# Shop-Fabricated Secondary Containment Steel Storage Tanks

**Secondary containment tanks were first introduced in the United States in the early 1980's. Since that time, technological advances have accelerated and acceptance has become nearly universal from the regulated community. Meanwhile, standards, codes and regulations have developed and have been revised numerous times over the past twenty years addressing both underground and aboveground storage tanks. This article will provide background and an update on the following: • Underground storage tank (UST) secondary containment technology • Integrity verification of secondary containment • Aboveground tank (AST) secondary containment technology • Standards and codes**

**Reasons for using secondary containment**
Secondary containment tanks were first introduced in the United States in the early 1980's. Since that time, technological advances have accelerated and acceptance has become nearly universal from the regulated community. Meanwhile, standards, codes and regulations have developed and have been revised numerous times over the past twenty years addressing both underground and aboveground storage tanks.
This article will provide background and an update on the following:

- Underground storage tank (UST) secondary containment technology
- Integrity verification of secondary containment
- Aboveground tank (AST) secondary containment technology
- Standards and codes
- Reasons for using secondary containment

**Underground storage tank (UST) secondary containment technology**

The first secondary containment underground storage tanks were introduced in California and were constructed of two walls of steel physically separated with angles or channels to create an annular interstice several inches wide. Initial regulations encouraged secondary containment to hold 110 percent of the primary tank capacity. Designated "Type II" by Underwriters Laboratories in 1985 for their double-walled construction, these tanks were both costly and bulky – leading the industry to explore other methods. One early outcome was recognition that 100 percent containment was sufficient to hold the entire contents of the primary tank in the unlikely event of a catastrophic failure.

In Germany, secondary containment tank technology had already evolved to facilitate environmental safety needs and requirements. The Steel Tank Institute (STI) introduced the first American national construction standard for secondary containment tanks in 1984 based, in part, on this German technology. Coined "Type I" steel secondary containment tank by Underwriters Laboratories, the outer steel wall was intimately wrapped over the primary tank. The two walls could act as a single structural unit, reducing fabrication (and end user) costs.

Any product or groundwater that penetrated into the interstice would drain to a monitoring port for detection. STI's philosophy was to give tank users flexibility to determine the best type of technology to detect liquids in the interstice and to enable such technology to develop. Thus, the STI Dual Wall Tank Standard gave limited specification to leak detection, but rather focused on the need for the tank construction to incorporate monitoring accessibility.

Several years later, the jacketed steel tank containment system was introduced. Nomenclature was a major issue, but over time, the jacketed tank meant that the construction used plastic rather than steel for the outer containment. Having been used as a means of corrosion control for many years (via bonding of the fiberglass reinforced plastic to a steel tank to form a coating and via non-metallic tank construction), fiberglass reinforced plastic was one such system that was separated from the steel primary tank to create an interstitial space to monitor and contain releases. The fiberglass-reinforced plastic is considered a thermoset plastic. Alternative jacketed steel tank systems utilized various thermoplastics as the outer wall material. With the jacketed tank, the jacket material must also be capable of withstanding various chemical/soil environments.

With over half a billion gallons of steel secondary containment tank storage capacity installed in the United States, the environmental benefits have clearly been proven. In addition, according to the US Environmental Protection Agency, all secondary contained steel tanks installed in the United States must also have some form of corrosion control technology applied to the secondary containment. (See EPA Technical Compendium 18 for how this impacts EPA monitoring requirements of cathodic protected tanks.)

Construction standards developed by Steel Tank Institute and Underwriters Laboratories have given the tank builder and user multiple options to comply with this requirement.

Since US EPA regulations were first promulgated in 1988, the installation of secondary contained tanks as a percentage of all steel USTs installed has increased three to four-fold. This rate of increase is mirrored in STI's verified database of secondary containment tanks constructed to STI standards. Similarly, double-wall fiberglass tanks likely comprise comparable a majority share of all-FRP USTs. Secondary containment has made even greater strides in other countries - for example, Mexico, much of Europe and portions of Canada require that all USTs have secondary containment.

Similar acceptance and technological advances have developed with pipe systems, sumps and dispenser boxes. Today, installation of secondary contained pipe has become the norm at most service stations.

**How is the integrity of secondary containment verified?**

The secondary containment must be sturdy to assure that it will not lose its integrity after it has been built and tested at a fabrication facility. A tank may get shipped long distances. It may sit in storage at a job site, or alternatively, be moved around to facilitate construction. The tank gets lowered into an excavation and backfill is poured around and over the tank.

One common technology used today to verify containment integrity is with vacuum, factory-installed in the interstice of shop-fabricated steel USTs and shipped to the installation site for tightness/integrity verification during storage and installation. By verifying that the interstice maintains the factory vacuum before backfilling the tank, the installer need not conduct a separate air pressure test of the primary tank and the interstice. The vacuum already ensures that both the primary and secondary vessels are tight. After the tank has been installed and the integrity of the tank is assured, the system is backfilled. Many installers release the vacuum and place a release detection probe into the secondary containment monitor opening. In Europe and soon to be required in the State of California, a vacuum or pressure must be maintained within the interstice during operations as well.

**Aboveground storage tank (UST) secondary containment technology**

Since 1990, there has been a tremendous movement towards the installation of secondary contained aboveground storage tanks also. As old tank systems were removed from the ground due to EPA regulation, tank owners looked to alternative storage options. One option was by placing the tank aboveground, where visual leak detection became possible. Common applications included motor vehicle fueling for private fleets, airports, and fuel for either back-up power or heating.

As the 1990’s proceeded, environmental regulations of aboveground storage tanks were reinforced nationally and became promulgated in various states and regions. Concern that the containment is impermeable until a spill or release could be removed caused many operators to consider an impermeable outer containment such as steel for the primary shop-built tank. Fire codes also gave recognition to shop-built secondary containment tanks as an alternative spill control method to diking or remote impounding.

Fire codes also became concerned with the potential hazards of motor vehicle fueling operations from aboveground tanks. As a result, some codes created new tank construction methods, such as protected tanks. A protected tank included insulation to protect the tank, along with an emergency vent, during a very hot petroleum pool fire. The codes required protected tanks to be secondary containment tanks.

As a result, aboveground tanks were shipped as Type I double wall tank construction, protected tank construction and as tanks inside a steel dike or bund.

Some fabricators indicated that their aboveground tank orders included some form of secondary containment at least 50% of the time, whereas such construction was nearly non-existent in 1990.

**Code Requirements and**
**Third Party Test Laboratories**
**for Tank Construction**

**Underwriters Laboratories**

Concurrent with the industry development of secondary containment, Underwriters Laboratories (UL) in 1985 adopted secondary containment into its UL 58 standard. In 1989, UL issued UL 1746, a corrosion control standard for steel jacketed tanks that also incorporates a qualification test protocol for jacketed tanks.

In 1992, UL expanded its UL 142 standard for construction of tanks storing flammable and combustible liquids to include secondary containment options. The protected tank standard, UL 2085, was published in 1993. Since then, UL has also created standards for fire resistant tanks and vault construction that enables an aboveground tank to be installed and subsequently inspected.

**Southwest Research Institute**

Southwest Research Institute has also created standards for protected tanks, SwRI 93-01, and fire resistant tanks, SwRI 97-04.

**National Fire Protection Association**

The National Fire Protection Association's NFPA 30, the Flammable and Combustible Liquids Code, references UL 58, UL 1746, UL 142, and UL 2085 construction standards, as well as the use of air pressure or vacuum as a means to ensure the shop-fabricated tank and its containment is tight before it is used to permanently store flammable liquids. NFPA 30 requires all tanks to be tested after installation and before being placed into service - as well as after repairs, relocation or when suspected of leaking.

**Environmental Protection Agency**

The federal Environmental Protection Agency (EPA) recognized secondary containment as one of the solutions to the problem of storage tank leaks. In July of 1986, the EPA issued their final rule for hazardous waste storage in the Federal Register as 40 CFR Part 265, Sub-Part J. This rule required that double wall tanks (1) be designed as an integral structure so that any release from the inner tank be contained by the outer shell, (2) protect the primary tank from corrosion, and (3) be provided with a built-in continuous leak detection system capable of detecting a release within 24 hours.

In September of 1988, EPA published further rules on underground storage tanks as 40 CFR Part 280. Under this rule, all hazardous stored substances required secondary containment, mirroring the hazardous waste rule, except it further required the secondary containment system be checked for evidence of release at least every 30 days. However, petroleum UST systems were exempted from the secondary containment requirement, even though petroleum storage systems accounted for approximately 90 percent of all UST's. The EPA focused its regulation on corrosion protection, overfill prevention, and release detection as its primary means to protect the environment. With regulated tanks incorporating these measures, EPA expected that single wall systems would adequately protect human health and the environment.

**State and local jurisdictions**

In the early 1980's, several local and state jurisdictions were beginning to investigate tank leakage and promulgate rules for hazardous wastes and chemical storage. A number of states have imposed their own requirements for secondary containment systems of underground storage tanks, with California being one of the first to require secondary containment for storage of petroleum liquids. Florida and most of the New England states also require secondary containment for all USTs, while other states such as Michigan, Nebraska and New Jersey mandate secondary containment for USTs in sensitive areas such as near certain public water supplies and aquifers.

Particularly noteworthy are very recent California regulations that stipulate all UST systems (tanks and piping) installed on or after July 1, 2003 be impervious to the liquid and vapor of the contained substance [H&S Code §25290.2(a)], a requirement readily met by steel with its innate impermeability to both liquid and vapor. California H&S Code was also revised to require that the interstitial space of underground tanks and product piping installed on or after July 1, 2004 be maintained under constant vacuum or pressure, and that a breach in the primary or secondary containment be detected before the liquid or vapor of the stored substance is released to the environment [H&S Code §25290.1(e)]. Tanks installed prior to 7/1/04 must still have a continuous monitoring system, although the code is a bit less specific, stating that the continuous monitoring system be "capable of detecting the entry of the hazardous substance stored in the primary containment into the secondary containment." [H&S Code §25290.2(d); CCR §2630(d)] California further requires tanks to be tested every three years to verify integrity of containment. Dispenser boxes and sumps must be integrity tested every three years. However, UST components monitored continuously using vacuum, pressure, or interstitial liquid level measurement methods are not subject to further testing or evaluation.

**Is secondary containment worth it?**

Regardless of any mandates, secondary containment is a logical choice for UST owners or operators. From a pure safety perspective, secondary containment provides that extra insurance against releases of contaminants into the soil or groundwater and prevents release of flammable liquids from draining into buildings or public ways and causing a fire or explosion.

The benefits extend beyond safety stewardship. From a straightforward financial analysis, there are numerous costs – potentially devastating to a business – associated with product releases into soil or groundwater: fines, cleanup costs, report writing, lawsuits, and business interruption. And in the event that the tank was improperly installed or maintained, secondary containment provides an added level of protection. Simply put, secondary containment offers peace of mind to the tank owner.

Further, the cost of a secondary containment system does not necessarily double the cost of the installed tank system – far from it! Installation and labor costs account for a significant portion of a new installation. The labor to install either single wall or secondary contained tanks and piping will be similar.

Given the significant advances in secondary containment options over the past 20 years, tank specifiers and owners have a wide range of choices to consider. But no matter which technology is chosen, secondary containment is a prudent decision.

*Portions of this article were taken from an article written by Wayne Geyer that appeared in Thompson Publications' Underground Storage Tank Guide and entitled "An Update on Secondary Containment Underground Storage Tanks.*"

Wayne Geyer is Executive Vice President of the Steel Tank Institute in Lake Zurich, IL. He makes frequent presentations to various regulatory agencies: NACE, NFPA, BOCA, API and Waste Management.