

**Standard for Inspection of In-Service Shop-Fabricated Aboveground Storage Tanks  
for Storage of Combustible and Flammable Liquids, STI Standard SP001-03**

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John Cignatta, Course Instructor of the Steel Tank Institute's Aboveground Storage tank (AST) Inspector Certification Course recently presented a good synopsis of why inspection of small aboveground storage tanks is important.

“ Few states have any certifications for AST installers and it shows in the *creative* ways the tank systems are installed.”

Certainly, if all tanks systems were designed, installed, operated and maintained according to industry practice, there would be no need for inspection standards. A recent evaluation at a major facility with more than 25 shop-built tanks clearly supported this statement. Nearly 90% of the tanks lacked adequate venting and overfill prevention equipment and over 50% lacked adequate containment and spill control. Other findings included:

- Emergency vents were rusted shut.
- No overfill alarms on tanks located adjacent to a waterway.
- A leaking tank.
- A 4” vent used on a 2” tank opening
- Inadequate foundations
- Doorways in dikes.

The STI SP001-00, “Standard for Inspection of In-Service Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids,” was introduced in late 2000 and recently revised in 2003. This standard was developed at the request of the Federal EPA and reviewed by various state agencies who provided valuable input.

The Clean Water Act requires that facilities covered under the EPA's SPCC regulations develop and submit a Spill Prevention, Control and Countermeasure (SPCC) Plan that is certified by a professional engineer. The purpose of this regulation is to prevent the discharge of oil into the U.S. navigable waters. The new rule states, “Test each aboveground container for integrity on a regular schedule... You must combine visual inspection with another testing technique such as hydrostatic testing, radiographic testing, ultrasonic testing, acoustic emissions testing, or another system of non-destructive testing... You must also frequently inspect the outside of the container for signs of deterioration, discharges or accumulation of oil”

### **Tank Construction Standards**

Before venturing too far into a discussion of inspection of shop built ASTs, it is imperative to obtain an understanding of how these tanks differ from the large bulk storage tanks often inspected under American Petroleum Institute standard API 653, “Tank Inspection, Repair, Alteration, and Reconstruction.” The scope of API 653 covers

tanks built to the API 650 construction standard. API 650 primarily covers the construction of large field-erected vertical tanks. The construction and installation of shop-fabricated tanks differ greatly from large, field-erected tanks.

Shop fabricated tanks are more commonly manufactured to other standards, such as from Steel Tank Institute, American Petroleum Institute, Southwest Research Institute and Underwriters Laboratories, with UL 142 or UL 2085 as the most often labeled set of tanks, such as often installed at commercial fueling applications. The Underwriters Laboratories standards include tables that specify the steel thickness based on tank diameter and capacity, although some performance tests are incorporated for rectangular tank designs.

Shop fabricated tanks have smaller capacities and therefore smaller hydrostatic pressures are encountered at the tank bottom. The tanks are manufactured in controlled shop environments and the maximum capacity tank built in the shop is normally limited to 12' diameter and 60' in length, equivalent to a 50,000 gallon capacity. In addition, a majority of UL and STI labeled shop fabricated tanks are horizontal cylindrical in geometry.

The inspection of horizontal cylindrical tanks, elevated rectangular tanks, as well as elevated vertical tanks includes very different requirements from large field-erected bulk storage tanks. This is because the bottom of the tank is visible and releases are more readily apparent. In addition, the tank supports can be visually inspected.

There is one exception to the type of tank construction that falls under API 650.

Appendix J of API 650 “provides requirements for the design and fabrication of vertical storage tanks in sizes that permit complete shop assembly” in one piece and in diameters 20’ or less. As a result, there is one category of tank where the STI SP001 and API 653 inspection standards overlap since both UL 142 and API 650, Appendix J, provide construction standards for shop-fabricated, single wall, vertical storage tanks on grade. These are tanks often used for bulk storage applications, and installed within a common dike. Hence, for these type of tanks, an inspection can be performed using either STI SP001 or API 653. The tank owner is likely to compare the two inspection methods and their associated costs. Although this paper is not intended to provide a detailed comparison of the two standards, the STI SP001 inspection standard does prescribe numerous metal thickness measurements of the tank floor to check for corrosion and pitting, whereas API 653 relies less upon such measurements, but more heavily on the judgment of the inspector.

When we compare tank construction today versus aboveground tank construction 10-15 years ago, we have seen a huge trend towards the purchase of secondary containment tanks. The potential risk of environmental release is greatly reduced when compared to tanks without adequate secondary containment and hence, also affords a different level of inspection. Thus, for all these reasons, a standard for inspection of shop-fabricated tanks was created to provide inspection efforts correlating to the risks imposed by the many different types of shop-fabricated aboveground tank construction.

## **Corrosion Concerns and Inspections**

One of the biggest issues pertaining to the long-term performance of shop built aboveground tanks that EPA wanted to address was to prevent releases from corrosion. Obviously, this concern is greatest with vertical tank bottoms in contact with the soil or a foundation and that cannot be visually inspected from outside the tank. But it is also important for the tank interior to be inspected, particularly when no containment is provided. Hence, the STI standard addresses this issue in a number of ways.

- Via a pressure test which is a static test of the tank's mechanical integrity at a point in time using nitrogen
- Steel tank wall thickness measurements using pit gauges, magnetic flux instrumentation, or using ultrasound technology, either A or B-Scan, by a certified NDE personnel, over a large area of the tank bottom surface area
- Check of interstice for fuel or water and of the secondary containment leak detection system
- Monthly, quarterly, annual, and ten year inspection frequency required by the owner and his certified inspector

The STI Certification Course provides significant detail on how these inspections take place and the type of equipment that can be used. Further, the SP001 provides criteria by which to evaluate the tank's integrity. The cost to inspect a tank depends on location,

inspector experience, number of tanks, type of tank, size of tank, age of tank, and the number and type of appurtenances associated with the tank. Excluding travel expenses, a typical inspection in the Midwest area of a small 2000 gallon 64" diameter tank may cost from \$1000 - \$2500; while an 8' diameter, 8000 gallon tank may cost from \$1500 to over \$3000, with the low end being a double wall tank and the high end being a single wall tank on grade, exclusive of any pressure tests.

### **Tank Repair and Internal Tank Maintenance**

Under certain conditions, if corrosion is found, the tank can be repaired. Some guidance is provided within the SP001 standard, although the Steel Tank Institute has developed a complimentary recommended practice for more comprehensive repairs of AST's, including provisions to add second tank bottoms. The STI Recommended Practice, SP031-04, was issued in March, 2004. In more severe corrosion situations, the tank must be re-inspected after 5 years by a certified inspector, rather than 10 years.

In all cases, the cause of the corrosion must be determined and either removed or addressed by the owner's maintenance program. For example, water is a common cause of pits to form on the inside of the tank. Water bottoms must be checked routinely per industry standards and the water removed in accordance with regulations and industry recommended practices..

## **Tank Appurtenances**

If the tank structure itself was the biggest culprit of oil releases into the environment, controlling this might be viewed as a slam- dunk. But it is not. A majority of releases may occur from filling and dispensing operations and from equipment that is attached to the tank.

This statement is not a new one. Once UL had developed new standards and certifications to address fire safety concerns for aboveground tank motor vehicle fueling facilities, important fire safety officials pointed out that there were much bigger problems than with the tanks. Important attachments, such as anti-siphon devices, normal and emergency vents, and overfill prevention equipment such as gauges, alarms, shut-off valves and spill buckets were not installed, were not installed improperly, or were inadequately maintained.

A former Chairman of NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages, and fire safety inspector in Alabama visited numerous AST sites in the mid-nineties and noticed these system deficiencies. As a result, fire codes implemented more safety-oriented language. Underwriters Laboratories developed a standard and a listing for a system, rather than just the tank or the individual components. And in 2003, NFPA 30, the Flammable and Combustible Liquids Code, bolstered their language for proper operation and maintenance for ASTs, including a reference to API 653, API 2350 (tank overfill prevention RP), and STI SP001.

The SP001 Standard imposes inspection requirements for these important tank appurtenances also. The owner must visually inspect such components every month and assure their operability on a regular basis. Valves must be inspected for any recent releases or weeping. Spill containment devices must be maintained and operable. Vents cannot be sealed shut. Emergency vents must be operable in case of exposure to hydrocarbon pool fires. Normal vents must allow the tank to breathe so that the tank does not get exposed to pressures or vacuum levels that can cause implosion or explosion and release of oil.

### **Not All that Meets the Eye**

At first glance, the small shop built tank seems unsophisticated and hardly worthy of its own standard. But as stated before, this simply is not true.

STI began certifying inspectors shortly after the SP001 standard was introduced. As part of the Course itinerary, there is a final exam provided immediately after a field visit is made to inspect a shop-fabricated tank in operation.

A few tank owners who volunteered to sponsor the visit were surprised by the outcome. Picture thirty to forty class participants and their instructor(s) congregating around a single tank to critically inspect the installation. Although the tank may have been signed off by the local jurisdiction as meeting local code and zoning laws, it is often the little

details that get overlooked. Appendix A provides some of the findings on the tanks inspected during the class.

Owners must remember, if they (or their friendly service provider) do not take the time to inspect and test the tank and its appurtenances, no one else will. Will these systems last 10 years? How about twenty or thirty years when no maintenance is performed?

### **The BIG Items**

When beginning an inspection, John Cignatta recommends that the inspector get the BIG picture first. Walk around the tank no closer than 20' and determine what the big problems are first.

- Does the tank have dirt spots that appear to have existed for years? This is often where fuel has spilled. Find the cause of the problem.
- Does the tank look like it was coated for underground use? If so, it probably was. Codes don't allow underground tanks to be used aboveground. They can be dangerous if used in such fashion and they often do not include emergency vents.
- Is the tank next to a river, yet it does not have any anchoring to prevent the tank from floating away during a flood?

- Is the bottom of the tank greater than 12” from grade? If so, this is another fire code safety issue. Supports must be structurally sound, free from excessive corrosion, and may require fireproofing.
- Are there only one or two openings atop the tank? This is a sure sign that it is missing important components to prevent releases.
- Is there containment around the tank and can it contain the entire contents of the tank – volumetrically and from static pressure loads? The containment must include additional volume for precipitation events, often called freeboard. Fire codes, such as the Flammable and Combustible Liquids Code, NFPA 30, also suggest that sufficient freeboard be incorporated to accommodate precipitation and fire-fighting water as governed by local conditions.
- Does the tank look like it has the original paint job given at the factory? And it looks like painting was applied fifty years ago? If so, then the tank is a good candidate for a thorough inspection.
- Can a fuel supplier delivering product determine the ullage level inside the tank while performing the delivery?
- Check the layout. Are there puddles of water under the tank bottom, even though it hasn't rained for 48 hours?

## The Little Details

After getting the BIG view, the inspection needs to go to the tank for a closer examination.

- Check the emergency vent. Can it be lifted? If a long bolt manhole assembly was provided, are the bolts still loose enough to allow the cover to rise, or are the bolts painted shut?
- Look at the normal vent too. If you see a bird's nest there, it is a good indication that no one has inspected the tank lately!
- Look hard for weep holes. Ultraviolet lights and localized cleaning of the tank surface can find hidden problems.
- Do the supports seem to make sense for the tank? Are the supports situated about a quarter of the length of the tank from each tank head? Is there any excess corrosion on the support? Can the bellyband impose high stresses on the tank circumference because of its positioning?
- Look inside the tank – SAFELY though. Many fatalities occur performing operations around tanks that store or have stored flammable liquids. Respect the power of these hazardous vapors. Get proper training and meet all OSHA requirements.

There is a lot more than meets the eye at first. That is why EPA wants all tanks to be inspected. The STI SP001 standard and inspection Certification Course provide a means to assure release free operations.

## Appendix

### **Inspection of 10,000 Gallon Fuel Tanks near Atlantic Coast During SP001 Course**

No grounding

Unsecured AST's in a flood plain (Not a single anchor bolt)

Electric Code Violations

Improperly Secured Conduits

OSHA Access Issue on the back stairs and top platform

PVC Caps atop various nozzles (No Fire Rating for PVC)

Labeling Issues

### **Inspection of Fuel Tanks During SP001 Course in Southwestern United States**

Catwalks were not OSHA rated for 42" rule, 200# force rule or toe boards or mid-rails

Unsupported Pipes

Leaking Submersible Turbine Pump

Kinked Flex Connector (i.e., exceeded minimum bend radius)

Improperly Installed Fuel Piping

No cathodic protection on buried steel pipe

Electric Code Violations

Combustible Materials stored inside dike

Spillage evident around fill opening

Conduits between fuel pipes in pipe trench

Unsupported Conduits

**Inspection of Fuel Tanks During SP001 Course in Northwest United States**

Valve on Return Piping

PVC Caps on various tank nozzles

Flex Fuel lines secured to Unistrut with conduit clamps

Normal vent on secondary tank's emergency vent opening

No Vehicle Damage Protection (i.e., bollards)

Improper labeling of nozzles

Tank not being sticked to check either ATGS accuracy or accumulation of water

**Inspection of Fuel Tanks During SP001 Course in North Central United States**

Emergency vents frozen shut

No anchor bolts to anchor tank into a foundation

No leak detection for pipe system