Leak Prevention

Tank–nically Speaking

by Marcel Moreau

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What Every Tank Owner Should Know About Overfill Prevention

A couple of *LUSTLines* ago, I discussed in gory detail the workings of my least favorite overfill prevention device, the float vent valve (*LUSTLine* Bulletin #18, "Overfill Prevention: Are We There Yet?"). As I wander the country talking to tank owners and operators, regulators, and installers, I become ever more painfully aware that there is a clear and present dearth of information about the workings of overfill prevention equipment. As I search my library for information about overfill devices, I find, too, that there is precious little written about how they work and how they interact with the delivery personnel they affect and the storage systems they inhabit. Ergo...I will hereby attempt to plug this information gap by putting forth a basic primer on overfill prevention. I suggest that you grab a cup of coffee, settle into your chair, and put your thinking caps on...

Some Basic Facts about Fuel Deliveries

To better understand how overfilling occurs and how to prevent it, let's review some relevant facts about how deliveries are made into underground motor fuel storage tanks.

- The volume of fuel delivered into the tank is metered when it is loaded into the tanker truck but not when it is transferred into the the underground storage tank. Fuel transport trucks are compartmentalized so that they can carry different grades and quantities of fuel. When a driver hooks up to a tank, he plans to deliver the entire contents of each fuel compartment into its appropriate tank.
- The driver calculates the amount of ullage (empty space in the tank) by gauging the tank with a stick and referring to a tank chart. He needs to know that the ullage volume is greater than the volume of the truck compartment that will be emptied into the tank. In general, flow from the tank truck to the UST is by gravity; no pumps are involved. Typical flow rate is about 400 gallons per minute.
- Deliveries into smaller tanks typically involve pumping the product into the tank. In this case, the amount of fuel that is delivered is metered at the tank and only alarms and devices specifically designed for pressurized deliveries can be used. Unless otherwise indicated, this discussion will deal exclusively with gravity deliveries.
- A typical delivery hose is 4 inches in diameter and 20 feet long and has a volume of about 14 gallons.
- Delivery hoses usually connect to fill pipes with an airtight connection known as a "tight fill." Older, smaller tanks may be filled by simply inserting a length of pipe into the tank fill pipe. This is known as a "loose fill." Only overfill prevention alarms can be used with loose fills.
- There is only one valve in the tanker-to-tank delivery path. This valve is located under the belly of the tanker. There are no valves at either end of the delivery hose itself.
- Fire codes require drivers to stand by their vehicles while they make deliveries.

How Does a Delivery Spill Occur?

Typically, a spill during a delivery occurs through some miscalculation (i.e., when the driver attempts to drain a compartment of the tanker that contains more product than there is room for in the tank). In the absence of any overfill prevention devices, the driver ends up with a tank chock full of product, vent lines that are full of product up to the level of product in the truck, and a delivery hose that is full of product. The only valve in the system is the one under the belly of the tanker, so the 14 gallons of product in the hose and the product in the vent line can neither be returned to the tanker truck nor stuffed into the UST.

The driver's options are either to wait for customers to buy enough product from the UST to empty the vent lines and hose or to disconnect the hose and drain its contents into the manhole around the fill pipe. All too often, the latter option is the most expedient. In the days before tank regulation, the fill pipe manhole had no bottom, and the product drained directly into the environment, producing that all too familiar phenomenon: soil contamination around the fill pipe.

What Do the Rules Say?

The federal UST rules say little about overfill prevention systems except to specify at what liquid level the devices must operate. In addition to the specifications contained in the original rule (September 23, 1988), the overfill specifications were amended on August 5, 1991 to allow more flexibility in the operation of overfill prevention systems.

So, What's the State-of-the-Art in Overfill Prevention?

Although fill pipe manholes on new tanks are liquid tight, the volume of the hose (14 gallons) is roughly three times the volume of the typical spill containment manhole (5 gallons) around the fill pipe. Spill containment manholes (spill buckets) are great for catching minor drips that may result when the delivery hose is disconnected from the UST, but they are **not** the answer to overfill prevention.

The solution to the tank overfill problem is to stop or severely limit the flow of product into the tank **before** the tank is overfilled, so that product levels never rise into the vent lines and adequate room is left in the tank for the contents of the hose. The ability to drain the contents of the hose quickly and easily is also important to successful overfill prevention.

Let's look at the technologies, regulatory requirements, operational characteristics, advantages, and problems associated with the three common approaches to overfill prevention.

Alarms

Alarms are the least frequently used of the overfill prevention technologies. A typical UST overfill alarm is tied into an automatic tank gauging system. Most automatic tank gauges have the ability to trigger a remote alarm when the liquid level in the tank reaches a programmed level.

- ***Regulatory Requirements***

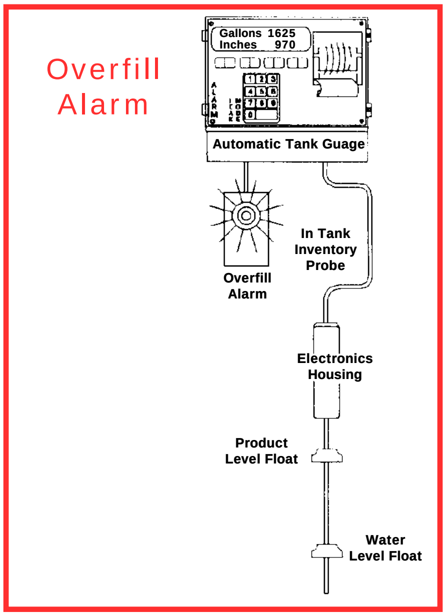
The original rule states that the alarm must be set to trigger when the UST is 90 percent full. The 1991 amendments added an alternative to allow one minute between the time the alarm sounds and the tank overfills. At a delivery rate of 400 gallons per minute, this translates to 400 gallons below tank top.

- ***Operational Characteristics***

When an alert driver hears an overfill alarm, he has 60 seconds to respond by shutting off the delivery valve (or valves, if more than one tank is being filled) that are open. If the driver is alert and conscientious and standing close to the valve, he can close the valve in this time frame. After he has shut the valve, the driver should silence the alarm to restore quiet to the neighborhood. Draining the contents of the hose into the tank is simply a matter of disconnecting it at the truck and holding it in the air until it drains. The hose should drain in a few seconds.

- ***Advantages***

Overfill alarms do not slow down the flow of product into the



UST. They provide the most rapid hose draining capability relative to other overfill prevention devices. They can be used with gravity drop or pressurized deliveries and even loose fills.

- ***Cautions***

The most serious deficiency of alarm systems is that most often the alarm itself is remote from the tank fill pipes and bears absolutely no label to identify it as an overfill device. Furthermore, the tank fill pipes are generally not labeled to indicate to the driver that an overfill alarm is installed at the facility. As a result, when the alarm sounds, the driver is more likely to think that a car theft alarm has gone off than that his tank is about to overfill.

Alarms must be located in the vicinity of the tank fill pipes, clearly visible from where the driver is likely to be standing, and clearly labeled as an overfill protection device with words like: "When alarm sounds STOP DELIVERY IMMEDIATELY." Unless it is properly located and identified, an overfill alarm is not likely to effectively warn the driver of the impending overfill.

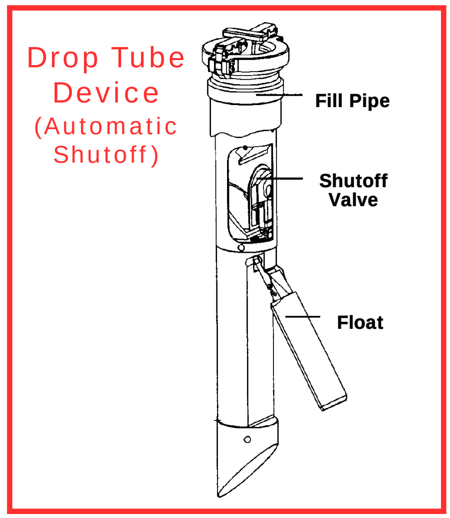
The driver must be present and alert in order for the overfill alarm to be effective.

- ***Cost***

The list price of the remote alarm itself is about $125. This alarm must be connected to an automatic tank gauge, which costs several thousand dollars. The installation cost of the alarm will depend greatly on the location of the automatic tank gauge relative to the mounting location of the alarm. Remember that the alarm must be near the tank fill pipes to be effective.

Drop Tube Devices

These devices replace a section of the drop tube, a thin aluminum tube that is inserted into the tank fill pipe and extends nearly to the tank bottom. There is usually a float-activated mechanism on the outside of the tube that releases a valve inside the tube that is forced shut by the flow of product. Typically, there is a bypass valve that allows a small amount of product to flow (5- to 10-gallons per minute) after the main valve closes. The bypass valve allows the hose to be drained after the main valve closes. If the delivery is allowed to continue (10 minutes or so after the main valve closes), the bypass valve also closes and the delivery hose can no longer be drained into the tank until the tank liquid level is lowered.



- ***Regulatory Requirements***

Because drop tube devices completely shut off the flow of product into the tank, they are allowed to be installed at a higher level in the tank than other types of overfill prevention devices. The original federal rule specified that these devices must activate at 95 percent of the tank capacity. The 1991 amendments specify that these devices can be installed at even higher levels, as long as the tank top fittings are not exposed to product.

- ***Operation***

As the primary valve is slammed shut by the force of the product flowing by, it creates a hydraulic shock,

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which typically causes the flexible delivery hose to "jump." The alert delivery driver notices this "jump," closes the delivery valve, and proceeds to drain the delivery hose through the bypass valve. Because flow is restricted initially to the bypass opening, the draining of the hose should take a minute or so.

• ***Advantages***

Drop tube devices allow the largest percentage of the tank capacity to be used. They are easy to retrofit on existing tanks, as long as the fill pipe goes straight into the tank.

• ***Cautions***

The sudden closing of the valve puts great stress on the delivery system. The hose connections to the tank and truck must be secure or they may pop off, creating a significant surface spill. The drop tube must be firmly attached to the fill pipe, and the shut-off device itself firmly attached to the drop tube, or else the tube can become a spear directed at the bottom of the tank, and may pierce it.

If the driver is not near the delivery truck, he may return to a situation where the delivery hose is full of product and the bypass valve has closed. He is now faced with the old dilemma of waiting for customers to buy product and lower the liquid level in the tank or trying to drain a 14-gallon hose into a 5-gallon spill containment manhole.

Fill pipe devices intended for underground storage tank use are designed for gravity deliveries only. If a delivery is made under pressure and the device activates, something is likely to break.

There must be a tight fill connection between the tank and the delivery hose, or else the fill pipe device will create a surface spill when the valve closes and the product has no where to go but up.

The valve mechanism must lift out of the way once the hose is removed so that the driver can stick the tank after delivery. Otherwise, the device is likely to be damaged by a frustrated driver trying to insert a gauge stick into the tank.

• ***Cost***

The list price of the device itself is around $375. Installation consists mostly of carefully attaching the device to a drop tube, a process which should take about an hour.

Vent Line Devices

Vent line devices are commonly known as "ball-float valves" or "float-vent valves." They are perhaps the most commonly used type of overfill prevention. They consist of a short length of pipe that extends down into the top of the tank from the vent opening. There is typically a wire cage fastened to the lower end of the pipe that contains a hollow metal ball. When the liquid level in the tank reaches the ball, the ball floats up and blocks the end of the pipe, blocking the vent opening. Also typical in this arrangement is a 1/8- or 1/16- inch vent hole in the pipe placed there to relieve the pressure in the tank. Manufacturers' recommendations and industry recommended practices require that float-vent valves be installed in extractor fittings to allow for the maintenance and inspection of these devices.

• ***Regulatory Requirements***

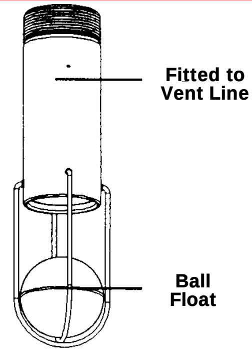
Float-vent valves, which are classified as "flow-restriction devices" for regulatory purposes, must be set to operate at 90 percent of the tank capacity (original rule) or 30 minutes before the tank is overfilled (1991 amendments). The 30-minute criteria is a little complicated to implement. According to measurements made by one manufacturer, in 30 minutes, a 1/16-inch hole will allow about 120 gallons to flow and a 1/8-inch hole will allow about 420 gallons.

An additional factor to consider is that when the ball first closes the vent, the air occupying the ullage space in the tank is compressed by the weight of the liquid in the tanker truck. The compression factor is about 25 percent of the ullage. For example, a 1,000-gallon ullage space would be reduced to about 750 gallons before the 1/8- or 1/16-inch hole begins to effectively control the flow rate into the tank. Careful calculations are required to use the 30-minute standard correctly.

• ***Operation***

Because of the compression of the ullage that occurs when the float-vent valve closes, the delivery flow into the tank reduces slowly, and there is no hydraulic shock. Consequently, there is no hose "jump" and no way for the driver to know that the float-vent valve has closed. The driver becomes aware that something is awry because the delivery seems to be taking too long. By looking at the observation window in the delivery hose, the driver will see that the hose is full of product. In addition, the driver can feel the hose to tell that the product is not flowing.

Vent Line Devices (Ball Float or Float Vent Valve)



At this point the driver can close the delivery valve under the belly of the truck to stop the delivery. However, in order for the hose to drain, the compressed air in the ullage space must be allowed to vent through the small hole in the float-vent valve. If the driver attempts to disconnect the hose before the pressure has been relieved, the pressure will push the product up through the drop tube and the delivery hose and into the driver's face. To avoid such an incident, the driver must wait 30 minutes or more for the pressure to be relieved. After the pressure is relieved, complete draining of the hose will take several more minutes.

• ***Advantages***

I cannot think of any operational advantages of the float-vent valve. They are often thought to be the cheapest form of overfill prevention, but the economic gains are small unless they are installed without extractor fittings. An extractor fitting, riser, and manhole are required to allow inspection and maintenance, but these parts are sometimes unwisely omitted.

• ***Cautions***

Float-vent valves must not be used with pressurized deliveries because, should the float-vent valve close, the pressure in the tank will rise 10- to 20-times above the tank's design pressure, a situation that has resulted in tank ruptures.

For the float-vent valve to operate properly, the top of the tank must be air tight. Tank-top tightness is most often compromised these days by the drain mechanisms of spill containment manholes. If the drain mechanism is not airtight, it will become the vent for the tank when the float-vent valve closes, releasing potentially explosive vapors at ground level. In fact, some drivers have learned to bypass float-vent valves by opening the spill containment manhole drain, thus venting the tank through this opening. This practice is very dangerous.

Float-vent valves should not be used with retail suction pumping systems, because the increased pressure in the tank can push product out through the air eliminator at the dispenser, causing a spill at the fuel island.

Float-vent valves are not compatible with coaxial Stage I vapor recovery as the float vent valve does not block the vapor return path around the drop tube, and so after an overfill, the driver ends up with both the delivery hose and the vapor return hose full of product with no place to go.

Float-vent valves will not work with loose fills.

• ***Cost***

The list price for the parts (valve itself, extractor, manhole, riser and cap) should come to around $250. Labor costs at a new site should be small. A retrofit would involve digging down to tank top and re-piping, which could be expensive.

The Bottom Line

At this point, you may have the impression that I haven't an abundance of warm and fuzzy feelings about the current state-of-the-art in overfill prevention. Well, you're right! If I were faced with the prospect of having to install overfill prevention, I'd probably go with a shut-off device, but I would want to be sure that my delivery person(s) knew that these devices were installed, how they worked, and at what liquid level they were set to trigger.

The major stumbling block in overfill prevention is that delivery personnel are expected to know this information through some magical osmotic process. The fact is that delivery personnel (and installers) need some cold hard information on how overfill prevention devices work if they are going to prevent overfills effectively. ■