MIL-STD-1518B
3 March 1980
Superseding
MIL-STD-1518A
20 February 1974

Military Standard

STORAGE, HANDLING AND SERVICING OF AVIATION FUELS, LUBRICATING OILS AND HYDRAULIC FLUIDS AT CONTRACTOR FACILITIES

FSC 9130

DEPARTMENT OF DEFENSE
Washington DC 20301

STORAGE, HANDLING AND SERVICING OF AVIATION FUELS LUBRICATING OILS AND HYDRAULIC FLUIDS AT CONTRACTOR FACILITIES

MIL-STD-1518B

1. This Military Standard is approved for use by all Departments and agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to SA-ALC/SFRM, Kelly AFB TX 78241 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION I

INTRODUCTION

1.1 PURPOSE: The purpose of this document is to set forth the performance requirements and quality control standards for receipt,storage, testing and servicing of all aviation fuels, lubricants and hydraulic fluids in support of USAF aircraft at manufacturing, maintenance or engine test facilities which are contractor operated.

1.2 APPLICATION: The provisions of this military standard apply to all contractor facilities located where no U.S. Government into-plane contract covers the servicing of aviation fuels and lubricants.

SECTION II

DEFINITIONS

2.1 JP-4 (NATO F-40): This grade of turbine fuel is the standard fuel for USAF turbine engine-powered aircraft. It is procured to the requirements of Specification MIL-T-5624. JP-4 contains both kerosene and gasoline fractions. It is a highly flammable material and must be handled accordingly. Commercial Jet B fuel closely conforms to JP-4 requirements in most respects.

2.2 JP-5 (NATO F-44): This fuel is primarily used in Navy aircraft and selected Presidential fleet aircraft. It is procured to the requirements of Specification MIL-T-5624.

2.3 JP-8 (NATO F-34): This fuel is similar to commercial Jet A-1 with the addition of corrosion and fuel system icing inhibitor and conductivity additive. Procured to meet Specification MIL-T-83133.

KEY PROPERTIES - JP-4/JP-8/JP-5

GRADE	FLASH PT	FREEZE POINT	VAP PRESS	API	WT(TYPICAL)
JP-4	-20°F(Typical)	-72°F	2-3 PSI	45-57	6.35 lb/Gal
JP-8	100°F Min	-58°F	Negligible	37-51	6.7 lb/Gal
JP-5	140°F Min	-51°F	Negligible	36-48	6.8 lb/Gal

2.4 FUEL SYSTEM ICING INHIBITOR: JP-4, JP-5, and JP-8 contain fuel system icing inhibitor (FSII) conforming to MIL-I-27686. This inhibitor consists of ethylene glycol monomethyl ether (2-Methoxyethanol) and effectively lowers the freezing point of small quantities of free water in fuel. This precludes the formation of ice in the fuel which can clog filter elements and result in engine fuel starvation. The inhibitor also exhibits biocidal properties restricting bacterial growth in fuel systems. Water removes FSII from fuel; therefore, introduction of water into a fuel system must be avoided and free water must be removed at any point in a system where it accumulates. A drop in FSII content (of fuel) is a definite indication of the presence of water in a system requiring immediate investigation and corrective action.

2.5 CORROSION INHIBITOR: This additive conforming to Specification MIL-I-25017, is required in JP-4, JP-5 and JP-8 fuel to inhibit corrosion of steel surfaces in contact with fuel. Corrosion inhibitor also provides added lubricity to fuel for more effective operation of aircraft fuel components, such as pumps and fuel controls. Since there are several qualified manufacturers of inhibitors, the amount blended into the fuel depends on the type used. This is governed by the Qualified Products List for MIL-I-25017, and ranges from a minimum of 3 pounds and a maximum of 16 pounds per 1000 barrels of JP-4.

2.6 CONDUCTIVITY ADDITIVE: A conductivity additive is added to JP-4 and JP-8 turbine fuel to decrease the time required to relax any electrical charge accumulated in the fuel during movement, pumping or filtration. The usual concentration of this additive is 1 part per million (PPM) or less. The conductivity level of the fuel on receipt at the using facility should be between 200 and 600 picosiemens or conductivity units (CU). Fuel serviced to aircraft should be between 100 and 700 CU.

2.7 OTHER INHIBITORS: Antioxidants and metal deactivators are optional additives that can be used by a refiner if desired. The amount and type, if used, are governed by MIL-T-5624 and MIL-T-83133 specs. Where finished fuel blends contain hydrogen treated components, an antioxidant must be added to preclude peroxide formation.

2.8 GRADE 100/130 AVIATION GASOLINE (NATO F-18): This grade of aviation gasoline is currently the standard fuel for USAF reciprocating engine aircraft. Specification MIL-G-5572 specifies the requirements of all AVGAS grades.

2.9 GRADE 115/145 (NATO F-22): This is also supplied to USAF activities and may be used where 100/130 is not available (when authorized).

SECTION III

QUALITY OF PRODUCT

3.1 QUALITY OF PRODUCT: Acceptable quality of fuels delivered to U.S. government aircraft shall be as follows:

a. The fuel shall conform to the applicable product specification.

b. Fuel delivered to aircraft will not contain more than 1 mg/liter or 4.0 mg/gal of total solids. Determination shall be made on the basis of solids retained on a 0.8 micron membrane filter. The filter will be evaluated either by weight or by comparing it to the color and particle assessment guide.

c. There shall be no evidence of free water when the fuel is examined visually. Aircraft shall not be serviced with jet fuel containing greater than 10 PPM of water as determined by the Gammen Aqua Glow or AEL free water methods or their equivalent.

d. When the fuel specification requires fuel system icing inhibitor, fuel serviced to the aircraft shall contain a minimum concentration of 0.07% by volume and a maximum of 0.20%.

e. Where conductivity additive is required, the conductivity level serviced shall be between 100 and 700 CU.

3.2 CONTAMINATION: Fuel contamination is generally categorized as chemical, biological or material.

a. Chemical Contamination. This type of contamination results from the mixing of two hydrocarbon fuels or contact of other chemicals with the fuel. The chemical and physical properties of the fuel are effected. This type of contamination is usually detected by laboratory testing. Chemical contamination is prevented by isolating fuels via separate handling systems or positive physical separation between systems; by strict adherence to good operating procedures; and by alertness of operating personnel. Carelessness is the major contributory factor for this type of contamination.

b. Biological Contamination. This contamination results from growth of bacteria and fungi. The micro-organisms are found in water deposits in the systems. Growth of organisms reach a consistency of a "slime" or "mayonnaise" material that extends into the fuel. This can result in contamination of aircraft by plugging filters, cause fuel quantity probe malfunctions, and corrosion of integral fuel tanks. To most effectively control biological contamination, remove water from the system.

c. Material Contamination. Material contamination of fuels usually consists of water or sediment.

3.3 WATER: Water is usually present in all systems. It may be delivered to tanks during receipt of product or through leaks which permit entry of surface or ground water. It may also be introduced as vapor which condenses within the system. Both fresh and salt water can be found in fuel systems. It may be present as dissolved, entrained, or free water.

a. Dissolved Water. Fuel always contains some dissolved water. The amount of water that is in solution, and can be retained in solution, is dependent upon the temperature and chemical composition (per cent aromatics) of the fuel. The quantity is small and measured in parts per million. For example, JP-4 fuel with about 10 per cent aromatics, at 50°F can retain about 54 parts per million of water in solution in the fuel. Dissolved water is precipitated or dropped out with cooling of the fuel. Fuel system icing inhibitor is added to jet fuels to prevent water which has dropped out of the fuel from forming into ice.

b. Entrained Water. This is free water which is present in suspension in the fuel in the form of extremely fine droplets. Small amounts, up to 30 PPM, usually are not visible to the naked eye, but increased percentages create a milky haze or cloud in the fuel. Water can become entrained in the fuel by condensation of the moisture in the atmosphere or in the vapor/air mixture in a tank resulting from a reduction in the ambient temperature.

Most entrained water will settle out of fuel, provided the fuel does not contain contaminants or materials such as surfactants, which hold this water in suspension. Entrained water is removed by the coalescing action of filter/separators installed in the fuel system.

c. Free Water. All water which is not in solution in the fuel is a form of free water. Usually, the reference, free water, is used to indicate water which has settled out of the fuel or has been coalesced into large droplets for removal from the system.

3.4 SEDIMENT: Sediment appears as dust, powder, grains, flakes, and stains. Sources of solids or sediment include storage tanks, ferrous vessels or containers, filter or filter/separator elements, valves, pumps, meters, pipelines, hose, grease, gaskets, diaphragms, and seals. Rust is by far the most common type of solid contamination. Particles that can cause damage may be extremely small, measured by the micron scale. One inch equals 25,400 microns. Particles larger than 10 microns are considered coarse particles while those smaller than 10 microns are considered fine. Fine particles are difficult to detect without the sampling and testing prescribed in this standard. Removal of particles in the 150 micron and larger size is accomplished with the use of screen, filters and filter/separators.

SECTION IV

FUEL SYSTEMS

4.1 FUEL SYSTEM REQUIREMENTS: Fuel systems at contractors facilities vary greatly in capacity and design. Basically, a fuel system consists of a bulk receiving and storage tank or tanks, a transfer system to either a refueler loading fillstand, hydrant operating tanks or hydrant outlets and aircraft refueling equipment. Screens, filters and filter/separators are located at strategic points in the receiving, transfer and delivery system to protect against delivery of water or excessive solids to the aircraft. Low point drains are installed in lines, tanks, refueling trucks, and filter/separator housings to remove any accumulation of water.

/NOTE/

The term "filter" and "filter/separator" refer to two different pieces of equipment. A filter is designed to remove particulate matter. A filter/separator is designed to remove particulate matter and to coalesce and remove free or entrained water from the fuel.

4.2 BULK FUEL SYSTEMS: Receiving and storage tanks can be either above or underground. They are equipped to receive fuel by one or more transportation methods such as tank truck, tank car or pipeline. Depending on the type of system, receiving lines must be equipped with either a filter/separator or an 40 mesh screen. Receiving line must also contain a sample

point upstream of filtration device for sampling during fuel receipt. Tanks will be equipped with either low point sumps and drains or other methods of effectively removing water. At some facilities, receiving storage tanks also serve as hydrant feed tanks.

4.3 FUEL DISPENSING COMPONENTS: Fuel Dispensing Components include pipelines, pumps, screens, meters, and filter/separators in a system designed to move fuel from storage tanks to refueler truck fillstands, hydrant system operating tanks or, in some cases, directly to hydrant fueling sites. In jet fuel systems, a filter/separator must be installed between the bulk storage tanks and refueler truck fillstand. A sampling point will be installed downstream from filter/separators. A screen of at least 40 mesh shall be installed immediately upstream from system pumps. Screens of at least 60 mesh will be installed upstream from meters unless meters are located immediately downstream from filters or filter/separators.

4.4 VEHICLE REFUELING SYSTEM: Tanks of refueling trucks used to service aviation fuel to aircraft are usually constructed of aluminum or stainless steel. Mild steel tanks should have an approved interior coating applied. All refueling trucks servicing jet fuel will be equipped with a filter/separator in the dispensing system. Refuelers will be equipped with drains for removing any accumulation of water. Refueling unit tank sumps will be checked visually for sediment and water at the beginning of each shift. Any contamination will be removed prior to servicing aircraft. A sample point will be provided downstream of the filter/separator. Servicing nozzles, both over the wing and single point will be equipped with a removable screen of 80 mesh or finer size. Filtration requirement for dispensing aviation gasoline is the same as for jet fuel except that a micronic filter may be substituted for the first filter/separators in the system. A filter/separator is required at the point of servicing.

4.5 HYDRANT REFUELING SYSTEMS: In this servicing method fuel is pumped from storage tanks through a filter/separator to outlets installed in the ramp or parking area. Fuel is then delivered to the aircraft through a filter/separator equipped hose cart or pit filter/separator and hose. Servicing nozzle must be equipped with a removable screen of 80 mesh or finer size.

4.6 FILTERS:

a. Fuel filters consist of treated paper elements or cartridges which are housed in cylindrical vessels. Filters are used for removing solid particles from the fuel as it passes through the filter elements. Because fine particles can be removed, the filters are commonly referred to as micronic filters. Elements are treated to repel water but are not designed to coalesce water from the fuel. Water will collect on the bottom of the filter housing and must be removed.

b. Filter or filter/separator sumps not equipped with a sight glass and density sensitive ball will be drained daily into a clean, clear glass container and checked visually for water, solids and color. Continue draining until the sample is water-free and the fuel is clear or until it is determined that the product is contaminated. If contamination is detected, isolate the system or refueler and take corrective action.

c. When a filter or filter/separator is equipped with a sight glass containing a density sensitive ball, check the sight glass daily and drain filter/separator sump weekly or whenever water is detected. Drain sight glass and clean as necessary.

4.7 FILTER CHANGE: Micronic filter elements will be changed when: pressure differential established by the manufacturer is reached; solids sample taken downstream of filter fails; elements have been in service 18 months or fuel throughput reaches 2 million gallons.

/WARNING/

Initial fill of vessel after element change should be at a very slow rate. This will minimize chances of static caused fires in the air/vapor area of the recently opened vessel.

4.8 FILTER/SEPARATOR:

a. The filter/separator is a cylindrical vessel containing elements or cartridges that are designed to remove fine sediment particles and to coalesce and separate water from the fuel. Both vertical and horizontal types are in use in contractor fuel systems. Filter/separator elements should meet performance criteria of MIL-F-8901.

b. Filter/separators contain either one set of elements which performs both functions or two different sets, each of which performs one of the two functions of the filter/separator. Whether one or two sets of elements are installed in the filter/separator, the coalescing function is performed as the fuel passes through the first stage or first section of the element assembly. As the fuel passes through the coalescing element, or coalescing section of the element assembly, fine particles of water that may be in the fuel are collected or coalesced into larger droplets. Since the openings or passages through which the fuel passes are very small to perform the coalescing function, fine filtration, or removal of fine solid particles, also occurs at this time. The fuel is then passed through a water-repellent filter or teflon screen to prevent coalesced water from being discharged with the fuel. The separated water flows to the sump area of the filter/separator for removal either through an automatic or manual drain system.

c. Filter/separator sumps will be checked at the frequency called for in para 4.6c.

4.9 FILTER/SEPARATOR ELEMENT CHANGE: Filter/separator elements will be replaced when any one of the following occurs:

a. Differential pressure across the filter/separator reaches the maximum recommended by the element manufacturer. (Differential pressure will be recorded each day fuel is pumped through the filter/separator.)

b. After 36 months in service. Date elements are changed should be stenciled on the filter/separator housing or imprinted on a metal tag permanently attached to the housing.

c. When solids test on samples taken downstream of filter/separator fail.

d. When free water results on samples taken downstream of filter/separator exceed 10 PPM.

/WARNING/

Initial fill of vessel after element change should be at a very slow rate. This will minimize chances of static caused fires in the air/vapor area of the recently opened vessel.

4.10 USE OF FILTERS AND FILTER/SEPARATORS:

a. Jet fuels, except drummed product, shall be serviced through two filter/separators. Using the truck refueling system, this is accomplished by feeding the refueler fillstand through a filter/separator and having a filter/separator on the refueler.

b. Hydrant servicing systems will have one filter/separator located at the outlet of the hydrant operating tanks and another at the servicing pit or on the hose cart.

c. Aviation gasoline will be serviced through a minimum of one micronic filter and one filter/separation. The filter/separation will be the second filter in the system.

4.11 STRAINERS:

a. Strainers are metal screens installed at selective points in the fuel system to remove large solid contaminants before they enter storage tanks or cause damage to meters and pumps. Strainers will also be installed in all servicing nozzles. For the purpose of this document, the terms "screen" and "strainer" are used interchangeably.

b. Forty (40) mesh screens shall be installed upstream from pumps in the fuel system.

/NOTE/

Mesh size refers to the number of openings per linear inch. A 100 mesh screen therefore has 100 openings per inch or 10,000 openings per square inch. This size opening is equivalent to 150 microns.

c. Nozzles on aircraft servicing units shall contain 80 mesh screens.

d. Screens of 40 mesh or finer will be installed in all bulk receiving lines.

e. Strainers in bulk receiving lines will be removed and cleaned monthly. Fuel servicing nozzles/screens will be removed, cleaned and inspected every 2 weeks if fuel has passed through them. If fuel is received or serviced less frequently than monthly, screens will be cleaned after each use. Other screens in the fuel system will be removed, cleaned and inspected every three months. These are minimum frequencies and when excessive buildup in the screen is noted the frequency should be increased.

f. The amounts and types of material retained on screens are indicators of problem areas (hoses have deteriorated; pipelines are dirty; filter/separator or filter elements have ruptured; tanks need cleaning etc.).

/NOTE/

A properly designed and installed strainer directs all flow through the screen. If incorrect installation allows flow to bypass the screen, or if the screen is broken, the strainer is useless. It is important that the seating surfaces provide a seal to prevent fuel from bypassing.

4.12 METERS: Approved meters shall be used for quantity determination of all fuel delivered to aircraft. Meters shall be calibrated at the beginning of a contract and as required by local, county or federal regulations thereafter to an accuracy of 0.2 percent by volume at normal flow rates. Where no local authority requires meter proving, the frequency of verification will be immediately prior to the beginning of a contract period and once each six months thereafter.

4.13 SERVICING OF DRUMMED FUEL:

a. Water and sediment are often found in AVGAS and jet fuels stored in drums. These contaminants must be removed prior to servicing drummed stocks to aircraft. Drums containing aviation fuel should be stored on their sides to minimize the chance of drawing water into the drums from outside sources. Before delivery of contents to aircraft, test drum for water by means of water finding paste or draw a sample from the bottom of the container by using a drum sampling thief. In the case of undyed products, such as jet and unleaded reciprocating engine fuels, it is sometimes difficult to determine by sampling whether the sample is composed of all water or all fuel. Make the determination by placing an inch of dyed gasoline in the bottle prior to transferring the drum thereto. If water is present, there will be a separation between the water and dyed fuel mixture. Siphon any water from drums before proceeding with the fueling operation.

b. After removal of water from drums, aviation fuel will be passed through a filter/separator prior to delivery into aircraft tanks.

SECTION V

TANKS

5.1 TANKS:

a. Water bottoms will not be maintained in fuel tanks. Some tanks may retain small quantities of water even when proper draining procedures are used; however, all possible water should be removed. In cases where sizeable quantities of water are retained after draining, tanks should be modified to allow complete drainage.

b. Above ground tanks equipped with sumps and water draw-off valves, water can most effectively be removed by controlling the flow through these valves. The water draw-off valve should be slowly and only partially opened. Fully opening the valve may cause fuel to be removed and result in stopping water draining prematurely.

/NOTE/

DRAIN WATER WEEKLY OR MORE OFTEN IF THERE IS HEAVY RAINFALL AND TANKS ARE OF FLOATING ROOF TYPE.

c. Underground operating tanks will be checked daily for water. Inactive tanks will be checked weekly. Water will be removed from underground tanks when the level reaches one-fourth inch.

5.2 TANK INSPECTION AND CLEANING: This chart gives tank inspection and cleaning frequencies for various types of aviation fuel tanks.

TANK INSPECTION AND CLEANING GUIDE

If Tank is	And	Physical Entry	Cleaned
Avfuel Bulk Storage	has no epoxy coating and	3 years	As req*
Avfuel Operational Storage	no filter/separator on the inlet side.	3 years	As req*
Avfuel Bulk Storage	has either epoxy coating or	4 years	As req*
Avfuel Operational Storage	filter separator on the inlet side.	4 years	As req*
Avfuel Bulk Storage	has both epoxy coating and	5 years	As req*
Avfuel Operational Storage	a filter separator on the inlet side.	6 years	As req*

*If sludge deposit averages more than 1/2 inch deep on the tank bottom, the tank should be cleaned. If deposit is less than 1/2 inch and tank is in good condition, cleaning is not required.

5.3 TANK PRODUCT CHANGE:

a. Change of product service from aviation gasoline to jet fuel, or vice versa, does not in itself, require tank cleaning. The requirement for tank cleaning will be based on the tank cleanliness and the actual need for cleaning. In most instances, if the tank has been recently cleaned, or by inspection determined to be clean, removal of all product is all that is necessary to change product in the tank.

b. Change of product service from black oil to clean product (aviation fuels) will require a chemical cleaning in addition to the other cleaning operations.

5.4 SETTLING TIME: Normal settling time for fuel prior to issue or transfer is 2 hours. In emergency conditions, this may be reduced to 30 minutes if the following procedure is followed: A visual, all level sample of the tank contents 30 minutes after receipt is clean and bright and a check of water in tank bottoms 30 minutes after receipt reveals no water buildup.

/WARNING/

UNDER NO CONDITIONS WILL SIMULTANEOUS RECEIPT AND ISSUE OF FUEL BE PERMITTED.

5.5 GENERAL PRECAUTIONS:

a. Precautions must be taken to prevent introduction of contaminants whenever repairs are made to the fuel system or components. Positive action must be taken to remove particles, shavings, welding rods, mud packs, or other materials introduced during repairs.

b. Idle sections of lines must be isolated or blanked from the active systems.

c. Valve lubricants can become contaminants in the system, particularly if an over-enthusiastic lubrication schedule is followed without regard to the actual need for lubrication. Lubricated plug valves used in normal operations need be lubricated only once a week. The lubrication necessary consists of a few turns of the lubricant screw or a few strokes of a lubricant gun. Where valves are infrequently used, lubrication need be performed only when opening or closing the valve. Lubricants containing graphite or molybdenum disulfide will not be used on fuel system valves. Consideration should be given to installing non-lubricated valves when replacement is necessary.

5.6 LINE DISPLACING PROCEDURES: Displace jet or avgas in pipeline systems if the system is inactive for over 30 days. Such action will preclude the deterioration of fuel and protect against corrosion. Quantity to be displaced is twice the contents of the pipeline. Lines should be displaced into a refueling unit and returned to bulk storage.

5.7 ISOLATION OF FUEL SYSTEMS: Each grade of fuel will be maintained in a separate receipt, storage and delivery system. No pumps or lines handling more than one grade of product are permitted.

5.8 IDENTIFICATION OF FUEL HANDLING SYSTEMS:

a. Piping Systems. Each petroleum piping system will be clearly identified as to product therein. Markings should be in accordance with either the American Petroleum Institute Bulletin No. 1542, "Airport Equipment Marking for Fuel Identification" or MIL-STD-161.

b. Mobile Units. Each refueling unit and hose cart will be clearly identified with the grade of fuel handled.

5.9 SERVICING CONTROL: To prevent servicing of the wrong grade of fuel to aircraft, assure that the right grade of fuel is loaded into refueling units and assure that the right unit is used to dispense fuel to the aircraft. Issues from fillstands and refueling units shall be controlled by mechanical means. If only one grade of fuel is stocked and issued, mechanical controls are not mandatory. The recommended mechanical controls are:

a. Bottom Loading. Use of selective couplers for different grades of fuel.

b. Top Loading Fillstands. Secure the fillstand loading arm, pump, switch or any valve essential to the fillstand operation by use of a padlock. The key for the padlock will be permanently attached to the clipboard(s) of those refueling units used for the same grade or permanently affixed to the unit by means of a chain.

c. Refueling Units. Lock either the access door or any valve essential to the operation of the unit. Permanently attach the key for this lock to the clipboard identified with the corresponding fuel. The person in charge of fueling operations will issue the proper clipboard for the grade of fuel required.

5.10 CONVERSION OF SERVICE: When it is necessary to convert a refueling unit from aviation gasoline service to turbine fuel service, or vice versa, the following procedure will be followed:

a. Completely empty the unit and drain hoses and sumps of the filter separator housings.

b. Fill the unit to capacity with the new grade of product.

c. Return all fuel to bulk storage, half through each hose, then refill unit.

d. Change unit markings and lock controls to conform to new grade of product.

SECTION VI

QUALITY ASSURANCE (CONTRACTORS)

6.1 QUALITY ASSURANCE AT CONTRACTORS FACILITIES: The purpose of this section is to establish minimum quality procedures required to deliver clean, dry fuel to aircraft on a continuing basis. The test procedures detailed here provide quantities or values for water content, solids, fibers, conductivity and fuel system icing inhibitor (FSII) of aviation fuels. In the case of JP-8 and JP-5, flash point will also be determined. Contractor personnel are responsible for performing all sampling and testing described herein.

6.2 RECEIPT OF PRODUCT:

a. Tank Car and Tank Truck. Visually examine each tank truck or tank car to assure the grade, quantity, and serial number of the seals agree with the shipping document. Ground trucks/tank cars in accordance with figures 9.3 and 9.4. Check the bottom of each compartment with water finding paste to verify that no water is present. Sample the product through the top hatch using a clean, clear, one-quart bottle. The sample will be taken from the lower third of the tank contents. Visually examine it for color, water and sediment. If the product is satisfactory, unload into storage. If the sample is not satisfactory or water is present in the conveyance, do not unload the product. For disposition instructions for commercially procured fuel, contact the supplier. If the fuel is government furnished, contact the government representative whose name appears on the shipping document.

b. When tank cars or tank trucks are from the same source, take one sample daily for solids determination and CU value if fuel contains conductivity additive. In addition, flash point will be determined on JP-8, commercial A, A1 and JP-5 deliveries. Where deliveries are from more than one source, take one sample from each source daily. Sample is to be taken during off-loading between the receiving header and the receiving tank at a point as close as possible to the tank car or tank truck. The bottle method or matched weight monitor method will be used for solids determination.

c. Sample incoming JP-4, JP-8 and JP-5 once each 14 days for FSII determination. (Commercial jet fuel does not contain FSII).

/NOTE/

Unless there is reason to suspect high solids content or incorrect concentration of FSII in the fuel, (or in the case of JP-8 or JP-5 off spec flash), the off loading and release of the tank car or tank truck need not be delayed pending results of these tests.

6.3 DRUM RECEIPT: Examine the condition of drums for damage to bung seals, bungs, chimes and seams. Check drum markings against the shipping document. If drums are government furnished, check against the DD-250

accompanying the shipment. Sampling is not required unless inspection indicates the necessity for product examination.

6.4 SAMPLING REQUIREMENTS: All samples taken for laboratory analysis will be in quantity of one gallon unless otherwise stated. Samples taken for visual analysis will be one quart.

6.5 CONTRACTOR LABORATORY ANALYSIS OF AVGAS: Every 30 days, a sample will be taken downstream from each filter or filter/separator on each refueling unit, hose cart, or filter meter pit used for servicing aircraft. The sample will be analyzed for sediment, either by the in-line matched weight method or by the bottle method and for water by the visual method.

6.6 CONTRACTOR LABORATORY ANALYSIS OF TURBINE FUEL: All samples are to be analyzed as soon as possible after sampling. The following samples will be drawn and tested in accordance with the requirements of Table I. Sediment may be determined by either the color and particle assessment guide technique or by the gravimetric method.

6.7 FREQUENCY: The sampling frequencies stated here are the minimum requirements. More frequent checks may be performed anytime there is reason to suspect fuel quality.

TABLE I

SAMPLING REQUIREMENTS FOR TURBINE FUEL
JP-4; JP-8; JP-5; COMMERCIAL JET AT
AIRCRAFT MANUFACTURING AND OVERHAUL SITES

SAMPLE POINT	FREQUENCY	TEST
TT & TC Receipts	Daily from each source - 2 minutes after start	Solids by gravimetric and CU reading; in addition for JP-8, JP-5 and commercial jet determine flash point.
TT & TC Receipt	Each receipt sample thru top hatch.	Visual
Downstream each F/S, each truck fillstand, refueling unit, hose cart & meter pit.	Weekly or prior to first service through units inactive more than one week. After maintenance that effects fuel quality.	Solids, Free H_2O, conductivity.
Downstream each F/S unit in system.	After filter replacement.	Fibers
Downstream of each F/S on transfer line between bulk & hydrant storage tanks.	Monthly	Solids, Free H_2O
Refueler Fillstand	Every 14 days	FSII
TT-TC	Every 14 days from each source.	FSII content
Hydrant Feed Tank	Every 30 days	FSII
Any tank showing increase in water.	Immediately	FSII
F/S sumps on all mobile & fixed equipment.	Daily	Visual
Water Bottoms	Monthly	If water is found submit to AF area lab for sulfides.
Prior to defueling	Each defueling	Visual
Bulk receipt (Unfiltered fuel) 2 gallon sample.	Quarterly	AF Area Lab

/NOTE/

Above samples are to be taken under normal flow conditions.

6.8 FSII: Concentration of FSII in jet fuel will be determined on samples from the following locations:

a. Every 14 days from tank that is used to receive bulk product from the supplier. Preferred sampling point is downstream of filter/separator on transfer line from bulk tank. If necessary to take the sample from the tank, it will be taken from the middle of the lower third of the tank contents.

b. Every 30 days from each hydrant system operating tank. Location of sampling is not restrictive if the product is representative of the tank contents. Sample can be taken on outlet line from the tank or from the tank itself.

c. Any tank which shows an abnormal increase in water content must be sampled immediately to determine the FSII content of the product.

6.9 FIBERS: A fiber check will be made on all filter/separators after new elements are installed (see para 6.22. for procedure). Fiber limit is 10 per quart.

6.10 DEFUELING AIRCRAFT:

a. Determine the fuel grade by consulting the aircraft record. Prior to taking a visual sample, clean a clear glass bottle by washing with soap; rinse with hot water then distilled or demineralized water and dry.

b. Draw a sample from the sump, first draining the sump into a separate container. If appearance is questionable, or fuel is suspected of being contaminated, isolate the fuel and submit a sample to the Air Force area laboratory for analysis. See paragraph 6.26 for area laboratory addresses.

c. The introduction of JP-8 as a second standard turbine fuel for Air Force aircraft will present problems in identifying and segregating defuels. AF aircraft in the UK are currently receiving JP-8. Plans are for all other U.S. AF bases in Europe to convert from JP-4 to JP-8 within the next three years. In the meantime, both JP-4 and JP-8 will be issued in Europe. At this time, there are no plans to convert to JP-8 in the US and Pacific areas.

d. Small quantities of JP-4 in JP-8 can lower the flash point of the JP-8 dramatically. Therefore, where a contractors site is receiving and servicing JP-8, an effort should be made to assure that no JP-4 or JP-4/JP-8 mix is returned to JP-8 storage. Where possible, defuel containing JP-4 should remain in the defuel unit and be reserviced to aircraft without returning the product to bulk provided it is determined fuel is not contaminated. Where this is not possible, return the defuel

to the smallest bulk tank on site and attempt to reissue it with a minimum of commingling with JP-8.

e. Where mixed fuel storage must be maintained, the solids, water and FSII limits will be the same as for either JP-4 or JP-8. The flash point limit will not apply.

f. Where JP-4 is the fuel received, stored and delivered by the contractor, there is no need to attempt to segregate the JP-4/JP-8 defuel mix from the bulk JP-4.

6.11 SOLIDS LIMIT:

a. The solids limit for aviation fuels is as follows:

Product	Receipt	Downstream of Filter/Separator
Jet Fuel	4.0 mg/gal	4 mg/gal or color rating 5 or less; particle rating - acceptable standard
Aviation Gasoline	6.0 mg/gal	4.0 mg/gal

b. When contamination limits are reached, shut down the system and conduct an investigation to determine the cause. The system will not be placed back into operation until the condition is corrected. If the contamination limit exceeds those above, aircraft serviced from that system, if at all possible, will not be permitted to fly until all sumps have been drained and the fuel in the aircraft has been checked for total solids. Experience has shown that a properly operated and functioning system will provide fuel containing less than 1.0 mg/gal of solid contamination.

c. Since a procurement solids limit has been placed on JP-4, fuel received at a using activity should contain less than 4.0 mg/gal total solids. In many cases, the solids content of the fuel will be much lower. Because of the nature of avgas, contaminants tend to settle out at a much faster rate than JP-4. If product received at the contractor plant exceeds the solids limit the supplier should be notified and advised that corrective action is required. If the fuel is government furnished, notify the QAR whose name appears on the shipping document.

6.12 VISUAL INSPECTION PROCEDURE:

a. Use a clean, round or rectangular, clear glass bottle. Clean the sample bottle with soap, rinse with hot water; rinse with distilled or demineralized water and dry.

b. Check for proper color and all forms of visual contamination by swirling the sample so that a vortex is formed. All sediment or water that has settled will accumulate on the bottom of the bottle directly beneath the vortex. Very fine suspended solids or water will render the product hazy. If the examination is questionable, a laboratory analysis will be made to verify the quantity of contaminant.

6.13 SAMPLING AND TEST PROCEDURES FOR SOLIDS: Three methods are used for determining solid contamination in fuel.

a. Color and Particle Assessment Method (In-line Sampler, para 6.14)

b. Matched Weight Monitor Method (In-line Sampler, para 6.15)

c. Bottle Method (para 6.16)

6.14 COLOR AND PARTICLE ASSESSMENT METHOD: GENERAL. A one-gallon sample is passed through the in-line sampler containing a monitor with a single filter. The color of the membrane filter and the quantity of particles retained on the filter are compared with color and particle standards provided in booklet form. This method applies only to turbine fuel samples taken downstream of filter/separator.

a. Equipment Required.

ITEM	MILLIPORE PART NO.
In-line Sampler	XX64 037 08
Single Filter Monitor	MAWP 037 PO
Remote Sampling Cap & Hose	XX64 037 05
Aviation Turbine Fuel Contamination Standards	XX64 037 85
Syringe, Metal w/2-Way Valve	XX62 000 35
Plastic Solvent Dispenser	Procure locally
Petroleum Ether or Freon	Procure locally

b. Sampling and Test Procedure. Remote sampling adapter hose will be used when sampling all fuels for solids contamination. Sample will be collected in one-gallon metal sample can, which must be grounded to sampler. One method of grounding the metal sample can is to attach the ground inside of the drain tube from the in-line sampler. To fabricate this internal grounding system, the following procedure will be followed:

(1) Straighten out a paper clip and bend it into a "Y" shape. The distance between the prongs of the "Y" should be approximately 3/8 inches. Solder a sufficient length of 1/16 inch diameter grounding wire to the base of the "Y".

(2) The base of the in-line sampler should be threaded through the base and tubing first. The rigid "Y" wire should hold the grounding wire in place and in contact with the in-line sampler. The grounding wire should extend beyond the tubing approximately six inches. This will provide sufficient contact with the sample can to dissipate any static electricity.

c. Sampling Procedure.

(1) Before using, rinse the interior of the sampler's metallic components with filtered petroleum ether or freon.

(2) Remove plugs from monitor. Install the monitor in the in-line sampler, as shown in Figure 6-3.

(3) Reassemble sampler tightly, insert bypass line into side of sampler, and attach remote sampling hose.

(4) Set three-way valve to OFF position (Figure 6-3, view C) and plug sampler into quick disconnect valve. If a valve is not installed upstream of the quick disconnect, this operation must be done quickly to prevent spray of product when quick disconnect valve is open.

(5) Set three-way valve to bypass or flush position (Figure 6-3, view A), and allow approximately one pint of fuel to flow through the hose and flushing line into the container. During the flushing operation, shut the valve off and on intermittently, to dislodge any solid particles that may be trapped in the line. When required, allow one quart of fuel to flow into an appropriate container for the fuel system icing inhibitor determination and one quart into a narrow mouth quart bottle for visual examination of fibers.

(6) Place the hose into a one-gallon can, turn three-way valve to test position (Figure 6-3, view B), and allow one gallon of fuel to flow through the monitor.

/NOTE/

It is recognized that in certain situations, such as refueling fighter aircraft, the refueling may be completed before a one-gallon sample is collected. When this situation is known, the matched-weight monitor method will be used in lieu of the color and particle assessment method.

(7) Turn three-way valve to OFF position, disconnect sampler from system, and replace dust cap on quick disconnect valve.

/WARNING/

Wait three minutes before disassembling the in-line sampler.

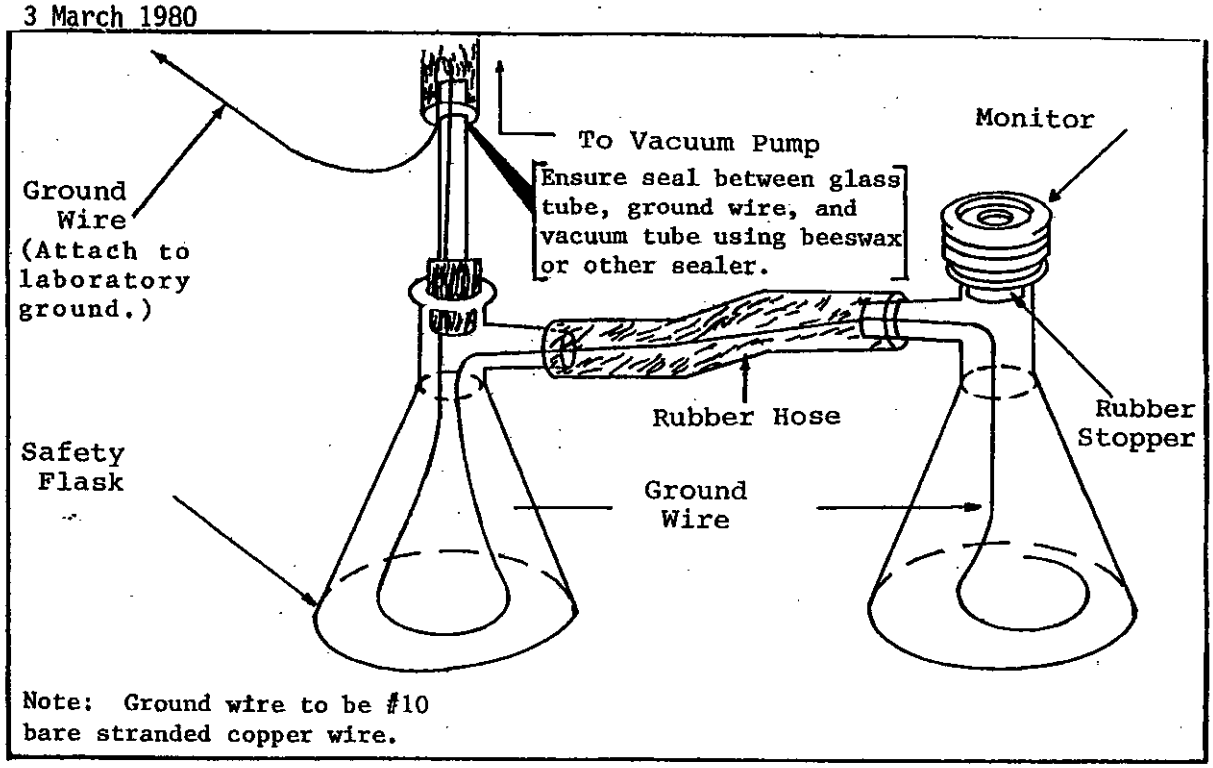

Figure 6-1 "Ground" Set-up During Flushing of Monitor

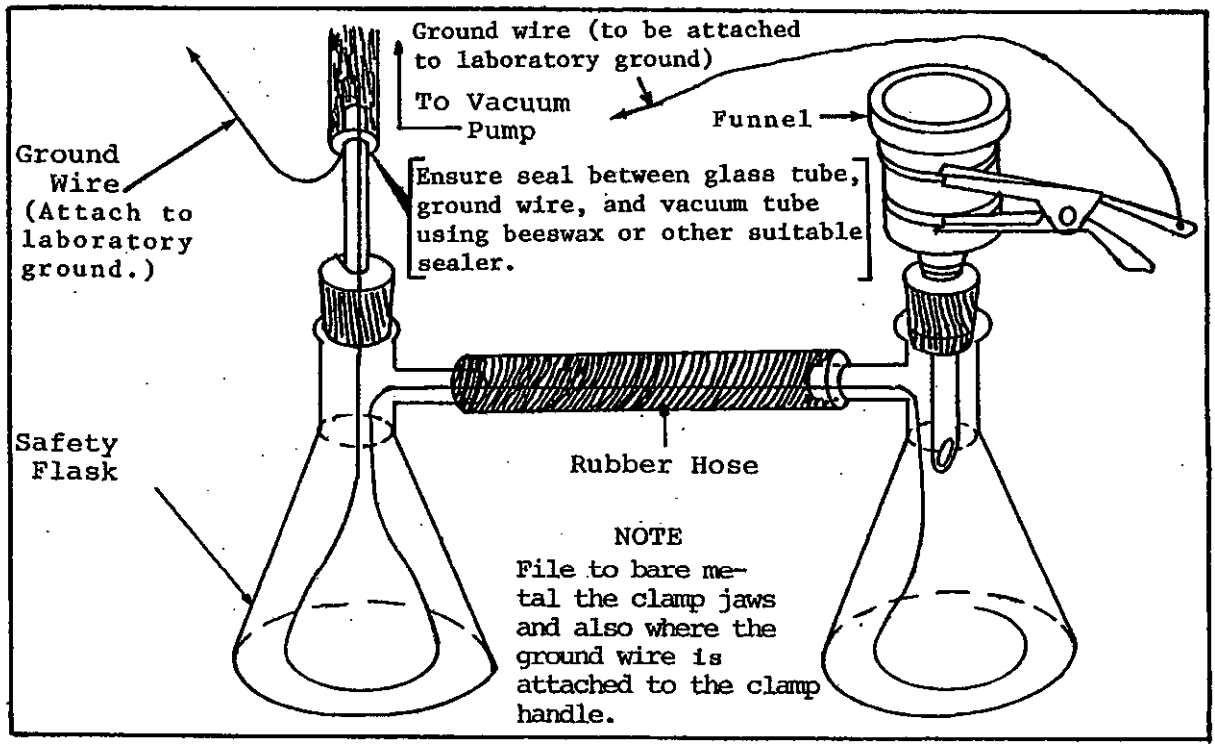

Figure 6-2 Filtration and "Ground" Apparatus

(8) Remove the monitor from the sampler, keeping it in an upright position. Remove residual fuel by use of the metal syringe. Rinse the filter by filling the monitor with prefiltered petroleum ether from the plastic solvent dispenser. Evacuate the monitor again, using the syringe. Continue pumping the syringe an additional 10 strokes in order to remove petroleum ether.

/NOTE/

The operating instructions contained in the Aviation Turbine Fuels Contamination Standards call for Freon (MIL-C-81302B Type II) as the rinsing agent. This is acceptable as is petroleum ether.

(9) Carefully remove the top cover from the monitor, exposing the filter. In case the filter adheres to the top, break the seal by carefully placing an object such as a small wire through the hole in the monitor. Do not remove the filter from the monitor case.

(10) Using the color assessment scales, match the color intensity of the filter to the closest matching color scale and graduation number by placing the monitor under the appropriate scale.

(11) Separately rate the quantity of solids on the filter by using the particle assessment scale. For this purpose, ignore the background color and match only the quantity of visible particles.

(12) A color rating of 5 or above on any three color scales and/or particles assessment above the acceptable standard will be considered unacceptable and requires further analysis. If just the color rating fails, a recheck sample will be taken using a single filter monitor. If the color rating again fails, investigation will be performed to determine the cause. Corrective action will include changing the filter/separator elements. If the solids or both solids and color fail, recheck sample will be taken using a matched-weight monitor. Verification that the color fails requires no further tests. Corrective action is then required as stated above. On checking the solids, replace the top of the monitor, plug the two openings and return the matched-weight monitor to the base fuels laboratory for gravimetric analysis as detailed in paragraph 6-15d. Should the solids content be in excess of 4.0 mg/gal, corrective action is required.

(13) Color and particle assessment ratings for each sample will be reported. If the color rating is less than 2, it will be designated A, B, or G2, and if darker than 7, it will be designated 7. Report intermediate values. Particle assessment will be designated acceptable (a), marginal (m) and unacceptable (u). If marginal or unacceptable, the gravimetric results will be reported along with the visual rating.

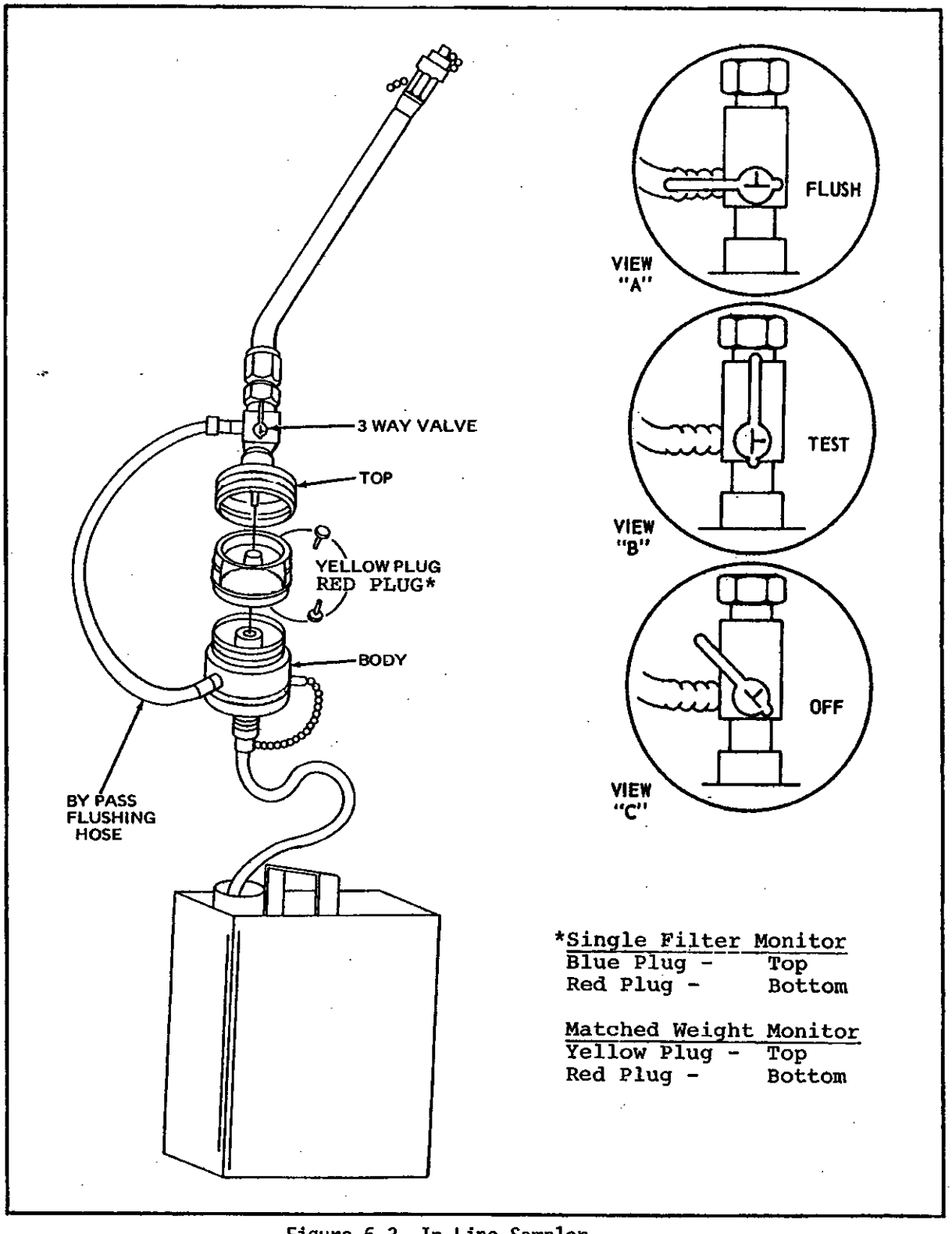

Figure 6-3 In-Line Sampler

/WARNING/

Grounded or ungrounded polyethylene one-gallon bottles will not be used with the in-line sampler method.

d. Sampling Connection. The in-line sampler requires couplers (quick disconnect valves) to be installed throughout the system at locations specified in paragraph 6.7. Dust plugs are to be inserted when the couplers are not in use. One source of these couplers and plugs is Snap-Tite, Inc., Union City PA. The items are identified as follows:

(1) Coupler, Part No. AVEC-4-4M, 1/4 inch nipple

(2) Coupler, Part No. AVEC-4-2M, 1/8 inch nipple

(3) Plug, Part No. AMPE-4

/NOTE/

Where fuel pressures are high enough to cause fuel to spray during in-line sampler hook-up, a shut-off valve should be installed immediately upstream of the quick disconnect valve. Recommended valve is a ball type, 303 stainless steel, teflon seat and seals, 1/4 inch NPT female inlet and outlet. Valves containing graphite will not be used. Hook up in-line sampler prior to pressurizing system whenever possible.

6.15 MATCHED-WEIGHT MONITOR METHOD: GENERAL. Each monitor in the in-line sampler contains two filters matched in weight to within + or -0.05 milligrams. Using an in-line sampler (Figure 6.3) at the sampling site, a one-gallon sample of fuel is passed through two matched-weight filters. Total solids contamination is determined as the increase in weight of the test (upper) filter after sample filtration and subsequent filter treatment. The matched-weight control (bottom) filter is subjected to the same procedures as the test filter, with the exception of actual contamination filtration, thereby serving to compensate for changes in laboratory conditions during processing.

a. Equipment Required. Part numbers shown are Millipore. Other items may be procured from laboratory supply houses.

ITEM	MILLIPORE PART NO.
Matched-Weight Monitors	MAWP 037 PM
In-line Sampler	XX64 037 08
Remote Sampling Cap & Hose	XX64 037 05
Vacuum Flask, 1 liter	Procure locally
Vacuum Pump	Procure locally
Solvent Filtering Dispenser	Procure locally
Forceps	Procure locally
Thermal Drying Oven	Procure locally
Static Master Brush	Procure locally
Rubber Stopper, One Hole #8	Procure locally
Analytical Balance	Procure locally
Analytical Weights	Procure locally
Petri Dish	Procure locally
Petroleum Ether or Freon	Procure locally
Isopropyl Alcohol (2-Propanol)	Procure locally

b. Sampling. Remote sampling adapter hose will be used when sampling fuels for solids contamination by matched-weight monitor method. Sample will be collected in one-gallon metal sample can. Collection can must be grounded to sampler as specified in paragraph 6.14b.

/WARNING/

SAMPLING WILL NOT BE PERFORMED ON RECIRCULATING LOOPS WHICH ARE NOT EQUIPPED WITH APPROVED STATIC GROUNDS. For example, systems which remove fuel from a hydrant tank or storage tank, not equipped with an approved static ground, and return it to the same tank from which it is removed, will not be sampled. Sampling may be performed on equipment which is recirculating provided it is connected to an approved static ground.

c. Sampling Procedure.

(1) Rinse the interior of the sampler's metallic components with filtered petroleum ether or freon.

(2) Before placing monitors in the in-line sampler, each monitor will be marked in a suitable manner in order to identify sample location, sample size, etc., when it is returned for processing in the lab. When the sample is taken, record the necessary data in a notebook opposite the corresponding number assigned that particular monitor.

(3) Remove plugs from monitor. Install the monitor in the in-line sampler, as shown in Figure 6.3.

(4) Reassemble sampler tightly, insert bypass line into side of sampler, and attach remote sampling hose.

(5) Set three-way valve to OFF position (Figure 6.3, view C) and plug sampler into quick disconnect valve. If a valve is not installed upstream of the quick disconnect, this operation must be done quickly to prevent spray of product when quick disconnect valve is open.

(6) Set three-way valve to bypass or flush position (Figure 6.3, view A) and allow approximately one pint of fuel to flow through the hose and flushing line into the container. During the flushing operation, shut the valve off and on intermittently, to dislodge any solid particles that may be trapped in the line. When required, allow one quart of fuel to flow into an appropriate container for the fuel system icing inhibitor determination and one quart into a narrow mouth quart bottle for visual examination of fibers.

(7) Place the hose into a one-gallon can, turn three-way valve to test position (Figure 6.3, view B) and allow one gallon of fuel to flow through the monitor.

(8) It is recognized that in certain situations, such as refueling fighter aircraft, the refueling may be completed before a one-gallon sample is collected. When this occurs, and immediately before ceasing refueling, the three-way valve will be placed in the OFF position and the amount of a sample collected will be noted for calculating total sediment in mg/gal.

(9) Turn three-way valve to OFF position, disconnect sampler from system, and replace dust cap on quick disconnect valve.

/WARNING/

Wait three minutes before disassembling the in-line sampler to allow dissipation of static electricity.

(10) Open the sampler; place yellow monitor cap on the top opening; remove the monitor from the sampler, keeping it in an upright position, and place the red cap on the bottom opening. The monitor will contain residual fuel, therefore, the plugs must be placed on tightly to insure against leakage.

(11) Record test location, date and sample volume.

(12) Fuel contained in can should be returned to the appropriate storage tank as usable product.

d. Determination of Total Solids.

/WARNING/

The filtration set-up should be assembled and grounded as shown in Figure 6.2 to prevent possible fires due to static electricity. A safety flask is required between the vacuum pump and the filtration apparatus to prevent flammable liquid from being drawn into the vacuum pump. Ground the vacuum pump, drying oven, and waste fuel container by running a wire from their chassis to an approved common ground.

(1) Flushing.

(a) Remove plugs and place monitor, spoke side down, on one-hole stopper in the four-liter filter flask attached to vacuum source.

(b) Turn on vacuum source and pull through existing fuel.

(c) Shut vacuum source off.

(d) Fill monitor with filtered petroleum ether; turn on vacuum and pull solvent through.

(e) Repeat Steps c and d.

(f) While vacuum is still on, remove cover of monitor, and carefully rinse the outer edges of the filter with petroleum ether or freon. The stream should be slight so as not to disturb the contaminants on the filter.

/NOTE/

In all cleaning procedures which require washing with a filtered solvent, the solvent is dispensed through the solvent dispenser. This assembly includes a wash bottle, a hand pump attachment, filter holder, and 25-millimeter diameter, 1.2 micron filter paper. Using this dispenser, the solvent is filtered as it is used. Inspect the filter before each day's operation to detect ruptured filters. These dispensers are available through Millipore Corporation as Part No. XX66 025 00 02, or through local laboratory supply houses. (25 filters, Millipore Filter Corporation, Catalog #RAWP02500, are included with the solvent filtering dispenser).

(2) Weighing.

(a) Any convenient means may be employed to remove the filters from the monitor provided care is exercised to insure that no solids are lost during the process. One such apparatus consists of a wooden block with a steel rod in the center. Stops are provided such that when the monitor has lowered until it rests upon them, the two filters are raised slightly above the monitor's edge. This permits the removal of the filters with a pair of forceps.

(b) The filters will be separated when wet. Both filters will then be placed in a petri dish with the cover ajar to allow volatiles to escape while affording protection from contamination. Place petri dish in a 90°C (194°F) oven for 10 minutes.

(c) Remove dish from oven. With cover still ajar, allow filters to cool and come to equilibrium with ambient room conditions.

(d) Brush off balance pans with staticmaster. Zero balance.

(e) Place test filter on left pan of balance and the control filter on right pan, and record the difference in weight as the total solids content in milligrams.

(3) Total Solids Content. The difference between the weights of the test and control filters is the weight of the total sediment in the sample filtered. Sample size is normally one gallon. However, if less than one gallon is filtered, the total sediment can be calculated by using the following equation:

$$\text{Sediment (mg/gal)} - \frac{\text{Weight of sediment in sample in milligrams (mg)} \times 3785 \text{ (ml in 1 gal)}}{\text{Sample size in milliliters (ml)}}$$

/CAUTION/

Do not reuse monitor cases for any type of sampling. Exposure of the cases to fuel distorts the mating surfaces, resulting in bypass of the sample and subsequent erroneous results. Monitors are factory-sealed under a specific pressure by equipment not available at base level or contractor facility.

6.16 BOTTLE METHOD: GENERAL. This method describes a procedure for determining solids content of fuel.

/NOTE/

Samples taken in bottles will be protected from light since exposure to light causes additive and gum dropout in fuel.

a. Equipment Required. Many of the items required for the Bottle Method are also used in the in-line sampler method. Numbers shown are Millipore Corporation catalog numbers.

ITEM	
Filter Discs 0.8 micron 47mm white plan	HAWG 047 A0
Laboratory Filter Holder	XX10 047 20
Cylinder, Graduated 1000 ml	Procure locally
Desiccator Plate	Procure locally
Desiccator	Procure locally
Petri Dishes	Procure locally
Bottles, One-gallon	Procure locally
Soap, Laboratory Glassware	Procure locally
Rubber Stopper, 1-Hole #12	Procure locally
Vacuum Flask, 4-liter	Procure locally
Vacuum Pump	Procure locally
Vacuum Gauge	Procure locally

Solvent Filtering Dispenser	XX66 025 00 Millipore Corporation
Forceps	Procure locally
Thermal Drying Oven	Procure locally
Static Master Brush	Procure locally
Analytical Balance	Procure locally
Analytical Weights	Procure locally

b. Sampling Procedure.

(1) Clean one-gallon bottles or cans and caps by washing with a soap solution, rinsing with tap water, followed by demineralized or distilled water and then dry in oven.

(2) Since the samples may originate from various sources using various sampling devices, no sampling technique is specified. Take necessary precautions to insure a representative sample, whichever device is used.

c. Preparation of Test Apparatus.

(1) Clean all glass components of the filter holder with a soap solution, rinsing with tap water, followed by demineralized or distilled water, then dry in the oven.

(2) Ground the filtration apparatus as shown in Figure 6.2.

d. Test Procedure for Solids.

(1) Membrane filters will be removed from the package and placed in a petri dish and put in an oven. Heat for 15 minutes at 90°C. Remove from oven and place in a desiccator for a minimum of 15 minutes.

(2) Handling of the membrane filters will be done by forceps. Dust off balance pan, zero balance and weigh one membrane filter to the nearest 0.0001 gram.

(3) Immediately prior to filtering the fuel, shake the sample to obtain a homogenous mix and assure that fuel temperature is between 70°F and 85°F. Clean the exterior top portion of the sample container with petroleum ether to insure that no contaminants are introduced.

(4) With the vacuum off, pour approximately 200 ml of fuel into the funnel.

(5) Turn vacuum on. Continue filtration of the one-gallon sample, periodically shaking the sample container to maintain a homogenous mix.

(6) After filtration, shut off vacuum and rinse the sample container with approximately 100 ml of filtered solvent and dispense into the filtration funnel. Turn vacuum off and wash the inside of the funnel with approximately 50 ml of solvent. Filter and then repeat the solvent rinse with the vacuum off and allow the 50 ml to soak the filter for approximately 30 seconds. With vacuum on, carefully remove the top funnel and rinse the periphery of the membrane filter by directing a gentle stream of solvent from the edge of the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess solvent from the filter.

(7) Using forceps, carefully remove the membrane filter from the filter base, place filter in a clean petri dish and dry in an oven at 90°C (194°F) for 15 minutes with the cover on the petri slightly ajar. Place dish in the desiccator and allow to cool for a minimum of 15 minutes. If more than one sample is processed, cooling time will have to be increased.

(8) Dust off balance pan, zero balance, and weigh the filter to the nearest 0.0001 gram, taking care not to disturb the contaminants on the surface of the membrane filter.

(9) Report the total solids content in mg/gal by using the following formula:

$$\text{Total Solids mg/gal} = \frac{\text{Weight gain of filter in milligrams} \times 3785 \text{ (ml in 1 gal)}}{\text{Volume of sample filtered in milliliters}}$$

6.17 WATER CONTENT OF AVIATION FUEL:

a. Free Water in Turbine Fuel.

(1) The equipment used in the free water determination detailed herein is Gammon Aqua-Glo Water Detector Kit Model GTP-322AF. This model has been modified to accept the standard 37 MM free water detector pad and is used in conjunction with the Millipore in-line sampler. Other models of the Aqua-Glo, as well as the AEL free water method are acceptable.

(2) Equipment Required. Part numbers shown are Gammon Technical designations and are available from: Gammon Technical Products, Inc., 235 Parker Avenue, P. O. Box 400, Manasquan NJ 08736.

Aqua-Glo Water Detector Kit	GTP-322AF
Battery Rechargers 120 volt 60 HZ	J-330
Battery, Rechargeable	J-333
Calibrating Screw Driver	GTP-765
Battery, 9 volt, for meter	GTP-892
Fluorescing Standard	GTP-763
Calibrating Standard	GTP-764

(3) This method allows quantitative measurement of undissolved water in aviation turbine fuel to be determined in flowing fuel streams without exposing the sample to the atmosphere or sample containers. A measured sample of fuel is passed through an uranin dye-treated filter pad. Undissolved (free) water in the fuel reacts with the dye to give a yellow fluorescence on the pad when exposed to ultraviolet (UV) light. The brightness of the pad under UV light is compared to a known standard using a photocell comparator. Free water is read out in parts per million by volume.

(4) Following are sampling procedures to determine the free or undissolved water present in turbine fuels:

(a) Clean the stainless steel detector pad holder with isopropyl alcohol and wipe or air dry.

/NOTE/

Do not handle detector pad with finders or use matched weight or single monitor cases for the water detection test. This procedure does not provide the necessary dispersion of fuel for the fuel stream over the pad.

(b) Remove the pad from the wrapper with forceps and place it in the stainless steel detector pad holder, orange side up. Press the detector pad holder together tightly. With the inlet side up, place the holder in the in-line sampler and screw the top of the sampler down tightly. Connect sampler to quick-connect sample point.

(c) Turn the valve on the in-line sampler to the FLUSH position and flush 300 ml of fuel. After flushing, turn the valve to TEST position and pass through 300 ml of fuel. When 300 ml has passed through, turn the valve to the OFF position and disconnect the sampler.

(d) Remove the detector pad holder from the in-line sampler. Connect the metal syringe to the detector pad holder and remove all excess fuel. Using forceps, remove the pad from the holder. If it is necessary to return the pad to the lab for reading, use a clean, dry (used) matched weight or single monitor holder with plugs inserted.

(e) Using forceps, put the pad into the test pad window. Turn on the lamp and press the photocell button. Zero the photocell comparator by moving the light modulating lever until the reading is steady at zero for 10-15 seconds. Always move the adjustment lever in the same direction to eliminate error due to slack in the linkage. Immediately turn off the meter to conserve battery power. Record the instrument reading, estimated to the nearest tenth, and the sample volume.

(f) Calculation. Multiply the meter reading by 5.3 when 300 ml of sample are used. The lowest reading on the instrument scale is 1, the lower limit obtainable with 300 ml of sample is 5.3 PPM free water. Since the free water limit for serviced fuel is 10 PPM, this value is acceptable. Should the need arise to measure free water at lower concentrations than 5.3 PPM, the sample size can be increased to any of the quantities listed below and the results multiplied by the corresponding factor shown. This allows values as low as 1.0 PPM to be measured.

SAMPLE SIZE	FACTOR
300cc	5.3
600cc	2.65
1000cc	1.6
1593cc	1.0

6.18 FLASH POINT DETERMINATION: Flash point may be determined by any of three ASTM methods. The Tag closed cup ASTM D 56, the Penski Martin ASTM D 93 or the Seta method ASTM D3243.

6.19 CONDUCTIVITY LEVEL DETERMINATION: Conductivity additive is added to turbine fuel to decrease the possibility of fires or explosions caused by static electricity. By increasing the electrical conductivity of the fuel static charges in the fuel generated by movement such as pumping or passage through filter separators is dissipated before sparks of sufficient energy level to ignite the vapors are reached. In general, 0.75 to 1.0 PPM additive in the fuel will produce the specification conductivity level of 200-600 conductivity units (C.U.). Sampling requirements for conductivity are shown in Table I.

a. Testing.

(1) Equipment required: Any ASTM/approved conductivity meter can be used. The meter and equipment listed here are manufactured by EMCEE Electronics, 177 Old Churchman Road, P. O. Box 32, New Castle, Delaware, 19720.

ITEM	PART NO.
Batteries	Silver Oxide Batteries, I.S.V.
Conductivity Meter	1151A
Extension Cable Kit	1151.08

Replacement batteries are readily available through most retail outlets handling camera and watch batteries or from Mallory & Co., South Broadway, Tarrytown, NY 10591. Eight batteries are required.

(2) The conductivity meter and cable extension kit provide the capability to measure fuel conductivity in either sampling containers or in storage tanks, tank trucks etc. The meter has a direct reading scale of 0-50 and a selector switch which permits readings to 500. CU ranges of between 500 and 1000 can be measured with a reduction in accuracy by altering the testing technique. Where the CU range is between 0-50 or 0-500, the stainless probe is immersed in the fuel until the top holes in the probe are covered with sample. If the extension cable kit is used, the probe can be fully immersed. Where the CU range is between 500 and 1000, a less accurate determination can be made by immersing the probe only as far as the first holes, the resultant reading is then multiplied by 2 to get an approximate CU value.

b. Calibration of Meter. Prior to the start of each conductivity test or series of tests, connect the stainless steel probe to the meter. Most meters supplied will have the serial number on the front panel immediately below the calibrate button. To calibrate these meters, set the CU RANGE switch to X-10 (CAL). For meters with internal serial numbers, set CU RANGE switch to X-1. The following procedure is the same for both meters once the proper switch is selected:

(1) Hold meter with probe vertical and depress MEASURE switch. The meter should deflect and gradually go to zero (approx. 3 seconds). If meter does not go to zero (within 1 division), the probe should be thoroughly rinsed with isopropyl alcohol and allowed to air dry.

(2) Depress both MEASURE and CALIBRATE buttons at the same time. Allow meter pointer to stabilize (approx. 3 seconds). The meter reading should be equal to the calibration number stamped on the probe ($\pm$ 1 division). If necessary, insert a small screwdriver in the side panel hole and adjust meter pointer to the number stamped on the probe.

c. Static Testing. For measurement of CU values of fuel in storage tanks, tank trucks, rail cars etc., 5 ft and 45 ft extension cables are included in the cable kit. Select the appropriate length needed, connect the cable to the meter, insert the attached ground plug into the fitting provided, attach the probe to the other end of the cable. Insert the cable to the desired depth and while holding the meter and cable as still as possible, depress the measurement button. A considerable "overswing" of the meter needle may occur, wait for the needle to stabilize briefly and read the value. The reading may decay rapidly so the value should be obtained quickly.

d. CU Measurement in Sample Containers.

(1) Most CU readings will be taken on samples drawn from containers or taken from lines under flow conditions. The type of container used is not critical. Glass, metal or plastic is satisfactory if the container is clean and the test performed within 10 minutes of sampling. If testing after sampling must be delayed, the sample must be protected from light. Metal containers, foil wrapping of the sample bottle or brown sample bottles will accomplish this. Testing in this case should be conducted within one hour.

(2) To perform test, attach the probe to the meter, verify calibration, insert the probe into the sample until fuel covers the top holes in the probe. Depress the measure switch and take the reading. If reading is over 500, withdraw probe until sample reaches the lower holes, take the reading and double the value obtained. If the meter again goes to 500, report the value as 1000 + CU.

e. Cleaning the Probe. No cleaning is required so long as the meter can be zeroed. Occasionally the probe will retain water or some other material which will cause the needle to "peg" or become erratic during attempts to calibrate the meter. When this happens, rinse the probe thoroughly with isopropyl alcohol followed by fuel and wipe clean. If the meter still will not zero, refer to the instruction manual.

6.20 CONDUCTIVITY SAMPLING LOCATIONS AND FREQUENCIES:

a. Receipt. Conductivity will be determined on samples taken under flow conditions during product receipts.

(1) Tank car and tank truck deliveries. One test daily from each supplier.

(2) Pipeline Receipt. One sample during first 15 minutes and one every six hours during remainder of receipt.

(3) Tanker/Barge. Determination to be made on sample drawn 15 minutes after start of discharge.

b. Bulk Storage Tanks. One sample from each bulk tank during first transfer from tank after receiving new product.

c. Refuelers. One sample per day from one refueler. Rotate refuelers sampled to include all refuelers before repeating cycle. Where contractor uses only one refueler, conductivity test will be performed weekly in conjunction with solids and water determination.

d. Hydrant Systems. One sample per day from each hydrant system pumphouse dispensing fuel. Sample point can be downstream of filter/separator at the pumphouse or downstream of the filter/separator at the point of servicing.

(1) For hydrant pumphouses that are inactive longer than 14 days, determination will be made either by circulating the system and taking a flow sample or by sampling through the tank hatch.

e. Limits. The minimum conductivity levels are 100 CU in servicing equipment and 125 CU in bulk tanks. The maximum is 700 CU in either. If CU levels approach either of the limits, the terminal supplying fuel to the contractor site should be notified and the quantity of conductivity additive injected can be adjusted accordingly.

6.21 FIBER CONTENT OF AVIATION FUEL:

a. General. Fibrous particles in aviation fuel are very difficult to detect by visual techniques. They exist in varying sizes, but usually are approximately 5 to 20 microns in diameter and up to 1/2 inch long. To give some idea of what the human eye can detect, the period at the end of this sentence is approximately 400 microns in diameter. One inch = 25,400 microns. Fiber limit is 10 per quart.

b. Equipment Required.

ITEM
Bottles, Clear Glass, quart capacity
Light - desk lamp
100-watt bulb
Aluminum Foil

c. Cleaning Procedure. Bottles used for fiber determination must be washed and cleaned as follows:

(1) Wash bottles and caps with soap and water.

(2) Rinse bottles and caps with tap water.

(3) Rinse bottles and caps with distilled or demineralized water.

(4) Rinse bottles and caps with approximately 100 ml of filtered isopropyl alcohol to remove water. Use the solvent dispenser for the isopropyl alcohol.

(5) Rinse bottles twice, using approximately 50 ml of filtered petroleum ether for each rinse. Use the solvent dispenser for petroleum ether. After last rinse, replace cap without drying bottles. Place aluminum foil over top of bottle to prevent dust and lint from getting under cap.

d. Sampling of Refueling Units/Hose Carts for Fiber Count After Elements Change. The following procedures apply to refueling units and hose carts equipped with quick disconnect sampling valve located between elements and servicing hose.

(1) Circulate 2,000 gallons of product through elements at normal refueling flow rate.

(2) Sample product into quart bottle using bypass on the in-line sampler.

(3) If visual fiber count is 10 fibers per quart or less, the unit is satisfactory for service.

(4) If fiber count is in excess of 10 per quart, circulate an additional 2,000 gallons of product and resample.

(5) Follow guidelines of para 6.22 for fiber analysis and action required if fiber count is excessive.

e. Sampling of Refueling Unit for Fibers Downstream of Nozzle Strainer. The following procedures apply to refueling units which must be sampled downstream of the hose nozzle strainer.

(1) Circulate 1,000 gallons of product through elements at normal refueling flow rate.

(2) Clean hose nozzle strainer.

(3) Circulate an additional 1,000 gallons of product at normal refueling rate.

(4) Clean hose nozzle strainer. Sample during circulation.

(5) If product is circulated through over-the-wing nozzle into the dome hatch, insert an S-shaped copper tube into the fuel stream to obtain sample. During flow, the nozzle must at all times be submerged in the fuel.

(6) If fiber count is less than 10 per quart, the unit is satisfactory for service.

(7) If fiber count is in excess of 10 per quart, circulate an additional 2,000 gallons of product, clean nozzle strainer, and resample.

(8) Follow the guidelines para 6.22 for fiber analysis and action required if fiber count is excessive.

f. Sampling of Hose Carts for Fiber Count. The following sampling procedures apply to hose carts.

(1) Position hose cart at hydrant outlet and connect single point to a defueling unit.

(2) Dispense 2,000 gallons through hose cart into defueling unit.

(3) Sample product into quart bottle using bypass on the in-line sampler.

(4) If visual fiber count is less than 10 per quart, the hose cart is satisfactory for service.

(5) If fiber count is in excess of 10 per quart, dispense an additional 2,000 gallons of product through the hose cart and resample.

(6) The fuel which has been passed into the defueling unit is satisfactory for return to bulk storage.

(7) Follow guidelines of para 6.22 for fiber analysis and action required if fiber count is excessive.

6.22 DETERMINATION OF FIBERS: After samples are obtained in the 1-quart bottle, examine for fibers, visually, by placing a light behind the bottle after swirling and viewing the bottle perpendicular to the light. All fibrous particles detected will be counted. If more than 10 fibers per quart are counted, obtain a recheck sample. If the recheck sample contains more than 10 visual fibers, change the elements and repeat the tests in accordance with para 6.21.

/NOTE/

The following practices contribute to high fiber counts in samples.

a. Bottles are not cleaned properly.

b. Wiping outside of sample bottles, especially the neck, with rags or cloth. (Rinse outside of bottles with filtered petroleum ether.)

c. Entering of airborne contaminants while taking sample.

d. Insufficient flushing of hose prior to taking samples.

e. Shipping samples to laboratories packed in sawdust or other fibrous material with no protecting wrapping around bottle.

6.23 FUEL SYSTEM ICING INHIBITOR: Fuel system icing inhibitor (FSII) which is composed of ethylene glycol monomethyl ether is added to all JP-4 and JP-8 fuel procured for the Air Force and most JP-5 used by the Navy. At the time of procurement, 0.09 to 0.15 percent by volume of FSII is required to be added to JP-4/JP-8 or JP-5.

a. Test Procedures for FSII. Two methods can be used to determine FSII content of turbine fuels, freeze point or colorimetric method.

b. Freeze Point Method. General. The purpose of this test is to determine the concentration of fuel system icing inhibitor in a sample of hydrocarbon fuel. This is done by extracting the icing inhibitor from a known volume of fuel with a known volume of water. Since the inhibitor depresses the freezing point of water, an accurate measurement of the freezing point of the inhibitor extract is used to determine the inhibitor content of the fuel.

(1) Equipment Required.

ITEM	
Test Tube, 16 mm x 150 mm	All items available from laboratory supply houses.
Separatory Funnel, 1000 ml	
Pipette 10 ml	
Beaker, 400 ml	
Graduated Cylinder, 1000 ml	
Ring Stand	
Clip-Type Test Tube Holder	
Ring-Type Holder	
Thermometer, ASTM #89-C	

Ice Crusher

Wire, Stainless
Steel, Copper
or Iron

Clamp Lab Support
Rod

Sodium Chloride
(Table Salt)

Rubber Stopper,
One-Hole #0

c. Test Procedure.

(1) Attach the clip-type test tube holder on the ring stand rod about 10 inches above the base and extending over the base. Attach the ring-type holder about 18 inches above the base of the ring stand to hold the separatory funnel.

(2) Using the graduated cylinder fill the cylinder to the 500 ml mark with the sample of fuel. Slowly empty the contents of the graduated cylinder into the separatory funnel.

(3) Fill the 10 ml pipette to about 1-inch above the graduation mark with distilled water. Drain the excess water from the pipette until the bottom of the meniscus coincides with the graduation mark. Transfer this 10 ml of water to the separator funnel, allowing it to drain freely. Do not force the residual water from the pipette by blowing or shaking, since it is calibrated to deliver 10 ml by gravity alone.

(4) Stopper the separatory funnel and shake about 10 times, then hold the stopcocked end up and, after a few seconds, open the stopcock to relieve any pressure buildup. Close the stopcock and shake vigorously for 3 minutes. Return the separatory funnel to the ring-type holder and allow the fuel mixture to separate until two distinct layers develop. An occasional, rapid twisting of the funnel stem will decrease settling time.

(5) Fill the beaker with finely crushed ice or snow. Add 1 1/2 tablespoons of salt, stir and add a small amount of water until a thick slush is formed. Wrapping a towel around the beaker and securing it with a large rubber band or tape will insulate the ice-bath and increase the number of tests obtainable with a single ice mix.

(6) Remove the stopper from the separatory funnel, place a clean dry test tube under the stem and drain about 7/8 of the (bottom) water layer into the tube. Do not permit fuel to drain into the tube. Insert the rubber stopper with the thermometer and wire agitating ring, already installed into the test tube and adjust the thermometer until the bulb is well immersed in the liquid, but not touching the tube wall or bottom. Insert this apparatus in the clip type test tube holder in such a manner that the mercury column may be easily seen.

(7) Lower the test tube holder with the above apparatus in the ice bath until the water level in the tube is well below the surface of the ice. Agitate the water in the test tube by raising and lowering the wire agitator gently but rapidly with 1/2 inch strokes. The temperature of the water will fall rapidly to a point below 0°C. As the water in the tube begins to freeze, a sudden rise in temperature will occur, as indicated by a sudden rise in the mercury column of the thermometer. This rise will cease at a point between 0°C and minus 2°C and the temperature will remain steady for about 1 minute. Read and record this temperature to the nearest 0.0°C. (The thermometer is graduated in tenths of a degree, centigrade.) Refer to Table II to find the FSII content which corresponds to the observed freezing point temperature.

d. Care and Calibration of the Thermometer.

(1) When not in use, the thermometer should be stored in an upright position in a refrigerator. During each test, examine the expansion chamber at the top of the thermometer to assure that no droplets of mercury have adhered to the chamber. If mercury has adhered to the chamber, warm the thermometer bulb gently by holding it in the hand until the column moves into the chamber. A gentle tap will usually dislodge adhering mercury droplets and rejoin them with the column.

(2) To rejoin a break in the column, warm the bulb by immersion in hot water, until the break moves into the expansion chamber. Tap gently to surface any gas bubbles. Cool in ice water and observe the column to insure the break has been rejoined. If the break is near the bottom of the stem, cool the bulb with dry ice until the entire column has moved into the bulb. Tap gently to surface gas bubbles and allow to warm slowly while examining the column.

(3) The ASTM 89C thermometer must be calibrated before it can be used with confidence. All ASTM 89C thermometers will be calibrated upon receipt, at 90-day intervals, after rejoining breaks in the mercury column, and when it is suspected that the thermometer is not accurately calibrated. Calibration is accomplished by running the above described test procedure on three test tubes containing 10-15 ml of distilled water only and averaging these values. If the average freeze point of the three water samples is above zero, the correction value is negative; if below zero, the correction value is positive. Once obtained, the thermometer correction value will be applied to all future readings.

Ex: If the average freeze point is found to be minus 0.4°C during calibration, the correction value will be plus 0.4°C.

This value will be added to all future readings. Place a label toward the top of the thermometer stem with the following information:

Date of calibration
Thermometer correction
Ex: 8/8/78
+0.4°C

/WARNING/

When inserting thermometers or glass tubing into rubber stoppers, the glass and stopper hold should first be lubricated with stopcock grease or liquid soap. To avoid injury in case of breakage, wrap a towel around the thermometer or tubing and the stopper and insert with a twisting motion.

TABLE II

FSII CONCENTRATION

FREEZE POINT TEMPERATURE, °C	PERCENT FSII
-0.1	0.014
-0.2	0.023
-0.3	0.034
-0.4	0.044
-0.5	0.053
-0.6	0.063
-0.7	0.074
-0.8	0.084
-0.9	0.094
-0.0	0.104
-1.1	0.115
-1.2	0.125
-1.3	0.134
-1.4	0.144
-1.5	0.154
-1.6	0.164
-1.7	0.174
-1.8	0.184
-1.9	0.195
-2.0	0.205

e. Colorimetric Method.

(1) Equipment Required.

ITEM	
Potassium dichromate-Sulfuric Acid ($K_2Cr_2O_7$-H_2SO_4) solution, 10 ml ampules.	All equipment available from laboratory supply houses.
Colordisc	
Pocket Comparator	
Sample Cells	
Hot Plate	
Beaker, 400 ml	
Interval Timer	
Screw Cap Culture Tubes, 50 ml cap., 25 x 150 mm	
Transfer Pipettes, 5 ml	
Transfer Pipettes, 10 ml	

(2) Test Procedure.

/NOTE/

The glassware used in the FSII test should not be cleaned with alcohol or acetone, as these solutions may leave residues that would interfere with the results of the test. Clean with soap and water and oven or air dry.

(a) Obtain a pint sample of the fuel to be tested either by bypassing the filter in the in-line sampler or by any other convenient method.

(b) Pipette 10 ml of water into a clean culture tube.

(c) Pipette 10 ml of fuel into the tube containing 10 m of water.

(d) Screw on cap and shake the tube for two minutes to extract the FSII content into the water phase. Allow the tube to stand in an upright position for at least 2 minutes.

(e) Snap off top of the glass ampule and empty the $K_2CR_2O_7$-H_2SO_4 solution contained in the ampule into a clean tube. Rinse the ampule with a few drops (approx. 2 ml) of distilled water to make certain all the acid solution is out of the ampule. Pour into tube.

(f) Using a 5 ml pipette and a pipette suction bulb, carefully withdraw a 5 ml portion of the bottom water phase from the tube containing the fuel-water mixture, and add to the tube containing the acid solution. Be careful that none of the fuel phase is transferred.

(g) Mix the contents of the water and acid solution thoroughly, by swirling. Immediately place the tube in a boiling water bath (beaker on the hot plate) for 10 minutes $\pm$ 30 seconds using an interval timer for control. Remove the tube from the bath and allow to cool to room temperature.

(h) Fill one comparator sample cell with the reaction solution and another cell with distilled water. Place the cell with the reaction solution in the left-hand compartment of the comparator and the other sample cell filled with water in the right-hand compartment. Slowly rotate the color dial until the nearest color-match is obtained.

(i) Report the result as the volume percent fuel system icing inhibitor representing the color standard which most closely corresponds to the sample. If the color of the sample is between the color of two color discs, report the results, numerically, as halfway between the two valves.

6.24 USE LIMITS OF FUEL SYSTEM ICING INHIBITOR (FSII): JP-4, JP-5 and JP-8 contain FSII. The use limit for FSII in these fuels are 0.07 percent minimum to 0.20 percent maximum by volume. Since the maximum procurement level is 0.15 percent by volume, instances of it containing 0.20 percent are very unusual. FSII in the amount of 0.07 percent or greater will lower freezing point of dissolved water in fuel to a freezing point as low as that of the fuel itself, under all operating conditions and locations. The icing protection decreases as the FSII content decreases. Fuel containing below 0.07 percent FSII content will be upgraded as soon as possible to use limits, where feasible, by commingling available stocks, local injection of FSII during intra-complex transfer, or by means of resupplied stocks.

/NOTE/

Since FSII is preferentially soluble in water, prevention and elimination of water from fuel transport and storage systems is essential. Fuel containing FSII in the range of 0.05 to less than 0.07 percent may be used only if operational necessities so dictate. If it is necessary to use stocks which contain from 0.05 to less than 0.07 percent FSII for operational requirements, the following procedures will be complied with:

Fuel will be sampled during refueling of aircraft and analyzed quantitatively for the presence of free water by the AEL water detector method. If free water in excess of 5 PPM is detected, aircraft must be defueled and refueled until refueling operation indicates less than 5 PPM free water.

6.25 SAMPLING PROCEDURES:

a. General. The operator taking the sample will use extreme care and good judgement to assure that the sample is truly representative of the product being sampled. Clean, lint-free wiping cloths will be used to wipe outside of bottle. Clean hands are important. When sampling relatively volatile products (2-pound Reid Vapor pressure or higher), the sampling equipment and container must be rinsed with the product prior to taking the sample. The bottles especially cleaned for sediment analysis, in accordance with paragraph 6.16b and for fiber analysis (paragraph 6.21c) will not be rinsed with the product before sampling. When all level samples are required from tank car, tank truck, and storage tanks, lower a weighted stopper bottle or beaker, to a point as near as possible to the draw-off level, uncorking it by a quick jerk, and raising the sampler at such a rate that it is nearly, but not quite full as it emerges from the liquid. When it is necessary to take the bottom samples from tank cars and tank trucks, use a sampling thief. Should it be necessary to sample from an underground operating tank, several locations and methods are available. Sampling through gauge hatches that do not extend to the bottom of the tank is one method. Some manhole covers have been modified with a sampling hatch. If neither of these points is available, an in-line sample can be taken between the tank and its filter/separator during flow conditions. As a last resort, the filter/separator pressure differential gauge inlet line can be disconnected and quick-disconnect valve installed for sampling with the in-line sampler. Do not take samples through a storage tank clean-out line, since such samples will not be representative of the material in the tank. Do not sample fuel or oil confined to and in contact with the hose. Drain the entire length of the hose and flush out thoroughly with the product to be sampled prior to sampling. Do not sample containers, such as drums, by tilting and using a funnel placed in the sample can. When sampling drums, use a tube or a thief. For additional information on sampling, see the ASTM Manual D270 on Measurement and Sampling of Petroleum Products.

/CAUTION/

Do not sample or gauge storage tanks during filling operations. Allow 30 minutes, or longer, after filling or partially filling a tank for static charges to dissipate.

b. Sample Validity. The validity of test results is greatly influenced by sampling procedures. The representative character of the sample is dependent upon the type and cleanliness of the sample container, the sampling operation, and the purpose for which the sample is being taken. The basic principle of any sampling procedure is to obtain a sample or composite of several samples in such a manner that the sample to be submitted for testing will be truly representative of the product.

c. Correlation Sample Submission. A two-gallon fuel sample taken during receipt from suppliers truck will be submitted to the Aerospace Fuels Lab each 90 days. Sample will be taken under flow conditions from the same sample point used for daily solids test on fuel receipts.

d. Sample Size. In general, all samples of aircraft reciprocating engine fuels and jet engine fuels will be a minimum quantity of two gallons. Samples of engine lubricating oils and other liquid petroleum products will be a minimum quantity of one gallon. Grease samples will be five pounds in size and should be submitted in original package, if possible. Sample quantities larger than those mentioned are not necessary, but are acceptable.

e. Questionable Quality Products. Samples may be submitted to an Aerospace Fuels Laboratory any time doubt exists as to the quality or identity of petroleum products in storage or use. These samples will be authorized by the Quality Assurance Representative with fuel surveillance responsibility at that facility.

f. Disposal of Samples. Unused portions of fuel samples must be accumulated in a waste container, such as a metal drum. The waste container should be appropriately labeled, segregated from other lab products, and kept away from sources of ignition.

6.26 SAMPLE SUBMISSION LOCATIONS: The Aerospace Fuels Laboratories test samples of aircraft fuel and aircraft lubricating oils, both petroleum and synthetic based, submitted by contractors facilities. Each laboratory has the responsibility for testing samples located within their assigned areas. Testing services provided by these laboratories are limited to the types of petroleum products indicated herein. Samples are also submitted to the laboratories when officially requested. The addresses of the laboratories and their assigned responsibilities and areas are as follows:

a. The Wright-Patterson fuels laboratory is responsible for the following:

(1) All samples of government petroleum products located in states outside territories served by the Searsport, Tampa, and Mukilteo laboratories.

(2) Samples of synthetic lubricating oils, greases, and chemicals, regardless of geographical locations.

(3) All samples from crashed aircraft.

(4) Samples officially requested to be submitted to the Wright-Patterson AFB Laboratory.

Address:

Transportation Officer WPAFB OH 45433 Attn: SFQLA Bldg 70 Area B	(Mailing)
Det 13, San Antonio ALC WPAFB OH/SFQLA	(Teletype)

b. The Searsport, Maine Laboratory serves facilities located in the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New York and Connecticut. This laboratory is equipped to assist installations in Greenland, Iceland, New Foundland, Israel and Spain.

Address:

Det 20 San Antonio ALC/SFQLB, Searsport, Maine 04974	(Mailing/Teletype)

c. The Tampa, Florida Laboratory serves facilities located in the states of Florida, Georgia, South Carolina, Alabama, Tennessee, North Carolina and Mississippi. This laboratory is equipped to assist installations in Bermuda, Azores, and Puerto Rico.

Address:

Aerospace Fuels Lab/SFQLC Bldg 1121 MacDill AFB FL 33608	(Mailing)
Det 21 San Antonio ALC MacDill AFB FL/SFQLC	(Teletype)

d. The Mukilteo, Washington Laboratory serves facilities located in the states of Arizona, California, Nevada, Utah, Oregon, Washington, Idaho and Montana. This laboratory is equipped to assist installations within the Alaskan Command and the SEA installations in Taiwan.

Address:

Det 35 San Antonio ALC/SFQLD (Mailing)
PO Box 118
Mukilteo WA 98275

Det 35 San Antonio ALC/SFQLD (Teletype)
PO Box 118
Mukilteo WA 98275

6.27 RECORD OF LABORATORY RESULTS: The results of laboratory tests will be recorded and maintained by contractor laboratory personnel. If a sample is found to contain excessive solids when tested by either the gravimetric or color and particle assessment guide, save the filter pad until all concerned have had an opportunity to see it. Filter pads may be retained indefinitely by taping them to a file folder and covering the filter surface completely with cellophane tape.

SECTION VII

ENGINE MANUFACTURING AND OVERHAUL FACILITIES

7.1 ENGINE MANUFACTURING AND OVERHAUL FACILITIES: This section covers quality control procedures for fuels and lubricants at facilities manufacturing or overhauling engine destined for delivery to the government.

7.2 QUALITY OF PRODUCT: Fuel used will meet the following quality requirements:

a. Fuel will conform to the appropriate product specification.

b. Fuel shall contain no more than 4.0 milligrams of solids per gallon as determined by any of the methods contained in Section 6 of this document.

c. The fuel shall contain no detectable water when examined visually and no more than 10 PPM as determined by AEL on equivalent water detection apparatus.

d. When the fuel specification requires the addition of a fuel system icing inhibitor, the minimum concentration will be 0.08% by volume.

e. When conductivity additive is specified, CU level will be between 100 and 700.

7.3 SYSTEMS: A wide diversity of fuel systems are operated at the various engine facilities, primarily they are of two types:

a. Direct piping systems consisting of a receiving system for tank trucks or tank cars with all bulk receiving/storage tanks connected directly to engine test cells. Product is fed from bulk tank through a filter separator to engine test cells. Where multiple receiving/storage tanks and test cells are used, the piping is usually manifolded through one filter separator and then to individual cells. A second filter or filter/separator may be located in the individual test cells. When only one filter/separator is used in this type of system it is important that it be located as near as practical to the test cell.

b. A second type of system consists of a receiving header for tank trucks and tank cars, a bulk storage tank and separate feed tanks supplying one or more test cells. The test cell feed tanks may be filled by either tank trucks or pipelines. The filter/separator is located between the feed tank and the test cell.

/NOTE/

Water in above ground tanks will be drained weekly.

7.4 FILTRATION REQUIREMENTS: Jet fuel must pass through at least one filter/separator before reaching the engine test cell. Aviation gasoline must pass through at least one filter.

a. Filter elements will be replaced in accordance with directions given in Section 4 of this document.

b. Filter/separator elements will be replaced in accordance with directions given in Section 4 of this document.

c. Fixed system filter sumps will be checked weekly for water.

d. Filter/separator sumps with sight glasses will be visually checked daily and drained weekly or when water appears in the sight glass. Filter/separators without sight glasses will be drained daily. Drains on filter/separators equipped with automatic water drains will be checked manually on a weekly basis to assure they are working.

7.5 STRAINER REQUIREMENTS: See para 4.11.

7.6 GENERAL PRECAUTIONS AGAINST CONTAMINATION: See Section 6.

7.7 IDENTIFICATION OF FUEL HANDLING SYSTEMS: See para 5.8.

7.8 CONVERSION OF PRODUCT CHANGE: See para 5.3.

7.9 SAMPLING REQUIREMENTS: See para 6.2 thru 6.12.

7.10 CONTRACTOR LABORATORY ANALYSIS OF TURBINE FUEL: Samples taken from the following locations will be visually examined and laboratory tested as soon as possible after sampling.

TABLE III

SAMPLING REQUIREMENTS FOR TURBINE FUEL JP-4; JP-8; JP-5 & COMMERCIAL JET AT ENGINE MANUFACTURING AND OVERHAUL FACILITIES

SAMPLE POINT	FREQUENCY	TEST
TT & TC Receipt, discharge line sample	Weekly - 2 minutes after start of receipt	Solids by gravimetric
TT & TC Receipt - thru top hatch	Each receipt	Visual
	1 per day each source	Conductivity
Downstream each filter/separator and each truck fillstand	Weekly or prior to first servicing through units inactive more than one week. After system maintenance that could effect fuel quality.	Solids by color and particle assessment guide or gravimetric. Free H_2O. Conductivity.
Downstream of filter/separator	After element replacement	Fibers
TC & TT thru top hatch or discharge line sample.	Every 14 days from each source	FSII content
Any tank showing increase in water.	Immediately	FSII content
Downstream of filters supplying test cells.	Monthly	Solids by color particle assessment. Conductivity.

SECTION VIII

QUALITY CONTROL OF LUBRICANTS AND HYDRAULIC FLUIDS

8.1 MARKING OF PACKAGED PRODUCTS: All packaged lubricating products and hydraulic fluids are marked and identified at origin to indicate name of manufacturer, origin, nomenclature and grade, specification, batch and QPL number, lot number, date filled and NSN. Product not identified in this manner will not be serviced to government aircraft.

8.2 QUALITY CONTROL OF TURBINE ENGINE LUBRICATING OIL:

a. Turbine engine lubricating oils are furnished in 55-gallon and 1-quart containers.

b. Hermetically sealed 1-quart cans will be serviced directly to aircraft by using the puncture type opener with spout. Proper opening devices should be used in all cases to prevent contamination of the oil. Screwdrivers and other maintenance tools shall not be used for opening hermetically sealed cans. Opening devices will be protected from airborne dirt and dust by enclosure in a plastic bag or similar devices when not in use.

c. Turbine engine lubricating oil furnished in 55-gallon drums may be serviced directly to engines through 25 micron filters. Drums of oil will be stored on their sides with bungs flooded prior to opening. After drums have been set upright and bungs have been opened, drums will be stored indoors or covered with appropriate cover to prevent the entrance of water and solid contaminants into the oil. When not in actual use to service turbine engines, all openings to the drum will be tightly closed. Servicing nozzles will be protected from contamination by use of caps, plastic covers or other similar devices.

d. Turbine engine oil servicing equipment other than cans or drums. The requirements of Individual Aircraft Technical Orders will apply to specialized aircraft servicing equipment.

8.3 QUALITY CONTROL OF RECIPROCATING ENGINE OIL:

a. Reciprocating engine oil is furnished in 55-gallon drums and 1-quart containers.

b. Reciprocating engine oil furnished in 55-gallon drums will be stored on their sides with the Bungs flooded prior to opening. After opening, drums will be stored inside buildings or protected from external contamination by covers. Reciprocating engine oil will be serviced to aircraft through nominal 60 mesh filters.

c. Reciprocating engine oil furnished in 1-quart containers may be serviced to aircraft without further filtration. The puncture type opener with spout will be used in all cases. Screwdrivers and other maintenance tools shall not be used for opening hermetically sealed cans. Opening devices will be protected from airborne dirt and dust by enclosure in a plastic bag or similar device when not in use.

8.4 QUALITY CONTROL OF AIRCRAFT HYDRAULIC FLUID:

a. Aircraft hydraulic fluid is normally furnished in 1-quart, 1-gallon and 55-gallon drums.

b. Servicing of hydraulic fluid to aircraft may be direct from the 1-quart can or 1-gallon can. In each instance only puncture type openers with spout will be used. Maintenance tools such as screwdrivers will not be utilized for this purpose. Openers will be protected from contamination by enclosure in a plastic bag or other similar device when not in use.

c. Hydraulic Fluid furnished in 55-gallon drums will not be serviced to aircraft except through specialized servicing equipment. Such equipment will contain a nominal 25 micron filter in the servicing system. Servicing connections will be protected from external contamination by covering hose ends with plugs or caps and placing connection in plastic bags.

d. Unused portions of 1-quart or 1-gallon containers of hydraulic fluid or engine lubricating oil will be discarded or transferred to servicing equipment.

SECTION IX

SAFETY

9.1 GENERAL SAFETY REQUIREMENTS

a. The utmost precaution toward fire prevention shall be exercised while servicing U. S. Government aircraft. All local fire and accident prevention requirements, including the following shall be complied with:

(1) Only authorized personnel, trained in the safe operation of the equipment to be used, in the operation of emergency controls, and in procedures to be followed in an emergency, shall fuel aircraft.

(2) Fuel servicing equipment shall be maintained in a safe operating condition. Fueling equipment or vehicles with any of the following defects/discrepancies shall be rejected for any fuels transfer or servicing operations until the defects/discrepancies are corrected or eliminated.

(a) Fuel leaks

(b) Defective exhaust systems, including spark arrestors.

(c) Defective tank vent valves.

(d) Engine overheating.

(e) Defective grounding equipment.

(f) Defective or inoperative emergency shutoff switch.

(g) Defective throttle or power take-off(PTO) interlock system.

(h) Defective hand or foot brakes.

(i) Defective shift linkage or gear indicator.

(j) Overdue hydrostatic test of hoses.

(3) Smoking and/or open flames or sources of ignition shall be prohibited within 50 feet of the fuel servicing operation. Normally, only personnel actually engaged in the fueling operation will be allowed in this restricted area and they will not carry matches, lighters, or other sparking or flame producing devices on their person. (NOTE: The "Power Off" portion of inspections may be performed when it is essential to meet established requirements. Aircraft pneumatic, oil, and water-alcohol systems may be serviced concurrently with aviation fuel servicing provided utmost caution, strict adherence to safety requirements, and maximum supervision is exercised during these operations.)

(4) Equipment and areas used for fuel servicing of U. S. Government aircraft shall be kept free of any accumulation of combustible materials.

(5) No automotive equipment (other than servicing vehicles) shall be allowed within 50 feet of a fuel servicing operation.

(6) Fuel servicing shall not be performed on any aircraft while any of its engines are running.

(7) Aircraft shall not be fueled or defueled inside any hangar other than TAB VEE shelters. Aircraft will not be fuel serviced within 50 feet of hangars or structures as measured from the servicing point or vents.

(8) At least two fully charged fire extinguishers shall be available in the immediate vicinity of each servicing operation. Access to fire extinguishers shall be unobstructed. Minimum sizes shall be as specified by the local fire department.

(9) Aircraft ground power generators or other electrical ground power supplies shall not be connected or disconnected while fuel servicing is being done on the aircraft. During overwing fueling or where aircraft fuel servicing vents are located on the upper wing surface, ground power generators shall not be positioned under the trailing edge of the wing. When ground power generators are required for fuel servicing, the unit will be placed the full length of the cable upwind from the fuel vents.

(10) Fuel servicing shall be terminated in event of a fuel spill until the leak is stopped and the spillage removed.

(11) Aircraft shall not be serviced with oxygen while fuel servicing operations are in progress.

(12) Aircraft will not be serviced with fuel while the aircraft radio is on. The inter-communication (intercom) system may be used for communication with personnel in the aircraft during fueling when required and circumstances indicate safe use is possible.

(13) Electric tools, drills, buffers, or similar tools likely to produce sparks shall not be used while fuel servicing is being done on the aircraft.

(14) Whenever one of the following occurs, the fuel servicing equipment will be disconnected from the aircraft and removed from the area:

(a) When winds reach hazardous velocities (as determined by the maintenance supervisor and fire department).

(b) When electrical storms or thunderstorms are within a three mile radius of the servicing area.

(c) Whenever hot ashes from any fire in the vicinity may prove dangerous.

(d) Whenever an aircraft crash or crash warning occurs at the same airfield.

(15) All support equipment (ground power units, ground heaters, air compressors, and similar equipment) which are not required in fueling operations, will be moved outside the 50 feet radius around the aircraft being serviced, and a clear path will be maintained to permit rapid evacuation of fueling vehicles and personnel in an emergency.

(16) Exhaust systems of any auxillary engine driven pump on a fueling unit shall be equipped with a flame or spark arrester.

(17) Only hose specifically designed for aircraft fuel servicing shall be used. Hose shall be fabricated of materials resistant to the action of aviation fuels and to aromatics in concentrations up to 30%. Fuel hoses shall be designed for a minimum working pressure of 125 PSI and a minimum burst pressure of 625 PSI.

(18) No U. S. Government aircraft shall be serviced with aviation fuels while it is in the beam of high powered radar capable of producing a peak power density of 5 watts per square centimeter at the point of fuel servicing.

(19) Refueling operators shall ground their person by grasping hand rails, grounded static cables, or other grounded surfaces with their bare hands prior to servicing aircraft.

(20) Whenever practicable, fuel service operators shall wear distinctive clothing made of 50% polyester blends. Materials of 100% polyester, nylon, rayon, silk or wool are prohibited except for the wearing of wool stockings, wool glove inserts, woolen navy stocking caps and underwear of nylon, silk or polyester. Shoes should not contain nails or other devices that might cause sparking.

(21) Outer garments shall not be put on or removed while engaged in fuel handling or servicing operations. This reduces the generation of static electricity caused by physical separation of materials. If outer garments must be removed, the individual will step out of the area of operation, remove the garment, ground himself, then re-enter the area.

b. Glowing or cracking sounds in fuel are caused by static electricity voltages in the fuel. If glowing or crackling fuel is noted when servicing aircraft, immediately cease all servicing operations until the static electricity charge has dissipated and glowing or crackling is no longer evident.

c. Servicing of aircraft shall not be performed until the fire department fire fighting equipment is present if any of the following conditions prevail:

(1) Aircraft to be serviced is experimental or involves systems with which servicing personnel are not thoroughly familiar.

(2) Return to service of a servicing unit or a fuel system which has undergone repair and has not been functionally tested prior to fueling the aircraft.

(3) Repair or modification of the aircraft fuel system which has not been functionally tested prior to fueling or defueling of the aircraft.

9.2 POSITIONING OF OPERATING EQUIPMENT

a. Fueling equipment shall not be moved into the servicing area if a major spillage (over 10 feet in any demension) is detected within 50 feet of the aircraft or if fuel is leaking from the aircraft.

b. Refuelers shall approach the aircraft in such a manner that the operator's side of the equipment is adjacent to the aircraft and the equipment is readily removable in the event of an emergency.

c. All refuelers shall be brought to a complete stop at least 20 feet from the aircraft and then directed into the servicing position. No part of any fueling unit will be positioned under any part of the aircraft which will settle due to onloading of fuel, and will be positioned at least 5 feet from any part of the aircraft.

d. If a fueler with a power take-off in lieu of an auxiliary pumping engine is used, the maximum possible distance shall be maintained between fueler exhaust outlets and aircraft filler points or vents.

e. All fueling units will be checked and the brakes set to prevent accidental movement during the fueling operation.

f. The refueling unit cab door will be left partially open to aid the operator in rapidly evacuating the unit from the servicing area if the need arises.

g. Prior to commencing any servicing operation the static grounding procedures shown in figures 9-1 thru 9-4 shall be accomplished.

h. Prior to removal of any filler cap on the aircraft, the over-the-wing type fuel nozzle shall be bonded to the aircraft with the static cable on the nozzle. This connection must remain in place until the tank cap is replaced.

i. All ventilating doors to the pumping system shall be placed in the open position prior to and until completion of the fueling operation.

j. The fuel servicing operator shall remain at the fuel servicing equipment and shall continuously monitor the equipment and aircraft for sparks and other ignition sources, leaks, unusual noises, and other indications of possible malfunctions. At any time the operator finds the operation to be unsafe, he will immediately stop servicing. Servicing shall not be resumed until deficiencies have been corrected.

k. Upon completion of the servicing operation, collapsible type hose used for single point servicing, and collapsible type hose used for over-the-wing servicing shall be evacuated of all fuel. The operator shall disengage the pump from the engine or turn the ignition off. Hose and nozzles shall be returned to the stored position. Static ground equipment shall be stored and refueling equipment shall then be moved from the area to its normal parking lot.

9.3 FUELING AND DEFUELING FROM HYDRANT SYSTEMS (SINGLE POINT)

a. In addition to general requirements of 9.1, the following will be complied with:

(1) Fueling and defueling operations employing hydrant systems shall be under competent supervision.

(2) A qualified operator will be stationed in the hydrant pump house during the entire operation for emergency shutdown if the need arises. (Not required for systems with built-in emergency deactivation features.)

(3) Before fuel delivery is begun, fuel tank caps on the aircraft will be checked to insure they are secure.

(4) The hose cart operator will hold the remote control switch in his hand, starting the fuel flow only on instruction from the supervisor.

(5) The hose cart operator will insure that there is no pressure at the outlet prior to hooking up the valve.

(6) The hose cart will be grounded to the hydrant outlet by a portable grounding cable (see figure 9-1).

(7) The hose cart operator will inspect the remote control cables to insure that they are hermetically sealed and serviceable when used.

b. Hoses will be pressurized and inspected for leaks prior to the first servicing of the day.

c. Hose cart operators will insure that all personnel involved in the servicing operation are aware of the location of hydrant emergency shut-off switches.

9.4 BONDING AND GROUNDING EQUIPMENT:

a. An effective grounding and bonding system will be used to electrically interconnect the aircraft and associated servicing equipment with a grounding point. The triangular method of grounding is required when servicing fuel to USAF aircraft, figures 9-1 and 9-2 illustrate this grounding and bonding method.

b. The grounding cable assembly consists of a stainless steel plug, a length of 3/32" corrosion resistant plastic covered steel wire and clip. A "Remove Before Flight" warning streamer should be attached to the plug end. A source of grounding hardware is Stewart R. Browne Manufacturing Company, Atlanta GA 30338. Parts and manufacturers stock numbers are listed below:

Stainless Steel Plug	MS3493
Clip	MS27610
3/32" Corrosion Resistent Plastic Coated Wire	No Part Number

/CAUTION/

The sequence of connecting static cables is detailed in figures 9-1 and 9-2. The stainless steel plug is to be inserted into the installed aircraft female electrical receptacle and the clamping device attached to an approved ramp ground. Attaching the clip to the aircraft is prohibited as damage will result. For other than Air Force aircraft, clips installed on each end of a length of cable may be required to ground aircraft not equipped with plug receptacles.

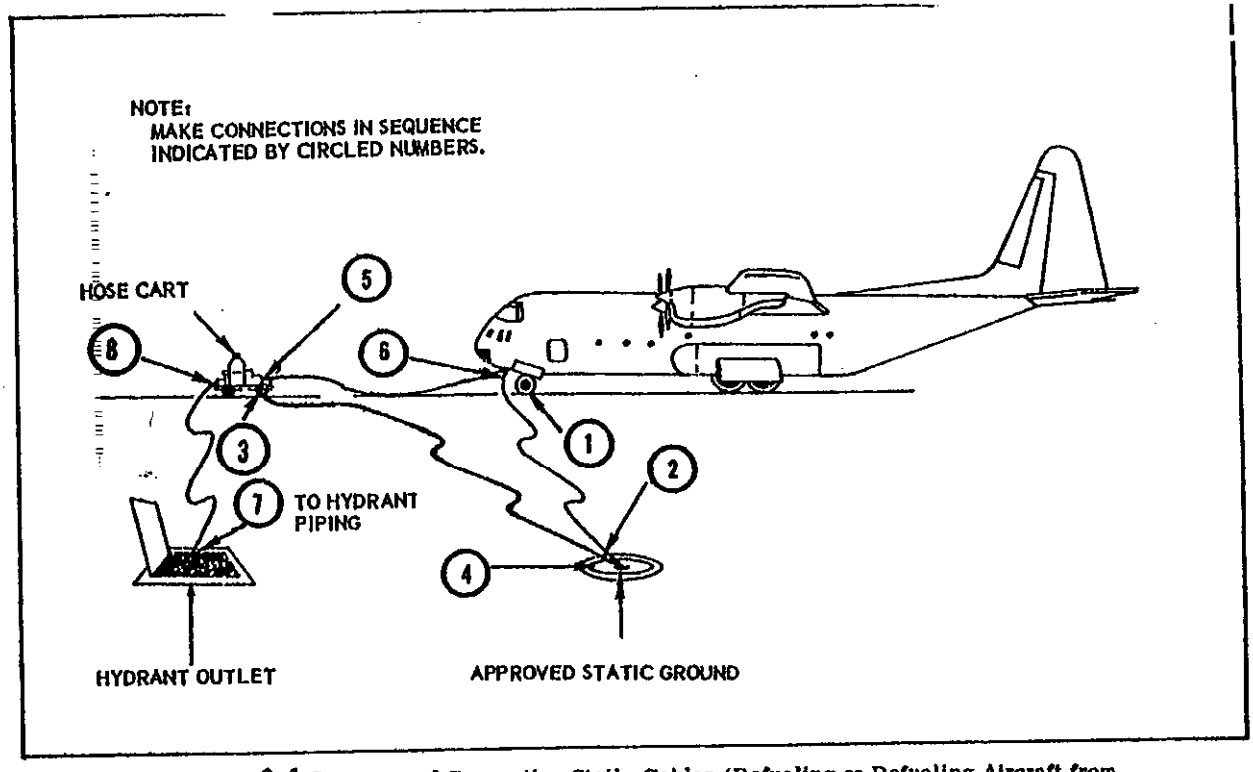

Figure 9-1 Sequence of Connecting Static Cables (Refueling or Defueling Aircraft from Hydrant System)

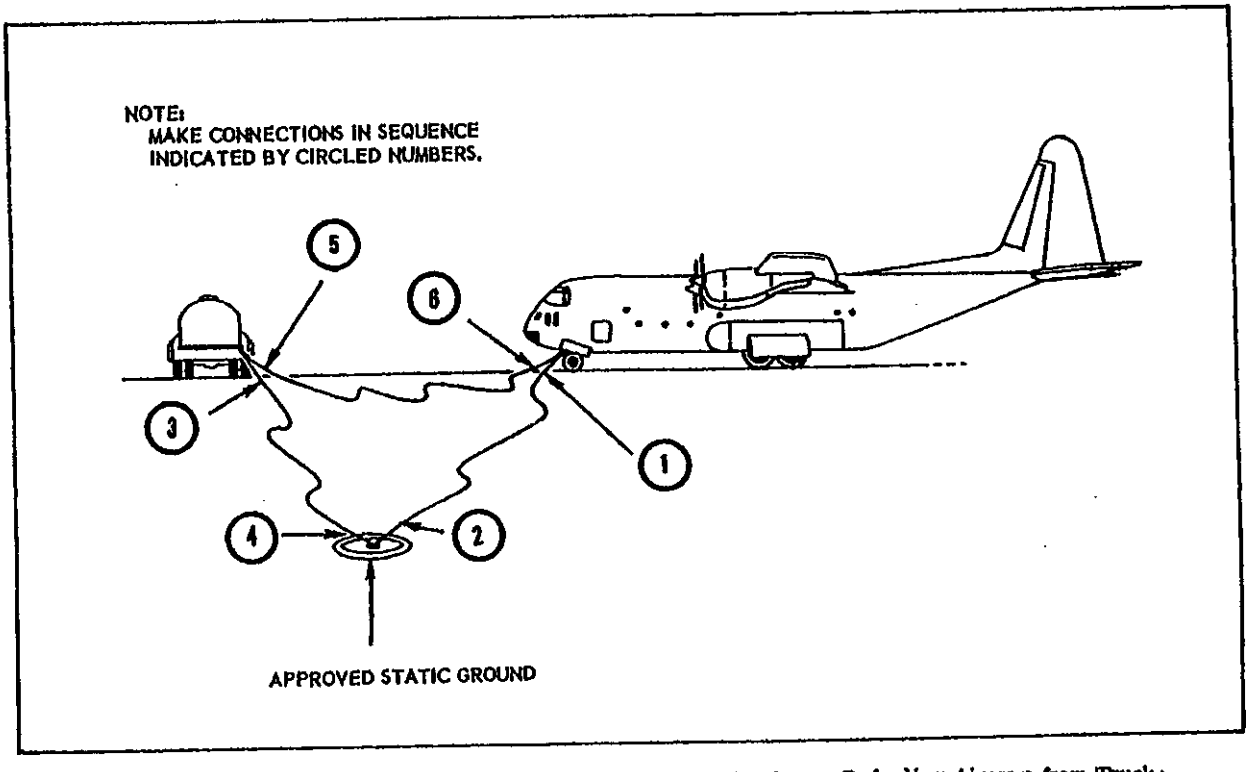

Figure 9-2 Sequence of Connecting Static Cables (Refueling or Defueling Aircraft from Truck)

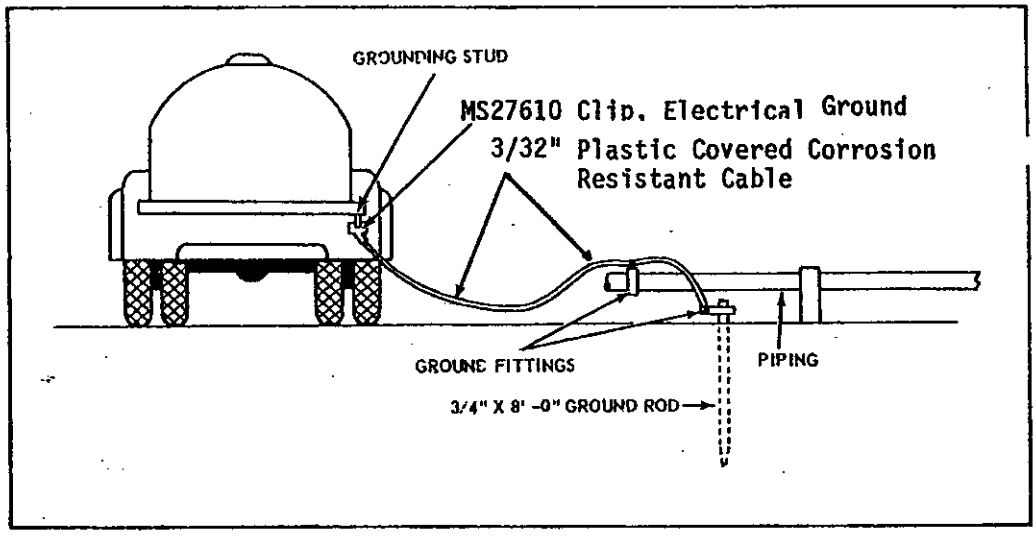

Figure 9-3 Static Ground Connections for Truck Fill Stand or Truck Unloading Facility

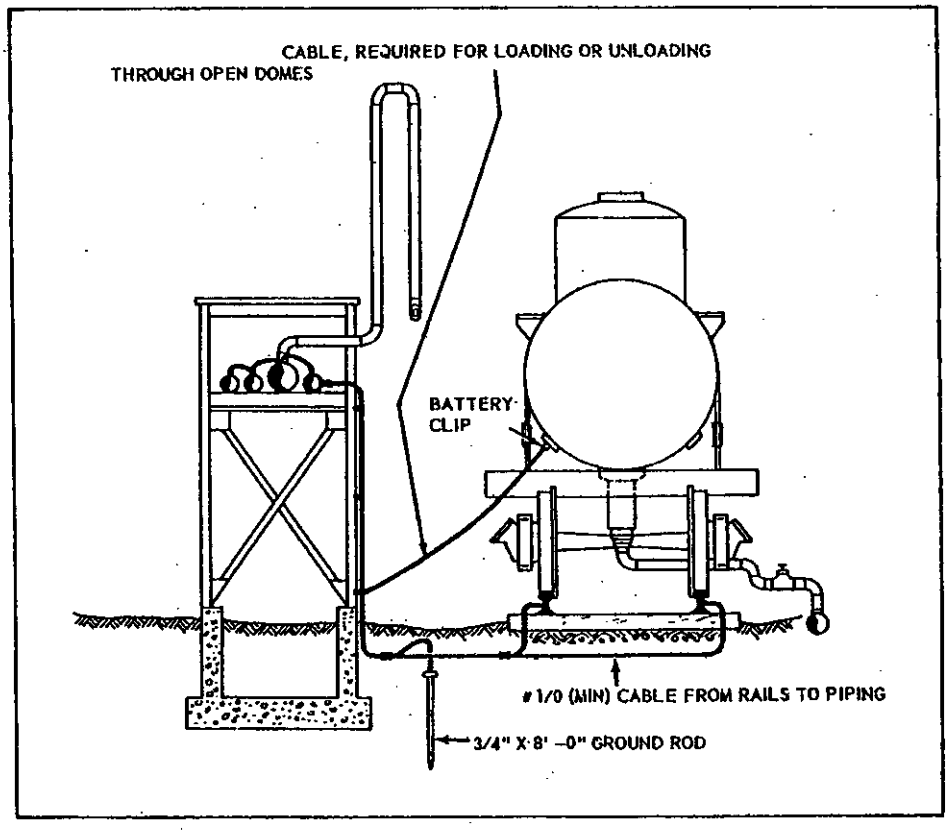

Figure 9-4 Static Connections for Loading and Unloading Tank Cars

c. The electrical continuity of ground reels on servicing units will be checked with a voltage ohmmeter once every three months to assure continuity. The ground resistance of approved static ramp grounds will also be checked at yearly intervals. Resistance up to a maximum of 10,000 ohms is acceptable; however, a lower resistance is preferred. A record will be maintained showing continuity and ground resistance checks made annually.

d. Refueling or Defueling Aircraft from Hydrant System. See figure 9-1.

(1) Ground the aircraft. This will be accomplished by attaching the plug end of the static ground cable to the aircraft and then clipping the other end of the cable to a static ground.

/NOTE/

Grounding connection point used on the aircraft must not be electrically insulated from other metallic and adjoining surfaces on the aircraft.

(2) Connect hose cart to the same ground used for grounding the aircraft. Use the static cable from the fuel inlet end of cart.

(3) Connect hose cart to aircraft with static cable from fuel outlet end of cart.

(4) Connect hydrant outlet piping to hose cart with a static grounding cable with clips on each end. Clip one end to hydrant outlet piping then connect other end to cart.

/NOTE/

If hydrant outlet piping has installed grounding cable, then connect clip end to hose cart and omit the portable cable in Step 4.

(5) Connect refueling hose from cart to hydrant outlet.

(6) Connect the single point nozzle to the aircraft.

(7) If workstands are used, bond workstands to aircraft.

/CAUTION/

Workstands, ladders and any other equipment must be clear of the aircraft. The fuel load added during servicing will cause the aircraft to settle.

(8) Connections for any auxiliary equipment, such as interphones, auxiliary power unit, and portable refueling panels, must be completed before starting the fuel transfer operation. This equipment shall remain connected throughout the operation.

(9) When refueling or defueling is complete, disconnect the single point nozzle from the aircraft.

(10) After both refueling hoses have been stored on the hose cart, disconnect static ground cable from the hydrant outlet. Then disconnect the static cable from the aircraft. Store all cables on the hose cart.

e. REFUELING OR DEFUELING AIRCRAFT WITH REFUELERS: See figure 9-2.

(1) Ground aircraft by attaching one end of a static ground cable to the aircraft, and then clipping the other end of this cable to a static ground.

(2) Ground vehicle by attaching one end of a static ground cable to the vehicle, and then clipping the other end of the cable to the same ground being used by the aircraft.

(3) Bond refueling vehicle to aircraft by attaching one end of a static cable to the refueling vehicle, and then attaching the other end of this cable to the aircraft.

(4) If workstands are used, bond workstands to aircraft.

/CAUTION/

Weight of the fuel may cause the aircraft to settle during refueling. For this reason all workstands and ladders must be clear of the aircraft before starting to refuel.

(5) Bonding of the single point nozzle is accomplished when the mechanical interlock is connected to the aircraft.

/CAUTION/

The "over-the-wing" nozzle must always be bonded to the aircraft before the tank fill cap is removed. This connection must remain in place until after the tank fill cap is replaced. The nozzle must remain in contact with fill opening during refueling. Failure to observe this procedure may result in a static spark causing fire or explosion.

(6) Fill tank. Replace fill cap before disconnecting nozzle static cable from aircraft.

(7) Do not remove more than one aircraft fill cap at a time.

(8) When the fueling is complete, return hose on the refueling vehicle.

(9) Remove the aircraft-to-refueling-vehicle static bonding cable.

(10) Remove refueling vehicle-to-ground static connection.

(11) Disconnect aircraft-to-ground static cable prior to movement of aircraft.

/NOTE/

The above sequence of connecting and disconnecting static cables insures that if an arc occurs during connection, it will occur at the static ground, not at the aircraft or refueling vehicle.

MIL-STD-1518B

CUSTODIAN:
Air Force - 68
Army - AR
Navy - AS

REVIEW ACTIVITIES:
Army - AV
Navy - YD

PREPARING ACTIVITY:
Air Force - 68

Project No. 9130-0102