CHAPTER 7

ASHORE SYSTEMS AND OPERATIONS

Among the more important duties performed in support of aircraft at naval air activities are those involving the handling of aviation fuel. Properly executed fuel-handling practices are deterrents to personnel injury, loss of life, and destruction of Government property on the ground and in the air. Personnel (whether military, civil service, or contractor employed) who are involved with these duties should possess a thorough knowledge of the equipment they operate and must follow the procedures associated with each operation.

Because of the variety of fuel-handling facilities and the types of fuel-handling equipment in use at air activities ashore, we cannot include in this manual all the pertinent information dealing with fueling facilities and equipment. Also, except for preoperational checks on trucks and pits, the ABF on shore duty rarely performs maintenance on the equipment. For this reason, equipment is identified where it would normally go and it's function is given, but the equipment is not broken down into parts. The operating procedures listed are typical for shore activities. Always use the approved operating procedures for each individual activity.

ASHORE FUELING EQUIPMENT

LEARNING OBJECTIVES: Identify the equipment used in fueling systems ashore. Explain the "function of equipment used in fuel systems ashore and describe where the equipment is located.

The following paragraphs provide a general description and the minimum requirements for equipment common to all ashore refueling systems, including mobile equipment. These requirements apply to both new and existing equipment. Figure 7-1 illustrates the typical arrangement for ashore systems.

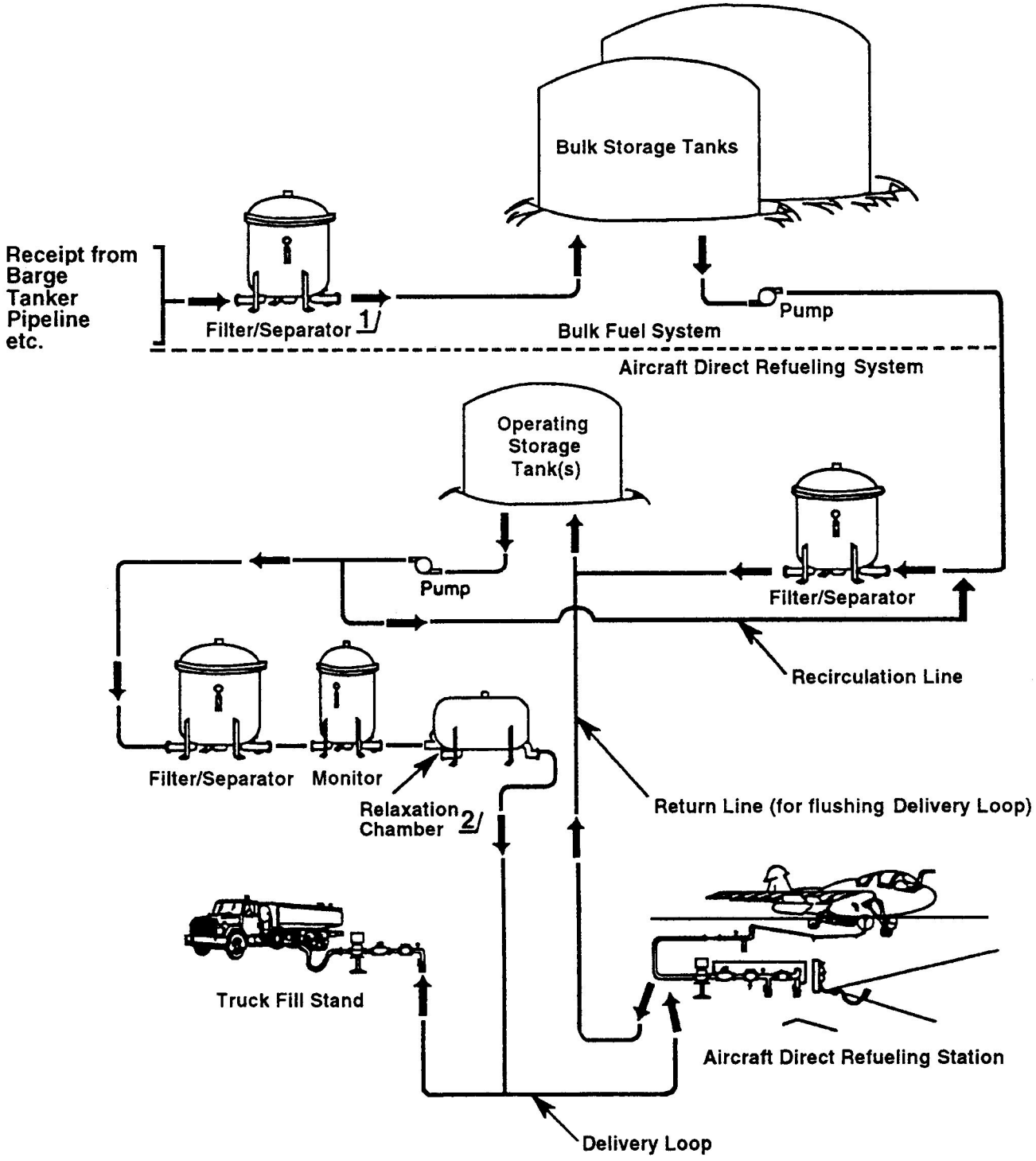
FILTER/SEPARATORS

The filter/separator is the primary device used at shore stations to keep aviation fuels clean and dry. Filter/separators are designed to remove 98% of all solids and 100% of all water. Each filter/separator is outfitted with the following minimum accessories:

- Manual water drain valve from the bottom of the water sump.
- Automatic air eliminator valve.
- Differential pressure gage with 1-psi graduations to measure the pressure differential across the elements.
- Pressure relief valve.
- Diaphragm-operated control valve on the main discharge line with a flow-limiting pilot and a float-operated pilot to close the main valve if the water level in the sump rises above the set point. This is commonly called a "slug valve."
- All manual water drains are connected to a portable or permanently installed recovery system. Pressure relief valves and the air eliminator should also be connected to a recovery system.

Filter/separators are provided at the following locations:

- In receiving lines upstream of all tanks from which fuel can be pumped directly to aircraft.
- In supply piping (downstream) from storage tanks to aircraft refueler truck fill stands.
- On any discharge (downstream) side of transfer pumps that supply aircraft or refuelers.
- On any equipment (including mobile and portable) that directly fuels aircraft.
- Upstream of the main receiving points for the bulk storage tanks. Filter/separators will reduce receipt of water and sediment into bulk storage tanks and increase the time between tank cleanings. The installation of a filter/separator is not practical at all receiving points. However, some device for the removal of particulate should be used, depending on the method of delivery and flow rates involved.



Notes: 1/ Pre-Treatment filtration system dependent on method of receipt, e.g., strainers, cyclonic filters.

2/ Downstream piping is acceptable substitute provided 30 seconds of retaxation time achieved.

Figure 7-1.—Ideal ashore fuel system flow diagram.

FUEL-QUALITY MONITORS

Fuel-quality monitors (formerly called go/no-go gages) are installed after filter/separators on truck fill stands and on all equipment that directly fuel aircraft. Monitors are not required for use with product receipt filters or those used exclusively for recirculation of fuel. A pressure gage is also installed on each monitor housing so that the differential pressure across the elements can be recorded. If the filter/separator also incorporates fuel monitor elements, the gage or gages are installed so that the pressure losses across the filter elements and monitor elements can be recorded separately.

The fuel-quality monitor (fig. 7-2) provides a continuous check on the cleanness of the fuel passing through the filter/separator. Fuel that meets a predetermined standard of cleanness passes through the monitor with a minimum drop in pressure. Fuel containing quantities of solids and/or water above the predetermined acceptable level is automatically cut off.

The fuel-quality monitor has an aluminum housing and various numbers of fuses, depending on the model. Each fuse of the monitor is a self-contained unit consisting of specially treated paper washers housed within a metallic housing and fitted with plastic end fittings. The sensing washers, housed within the metallic housing, absorb free or suspended water from the fuel.

RELAXATION CHAMBERS

A relaxation chamber, consisting of a tank or piping, follows the fuel monitor, or filter/separator if no monitor is installed in the system. This chamber allows static electric charges, which develop as the fuel passes through the filtration equipment, to "relax" before the fuel enters a tank. Since the fuel must be in contact with the metal walls of the relaxation device for at least 30 seconds, the exact size of the relaxation tank, or length of piping, is determined from the maximum flow rate of the system. Only one relaxation chamber is needed for each fuel monitor, filter/separator combination. Any tank, chamber, or other arrangement used to meet this requirement must assure complete product turnover, have a water drain at its low point, and a manual or automatic air eliminator.

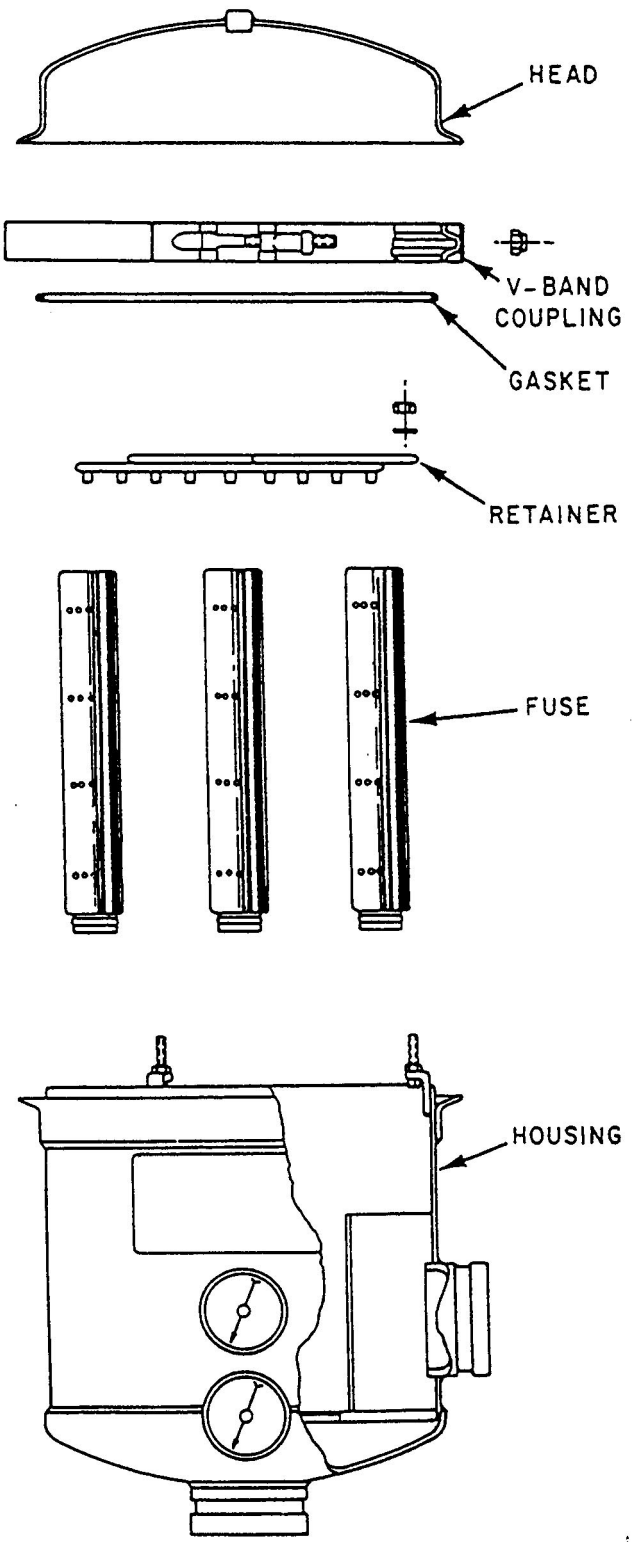


Figure 7-2.—Fuel-quality monitor.

FUEL METERS

Temperature-compensated meters should be installed at point of custody transfer. Meters used for services such as fueling of aircraft, motor vehicles, and boats or loading of tank trucks or tank cars are positive displacement meters. Turbine meters may be used for larger volume steady transfers such as loading of ships, barges, or pipeline transfers.

FUEL PRESSURE GAGES

Pressure gages must be easy to read and accurate within 1 psi, with graduations in 1-psi units.

SAMPLING CONNECTIONS

All sampling connections are the flush-type, dry-break, quick-disconnect (Gammon fittings) with dust caps. Fuel-sampling and pressure-testing connections are installed at the following locations:

- Receiving points
- Tank outlets
- Inlet and outlet sides of filter/separators and fuel monitors
- Refueling nozzles
- Each side of a block valve, so that the fuel remaining in each portion of a fuel transfer pipeline can be sampled.

HOSES

All hoses used for aviation fuel service at shore activities should be semihard-wall, noncollapsible hose. The diameter of the hose must be compatible with the desired delivery rate to the aircraft. Unless otherwise specified, aircraft delivery hose on refueler trucks must be a minimum of 50 feet long.

Shore-base hoses contain no electrical bond or bonding wire through the center of the hose. Where two hose assemblies are attached to the same outlet or source of fuel, each hose assembly must have its own shutoff valve in the piping upstream of the hose.

EMERGENCY DRY-BREAKAWAY COUPLING

An emergency dry-breakaway coupling should be installed on the refueling hose at or near the place where the hose attaches to refueling equipment piping or the hose reel. This device is required for each direct refueling system pantograph and is recommended for all other installations.

DRY-BREAK QUICK-DISCONNECT COUPLING

A dry-break quick-disconnect coupling is installed at the nozzle end of the hose and has a 60- or 100-mesh screen that is readily accessible without the use of tools.

HOSE END PRESSURE REGULATOR

The single point pressure refueling nozzle assembly includes a hose end pressure regulator set for a maximum of 55 psi.

AIRCRAFT REFUELING NOZZLES

The pressure refueling nozzles used for shore refueling are the same as for afloat refueling. The typical nozzle is the Carter D-1 or MD-1.

The overwing (gravity) nozzles used for shore refueling are also the same as used for afloat refueling. See chapter 5 for details on both types of nozzles.

AIRCRAFT REFUELER TRUCK FILL STANDS

The loading rack has a separate loading system for each grade of product to be handled. The equipment required at a truck fill stand for aviation fuel is as follows:

SPR (pressure) nozzle with dry-break quick-disconnect and strainer.

Loading hose approximately 10 feet long or mechanical loading arm with nonlubricated swivels.

Loading-hose fuel-thermal-pressure relief valve.

Diaphragm-operated two-stage control valve (low flow/high flow) with adjustable time delay to prevent the high-flow pilot from opening until 1 minute after start of fuel flow.

Meter with rated capacity equal to the maxium flow rate of the loading station. Temperature-compensating positive displacement meters are recommended.

Filter/separator.

Fuel-quality monitor.

Relaxation tank or equivalent piping.

Shutoff valves for maintenance.

Sample outlet.

A high-level cutoff system.

Low-intensity instrument lighting to permit full visibility of all equipment and controls during night operations.

Spill containment system that will prevent the run-off of fuel in the event of tank rupture or a major spill during loading operations.

Overhead lighting in the immediate truck-fueling area.

RECEIVING STATIONS

Fuel can be received by pipeline, barge, railroad tank car, tank truck, or any combination thereof. Receiving stations are tailored to the method, quantities, and rates of fuel delivery. Aviation fuel should be received through a filter/separator or other appropriate filtration device. This is an essential requirement when fuel is received directly into an air station's or facility's operational storage tanks. Weight-handling equipment may be necessary with barge receipts to help with large-diameter-hose handling. Communications equipment may be necessary for barge or pipeline receipt to coordinate an uninterrupted product flow. Appropriate environmental protection equipment, facilities, and procedures must be provided to comply with Federal, state, and local environmental laws.

STORAGE TANKS

Tanks located at air activities provide the operating supplies of aviation fuel for aircraft. Storage tanks are classified as bulk storage or operational storage.

All tanks must comply with the following requirements:

All operational or ready-issue steel tanks must be 100 percent coated with an inert material such as polyurethane or epoxy. All bulk-steel fuel storage tanks must be coated on the bottom and up 18 inches on the walls. All concrete tanks storing aviation fuel must be 100 percent lined on the floor and walls to make them impervious to fuel.

All aviation turbine fuel operational storage tanks must be equipped so the fuel can be circulated through a filter/separator and returned to the tank, thus removing any bottom sediment and water. Outlets must be at lowest point of the tank, to prevent water-bottoms. All aviation fuel tanks must also be equipped with a water-stripping system.

Tank roofs must be in good repair and must not allow rainwater to enter.

Fill connections for all types of tanks must be sized so that the velocity of the fuel during falling will not exceed 3 feet per second. Inlets discharge fuel horizontally near the bottom of the tank.

All bulk storage tanks must be equipped with adequate sumps, drain lines, and water draw-off lines, so that tank water-bottoms can be kept to an absolute minimum. Recovery tanks that remove water and recover fuel are recommended for environmental reasons.

All tanks must be fitted with automatic gageing devices and high- and low-level alarms and controls to prevent the overfilling of tanks and the exposure of pumps to cavitation. The alarms are left in the active mode at all times.

All aboveground tanks must be within an enclosure capable of holding the entire capacity of the tank plus l-foot freeboard, in case the tank should rupture or leak. This is usually accomplished with impermeable dikes.

Other environmental facilities/equipment as necessary to comply with Federal, state, and local laws.

TRANSFER LINES

Fuel passes through transfer pipelines of various diameters and construction materials in its route from tank to tank, storage to truck fill stands, and storage to hydrant systems. Transfer lines must not leak or introduce excessive contaminants to the fuel. Internally coated pipe or other noncorrosive materials in these lines should be used to reduce iron contamination in fuel.

All piping systems are marked to identify the grade of product being carried. These markings

(fig. 7-3) are placed next to all operating accessories such as valves, pumps, regulators, and manifolds. Table 7-1 lists the sizes of bands and letters used for petroleum products.

AIRCRAFT FUELING SYSTEMS

LEARNING OBJECTIVES: Identify the typical fueling systems used on shore activities. Describe the equipment contained in each system.

The following are three typical aircraft fueling systems used on shore activities:

- Aircraft Direct-Refueling System (more commonly known as a "pit").

- Mobile Aircraft Refuelers. These are tanker trucks of various capacities and configurations.

- Portable Fueling Systems. These are air-transportable, advanced base systems used primarily to support tactical operations. As an ABF, you most likely will never use this type system; therefore, it is not discussed further in this manual.

AIRCRAFT DIRECT-REFUELING SYSTEM (PIT)

Aircraft direct-refueling systems (fig. 7-4) are designed primarily for "hot" refueling of aircraft. All direct-refueling systems have the following minimum features:

Filter/separator.

Fuel-quality monitor.

Relaxation chamber or equivalent piping configuration capable of providing 30 seconds of static relaxation from point of last filtration to the nozzle.

Diaphragm-operated primary control valve.

Remote, hand-held, deadman control for each pantograph or hose installed at each station.

Emergency pump-shutoff switch.

Meter on each station outlet.

Recirculation/flushing capability of the nozzle and/or hose/pantograph system.

Emergency dry-breakaway coupling on each hose or pantograph.

Bonding/grounding cable. This requirement is considered satisfied if the fueling hose/pantograph system has continuity (10,000 ohms or less).

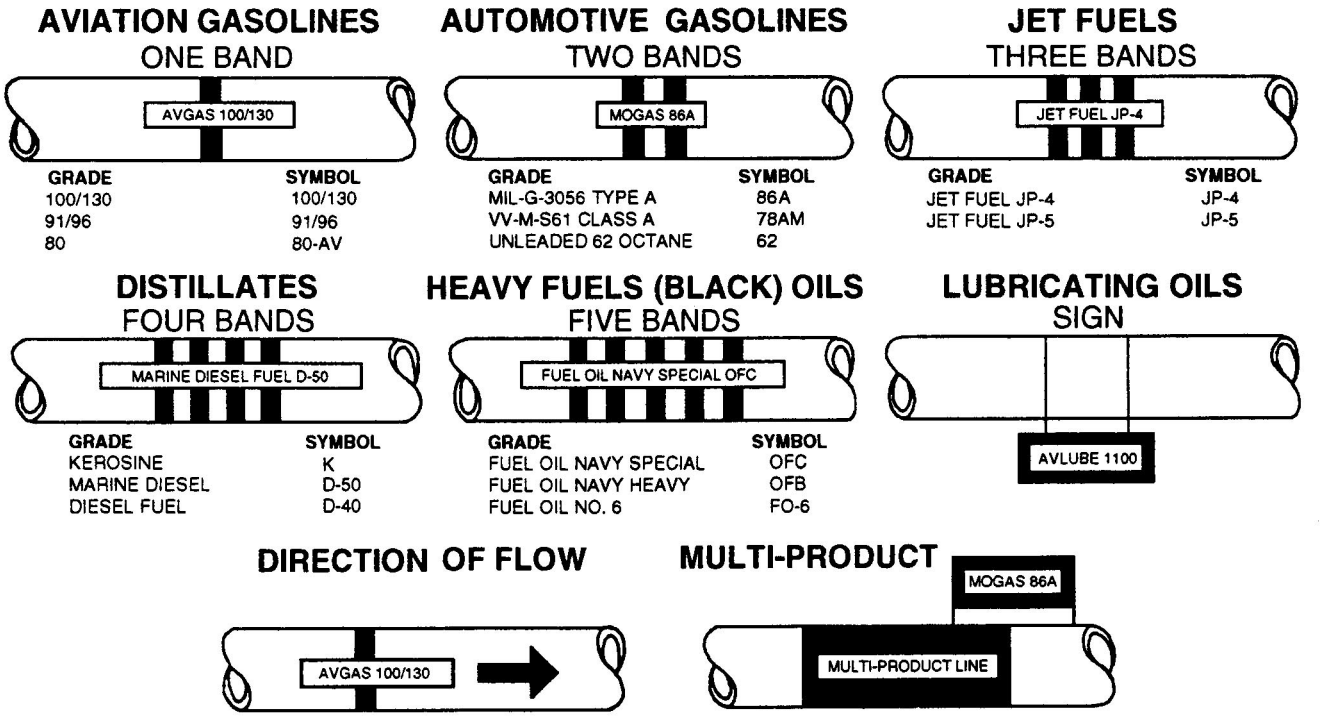


Figure 7-3.—Identification for bulk petroleum product lines.

Table 7-1.—Sizes of Bands and Letters for Petroleum Products

	Width of Bands		Space Between Bands	Length of Bands	Title Letter Size
	Wide	Narrow			
Pipe Diameter: Under 3"	6"	3"	3"	encircle	1/2"
3" to 6"	6"	3"	3"	encircle	1"
6" to 9"	6"	3"	3"	encircle	2"
Over 9"	8"	4"	4"	encircle	3"
Tank Capacity: 10,000 bbl and under	6"	3"	3"	33"	6"
Over 10,000 bbl	8"	4"	4"	54"	12"
Tank Car, Trucks: 2,000 gal and under	6"	3"	3"	24"	3"
Over 2,000 gal	6"	3"	3"	33"	6"

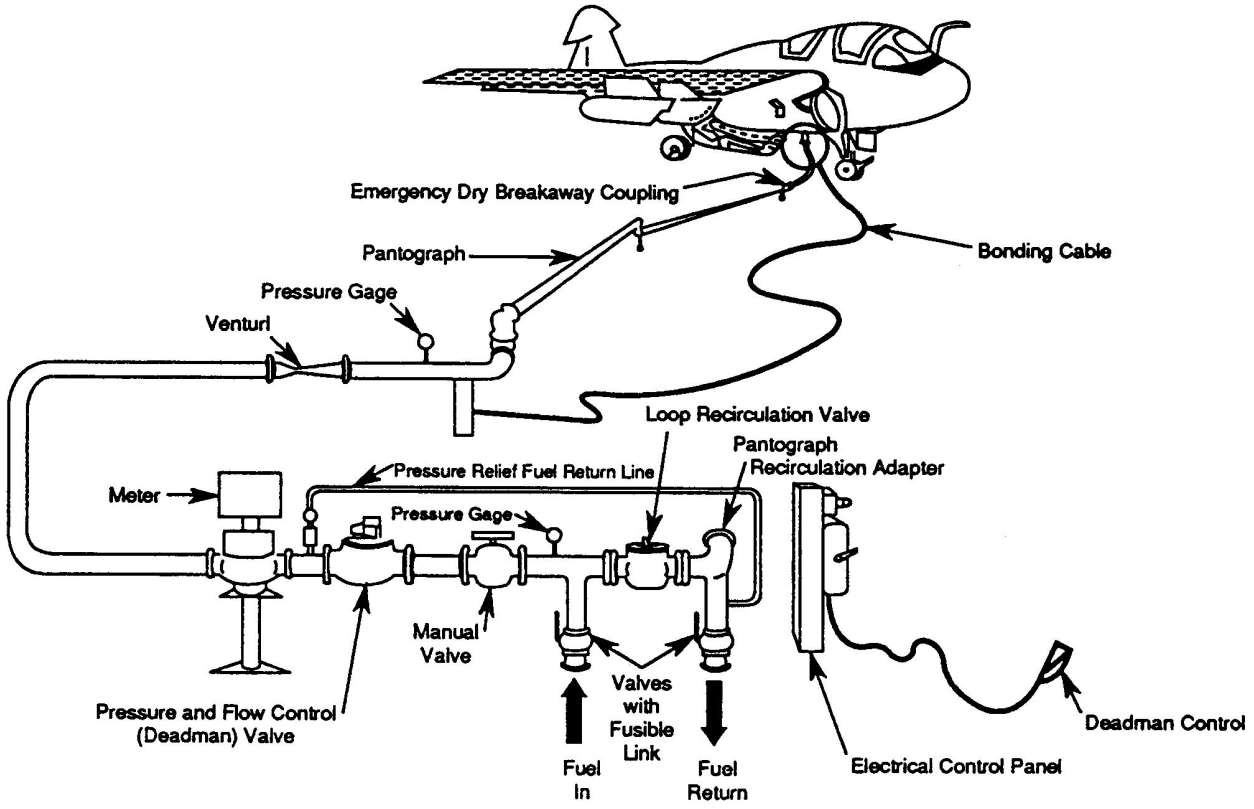


Figure 7-4.—Aircraft direct refueling system (pit).

Pantograph and/or hose with approved, nonlubricated swivel. Zerk-type grease fittings in pantograph swing joints are not authorized, because of the possibility of contaminating the fuel with grease.

Dry-break quick-disconnect fuel-service coupling with a 60- to 100-mesh strainer.

Single-point-pressure refueling nozzle with a 55-psi maximum pressure regulator.

Fire extinguisher(s) in accordance with NAVAIR 00-80R-14 (minimum of one 150-pound Halon or TAU unit per fueling point).

Emergency eyewash/shower system available in the immediate area.

Fire alarm.

MOBILE AIRCRAFT REFUELERS

Mobile refuelers are used primarily for cold fueling operations, with occasional hot-refueling operations at stations where installation of a direct refueling system is not justified. If continuous or extensive hot fueling is being performed with mobile refuelers, the use of an anchored pantograph, as shown in figure 7-5, should be considered.

Mobile aircraft refuelers vary in capacity and configuration. However, whether contractor- or Government- owned, all mobile aircraft refuelers have the same basic requirements. These requirements are the following:

Tank construction is one compartment only, with necessary baffles. Tank must completely drain at the low point without traps of liquid remaining in pockets. The tank is designed so that all portions are accessible for cleaning and maintenance.

Tank is aluminum or stainless steel.

Tank top opening(s) must be semi-permanently secured and used only for inventory and for interior inspections and repairs. Manhole covers must in-corporate a fusible plug or plugs, each equipped with fine screens to provide additional emergency release of vapor.

Tank must be configured for bottom loading. The bottom loading hardware includes a cutoff valve, an adapter to accept the standard pressure (SPR) nozzle, and must be of sufficient size to receive the product at 600 gallons per minute. A fill stand anti-driveaway device is incorporated.

Each tank must have an electronic system for controlling the filling operation (Scully Dynaprobe or equivalent) that is compatible with the system on the truck fill stand. It should be located near the bottom loading adapter and include art anti-driveaway feature (can be combined with anti-driveaway device previously mentioned).

The piping system, including all hardware components, must be capable of dispensing fuel at the rated flow. A flow diagram of the general configuration of these system devices is shown in figure 7-6.

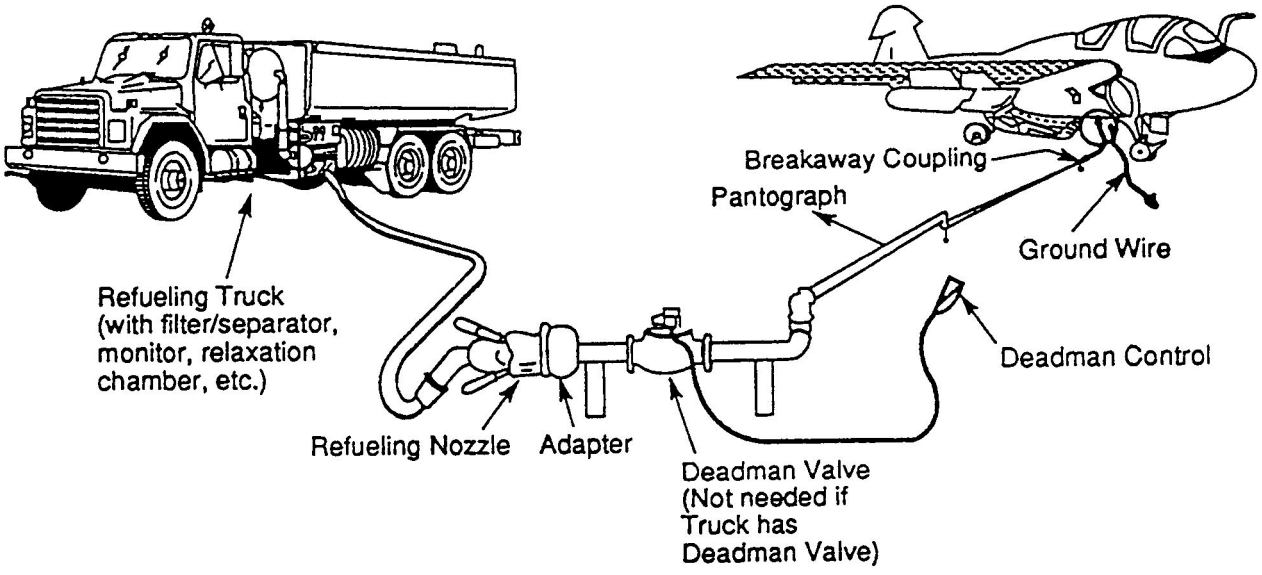


Figure 7-5.—Hot-refueling with truck and pantograph.

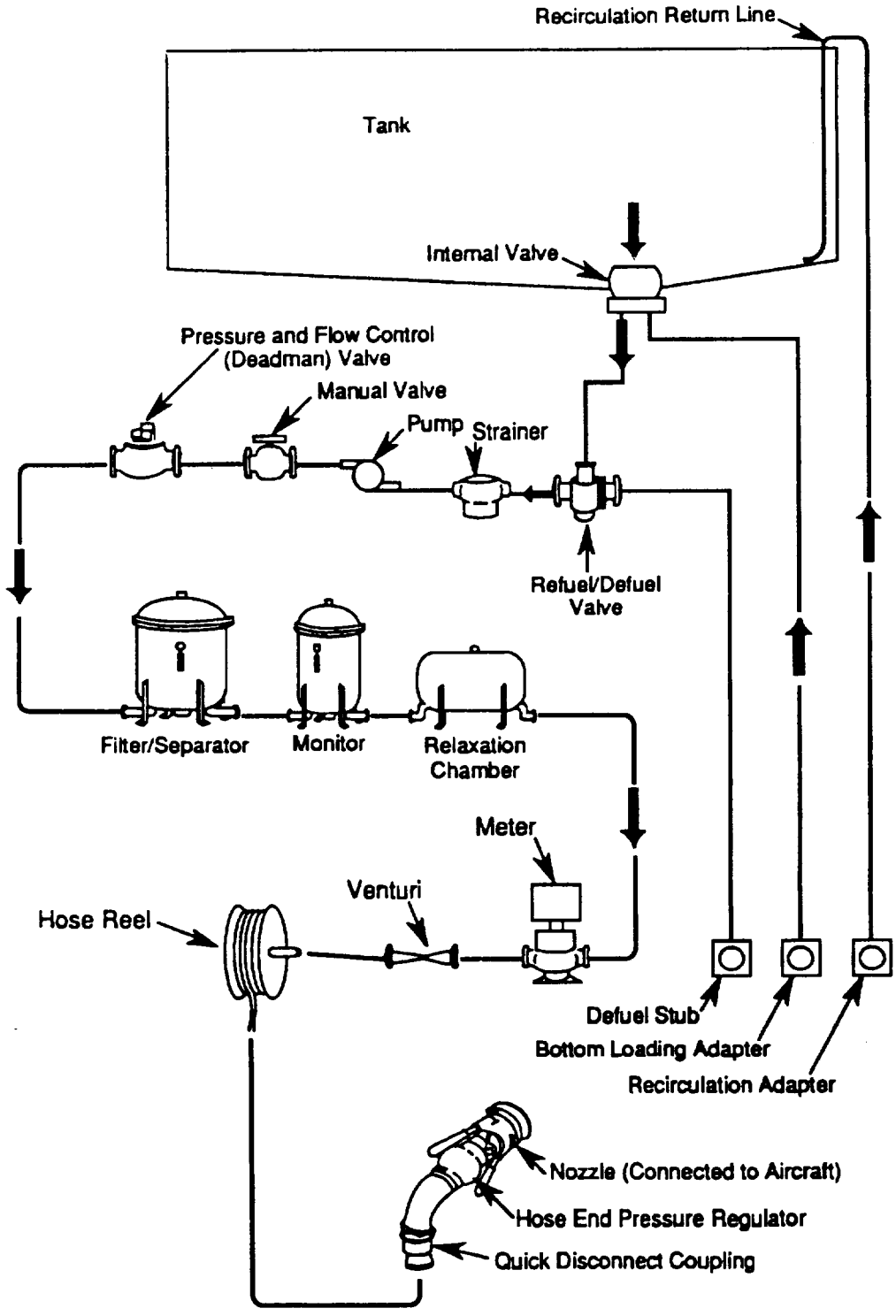


Figure 7-6.—Flow diagram for mobile refuelers.

Filter/separators.

Fuel-quality monitor.

Relaxation chambers.

Pressure and differential pressure gages.

Meter (temperature-compensating meters are desired).

Approved aircraft-refueling hoses.

Dry-break quick-disconnect coupling.

Hose-end pressure regulator.

Approved aircraft-refueling nozzles.

NOTE

Refueler/defuelers have two separate hose/pressure nozzle assemblies: one includes a hose end pressure regulator (for refueling service) and the other doesn't (for defueling operations).

Bonding cable.

Aircraft fuel servicing vehicles must have at least two fire extinguishers installed: One must be on the left front (driver's) side, readily accessible from the operator (refueler control panel) position. The other extinguisher must be on the right rear portion of the vehicle.

Remote, hand-held deadman control.

Tires are of a non-FOD type, with slick tread or wide-lug, wide-groove tread. The tread must NOT have a narrow groove design, in which small stones and foreign matter could become imbedded and deposited on airfield surfaces. Recaps and slicks are not authorized for use on the steering wheels when the vehicle is operated off base.

The exhaust of all engines, including auxiliary engines, must have a suitable spark arrestor.

Refuelers/Defuelers

The most ideal and cost-effective method of handling non-suspect defueled aviation turbine fuel is to reissue it to an aircraft. Most facilities that handle size able quantities of such fuel have designated one or more aircraft refueling trucks as "refueler/defuelers."

In addition to the requirements for refuelers, refueler/defuelers must also meet the following minimum requirements:

- Refuel/defuel trucks carry the marking "JET FUEL/JP" in place of the normal markings (for example, "JP-5 JET FUEL F-44" or "JP-4 JET FUEL F-40").
- A dedicated defuel connection to piping system that passes the fuel through the pump, falter/separator, monitor, and relaxation chamber before it enters the tank.
- Separate hose and nozzle assemblies provided on refuel/defuelers for each of the two different operations, refueling and defueling.
- Maximum defuel is 100 gpm.
- High-level alarm. A high-level cutoff system is also highly recommended.

Defuelers

Defuelers are used for defueling only. Fuel placed in a defueler is not to be directly reissued into an aircraft; since the defueler is generally configured without filtration equipment, the fuel placed in a defueler unit is often suspect. Fuel in a defueler must be sampled and tested to determine disposition.

CAUTION

Hose evacuation systems must NOT be used for defueling.

Defuelers must have the following minimum requirements:

- A centrifugal pump with the maximum defuel rate of 100 gpm
- A cutoff or alarm system for overfill protection
- A defuel hose and nozzle

PREVENTIVE MAINTENANCE PROGRAM (INSPECTIONS)

Proper maintenance is critical to the delivery of clean, dry, uncontaminated fuel to aircraft. A well-executed and documented PM program will help achieve this goal, but a formal inspection program is also necessary. The implementation of an inspection program is the responsibility of the Fuel Management

Officer (FMO). The inspection program includes the following:

- Inspections of equipment and facilities before use
- Inspections before major operations
- Seasonal or special inspections
- Routine inspections and checklists

Inspections Before Use

New construction, out-of-service facilities, broken equipment, and facilities or equipment undergoing corrective or programmed maintenance must be inspected before acceptance or reactivation. Special attention should be given to rated capacities of hardware, pipeline sizing, drainage, accessibility, emergency controls, safety, and fire prevention features.

Inspections must be conducted before starting major operations, such as receipt of products from a ship or barge, transfers between large storage tanks, or high-tempo training exercises. Inspections should cover equipment performance, pipeline integrity, valve positioning, tank arrangement. and personnel manning.

Seasonal or Special Inspections

In climates where freezing weather is encountered, winterization inspections should be made in early autumn. Extensive inspections for damage or malfunctioning should be conducted following any storm, flood, fire, earthquake, lightning strike, suspected act of sabotage, or vandalism. Special inspections are called for when abnormal variations in performance, flow rates, pressures, or capacities are experienced by operators.

Daily Checks

A daily check (once in every 24-hour period) must be conducted on all aircraft fuel delivery equipment that is in continuous use. Equipment that fails to meet established requirements must be removed from service until corrective action is completed.

The inspection varies on different equipment, and locally developed checklists that are specific to individual installations or systems may be developed. A typical daily checklist includes the following:

1. Check that fire extinguishers are in place, filled, operable, and have a current inspection tag.

2. Inspect the nozzle for damage.

3. Hook up the nozzle to the bottom-loading adapter or recirculation fitting and again inspect the nozzle for damage or evidence of leaks.

4. Check the entire length of the hose for cuts, cracks, abrasions, and fuel saturation.

5. Check that bonding cables are in place and in good condition, clean, and have serviceable plugs and clips securely attached.

6. Carefully inspect tanks, piping, valves, pumps, meters, and couplings for leaks.

7. Check the emergency valve controls for condition and ease of operation.

8. Make sure exterior surfaces are wiped clean of oil, grease, and fuel. Make sure the cabinets, troughs, cab, and any enclosures are free of an accumulation of fuel, dirt, cleaning material, and unnecessary items. Check fenders and mudguards to ensure adequate protection against the throwing of mud and dirt on fueling equipment and the rear of the unit.

9. Check the fluid levels of the battery, radiator, gas, and engine oil.

10. Make sure all lights are operable, all electrical wiring outside the cab is enclosed in tubing, and the rear view mirrors are serviceable.

11. Drain all low-point drains (tank, filter/separator, monitor, relaxation chamber). If water is found, empty the sample into a safety can and repeat the process until a clean, water-free sample is obtained.

12. Carefully inspect the exhaust pipe and muffler system, including any auxiliary engine system, for leaks, cracks, noise, and proper placement.

13. Check the emergency brake to make sure it holds.

14. Drain air tanks of moisture and check for fuel contamination.

15. Engage the pump and pressurize the system. Check the entire system for leaks.

16. Place the nozzle's flow-control handle in the fully opened and locked position and recirculate. On refueling trucks. recirculation is to be performed at standard RPM settings, where flow rates and differential pressures can be accurately measured. The recirculation of trucks more than one-half full is limited to 10 minutes, each 10-minute period followed by a 1-minute rest to allow electrostatic charges to dissipate. For trucks less than one-half fill, the recirculation time is limited to 3 minutes. All equipment must be

recirculated long enough to flush out all piping downstream of the fuel monitor elements.

17. Check the operation of the pump. Listen for unusual sounds and feel for overheating and/or abnormal vibrations.

18. Obtain a nozzle sample and visually inspect it for color, water, and solids. Record the results.

19. With the system recirculating, observe and record the pressure drop across the filter/separator and the monitor.

Weekly Checks

The weekly check is performed by a senior operator or fuel shop personnel. The weekly inspection is also required to be performed on equipment being returned to service following any DOWN time that exceeds 72 hours. The typical weekly inspection checklist is as follows:

1. Complete items 1 through 17 on the daily checklist.

the CFD and FWD. Log the results in the appropriate laboratory log.

3. Clean and inspect all nozzle screens (pressure and overwing).

4. Inspect tires, brakes, horn, windshield wipers, steering, trainer coupling and electrical wiring. The brake linings and/or pads must be checked by normal application of the brake while observing pedal travel. Test the emergency brake under drive conditions. Make sure all electrical wiring outside of the cab is encased in tubing that terminates in securely mounted vapor-tight fixtures or junction boxes with compression fittings. The use of a transportation inspector is recommended for these checks.

5. Measure and record the pressure drop across the filter/separator and the fuel monitor using a sensitive, hand-held pressure gage accurate to 1 psi, with graduations in 1 psi, or smaller, units, This measurement MUST be taken with the system operating under normal flow conditions.

Monthly Checks

The monthly checks require special equipment and moving of mobile equipment to a location other than the operating area. The typical monthly checklist is as follows:

1. Complete the daily and weekly checklists.

2. Check the continuity of grounding cables, bonding cables, and reels. Continuity must be measured with the cable in the stowed, intermediate, and fully extended positions. Check the continuity of the grounding cable on each overwing fueling nozzle.

3. Inspect and clean all line strainers, including the meter strainers when installed.

4. Test the anti-driveaway device installed on all refuelers.

5. Perform the engine spark check at night. The purpose of this check is to locate any electrical arcing over the outside surfaces of wiring, spark plugs, and the like. Any auxiliary engines should be included in the test. Any observed arcing—however slight—is sufficient cause to remove the equipment from service.

6. Test maximum flow rate. If pressure tests indicate that nozzle pressure exceeds 55 psi or that the flow rate exceeds 600 gpm, the equipment must be removed from service.

7. Test the primary pressure-control system.

8. Check the refueling adapters (receptacles), using the go/no-go gage.

9. Make sure fuel-handling equipment is marked in accordance with NAVFAC P-300 or MIL-STD-161.

Periodic Inspection and Annual Record

The Periodic Inspection and Annual Record provides an important historical record for each piece of refueling equipment. It is a written record of inspections, calibrations, element changes, and other maintenance actions performed through the year. As with other checklists, this record may be tailored to meet the requirements of each station.

Filter/Separator—Fuel-Monitor Pressure Log and Graph

The pressure drop across each housing must be accurately determined so that the integrity of the elements can be verified. Over time, differential pressure will increase as more and more dirt and/or water is trapped. Additionally, ruptures or breaks are identified by a significant drop in differential pressure. All activities must maintain a log for each filter or monitor.

Filter and monitor elements in refueling equipment or at truck-fill stands are changed every 3 years

unless an earlier change is forced by one of the following conditions:

- The pressure drop across either the filter or the monitor elements reaches 20 psi.
- The combined pressure drop across the filter and monitor elements reaches 25 psi.
- A significant drop in differential pressure occurs, indicating an element rupture.
- The differential pressure fails to increase after an extended pied, indicating either ruptured elements or improper installation.
- The complete shutdown of fuel flow and/or a very rapid increase in pressure differential across the monitor elements. This usual] y indicates a failure of the filter/separators. If this condition occurs, both the filter/separator and monitor elements must be changed.

During filter changes, the permanent second-stage water separator elements should be tested for their ability to repel water. If the separator element does not repel or cause the water to bead, it should be washed with warm water and tested again.

Records and Reports

Observation of abnormal operating conditions is vital to a good preventive maintenance program. The detection of small operating faults and their subsequent minor correction or repair can often avert the development of major problems requiring extensive repairs. Such conditions must be promptly reported to the proper authorities in order to achieve the necessary repairs or corrections. These deficiency reports are in written form.

Facilities "must maintain maintenance records in sufficient detail to provide the following:

- Identification of each major structure, equipment item, group of items, or system
- Current maintenance status, including unfunded deficiencies and uncompleted job orders
- Past maintenance history, including description and cost of major repairs or replacements
- Recommendations for future programmed repairs or replacements, including estimates of funds or manpower requirements

ASHORE OPERATING PROCEDURES

LEARNING OBJECTIVE: Explain the procedures for various ashore fueling operations.

The operating procedures presented and discussed in this section are for general types of fuel facilities and equipment common to all or most activities engaged in the fueling of aircraft. Since the actual facilities and equipment vary greatly from installation to installation, these procedures and accompanying information are designed to serve as a basic outline and guide. As always, use your station's specific operational procedures for actual fueling and defueling operations.

SPILL PREVENTION AND CONTROL

Proper training of fuel-servicing personnel is essential. Proper maintenance of the equipment is equally essential. Leaking or malfunctioning equipment must be removed from service. Self-closing nozzles or deadman controls must not be blocked open or bypassed. Kinks and short loops in fuel hoses should be avoided. In addition, a fuel-spill/fire prevention drill must be conducted at least quarterly.

When a spill is observed, the fuel servicing must be stopped immediately by release of the deadman control, by closing the nozzle handle, or by operation of the emergency fuel shutoff. The supervisor is notified at once, and the operation must not be resumed until authorized by the supervisor. Every fuel spill must be investigated to determine the cause, whether emergency procedures were properly carried out, and what corrective measures are required.

Priming Spills

Pint-size spills, involving an area less than 18 inches in any dimension, require no emergency action during cold-refueling operations. However, ramp personnel should stand by with a fire extinguisher until operations are complete and/or the aircraft departs. A spill or leak of any size is cause for terminating a hot-refueling operation.

Small Spills

Other small spills involving an area of from 18 inches to 10 feet in any dimension must have a fire guard posted, equipped with at least one fire extinguisher. Either absorbent cleaning agent or emulsion

compound may be used to absorb the spilled fuel. Contaminated absorbent must be placed in metal containers with closed lids until it can be removed and disposed of according to local hazardous-waste disposal procedures. An exception to this method maybe authorized if the spill occurs in an area where no operations are in progress or will be conducted until ample opportunity is provided for volatile fuels to evaporate harmlessly. In such an event, the area must be roped off. Fuels such as JP-5, which will not evaporate readily, must be removed by one of the methods indicated previously.

Large Spills

Spills covering an area greater than 10 feet in any dimension or more than 50 square feet in area require handling by the Spill Response Team. The team must be summoned immediately and all other personnel evacuated to a safe distance. No one will be permitted to walk through the liquid area of a fuel spill.

All fuel spills must be reported immediately to the activity's Environmental Coordinator in accordance with the local oil-spill contingency plan. All fuel-handling personnel must be familiar with the local oil-spill contingency plan.

PRESSURE REFUELING AT DIRECT FUELING STATIONS (PITS) WITH ENGINES OFF (COLD REFUELING)

Cold refueling of aircraft at fueling hydrants, direct refueling stations, skid mounts, and other fuel service units requires a minimum of two people. Required are a nozzle operator (supplied from the squadron, maintenance department, or transient line) and a fuel system operator (from the fuels division), who also performs the duty of a fire extinguisher operator. Aircraft refueling tasks are to be performed in the following sequence and verified by the pit station operator. The individual who actually performs the task is indicated within parentheses following the task.

1. Recirculate (flush) the station and take fuel sample(s) for quality control checks as appropriate (station operator). Fuel is recirculated or flushed through the refueling hose and nozzle, and tested for contamination prior to refueling the first aircraft each day. Fueling must not begin until acceptable results have been obtained.

2. Check for "hot-brake" condition (plane captain). The hot-brake check applies to fixed-wing aircraft only.

3. Tow the aircraft into the direct refueling station; position and chock it (plane captain).

4. Secure all electronic and electrical switches on the aircraft not required for fueling (plane captain).

5. Verify that fire-fighting equipment is in the immediate vicinity of the refueling operation and manned (station operator).

6. Attach the bonding cable between the refueling equipment and the aircraft (plane captain). In direct fuel systems, bonding is usually accomplished through the nozzle/hose/pantograph system. If bonding is not accomplished via the nozzle/hose/pantograph system, the bonding connection is made using the grounding receptacle near the aircraft's refueling adapter. If this is not possible, the connection must be to bare metal on the aircraft.

7. Pull out the pantograph (or reel out the hose) and place it in the proper position for refueling (nozzle operator and station operator).

8. Remove the refueling adapter cap from the aircraft and the dust cover from the pressure nozzle. Inspect the face of the nozzle to make sure it is clean, and verify that the flow-control handle is in the fully closed and locked position (nozzle operator).

CAUTION

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

9. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear (nozzle operator).

CAUTION

The nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which could lead to a fuel spray or spill.

10. Lift the nozzle by the lifting handle; align the lugs with the slots on the aircraft adapter; and hookup to the aircraft by pressing the nozzle firmly onto the adapter and rotating it clockwise to a positive stop (nozzle operator).

11. Zero the refueling station's meter or note the station's totalizer reading (station operator).

12. Upon receiving signals from the nozzle operator and plane captain that hook-up has been completed and the fueling operation is ready to begin, the station operator actuates the remote, hand-held deadman control. Deadman controls must NOT be blocked or overridden in any way. Such action defeats the purpose of the device and can lead to a catastrophic accident.

13. Rotate the nozzle flow control handle to the FULL OPEN position. The handle must rotate 180 degrees to ensure that the poppet valve is fully open and locked (nozzle operator). The flow-control handle of the pressure refueling nozzle will be placed in either of two locked positions: fully open or fully closed. The handle is NOT to be used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to "float" in the unlocked position.

14. Once fuel flow is established, test the aircraft's precheck system (plane captain).

NOTE

The precheck system simulates the completion of a complete refueling by closing all the tank inlet shutoff valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. The refueling station meter is the primary means of detecting that fuel flow has stopped and that the precheck was successful. If a meter is not available, successful precheck may be confirmed by observing the jerk and stiffening that occurs in the refueling hose and/or the pressure spike that occurs at the refueling station. An aircraft may be cold refueled if it fails precheck but special procedures are required. See the appropriate aircraft NATOPS manual. Cold refueling after precheck failure should be done only if it is an operational necessity.

15. Fuel aircraft as directed by the plane captain. The plane captain monitors the aircraft vents, tank pressure gage(s), and/or warning lights as necessary.

16. When directed by the plane captain, release the deadman control (station operator).

17. Rotate the nozzle flow-control handle into the OFF and fully locked position (nozzle operator, and verified by the station operator). Failure to lock the flow-control handle in the OFF position can contribute to failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

18. Disconnect the nozzle from the aircraft adapter (nozzle operator).

19. Stow the pantograph or hose (nozzle operator and station operator).

20. Complete the paperwork (nozzle and station operators).

Overwing (Gravity) Refueling at Direct Fueling Stations (Pits)

Overwing (gravity) refueling of aircraft at fueling hydrants, direct refueling stations, skid mounts, and other fuel service units is done using the procedures previously mentioned but with the following modifications:

- The overwing nozzle must be bonded to the aircraft via a nozzle bonding cable prior to removing the filler cap.

CAUTION

Overwing refueling with the aircraft's engines operating (hot refueling) is NOT authorized

- The overwing nozzle is inserted into the aircraft's refueling port. Metal-to-metal contact between the nozzle and the aircraft fueling port must be maintained during the entire fueling operation.

TRUCK FILL STANDS

Operating truck fill stands is a one-person operation for trucks equipped with high-level alarms/shutoff and deadman control valves at the fill stand. This is a two-man operation for equipment not having these devices.

CAUTION

Top loading must NOT be performed. This method of filling is extremely dangerous because of the highly flammable vapors and static charges produced.

Trucks are filled in the following sequence:

1. Position the truck, turn off lights, place the gear shift in the neutral or park position, set the parking brake, stop the engine, and turn off all switches except necessary alarms.

2. Verify the product and estimate the amount of product to be loaded.

CAUTION

Vehicles without high-level controls or alarms must be monitored via the fill stand meter during the filling process. Secure pumping if the meter exceeds the amount previously issued from the truck.

3. Connect the bond or high-level control cable.

4. Connect the delivery nozzle to the truck's bottom loader.

5. Set the meter and enter the necessary information on the truck fill order or other form.

6. Start the filling operation slowly.

CAUTION

Trucks that have been completely drained must be minimally fueled (500 to 1,000 gallons) using another truck set at a low flow rate, to cover the bottom inlet valve inside the empty truck's tank.

7. After the tank is filled, secure the pump unless it has secured automatically.

8. Disconnect the nozzle.

9. Disconnect the bond or high-level control cable.

10. Complete the paperwork.

11. Inspect the truck for leaks.

12. Remove the refueler to the truck parking area.

COLD REFUELING OF AIRCRAFT BY TRUCK

Positioning of refuelers to service aircraft is done in the same manner—without variation—so that all personnel involved know exactly what to expect. Whenever possible, refuelers should proceed down a line of parked aircraft, with the driving path perpendicular to the aircraft fuselage axis, at the maximum distance the hose length will permit servicing. However, a truck must never approach closer than 10 feet of an aircraft. The normal refueler approach path, shown in figure 7-7, applies to all fixed-wing tactical aircraft and helicopters. Normally, no turns are made except at the end of the parking line. Driving between aircraft parked in line should be avoided; however, the preferred approach is not always possible. Figure 7-8 shows acceptable alternate methods when aircraft are not parked in line or when hose lengths are insufficient for service. Figure 7-9 shows the safe approach paths to prop, prop/jet, and

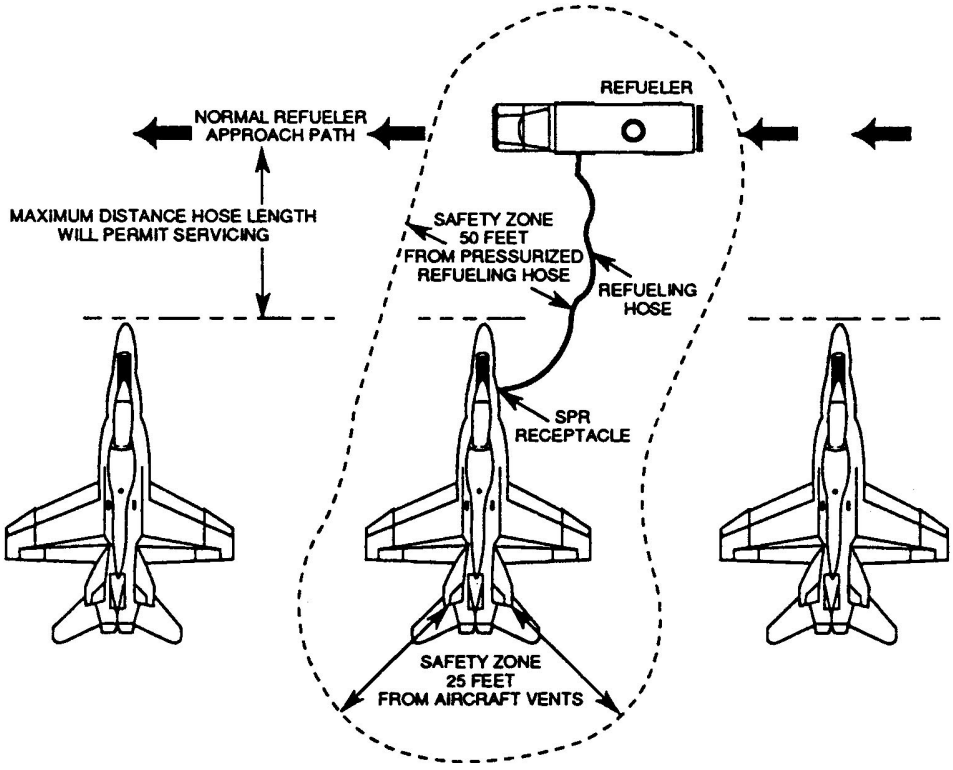


Figure 7-7.—Normal refueler approach path and safety zone.

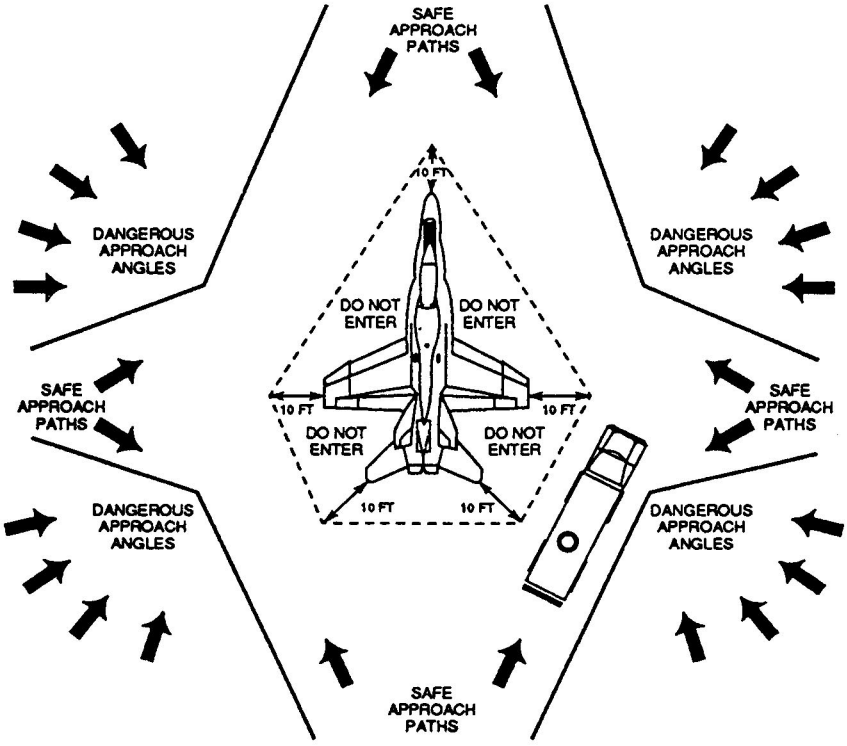


Figure 7-8.—Alternate refueler approach paths.

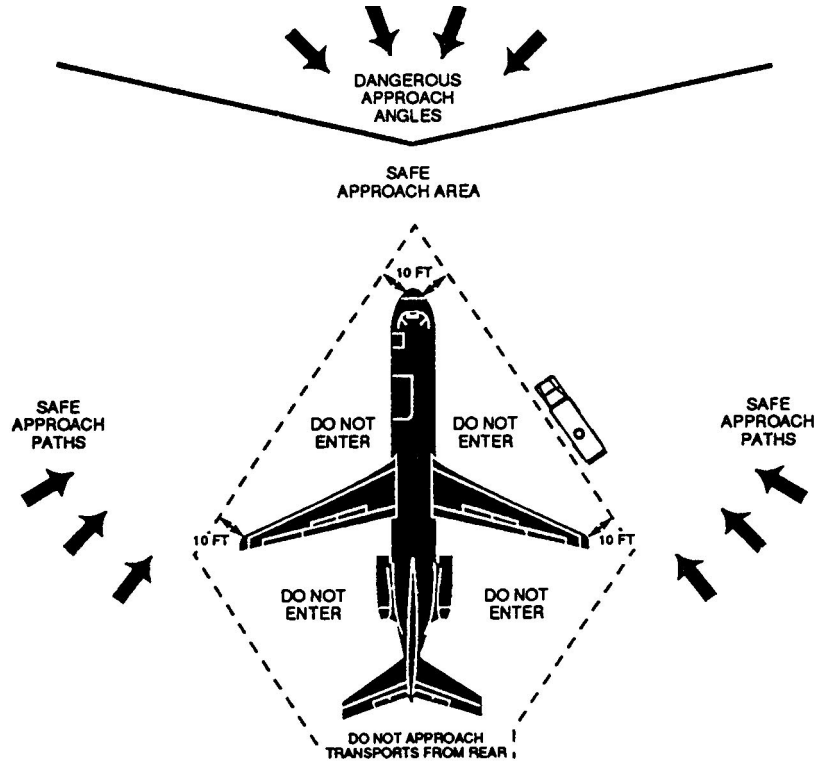


Figure 7-9.—Refueler approach to prop, prop/jet, and transport aircraft.

transport aircraft; figure 7-10 illustrates the alternate approach paths for helicopters. Refuelers must NEVER

- be left pointing toward any part of an aircraft;
- be driven in the area described by straight line projections connecting points 10 feet from an aircraft's extremities (see figures 7-8, 7-9, and 7-10); or
- be backed in proximity to aircraft.

The refueler is parked in a position on the same side of the aircraft as the aircraft's adapter, so that the driver/operator has a direct line of sight to the refueling nozzle operator while actuating the deadman control. Failure of the driver/operator to visually observe the nozzle operator throughout the refueling operation can lead to a fuel spill and fire.

Tailpipe temperature and the location of aircraft tank vents are important considerations when determining alternate routes and fueling positions.

The hose must NOT pass underneath the aircraft's fuselage to reach the aircraft's fueling adapter.

Aircraft refueling with trucks is a three-person function. Required are a nozzle operator (supplied from the squadron, maintenance department, or transient line), a driver/operator (from the fuels division), and a fire extinguisher operator (supplied by the squadron). The nozzle operator assists the driver/operator in removing and replacing the hose on the refueler.

The driver/operator prepares the truck for refueling operations as follows:

1. Recirculate (flush) the truck and take a fuel sample for quality control checks as appropriate. Fuel is recirculated/flushed through the refueling hose and nozzle, then tested for contamination prior to refueling the first aircraft each day. Fueling must NOT begin until acceptable results have been obtained.

2. After a hot-brake check of the aircraft (fixed-wing only) has been performed, drive the refueler into position for refueling, following the approach paths discussed previously. The refueler should be positioned so that it can be driven away quickly in an emergency. Wheel chocks should NOT be used.

3. Set the brakes.

4. Place the gear shift in neutral.

5. Turn off the headlights and unnecessary switches.

6. Open the driver's side door. It remains partially open during the entire refueling operation.

CAUTION

A window in the truck cab must be kept at least partially open whenever the truck is stationary and the engine is running, to prevent the buildup of carbon monoxide inside the cab.

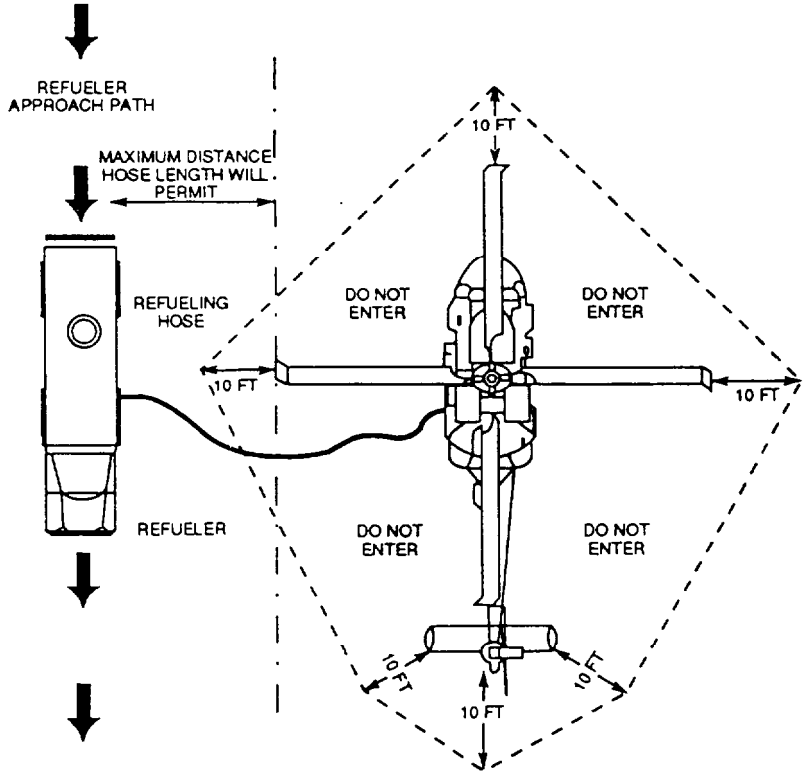


Figure 7-10.—Alternate refueler approach to a helicopter.

When the truck is in position and prepared as above, conduct fueling operations as follows:

1. Secure all electronic and electrical switches on the aircraft that are not required for fueling (plane captain).

2. Verify that manned fire-fighting equipment is in the immediate vicinity and upwind of the refueling operation (refueler operators).

3. Attach the bonding cable between the refueling equipment and the aircraft (plane captain).

4. Pull out the hose (or pantograph) and place it in the proper position for refueling (nozzle operator and refueler operator).

5. Remove the refueling adapter cap from the aircraft, and the dust cover from the pressure nozzle. Inspect the face of the nozzle to make sure it is clean, and verify that the flow-control handle is in the fully closed and locked position (nozzle operator).

6. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. A worn or broken adapter can defeat the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

7. Lift the nozzle by the lifting handles, and align the lugs on the nozzle with the slots on the aircraft adapter. Hook up the nozzle to the aircraft by pressing the nozzle firmly onto the adapter and rotating it clockwise to a positive stop (nozzle operator). The nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which could lead to a fuel spray or spill.

8. Zero the refueling meter or the totalizer reading (refueler operator).

9. Rotate the nozzle flow-control handle to the FULL OPEN position. The handle must rotate 180 degrees to ensure the poppet valve is fully open and locked (nozzle operator).

10. Upon receiving signals from the nozzle operator and the plane captain that the hook-up has been completed and that they are ready to begin the fueling operation, the refueler operator actuates the remote, hand-held deadman control.

11. Once fuel flow has been established, test the aircraft's precheck system (plane captain).

12. Fuel the aircraft as directed by the plane captain. The plane captain monitors aircraft vents, tank pressure gage(s), and/or warning lights, as necessary.

13. When directed by the plane captain, release the dead man control (refueler operator).

14. Rotate the nozzle flow-control handle to the OFF and fully locked position (nozzle operator, and verified by the refueler operator).

15. Disconnect the nozzle from the aircraft adapter (nozzle operator).

16. Stow the pantograph or hose (nozzle operator and refueler operator).

17. Complete the paperwork (nozzle and refueler operators).

OVERWING (GRAVITY) REFUELING BY TRUCK

Overwing (gravity) refueling of aircraft from trucks is done using the procedures as above but with the following modifications:

- The overwing nozzle must be bonded to the aircraft via a nozzle bonding cable prior to removal of the filler cap.

CAUTION

OverWing refueling with the aircraft's engines operating (hot refueling) is NOT authorized.

- The overwing nozzle is inserted into the aircraft's refueling port. Metal-to-metal contact between the nozzle and the aircraft fueling port must be maintained during the entire fueling operation.

REFUELER PARKING

All activities require that refueling vehicles be constantly attended whenever the engine is operating. The operator is considered in attendance when performing tasks directly associated with fueling an aircraft; for example, assisting the aircraft refueling operator, transporting the hose. If the operator is to leave his truck unattended, he must first

1. drive the truck clear of the aircraft;

2. place the air brake in ON and LOCKED position, if applicable;

3. set the parking brake;

4. direct the front wheels to an open, unobstructed area;

5. stop the engine; and

6. chock the drive wheels.

FUELING WITH ENGINES OPERATING (HOT REFUELING)

Hot refueling is performed only when operations require rapid turnaround of aircraft, since hot refueling is significantly more dangerous and costly in terms of fuel and manpower expenditures. Only pressure hot refueling is performed.

A minimum of three ground crew personnel are required for each hot-refueling operation. All personnel performing hot-refueling operations must be fully trained and qualified. The usual duties of each of these personnel are listed in the following paragraphs. Local conditions or procedures, however, may require that the duties be distributed differently among the refueling personnel. If the station is configured such that the deadman control operator does not have a direct line-of-sight of both the aircraft pilot and the nozzle operator, a fourth person (refueling coordinator) is mandatory.

Personnel required for hot-refueling aircraft are as follows:

- One station operator. The station operator must be a fully qualified station operator from the local fuels management organization. He or she must be positioned to observe and monitor the entire hot-refueling operation. Duties include actual operation of the deadman control.

- One nozzle operator. The nozzle operator must be a squadron crewmember qualified for aircraft refueling duties related to the specific aircraft type model being refueled. Duties include the performance of necessary aircraft refueling checks, such as the testing of the precheck system and the vent and refueling panel monitoring. The nozzle operator remains at the nozzle throughout the refueling and leaves only to conduct necessary vent checks.

- One fire watch operator. This operator is normally TAD from one of the squadrons being refueled.

- One refueling coordinator (plane captain). The refueling coordinator will be a crewmember of the squadron whose plane is being hot-refueled. The coordinator's primary duties include directing all movements of the aircraft and coordinating hand signals between fuel crew and the pilot. If the deadman control operator has a direct line-of-sight to both the aircraft pilot and the nozzle operator, the refueling coordinator's duties may be performed by either the station operator or the nozzle operator.

Equipment Requirements

The following equipment is the minimum required to conduct hot-refueling operations at shore activities:

One fuel service unit, such as a direct refueling station (pit) or mobile refueler. This unit must possess all of the required features and systems listed earlier in this chapter for systems/facilities that refuel aircraft (filter/separator, fuel monitor, and so forth). The fuel service unit MUST have a completely operational deadman control, which MUST cut off the flow of fuel to the aircraft immediately (within 2 seconds) upon release. Leakage past this valve with the deadman in the released position cannot exceed 1 gallon in 5 minutes.

A pantograph or a minimum of 50 feet of refueling hose. Pantograph fueling arms are preferred, because they are significantly less prone to rupture.

One bonding/grounding cable. Newer direct refueling stations (pits) are designed with the bonding/grounding cable built into the pantograph and along the hose. A separate bonding cable is therefore not needed with these systems. Both the truck and aircraft must be grounded to the earth as well as bonded to each other during hot-refueling operations with trucks.

Aircraft wheel chocks.

Sound-attenuating ear protectors, goggles, cranials, and long-sleeved shirts and pants for each crewmember. Personnel must NOT wear shoes that have nails or other metal devices on the soles of their shoes that might cause sparking.

A fire extinguisher at each relueling station. All ground personnel involved in the hot-refueling operation must be qualified in operating the fire-extinguishing equipment in use.

One emergency dry-break quick-disconnect. This device is attached to the refueling hose near the pantograph (on direct refueling stations) or attachment point to the fuel servicing unit.

Hot-Refueling Procedures

The following must be accomplished before aircraft enter the hot-refueling area:

CAUTION

No nozzle samples are taken after the aircraft has taxied into the designated hot-refueling area. Sampling increases the possibility of a fuel spill.

• The station or mobile refueler must be recirculated (flushed) and fuel sample(s) taken for quality control checks as appropriate (station operator).

• The area must be policed for FOD.

• Ground crew must wear sound-attenuating ear protectors, goggles, and cranials.

CAUTION

Hot refueling must NOT be performed if a hot-brake condition exists.

• Fixed-wing aircraft must be checked for hot-brake condition (plane captain). The hot-brake check is applicable to fixed-wing aircraft only.

• Qualified squadron personnel MUST verify that all ordnance is safed. *Safed* is defined as the replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin; securing of armament switches; and/or any other action that renders any ordnance earned as being safe.

• The aircraft is taxied into the hot-refueling area under the guidance of a qualified aircraft director. The aircraft enters the area so that the refueling receptacle is on the side of the aircraft nearest the pantograph or hose.

CAUTION

The pantograph must be extended a distance sufficient for the emergency dry-break-away device to work properly without the pantograph interfering with movement of the aircraft. See figure 7-11.

— The hose or pantograph must NOT pass underneath the aircraft to reach the nozzle receptacle.

— Refueling must be stopped immediately if any leaks are discovered during the operation.

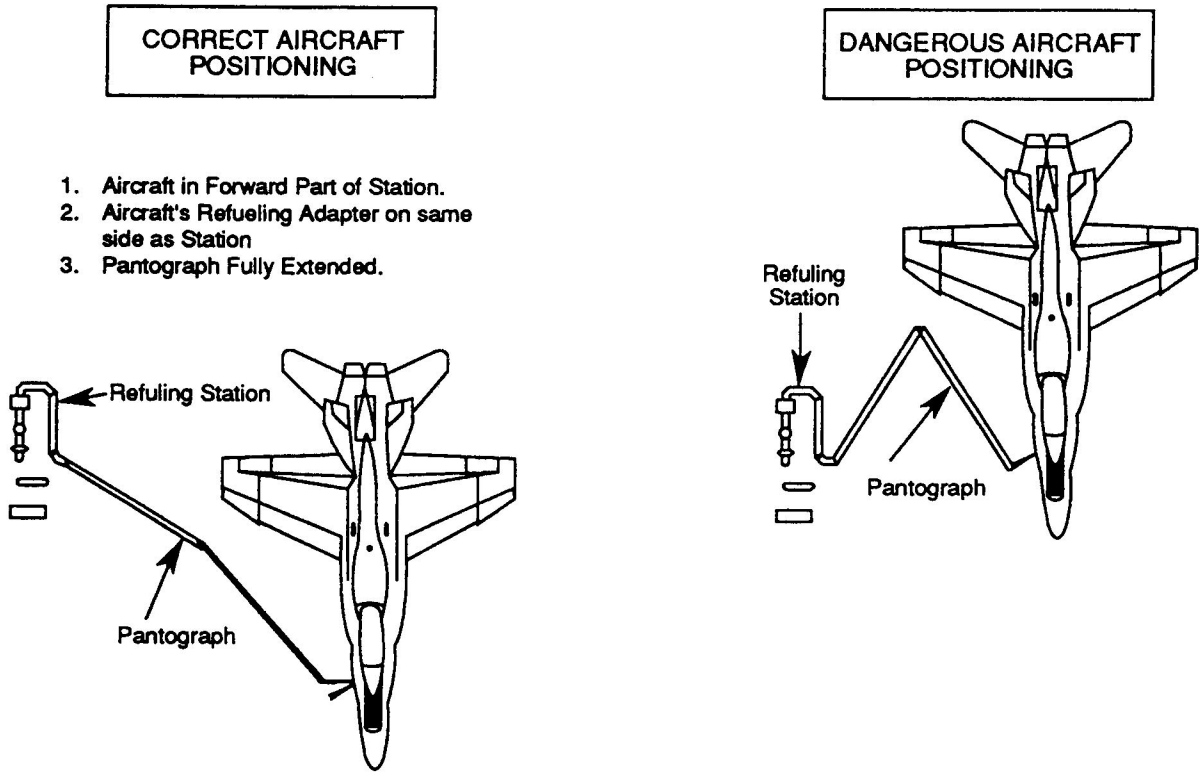


Figure 7-11.—Positioning aircraft for pantograph refueling.

— The deadman control operator must have a direct line-of-sight to the refueling nozzle operator at the aircraft receptacle whenever he or she is actuating the deadman control.

— If either the primary or secondary shutoff-valve test indicates a failure, stop the hot-refueling operation immediately.

— The aircraft canopy remains closed during the entire refueling evolution.

— Both engines on dual-engine aircraft are assumed to be operating. Although some aircraft can, and do, shut down the engine on the side where the refueling adapter is located (F-14), most aircraft currently do not (F-18, A-6).

— Hot refueling of rotary-wing aircraft by mobile refueler without the use of a pantograph is accomplished only with the rotor blades disengaged. Hot refueling by mobile refueler should be avoided whenever possible. refueler operators must be thoroughly checked out and PQS-certified in hot-refueling operations.

• Secure all unnecessary electrical and electronic equipment.

• Verify that manned fire-fighting equipment is in the immediate vicinity of the refueling operation (station operator).

• Attach the bonding cable between the refueling equipment and the aircraft (plane captain). In direct fuel systems (pits), bonding is usually accomplished through the nozzle/hose/pantograph system. If bonding is not accomplished via the nozzle/hose/pantograph system, the bonding connection is made using the grounding receptacle near the aircraft's fueling adapter. If this is not possible. the connection must be to bare metal on the aircraft.

• Pull out the pantograph (or reel out the hose) and place it in proper position for refueling (nozzle operator and station operator).

• Remove the refueling adapter cap from the aircraft and the dust cover from the pressure nozzle. Inspect the face of the nozzle to make sure it is clean, and verify that the flow control handle is in the fully closed and locked position (nozzle operator).

• Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. A worn or broken adapter can defeat the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

• Lift the nozzle by the lifting handles and align the lugs with the slots on the aircraft adapter. Hookup to the aircraft by pressing firmly onto the adapter and rotating it clockwise to a positive stop (nozzle operator). The nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which can lead to a fuel spray or spill.

• Zero the refueling meter or note the totalizer reading.

• Upon receiving signals from the nozzle operator and plane captain that hook-up has been completed and that the fueling operation is ready to begin, the station operator actuates the remote, hand-held, deadman control.

CAUTION

The deadman controls must NOT be blocked open or overridden in any way. This defeats the purpose of the device and can lead to a catastrophic accident.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections must not be changed until the evolution has been completed or refueling has been stopped for an emergency. NO aircraft engines or auxiliary power units can be started or stopped, and external power CANNOT be connected, disconnected, switched on or off. Changing the aircraft's electrical power status can create significant ignition sources.

• Rotate the nozzle flow-control handle to the FULL OPEN position. The handle must rotate 180 degrees to make sure the poppet valve is fully open and locked (nozzle operator). The flow-control handle of the single-point pressure refueling nozzle is-placed in either of two locked positions: fully open or fully closed. The handle is NOT to be used as a flag to indicate fuel flow.

Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

- Once fuel flow has been established, test the aircraft's precheck system (qualified squadron personnel).

- Fuel the aircraft as directed by the plane captain. The plane captain monitors aircraft vents, tank pressure gage(s), and/or warning lights as necessary.

- When directed by the plane captain, release the dead man control.

- Rotate the nozzle flow control handle into the OFF and fully locked position (nozzle operator, and verified by the station operator). Failure to lock the flow control handle in the OFF position might result in a fuel spray or spill.

- Disconnect the nozzle from the aircraft adapter (nozzle operator).

- Stow the pantograph or hose (nozzle operator and station operator).

- Complete the paperwork (nozzle and station operator).

- Make sure the area is clear of equipment and personnel.

MULTIPLE-SOURCE REFUELING

Normally only one refueling truck at a time is used to service aircraft. However, there are situations when multi-truck or truck and hydrant servicing is considered desirable, especially when very large aircraft must be refueled. The advantage of multiple-source refueling is reduced aircraft turnaround time. The aircraft's NATOPS manual or equivalent aircraft servicing manual should be consulted for specific guidelines and instructions on multiple-source refueling before such operations are performed.

PIGGYBACK REFUELING

Piggyback refueling is a special refueling process sometimes used to refuel very large aircraft such as C-5As or E-6As. Two or more refueling trucks are used. One truck is attached to the aircraft's refueling adapter, and other trucks are used to refuel this truck while it continuously refuels the aircraft, This is a potentially dangerous operation and will be conducted only with properly configured vehicles and under the direct supervision of the Fuels Maintenance Officer.

REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) RUNNING

The aircraft's APU may be used to supply electrical power for pressure refueling on military aircraft so equipped. This operation is not considered "hot refueling." However, the following precautions are observed in addition to the normal refueling procedures:

One man remains outside the aircraft within 10 feet of the APU exhaust with a fire extinguisher of the size specified by the station's Fire Chief.

The fuels operator verifies that the aircraft is grounded.

One person is at the GTC controls in the cockpit.

Communications are established between the cockpit and the personnel performing the refueling, to ensure immediate shutdown in an emergency.

Personnel near the aircraft must wear sound-attenuating ear protectors.

DEFUELING AIRCRAFT

As was stated in chapter 5, defueling is one of the most technically demanding and potentially dangerous operations performed by fuels personnel. The following rules apply to every defueling operation performed on shore stations:

1. Aircraft defueling must be requested by an authorized representative of the squadron's CO, using an Aircraft defueling Certificate similar to the one

shown in figure 7-12. The Fuels Maintenance Officer of each activity maintains a list of these officially designated personnel. This list is updated at least quarterly.

2. During defueling operations, maintenance not directly required to facilitate the defueling operation is NOT to be performed.

3. Aircraft will be spotted 100 feet from all structures and other aircraft. Grounding and tiedown padeyes must be available. In addition, at least one fire extinguisher must be available in the immediate vicinity of the operation.

4. Only defueled aviation turbine fuel can be reissued to aircraft. All defueled AVGAS is downgraded and not used as aviation fuel.

5. Suspect aviation turbine fuel must be removed from the aircraft using a defueler only (not a refueler/defueler) and deposited in a designated holding tank. Ultimate disposition will depend on the results of later laboratory tests. Every effort should be made to reclaim off-specification fuel as JP-5, F-76 or fuel oil reclaimed (FOR).

6. All fuel removed from turbine engine aircraft is assumed to be a mixture of JP-4 and JP-5. Defueled turbine fuel must not be returned to JP-5 storage tanks without first confining the flash point of the fuel to be 140°F or higher.

7. Fuel containing leak-detection dye can be reissued to aircraft of the same squadron as long as the squadron's requesting official signs a statement that the fuel is nonsuspect and is safe for use.

NOTE

Refuelers/defuelers may be used to defuel dyed fuel. However, this may present logistics problems since it may take several loads of fuel to flush the dye out of the refueler/defueler. The fuel may appear off-color when sampled prior to issue to another squadron's aircraft.

8. The Fuels Maintenance Officer will personally decide the disposition of all defueled products.

9. The defueling unit is required to maintain a flooded suction above the anti-vortex splash plate in its tank to minimize turbulence and possible ingestion of air. Historically, a minimum of 1,000 gallons has been required in the defueling unit to resolve turbulence and air ingestion problems. Because of the wide variety of configurations of pump piping systems and tank sizes, 1,000 gallons of product mayor may not be enough. It is up to the local commands to determine the minimum amount by using manufacturers' technical manuals and historical data.

10. The valve(s) that control the flow of fuel from the tank to the upstream side of the pump remain closed during defueling operations. This is to prevent the recirculation of product in the tank. The valve(s) may be opened to prime the pump only when the pump is not operating.

11. If, during the defuel operation, the pump starts to lose prime or cavitates, the operation must be discontinued until the problem is resolved and the fuel supervisor authorizes a restart. At no time will a restart be authorized without waiting a minimum of 1 MINUTE to allow relaxation of any static charges.

12. At no time will defueler tank tops be opened during defueling operations.

13. Every aircraft defueling operation requires a minimum of three personnel: the defuel truck operator (supplied by the fuel division), a nozzle operator (supplied by the squadron), and a fire watch (supplied by the squadron).

14. A special log of each defueling operation is maintained. The following minimum information is contained in the log:

a. Complete list of all squadron personnel authorized to sign defuel request forms. This list must be updated at least quarterly.

b. All abnormal happenings.

c. Aircraft buno number.

d. Defueler number.

e. Grade of product.

f. Amount of product actually defueled.

g. Scheduled amount to have been defueled.

h. Disposition of product.

i. Times when the defuel operation was started and completed.

j. Names of the defueler operator and squadron personnel present during the defuel operation.

AIRCRAFT DEFUELING CERTIFICATE

PART I [to be completed by person authorizing the defuel operation (person's name shall be on file with the fuel officer).]

I CERTIFY THAT THE AVGAS/TURBINE FUEL (cross out one) TO BE DEFUELED FROM AIRCRAFT NUMBER _____:

☐ WOULD NOT PREVENT THE RELEASING OF THIS AIRCRAFT FOR FLIGHT.

☐ IS SUSPECT OF CONTAMINATION WITH _____

_____

☐ CONTAINS DYE BUT WOULD NOT PREVENT THE RELEASING OF THIS AIRCRAFT FOR FLIGHT. REISSUE DYED FUEL TO AIRCRAFT NUMBERS _____ AND _____.

THE ESTIMATED GALLONS TO BE DEFUELED ARE: _____

THE REASON FOR DEFUELING IS: _____

_____

_____ _____ _____

Signature Title Date

PART II [to be completed by operator after completion of defueling operation.]

METER READING: _____

VOLUME OF FUEL REMOVED FROM AIRCRAFT: _____

_____ _____ _____

Signature Title Date

Figure 7-12.—Aircraft Defueling Certificate.

Defueling Procedures

Aircraft defuelings are to be performed in the following sequence:

1. Prior to starting the defuel operation, take samples of the fuel to be defueled from the aircraft's drains and visually inspect them for contamination (qualified squadron personnel under the observation of the driver/operator).

2. Determine the status of the fuel, that is, suspect or nonsuspect (defuel truck operator). The person requesting the defueling operation will confirm that the fuel is or is not suspect. Fuel is considered suspect if the aircraft has malfunctioned and the fuel is believed to have contributed to the problem or the fuel is thought to be of the wrong type.

3. Determine the amount of fuel to be removed from the aircraft (defuel truck operator). Again, the squadron personnel requesting the defueling operation will provide this estimate as part of the official request.

4. Select the defueling equipment to be used, that is, defueler for suspect product or refueler/defueler for nonsuspect fuel (FMO and station operator). Always check the remaining capacity of the defueler or refueler/defueler to make sure there is adequate room to hold the fuel being defueled. In addition, remember that sufficient fuel must be in the defueling tank to maintain a flooded suction above the anti-vortex splash plate.

5. Position the defueler (defuel truck operator).

6. Verify that the aircraft is spotted properly (all personnel).

7. Check for possible sources of ignition (all personnel).

8. Verify that the defueling request chit corresponds to the instructions from the dispatcher (defuel truck operator).

9. Connect the bonding wire from the defueler to the aircraft (defuel truck operator).

10. Unload, position, and connect the defuel hose to the aircraft and the defueling stub on the defueler (plane captain).

11. Start defueling upon signal from the nozzle operator (defuel truck operator).

12. Adjust the valve downstream of the pump to optimize the defuel rate. Maximum defuel rate is 100 gpm (defuel truck operator). When nearing completion of the defuel process, very close attention should be paid to the defuel rate to prevent pump cavitation and/or loss of prime. Discontinue defueling of an aircraft if pump cavitation is a persistent problem.

13. Upon completion of the defuel operation, secure all equipment and CHECK THE AREA FOR FOD (all personnel).

Disposition of Nonsuspect Fuel Removed From Aircraft

All USN and USMC aircraft are authorized to use JP-4, JP-8, commercial JET A and JET A-1, as well as JP-5 fuel. Fuel removed from a USN or USMC aircraft will contain mixtures of these fuels, and the specific grade of fuel will be impossible to determine without extensive specification testing. USA and USAF aircraft also may contain such mixtures. Therefore, fuel in any properly operating DOD aircraft with turbine engines that is NOT suspect of being contaminated can be defueled into a designated refueling vehicle and then used to refuel any aircraft with the user's knowledge and permission.

First preference will be given to using the fuel to load an aircraft in the same squadron as that from which the fuel originated. Second choice will be to issue the fuel to aircraft having engine fuel controls that automatically compensate for fuel density changes. Aircraft with T-56 engines, such as the P-3 and E-2, should be preferentially used since these engines are the most tolerant to such fuel changes. In addition, the following roles apply to reissuing defueled fuel:

1. Since fuel removed from any aircraft almost definitely has a flash point below 140°F, it must NOT be used to refuel any aircraft scheduled for immediate sea duty.

2. Any designated defuel or refuelers must pass their fuel through filter/separators and fuel monitors before reaching the aircraft.

3. The FSII content of defueled turbine fuel must be checked using the FSII refractometer prior to refueling S-3 and SH-60 USN aircraft and all U. S. Army and U.S. Air Force and foreign aircraft.

Nonsuspect fuel that has been dyed for the detection of aircraft fuel system leaks also can be used in aircraft provided the above procedures are followed. Nonsuspect fuel removed from piston engine aircraft can also be reissued provided

1. the fuel is a known grade (80/87 or 100/130), and

2. it is properly filtered before reissue.

Disposition of Suspect Fuel Removed From Aircraft

Fuel removed from any aircraft that has recently experienced engine or airframe fuel system problems possibly related to fuel quality must be segregated by collecting in a designated defueler, a clean storage tank, or any container as "salvage fuel." It must then be sampled and tested to determine if it is in conformance with the deterioration use limits. If the fuel tests within the established limits, it can be returned to station storage and reissued as the grade and type determined providing adequate filtration and water separation can be accomplished prior to dispensing the fuel.

Aviation turbine fuels that do not meet the requirement specified previously generally cannot be downgraded for any aircraft use. Questions concerning the use or disposition of fuel not meeting the deterioration use limits should be referred to the Naval Petroleum Office.

PRODUCT RECEIPT

Barge or tanker receipt of product requires planning. The Fuel Maintenance Officer must post written orders designating the following:

1. Pier preparation and inspection
2. Pipelines to be used
3. Number and sizes of hoses to be connected
4. Tanks into which cargo is to be received
5. Pumphouses and pumps to be operated
6. Number of samples and location where samples are to be taken
7. Tests required
8. Communications to be used
9. Personnel assignments
10. Preparation of the "Declaration of Inspection" (an Environmental Protection Agency requirement in the 33 Code of Federal Regulations administered by the Coast Guard).

The activity instruction covers standard operating procedures for the following:

1. Filling of lines before the barge is docked
2. Notification to start unloading
3. Unloading speed
4. Line patrol and gage check
5. Changing tanks
6. Change in pump operation
7. Barge stripping procedure and stripping speed
8. Final inspection of barge tanks
9. Draining pier lines
10. Personnel manning level
11. Personnel training requirements
12. Special clothing requirements
13. Fuel sampling and testing requirements

Pipeline receipt of product requires essentially the same planning as barge receipt, and a written order is required. Some pipeline operations, however, are relatively simple and, therefore, require minimum personnel.

Incoming tank trucks and tank cars of aircraft fuel might arrive separately or in groups. All must be sealed at the source of supply. Unloading of tank trucks requires approximate y 1/2 hour and is a two-man operation. Tank cars are usually left on a siding or in place for the offloading operation. The following procedures apply to both tank truck and tank car receipt:

1. Ensure that the seals are intact.

2. Verify that seal numbers are identical to those on the shipping document.

3. Verify the specification and grade number of the product on the shipping document.

4. Make sure the fuel level coincides with the marking on the tank and the quantity on the shipping document.

5. Take a bottom sample from each compartment, first drawing off water if present.

6. Make a visual inspection of samples.

7. Unload the product into a segregated storage tank.

8. Check the vehicle's tank interior after delivery.

9. Upon completion of fuel receipt (multiple tank car or truck loads), sample the storage tank and perform quality control tests.

CHANGE OF PRODUCT IN AIRCRAFT REFUELERS

Change of product in mobile refuelers is performed according to table 7-2. Product used to flush tanks and piping MUST be treated as contaminated fuel. Samples must be visually inspected for sediment and water, and the specific gravity of each must check within 0.5 of the corrected API of the appropriate product in storage.

Change of Product in Storage Tanks

The Naval Petroleum Office must be contacted concerning instructions for the change of product grade in storage tanks.

ASHORE AVIATION FUELS SAFETY

LEARNING OBJECTIVE: Describe the safety requirements and procedures that must be followed during fueling operations ashore.

This section contains safety procedures and requirements that either are general in nature and therefore not covered in other chapters of this manual or are extremely important and repeated here for emphasis. Any departure from the procedures of this section may adversely affect the overall safety of the operation being performed.

Although the procedures and requirements contained in this manual are as complete as possible, they are no substitute for experience and a thorough knowledge of aviation fuels and their inherent

TO → / FROM ↓	AVGAS LOW GRADE	AVGAS HIGH GRADE	JP-4	JP-5	JP-8
AVGAS LOW GRADE	N.A.	C	C	C	C
AVGAS HIGH GRADE	A	N.A	C	C	C
JP-4	B	B	N.A.	D	D
JP-5	B	B	A	N.A.	A
JP-8	B	B	A	B	N.A.
MOGAS	B	B	C	C	C
KEROSENE	B	B	B	B	B
DIESEL	B	B	C	C	C

Table 7-2.—Change of Grade Procedures for Aircraft Refuelers

LEGEND:

A. Drain, fill with desired product.

B. Drain, flush 300 gallons (600 gallons if total filter/separator capacity is 600 gpm) of desired product, drain, fill with desired product. recirculate, sample and test. Pay particular attention to sumps, pumps, filters, hoses and other components likely to trap quantities of liquid.

C. Drain, steam clean, and dry. Remove fuel from all refueling system components—that is, sumps, pumps. filters, hoses, and piping—prior to initiating steam cleaning. Replace the filter separator and monitor elements.

D. Drain, gas-free, and fill with desired product.

characteristics and dangers. The better you, as an ABF, know and understand aviation fuel hazards, the better you will be at avoiding, or correcting, unsafe situations.

REDUCING ELECTRO-STATIC CHARGES

One of the primary sources of ignition is static electricity. To ensure the safe relaxation of static charges relevant to fuel operations, all activities must do the following:

Prohibit the top loading or splash filling of any fuel trucks or tanks.

Refill filter/separator slowly or monitor vessels whenever they have been drained.

Keep tanks free of foreign objects, such as small conductive objects that can be floated by foaming fuel, thereby becoming an unbonded charge collector. This does not prohibit suspending thermometers or samplers in tanks. However, these devices must be removed prior to any receipt.

Always electrically bond the refueling equipment to the aircraft or truck into which the fuel is being loaded.

Earth (ground) the aircraft and the refueling vehicle whenever refueling operations are conducted on any surface other than concrete, such as asphalt and plastic-coated surfaces. Earthing is also required for all hot-refueling operations and when refueling U.S. Air Force aircraft.

Check the electrical resistance of pressure nozzles monthly.

Bond overwing (gravity) refueling nozzles to the aircraft, using a separate bonding pigtail before tank's caps are removed.

Attach bonding cables to aircraft, using plug and jack method whenever available.

Inspect bonding and grounding cables, clamps, and plugs daily.

Check the electrical resistance of cables monthly.

Never conduct fuel operations during an electrical storm .

Remove refuelers from aircraft parking areas during electrical storms.

Require fuel personnel to wear non-static-producing clothing, such as cotton.

ELIMINATING OTHER SOURCES OF IGNITION

To prevent or eliminate other sources of ignition, activities must ensure the following:

Never allow fuel personnel to wear shoes that have nails or other metal devices on the soles.

Advise fuel personnel not to carry or wear loose metal objects, such as knives or keys.

Check the exhaust piping on mobile refuelers daily to ensure that holes, cracks, or breaks do not exist.

Never permit smoking, spark- or flame-producing items, open flames, or hotwork within 50 feet of any refueling operation.

Defer all repair work on fueling equipment during fuel-handling operations.

Except approved safety lights for use in hazardous locations, do NOT introduce lights into any compartment or space where fuel or flammable vapors may be present.

Do NOT allow fuel personnel to carry "strike anywhere" matches or cigarette lighters.

Be certain that no repair or maintenance work is being conducted on the aircraft before starting the refueling or defueling operation.

Be certain that LOX operations are not being performed and that LOX-handling equipment is not located within 50 feet of fuel operations.

Be certain that aircraft radar and all unnecessary radio equipment is switched off before refueling or defueling is begun.

Do NOT conduct aircraft fuel-handling operations within 300 feet of ground radar equipment.

Equip all internal combustion engines operated within 50 feet of fuel-handling operations with spark-arresting-type mufflers.

Do not start or stop any engine, regardless of its configuration, within 50 feet of a fueling or defueling operation. This prohibition includes aircraft being serviced and adjacent aircraft, as well as ground support equipment. The starting or stopping of an engine within 50 feet of a fueling or defueling operation is sufficient cause for the operator to immediately shutdown the fuel pump.

Open valves slowly to reduce or prevent any splashing in tanks.

Conduct overwing refueling only as a last resort and then only if of operational necessity or if aircraft design dictates.

Hold hot-refueling operations to the absolute minimum possible. Cold refueling operations are inherently safer and are preferred to hot refueling.

REDUCING AND CONT ROLLING VAPOR GENERATION

To help prevent fires by reducing or controlling vapor generation, activities must ensure the following actions:

1. Do NOT handle aviation fuel in open containers.

2. Do NOT refuel, defuel, or drain aircraft or conduct fuel-handling operations in a hangar or confined area except for the removal of water and the extraction of samples from aircraft low-point drains. This does not apply to structures specifically designed for these operations.

3. Keep all fuel containers, such as aircraft fuel tanks or filters, closed except when necessary to open for actual operation or maintenance.

4. Avoid spilling fuel during fuel-handling operations.

5. Take immediate action to clean up any spill that occurs.

6. Properly dispose of oily waste or rags immediately after using.

7. Never drive or move a refueler or defueler with a leak in the tank, piping, or other equipment.

8. Report all leaks in any portion of the fuel-handling facilities to the FMO.

9. Treat empty or apparently empty carts or containers that formerly held aircraft fuels as though they still contain fuel. These containers will still contain vapors and are dangerous for many days after they have been emptied.

10. Be aware that fuel vapors are heavier than air and will collect in low places, such as pits, sumps, and open sewers.

11. Never dispose of waste fuel in storm water or sanitary sewer systems.

12. Never top load or splash fill tanks. (This does not prohibit overwing refueling of aircraft that are solely configured for this operation).

13. Keep all equipment and work areas neat, clean, orderly, and in good mechanical condition.

14. Make sure fire-fighting equipment and extinguishers are in good condition and readily available.

15. Never use gasoline or jet engine fuel as a cleaning agent.

EXTINGUISHING FIRES

Although the Air Station's Crash Crew has prime responsibility for firefighting, all fuel-handling personnel should be aware of the basic principles involved in extinguishing fires, as well as the equipment used. They also should make certain that appropriate fire-fighting equipment, in good condition, is readily available whenever and wherever fuel-handling operations are being conducted. All refueling personnel will receive flightline fire-fighting training initially and annually thereafter.

MINIMIZING HEALTH HAZARDS

Not only must aviation fuels be handled with caution because of the obvious dangers associated with possible fires and/or explosions, the materials themselves present a danger to the health of fuel-handling personnel. These dangers are equally important as those of fires and explosions even though they are not so well known.

To minimize health dangers, fuel-handling personnel must take the following actions:

Avoid entering enclosed areas where fuel vapors are present.

Keep to an absolute minimum the amount of time spent breathing fuel vapors. Good ventilation of work spaces is essential.

Stay on the windward, or upwind, side of a spill if you must remain in an area where a large spill has occurred.

Stay on the windward, or upwind, side when conducting fuel-handling operations where the formation of vapors is unavoidable, such as at a truck fill stand.

Stop the fuel-handling operation and move to a fresh air location immediately if you feel dizzy or nauseated.

Avoid skin contact with liquid fuels and tank water bottoms that can contain a high concentration of FSII. If fuel or water bottoms do contact the skin, wash with soap and water immediately.

Never wash hands in gasoline or jet engine fuels.

Remove fuel-soaked clothing or shoes at once.

Wear eye protection and clothing that leaves a minimum amount of skin exposed during refueling operations. This will help reduce bums in a fire.

Only use footwear that completely covers the feet to provide protection against fuel spills and fires. Shoes made of fabric or other absorbent materials are not acceptable.

CONFINED SPACES

Personnel entering or working in or around confined spaces who are exposed to fuels and fuel vapors might encounter hazards such as

- the lack of sufficient oxygen,
- the presence of flammable or explosive vapors, or
- the presence of toxic vapors and materials.

These hazards may not always be readily apparent, detectable by odor, or visually obvious to persons entering or working within such spaces. Therefore, all confined or enclosed spaces such as fuel tanks, refueler/truck tanks and unvented deep pits (more than 5 feet) must be well-ventilated and tested prior to entry. Poorly vented or unvented pump rooms, storage areas, and unvented shallow pits (under 5 feet) must be surveyed to determine steps necessary for gas-freeing or designation as a safe work environment.

To reduce risk, fuel-handling personnel ensure the following:

1. NEVER enter a tank or equipment that has contained any fuel until all safety precautions have been followed, and then only with experienced, knowledgeable supervision present.

2. Always use a blower-type mask or positive pressure hose mask, boots, and gloves if you must enter a confined area where fuel vapors may be present.

3. Employ the buddy system when entering deep unvented or poorly vented pits—that is, low-point drain pits.

SUMMARY

In summary, it is noted that the fueling operations ashore or afloat are similar. The functions are basically the same, but the problems are a little different. Many of these problems are made more acute, because of the sprawling area covered by fuels operations ashore and the many chances for introducing foreign or contaminating materials into the fuel.

Some of the problem areas that require special attention from senior ABFs are quality surveillance; the close supervision and training of new personnel; an effective training program; preventive maintenance and proper use of equipment; cheerful cooperation with civilian personnel of the fuels division; and good management practices within the division.