD and NJ in those years. These were presumably electronic LLDs that had not been tested previously. The substantial increase in failure rate for the "first time" tests points to the importance (despite some manufacturer's claims) of evaluating the performance of these devices. Failure of electronic LLDs to detect leaks can be due to improper programming, air pockets in the piping, or failure of the hardware itself. Review of the actual test records would be required to determine which of these factors might be responsible for the failed tests.

FIGURE 5. SPILL BUCKET TESTS PASSED

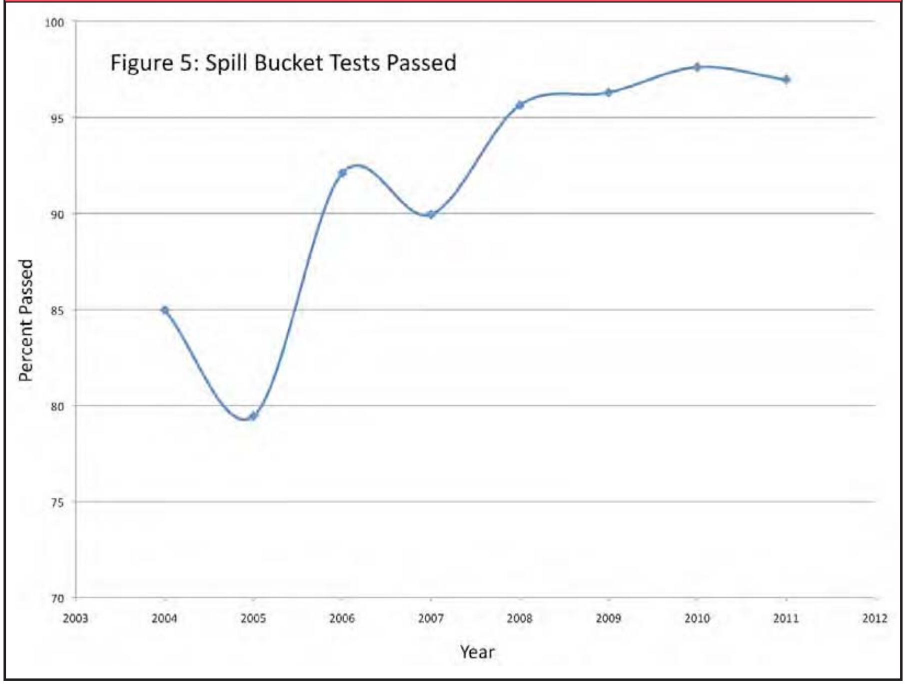
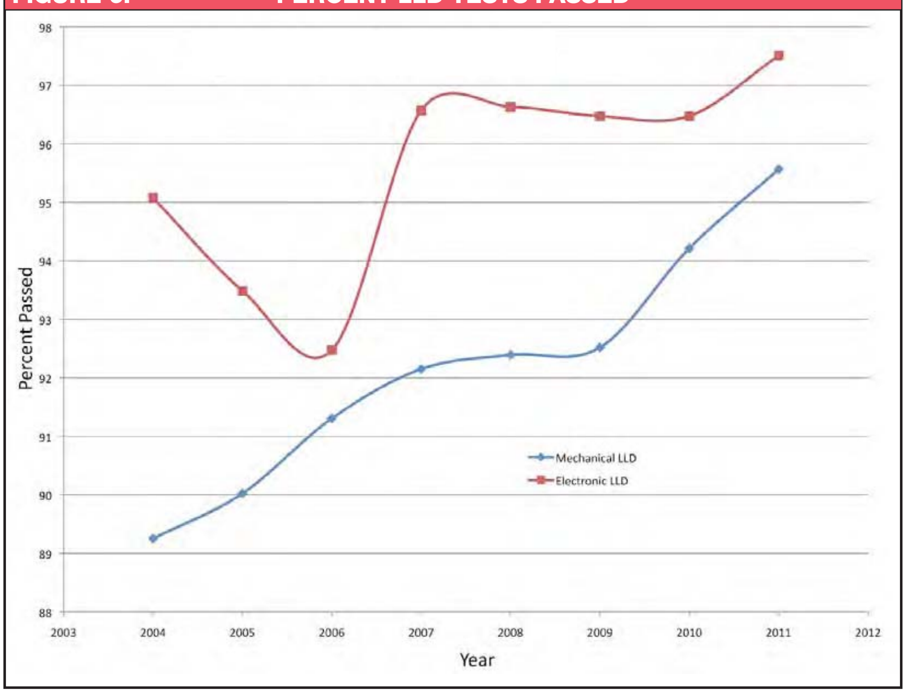


FIGURE 6. PERCENT LLD TESTS PASSED



Monitor Certification

Monitor certification typically involves checking the functionality of the different components of a tank gauge, including everything from the alarm and indicator lights to the sump and interstitial space sensors. The data (Figure 7) show a pronounced dip in 2006 and 2007. This dip is associated with large increases in the number of tank gauges that were tested in these years in Massachusetts and New York, and likely indicates that when checked for the first time, the performance of UST equipment is substantially less than the performance when equipment is routinely tested. Even when routinely tested, however, the passing rate for ATGs seems to level off at about 85 percent. Just looking at the raw data, it is not possible to tell whether the failures are due to programming errors, burned-out light bulbs, or

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failing sump sensors. A closer look at the individual records would be required to answer these questions.

Compliance Inspections

A number of states have third-party inspection programs, and Crompco personnel are certified as inspectors in a number of states. The data for Maryland, Massachusetts, and Pennsylvania (Figure 8) strongly point to some consistency issues among the state programs. While nearly all inspections conducted in Massachusetts have a passing result, in recent years less than 20 percent of the inspections conducted in Maryland have had a passing result. Pennsylvania fits in the middle, where generally between 40 and 60 percent of inspections have a passing result. These dramatic differences in results are likely due to substantial differences in the compliance criteria in each of these states. Ed says the low passing rate in Maryland may be because the state's inspection criteria include not only the usual UST issues but also Stage II vapor recovery equipment, maintenance records, and testing documentation.

A representative of a very conscientious tank owner who has tanks in several states and saw a presentation that included these compliance inspection statistics commented to Ed that, "It's funny, in Pennsylvania I never have a facility operations inspection that fails, yet in Maryland I never have a third-party inspection that passes." A conscientious tank owner who has a uniform standard of UST operation for all of his storage systems and who operates in these three states would have good cause to be frustrated.

FIGURE 7. MONITOR CERTIFICATION TESTS PASSED

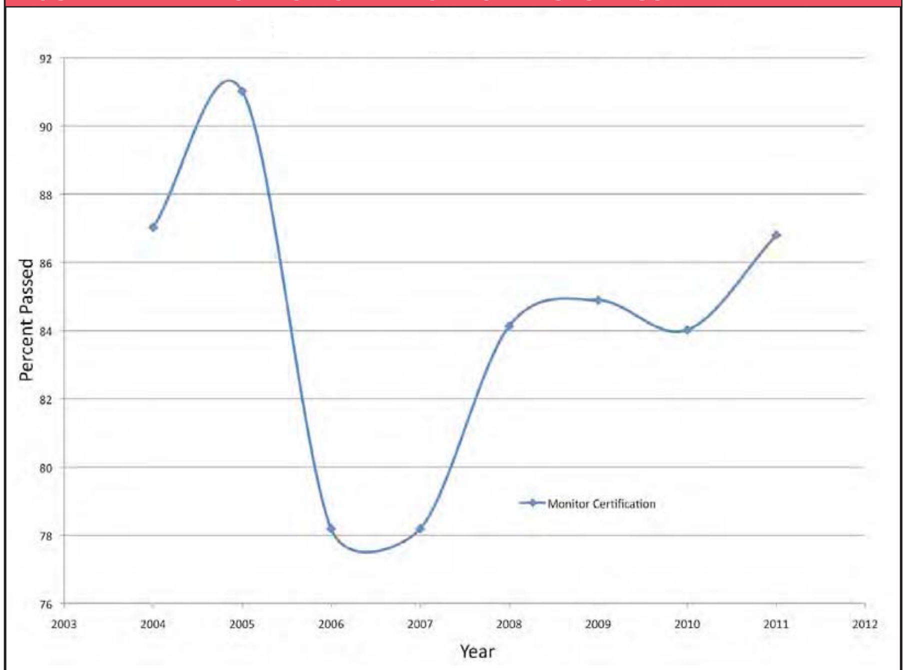
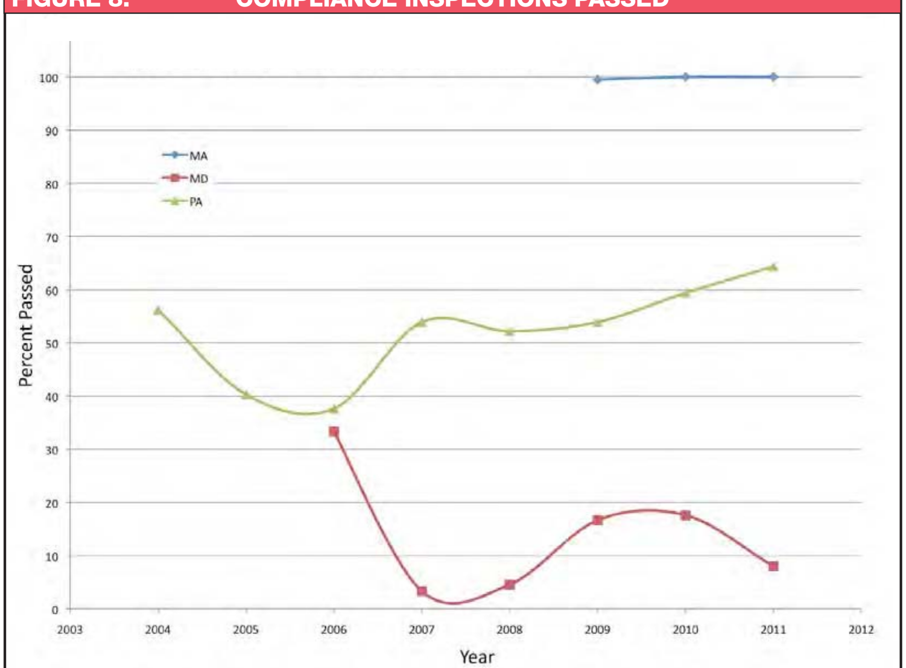


FIGURE 8. COMPLIANCE INSPECTIONS PASSED



So What Have We Learned?

Here are our observations:

- While we have not applied any formal statistics to these data, the test numbers are fairly large and the trends fairly consistent among different states, so we feel that these data are reasonably reliable. Overall, it looks like UST system integrity is generally good and improving in the states that we evaluated.
- Tanks and piping are performing quite well, but there are some trends worth watching and it may be worthwhile to dig deeper into the data to try to understand the causes behind some of the observed trends. Are failures related to the type of fuel or some other factor? Where are the failures happening in double-walled steel tanks—vapor leaks at the top or liquid leaks at the bottom?
- Take this analysis with a large grain of salt. Storage systems that pass tightness tests are not necessarily free of releases. Some components are not included in routine tests and repairs are often made before test results are reported. Testing data will underestimate release events because components that frequently leak (i.e., dispensers and submersible pumps) are not reported as part of piping tightness tests, and service technicians who observe leaks repair them without conducting a tightness test. We need to consult with service technicians to get a more complete picture of how

USTs are performing. It might also be instructive to gather data on the "as found" condition of containment sumps and spill buckets so we can have a better idea of whether these components are tight when the tester first comes to a site.

- Sump and spill bucket integrity testing appears to improve the reliability of these systems. Sump and spill bucket integrity is typically low during a first round of testing but improves over time. Reliability of sumps and spill buckets is critical for secondary containment to be a viable leak-detection (and, even more importantly, leak-prevention) method.
- We should study why ATG systems are failing certification procedures so we can figure out how to improve their reliability. Ed says that this may be possible by delving further into the records.

A big question is: Will compliance inspection procedures and compliance criteria ever be standardized enough to compare compliance inspection results from state to state? At the moment the differences between state evaluation procedures and passing criteria make such comparisons and data aggregation impossible. Eventually, we may arrive at a "just right" consensus on compliance inspections, but for now comparing data across states only tells us that states are wildly different in their approaches, much to the consternation of multi-state tank owners. ■

Postscript

As we dig into the data, we keep finding new questions to ask and new ways to slice and dice the numbers. We're thinking there are likely at least a few more LUSTLine *articles in these numbers. Are you interested? Let us know:*

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-Ed Kubinsky:
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-Marcel Moreau:
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Also, we'll be presenting and discussing testing data at a session at next year's National Tanks Conference not only from Crompco, but also from Tanknology and Protanic. See you there!

Those Lead Scavengers Still Persist in Old Product

by Jim Weaver and David Spidle

Thomas Midgley, Jr. patented the use of tetraethyllead (TEL) as a gasoline additive in 1926 (Midgley, 1926) to eliminate the newly found problem of engine knock. TEL was not a benign additive as it tended to precipitate on engine components. So Midgley soon found compounds, now known as "lead scavengers," that would prevent this problem by combining with lead during combustion. Early on, lead and lead scavengers were sold as a package to be added to gasoline at refineries.

One prominent "scavenger," ethylene dibromide (EDB), proved to be an effective solution to this problem. However, when the law of unintended consequences was applied, EDB proved to have lower volatility, higher water solubility, and more toxicity than benzene. EDB has a maximum concentration level (MCL) 100 times lower than benzene (0.05 µg/L EDB vs. 5 µg/L benzene) and has been found to persist in groundwater.

EDB has been discussed in *LUSTLine* several times. Ron Falta and Nimeesha Bulsara of Clemson University described many of the issues associated with lead scavengers in LL #47 (Falta and Busara, 2004). Based on their study of South Carolina data, they found that EDB was detected above its MCL at 25 percent of sites and at concentrations of 0.5 µg/L to more than 50,000 µg/L. In LL #50, Read Miner of South Carolina reported on a study of 104 EDB confirmed sites to better understand the lead scavenger problem. The results showed plume lengths from 100 to 2,800 feet and concentrations up to 40,000 µg/L (Miner, 2005). The prospects for various remedial technologies were assessed from experience at these sites.

In subsequent *LUSTLine* issues Steve Burton from USEPA Region 4 pointed out that leaded aviation gasoline and racing fuel were still sold, but that manufacturers' material safety data sheets didn't always indicate the presence of the lead scavengers (Burton, 2005). Mark Toso (Toso, 2007) reminded us that 1,2-dichloroethane (DCA) was also a lead scavenger and that in Minnesota, EDB detections were rare in comparison to DCA detections. That fewer EDB detections were seen in Minnesota's groundwater than in South Carolina's could be attributed to various causes, including differences in geochemistry and temperature.

The USEPA Office of Underground Storage Tanks (OUST) and Office of Research and Development (ORD) analyzed groundwater samples submitted by state tanks agencies from sites that were likely to contain leaded gasoline releases. The study found that EDB was above its MCL at 42 percent of sites, and DCA, as detected, was above its MCL at 15 percent of sites (Wilson et al., 2008). As a result of all of this work, OUST issued a recommendation that states test for the presence of lead scavengers at sites where they are likely to persist (*www.epa.gov/oust/cat/lead_scavengers_memo_05212010.pdf*).

Ferreting Out State Data

To address an aspect of lead scavengers that was not previously studied, we asked states for product samples from pre-1985 release sites to see how much of the scavengers were still in old product (Weaver et al., 2011). We received gasoline samples drawn from wells located primarily in eastern states, which were about evenly divided between north and south. With our 76 samples in hand from 10 states and 41 sites, we analyzed for TEL, EDB, and DCA.

Some of the results were as expected: Samples containing TEL or other forms of lead (tetramethyllead and triethylmethyllead), also contained EDB and DCA. Some leaded gasoline samples contained only EDB, which could be due to leaching of the more highly water soluble DCA. And then some leaded gasoline samples contained no scavengers, presumably also a result of leaching.

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