Chapter 15 - Airport Fueling

Introduction

This chapter covers fuel servicing for aviation, including the following technical areas:

- Types of Aviation Fuel
- Fire Prevention
- Aircraft Fueling Procedures
- Spill Prevention and Protection
- Minimum Inspections
- Recordkeeping

Types of Aviation Fuel

There are primarily three types of fuel used in aviation today: aviation gasoline or AVGAS, Jet A and automotive gasoline or MOGAS. Jet A is often mixed with an anti-bacterial/anti-icing agent. Many smaller, GA airports choose to order the Jet-A premixed with this additional agent.

Aviation Gasoline

Aviation gasoline, normally referred to as AVGAS, is highly flammable and extreme care should be used when fueling with this type of fuel. The term AVGAS is usually followed by the description of the grade number that was recognized by all commercial and military specifications. AVGAS can be identified by a colored dye that is mixed for easier identification. The grade of AVGAS used today is 100LL, which has a blue dye mixed for easier identification. The number "100" refers to the octane rating for aviation fuel and the "LL" refers to "Low Lead" content in the fuel.

Usually tanks or trucks which contain AVGAS are labeled with white letters and numbers printed on red backgrounds. The red background was chosen to highlight the fact that extreme care should be taken when handling this volatile fuel type.

Jet A

There are two types of Jet A fuel normally used for aircraft fueling: Jet A and Jet A-1. These two types of Jet A fuels are basically the commercial grade kerosene. These jet fuels are used in turbojet and turboprop aircraft engines. Jet A fuels do no have much higher flashing points than AVGAS, thus making them less flammable than AVGAS. However, as with all fuel types used, extreme care and caution should be exercised when fueling and handling these materials.

The two Jet A fuel types and their freezing points are identified below:

- Jet A Jet A kerosene having a -40° F freezing point.

- Jet A1 Jet A-1 kerosene similar to Jet A but has lower temperature characteristics. This type has a freezing point of -53° F

Jet A fuel trucks and tanks are usually painted in white letters with black backgrounds designating the fuel types. Normally hoses and piping containing Jet fuels are painted or taped with colored circular bands. For instance one 4-inch (minimum) black band is used to identify Jet A fuel and two 4-inch bands are used to identify Jet A-1 fuel.

Automotive Gas

Certain automobile gasoline may be used in aircraft engines as a replacement for AVGAS. The use of automobile gasoline may be used if a Federal Aviation Administration (FAA) Supplemental Type Certificate (STC) has been obtained for the aircraft. Automobile gasoline used for aircraft engines is commonly referred to as MOGAS. The grade type and performance number established under all commercial and military specifications usually will follow the term MOGAS.

No color coding system has been established for identifying fuel trucks, tanks, fuel line hoses or piping which contains automobile gasoline.

Fire Prevention And Safety

A clean and orderly facility is a first essential step for fire and accident prevention. Regardless of the cause, almost all fires can be prevented or controlled. The facility operator should be familiar with the more common causes of fires. Before a fire can occur, three things are necessary to produce fire: fuel in the vapor form; air (oxygen); and a source of ignition. Two of these are normally present during fueling operations or at a spill. Fuel in the form of flammable vapors is present because all aviation fuels vaporize to some degree, even at low temperatures. Therefore, it is important to control all sources of ignition where there are vapor-air mixtures. All employees involved in aircraft fuel servicing operations should be trained in fuel servicing operations, firefighting methods, the use of fire extinguishers, and be made aware of the potentially dangerous conditions associated with flammable liquid fires.

Ignition Source Control

Smoking obviously should be prohibited in the fueling area. Smoking should be permitted only in safe, designated areas away from ramps, hangars, aircraft, and fueling equipment. “No Smoking” signs should be posted throughout areas where flammable liquids and flammable liquid vapors are normally present.

Heating and electrical equipment should be located away from fueling areas as much as possible. Heating equipment should be located so that it would not be exposed to normal flammable vapors. Electrical equipment should be maintained in accordance with local regulations and any part of the electrical system or equipment installed or used in areas where fuel or its vapors could be present should be of approved explosion-proof design. Power equipment such as mowers,

electric drills, grinders and other possible spark producing power equipment should not be operated in areas where tanks are being filled by pumping or when the tanks are being ventilated or cleaned.

Trucks should be electrically bonded to the loading rack piping by means of a bonding cable during loading operations to minimize sparks from static electricity. Fuel handling personnel can sometimes cause static electrical build-up as a result of the clothing they are wearing. The combination of a wool sweater and a nylon jacket will produce static. The use of taps or hobnailed boots should not be permitted around fuel.

Waste paper, packing material, and oily or paint rags can be a ready fuel source for an accidental fire. Adjacent areas of dry grass and weeds can also spread an accidental fire from its source. Good housekeeping such as placing all waste paper and rags in covered metal containers and emptied daily is essential in reducing ignition sources. No barrels or drums, empty or full, and no combustible materials should be permitted within at least 10 feet from any storage tank. Elimination of grass and weeds will minimize the spread of outside fires into adjacent areas.

Vapor Control

When volatile flammable liquids are exposed to air, a combustible mixture may be formed. Flammable vapors released during fueling are heavier than air. Transferring these liquids to an open container releases vapors into the air and whenever possible should be avoided.

When filling a fueling truck, bottom loading is preferred. During top loading, the use of extension spouts in order to deliver fuel to the bottom of the tank reduces the amount of vapors released. All valves, pumps, and flanges should be maintained in leak-proof condition so as to minimize leaks and spills. In the event of a major spill or overflow, all operations in the vicinity should stop until the area has been made safe. Spill prevention and control are discussed later in this chapter.

Here are other safety concerns:

- No heating equipment should be located in the area where they may contact flammable vapors.

- All power equipment should not be permitted to operate in areas where flammable vapors may be present.

- All trucks should be electrically bonded (grounded) using bonding cable to minimize possible sparks from static electricity.

- All aircraft being fueled should be electrically bonded (grounded) using bonding cable to minimize possible sparks from static electricity.

- Clothing worn by fuelers should not be susceptible to produce static electricity (such as wool, nylon, etc.).

- All electrical cords, circuits and fuses in the area should be maintained in premium condition.

Equipment Marking

All airport equipment should be marked to identify the type of grade of aviation fuel being dispensed in order to prevent intermixing or contaminating fuels. All airport fueling systems shall be marked according to the detailed marking codes in the Federal Aviation Administration (FAA) Advisory Circular AC 150/5230-4 "Aircraft Fuel Storage, Handling, And Dispensing on Airports". Particular attention should be given to the marking of fueling vehicles, fuel lines, pumps, and valves used for the loading and unloading of fuel.

Aircraft Fueling Procedures

General Fueling

Written standard operating procedures (SOP) for aircraft fueling should be available in each fueling truck and also in the airport manager's office. These procedures should include all safety requirements of the National Fire Protection Association (NFPA) Standard 407 and the particular petroleum company's standard. A typical fueling procedure is outlined below.

1. In order to service the aircraft promptly and efficiently upon arrival the fueler should obtain as much advance data as possible, including:

   -Arrival and departure times.
   -Quantity and grades of product required (fuel, oil, etc.).
   -Fueling method (hydrant, refueler, overwing, single-point).

2. Upon aircraft arrival, obtain quantity and grades of products required from airline or aircraft personnel.

3. The aircraft should not be approached until it has come to a complete stop, the engines have been shut down, and it is ready for servicing.

4. The fueling vehicle should be positioned with a clear path to permit its rapid removal after fueling is completed or in the event of an emergency. Consideration should be given to the location of the fueler's engine and location of the aircraft's fuel vent system. The fueling vehicle must not be positioned where it would obstruct aircraft exits and loading areas. Always chock the truck's wheels and set the emergency brake after the vehicle is in position.

5. All fueling operations must be conducted outside of hangars or enclosed buildings.

6. After the fueling vehicle is in position, fire extinguishers must be readily available in accordance with NFPA standards.

7. Attach a grounding cable from the fueling vehicle to a satisfactory ground connect. Connect a grounding cable from the ground to the aircraft fitting, if available, or any convenient unpainted metal point on the aircraft. Bond the vehicle to the aircraft. Bonding and grounding requirements and electrical continuity checks shall be in accordance with applicable NFPA standards.

8. Hoses should be run out on selected routes which will prevent them from being run over by servicing vehicles or obstructing passenger access to and from the aircraft. Kinking and twisting of hoses should be avoided. Pressure fueler couplings and overwing nozzles should not be dragged over the ground. Dust caps should be in place at all times when pressure coupling and nozzles are not in use.

9. Before fueling, check with the aircraft representative to confirm that all pertinent equipment on the aircraft is positioned ready to receive fuel.

10. If fueling is performed at night, the fueling area should be well lit.

11. No fueling should be conducted during any aircraft maintenance that might provide a spark or source of ignition of fuel vapors. All radio and radar equipment in the aircraft must be "OFF" and switches must not be manipulated.

12. If an aircraft is fueled with passengers on board, an aircraft representative should be on board to ensure that “No Smoking” rules are observed.

13. While under fuel flow, check vehicle and fuel system for leaks, and observe that the filter pressure differential does not exceed acceptable limits. If leaks or signs of leaks occur, all fueling operations must stop immediately.

14. Flow rate for fuels with flash points below 100°F should be reduced to decrease static electricity build up.

15. The operator should be positioned at a point where there is a clear view of the vehicle control panel and aircraft fueling points. Deadman controls must always be used and never wedged or blocked open; this defeats their purpose.

16. "NO SMOKING" signs should be displayed in prominent positions near the aircraft and on the fueling vehicle.

17. Unauthorized persons should not be permitted in fueling area under any circumstances.

Underwing (Single-Point)Fueling

The basic fueling procedures for underwing fueling are as follows:

1. Ground and bond the fueling vehicle to the ground and to the aircraft.

2. For hydrant services only:

   -Open hydrant pit cover (check product grade before connection).
   -Place "WARNING" signs or lights in position at hydrant box.
   -Remove dust caps from valve in hydrant box and from coupler of inlet hose.

3. Open aircraft fueling station access door and remove dust covers from hose nozzle and aircraft valves.

4. Connect delivery hose to aircraft fueling point, open nozzle, place appropriate aircraft fuel switch to the "ON" position, connect the hose coupler to the hydrant valve after checking both valve surfaces to be sure they are clean and dry, then activate fueling vehicle with deadman control.

5. Start fueling -- keep alert and take all precautions for safety and be sure not to exceed aircraft structural fuel pumping pressure.

   -Continually monitor the underwing fuel gages and be in a position to quickly shut off flow in an emergency.
   -Never block a deadman control in the “ON” or open position. Under no circumstances should the nozzle be left unattended during fueling.

6. Never overlook the possibility of an accidental fuel spill or leak from the aircraft or the fueling vehicle.

7. Upon completion of fueling:

   -Check fuel quantity that was dispensed with the fuel quantity requested.
   -Disconnect hydrant coupler and put away hoses.
   -Disconnect hose nozzle and replace dust caps and aircraft fuel caps.
   -Remove ladders or lower platform.
   -Remove bond cable from aircraft to fueling vehicle and ground cable from ground to fueling vehicle.

8. Check the filter/separator sump or the fueling vehicle for water following fueling.

9. Remove fueling vehicle from aircraft area as soon as possible after servicing is complete.

Overwing Fueling

Overwing fueling is the most common type of fueling for general aviation.

In addition to the procedures for underwing, where applicable, the following should also be applied.

1. Always use suitable ladders and mats to avoid damaging the aircraft's wing. Use extreme care to prevent the hose or nozzle from damaging the de-icer boot, leading edge of wing, or aircraft skin.

2. Set wing mat in place.

3. Connect static bonding wire from nozzle to receptacle, post, or other metal part of the aircraft before opening fuel tank cover.

4. Open tank access, remove nozzle dust cap and insert nozzle, keeping a constant contact between the nozzle and the filler neck while fueling.

5. Start fueling -- Overwing nozzles should not be equipped with the "hold open ratchets" which will prevent the nozzle from being unattached during delivery. Make frequent visual checks of tank capacity, taking extreme care to prevent spillage or overfilling.

6. Upon completion of delivery, the quantity in tank should be checked with fuel quantity requested. Replace and secure tank access cap. Disconnect nozzle static bond wire. Replace nozzle dust cap.

7. Return hose to fueler reel.

Defueling Procedures

Defueling an aircraft may be necessary for a load adjustment or maintenance work. The safety procedures are similar to those used in fueling. In making a load adjustment, defueling normally follows after the aircraft has been fueled. Defueling for maintenance work will normally require the aircraft tanks to be emptied.

The defueled product should be held in the defueling unit and returned to either the aircraft from which it was removed, or to other aircraft using the same fuel type. However, if the fuel is known or suspected of being contaminated, has an unknown grade of fuel or mixtures, or if the fuel was removed due to an accident or other unusual circumstances, then the defueled product that is withdrawn should be emptied into an empty refueler and handled as contaminated fuel and **not** returned to any aircraft.

Spill Prevention, Protection And Clean Up

Preventing Spills And Overfills

Because human error causes most spills and overfills, these mistakes can be avoided by following correct tank filling practices. First make sure that the volume available in the tank is greater than the volume of product to be transferred to the tank before the transfer is made. Second, make sure that the transfer operation is watched constantly to prevent overfilling and spilling. Third, use equipment that can prevent or severely limit spills and overfills.

Spill prevention devices, such as spill catchment basins or dry disconnect couplings, are readily available. Overfill prevention devices automatically shut off flow when the tank is nearly full. Other overfill devices either restrict flow or trigger an alarm when the tank is nearly full.

Spill Response Plan

Spills and leaks of fuel present extremely hazardous situations. Because there are many different ways a fire can be started, extreme care should be given and a prompt response should always be used when a spill occurs. One of the single most important safety documents an airport manager can have is an effective spill response and clean-up plan. All spill response plans should be made readily available to all tenants, pilots, fuelers, and any other personnel that may come in contact with fuel spills.

The spill response plan should describe:

- Identification of a spill response "team" responsible for implementing the plan.
- Appropriate safety measures.
- Procedures to notify appropriate authorities providing assistance (fire, police, hospital, spill response contractor, etc.).
- Spill containment, diversion, isolation, and clean-up procedures.
- Spill response equipment, including:
  -Safety equipment such as fire extinguishers, protective clothing, two-way radios, respirators, etc.
  -Clean-up equipment such as booms, barriers, sweeps, absorbents, containers, etc.

Each spill is different, therefore no one set of instructions will apply in every case. If fuel is discovered spilling from fuel service equipment or from the aircraft itself, the fuel servicing shall be stopped immediately by the release of the deadman control or by operation of the emergency fuel shutoff. Every spill, no mater how small, should be reported immediately to the supervisor and cleanup actions taken. Pint size spills do not require emergency action.

Spills From 18 Inches To 6 Feet In Any Direction

Any fuel spill presents a potential fire hazard. A minimum protection for this size spill would be to post a person to guard and maintain a restricted area around the spill and to keep out unauthorized persons. This guard should be equipped with at least one 15-pound dry chemical or carbon dioxide extinguisher. This spill should be cleaned up as quickly as possible with absorbent cleaning agents, emulsion compounds, or rags. Contaminated absorbents and fuel-soaked rags should be placed in metal containers with self-closing lids until burned at a safe location or otherwise disposed of properly.

Spills Over 6 Feet In Any Direction Or Of A Continuous Flowing Nature

These spills are extremely hazardous. The airport emergency fire crew should be called at once. If an emergency crew is not available, airport personnel should mobilize all available firefighting equipment as standby protection. The equipment and assistance of other fire protection units should also be requested. Large spills of gasoline and Jet B fuel (JP-4) should be blanketed with foam. The spill should then be washed away with water and any residue allowed to evaporate before the area is used again. These spills should not be washed down sewers or drains. If such an action occurs, it should only be on the orders from the chief of the fire department. If any spillage should reach the sewers, the sewers should be thoroughly flushed with water. Any fuel that is flushed into the storm water system should be collected before it enters a natural waterway. Any fuel spillage recovered should be disposed of properly.

Every spill should be thoroughly documented describing the date, location, amount, and reason for the spill. Also, procedures used to clean up the spill, personnel mobilized and corrective actions taken as a result of the spill should also be documented.

Local environmental regulations, in particular the National Pollutant Discharge Elimination System (NPDES), must be considered. Each airport has different drainage routes that may affect how spills are cleaned-up. These situations should also be considered when developing effective spill response plans.

Minimum Inspections

At an aircraft fuel servicing facility every possible precaution must be taken to prevent contamination of the fuel tanks and piping by solids, water and other products. Daily handling procedures should be designed to reveal any problems or equipment malfunctions or any other conditions that might need corrections. An airport fuel servicing facility should have some MINIMUM inspections that would occur on a daily, weekly, and monthly basis. These inspections should not only cover all fueling equipment, but should also include safety and inventory control items as well. Additional inspections of aircraft fueling vehicles are also included.

Daily Inspections

The following items should be checked daily and corrective actions taken as necessary:

1. Check the bottoms of all storage tanks for water using a water drawoff connection for above ground tanks or thief pump for underground tanks. A visual test, or a water finding paste on a gauge stick or tape should also be performed.

2. Check manual water drains of filters for and other contaminants before and after each receipt of product and after a heavy rainfall. Draw off any accumulation of water and dispose of water properly.

3. Check and record filter, filter/separator, and contaminant monitor (if applicable), and also check differential pressure while operating flow conditions.

4. Check and record the fuel quantity in each storage tank.

5. Check all mobile refuelers for proper operation, fuel contamination and filter operation.

Aircraft Fueling Vehicles

1. Check both the truck engine and auxiliary pumping engine fuel, oil, and radiator levels, battery water levels and record any added amounts, and check for leaks.

2. Check the fire extinguishers to see if they are in place, filled and are operable.

3. Check to see if the static strap is in contact with the ground.

4. Check to see that the fuel marker signs are in place.

5. Make a fuel color check to see that the fuel marker signs agree.

6. Check the entire length of all hoses for cracks, cuts, or breaks. Remove, inspect, and clean the hose nozzles and strainer and comment on any impurities found. Be sure the nozzle spout cap is in place.

7. Check the refueler truck engine exhaust piping for leaks and cracks and make sure the muffler flame arrester for leaks and noise.

8. Make sure the engine shrouding is secure and in place.

9. Check the engine exhaust piping for leaks and cracks.

10. Check all tank drain samples for water and drain until free of water.

11. Check all separators for water and drain until free of water.

12. Check all emergency valves for proper operation of controls.

Weekly Inspections

The following items should be checked weekly and corrective actions taken as necessary:

1. Check and clean all strainer baskets. If breaks are found in basket, it must be repaired or replaced.

2. Check and clean screens in all bottom loading and other hose nozzles. If breaks are found, the screen must be repaired or replaced.

3. Visually inspect all hoses for abrasions, separations, or soft spots. Damaged or deteriorated hoses must be replaced.

4. Check the storage tank floating suction and test cables, where applicable, for freedom of operation.

Aircraft Fueling Vehicles

1. Check the vehicle battery water level. If water is required, service each cell to the full mark.

2. Check the condition and appearance of the vehicle. Check for broken and missing window glass, damage to interior and exterior surfaces, missing panel doors, etc. Assure that there are non-skid pads on the brake and clutch pedals and they are in serviceable condition.

3. Check that the contents of the vehicle are prominently displayed. Assure that there are at least two product identification placards ("JET A" or "AVGAS," etc.) on each side of the vehicle. The placards must be legible and the letters should be at lest three inches high on a background of sharply contrasting color.Check that there are at least two "FLAMMABLE" placards prominently displayed on the vehicle. The placards must be displayed on two sides or on the front and rear bumpers. The placards must be legible and the letters should be at lest three inches high and on a background of a sharply contrasting color.

4. Check the condition and operation of fuel tender compartment dome covers, cover gasket, and tank compartment vents.

5. If the vehicle is so equipped, check that the proper aircraft sumping drain tools are all in serviceable condition.

6. Check the condition of ladders or approached metal steps. If unserviceable, tag, remove from vehicle, and replace. Wooden boxes, milk cases, etc. are NOT approved for use while fueling aircraft.

7. Check the general condition of the vehicles electrical system and wiring. Check for broken conduit, bare wires, missing junction box covers, and other discrepancies. If applicable, assure that there is a cover over the battery and it is properly installed.

8. Check the condition of the vehicle plumbing, valves, and gauges in the pumping station. Check for leaks, proper operation of all valves, gauge faces, and any other discrepancies.

Monthly Inspections

The following items should be checked monthly and corrective actions taken as necessary:

1. Check the lubrication and the oil level (in those pumps equipped with a gear box) of the pumps, motors, hose reels, and other machinery requiring lubrication. For those reels and lubricated valves, use lubricants that will not clog fuel screens in aircraft system at all aircraft operating temperatures. Make sure the correct seasonal grade of lubricant is used.

2. Check the action of all valves.

3. Check the condition and electrical continuity of the static grounding clips, wires, and bonds at the loading racks, pits, and other points, of fuel transfer.

4. Inspect all fire extinguishers for broken seals, proper pressure, and recharge date. Recharge as necessary.

Demand Inspections

The following items should be checked on a demand basis and corrective action or maintenance performed as necessary:

1. Check the entire fueling facility to see that all aspects of the product identification system are marked clearly and correctly.

2. Conduct a check of the cleanliness level of jet fuels discharged at the downstream side of the filter/separator. Conduct a check of monitoring devices as required by the manufacturer.

3. Conduct a thorough inspection of all mobile refuelers.

Recordkeeping

Proper recordkeeping such as documenting all fuel spills, inspections, and maintenance activities are essential elements in the safe and efficient operation of an aircraft fuel servicing facility. All fueling operators should develop and maintain (for at least a period of 12 months) adequate records.

The records should show at least the following information:

1. Source, tests run on, and ultimate delivery point of all fuel brought onto the airport.

2. Checks, and any corrective action taken, made on equipment required for aircraft fuel servicing.

3. Training given and qualifications/achievements of all fueling staff on the airport.

4. Records of all significant (release in excess of the Environmental Protection Agency's "List Of Hazardous Substances And Reportable Quantities") fuel spills and leaks describing:

    - Whether the incident was a spill or leak
    - Date of incident
    - Location of incident
    - Type of material spilled or leaked
    - Quantity of material spilled or leaked
    - Source (if known) of spill or leak
    - Reason for spill or leak
    - Amount of material recovered as a result of cleanup efforts
    - Preventive measures taken during cleanup for safety and environmental concerns

These records, as with all records, should be made available for inspection by the airport operator or the Federal Aviation Administration upon request.

References

Federal Aviation Administration, "Fuels and Agents".

Federal Aviation Administration, "All About Fuel".

Federal Aviation Administration Advisory Circular AC 00-34A, "Aircraft Ground Handling and Servicing".

Federal Aviation Administration Advisory Circular AC 20-43C, "Aircraft Fuel Control".