SUBCOURSE **EDITION**

QM 5183 **A**

MANAGE LABORATORY OPERATIONS

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

MANAGE LABORATORY OPERATIONS

Subcourse Number QM 5183

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 on: laboratory procedures, responsibilities, and operations; establishing laboratory Standing Operating Procedures (SOP); monitoring laboratory testing facilities; and developing a maintenance, supply, and calibration program.

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: laboratory procedures, responsibilities, and operations; establishing laboratory Standing Operating Procedures (SOP); monitoring laboratory testing facilities; and developing a maintenance, supply, and calibration program.

CONDITION: Given subcourse QM5183

STANDARDS: To demonstrate proficiency of this task you must achieve a minimum of 70 percent on the subcourse examination.

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ADMINISTRATIVE INSTRUCTIONS

1. Number of lessons in this subcourse: Four

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

LESSON 1

LABORATORY PROCEDURES, RESPONSIBILITIES, AND OPERATIONS

Critical Task:
101-523-4400

OVERVIEW

It is important for the petroleum laboratory NCO to understand all laboratory procedures, responsibilities, and operations.

Lesson Description:

During this block of instruction we will discuss general laboratory duties, responsibilities, and operations.

Terminal Learning Objective:

Action: The soldier will acquire knowledge on laboratory operations, soldier's responsibilities, safety considerations, terminology, and laboratory procedures and environmental considerations.

Condition: Given subcourse QM 5183.

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

INTRODUCTION

The operation of a petroleum laboratory is very crucial to the overall success of any unit's mission. As you are aware the majority of all Army operations rely on fuel to make them successful. The quality, availability, and continued supply of the right fuel are major responsibilities of the petroleum laboratory specialist. In this lesson we will discuss general petroleum laboratory terminology, laboratory operations, and responsibilities.

PART A – LABORATORY OPERATIONS, DUTIES, AND RESPONSIBILITIES

General Procedures. Due to the nature of a petroleum laboratory, and the mission in general and the procedures are at times, very crucial and complex. As a senior petroleum laboratory NCO you are ultimately responsible for the successful accomplishment of the varied tasks and procedures including environmental and safety considerations that are identified below.

- Fire and safety
- Environmental stewardship
- Sample receipt and testing
- Equipment calibration
- Laboratory supply
- Equipment maintenance
- Quality surveillance
- Base laboratory facility monitoring
- Aviation unit facility monitoring
- Air-mobile and mobile petroleum laboratory operations
- Correlation testing
- Personnel training
- Overall laboratory facility quality assurance

As a petroleum supply senior NCO, you are responsible for assuring that your units function is accomplished successfully in order to ensure the overall success of the U.S. Army, other DOD agencies, and foreign allies. Your responsibility will be overall quality surveillance of the petroleum testing facility.

Identification and Quality Surveillance of Bulk Petroleum Products. Quality surveillance of bulk product must begin from receipt until the product is used. This entire process depends upon sampling, testing, and observes the QS Standard Quality Surveillance procedures which include filtering, product isolation, product maintenance, and rotation. All samples will be taken in accordance with the standard procedures described in ASTM Method D-4057. A list of the types of products that your laboratory may receive and their methods of storage or issue can be obtained by contacting all units within your area of operation that store and/or issue petroleum products. After this has been obtained, you must ensure that you have all of the product specifications, standards, and deterioration limits on hand. Testing petroleum product samples is the primary function of any petroleum laboratory. Listed below are the steps that must be followed in order for your mission to be accomplished successfully:

Frequency of Testing. To determine the minimum frequency of sampling and testing you would refer to MIL-HDBK-200, Table II and Table III. With these tables and the information obtained on the DA Form 1804 (Petroleum Sample) you can determine what type of test is required to be performed on the samples received.
Sample Processing. Several steps will be followed for processing samples. Sample tags will be checked for the following required information:

- The laboratory number is assigned and entered on the top and bottom section of the sample tag.
- Log following information from DA Form 1804 (Petroleum Sample), adjacent to assigned laboratory number, in the sample log book:
  - Sample number
  - Submitting unit
  - Grade of product
  - Specification
  - Source of sample
  - Quantity represented

- Date sampled
- Date received
- Date test started
- Date test completed
- Test results

Testing Sequence. The sequence of samples to be tested will be FIRST COME, FIRST SERVE in the following priority:

- Samples for emergency vehicles and aircraft
- Samples for crashed aircraft
- Samples of stalled vehicles
- Re-samples for off-specification products
- Special samples
- Routine samples.

Sample Out Processing: The laboratory NCOIC, after all test results are returned to the senior laboratory technician, begins the processing. Worksheets are reviewed to identify test results, record results and recommended disposition in the remarks section of the section of the worksheets by the laboratory NCOIC. DA Form 2077 (Petroleum Products Laboratory Analysis Report is typed from the worksheet (1 original, 3 copies) and then reviewed by the laboratory NCOIC and signed by the laboratory officer.

- DA Form 2077 disposition
- One original for the laboratory official result file. (filed in laboratory number sequence)
- One copy to the laboratory higher command.
- Two copies to the sample submitting unit.

PART B – LABORATORY TERMINOLOGY

Some of the terms related to petroleum operations (laboratory and supply), are as follows:

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.
American Society for Testing and Materials (ASTM) A national scientific technical organization formed for the development of standards or characteristics performance of materials, products, systems, and services and the promotion of related knowledge.
API Gravity An arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API. The gravity of any petroleum product is corrected to 60° Fahrenheit (16°Celsius).
automotive gasoline (MOGAS) A hydrocarbon fuel for use in internal combustion engines and procured by the military under two specifications. The specification for leaded and unleaded gasoline is VV-G-(K)1690. Specification MIL-G-3056 specifies combat grade type 1 and 11.
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 tetraethyllead content. It is procured by the military under specification MIL-G-5572.
barge A flat-bottomed vessel used to carry cargo on inland waters or as lighterage service. Barges are usually towed. A petroleum barge has internal tanks to store liquid cargo.
bitumen A mixture of hydrocarbons of natural or pyrogenous origin, or both, which are frequently accompanied by their nonmetallic derivatives and which are completely soluble in carbon disulfide.
bottoms In a distilling operation, the portion of the charge remaining in the still or flask at the end of a run, in pipe stilling or distillation, the portion which does not vaporize.
calibration The graduation of a measuring instrument. The determination of accuracy of graduation in a measuring instrument.
centrifugal pump An apparatus that builds up head pressure using centrifugal force as the principal means and angular velocity as the secondary means.
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.

cut A fraction obtained by a separation process. Product withdrawn from a pipeline and routed into tankage. Product withdrawn from the middle of a batch is referred to as a heart cut. In gaging bulk contact with the gaging instrument. The cut shows the level of the product.
Defense Energy Fuel Supply Center (DESC) An activity under the Defense Logistics Agency (DLA) with responsibility as the integrated materiel manager (IMM) for wholesale bulk petroleum products until their delivery to the point of sale. This responsibility includes contract administration in oversea areas.
density Specific weight or mass of a substance per unit volume (pounds per cubic foot or gallon or grams per cubic centimeter). Specific gravity is the ratio of the mass of any volume of a substance to the mass of an equal volume of some standard substance (water in the case of liquids and hydrogen or air in the case of gases) at 40° Celsius (104° Fahrenheit). In POL density is mass per unit volume at a specified temperature (15°C). Density is a fundamental property that can be used in conjunction with other properties to characterize both the light and heavy fraction of petroleum and petroleum products.
deterioration Any undesirable chemical or physical change that takes place in a product during storage or use. Some of the more common forms of deterioration are weathering, gum formation, weakening of additives, and change in color.
distillation Vaporization of a liquid and its subsequent condensation in a different chamber. In refining, it refers to the separation of one group of petroleum constituents from another by means of volatilization in some form of closed apparatus, such as a still, by the aid of heat. ASTM distillation: Any distillation made according to an ASTM distillation procedure, especially a distillation test made on such products as gasoline, jet or turbine fuels, and kerosene to determine the initial and final boiling points and the boiling range.
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.
foaming The formation of froth or foam on lubricating oils or other oils as a result of aeration or release of gas dissolved in the oil. Foaming characteristics of lubricating oils are determined by ASTM Method D 892.
Fuel System Icing Inhibitor (FSII) An agent to be used only as an anti-icing additive for jet turbine engine fuels.
gum Varnish-like, tacky, noncombustible insoluble deposits formed during the deterioration of petroleum and its products, particularly gasoline. The amount of gummy material in gasoline is known as its gum content, which is determined by ASTM Methods D 381 and D 873.
identification tests Selected tests applied to a sample to identify quickly the type or grade of material represented or to determine that the quality has not been altered by time or handling.
inhibitor A substance added in small amounts to a petroleum product to prevent or retard undesirable chemical changes from taking place in the product or in the condition of the equipment in which the product is used. The essential function of inhibitors is to prevent or retard oxidation or corrosion.
innage The height or volume of liquid in a storage tank as measured or gaged from the bottom of the tank to the top of the liquid.
light ends The most volatile portions of a carbon and hydrogen mixture, the low boiling components that boil off first in distillation. Opposite of heavy ends.
micron One micron is a thousandth part of one millimeter (approximately 25,400 microns equals I-inch). The average human hair is about 100 microns in diameter.
off-specification product A product which fails to meet one or more of the physical, chemical, or performance requirements of the specification.
olefin One of a major series of hydrocarbons that appear chiefly in refinery operations. They have the general formula of naphthenes and the chain structures of paraffin, but they are unsaturated. Molecular structure and nomenclature correspond to paraffin having the same amount of carbon. Ethylene, or ethene, is the lowest, member of the olefins, and the series is sometimes called the ethylene series.
Reid Vapor Pressure (RVP) The measure of pressure exerted by a product on the interior of a special container due to its tendency to vaporize.
ullage The amount a tank or container lacks of being full.
upgrade A grade that slopes upward in the direction of pipeline flow. To change service from a dark or heavy product to a light or volatile product; refers to the nature of a product stored in a tank or transported in a tanker, tank car, or tank truck. To blend a higher grade gasoline interface into tankage containing a lower grade gasoline.
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° Fahrenheit (15.6°Celsius) after deducting bottom water and sediment.

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. Which of the following information is required on the sample tag, DA Form 1804?
   A. Off-specification limits.
   B. Submitting unit.
   C. Name of person conducting laboratory tests.
   D. Shipment delivery date.

2. Which of the following is the priority sequence for testing samples?
   A. Special samples, routine samples, re-samples for off-specification products.
   B. Samples for emergency vehicles and aircraft, samples for crashed aircraft, re-samples for off-specification products, special samples, routine samples.
   C. Special samples, samples for crashed aircraft, routine samples.
   D. Samples for emergency vehicles and aircraft, routine samples, re-samples for off-specification products

3. Which of the following is a term used for the amount a tank or container, lacks of being full.
   A. Density.
   B. Innage.
   C. Bottoms.
   D. Ullage.

4. All samples will be taken IAW which of the following ASTM Test Methods?
   A. D-1250.
   B. D-2272.
   C. D-4033.
   D. D-4057.

5. Minimum frequencies for sampling and testing are contained in which of the following?
   A. MIL-HDBK-200.
   B. FM 10-67-1.
   C. FM 10-67-2.
   D. AR 200-1.

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LESSON 2

ESTABLISH LABORATORY STANDING OPERATING PROCEDURES

Critical Tasks:
101-523-4400
101-523-4401
101-523-4402
101-523-4403

OVERVIEW

Lesson Description:

This lesson covers the procedures for implementing an environmental stewardship program.

Terminal Learning Objective:

Action: Acquire knowledge on the steps to implement a petroleum environmental stewardship, laboratory fire and safety, and equipment maintenance SOPs.

Condition: Given subcourse QM5183

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

INTRODUCTION

As a senior NCO assigned to a petroleum laboratory you are responsible for the development and implementation of standard procedures required by your personnel to accomplish the various functions associated with the testing of petroleum products. You also must ensure that all personnel are aware of and incorporate environmental, fire, safety, and preventive maintenance practices into their everyday duties. This lesson will the present "standard" SOP format, and outline the types of information you will need to include when developing the various SOPs required for effective and efficient petroleum laboratory operation.

PART A - LABORATORY STANDING OPERATING PROCEDURES

SOPs are used for all facets of work-related duties in military and civilian sectors. The Army uses a standard format that can be tailored to reflect the duties and responsibilities of each function required to be performed. The following format is taken from FM 10-426 (Petroleum Supply Units), Appendix B:

- 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 for your laboratory.
- 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.

Keep in mind that every function in every unit is not the same, and in order for any SOP to be as effective as possible, all unit peculiar differences, depending upon your unit's mission requirements, must be reflected and addressed in any SOP. The following material is provided to give you an indication of what types of material will go into each SOP required for petroleum laboratory functions.

PART B –IMPLEMENT A PETROLEUM ENVIRONMENTAL STEWARDSHIP SOP

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 to 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 the 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, 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.

Importance of Protecting the Environment and Consequences of Non-Compliance with Environmental Laws and Regulations. 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.

There are many benefits of environmental protection:

- Enhance combat readiness.
- Ensure mission completion.
- Conserve the fighting strength.
- Protect the environment.
- Reduce the Army's and nation's current and future cost for environmental restoration.

An excellent way to communicate the consequences of noncompliance to subordinates is to explain, that noncompliance under the Federal Facilities Compliance Act (FFCA) 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:

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

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 didn't 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 that can be incorporated into everyday work life through training, SOP, orders, mission planning, etc. 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. Local unit SOP and policies 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. 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.

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.

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 maker 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.

- 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).

- 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 the 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.
- Always rehearse.

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.

Planning and Conducting Environmentally Sustainable Actions and Training. When planning lab training exercises or preparing a lab 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.

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 (DOD Single Line Item Release/Receipt Document), the containers, fill capacity, markings, labeling, empty containers, and inspection.

DD Form 1348-1(DOD Single Line Item Release/Receipt Document)**.** 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 Department of Transportation (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, e.g., 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 HM? Are MSDSs readily available to all workers with exposure to HM?
- 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 (i.e., gun/mortar sights, M8A1 alarms) properly stored to prevent breakage and release of radioactive materials? Are incidents reported properly?
- Is ammunition stored properly?

Verification of the Proper Conservation of Resources. AR 200-1 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 non-hazardous 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. You can verify support among your unit by ensuring 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 un-recyclable 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.

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 laboratory operation, conduct an inspection of the petroleum laboratory 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 lab should conduct exercises to verify that personnel are trained in up-to-date spill containment and cleanup procedures. Verify that petroleum laboratory 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, etc.).
- Contain the spill.
- Apply absorbents.
- Ensure adequate ventilation.
- Erect barriers or otherwise restrict or stop the 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.

Resources and Procedures for Proper Disposal and Handling of Hazardous Materials.

- ISO 9000-2. Every petroleum laboratory 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.
- Hazardous Material Information System (HMIS). Sheets for hazardous substances can be maintained for each applicable substance used in your laboratory. 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.”
- Material Safety Data Sheets (MSDS) are required at a minimum to be maintained for each hazardous substance used in your laboratory. 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 C – PETROLEUM LABORATORY FIRE PREVENTION AND SAFETY SOP

Laboratory Safety and Emergency First Aid. As an NCOIC of a petroleum laboratory you will have to prepare and review petroleum laboratory fire prevention and safety SOPs. You will have to cover such things as: safety, standards of behavior, fire prevention procedures, assignment and positioning of fire fighting equipment, procedures for handling chemicals and petroleum products, first aid procedures, equipment inspections, training, and ensuring that the fire fighting equipment on hand is appropriate for the types of fires anticipated. It should be noted that all the procedures mentioned above are the same for each laboratory SOP and should be adapted to your specific laboratory.

Common emergencies which we are exposed to every day are instances where we can receive minor wounds, minor burns, foreign bodies in the eyes, and electrical shocks or electrical burns.

Minor Wounds. Most small wounds such as cuts do not usually bleed very much. Infection from contamination is the principle danger. If you receive a minor wound, take the following first aid measures:

- Do not allow anything to touch the wound, except as described in the minor burn and foreign body in the eye sections below.
- Wash the surrounding skin thoroughly with soap and water. Gently clean the wound. If a disinfectant solution is available, apply it to the wound. In no instance should solutions stronger than 1:750 be used. Place a sterile compress over the wound without allowing it to touch anything else and secure it with a bandage.

Minor Burns. Minor burns may be caused by exposure to dry heat, hot liquids, chemicals, electricity, or rays of the sun. If you receive a minor burn, you should immerse it or flush it with the coldest water available until the pain subsides (usually about 5 minutes). Minor burns are of two types:

- Small burns which include blistering or charring. Since the skin is most likely to break when it is blistered or charred, cover it with a sterile compress to protect it from contamination and possible infection. Do not attempt to break the blisters. Secure the compress in place with a bandage.
- Burns with no blistering or charring. If the burn does not cause the skin to blister, char, or break, it is a minor burn even though it may cover a large area of the body as in a mild sunburn. It is not necessary to cover such a burn with a sterile compress.

Foreign Body in the Eye. Foreign material that may enter the eyes during laboratory operations include particles such as dust, glass, or metal and caustic or irritating material, such as acid and chemicals.

- Foreign Particle. If a foreign particle gets into the eye, do not rub the eye. If the particle is beneath the upper eyelid, grasp the eyelashes of the upper lid and pull the lid up and away from contact with the surface of the eyeball. Hold the eyelid in this manner until tears flow freely. The tears will possibly flush out the particle.
- Glass or Metal. If the foreign particle is glass or metal or it cannot be removed by the techniques described above, bandage both of the soldier's eyes and get him to a medical treatment facility

immediately. If only one eye is bandaged, the soldier will use his unaffected eye. Since eye movements are synchronized, use of the unaffected eye may result in movement of the affected eye, thereby subjecting it to further injury.

- Caustic or Irritating Material. If caustic or irritating material, such as acid or ammonia gets into the eye, immediately flush it with a large volume of water. To flush the right eye turn the head to the right side; to flush the left eye, turn the head to the left side. This prevents the caustic or irritating material from being washed into the other eye. The soldier should be immediately evacuated to the nearest medical treatment facility for care to prevent further damage.

Electrical Hazards. Electrical hazards fall into two categories: shocks and burns.

- Electrical Shock. Electrical shock accidents frequently result from contact with a "live" wire and occasionally occur when a person is struck by lightning. Electrical shock is defined as a sudden disruption of certain body functions as a result of an electric current flowing through the body between two points. If a person has come in contact with an electric current, take the following steps:
  - Turn off the switch if it is nearby but do not waste time looking for it. Instead use a dry wooden pole, dry clothing, dry rope, or some other material which will not conduct electricity to remove the person from the wire. If a pole is not handy, simply drag the soldier off the wire by means of a loop of dry rope or cloth. Do not touch the wire, apparatus, or the soldier with your bare hands, or you will also get a shock.
  - Administer artificial respiration immediately after freeing the person from the wire or apparatus, as electric shock causes breathing to cease. Also check the soldier's pulse, since electric shock may cause his heart to stop. If you do not feel a pulse immediately, administer cardiopulmonary resuscitation (CPR).
- Electrical Burns. Usually electrical shock is complicated by the simultaneous incidence of internal and/or external burns. Considerable damage can occur to tissues, nerves, and muscles simply from the heat generated by the passage of the electric current. Where internal tissues are destroyed, hemorrhaging can occur, still further complicating the traumatic effects. External burns can also occur by contact with the electrical source, which may be hot.

Hazardous Communication Procedures.

As the supervisor of the petroleum laboratory you will be expected to obtain and maintain Material Safety Data Sheets (MSDS) and Hazardous Material Information System (HMIS) information when available, for all hazardous substances used and stored in the laboratory.

Ensure that fire prevention and safety SOP contain the MSDS and HMIS location for each hazardous substance used in the laboratory, for reference in case of emergency. These documents should be kept in an easily accessible and central location. The following types of information can be found in these sheets:

MSDS.

- Psychological and Health Effects.
- Emergency First-Aid Procedures.
- Special Protective Information.
- Fire Protection.
- Special Precautions.
- Environmental Protection.
- Reactivity Data.
- Physical Properties.
- Additional Health Data.

HMIS.

- General Information.
- Ingredients / Identity Information.
- Physical / Chemical Characteristics.
- Fire and Explosion Hazard Data.
- Reactivity Data.
- Health Hazard Data.
- Precautions for Safe Handling and Use.
- Control Measures.

Safe Handling of Hazardous Waste/Material.

Handling Chemicals. To prevent personal injury and damage to surrounding areas while handling chemicals, the following measures should be employed:

- Always pour acid into water especially sulfuric acid. Never pour water into acid.
- Use Pyrex glassware when diluting acids. Ordinary glassware may be broken by the heat generated from the mixture of acid and water.
- Never heat mercury in an open container and never shake more than 20 millimeters of mercury in a glass container. If a spill occurs, ensure adequate ventilation.
- Hold the container cap in your hand when pouring a sample from a container or bottle.
- Never place the cap or stopper on a counter as it may contaminate the sample. Clean up the mercury and sulfur together and put them in a suitable container for disposal IAW local environmental regulations.

- If any chemical is spilled or splashed on the body, immediately wash the contaminated area thoroughly with water.
- If a strong solution of tetraethyl lead is spilled, cover the spill with dry chloride of lime, CaOC12 , sand, or other noncombustible absorbent material. Wait 5 minutes for reaction to be completed.
- Flush off with water and wash area with soap and water. If the solution is spilled on the clothing, remove clothing and discard contaminated articles. Do not attempt to wash the contaminated clothing for reuse.
- Collect all contaminated absorbent materials and place them into a suitable container for disposal IAW local environmental regulations or SOPs. Contact the local environmental office for further guidance on spill reporting, cleanup, and disposal procedures.
- Make certain that a supply of dilute (18 percent) acetic acid is available when a doctor test or alkali wash is being performed. Use the dilute acetic acid freely on any part of the body, except the eyes that may be contaminated with doctor or caustic solution. If doctor or caustic solution should contaminate the eyes, immediately wash out the eyes with water and report to the hospital.

Substitute Solvents. Field conditions may require the substitution of certain solvents. In this case, the commonsense rule of "like dissolves like" should be used. When in doubt as to the correct solvent to substitute, consult the ASTM test method. For example, toluene could possibly be substituted for benzene in a solvent capacity but nhexane would not serve the purpose.

Handling Excess Chemicals. Contaminated chemicals are useless. Do not place spatulas and other objects in chemical containers as the spatula may contain foreign matter that will cause contamination. Similarly, if excess chemicals or samples are removed from a container, do not put back into the tile container. All used chemicals should have well-established rules for disposal.

Handling Solutions. When handling solutions always follow the applicable safety procedures.

- Prepare a chromic acid cleaning solution by slowly adding 800 milliliters of concentrated sulfuric acid to 500 milliliters of a saturated solution of potassium dichromate and water. Prepare the solution in a sink, using a Pyrex container or equivalent glassware. Although chromic acid is more effective as a cleaning agent when it is heated precaution should be taken to avoid boiling the solution. If the solution develops a greenish color, it is useless and should be discarded.
- Handle the solution with extreme care to avoid personal injury. A face shield and rubber gloves should be used. Chromic acid is a powerful oxidizing agent.

Proper Behavior and Conduct While in the Laboratory. Any problems arising from test results, laboratory equipment, and problems with personnel may be taken directly to the NCOIC of the Laboratory. If you are in doubt about anything ask your supervisor.

Laboratory personnel and personnel who handle petroleum products in the field are exposed to similar hazards. Because of their continuous exposure to a wide variety of dangerous materials (such as working with chemicals in close quarters), laboratory personnel must have a high degree of awareness of the specific hazards involved. Generally speaking fire and explosion are the most prevalent hazards. A constant watch should be maintained during operations because of exposure to fire, chemicals, dangerous pressure or vacuums, and toxic fumes or vapors. The following are general safety rules your personnel should be made aware of during routine laboratory operations.

- Consult the NCOIC of the particular test when in doubt concerning any laboratory procedure or operation.
- Do not attempt to perform more than one test at a time, unless each test can be given the proper attention needed to complete it efficiently and safely.
- Do not attempt shortcuts or improvisations because laboratory procedures have been developed with a focus on quality, efficiency, and safety. Discuss recommended changes with the supervisor.
- Give complete attention to the test in progress. Request assistance from another technician or notify the supervisor if it becomes necessary to leave the laboratory for even a brief period of time.
- Do not engage in any form of horseplay in the laboratory because it diverts attention from other operations in progress and can cause existing hazards to become real dangers.
- Systematically check the laboratory and its equipment at the end of each day to be sure that no hazardous situations can develop while the laboratory is unoccupied.

Storage Procedure for Chemicals and Other Hazardous Materials. To prevent personal injury when storing chemicals in the laboratory ensure the following measures are employed:

- Make sure that every container and bottle is properly labeled.
- Store heavy and/or large containers of chemicals on or as near to the floor as possible.
- Do not fill a container with material other than that indicated on the label.

- Store a standard solution of an acid or a base to avoid contamination by atmospheric carbon dioxide.
- Do not store oxidizing agents with reducing agents.
- Do not store acids and bases together. They will react with each other.
- Do not place bottles containing acids or alkalis on high shelves or on top of equipment. Store them on low shelves so they can be easily reached.
- Store caustic soda solution and sulfuric acid in strong glass containers never in galvanized iron drums.
- Keep all sample containers capped or plugged at all times except when pouring out test portions. Always replace the same cap or stopper in the container from which it was removed.
- Hold the stopper of a reagent bottle between two fingers of the pouring hand when pouring from a bottle. Never lay the stopper on a surface that might be touched by personnel or their garments.
- Keep reagent bottles stoppered tightly, and dry reagent bottles before replacing them on the shelf.
- Wipe up any acid that spills or splashes on benches, tables, or floors.
- Dispose of all unlabeled and contaminated chemicals IAW local environmental regulations or SOP.

Inspection Procedure for Fire Extinguishers. Ensure that petroleum laboratory fire extinguishers are inspected on a monthly basis using the following criteria:

- Extinguisher in designated location.
- Pressure gage is operational.
- Technical inspection tag is up-to-date.
- Corrosion.
- Distortion.
- Weakening or degradation of seals.
- Hose is not cracked, clogged, or otherwise inoperable.

Upon discovery of a possible non-functioning fire extinguisher, remove it from service and notify the unit or installation fire safety office for pick-up and replacement.

Spill Clean-Up Procedures. Ensure the following procedures in addition to any procedures required by local unit regulations, are included as part of the laboratory fire and safety SOP. Upon discovery of a spill, personnel shall take action as follows:

- Safely stop the source of the spill if possible (closing valves, up-righting containers, etc.).
- Contain spill.
- Apply absorbents.
- 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 quantity of the spill.

- Is the spilled oil 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 substance spilled classified with a required quantity (RQ) value?

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.

Inspection Schedule for Laboratory Facility and Laboratory Operations. An inspection schedule should be developed as part of the SOP. For each area of laboratory operations listed below, you should develop an inspection schedule to include each of the following areas:

- Laboratory Testing Equipment.
- Fire Extinguishers.
- Ventilation Systems.
- Electrical Systems.
- Hazardous Materials Containers and Storage.

- Laboratory Safety Equipment.

The inspection schedule will also include the following for each area:

- Inspection Intervals (i.e. daily, weekly, monthly, etc.).
- Inspection Checklist.
- Special instructions (so that inspections do not interfere with normal laboratory operations, holidays, or other activities).

Conduct a Physical Inspection of the Laboratory. An inspection of the laboratory and operations should be conducted IAW the laboratory SOP. For each area of laboratory operations listed below you should perform an inspection on a scheduled basis, to include each of the following areas:

Laboratory Testing Equipment and Materials.

- Equipment is clean.
- No exposed wiring or other electrical hazards.
- Materials are stored in the proper places and are usable.

Fire Extinguishers.

- Extinguisher in designated location.
- Pressure gage is operational.
- Technical inspection tag is up to date.
- Corrosion.
- Distortion.
- Weakening or degradation of seals.
- Hose is not cracked, clogged, or otherwise inoperable.

Ventilation Systems.

- Dirty filters or vents.
- Blocked vents.
- Fan(s) broken or otherwise not operational.

Electrical Systems.

- Exposed wiring.
- Unsafe connections, outlets, or connectors.
- Wet areas or otherwise unsafe conditions.

Hazardous Materials Containers and Storage.

- Cracked, corroded, open, or otherwise damaged containers.
- Improper containers for materials.
- Materials not stored according to regulations.
- Acids and alkalis on high shelves.

Laboratory Safety Equipment.

- Equipment is on hand and in required quantities.
- Equipment is in good condition.
- Equipment is in the proper location.

Hazardous Materials Spill Containment and Clean-Up Materials and Equipment.

- Materials and equipment are on hand in required quantities.
- Materials and equipment are in the proper location.

The above visual inspections should be accomplished on a daily basis prior to beginning daily laboratory operations. More detailed operational inspections should be scheduled and accomplished according to local unit policy by qualified personnel.

Verify Personnel are Familiar with Fire and Safety SOP. As the petroleum laboratory supervisor, you are responsible for ensuring that the personnel assigned to you are familiar with, and understand the importance of the procedures contained in the laboratory fire prevention and safety SOP. Some of the methods that you as a supervisor can use to verify that the personnel assigned to you are familiar with SOP are as follows:

- Informal oral testing (asking questions on the job).
- Stage a scenario-based practical exercise with fire and safety as the objective.
- Formal quizzes.

These methods should be employed often to make sure that your subordinates retain the information as part of their everyday work knowledge and to ensure that new personnel are informed.

Verify Personnel Know the Location of HMIS, MSDS, Emergency Exits, Phone Numbers, and Eye Wash Units. The petroleum laboratory fire prevention and safety SOP will contain a diagram that depicts/contains the following information for emergency situations:

- Location of HMIS and MSDS information.
- Location of emergency exits.
- Emergency phone numbers.
- Location of eye wash units.

This diagram should be posted at multiple highly visible locations around the lab. As the petroleum laboratory supervisor you should periodically ask your personnel to point out the location of the emergency equipment/information listed above. Conduct awareness drills to ensure personnel can locate emergency equipment information.

Develop a Layout of a Laboratory Facility. Another responsibility as laboratory supervisor is to develop a layout of the lab (Figure 2-1) identifying all exits to be used in case of an emergency, fire, or other mishap that would require all personnel to evacuate the lab through the nearest exit. This layout should be posted throughout the lab in highly visible locations.

- Make sure the diagram approximates the dimensions of the lab.
- All exits should be identified even though they are not direct exits (if you must pass through another room, or through a hallway before you are outside).
- Identify all worktables, partitions, equipment, and whatever else might be an obstacle when exiting.
- All exit routes should be identified by arrowed lines drawn with a colored marker that clearly identify the exit route.

Accident Report Completion Procedures. The immediate supervisor of an individual involved in an accident will prepare the appropriate forms and submit them to the department safety officer after the accident occurs. Accident reports will not be delayed pending statements of charges, reports of survey, or line of duty determinations.

- Military personnel. A sick slip will be prepared and forwarded in duplicate when military personnel are treated for minor injuries on duty and report for duty prior to midnight the day following the accident. An accident report will be prepared and forwarded in quadruplicate when military personnel are injured on duty and are unable to report for duty by midnight of the day following the injury. In case of a fatality, two additional copies of the accident report are required.
- Civilian personnel. A record of injury will be prepared and forwarded in duplicate when civilian personnel are injured on duty and unable to report for duty on the next regular working day. An accident report will be prepared and forwarded in quadruplicate when civilian personnel are injured on duty and are unable to report for duty on the next regular working day. In case of a fatality two additional copies of the accident report are required.

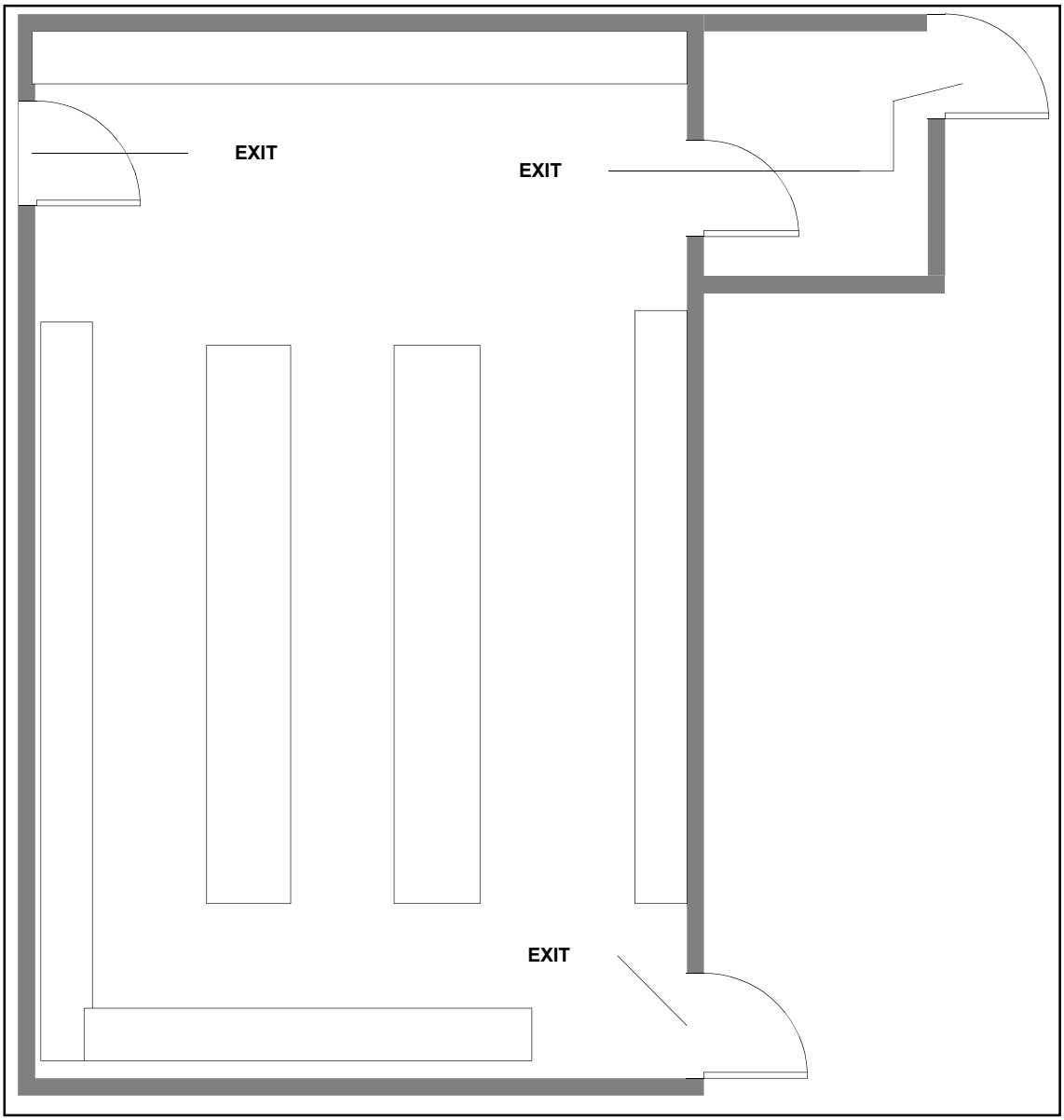

Figure 2-1, Sample laboratory layout.

PART D – PREPARE A PETROLEUM SAMPLE SUBMISSION, RECEIPT, AND TESTING SOP

Sampling, Receiving, and In-Processing Procedures. Check the sample tag (DA Form 1804) for required information. The following information should be entered on the sample tag for each sample taken and/or submitted.

- Product.
- From (Requesting Activity).
- Sample Number (Entered by lab).
- Laboratory Number
- Specification Number
- Amt. Product Sample Represents.
- From (Where sample was taken from).
- Source (What storage type sample was taken from: Truck Number, Tank Number, Other).
- Sampled By (Individual).
- Stock Number.

- Date Sampled.
- Shipment Delivery Date.
- Fuel Origination.
- Sample Type.

Acceptable Condition for Samples and Sample Containers.

Samples.

- Samples should be taken IAW the appropriate ASTM Test Method and MIL-HDBK-200.
- Samples should be representative of the information on the sample tag.

Sample Containers.

- Containers should be tightly closed, with no wax, paraffin, rubber gaskets, pressure sensitive tape, or any other contaminating substances.
- Kerosene, jet fuel, and gasoline should be stored in cans or brown bottles to protect the product from the sunlight.
- Aviation fuel samples should be stored in brown or clear glass bottles if they are to be submitted for water and sediment tests.

Assign a laboratory number and enter it into the top section of the sample tag.

The following information is to be logged in the sample logbook adjacent to the laboratory number assigned:

- sample number
- submitting unit
- grade of product
- source of sample
- quantity represented
- date sampled
- date test completed

Blocks 9 through 11 are completed as work is done.

Determine Test Sequence and Type of Test to be Performed. The sequence of samples to be tested will be first come, first serve in the following priority:

- Samples for emergency vehicles and aircraft.
- Samples for crashed aircraft.
- Re-samples for off-specification products.
- Special samples.
- Routine samples.

Type test to be performed will be determined from MIL-HDBK-200 and product specifications.

Determine Laboratory Test Capabilities. The senior laboratory technician will supervise all testing and will assign all tests to technicians. This will allow performance of many different tests concurrently, eliminating unnecessary man-hours.

Hours will vary depending on capability of performing lean and rich mixture rating. The number of hours required for one technician to perform various types of tests is as follows:

MAN-HOURS PER TEST TYPE

Type of Product	Type of Test			
	B1	B2	B3	C
Jet	6	6	6	3/4
AVGAS	12 1/2 (1)	24 (1)	24 (1)	1/4
MOGAS	3 (1)	24 (1)	9(1)	1/4
Diesel Fuel/Kerosene	46	6	1	
Burner Fuel	3	6	1	1
Lube/grease	2	8	NA2	

Example of a projected workload computation:

PROJECTED WORKLOAD

No.	Type	Product		Units		Total M/H
10	B1	JP4	x	6.00	=	60.0
10	C	JP4	x	.75	=	7.5
2	B2	AVGAS	x	24.00	=	48.0
20	B1	MOGAS	x	3.00	=	60.0
40	B1	MOGAS	x	24.00	=	960.0
100	C	MOGAS	x	.25	=	25.0
10	B1	KERO	x	4.00	=	40.0
40	B1	DF	x	4.00	=	160.0
100	C	DF	x	1.00	=	100.0
25	B2	BF	x	6.00	=	50.0
10	B1	LUBES	x	2.00	=	20.0
25	B2	LUBES	x	8.00	=	200.0
10	C	LUBES	x	2.00	=	20.0
					TOTAL	1850.5

Man-hours available.

- Workdays. Twenty-two workdays in a month. Eight hours per day.
- Assigned Personnel. One E-7 (supervisor), four E-5's, and five E-4's.
- Hours Available. 4 x 22 x 8 = 704
  5 x 22 x 8 = 880
  1,584

As can be seen in the example the lab falls short 266.5 hours (1,850.5 - 1,584 hours). The figure will actually be greater when extra duties, passes, leaves and training time are considered. This can be determined on a past history basis. The solution to the shortage of man-hours can be made by overtime, increased manpower, and/or having supervisor become a worker in the busy times. Local policy will dictate the solution.

Assign test to technician. Assignment of test lab technicians can be accomplished by:

- Informal test memorandum.
- Worksheet. DA Form 2077 (Petroleum Products Laboratory Analysis Report) is filled out according to data on the sample tag.

Out-Processing Test Results. After all test memorandums and worksheets are returned to the senior laboratory technician, the result of out-processing begins. Worksheets or W/S's are reviewed to identify analysis results and to record the results and recommended disposition in the "Remarks" section of the W/S by the laboratory NCOIC. DA Form 2077 is prepared from the W/S and then reviewed by the laboratory NCOIC and signed by the laboratory NCOIC. DA Form 2077 disposition:

- Original for the laboratory official result file (filed in laboratory number sequence).
- One copy to the laboratory's higher command.
- Two copies to the sample submitting unit.

The sample tag is removed from the testing file and stapled to the W/S and test memorandums. They are filed in laboratory number sequence in the completed working file.

PART E – DEVELOP A MOBILE PETROLEUM LABORATORY SOP

Deployment/Re-Deployment of the Mobile Petroleum Laboratory. The movement of the mobile laboratory (Figure 2-2) requires numerous documents and coordinated procedures to ensure a smooth, safe, and organized operation.

Mode of transportation. The first step in planning the deployment or movement of the Mobile Laboratory is to determine the most mission effective form of transportation.

- Air (Military or commercial aircraft).
  - Base Laboratory C-130.
  - Mobile Laboratory C-141 or C-5A.
  - Airmobile Laboratory C-130.
- Water.
- Rail.
- Road.

Documentation. Procedures for shipping hazardous materials (part of Petroleum Laboratories) by military aircraft, are provided in TM 38-250 (Preparing Hazardous Materials For Military Air Shipments). Other forms/documentation are as follows:

- DD Form 1387-2 (Special Handling Data/Certification).
- Air Shipping Papers.
- Waivers. Waivers are used during tactical or contingency operations. An example of an Air Force waiver can be found in FM 10-67-2 (Petroleum Laboratory and Testing Operations). Request for Shipment by Military Aircraft, Headquarters (HQ) United States Air Force (USAF) or HQ Department of the Army (DA).
  - Reason for shipment.
  - Reason other modes of transportation cannot be used.
  - Date of movement.
  - Route.
  - Type of aircraft required.
  - Point of Contact at origin and destination.

Preparation of the Mobile Laboratory.

Equipment storage (TM 10-6640-215-13 Operator's, Units, and Direct Support Maintenance Manual For Petroleum Laboratory, Semi-Trailer Mounted).

- Equipment stripped and put in drawers.
- Equipment drawers locked.
- Equipment doors taped.

Electrical Systems (TM 10-6640-215-13).

- All outlets checked.
- All power switched to OFF position.
- Main breaker in OFF position.
- All lights/glass items taped.

Testing Apparatus and Equipment (TM 10-6640-215-13).

- All baths drained and emptied.
- Apparatus secured to designated location.

Testing References.

- All references will be stored in the designated locations.
- The slide doors of the reference area will be taped closed.

Other Laboratory pre-deployment requirements.

- Weigh and center balance Mobile Laboratory.
- Inventory all equipment, chemicals, and reagents.
- Mobile Laboratory overpack.
- Final preparation for tiedown.
- Generator (60 kW or 30 kW).

Hazardous Materials Shipping and Safety Review.

- Review MSDS. The NCOIC of the base Petroleum Laboratory is responsible for ensuring that the Mobile Laboratory has applicable MSDS for each chemical, solvent, and reagent used and deployed with the Mobile Laboratory.

- Review DD Form 1387-2 (Special Handling Data Certification). The NCOIC is also responsible for the review of DD Form 1387-2.

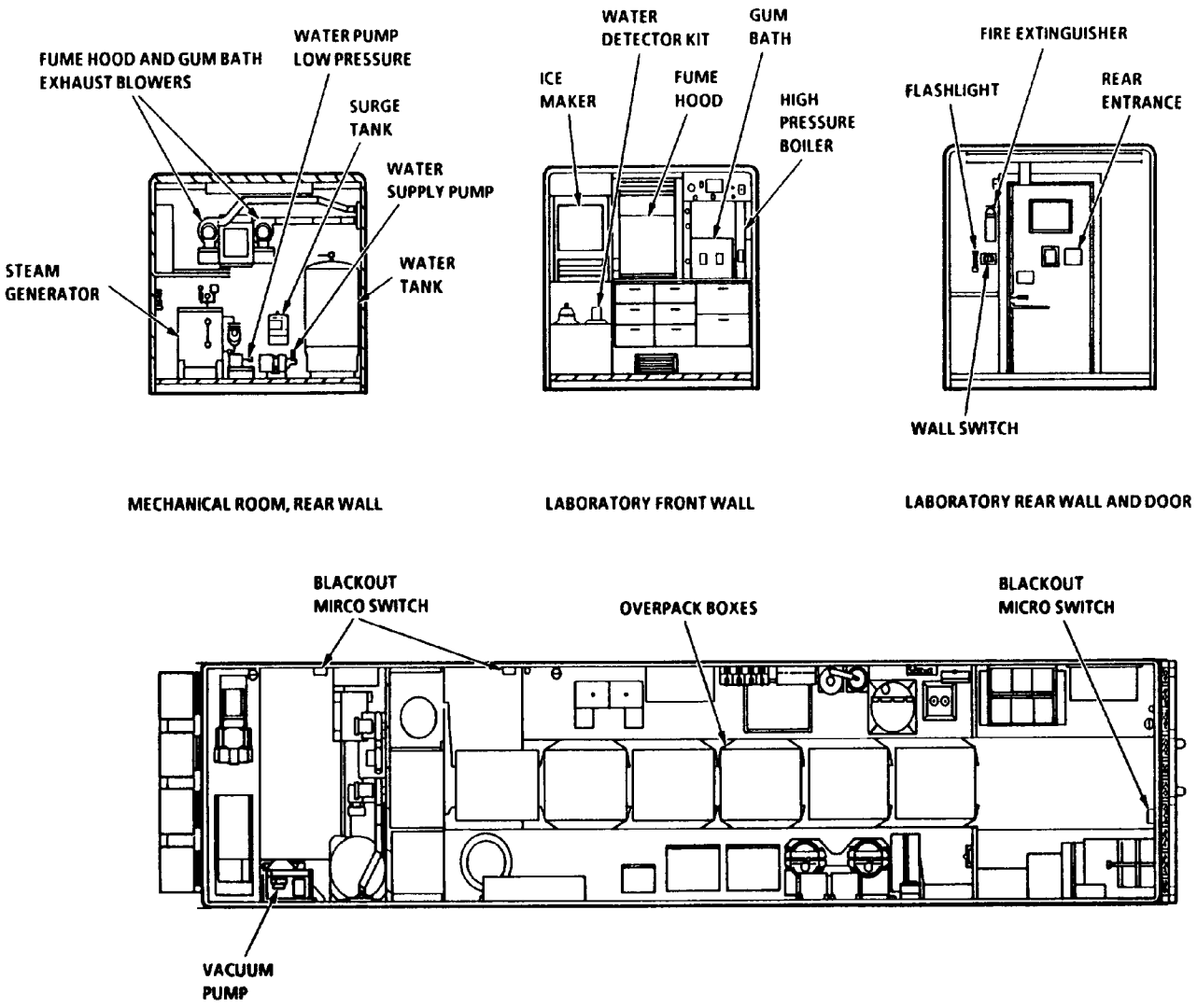

Figure 2-2, Mobile petroleum laboratory.

Mobile Petroleum Laboratory PMCS. Ensure that the following general procedures are accomplished by assigned personnel concerning PMCS of the mobile laboratory:

- Inspect the petroleum lab body exterior starting at the rear to cover rear, curbside, roadside, front, top, and bottom. Inspect for damage, tears, breaks, or corrosion.
- Service petroleum laboratory exterior IAW TM 9-2330-362-14&P (Operator's Organizational, Direct Support and General Support Maintenance Manual).
- Inspect and service the Electronic Control Units (ECUs) in accordance with TM 5-4120-371-14.
- Remove the overpack boxes.
- Inspect laboratory for broken equipment or equipment that is loose and not secured.
- Close doors and vents to determine if light leak exists.
- Inspect doors for damaged or rotted seals and tightness of closure.
- Inspect interior for evidence of water damage, fungi, mildew, or corrosion.
- Inventory section contents against Components of End Item and Basic Issue Items Lists (TM 10-6640-215-13, Appendix C).
- Inventory consumable supplies contained in section (TM 10-6640-215-13, Appendix E).
- Ensure that any damage or discrepancies are reported IAW AR 735-11 (Accounting for Lost, Damaged, and Destroyed Property), and AR 735-11-2 (Reporting of Item and Packing Discrepancies).

Set petroleum laboratory up and conduct operational checks (to include Set-up, Power-up and Shut-down procedures) IAW Chapter 2 of TM 10-6640-215-13, when operators are available and power can be safely provided to the van body. Ensure that any damage or discrepancies are reported IAW AR 735-11 and AR 735-11-2.

Site Selection and Movement Criteria during Pre-Deployment

Select an appropriate site.

- Select a site that has ample space for maneuvering the laboratory and all support equipment.
- Avoid ground that is excessively sloped; excessive sloping could hamper leveling of the laboratory.
- Verify that the site is firm, has well-drained terrain, and is relatively free of surface rocks and large stones.
- At least 500 feet away from other areas of operation and not uphill or upstream from other facilities which might be in the path of escaping fuel or vapor.
- Not adjacent to low areas where dangerous vapors might collect.
- Near a stream or pond (minimum of 500 ft for environmental reasons) or an established water facility. This provides an outside water source for the petroleum laboratory water system.
- Easy access to road nets. At least one road should run in the vicinity of the petroleum laboratory.
- Utilize GPS to coordinate movement to selected site IAW TM 11-5825-291-13 (Operations and Maintenance Manual for Satellite Signals).
  - Perform set-up on the E-A.
  - Initialize E-PLGR.
  - Obtain a position.
  - Enter a waypoint.
  - Navigate to a waypoint.

Verifying that the Mobile Laboratory has been Packed and Secured IAW TM 10-6640-215-13.

Interior.

- Chemical/hazardous waste storage.
- Loose test/support equipment and supplies.
- Drain and clean laboratory equipment.
- Manometer, recording pressure gage, and barometer are properly secured.
- All gas systems/bottles turned off and properly secured.
- Ovens and burn out furnace are clean and desiccant is removed from desiccating cabinets and stored.
- Analytical balance is covered and secured to vibration mount.
- Shipping straps and brackets are used where required and retaining screws are tight.
- Contents of cabinets are properly stored for movement.
- Gas alarm tested.
- All AC MAIN POWER PANEL circuit breakers set to OFF, except A1CB1, A1CB2, A1CB9, A1CB11, and A1CB13.
- Mechanical Room POWER PANEL Number 2 circuit breakers set to OFF except for A15CB10.
- Water tank, steam generator, high pressure boiler, and air system moisture trap are all drained.
- POWER PANEL Number 2 circuit breaker A15CB10 set to OFF.
- Eight overpack boxes have been secured in the laboratory compartment with tie-down straps IAW the loading diagram.
- MAIN POWER PANEL circuit breakers A1CB1, A1CB2, A1CB11, and A1CB13 set to OFF.
- EMERGENCY LIGHT switches S17 and S18 set to OFF.

Exterior.

- Mechanical room, laboratory compartment access, and rear access doors are closed and locked.
- External power at generator Set is OFF.
- Main power cable is removed from petroleum laboratory connector and generator set connector, cleaned, and stored in roadside storage box. Ensure protective covers are installed on all electrical connectors.
- Grounding Cable is removed from grounding lug in power input panel.
- Power input panel is closed and latched.
- Grounding clamp and cable removed from grounding rod.

- Grounding rod and driver/puller removed from ground.
- Grounding rod, driver/puller, grounding cable, and clamp are cleaned and stored in roadside storage box.
- Drain Hoses are disconnected, cleaned, and stored in roadside storage box.
- Hose Adapters are stored and protective covers are installed on deck drains.
- Utilities box door closed and latched.
- Gum bath/fume exhaust door closed and latched.
- Purge exhaust and intake doors closed and latched.
- ECU canvas covers rolled down and secure.
- Ladders removed from rear access and laboratory compartment access, and mechanical room access doors removed and stored IAW TM 9-2330-362-14&P.
- Rear platform stored.
- ECU maintenance platform stored.

Development of a Mobile Petroleum Laboratory SOP. It is the responsibility of the petroleum laboratory supervisor to develop a mobile laboratory SOP. The following content is required for an effective and efficient SOP.

- Preventive maintenance procedures. PMCS procedures for the mobile laboratory are provided in TM 10-6640-215-13, Chapter 4.
- Set-up, power-up, and shut-down procedures. Set-up, power-down, and shut-down procedures are provided in TM 10-6640-215-13, Chapter 2.
- Supply replacement procedures.
- Mobile laboratory storage procedures and overpack (TM 10-6640-215-13).
- Placarding procedures.

The recommended format for the mobile laboratory SOP can be found in FM 10-426, Appendix B.

LESSON 2

PRACTICE EXERCISE

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

1. What environmental regulations and policies will you be responsible for ensuring that your subordinates are familiar with?
   A. FM 20-400 and TC 20-401.
   B. Local, state, federal, host nation, and local unit.
   C Local unit.
   D. HMIS and MSDS.

2. How often do fire extinguishers need to be inspected in the lab?
   A. Daily.
   B. Weekly.
   C. Monthly.
   D. Yearly.

3. When developing a laboratory inspection schedule as part of the SOP, which of the following areas should be included?
   A. Electrical systems.
   B. Field testing equipment.
   C. Accountability of packaged fuel products.
   D. Accident report postings.

4. Which of the following should be avoided when selecting a site for the mobile petroleum laboratory?
   A. Firm, drained terrain.
   B. Ground near a stream or pond.
   C. Ground that is excessively sloped.
   D. Terrain near road nets.

5. Which of the following is an alternative to the general use of hazardous materials?
   A. Discontinue use.
   B. Direct ordering.
   C. Change mission requirements.
   D. There are no alternatives.

LESSON 3

MONITOR LABORATORY TESTING FACILITIES

Critical Tasks:
101-523-4400
101-523-4402
101-523-4403

OVERVIEW

The ability to identify sources of contamination, monitor sampling procedures, evaluate the submission of samples to test facilities, and recommend changes to quality surveillance SOPs is important for the petroleum laboratory NCO when evaluating quality surveillance procedures at aviation unit refueling facilities.

Lesson Description:

During this block of instruction we will discuss identifying sources of contamination, monitoring sampling procedures, evaluating the submission of samples to test facilities, and recommending changes to quality surveillance SOPs.

Terminal Learning Objective:

Action: Acquire knowledge on identifying sources of contamination or deterioration for aviation fuel, monitoring sampling procedures, evaluating submission of samples to test facilities, recommending changes to quality surveillance procedure SOPs, and assisting in aircraft crash investigations when required, while addressing applicable safety procedures and environmental concerns.

Condition: Given subcourse QM 5183

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

INTRODUCTION

As a petroleum laboratory NCO you play an important role in evaluating the quality surveillance procedures at aviation unit refueling facilities. You must have a thorough base knowledge of contamination sources, sampling procedures, sample testing, and SOPs in order to make the right decisions. You will be responsible for evaluating the unit's operational SOP to verify that procedures for maintaining the quality of a petroleum product are established and make recommendations, when required.

PART A – MONITORING LABORATORY TESTING FACILITIES

One of the many responsibilities you will take on, will be the monitoring of petroleum testing operations at aviation unit refueling facilities. Due to their size and mission, it is not always possible to maintain petroleum supply specialists in these units, with the experience required to ensure quality surveillance on aviation fuels. Due to the complex nature of aircraft, safety considerations, and expense, quality surveillance at these facilities is of the utmost importance. When assigned to this type of duty, your primary function will be to perform the following tasks:

Monitor Sampling and Gaging Procedures.

- Verify annotation in sample log box.
- Inspect sample submission procedures.

Records Inspection. Inspect logbooks/records to verify that required quality surveillance procedures are being performed.

- Inspect product rotation history.
- Review completed DA Form 2077 (Petroleum Products Laboratory Analysis Report).
- Review DA Form 4702-R (Monthly Bulk Petroleum Accounting Summary).

Crash Investigations. Provide assistance in the investigation of aircraft crashes.

- Testing of aviation fuels for possible contamination/deterioration.
- Report results of findings to proper investigating agencies.

PART B - IDENTIFY POTENTIAL SOURCES OF CONTAMINATION FOR AVIATION FUEL

Contamination with other products. This type of contamination is usually a result of inadvertent mixing with other petroleum products during transportation and storage. Contamination is detected by laboratory tests.

Contamination with Water, Solids, and Microbiological Growth. These types of contamination can usually be detected visually since they are not mixable with the fuel. A detailed list of the frequently encountered types including appearance, characteristics, and effects on aircraft performance can be found in Table X, MIL-HDBK-200.

- Water. Water in fuel may be either fresh or salt and may be present either as dissolved or free water. Dissolved water is that which has been absorbed by the fuel and is not visible. Free water may be in the form of a cloud, emulsion, droplets, or in large amounts in the bottom of a tank or container. Free water can cause icing in an aircraft fuel system, malfunctioning of fuel quantity probes, and corrosion of fuel system components. Saltwater will promote corrosion more rapidly than fresh water.
- Sediment. Sediment appears as dust, flakes, or granular or fibrous materials. Total sediment includes both organic and inorganic materials. Presence of appreciable quantities of fibrous materials is indicative of filter element breakdown due to a ruptured element or mechanical disintegration of the filter element in the fuel system. Sediment or solid contamination will be either coarse or fine. Coarse sediment is ordinarily 10 microns in size or larger. It easily settles out of the fuel or can be removed by adequate filtration. Fine sediment is smaller than 10 microns and to a limited degree can be removed by settling, filtration, or centrifuging.
- Microbiological growth. Microbiological growth consists of living organisms that grow at the fuel water interface. These organisms include protozoa, fungus, and bacteria, all of which can cause problems associated with microbiological contamination of aviation turbine fuels. Microbiological growth is generally found wherever pockets of water exist in fuel tanks. It has a brown, black, or gray color, and a stringy,

fibrous-like appearance. FSII additive at 15 percent by volume is effective in controlling microbial contamination. If water is absent, microbiological growth cannot occur.

PART C – QUALITY SURVEILLANCE OF TESTING PROCEDURES

Fuels can be contaminated from time to time during the refining process. Particulate contaminant testing is performed at various distribution locations to determine the effectiveness of fuel supply filtration systems. When aviation fuel contains moderate to heavy sediment levels, the aircraft's fuel filter may clog and shut off the fuel supply to the engine(s).

ASTM D-2276 – Standard Test Method for Particulate Contamination in Aviation Turbine Fuels

Test Apparatus:

- Analytical balance
- Oven - static type
- Petri dishes - approximately 125 mm in diameter with removable glass supports for membrane filters
- Forceps - flat-bladed with unserrated, non-pointed tips
- Vacuum system
- Test membrane filters, plain, 37-mm diameter, nominal pore size 0.8 micron
- Control membrane filter (gridded control membrane filters may be used for purpose of identification)
- Dispenser for flushing fluid with 0.4 micron membrane filters
- Field monitor - complete with protective plugs and 34-mm support pads
- Air ionizer - for the balance case
- Multimeter/VOM
- Flushing apparatus
- Ground/bond wire

Selection and Preparation of Reagents.

- Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society. Other grades may be used, provided it is ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.
- Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type III of Specification D-1193.
- Isopropyl alcohol. **NOTE:** Isopropyl alcohol is flammable.
- Liquid detergent - water soluble.
- Petroleum spirit (petroleum ether or IP petroleum spirit 40/60), boiling range 35 to 60 degrees Celsius.

Preparation of Test and Control Membrane Filters and Field Monitoring Prior to Sampling.

- Two 37-mm membrane filters of nominal pore size 0.8-um are required: A test and a control membrane filter. Matched-weight membrane filters may be used if so desired.
- If matched-weight membrane filters are used, it is unnecessary to carry out the procedures detailed below because they have been carried out previously by the membrane filter supplier. The two membrane filters used for each individual test should be identified by marking the petri dishes used as containers.
  - Using forceps place the test and control membrane filters side by side in a clean petri dish. To facilitate handling the membrane filters should rest on clean glass support rods in the petri dish.
  - Place the petri dish with its lid slightly ajar, in an oven at 90±5 Celsius and leave it for 30 minutes.
  - Remove the petri dish from the oven and place it near the balance. The petri dish cover should be ajar but still protecting the membrane filters from contamination from the atmosphere. Allow 30 minutes for the membrane filters to come to equilibrium with the ambient air temperature and humidity.
  - Remove the control membrane filter from the petri dish with forceps, handling by the edge only, and place it centrally on the weighing pan. Weigh it and return it to the petri dish.
  - Repeat step 4 for the test membrane filter. Record the membrane filter masses.
  - Take a clean field monitor, mark for identification, rinse with filtered flushing fluid, and insert a clean support pad.

- Using clean forceps, place the weighed control membrane filter centrally on the support pad in the field monitor and place the weighed test membrane filter on top of the control membrane filter. Assemble the two parts of the field monitor, ensuring that the membrane filters are firmly clamped inside and the protective plugs are in position.
- Record the monitor identification.

Collecting an Aviation Turbine Fuel Sample.

- Fix the self-sealing connection to the sampling point ensuring that the dust cap at the exposed ends is in place. The sampling connection is normally left in place at all times.
- Unscrew the field monitoring casing.
- Remove the bottom protective plug from the monitor and place it in a clean safe place.
- Place the monitor in its casing.
- Remove the other protective plug from the monitor and place it in a clean safe place.
- Reassemble the monitor casing by hand-tightening only.
- Ensure that the flushing line is connected to the selector valve. Return the free end of the flushing line to the sampling assembly downstream of the field monitor or lead it directly into a receiver.
- Ensure that the flexible sampling line is connected to the bottom of the monitor casing and lead the free end to the graduated sample receiver.
- Remove the dust caps from the sampling connection and the flexible pressure hose connector, and connect the sampling apparatus to the sampling connection with the selector valve in the "off" position.
- When the desired fuel flow and pressure conditions are established in the line or hose, operate the selector valve to the "flush" position.
- When at least 2 L of fuel are collected, operate the selector valve to the "sample" position. During normal operations a line pressure of 35 psi (0.24 MPa) minimum is suitable to obtain a reasonable sampling rate. Constant line pressure should be maintained during sampling.
- Take a 3.785-L (1-gallon) to 5-L fuel sample if conditions permit. When the required amount of fuel is collected, operate the selector valve to the "off" position.
- After sampling is completed, allow 1 minute to pass; then disconnect the sampling unit from the sampling connection and replace the dust caps.
- Remove the field monitor from its casing and replace the protective plugs. Do not open the field monitors under any circumstances before returning them to the laboratory. If they are opened, the membrane filters and the field monitor must be discarded.

Preparing the Test Apparatus.

- Wash the petri dishes and supports with warm water containing detergent. Rinse with warm water and then with distilled water.
- Rinse thoroughly with filtered isopropyl alcohol and then with filtered petroleum ether or 1,1,2-trichloro-1,2,2-trifluoroethane.
- Drain for a few seconds and then air or oven dry.
- Ensure that all glass and plastic tubing attached to the solvent filtering dispenser is clean by flushing thoroughly with filtered petroleum ether or 1,1,2-trichloro-1,2,2-trifluoroethane.

Perform the Test Procedure.

- Assemble the apparatus with the sample monitor in place on the stopper of the vacuum flask.
- Place the tip of the delivery spout of the solvent filtering dispenser in direct contact with the monitor inlet hole. Introduce petroleum ether of 1,1,2-trichloro-1,2,2-trifluoroethane until the monitor is full.
- Apply a vacuum to the flask and allow approximately 250 ml of petroleum ether or 1,1,2-trichloro-1,2,2-trifluoroethane to pass from the solvent filtering dispenser through the monitor and into the vacuum flask.
- Remove the solvent filtering dispenser and slowly release the vacuum.
- Remove the monitor from the stopper of the vacuum flask and carefully dismantle it in an upright position.
- Carefully remove the test and control membrane filters and place side by side on clean glass supports in the clean, covered petri dishes.
- Dry and reweigh the membrane filters. Care should be taken not to disturb the contaminant on the surface of the test membrane filter.

Calculate the Test Results.

- Subtract the initial weight of the test membrane filter (W1) from the final weight (W2).

- Subtract the initial weight of the control membrane filter (W3) from the final weight (W4).
- Divide the correct weight of contaminant, (W2 - W1) - (W4 - W3), by the volume in liters of the sample filtered.
- Report the result as total contaminant, expressed in milligrams per liter to the nearest 0.01 mg/L, and also the sample volume used in the test.

Perform PMCS. Perform PMCS on all applicable laboratory equipment.

- Apparatus and containers will be rinsed with a portion of the product being sampled to ensure that the sample is not contaminated with the previous material, unless otherwise specified in the test procedures.
- Soaking and rinsing material will be discarded.
- Sampling apparatus will be cleaned immediately after use and stored so it will remain clean until after next use.
- The sampling area should remain clean to prevent contamination of intended sample.
- All testing apparatus must be cleaned, prepared for next use, and properly stored as soon after completing of the test method is practicable. Consult the test method for apparatus manual for additional information.
- Clean up all spills immediately. Dispose of hazardous materials and hazardous waste in accordance with laboratory standard operating procedures. Report all hazardous material and hazardous waste spills immediately. Be familiar with and know the location of material safety data sheets for all hazardous materials present in the workplace.

TEST D-5452 – Standard Test Method for Particulate Contamination in Aviation Fuel by Laboratory Filtration.

Selecting and Preparing the Test Apparatus.

- Analytical balance - single- or double-pan, the precision standard deviation of which must be 0.07 mg or better.
- Oven - static type
- Petri dishes - approximately 125 mm in diameter with removable glass supports for membrane filters
- Forceps - flat-bladed with serrated, non-pointed tips
- 5Vacuum system
- Test membrane filter - 47-mm diameter, nominal pore size 0.8 micron
- Control membrane filter - 47-mm diameter, nominal pore size 0.8 micron
- Dispenser for flushing fluid - 0.45-um membrane filters to be provided in the delivery line
- Air ionizer
- Filtration apparatus consisting of a funnel and funnel base with filter support
- Support apparatus - having adjustable height, integral spill collection pan at the base and an edge on the can shelf to prevent the can from slipping off. The shelf is slotted.
- Dispensing cap or plug - with approximately 9.5 mm inside diameter hose barb 32 mm long on which a 75 to 100 mm long piece of fuel resistant, flexible, plastic tubing is installed. The closure gasket shall be made of a fuel resistant material.
- Feed container - preferably the same container in which the sample was collected
- Graduated receiving flask - glass with a sidearm to connect the vacuum system
- Safety flask - glass containing a sidearm attached to the receiving flask with a fuel and solvent resistant rubber hose and connected to the vacuum system
- Ground/bond wire - bare stranded flexible, stainless steel or copper installed in the flasks and grounded.
- Plastic film - polyethylene or other clear film not affected by flushing fluids
- Multimeter/VOM - used for determining whether electrical continuity is 10 ohms or less between 2 points.

Selecting and Preparing the Reagents. Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. Reagents for this test method consist of the following:

- Water - understood to be reagent water as defined by Type III of Specification D-1193

- Isopropyl alcohol. Isopropyl alcohol is flammable.
- Liquid detergent - water soluble.
- Flushing fluids - petroleum spirit (aka, petroleum ether or IP Petroleum Spirit 40/60).
- Filtered fluid (use 0.45-micron membrane filter)

Preparing the Sample Containers.

- Clean all components of the filtration apparatus, petri dishes, sample containers and their closures.
- Remove any labels, tags, etc.
- Wash with warm tap water containing detergent.
- Rinse thoroughly with warm tap water.
- Rinse thoroughly with reagent water. Container caps should only be handled externally with clean laboratory crucible tongs during this and subsequent rinsing.
- Rinse thoroughly with filtered isopropyl alcohol.
- Rinse thoroughly with filtered flushing fluid.
- Keep a clean piece if plastic film rinsed with filtered flushing fluid over the top of the sample container until the closure is installed. Similarly protect the funnel opening of the assembled filtration apparatus with clean plastic film until ready for use.

Preparing the Test and Control Membrane Filters. Two 47-mm membrane filters of nominal pore size 0.8-um are required: a test and a control membrane filter. Matched-weight membrane filters may be used if so desired. If matched-weight filters are used, it is unnecessary to carry out the procedures detailed in this section because they had been carried out previously by the membrane filter supplier. The two membrane filters used for each individual test should be identified by marking the petri dishes used as a container.

- Wash two petri dishes and supports with warm water containing detergent. Rinse with warm water; rinse with distilled water; rinse with filtered isopropyl alcohol; and do a final rinse with filtered petroleum ether or 1,1,2-trichloro-1,2,2-trifluoroethane. Drain the petri dishes and air or oven dry.
- Using forceps, place the test and control membrane filters side by side in the clean petri dishes (mark the dishes to identify test from control). To facilitate handling, the membrane filters should rest on clean glass support rods in the petri dish.
- Place the petri dishes with lids slightly ajar in an oven at 90 $\pm$ 5 degrees Celsius for 30 minutes.
- Remove the petri dishes from the oven and place them near the balance. The covers should remain slightly ajar, but still protect the membrane filters from being contaminated. Allow 30 minutes for the membrane filters to come to equilibrium with the ambient air temperature and humidity.
- Remove the control membrane filter form its petri dish with forceps, handling by the edge only, and place it in the center of the weighing pan. Weigh it and return it to its petri dish.
- Repeat the weighing procedure for the test filter.
- Using clean forceps, place the weighed test membrane filter on top of the membrane filter. Place the weighed test membrane filter on top of the control membrane filter. Install the funnel. Do not remove the plastic film from the funnel opening until ready to start filtration.

Perform the Test Procedure.

- Take precautions to minimize apparatus contamination from airborne dust. Use a protective hood or cover. Clean all equipment used for handling samples and membrane filters before use.
- With the membrane filters in place, perform a continuity test using a multimeter between the funnel and the filter holder. The meter shall read 10 ohms or less.
- The assembled apparatus shall be grounded by connecting a wire to the laboratory ground from the locking ring of the filtration assembly to the support stand and to the sample container. Another ground wire is required from the inside of the receiving and safety flasks, and from the sample container.
- Thoroughly clean the outside of the sample container in the region of the closure by washing with detergent in water and rinsing with tap water and filtered isopropyl alcohol. Shake the container vigorously for about 1/2 min. Remove the closure; remove any external contaminant that may be present in the threads of the sample container by washing with filtered flushing fluid ensuring that none of the washings enter the container.
- Screw the closure on the container. If the closure is not clean, rinse thoroughly with filtered flushing fluid and dry with compresses air before use. Slip a length of plastic tubing snugly over the house barb.

- If the closure will not fit the original sample container, shake the original container briefly and quickly transfer the sample to an appropriate container that has been rinsed. Tighten the dispensing cap or plug on the container.
- Assemble the receiving flask, preweighed filter(s) and funnel as a unit, and place on the pan of the support. Snap the support shelf on the support apparatus. The shelf should be positioned approximately 25 to 50 mm above the top of the funnel. Secure a grounding clip and wire to the container support and electrically ground in series.

Calculate and Report the Results.

- Subtract the initial weight of the test membrane filter (W1) from the final weight (W2).
- Subtract the initial weight of the control membrane filter (W3) from the final weight (W4).
- Divide the correct weight of contaminant, (W2 - W1) - (W4 - W3), by the volume in liters of the sample filtered.
- Report the results to the nearest 0.01 mg/L.
- Report the volume of the sample used in the test.

Perform PMCS on Applicable Equipment.

- Apparatus and containers will be rinsed with a portion of the product being sampled to ensure that the sample is not contaminated with the previous material, unless otherwise specified in the test procedures.
- Soaking and rinsing material will be discarded.
- Sampling apparatus will be cleaned immediately after use and stored so it will remain clean until after next use.
- Sampling area should remain clean to prevent contamination of the intended sample.
- All testing apparatus must be cleaned, prepared for next use, and properly stored as soon after completing of the test method is practicable. Consult the test method for apparatus manual for additional information.
- Clean up all spills immediately. Dispose of hazardous materials and hazardous waste in accordance with laboratory standard operating procedures. Report all hazardous material and hazardous waste spills immediately. Be familiar with, and know the location of material safety data sheets for all hazardous materials present in the workplace.

LESSON 3
PRACTICE EXERCISE

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

1. When is contamination with other products most likely to occur?
   A. During receiving and distribution.
   B. During inspection.
   C. During sampling and gaging.
   D. During transportation and storage.

2. Fine sediment can be removed to a limited degree by which of the following?
   A. Absence of water.
   B. Settling, filtration, or centrifuging.
   C. Reduction of commingling.
   D. Improved quality surveillance.

3. Microbiological growth occurs in the presence of what?
   A. Fine sediment.
   B. Coarse sediment.
   C. Water.
   D. Fibrous materials.

4. How are sampling and gaging procedures monitored at an aviation unit refueling facility?
   A. Inspecting product rotation history and reviewing completed DA Form 2077.
   B. Keeping aviation fuel free of solid and water contamination before sampling and gaging.
   C. Installing filter/separators and reviewing DA Form 4702-R.
   D. Verifying annotation in sample log box and inspecting sample submission procedures.

5. Which of the following tests are performed to detect aviation fuel contaminants?
   A. D-4057, D-4058.
   B. D-1250, D-93.
   C. D-2276, D-5452.
   D. FTM-2276, FTM-5452.

LESSON 4

DEVELOP A MAINTENANCE, SUPPLY, AND CALIBRATION PROGRAM

Critical Task:
101-523-4403

OVERVIEW

Lesson Description:

During this block of instruction we will discuss petroleum sample receiving and in-processing procedures, procedures for recording and reporting test results, and sampling and testing safety procedures.

Terminal Learning Objective:

Action: Acquire knowledge concerning the development of a maintenance, supply, and equipment calibration program

Condition: Given subcourse QM 5183.

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

PART A – DEVELOP A LABORATORY EQUIPMENT AND CALIBRATION SOP

Develop a Laboratory Equipment SOP. Calibration standing operating procedures: Ensure the following sections are included when establishing a calibration SOP:

- Purpose: This section describes the purpose of preparing and maintaining the SOP.
- Scope: This section describes the broad concepts of equipment calibration, proper record keeping, and training of personnel.
- Responsibilities: This section describes the specific responsibilities of all personnel assigned to the laboratory.
- Procedures: This section describes the procedures to be followed concerning equipment calibration, identification of equipment that needs calibration, procedures for establishing calibration schedules, procedures for internal C level and external A level calibration, safety and environmental considerations to be addressed during operator calibration procedures, record keeping, and personnel training on a daily, weekly, monthly, etc., basis. Instructions for calibrating equipment are in the applicable TMs.
- Record keeping: This section describes the purpose, use, instructions for completion, and disposition of forms and other record keeping systems that must be followed.
- Equipment maintenance: This section lists the equipment and systems that must be calibrated on a periodic basis.
- Miscellaneous: This section contains other specifics such as definitions, when to use/not use specific forms, symbols, special instructions, and calibration of equipment.
- References: This section lists the references used to guide personnel in SOP procedures.

When implementing a calibration SOP, the following steps are included:

- Identification of equipment that requires calibration.
- Establishment of a calibration schedule for each piece of equipment.
- Establishment of procedures for internal C level calibration.
- Identification of external agencies for A level calibration.
- Identification of safety and environmental considerations to be addressed during operator calibration procedures.

Implement a Laboratory Equipment Calibration SOP. Calibration requirements can be found in TB 43-180 (Calibration and Repair Requirements for Maintenance of Army Material), applicable ASTM methods, (Military Standard) MIL-STD-978, and AR 750-25 (Army Test Measurement and Diagnostic Equipment (TMDE) Calibration).

- Personnel requirements. According to AR 750-25, all petroleum laboratory personnel are responsible for ensuring all of the laboratory equipment listed in TB 43-180 is periodically calibrated.
- Calibration logs. Though not required, these have proven valuable in maintaining an equipment audit trail. They can then be used to schedule the C level calibration workload within the laboratory and A level calibration by the Test, TMDE personnel.
- Calibration of test kits. In addition to petroleum laboratory equipment, components of the test kits may also require calibration. The sampling and gaging kit contains an innage tape and bob that must be periodically calibrated. Kits that contain thermohydrometers or thermometers and hydrometers will need calibration. Personnel responsible for the operation of these kits should contact the nearest mobile or base petroleum laboratory for C level calibration support. Most of the time, a one for one exchange of each item of equipment can be arranged. The captured fuels test kit does not require calibration.
- "A" level calibration. "A" level calibration is not performed by petroleum laboratory personnel. It is performed by personnel from a TMDE calibration center. Petroleum laboratories can either schedule a TMDE calibration laboratory team to perform A level calibration on site or send the equipment to a TMDE calibration and repair center, or a combination of both. The chosen method depends on the regulations and policies within the specific command. Laboratories sending equipment for calibration must have at least two sets of the equipment on hand. Never turn in both sets at the same time. Rotate them to keep a calibrated set on hand. DA Form 2402 (Exchange Tag) is filled out and attached to each item of equipment that must be sent to a calibration facility. The sending petroleum laboratory files the bottom portion of the tag for accountability purposes.
- "C" level calibration. "C" level calibration (standardization) is performed at the petroleum laboratory by laboratory personnel using an "A" level calibrated set of equipment. Once an item of equipment has

passed C level calibration, a completed DA Label 80 (US Army Calibrated Instrument) is either attached to the item of equipment or to the DD 314 and kept on file. Items of equipment which fail C level calibration should have a DA Form 2417 (US Army Calibration System Rejected Instrument) attached so that they will not be used. These items of equipment, along with items of equipment being returned from the A level calibration facility, should be turned in for repair or disposal.

It is necessary to verify that calibration requirements for laboratory equipment have been established in accordance with:

- TB 43-180.
- Applicable ASTM test methods.
- MIL-STD-978.
- Manufacturer specifications.

Check Calibration Due Dates, Review Calibration Suspense According to Schedule on DD Form 314 (Preventive Maintenance Schedule and Record), and File and Review "C" Level Procedures.

- Calibration due dates. DD Form 314 is used to record calibration due dates of petroleum laboratory equipment. These due dates are based on the manufacturers recommended calibration requirements.
- Check calibration due dates. It is necessary to check DD Form 314 for each piece of equipment that requires periodic calibration. For the equipment that needs to be calibrated at another location, it is necessary to be sure that the turn-in procedures have been followed correctly.
- Review calibration suspense file for completeness and accuracy. Calibration suspense files are used to track periodic calibration for various equipment. Be sure to review these suspense files regularly for accuracy and completeness.
- Review laboratory internal "C" level calibration procedures. DA Label 80 should be checked to ensure the calibration procedures are being completed in accordance with manufacturer specifications. It is necessary to verify that laboratory technicians follow calibration guidelines in the applicable TM or manufacturer's instructions for specified equipment.

PART B – DEVELOP A PETROLEUM LABORATORY SUPPLY SOP

Ordering Supplies. Ensure the following general procedures and comments are covered in detail in the appropriate section of the laboratory SOP.

- Via the laboratory SOP each individual assigned to a base, mobile, or airmobile laboratory will be capable of ordering supplies for the laboratory.
- Supply requirements may vary due to the type of laboratory. Technical manuals list components and maintenance requirements for each type of laboratory. The appropriate technical manuals for the three types of laboratories are as follows:
  - Base Laboratory TM 5-6640-214-14.
  - Mobile Laboratory TM 10-6640-215-13.
  - Airmobile Laboratory TM 10-6640-216-13&P.
- Supply requirements for the laboratories are determined by Table of Organization and Equipment (TOE), Table of Distribution and Allowances (TDA), technical manuals, military and federal specifications, and military handbook MIL-HDBK-200.
- When ordering supplies, it is important to know the type of supplies being ordered. There are six major types:
  - Non-expendable - major pieces of equipment or nonperishable items.
  - Expendable - perishable, emptied, or used up. Use a breakage list to keep track of items broken during laboratory operations.
  - Major end items.
  - Component parts - secondary pieces of equipment to a major end item (such as the test apparatus is to a mobile laboratory or tools in a tool kit).
  - Self-service supplies - perishable supplies such as paper, pens, toilet items, etc.
  - High dollar or controlled supplies - cost excessive controlled items such as fuel, ammunition, paint, etc.
- All supplies that need to be ordered should be identified in one of four ways:
  - National Stock Number (use FEDLOG to verify numbers).

  - Line item number (LIN) number.
  - Manufacturer.
  - Technical manual hand receipt.
- Laboratory supplies are ordered (requisitioned) using one of three forms:
  - DA Form 2765-1 (Request for Issue or Turn-In).
  - DD Form 1348 (DOD Single Line Item Requisition System Manual).
  - DA Form 3161 (Request for Issue or Turn In - Temporary Issue).
- When supplies are ordered and received, they are listed and annotated, respectively, on DA Form 2064 (Document Register for Supply Actions).
- A separate document register is kept for non-expendable and expendable items used in the laboratory.
- You must account for each piece of laboratory equipment. Usually, the officer in charge or person accountable for the equipment is the property officer.
- Numerous laboratory supply items (chemicals, solvents, and equipment) must be obtained through local supply sources. This is due to the rare requirement for the item. When there is no demand for the item, the Army will not keep the item in the supply system. Commercial catalogs may be obtained directly from the company or the supply officer.
- A record will be established for the replenishment of expendable laboratory supplies; therefore, when you are down to an established reorder point, you will requisition the quantity to replenish to the required stock level.
- Overpack supplies (mostly expendable, additional) are required by deployable laboratories. These supplies are used when deployed (usually 60 to 90 days of expendable supplies) until a supply channel can be established.

Supervisor Responsibilities. Verify that technicians are filling out the breakage list and establish procedures to:

- Requisition supplies.
- Use FEDLOG.
- Keep track of required supplies.
- Receive supplies.
- Store supplies.

PART C – PETROLEUM LABORATORY PREVENTIVE MAINTENANCE SOP

Maintenance Standard Operating Procedures. Maintenance of equipment is a necessary function of any petroleum laboratory. Normally, 77Ls learn maintenance procedures through practical experience in the laboratory under qualified supervision. Personnel who do not have the chance to learn through actual hands-on experience should be directed to review maintenance manuals, manufacturer's instructions, and similar references for maintenance requirements on specific equipment.

In addition to specific pieces of laboratory test equipment, there are other items associated with the laboratory which require periodic maintenance. Such items include air compressors, vacuum pumps, generators, and in some cases, motor vehicles. In order to keep the laboratory operating at maximum efficiency, it is important that all assigned personnel be knowledgeable in the maintenance of all equipment assigned to the laboratory and maintain a workable system of maintenance records. The procedures to be followed should be organized into a preventive equipment maintenance SOP.

Preventive maintenance of equipment is a necessary function of every petroleum laboratory to ensure that it operates at maximum efficiency. An SOP establishes a standardized and workable system to maintain records, publications, training, and standard procedures for the laboratory. The preventive maintenance SOP contains the following sections:

- Purpose: This section describes the purpose of preparing and maintaining the SOP.
- Scope: This section describes the broad concepts of equipment maintenance, proper record keeping, and training of personnel.
- Responsibilities: This section describes the specific responsibilities of all personnel assigned to the laboratory. Because maintenance personnel are not assigned to petroleum laboratories, all laboratory personnel must perform operator maintenance on the equipment.

- Procedures: This section describes the procedures followed concerning equipment maintenance, record keeping, and personnel training on a daily, weekly, monthly, etc., basis. Instructions for maintaining the laboratories and their special components are in the applicable TMs.
- Record keeping: This section describes the purpose, use, instructions for completion, and disposition of forms and other record-keeping systems that must be followed.
- Equipment maintenance: This section lists equipment and systems that must be maintained on a periodic basis.
- Miscellaneous: This section contains other specifics such as definitions, when to use/not use specific forms, symbols, special instructions, and calibration of equipment.
- References: This section lists the references used to guide personnel in SOP procedures. When establishing maintenance requirements for petroleum laboratory equipment, the operator, organizational, direct support, and general support maintenance manuals should be used.

Listed below are the specific manuals to be consulted:
Petroleum Base Laboratory.

- TM 5-6640-214-14 (Operator's Organizational, Direct Support and General Support Maintenance).
- TM 10-1161, C2. (Petroleum Basic Laboratory Assembly).
- FM 10-67-2 (Petroleum Laboratory Testing and Operations).

Airmobile Aviation Fuel Laboratory.

- TM 10-6640-216-13&P (Operator's Unit, and Direct Support Maintenance Manual for Airmoble Aviation Fuel Laboratory).
- TM 5-4120-295-15 ((Operator's Organizational, Direct Support, General Support and Depot Maintenance for Air Conditioner Floor Mounted Air Cooled; 60,000 BTU/Hr).
- TM 9-2330-271-14(Operator's, Organizational, Direct Support, and General Support Maintenance Manual, Semitrailer, Van; Electronic, 10-ton 4-wheel).
- FM 10-67-2. (Petroleum Laboratory Testing and Operations).

Mobile, Semitrailer Mounted Petroleum Laboratory.

- TM 10-6640-215-13 (Operator's, Unit, and Direct Support Maintenance Manual for Petroleum Lab, Semi-trailer Model).
- TM 5-4120-274-15(Operator's, Organization, Direct Support, General support and Depot Maintenance Manual: Air Conditioning, Electronic Motor Driven 9,000 BTU).
- TM 11-5410-213-14P (Operator's Direct Support and General Support Maintenance Repair Parts and Special Tools List for Shelters Electronic Equipment).
- FM 10-67-2. (Petroleum Laboratory Testing and Operations).

Supplemental maintenance requirements can be obtained from instruction maintenance booklets or owner/operator manuals usually supplied from the manufacturers of the various equipment. If not available, they may be requested from the appropriate manufacturer through command or supply channels.

Maintenance Intervals. Maintenance intervals are established by the appropriate maintenance manual (TMs, FMs, or operator's maintenance manual) covering a particular unit. Depending on where the equipment may be physically located, there could be local factors that would increase maintenance intervals such as dust, temperature, and humidity. Age of equipment and maintenance history of equipment could also require an increase of preventive maintenance.

Laboratory personnel should always be aware of symptoms in equipment that may indicate a change in the interval of preventive maintenance is needed. Such examples might be temperature, vibration, reduced efficiency, noise, and smell. All maintenance intervals that are established should be recorded in the maintenance schedule and maintenance SOP.

Maintenance Schedule Check Sheet. A maintenance schedule check sheet should be prepared detailing the maintenance to be performed on each piece of equipment. Variations may be used to keep track of upcoming PMCS events.

Suspense Folders. Suspense folders containing DD Form 314 (Preventive Maintenance Schedule and Record) should be maintained. These folders are given to technicians in the laboratory to check the listed items and perform the required maintenance. A checklist format is satisfactory. The equipment in the laboratory, whether in use or not, should remain in a high state of readiness.

Use of DD Form 314 (Preventive Maintenance Schedule and Record). The DD Form 314 is used to show when equipment is scheduled for periodic preventive maintenance and when maintenance has been performed. The reverse side of DD Form 314 is used to record the time a piece of equipment was not mission-capable either because of maintenance or because repairers were waiting for parts from supply. Not all preventive maintenance should be recorded on DD Form 314.

Only preventive maintenance that is performed on a time or mileage basis should be scheduled and recorded on DD Form 314. For example, DD Form 314 should be used to schedule and record maintenance that is done every 3 months, after 1,000 hours of operation, or every 5,000 miles.

Complete DA Form 2407 (Maintenance Request) When Requesting Maintenance Support. DA Form 2407 (Figure 4-1) is used by organizational maintenance personnel mainly to request support maintenance. It is used when organizational maintenance personnel cannot repair a piece of equipment because of a lack of ability or proper tools. All copies of DA Form 2407 are sent with the faulty equipment to the support activity. The receipt copy is sent back to the owning organization where it is kept on file until the equipment is returned.

DA Form 2407 is also used to report maintenance on certain sample items and to submit warranty claims. DA Form 2407-1 is used where there are not enough lines on DA Form 2407. DA Form 2405 is used by the owning organization to keep a record of DA Forms 2407 sent to support maintenance.

Purpose. Both DA Form 2407 (Maintenance Request) and DA Form 2407-1 (Maintenance Request Continuation Sheet) serve as a request for maintenance support and give information to all levels of maintenance management.

The DA Forms 2407/2407-1 are the source of information for the Army's work order data base, called the Work Order Logistics File (WOLF) that provides statistical weapon analyses such as mean time to repair and repair parts usage at the Direct Support (DS)/General Support (GS) levels of maintenance for selected major weapon systems.

Submit the maintenance request data to AMCs Logistics Support Activity (LOGSA) through the Standard Army Maintenance System (SAMS) or the Maintenance Information Management System (MIMS).

Use. DA Forms 2407/2407-1 are used as maintenance requests for:

- Requesting support maintenance.
- Repairs beyond the unit's authorized capability or capacity.
- Application of Military Work Orders (MWOs).
- Fabrication or assembly of items.
- Reporting work on DA-directed items under an approved sampling plan.
- Initiating work requests that may become warranty claim actions.
- Showing all support maintenance done on general purpose and passenger-carrying vehicles, and combat and tactical equipment.
- Requesting an estimated cost of damage (ECOD) or technical inspection to determine the serviceability/repairability of an item prior to repair or turn-in for replacement.

General Instructions. A separate DA Form 2407 will be filled out on each item reported under AR 700-138 (Army Logistics Readiness and Sustainability). A separate form will also be filled out on each component of an item reported under AR 700-138, when submitted separate from end item. You may combine items with the same make, model, and NSN on a single DA Form 2407 when they are not reported under AR 700-138. DA Form 2407-1 may be used when more room is needed. Items turned in for classification will be on separate forms. Send a copy of DA Form 2408-5 (Equipment Modification Record) with the equipment to support maintenance. The organization asking for maintenance fills out Section 1 of the DA Form 2407 and sends all copies of the form with the equipment. The support unit fills in Block 24 and puts a local work order number on the form. Copy 1 then goes back to the organization as a receipt for the equipment. The unit returns Copy 1 when the equipment is fixed and ready for pickup. Disposition involves retaining Copy 1 and destroying it when the equipment is returned to the unit.

MAINTENANCE REQUEST
For use of this form, see DA PAM 738-750 and 738-751; the proponent agency is DCSLOG

PAGE NO	NO OF PAGES	REQUIREMENT CONTROL SYMBOL CSGLD-1047(R1)

SECTION I - CUSTOMER DATA

1a. UIC CUSTOMER	1b. CUSTOMER UNIT NAME	1c. PHONE NO

2a. SAMS-2 UIC/SAMS-I/TDA	2b. UTILIZATION CODE	2c. MCSR

SECTION II - MAINTENANCE ACTIVITY DATA

3a. WORK ORDER NUMBER (WON)	3b. SHOP	3c. PHONE NO

4a. UIC SUPPORT UNIT	4b. SUPPORT UNIT NAME

SECTION III - EQUIPMENT DATA

5. TYPE MNT REQ CODE	6. ID	7. NSN

15a. FAILURE DETECTED DURING/WHEN DISCOVERED CODE (Enter code) See DA Pamphlets 738-750 and 738-751	

8. MODEL	15b. FIRST INDICATION OF TROUBLE/HOW RECOGNIZED CODE (Enter Code) See DA Pamphlets 738-750 and 738-751	16. MILES/KILOMETERS/HOURS/ROUNDS M	K	H	R

9. NOUN

10a. ORG WON/DOC NO	10b. EIC

11. SERIAL NUMBER	12. QTY	13. PD

17. PROJECT CODE (if assigned)	18. ACCOUNT PROCESSING CODE	19. IN WARRANTY? (enter Y or N)	20. ADMIN NO

14. MALFUNCTION DESCRIPTION (for DSU, GSU/AVIM, DEPOT use)	21. REIMBURSABLE CUSTOMER (if intransit customer enter Y or N)
	22. LEVEL OF WORK / 23. SIGNATURE

24. DESCRIBE DEFICIENCIES OR SYMPTOMS ON THE BASIS OF COMPLETE CHECKOUT AND DIAGNOSTIC PROCEDURES IN EQUIPMENT TM (Do not prescribe repairs)

25. REMARKS

26. TECHNICAL REFERENCES

SECTION IV - TASK REQUIREMENTS DATA

27a. FILE INPUT ACT CD	27b. TASK NO	27c. ACT CODE	27d. TASK DESCRIPTION	27e. QTY TO BE RPR	27f. WORK CENTER	27g. FAILURE CODE	27h. MH PROJ	27i. MH EXP

SECTION V - PART REQUIREMENTS

28a. FILE INPUT ACT CD	28b. TASK NO	28c. ID NO	28d. NSN OR PART NUMBER	28e. SFX CD	28f. QTY RQD	28g. QTY ISSUED	28h. NMCS CD	28i. FAILURE CODE	28j. STORAGE LOCATION	28k. INITIALS	28l. COST $

28m. TOTAL MANHOURS	28n. TOTAL MANHOURS COSTS $	28o. TOTAL PARTS COSTS $	

SECTION VI - COMPLETION DATA

29. QTY RPR	30. QTY CONDEMN	31. QTY NRTS	32. EVAC WON	33. EVAC UNIT NAME

SECTION VII - ACTION SIGNATURES

34a. SUBMITTED BY	35a. ACCEPTED BY	35c. DATE	36a. WORK STARTED BY	37a. INSPECTED BY	38a. PICKED UP BY

34b. DATE	35b. STATUS	35d. TIME	36b. STATUS	36c. DATE	36d. TIME	37b. STATUS	37c. DATE	37d. TIME	38b. STATUS	38c. DATE	38d. TIME

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Figure 4-1, DA Form 2407.

DA Form 2407 Completion. Section I Customer Data. Blocks (BLK) 1, 5, 6, 7, 10a, 10b, 11, 12, 13, 15, 16, 20, and 24 are mandatory if equipment is inoperable. Inoperable equipment is equipment that is not-mission-capable (NMC), in accordance with AR 700-138, a subsystem of a reportable weapon system, or command maintenance significant.

- (1a) UIC Customer: Enter the UIC of the customer that owns the equipment.
- (1b) Customer Unit Name: Enter the name of the unit identified by the UIC in Block 1a.
- (1c) Phone Number: Enter the phone number of the unit identified by the UIC in Block 1a.
- (2a) SAMS2UIC/SAMSI/Table of Distribution and Allowances (TDA): If in transit, enter UIC for SAMS2 or SAMS1/TDA unit.
- (2b) Utilization Code: Enter Utilization Code. See Appendix B (Maintenance Management Update 3-14).
- (2c) MCSR Item: Print the word "yes" or the letter "Y" if the item is reported under AR 700-138. This also applies to components and subsystems of an item/system that is reportable. If not, leave this block blank.

Section II Maintenance Activity Data: To be completed by support maintenance Direct Support Unit (DSU)/General Support Unit (GSU)/Aviation Intermediate Maintenance (AVIM)/DEPOT.

Section III Equipment Data.

- (5) Type MNT REQ Code: Enter the Type Maintenance Request Code. Appendix B, Table B-20 (Maintenance Management Update 3-14), lists the codes.
- (6) ID: Enter the Identification (ID) Code as shown below that identifies the type of number you will enter in Block 7.
  - A: National/NATO (North Atlantic Treaty Organization) Stock Number.
  - C: Manufacturer's Code and Reference Number (Part Number).
  - D: Management Control Number (MCN).
  - P: Other Numbers.
- (7) NSN: Enter the National Stock Number or appropriate number identified in Block 6.
- (8) Model: Enter model number.
- (9) Noun: Enter noun nomenclature of item.
- (10a) ORGWON/DOC NO: Enter organization work order number or organization document number.
- (10b) EIC: Enter the end item code (EIC). See Army Master Data File (AMDF).
- (11) Serial Number
  - Enter the serial number of the item in Block 9.
  - For nontactical wheeled vehicles, use the register number.
  - For ammunition, use the lot number.
  - Leave blank if the form is used for more than one item.
  - Leave blank if the equipment has more than one serial number.
  - Mandatory entry if equipment is (inoperable) INOP.
- (12) QTY: Enter the number of items. (Must be only one item listed if equipment is reportable under AR 700-138 and is NMC.)
- (13) PD: Enter the Priority Designator (See DA Pam 710-2-1).
- (14) Malfunction Description (DS, GS, AVIM, Depot Use).
- (15a) Failure Detected During/When Discovered Code.
  - Enter Failure Detected Code from Table B-3 or When Discovered Code from DA Pam 738-751.
  - Leave blank if no failure occurred.
- (15b) First Indication of Trouble/How Recognized Code: Enter First Indication of Trouble Code from Table B4 or How Recognized Code from DA PAM 738-751.
- (16) Miles/Kilometers/Hours/Rounds: Enter hour reading (to nearest hour) beside the "H" from the hour meter mounted on the equipment. If the equipment has no meter, leave blank.
- (17) Project Code: Enter the project code if one has been assigned. If not, leave blank.
- (18) Account Processing Code: Enter the Account Processing Code (APC) if required by your unit. The APC is a code prescribed locally for costing and budget identification of customers and organizations (reference TM 38-711-13). If not required, leave blank.
- (19) In Warranty? - enter Y or N to indicate whether equipment is still under manufacturer's warranty. If Y, submit one work request for each serial numbered item.
- (20) Admin Number: Enter the bumper number/materiel control number or administrative number assigned to the item of equipment.

- (21) Reimbursable Customer: For DSU/GSU/AVIM/Depot use.
- (22) Work Performed By: Enter code for level of work from Table B-24 (Maintenance Management Update 3-14).
- (23) Signature: The commander or the commander's designated representative will sign for all priority 01 through 10 requests. This signature approves the use of the PD.
- (24) Describe Deficiencies or Symptoms.
  - Using the information in column "c" of DA Form 2404, briefly describe the fault or symptoms. For example, print "Engine does not develop full power" or "Equipment uses two quarts of oil daily," etc. Do not ask for general or specific repair of parts to be replaced; for example, do not tell support to "replace the hydraulic system" or "repair as needed."
  - When the form is asking for work on more than one item with the same NSN, list the number of items, their serial numbers (if they have serial numbers), and anything else support will need. INOP equipment (equipment reported on the Materiel Condition Status Report), components/subsystems of reportable equipment, or command maintenance significant equipment) must have its own separate forms.
  - When the form is for components or assemblies with a recoverability code of A, D, F, H, or L, give the end item NSN. Put the NSN on the last line of Block 25. You will find recoverability codes in the RC code column on the AMDF. You will also find the codes listed as part of the item's Source, Maintenance, and Recoverability (SMR) code in the parts manual.
  - If you need more room, use a DA Form 2407-1.
  - When the form is requesting standard repair after a battle damage expedient has been applied, print "BDAR" in bold letters before describing the fault or symptoms. NOTE: The end item's Battlefield Damage and Assessment Repair (BDAR) TM and AR 750-1 describe when and how BDAR repairs will be made.
- (25) Remarks. When the item in Block 7 needs onsite or deferred maintenance, support will note that action here. Shop office NCO will make one of these entries for onsite or deferred work:
  - Maintenance request received on (date), signature of shop office NCO.
  - Onsite repair scheduled for (date), signature of shop office NCO.
  - Owner to return item on (date) for repair, signature of shop office NCO.
  - Block 35a will be completed by support only when onsite repair is started or the deferred item is brought back to support. The receipt copy will be sent to the support unit. The owning unit keeps all other copies until the onsite repair is started or deferred item is taken back to support.

Section VII - Action Signatures.

- (34a) Submitted By: The person sending in the DA Form 2407 enters first initial and last name in this block.
- (34b) The person signing the forms enters the original ordinal date the form was given to support.

Verification that Before-, During-, and After-Operation PMCS on Equipment has been Correctly Done and Correctly Annotated On DA Form 2404 (Equipment Inspection and Maintenance Work Sheet). DA Form 2404 (Figure 4-2) is used to report any faults or malfunctions discovered by an equipment operator. It is also used by organizational maintenance personnel to record periodic maintenance services and spot-check inspections. This form is a temporary record of needed and completed repairs. DA Form 2404 should be destroyed after uncorrected faults have been recorded on DA Forms 2402 and 2407 or action has been taken to request repair parts. However, if equipment is not combat-ready because of needed repairs, DA Form 2404 should be kept on file until the equipment has been repaired.

Purpose. DA Form 2404 has three major purposes. Operators and crews, firstline leaders, maintenance supervisors, and commanders are equally responsible for keeping information current and correct on the DA Form 2404. This form is the central record for managing and controlling maintenance as follows:

- It is a record of faults found during an inspection. These faults include PMCS, maintenance activity inspections, diagnostic checks, and spot-checks (unless otherwise noted).
- It shows faults and repairs required for ECOD reports.
- It shows Battlefield Damage and Assessment Repair (BDAR) performed.

Use. DA Form 2404 will be used by personnel performing inspections, maintenance services, diagnostic checks, technical evaluations, marine condition surveys on watercraft, and PMCS (unless otherwise noted):

- To inspect all components or subsystems that make up one equipment system, you may use one DA Form 2404 or separate forms for each subsystem.

- To inspect several like items of equipment; e.g., one DA Form 2404 to inspect 25 M16A1 rifles.
- As a temporary record of required and completed maintenance.
- To list faults that operators or crews cannot fix and list parts replaced.
- By unit maintenance during periodic services to list all faults found and action taken to fix faults. When used to inspect several like items, the DA Form 2404 will list all deficiencies, shortcomings, and corrective action taken.

General instructions. The way to complete some blocks and columns on DA Form 2404 varies with the form use. Make sure to read the instructions that apply to the use of the form. When more than one DA Form 2404 is needed for an inspection or service, print the page number on the right side of the form's title block. (Put 1 of 2 on the first page and 2 of 2 on the second, etc.) Parts on order or actions pending under Anticipated Not-Mission-Capable (ANMC) conditions may go on the DA Form 2408-1-4 with a diagonal status symbol. Administrative motor pools, using ADP cards or other automated forms, do not need the DA Form 2404.

Disposition. The DA Form 2404 will be kept in the equipment record folder or in a protected cover until it is completed if no faults have been found. If faults are found during an operator's or crew's PMCS, it will be given to the maintenance supervisor for action. Maintenance section leaders will review the DA Form 2404 prior to destruction to ensure all corrective actions have been completed. Transfer faults that must be fixed at support maintenance to the DA Form 2407 and attach DA Form 2404. Faults that cannot be fixed until a part comes in or action(s) that must be deferred will be entered on the DA Form 2408-1-4.

PMCS Verification. It is the responsibility of all personnel to keep the DA Forms 2404 up to date and accurate. In order to support the mission, the operability of each piece of equipment must be known at all times. In order to keep current on the status of identified faults or malfunctions, periodic maintenance services, and needed/completed repairs, personnel should spot-check DA Forms 2404 frequently.

Verify Operators Are Able To Correct And Report Maintenance Deficiencies.

- Maintenance Deficiencies. Based on a preventive maintenance checklist, operators are required to perform before-, during-, and after-checks to equipment/systems. If maintenance deficiencies are discovered, operators are expected to notify their supervisors immediately. Some maintenance can be performed by operators. Tools and supplies needed for maintenance by laboratory personnel must be requested as needed.
- Tools and Supplies. A list of tools and supplies that are required can be found in FMs and supply catalogs (SC) of the appropriate laboratory. For maintenance by direct support or facility engineers, tools and general purpose supplies are normally supplied by the support organization. Specialized repair parts installed by support organizations should be stocked by the laboratory. Examples include replacement heating elements for water stills, flash-point apparatus, and gum baths. Many repair parts for laboratory apparatuses are now available by national stock number (NSN) or part number. A listing of the current NSNs of major items in petroleum laboratories and their component repair parts, manufacturer codes, and related information are available in Petroleum/Chemical Laboratory Supplies, Equipment, and Related Technical Assistance Program, STSGPIM. This publication is available from the U.S. Army General Materiel and Petroleum Activity, New Cumberland Army Depot, New Cumberland, PA 17070.
- Verifying and Reporting Deficiencies. If repairs can be performed at the unit level, DA Form 2404 is used to identify faults. If the senior technician/sergeant determines that repairs are beyond unit capabilities, it becomes necessary to request maintenance from supporting units by completing a Maintenance Request (DA Form 2407). DA Form 2404 accompanies the work order.

EQUIPMENT INSPECTION AND MAINTENANCE WORKSHEET

For use of this form, see DA PAM 738, 780, and 738-751: the proponent agency is DCSLOG

1. ORGANIZATION	2. NOMENCLATURE AND MODEL
262d QM BN	6-INCH SINGLE-STAGE PUMP

3. REGISTRATION/SERIAL/NSN	4a. MILES	b. HOURS	c. ROUNDS FIRED	d. HOT STARTS	5. DATE	6. TYPE INSPECTION
NG 04219					4 AUG 98	**BEFORE-OPERATION**

7. APPLICABLE REFERENCE

TM NUMBER	TM DATE	TM NUMBER	TM DATE
TM 10-4320-307-10	**FEB 66**		

COLUMN A - Enter TM Item Number

COLUMN B - Enter the applicable condition status symbol.

COLUMN C - Enter deficiencies and shortcomings.

COLUMN d - Show corrective action for deficiency or shortcoming listed in Column c.

COLUMN e - Individual ascertaining completed corrective action initial in this column.

STATUS SYMBOLS

"X" - Indicates a deficiency in the equipment that places it in an inoperable status.

CIRCLED "X" - Indicates a deficiency; however, the equipment may be operated under specific limitations as directed by higher authority or as prescribed locally, until corrective action can be accomplished.

HORIZONTAL DASH "(-)" - Indicates that the required inspection, component replacement, maintenance operation check, or test flight is due but has not been accomplished, or an overdue MWO has not been accomplished.

DIAGONAL "(/)" - Indicates a materiel defect other than a deficiency which must be corrected to increase efficiency or to make the item completely serviceable.

LAST NAME, INITIAL IN BLACK, BLUE-BLACK INK, OR PENCIL - indicates that a completely satisfactory condition exists.

FOR AIRCRAFT - Status symbols will be recorded in red.

ALL INSPECTIONS AND EQUIPMENT CONDITIONS RECORDED ON THIS FORM HAVE BEEN DETERMINED IN ACCORDANCE WITH DIAGNOSTIC PROCEDURES AND STANDARDS IN THE TM CITED HEREON.

8a. SIGNATURE (Person performing inspection)	8b. TIME	9a. SIGNATURE (Maintenance Supervisor)	9b. TIME	10. MANHOURS REQUIRED
P. Moynihan PFC	**0830**			

TM ITEM NO. a	STATUS b	DEFICIENCIES AND SHORTCOMINGS c	CORRECTIVE ACTION d	INITIAL WHEN CORRECTED e
	/	**ENGINE OIL LOW**	**ADDED 1 QT**	**PM**
	/	**FUEL LOW**	**ADDED 3 GALLONS**	**PM**
	/	**HAIRLINE CRACK IN ENGINE HOUSING SUPPORT**		
	/	**LOOSE BATTERY CABLES**	**TIGHTENED CABLES**	**PM**

DA FORM 2404, APR 79 Edition of 1 Jan 64, which will be used

Figure 4-2, DA Form 2404.

Spot-Check Operator Maintenance Procedures and Verify Maintenance Is Done Within Guidelines of Environmental Laws, Regulations, and Procedures.

Conducting Maintenance. When operators and other personnel are performing maintenance on equipment and systems, they are required to conduct their activities in accordance with applicable environmental laws, regulations, and procedures.

SOP and Environmental/Legal Considerations. The maintenance and operating SOP should contain guidelines, procedures, and references to those laws, regulations, and procedures. These topics should cover:

- Laboratory conduct.
- Fire prevention.
- Handling chemicals and solutions.
- Handling and using equipment.
- First-aid procedures.
- Accident reporting.
- Hazardous-materials management.
- Spill prevention control and countermeasures.
- Maintenance, housekeeping, and inspection.

Quality Control and Safety. It is the responsibility of all personnel to follow correct maintenance procedures according to the applicable environmental laws, regulations, and procedures. It is also necessary for supervisory personnel to spot-check personnel activities to ensure compliance with these requirements. In addition, laboratory maintenance SOP should be specific in addressing procedural steps to minimize safety risks to personnel.

Conduct Follow-Up Checks on Deferred Maintenance and Parts Orders to Verify that Action Occurred.

- DA Form 2407. Operators are required to complete DA Form 2407 for defective/faulty equipment. All copies of DA Form 2407 are sent with the faulty equipment to the support activity. The receipt copy is sent back to the owning organization where it is kept on file until the equipment is returned.
- Status Checks and Follow-up. Support maintenance personnel are required to make annotations on the same DA Form 2407. They enter information concerning initial inspections, discovered faults, deficiencies, symptoms, parts ordered, the need for onsite or deferred maintenance, and final inspections. Laboratory personnel may check with the support maintenance unit or inspect the DA Form 2407 to determine the current status of the requested maintenance.

Verify Personnel have Licenses to Operate Equipment, if Applicable, and Conduct Training Programs to License Those Who Do Not.

Maintenance Training - External Considerations. The proper methodology for conducting general training programs is found in FM 25-100 (Training the Force). Various external challenges have been identified that can spell success or failure for a proper maintenance training program. Some external factors the commander cannot influence are personnel turbulence, personnel shortages, key NCO inexperience, complexity of equipment, and first-term operator inexperience.

Maintenance Training - Internal Considerations. Internal challenges can be influenced by commanders. Their effects can be minimized to ease the effects of external challenges. Some internal factors include:

- Workload.
- Garrison maintenance only.
- Lack of operator maintenance.
- A poor maintenance training plan or none at all.
- Maintenance not system oriented.
- First-line leaders not involved in maintenance operations.
- First-line leaders with little or no maintenance training.
- Little or no operator/crew maintenance training.
- Personnel not having or using maintenance publications.
- Improper use of assigned personnel.
- Test, measurement, and diagnostic equipment (TMDE) not being used.
- Poor quality control procedures.
- Available training assistance not being used.

- Technical experts not consulted on maintenance problems.

Personnel Capabilities.

- No assumptions should be made about what the operator or supervisor/leader knows.
- All units must have their own testing and training programs.
- The company or unit commander must know what all equipment operators and their leaders know.
- All personnel must know what they are checking and what to do when they find a problem.
- The supervisor must know what the operator knows.
- Should additional training be required, the supervisor should give it or advise the unit commander that training assistance is required.
- Continual testing and training must be provided in order to provide confidence and improved competence of personnel.

Supervisor Responsibilities. The supervisor has specific responsibilities concerning maintenance training.

- Each supervisor must analyze their maintenance training.
- The maintenance training plan should then be developed from the analysis.
- Personnel skill shortfalls should be identified and the available training courses scheduled.
- NCOs must be trained to supervise and conduct the necessary maintenance training.
- Since maintenance begins with the equipment operators, supervisors who invest time in operator training will receive dividends in equipment availability.
- First-line leaders require training in inspection techniques for their equipment as well as its operation.
- Both formal and on-the-job training assistance is available from the following external sources:
  - Maintenance Assistance and Instruction Team (MAIT).
  - Direct Support (DS) maintenance unit.
  - Army Materiel Command (AMC) Logistics Assistance Office (LAO).
  - Exportable training packages.

Licensing. The supervisor must verify that personnel have licenses for the equipment they are operating, if applicable. In the case of vehicles, instructions for completing licensing of vehicle operators should be incorporated in the unit SOP. AR 600-55 (The Army Driver and Operator Standardization Program) provides the basic requirements for a good licensing program. Use FM 21-305 (Manual for the Wheeled Vehicle Driver), FM 21-306 ((Manual for the Track Combat Vehicle Driver), and FM 55-30 (Army Motor Transport Units and Operation) for more detailed information on licensing vehicle operators. Also consult these publications for procedures on how to fill out applicable forms.

LESSON 4

PRACTICE EXERCISE

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

1. Internal C and external A calibration steps are found where in the Calibration SOP?
   A. Equipment maintenance.
   B. Procedures.
   C. Record Keeping.
   D. Responsibilities.

2. Which form is required to record calibration due dates of petroleum laboratory equipment?
   A. DD Form 314.
   B. DA Label 80.
   C. DA Form 2402.
   D. DA Form 2417.

3. Cost excessive items such as fuel, ammunition, and paint are referred to as what type of supplies?
   A. Non-expendable.
   B. Major end items.
   C. Expendable.
   D. High dollar or controlled.

4. Whose responsibility is it to keep the DA Forms 2404 current and accurate?
   A. Operators.
   B. Firstline leaders.
   C. Maintenance supervisors.
   D. All personnel involved.

5. On what form do maintenance support personnel make annotations concerning initial and final inspections of the faulty equipment?
   A. DA Form 2407.
   B. DA Form 2404.
   C. DD Form 314.
   D. DA Form 2402.

Lesson 1 Practice Exercise Answer Key and Feedback

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

Lesson 2 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	C. Part B, page 2-3
2.	C. Part C, page 2-11
3.	A. Part C, page 2-12
4.	C. Part E, page 2-20
5.	B. Part B, page 2-7

Lesson 3 Practice Exercise Answer Key and Feedback

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

Lesson 4 Practice Exercise Answer Key and Feedback

Item	Correct Answer and Feedback
1.	B. Part A, page 4-2
2.	A. Part A, page 4-3
3.	D. Part B, page 4-4
4.	D. Part C, page 4-9
5.	B. Part D, page 4-9

GLOSSARY

Army Materiel Command (AMC) Logistics Assistance Office (LAO).

Section I Acronyms and Abbreviations

AAR	After Action Report	MAIT	Maintenance Assistance and Instruction Team
ACCP	Army Correspondence Course Program	MIL-STD	military standard
AIPD	Army Institute for Professional Development	MOS	Military Occupational Specialist
Amt.	Amount	MSDS	Material Safety Data Sheets
API	American Petroleum Institute	NCOIC	Noncommissioned officer in charge
ASTM	American Society for Testing and Materials	No.	Number
BDAR	Battlefield Damage and Assessment Repair	OPFOR	Opposing forces
BS&W	bottom sediment and water	POL	Petroleum, oils, lubricants
DD	Department of Defense	PMCS	Preventive Maintenance Checks and Services
DETC	Accrediting Commission of the Distance Education and Training Council	psi	Pounds per square inch
DOD	Department of Defense	pt.	Pint
DS	Direct Support	QM	Quartermaster
ECU	Electronic Control Units	RCRA	Resource Conservation and Recovery Act
ECOD	estimated cost of damage		
EPA	Environmental Protection Agency	RQ	Required quantity
F	Fahrenheit		
FFCA	Federal Facilities Compliance Act	RVP	Reid Vapor Pressure
HM	hazardous material	qt.	Quart
HMIS	Hazardous Material Information System	SOP	Standing operating procedures
HW	hazardous waste	SPCC	Spill Control and Countermeasures Plan
IAW	in accordance with	TMDE	Test Measurement and Diagnostic Equipment
ICE	Interservice Correspondence Exchange	TRADOC	Army Training and Doctrine
ISCP	Installation Spill Contingency Plan	TDA	Table of Distribution and Allowances
		W/S	Worksheet

Section II. Terms

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.

American Society for Testing and Materials (ASTM) A national scientific technical organization formed for the development of standards or characteristics performance of materials, products, systems, and services and the promotion of related knowledge.

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

barge A flat-bottomed boat used to carry cargo on inland waters or in lighterage service. Barges are usually towed. A petroleum barge has internal tanks to transport liquid cargo.

cut A fraction obtained by a separation process. Product withdrawn from a pipeline and routed into tankage. Product withdrawn from the middle of a batch is referred to as a heart cut. In gaging bulk fuel, the mark made by a petroleum product in contact with the gaging instrument. The cut shows the level of the product.

light ends The most volatile portions of a carbon and hydrogen mixture, the low boiling components that boil off first in distillation. Opposite of heavy ends.

Reid Vapor Pressure (RVP) The measure of pressure exerted by a product on the interior of a special container due to its tendency to vaporize.

ullage The amount a tank, or container, lacks of being full.

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.