THE GAMGRAM

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When I had my first car, I cleaned it and polished it, but no matter what I tried, the windshield wouldn't come clean. A friend of mine told me to use a simple trick used by car dealers; clean it with newspaper, not a cloth. I was amazed at how well this odd trick worked! Jet fuel system design, like all specialities, has its tricks. We've spent 32 years learning them. We have seen many different jet fuel system designs over the years. Some of these systems are good, some are poor and some are dangerous and frightening. In the USA, flight safety from a fuel quality standpoint has proven to be excellent without direct government regulations. There may be a lesson about regulations in that!

There are literally hundreds of special points we could make to anyone who wants to build a fuel system. This article crams dozens together in a small space. See the next issue of the GamGram for our advice on tank design and pumps.

Where do you begin in planning a new jet fuel facility? If you are not really experienced in the industry, you will need help. The first step should be to ask the oil company whose fuel you plan to pump. If you plan to refuel airline or commuter aircraft, these companies can provide help and should be called. We recommend you consider hiring an independent engineer who really knows jet fuel. Not diesel, not gasoline or plumbing -- read my lips “JET FUEL”.

Be careful of people who claim to be able to give you the perfect solution. We know of one company that claims that their systems meet all FAA regulations. This may seem pretty good except that there are no FAA regulations. There is a good “advisory”, but it is not a regulation.

We offer the following as a basic guideline. Use this as a starting point. You may ask why is Gammon giving away what has taken them 32 years to learn? Well, we're simply getting tired of running into inadequate designs.

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SYSTEM BASICS

1. Pump the fuel through a filter separator as it flows into storage, to refueler trucks and to aircraft. Why all three places? To keep fuel as clean as possible and to help avoid contamination. The truth is that you can get a bad load of fuel!

2. The flow rate to storage from the delivery vehicle should be at least 150 gpm or the truck will have to wait too long. A 7,500 gallon tanker truck takes 50 minutes to unload at 150 gpm.

3. Locate emergency stop switches and fire alarms properly. Ninety percent of all systems we have seen are missing or have improperly located emergency stop switches or fire alarms.

4. We do not recommend you meter fuel as it flows into storage. If you insist, you must take special care to get rid of all air. The only sure way is to install a special high volume bulk air eliminator between the pump and the meter. This valve closes if air is being released by the air eliminator and stops flow until the air is gone. Without this or a similar control, you will have great trouble with air. The pump and filter both break the air into tiny bubbles. The air eliminator on the filter separator is totally incapable of removing all of this air. Ask the meter manufacturer for his advice. In addition, when this air is released, it will be in the form of foam. This means that it will create a mess if allowed to be discharged into the ground.

5. You should design your system to handle a spill. Try to prevent spills, but design to deal with them. If you do not prepare, you will regret it. Spills can take place while unloading delivery trucks, loading refueler trucks, refueling aircraft or even when the system is not in use. Do not only protect against storage tank leaks. What if the transport (delivery truck) hose or the refueller truck high level shutdown fails? These failures are just as likely as a tank leak.

6. Clearly identify the type of fuel in the system to help prevent the wrong fuel from being unloaded from a transport truck. In addition, either use different connectors for loading jet fuel and avgas into refueler trucks or use connectors with special product selection. We recommend transport unloading connection dust covers be equipped with different locks for different fuels.

7. Deadman controls for truck loading and underwing fueling should have sufficient length so you can operate the deadman while you observe fueling. It is important that the operator be able to test the operation of the high level control. In addition, if the deadman control is electric, the amount of power in the cord and handle should be rated at the intrinsically safe level.

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8. We recommend static relaxation for truck loading. This is to dissipate static electricity that is generated in the filter separator. This can be done with a special chamber or an extra long pipe. You don't need it it you have static conductivity improver in your fuel. See GamGram 7.

9. Be sure to use the right hose (Check with your oil company). The refueling hose should be to API-1529. The hose should meet the latest edition of the specification.

10. If you have a hose reel, we suggest a short piece of aviation hose, a flexible metal hose or other means to prevent misaligned pipes from putting stress on the hose reel swivel joint. This can greatly extend the life of the swivel. We recommend power rewind, but you should also get a gear reduction type manual crank rewind as a backup. A spring rewind reel can be a safety problem if the operator is pulling the hose out on ice or snow. You may find yourself skating -- toward the reel and out of control.

11. We strongly recommend the only pipe thread sealant you use on tapered threads is teflon tape. If you must use paste or goop, be sure it is rated for use in jet fuel. No matter what you use, do not put it on the end of the pipe or it will end up in the fuel. Teflon tape should always be put on firmly in a clockwise direction when observed from the pipe end. See GG 22.

12. Be sure to use flange gaskets which are rated for use in jet fuel. Never bury flanged connections, because they will leak eventually and may need to be tightened periodically.

13. You must have a dike around an above ground tank and the pumping equipment. You may also need to put a catch basin under the delivery and refueler trucks to catch spills. Be sure to use a concrete sealant or special paint. This is because fuel will go right through concrete. We've seen it happen and it is amazing.

14. Do not use galvanized pipe. The zinc destroys the thermal stability of the fuel causing corrosion and deposits in the hot section of a turbine engine. Minimize the use of copper and brass to essential components such as nozzle bearings and hose fittings. Use stainless steel tubing.

15. Do not use plain cork or neoprene rubber. Buna N, Buna N/cork mixture and Viton rubber are accepted for use in jet fuel.

16. Centrifugal pumps may have pressure given in psi or feet of head. For converting head to psi, multiply the feet of head by .35 for jet fuel. For example, 85 feet of head = 30 psi (85 x .35 = 29.75).

17. Jet A fuel has a flash point of over 100 degrees F. Some people feel that they do not need explosion proof electrical fittings for this reason. We disagree. Use explosion proof (flame proof) electrical components.

FILTER SEPARATORS AND ACCESSORIES

1. Be sure to include an automatic air eliminator and a pressure relief valve. For below ground tank systems, install a check valve on the outlet of the air eliminator. This check valve should have a Buna N or Viton seal and it should open easily. If you don't have an air eliminator check valve, the system may drain back into the tank, resulting in a variety of air problems. Without a check valve, the air eliminator lets air in as well as out. Pump inlet check valves will not positively prevent this, as they tend to leak.

2. See GamGram 37 regarding air and pressure relief lines.

3. Specify stainless steel sampling connections at the filter separator inlet and outlet. We recommend sample probes that draw fuel from the pipe flow stream. Rather than from a no-flow pocket on the side of the pipe.

4. A filter separator without a sump water control is just a “filter”. The water level, collecting in the sump, can build until it reaches the outlet. This water control should stop the flow of fuel. If the water control is float operated, the float should have a manual tester. Electric units should be explosion proof and have an indicator light.

5. We recommend you do not use automatic water drain valves because they tend to leak and don't respond until you have a lot of water. Something may be very wrong if you get more than 2 or 3 ounces of water.

6. Specify a good quality differential pressure gauge such as the Gammon Gauge. If you must save money, use a single regular pressure gauge and a selector valve. Even if the gauge is not accurate, the difference between the inlet and outlet readings should give you a fairly accurate indication. A snubber (a small fitting with a porous metal plug in it) will greatly extend the life of a cheap gauge by removing pressure pulsations. No matter what you do, do NOT use two simple gauges.

7. Use a filter separator vessel that is API qualified to the latest standard. The filter separator must meet the current API 1581 requirements.

8. We highly recommend the use of a sump drain line heater for cold weather operation of a filter separator. This heater should have a built-in thermostat and stainless steel elements. The heater should be specifically made for use in jet fuel. The heater should not produce more than 20 watts per square inch. See GamGram 30.

There are many elements of design to be careful with when you put in a new aviation fuel facility. The fuel quality, fire safety and the environment must all be considered.

Your customers cannot pull over to the side of the road and wait for help if the engine stops. Aviation fuel system designs require special care. Don't build a cheap fuel system, too much rides on it.

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