SUBCOURSE
QM 5094

EDITION
A

DIRECT TANK VEHICLES

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

DIRECT TANK VEHICLES

Subcourse Number QM 5094

EDITION A

United States Army Combined Arms Support Command
Fort Lee, VA 23801-1511

2 Credit Hours
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SUBCOURSE OVERVIEW

This subcourse was designed to provide the soldier with information on the proper methods for supervising petroleum tank vehicle operations. In particular, the supervision of the loading and unloading of tank vehicles, the gaging of tank vehicles, the operation and PMCS of these vehicles and associated tank and pump equipment, and the proper maintenance of PMCS records and equipment manuals.

There are no prerequisites for this subcourse.

This subject reflects the doctrine which was current at the time it was prepared. In your own work situation, always refer to the latest official publications.

Unless otherwise stated, the masculine gender of singular pronouns is used to refer to both men and women.

TERMINAL LEARNING OBJECTIVE:

ACTION: The soldier will learn to supervise the loading and unloading of tank vehicles, gaging of tank vehicles, PMCS, verify appropriate entries on DA Form 2404 and DA Form 5988-E (ULLS) and correction of deficiencies, operation of tank units and vehicles, observe fire and safety precautions, and identify environmental considerations.

CONDITION: Given subcourse QM 5094.

STANDARDS: The soldier must score a minimum of 70 percent on the end of subcourse examination.

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ADMINISTRATIVE INSTRUCTIONS

1. Number of lessons in this subcourse: Nine
2. Materials you need in addition to this booklet are a number 2 lead pencil, the ACCP examination response sheet, and the preaddressed envelope you received with this subcourse.
3. Supervisory requirement: None

GRADING AND CERTIFICATION INSTRUCTIONS

Examination. This subcourse contains a multiple-choice examination covering the material in the nine lessons. After studying the lessons and working through the practical exercises, complete the examination. Mark your answers in the subcourse booklet, then transfer them to the ACCP examination response sheet. Completely black-out the lettered oval which corresponds to your selection (A, B, C, or D). Use a number 2 lead pencil to mark your responses. When you have completed the ACCP examination response sheet, mail it in the preaddressed envelope you received with this subcourse. You will receive your examination score by return mail. You will receive two credit hours for successful completion of this examination.

LESSON 1

INSPECT PETROLEUM MARKINGS, VEHICLES, AND EQUIPMENT
Critical Task:
101-519-3313

OVERVIEW

Inspecting the petroleum markings on tank vehicles and equipment and directing the proper loading and dispensing of petroleum products from assigned vehicles are necessary for the supervision of tank and pump operations.

Lesson Description:

This lesson covers the procedures for inspecting petroleum markings and loading and unloading tank vehicles.

Terminal Learning Objective:

Action: Acquire knowledge on the inspection of petroleum markings on tank vehicles and equipment and identify environmental considerations.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

As a petroleum supervisor, you must be able to ensure that vehicles and equipment are properly marked for both safety reasons and to prevent commingling of products.

PART A - INSPECTION OF PETROLEUM MARKINGS

Tank vehicles include the M49A2C, M131A5C (Figure 1-1), M967, M969, M970, and M978. The driver's side of the tanker is the roadside, and the passenger side of the tanker is the curbside.

Safety Markings. Vehicles used for the bulk transportation of gasoline, fuel oil, or other flammable liquids will be marked on both sides and on the rear of the body with the word "FLAMMABLE" in 6-inch block letters, and directly below where space permits, or on the same line with the words "NO SMOKING WITHIN 50 FEET" in 3-inch block letters and numerals. On vehicles which are used under tactical conditions, markings will be lusterless white number 37875. Vehicles which are used on public highways in CONUS, whether military or commercial design, must comply with Title 49, Code of Federal Regulations, Section 177.823, which requires the above markings in red lettering on a white background allowing a 1-inch margin all around the lettering. Lettering will be gloss red number 11105 or 11136, and background will be gloss white number 17875. On vehicles customarily used on public highways, the markings may be permanently installed by painting or by use of adhesive-backed decals. Vehicles infrequently used on public highways and camouflaged vehicles will be marked by the use of removable or reversible signs which are securely fastened while in use. Individual vehicles and convoy must comply with the above requirements.

Type of Product Service. Fuel and oil dispensing vehicles and equipment used for servicing aircraft will be marked with the grade of fuel or oil on each side of the tank. Marking will be lusterless white number 37875 in the following sizes:

- Semitrailer.....6 inches high.
- Trucks.....4 inches high.
- 2-wheel trailers….....3 inches high.

Tanker Vehicles Colors.

- Yellow - warning color.
- Red - fire protection materials and equipment.
- Black or white - identification.
- Gray or black - when using camouflaged.

U.S. Army and Registration Numbers.

- Color - black or white.
- Placement - sides and back.
- Sizes - 2" on sides and 3" on back.

According to AR 750-58, there is no further requirement to mark vehicles and equipment with the identification legend "U.S. Army." When vehicles and equipment are camouflaged, both the "U.S. Army" and the registration number will be removed from vehicle/equipment exterior.

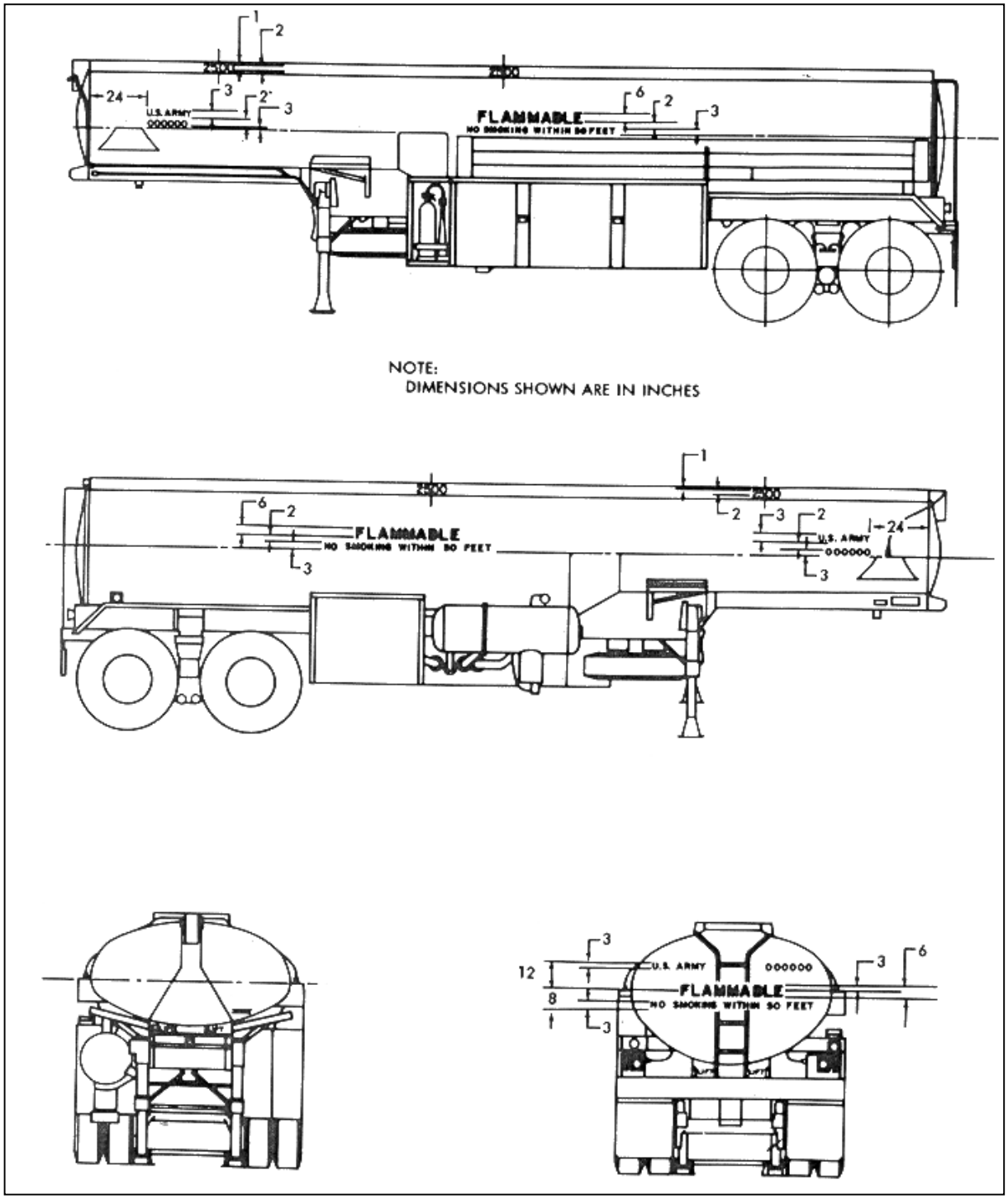

Figure 1-1. M131A5C.

Tank Capacity Tire Pressure, Hearing Protection, Diesel Fuel Only, Lift and Emergency Valve.

- All sizes are the same (1”).
- All colors are the same (black, gray, or white).
- The emergency valve size is 1” and red in color.

Bulk Systems. The piping systems are any pipeline or part thereof used to convey liquid petroleum products, including heating fuel and hydrocarbon missile fuels. These may be classified as tank car and tank truck loading and unloading connections; storage tank valves; pump manifold and valves; cross-country pipelines and their points of tie-in with pumping stations; oil tankers' connections and manifolds; and other similar dispensing outlets. Storage systems include all exposed fixed storage tanks except aircraft and ships.

Bulk petroleum products and hydrocarbon missile fuels are classified by groups. This method assigns a yellow band (or group of yellow bands) to each of eight groups or similar type products in a distinctive and conspicuous manner as a visual aid and shipment to the written identification. The groups and number of bands are:

- Aviation gasoline — One narrow band
- Automotive gasoline — Two narrow bands
- Jet fuels — Three narrow bands
- Distillates — Four narrow bands
- Heavy fuel (black oils) — Five narrow bands
- Lubricating oils — Sign (refer to FM 10-67-1 Concepts and Equipment of Petroleum Operations)
- Thermally stable jet fuels — Wide band-narrow band-wide
- Missile fuels — One wide/one narrow band

The title shall identify the contents by complete nomenclature, type/grade or product, and military symbol (if established).

A NATO symbol number indicates that the product is interchangeable or has an intended use with a particular product produced in one or more of the NATO participating nations. Systems handling products for which a NATO symbol has been established, and are located in an area subject to servicing ground, sea, or air equipment of NATO countries will, in addition to the NATO symbol, include the appropriate U.S. military symbol. Should the product become off-specification in any respect in any excess of the NATO allowable deterioration limits before use, a line of color contrasting with the NATO symbol and the background color will be drawn diagonally across and beyond the rectangle enclosing the NATO symbol. The thickness of this line will be such that it is clearly visible and the NATO symbol is then considered canceled and the product may, if desired, be considered as an emergency substitute to the original product and will be used only under technical advice. The line or system will be promptly remarked when the deteriorated product is replaced. NATO symbols are:

- Combat MOGAS — F-49
- JP-4 — F-40
- JP-5 — F-44
- Kerosene — F-58
- DF-2 — F-54
- JP-8 — F-34

Yellow is assigned as a primary warning for all flammable materials in accordance with the provisions of the basic code, MIL-STD-101. Black and white are used to mark titles across yellow bands. Markings (which include titles, bands, and arrows) will be applied by painting and stenciling or, if desired, by means of decals, elastomeric film, or reflective sheeting. Markings shall be applied at all receiving concessions; at all dispensing outlets; at all tank fill and discharge lines; at locations where line connections are made to manifolds; and at any other locations necessary to assure ready identification of the product in the system.

On 5-gallon cans:

- Use 3/4-inch letters.
- Stencil the front of each can with the nomenclature, NATO code number, and fill dates.

On 55-gallon drums:

- Use lettering at least 3/4 of an inch tall.
- Stencil the top of each drum with the nomenclature, NATO code number, weight or volume of contents, and fill date.

On 500-gallon collapsible drums:

- Stencil both ends of each drum with the nomenclature, weight or volume of contents, and the NATO code number of the product in the drum.
- Stencil both ends of each drum with the fill date when using drum for temporary storage of fuels.
- Stencil both ends of each drum with the word "flammable."

Titles will be applied in such a manner as to be clearly visible from operating positions. The black background will have a minimum border three-fourths of an inch wider than lettered area. For piping smaller

than three inches in diameter, metal flags or signs securely fastened to the pipe may be used with the appropriate title and product group band(s) lettered thereon. For multiproduct lines, a flag or sign identifying the product currently in transit may be used in lieu of or as a supplement to the yellow band and nomenclature. An arrow painted in yellow may be used to indicate direction of flow of the product in the line. It will appear adjacent to the title and band(s). In instances where a piping system or tankage is buried or inaccessible, and only a valve stem and wheel or gaging hatch are exposed, a metal flag or brass disc will be used as an aid identifying the product in the facility. The flag post may be permanently fixed to the pipeline or tank or in concrete adjacent thereto. The brass identification disc will be placed on top of the valve or gaging hatch. In concrete pits and similar conditions where space will not permit banding and stenciling of the pipe, the vertical band(s) will be painted on the wall adjacent to the pipe. The title of the product will be stenciled horizontally in white across the band(s). Where pit covers are installed, markings may be applied to the top of the covers.

Camouflaged Systems.

- Product title, grade, and NATO symbol stenciled at the same locations as non-camouflaged systems using gray or black, whichever shows up best against background color.
- Yellow bands and markings which would detract from the camouflage will not be used.

LESSON 1

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. On a semitrailer, safety markings for the type of fuel or oil will be how many inches high?
   A. 3 inches high.
   B. 4 inches high.
   C. 5 inches high.
   D. 6 inches high.

2. The color yellow is used to represent what?
   A. Warning color.
   B. Fire protection materials.
   C. Identification.
   D. Camouflage.

3. For the group jet fuel, how many bands are used?
   A. One narrow band.
   B. Three narrow bands.
   C. Five narrow bands.
   D. One wide/one narrow band.

4. What is the NATO symbol for DF-2?
   A. F-44.
   B. F-58.
   C. F-54.
   D. F-34.

5. Vehicles used for bulk transportation will be marked with the word “FLAMMABLE” in what size block letters?
   A. 6-inch.
   B. 5-inch.
   C. 3-inch.
   D. 2-inch.

LESSON 2

SUPERVISE THE OPERATION OF FILTER/SEPARATORS

OVERVIEW

Supervision of the performance of Preventive Maintenance Checks and Service (PMCS) of pumps, filter/separators, and related equipment includes preparation of advance sheets and observation of proper safety precautions.

Lesson Description:

This lesson covers the PMCS of pumps, filter/separators, and related equipment.

Terminal Learning Objective:

Action: The soldier will acquire knowledge on monitoring PMCS on filter/separators, verifying appropriate entries on DA Form 2404 and correcting any deficiencies, observing safety precautions, and identifying environmental considerations.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

Pumping units and filter/separators are widely used throughout the theater. Pumping units serve as a primary means for the receipt, storage, and issue of petroleum fuels during bulk and retail Class III operations. Filter/separators provide an effective means for insuring that fuels are free from contamination. As an NCO there are several assignments that require knowledge of maintaining this equipment.

PART A - USE OF FILTER/SEPARATORS

Filter/separators (Figure 2-1, and 2-2) remove solid contaminants and entrained water from liquid fuels. Filter/separators range in size from 15-GPM to 600-GPM capacity. Organizational maintenance personnel are responsible (with the help of the equipment operators) for replacing the filter elements in all filter/separators. The use of standard interchangeable elements and canisters make it simple to replace elements in filter/separators. They may be used when ground product, such as automotive gasoline and diesel fuel, are pumped to the user's vehicles. They must be used on all lines pumping fuel directly to aircraft and to vehicles that refuel aircraft. In addition, all fuel loaded into aircraft refueling vehicles should be filtered again before it is pumped to aircraft.

The standard filter element fits inside the canister. It is a perforated tube surrounded by a fiberglass filtering material, which in turn is wrapped with several layers of different material. The fiberglass material filters solid particles from fuel. The cotton knit and fiberglass screen and combine fine particles of water in fuel to form water droplets which settle because they are heavier than fuel. The expected service life of the standard filter element is 24 months.

The canister is a cylinder approximately 5 inches in diameter and 23 inches long. It consists of an outer and inner-tube. The inner tube is made of perforated metal and metal screen. The outer tube is made of perforated metal lined with a Teflon coated screen.

Raw fuel enters the center tube of the filter element through a fitting at the bottom of the canister. Solid contaminants are removed as the fuel flows outward from the perforated center tube, through the fiberglass filtering material. As the fuel passes through the outer layers of the element, fine particles of water in the fuel are coalesced into droplets. The fuel containing the coalesced water passes through the inner tube of the canister to the space between the inner and outer tubes. The Teflon coated screen of the outer tube throws off water droplets, and they fall to the bottom chamber of the filter separator. Only clean fuel passes through the outer canister tube into the filter separator tank. Tank vehicles such as the M131A5C tank semitrailer have filter/separators that work in three stages. The first stage has 15 filter elements that remove solid contaminants. The second stage has five canisters to separate water from fuel and let water drain into the sump. The third stage has 15 go/no go fuses. They shut off the flow of fuel if the other two stages allow water or contaminants to exceed a safe level. M49AC filter/separators have three filter elements, three separator canisters, and three go/no go fuses. The go/no go fuses automatically shut off the flow of fuel if the water and/or contaminants reach a high level.

Performing Before Operational Maintenance.

- Make a visual check for leaks and for loose or missing parts in cover assembly and other connections.
- Ensure that all valves operate freely and do not leak. Ensure drain valves are in closed position.
- Ensure the ground wire is connected properly and is not broken.
- Ensure gaskets are in place and not leaking.
- Ensure a fire extinguisher is easily accessible and in working order.

Performing During Operational Maintenance.

- Check the pressure gage reading to ensure pressure reading is below the red band on the gage. If it is in the yellow band change elements after the operation. (If in the red stop operation).
- Check the water level sight gage and drain the water if necessary.
- Check the filter separator for leaks.

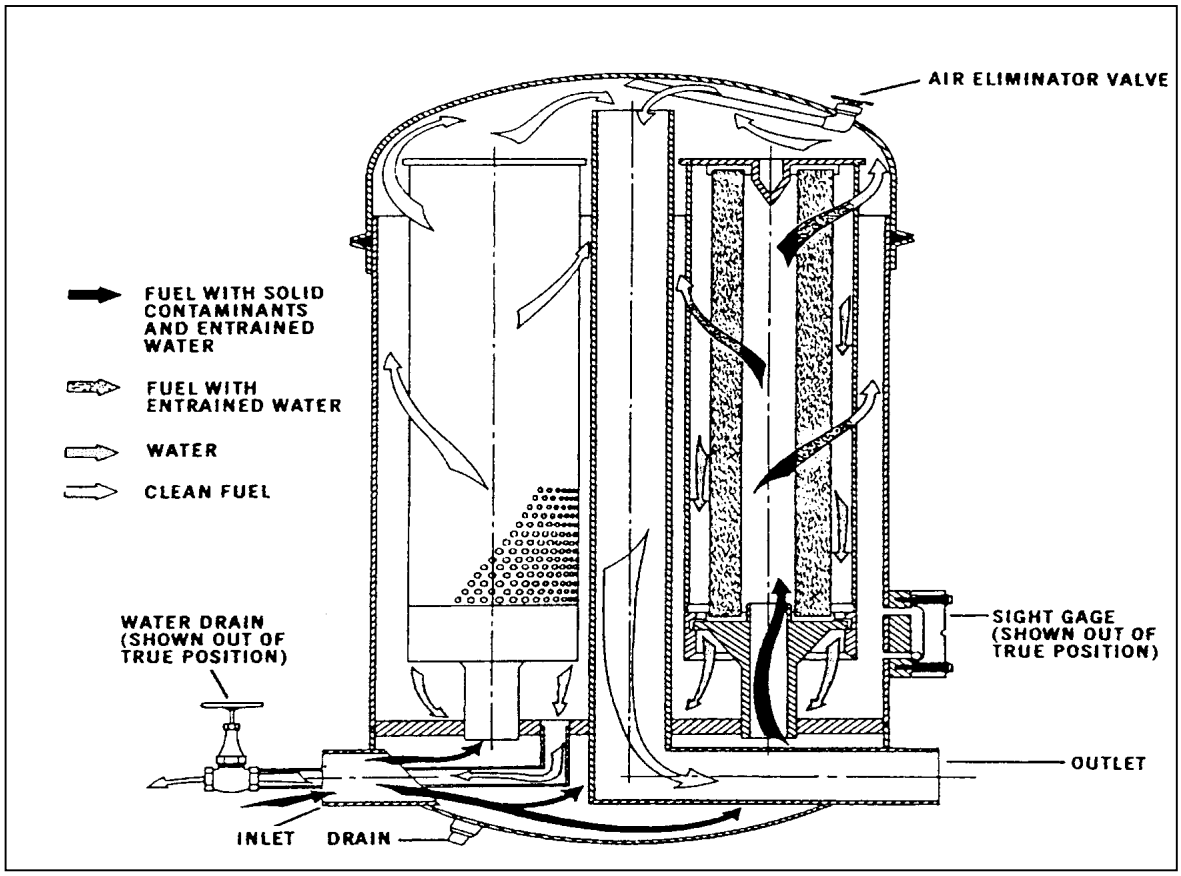

Figure 2-1. Typical flow through a filter/separator.

Performing After Operational Maintenance.

- Clean and store the equipment.
- Ensure all dust caps and plugs are installed after the operation.

Different Sizes of Filter Separators.

- 15 GPM liquid fuel filter separator is a vertical, portable unit consisting of an aluminum tank mounted on an aluminum skid. This tank has fuel inlet and outlet valves, a water drain valve, and a water level sight gage. The pressure vent valve's working pressure is 25 psi. The 15 GPM filter separator is used with the 15 GPM hand operated dispensing pump.
- 50 GPM filter separator consists of an aluminum tank with removable cover, inlet pipe with dust plug, outlet pipe with dust cap, water drain valve, an air vent valve, a pressure differential indicator, eight glass, four elements and a canister. A reading in the green (0-20 psi) means the elements are clean. A reading in the yellow (20-35 psi) means the elements must be changed at the end of the day's operations. A reading in the red (35 psi and up) means the elements must be changed at once. The maximum working pressure is 75 psi. It is used in refueling systems and for servicing ground vehicles.
- 100 GPM filter separator, aluminum pressure tank with removable head. The tank is welded in a tubular aluminum frame. The maximum working pressure is 75 psi.
- The 350 GPM filter separator is used in the 150 psi airfield refueling systems, motor fuel servicing equipment and military hoseline systems, and as a component of the FSSP.

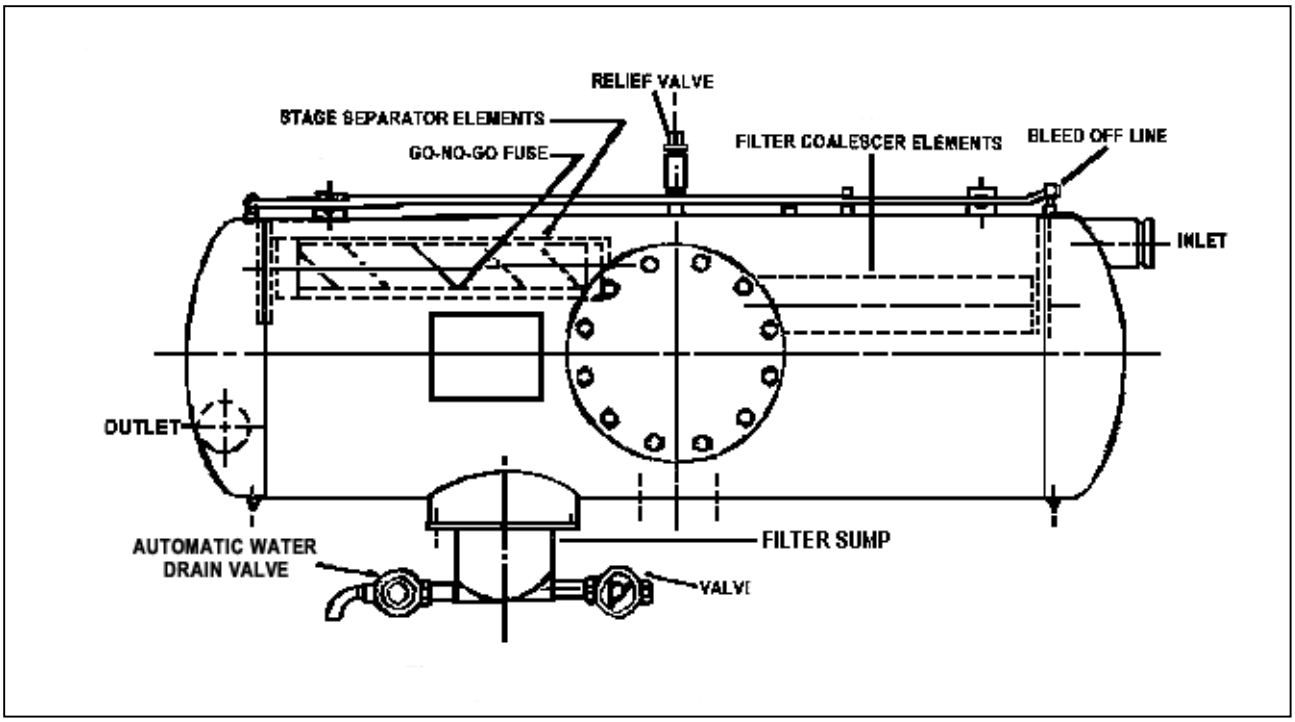

Figure 2-2. M969 and M970 Tank Truck Filter/Separator

PART B - DIFFERENT TYPES OF PUMPS AND THEIR CHARACTERISTICS

The 50 GPM pumping assembly (Figure 2-3) consists of a pump and engine assembly mounted on an oval aluminum base. A one cylinder four-cycle air cooled gasoline engine is used to power the pump. The pump is a self-priming, centrifugal pump. The pump suction and discharge port have 1 1/2-inch cam locking coupling adapters with dust caps.

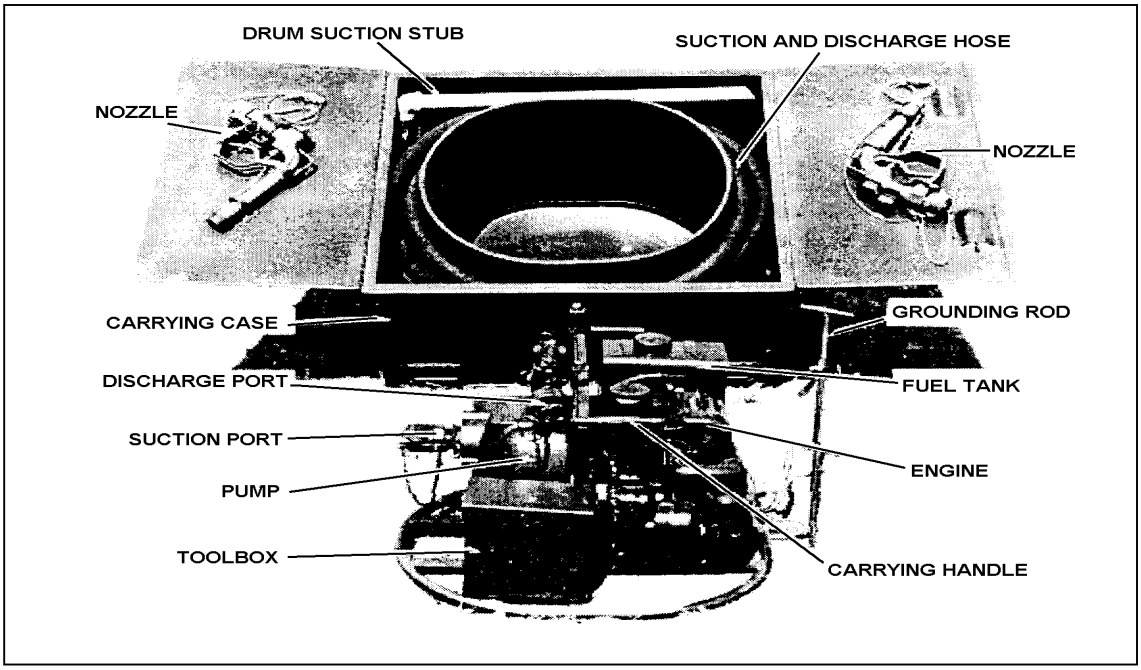

Figure 2-3. 50-GPM pumping assembly.

The 100 GPM pumping assembly (Figure 2-4) is used as a component of the FARE system. An air cooled, one cylinder, gasoline driven, four cycle engine is used to power the pump. It develops 2 1/2

horsepower at 3,500 RPM. The 100 GPM pumping assembly is used to transfer fuel from storage tanks, tank cars, and tank vehicles to smaller capacity containers.

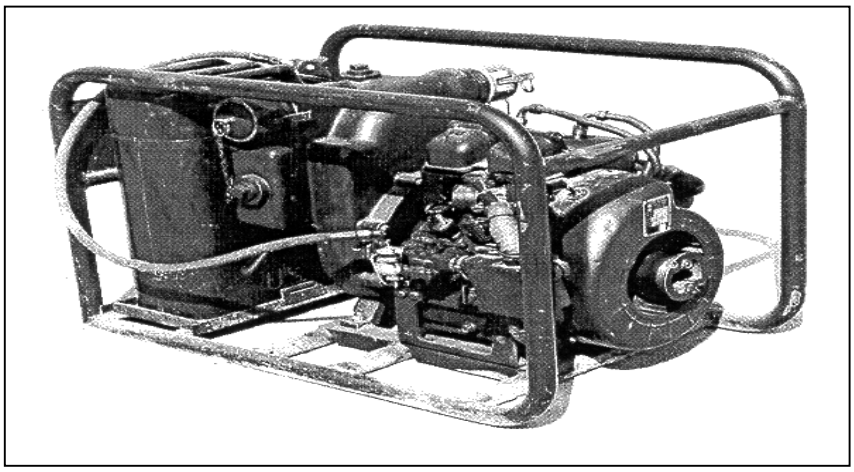

Figure 2-4. 100-GPM pumping assembly.

The 350 GPM pumping assembly (Figure 2-5) is used mainly with the fuel system supply point (FSSP). Towing speeds.

- Hard surface 20 MPH
- Gravel road 10 MPH
- Rough cross country 8 MPH

Gasoline Models (350 GPM)

- Barnes Model, Idle speed 700-800 RPMs. The normal operational speed 3200-3600 RPMs.
- Gormann Rupp Model, Idle speed 1000 RPMs. The normal operational speed 220-2350 .

Diesel Models. The 350 GPM pumping assembly is designed specifically to transfer gasoline, jet fuels, light liquid petroleum fuels and water. It consists of an air cooled, three cylinder diesel engine and a self priming centrifugal pump mounted on a two wheel frame assembly .

- Model 1322021070 (97403). This model is used to transfer fuel only and does not have a regulator. It is manually controlled and has a recommend warm up and cool down time of 2 minutes.
- Model 13226E2289 (97403). This model is used to transfer fuel only and has a regulator that provides manual and automatic modes of operation.
- Model 13225E9200 (97403). This model is used to transfer water only and does not have a regulator.

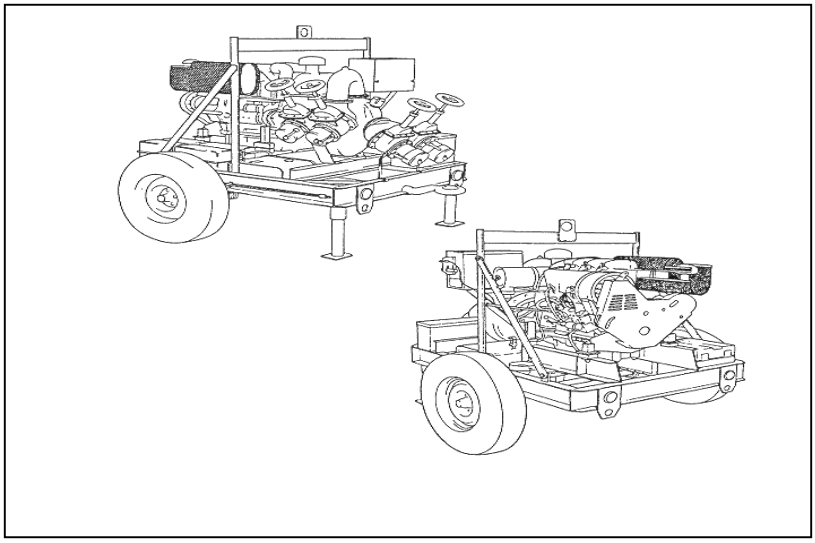

Figure 2-5. 350-GPM pumping assembly.

LESSON 2

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. What is the average service life of a standard filter element?
   A. 4 months.
   B. 6 months.
   C. 12 months.
   D. 24 months.

2. What are the dimensions of the standard interchangeable canister?
   A. 5 inches in diameter and 23 inches long.
   B. 7 inches in diameter and 22 inches long.
   C. 23 inches in diameter and 5 inches long.
   D. 22 inches in diameter and 7 inches long.

3. What is the first step in -performing before operational maintenance on the filter/separator?
   A. Ensure that all valves operate freely.
   B. Make a visual check for leaks.
   C. Ensure the ground wire is connected.
   D. Ensure gaskets are in place.

4. When does the 50 GPM-Filter/separator reach a pressure reading in the red?
   A. 20 psi and up.
   B. 25 psi and up.
   C. 35 psi and up.
   D. 40 psi and up.

5. Which pumping assembly is used mainly with the FSSP?
   A. 15-GPM pump.
   B. 50-GPM pump.
   C. 100-GPM pump.
   D. 350-GPM pump.

LESSON 3

DIRECT THE USE OF PUMPS

OVERVIEW

Knowledge of the advantages and disadvantages of various types of pumps is helpful to the petroleum staff NCO when supervising the use of the pumps and performance of PMCS.

Lesson Description:

This lesson covers advantages and disadvantages of various types of pumps and the performance of PMCS on the pumps.

Terminal Learning Objective:

Action: The soldier will acquire knowledge on monitoring PMCS on pumps, verifying appropriate entries on DA Form 2404 (Maintenance Request) and DA Form 5988-E (ULLS)(Equipment Maintenance Worksheet) and correcting deficiencies, observing safety precautions, and identifying environmental considerations.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

As a petroleum supervisor, you must understand the basic workings of the types of power units used in petroleum operations. You must also understand the operating characteristics of pumps in order to properly supervise you subordinates.

PART A - TYPES OF POWER UNITS

There are two types of internal combustion engines: reciprocating and turbine. The reciprocating spark ignition engine is of the gasoline burning type. The fuel is ignited by a spark plug when the piston is at the top of the cylinder. There are two classifications of reciprocating engines: four cycle and two cycle, The four cycle produces more power than the two cycle engine, but it is a much heavier engine than the two cycle. Gasoline engines used in the military are generally used with small equipment such as 100 GPM pumps (four cycle), chain saws, and outboard motors (two cycle).

The compression ignition engine functions the same as the spark ignition except it does not have spark plugs. Heat of compression is the source of ignition. For this reason, the engine is of much heavier construction. As the piston moves in the upward stroke, the air is compressed and heated to approximately 900 to 1000 degrees Fahrenheit. At this point fuel is forced into the chamber by means of an injector and combustion takes place. The compression ignition engine will produce more horsepower and because of fuel injection is much more efficient than the spark ignition engine. The cost is much more than the gasoline engine, but there is less maintenance required. Diesel engines are very well suited for large pumps and stationary applications where low speeds and high horsepower are required. Because diesel engines use heat compression for ignition, they need assistance in order to start in cold weather. This is accomplished by glow plugs or ether injection.

Turbine engines work on the principal of heat of compression, but do not use pistons to create hot air. The air is compressed by the use of compressors and is directed to a combustion chamber where fuel is injected and combustion takes place. The basic design is very simple and there are less moving parts than reciprocating engines. The following are characteristics of turbine engines:

- Lightweight.
- Produce more horsepower per size.
- Require less maintenance.
- Initial cost is very high.
- Sensitive to dust and dirt.

Electric motors are used in fixed facilities because of their lower maintenance and operating cost. Electric motors operate in a magnetic field. When energy is applied, the magnetic field is established and creates a push-pull action which causes the armature to turn.

PART B - PRINCIPLES OF PUMPS

There are three basic types of pumps used by the Army. These are: reciprocating, rotary, and centrifugal. Reciprocating pumps displace liquid by a reciprocating or back and forth motion. The most common application is a piston or plunger moving back and forth in a cylinder. As the piston moves backward, a suction is created and the liquid is drawn into the cylinder. As the piston moves forward the liquid is expelled. When only one piston is used, it is classified as a simplex pump. When two pistons are used, it is known as a duplex pump, this will move fluid in both directions. Because of their action, they are classified as positive displacement pumps. These pumps create special problems.

- They must be equipped with surge tanks or pressure relief valves.
- They create pulsations on a pipeline.
- They require a higher degree of maintenance than other types of pumping units (i.e., packing around the piston, cooling the unit).

The pump you will see the Army use is the ROWPU, because of the high pressure required to pump the water through the system. Advantages of the reciprocating pumps are:

- Self priming.
- High suction pressure, high discharge pressure.

Disadvantages of the reciprocating pumps are:

- Must have relief valve and surge tank.
- Pulsating effect on pipelines.

Rotary pumps are positive displacement pumps in which the main pumping action is caused by rotating gears. As the gears rotate, the fluid is trapped between their teeth and is carried around to the discharge outlet. There are a variety of rotary pumps. In petroleum handling operations, their principal application is in low pressure, low capacity operations. The advantage of rotary pumps is their ability to pull fluid into the housing without the aid of a priming tank or vacuum pump (self-priming). They also have constant discharge characteristics. The only petroleum vehicle that presently uses rotary motion is the M49A2C.

Centrifugal pumps employ centrifugal force as the principle of operation. Simply put, the action of this pump is an impeller rotating in a volute casing. Fluid forced into the eye of the impeller is picked up by the vanes and discharged into the casing by centrifugal force. Because of their simplicity and low cost and ability to operate under a wide variety of conditions, centrifugal pumps are one of the most popular types. Centrifugal pumps that are in use in the petroleum pipeline and TPT operations include:

- The 600-GPM hose line pump which is a 6-inch, single stage, self-priming pump, diesel-engine-driven, wheel-mounted, air-cooled, centrifugal pump.
- The 1,250-GPM flood and transfer pump is a 6-inch, single-stage, skid-mounted, diesel-engine-driven, self-priming centrifugal pump.
- The 800-GPM mainline pump is a skid-mounted, diesel-engine-driven, three stage centrifugal pump.

Centrifugal pumps can be classified or described by:

- Size of the suction and discharge ports.
- Number of impellers or stages.
- Whether they are self priming or must be force fed.
- Six inch, single stage, self priming pump.

Centrifugal pumps are used to transfer fuel from storage tanks to truck loading racks, from one tank to another, and to feed pump stations on the main pipeline.

- Six inch, two stages: Used on six, eight, and ten inch pipelines as booster pumps. May be used in parallel at ocean terminals to off load tankers.
- Four inch, four stage: Used on four and six inch pipelines as booster pumps.
- Six inch, three stage, diesel engine driven: Used on six, eight, and ten inch pipelines as booster pumps. This pump will replace the four-inch, four stage and the six inch, two stage pump in the Army system.

LESSON 3

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. Which engine will produce more horsepower?
   A. Compression ignition engine.
   B. Gasoline engine.
   C. Spark ignition engine.
   D. Two cycle engine.

2. Which pump would have a piston or plunger moving back and forth in a cylinder?
   A. Rotary pump.
   B. Centrifugal pump.
   C. Reciprocating pump.
   D. Vacuum pump.

3. Which of the following is a characteristic of a turbine engine?
   A. Produce less horsepower per size.
   B. Lightweight.
   C. Initial cost is very low.
   D. Require more maintenance.

4. As the piston moves in an upward stroke in a compression ignition engine, the air is heated to approximately what degree?
   A. 500 to 600 degrees Fahrenheit.
   B. 900 to 1000 degrees Fahrenheit.
   C. 700 to 800 degrees Fahrenheit.
   D. 300 to 400 degrees Fahrenheit.

5. Four cycle and two cycle are classifications of what type of engine?
   A. Reciprocating.
   B. Turbine.
   C. Diesel.
   D. Electric.

LESSON 4

SUPERVISE PETROLEUM TANK VEHICLE OPERATIONS
Critical Task:
101-519-3313

OVERVIEW

Directing the transfer of petroleum products from tank vehicles must be carefully planned in order to accurately account for the quantities delivered and issued, verify the quality of the products in transition, and to prevent spills.

Lesson Description:

This lesson covers the procedures for loading and unloading tank vehicles, their maintenance and gaging.

Terminal Learning Objective:

Action: The soldier will learn to supervise the operator maintenance and operation of assigned vehicles and equipment.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

The use of the tank vehicles in the Army is increasing because of the need for larger volumes of bulk fuels and rapid, uninterrupted distribution requirements for refueling military aircraft and vehicles.

PART A - TANK TRUCKS

The Army utilizes several different tank vehicles for use in refueling operations. Below is a description of these vehicles and their typical uses.

M49A2C Tank Truck. The M49A2C tank truck is mounted on a modified M45A2 chassis (2 1/2 ton). The truck has a multi-fuel engine with single front and rear dual tires. It is about 23 feet long, 8 feet wide and 7 2/3 feet high. TM 9-2320-209-10 (Operator's Manual for Truck, 2 1/2 ton 6x6 Gasoline Engine Models) gives details on this truck. The tank body is a stainless steel 1,200-gallon tank shell divided into two 600-gallon compartments. Each compartment has a manhole cover. One each five-pound carbon dioxide fire extinguisher is mounted on the left and right front of the vehicle. The rear equipment cabinet consists of a manifold, pump, filter/separator, discharge valve control and meter, water separator chamber, gage stick, grounding assembly, pump delivery line valve, gravity delivery line valve, filter/separator drain valve, and pressure gage. The pressure differential gage measures the effectiveness of the filter/separator. When the pressure differential between the inlet and outlet pressure is more than 20 psi, change the filter elements and the go/no go fuses. If pressure differential between the inlet and internal is 15 psi, replace filter elements only. Change only the go/no go fuses when the pressure differential reading is 15 psi between the internal and the outlet. A power take off shifting lever is located in the cab to the left side of driver seat. It operates the pump. The lever is moved backward to ENGAGE the pump. To DISENGAGE the pump, pull lever forward. The M49A2C is used for top and bottom loading, defueling aircraft, and pressure discharging.

M131A5C 5,000-Gallon Semitrailer. The M131A5C 5,000-gallon semitrailer (Figure 4-1) is the most commonly used fuel servicing tank semitrailer in the Army. It has 5,000-gallon capacity and weighs 12 tons. The entire vehicle is about 31 feet long, 8 feet wide, and 9 feet high. It is towed by a 5 ton, 6x6 tractor truck or like vehicle that has a fifth wheel. The semitrailer is used to carry and transfer fuel, service containers, and refuel ground vehicles. The semitrailer can travel cross-country at a reduced payload of 3,300 gallons (1,650 gallons in each tank compartment). It can fill or empty 3,000-, 10,000- or 50,000-gallon collapsible tanks. The vehicle can transfer product to or receive it from the fuel system supply point (FSSP). The stainless steel tank body is divided into two 2,500-gallon compartments, has a 20-inch manhole and filler cover assembly, with a vent valve and locking device, a discharge valve with screw assembly, and a drain pipe. A full marker gage that indicates when the tank is full is welded to each manhole cover. There is a walkway on top of the tank body with a slip-resistant steel grating. A ladder at the rear of the vehicle gives access to the manhole covers. The two compartments are connected by piping to the vehicle's fuel delivery system. There is one equipment cabinet and a filter/separator on the curbside of the vehicle. The curbside equipment cabinet houses an auxiliary engine, pump, and battery. There are three hose tubes and one equipment cabinet on the roadside of the vehicle. The roadside equipment cabinet houses a meter, a 1 1/2-inch (0-55 GPM) dispensing assembly, 2 1/2-inch (225 GPM) dispensing assembly, filter/separator pressure gages, engine controls, fixed fire extinguisher system, portable fire extinguisher, and fuel handling controls. The three hose tubes are located directly above the roadside equipment cabinet. They hold three sections of suction hose and a gage stick. There is a door on both ends of the hose tubes. The auxiliary engine and pump assembly have a 2-cylinder, 4-cycle, air-cooled gasoline engine, a self-priming centrifugal pump and a 24-volt battery. The choke is on the left side of the engine. The engine controls are on the instrument panel located in the roadside equipment cabinet. These controls consist of a power panel switch, starter button, ignition switch, oil pressure, and voltage gage. The pump is connected to the auxiliary engine by bearing mounted shaft. A firewall separates the two items. The entire pumping system has a total capacity of 225 GPM. The filter/separator has three filtering stages. In the first stage 15 filter elements remove solid contaminants and coalesce any water in the fuel. In the second stage, five canisters separate the water from the fuel and let it drain into the filter/separator sump. Finally, there are 15 go/no go fuses as safety devices to shut off the flow of fuel if the other two stages allow water or solid contaminants to exceed a safe level. There are three of these fuses in each of the second-stage canisters. Other parts of the filter include an automatic dump valve, a manual drain valve, an emergency shutoff control, and three pressure gages. Any water collected in the filter/separator is removed by the automatic dump valve. This valve is operated by a float that rises in water

and sinks in fuel. Drain water from the unit by opening the manual drain valve located at the bottom of the sump. Keep the valve open as long as water is running out. When fuel appears close the value. While product is flowing through the separator, check the pressure differential. A 300 GPM positive displacement meter is located on the right side of the roadside equipment cabinet. The meter counter registers up to 9,999 gallons. A knob on the side of the meter is used to reset the counter. Turn the knob clockwise until the counter is back to zero. The meter also has a totalizer which keeps a record of all issues. There are three dispensing assemblies on the M131A5C tank semitrailer. One assembly is made up of three 15-foot sections of 3-inch suction hose. These sections are stored in tubes located on the roadside of the vehicle. The other two assemblies are housed in the roadside equipment cabinet. The one on the left side of the cabinet is a 0-55 GPM dispensing assembly. It has a 50-foot section of 1 1/2-inch discharge hose, a hose reel, and a 1 1/2-inch nozzle with a bonding clip and a plug. The assembly on the right side of the cabinet is a 225 GPM dispensing assembly. It has a 50-foot section of 2 1/2-inch discharge hose, a hose reel and a 2 1/2-inch nozzle with bonding clip and plug. The 2 1/2-inch nozzle comes with two nozzle spouts. The standard 14-inch spout used for most fueling operations is normally attached to the nozzle. The 24-inch spout, is used only for defueling operations and is stored on the left side of the fire extinguisher, in the roadside equipment cabinet. Each dispensing assembly is controlled by a brake assembly and a rewind mechanism. There are two fusible link connections and two fusible nut connections on the semitrailer. The two fusible links are installed at the tank compartment discharge valves and the two fusible nuts are part of the operating lever assembly. If there is a fire in any of these places, the fusible links and nuts melt and close the tank compartment discharge valves.

Figure 4-1. M131A5C 5,000-gallon semitrailer.

M967 5,000-Gallon Semitrailer. The M967 5,000-gallon semitrailer is a bulk hauler with self-load/unload capability. It is designed for general highway and limited cross-country use. It has a 5,000-gallon capacity and weighs 13,000 pounds empty and 46,950 pounds full. The entire vehicle is about 31 feet long, 8 feet wide, 9 feet high. The semitrailer can be transported by a C-130 aircraft. It is also designed to be towed by a 5-ton, 6x6 truck tractor or similar vehicle equipped with a fifth wheel. It has a fording capability of 24 inches in salt or fresh water without major component preparation. TM 9-2320-356-12&P gives detailed information on this tank semitrailer. The stainless steel tank body of the M967 is constructed as one 5,000 gallon compartment with evenly distributed integral baffles. The compartment has pressure and vacuum vents and a manhole with locking device. There is a walkway on top of the tank body with a slip-resistant steel grating. A ladder at the front of the tank leads to the walkway. The tank compartment is connected by piping to the vehicle's fuel receipt and delivery system. This system is mounted on the roadside of the vehicle. There is a pump and engine compartment, pump engine fuel tank, landing gear crank, and landing gear ground board on the curbside of the vehicle. There is also a hose trough, emergency valve shutoff, and two batteries on the curbside of the vehicle. There is a hose trough, landing gear ground box, toolbox, and control panel on the roadside of the vehicle. There is also a portable grounding rod and manifold valve on the roadside of the vehicle. The auxiliary engine and pump assembly are located in the curbside equipment cabinet. It has a 4-cylinder, 4-cycle, variable speed, air-cooled diesel engine and a self-priming, centrifugal 4-

inch low pressure pump. The auxiliary engine is started by two 12-volt batteries connected in series. The batteries are located on the left side of the equipment cabinet. The engine controls are on the instrument panel located on the roadside of the vehicle. These controls include an engine preheater switch, engine throttle, and control panel light. The instrument panel also includes a voltmeter, tachometer, hour meter, oil pressure gage, fuel pressure gage, and pump pressure gage. The pump is connected to the auxiliary engine by a bearing-mounted shaft. A firewall separates the two items. The pumping system has a bulk fuel deliver rate of up to 600 GPM and a self-load rate of up to 300 GPM.

M969 5,000-Gallon Semitrailer. The M969 5000-gallon semitrailer is a fuel dispensing semitrailer used primarily for refueling ground vehicles. The M969 has the same bulk delivery and self load capabilities as the M967. It has a 5000-gallon capacity and weighs 15,000 pounds empty and 48,950 pounds full. The M969 has the same dimensions and can be towed and transported in the same manner as the M967 tank semitrailer. The tank body and auxiliary engine and pump assembly are identical to that of the M967. TM 9-2320-356-12&P gives detailed information on this tank semitrailer. In addition to the equipment included with the M967, the M969 includes equipment required for automotive refueling and limited aircraft refueling. This equipment is mounted on the sides of the vehicles. There is a filter/separator, pump and engine compartment, engine fuel tank, landing gear crank, and landing gear ground board on the curbside of the vehicle. There is also an emergency valve shutoff, hose trough, and battery compartment for two batteries on the curbside of the vehicle. There is a hose trough, portable grounding rod, landing gear ground board, toolbox, control panel, manifold assembly, and hose reel cabinet on the roadside of the vehicle. The filter/separator is rated at 300 GPM and 15 psi. It has three filtering stages. In the first stage, 15-filter elements remove solid particles and coalesce any water in the fuel. In the second stage, five canisters separate the water from the fuel and let it drain into the filter/separator sump. Finally, 15 go/no go fuses act as safety devices to shut off the flow of fuel if the other two stages allow water to exceed a safe level. Three of these fuses are in each of the second stage elements. Other parts of the filter/separator include an automatic drain valve, a manual drain valve, and a pressure gage. When water in the filter sump reaches a certain level, the water is removed by the automatic drain valve. This valve is operated by a float which rises in water and sinks in fuel. As water enters the filter sump the float rises. When the float rises to a certain level, a valve opens in the drain valve assembly allowing pump pressure to be applied to a diaphragm valve. The opening of diaphragm valves causes the automatic drain valve to open, allowing the water to drain. As the water is being drained, fuel flow is continued. If water enters the sump faster than the automatic drain valve can carry it away, or if the filter elements fail, the go/no go fuses stop the flow of fuel completely. The pressure gage is located on the instrument panel in the roadside equipment cabinet. It indicates the amount of restriction in the filter/separator. Two 100 GPM meters are located in the roadside equipment cabinet of the M969. The meter counter registers up to 9,999 gallons. To reset the count to zero, push in the meter reset knob on the side of the meter and turn clockwise. The meter may also be used during defueling operations. If any trouble with the meter occurs, take the vehicle to organizational maintenance. The utility meter must also be checked for accuracy to make sure the correct amount of fuel is being delivered. There are three dispensing assemblies on the M969 tank semitrailer. One assembly is made up of three 14-foot sections of 4-inch suction hose. These sections are stored in troughs located on both sides of the vehicle. This assembly has a bulk deliver rate of up to 600 GPM and a self-load rate of up to 300 GPM. The other two assemblies are housed in the roadside equipment cabinet. Each of these dispensing assemblies includes a meter, a hose reel with electric rewind, 50 feet of 1 1/4-inch dispensing hose, and a dispensing nozzle. Flow rate for metered delivery of fuel (gasoline or diesel) is up to 600 GPM, through one nozzle only or through both nozzles at the same time.

M970 5,000-Gallon Semitrailer. The M970 5,000-gallon semitrailer is a fuel dispensing semitrailer used primarily for under-wing/over-wing refueling of aircraft. It has a 5,000-gallon capacity and weighs 15,200 pounds empty and 49,150 pounds full. The M970 has a bulk delivery rate up to 600 GPM and a self-load rate up to 300 GPM. It is designed to be towed by a 5 ton, 6x6 truck or similar vehicle equipped with a fifth wheel. The tank body is stainless steel and is constructed as one 5,000-gallon compartment with evenly distributed integral baffles. The compartment has pressure and vacuum vents and a manhole with locking device. The tank compartment is connected by piping to the vehicles fuel receipt and delivery system. In the curbside cabinet there is a filter/separator, two 12-volt batteries, pump and engine compartment, engine fuel tank, landing gear control, and emergency valve shutoff. The roadside cabinet houses the landing gear ground board, recirculation fitting, portable grounding rod, toolbox, manifold assembly, control and instrument panel, hose reel cabinet. In the hose reel cabinet you have 1 1/2-inch hose reel and hose, 2 1/2-inch hose reel and hose, and 300 GPM meter assembly.

M978 Heavy Extended Mobility Tactical Truck (HEMTT) Tanker. The M978 HEMTT tanker (Figure 4-2) is used for refueling wheeled and track vehicles, and aircraft, which on today's modern battlefield, are more mobile than ever before. The M978 comes equipped with two hose reels, each containing 50 feet of 1 1/2 inch hose, with service nozzle of 2 1/2 inch in diameter and a pressure differential gage which indicates a dirty or clean filter/separator. There are 18 elements and 18 canisters. The vehicle can operate in temperatures from 25 to 120 degrees Fahrenheit, ford water up to 48 inches deep for 5 minutes without damage or requiring maintenance before operation can continue, maintain a speed of 25 MPH on a 3 percent grade with full trailer (100,000 lbs) and 40 MPH on a 3 percent grade vehicle only (60,000 lbs), maintain speed up to 55 MPH while operating at full load without a trailer on good, level road, and start and climb a 30 percent grade fully loaded with a trailer or start and climb a 60 percent grade fully loaded without a trailer. The normal operating range for the transmission, eight wheel drive vehicle is 300 miles, based on 159 gallons of fuel. The M978 can be utilized for self-loading (filtered or nonfiltered), recirculation, bulk delivery filtered, dispensing using over wing/CCR nozzle, and defueling. The M978 can also be used for aircraft refueling operations by utilizing the HEMTT Tanker Aircraft Refueling System (HTARS). The HTARS kit, it's components, use, and operation are discussed in the following lesson.

Figure 4-2. M978 HEMTT tanker.

Vapor Recovery System. The vapor recovery system can be installed on all models of tank semi-trailers, and is required in certain ecological areas. The system allows a fuel depot to collect or recover the vapors and gases that are present during the loading operation. Vapors can also be recycled back to the semitrailer through the recovery system during the loading operation. This system consists of a vapor-tight line running from the sealed hood on the emergency valve vent (directly behind the manhole cover) to the rear of the tank. The rollover rail on the roadside of the semitrailer is used as part of the line. The adapter on the end of the line is compatible with the 4-inch quick-disconnect, vapor recovery connections at a majority of fuel depots.

Tank and Pump Unit. The tank and pump unit consists of a 50-GPM pumping assembly, two 500- or 600-gallon aluminum tanks, and related equipment. The unit is designed to be transported on the 5-ton, 6X6 cargo truck due to the fact that when the unit is filled with fuel it exceeds the load limit of the 2 ½-ton cargo truck. The unit can be used to fill and empty 500- and 600-gallon collapsible drums, 55-gallon drums, and 5-gallon cans; temporarily store product; refuel ground vehicles; and replace or supplement special purpose vehicles. The unit may also be used to fuel aircraft if no other aircraft refueling equipment is available. There are several standard models of the tank and pump unit. The main differences are in their pumps, filter/separators, manifolds, and hoses. TM 10-4930-204-15(Operator's Organizational Direct Support General Support, and Depot Maintenance Manual) gives details on installing, operating, and maintaining the different models of the unit. A description of the various components is provided as follows:

Tanks. The tank shells have a manhole assembly, pump-port drain plug, and discharge valve assembly. Controls for the discharge valve are on the top of the tanks. The discharge valve outlet is at the bottom rear of

the tank, and the drain plug is at the bottom front. A baffle inside the shell helps keep down the surge of the product during transport. Two lifting rings are attached to the top of each end of the shell to make handling easier. Tie downs are provided for securing the tanks in the vehicle bed.

Pump. The pump is a 50 GPM, self-priming, centrifugal pump. The impeller is screwed on the extension of the engine crankshaft. The engine is a 1-cylinder, 4-cycle, air-cooled, hand cranked engine. Some models have 2-cylinder, 4-cycle, overhead-valve, air-cooled engines. A radio-shielded magneto supplies the ignition spark, and a governor controls the engine speed by varying the throttle openings to suit pump loads. The gasoline tanks hold one gallon. The pump and engine are mounted on a common base so that they can be easily removed for servicing and can be used in other pumping operations.

Filter/Separator. The filter/separator is a vertical, 50 GPM capacity unit with four standard canisters and filter elements. The tank and pump unit can be used to refuel aircraft because the filter/separator qualify under military specification MIL-F-8901C.

Manifold. The manifold controls the flow of product to the suction side of the pump. Two quick couplers provide connections or inlets for the tank suction lines. The product flows from either or both tanks to the pump suction through the manifold outlet and a section of hose. Some models have a discharge hose that runs from the filter/separator to the manifold and product can be discharged from the manifold outlet when the three-way valve issued to close off the suction side. Other models use the only manifold for suction.

Hose Reels. The dispensing hoses are stored on two hose reels each with a recoil tension spring. A 40-foot length of 1 1/2-inch non-collapsible discharge hose is used on each reel. Product from the filter/separator enters through a pipe at the hub of the reel and is discharged through the hoses.

Ground Reel. A ground reel is attached to the frame of the pumping assembly so that the tank and pump unit can be grounded. One section of the ground wire must be clipped to a ground rod near the tank and pump unit before the other section is connected to the vehicle being fueled.

Metering Kit. The metering kit consists of a meter, hose assembly, couplers, cap screws, and washers. The kit is used with pumping assemblies on all tank and pump units.

Other Items. Other items issued with the pumping assembly are a drum-unloaded suction stub for emptying 55-gallon drums, two dispensing nozzles, a starter rope, a carbon dioxide fire extinguisher, and tie down assemblies. If the nozzles have lock-on, latch-open devices, the devices must be fixed so that they must be held open by hand and attended at all times.

PART B - GAGING PETROLEUM TANK VEHICLES

Each tank has its own gage stick. It may be made of wood or metal depending on the type of vehicle. It is important that you keep the stick protected from the elements whenever not in use. The gage stick is usually graduated into 25-gallon divisions. Before gaging any type of vehicle, bond and ground the tank vehicle and ground yourself from static electricity by touching a bare hand to the tank shell. Do not wear headgear or loose items when you are on top of the tank vehicles. Never gage during an electric storm. Position the fire extinguisher within 10 to 15 feet of the tank vehicle. Verify the shipping document for kind of fuel in the tank vehicle. Insert the thermometer as soon as you open the hatch. (If quantity is less than 3,500 gallons, it is not necessary to take the temperature). Gage the compartment. Take all-level sample. Measure the API gravity of the sample and record it on the gage work sheet. Correct the volume to 60 degrees Fahrenheit if required.

LESSON 4

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. The M49A2C tank truck contains
   A. Two 600-gallon tanks.
   B. A 1200-gallon shell divided into two 600-gallon compartments.
   C. One 1200-gallon tank.
   D. A 5000-gallon shell divided into two 2500-gallon compartments.

2. The M131A5C Semitrailer
   A. Is the most commonly used fuel servicing semitrailer in the Army.
   B. Has a 1200-gallon shell divided into two 600-gallon compartments.
   C. Has a 5000-gallon shell divided into two 2500-gallon compartments.
   D. A and C.

3. Which semitrailer is used primarily for the fueling of under wing/over wing aircraft?
   A. M967.
   B. M969.
   C. M970.
   D. M978 HEMTT.

4. A tank vehicle gage stick is usually graduated into
   A. 5-gallon divisions.
   B. 10-gallon divisions.
   C. 20-gallon divisions.
   D. 25-gallon divisions.

5. When is it not necessary to take the temperature of product when gaging a tank vehicle?
   A. Temperature of the product must always be taken for accurate API gravity and volume calculations.
   B. If the quantity is less than 3500 gallons.
   C. If the quantity is less than 2500 gallons.
   D. If the quantity is less than 1500 gallons.

LESSON 5

DIRECT UNIT MAINTENANCE WITHIN THE ARMY MAINTENANCE MANAGEMENT SYSTEM (TAMMS) ON ASSIGNED EQUIPMENT
Critical task:
101-519-3302

OVERVIEW

All Army equipment must be maintained in a state of readiness at all times. In order to verify the condition of the equipment certain procedures must be followed and specific forms completed.

Lesson Description:

This lesson covers the procedures for directing the PMCS and verification of DA Form 2404 (Maintenance Request) information.

Terminal Learning Objective:

Action: The soldier will learn to supervise the operator maintenance and operation of assigned vehicles and equipment.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

The Army must remain in a state of readiness at all times. It is imperative that all equipment be maintained and that records indicating conditions which render any piece of equipment not mission-ready be maintained and updated in a consistent manner at all bases. This lesson provides the background and procedures to accomplish this task.

PART A - TECHNICAL MANUALS (TM)

The most important task associated with the proper performance of operator/crew-level preventive maintenance checks and services (PMCS) is mastering the proper use of the operators TM. Once an understanding of how to use the TM as a guide through the PMCS task is acquired, a PMCS on any piece of Army equipment can be accomplished with minimal additional training. All TM (-10s) are broken down into the following sections:

- Table of contents
- Cautions and warnings
- The chapter containing the PMCS table
- The Basic Issue Items List
- The chapter containing maintenance instructions.

The PMCS table lists the services that are to be performed by the operator or crew. They are performed within the interval shown and in numerical sequence within each interval as indicated by item number. The PMCS tables are broken into the following sections:

- Item/sequence numbers column
- Intervals
- Not ready if/not mission capable column
- Item to be inspected/checked column

All Army vehicles, and most other equipment that requires operator-level maintenance have a -10 TM organized in a similar manner. Operators/crews perform different types of checks and services at different intervals for different reasons as described below:

- **Before-Operation PMCS** -These are checks performed by the operator/crew per the -10 TM PMCS. The tables identify faults which prevent the performance of the mission and must be corrected prior to the start of the mission. All other faults are corrected or (if above operator/crew authorization to correct) reported during or after the mission.
- **During-Operation PMCS** - These are checks performed by the operator/crew per the -10 TM PMCS tables. These tables monitor and identify faults in equipment performance during the mission. Faults which render the equipment not-mission-capable (NMC) require immediate correction. All other faults are corrected or (if above operator/crew authorization to correct) reported during or after the mission.
- **After-Operation PMCS** - These are checks and services performed per the -10 TM PMCS tables. The tables immediately at the conclusion of the mission are used to identify and correct faults which will prevent the next mission and to maintain the equipment to -10/20 standards. Faults which render the equipment NMC must be corrected prior to the start of the next mission. All other faults are corrected or (if above operator/crew level authorization to correct) reported to unit maintenance before the next mission.
- **Periodic Operator/Crew PMCS** - Checks and services performed by the operator/crew per the -10 TM PMCS tables Items-To-Be-Checked column to identify faults which must be corrected to maintain equipment to the -10/20 TM standards. Faults requiring correction beyond operator/crew level will be reported to unit level maintenance for correction.
- **The LO (lubricating order)** - This is where you find the locations for, type of, and capacity of POL products for the equipment.

The purpose of the various checks and services is to identify equipment faults (things that are wrong with the equipment), and service some points that require frequent attention. There are two types of equipment defects that are identified during PMCS periods:

- **Fault** - A fault is a defect in a piece of equipment that does not prevent the operation of the equipment, but must be corrected as soon as possible. The "/" status symbol is entered on DA Form 2404 to indicate a fault exists.

- **Deficiency** - A deficiency is a fault in a piece of equipment so severe that it causes the equipment to be not mission capable (NMC). The "X" status symbol is entered in the status column on DA Form 2404 to indicate a deficiency.

As the PMCS is being performed, the "Item To Be Checked/Inspected" column of the PMCS table tells what to check and how to check to see if there is an equipment fault or deficiency. If a fault or deficiency is identified, it must be determined if it can be corrected at the operator/crew level or if it will have to be entered on DA Form 2404 for unit level mechanics to correct. If it is beyond the capability of the operator/crew to correct, then you must find out if the fault has been previously identified and reported to unit maintenance personnel.

If the fault has been previously identified, it should be entered on the equipment's Uncorrected Fault Record (DA Form 2408-14). This form lists all faults on the equipment and tells why the necessary corrective action has been delayed. A copy of the equipment's DA Form 2408-14 should be in the equipment record folder whenever PMCS are performed so the previously reported faults are not entered again. If a new fault has been identified while checking DA Form 2408-14, enter the sequence number of the check being made when the fault was found and a description of the fault. Then look to the Not Ready/Available If column of the PMCS table to determine if the fault identified fits the description of a deficiency. The last step in the recording process is to circle the PMCS item number and enter the status symbol "X" which tells unit level mechanics that the equipment is not mission capable. There are four categories of maintenance that you should be familiar with:

- **O/C** - operator or crew maintenance (check and tighten or replace screws).
- **F** - direct support maintenance (replace and adjust).
- **H** - general support maintenance (rebuilt).
- **D** - depot maintenance (renovates and sends equipment back to supply systems)

PART B - THE EQUIPMENT RECORD FOLDER

The Equipment Record Folder holds the forms needed to keep up with equipment use, operation, and condition while on dispatch. It is used each time an item of equipment goes on dispatch. Descriptions of the items it contains are as follows:

- **DD 314 (The Equipment Identification Card)** - Ties a particular Equipment Record Folder to an item of equipment. An Equipment Identification Card goes in the outside front pocket of each Equipment Record Folder. Information on the card is used to identify the equipment covered, keep track of services due, and identify the assigned operator and leader. The dispatcher and operator make the card locally, use the card to keep up with services, and make sure the right folder is issued. The dispatcher and whoever keeps the DD Form 314 update the information on the card after each scheduled service. It is extremely important that you keep information on the Equipment Identification Card current. The Equipment Identification Card is thrown away when it is no longer needed or no longer readable. Replace forms when they are no longer readable.
- **DD Form 1970 (Motor Equipment Utilization Record)** - Used to record motor equipment use in order to control the use of special purpose, combat, tactical and nontactical vehicles and equipment, including material handling equipment. This form also keeps the running time on equipment that requires services by hours only. This includes such equipment as generators, air compressors, and centrifugal pumps. Running time is the period of operation. Forms keeping running time only will be used until the destination section is filled. This form is used for varying periods depending on its use. For regular dispatches this form is used until all the spaces in either the operator or destination section have been filled. For extended dispatches, this form is used until all the spaces in the operator or destination section have been filled. DA Form 5987-E (Motor Equipment Dispatch (EGA), when generated by ULLS, replaces the requirement for a DD Form 1970.

  The dispatcher fills out the following spaces:
  - Date (day, month, year).
  - Type of equipment.
  - Registration or serial number.
  - Administration number.
  - Organization name (user).
  - Operator name.
  - Time out, miles, hours.
  - Person to whom the operator reports.
  - Dispatcher's signature.

The operator fills in the following:

- Operator's signature.
- Time in, miles, hours.
- Total time equipment was used, total miles, hours.
- Destination section.
- Fuel, oil added.
- Remarks.

The person named in the "Report To" section of the form signs the form in the “Released By” section. The operator returns the completed form to the dispatcher.

- **DA Form 2404 (Maintenance Request)** - Used to report battlefield damage, repair, and/or replacement actions by unit level maintenance. It is also used by anyone performing inspections, maintenance services, diagnostic checks, technical evaluation, and PMCS. Operators use this form to list faults they cannot fix; it is also used as a temporary record of required and completed maintenance. DA Form 5988-E, when generated by ULLS, replaces the requirement for a DA Form 2404.
  Status Symbol entries on DA Form 2404 are made as follows:
  - **X** indicates a deficiency in the equipment that places it in an inoperable status.
  - **CIRCLED "X":** indicates a deficiency; however, the equipment may be operated under specific limitations as directed by higher authority as prescribed locally until correction action can be accomplished.
  - **HORIZONTAL DASH "-":** indicates that a required inspection, component replacement, maintenance operation check, or test flight is due but has not been accomplished, or an overdue Modification Work Order (MWO) has not been accomplished.
  - **DIAGONAL "/":** indicates a material defect other than a deficiency that must be corrected to increase efficiency or to make the item completely serviceable.
  - **LAST NAME INITIAL IN BLACK OR BLUE-BLACK INK, OR PENCIL:** indicates that a completely satisfactory condition exists.
  - **FOR AIRCRAFT:** status symbols are recorded in red.

  Status symbols can be changed at the discretion of the commander or the maintenance/motor officer. When the commander or the maintenance/motor officer disagrees with an assigned status symbol, he/she takes the following actions:
  - In column d, write "status symbol changed.”
  - On the next open line, enter the new status symbol and fault.
  - Sign in block 9a and initial column e.

  The commander or the maintenance/motor officer are the only persons who can CIRCLE X or change status symbols. Other entries on DA Form 2404 are made as follows:
  - Block 1: unit to which equipment belongs.
  - Block 2: name and model of equipment.
  - Block 3: serial number or registration number of equipment.
  - Block 6: type of PMCS performed (daily, weekly, etc.).
  - Block 7: TM number, TM date (if manual has changes, print latest change number after TM number).
  - Blocks 4, 5, 8a, and columns a, b, and d: Left blank until the deficiency or fault is found. When the deficiency or fault is corrected or downgraded to a CIRCLE X, entries will be made in blocks 4 and 5 at the end of the dispatch or operation.
  - Block 4a and 4b: miles, hours. Enter the applicable meter reading as of the date in block 5.
  - Block 5: current calendar date.
  - Column a: TM item number. If TM has no number for deficiency or fault, enter page, paragraph, or sequence number. Faults not covered by the PMCS, leave blank.
  - Column b: status symbol that applies.
  - Column c: deficiencies or shortcomings. Briefly describe the fault. Continue inspection to make sure no other faults exist.
  - Column d: list corrective action taken.

After the PMCS is completed and all faults that cannot fixed by the operator are listed, the form is turned over to the maintenance supervisor.

LESSON 5

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. A fault is a
   A. Defect that renders the equipment not-mission-ready.
   B. Defect that does not prevent the operation of the equipment.
   C. Defect that requires immediate attention.
   D. Defect that can only be repaired at a depot.

2. The Equipment Identification Card is
   A. Used by the dispatcher and operator to keep up with services.
   B. Thrown away when it is no longer readable.
   C. Used to identify the equipment covered.
   D. All of the above.

3. A record of motor vehicle use is maintained on what form?
   A. DA Form 2404.
   B. DD Form 314.
   C. DD Form 1970.
   D. DD Form 3643.

4. On DA Form 2404, the status symbol that indicates a deficiency in the equipment that places it in an inoperable status is
   A. / (diagonal).
   B. - (horizontal dash).
   C. (X) (circled “X”).
   D. X (letter “X”).

5. Once DA Form 2404 is completed it is turned over to
   A. The NCOIC.
   B. Your supervisor.
   C. Your maintenance supervisor.
   D. The depot commander.

LESSON 6

DIRECT REFUEL-ON-THE-MOVE (ROM) OPERATIONS
Critical task:
101-519-3311

OVERVIEW

Refuel-on-the-Move (ROM) operations allow the fastest penetration into an area. When properly directed, a minimum amount of time is required to dispense an adequate amount of fuel to all vehicles that will allow them to reach their next destination.

Lesson Description:

This lesson covers the procedures for directing the refuel-on-the-move operations (ROM).

Terminal Learning Objective:

Action: The soldier will learn to supervise the layout of the equipment and refueling operation, document the quantity of fuel issued on DA Form 3643 (Daily Issues of Petroleum Products), observe fire and safety precautions, and identify environmental considerations.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

Due to an increase in ground equipment, convoys are being used throughout the theater to transport personnel, equipment, and fuel to forward areas. The "doctrinal purpose" of ROM is to extend the time that ground maneuver forces can spend on the objective. Refuel-on-the-move operations are flexible and should be tailored to meet the situation. While providing several options on how to conduct a ROM operation, this lesson does not dictate a one-and-only "school solution."

Safety is a consideration, especially in peacetime training. ROM operations should be carefully thought out and properly supervised and executed. Remember to consider Mission, Enemy, Terrain, Troops and Time Available (METT-T).

PART A - REFUEL-ON-THE-MOVE CONCEPT

ROM for ground vehicles is synonymous with rapid or hot refueling for aircraft. ROM is normally accomplished as far forward on the battlefield as the tactical situation permits prior to the tactical assembly area. The "doctrinal purpose" of ROM is to extend the time that ground maneuver forces can spend on the objective, although ROM can be tailored to other situations as well. When vehicles enter a ROM site for refueling, they receive a predetermined amount of fuel (usually timed) and move out to return to their convoy or formation. This distinguishes it from routine convoy refueling operations. The manner in which this refueling is done depends upon the tactical situation. Each refueling operation is unique depending on the number of vehicles to be refueled, the distance the unit is traveling, and how many times the unit wants to be refueled. However, the assembly and operation of each ROM are basically the same. Due to safety considerations normal vehicle refueling is done with engines off.

PART B - COMPONENTS OF THE ROM

The following components make up the ROM kit (Figure 6-1):

NSN	Quantity	ITEM
N/A	3	14 feet X 4 feet suction hose
4720-00-083-0048	8	50 feet X 3 feet discharge hose
4720-00-555-8325	8	25 feet X 1-1/2 feet refueling hose
4730-00-075-2405	1	4 feet X 4 feet X 4 feet tee assembly
4730-01-096-1039	8	3 feet X 3 feet X 3 feet X 1-1/2 foot tee assembly
4930-00-471-0288	8	1-1/2 foot nozzle
4730-00-951-3293	2	4 feet to 3 feet reducer
4810-01-098-4925	8	quick shut-off valve with 1-1/2 inch adapters
5975-01-050-5707	8	grounding rod
4210-00-257-5343	8	fire extinguisher

Figure 6-1. ROM assembly/disassembly.

PART C - ROM ENVIRONMENTAL AND SAFETY PROCEDURES

- Enforce grounding and bonding procedures for fuel semitrailers, pumps, filter/separators and each refueling point.
- Make sure fuel handlers wear protective clothing (for example, standard combat uniforms, hearing protection, goggles, and gloves). With the exception of the standard uniform, other items are normally provided by the organization.
- Locate fire extinguishers at each refueling point and the source of fuel.
- Place fuel drip pans at each refueling point and at the fuel source. When draining drip pans, observe fire, safety, and environmental precautions.
- Ensure the fuel spill procedures and equipment, as a minimum, include: absorbents, shovels, and containers. The Standing Operating Procedures (SOP) should detail equipment and procedures for response in a field environment. Ensure that the SOP follows federal, state, and local requirements.

PART D - ROM EQUIPMENT CONFIGURATION

ROM is a concept that is equipment independent. As long as the concept is followed, any number of current equipment configurations can be used to do a ROM operation. ROM operations can be employed anywhere on the battlefield where there is a need to rapidly refuel combat vehicles.

The ROM kit consists of enough hoses, valves, and fittings to refuel up to eight combat vehicles at the same time. The kit takes care of transporting the ROM. Any cargo vehicle with a payload capacity greater than 1.5 tons can be used. The ROM weighs about 2,900 pounds. It cannot be loaded on the fuel-transporting semitrailer due to the weight limit of the semitrailer. The main fuel source is the 5,000-gallon fuel semitrailer (model 969 and M131A5C) using the onboard pump and filter/separator. The average flow rate at each of the eight nozzles using the fuel semitrailer is 35 GPM. The area to set up and operate the eight-point ROM kit is about 550 feet long by 150 feet wide. Multiple tankers can be connected to the ROM kit by means of a Y- or T-fitting and valves. One tanker will be dispensing fuels through the ROM to refuel vehicles. The remaining tanker is backup and ready to replace the issuing tanker when it is empty.

NOTE: If conducting multiple tanker operations, fuel should not be received into and dispensed out of the same tanker at the same time. This would only be possible through top loading, which is a safety hazard.

As a tanker is emptied, the fuel-dispensing source is transferred to the backup tanker by the resetting of the values at the Y and/or T. This will allow fuel issues to continue to the combat vehicles. Fuel semitrailers can be shuttled to and from the ROM site to maintain a fueling tanker on-site.

PART E - REFUELING OPERATIONS

Site Selection and Signaling. Plan a contingency plan for equipment failure. Make sure that there is enough room in the site to move equipment. Make the most of natural cover and concealment. Include a signal system to coordinate the operation. Use signals to start and stop refueling operations and coordinate the vehicle serials to and from the holding areas. Use the arm and hand signals or flags during the day. Long distances may require radio communications. At night or in low visibility conditions, use chemical light or flashlights for signals.

Refueling Operations. Set up these areas at locations before and after the ROM site. Coordinate areas before to the start of the operation. Use the first area (prior to the ROM site) to organize the march column into serials of vehicles equal to the number of refueling points available. Call the vehicles forward out of the holding area one serial at a time to move into position to receive the predetermined amount of fuel. When each serial has received its allotted fuel, it moves to the second holding area (after the ROM site). In the second holding area, organize the vehicles back into their convoy march elements or combat formations.

Set up, perform PMCS, operate, and retrieve the equipment used in the operation. Ensure safety (for example, grounding, bonding, fire extinguishers, no smoking signs, drip pans, spill equipment is in place and personnel are familiar with procedures). Ensure personnel are familiar and equipped with operational control signals (flags, lights, radio) to be used. Man fuel nozzles to refuel vehicles when convoy personnel (assistant driver or commander) are not available to refuel their own vehicles. Ensure vehicles safely enter and move through the ROM site and receive the prescribed amount of fuel.

Document the Quantity of Fuel Used. To document the quantity of fuel issued, use either DA Form 3643 (Daily issues of Petroleum Products) or DA Form 2765-1 (Request for Issue or Turn-In), depending on the situation.

LESSON 6

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. Typically, the amount of fuel issued to each vehicle in a ROM operation is based on
   A. The size of tank in the vehicle.
   B. The maximum rate of fuel acceptance of the vehicle being refueled.
   C. A predetermined time.
   D. The rate of flow of the pumping system used.

2. A ROM kit contains enough hose, valves, and fittings to refuel
   A. A complete battalion.
   B. Up to eight combat vehicles simultaneously.
   C. Any size of convoy as long as sufficient fuel is available.
   D. Up to four combat vehicles simultaneously.

3. The ROM kit can be transported on a vehicle with a payload capacity of
   A. .5 ton.
   B. 1 ton.
   C. 1.25 tons.
   D. 1.5 tons.

4. Approximately how much does the ROM weigh?
   A . 1,900 pounds.
   B. 2,000 pounds.
   C. 2,900 pounds.
   D. 3,400 pounds.

5. What is the average flow rate for each of the eight nozzles when dispensing fuel from the fuel semitrailer?
   A. 35 GPM.
   B. 40 GPM.
   C. 45 GPM.
   D. 50 GPM.

LESSON 7

DIRECT THE ASSEMBLY, OPERATION, PMCS, AND DISASSEMBLY OF THE HEAVY EXTENDED MOBILITY TACTICAL TRUCK (HEMTT) TANKER AVIATION REFUELING SYSTEM (HTARS)
Critical Task:
101-519-3317

OVERVIEW

Due to the extreme hazards associated with refueling aircraft in a theater of operations and the stringent quality requirements of aviation fuels it is imperative that all HTARS systems be properly maintained, assembled, and operated.

Lesson Description:

This lesson covers the procedures for directing the assembly, operation, PMCS, and disassembly of the HTARS system.

Terminal Learning Objective:

Action: The soldier will learn to select an HTARS site, supervise the assembly, operation, PMCS, and disassembly of the HTARS system, observe fire and safety precautions, and identify environmental considerations.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

The HTARS is a kit that consists of enough hoses, fittings, and nozzles to expand the HEMMT tankers capabilities to hot refuel up to four helicopters simultaneously using the on-board fuel-servicing pump. The equipment is lightweight, has manually operated controls, and is equipped with valve and swivel adapters that allow connections between camlock and unisex type fittings. This equipment can be used in forward areas. It can be transported in the storage box of the HEMTT tanker.

PART A - EQUIPMENT

Discharge Hoses. The system consists of 2- and 3-inch discharge hoses. One 3-inch by 50-foot hose is used to connect the HTARS to the HEMTT tanker. Ten 2-inch by 50-foot discharge hoses transfer the fuel from the HEMTT tanker to the aircraft. Six hoses are used in the manifold and one in each of the four issue lines. There are 11 carrying straps for easy handling of rolled hoses.

Valves and Fittings. The following valves and fittings are components of the HTARS:

- Three T-connectors with a flow control handle to open and close the valve. The T-connector splits the flow of fuel.
- Two elbow connectors to direct the flow of fuel.
- Three valved adapters to connect threaded and unisex parts as well as camlock and unisex parts.
- One swivel adapter to connect camlock and unisex parts.

Nozzles. The HTARS is equipped with four types of nozzles. There are four CCR nozzles with unisex adapters. Four overwing nozzles can be mated to the CCR nozzles to perform open-port refueling. The system has one recirculation nozzle that can be connected to the HEMTT tanker to recirculate fuel in the system. It is equipped with a fuel sample port to obtain a sample of fuel. The recirculation nozzle mates to the CCR nozzle. There are four D-1 nozzles to equip the system for center-point refueling.

Overpack and Other Required Items. Each system has one overpack spare with additional parts and accessories. The following parts are in the overpack spares: one T-connector, one 2-inch by 50-foot discharge hose, one carrying strap for easier handling of the rolled hoses, 10 dust seals, two dust caps, and four grounding rods.

Other items of equipment are required to conduct aircraft refueling operations with the HTARS. A minimum of five fire extinguishers is required, one to be within reach of the on-board pump and one at each refueling point. Signs will need to be posted at the refueling site. Also, water cans and spill containers will need to be available.

Figure 7-1. Major components.

PART B - EQUIPMENT LAYOUT

Lay out the HTARS (Figure 7-2) in a manner most practical for the situation. Avoid obstacles and take advantage of terrain features. When laying out the equipment, never remove a dust cap until you are ready to make a connection. This will prevent dust or particulate matter from entering the system and causing fuel contamination. Likewise, when disassembling cap equipment immediately after uncoupling. When laying out the HTARS follow the procedures below.

Position Vehicle. Select the most level ground to position the M978 HEMTT tanker. Avoid areas near bodies of water to avoid contamination and use the highest ground possible to prevent vapor accumulation. When positioning the vehicle remember the system should be laid out so that helicopters can land and refuel into a headwind or crosswind. Make the most use of natural concealment. Position the vehicle to allow easy exit without blocking any exits. After positioning vehicle, drive a ground rod at least 3 feet into the ground, attach the vehicle ground cable to the ground rod, and position fire extinguishers within easy reach, and post the "NO SMOKING" signs.

Connect System Components. Connect the 3-inch by 50-foot discharge hose to the suction hose on the HEMTT tanker (the tanker suction hose is connected to the bulk receptacle filtered on the HEMTT tanker). Connect the T-to the 30-inch discharge hose. Roll a 2-inch by 50-foot discharge hose from both sides of the T-and connect both discharge hoses to the T. Connect another T to the end of each 2-inch discharge hose. Roll out and connect two 2-inch by 50-foot discharge hoses to each outer tree. At the end of both outer 2-inch discharge hoses, connect an elbow fitting. Unroll and connect a 2-inch by 50-foot discharge hose to each of the two Ts and elbow fittings. Put FLOW handles in flow position after connections are made.
NOTE: The unisex fittings will not connect if the FLOW handles are in the flow position.

Connect Nozzles. Connect the type of nozzle to be used for the operation to the 2-inch discharge hose at each point. The CCR and D-1 nozzle connect to the 2-inch discharge hose. The overwing (open-port) and recirculation nozzle mate to the outlet of the CCR nozzle. Refer to TM 5-4930-235-13&P (Operators, Unit, and Intermediate Direct Support Maintenance Manual and repair Parts and Special Tools List for Closed Circuit Refueling Nozzle Assembly, Model Number 125-10,000 and Model Number 125-0505) for information on nozzles.

Ground Equipment. Drive a grounding rod into the ground 10 feet back from the end of each dispensing hose. Loop the dispensing hose at each point back to the ground rod and hang the nozzle on the ground rod hanger. Connect the clip of the nozzle grounding wire to the ground rod at each point. At each point, place a CO_2 or dry chemical fire extinguisher. Also, place a spill container and a filled 5-gallon water can at each point.

Camouflage Equipment. Camouflage the truck and system to the extent required by the tactical situation. Natural concealment such as woodlines, hedgerows, vegetation, and natural terrain contours should be used when possible. Straight lines of the hoseline can be broken up by breaking branches and placing them under the hoseline to hold the branches in place

Figure 7-2. HTARS setup.

PART C - OPERATION

Preparation for Operation. Ensure all safety and environmental precautions have been taken. Verify that all safety and fire-fighting equipment is in place and serviceable. Check landing lights if they are required. Perform daily and before operations PMCS on the HEMTT tanker IAW TM 9-2320-279-10-1 (Operator's Manual, Volume No. 11 for M977 Series 8x8 Heavy Expanded, Mobility Tactical Trucks (HEMTT)) and on the HTARS TM 5-4930-237-10. Inspect the discharge hoses, valves and fittings, nozzles, and grounding systems. Ensure that all refueling personnel are wearing the proper protective clothing. As soon as the system is full of fuel and ready to operate each day, draw a sample from each nozzle. If the fuel does not pass tests and inspections. Do not use it. Isolate, resample, and send the fuel sample to the supporting laboratory, and await the laboratory's instructions on disposition.

Sequence of Operations. The HTARS has two primary modes of operation, refuel and recirculation. In the refueling mode, fuel is pumped from the HEMTT tanker through the system hoses to the refueling points (nozzles). In the recirculation mode, the refueling nozzle (CCR or D-1) is disconnected from the refueling point and the recirculation nozzle is connected. The recirculation nozzle is connected to the HEMTT tanker and fuel circulates through the system hoses and back to the tanker. The HTARS can operate in both modes at the same time.

Refueling mode. To operate the HTARS in the refueling mode, follow these procedures:

- Start and operate the HEMTT tanker IAW TM 9-2320-279-10-1.
- Ensure the soldier manning the nozzle guides the aircraft into position using signals. Check with the pilot to be sure that all armaments are on SAFE.
- Deplane the crew and passengers. Passengers must go to the designated passenger marshaling area. Members of the crew, except the pilot or copilot who may remain at the controls if necessary, should deplane and assist with the refueling, and place it within reach of the aircraft fill port.
- Ensure the pilot notifies his commander that he will be off the air during refueling. He may monitor his radios during refueling but he should never transmit. The crew chief and pilot may talk by intercom during refueling.

NOTE: Ground the aircraft. Grounding of aircraft during refueling is no longer required by NFPA standards 77 and 407. Grounding will not prevent sparking at the fuel surface.

- Bond the nozzle to the aircraft in one of two ways. Either by inserting the bonding plug into the plug receiver or attaching the clip of the nozzle bonding cable to a bare metal part of the aircraft other than the antenna.

- After the nozzle is bonded to the aircraft, remove the dust cap from the nozzle and open the aircraft's fill port.
- Verify that all valves between the HEMTT tanker and the fuel nozzle are open.
- Do not leave the nozzle at any time during refueling. Stop the flow of fuel if there is any emergency at the refueling point. Three types of nozzles can be used for aircraft refueling. Use of the center point (D- 1), CCR, and overwing (open-port) nozzle are described below.
  - Center point refueling nozzle operation. Remove the dust cover from the end of the nozzle body. Grasp the handles and hold the nozzle in alignment with the aircraft refueling adapter. Press the nozzle body against the adapter and turn handles to the right until the end of the nozzle mates and locks to the aircraft refueling adapter. Rotate the control handle to the full OPEN position. The pilot will signal when the tank is full. To disconnect, rotate the control lever to the fill CLOSED position. Grasp the handles and rotate the nozzle body to the left until it disconnects from the aircraft adapter.
  - CCR nozzle. Mate the CCR nozzle to the fill port. Pull back on the control handle latch, and then push the control handle up toward the aircraft into the FLOW position. If the aircraft is to be filled completely, watch the back of the nozzle. A red indicator will pop out of the back of the nozzle when the aircraft tank is full. Pull back on the flow control handle to move it into the NO FLOW position. Unlatch the nozzle.
  - Overwing (open-port) nozzle. Rapid refueling (hot) using the open-port nozzle is restricted to combat or vital training (Chapter 14, FM 10-67-1). The decision to use the open-port nozzle must be made by the commander. The open-port nozzle is mated to the CCR nozzle. The end of the nozzle is placed in the aircraft fuel tank adapter. Set the CCR nozzle to FLOW. Squeeze the control handle to dispense fuel. Watch the fill port when filling the tank. As the tank nears full, ease up on the trigger and finish filling more slowly. When the tank is full, release the trigger. Move the flow control handle on the CCR nozzle to the NO FLOW position. Be sure that flow has stopped completely before removing the nozzle from the fill port.
- Replace the cover of the aircraft fill port and put the dust cap back on the nozzle.
- Unplug the nozzle bonding plug or release the bonding clip. Carry the nozzle back to the hanger. Do not lay it or drag it across the ground.
- Release the grounding cable clip from the aircraft.
- Take the fire extinguisher back to a position near the nozzle hanger.
- Have the aircrew and passengers reboard the aircraft.
- Turn off the pump on the HEMTT tanker if no other aircraft is being refueled.
- After receiving clearance, the aircraft lifts off.

Recirculation mode. One recirculation nozzle is supplied with the HTARS. To recirculate the entire system, the recirculation procedure must be performed for each refueling point. To perform recirculation, follow the procedures listed below:

- Connect the recirculation nozzle to the refueling point (CCR nozzle).
- Reposition hoses as required to reach the HEMTT tanker.
- Connect the recirculation nozzle to the HEMTT tanker bottom loading receptacle A. Press the nozzle body against the A receptacle and turn the handles to the right until the nozzle body locks firmly to the receptacle.
- Start and operate the HEMTT tanker IAW TM 9-2320-279-10.
- Set the CCR nozzle to OPEN. Rotate the recirculation nozzle control lever to the full OPEN position.
- If needed, fuel samples may be taken during the recirculation mode. The recirculation nozzle is equipped with a hand-operated ball valve to allow sampling of the fuel entering the tanker. To take the fuel sample, place the end of the tube in the sample container. Slowly move the control handle on the ball valve to the open position. When sampling is complete, set the control handle on the ball valve to the closed position.
- When recirculation is complete, set the recirculation nozzle control handle to the closed position. Set the CCR nozzle to the NO FLOW position.
- Shut down the HEMTT tanker IAW TM 9-2320-279-10-1.
- Disconnect the recirculation nozzle from the HEMTT tanker.

LESSON 7

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. Which nozzle in the HTARS equips the system for center-point refueling?
   A. CCR nozzle.
   B. Overwing nozzle.
   C. Recirculation nozzle.
   D. D-1 nozzle.

2. How many modes of operation can the HTARS operate at the same time?
   A. 2.
   B. 1.
   C. 4.
   D. 3.

3. Which nozzles can be used for refueling?
   A. Recirculation, open-port, CCR.
   B. Center point, recirculation, CCR.
   C. CCR, Overwing, center point.
   D. Overwing, center point, recirculation.

4. A grounding rod is driven into the ground how many feet back from the end of each dispensing hose?
   A. 5 feet.
   B. 10 feet.
   C. 15 feet.
   D. 20 feet.

5. Up to how many helicopters can be hot refueled simultaneously with the HTARS kit?
   A. 2.
   B. 4.
   C. 6.
   D. 3.

LESSON 8

DIRECT THE LOADING AND UNLOADING OF WATERBORNE BARGES AND TANKERS
Critical Task:
101-519-3166

OVERVIEW

The handling of petroleum products around waterfront terminals must be carefully controlled in order to accurately account for the quantities delivered and issued, verify the quality of the products in transition, and to prevent spills.

Lesson Description:

This lesson covers the procedures for directing the loading and unloading operations of waterborne barges and tankers.

Terminal Learning Objective:

Action: The soldier will learn to supervise the loading and unloading of waterborne barges and tankers, verify appropriate entries on DD Form 250-1 (Tanker/Barge Material Inspection and Receiving Report), observe fire and safety precautions, and identify environmental considerations.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

More than half the tonnage handled in the military is petroleum. To do your job as a supervisor, you must know the responsibilities and procedures for loading and unloading petroleum tankers and barges.

PART A - TANKERS

The Military Sealift Command (MSC) controlled tanker fleet provides worldwide transportation for the delivery of petroleum products from refineries to Department of Defense (DOD) storage facilities. The tanker fleet consists of approximately 30 tankers, which vary in size from 27,000 to 38,000 tons. The various types of lease contracts are as follows:

- **Bareboat Charter** - The tanker is leased to MSC and MSC personnel crew the ship and are responsible for all expenses.
- **Time Charter** - From a few weeks to a number of years the owner provides the crew and pays all expenses.
- **Single Voyage Charter** - The ship is leased for a single voyage and the owner is responsible for the crew and all expenses.
- **Dirty Service** - For heating oils and crude service.
- **Clean Service** - For finished products only. Ships cannot carry split cargoes without prior approval from the Defense Energy Supply Center (DESC).

When referring to various locations on a ship, or when describing certain conditions of the ship, the following terms are used:

- **Bow** - Front end vessel
- **Stern** - Rear end of the vessel, also called the “aft section”
- **Midships** - Center of the vessel
- **Port** - The left side of the ship when standing midships and facing the bow.
- **Starboard** - The right side of the ship when standing midships and facing the bow.
- **Bunkering** - The fuel that is used to power the ship.
- **Gross Tonnage** - The total internal cubic capacity of a vessel less exempted spaces, such as tanks for ballast water. This weight is expressed in units of 100 cubic feet per ton.
- **Net Tonnage** - The registered tonnage of a ship after deductions have been made from the gross tonnage. Examples of deductions are crew and navigation spaces.
- **Light Displacement** - The weight of the vessel. This does not include the weight of cargo, passengers, fuel, water, stores, and other items that are needed on a voyage.
- **Loaded Displacement** - The total weight of the vessel. This includes the weight of cargo, passengers, fuel, water, stores, and other items that are needed on a voyage.
- **Deadweight Tonnage** - The carrying capacity of a vessel in long tons (2,240 pounds). It is the difference between light and loaded displacement.

PART B - BARGES, PUMP, TANKS, AND MANIFOLDS

Barges.

- Self propelled. These barges move under their own power and are used in inland and coastal waterways. They must maintain a crew at all times.
- Non-self propelled. They must be moved by tugboats, and can be used for temporary storage. They are equipped with their own pumping systems.

Pumps. Most tankers have two pumping systems.

- Centrifugal pumps for off loading the cargo.
- Gear or piston pumps for stripping the cargo tanks dry.

Ship’s Tanks and Manifolds. Most tankers have the capability to carry up to five different products. Ships' tanks are arranged abreast and numbered from bow to stern.

PART C - WATERFRONT FACILITIES

- Multileg mooring systems.
- Single point mooring systems (mono buoy).
- Jetties: Jetties are used when the water depth or the shore line is unsuitable for bringing in tankers.
- Docks and piers: Docks or piers are the most secure for unloading tankers. Security is easier to maintain. Access to the tanker is easier in case of emergency and for maintenance. They are protected from winds and tide and should be separated from other classes of supply. The depth should be at least ten feet of water under the biggest tanker you expect to receive fully loaded at mean low tide (Figure 8-1).

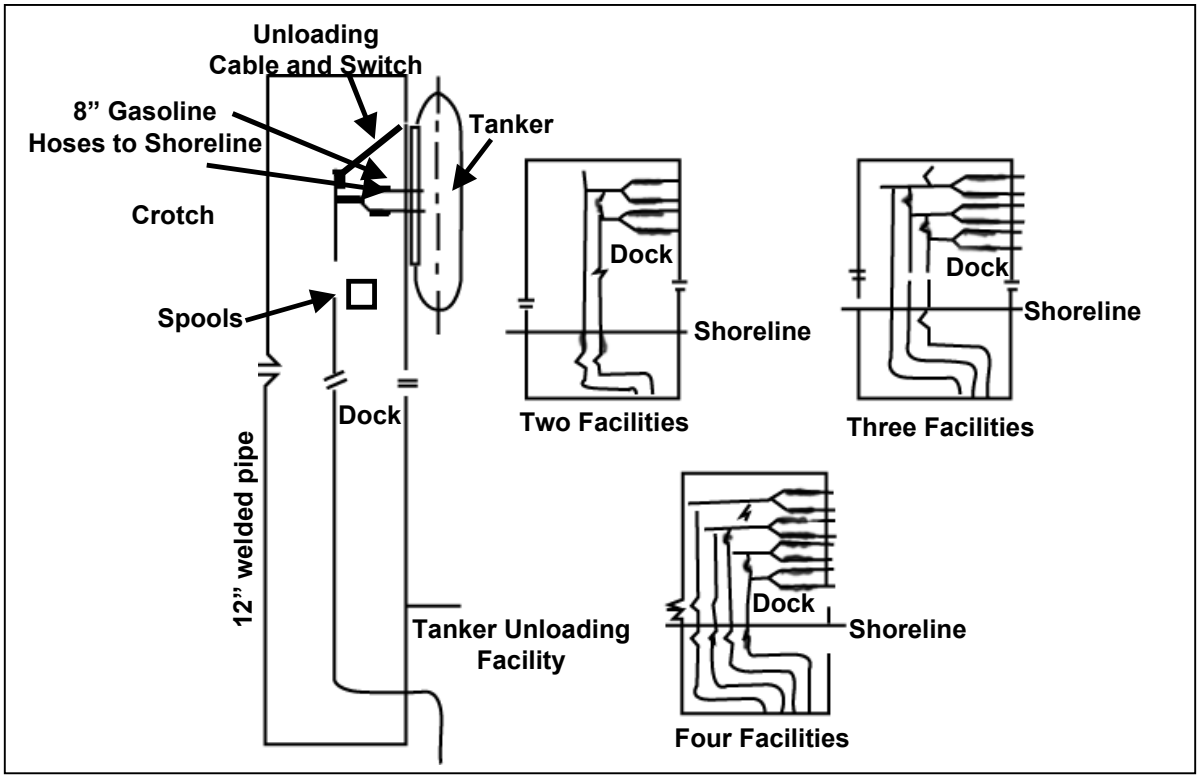

Figure 8-1. Layout of marine dock facilities for tanker unloading.

PART D - EQUIPMENT REQUIREMENTS

- Storage tanks. Minimum of two tanks for each product and ballast water.
- Oily water separator for treatment of ballast water.
- Fire fighting equipment. Portable fire extinguishers and an engineer fire fighting detachment.
- Pollution control equipment. Skimmer boats, sorbent materials, and containment booms.
- Communications. Communications have to be from the dock to the ship and to the tank farm.
- Transportation. Ground transportation and workboats for transporting men and equipment to the tanker.
- Grounding system. For bonding the ship to the dock. If the dock has a cathodic protection system it should be turned off before the transfer of fuel begins.
- Base laboratory. A lab should be available for testing the products.

PART E - PREPARATION FOR ARRIVAL

The tanker arrival schedule is checked to ensure the type and quantity of product is known. Personnel are required to meet the tanker and go aboard in the harbor. A terminal representative, lab technician, and customs official may also be required. Make sure the berthing facilities are cleared for the tanker to tie up. The cargo loading arms will be checked and maintenance performed. If cargo hoses are to be used, they will

be pressure tested and the flanges checked. Shore tanks are gaged and sampled and product is transferred to create ullage if required. All pipelines and manifolds are checked and packed with product to the dock. Maintenance is performed on all pumps and all gages are checked. All communications are checked from the dock to the vessel and to the tank farm. Booms and skimmer boats are made ready to be deployed. Portable fire extinguishers are placed at all critical locations.

The terminal commander is responsible for all operations starting at the ship's manifold:

- Pipeline patrol.
- Hose watch.
- Shift changes.

The master of the vessel is responsible for all shipboard actions. Paper work includes the tanker activity report and DD Form 250-1 (Tanker/Barge Material Inspection and Receiving Report). The tanker activity report is used as a worksheet to fill in DD Form 250-1. Information concerning the completion of DD Form 250-1 can be found in AR 710-2-1.

PART F - UNLOADING PROCEDURES

As the supervisor, you are to ensure that all environmental and safety procedures are observed and that any infractions are immediately corrected. All spills will be cleaned up and reported IAW applicable regulations and procedures.

- Valve seals. Prior to unloading, the valves aboard the vessel are checked to ensure they have been sealed and the seal numbers have been recorded on DD Form 250-1.
- Pumping. For JP-4, pumping will commence at a reduced flow rate not to exceed three feet per second until the fill line in the tank is covered with fuel.
- Delays. Any delays will be recorded in the time section of DD Form 250-1. This may determine who pays demurrage.
- Stripping. Once the centrifugal pumps lose suction the stripper pumps are brought on line and the tanks are pumped dry.
- Completion of off loading. When the ships' tanks are empty, they are inspected by terminal personnel and a dry tank certificate is issued. If product is found in a tank and cannot be removed the fact is recorded in the remarks section of the DD Form 250-1.
- Gaging of shore tanks. After the proper settling time, the shore tanks are gaged and the amount is recorded on the DD Form 250-1. If the amount received is less than that recorded on the DD Form 250-1 as loaded, and the shortage is more than one half of one percent it will require an investigation by the applicable DFSC fuel region upon receipt of the DD Form 250-1. For this reason the inventories and submission of the paper work must be done as soon as possible.
- Departure. After the tanker has departed, the pier is cleaned up and made ready for the next operation.

PART G - LOADING PROCEDURES

- As soon as the vessel is docked, the terminal commander or his representative should check the cargo to determine which product will be loaded first. This action will be mutually agreed upon.
- Ballast. The shore ballast tanks should be checked to ensure that enough ullage is available to accept ballast from the tanker.
- Checking ship's tanks. The ship's tanks should be checked to ensure they are clean and free of ballast and suitable for receiving product.
- Pumping. Follow the same procedures as for unloading.
- When tanks are 90 percent full, reduce the pumping rate to avoid spills or overflow.
- Follow up procedures. Allow enough time for tanks to settle before gaging each tank. Calculate the quantity loaded.
- Obtain an all-levels sample from each compartment and run a type c test according to MIL HDBK 200.
- Gage shore tanks and compare quantities pumped with quantities received.
- After the product quality and quantity have been determined, check and seal all hatches, seal valves and crossovers, and record all seal numbers on the DD Form 250-1.

LESSON 8

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. A Military Sea Lift Command “dirty service” contract refers to a
   A. Contract to clean a tanker's cargo tanks.
   B. Contract for the transportation of contaminated petroleum products.
   C. Contract for the transportation of heating and crude oils.
   D. Contract for the transportation of petroleum products on vessels prior to an overhaul.

2. Which waterfront facility is the most secure for loading and unloading tankers?
   A. Multileg-mooring system.
   B. Single-point mooring system.
   C. Jetty.
   D. Dock.

3. Why must any delay in loading or unloading be logged on DD Form 250-1?
   A. To help determine who pays demurrage.
   B. To asses the effectiveness of the work crew.
   C. To account for time in excess of that allotted by the terminal commander.
   D. To help determine a more accurate time for loading and unloading for future missions.

4. What is the shortage amount that would require an investigation by the applicable DFSC fuel region?
   A. 1/4 of 1 percent.
   B. 1/2 of 1 percent.
   C. 3/4 of 1 percent.
   D. 1 percent.

5. As soon as the vessel is docked, what is the first step taken by the commander or his representative?
   A. Check the cargo.
   B. Check the shore ballast tanks.
   C. Obtain an all-levels sample from each compartment.
   D. Gage shore tanks.

LESSON 9

DIRECT RAIL CAR OPERATIONS
Critical Task:
101-519-3314

OVERVIEW

Following the proper procedures for loading and unloading petroleum products from rail tank cars will enable you to accurately account for the quantities delivered and issued, verify the quality of the products in transition, and prevent spills.

Lesson Description:

This lesson covers the procedures for loading and unloading rail tank cars, their maintenance, and gaging.

Terminal Learning Objective:

Action: The soldier will learn to supervise the operator maintenance and operation of assigned vehicles and equipment. Inspect rail cars for suitability of use; proper documentation, and security seals; loading and unloading of rail cars; and gaging of rail cars.

Condition: Given subcourse QM 5094.

Standards: The soldier must score a minimum of 70 percent on the end of subcourse examination.

INTRODUCTION

Most countries in the world have established railway networks as a major means of transportation. Petroleum rail tank cars can provide an effective way to transport large quantities of bulk fuel efficiently. As a petroleum specialist, you are subject to worldwide assignment and may encounter rail tank cars at every duty station. It is essential that you be proficient in all aspects of rail tank car operations.

PART A - INSPECTION OF RAIL CARS

Cars are inspected for suitability of use, proper documentation, and security seals. Generally, a petroleum rail car has only one compartment; however, some have more than one compartment and can carry multi-products. Cars are manufactured from different gages of steel depending on usage and may be equipped with heaters to liquefy highly viscous product. Typically each compartment has a bottom outlet. In the U.S. 5-inch outlets are standard; overseas 4-inch outlets are standard. Each compartment has a dome through which the rail car may be loaded, unloaded, inspected, cleaned, and repaired. The dome provides room for expansion of product in the event of temperature rise and may be hinged and bolted or screwed on. The tank car is also equipped with a safety valve. The safety valve used on most tank cars consists of a poppet valve, that is spring-loaded to predetermined pressure. As pressure develops in the dome and increases to a point in excess of the pressure setting of the valve. The valve is forced off the valve seat, thereby permitting excess vapor to escape. When the pressure drops to a level equal to the valve setting, the spring closes the valve automatically.

PART B - LOADING AND UNLOADING OF RAIL TANK CARS

The minimum distance from a tank car loading operation to a building should be 100 feet. A spur track or bypass should be provided for loading or unloading tank cars. Trackage should be level to maintain equal depth of product throughout the tank car compartments. Level trackage is necessary for accurate gaging of the tank and to prevent air from being trapped at one end of a tank when the tank is closed. The site should provide adequate drainage. Bond and ground the car with a minimum of four cables. Derails should be installed at the head of the siding to prevent other cars from backing into the siding during transfer operations. A metal derail is approximately 18-inches long; the forward or flat portion is about 6-inches long and the rear or wedge shaped portion, is about 12-inches long. It is attached to the top of one rail of the track. The 6-inch portion lays flat on the track and the wedge shaped portion gradually elevates to a height of about 1-foot 1/4-inch to either stop or derail the first car of a train backing into the siding. Some derails designed in a similar manner, are made of wood. Derails may also be installed at other locations to prevent cars from rolling into danger areas if the brakes are released accidentally or fail to hold. Where derails are provided, they must be set and locked or operated so that they furnish the protection intended.

PART C - LOADING/UNLOADING FACILITIES AND EQUIPMENT

Where more than one filling point is used, loading racks should be spaced to allow several cars to be loaded at one time. Each filling point should be grounded and should be equipped with bonding cables for bonding the filling point to the tank car shell and to the track. A flexible hose long enough to reach the bottom of the tank should be connected to the outlet of the loading arm. An emergency valve should be located some distance from the rack so that the line can be cut off in case of fire at the loading rack. Loading racks may be supplied with product directly from bulk storage tanks or pipelines by gravity flow or fixed or portable pumping units may be used to transfer product. A distribution manifold consisting of necessary piping and valves, extends along the loading rack and provides outlets for loading and unloading several cars at one time. Flexible hose lengths should be provided to permit loading cars through the domes. Manifolds must be grounded and equipped with cable for bonding the manifold to the track and to the tank car. A standard car mover should be provided for spotting tank cars. Electrical equipment operating in the area such as lights, switches, and motors, must be of explosion proof construction and must be in good working condition. A wooden cone-shaped plug, suitable for plugging the bottom outlet of the tank car, should be available in case of emergency. The pump assembly must be positioned a minimum of 50 feet away from rail car.

PART D - PRECAUTIONARY AND SAFETY MEASURES

Place signs prohibiting smoking conspicuously about the area. Do not allow welding, matches, lighters, open flames of any kind, or lights, other than approved explosion proof flashlights or lanterns, within 100 feet of the transfer operation. Coal burning locomotives operating near the transfer area should be equipped with smokestacks and fire box screens. All loading and unloading equipment must be grounded and bonded. Position one CO^2 or foam fire extinguisher on the ground, the other on the loading rack.

PART E - PROCEDURES FOR LOADING TANK CARS

Preparation for Loading.

Sampling and Gaging Product to be Transferred. Take a sample of product that is to be transferred to the tank car and inspect visually to make sure that product has no unusual appearance. If the identity or quality of product is questionable, have the test performed to make sure that product meets specifications before starting the transfer operation. Gage the contents of supply tank and record data. Obtain a water cut from the supply tank measuring with water indicating paste. If the water layer in the tank approaches the level of the tank outlet, drain water before transferring product. Inspect pumps, hose, loading racks, pipelines, and manifolds to see that they are clean, free of any contaminating product, and in good operating condition.
Equipment preparation. When possible, use equipment exclusively for handling one product. If it is necessary to use the same equipment for handling several products, drain the equipment thoroughly of preceding product before introducing the new product into the line. See that track rails are properly bonded and grounded. Inspect cable connections to make sure that they are secure and make bare metal-to-metal contact. Position car so that there will be no unnecessary strain on hose connections. If the loading rack is to be used, position the car so that dome is opposite the filling point. Set brakes and block wheels of the tank car to prevent movement and to ensure safety of connections during loading operations. Set and lock derails, if provided. Place warning signs and fire extinguishers as required. Attach a ground wire to the shell of the tank car and to the stake and saturate the ground around the stake with water to make sure that grounding is effective. If a loading rack or tank car manifold is to be used, bond it to the tank car shell and to the loading rack.

Tank preparation. Remove the dome cover and determine whether the tank car is suitable for receiving product. Make sure that the product last carried by the tank is the same as the product that is to be transferred to the tank. If the product differs the tank must be cleaned before it is released for filling. Inspect the interior of tank for cleanliness; if there is residue on the bottom of the tank, the tank must be rejected and cleaned before it can be filled. Look for any foreign objects, such as tools, bolts, or old tank car seals that may have fallen into the tank. Objects should be removed by authorized persons. Although some objects do not contaminate the product, they may damage valves. Inspect the interior and exterior of tank to make sure that there are no holes, cracks, or loose plates. Be sure that there are no leaks in loose the plates. Be sure that there are no leaks in the tank. See that the tank is properly mounted to under frame and that the tank is safe and road worthy. Inspect the dome, dome cover, and safety valve to see that they are operable and in good condition. Make sure that the vent holes in the dome cover are open and free of dirt. See that outlet chamber has not been damaged.
Tank valve inspection. Make sure that the outlet valve closes and seals properly. Place a suitable container underneath the bottom outlet chamber to catch drainage and open and close the outlet valve several times by operating the valve rod handle or hand wheel located inside dome. If valve does not close properly, the valve gasket should be replaced or the valve repaired. In an emergency, a tank car may be loaded without repairing the outlet valve; however, this condition must be reported so that persons receiving the tank will unload through the dome. In this case the car should be scheduled for repair as soon as possible. When the outlet valve is operating properly, close the valve. The drainage tub should remain underneath the outlet until the transfer operation is completed. When considered necessary, tank cars may be flushed with a small amount of the product to be loaded to remove the last traces of previous product, as well as rust and scale, from the outlet sump of the tank car. Before removing the bottom outlet cap make sure that the outlet valve is properly closed. With a tank car wrench, remove the bottom outlet cap. Allow any product trapped in outlet chamber to drain into the drainage tub. If there is any residual product in the tank, open the outlet valve and allow the product to drain into the tub. Close the outlet valve, but do not replace the outlet cap until the car is completely loaded. Dispose of any product collected in the drainage tub, and place tub in position to catch leakage.

Loading Product. Tank cars should be loaded through the bottom outlet (Figure 9-1) whenever possible to prevent vapor loss, reduce the generation of static electricity, and protect the fuel against contamination from outside sources. To bottom load a tank car proceed as follows. Locate and ground a pumping assembly at least 50 feet away from the tank car. Make sure that the supply container is properly grounded and vented. Connect the hose lines and take care to prevent hose connections from lying on the ground or from becoming otherwise contaminated. Station a man on the windward side of the dome to signal when the full mark is reached. Before starting the pump, open the appropriate valves to avoid pumping against a closed system. Start the pump and observe safety precautions. When the transfer operation is halted for any reason, disconnect the pump discharge hose. When the level of product in the tank car is near the full mark of the bench mark, signal the pump operator to reduce the pump speed and be alert to stop the pump. When using a loading rack or other system that provides a control valve, reduce the flow of product into the tank by partially closing the valve. If the tank does not have a full mark, load the tank until the product reaches the top of the shell. When the product reaches the full mark or top of shell shut down the pump, close all valves, and disconnect the pump discharge hose.

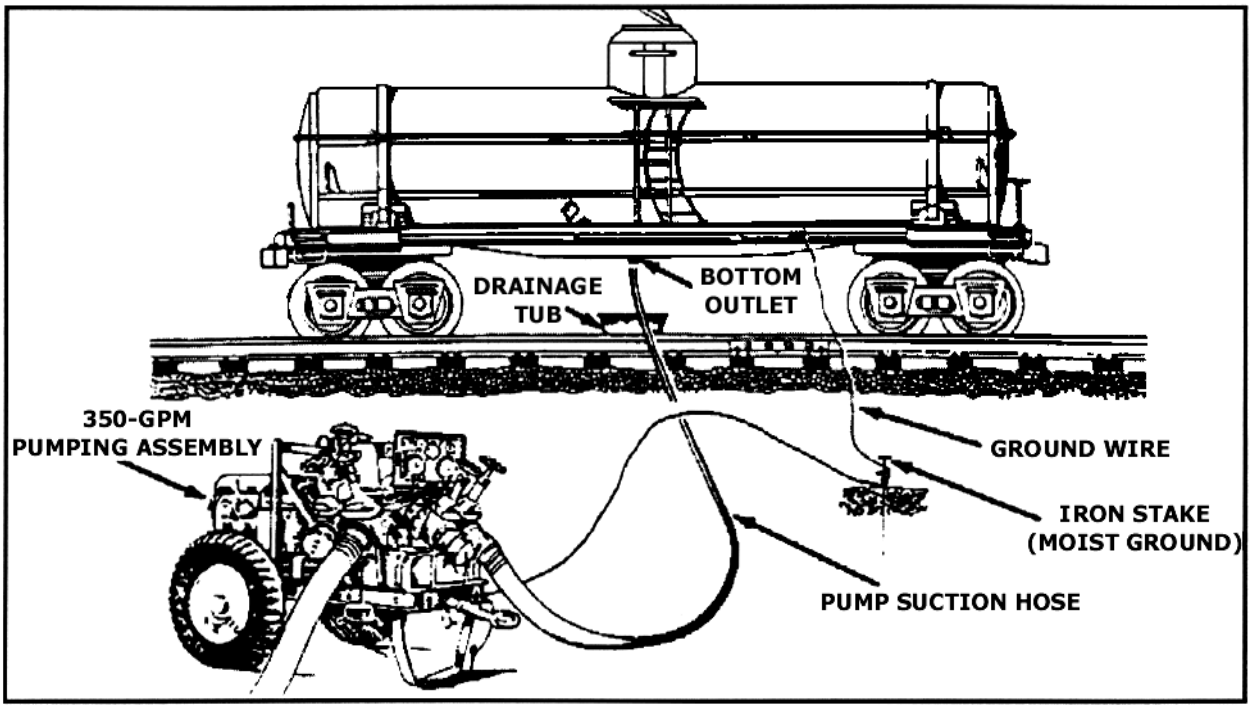

Figure 9-1. Loading from the bottom.

Top Loading. Top loading is done only in emergency situations when bottom loading is not possible and is accomplished by inserting the end of the loading hose or drop tube through the dome of the tank until it almost touches the bottom of the tank (Figure 9-2). If the hose or drop tube does not extend far enough into the tank, the product splashes, causes undue loss of product through vaporization, and creates a potential fire hazard. Make sure that there is no unnecessary strain on the hose, which could cause the hose to move or come out of the tank during the transfer. Before starting the pump, open the appropriate valves to avoid pumping against a closed system. When all connections are secure and the necessary valves are open, start the pump. When product starts to flow into the tank, observe the bottom outlet to see if there is any leakage. If leakage is apparent, stop the pump and attempt to seat the bottom outlet valve by turning the valve rod handle in a clockwise direction. If the leak cannot be stopped, discontinue loading operations, recover product from the tank, and clear the area of spilled product. Follow safety precautions as given for bottom loading above.

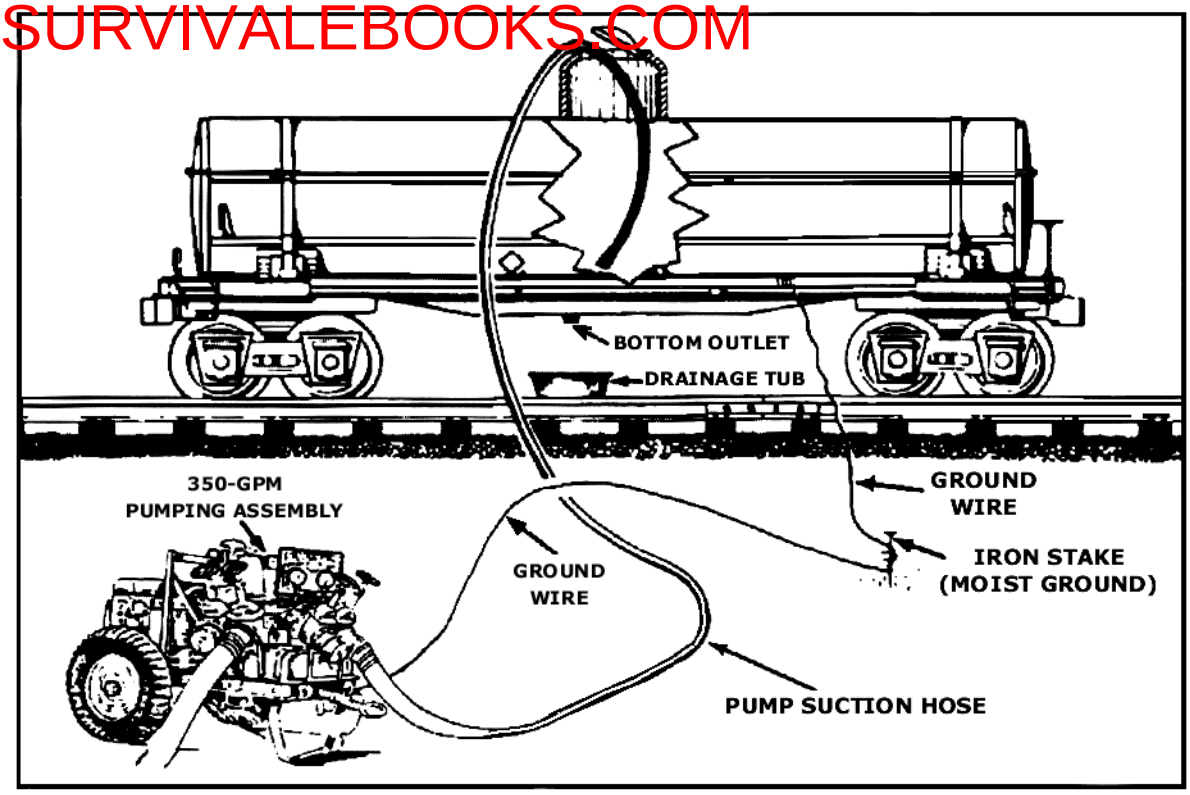

Figure 9-2. Loading from the dome.

Follow-Up Procedures. After loading the car follow-up procedures are performed. Allow product to stand for 15 minutes so that suspended water or sediment can settle. Gage and sample contents of tank. Take the temperature of product, correct volume to 60 degrees F, and record data. Retain sample for reference until car has been delivered. If tank contains any water or sediment, drain it from the tank, and again load product until the tank is full. After daily closing gages are taken, compare total storage tank issue with total quantities loaded on tank cars. Report excessive loss to the proper authority. When a tank car is full of product, replace bottom outlet, cap, and close and lock the dome cover. Place an identification seal on the dome cover; it must be an approved seal, one which cannot be removed without being destroyed. The receiver is assured that the car has not been tampered with if the seal is in place. Record the seal marking on all shipping papers. Remove the drainage tub from under the bottom outlet and discard any product that is in the tub. If the car has DANGEROUS-EMPTY placards, remove them and replace them with FLAMMABLE placards. Some placards bear the two signs; they only need to be reversed. Disconnect grounding wire from tank car; remove derails, if provided; and remove TANK CAR CONNECTED signs. Release brakes and remove car from transfer area.

PART F - PROCEDURES FOR UNLOADING TANK CARS

Equipment Preparation. Inspect the unloading equipment such as pumps, hose, loading racks, pipelines, and manifolds to see that they are clean, free of any contaminating product, and in good operating condition. When possible, use equipment exclusively for handling one product. If it is necessary to use the same equipment for handling several products, drain the equipment thoroughly of preceding product before introducing the new product into the line. If product in the tank car is to be transferred to cans, drums, tank trucks, or semitrailers inspect the containers or vehicle and make sure that they are clean and in good condition. If the product in the tank car is to be transferred to storage tanks, make sure that the tanks are clean and suitable for receiving the assigned product. If the tanks are not clean, they must be freed of vapors and cleaned before receiving product.

Sampling and Gaging Receiving Tank. When a receiving tank already contains product, gage and sample the contents of tank. Take the temperature of the product, correct volume to 60 degrees Fahrenheit, and record data. Make sure that there is enough space (outage) in tank to receive product. Inspect the sample visually to make sure the product in the receiving tank is the same as product in the tank car. If there is any doubt as to the identity or quality of the product, have the test performed to verify correct grade and quality

before mixing new product with it. Drain water from the tank before starting transfer. Gage tank again and record the data. Make sure that the receiving container and tank car are properly grounded and vented.
Tank Car Inspection. Compare car number and seal number with numbers on shipping papers to see that the car to be unloaded is at the right destination. Examine the seals and locks carefully for evidence of tampering. If cars arrive with broken seals or locks, notify the proper authority. If it is absolutely necessary that the car be released because of a shortage of tank cars, transfer the contents into a separate container, but do not use the product for any purpose until tested samples have been approved. Shortage of product should be made a matter of record. Pry seals loose and remove the dome cover. In hot weather extremely high pressures may develop in tank cars if the safety valve is not functioning. When time permits, relieve pressure by permitting the car to cool overnight. If pressure is released by venting, large quantities of product are lost through vaporization creating potential fire hazard. Inspect the tank car for leaks through the shell and bottom outlet. If the car shows evidence of leaking, schedule the car for immediate unloading. Place containers in position to catch leaking product.
Sampling and Gaging Tank Car. Gage and sample the contents of the tank car, and examine the sample for appearance and color. Take temperature of the product, correct the volume to 60 degrees Fahrenheit, and record the data. Remove any water present in the tank by draining water slowly through the bottom outlet. If water is removed, gage the contents again, correct volume to 60 degrees Fahrenheit, and record data. Examine a sample of the product visually to make sure that the product is of proper grade. Fuel having a cloudy or decidedly “off color” appearance should be suspected of having some contamination. Any questionable product should be thoroughly tested to make sure that it meets specifications before it is unloaded.
Tank Car Valve Inspection. If the car is to be unloaded through the bottom outlet; make sure that the outlet chamber is in good condition and that the outlet valve is operating properly. The valve may become inoperable in cold weather because water in the tank is likely to settle and freeze around the outlet valve. To free frozen valves, apply steam jet, hot water, or hot cloths to the outlet chamber. When authorized a hot air duct tent heater, or a slave kit may be used by trained personnel to thaw the outlet. If time permits, allow the valve to thaw during the warm part of the day.

Unloading Tank Car.

- To unload a tank car through the bottom outlet, locate the pump at least 50 feet from tank car and ground the pump.
- Make sure that the outlet valve is seated properly.
- Place a suitable drainage tub under the bottom outlet.
- The tub should remain under the outlet until the transfer operation is completed.
- Loosen the bottom outlet cap one or two turns to permit product trapped in the outlet chamber to drain out around the threads into the tub. (If flow from the outlet does not slow down after approximately 15 minutes, attempt to seat the valve properly.
- If the valve cannot be seated, unload the tank car through the dome. Connect the pump suction line to the tank car outlet.
- Connect the pump discharge line to the inlet of the receiving container.
- Dispose of drainage collected in the drainage tub and again place the tub in position to catch any further leakage.
- Place the dome cover over the manhole in such a way that air can enter the tank as product is unloaded.
- Place a block of wood under the edge of a hinged dome cover to ensure ample venting.
- When all connections are secure, open the bottom outlet valve.
- Open the necessary valves in the line to permit the free flow of product, and start the pump.
- As product starts to flow through the line observe all connections to make sure that there are no leaks.
- If leaks are apparent, stop the pump and make necessary repairs or adjustments to stop the leaks before continuing.
- When all product has been unloaded from the tank, wait until the pump drains the suction line, and then shut down the pump.
- Close the inlet valve of the receiving container immediately after shutting down the pump so that product will not drain back into the line.

Dome Unloading. To unload the tank car through the dome locate the pump at least 50 feet from the tank car and ground the pump. Place a drainage tub under the bottom outlet to catch any drainage. Insert the end of the unloading hose through the tank dome until it almost touches the bottom of the tank. Keep the

hose below the surface of the product until the tank is completely unloaded. Connect the pump discharge line to the inlet of the receiving container. Place the dome cover over the manhole so that the cover rests against the hose and allows ample space for venting. Follow pumping procedures described above. When the tank car is almost empty, manipulate the hose so that all product is drawn from the car. If possible, remove the bottom outlet cap and drain product from the outlet chamber into the tub.

Follow-Up Procedures. Make sure that the tank car is completely empty. Gage and sample the contents of the receiving tank, correct volume to 60 degrees Fahrenheit, and record the data. Compare the quantity of product delivered to the receiving tank with quantity taken from the tank car. Report excessive loss to the proper authority. Allow ample time for any suspended water and sediment to settle in the receiving tank, drain the water, gage the contents again, and record data. Close the bottom outlet valve. Remove the unloading hose from the tank car. If a wooden block is used to hold the dome cover open, be sure that the block does not fall into the tank car. Disconnect the tank car adapter, and replace the outlet cap; tighten the cap with a tank car wrench. Close and lock the dome cover; remove the drainage tub and discard any product in the tub. If the car has FLAMMABLE placards, remove and replace them with DANGEROUS-EMPTY placards. Disconnect grounding wire from the tank car; remove derails, if provided; and remove TANK CAR CONNECTED signs. Release the brakes and remove the car from the transfer area. Notify the proper authority that the unloaded tank car is ready for removal and is being returned empty, free for load. Report any defective car to the property authority.

PART G - CLEANING TANK RAIL CARS

The two most common reasons for cleaning tank cars are contamination and change of product. Prior to beginning cleaning operations, appropriate safety measures must be taken. These include bonding and grounding the car and placement of safety signs and fire extinguishers. Clean uncoated tanks by steaming for one hour. If sludge remains, continue steaming until clean. On tank cars with multiple compartments clean one compartment at a time. Allow the tank(s) to cool then check with explosimeter. Remove residual sludge and steam again with cleaning solvent. Allow the tank to cool then dry with lint-free rags.

Never clean coated tanks with steam. Use air ejector or air eductor to vapor free the tank, check with explosimeter, then remove sludge. Scrub the tank with solvent, rinse with warm water and dry with lint-free rags.

LESSON 9

PRACTICE EXERCISE

The following items will test your knowledge of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the appropriate answer key at the end of this subcourse. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. How far from a building must a rail car be during loading or unloading operations?
   A. 50 feet.
   B. 75 feet.
   C. 100 feet.
   D. 150 feet.

2. What is the minimum number of cables required to bond and ground a rail tank car?
   A. 2.
   B. 4.
   C. 6.
   D. 8.

3. When a receiving tank already contains product, to what degree Fahrenheit should the product be corrected?
   A. 45 degrees Fahrenheit.
   B. 50 degrees Fahrenheit.
   C. 60 degrees Fahrenheit.
   D. 70 degrees Fahrenheit.

4. A soldier is stationed on the windward side of the dome to
   A. Watch for unauthorized activity in the area.
   B. Alert the pump operator if a train approaches.
   C. Alert the pump operator when the tank is full.
   D. Alert the pump operator of electrical storm activity.

5. Loading and unloading through the dome
   A. Should only be done when no other means of loading or unloading is available.
   B. Presents a potential fire hazard.
   C. Is an acceptable method of transfer in all situations.
   D. A and B.

GLOSSARY
Section I
Acronyms and Abbreviations

ACCP	Army Correspondence Course Program
API	American Petroleum Institute
ATC	air traffic control, air traffic controller
BS + W	Bottom sediment and water
BSA	Brigade support area
COMSEC	Communications Security
DA	Department of the Army
DD	Department of Defense
DESC	Defense Energy Supply Center
DSA	Division support area
F	Fahrenheit
FARE	Forward Area Refueling Equipment
FSSP	Fuel System Supply Point
GPM	gallons per minute
GPS	Global Positioning System
HM	hazardous material
HW	hazardous waste
HEMITT	Heavy Extended Mobility Tactical Truck
HTARS	Hemitt Tanker Aviation Refueling System
ICE	Interservice Correspondence Exchange
MPH	Mile per hour
MSDS	Material Safety Data Sheet
MSC	Military Sealift Command
NCO	Noncommissioned officer
NCOIC	Noncommissioned officer in charge
Para	Paragraph
PMCS	Preventive maintenance checks and Services
POL	Petroleum, oils, lubricants
PSI	Pounds per square inch
QM	Quartermaster
RVP	Reid vapor pressure
S + T	Supply and transport
SLGR	Small Lightweight Global Positioning Receiver
SOP	Standard operating procedure
TRADOC	US Army Training and Doctrine Command

American Petroleum Institute (API) The institute represents and is supported by the petroleum industry. It standardizes the tools and equipment used by the industry and promotes the advancement of research in the petroleum field.

API Gravity An arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API. The gravity of any petroleum product is corrected to 60'F (16'C). *(See Specific Gravity.)*

API gravity test A test to confirm the identities of fuel supplies.

Aqua-Glo test A test to detect water in fuel supplies.

Section II
Terms

bulk petroleum products Those petroleum products (fuels, lubricants) which are normally transported by pipeline, rail tank car, tank truck, barge, or tanker and stored in tanks or containers having a capacity of more than 55 gallons, except fuels in 500-gallon collapsible containers, which are considered to be packaged.

Class III (POL) Petroleum fuels: lubricants, hydraulic and insulating oils, preservatives, liquid and compressed gases, chemical products, coolants, deicing and antifreeze compounds, together with components and additives of such products and coal.

contamination The addition to a petroleum product of some material not normally present. Common contaminants are water, dirt, sand, rust, mill scale, and other petroleum products.

filter/separator A device used to separate both solid contaminants and water from a petroleum fuel.

flash point The lowest temperature at which a liquid petroleum product gives off vapor in sufficient

concentration to ignite (that is, flash) on application of a flame under specified conditions.

jet fuel Fuel meeting the required properties for use in jet engines and aircraft turbine engines. Jet fuels are procured for the Armed Forces in several grades. The most important grades are JP-4 (low vapor pressure) and JP-5 (high flash point), and JP-8.

Millipore test A test for particulate contaminants in fuel supplies.

specific gravity The ratio of the weight of any quantity of matter, a petroleum product for example, to the weight of an equal quantity of water; usually determined by use of a hydrometer. (See AN Gravity.)

static electricity Electricity generated by friction between unlike substances and in the atmosphere; contrasted with voltaic or current electricity.

Lesson 1 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	D. Part A
2.	A. Part A
3.	B. Part A
4.	C. Part A
5.	A. Part A

Lesson 2 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	D. Part A
2.	A. Part A
3.	B. Part A
4.	C. Part A
5.	D. Part B

Lesson 3 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	A. Part A
2.	C. Part B
3.	B. Part A
4.	B. Part A
5.	A. Part A

Lesson 4 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	B. Part A
2.	D. Part A
3.	C. Part A
4.	D. Part B
5.	B. Part B

Lesson 5 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	B. Part A
2.	A. Part B
3.	C. Part B
4.	D. Part B
5.	C. Part B

Lesson 6 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	C. Part A
2.	B. Part D
3.	D. Part D
4.	C. Part D
5.	A. Part D

Lesson 7 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	D. Part A
2.	A. Part C
3.	C. Part C
4.	B. Part B
5.	B. Intro

Lesson 8 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	C. Part A
2.	D. Part C
3.	A. Part F
4.	B. Part F
5.	A. Part G

Lesson 9 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	C. Part B
2.	B. Part B
3.	C. Part E
4.	C. Part E
5.	D. Part E