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.**

A Primer for the Next Generation of Tank People

Part 2 – UST Ancillary Equipment

In LUSTLine *#60, I began a review of Tank and Piping Technology for today's new generation of tank workers and inspectors in order to give them a sense of where we are and how far we have come with regard to tank-related technology. This discussion may also be of interest to experienced tank folk who may have thoughts or comments they would like to share. So now, in Part 2, let's take a look at the other ancillary stuff (pumping and dispensing systems, fill pipes, and vapor and vent piping) that is so much a part of the life and times of UST-dom.*

Galvanized-pipe installation from days of yore.

Pumping and Dispensing Systems

In the very early years of underground petroleum storage, fuel was moved from the tank to the fuel dispenser by means of a hand-operated pump located in the base of the dispenser. Fuel was drawn out of the tank via suction, much the same way as a drink is sipped through a straw, and the pump was known as a suction pump. Hand pumps were later replaced by electrically operated pumps, but the principle of operation and the location of the pump at the bottom of the dispenser did not change for several decades.

Beginning in the mid-1950s a new type of pump was introduced whereby the pump mechanism was located near the bottom of the underground tank and thus submerged in the fuel. This type of pump pushes the fuel under a pressure of approximately 30 pounds per square inch through the piping and is variously known as a pressure pump, turbine pump, or STP (submerged turbine pump). This type of pumping system is the predominant pumping method utilized at today's retail motor-fuel locations.

Leaks from suction-pumping systems are often self-limiting. If the piping is not tight, the problem is generally noticed because air is drawn into the piping and the pump functions erratically. The advent of the submersible pump however, changed this picture dramatically. With the pump inside the tank instead of inside the dispenser, and the piping operating under positive rather than negative pressure, even large leaks in the piping did not affect the operation of the dispensing system. To this day, leaks in pressurized pumping systems account for the great majority of substantial subsurface product releases.

The Fill Pipe

The fill pipe is a vertical length of steel pipe, typically four inches in diameter, that is screwed into a fitting at the top of the tank, extending upward to just below the ground surface. The top end of the pipe is fitted with a special adapter that mates with a special fitting that is carried on delivery trucks so delivery personnel can quickly and easily clamp the delivery hose to the fill pipe.

In most of today's gasoline USTs, a drop tube is inserted inside the fill pipe. The drop tube extends from the top of the fill pipe to within six inches or so of the bottom of the tank. Delivering fuel through a drop tube reduces the amount of vapors that are generated inside the tank, because the incoming fuel does not free-fall and splash into the product already in the tank. In addition, drop tubes accelerate the flow of fuel into the tank so that the delivery time is shortened.

In today's storage systems, the fill pipe is surrounded by a below-grade container designed to be liquid tight so it can capture leaks from loose delivery fittings or any minor spills that may occur when the delivery hose is detached. This container is normally covered by a lid that protects the top of the fill pipe and is designed to prevent water from entering the spill container. These spill containers have been required for nearly all operating storage systems since December 1998, but they are a relatively recent addition to storage tanks, having been first introduced in the mid-1980s.

■ *continued on page 16*

■ Tank-nically Speaking
from page 15

Fill pipes themselves are not often a source of releases, but loose delivery fittings and the delivery process, especially the frequent disconnection of large cumbersome delivery hoses that have been incompletely drained, frequently result in the spillage of small quantities of fuel. If a spill-containment manhole is not present, or if the spill-containment manhole leaks, this fuel is spilled into the soil surrounding the fill pipe.

Due to miscalculations in ordering and mistakes in delivering fuel, delivery drivers can sometimes bring too much fuel to a site. This can result in a situation where a tank is overfilled, and anywhere from a few gallons to a few hundred gallons can be spilled onto the ground. During the 1990s, overfill-prevention devices were added to motor-fuel storage systems to help reduce the frequency of these incidents, but despite these devices, overfill incidents resulting in significant releases still occur. (See "What Every Tank Owner Should Know About Overfill Prevention," *LUSTline* #21, December 1994, for a detailed discussion of the workings of overfill-prevention devices.)

Vapor and Vent Piping

In areas of the country that suffer from air pollution, measures are taken to prevent the escape of gasoline vapors to the atmosphere. Gasoline vapor-control systems originated in California in the 1970s and spread to many other urban areas of the United States during the 1980s and 1990s. These measures are commonly referred to as Stage I and Stage II vapor recovery. USEPA rules enacted in January 2008 require more extensive use of Stage I vapor recovery to help reduce atmospheric concentrations of hazardous air pollutants such as benzene.

Stage I Vapor Recovery

In Stage I vapor recovery (Figure 1), two hoses are connected between the tank truck and the UST in order to accomplish the fuel delivery. Liquid gasoline flows through one hose from the truck to the underground tank, while at the same time, vapors present in the tank flow upward to the tanker truck. The fuel in the truck and the vapors in the underground tank are simply changing places. In the absence of Stage I vapor recovery, fuel vapors present in the tank would be exhausted through the vent pipe into the atmosphere as the fuel enters the UST.

There are two types of Stage I vapor recovery. The type illustrated in Figure 1 is called "two-point" because it uses two separate connections to the underground tank, one for fuel and one for vapor. The other type is called "coaxial" Stage I vapor recovery (see Figure 2). The coaxial system modifies the fill pipe so that fuel can enter and vapors can exit from the same tank opening. This is usually accomplished by installing a 3-inch diameter drop tube inside the 4-inch fill pipe, creating a gap between the drop tube and the fill riser through which vapors can pass. The delivery driver uses a special fitting to connect to the tank fill pipe that allows the fluid-delivery hose from the truck to connect to the drop tube while the vapor-recovery hose from the truck connects to the space between the drop tube and the fill pipe.

Figure 1: Diagram of Stage I Two-Point Vapor Recovery

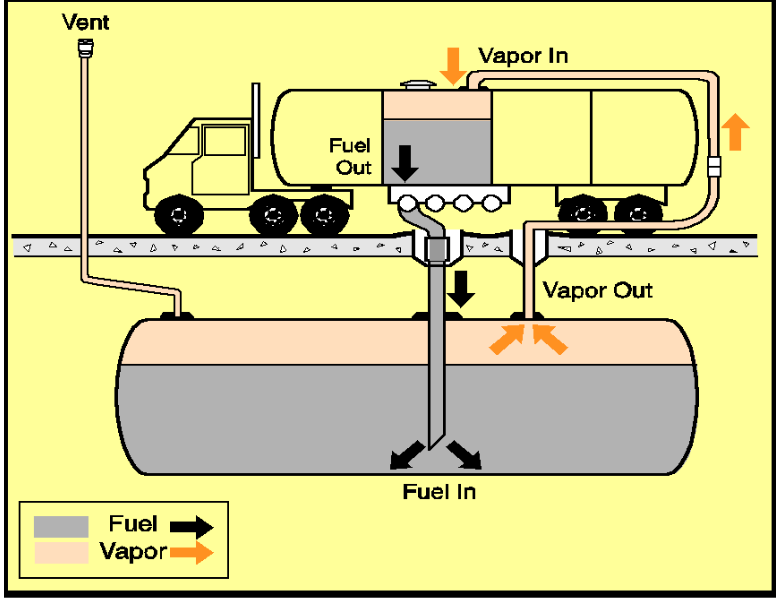
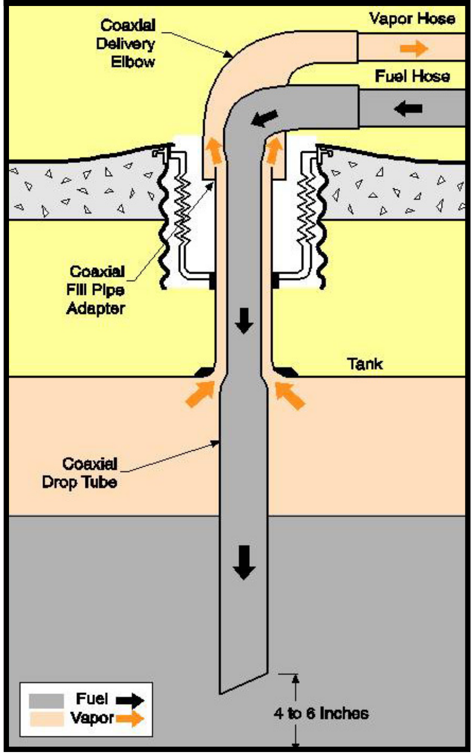


Figure 2: Diagram of Coaxial Stage I Vapor Recovery

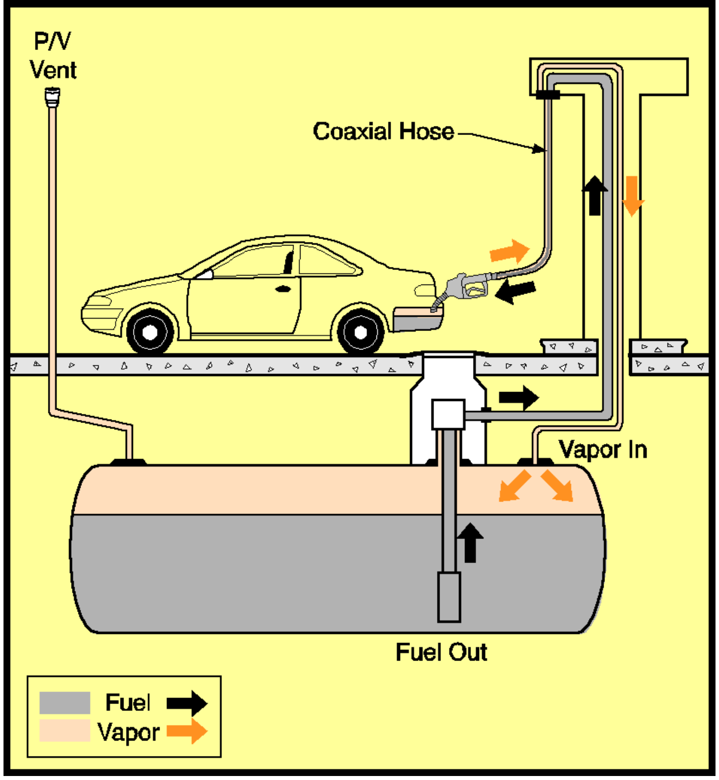


Stage II Vapor Recovery

In Stage II vapor recovery (Figure 3), vapors are transferred from a vehicle fuel tank into the UST when fuel is dispensed into the vehicle. This requires the installation of vapor piping from the dispensing nozzle all the way back to the UST. This vapor piping generally consists of a special nozzle that includes a vapor path as well as a fuel path, a vapor-carrying hose between the nozzle and the dispenser, vapor piping within the dispenser, and a separate, below-ground vapor-piping run between the dispenser and the tanks.

There are two main types of Stage II vapor-recovery systems: balance and vacuum assist.

Figure 3: Diagram of Stage II Vapor Recovery



removed from the tank.

The methodology for capturing gasoline vapors generated during vehicle fueling is presently in a transition phase. Stage II vapor recovery is being replaced by onboard refueling vapor recovery (ORVR). Rather than capturing gasoline vapors at the fuel inlet of the vehicle and bringing them to the underground storage tank, ORVR uses a carbon canister to capture the vapors as they leave the vehicle gas tank and retain them in the vehicle. Vehicles equipped with onboard canisters were first produced in the 1998 model year in the United States. Since 2006, all cars as well as light and medium duty trucks sold in the United States have been equipped for ORVR. Federal regulations state that once ORVR is in "widespread use" Stage II vapor recovery will no longer be required.

The USEPA has been tasked with determining when ORVR will be in "widespread use." Once this determination has been made, state and local air quality control agencies may permit gasoline-dispensing facilities to discontinue the use of Stage II vapor-recovery systems.

- **Balance vapor-recovery systems** have been in use since the 1970s. In the balance system, no motors or pumps are used to move the gasoline vapors from the automobile tank to the underground tank. Instead, a bellows-type device surrounds the nozzle spout and creates an airtight seal around the automobile fill pipe. As fuel enters the vehicle tank, vapors in the tank are forced out and flow through the bellows, the nozzle, and the vapor piping to reach the UST.
- **Vacuum-assist vapor-recovery systems** did not come into common use until the mid-1990s. In the vacuum-assist type of Stage II vapor recovery, a special vapor pump, typically located inside the dispenser cabinet, pumps the gasoline vapors out of the vehicle gas tank and into the UST. Nozzles used with vacuum-assist systems do not have a bellows and look very much like a conventional gasoline-dispensing nozzle. Because vacuum-assist systems forcibly push vapors into the UST, they can build up slight pressures inside the tank if the volume of vapors returned to the tank is greater than the volume of liquid gasoline

Vent Pipes

Underground tanks are not designed to withstand any great pressure or vacuum; they must constantly remain at or near normal atmospheric pressure. To ensure that underground tanks can "breathe" as fuel is added or removed, they are equipped with vent pipes that connect the inside of the tank to the atmosphere. The vent pipe is connected to the top of the UST and typically runs below the ground surface to an out-of-the-way location where it can be brought above ground.

Most aboveground portions of vent pipes are constructed of galvanized steel pipe and extend 12 feet or more above the ground surface. Vent piping belowground is usually constructed of fiberglass, though it may be constructed of galvanized steel. Galvanized steel is acceptable for vent piping because it does not routinely contain liquid product and so is not subject to the federal regulations regarding corrosion protection or leak detection.

Vent piping must slope uniformly back to the tank so that any liquid that enters the vent piping does not get trapped in any low spots. Flexible piping is difficult to install with a uniform slope and is not often used for below-grade vent piping. Most aboveground portions of vent pipes are constructed of galvanized steel and extend 12 feet or more above the ground surface.

When fuel is added to the tank, vapors inside the tank are either expelled through the vent pipe into the atmosphere, or, if Stage I vapor recovery is present, returned to the tank truck. When fuel is removed from the tank, ambient air can enter the tank via the vent pipe to prevent the creation of a vacuum in the tank. Alternatively, if Stage II vapor recovery is present, vapors removed from the automobile gas tank are returned to the underground tank, and there is little or no need for air to flow into the tank from the vent pipe.

To further contain vapors in the UST, vent pipes associated with tanks where vapor recovery is installed are often fitted with special caps that seal the vent-pipe opening. These vent caps will only open when there is a small pressure imbalance between the tank and the atmosphere that causes the vent cap to open to relieve the pressure or vacuum inside the storage tank.

Comments?

Well, that ends my very short course on tanks, piping, and other ancillary UST stuff. If you have any historical footnotes or anecdotes you would like to add, please send me an e-mail at marcel.moreau@juno.com. ■