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## CHAPTER 16

### REFUELING FROM TANK VEHICLES

#### Section I. Refueling Vehicles

##### Use

Petroleum tank vehicles serve two functions. They may be used for fuel servicing or bulk transport. The major difference is that fuel servicing vehicles have a filter/separator and bulk transporters do not. Refueling vehicles are used to refuel Army aircraft at a fixed or semifixed, airport type facility. However, refueling vehicles are not used exclusively to refuel fixed-wing aircraft. They are not normally used in rapid refueling. Although their use with the HTARS or FARE components can aid in tactical situations where mobility is an asset. Refueling vehicles are mainly used when it is more practical to take the fuel to the aircraft than to take the aircraft to the fuel.

#### VEHICLE REQUIREMENTS

All aviation fuel must pass through a filter/separator before it is loaded into a refueler. (A refueler is a tank truck, tank semitrailer, or truck with a tank and pump unit.) It must be filtered again before it is pumped into an aircraft. All vehicles, except the M131A4, M131A5, and the M967, have filter/separators. (On the M49 and M131 series, the suffix "C" indicates a filter/separator.) Any of the refuelers described can be connected to the CCR system by substituting the CCR nozzle for the standard open-port (gravity-flow) nozzle. Tank vehicle fuel compartments must carry only one grade or type of fuel.

#### FUEL-SERVICING TANK SEMITRAILERS

The fuel-servicing tank semitrailers are the M969, M970, M131A4C, and M131A5C. See the appropriate technical manual for operation and maintenance information. These refuelers are described below. For more information see Chapter 24.

#### M969

The M969 tank semitrailer is used mainly for automotive refueling. It has a four-cylinder diesel engine-driven, 4-inch centrifugal, self-priming, low-head pump assembly. It has a stainless steel, single compartment tank that holds 5,000 gallons, plus 3 percent capacity for expansion. It is equipped with a filter/separator and a dual dispensing system. The

filter/separator consists of 15 filter elements, 5 canisters, and 15 go/no-go fuses. Each dispensing system has a meter, a hose reel with electric rewind, 50 feet of 1 1/4-inch dispensing hose, and a dispensing nozzle. The M969 semitrailer may be used for open-port refueling. Its nozzles cannot be used when the D-1 or the CCR nozzle is required. The fuel flows at a rate of 60 GPM through one nozzle only or through both nozzles at the same time. The M969A1 tank semitrailer is equipped with a hose trough cover, a control panel cover, a rear ladder, front and rear drains, and a tachometer and lead assembly that have been introduced for repairing or upgrading the M969. More information on the M969 can be found in [TM 9-2330-356-14](#).

### **M970**

The M970, 5,000-gallon, fuel-dispensing tank semitrailer is designed for underwing and overwing refueling of aircraft. The M970 has the same engine as the M969, but has a 3-inch, high-pressure, centrifugal pump. It also is equipped with the same 3-stage filter/separator as the M969, a recirculation system, and two refueling systems--one for underwing and one for overwing. One meter is used with both refueling hoses. The M970A1 is equipped with the same additional features as the M969A1 (described above).

- Underwing refueling system. The system consists of 50 feet of 2 1/2-inch hose, an electric-rewind reel, and a deadman control.
- Overwing refueling system. The overwing refueling system consists of 50 feet of 1 1/2-inch hose, an overwing dispensing nozzle, an electric-rewind hose reel, and a closed-circuit dispensing nozzle. This nozzle is interchangeable with the overwing nozzle.
- Recirculation system. This system allows fuel sampling and complete recirculation of fuel through the filtering and dispensing system to remove condensation and contamination.

### **M131A4C**

The uses of the M131A4C are the same as the M131A5C. The main difference between this model and the M131A5C is the tank configuration. This tank semitrailer has four tank compartments each of which holds 1,250 gallons of fuel. There are slight differences in the pump, pump engines, hose reels, filter/separators, and other equipment. They are also located differently. The M131A4C has three 15-foot sections of suction hose stored in hose tubes. It has a rear roadside equipment cabinet equipped with a reel of 2 1/2-inch hose (225-GPM dispensing) and a 2 1/2-inch, automotive type nozzle. The forward roadside cabinet of the M131A4C has a 1 1/2-inch hose (0- to 55 GPM dispensing) on reel with the standard 1 1/2-inch, automotive-type nozzle.

### **M131A5C**

The M131A5C tank semitrailer is one of the most commonly used fuel-servicing tank semitrailers in the Army. It has a 5,000-gallon capacity and weighs 12 tons. The entire vehicle is about 31 feet long, 8 feet wide, and 9 feet high. This semitrailer has a great deal of flexibility because it can be used in most fueling operations; that is, it is capable of fuel transport, fuel transfer, and fuel servicing of containers, ground vehicles, and aircraft. It is

used in open-port refueling of aircraft that have a maximum fuel acceptance rate of 225 GPM.

- Tank body. The tank is made of stainless steel. It has two fuel compartments. Each holds 2,500 gallons of fuel. A slip-proof walkway of steel grating runs along the top of the tank body. Each compartment has a 20-inch manhole cover with a filler cover and lock, an emergency dump valve, and a drainpipe. A load level indicator is welded to the collar of each manhole.
- Side cabinets. The M131A5C has an equipment cabinet on each side of the tank body. The roadside cabinet is equipped with a reel of 1 1/2-inch, reinforced dispensing hose with 2 1/2-inch, automotive type nozzle equipped with 100-mesh nozzle screen; the rate-of-flow selector dial; the engine control instruments; and the filter/separator pressure gages. The manifold valves and dump valve levers are also in this cabinet. The curbside cabinet holds the pump, pump engine, and battery.

## TANK TRUCKS

The tank trucks used for aircraft refueling are the M978 and the M49A2C. These tank trucks are described below. See Chapter 29 for more information.

### M978

The M978 tank truck, also called the HEMTT, is used to refuel aircraft, transport bulk fuels, and service combat vehicles. The M978 tank truck is able to transport bulk fuels in areas where other tank trucks cannot operate. It has a stainless steel 2,500-gallon tank with a single compartment shell. The fuel system of the truck includes a pump and a filter/separator. Power for the 300-GPM centrifugal pump comes from the truck engine. The truck also has an alternate fuel delivery pump. This 25-GPM pump is powered by 24 DC from the truck's electrical system. The filter/separator is located in the rear cabinet. It is a 300-GPM unit with a pressure differential indicator, 15 filter and canister assemblies, and a manual drain valve. A sampling probe, for use with the Aqua-glo water test kit, is located on the discharge side of the filter/separator. The tank truck has two hose reels in the rear cabinet. Each hose reel has 50 feet of 1 1/2-inch dispensing hose. Each 1 1/2-inch hose has a 50-GPM capacity. The hose ends have male, quick-disconnect fittings and bonding connections. Each hose reel has a fuel-servicing nozzle. The HEMTT also has a 15-foot section of 3-inch suction hose. The HEMTT can also refuel aircraft with the HTARS. See Chapter 15 for more information.

### M49A2C

The M49A2C tank truck is used in open-port refueling, in transporting fuel, and in servicing fuel containers and ground vehicles. It has a stainless steel 1,200-gallon tank. The tank is evenly divided into two compartments. Power for the pump comes from the truck engine. A speed control linkage controls the speed of the truck engine, its power takeoff, and the fuel delivery pump. A 35-foot length of 1 1/2-inch reinforced hose (with a standard 1 1/2-inch, automotive-type nozzle equipped with 100-mesh nozzle screen) is mounted on the roadside of

the tank.

## **TANK AND PUMP UNIT**

The tank and pump unit is also used in aircraft refueling. The tank and pump unit consists of a 50-GPM pumping assembly, two 600-gallon aluminum tanks, and related equipment. The frame assembly makes it easier to take the pump off the truck for maintenance work or to use it as a pump unit for fuels that are stored in ground tanks. One electric model and several gasoline models of the tank and pump unit are currently in use. A newer model tank and pump unit (Figure 24-3, page 24-5) consist of tank control levers at the rear of the unit, a bottom loading port, 500-gallon fuel tanks, and a bottom loading valve that opens automatically when fuel pressure is applied and is closed automatically by the jet level sensor when the tank is full (when filled through bottom loading port).

## **Section II. Refueling Operations**

### **PERSONNEL TRAINING**

The drivers (operators) of tank vehicles may not have received formal training in the specialized field of aircraft refueling. The responsible unit commander should set up and maintain a safety training program for them. They should be thoroughly trained in the step-by-step procedures covered in this section. Emphasis should be placed on the quality requirements for aviation fuels (Chapter 13), on fuel spills and fire-fighting techniques (Chapter 19), and petroleum safety (Chapter 2). Any accident involving fuel, an aircraft, or a tank vehicle may result in fire. Only drivers who have completed the safety training and have demonstrated their ability to refuel aircraft using the proper procedures should be assigned to aircraft refueling operations.

### **VEHICLE PREOPERATIONAL CHECKS**

There are two types of preoperational checks on refueling vehicles. One type is the preoperational check on the vehicle as a vehicle. For example, checking the inflation of the tires or the water level of the radiator is a vehicle check. Checks of this type are outlined in the equipment technical manual. The other type are the checks performed to ensure that the vehicle is ready to refuel aircraft.

### **DAILY PREOPERATIONAL CHECKS AND PROCEDURES**

Each day, before operations, the driver of the refueling vehicle should check the condition of the truck's electrical system. This system is important since defective wiring can cause sparks. Also, it is a good safety practice to equip refueling vehicles with a hard-shell cab top as opposed to a canvas top. This is for the protection of vehicle operators. In addition, before refueling an aircraft, personnel must perform the actions described below.

#### **Recirculate Fuel**

Ground the refueler to a ground rod. Then, with the help of an assistant, assemble the hose

to recirculate the fuel that was in the hose overnight. Start the pump engine and pump (or the truck engine and pump). Recirculate the fuel. Recirculation of the fuel does two things. Passing the fuel through the filter/separator removes any water that has settled overnight. The process allows the filter/separator pressure differential to be checked. The refueler must be grounded while fuel is being recirculated because of the static charge that builds on aviation fuels in motion.

### **Check Equipment**

Check the pressure differential of the filter/separator. Record it. Check the oil level in the pump engine. (or truck engine if it powers the pump). Check the engine for oil leaks. Check the exhaust pipe and spark arrester for cracks and leaks.

### **Check for Leaks**

Check the tanks, pipes, pump, filter/separator, meter, hose reels, manhole cover, valves, and nozzles for leaks.

### **Inspect Hoses**

Inspect all hoses as described below. These checks are important to follow:

- Check hose cover. Extend all hose completely, and check the outside cover of the hose. If any part of the hose length shows signs of blistering, saturation, or nicks and cuts that expose reinforcing material, remove that length of hose from service. Focus particular attention within 12 inches of the couplings, as this is where most hose failures occur. Usable parts of the hose should be salvaged and recoupled.
- Check couplings. Look for coupling slippage. Coupling slippage usually shows first as a misalignment of the hose and coupling or as a scored or freshly exposed part of the hose where the slippage has occurred. Look for signs of leakage at the coupling. If a coupling is slipping or leaking, remove that length of hose from service. Salvage and recouple.
- Test hose. Test the hose at normal operating pressure. Run the pump with the nozzle closed. Look for abnormal twisting or ballooning. Twisting or ballooning shows that the hose carcass is weakening, so remove the hose from service.
- Check nozzle screens. Remove the nozzle screens. Check their contents for particles of hose lining. Particles of rubber left in new hose from the manufacturing process may appear during the first week of use. If particles appear more than twice during the first week or appear thereafter, remove the length of hose from service because it is deteriorating. Also check the screens for dirt and for other particles that may show that the filter/separator has failed or that moving parts are wearing down. Report any such indications. Clean and replace the nozzle screens. The nozzle screens must be hand tightened only.

### **Check Bonding**

Check the nozzle bonding cable, bond plug, and bond clip. They must be in good condition to make the positive bond required to prevent a spark.

### **Check Grounding**

Check the grounding cable and its clips for defects. They must be in good condition to make a safe ground to carry the static charge off the truck. Be sure the refueler is carrying a ground rod.

### **Check Placement**

Check to see that the fire extinguisher, spill container, dust plugs, and dust caps are in place.

### **Test Fuel**

Draw a sample of fuel from the fuel probe coupling after recirculating the fuel and making other checks. Test the fuel as discussed in Chapter 13. If the fuel does not pass the tests, notify the person in charge. Isolate the suspect fuel, resample it, send the sample to your supporting laboratory, and await the laboratory's instructions on disposition.

## **QUARTERLY PREOPERATIONAL CHECKS**

Once a quarter, before operations, check the fueling system of the tank vehicle. Remove the pump strainer and line strainers. Check them for dirt. Clean and replace them as necessary. Also check and clean the meter screens. Perform these maintenance checks immediately whenever a nozzle strainer or a lab report on a fuel sample shows contamination or whenever filter/separator elements are inspected or changed.

## **SEQUENCE OF OPERATIONS**

Refueling from a tank vehicle requires at least two people. If only the vehicle operator and his assistant are present, the operator should attend the pump and the assistant should handle the nozzle. A fire extinguisher should be within reach of each. Where possible, the aircraft crew chief should be present to oversee the entire operation and another member of the aircraft or ground crew should man the fire extinguisher at the nozzle. After the aircraft parks, its engines are shut down, the rotor blades are secured, and armaments are set on SAFE, the refueling operation sequence can start. The procedures must be done in the sequence described below. If you are rapid refueling from the refueler, supplement the procedures with those in Chapter 15.

### **Check the Aircraft**

Check the interior of the aircraft. No one should be on board during refueling unless the pilot must be on board to monitor the quantity of fuel to be loaded. Find out before starting the refueling sequence whether or not there is a person in the aircraft. Check with the pilot to ensure that all armaments are on SAFE.

### **Position the Refueler**

Drive the tank vehicle into position in front of the aircraft. Use the approach route shown in

A, Figure 16-1. Do not drive the refueler directly toward the aircraft because brake failure could cause a serious accident.

- Minimum distances. Keep a distance of at least 10 feet between the refueler and the aircraft. There must be at least 10 feet between the refueler and rotor blades of a helicopter. Keep a distance of at least 20 feet between the exhaust pipe of the pump engine (or truck engine) and the aircraft fill port and tank vent. See B, Figure 16-1.
- Refueler path. Park the refueler so that there is a clear open path to drive it away from the aircraft in an emergency. Do not detach a tank semitrailer from its tractor when refueling an aircraft. The tractor must be ready to pull the trailer away from the aircraft if the need arises.
- Ground guides. If the refueler can be driven into position without backing, do so. If the refueler must be backed toward the aircraft, bring the truck to a full stop 20 to 25 feet away from the aircraft or its rotor blades. Have another soldier act as a ground guide. Follow his signals to guide the final backing approach until he stops the refueler at the proper distance from the aircraft and its fill port or vent. See C, Figure 16-1.
- Parking. Stop the refueler's engine (unless it powers the pump), and set the brake. Chock the tires of the refueler and, if appropriate, the aircraft.

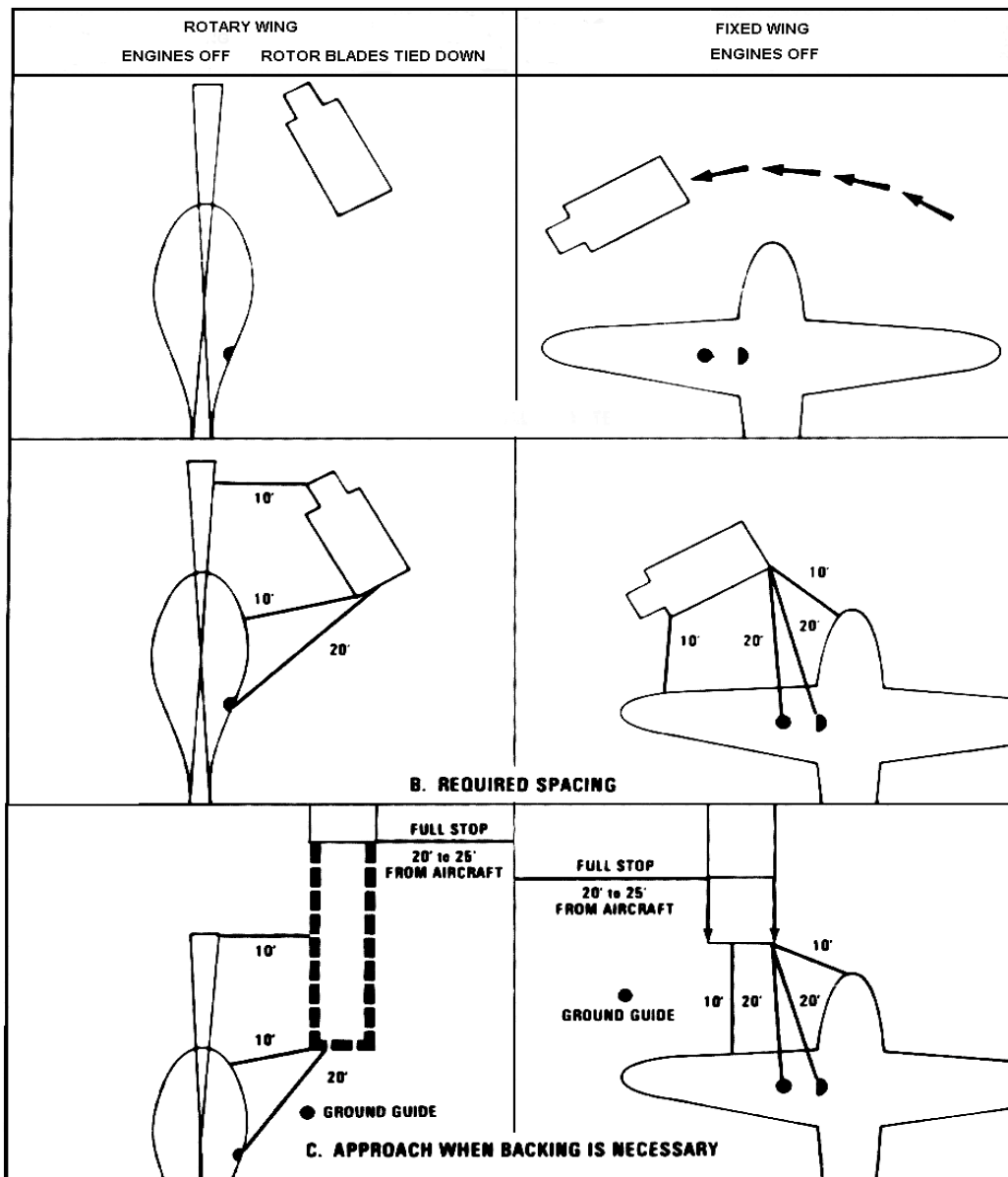


Figure 16-1. Positioning tank vehicle for refueling aircraft

### Check the Fuel

Check the fuel in the tank to make sure it is the right type for the aircraft. Check the sight glass of the filter/separators to make sure all water has been drained out.

### Position Fire Extinguishers

Place the truck fire extinguisher by the pump. Place a fire extinguisher by the aircraft fill port. Have members of the ground crew or aircrew man these two fire extinguishers. If there are no personnel available to man the fire extinguishers, place them near the pump and nozzle operators. Position them where they will not be in the operator's way and where they are not likely to be engulfed if a fire should start.



## Ground the Refueler

Unreel the ground cable, and attach it to an existing ground rod. If no ground rod exists at the location, drive the refuelers ground rod into the earth to required depth and attach the clip to the rod. See Chapter 2.

## Bond Nozzle to Aircraft

Bond the nozzle to the aircraft before the dust cap is removed from the nozzle and the plug is removed from the fill port. If the aircraft has a receiver for the bond plug, use the plug. If not, attach the bonding clip to a bare metal part of the aircraft.

## Open Fill Port

Open the fill port and remove the nozzle dust cap. If an open-port nozzle or the CCR nozzle adapter is being used, put the nozzle well down into the fill port. Do not open the nozzle until it is inside the fill port. If the CCR nozzle is being used, mate the nozzle into the fill port. If they will not latch together, look for dirt in the fill port or on the nozzle. Wipe the fill port out and clean the nozzle; then mate the two together.

## Refuel

The procedures for refueling depend on the type of refueling. They are described below.

- CCR. Pull back on the control handle latch, and then push the flow control handle up toward the aircraft and into the FLOW position. If the tank will be filled completely, watch the back of the nozzle. A red indicator will pop up at the back of the nozzle when the tank is full. The flow shuts off automatically. If the tank will be filled only partially, watch the pilot for a signal to stop the flow. Pull the flow control handle back toward the hose to move it into the NO FLOW position. Unlatch the nozzle. Replace the fill port plug and the nozzle dust cap.
- Open-port refueling. Open the nozzle slowly to reduce splashing and to reduce the turbulence of the fuel already in the tank. Do not leave the nozzle at any time during the refueling operation. Do not block or wedge the nozzle lever open. If the nozzle handle has been notched, remove the notches so that the handle cannot stay open unless someone is holding it open. Slow the flow of fuel as the tank nears the fill level. Top off the tank so that the fuel will not overflow. Stop the flow completely before taking the nozzle out of the fill port.
- D-1 (underwing) refueling. Mate the D-1 (center-point) nozzle to the receiver mounted on the aircraft by gripping the two handgrip handles and turning them clockwise to lock the nozzle to the receiver. Turn the latch handle counterclockwise, parallel to the hoseline, to allow fuel to flow. (The latch handle will not turn to the OPEN position unless the nozzle is locked to the receiver. If it will not turn, release the nozzle by turning the handgrips counterclockwise. Begin again.) The M970 (5,000-gallon semitrailer) and the M978 HEMTT (2,500-gallon tank vehicle) are equipped with a fuel safety device (deadman control) and a D-1 nozzle. To start the flow of fuel to the nozzle, squeeze the

deadman control. The flow is stopped by releasing the pressure on the deadman control upon the pilot's signal. Turn the latch handle clockwise, across the hoseline, and turn the handgrip handles counterclockwise to release the nozzle from the receiver. (The handgrip handles will not turn back to release the nozzle unless the latch handle has been turned back to the NO- FLOW position.)

### **Close Fill Port**

Replace the plug on the fill port. Replace the nozzle dust cap before disconnecting the nozzle bond.

### **Undo Nozzle Bond**

Remove the nozzle bond plug or undo the bonding clip. Reel up the hose and nozzle. Do not drag the nozzle across the ground.

### **Replace Fire Extinguisher**

Replace the fire extinguisher used at the nozzle.

### **Undo Refueler Ground**

Release the clip on the ground rod, and reel up the grounding cable. Do not drag the cable clip across the ground. Guide the cable back onto the reel to prevent damage to the grounding system. If the refueling operation is over and the refueler's ground rod was used, pull the rod up and stow it in the refueler. Place the fire extinguisher in the refueler.

## **EMERGENCY FIRE AND RESCUE PROCEDURES**

The best preparation for a fire emergency is knowing the dangers, particularly the rate of flame spread on aviation fuels, knowing how to use a fire extinguisher, and preparing yourself to make an instant decision and take instant action. The basic actions that should be planned for and carried out quickly if a fire breaks out are described in Chapter 19.