THE GAMGRAM

No. 39 JET REFUELING FACILITY BASICS, PART 2 MAR. 1992

One of our employees had an idea a few years ago. He wanted to get a gallon or two of jet fuel to mix with the gasoline for his motorcycle. He had the idea that this would make his motorcycle go like a rocket! He was disappointed when I told him that jet fuel was really just kerosene and would ruin his engine. He had great expectations, but did not know the facts. The same can be said for people who feel that above ground tanks are a simple solution to their below ground tank problems. Above ground tanks can be a good decision, but they have their own design problems. For example, a leak anywhere in the system can drain your entire tank out on the ground. Whether you go above ground or below, the regulations are changing and you must be sure to meet the latest applicable standards and have an intelligently designed system. In addition, proper fuel quality control practices must be followed. As we stated in GamGram 38, we recommend you get help from an experienced engineer. And the engineer has to be sharp enough to specify what he really wants. As a humorous example, an engineer specified a 50' deadman. The contractor provided a 50' string attached to a microswitch on the system. This was not what the customer wanted! If your system is wrong, you have to deal with the consequences.

TANK DESIGN BASICS

1. A floating suction assembly will draw fuel from near the surface of the fuel in the tank. You avoid sediment and trace water with a floating suction, but what is more important, you get an extra element of protection against a large water contamination problem.

2. If a vertical tank has a greater height than diameter, you must install a float restraining cable (from the float to the tank floor) to keep the arm from going vertical. If it does, it won't swing back down! We recommend the angle does not exceed 60 degrees, but some manufacturers may not want the angle to exceed 45 degrees. Don't forget a retrieving cable. This cable is usually included with the floating suction by the manufacturer. A connection at the top of the tank allows you to check that the floating suction swivel moves freely and that the float is floating.

3. Possibly the most prevalent problem in newer underground tanks is failure of the pump to prime or loss of prime after shutdown. The fact is that pumps do not lose prime, piping or valves lose prime. In most cases this is caused by pipe joint leaks on the suction side. The worst problem is found when the floating suction connection at the tank roof is leaking. This is because the leak cannot be corrected without emptying the tank. Imagine installing a floating suction in a below ground tank. You are on a ladder and the floor is slippery. The light is poor, and you must work over your head. First you must tighten a pipe and flange into the roof of the tank. Then, to make things worse, the flanges are raised face type. If you don't tighten the bolts evenly, you will have a leak. We suggest you make an extension so you can tighten the pipe into the roof while standing on the floor of the tank. Then remove the extension and use a spacer gauge to make sure you tighten the flanges evenly. We have seen many leaks at this point.

4. Epoxy lined steel tanks. Make sure that the surface is sandblasted to the SSSP specification and be sure to specify the correct grade of epoxy.

5. Do not locate the tank fill inlet and the inlet end of the floating suction close together. If you have a contamination problem in the future, you will not be able to clean it up properly by recirculating the fuel through the filter separator. You will only recirculate the fuel between these two connections, For horizontal tanks we recommend the tank inlet be at the high end of the tank slope, cut off at a 45° angle. This helps the incoming fuel to wash any water or sediment toward the low end of the tank.

6. Either have a low point drain valve or a thief pump. Thief pumps mount to the top of the tank and have a ¾" or 1" pipe that draws from within ¼" of the tank bottom. You can use a piece of hose for the last few inches so that if the tank settles, the pipe will not poke a hole in the tank bottom. We recommend above ground tanks with drain valves to be of the spring-loaded self-closing type.

7. Filter the fuel properly into storage! Use pump piping set up so you can recirculate the fuel in the tank through the filter and back. Not only does this make sense from a fuel cleanliness stand point, but it allows you to run periodic tests during recirculation.

8. On all tanks, use a high level shut off. Do not rely on it. Test high level controls regularly. Having seen it happen, we can tell you it is a very upsetting thing to see fuel spraying out of a vent! (No, it wasn't our fault, thank goodness.) I know of someone just recently who spilled 60,000 gallons of fuel on a pipeline transfer. Both the primary and backup controls failed. A review showed no procedure for checking these controls, and actually the controls were not designed to be tested. Are yours?

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9. If the tank is horizontal, pitch (slope) the tank ¼" per foot. A 30 foot long tank should be 7.5 in. High at one end than the other. Vertical tanks should have the floor pitched to a center low point drain.

ABOVE GROUND TANKS

1. On above ground tanks, use an automatic fire shutdown valve on the outlet pipe. This helps avoid feeding a fire.

2. Put a check valve on the connection for fuel going into the storage tank. This prevents reverse flow in a fire or if the equipment is physically damaged. You may also want to put a check valve on the truck unloading connection.

3. On above ground tanks, you should specially protect the tank and the pumping equipment from impact.

4. Be sure to get a high capacity emergency tank vent. Otherwise the tank WILL explode in a fire. Expanding gases can't escape fast enough with a small vent. It's like putting a sealed can of fuel in a fire.

5. Do not use fittings or valves made of cast iron or malleable iron on an above ground tank. These materials fracture in a fire. Ductile iron is allowed, as well as steel. Some people call malleable iron "black steel" -- beware; it is not steel!

6. Do not use gaskets which will burn in a fire on the tank connections. Obviously, this will cause the tank to drain in a fire.

7. The greatest risk of an above ground tank is dumping fuel on the ground. For this reason, containment is necessary. Not only for the tank, but for the pumping equipment. In addition, you may need containment for the delivery truck. What if the unloading hose fails?

8. You will have to do something with the rain water which falls in the dike. This rain water is considered hazardous waste if there is any fuel in it. Water drained from the fuel system is definitely a hazardous waste.

9. Be sure that flow stop when the deadman is released or when the pump power is shut off. Tank head can push fuel through the system and you can lose all the fuel in the tank in the event of a leak. A new anti-syphon valve solution should be available soon.

PUMPS

1. The two types of pumps you may use are either a centrifugal or a positive displacement type. There are advantages to both. Positive displacement pumps usually cost more but prime better and faster. In addition, they must have an adjustable bypass pressure control which allows you to adjust pressure - this is very handy. Centrifugal pumps are cheaper and much quieter.

2. Pumps should have an inlet strainer to protect them from debris. The best is a top cleanout basket type strainer with a s/s mesh screen, but we frequently use an inexpensive "T" type with a simple perforated metal element. We feel that on aviation fuels, a perforated strainer is sufficient.

3. You should avoid high points in the suction pipe. We saw a bad one with a below ground tank. The suction pipe came out of the tank and went 8 feet in the air, turned horizontal over a fence and turned back down 7 feet to the pump inlet. They never got it to work because the pump could not draw the air out of the pipe. Even if the suction pipe rises a foot above the pump inlet, many centrifugal pumps will choke. Positive displacement pumps are a little more tolerant of high points, but still can be a problem.

4. The pump motor should be explosion proof. In addition to a circuit breaker and disconnect, you will need a magnetic motor starter. This is really a big relay with an automatic shut-off if the motor draws too much power. If you can locate this starter indoors, in a safe area, this will allow you to use one with an indoor housing instead of one rated explosion proof. This can save as much as 60% of the cost. That may not seem like much, until you consider that small, explosion proof starters cost $700.00 to $1,000.00. All electrical work should be explosion proof.

5. Be sure of the power available. For example, some explosion proof motors rated 220 VAC can be run on 208 VAC but some can't. Do not assume voltage, measure it. If you only have single phase power, you will not be able to buy a very large motor. This will limit the maximum flow rate.

6. Do not put restrictions or a long suction line on the inlet of a pump. We have seen installations with up to 200' suction lines! Even if a pump were capable of creating a perfect vacuum, you would only have 14.7 psi to work with. We have even seen installations with meter and filter vessels on the inlet side of the pump. Take our word for it, you will be in trouble even if you have an above ground tank.

For more on related elements of fuel system design, see GamGram 38. The most important thing is to always have the oil company and airline (if applicable) review the system design before you build.