SUBCOURSE
QM 5097

EDITION
A

CONTROL GENERAL PETROLEUM OPERATIONS

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

CONTROL GENERAL PETROLEUM OPERATIONS

Subcourse Number QM 5097

EDITION A

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

2 Credit Hours
Edition Date: May 1999

SUBCOURSE OVERVIEW

This subcourse was designed to provide the soldier with information about petroleum operations, fire and safety theater operations, determining petroleum requirements, preparing accounting summaries, developing a petroleum environmental control program, and supervising sampling and gaging.

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 acquire knowledge on fire and safety, petroleum supply, determining petroleum requirements, preparing accounting summaries, monitoring an environmental control program, theater operations, and supervising sampling and gaging. The soldier will also acquire knowledge on related environmental impediments and viable resolutions.

CONDITION: Given subcourse QM 5097.

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: Six

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 six lessons. After studying the lessons and working through the practical exercises, complete the examination. Mark your answers in the subcourse booklet, and 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

FIRE AND SAFETY

Critical Task:
101-519-4311

OVERVIEW

The operation of a petroleum facility is extremely hazardous: however; there are a number of precautions which can be taken to reduce the possibility of a serious incident occurring.

Lesson Description:

During this block of instruction we will discuss how we can prevent loss of life and property caused by fire and safety hazards through the development and application of proper safety procedures.

Terminal Learning Objective:

Action: Identify POL safety equipment and clothing, procedures to control ignition procedures, first aid procedures for casualties resulting from petroleum handling, types of extinguishers required for different classes of fire, and procedures for developing a Petroleum Fire Prevention and Safety Program, while identifying environmental considerations and viable resolutions.

Condition: Given subcourse QM 5097.

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

INTRODUCTION

Because of the very nature of petroleum products, there are many hazards involved in the handling and storing of them. The greatest and most obvious is fire. However, we must not overlook the many health and safety hazards in addition to fire that are also present in petroleum facility operations. As a senior NCO, you are responsible for the fire prevention and safety program best suited to your petroleum facility. In addition you must ensure through periodic training, drills, and inspections, that petroleum personnel in your area of responsibility are knowledgeable of the fire and safety precautions and procedures discussed below.

PART A – FIRE AND SAFETY TRAINING, INSPECTIONS, AND DRILLS

Your duties and responsibilities as a senior petroleum NCO often require you to ensure that procedures and policies are being carried out. When dealing with petroleum, it is clear that fire and safety are probably the most important considerations that you must make when developing general procedures and specific SOPs.

Fire and Safety Training. Fire and safety training begins when the soldier receives initial MOS training and continues all the way through the soldier's career. Given that the personnel in your unit will be in almost constant contact with highly flammable products, fire and safety training will be an ongoing function. Training should be incorporated into every function your unit performs. When developing an SOP, a periodic training program should be incorporated into the procedures, ensuring that all personnel know and practice all applicable fire and safety precautions and practices. Planned drills are an excellent way to enforce training requirements and provide you as the senior NCO with an effective measurement tool that ensures personnel training is sufficient.

Inspections. Periodic planned and surprise inspections can also allow you to ensure that personnel are following all applicable procedures related to fire prevention and safety. Most importantly , inspections can serve to show you in what areas you may need to stress training, allowing you to develop a more complete training program related to petroleum fire and safety. Some of the areas that you will need to establish inspection procedures and intervals for are as follows:

- Work area hazards.
- Fire fighting and safety equipment.
- Fire reporting and fighting procedures.
- First-aid supplies and procedures.
- Locations and availability of pertinent fire and safety information.
- Fire and safety training records.
- Fire and safety precautions and procedures during the performance of duties.

PART B – NATURE AND CLASSES OF FIRES

Nature of fire.

Three elements are required to start and sustain a fire:

- Heat (source of ignition) such as sparks, open flame, or static electricity.
- Oxygen (air) which is always present.
- Fuel (vapors) which in petroleum operations includes items such as MOGAS, diesel fuel, and JP4.

By ensuring that personnel know how to remove or prevent the presence of any one of these elements, a fire can be easily prevented or extinguished.

Classes of Fires.

There are four main classes of fire that you must ensure your personnel are familiar with. They are based on the combustion characteristics of the material that is ignited:

- **Class A fire** - These fires occur in combustible materials such as bedding, mattresses, books, cloth, wood, and paper. The remains of these fires are charred embers.
- **Class B fire** - These fires occur in flammable liquids such as gasoline, jet fuels, kerosene, oils, paints, turpentine, grease, and tar.
- **Class C fire** - These are electrical fires, and they can occur in wiring, electrical switches, and generators.

- **Class D fire** - These involve combustible chemicals and metals such as sodium, potassium, titanium, magnesium, zirconium, and phosphorous.

PART C – CHARACTERISTICS AND SOURCES OF FIRE AND SAFETY HAZARDS

Vapor Characteristics. In a fire, it is the vapor that actually burns. Characteristics of vapors include:

- Vapors are heavier than air and collect in low areas.
- Vapors will hang low to the ground and spread over large areas.
- On hot humid days vapors are produced in greater volume.
- When vapors are allowed to collect, flashbacks can occur as the vapors come in contact with a heat source and the heat travels back to the source of the vapors, causing a fire and possibly an explosion.
- A 1- to 8-percent ratio by volume of vapors when mixed with air, will form an explosive range. An explosive range is that point where the vapor and the air mixture will burn. A mixture above 8 percent is too rich in vapors and will not ignite. A mixture below 1 percent is too lean in vapors (too rich in air) and will not ignite.

Control of Vapors.

- Empty containers (5 gallon, 55 gallon) that have previously contained petroleum product are more dangerous than full ones. Fill such containers as soon as possible, or when they are stored empty, ensure caps and bungs are on tight.
- Store containers that have fuel in them or containers that previously contained product in a safe area.
- Do not overfill or fill containers at too fast a rate as vapors will be displaced to the atmosphere and become a hazard.
- Repair leaking pipes and containers as soon as possible.
- Clean up spills immediately (as long as the contamination is present, vapors are a hazard).

Sources of Ignition. A source of ignition can be either a flame, spark, or other heat-generating source. Some of the most common causes of heat are:

- Smoking material (matches, lighters, and cigarettes).
- Sparks (static electricity, moving fuel, moving equipment, welding and cutting).
- Spontaneous combustion (oxidation and chemical reaction).

As a minimum, you should post “No smoking within 50 feet” signs in critical areas of the facility and enforce the rule. Other precautions should also be observed/practiced, such as:

- Designate all smoking areas at least 100 feet away from refueling operations.
- In very hazardous areas, collect smoking materials at the entrance to the facility and keep them in separate airtight containers at the entrance to the facility.
- Welding and grinding should only be done under controlled conditions (that is, fire department notified, vapor freeing completed, or when product in a pipeline is moving).
- Electrical equipment must be maintained in safe working condition (approved electrical fixtures), and grounding and bonding procedures must be utilized to minimize static electricity and arcing.
- Ensure dispensing and receiving equipment is bonded and grounded.
- Bottom load whenever possible, as top loading generates static electricity and splashing while filling.
- Ensure that all personnel involved in gaging activities are trained to always bond themselves before gaging storage tanks and tank vehicles.
- Before gaging and sampling, allow a minimum of 30 minutes for the static charge to dissipate from fuel receipts.
- Always ensure that all fire extinguishers are in place and are operational.

PART D - TYPES OF FIRE EXTINGUISHERS AND INSPECTION PROCEDURES

Types of Fire Extinguishers.

There are four types of fire extinguishers your personnel should be familiar with: water, carbon dioxide, dry chemical, and Halon.

- **Water extinguishers** (pumped or pressurized) - May be used for Class A fires. This type of extinguisher is used to control the heat. DO NOT USE for electrical, combustible metal, or flammable liquid fires.
- **Carbon dioxide extinguishers** - May be used on electrical, chemical, or petroleum fires (Class B, C, and D). This type of extinguisher controls the fire by diluting the air, thus choking the fire.
- **Dry chemical extinguishers** - May be used on Class B, C, and D fires. This type of extinguisher is used to smother the fire.
- **Halon extinguishers** - Are effective against Class A, B, and C fires. The Halon extinguisher works chemically to stop the combustion process. The agent, discharged as a liquid becomes a gas when it contacts the fire.

Inspection Procedures.

You must ensure that fire extinguishers are inspected at least monthly for serviceability. Any fire extinguisher found unserviceable or discharged should be taken to the fire station for repair or recharging. The areas on the extinguisher to be checked are:

- In the body, check for dents, cracks, and excessive rust.
- In the hose, check for dry rot, cracks, and missing parts.
- Ensure that the seal is intact.
- Ensure that the pressure gauge is in the “green,” fully-charged position.

PART E- PRINCIPLES OF EXTINGUISHING FIRES

There are three basic methods your personnel will use to control and/or extinguish a fire:

- **Control the heat** - Cooling or reducing the temperature of the fire below the ignition point will remove the source of heat and control the fire.
- **Control the air** - By reducing or eliminating oxygen in the air, combustion will no longer be supported. Air is diluted by reducing the percentage of oxygen to the point where it will no longer support combustion. If all air is cut off at the surface of combustion, a fire is smothered.
- **Control the fuel** - Removing the combustible material or shutting off the flow of fuel will control the fire.

General Procedures to Extinguish a Fire. As a petroleum manager you can use drills or other testing methods to ensure that your personnel are aware of the sequence of steps to take when a fire is discovered. The recommended sequence is as follows:

- Sound the alarm.
- Call the fire department.
- Determine the class of fire (A, B, C, D).
- Select the appropriate fire extinguisher.
- Stand upwind so that the flames and smoke blow away from you.
- Point the fire extinguisher nozzle at the base of the fire.
- Move the nozzle from side to side until the fire is extinguished.

PART F - FIRE FIGHTING TOOLS, CLOTHING, AND SAFETY TECHNIQUES

Tools. There are several types of tools used to fight ground cover fires. As a senior petroleum NCO, you should ensure that the following items are on hand and in serviceable condition for all petroleum operations:

- **Rakes** - Rakes are used to rake ground cover and dirt and to chop light growth. The types of rakes used are as follows:
  - McLeod.
  - Council.

  - Rich Tool.
- **Fire Swatters** - The fire swatter, or flapper, is used to beat the flames out. It may be effective on small fires, but it could cause a fire to spread due to flying embers.

Clothing. When faced with fighting a brush fire, nothing is more important to success than having the proper equipment. An integral part of fire fighting equipment is clothing. It is your responsibility to ensure that there is adequate clothing on hand for any type of fire fighting situation that may arise. The type of clothing required varies in relation to your mission and the type of fires that may occur. When planning operations, as well as ensuring base-unit readiness, you must always consider the availability of the proper fire fighting clothing.

Safety Techniques. As a senior NCO, you should ensure that personnel are thoroughly familiar with the following techniques for fighting a ground cover fire:

- Always know the current escape routes.
- Safety may be gained by moving into the burned area (as a last resort only).
- Always work a fire on a slope from below.
- Always work downwind of a fast-moving fire.
- Use caution in felling or cutting trees.
- Pace yourself; ground cover fires usually require long periods of hard work.
- Stay with your crew.
- When working on the fire line, stay 10-15 feet from the nearest co-worker.
- Post a lookout to watch for a change in the fire's behavior.
- Work as a crew; this is not a contest to see who can cut the most line.
- If you find yourself surrounded by fire, dig a pit and cover yourself with dirt.

PART G – GENERAL PETROLEUM HEALTH HAZARDS

Dusts. Dust results from the grinding, scraping, sanding, or sandblasting of tanks, especially in the case of tanks that have held leaded fuels. Lead dust can also result from burning sludge taken from leaded gasoline storage tanks. Lead, manganese, mercury, arsenic, and any compound made of these items can produce dust that is poisonous to the body. Silica dust resulting from the operation of grinding and polishing machines or sanding and sandblasting operations can be fibrous-producing, causing injury to the lungs. Nuisance dusts may cause inflammation and respiratory ailments.

Gases and Vapors. The terms "gas" and "vapor" are often used to mean the same thing, although there is a difference. A gas exists as a gas at ordinary temperature and pressure. A vapor is a gas-like form of a substance that is ordinarily a liquid. Gasses and vapors are divided into four groups. Poisonous or toxic gasses and vapors have various effects on the body. They may injure or destroy the visceral organs, the blood-forming system, tissues, or bones. Examples of poisonous gasses or vapors are hydrogen sulfide found in crude oil of high sulfur content and tetraethyl lead vapor from leaded gasoline. You must avoid exposure to them at all times. Simple asphyxiates are gasses and vapors that keep the lungs from getting air. In other words, they replace oxygen that is in the air. Anesthetic gasses and vapors have a narcotic effect, depressing the central nervous system to the point where respiratory failure may occur. All hydrocarbon vapors have this effect. Irritant gasses and vapors inflame the lungs and respiratory tract. They may cause pneumonia and other pulmonary diseases or make the victim more susceptible to them. Most flammable gasses and vapors are irritants whether or not they are poisonous or narcotic.

PART H - FIRST AID FOR SITUATIONS INVOLVING PETROLEUM PRODUCTS

When personnel swallow petroleum products, assisting personnel should:

- Keep the victim calm, if possible.
- DO NOT INDUCE VOMITING.
- Get the victim to medical help immediately.

In the eyes:

- Flush the eyes for several minutes with clean water to try to remove the product.

- Cover the eyes for several minutes with a sterilized dressing, and prevent the victim from rubbing the eyes.
- Seek medical help immediately.

On the clothing:

- Remove the clothing after soaking the fuel-soaked clothing first with water. (This should prevent sparking.)
- Wash with soap and water and rinse thoroughly.
- Get to medical help, if needed.

PART I - ACCIDENT REPORTS

Accident reporting is a very important aspect of a fire and safety program. Accident reports allow all personnel, from the front line supervisor to senior doctrinal planners, to track and quantify safety-related trends that may lead to changes or revisions in Army or even DOD policy related to doctrine and general procedures. By ensuring the proper completion of accident reports, you, as a supervisor, are providing useful data that may be used to effect changes in unsafe procedures and practices that in turn will save lives in the future and provide for a more efficient and effective Army. Instructions for the use and procedures for properly completing DA Form 285 can be found in AR 385-40.

PART J - PETROLEUM FIRE PREVENTION AND SAFETY SOP

All of the information provided in this lesson would be useless if it were not documented and used to establish a standard set of daily operating procedures that can be incorporated into your personnel's everyday tasks. As the senior NCO of your unit , you are responsible for developing a petroleum supply fire and safety SOP. The format for most SOPs is standard and is provided in Appendix B of FM 10-426 (Petroleum Supply Units). Below is an extract from FM 10-426, Appendix B. This format is designed to ensure a standard and complete set of procedures related to the particular SOP being developed. It is important to realize that while this format dictates the sequence and content requirements for an effective SOP, you must also include procedures that are peculiar to your unit and overall mission.

- Unit Location - Using unit location.
- References - Applicable references used to develop SOP.
- Required - SOP content.
- Purpose - Tell the reason you are establishing the SOP.
- Scope - Specify procedures and requirements to be covered by the SOP.
- Responsibility - Responsible personnel for each set of procedures.
- Procedures - State which operating procedures are to be used and intervals when applicable.
- Miscellaneous - Any additional pertinent information to be included.
- Definition Section - Definitions of terms.
- Signs and Symbols - Explanation of symbols and/or signs used.
- Special Instructions.

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 answer key. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. As a petroleum supply senior NCO, which of the following is a method of determining the status of fire and safety training in your unit?

   A. Formal testing.
   B. Real-life situations.
   C. MOS training scores.
   D. Periodic inspections and drills.

2. Personnel involved in gaging activities must be trained to always perform which of the following actions before gaging storage tanks and tank vehicles?

   A. Have the wind at their back.
   B. Bond themselves to the tank.
   C. Ground themselves.
   D. A and B.

3. After a fire is discovered and the alarm is sounded personnel should _____.

   A. Select a fire extinguisher.
   B. Call the fire department.
   C. Determine the class of the fire.
   D. Move all vehicles from the area.

4. When working on a fire line, personnel should stay how many feet from their nearest co-worker?

   A. 25-20.
   B. 15-20.
   C. 10-15.
   D. 5-10.

5. As a petroleum facility supervisor, you should be aware that lead dust can result from which of the following?

   A. Burning sludge taken from leaded gasoline storage tanks.
   B. Sandblasting of the outer skin of a leaded gasoline storage tank.
   C. Welding repair operations to a leaded gasoline storage tank.
   D. All of the above.

LESSON 2

PETROLEUM SUPPLY IN A THEATER OF OPERATIONS

OVERVIEW

Distribution of fuel to US Army, Air Force, Navy, and Marine organizations and allied forces in a theater of operations requires knowledge of the types of US Army units responsible for the distribution of petroleum.

Lesson Description:

During this block of instruction we will discuss how US Army units distribute petroleum to military organizations and allied forces in a theater of operations.

Terminal Learning Objective:

Action: Acquire knowledge on distributing fuel to US Army, Air Force, Navy, and Marine organizations and allied forces in a theater of operations, the types of US Army units responsible for the distribution of petroleum in a theater of operations, and environmental considerations.

Condition: Given subcourse QM 5097.

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

INTRODUCTION

In any major conflict, the anticipated tonnage associated with bulk petroleum products will account for over 50 percent of the total tonnage shipped into a theater of operations. The petroleum distribution system must be flexible enough to meet the changing priorities of a fluid battlefield and reallocate resources as necessary. Adjustments must be made to meet variations in intensity of warfare. As a petroleum NCO, understanding the petroleum distribution system will assist you in planning for support.

PART A - DISTRIBUTING FUEL IN A THEATER OF OPERATIONS

The flow of fuel requirements begins with the submission of fuel forecasts from consuming units. Forecasted fuel is then distributed as far forward as possible to satisfy the most forward needs first and then and only then is any fuel placed in storage.

The using unit submits their forecast through the S4 channels to the Division Material Management Center (DMMC). The DMMC prepares the division forecast from the main support battalion (MSB), forward support battalion (FSB), and Aviation Brigade (AVN BDE) units logistics reports and forwards the requirements to the Corps Material Management Center (CMMC).

The CMMC consolidates all the requirements from other divisional and nondivisional commands within the corps area and forwards the entire corps forecast to the Theater Materiel Management Center (TMMC).

PART B - UNITS RESPONSIBLE FOR DISTRIBUTION

Communications Zone. The communications zone (COMMZ) is the rear part of the theater of operations and contains the lines of communication establishment for supply and evacuation and other agencies required for the immediate support and maintenance of the field forces. The Joint Petroleum Office (JPO) consolidates theater petroleum requirements for all services. prepares the “slate” (request for delivery of fuel byproduct, quantity, and location), and forwards it to the Defense Energy Support Center (DESC). The Petroleum Group operates the bulk petroleum distribution system extending from ports of entry through the COMMZ and as far into the combat zone as practicable.

Combat Zone. The combat zone is the area required by combat forces for the conduct of operation. This area is the territory forward of the Army rear area boundary.

Corps Area. The Corps Support Command (COSCOM), located in the corps area, provides combat service support to Army forces in the corps area, direct support (DS) and general support (GS) to nondivisional units, and GS to divisional units.

- Petroleum Supply Battalion. Provides DS and GS petroleum in the corps and divisional areas.
- Petroleum Supply Company. Receives, stores, and issues bulk petroleum to divisional and nondivisional DS companies on a 24-hour basis. Receives fuel from the petroleum pipeline and terminal operating company. Issues fuel to divisional and nondivisional DS supply and services companies and aviation brigade and/or battalions. The capabilities and/or responsibilities of this organization are:
  - Install, operate, and retrieve approximately 10 miles of collapsible hoseline per day.
  - Maintain prescribed reserve stock supply.
  - Provide limited mobile filling station service.
  - Operate two to four supply points at different locations. Storage capacity includes twenty-eight 10,000-gallon collapsible tanks and twenty-four 50,000-gallon collapsible tanks for a total of 1,480,000-gallon capacity.
- Medium Truck Company (Petroleum). Provides transportation for bulk petroleum between GS and DS petroleum organizations. The capabilities and/or responsibilities of this organization are:
  - Assigned sixty 5,000-gallon tanker trucks.
  - Can line haul 450,000 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and two round-trips completed each day.
  - Can local haul 900,000 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and four round-trips completed each day.
  - Has storage capacity of 300,000 gallons in the 5,000-gallon tanker trucks.

COSCOM Support Group. Provide area supply and services to units passing through or located in its assigned corps areas.

- Supply and Services Battalion. Provides supplies and field services on a DS basis to nondivisional units passing through or located in the corps area.
- Supply and Services (S&S) Company DS. Provides direct support petroleum supply to nondivisional units located in or passing through the corps area. Receives fuel from the Petroleum Supply Company. The capabilities and/or responsibilities of the organization are:
  - Storage capacity of 120,000 gallons in two Fuel System Supply Points (FSSPs).
  - Assigned nine 5,000-gallon tankers.
  - Can line haul 81,900 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and two round trips completed each day.
  - Operate mobile filling stations when required.

Divisional Area. The Division Support Command (DISCOM), located in the divisional area, provides division-level combat service support (except COMSEC logistics, construction, financial services, legal services, and public affairs) to all organic and attached elements of the division. Subordinate elements of the DISCOM are the Main Support Battalion (MSB) and three Forward Support Battalions (FSBs).

- MSB. Provides division-level combat service support to all organic and attached elements of the division. The MSB provides direct support to units located in the Division Support Area (DSA) and backup to the FSB.
- Supply and Services (S&S) Company DS. Provides division-level supply and services to all organic and attached elements of the division. The S&S Company provides direct support to units located in the DSA and backup to the FSB's Supply Company. Receives fuel from Petroleum Supply Company. The capabilities and/or responsibilities of this organization are:
  - Storage capacity of 304,000 gallons in two Fuel System Supply Points (FSSPs), two Forward Area Refueling Equipment (FARE) systems, thirty-four 5,000-gallon tanker trucks, and two tank and pump units (TPUs).
  - Can line haul 258,600 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and two round-trips completed each day.
  - Can local haul 517,200 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and four round-trips completed each day.
  - By doctrine, can handle only ground fuel (MOGAS and diesel).
- Forward Support Battalion (FSB). Provides brigade-level combat service support to all organic and attached elements of the brigade.
- Supply Company. Provides brigade-level petroleum to all organic and attached elements of the brigade. Receives fuel from the Petroleum Supply Company and backup from the MSB AMS Company. The capabilities and/or responsibilities of this organization are:
  - Storage capacity of 53,600 gallons in ten 5,000-gallon tanker trucks and two tank and pump units.
  - Can line haul 78,600 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and two round-trips completed each day.
  - Can local haul 157,200 gallons of fuel each day. This is based on an assumption of 75 percent vehicle availability and four round-trips completed each day.
  - By doctrine, handles only ground fuels (MOGAS and diesel) and single fuels on the battlefield (JP8/MOGAS).
- Combat Aviation Brigade (CAB). Provides DS petroleum to the units organic to the CAB. The CAB receives fuel directly from the COSCOM by means of either hoselines or tanker trucks from the Petroleum Supply Battalion. Capabilities - The CAB provides petroleum to its subordinate units using either the air transportable 500-gallon collapsible drums, heavy expanded mobility tactical trucks (HEMTTs) or the tank and pump units. The CAB will normally form forward area refueling points in the division forward area to minimize the time required to replenish the aviation logistics necessary to continue combat operations.
- Light Division, Division Support Command (DISCOM). In the light divisions, the DISCOM fulfills its petroleum DS mission through its organic Supply and Transportation (S&T) Battalion. The S&T Battalion establishes refuel points in the DSA and forwards in the BSA to provide fuel on an area basis. It will use the organic truck company to refuel the refueling points via the 5,000-gallon tankers organic to the company.

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 answer key. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. What does the flow of fuel requirements begin with?

   A. Satisfying the most forward needs first.
   B. Placing fuel in storage.
   C. The submission of fuel forecasts from consuming units.
   D. Consolidation of all requirements by the CMMC.

2. What is the function of the petroleum supply company in the corps area of the combat zone?

   A. To receive, store, and issue bulk petroleum to divisional and nondivisional DS companies on a 24-hour basis.
   B. To provide transportation for bulk petroleum between GS and DS petroleum organizations.
   C. To provide DS and GS petroleum in the corps and divisional areas.
   D. To provide direct support petroleum supply to non-divisional units located in or passing through the corps area.

3. Which of the following is a capability or responsibility of the Supply and Services Company DS of the COSCOM support group?

   A. Can line haul 81,900 gallons of fuel each day.
   B. Has storage capacity of 300,000 gallons in the 5,000-gallon tanker trucks.
   C. Can operate two to four supply points at different locations.
   D. Assigned sixty 5,000-gallon tanker trucks.

4. By doctrine, the divisional area Supply Company provides what type of support?

   A. Fuel to attached elements.
   B. Division level supply and services.
   C. Brigade level support to all organic and attached elements of the brigade.
   D. Combat service support.

5. Where does the divisional area Combat Aviation Brigade receive fuel from?

   A. DISCOM.
   B. COSCOM.
   C. S&S.
   D. TPU.

LESSON 3

DETERMINE PETROLEUM REQUIREMENTS

OVERVIEW

During petroleum operations, various mathematical techniques are used in computing numerical quantities.

Lesson Description:

During this block of instruction we will discuss how to compute the numerical quantities required during petroleum operations.

Terminal Learning Objective:

Action: Acquire knowledge on various mathematical techniques used in computing requirements for petroleum operations.

Condition: Given subcourse QM 5097.

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

INTRODUCTION

One of the most important functions of a petroleum manager is the adequate forecasting of petroleum requirements. Without an accurate forecast of requirements, the orderly flow of petroleum products is threatened. There are five methods for computing petroleum requirements. They are listed in order from best to worst: historical data method, combat profile, fuel consumption unit (STANAG 2115), equipment consumption, and gallons per person per day.

PART A - HISTORICAL DATA METHOD

The historical data method is the best method and considers the following factors: same vehicles, same distances, and similar resupply source, weather, and terrain. Record keeping for actual consumption during major training exercises and tactical marches is essential for correct calculations using this method.

PART B - COMBAT PROFILE

The combat profile method tracks combat vehicles only. You must use FM 101-10-1/2, Table 2-12, Combat Consumption Rates for Bulk Fuels (Figure 3-1) to obtain consumption rates (factors) and Table 2-14, Daily Equipment Usage Rates for Tracked Combat Vehicles (Figure 3-2). Add together subtotals (shown below) and multiply by number of vehicles to get the total fuel requirement.

	CONSUMPTION FACTOR		USAGE RATES		SUBTOTAL
IDLE		X		=	
CROSS COUNTRY		X		=	
SECONDARY ROADS		X		=	

PART C - FUEL CONSUMPTION OF UNIT

The NATO STANAG 2115 method is a standard used by NATO in determining fuel consumption. The fuel consumption unit (FCU) considers combat, terrain, and climate. You must use tables found in FM 101-10-1/2, Table 2-12, Combat Consumption Rates for Bulk Fuels (Figure 3-1) (excerpt provided) to obtain consumption rates (factors), Table 2-13, Daily Equipment Usage Rates for Other than Tracked Combat Vehicles (Figure 3-3), and FM 10-13, Table 3-1, Additional Situations (Figure 3-4), (excerpt provided)..

COMBAT CONSUMPTION RATE	X	QUANTITY OF EQUIPMENT	X	USAGE RATE	=	TOTAL GALLONS

TOTAL GALLONS	X	COMBAT FACTOR	X	TERRAIN FACTOR	X	CLIMATE FACTOR	=	FCU

PART D - EQUIPMENT CONSUMPTION

When using the equipment consumption method, you must know what equipment is to be used (TOE, TDA, or equipment listing) and must use FM 101-10-1/2, Tables 2-12, Combat Consumption Rates for Bulk Fuels (Figure 3-1, excerpt provided) to obtain consumption rates (factors), Table 2-13, Daily Equipment Usage Rates for Other than Tracked Combat Vehicles (Figure 3-3, excerpt provided), and Table 2-14, Daily Equipment Usage Rates for Tracked Combat Vehicles (Figure 3-2, excerpt provided). This method may be used at all levels. Here is an example:

Combat Consumption Rate	X	Quantity Equipment	X	Area Usage	=	Bulk Fuel Rate Requirement

PART E - GALLONS PER PERSON PER DAY

The least desirable or accurate method is the gallons per person per day method and it is primarily used for early planning stages and for funding. You must use FM 101-10-1/1, and FM 10-13, Table 3-2, Planning Factors (Figure 3-5), types of fuel to be used, and geographic consumption rates.

TROOP STRENGTH	X	THEATER CONSUMPTION	=	ESTIMATE PETRL REQ

Table 2-12. Combat Consumption Rates for Bulk Fuels (extract)

LI	EI NSN	SNSN CMD	FUEL NSN	EQUIP TYP	CONSUMP CD	IDL/AV	XCNTRY	2NDRDS	NOMENCLATURE	MULTIFUEL
Z38195	2302 01 123 1602	K	9140 00 273 2377	WV	K	0.1367			LT ARMD VEH M1047	
Z44650	2340 Z4 465 0001	K	9130 00 160 1818	WV	K	0.0249			MOTORCYCLE XM1030	
Z46347	1520 01 125 5476	H	9130 00 256 8613	AV	H	39.90			CPTR RECON OH-58D	

Figure 3-1. Combat consumption rates for bulk fuels (FM 101-10-1/2 extract).

Table 2-14. Daily Equipment Usage Rates for Tracked Combat Vehicles (Extract)

		KOREA			EUROPE			ALASKA			PANAMA CANAL ZONE			CONUS		
LIN	NOMENCLATURE	IDLE/ AV	XCNTRY	2NRDS	IDLE/ AV	XCNTRY	2NRDS	IDLE/ AV	XCNTRY	2NRDS	IDLE/ AV	XCNTRY	2NRDS	IDLE/ AV	XCNTRY	2NRDS
A93125	M551 ARAAV 152MM	6.0	6.5	5.0	6.0	6.5	5.0							4.8	7.7	4.6
C76335	CAV FGT VEH XM3	3.0	5.5	5.5	3.0	5.5	5.5	3.0	5.5	5.5	3.0	5.5	5.5	3.0	5.5	5.5
D10726	M125A1 CARR 81MM	4.1	5.0	5.0	4.0	5.0	5.0	2.9	0.5	3.6				5.0	3.8	1.6

Figure 3-2. Daily equipment usage rates for tracked combat vehicles (FM 101-10-1/2 extract).

Table 2-13. Daily Equipment Usage Rates for Other than Tracked Combat Vehicles (Extract)

Equipment Type						
Code	Nomenclature	Alaska	Panama Canal Zone	CONUS	Europe	Korea
AB	Amphibious	15H	20H	10H	12H	10H
AV	Aviation	4H	4H	4H	4H	4H
CE	Construction	15H	20H	10H	12H	10H

Figure 3-3. Daily equipment usage rates for other than tracked vehicles (FM 101-10-1/2).

Table 3-1. Additional Situations

Situation	Multiplication Factor
Combat	
Attack	2.5
Delay / withdrawal	2.0
Defense	1.5
Terrain	
Flat	1.0
Hilly	1.2
Mountain	1.5
Cross-country	1.5
Climate	
Hot	0.9
Temperate	1.0
Cold	1.3

Figure 3-4. Additional situations (FM 10-13 extract).

Table 3-2. Planning Factors

Type of Fuel	Consumption Rates (gallons per man per day)			
	Europe	Pacific	Alaska	Canal Zone
MOGAS	1.5821	1.0606	2.4821	2.4273
Diesel (including diesel used for heating)	5.9217	2.1566	2.6361	0.8738
JP-4 (jet fuel) JP-4 and JP-5	2.2111	4.1830	7.8115	1.6991

Figure 3-5. Planning Factors (FM 10-13 extract).

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 answer key. 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 considered the best method for computing petroleum requirements?

   A. Historical data method.
   B. Equipment consumption method.
   C. Gallons per person per day method.
   D. Fuel consumption unit method.

2. What is essential for correct calculations using the historical data method for computing petroleum requirements?

   A. FM 101-10-1/2, Table 2-12.
   B. STANAG 2115.
   C. Recordkeeping for actual consumption during major training exercises, tactical marches, etc.
   D. FM 10-13, table 3-2.

3. What factors does the fuel consumption of unit method for computing petroleum requirements consider?

   A. Troop strength and theater consumption.
   B. Equipment and geographical area.
   C. Same vehicles, same distances, and similar resupply source.
   D. Climate, combat, and terrain.

4. What is considered the least desirable or accurate method of computing petroleum requirements?

   A. Equipment consumption method.
   B. Combat profile method.
   C. Historical data method.
   D. Gallons per person per day method.

5. Which of the following is true of the equipment consumption method of computing petroleum requirements?

   A. This method tracks combat vehicles only.
   B. This method may be used at all levels.
   C. This method is a standard used by NATO.
   D. This method is primarily used for early planning stages and for funding.

LESSON 4

PREPARE ACCOUNTING SUMMARIES

OVERVIEW

Petroleum accountability includes preparing bulk petroleum accountability documents, determining allowable and actual losses, describing implementation of required adjustment actions, and computing volume corrections.

Lesson Description:

During this block of instruction we will discuss how to prepare bulk petroleum accountability documents, determine allowable and actual losses, implement of required adjustment actions, and computing volume corrections.

Terminal Learning Objective:

Action: Acquire knowledge on preparing bulk petroleum accountability documents, determining allowable and actual losses, and verifying implementation of required adjustment actions.

Condition: Given subcourse QM 5097.

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

INTRODUCTION

Until bulk petroleum products are consumed, they must be handled many times. Accurate records for receipts, storage, issue, and shipment of petroleum products must be maintained. As a petroleum manager, your duties will require supervising and reviewing accountability procedures. Accountability is necessary in determining the quantities of petroleum products on hand and for the verification of quantities received and issued.

PART A - PETROLEUM ACCOUNTABILITY

Procedures to properly manage, control, safeguard, and account for petroleum products must be pursued and involve prompt and accurate identification of shortages and overages and taking action to identify causes for deviation.

Organizations handling bulk fuels will establish, maintain, and provide an SOP to operating personnel for handling and accounting for bulk fuel by the particular organization. Organizations will train petroleum handling personnel to ensure that safe and proper procedures are followed. All storage tanks greater than 10,000 gallons will have a certified capacity table. A certification of capacity table for tanks of 10,000 gallons or less is optional.

The appointment of a seal custodian, responsible for the quality and quantity of inspected petroleum products, is another responsibility of senior petroleum NCOs. This appointment must be accomplished in writing and is recommended that this appointment be noted in the applicable petroleum supply SOPs.

As a senior NCO in a petroleum organization, you are responsible for establishing and maintaining a viable SOP to be used by your organization for petroleum inventory, accountability, and pilferage control operations. Using the format provided in FM 10-426, Appendix B, and the information contained in this lesson, will give you an idea of the general coverage area required for this particular SOP. As with any SOP, it is important to remember that that specific procedures will be developed and implemented based on your unit's specific operations and mission responsibilities.

PART B- PREPARING BULK PETROLEUM ACCOUNTABILITY DOCUMENTS

Soldiers storing or transferring Class III products must accurately account for receipt, issue, and stocks on hand for both bulk and packaged products. The biggest challenge in accounting for Class III products (particularly bulk products) is adequately measuring them. Descriptions and procedures for completing the forms mentioned above can be found in DA PAM 710-2-1, Using Unit Supply System (Manual Procedures).

Petroleum accounting records include:

- Daily status report. Soldiers operating a Class III facility submit reports showing quantities of product received, issued, and on hand.
- DD Form 1348-1, DOD Single Line Item Release/Receipt Document. Soldiers receiving petroleum into a Class III facility use this form to record the receipt.
- DA Form 2765-1, Request for Issue or Turn-In. Customers use this form to request packaged and bulk products or to turn in excess cans, drums, or supplies.
- DA Form 3643, Daily Issues of Petroleum Products. This form is the basic accountability record for receipts and issues at a supply point.
- DA Form 3644, Monthly Abstract of Issues of Petroleum Products and Operating Supplies. Soldiers doing accountability post summarized information from DA Form 3643 to this form to show total monthly issues and receipts.
- DA Form 4702-R, Monthly Bulk Petroleum Accounting Summary. Units use this form to report all losses or gains revealed by monthly inventories.
- DA Form 2064. Document Register for Supply Actions. Personnel operating Class III storage facilities must establish a stock record card or property record for each type or grade of product. They use this form to post accountable records.

- DA Form 1296 (Stock Account Record) or DA Form 3-8 (Stock and Property Records) will be used to keep day-by-day stock/property records that reflect where and how much of each product is on hand at a storage facility.

- DA Form 3853-1, Innage Gage Sheet (Using Innage Tape and Bob). This form is used to record physical inventories of bulk fuel.

PART C - DETERMINING ALLOWABLE AND ACTUAL LOSSES

Some losses or gains are to be expected when handling and storing volatile products. Allowable loss and gain percentages prescribed in the regulation are considered sufficient to accommodate expected normal product losses and gains. Handling loss or gain of jet fuels, AVGAS, gasoline, and all other products are allowable up to the extent of the actual loss or gain allowances. Losses or gains for jet fuels, AVGAS, and gasoline, must not exceed ± 1 percent of the total of the opening inventory plus the receipts for the monthly period covered by the Monthly Bulk Petroleum Accounting Summary (MBPAS). Losses or gains for all other petroleum products must not exceed ±1/2 of 1 percent of the total opening inventory, plus the receipt amount on the MBPAS.

- In instances where the total loss of a specific bulk petroleum product may be less than the loss allowance for that product, only the actual loss will be allowable.
- For actual losses that exceed the stated allowance and the entire loss has a monetary value of $500 or more, a report of survey is required.
- Actual losses exceeding the allowable, but having a total monetary value less than $500 will require a causative research to be initiated. A copy of either the report of survey or causative research will be attached as supporting documentation to the MBPAS.

PART D - ADJUSTMENT OF ACCOUNTABLE RECORDS

The DA Form 1296 for bulk petroleum products will be adjusted by using DA Form 4702-R (MBPAS) for all losses and gains revealed by the monthly inventory. You must ensure that the accountable officer completes the MBPAS, assigns it a voucher number, and posts it to the respective accountable records within 3 working days of the last day of the month for the report.

The MBPAS is used to reflect the on-hand inventory and to make adjustments to the accountable stock records.

- Losses due to spillage or contamination will be documented by the accountable/responsible officer for quantities over 25 gallons.
- The documentation of loss will be attached to the MBPAS as a supporting document to adjust the accountable records.
- Adjustments to product inventories are required for blending, or regrading actions as follows:
  - The accountable/responsible officer will prepare a statement stating the quantities of all products blended/regraded during the month and the reason for action.
  - The statement and a copy of the proper laboratory report are attached to the MBPAS as supporting documents.
- The MBPAS upon completion, will be forwarded to the approving authority, who may disapprove any item on the MBPAS. If the approving authority disapproves an item, the initiation of a report of survey is required.
- The MBPAS with all supporting documents (receipts and issues) will be retained in an active file for 1 year and in an inactive file for 2 years.

PART E - COMPUTING VOLUME CORRECTIONS

When monitoring accountability functions, you must ensure that personnel use the volume correction factor to correct fuel volume observed at temperatures other than 60°F. Do this after obtaining the API gravity reading at 60° F and the average temperature of product in the tank.

- Volume correction of quantities less than 3,500 gallons is optional.
- Correct the volume of residual fuel (FO #4, FO #5, FO #6) regardless of measured quantity.
- Volumes that equal or exceed 3,500 gallons must be corrected. Use the volume correction factors in ASTM tables 5B and 6B for petroleum products other than JP4.
  - ASTM Tables 5A and 6A will be used for JP4.
  - Use ASTM Tables 52, 53B, and 54B to correct measured volumes to gallons at 15° Centigrade.

PART F – PILFERAGE CONTROL MEASURES

Casual Pilferage. The most practical and effective method for controlling casual pilferage is through the use of psychological deterrents. One psychological deterrent is to search individuals and vehicles leaving the installation at unannounced times and places. When conducting spot searches, care must be taken to ensure that personnel are not demoralized nor their legal rights violated by oppressive physical controls or unethical security practices. An aggressive security education program is also important. All employees must realize that pilferage is morally wrong no matter how insignificant the value of the item taken. It is up to you to set a proper example. All employees must be impressed with the fact that they have a responsibility to report any loss to property authorities. Inventory and control measures such as identification of all tools and equipment should be instituted to account for all material, supplies, and equipment. Do not lose sight of the fact though, that most employees are honest and disapprove of thievery.

Systematic Pilferage. Control measures must be taken to prevent systematic pilferage. In order to ensure effective pilferage control throughout the facility you must first eliminate potential thieves during the hiring procedure by careful screening and observation and by establishing customer identification. Inside the facility, you must establish an effective key control system and an effective package and material control system. It may be advisable to install mechanical and electrical devices including appropriate perimeter fencing, lighting, and parking facilities and effective pedestrian, railway, and vehicle gate security controls in order to establish security surveillance of all exits. The facility security can also be increased by establishing adequate security patrols to check buildings, grounds, perimeter, and likely locations that may be used for storage of pilfered items. Additionally, you may locate parking areas for private vehicles outside the perimeter fencing of the activity. In the event of a loss, investigate quickly and efficiently.

In all cases, develop local SOPs according to security requirements and implement SOPs as soon as possible to prevent pilferage at the facility.

PART G - IDENTIFY OPPORTUNITIES FOR PILFERAGE AND SECURITY HAZARDS

Opportunities for pilferage are present when supplies are being transported in trucks, trains, planes, or ships. The greatest vulnerability and the widest variety of opportunities occur at the various points where supplies are transferred from one means of transportation to another or from storage to transportation and vice versa.

Petroleum pipelines present a unique set of security problems. Establish pipeline patrols to look for loose flange belts and couplings on pipelines, holes dug under pipelines/hose lines, and holes cut into hose lines. Watch for sabotage by looking for open pipes or cut hose lines, fires, or explosive charges.

PART H - SET UP CHECKPOINT INSPECTIONS

An orderly system is a must at a checkpoint. Examine drivers, helpers, passengers, and vehicle contents. Establish a security log containing the date, operator's name, description of load, time entered, and time departed. Establish a seal log for all goods leaving the facility, and verify seal number with shipping document and examine seals for signs of tampering.

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 answer key. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. What kind of storage tanks need to have a certified capacity table?

   A. All storage tanks of 10,000 gallons or less.
   B. All storage tanks greater than 10,000 gallons.
   C. All storage tanks.
   D. Certified capacity tables are optional.

2. When preparing bulk petroleum accountability documents, where will you find the procedures for completing the necessary forms?

   A. FM 10-67-1.
   B. MIL-HDBK-200.
   C. DA PAM 710-2-1
   D. DA PAM 710-2-2.

3. What is required when actual losses of petroleum product exceed the stated allowance and the entire loss has a monetary value of $500 or more?

   A. A report of survey.
   B. A causative research.
   C. Stock and property records.
   D. Request for Issue or Turn-In.

4. What is the MBPAS used for?

   A. To record the receipt of petroleum into a Class III facility.
   B. To request packaged and bulk products or to turn in excess cans, drums, or supplies.
   C. To reflect the on-hand inventory and to make adjustments to the accountable stock records.
   D. To post accountable records.

5. When should you correct fuel volume using the volume correction factor?

   A. When losses or gains are less than ±1%.
   B. When losses or gains exceed ±1%.
   C. When volume quantities are less than 3,500 gallons.
   D. When volumes observed at temperatures other than 60°F equal or exceed 3,500 gallons.

LESSON 5

MONITOR AN ENVIRONMENTAL CONTROL PROGRAM

Critical task:
101-519-3312

OVERVIEW

The US Army and other services are highly mechanized and use thousands of barrels of petroleum, oils, and lubricants. In order to supply petroleum products to using units, we must operate loading and unloading facilities for ships, barges, tank trucks, and rail tank cars, as well as operate pipelines and storage facilities. Every time a product is handled, a potential for spills exists.

Lesson Description:

During this block of instruction we will discuss how, as a petroleum supply manager, you can identify, establish, and enforce procedures that can help prevent oil spills through the application of proper procedures and how to properly contain, treat, and dispose of a petroleum spill.

Terminal Learning Objective:

Action: The soldier will acquire knowledge on the correct procedures for containing, cleaning up, and disposing of spilled petroleum, as well as establishing and enforcing an environmental control program.

Condition: Given subcourse QM 5097.

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

INTRODUCTION

Even when a product is lying dormant in a pipeline or storage tank, there is the possibility of a spill occurring. The costs involved in petroleum spills are high: revenues lost from a valuable resource and containment, cleanup, disposal, and restoration costs. Spills contaminate the soil and water, resulting in the loss of seafood and fowl. Spills also pollute beaches, lakes, and rivers causing lost revenues from recreational facilities. Both the federal and state authorities can levy fines against the individual or company which causes the spill.

PART A - COMMUNICATION OF GOOD ENVIRONMENTAL ETHICS TO SUBORDINATES

Each mission has, in some way, an impact on the surrounding environment. The environmental impact considerations for each mission should be weighed and considered, when possible, in every situation. When training subordinates identify the environmental impact of a mission, the following elements should always be present in training standards:

- Identify hazards to the environment during mission analysis. Environmental hazards are conditions that have the potential to pollute the air, soil, water, and/or degrade natural/cultural resources.
- Assess probability of environmental damage/violations using risk-assessment matrices.
- Make decisions and develop measures to reduce high risks.
- Implement environmental measures by integrating them into plans, orders, SOPs, training performance standards, and rehearsals.
- Supervise and enforce environmental standards and train to the standard.

The most important technique for training subordinates to identify environmental risks and possible impact is to make them think like they are in their house, and it is their health, land, and water at stake.

Getting subordinates to see the relevance and importance of good environmental ethics is crucial. Not only is the identification of environmental risks and their potential impact important, but also equally important are the consequences of noncompliance with environmental laws and regulations. The importance of protecting the environment can be stressed by discussing the consequences of environmental degradation and the benefits of environmental protection.

Consequences of Environmental Degradation. Consequences of environmental degradation include the following:

- The loss of historical sites, vegetation, water resources, and wildlife.
- Diminished quality of available realistic training areas.
- Diminished operational security.
- Ineffective tactical operations.
- The creation of safety hazards to personnel and equipment.
- An increase in training, maintenance costs, and litigation.

Benefits of Environmental Protection. There are many benefits of environmental protection:

- Enhances combat readiness.
- Ensures mission completion.
- Conserves the fighting strength.
- Protects the environment.
- Reduces the Army's and nation's current and future cost for environmental restoration.

Consequences of NonCompliance With Environmental Laws and Regulations. An excellent way to communicate the consequences of noncompliance to subordinates is to explain, in general, that noncompliance under the FFCA (Federal Facilities Compliance Act) can empower federal and state regulatory agencies to impose fines on federal agencies (including the Army) for Resource Conservation and Recovery Act (RCRA) violations. Penalties and intervention can take any of the following forms:

- Damage awards.
- Intervention from the EPA and other federal, state, and regional agencies.
- An increase in monitoring from federal agencies.
- Fines.

Unit leaders and their subordinates are required to comply with all federal, state, and local laws to protect the environment. Violators can be held personally liable for cleanup costs and civil or criminal penalties. Violators include the actual person who causes the contamination and the commanders, supervisors, and leaders who allowed the contamination to occur and did not take immediate action to prevent or correct the occurrence. The penalty can be up to $50,000 for each day in violation and/or up to two years in jail.

After Action Report. After-action Reports (AARs) are an excellent platform for reporting environmental considerations and can be incorporated into everyday work life through training, SOP, orders, and mission planning. Upon completion of an exercise or other training function, always remember to include any environmental considerations, good or bad, into the report.

Environmental Laws and Policies. As a petroleum supply supervisor, it is imperative that your subordinates are familiar with the local unit SOP and policies which should be explained and available immediately upon arrival at post. These are often the most stringent and all-inclusive as they tend to combine federal, state, and local laws, regulations, and policies. The local and state environmental laws vary by region and should be available to all subordinates as an important reference within the lab. The major federal laws and regulations can be found in FM 20-400. Subordinates should be routinely quizzed and observed in the performance of their duties to ensure that they are in some way familiar with the laws and regulations that are applicable to them. The host nation environmental laws and regulations may be very numerous and complex, the same as the U.S., or almost nonexistent. At any rate, given the fact that you may be in a foreign country where the penalties can be very tough, it is a good idea to ensure that your subordinates are familiar with the laws and regulations of the host nation.

PART B - ENVIRONMENTAL RISK ASSESSMENTS

The identification of environmental risks associated with a given mission or training exercise is one of the most important functions you perform as a supervisor or unit leader. In the Army, as you all know, much importance is placed on environmental stewardship and the idea of identifying possible risks ahead of time. There are three major phases of environmental risk identification associated with training missions: actions before training, actions during training, and actions after training.

Assessing Environmental Risks. Environmental risk assessment allows the commanders and unit leaders to address environmental considerations using the following steps:

- Identify the hazards to the environment during mission analysis. Environmental hazards are conditions that have the potential to pollute the air, soil, water, and/or degrade natural/cultural resources.
- Assess probability of environmental damage/violations using environmental risk assessment matrices.
- Make decisions and develop measures to reduce high risks.
- Brief chain of command (to include the installation environmental office, if applicable) and appropriate decision makers on proposed plans and residual risk.
- Implement environmental measures by integrating them into plans, orders, SOPs, training performance standards, and rehearsals.
- Supervise and enforce environmental standards. Train to the standard.
  The Environmental Risk Assessment Matrix provides an approach to assess the relative risk of generic unit-level activities on specific environmental areas. Each environmental risk assessment matrix has three main categories: environmental area, unit operation, and risk impact value.
  - Environmental Area Includes:
    Air pollution.
    Archeological and historic sites.
    Hazardous materials and hazardous waste.
    Noise pollution.
    Threatened and endangered species.
    Water pollution.
    Wetland protection.
  - Unit Operations (Company-Level Activities) includes:
    Movement of heavy vehicles and systems.
    Movement of personnel and light vehicles/systems.
    Assembly area activities.

Field maintenance of equipment.
Garrison maintenance of equipment.

- Risk Impact Value (Numeric Value). This value represents an estimate of the conditions under which the unit will operate and is an indicator of the severity of environmental degradation.

Use the following steps for assessing environmental impacts on planned activities:

- Identify hazards to the environment: degradation of wetlands, polluting streams, disturbing endangered species habitat and archeological sites and/or structures, creating oil spills, and improperly handling HW and HM.
- Assess probability of environmental damage/violations using environmental risk-assessment matrices.
- Make decisions and develop measures to reduce high risks.
- Brief chain of command and installation environmental office, if applicable, on proposed plans and pertinent high-risk environmental matrices.
- Integrate environmental measures into plans, SOPs, training performance standards, and rehearsals.
- Supervise and enforce environmental standards. Train to the standards.

Controls to Reduce Risks. Once the risks are identified, plans must be developed and implemented to control and reduce the risks. The development of environmental risk controls can come from AARs and environmental risk assessments. These controls are identified from known and previous risks that have been identified. Some examples of risk controls that can be implemented are:

- Restrict high-risk land areas, if practical, from vehicular operations.
- Sensitize personnel on performing maintenance or other tasks involving hazardous materials and substances near water sources.
- Use portable containment systems for field handling of hazardous substances.
- Be prepared to correctly respond to spills (have qualified personnel and correct equipment on hand).
- Have highly qualified leaders supervise high-risk tasks/operations.

Supervise and Evaluate Risk Controls Implemented. As part of environmental risk reduction measures, implementing risk controls involves incorporating them into mission planning, orders, SOP, training performance standards, rehearsals, and other activities where environmental considerations should be addressed. The supervision and evaluation of environmental risk controls can involve the following considerations: the mission, the enemy, terrain and weather, troops and equipment, and time.

- **Mission.**
  Anticipate or assess environmental risks during planning.
  Analyze the effects of environmental risks on mission operations.
  Simplify scheme of maneuver.
  Issue complete and concise orders.
  Ensure key leaders track the exercise and render timely reports.
  Identify alternative training scenarios or techniques.
  Use large-scale battalion or brigade sector sketches for detail.
  Send key leaders on objective reconnaissance.
  Set the environmental standard within the unit, and ensure soldiers are aware of and comply with that standard.
  Keep the chain of command informed of environmental problems and concerns.
  Take immediate, effective action in response to spills and other emergencies.
- **Enemy (Opposing Forces [OPFOR]).**
  Ensure the OPFOR commander understands environmental problems and concerns.
  Know enemy characteristics and equipment.
  Identify environmental impacts of decisions.
- **Terrain and Weather.**
  Ensure high-risk areas (surface waters, archeological sites, and endangered species) are identified/marked.
  Navigate accurately; know your location.
  Ensure that unit boundaries are identifiable.
  Ensure that there are redundant navigation aids or checks.
  Know weather effects (dry/windy or wet/soggy conditions) and limit/alter operations accordingly.
- **Troops and Equipment.**
  Ensure that soldiers are briefed on environmental concerns/standards.

Demand situational awareness – units, enemy, hazards, and environment.
Anticipate where maneuver density will be highest.
Use validated SOP to simplify operations.
Insist on accurate and timely spot reports.
Recognize soldier stress.
Rehearse always.

- **Time.**
  Maximize planning time.
  Prioritize tasks, rehearsals, and reconnaissance.
  Adjust pace and tempo.

Again, the best way to supervise and evaluate any type of controls or measures takes a wide-ranging effort. By continually stressing environmental stewardship in everyday work duties and functions, you as the supervisor can ensure that your subordinates integrate environmentally friendly and sustainable actions into their daily duties.

PART C - PLANNING AND CONDUCTING ENVIRONMENTALLY SUSTAINABLE ACTIONS AND TRAINING

When planning training exercises or preparing a petroleum facility SOP, always address the environmental risks associated with the activity. Make sure that subordinates are aware of the risks involved with a given exercise, mission, or other activity. Then, ensure subordinates are able to identify environmental risks associated with everyday and out of the ordinary tasks.

In the absence of specific guidance (when laws, regulations, and policy do not necessarily apply), it should be assumed that the toughest laws apply. This is the root of the Army's environmental ethic. Imagine the worst possible scenario as a consequence of not acting morally right with regard to the situation.

PART D - VERIFICATION THAT HAZARDOUS SUBSTANCES ARE TURNED-IN AND STORED IAW LOCAL UNIT POLICY AND APPLICABLE ENVIRONMENTAL REGULATIONS

Using your local Hazardous Waste Management Plan, ensure that the following have been checked and completed: DD Form 1348-1, the containers, fill capacity, markings, labeling, empty containers, and inspection.

DD Form 1348-1. The Hazardous Waste Accumulation Facility Manager completes DD Form 1348-1. The materials need to be properly classified, described, packaged, marked, labeled, and in proper condition for transportation.

MIL-STD-129. The minimum requirements for the uniform marking of military supplies and equipment for shipping and storage are provided in MIL-STD-129.

Containers. If a container is not in good condition or begins to leak, the contents are transferred to a serviceable container or over-packed immediately. Only DOT-approved containers, compatible with the materials being stored, will be used. A container holding waste is always closed during storage. Containers holding waste are not opened, handled, or stored in a manner which causes the container to rupture or leak. Containers holding ignitable or reactive wastes are located at least 50 feet from the installation's property line.

All containers must be labeled with label marking pens, for example, the Sharpie extra-fine point marking pen. Do not use ballpoint pens. Labels and markings must be replaced if they become damaged or lost. Store containers to allow easy access to container labels. The type of label corresponds with the type of waste. Labels are not placed over labels. All drums and drum-like containers are labeled as to their contents. Empty drums and drum-like containers are labeled "empty."

A container or an inner liner removed from a container that has held any hazardous waste is empty if all wastes have been removed using the practices commonly employed to remove materials from that type of container by pouring, pumping, aspirating, or scraping. A container that held a hazardous waste of compressed gas is empty when the pressure in the container is at atmospheric pressure. A container or inner liner removed from a container that held an acutely hazardous waste is empty if: it is triple rinsed using a

solvent capable of removing the commercial chemical product or manufacturing chemical intermediate, and is then cleaned by another method that has been shown in the scientific literature, or by tests conducted by the generator, to achieve equivalent removal; or if the inner liner that prevented contact of the commercial chemical product or manufacturing chemical intermediate with the container is removed.

Inspection. Facilities provided to store, handle, or use hazardous substances will be periodically tested and inspected. Some HM/HW considerations for inspection include:

- Are amounts of HM on hand limited to the minimum needed (no stockpiling of HM)?
- Is the unit's HM/HW inventory (quantity and location) up to date?
- Do HW containers have drum logs to account for all additions and to specify personnel authorized to make additions to the containers?
- Are MSDSs on hand for all HMs? Are MSDSs readily available to all workers with exposure to HMs?
- Is HW accumulated in authorized containers?
- Are containers labeled according to directives?
- Are containers in good condition and closed when not in use?
- Are contents of containers compatible with the container?
- Are accumulation start dates and HW labels on each HW container?
- Are container storage areas inspected at required intervals?
- Is HM/HW managed for prompt pick up and transportation to disposal facility according to directives?
- Are used oil accumulation tanks used for collection of HW and other pollutants?
- Are danger and warning signs conspicuously placed?
- Is spill-prevention and -control equipment adequate?
- Are personnel trained in the proper handling, collection, storage, or transportation of HM/HW?
- Are dumpsters free of HM/HW items?
- Are used POL cans and drums disposed of properly?
- Are asbestos-containing parts (brake shoes, clutch plates, and equipment insulation) removed, collected, and disposed of properly?
- Are batteries stored/disposed of properly?
- Is equipment containing radioactive sources (for example, gun/mortar sights and M8A1 alarms) properly stored to prevent breakage and release of radioactive materials? Are incidents reported properly?
- Is ammunition stored properly?

PART E - VERIFICATION OF THE PROPER CONSERVATION OF RESOURCES

AR 200-1 (Environmental Protection and Enhancement) addresses the Army Hazardous Materials Management Program. This program outlines the procedures to be implemented by installations and units to minimize or eliminate the use of hazardous materials when possible, using the following alternatives:

- Substitute less hazardous or nonhazardous material.
- Modify processes or procedures to reduce or eliminate use.
- Restrict user inventory.
- Reduce consumptive use.
- Direct ordering.
- Extend shelf life.
- Regenerate spent material.
- Downgrade and reuse spent material.
- Reuse for other purposes.
- Combinations of the above.

Hazardous materials required for testing petroleum products can be some of the most dangerous substances in use. Most of the hazardous materials used to perform the various tests in the petroleum lab are not substitutable. Therefore, supervisors have to focus the hazardous materials management efforts on minimization and conservative use of these materials.

Unit Recycling Program. Ensure that subordinates are familiar with and participate in the recycling program. Ensure that all recyclable materials are being recycled, such as:

- Computer paper.
- Corrugated cardboard.
- Newspaper.
- High-grade white paper.
- Aluminum cans.
- Plastics.
- Oil.
- Solvents.
- Glass.
- Steel.
- Brass.

Make sure that recyclable material is separated at the source. Contaminated or otherwise unrecyclable material should be removed, cleaned, or properly disposed of. Check with the installation Environmental Office to verify and get information on the material being recycled in your area.

Implementing Techniques to Avoid Overuse or Pollution. Implementation of techniques to protect training area land can be accomplished by integrating them into the environmental risk assessment matrices, mission planning, SOP, orders, and training/performance standards.

PART F - VERIFICATION OF EQUIPMENT, PERSONNEL, AND CORRECT PROCEDURES TO CONTAIN AND CLEAN UP A HAZMAT SPILL

Equipment and material required for each work area can be found in the local unit ISCP and SPCC. Prior to beginning any operation, conduct an inspection of the petroleum facility to verify the presence/condition of the following hazardous materials spill containment and cleanup equipment/materials:

- Solusorb solvent absorbent.
- Gloves.
- Scoops.
- Disposal bag/tie/label.
- Instructions.

Periodically check the equipment/materials for serviceability, making sure that they are in serviceable condition. Ensure that personnel are familiar with the local unit ISCP and SPCC.

Spill Containment and Clean-Up Training Verification. Periodically the supervisor of the petroleum facility should conduct exercises to verify that personnel are trained in up-to-date spill containment and cleanup procedures. Verify that petroleum facility personnel are current with the emergency spill containment and cleanup procedures/requirements. Upon discovery of a spill, personnel shall take action as follows:

- Safely stop the source of the spill, if possible (closing valves, uprighting containers, and so forth.
- Contain spill.
- Apply absorbents.
- Ensure adequate ventilation.
- Erect barriers or otherwise restrict or stop flow.
- Block sewers.

When reporting a spill to the installation's Fire and Emergency Service or 911, the following questions should be considered to determine the nature and severity of the spill.

- Is the spilled substance classified as a flammable liquid?
- Is the quantity spilled 25 gallons or more?
- Is the spill confined to a hard surface?
- Is it possible that the spill will reach surface waters, wetlands, groundwater, streams, ditches, sewers, or drains?
- Does the reporting activity have the capability to contain or clean up the spill?
- Is the spilled substance classified with an Required Quantity (RQ) value?

Not only is the appropriate equipment important when handling a spill, but it is also important to have properly trained personnel. The supervisor's duty is to verify that personnel conducting an operation are trained in the

proper use of spill cleanup and containment equipment. Those handling the spill must also employ the proper procedures IAW the ISCP and SPCC.

Once the spill has occurred and been taken care of, it must be reported. The petroleum or other hazardous spill must be reported immediately via the chain-of-command and cleaned up immediately after personal safety precautions have been taken and notification to people in the area has been made IAW the ISCP, the SPCC, and unit SOP.

Spill Prevention Control and Countermeasures Plan. The purpose of the Spill Prevention Control and Countermeasures Plan (SPCC) is to identify potential sources of oil and hazardous substances and the measures required to prevent and contain any accidental discharge resulting from equipment or storage facility failure. At a minimum the SPCC must contain a detailed description of oil spill prevention, control, and countermeasures. This includes structures and equipment for diversion and containment of discharges, facility drainage, and identification of resources to clean up spills, a description of spills which have occurred in the last 12 months with corrective action taken and plan recurrence, and an inventory list of storage, handling, and transfer facilities which present oil spill hazards. Include prediction of direction of flow, rate of flow, and total quantity which could be discharged.

Containment of Spills. It is important to contain spills in order to prevent oil dispersement, lessen the degree of pollution, and ease the problem of cleanup. In a situation where there is a spill-related fire, containment prevents a larger fire hazard and contains the existing fire.

Water spills present a unique set of environmental factors which affect how such spills are handled. Strong wind or current creates headwaves which may go over or under a single boom. However, large waves at sea will aid in breaking up the spill. Low temperatures and atmospheric conditions such as snow, fog, and sleet cause oil to be more viscous, and therefore dispersants work more slowly.

Containment of spills in water is typically done with the aid of booms. The booms should be positioned downwind or down current. In a situation where there are large headwaves, use more than one boom. In addition, you can use fire hoses, propeller wash, wind jet, or piston film to control a water spill.

Containment of land spills requires you to consider several factors. Elevation of storage site, direction spill would flow, and the proximity to water sources need to be evaluated before a containment method is employed. Depending on the situation, berms made of sandbags, piles of dirt, straw, cloth, fiber, or wood chips and dikes, ditches or natural barriers may be used to contain a spill. In addition, alarms and automatic shutoff devices, drip pans, and slop tanks can be used to prevent ground contamination.

Spill Cleanup Methods. Spill cleanup in water is accomplished with the use of sorbents (adsorption and absorption) such as rolls, sweeps, pads, particulate, oil snares, bags, and booms. Depending on the situation, weir, belt, or drum oil/water skimmers may also be employed to remove the oil.

Spill cleanup on land is performed in different ways depending on the size and nature of the spill. Sorbents are used on small spills, while large spills would require the use of mechanical equipment such as scrappers, graders, or bulldozers. In some instances, plowing and tilling of the soil is all that is required. Pumps may also be utilized to remove oil from some areas and wash it into retrieval areas.

Beaches are extremely sensitive to oil spills; oil will penetrate two inches and, if chemically treated, will penetrate two to five times deeper. Federal studies indicate chemicals can cause more harm than the spill itself. EPA approval is needed to use chemical cleanup methods such as dispersants, biological agents such as oil-eating bacteria/enzymes, sinking agents, gelling agents, and burning agents. Chemical agents can be used with government approval under two conditions:

- Danger of fire exists which could be harmful to lives.
- When a spill is traveling in the direction of fish or wildlife-sensitive areas.

PART G - RESOURCES AND PROCEDURES FOR PROPER DISPOSAL AND HANDLING OF HAZARDOUS MATERIALS

In order to maintain compliance with the necessary safety guidelines in a petroleum facility, there must be on hand reference materials to which technicians can refer. The latest versions of hazardous material references are required to be kept in a central, visible, and easily accessible location within the petroleum facility.

ISO 9000-2. Every petroleum facility should maintain a copy of the latest version of ISO 9000-2. This document contains procedures for the safe handling and disposal of hazardous materials listed by type of substance or material.

HMIS. Hazardous Material Information System (HMIS) sheets for hazardous substances can be maintained for each applicable substance used in your facility. Procedures for the safe handling and disposal of these hazardous substances are listed on each sheet under the heading “Precautions For Safe Handling And Use”.

MSDS. Material Safety Data Sheets (MSDS) are required at a minimum to be maintained for each hazardous substance used in your facility. Procedures for the safe handling and disposal of these hazardous substances are listed under the heading of “Handling and Storage Precautions” for handling and “ Spill or Leak Procedures” for disposal.

PART H – PETROLEUM SUPPLY ENVIRONMENTAL SOP

Probably the most important document related to petroleum supply environmental stewardship, will be the Standing Operating Procedures developed by you, as a senior NCO in a petroleum supply unit.

The petroleum supply environmental SOP should contain all applicable environmental safety, training, reporting, clean-up, and doctrinal procedures as presented in this lesson. In addition, this SOP must address situations and procedures that are specific to your particular unit’s mission. The following format taken from FM 10-426, Appendix B, will be used when developing your unit’s environmental SOP. This format outlines the sequence and content coverage required for an effective SOP.

- Unit Location - Using unit location.
- References - Applicable references used to develop SOP.
- Required Content - SOP content.
- Purpose - Tell the reason you are establishing the SOP.
- Scope - Specify procedures and requirements to be covered by the SOP.
- Responsibility - Responsible personnel for each set of procedures
- Procedures - State which operating procedures are to be used.
- Miscellaneous - Any additional pertinent information to be included.
- Definition Section - Definitions of terms
- Signs and Symbols - Explanation of symbols and/or signs used.
- Special Instructions.

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 answer key. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. Major federal laws and regulations can be found in _____.

   A. MIL-HDBK-200.
   B. FM 20-400.
   C ISO 9000-2.
   D. HMIS.

2. What are the three main categories of each environmental risk assessment matrix?

   A. Mission, enemy, and time.
   B. SOPs, training performance standards, and rehearsals.
   C. Air pollution, noise pollution, and water pollution.
   D. Risk impact value, environmental area, and unit operation.

3. When laws, regulations, and policy do not necessarily apply, how should environmental issues be addressed?

   A. Base decisions on laws in a similar environment.
   B. Apply laws that are average for the area.
   C. Assume that the toughest laws apply.
   D. Apply the laws from the nearest location.

3. How far should you ensure that containers holding ignitable or reactive wastes be located from the installation's property line?

   A. 25 feet.
   B. 50 feet.
   C. 75 feet.
   D. 100 feet.

4. Which of the following cleanup equipment/materials should be present at the petroleum facility before beginning any operation?

   A. Newspaper, aluminum cans, and corrugated cardboard.
   B. Piston film, fire hoses, and propeller wash.
   C. Booms, pads, and water skimmers.
   D. Instructions, gloves, and solusorb solvent absorbent.

LESSON 6

SUPERVISE SAMPLING AND GAGING

Critical task:
101-523-3408

OVERVIEW

When directing petroleum products sampling and gaging, it is necessary for the petroleum supply NCO to have knowledge of requirements, identification of proper equipment, evaluation of operations, quantity calculations, supporting unit submission, safety procedures, and the establishment and implementation of a petroleum supply quality surveillance SOP.

Lesson Description:

During this block of instruction we will discuss sampling and gaging requirements, identification of proper sampling and gaging equipment, evaluation of sampling and gaging operations, quantity calculations using DA Form 3853-1, supporting unit submission, safety procedures, and the implementation of a sampling and gaging SOP.

Terminal Learning Objective:

Action: The soldier will acquire knowledge on selecting the proper apparatus, specifying the proper procedures for obtaining a given petroleum sample, verifying temperature readings and volume correction computations, and identifying environmental considerations and viable resolutions.

Condition: Given subcourse QM 5097.

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

INTRODUCTION

As a senior petroleum supervisor assigned to a petroleum facility, you are responsible for directing the sampling and gaging tasks performed by your personnel. The time spent in this lesson, learning how to properly direct sampling and gaging operations, will ensure that your subordinates are proficient and are aware of all the safety precautions needed to perform their mission.

PART A - SAMPLING AND GAGING EQUIPMENT VERIFICATION

Periodically and/or during scheduled inspections, you as a supervisor should ensure that the proper equipment required for sampling and gaging operations is on hand and in good working condition. Items that could be used to successfully perform sampling and gaging procedures, depending on the particular mission, are listed as follows:

- Bacon Bomb Sampler (Figure 6-1) – consists of a nickel-plated brass cylinder tapered at both ends and fitted with an internal, plunger-type valve, and a drop cord. This sampler is used to take bottom samples of liquid products of 2 psi or less RVP and samples of semiliquid products.

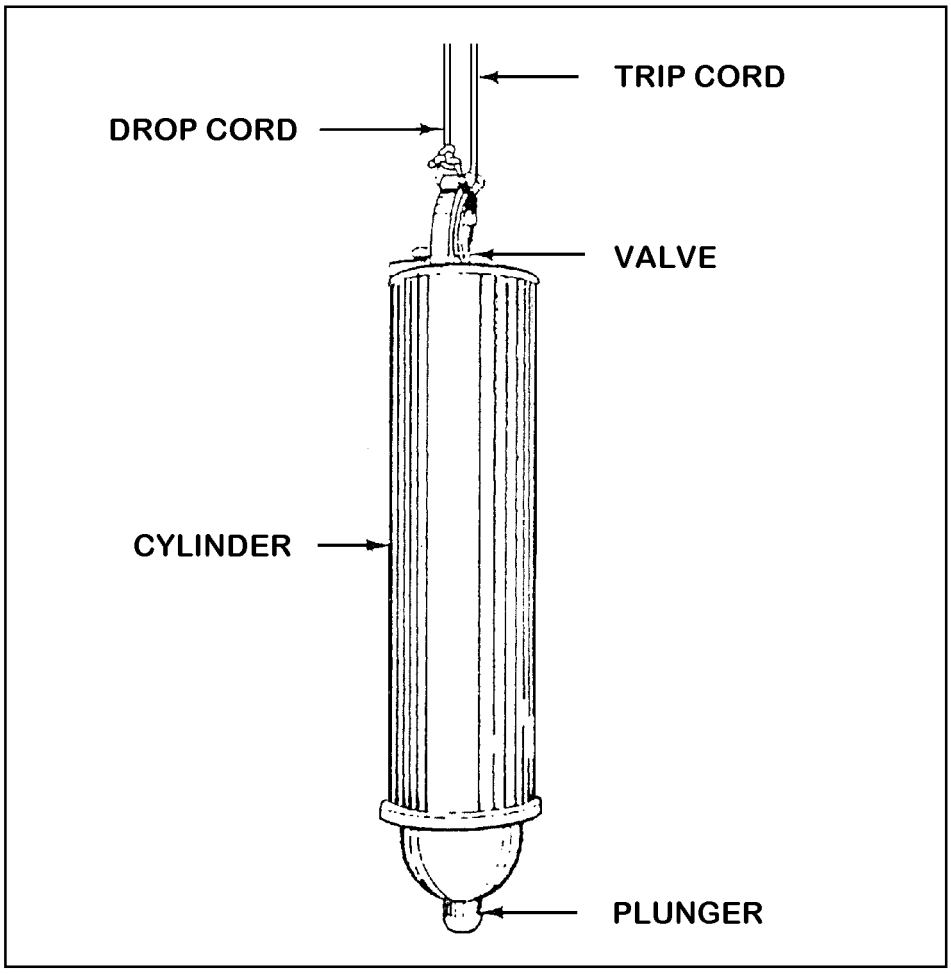

Figure 6-1. Bacon bomb thief.

- Drum Thief Sampler – consists of a two-piece, plastic tube 39 ½ inches long and 1 ½ inches at maximum diameter. The tube is fitted with two finger rings at the upper end and three supporting legs at the bottom. Both ends are tapered and have openings. This sampler is used to take samples of liquid products of 12 psi or less RVP and samples of semiliquid products.
- Core Thief Sampler – designed so that a sample can be obtained from the bottom ½ inch of the car or tank. One type is lowered with valves open to permit the oil to flush through the container. When the thief strikes the bottom of the tank, the valves shut automatically. The other type has a projecting stem on the valve rod which opens the valves automatically as the stem strikes the bottom of the tank.

- Bottle/Beaker Sampler (Figure 6-2 and 6-3) – the weighted copper beaker sampler consists of a copper bottle permanently attached to a lead base and a drop cord. This sampler is used to take upper, middle, lower, or all-level samples of liquid products of 16 psi or less RVP. The weighted bottle sampler consists of a glass bottle within a square, weighted metal holder and a drop cord. This sampler has the same application as the weighted beaker sampler, but with its wider mouth, it can be used for sampling heavier products.

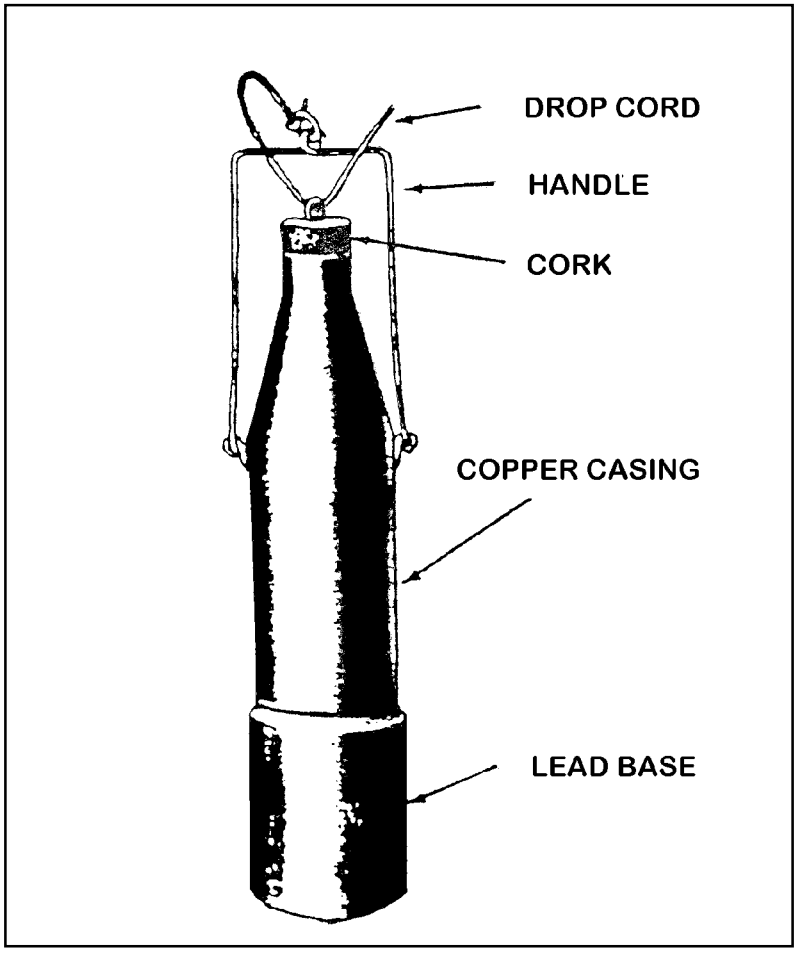

Figure 6-2. Weighted beaker sampler.

- Extended Tube Sampler – consists of a flexible tube connected to the suction of a manually operated pump. The tubing is attached to the weighted end of a conductive wire or tape. This sampler may be used only for obtaining bottom water samples.
- Closed Core Thief Sampler - designed so that a sample can be obtained from the bottom ½ inch of the car or tank. It has a uniform cross section and bottom closure with a capacity depending upon the size of the sample required, and it may be used for sampling crude petroleum.
- Manual Sampling Probes – used to withdraw from the flowing stream a portion that will be representative of the entire stream.
- Dipper (size relative to sample size desired) – consists of a flared bowl and a handle of convenient length, made of material such as tinned steel that will not affect the product being tested. The dipper should have a capacity suitable for the amount to be collected and must be protected from dust and dirt when not in use.

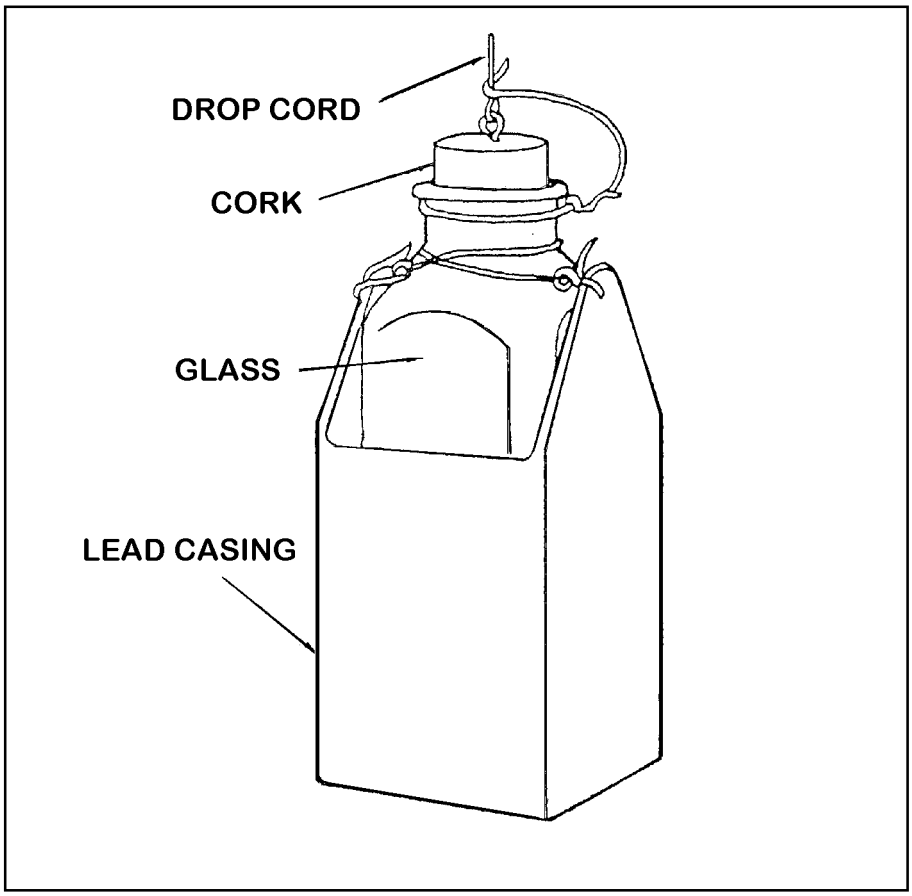

Figure 6-3. Weighted bottle sampler.

- Tube Sampler – either a glass or metal tube may be used, designed so that it will reach within about 1/8 inch of the bottom and have a capacity of approximately 1 pint. or quart. This procedure is applicable for sampling liquids of 2 psi RVP or less and semiliquids in drums, barrels, and cans.
- Vacuum Pump Sampler – consists of a tube, plunger handle, and tubing. It has an outside diameter of 1 ¼ inches and is 7 inches long. The sampler can lift about 25 feet of water at sea level.
- Thermometers.
- Polyethylene Pails.
- Sample Containers and Materials.
  - Glass (clear and dark).
  - Metal.
  - Aluminum or steel scoops.
  - Labeling materials.
- Sampling and Gaging Kit.
- Gaging Equipment.
  - Tape and bob.
  - Petroleum gage stick.
  - Tank vehicle gage stick.
  - Yardstick.
  - Tank car gage stick.

PART B - CHECKING PROCEDURES USED TO OBTAIN THE TEMPERATURE OF PETROLEUM PRODUCTS

Temperature Measurement. Because the volume of petroleum products increases or decreases in direct proportion to temperature increase and decrease, accurate measurement of the temperature of a product must be taken at the time of gaging. The measured quantity must be corrected to the standard temperature of 60°F for volumes over 3,500 gallons. When gaging large quantities, take temperature readings at various levels and average them to determine the true average temperature of the product. Table 3-1 of FM 10-67-1 (Concepts and Equipment of Petroleum Operations) (Figure 6-4) shows the number of readings necessary and the levels at which tank thermometers should be placed.

Depth of Product	Minimum Number of Temperature Measurements	Measurement Levels
More than 15 feet	3	3 feet below top surface of product, middle of product, and 3 feet above the bottom
10 -15 feet	2	3 feet below top surface of product, and 3 feet above the bottom
Less than 10 feet	1	Middle of product

Figure 6-4. Petroleum product temperature measurements (FM 10-67-1, Table 3-1 extract).

Measuring Instrument. The cup-case thermometer (Figure 6-5) is used to measure the temperature of a product in storage tanks. The thermometer is attached to a hardwood backing with the base of the mercury column extending into the cup case. The cup case, when filled with liquid under measurement, minimizes fluctuation of the reading when the thermometer is suddenly withdrawn from the tank. The minimum immersion time for the cup-case thermometer in various petroleum products is given in Table 3-2 of FM 10-67-1 (Figure 6-6). To avoid the long immersion time required for measuring the temperature of heavy fuel oils, it may be practical to leave thermometers suspended in the tanks at all times.

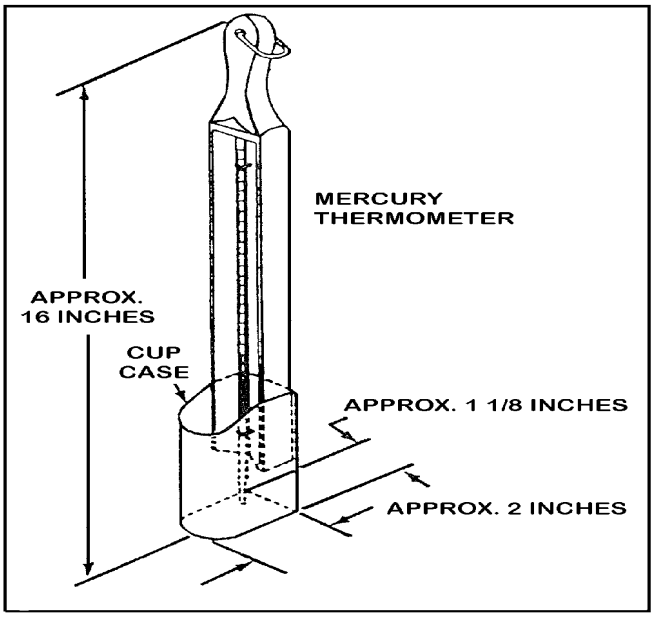

Figure 6-5. Cup-case thermometer.

PRODUCT	TIME (MINUTES)
Automotive gasoline (MOGAS), aviation gasoline (AVGAS), kerosene, diesel fuel, jet fuel, and grades 1 and 2 burner fuel oil	5
Grades 4, 5, 6, and Navy Special burner fuel oil	15
NOTE: This conforms to Table IV, Minimum Immersion Time for Cup-Case Assembly, API Standard 2543, ASTM Designation D 1086. Product listings are not comprehensive.	

Figure 6-6. Minimum immersion times for the cup-case thermometer (FM 10-67-1, Table 3-2 extract).

Measuring Procedures. To measure the temperature of petroleum products in storage tanks, the following procedures are used:

- The thermometers are inspected for separation of the mercury column, and any faulty thermometers are replaced. Separation of the mercury column results in incorrect readings. Each thermometer is checked for accuracy by comparing the readings of a number of thermometers exposed to atmospheric temperature at the same time and location. Any thermometer that has a reading deviation from the other readings by more than 0.5°F is replaced.
- The cup case is attached to the end of a gage tape or suitable cord.
- The thermometer is then lowered to the required product level and allowed to remain at this level at least as long as the minimum time specified in Table 3-2 of FM 10-67-1 (Figure 6-6).
- The thermometer is then withdrawn and read immediately with the cup sheltered below the edge of the hatch to minimize any change of reading that may be caused by wind or atmospheric temperature. The cup must be full when withdrawn, and the product must not be spilled from the cap when taking a reading. As quickly as accuracy will permit, the temperature is recorded to the nearest 0.5°F.
- When readings are taken at more than one level, all readings are added and divided by the number of readings in order to obtain the true average temperature of the product. For example, assume a tank had 20 feet of product in it. You would take recordings at 3 feet, 12 feet, and 21 feet, according to Table 3-1 of FM 10-67-1 (Figure 6-4). Assume that readings of 82° F, 81° F, and 80°F were obtained. Add these readings and divide by three to get an average temperature.

PART C - CHECKING GAGING PROCEDURES

Accurate gage readings, temperature API gravity, and the volume of bottom sediment and water (BS&W) are necessary to calculate the net volume of petroleum at the standard temperature of 60°F. Gages are determined through specified gaging hatches in tanks, ships, barges, tank cars, and tank trucks. There are two basic types of procedures for obtaining gages: innage and outage. Normally, outage gage is used for vessels and railcars, and innage gage is used for storage tanks. Bulk petroleum products are often handled many times before they are used. Throughout this handling, they must be rigidly accounted for, and accurate quantity records must be maintained at all times. For accountability purposes, products must be gaged periodically to determine the quantity of products on hand, verify of quantities received or issued, detecting leaks or unauthorized withdrawals, determine presence and amount of BS&W, and determine the terminal capacity for receiving shipments. Accounting for all receipts, issues, transfers, and operational gains and losses of bulk petroleum products is a major responsibility of the terminal accountable officer.

Gaging Terms. The following gaging terms are used:

- Innage. The depth (height or volume) of product in a tank measured or gaged from the surface of the product to the tank bottom.
- Outage (Ullage). A measurement of the free space above the surface of the product extending to the reference mark.
- Reference Mark. A horizontal line put in the rim of the gaging hatch representing a fixed point from which measurements are made.
- Datum Plate. A level metal plate at the tank bottom and directly under the reference mark. This plate provides a smooth, level surface for the innage bob to rest upon.

- Reference Height. The distance from the reference mark to the tank bottom or datum plate. After the reference height is established, it is stenciled in a conspicuous place adjacent to the gaging hatch.
- Innage Tape and Bob. A graduated, metallic tape and pointed bob used to determine the amount of innage in a bulk storage tank.
- Outage Tape and Bob. A graduated, metallic tape and flat bob used to determine the amount of ullage in a bulk storage tank.
- Product-Indicating Paste. A chemical paste used in measuring the amount of liquid petroleum in a storage tank. It will change color when it comes in contact with a petroleum product.
- Water-Indicating Paste. A chemical paste used to differentiate between liquid petroleum product and water. The paste changes color when it comes in contact with water, but is not affected by petroleum products.
- Tape Cut. The line made on the tape measuring scale by the product being measured.
- Bob Cut. The line made on the bob by the BS&W being measured.
- Opening Gage. A gage of a product taken before delivery, issue, or receipt of a product.
- Closing Gage. A gage of product taken after delivery, issue, or receipt of a product.
- Total Measured Quantity. Total measured quantity is the volume of product and BS&W in a tank at the observed temperature of the product at the time of gaging. It is usually obtained from a tank's capacity table or strapping chart.
- Bottom Sediment and Water (BS&W). The amount of sediment and water measured in the bottom of a tank.
- Net Volume Uncorrected. The volume of product in a storage tank at the observed temperature.
- Net Quantity at 60°F. The net volume, uncorrected and converted to the equivalent volume at 60°F.

Gaging Equipment. Items of gaging equipment are described below.

- Innage Tape and Bob (Figure 6-7). The steel innage tape is graduated to 1/8 inch, and the first whole number on the tape is 9 or 10. Consequently, from the pointed tip of the conical bob to the first number on the tape is 9 or 10 inches. From the tip of the bob to the top of the eyelet is 6.6 inches. The bob is made of nonsparking metal, and "0" is at the bob's tip.

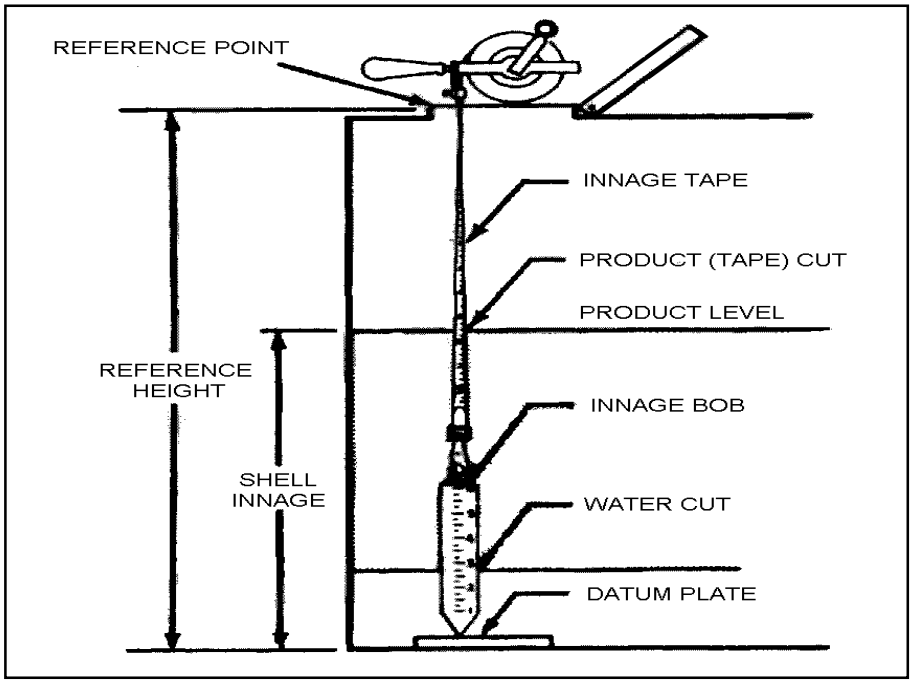

Figure 6-7. Innage tape and bob.

- Outage Tape and Bob (Figure 6-8). The steel outage tape is similar to the innage tape except that the readings begin at the 2-inch level. The "0" reference is where the harness snap connects to the bob. The rectangular bob is 6 inches long, but the 1/8-inch graduations start with the 6-inch mark at the bottom and

are read upward to 1 inch as the last whole number on the top. The outage bob has a flat nose and is made of nonsparking metal.

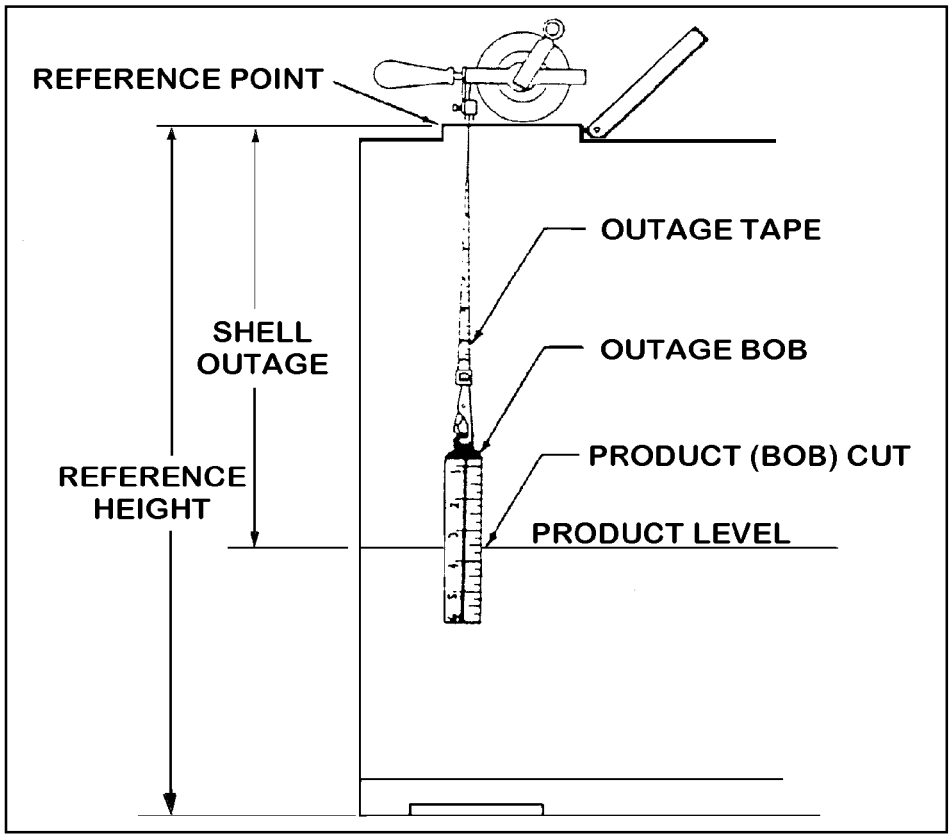

Figure 6-8. Outage tape and bob.

General Precautions. General precautions for gaging are as follows:

- Remove gaging device housing by unscrewing it carefully and slowly. If pressure exists, unscrew housing two or three threads to relieve pressure. Do not unscrew housing completely or release gage-tube lock with head or body over it as high pressure may cause the gage tube to rise rapidly.
- Whenever there is a gage-tube safety latch, tighten the packing nut to prevent leakage and replace the gaging device housing.
- Use care in operating all valves and removing and replacing their plugs. Use open-end or socket wrenches on the plugs, and do not apply much force on valves with broken stems.
- If there is any pressure or sound of escaping vapor, the pressure must be relieved.
- Be sure all loading connections are tight before operations are started. After shutting the supply valves, release pressure in the line before disconnecting.
- To test for leaks, spread soapy water or light mineral oil on the suspected part to aid in verification. Never test with a flame.
- If excess-flow valves close, it is necessary to close the operating valves to allow pressure to equalize.
- Carefully regulate the rate of flow to prohibit an excessive rate of flow.

Innage Method of Gaging. Gaging procedures for atmospheric and other non-pressure tanks using the innage tape and bob are as follows:

- Raise the appropriate hatch cover and locate the reference point.
- Apply water-indicating paste to the bob and product-indicating paste to the tape at the expected level of the product in the tank. Apply the paste thinly and to the graduated side of the tape.
- The ungraduated side of the tape is held in contact with the metal rim of the gaging hatch at the reference point as the tape is lowered into the tank.
- The bob and tape are lowered into the tank until the bob is within a short distance of the tank bottom. This can be determined by comparing the length of tape unwound from the reel with the reference height of the tank.

- Continue to unwind the tape slowly until the tip of the bob just touches tank bottom or datum plate. The bob must not rest on a rivet or other obstruction. If the tape is lowered too far, the bob will tilt and an incorrect gage reading will be obtained as the product cut shown on the tape will be too high. The tape reading at the reference point should be compared with the reference depth of the container to make sure that the gage is accurate.
- The tape should be withdrawn after at least 30 seconds, and the product cut on the tape should be read and recorded as the innage gage. The water cut on the bob is read and recorded as the BS&W cut.
- Two identical readings are obtained to ensure that the measurement is accurate. The same gaging equipment and gaging hatches are used in obtaining both opening and closing gages, and the tape is lowered to the same depth for both gages.

Outage Method of Gaging. The outage method is used for gaging barges and tankers. All safety procedures apply. Gaging procedures for the outage method are as follows:

- Apply product indicating paste to the length of the bob.
- The bob and tape are lowered into the tank until the bob touches the surface of the product.
- When the bob is motionless, the tape is lowered slowly until the bottom of the bob is 2 or 3 inches below the surface of the product and an even inch graduation mark on the tape is at the reference point. The reading on the tape at the reference point is recorded as the tape reading.
- The tape is withdrawn quickly, and the product cut on the bob recorded as the bob reading. The scale is read to the nearest 1/4 inch.

The bob reading is added to the tape reading to obtain the outage gage as shown in the following example:

Tape reading at reference point		21 feet, 6 inches
Bob reading	+	3 3/4 inches
Outage gage		21 feet, 9 3/4 inches

An outage gage can be converted to an innage gage if the tank being gaged is calibrated only in innage measurements. The procedure is as follows:

- Use the outage gage above (21 feet, 9 3/4 inches) and an assumed reference height of 50 feet.
- The outage gage is 21 feet, 9 3/4 inches (point A to B). The reference height is 50 feet (point A to C). The innage gage will be the distance from points B to C.
- To convert outage to innage simply subtract the outage from the reference height:
  EXAMPLE:

Reference Height	-	Outage	=	Innage Gage
50 feet	-	21 ft, 9 3/4 inches	=	28 ft, 2 1/4 inches

Bob cuts for BS&W in the outage method must be done with an innage bob as described previously.

Volume Correction. The volume of liquid petroleum products changes because of changes in temperature. Therefore, gaged volumes in excess of 3,500 gallons must be corrected to account for this change of volume. When the observed temperature is above 60°F, the observed volume is reduced to 60°F because expansion has taken place. However, when the observed temperature is below 60°F, the observed volume is increased to the volume at 60°F because contraction has taken place.

DA Form 3853-1 (Innage Gage Sheet (Using Innage Tape and Bob)) (Figure 6-9) will be used to record volume correction data. All tanks have individual strapping charts or tank calibration tables which show the volume of product in the tank per foot, per inch, and even per fractions of an inch, usually 1/8 inch. Using the physical gage (product and BS&W) measurements, the gager can determine the total volume of product in the tank. By using the same tank table, the gager determines the volume of water in the tank. The volume, and only the volume, of petroleum products is left.

INNAGE GAGE SHEET *(USING INNAGE TAPE AND BOB)*
For use of this form, see FM 10-69; the proponent agency is TRADOC

UNIT	DATE	TIME
LOCATION	API GRAVITY	☐ OPENING ☐ CLOSING ☐ INVENTORY
TANK NO. / NOMINAL TANK CAPACITY	PRODUCT AND GRADE	

LINE NO.	PROCEDURE	LINEAR READING	VOLUMETRIC EQUIVALENT *(Gallons)*
1	Tape reading *(innage)*		
2	Bob reading *(bottom sediment and water)*		
3	Net volume of product, uncorrected for temperature *(Line 1 minus line 2)*		
4	Average temperature		
5	Multiplier		
6	Net quantity of product at 60° F *(U.S. Gallons)(Line 3 multiplied by line 5)*		

REMARKS *(Include sample number)*

NAME AND GRADE OF OPERATIONS OFFICER *(Print)*	NAME AND GRADE OF GAGER *(Print)*
SIGNATURE OF OPERATIONS OFFICER	SIGNATURE OF GAGER

DA FORM 3853-1, 1 MAY 72 USAPPC V1.00

Figure 6-9. DA Form 3853-1, (Innage Gage Sheet (Using Innage Tape And Bob)) Sample.

You must remember to subtract volume from volume, never inches from inches. The resulting figure is at the observed temperature and is ready to be corrected to volume at 60°F. To determine the multiplier necessary to convert the volume at observed temperature to the volume at 60°F, one would need an average tank temperature and the API gravity of the product. Example of volume correction (innage gaging):

Tape Cut Reading:	6 feet, 3 5/8 inches
Bob Cut Reading:	0 feet, 1 1/8 inches
Tank Temperature:	67.5°F
API Gravity at 60°F	56.3 (JP-4)

STEP 1. Convert gage readings to gallons.
Bob cut of 0 feet, 1 1/8 inches converts to 255.6 gallons.
The tape cut of 6 feet, 3 5/8 inches converts to 17,181.4 gallons.

STEP 2. Subtract the BS&W (bob cut volume) from the total volume to get the uncorrected net volume of the fuel.
17,181.4 gallons - 255.6 gallons = 16,925.8 gallons

STEP 3. Find the volume correction factor in ASTM Petroleum Measurement Table 6B.
Round the API gravity at 60°F to the nearest 0.5 API. 56.3 rounds to 56.5.
Locate the tank temperature of 67.5°F in the extreme left-hand column.
Go across from 67.5 until you are under the rounded API gravity of 56.5.
The volume correction factor is 0.9950.

STEP 4. Multiply the uncorrected net volume from step 2 (16,925.8 gallons) by the volume correction factor in step 3 (0.9950).
16,925.8 X 0.9950 = 16,841.2

STEP 5. Round out the result to the nearest gallon and report as 16,841 gallons at 60°F.

Review Quantity Calculations on DA Form 3853-1 and Gaging Records for Accuracy.

As supervisor of a petroleum supply unit, you must ensure that all quantity calculations and gaging records generated by petroleum supply personnel are accurate. Mistakes or oversights on quantity calculations and gaging records could lead to the recommendation of the improper disposition of a large quantity of fuel that may or may not be contaminated. The steps that may be taken to ensure the accuracy of calculations on DA Form 3853-1 and gaging records are as follows:

- Ensure personnel are familiar with gaging procedures and cautions outlined in FM 10-67-1, MIL-HDBK-200 (Quality Surveillance Handbook for Fuel, Lubricants, and Related Products), and AR 710-2 (Inventory Management Supply Policy Below the Wholesale Level).
- Periodically spot-check the calculations and conversions against records and tables.
- Assign technicians the task of checking fellow technicians' calculations and records for accuracy.
- Provide continuous training for lab personnel with regard to gaging procedures.
- Ensure all entries on DA Form 1358-1 are clear and legible.

Review of calculations and record information can be routinely accomplished by the supervisor or a named, responsible individual. At minimum the following entries must be reviewed for possible inaccuracies:

- API Gravity.
- Tape Reading.
- Bob Reading.
- Net Volume (uncorrected).
- Average Temperature.
- Multiplier.
- Net Quantity (at 60°F).

PART D - ASTM METHOD D- 4057 SAMPLING PROCEDURES

Samples of petroleum and petroleum products are examined by various methods of testing for the determination of physical and chemical characteristics. It is necessary that the samples be truly representative of the petroleum products in question. The precautions required to ensure the representative character of the sample are numerous and depend upon the type of material sampled, the source from which the sample is obtained, the type and cleanliness of the sample container, and the sampling procedure that is used. A summary of sampling procedures and their application is presented in this lesson. Each procedure is suitable for sampling a number of specific materials under definite storage, transportation, and container conditions. The basic principle of each procedure is to obtain a sample or a composite of several samples in

a specific manner and from specific locations in a tank or other container in order that the sample or composite will be truly representative of the petroleum product(s) being tested.

Types of Samples. A sample is a small portion of a substance used to inspect or to determine the quality of the total substance. The various types of samples of petroleum products are listed below:

- Top Sample. A sample taken with a weighted bottle or beaker sampler from a depth of about 6 inches below the surface of the tank's contents.
- Upper Sample. A sample taken with a weighted bottle or beaker sampler from the middle of the top third of the tank's contents.
- Middle Sample. A sample taken with a weighted bottle or beaker sampler from the middle of the tank's contents.
- Lower Sample. A sample taken with a weighted bottle or beaker sampler from the middle of the bottom third of the tank's contents.
- Bottom Sample. A sample taken with a bacon bomb or thief sampler from material present on the bottom of a tank.
- All-Levels Sample. A sample taken by submerging a stoppered, weighted bottle or beaker sampler to a point as near as possible to the tank draw off point, opening the sampler, and raising it at a constant rate so that it is 75 to 85 percent full when it emerges from the liquid.
- Average Sample. A sample that consists of proportionate parts from all levels of the container. For example, an average sample from a horizontal, cylindrical tank or from a spherical tank should contain more material from the middle of the tank where the diameter is greatest.
- Composite Sample. A sample combining individual samples that represents the bulk of the product from which it was taken.
  - Single tank composite sample. A sample that is a blend of the upper, middle, and lower samples from a tank's contents.
  - Multiple tank composite sample. A sample that is a proportionate blend of individual, all-levels samples taken from compartments containing the same grade of product. The sample consists of parts in proportion to the volume of product in each compartment sampled.
- Outlet Sample. A sample taken with a weighted bottle or beaker sampler at the level of a tank outlet, whether fixed or swing line.
- Drain Sample. A sample taken from the water drain-off or discharge valve.
- Continuous Sample. A sample taken from a flowing pipeline in such a manner that the sample is a representative average of the stream during the period of sampling.
- On-Line Sample. A sample taken from a flowing pipeline by opening a valve and collecting the sample during the flow of the product.

Sampling Procedures. A simple set of sampling procedures cannot be given because products are different; the method of transportation and storage are different. Sampling requirements of many tests are different. A few important sampling points are as follows:

- Representative Sample. A sample must represent the entire quantity of product sampled. Otherwise, the resulting analysis can only reflect the quality of a portion of the whole substance, and the quality reflected may be better or worse than the true quality.
- Size of Sample. The normal size of a sample is 1 gallon for liquids and 5 pounds for semisolids. Special samples and gasoline samples for testing performance number by the super charger method should be 5 gallons. Samples of jet fuel to be tested for thermal stability should be 5 gallons.
- Standard Sampler. The sampler should be one of the standard types (ASTM D270) and the one best suited to the product and to the carrier or container. However, in situations where a standard sampler is not suitable because of the small opening through which the sample must be taken, an improvised sampler can be used. In any case, the sampler must be clean and made of a material that will not contaminate the sample.
- Cleaning the Sampler. Rinse sampler and container with the product being sampled.
- Protecting Samples. All sample containers should be protected for shipment. Samples of gasoline, jet fuel, and kerosene should be protected from direct sunlight by using brown bottles or cans or by covering clear bottles with paper or foil. Samples of gasoline and JP-4 should be kept cool (30° to 40°F) if possible to prevent loss of light ends. Samples of product containing lead additives must be protected from sunlight.
- Sample Numbers. A sample number should be assigned to each sample and entered on the sample tag. This number is made up of the last two digits of the calendar year and the sample number for that year.

For example, the first sample from an activity for 1998 is number 98-1. A station log should be kept with a record of samples submitted to the designated testing laboratory.

PART E - VERIFYING SAMPLE INFORMATION IS COMPLETE

Sample Numbers. Ensure that the proper numbering convention (for example, unit's first sample from 1998 = 98-1), and that there are no duplication or skipping of numbers assigned from your unit.

Laboratory Log. A log should be maintained as a permanent record of samples received for testing. The following information should be entered on the sample tag:

- Date of receipt.
- Type of product.
- Unit sample number.
- Source of the sample.
- Quantity the sample represents.
- Sampler's name.
- Date sampled.
- Date of completion of tests.

PART F - SAFETY PRECAUTIONS FOR HANDLING SAMPLES

A sampling and gaging SOP should be developed for your unit according to the specific mission assigned. The following safety precautions should be known/available to all assigned personnel handling samples:

- Before a tank is gaged, static electricity must be grounded by touching the bare hand to the tank shell (or handrail).
- When possible, tanks should be gaged from the side of the gaging hatch with the wind at your back, and caution should be exercised against breathing vapor from the contents of the tank.
- Tanks should never be gaged during an electrical storm.
- When gaging must be done from the roof, personnel should stand at the same location on the roof for both opening and closing gages.
- Innage gaging should be to the nearest 1/8 inch. Outage gaging is done to the nearest 1/4 inch.
- Gaging should be repeated until two gagings are identical.
- The tape should touch the rim of the gaging hatch at all times to ground static electricity.
- The tape should be wiped clean and dry after each use.
- After the product has been discharged into a tank, it should stand at least 30 minutes to eliminate static electricity.
- A product temperature reading for volume correction should be taken immediately before or after volumes of 3,500 gallons or over are received or issued.
- Use the same tape and bob for opening/closing gages.

All personnel, in addition to being familiar with specific safety measures for sampling and gaging, should also be familiar with the general safety precautions outlined in the fire prevention and safety SOP.

PART G - ENVIRONMENTAL CONSIDERATIONS

Environmental considerations should always be taken into account, especially when performing sampling and gaging operations. The fire prevention and safety SOP should be used to the fullest extent possible. Some of the considerations that will need to be addressed in relation to sampling and gaging SOP are as follows:

- Storage Procedures.
- Hazardous Materials Handling.
- Spill Containment and Cleanup.
- MSDS and HMIS.
- SPCC and ISCP Procedures.

PART H - FREQUENCY OF TESTING

Guidelines and procedures for testing of petroleum products must also be contained within the sampling and gaging SOP. Listed below are some of the general requirements; more detailed information can be found in MIL-HDBK-200.

To determine the minimum frequency of sampling and testing, you would refer to MIL-HDBK-200, Tables II and III (Figure 6-10 and 6-11). With these tables and the information obtained from the DA Form 1804 (Petroleum Sample) Tag, you can determine what type of minimum test is required to be performed on the samples taken (such as type A, B-1, B-2, B-3, or C test). The same tables list the type of samples to be taken (such as an upper, middle, lower, composite, all-level, line sample or a representative sample for packaged products).

The proper size of the sample is covered in paragraph 5.4, MIL-HDBK-200. Normally, liquid samples submitted for analysis will not be less than 1 gallon in size; semisolids will not be less than 5 pounds.

Special samples and gasoline samples requiring ASTM aviation supercharge method of determining performance numbers will be of 5-gallon size unless otherwise directed. Samples of jet fuel requiring full specification tests will be 5 gallons.

PRODUCT DESCRIPTION	**MINIMUM TESTING**	**FREQUENCY (MONTHS)**
	BULK	PACKAGED
Gasoline, Aviation	6	6
Gasoline, Automotive 1/	6	12
Turbine Fuels, Aviation 1/	6	12
Diesel Fuels	6	12
Kerosene	6	12
Fuels, Burner	6	12
Fog Oils	6	12
Note – Product stored in collapsible containers shall be tested every month as a minimum.		

Figure 6-10. Minimum frequency for testing petroleum products (MIL-HDBK-200, Table II - excerpt).

SERIAL	**LOCATION OF STOCKS**	**TYPE STORAGE**	**WHEN SAMPLED**	**TYPE SAMPLE**	**TESTING REQUIRED**	**REMARKS**
1	At refineries, blending installations, etc., on procurement	Bulk	After establishment of new batch	Upper, Middle, and Lower Composite, or All-level Composite.	A	
2	Shore tanks and pipeline, main depot receiving tank	Bulk	Before Transshipment	Same as Serial 1	Appearance, API gravity, Color, Flash Point, Filtration Time, FSII, Water Reaction (as Applicable)	
3/4	Waterborne Shipments					

Figure 6-11. Minimum sampling and testing requirements for petroleum products (MIL-HDBK-200, Table III – excerpt).

PART I - DA FORM 1804 COMPLETION

The following information must be entered on DA Form 1804 (Figure 6-12) for each sample taken and/or submitted:

- Product.
- From (Requesting Activity).
- Sample No. (Entered by lab).
- Laboratory No.
- Specification No.
- Amt. Product Sample Represents.
- From (Where sample was taken from).
- Source (What storage type sample was taken from: Truck No., Tank No., Other).
- Sampled By (Individual).
- Stock Number.
- Date Sampled.
- Shipment Delivery Date.
- Fuel Origination.
- Sample Type.

DA FORM 1804 1 NOV 67 PETROLEUM SAMPLE (FM 10-67-1)			REPLACES EDITION OF 1 DEC 62, WHICH IS OBSOLETE, USE REVERSE SIDE FOR REMARKS
PRODUCT COMBAT GRADE TYPE I MOGAS			
FROM (Installation) CHARLIE COMPANY, 103RD QM BATTALION			
SAMPLE NO. 013		LABORATORY NO.	
PRODUCT COMBAT GRADE TYPE I MOGAS			
SPECIFICATION NO. MIL- G - 3056		AMT. PRODUCT SAMPLE REPRESENTS 75,000 GALLONS	
FROM (Intallation) CHARLIE COMPANY, 103RD QM BATTALION			
MANUFACTURER / SUPPLIER FRANKLIN OIL COMPANY, LAFAYETTE, LA			
SAMPLE SOURCE	TRUCK NO.	TANK NO. 9	OTHER (Specify)
SAMPLED BY (Name) PVT. W. BANKS		ARMED SERVICES PROCUREMENT NO.	
STOCK NO. 9130- 00- 160 - 1818		DATE SAMPLED 15 JAN 1999	
QUALIFICATION NO. NA		BATCH NO. NA	
FILL DATE NA		SHIPMENT DELIVERY DATE 27 DEC 1998	
CONTRACT BULLETIN NO. NA		ITEM NO. NA	
___FUEL BULK STORAGE ___ALLIED PRODUCTS ___SPECIAL	___ROUTINE SURVEILLANCE ___PROCUREMENT ___QUAL CONTRACT	__FUEL PACKAGED ___FILTER EFFECTIVENESS ___DEPOT	__PROCUREMENT ORIGIN
TYPE SAMPLE ___COMPOSITE	___TOP __OTHER (Specify)	___MIDDLE	_X_BOTTOM

Figure 6-12. DA Form 1804 (Petroleum Sample).

PART J – PETROLEUM SUPPLY QUALITY SURVEILLANCE SOP

As a senior petroleum NCO, you have by now become quite familiar with SOPs. While most SOPs cover procedures related to certain functions, ensuring that they are accomplished in an efficient and effective manner, the petroleum supply quality surveillance SOP is designed to encompass all aspects of quality surveillance related to petroleum operations. The following standard format will be used in order to ensure the coverage required for an effective and efficient SOP:

- Unit Location - Using unit location.
- References - Applicable references used to develop SOP.
- Required Content - SOP content.
- Purpose - Tell the reason you are establishing the SOP.
- Scope - Specify procedures and requirements to be covered by the SOP.
- Responsibility - Responsible personnel for each set of procedures
- Procedures - State which operating procedures are to be used.
- Miscellaneous - Any additional pertinent information to be included.
- Definition Section - Definitions of terms.
- Signs and Symbols - Explanation of symbols and/or signs used.
- Special Instructions.

Your main responsibility in developing and maintaining a petroleum supply quality surveillance SOP will be to ensure that all procedures are pertinent to your unit's particular mission. The following areas (depending on the local situation will be addressed throughout this course) should be addressed in the SOP as a minimum:

- Policies and procedures for determining and maintaining petroleum quality during storage.
- Policies and procedures for determining and maintaining petroleum quality while loading and unloading tankers and barges.
- Policies and procedures for determining and maintaining petroleum quality while loading and unloading tank vehicles and tank cars.
- Policies and procedures for determining and maintaining petroleum quality during pipeline operations.
- Quality standards for aviation fuels.
- Sampling and maintenance procedures for filter/separators.
- Marking procedures for petroleum containers and equipment.
- Environmental and safety considerations for petroleum quality surveillance operations.
- Other quality surveillance procedures as dictated by higher headquarters.

Once you have developed and established the petroleum quality surveillance SOP, it is your additional duty to ensure that you and your subordinates integrate it into your unit's everyday work requirements. This can be accomplished first by ensuring that all personnel have a physical copy that they can familiarize themselves with. Other ongoing ways to enforce compliance can take the form of scheduled and unscheduled inspections, drills, testing, and routine observations.

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 answer key. If you answer any items incorrectly, go back to the part of the lesson that contains the information involved and study again.

1. Which of the following samplers is used to take samples of liquid products of 12 psi or less RVP and samples of semiliquid products?

   A. Drum Thief Sampler.
   B. Core Thief Sampler.
   C. Extended Tube Sampler.
   D. Dipper.

2. What is the main difference between the innage tape and bob and the outage tape and bob?

   A. The readings for the outage tape begin at the 2-inch level.
   B. The readings for the innage tape begin at the 2-inch level.
   C. The innage bob is made of nonsparking metal.
   D. The outage bob is made of nonsparking metal.

3. Which of the following sample types is taken by submerging a stoppered, weighted bottle or beaker sampler to a point as near as possible to the tank draw off point, opening the sampler, and raising it at a constant rate so that it is 70 to 85% full when it emerges from the liquid?

   A. Middle Sample.
   B. Composite Sample.
   C. All-Levels Sample.
   D. Average Sample.

4. Which of the following is a safety precaution/procedure to be observed by all assigned personnel handling samples?

   A. Outage gaging should be to the nearest 1/8 inch.
   B. Innage gaging should be to the nearest 1/4 inch.
   C. The tape should never touch the rim of the gaging hatch.
   D. The tape should touch the rim of the gaging hatch at all times.

5. Which of the following is a consideration that will need to be addressed in relation to sampling and gaging SOP?

   A. Inspections.
   B. Spill containment and cleanup.
   C. PMCS on equipment.
   D. Sample inventory.

Lesson 1 Practice Exercise Answer Key and Feedback

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

Lesson 2 Practice Exercise Answer Key and Feedback

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

Lesson 3 Practice Exercise Answer Key and Feedback

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

Lesson 4 Practice Exercise Answer Key and Feedback

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

Lesson 5 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1. B.	Part A, page 5-3
2. D.	Part B, page 5-3
3. C.	Part C, page 5-5
4. B.	Part D, page 5-5
5. D.	Part F, page 5-7

Lesson 6 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1. A.	Part A, page 6-2
2. A.	Part C, page 6-7
3. C.	Part D, page 6-12
4. D.	Part F, page 6-13
5. B.	Part G, page 6-13

GLOSSARY

Section I Acronyms and Abbreviations and Section II Terms

ACCP	Army correspondence course program
AAR	after action report
API	American Petroleum Institute
AIPD	Army Institute for Professional Development
ATC	air traffic control, air traffic controller
ASTM	American Society for Testing and Materials
AVGAS	aviation gasoline
AVN BDE	aviation brigade
BSA	Brigade support area
BS&W	Bottom sediment and water
C	Celsius
CAB	Combat aviation brigade
CMMC	Corps Material Management Center
CONUS	Continental United States
COMMZ	Communications zone
COMSEC	Communications security
CONUS	Continental United States
COSCOM	Corps Support Command
DA	Department of the Army
DD	Department of Defense
DF	Diesel fuel
DETC	Distance Education and Training Council
DFM	Diesel Fuel Marine
DESC	Defense Energy Support Center
DISCOM	Division Support Command
DLA	Defense Logistics Agency
DMMC	Division Material Management Center
DS	Direct support
DSA	Division support area
DOD	Department of Defense
EPA	Environmental Protection Agency
DOT	Department of Transportation
F	Fahrenheit
FARE	Forward Area Refueling Equipment
FFCA	Federal Facilities Compliance Act
FM	Field manual
FSB	Forward Support Battalion
FSII	Fuel system icing inhibitor
FSSP	Fuel System Supply Point
FCU	Fuel consumption unit
gal	Gallon(s)
GPM	Gallons per minute
GS	General support
HAZMAT	Hazardous material
HEMTT	heavy expanded mobility tactical truck
HDBK	handbook
HM	hazardous material
HMIS	hazardous material information system
HN	host nation
HW	hazardous waste
IAW	in accordance with
ICE	Interservice Correspondence Exchange
ISCP	Installation Spill Contingency Plan
JP	jet propulsion

JPO	Joint Petroleum Office
LCD	lowest common denominator
LIN	line item number
MBPAS	monthly bulk petroleum accounting summary
MIL	military
MOGAS	motor gasoline
MOPP	mission-oriented protective posture
MOS	military occupational specialty
MSB	Main Support Battalion
MSDS	Material Safety Data Sheet
NATO	North Atlantic Treaty Organization
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
NSN	national stock number
OPFOR	opposing forces
PMCS	preventive maintenance checks and services
POL	petroleum, oils, lubricants
ppm	parts per million
psi	Pressure per square inch
QS	quality surveillance
RCRA	Resource Conservation and Recovery Act
RVP	Reid vapor pressure
RQ	required quantity
S4	Supply Officer (US Army)
S&S	supply and services
S&T	Supply and transport
SF	standard form
SOP	standard operating procedure
SPCC	Spill Control and Countermeasures Plan
STANAG	Standardization Agreement
STD	standard
TDA	Table of distribution and allowances
TM	Technical manual
TMMC	Theater Material Management Center
TOE	Tables of organization and equipment
TPU	Tank and pump unit
TRADOC	Training and Doctrine Command
US	United States (of America)

Section II Terms

additive An agent used for improving existing characteristics or for imparting new characteristics to certain petroleum products.

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.

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

appearance Refers to the visual examination of fuels. The terms used to describe appearance are clear and bright, hazy and cloudy.

aviation fuels (AVFUELS) Those refined petroleum products specifically formulated and blended for use in aircraft engines, both jet engines and piston (reciprocating) engines. AVGAS (below) is an aviation fuel.

aviation gasoline (AVGAS) A hydrocarbon fuel for use in reciprocating piston-type aircraft engines. AVGAS is characterized by high vapor pressure and distillation range and high tetraethyl lead content. It is procured by the military under specification MIL-G-5572.

bonding Electrically connecting units of containers before operations begin in order equalize any static potential that might exist and to provide a continuous path for any static potential that might be generated after operations begin. *(See Grounding.)*

bottom loading Refers to the loading of a railway tank car or tank vehicle through the bottom outlet. Bottom loading reduces loss through vapor formation.

burner fuel oil A fuel oil used under boilers and in furnaces to generate power or heat. Under Federal Specification (FS) W-F-815, it is produced in six grades: FS No. 1, FS No. 2, FS No. 4, FS No. 5 (Light) FS No. 5 (Heavy), and FS No. 6. Under specification MIL-F-859, one grade, Navy special, is produced.

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.

Class III A (Air) Petroleum and chemical products used in support of aircraft.

Class III W (Ground) Petroleum and chemical products and solid fuels used in support of ground and marine equipment.

clear and bright Clear is the absence of visible solids, a cloud, a haze, an emulsion, or free water in the product. Bright is the sparkle of clean, dry product in transmitted light.

compression ignition Ignition in a diesel engine, in which the heat of compression ignites the fuel, in contrast to the spark ignition in a gasoline engine.

contaminant A foreign substance in a product.

contaminated product A product in which one or more grades or types of products have been inadvertently mixed, or a product containing foreign matter, such as dust, dirt, rust, water, or emulsions.

corrosion Rusting; a gradual eating away or oxidation ,such as the action of moist air on steel and the more rapid chemical action of acid on metal or steel.

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.

ground products Refined petroleum products normally intended for use in administrative, combat, and tactical vehicles, materials-handling equipment, special-purpose vehicles, and stationary power and heating equipment.

innage tape and bob A steel measuring tape connected by a harness snap to the eye of cone-tipped bob. Used to measure the distance from the bottom of the tank to the liquid level of product in a tank or gage pipe.

Joint Petroleum Office (JPO) An office established by the Joint Chiefs of Staff with petroleum logistics responsibilities in a unified command in oversea areas.

off-specification product A product which fails to meet one or more of the physical, chemical, or performance requirements of the specification.

petroleum measurement tables ASTM-IP tables provided for the calculation of quantities of petroleum and its products under the required conditions in any of three systems of measurements. Tables are provided for the reduction of gravity and volume to standard states over normal operating ranges, for calculation of weight-volume relationship, and for interconversion of a wide variety of commercially useful unit's (ASTM Method D 1250).

POL Petroleum, Oils, and Lubricants. Included are petroleum fuels, lubricants, hydraulic and insulating oils, temporary protectives, liquid and compressed gases, chemical products, liquid coolants, deicing and antifreeze compounds, together with components and additives of such products.

quality surveillance The measures taken to ensure that petroleum products which have been accepted by the government as being of the required quality are still of the required quality when delivered to the user. QS includes watching over and caring for products during all storage and handling operations, adhering to handling methods and procedures designed to protect quality, and examining and testing of products in storage and on change of custody.

sediment and water Solids and aqueous solutions which may be present in an oil and which may be left to settle or which may be separated more rapidly by a centrifuge.

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.

volatile Tending to evaporate or vaporize readily; volatility is the extent to which a liquid vaporizes or the ease with which it turns to vapor.

volume correction The correction of measured quantity of product, determined by gaging at observed temperature and gravity and reference to a gage table, to net quantity of product at 60°F (16°C) after deducting bottom water and sediment.

water contamination Water present in a fuel in any form; includes dissolved water similar to moisture in the air, entrained water suspended in the form of minute droplets, and free water.