NONRESIDENT
TRAINING
COURSE

Aviation Boatswain's Mate F

NAVEDTRA 14322

NOTICE

Pages 1-7, 1-16, and 2-86 must be printed on a COLOR printer.

Sailor’s Creed

"I am a United States Sailor.

I will support and defend the Constitution of the United States of America and I will obey the orders of those appointed over me.

I represent the fighting spirit of the Navy and those who have gone before me to defend freedom and democracy around the world.

I proudly serve my country’s Navy combat team with honor, courage and commitment.

I am committed to excellence and the fair treatment of all."

PREFACE

By enrolling in this self-study course, you have demonstrated a desire to improve yourself and the Navy. Remember, however, this self-study course is only one part of the total Navy training program. Practical experience, schools, selected reading, and your desire to succeed are also necessary to successfully round out a fully meaningful training program.

COURSE OVERVIEW: Serves as an introduction to Quality Surveillance Of Aviation Fuels, JP-5 Afloat Below Deck Systems And Operation, JP-5 Flight Deck Fuel Systems, Shipboard Aviation Lube Oil And MOGAS Systems, Shorebase Fuel Systems and Operations, and Fuels Administration.

THE COURSE: This self-study course is organized into subject matter areas, each containing learning objectives to help you determine what you should learn along with text and illustrations to help you understand the information. The subject matter reflects day-to-day requirements and experiences of personnel in the rating or skill area. It also reflects guidance provided by Enlisted Community Managers (ECMs) and other senior personnel, technical references, instructions, etc., and either the occupational or naval standards, which are listed in the *Manual of Navy Enlisted Manpower Personnel Classifications and Occupational Standards,* NAVPERS 18068.

THE QUESTIONS: The questions that appear in this course are designed to help you understand the material in the text.

VALUE: In completing this course, you will improve your military and professional knowledge. Importantly, it can also help you study for the Navy-wide advancement in rate examination. If you are studying and discover a reference in the text to another publication for further information, look it up.

2002 Edition Prepared by
ABFC(AW) Solomona Leauanae

Published by
NAVAL EDUCATION AND TRAINING
PROFESSIONAL DEVELOPMENT
AND TECHNOLOGY CENTER

NAVSUP Logistics Tracking Number
0504-LP-100-6288

TABLE OF CONTENTS

ASSIGNMENT QUESTIONS follow the Index.

INSTRUCTIONS FOR TAKING THE COURSE

ASSIGNMENTS

The text pages that you are to study are listed at the beginning of each assignment. Study these pages carefully before attempting to answer the questions. Pay close attention to tables and illustrations and read the learning objectives. The learning objectives state what you should be able to do after studying the material. Answering the questions correctly helps you accomplish the objectives.

SELECTING YOUR ANSWERS

Read each question carefully, then select the BEST answer. You may refer freely to the text. The answers must be the result of your own work and decisions. You are prohibited from referring to or copying the answers of others and from giving answers to anyone else taking the course.

SUBMITTING YOUR ASSIGNMENTS

To have your assignments graded, you must be enrolled in the course with the Nonresident Training Course Administration Branch at the Naval Education and Training Professional Development and Technology Center (NETPDTC). Following enrollment, there are two ways of having your assignments graded: (1) use the Internet to submit your assignments as you complete them, or (2) send all the assignments at one time by mail to NETPDTC.

Grading on the Internet: Advantages to Internet grading are:

- you may submit your answers as soon as you complete an assignment, and
- you get your results faster; usually by the next working day (approximately 24 hours).

In addition to receiving grade results for each assignment, you will receive course completion confirmation once you have completed all the assignments. To submit your assignment answers via the Internet, go to:

https://courses.cnet.navy.mil

Grading by Mail: When you submit answer sheets by mail, send all of your assignments at one time. Do NOT submit individual answer sheets for grading. Mail all of your assignments in an envelope, which you either provide yourself or obtain from your nearest Educational Services Officer (ESO). Submit answer sheets to:

COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

Answer Sheets: All courses include one "scannable" answer sheet for each assignment. These answer sheets are preprinted with your SSN, name, assignment number, and course number. Explanations for completing the answer sheets are on the answer sheet.

Do not use answer sheet reproductions: Use only the original answer sheets that we provide—reproductions will not work with our scanning equipment and cannot be processed.

Follow the instructions for marking your answers on the answer sheet. Be sure that blocks 1, 2, and 3 are filled in correctly. This information is necessary for your course to be properly processed and for you to receive credit for your work.

COMPLETION TIME

Courses must be completed within 12 months from the date of enrollment. This includes time required to resubmit failed assignments.

PASS/FAIL ASSIGNMENT PROCEDURES

If your overall course score is 3.2 or higher, you will pass the course and will not be required to resubmit assignments. Once your assignments have been graded you will receive course completion confirmation.

If you receive less than a 3.2 on any assignment and your overall course score is below 3.2, you will be given the opportunity to resubmit failed assignments. **You may resubmit failed assignments only once.** Internet students will receive notification when they have failed an assignment—they may then resubmit failed assignments on the web site. Internet students may view and print results for failed assignments from the web site. Students who submit by mail will receive a failing result letter and a new answer sheet for resubmission of each failed assignment.

COMPLETION CONFIRMATION

After successfully completing this course, you will receive a letter of completion.

ERRATA

Errata are used to correct minor errors or delete obsolete information in a course. Errata may also be used to provide instructions to the student. If a course has an errata, it will be included as the first page(s) after the front cover. Errata for all courses can be accessed and viewed/downloaded at:

https://www.advancement.cnet.navy.mil

STUDENT FEEDBACK QUESTIONS

We value your suggestions, questions, and criticisms on our courses. If you would like to communicate with us regarding this course, we encourage you, if possible, to use e-mail. If you write or fax, please use a copy of the Student Comment form that follows this page.

For subject matter questions:

E-mail: n315.products@cnet.navy.mil
Phone: Comm: (850) 452-1001, Ext. 1780
DSN: 922-1001, Ext. 1780
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N315
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32509-5237

For enrollment, shipping, grading, or completion letter questions

E-mail: fleetservices@cnet.navy.mil
Phone: Toll Free: 877-264-8583
Comm: (850) 452-1511/1181/1859
DSN: 922-1511/1181/1859
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC CODE N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

NAVAL RESERVE RETIREMENT CREDIT

If you are a member of the Naval Reserve, you may earn retirement points for successfully completing this course, if authorized under current directives governing retirement of Naval Reserve personnel. For Naval Reserve retirement, this course is evaluated at 9 points. (Refer to *Administrative Procedures for Naval Reservists on Inactive Duty,* BUPERSINST 1001.39, for more information about retirement points.)

Student Comments

Course Title: *Aviation Boatswain's Mate F* ____________________

NAVEDTRA: *14322* ____________________ **Date**: ____________________

We need some information about you:

Rate/Rank and Name: ____________________ SSN: __________ Command/Unit ____________________

Street Address: ____________________ City: __________ State/FPO: __________ Zip __________

Your comments, suggestions, etc.:

Privacy Act Statement: Under authority of Title 5, USC 301, information regarding your military status is requested in processing your comments and in preparing a reply. This information will not be divulged without written authorization to anyone other than those within DOD for official use in determining performance.

NETPDTC 1550/41 (Rev 4-00)

CHAPTER 1

QUALITY SURVEILLANCE OF AVIATION FUELS

INTRODUCTION

The fuels that the ABF will most commonly work with are motor gasoline (MOGAS) and jet propulsion (JP). Because of the complexity and hazards of handling fuels, all personnel must be fully knowledgeable of their characteristics and operating qualities. We will discuss the properties of gasoline and jet propulsion fuels so that you can understand the need for safety and caution in handling them. We will also discuss quality surveillance and the test equipment used to ensure the delivery of a clean product.

CHARACTERISTICS OF FUELS

LEARNING OBJECTIVE: Describe the characteristics of the fuels commonly handled by the ABF.

Motor gasoline (MOGAS) and jet propulsion (JP) fuels are petroleum products manufactured from crude oil by oil refineries. Through distillation, the crude oil is separated into fractions, which are groups of compounds having boiling points within a given range. Nearly all of the distillate fractions may be used as fuels. These fractions (which include gasoline, kerosene, jet fuels and diesel fuel) are known as distillate fuels.

Distillate fuels are flammable liquids. This means they burn when ignited. Under proper conditions they even explode with forces similar to those of TNT or dynamite. Death can result if the vapors of any of these fuels are inhaled in sufficient quantities. Serious skin irritation also can result from contact with the fuels in the liquid state.

In the liquid form, petroleum fuels are lighter than water, and in the vapor form they are heavier than air. So any water present in these fuels usually settles to the bottom of the container. On the other hand, vapors of these fuels, when released in the air tend to remain close to the ground. This increases the danger to personnel and property. Motor gasoline and jet propulsion fuels must be handled with caution.

SOURCE OF ENERGY

Petroleum fuel is a liquid that contains heat energy that is converted into mechanical energy through combustion in an engine. The jet aircraft engine, like the piston engine, produces power by the expansion of heated air caused by the combustion of fuel and compressed air. The major requirement of a fuel for any jet or piston engine is that it be a source of heat energy.

Jet aircraft performance does not vary as much with fuel type as does piston engine performance, however the jet engine fuel must also be suitable for the aircraft under a wide variety of operating conditions. There is no such thing, as a universal fuel since a fuel suited for a gasoline engine does not work in a diesel engine and vice versa.

MOGAS DESCRIPTION

MOGAS (NATO Code Number F-46) is gasoline composed of a mixture of highly volatile liquid hydrocarbons designed for use in internal combustion engines. It is composed of the lower boiling elements of petroleum and is explosive and volatile, and must be handled with extreme caution.

The octane number of MOGAS is:

Motor Method – 83

Research Method – 91

The performance characteristics of MOGAS are determined by its knock value. Knocking refers to the ability of the fuel to burn uniformly and evenly in a cylinder without pre-ignition or detonation. Fuels of inadequate knock value will reduce power output in all types of engines and, if used for more than brief periods, can cause engine damage. The knock value for automotive type engine gasoline is normally expressed as an octane number.

The octane number is a numerical measure of the antiknock properties of motor fuel, based on the percentage of volume of isooctane in a standard reference fuel. Isooctane is a highly flammable liquid used to determine the octane numbers of fuels. For example, a motor fuel that produces the same degree of knocking as a standard reference fuel containing 80 percent isooctane has an octane number of 80. The octane number also may be referred to as octane rating.

JP-5 DESCRIPTION

JP-5 (NATO Code Number F-44) is best described as a kerosene-based jet fuel. It was developed to provide a fuel with a higher flashpoint that could be safely stored on board ship unlike gasoline or earlier jet fuels. Like gasoline, it is a mixture of liquid hydrocarbons produced from petroleum. However, JP-5 is composed of higher boiling components than gasoline and is not as explosive or volatile as gasoline. JP-5 is the only grade of jet fuel authorized for use on board naval ships.

Although JP-5 does have a high flashpoint (140°F minimum) when manufactured, if it is mixed with other fuels that have a lower flashpoint, the liquid becomes unsafe. Even with its high flashpoint, JP-5 is highly flammable in a mist under pressure (ruptured gasket) or spilled on rags and clothing, which act as wicks.

JP-5 is also an acceptable substitute for F-76 (commonly known as DFM), for use onboard ships driven by gas turbine engines (FFG, DDG, and CG), LCACs (landing craft air cushion), and in aviation support equipment.

JP-4 DESCRIPTION

JP-4 (NATO Code Number F-40) is a wide-cut gasoline-type jet fuel having a low flashpoint, typically below 0°F (-17.8°C). The Air Force, Army, and some Navy shore stations use it. It is **highly volatile, flammable, and dangerous,** and when mixed with JP-5, will lower the flashpoint of JP-5 to an unacceptable level for shipboard use.

JP-8 DESCRIPTION

JP-8 (NATO Code Number F-34) is a kerosene-type jet fuel having a flashpoint of 100ºF (37.8ºC). The Air Force in Europe and the British Isles use it as a replacement for JP-4. JP-8 mixed with JP-5 will also lower the flashpoint of JP-5 to an unacceptable level for shipboard use.

VOLATILITY

The volatility of a petroleum fuel is usually measured in terms of vapor pressure and distillation. The vapor pressure indicates the tendency toward vaporization at specific temperatures, while distillation provides a measure of the extent to which vaporization proceeds at a series of temperatures.

Vapor pressure is measured in a Reid vapor pressure test bomb. In the test, one volume of fuel and four volumes of air are contained in a sealed bomb fitted with a pressure gage. The container and fuel are heated to 100ºF, shaken, and the pressure read on the gage. The pressure shown on the gage is known as the Reid vapor pressure (RVP) and is expressed in pounds per square inch (psi).

The measurement for volatility by distillation is done in a standard distillation apparatus. The fuel in this test is heated to given temperatures with an amount of fuel boiled off as each temperature is measured. The military specification for the fuel gives these temperatures and the percentages of the fuel allowed boiling off to meet the desired standard.

Any fuel must vaporize and the vapor is mixed in a given percentage of air for it to burn or explode. For gasoline vapors in air, the limits are approximately a minimum of 1 percent and a maximum of 6 percent by volume. Other types of fuel vapors may have different limits.

Volatility is an important factor in the proper operation of internal-combustion piston engines. In a piston engine, the fuel must vaporize and be mixed with a correct volume of air to burn and deliver power. If part of the fuel does not vaporize, it is wasted. Furthermore, it can damage the engine by washing the lubricant from the engine cylinder walls, which causes rapid wear to the piston rings and cylinder walls.

Military jet fuels in use at the present include JP-4, which has a vapor pressure of 2 to 3 psi, and JP-5, which has no specification for vapor pressure. The vapor pressure for JP-5 is almost 0 psi at normal room temperatures and at standard atmospheric pressure.

Gasoline has a very strong tendency to vaporize and, as a result, always has considerable vapors mixed with the air over the surface of the liquid. In fact, in a closed tank at sea level with temperatures approximately 10ºF or higher, so much fuel vapor is given off by gasoline that the fuel-air mixture is too rich to burn. When fuel is in contact with air, the fuel continues to evaporate until the air is saturated.

The amount of fuel vapor in the air above a fuel can never be greater than the saturation value. Of course, it takes time to saturate the air with fuel vapor, so the actual percentage of fuel vapor may be considerably below the saturation point, especially if the fuel container is open to air circulation.

JP-5 fuel does not give off enough vapors to be explosive until it is heated considerably above 100ºF. However, if the JP-5 fuel is contaminated with even a small amount of gasoline or, more likely, JP-4, the amount of vapor given off increases to the point where it is in the flammable range at a much lower temperature. At room temperatures, 0.1 percent gasoline or JP-4 in JP-5 results in a fuel that is unsafe to store aboard ship since it fails the flashpoint requirement for unprotected storage.

Because of the range of its vapor pressure, grade JP-4 forms explosive vapors from minus 10ºF to plus 80ºF, its normal storage and handling temperatures. **This means that the space above the liquid almost always contains an explosive mixture.**

SPECIFIC GRAVITY

Specific gravity is the ratio of the weight of a given volume of a fuel. At the same temperature, it is to the weight of an equal volume of distilled water. Normally, the gravity of petroleum products is converted to degrees, according to the *American Petroleum Institute* (*API)* scale. All gravity determinations are correlated with a specific temperature of 60ºF by use of *ASTM Standard D1250-80*.

The specific gravity of petroleum products must be determined to correct the volume at different temperatures when gauging the liquid content of storage tanks, tankers, and barges. The specific gravity of JP-5 is also used to select the proper size discharge ring to use on the centrifugal purifier.

A change of the specific gravity of a fuel may indicate a change of composition caused by the mixing of different fuels, or even mixing different grades of the same fuel.

VISCOSITY

Viscosity is the measure of a liquid's resistance to flow. The significance of viscosity depends on the intended use of the product. For application and performance, proper viscosity is highly important since specified minimum and maximum flow rates of flow are required for all fuels and lubricating oils. In fuel, viscosity determination serves as an index of how it will flow to the burners, the extent to which it will be atomized, and the temperatures at which the fuel is maintained to be properly atomized.

SOLVENCY OF FUELS

All petroleum fuels have the characteristic of being able to dissolve some materials. They can dissolve common lubricants, such as oils and greases in pumps, valves, packing, and other equipment. This characteristic requires the use of special lubricants for gasoline services.

Gasoline also causes serious deterioration of all rubber materials except those synthetic types designed especially for gasoline service. It is very important, therefore, that only hose specially made and designated for gasoline be used in this service. This also applies to packing, gaskets, and other materials that must be used in gasoline systems.

Like gasoline, jet engine fuels have certain solvent properties that dissolve greases and cause deterioration of some rubber materials. Therefore, only specially designated greases and synthetic materials should be used for jet engine fuel service. Another important solvent property of jet engine fuels is their ability to dissolve asphalt used for aircraft runways and pavements. Jet engine fuels seriously damage asphalt pavements, and even small spills of this fuel on asphalt pavement should be avoided.

FREEZING POINTS OF FUELS

The freezing point of a fuel is the temperature at which solid particles begin to form in the fuel. These particles are waxy crystals normally held in solution in the fuel. These particles can readily block the filters in an aircraft fuel system. The fuel almost always becomes cloudy before the solid particle form. This cloud is due to the presence of dissolved water in the fuel coming out of the solution and freezing.

The freezing point of JP-5 is –51ºF. The fuels used by other NATO countries and by commercial users vary widely.

FLASHPOINT OF FUELS

The flashpoint of a fuel is the lowest temperature at which the fuel vaporizes enough to form a combustible vapor. These temperatures vary according to the fuel in question.

The flashpoint of a fuel is an index of the fuel's potential safety when being handled or when in storage.

JP-5 must have a flashpoint of at least 140 °F to have the high safety factor required for storage aboard an aircraft carrier in unprotected tanks. F-40 (JP-4) and F-34 (JP-8) fuels flash at any normal temperature and are in danger of ignition any time they contact a hot surface. Therefore, these fuels must be handled with caution.

HEALTH HAZARDS OF FUELS

Most people are aware of the explosive and fire potential of aviation fuels. Furthermore, there is a danger to the health of the individual who must work where hydrocarbon vapors are present. Prolonged inhalation of hydrocarbon vapors can cause dizziness, intoxication, nausea, and death. Consequently, approved safety procedures that minimize the dangers to the health of fuel-handling personnel must be followed meticulously.

Motor Gasoline

The concentration of gasoline vapors that can be tolerated by man is far below that required to produce combustible or explosive mixtures with air. Even one-tenth of the amount necessary to support combustion or to form an explosive mixture is harmful if inhaled for more than a short time, causing dizziness, nausea, and headache. Large amounts act as an anesthetic causing unconsciousness or death.

Personnel should not be permitted to work in spaces where hydrocarbon vapor concentrations exceed 500 parts per million by volume, unless they are protected by an air-supplied respirator. It is recommended that personnel be permitted to work only in well-ventilated spaces where the hydrocarbon vapors are at or below the permissible limit.

The occurrence of any of the symptoms mentioned, among personnel who are handling gasoline or who are within an area in which gasoline is handled or spilled, should be taken as a warning of the presence of dangerous amounts of gasoline vapor in the air. All exposed personnel must be sent out of the area until the vapors have been cleared. Recovery from early symptoms is usually prompt after removal to fresh air. Anyone who is overcome should be given first aid at once and medical attention should be obtained promptly. First aid includes removing gasoline from the skin (if the skin or clothing has been contaminated in a fall or other accident), preventing chilling, and applying artificial respiration if breathing has ceased.

Tetraethyl lead, which was added to increase the antiknock value of gasoline, is no longer used, **but it could remain impregnated in tanks or piping systems.** The lead compound may enter the body through inhalation, by absorption through the skin, and by the mouth. Also, the gasoline vapor itself, when inhaled may result in sickness. Therefore, take the following precautions:

- Avoid contact with liquid gasoline.
- Do not inhale gasoline vapors.
- Do not enter tanks that have contained gasoline until all traces of gasoline vapors have been eliminated.

WARNING

Sediment and sludge impregnated with gasoline may be present at the bottom of the tank. These constitute a serious fire and poison hazard until the tank is thoroughly cleaned. Before you enter the gasoline storage tanks; you must obtain permission from the Commanding Officer and the Gas-Free Engineer must test and certify the tanks are safe for entry.

Gasoline causes severe burns if it is allowed to remain in contact with the skin, particularly when the contact is maintained under soaked clothing or gloves. Clothing or shoes having gasoline on them should be removed at once. Repeated contact with gasoline removes the protective oils from the skin and produces drying, roughness, chapping, and cracking. Skin infection may follow this damage to the skin. A severe skin irritation may develop, beginning usually on the hands and perhaps extending to other parts of the body.

As soon as possible after contact, gasoline should be removed from the skin, preferably by washing with soap and water. Rags or waste, wet with gasoline, must not be put in a pocket, but must be disposed of at once. Soaked clothing should be kept away from flames or sparks, and should be washed out thoroughly with soap and water as soon as possible. If gasoline comes in contact with the eyes, use an eye wash station immediately and seek medical attention.

Tank Cleaning Maintenance

Tank cleaning operations is inherently dangerous, even more so when dealing with tanks used for storing gasoline or any other type of fuel. Extreme care must be taken when performing these operations because of possible exposure to toxic concentration of gasoline vapors. These types of spaces are classified as ***Immediate Danger to Life and Health (IDLH)*. Access to these spaces can only be obtained with the expressed permission of the Commanding Officer and the Gas-Free Engineer must certify that they are safe for entry.**

Strict adherence to established guidelines and safety precautions will be followed without deviation. All personnel working with tank cleaning evolutions must study *OPNAVINST 5100.19, NSTM chapter 074 Vol 3-Gas-Free Engineer* and local applicable instructions. It is crucial that personnel involved with these operations are properly trained in safety precautions and the hazards associated with tank cleaning. The Tank Cleaning Team POIC is responsible for the safety of his personnel and ensuring that the Gas-Free Engineer's instructions are implemented. **SAFETY IS PARAMOUNT!**

Jet Fuels

Jet fuels may contain more toxic aromatics than gasoline. They should, therefore, be handled with the same health precautions as apply to gasoline. They should not be used for cleaning. The hygienic or health aspects for gasoline, therefore, apply equally well to jet fuels. These include precautions covering particularly the inhalation of vapors, skin irritations, and container hazards.

An important step in preventing the buildup of fuel vapors is to operate the ventilation system provided for all spaces where fuels are handled. The aviation fuels security watch must monitor the ventilation in these spaces when they are not manned. Vapor buildup due to inoperative ventilation is dangerous to both you and your ship. Notify your supervisor immediately if you discover the ventilation system in one of your fuels spaces is not working.

The *Standard First Aid Training Course, NAVEDTRA 82081-A*, should be studied by all personnel working with fuels for information on the treatment of those overcome or injured when handling fuels.

SUMMARY OF THE CHARACTERISTICS OF FUELS

It is important that you remember the following characteristics of fuels:

- From the standpoint of fire, explosion, and health, gasoline, JP-4, and JP-8 are extremely hazardous and must be handled with equal caution. JP-5 jet fuel is safer with respect to possible explosions and poisoning. However, the potential hazards of fire from fuel-soaked rags and of skin blistering from fuel soaked clothing must not be ignored.
- Jet engine fuels and gasoline are designed for entirely different types of engines. The proper fuel must be used for each type of engine.

Q1-1. What is the numerical measure of a gasoline's anti-knocking property?

Q1-2. What fuel quality serves as an index of how a liquid flows?

Q1-3. What fuel quality serves as an index of a fuel's potential safety and handling characteristics?

QUALITY SURVEILLANCE

LEARNING OBJECTIVES: Describe the problems caused by fuel contamination. State the types and limits of fuel contaminants.

The major objective of fuel-handling personnel is to deliver fuel to aircraft, clean and water free. The complex fuel systems of modern aircraft do not function properly if the fuel is contaminated with dirt, rust, water, or other foreign matter. Even very small quantities of dirt or solid matter can plug or restrict fuel-metering orifices and accelerate the clogging of fuel filters. Very small quantities of water are also harmful since ice may form in aircraft tanks at high altitudes. Ice affects orifices, controls, and filters like dirt. The partial stoppage of fuel flow by ice or dirt causes poor engine performance and complete stoppage causes engine failure.

PROBLEMS CAUSED BY FUEL CONTAMINATION

Contaminated fuel can cause aircraft accidents with loss of life, loss of aircraft, and/or the grounding of entire squadrons. This means that clean fuel is a LIFE-OR-DEATH matter with aviation personnel. The lesson has been learned the hard way by too many. The time to become fuel conscious is NOW.

ENGINE FAILURES

Besides being deadly, contaminants can be sneaky. A certain type of emulsion resulting from the presence of water and rust particles can stick to the sides of an aircraft's fuel cells and not be noticed. You can even drain out a sample of fuel and find no evidence of this deposit. It can continue to build up until part of it washes off and passes through a strainer into a fuel control. The result is reduced power or engine failure.

Foreign particles so small they cannot be seen with the naked eye can cause damage in a jet engine. The fuel control of a jet engine is a masterpiece of engineering and craftsmanship. It automatically regulates fuel flow to compensate for changes in altitude and speed. It makes practical the piloting by human beings of incredibly powerful jet aircraft. But doing these things requires that the fuel control have precisely fitted meters and valves. The moving parts within some of these meters and valves have clearances of less than 0.005 of an inch. Particles of foreign matter only slightly larger than this clearance can jam the valve or prevent it from seating properly. Particles slightly smaller can stick and build up, or wedge between the parts. Thus, we must remove particles so small they can be seen only with a microscope.

UNNECESSARY REPAIR WORK

Fuel carrying water or dirt can cause a great deal of extra maintenance work. For example, in a typical Navy engine overhaul shop it became necessary at one time to completely disassemble every jet engine fuel control that came into the shop because of the chance of internal damage. Ordinarily, the controls that had been in use less than half of their overhaul time could have simply been bench-checked to verify their performance and then returned for use on the engine. However, experience showed that more than 50 percent of the fuel controls overhauled had failed because of internal corrosion. The cause was water in the fuel. Such extra repair work is not confined to jet engines. Water in the fuel also can cause erroneous readings on the aircraft's fuel quantity gages, which can be exceedingly dangerous in flight.

DELAYED FLIGHTS

In addition to causing engine failures, fuel contamination can mean serious delays in flight operations. Normal procedure requires that all aircraft fueled from a source where contamination is discovered be checked. In some cases, aircraft must be defueled and then refueled before flight operations can proceed.

When a fuel is found to be contaminated the contaminant must be tracked back to its source and the cause corrected. Until the cause of the contamination is found and corrected, the contaminated system cannot be used. The fuel system may be a mobile refueler, air station hydrant refueling system, or the entire fuels system of an aircraft carrier. Contaminated fuel may affect the operation of one aircraft or the operation of an entire air wing. For these reasons, be careful in every phase of fuel handling to prevent contaminants from entering the fuel.

PREVENTION OF FUEL CONTAMINATION

Contamination of aircraft fuel can only be prevented by the use of proper equipment and by following proper operating procedures. Filter separators, stripping pumps, and fuel detecting equipment are useless in preventing and detecting fuel contamination if they are operated negligently or maintained improperly. Equipment now in use can remove most of the contamination that may be present in a fuel. It cannot separate two mixed or blended fuels. It cannot effectively reduce the contamination below the required limits if the contaminant level is too high. You must be careful to prevent the introduction of contamination in all phases of fuel handling. Additionally, all steps of contamination removal MUST be properly performed.

Inspection and sampling procedures are the only means to ensure that the equipment is performing properly. Unless the equipment is properly operated and the sampling procedures are carefully followed, the problem will always remain. Thus, the most important factor in preventing and removing contamination in fuels is the awareness of the people who handle the fuel.

LIMITS OF CONTAMINATION

How can you find out the causes of fuel contamination? How can you find out how much contamination is too much? Before you can determine amounts of contamination, you have to be able to understand the units of measurement used to identify contamination. The two major units for measuring contamination are microns for solids and parts per million (ppm) for water.

There are approximately 25,400 microns in 1 inch. Figure 1-1 gives you a microscopic view of a human

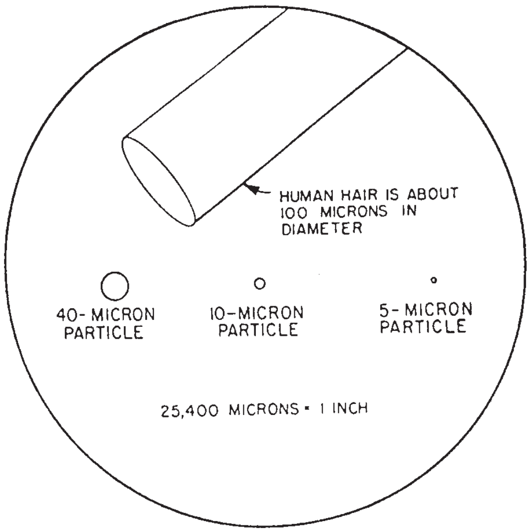


Figure 1-1.—Enlargement of small particles and comparison to a human hair.

hair, which is about 100 microns in diameter, and compares it with a 5-micron contaminant.

Parts per million (ppm) is the reference used for water contamination of fuel. One molecule of water per one million molecules of fuel is referred to as one part water per million parts of fuel.

To be acceptable for delivery to aircraft, jet fuel must be clean and bright. They must not contain more than 5-ppm free water or 2-mg/liter particulate contamination. The terms clean and bright have no relation to the natural color of the fuel. Jet fuels are not dyed and they vary from clear, water-white to straw yellow colored. Clean means the absence of any cloud, emulsion, visible sediment, or free water. Bright means the fuel has a shiny, sparkling appearance. Clouds, haze, specks of particulate matter, or entrained water indicate that the fuel is unsuitable and point to a probable breakdown in fuel handling equipment or procedures. If contamination limits are exceeded, delivery of fuel to aircraft shall be stopped and corrective measures completed before resuming fueling operations.

TYPES OF CONTAMINATION

Aircraft fuel can be contaminated with particulate matter, free water, foreign chemicals, microorganisms, or any combination of the four. They are equally destructive when present in fuel, and as an ABF, you must understand and be able to identify these types of contaminants. Steps should be taken to find the source of trouble and corrective measures taken immediately. See (fig. 1-2) for the various type of contamination that

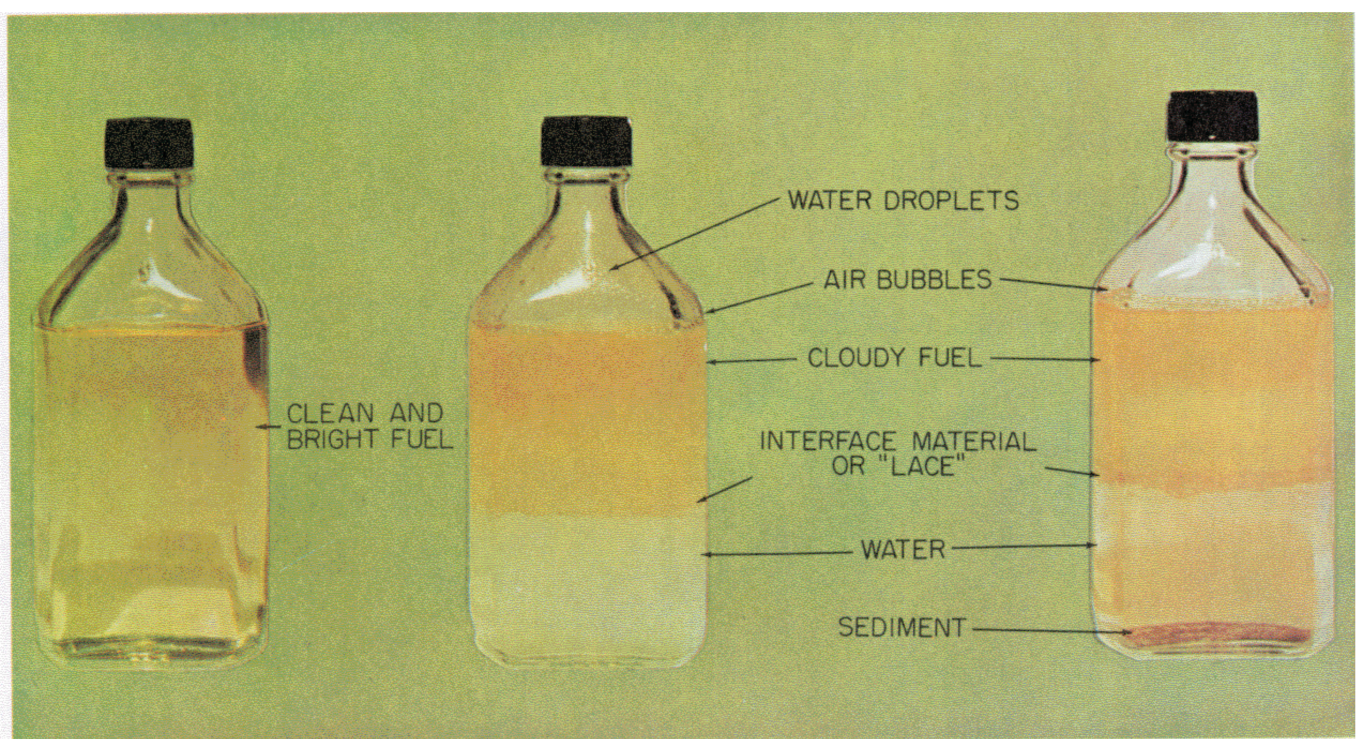


Figure 1-2.—Samples of JP-5 showing common types of visually detected contamination. The air bubbles are not contaminants and are shown for information only.

may be detected visually. The first sample of fuel in this illustration is an acceptable fuel, which all ABFs strive to deliver.

Water

Water is the most common contaminate of fuel and may be present either as free, entrained, or dissolved water. Free water may be fresh or saline (salt). Free water may be in the form of a cloud, emulsion, droplets, or in gross amounts in the bottom of a tank or container. Any form of free water can cause icing in the aircraft fuel system, malfunctioning of fuel quantity probes, and the corrosion of fuel system components.

A Fuel System Icing Inhibitor (FSII), which we will discuss later, is added to JP-4, JP-5, and JP-8 to prevent the formation of ice in aircraft fuel systems when temperatures fall below the freezing point of water at high altitudes. Because FSII is soluble in water, prevention and elimination of water from fuel storage systems is essential to eliminate the loss of FSII below an acceptable use limit.

Entrained water is found in fuels in the form of very small droplets, fog, or mist and it may or may not be visible to the naked eye. Water usually becomes entrained in the fuel when it is broken up into small droplets and becomes thoroughly mixed with the fuel. When large quantities of entrained water are present, the fuel will have a hazy or milky appearance. Jet fuels will hold entrained water in suspension for long periods of time compared to MOGAS because of the density of jet fuel but given sufficient time and the proper conditions. Entrained water will settle and separate from the fuel and collect at the bottoms of tanks, pipes and other fuel system components.

Ordinarily, a cloud indicates water-contaminated fuel. Occasionally, a cloud indicates excessive amounts of fine sediment or finely dispersed stabilized emulsion. Fuel containing a cloud from either cause is not acceptable. Fuel will actually dissolve a small amount of water. The dissolved water is absorbed into the fuel and is not visible. The amount of water fuel will hold in a dissolved state is dependent upon the fuel's temperature. When clean and bright fuel cools, a cloud may form, indicating that dissolved water has precipitated out.

This precipitation cloud represents a very slight amount of fresh water. This cloud appears when warm fuel is pumped to a cool area where the sample is taken. Remember, even though this is a very slight amount of water, if the fuel is not clear and bright, it does not go into an aircraft.

Sediment

Sediment appears as dust, powder, fibrous material, grains, flakes, or stain. Specks or granules of sediment indicate particles in the visible size (approximately 40 microns or larger). See (fig.1-1). The presence of any appreciable number of such particles indicates a malfunction of the filter/separators, a source of contamination downstream of the filter/separators, or an improperly cleaned sample container. Even with the most efficient filter/separators and careful fuel handling, an occasional particle may be seen. These strays are usually due to particle migration through the filter media and may present no particular problem to the engine or fuel control. The sediment ordinarily encountered is an extremely fine powder, rouge, or silt. The two principal components of this fine sediment are normally sand and rust.

Sediment includes both organic and inorganic matter. The presence of large quantities of fibrous materials (close to naked eye visibility) is usually indicative of filter element breakdown, either because of a ruptured element or mechanical disintegration of a component in the system. Usually, high metal content of relatively large particles suggests a mechanical failure somewhere in the system, which is not necessarily limited to a metallic filter failure.

In a clean sample of fuel, sediment should not be visible except upon the most meticulous inspection. Persistent presence of sediment is suspect and requires that appropriate surveillance tests and corrective measures be applied to the fuel-handling system.

Sediment or solid contamination can be separated into two categories:

1. Coarse sediment
2. Fine sediment

Coarse sediment is sediment that can be seen and that easily settles out of fuel or can be removed by adequate filtration. Ordinarily, particles 10 microns and larger are regarded as coarse sediment. See (table 1-1) for more information. Coarse particles clog orifices and wedge in sliding valve clearances and shoulders, causing malfunctions and excessive wear of fuel controls and metering equipment. They also can clog nozzle screens and other fine screens throughout the aircraft fuel system.

Table 1-1.—Visual Contamination Table

TYPE CONTAMINANTS	APPEARANCE	CHARACTERISTICS	EFFECTS ON AIRCRAFT	ACCEPTABILITY LIMITS FPR DELIVERY TO AIRCRAFT
A. WATER (1) Dissolved Water	Not visible.	Fresh water only. Precipitates out as cloud when fuel is cooled.	None unless precipitated out by cooling of fuel. Can then cause ice to form on low pressure fuel filters if fuel temperature is below freezing.	Any amount up to saturation.
(2) Free Water	Light cloud. Heavy cloud. Droplets adhering to sides of bottle. Gross amounts settled in bottom.	Free water may be saline water or fresh water. Cloud usually indicates water-in-fuel emulsion.	Icing of fuel system-usually low pressure fuel filters. Erratic fuel gage readings. Gross amounts of water can cause flame-outs. Salt water will cause corrosion of fuel system components.	Zero-Fuel must contain no visually detectable free water.
B. PARTICULATE MATTER (1) Rust	Red or black powder, rouge, or grains. May appear as dye-like material in fuel.	Red rust (Fe_2O_3)-nonmagnetic. Black rust (Fe_3O_4)-magnetic. Rust generally comprises major constituent of particulate matter.	Will cause sticking, and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc.	*Refer to NOTE 1
(2) Sand or Dust	Crystalline, granular or glass-like.	Usually present and occasionally constitutes major constituent.	Will cause sticking, and sluggish or malfunction of fuel controls, flow dividers, pumps, nozzles, etc.	*Refer to NOTE 1
(3) Aluminum or Magnesium Compounds	White or gray powder or paste.	Sometimes very sticky or gelatinous when wet with water. Usually present and occasionally represents major constituent.	Will cause sticking, and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc.	*Refer to NOTE 1
C. MICROBIOLOGICAL GROWTH	Brown, gray, or black. Stringy or fibrous.	Usually found with other contaminants in the fuel. Very light weight; floats or “swims” in fuel longer than water droplets or solid particles. Develops only when free water is present.	Fouls fuel quantity probes, sticks flow dividers, makes fuel controls sluggish.	Zero
D. EMULSIONS (1) Water-in-fuel Emulsions	Light cloud. Heavy cloud.	Finely divided drops of water in fuel. Same as free water cloud. Will settle to bottom in minutes, hours, or weeks depending upon nature of emulsion.	Same as free water.	Zero-Fuel must contain no visually detectable free water.

Table 1-1.—Visual Contamination Table—Continued

TYPE CONTAMINANTS	APPEARANCE	CHARACTERISTICS	EFFECTS ON AIRCRAFT	ACCEPTABILITY LIMITS FPR DELIVERY TO AIRCRAFT
(2) Fuel and Water or "Stabilized" Emulsions	Reddish, brownish, grayish, or blackish. Sticky material variously described as gelatinous, gummy, like catsup, or like mayonnaise.	Finely divided drops of fuel in water. Contains rust or microbiological growth, which stabilizes or "firms" the emulsion. Will adhere to many materials normally in contact with fuels. Usually present as "globules" or stringy, fibrouslike material in clear or cloudy fuel. Will stand from days to months without separating. This material contains half to three-fourths water, a small amount of fine rust or microbiological growth and is one third to one half fuel.	Same as free water and sediment, only more drastic. Will quickly cause filter plugging and erratic readings in fuel quantity probes.	Zero
E. MISCELLANEOUS (1) Interface Material	Lacy bubbles or scum at interface between fuel and water. Sometimes resembles jellyfish.	Extremely complicated chemically. Occurs only when emulsion and free water is present.	Same as microbiological growth.	Zero-There should be no free water.
(2) Air Bubbles	Cloud in fuel.	Disperses upward within a few seconds.		Any amount.

* NOTE 1:

Particles large enough to be visible should rarely be present. At the most, the total sediment should be a spot of silt. If any appreciable contamination is found, the test must be repeated. When testing with the AEL Mk III/CCFD the max is 2mg/1.

Fine sediment consists of particles smaller than 10 microns in size. Proper settling, filtration, and centrifuging can remove 98 percent of the fine sediment in fuel. Particles in this range accumulate throughout fuel controls. They appear as dark shellac like surface on sliding valves. They also may be centrifuged out in rotating chambers as sludge like matter that causes sluggish operation of fuel-metering equipment. Fine particles are not visible to the naked eye as distinct or separate particles. However, they scatter light and may appear as point flashes of light or a slight haze in fuel.

Maximum settling time should be allowed in fuel stowage tanks after they are filled to allow reasonable settlement of water and sediment. This can be done by proper rotation of the fuels.

Microbiological Growth

Microbiological growth consists of living organisms that grow at a fuel/water interface. These organisms include protozoa, fungus, and bacteria. Fungus is the major constituent and the cause of most problems associated with microbiological contamination of jet fuels. Fungus is a vegetable life; it holds rust and water in suspension and is an effective stabilizing agent for fuel-water emulsion. It clings to glass and metal surfaces and can cause erroneous readings in fuel quantity systems, sluggish fuel control operation, and sticking flow dividers. Microbiological growth is generally found wherever pockets of water exist in fuel tanks. It usually has a brown, black, or gray color and a stringy, fibrous like appearance.

For microorganisms to develop in jet fuels, free water must be present. Traces of metallic elements are also necessary, but water is the key ingredient. Without water there is no growth. Remove any free water and growth ceases.

Microorganisms in jet fuel can cause severe corrosion damage to metal aircraft fuel tanks. Organic acids, or other byproducts produced by the growth of fungi or bacteria, react chemically with certain matter contained within the fuel to penetrate tank coatings. Once the coating is penetrated, the metal tank is attacked.

Microbiological growth causes fouling of aircraft fuel system filters and erratic operation of fuel-quantity probes. Microbiological contamination is more prevalent in tropical and semitropical climates because of the more favorable temperature and higher humidity. The presence of microbiological growth in fuel being delivered to an aircraft is a reliable indication of failure of the fuel system filtering equipment and personnel.

The fuel from an aircraft suspected of having microbiological contamination must not be defueled into a clean system. Once a fuel system is contaminated with microbiological growth, the organisms continue to multiply unless the system is thoroughly cleaned.

Emulsions

An emulsion is a liquid suspended in other liquids. There are two types of emulsions; water-in-fuel and fuel-in-water (inverse) emulsions.

The water-in-fuel emulsion is the most common of emulsions found by fuel handlers. It appears as a light-to-heavy cloud in the fuel. (See the second and third bottles of fuel shown in (fig.1-2.) This type of emulsion may break down and settle to the bottom of the sample container at any time ranging from a few minutes to a week, depending on the nature of the emulsion.

Surfactants

Surfactant is a contraction of term surface-active agent. A surface-active agent is a substance that causes a marked reduction in the interfacial tension of liquids. A surfactant in fuel causes the fuel and water to mix more easily and become much harder to separate. Surfactants disperse both water and dirt in fuel and in some cases form very stable emulsions or slimes.

The surfactants that appear in jet fuels are usually the sultanates or naphthalene of sodium. These can be present as naturally occurring materials in the crude oil or as residual refinery treating materials. Refinery processing must be such that it removes all traces of these materials, or poor quality fuel results.

Many other materials are also surface active. The list includes common household detergents, cleaning compounds used to clean fuel storage tanks and carrier vehicles, greases used to lubricate valves, and corrosion inhibitors used in petroleum products to reduce rust in pipelines and tanks.

Surfactants in jet fuel can be a major problem. These materials accumulate and concentrate in the coalescer elements of filter/separators, destroying the ability of the elements to coalesce and remove water from fuel. Concentrations of less than 1 ppm of a surfactant in jet fuel have been known to cause malfunctioning of coalescer elements. Elements so affected pass free water and suspended particulate matter.

Surfactants are also associated with microbiological slime growths. It is not necessary that surfactants are present for microorganisms to flourish, but they promote luxuriant growth by aiding the mixing and emulsifying of fuel and water. Microorganisms need free water to multiply and grow. Surfactants help them to get it.

The problem with surfactants is that they quite often are not detected in jet fuels until after they have "poisoned" filter/separators, which in turn have allowed water and/or slime to be delivered to aircraft. There are laboratory tests for surfactants in fuel, but as yet there are no accurate field tests. However, one or more of the following observations can usually detect a surfactant problem:

1. Dark, red-brown, or black water in filter/separator sump drains, refueler sump drains, or pipeline low-point drains

2. Excess quantities of dirt and/or free water in the fuel at dispensing points or downstream of filter/separators

3. Storage tanks not yielding a clear, bright fuel after prescribed settling times

4. Dark or black water and/or slime in drawoffs from storage tank bottoms

5. Triggering of fuel monitors in delivery systems

No two cases of surfactant contamination in fuel systems are exactly alike. However, some general measures can be used to correct and control this type of contamination. Some of these procedures are as follows:

1. Change monitor fuses.

2. Change filter/separator elements and clean out filter/separator cases.

3. Clean out pipelines.

4. Remove contaminated tanks from service and clean them thoroughly.

5. Re-circulate fuel and return it to the system upstream of as many filter/separators as possible.

6. Investigate the source of contamination and eliminate it. Notify *cognizant Military Inspection Service* and *Navy Fuel Supply Office* if fuel is contaminated on receipt.

Commingling

The inadvertent mixing of two or more different fuels is known as commingling. Most hydrocarbon products (greases, oils, alcohol, and so on.) are readily capable of mixing with other hydrocarbon products and cannot be separated by mechanical means such as settling, filtering, or centrifuging. A fuel that has been contaminated by commingling with another petroleum product is extremely dangerous whether in storage or in use, because there may be no apparent visual or odor change.

Carelessness or a misunderstanding of the operations of a fuel system usually causes this type of contamination. Most fuels systems are segregated from each other and from other types of fuel systems; but in some cases the piping of one fuel system may be interconnected with another system through valves, blanks, or flanges. The inadvertent opening of a wrong valve can result in commingling the two different products. Where ever you have two different fuels being handled in close proximity (CV's/LPD's/LHA's/LHD's), you must be extremely vigilant in your fuel handling operations.

In other instances, fuel may be pumped into a tank that has contained another product without the tank being properly cleaned. The small amount of the other product may be enough to contaminate the fuel.

Contamination can be detected by laboratory tests ranging from a simple flashpoint test aboard ship to shore based laboratory gravity test and knock rating test in a laboratory engine. JP-5 contaminated with other jet fuels or gasoline must not be stored aboard ship unless a laboratory test indicates that the flashpoint is within allowable limits.

Q1-4. What three areas of concern are associated with fuel contamination?

Q1-5. What two units of measure are used to determine the size of fuel contaminants?

Q1-6. The term "clean and bright" refers to what fuel characteristics?

Q1-7. What type of water is absorbed in the fuel and is not visible to the naked eye?

Q1-8. Microbiological growth is most common in what type of climate?

INSPECTION OF FUEL

LEARNING OBJECTIVE: Describe the specific types of fuel samples taken by the ABF and explain proper sampling procedures.

The shipboard fuel systems and mobile refuelers now in use by the Navy are designed to deliver an acceptable uncontaminated fuel safely into the tanks of an aircraft when they are properly operated. To ensure that this fueling equipment is working properly and is being operated properly, samples of the fuel must be taken at several points and after each step in the operation.

SAMPLES

All ABFs must know the procedures for the drawing of samples and examining them for visual contamination. A sample must be taken in such a manner and from such a location that the sample will be a true representative of the fuel sampled.

Many types of samples and sampling methods are used in the inspection of fuels. We discuss the most common ones here. A detailed description of the other types of samples is given in the *Quality Surveillance Handbook for Fuels and Lubricants, MIL-STD-3004.*

Line Sample

A line sample is one taken from a pipeline or hose at or near the discharge point while the system is operating at normal flow rates. This sample is taken for laboratory analysis and visual identification of fuel quality.

Composite Sample

A single tank composite sample is a blend of samples taken from the upper, middle, and lower levels of a tank's contents. A multiple tank composite sample is a blend of individual all-levels samples from each of the tanks that contain the same type of product being sampled. These samples are in proportion to the volume of the product in each tank.

All-Levels Sample

This sample is one obtained by submerging a closed sampler (fig. 1-3 “thief”) to a point as near as possible to the drawoff level, then opening the sampler and raising it at such a rate that it is nearly but not quite full as it emerges from the liquid.

Representative Sample

This type of sample is used for packaged stocks of fuel. One container from a large stock of packaged fuel when all are of the same age and grade may be selected as a representative of the entire stock. When the containers of fuel are small and suitable for shipment, a container of fuel is taken as the sample without its being opened. For drums of fuel, the sample is drawn from one drum.

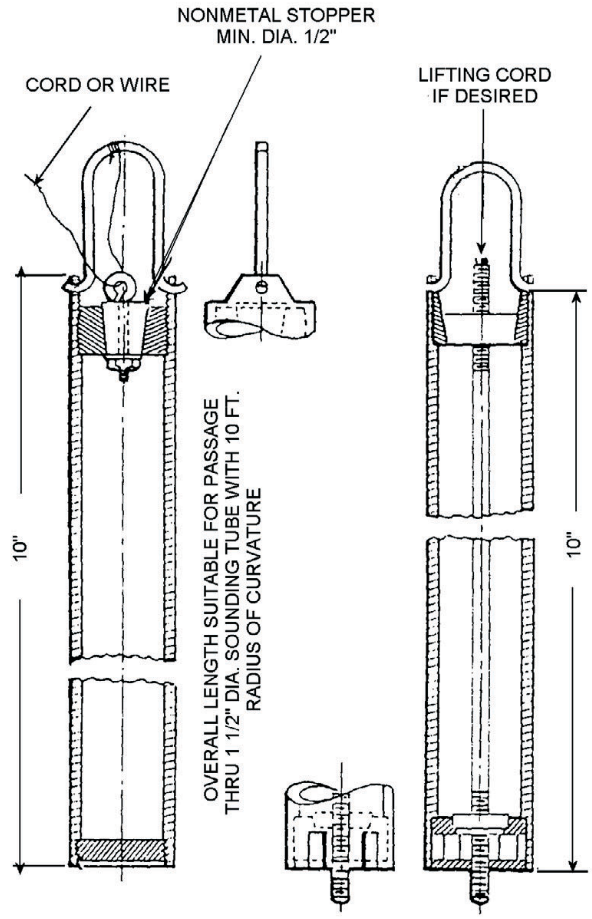


Figure 1-3.—Thief samplers.

Correlation Samples

Duplicate correlation samples are taken to verify that in-house testing procedures and equipment are working properly. The results from this sampling are used by the *Type Commanders (TYCOMs)* and *System Commanders (SYSCOMs)* to monitor the general quality of fuel loaded into aircraft.

In accordance with PMS, duplicate samples are taken at the same time from specific sampling points throughout the system. One set of samples is tested in-house and the other set is shipped to a regional fuel testing laboratory *(see Table 542-7-2 in NSTM CH 542*) for a list of laboratories). When results from the regional laboratory are received, the results of the duplicate samples are compared to verify the accuracy of in-house testing equipment.

FUEL SAMPLING

Correct sampling and labeling of petroleum products is as important to fuels inspection as correct testing. Improper containers of poorly drawn samples or incorrectly identified samples can cause laboratory results to be meaningless or, worse, misleading.

Directions for sampling cannot be made explicit enough to cover all cases. Since improperly taken samples can completely invalidate a test, only trained, competent, and experienced personnel should be assigned to take fuel samples.

Sample Containers

The minimum size sample container for taking samples of fuel is a 1-quart glass bottle with a non-metallic cap. This size sample is of sufficient size for sediment, water, and flashpoint tests only. For other types of tests usually performed at the regional laboratories, the sample submitted should be at least 1 gallon.

Polyethylene bottles shall not be used for shipping samples to laboratories or for performing visual inspections.

Cleanliness

The sample bottle must be meticulously clean. It should be thoroughly cleaned and inspected before use. Before a sample is taken, the clean container should be rinsed and flushed with the fuel being sampled.

Sample bottles are washed with an approved laboratory glassware detergent and water, rinsed with clean water and oven or air-dried on bottle racks. Figure 1-4 shows an ideal set-up that includes an automatic bottle washer with drying rack. Alcohol and other general-purpose cleaners shall not be used to clean sample bottles.

Sampling Procedures

Some general rules in sampling follow:

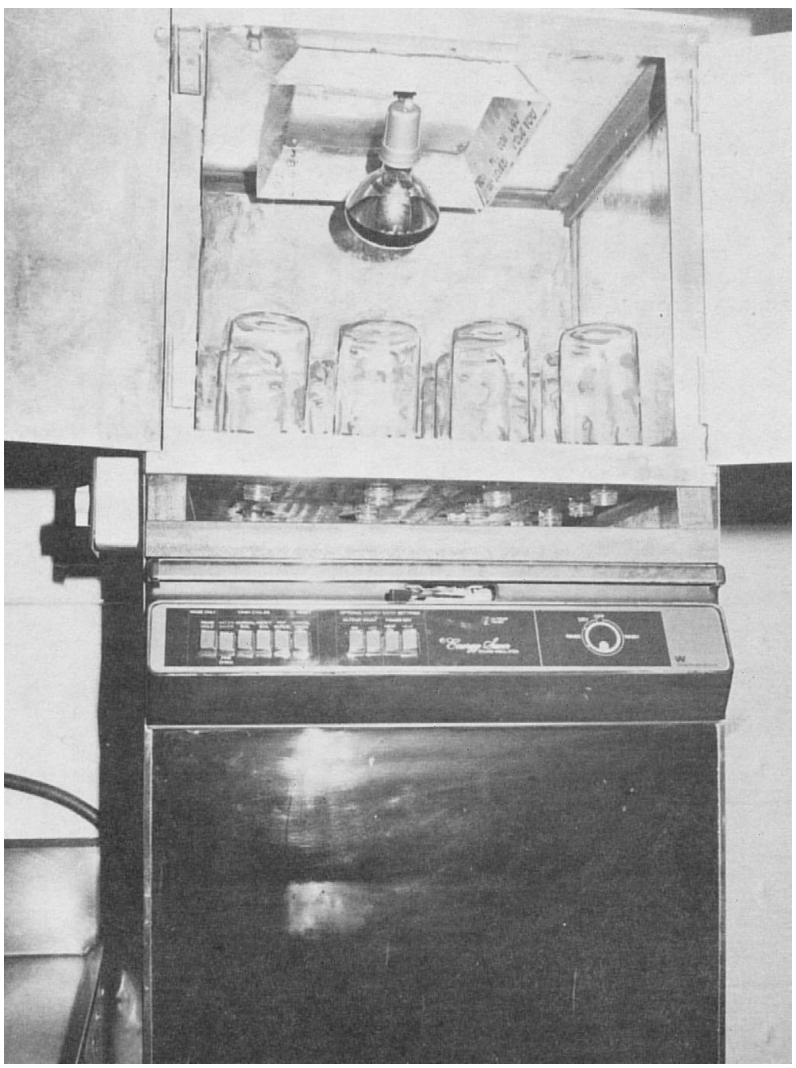


Figure 1-4.—Bottle washer and drying rack.

1. The sampler's hands must be clean.

2. Samples shall be capped promptly and handled expeditiously.

3. All samples must be representative of the product being sampled. Any sample of fuel being delivered to an aircraft should be taken from the fueling nozzle during actual fueling operations. A sample taken to test filter/separator efficiency should be taken at the filter discharge.

4. Do not use sealing wax, rubber gaskets, or caps with wax seals. Use only non-metallic caps.

5. Each sample should be drawn from a connection in a vertical pipe run where practical. If it must be drawn from a horizontal run, the connection should be halfway between the top and the bottom of the pipe.

6. A sample should be taken with the system operating at normal and steady flow rate, if possible. Samples drawn during static (no flow) conditions are not representative of the full fuel flow and may give false high contaminant results.

7. To prevent leakage due to increased pressure caused by thermal expansion of the product, do not fill any container above 90 percent capacity.

8. A container such as a drum should be sampled with a thief sampler and not by tilting. Be careful to remove all foreign matter from the area before the plug is removed from the drum.

9. To obtain a composite or bottom sample of a fuel storage tank, there are two types of thief samplers shown in (fig. 1-3). Both can be used in a standard 1-1/2 inch diameter sounding tube. Type A is used where it is not necessary to obtain a sample from the very bottom of a tank. Type B can be used (if rigged properly) for any level or bottom sampling.

10. For nozzle samples, the sample should be taken from the overwing nozzle during or immediately after the fueling of an aircraft. A pressure nozzle has a sample connection that allows a sample to be taken while the aircraft is being fueled.

Identification of Samples

Proper identification and accurate records of samples are necessary so the test results may be correlated with the samples submitted to regional laboratories. Samples should be marked as soon as they are taken to allow identification of the sample point should testing determine there is contamination.

The following is a sample of what should be used as a guide for sample identification:

1. Classification
2. Activity address
3. Sample serial number (activity number)
4. Type fuel (JP-5, MOGAS, and so on.)
5. Date sample taken
6. Approximate time the sample was taken
7. Location of sample point (nozzle sample, filter number, tank number, refueler number, and so on.)
8. Name of person taking sample
9. Classification of sample and test required (routine or special)
10. Remarks

Sample Classification

Samples are classified as either ROUTINE or SPECIAL. ROUTINE samples are taken when no fuel problems or aircraft problems attributable to fuel are known or suspected. An example is the periodic sampling taken as a part of a quality surveillance program. These samples should be tested for sediment and water, and for flashpoint. SPECIAL samples are submitted for test because the quality of the fuel is suspected, either as the result of aircraft malfunctions or other information. SPECIAL samples should have the highest priority in handling, testing, and reporting.

Visual Inspection Procedures

Since very small percentages of water or foreign matter can cause trouble, the sampling and inspection of fuel must be done carefully. Proceed as follows:

1. The first check you make is to visually inspect the color of the sample. The color of the sample must agree with the color for the grade of fuel that the system is supposed to carry. The color of the fuel may have changed because the fuel has been mixed with another petroleum product. Lubricating oil, diesel oil, or jet fuels may cause a definite yellow cast or darkening of color in gasoline. Lubricating oil and diesel fuel also can cause a change in color in jet fuels. Since the percentage of another petroleum product in a fuel may be so small that it cannot be detected visually, yet can make it unacceptable for use, no off-color fuel should be used until an analysis is made to determine its usability.

2. A sample of JP-5 must have a clean and bright appearance to be acceptable. See the first sample illustrated in (fig. 1-5) for an example of acceptable fuel for this visual check. The sample must be clear enough that newsprint can be read through a 1-quart sample. If the fuel is cloudy and the cloud disappears at the bottom, air is present. If the cloud disappears at the top, water is present. If the cloud does not begin clearing in a few minutes, it is due to entrained water or very fine particulate matter. DO NOT use any fuel containing a cloud that does not disappear in a few minutes after it is drawn or use a fuel containing any visible water to fuel an aircraft.

3. The third check should be for sediment. Swirl the sample bottle to form a vortex in the fuel. All sediment that has settled accumulates on the bottom of the bottle directly beneath the vortex. At the most, the total sediment should be only a point or spot of silt. In a quart sample, the sediment should be no more than a slight smudge if picked up on a fingertip.

Coarse contamination can be detected visually. Sediment in the fuel is visible when the particles are 40 microns or larger. Groups of particles less than 5 microns in size may be seen in the fuel when viewed at a right angle to a strong light. Any coarse particles that settled to the bottom center of the bottle will usually collect in a group. Any sediment that can be seen is too much for aircraft use.

The Free Water Detector (FWD) test should be used to determine the presence of free water above the allowable limit (for aircraft) of 5 ppm. Free water at this level of contamination may or may not be visible to the naked eye.

Fuel that is contaminated by commingling with another petroleum product is hard to detect visually. In gasoline, if the percentage of the other petroleum is fairly high, there may be a color change. A test for flashpoint and a laboratory test for distillation can detect JP-5 contaminated by JP-8, or vice versa.

Results

If any contamination is discovered during the visual inspection procedure, the test shall be repeated, paying particular attention to cleaning and rinsing the bottle prior to drawing a sample. Also, if there is any question as to the quality of the fuel, both particulate and water measurements must be made using the Combined Contaminated Fuel Detector (CCFD) and the Fuel Water Detector (FWD).

Figure 1-5.—Degrees of cloudiness in JP-5. The left sample is clean and bright and is the only acceptable fuel for aircraft.

Action

A contaminated sample should be suitably tagged and retained until it is determined that a laboratory analysis of the sample is not required. When any contamination is found, another sample should be taken using a new sample container. Once contamination is found and the system placed out of use, a check must be made for the source and cause of the contamination and the cause corrected before the system is placed in use again. The type of contamination discovered usually gives a clue to the source and cause. Some of these indications are as follows:

1. Mixed or commingled fuels—the valve or blank flange is open between two different systems or there is a leak through a bulkhead where two tanks containing different fuels are adjacent.

2. Water—the filter/separator elements are ruptured or contaminated. Large amounts of water also indicate that the filter/separator float control valve was not operating and water-stripping operations for the service tanks were inadequately performed.

3. Sediment and microbiological growth—the filter/separator elements are ruptured or contaminated. Large amounts of sediment or biological growth also would indicate that the storage tanks and service tanks need cleaning.

Q1-9. What type of sample is drawn for visual identification?

Q1-10. What method is used to obtain a sample from a drum?

Q1-11. Fuel samples are designated by what classification(s)?

Q1-12. What is present in fuel when a cloudy sample begins to clear at the bottom of a sample container?

FUELS LABORATORY TESTING EQUIPMENT

LEARNING OBJECTIVE: Describe the quality surveillance test used to determine fuel contamination levels and explain the correct operating procedures for the equipment.

The fuels quality surveillance laboratory contains some of the most important equipment in your division. The testing equipment is very good for what it was designed to do, but it does not replace the services provided by the regional fuels laboratories. The equipment is sensitive and fragile. Take care of "your" equipment and it will last a long time. Also, remember the equipment is only as good as the personnel who use it.

A good fuels lab has the following facilities: good ventilation, hot and cold water, bottle washer and drying rack, and adequate lighting.

The CCFD (combined contaminated fuel detector) is a newer model of the AEL Mk III (fig. 1-6) with an

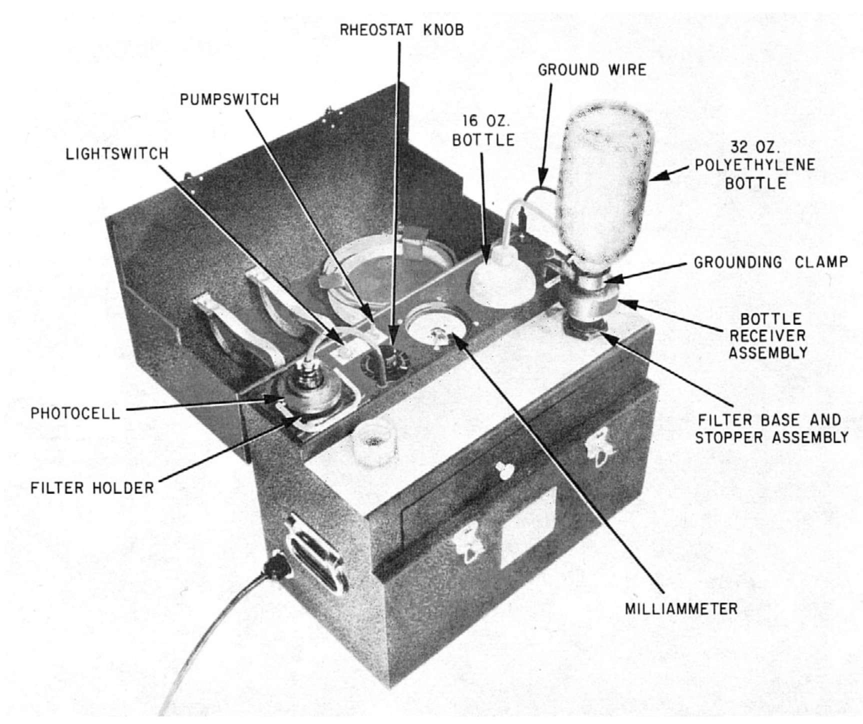


Figure 1-6.—AEL Mk III combined contaminated fuel detector (front view).

AEL Mk I (fig. 1-7) built in the same case. The CCFD gives the sediment reading by digital display. The theory and operation of the CCFD are the same as for the individual units. The NAVIFLASH method and closed-cup flashpoint tester are both used to determine the flashpoint of aviation fuels. The refractometer indicates the amount of fuel system icing inhibitor (FSII) present in fuel, and the hydrometer and thermohydrometer is used to measure the specific gravity.

With any of the units, for initial startup or after moving them from one space to another, you MUST allow adequate time for the unit to reach the same temperature as the space in which it is to be used. This is IMPORTANT so any condensation that may form inside the machines will not affect your readings.

COMBINED CONTAMINATED FUEL DETECTOR (CCFD)

The combined contaminated fuel detector is a portable self-contained unit designed for both gasoline and jet fuels. This instrument is used to determine the quantity of solid and free water contamination present in fuel.

The detector consists of a fuel sample container, a light transmission system for determining the quantity of solid contaminants on the millipore filters, a fuel filtration system employing millipore filters and water detector pads, and an ultraviolet light for determining the quantity of free water. All components necessary for filtration and measuring transmitted light are incorporated into one serviceable package. See figure 1-8.

The level of solid contamination is measured by using the principle of light transmission through a millipore filter. A sample of fuel is filtered through the millipore membrane and any particulate matter is then retained on the surface of the membrane. The millipore filters have 0.65-micron pores. If a beam of light is directed through the membrane, part of the light is absorbed by particles of solid contaminants.

To increase accuracy, and to eliminate any fuel color effect, two millipore filters are used in series. The first filter traps the solid contaminants, plus fuel color effect; the second filter is subjected to clean fuel and retains only the fuel color effect. Thus, the difference between light transmission through the two filters depends only on the amount of solid contamination. By

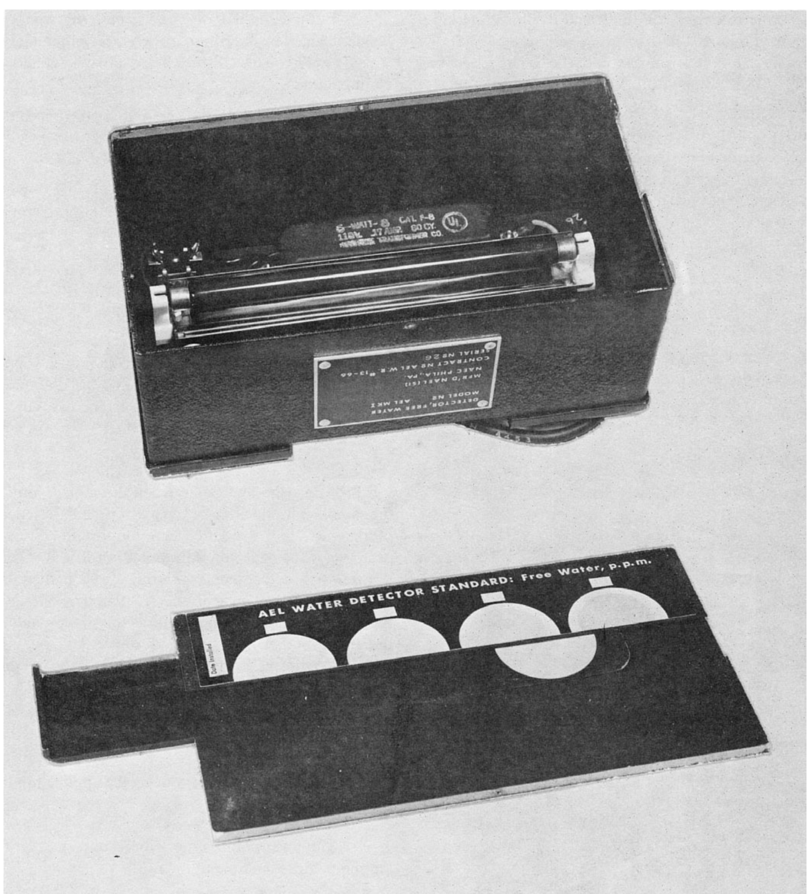


Figure 1-7.—AEL Mk I free water detector.

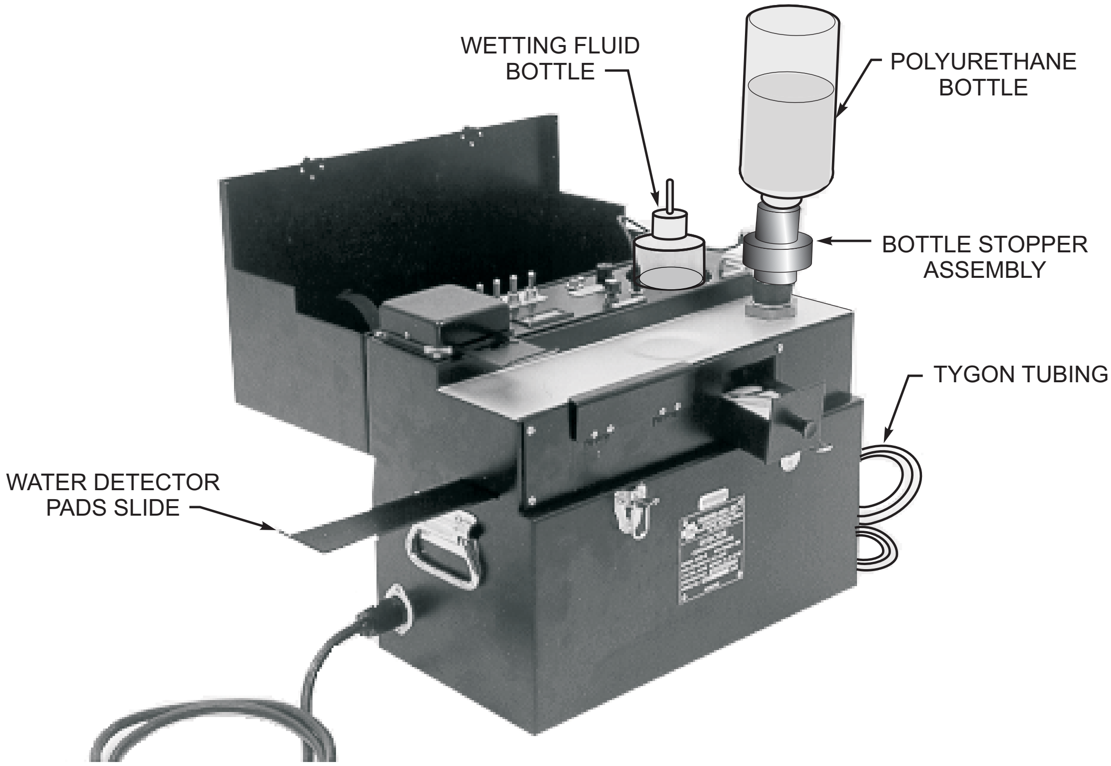


Figure 1-8.—CCFD (front view).

measuring the difference between the amount of light transmitted through the contaminated membrane and the clear membrane, it is possible to establish the level of contamination in fuel. The CCFD has a detection range of 0-10 mg/L of solid contamination.

Fuel Sample Container

The sample container used with the CCFD consists of a 32-ounce polyethylene bottle that holds the fuel sample during testing. The bottle is marked with 800 and 500-ML lines to indicate the filling levels for conducting sediment and free water test.

Light Transmission System

The light transmission system of the CCFD determines the amount of sediment and free water contamination in a fuel sample. The system consists of a lamp, rheostat, milliamp meter, photovoltaic cell, and a water standard card.

The lamp provides a constant source of light intensity and has an ON/OFF switch on top of the casing. The rheostat, located on top of the casing, is used to control the intensity of the lamp. The milliammeter measures the light intensity detected by the photovolatic cell and displays the results in a digital reading located on the top of the casing. The photovoltaic cell is a light sensitive cell, which produces a voltage when illuminated by the lamp. The amount of voltage the cell produces varies in proportion to the light intensity. The cell housing contains a slide with an impression to place the millipore filters on and insert into the cell housing for testing.

An ultraviolet light for detection of free water on the water detecting pads is also enclosed in the casing. A view port allows for a visual inspection of the water detecting pads. The standard card is located inside the case housing. The card consists of four standard water detector pads that give an accurate comparison of water contamination. The pads are calibrated in parts per million (PPM). The standards of calibration are 0, 5, 10, and 20 PPM.

Fuel Filtration System

The fuel filtration system consists of the bottle receiver assembly, fuel flask, and vacuum. The system draws the fuel sample through the millipore filters and water detector pads.

The bottle receiver assembly holds the sample bottle during the filtration cycle. It interlocks with the filter base and stopper, which holds the two millipore filters or one water detection pad. A grounding wire is attached to the bottle receiver for grounding the receiver during filtration. The fuel flask receives the fuel from the sample bottle during filtration. An inner pipe runs from the vacuum pump inlet to near the top, inside of the flask, which enables the pump to remove air from the top of the flask and draws the fuel sample through the filter(s). A drain cock and hose drains fuel from the flask into a safety can after each operation.

The vacuum pump is a rotary vane type pump. It creates sufficient vacuum to draw the fuel samples through the filters and is protected by an overflow switch that shuts off the pump to prevent overflowing the fuel flask and flooding the pump. The pump is operated by a 110 Vac-60 hertz electric motor.

OPERATION OF THE CCFD

The following steps are for the preparation and use of the CCFD for sediment content testing. Refer to the *Operation and Maintenance Manual* provided with each unit for specific guidance.

1. Remove the power cable from inside the instrument cover and connect it to a suitable source of 110-volt, 60-hertz power. The power cable contains a ground wire to ground the instrument.

2. Turn the light switch ON. The light system should be allowed to warm up for 3 to 5 minutes before use.

3. Insure the fuel flask is empty and the drain cock is CLOSED. If drain cock is left open, fuel will be pulled up and out of the safety drain can. When the pump is turned ON, it will flood the unit.

4. The filter base and bottle receiver assembly located in the lid should be disassembled into its two components. The section with the rubber stopper is the filter base and should be inserted into the opening in the fuel flask.

5. The millipore filter is a paper-thin white membrane. Place two millipore filters on the filter base. These filters should be handled only with forceps, and only by their edges. Do not handle the filters with your fingers. Reassemble the filter base and bottle receiver assembly. Rotate the locking ring carefully to prevent damage to the filters.

6. Fill the 32-ounce polyethylene sample bottle to the 800-milliliter (ml) mark with the fuel to be tested. Place the filter base and bottle receiver over the top of the bottle.

7. Insert the ground wire attached to the filter base and bottle receiver assembly into the ground opening provided on the unit. Turn ON the pump switch.

8. Insert the entire assembly (filter base, bottle receiver, and fuel sample bottle) into the opening above the fuel flask. During the filtration cycle, the fuel in the sample bottle should be agitated occasionally by gently shaking the bottle to ensure that any contaminants are washed down and not lodged on the inside surface of the bottle. If the sample bottle tends to collapse, gently loosen the bottle in the bottle holder by tilting it slightly during the filtration cycle. After all the fuel has passed through the filters, stop the pump.

9. OPEN the drain cock valve and drain the fuel from the flask through the *Tygon* tubing into a 5-gallon safety can. When the flask is empty, CLOSE the drain cock valve.

10. Adjust the rheostat knob to read 0.6 on the milliammeter before placing the millipore filter in the receptacle.

11. Using forceps, pick up the top contaminated filter and wet it with clean (pre-filtered) fuel. Ensure the entire filter becomes wet with fuel. This pre-filtered fuel is called wetting fuel. It is used to keep the entire millipore filter wet. It is NOT used to wash contamination off the millipore filter. By keeping the entire filter wet you do not get a change of reading from the dry areas to the wet.

NOTE

Re-running the same sample through millipore filters produces WETTING FUEL. Although no exact number of times is required to re-run the sample to make wetting fuel, it is recommended that the SAME sample be rerun until the light transmission readings for both millipore filters are identical.

12. Slide out the filter holder from the photovoltaic cell housing and using forceps, place the contaminated filter in the receptacle. If you do not place the filter in the slide properly, the filter may come off inside the machine.

13. Slide the plate back into the measuring position and ensure it is fully seated.

14. Record the reading on the milliammeter; this reading is in thousandths of a milliamp.

15. Remove the filter. Check to see that the meter still reads 0.6 milliamps; if not, adjust the meter to 0.6.

16. Repeat steps 11 through 15, using the clean (bottom) filter.

17. Subtract the meter reading obtained from the contaminated filter (top), from the meter reading obtained from the clean filter (bottom). This change in reading value is used with the calibration chart in (fig. 1-9).

18. Find this value on the left of the chart, and then move horizontally until the reference line is intersected. Read vertically at either the top or bottom of the chart to determine the amount of contamination in either milligrams per gallon or in milligrams per liter.

> **NOTE**
>
> Each contaminated fuel detector has its own calibration chart that is marked with the same serial number as the unit.

19. Record the reading. The maximum solid contamination that may be delivered to an aircraft is 2 milligrams per liter (mg/L).

CCFD Free Water Detection

A sample of fuel is passed through a chemically treated filter pad in the filter holder of the CCFD. The chemical on the water detector pad is sensitive to any free water in the fuel. If water is present in the fuel, the pad produces a visible fluorescent pattern when it is placed under an ultraviolet light.

The steps for preparation and use of the CCFD for testing fuel for free water content are as follows:

1. Fill the 32 ounce polyethylene sample bottle to the 500 ml mark (3 1/4 inches from the bottom) with the fuel to be tested.

2. Open a free water detector pad envelope and place the detector pad, orange side up, on the screen of the filter base. Attach the bottle receiver to the filter base and twist to lock it together.

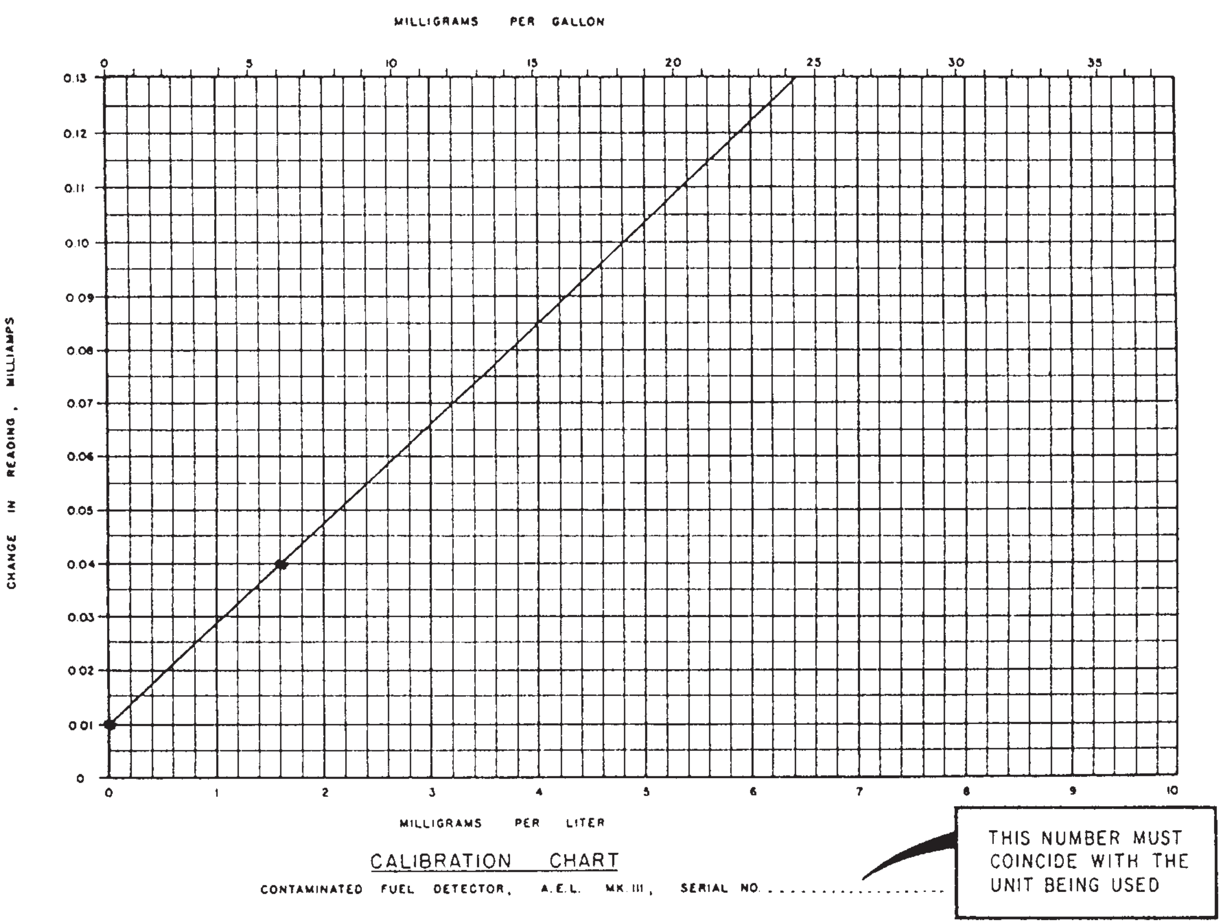


Figure 1-9.—Calibration chart.

> **NOTE**
>
> Handle the detector pad with forceps only. Do not touch the pad with your fingers or it becomes contaminated before you even start the test.

3. Check to see that the fuel flask in the CCFD is empty and the drain cock closed. **If it is not closed, fuel from the safety can will be pulled up and flood the unit.**

4. Shake the bottle containing the 500-ml fuel sample vigorously for approximately 30 seconds.

5. Immediately after shaking, turn the vacuum pump ON. Unscrew the bottle cap and place the bottle receiver firmly over the end of the bottle. Insert the ground wire jack into it's receptacle in the top of the CCFD casing. Insert the filter base into the top of the fuel flask. This step should be done in as short a time as possible to keep any free water in suspension.

6. After the sample has passed through the detector pad, turn OFF the vacuum pump IMMEDIATELY and remove the bottle and bottle receiver.

> **NOTE**
>
> DO NOT continue to draw air through the detector pad. If the moisture in the air is drawn through the pad, you get an incorrect reading.

7. Unlock the bottle receiver assembly and remove the pad from the filter base with forceps and place it (orange side up) in the depression on the free water detector slide.

8. Light the ultraviolet bulb in the CCFD by holding the light switch in the ON position, and insert the slide containing the test pad.

9. Look through the view port in the front of the CCFD and compare the brightness of the test pad with that of the set of standards to determine the amount of free water. Free water content is indicated by a yellow-green fluorescence when viewed under the ultraviolet light. Read the results to the closest PPM by the numbers located directly above the standards. Results should be reported as "No Free Water," or "5, 10, or 20 PPM." These are exact readings. There are no in-between readings. It is 0, 5, 10, or 20 PPM.

10. Record the reading. The maximum allowable water contamination that may be delivered to an aircraft is 5 PPM. If the result is over 20 PPM, take a new sample of one-half the standard sample and double the result.

CCFD MAINTENANCE

You should recognize that this instrument is only a secondary standard and does not replace the requirements for periodic laboratory analysis; it supplements the laboratory analysis. Extensive field tests have demonstrated that the calibration chart with this unit is valid for most fuel samples. However, there are occasional samples that do not fit the normal pattern. It may become necessary to establish a new or modified calibration chart in a few unusual cases where the contaminants in a particular system do not follow normal patterns. Duplicate samples sent to the laboratory for gravimetric analysis can give a crosscheck on the instrument and quickly pinpoint these unusual situations.

Light Intensity Adjustments

If insufficient adjustment is available to obtain a reading of 0.60 milliamps on the meter as outlined in step 11 of sediment testing, proceed as follows: Set the rheostat at mid-scale and note the meter reading with the light ON and no filter in the receptacle. Unplug the instrument and open the back.

See (fig. 1-10). Loosen the light bulb holder slightly. If the meter reads below 0.60 milliamps, slide the bulb holder up. If the meter read over 0.60 milliamps, slide the bulb holder down. The filament of the light bulb should be horizontal after the change is

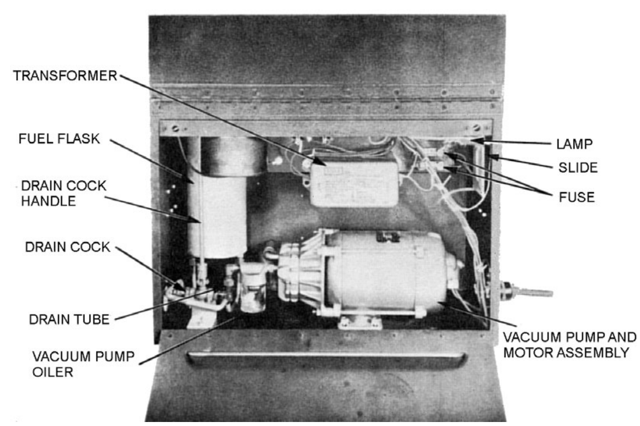


Figure 1-10.—CCFD and AEL Mk III (rear view).

made. Temporarily close the case; plug in the instrument, turn on the light, and check the meter reading.

It is not necessary to obtain an exact 0.60 reading by adjustment of the light bulb because final adjustments will be made by use of the rheostat. When a suitable position for the light bulb has been found that will permit adequate adjustment by the rheostat, retighten the nuts on the bulb holder. Refasten the back of the instrument.

Calibrating the CCFD

Each CCFD comes with 2 WRATTEN calibration filters that are provided by the manufacture. The Wratten calibration filter set is a pair of filters with a known contamination value. The filters are packaged in silver foil wrappers so that you don't scratch them and to protect them from dust, which can affect the readings you get. When the filters are not in use, it is imperative that you keep them protected.

NOTE

Calibrate quarterly, when it's moved or when a part is replaced according to PMS.

The following instructions are basic steps. Refer to the *PMS card*, *AFOSS*, and the *Operation and Maintenance Manual* provided with each unit for specific guidance.

When you handle the filters, use FORCEPS. The area of contact should be within 1/4 inch of the edge of the filter to avoid damage to the filter's surface. The calibration should be done in the following manner:

1. Turn ON the CCFD and let it warm up for 3 to 5 minutes.

2. Adjust the light intensity, using the rheostat knob, until the milliammeter scale reads 0.6.

3. Pick up the first WRATTEN filter, using the forceps. Pull out the slide plate and insert the filter into the receptacle and slide the plate back in. Record the milliammeter reading in the logbook.

4. After logging your results remove the WRATTEN filter and put it back into its protective wrapper.

5. Readjust the rheostat if the milliammeter reading is not 0.6.

6. Repeat steps 3 and 4 with the second WRATTEN filter.

7. To obtain the calibration point, subtract the lower of the two milliammeter readings from the higher reading. This difference is plotted on the calibration chart versus the weight of contaminant per liter given for the set of WRATTEN filters. A second point is plotted at 0 milligrams per liter and 0.01 milliamps change in light reading. Example (fig. 1-9):

a. Filter contamination factor = 1.6 milligrams per liter.

b. Difference between WRATTEN filters = 0.04 milliamps.

c. Plot this point with the calibration chart.

d. Plot second point where 0 milligrams per liter and 0.01 milliamps BISECT.

e. Now draw a line connecting the two.

f. Date the calibration chart and insert the serial number of the CCFD into the space provided.

NOTE

On the back of the chart it is a good practice to put the serial number of the Wratten filters used.

Water Standards Card and Ultraviolet Light Replacement

The reason for replacing the water standards card is that the fluorescent inks in the pads deteriorate after prolonged exposure to ultraviolet light. The standards card in the CCFD must be replaced after 6 months of use in accordance with PMS.

To replace the ultraviolet bulb, turn the used bulb one-quarter turn and lift it out of the fluorescent lamp holder. To insert a new bulb, rotate it one-quarter turn until it is locked in place. DO NOT FORCE THE BULB during removal or installation. Always refer to the maintenance manual or PMS card for Standard card or bulb replacement.

AEL MK I AND MK II FREE WATER DETECTORS

The AEL MK I (see fig. 1-7) and MK II free water detectors were developed to measure the amount of free water in fuels. These detectors are used together with the AEL MK III (see fig. 1-6) to measure water contamination in a fuel sample. A test sample of fuel is passed through a chemically treated pad in the filter holder of the MK III detector. After a fuel sample has run through a chemically treated water detector pad on the AEL MK III, the water detector pad is place into either the AEL MK I or the AEL MK II free water detectors and under the ultraviolet light of these machines for analysis.

FLASHPOINT TEST EQUIPMENT

The flashpoint of a fuel is the LOWEST temperature at which the fuel gives off a VAPOR that can ignite. To determine this temperature, equipment was designed to heat a closed cup of fuel at a specified rate until a flash is detected, either visibly or by sensing pressure build-up, signifying flashpoint. This equipment allows for the determination of the fuel flashpoint *IAW ASTM D-93*, Standard Test Method for Flashpoint by *Pensky-Martens Closed-Cup Tester.*

There are various manufacturers of the tester, including *Pensky-Martens*, *Koehler, Boekel and NAVIFLASH*. We will discuss the Pensky-Martens and NAVIFLASH tester in this chapter. The Pensky-Martens method uses an open flame, which is periodically dipped into the test chamber; the NAVIFLASH method uses an electric spark and pressure transducer to detect flashpoint.

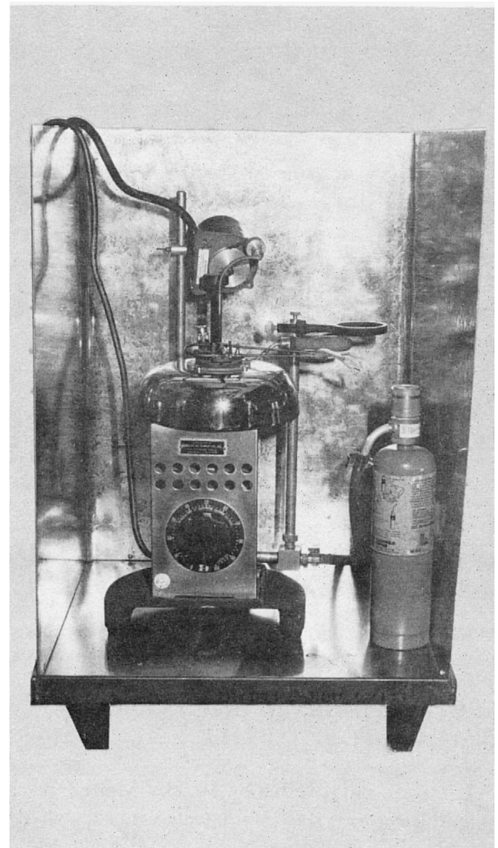


Figure 1-11.—Flashpoint tester and metal shield.

Pensky-Martens Method

In preparation for use, the flashpoint tester (fig. 1-11) is to be placed on a level, steady surface. If the room where the tests are to be conducted is drafty, results could be inaccurate. When performing a flashpoint test with the Pensky-Martens Flashpoint Tester, the test should be done in an approved enclosed explosion proof cage. The Pensky-Martens Flashpoint Tester is designed to test fuels with a flashpoint of 20°F to 700°F depending on the thermometer used.

The following procedure summarizes the operation of the Pensky-Martens method:

1. Thoroughly clean and dry all parts of the cup and its accessories before starting any test.

2. Fill the cup with the fuel to be tested up to the level indicated by the filling mark. Testing fuel containing free water is not recommended, the results would not be accurate. If absolutely necessary, filter the fuel through filter paper to remove all water before testing.

3. Place the lid on the cup and set the cup in the stove. Take special care because the lid has locking devices so it fits only one way.

4. Insert the thermometer into the thermometer ferrule. It is known that JP-5 fuel has a flashpoint of 140°F, so use the appropriate thermometer that has the range of 20° to 230°F.

5. Light the test flame and adjust it by the valve screw on the burner block, so the flame has a 5/32-inch diameter-the same size as the bead provided for comparison.

CAUTION

Propane is used to keep the test flame lit during testing. Always ensure that the propane bottle is secured and not subjected to extreme temperatures.

6. Plug in the unit to a 115-volt power supply. Adjust the supply of heat by adjusting the dial on the powerstat until the temperature reading increases by not more than 11°F per minute or less than 9°F per minute.

7. Connect the stirrer to the stirrer motor via the flexible shaft.

8. Turn on the stirrer and apply the test flame when the temperature of the sample is 30° to 50°F below the expected flashpoint of the fuel, and thereafter in multiples of 2°F. For example, if the expected flashpoint is 140°F (JP-5), the test flame should be applied starting at 90°F, then 92°, 94°, and so forth. You apply the test flame by operating the knurled hand knob that controls the shutter and test the flame burner. The flame is lowered in one-half second, left in the lowered position for 1 second, and quickly raised to its high position. Discontinue stirring during the application of the test flame.

9. The flashpoint is the temperature read on the thermometer at the time of the flash. The true flash must not be confused with the bluish halo that sometimes surrounds the test flame for the applications preceding the one that causes the actual flash.

10. Allow the unit to cool. Remove the cover apparatus and pour the residue sample into a suitable waste container and clean out the cup.

CAUTION

Ensure the oven is turned off and that the propane supply is properly secured upon completion of testing.

NAVIFLASH Method

The NAVIFLASH method, like the Pensky-Martens method, heats the fuel sample in a closed cup at a specified rate.

The difference with the NAVIFLASH flashpoint tester (fig. 1-12) is that it uses an electric spark to ignite combustible vapors, has a pressure transducer which senses pressure build-up, signifying flashpoint.

The NAVIFLASH performs the flashpoint test essentially "hands-off". The operator need only to fill the sample cup and press a few buttons and the machine does the rest. The NAVIFLASH is a very sensitive piece of equipment and does require calibration.

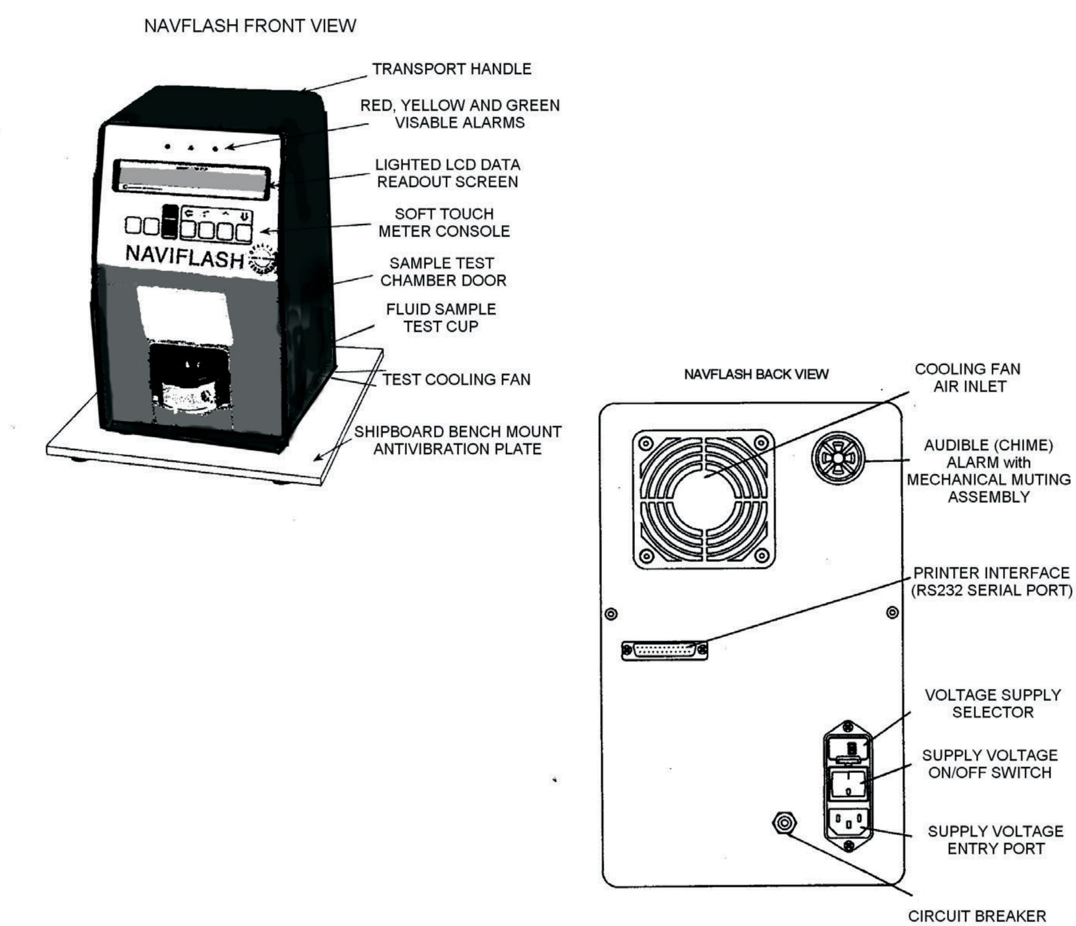


Figure 1-12.—NAVIFLASH flashpoint tester.

The following procedure summarizes the operation of the NAVIFLASH method:

1. Power-up the unit by depressing the rear-mounted rocker ON/OFF switch.

2. Select the Shipboard Program Number 1 or 4, for Fuel, Acceptance Test or Calibration Programs, respectively. Press TASK key to select.

NOTE

Both calibration and fuel acceptance operations are identical, except N-dodecane fluid, vice fuel, is used for calibration.

3. The LCD screen will display FUEL ACCEPTANCE-FLASH/NO FLASH, OVEN HEATING WAIT. During this period, the oven is heated to its programmed starting fuel temperature.

4. Shake the sample bottle and using a pipette, transfer 1.0 ml of fuel to the sample cup. A scribed line in the interior of the sample cup should indicate this.

5. Once LCD screen displays FILL & INSERT CUP IN CHAMBER, insert the cup into the test chamber, close external door and press RUN key. MEASUREMENT IN PROGRESS will then be displayed on screen.

6. Upon completion of test, flashpoint temperature, in degrees F will be displayed on LCD screen, accompanied by GREEN/RED lights.

7. If the measure flashpoint is greater than or equal to 140ºF, the GREEN light will flash and the screen will display the ACCEPT FUEL message. If less than 140ºF, a RED light will flash, accompanied with an audible alarm, and the REJECT FUEL message will be displayed. Press STOP to silence the alarm and acknowledge message.

NOTE

Flashpoint measurement shall be performed in duplicate using separate samples. Agreement should be within ±5ºF.

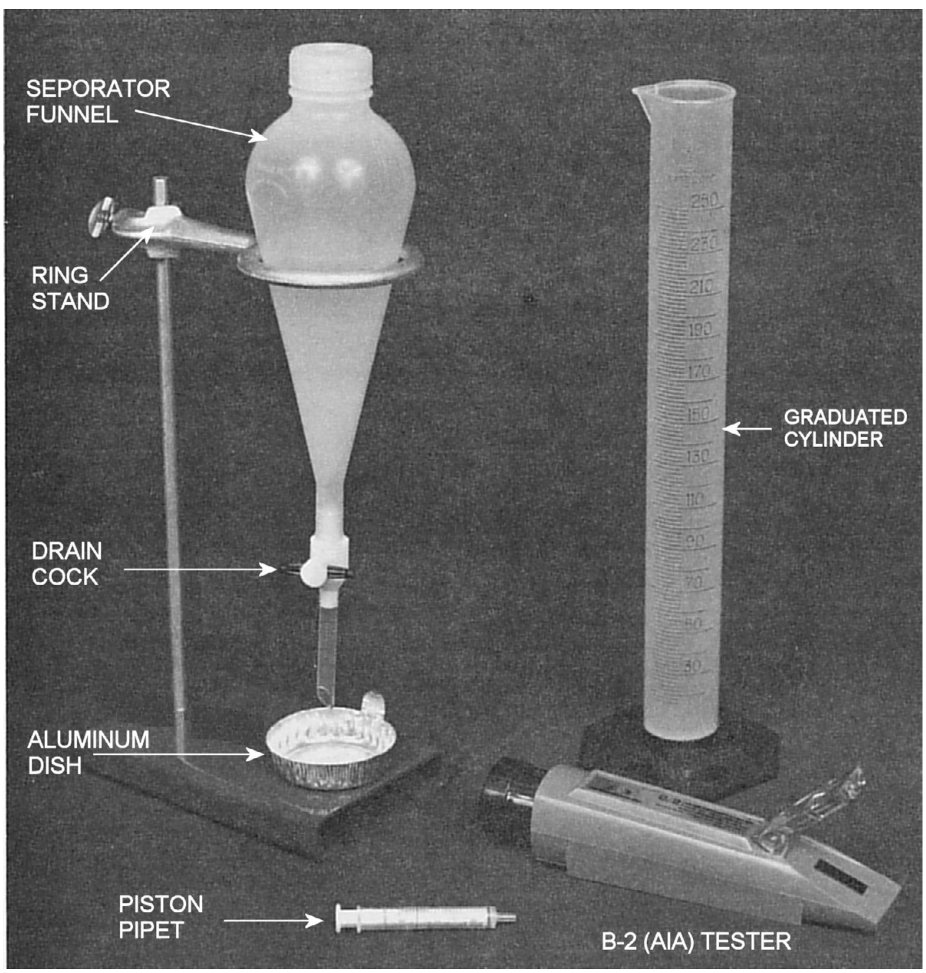


Figure 1-13.—AIA test equipment kit.

8. Once STOP is pressed, the oven is cooled down to the starting temperature automatically. Empty the sample cup and thoroughly wipe cup reservoir.

B/2 ANTI-ICING ADDITIVE (AIA) TEST KIT

The B/2 AIA test kit (fig. 1-13) is used to determine the amount of fuel system icing inhibitor (FSII) in jet fuels. The kit consists of a refractometer, apparati, graduated cylinder, and separatory funnel. Although the refractometer is small and made of plastic, it is neither cheap nor more durable than other equipment in the quality surveillance laboratory. Be careful when it is in use or in storage.

Operation of the Refractometer

The name refractometer tells you how it works. By the prism on the front (fig. 1-14), light is refracted through the sample being tested onto the scale inside the refractometer. The refractometer is to be used in the quality surveillance lab, not on the flight deck or on the sponson. The light source can be a fluorescent or incandescent bulb, but the area must be well lighted. Detailed instructions are provided with the test kit, the following procedures summarize the operation of the kit.

1. Set up the apparati assembly as shown in (fig. 1-13).

2. Use prescribed sampling procedures and take a 1-quart sample of the fuel to be tested in a clean sample bottle.

3. Fill half of the aluminum dish with tap water.

4. Fill the graduated cylinder (fig. 1-13) and the separatory funnel about one-third full with the fuel to be tested. Rinse the cylinder and funnel thoroughly to clear them of any foreign material and empty the contents.

5. Now fill the graduated cylinder with exactly 160-ml of the fuel sample.

6. Check to see if the drain cock on the separatory funnel is closed. If not, close it and pour the 160-ml from the graduated cylinder into the separatory funnel.

7. Using a piston pipet, add exactly 2 ml of water from the aluminum dish to the separatory funnel. Place the cap on the funnel and shake it vigorously for 3 minutes. Place the funnel in the ring stand. By vigorously shaking the sample in the graduated cylinder, you have allowed the icing inhibitor to leach into the water.

8. Open the hinged prism cover of the refractometer's window (fig. 1-14); make sure the window and prism are clean. Place several drops of tap water on it from the aluminum dish using a piston pipet, close the cover and look through the eyepiece. Observe

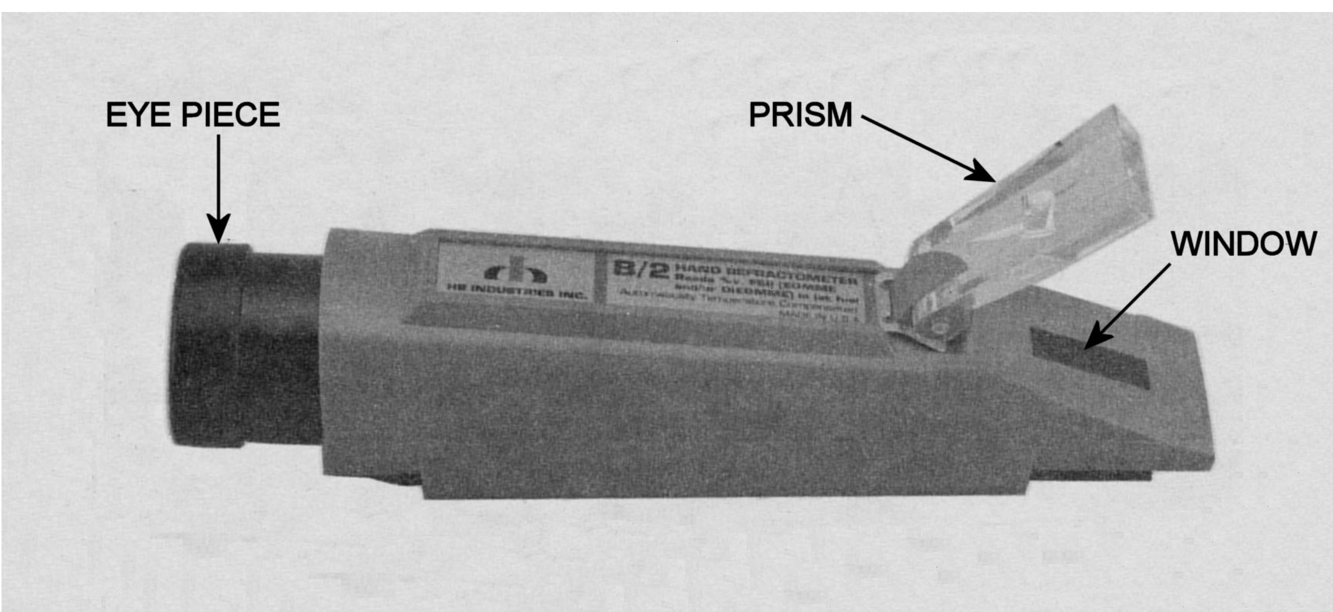


Figure 1-14.—Refractometer.

the shadow line. You should read zero across both graphs.

9. If a reading of zero cannot be obtained, remove the black plastic rod from the back of the refractometer and adjust the set-screw (on the bottom of the refractometer) until the shadow line meets the zero line of the scale. See figures 1-15 and 1-16. By adjusting the setscrew (fig. 1-15) until you read zero, you have made the refractometer ready to compare the FSII in the fuel to the scale inside the refractometer (fig. 1-16), and you have also calibrated the refractometer. NEVER use a metal screwdriver to calibrate the refractometer. The screwdriver may pass a static electrical charge onto the refractometer.

CAUTION

The refractometer unit is made entirely of plastic. The use of any metal objects to calibrate it will damage the equipment.

10. Open the plastic cover and wipe off the water from the window and cover.

11. Carefully turn the drain cock on the separatory funnel so several drops of water can trickle into a clean, dry aluminum dish.

12. Open the hinged prism cover and place two or three drops of liquid (from the funnel) on the window using a clean (one that has not been used) piston pipet. Close the cover. Look through the eyepiece and read the point where the shadow line is on the scale. This gives you the percentage of FSII by volume. Make a log entry of your finding. Your readings should read two digits to the right of the decimal point: for example, .08, .04, .06, etc. See (fig. 1-16).

NOTE

The refractometer contains two FSII scales; one for each of the two different FSII materials currently in use. All JP-5 fuel tested shall be assumed to contain the high flashpoint type of FSII material, *Diethylene Glycol Monomethyl Either*, or *DiEGME*, which is read from the scale on the left side of the refractometer marked *"JP-5" or "M"*.

13. Empty the funnel and properly dispose of the fuel. Clean the equipment with soap and water, and ensure the equipment is thoroughly clean by rinsing with water.

The minimum level for USN and USMC aircraft that require FSII to prevent water-ice formation is 0.03 percent. Currently these aircraft are the S-3, US-3, ES-3B, and SH-60. All other USN and USMC aircraft do not require FSII and may use JP-5 or other approved fuel even if it does not contain FSII.

If the FSII level falls below the 0.03 percent limit, the appropriate Navy or Marine Corps squadron commanding officer of a squadron containing the above aircraft, or his/her designated representative, shall be notified.

WARNING

Failure to notify appropriate squadron personnel of low FSII conditions can result in safety-of-flight problems.

Transient (USAF, USA, and visiting foreign military aircraft) crewmembers and pilots will be notified of FSII levels of 0.07 percent or less.

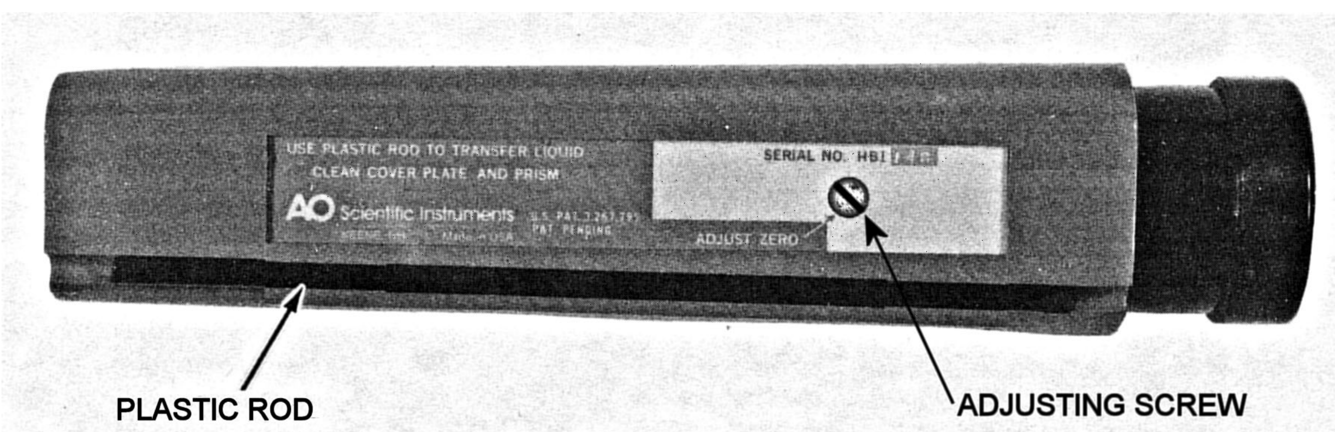


Figure 1-15.—Refractometer (bottom view).

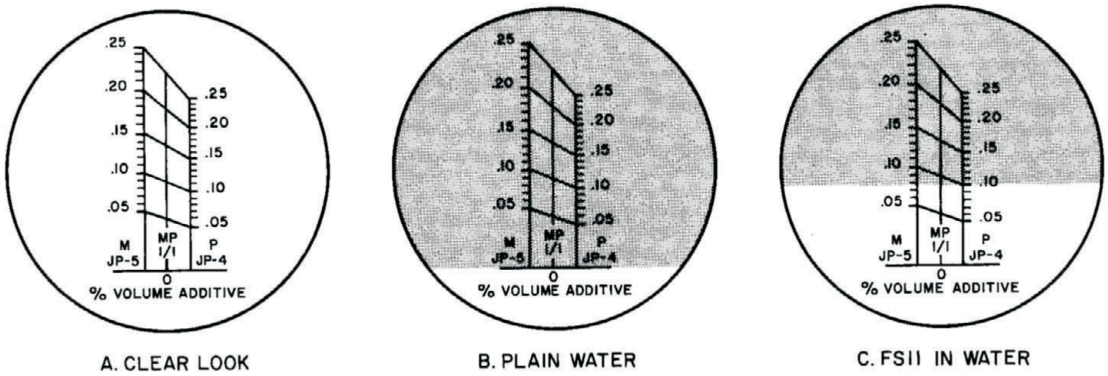


Figure 1-16.—Views through a refractometer.

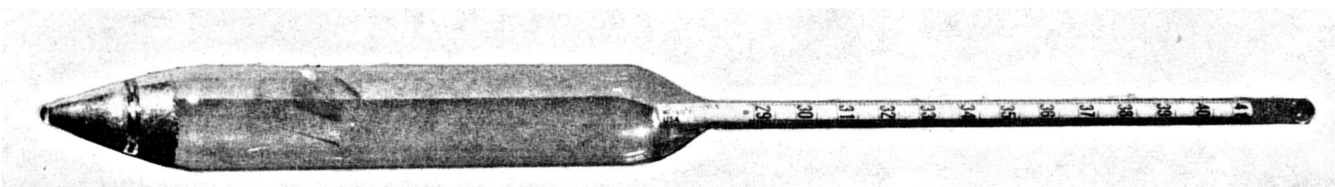


Figure 1-17.—Hydrometer.

API/SPECIFIC GRAVITY TEST

The specific weight of JP-5 is important to know for the proper operation of the centrifugal purifier. The specific gravity test is used to determine the correct purifier discharge ring size. A hydrometer (fig. 1-17) or thermohydrometer is used to determine the specific gravity of the fuel. Both are used practically in the same manner. Only exception, when using the hydrometer, you will need to used a suitable thermometer to take the temperature of the fuel in the glass cylinder.

The thermohydrometer (fig. 1-18) contains a thermometer in the stem of the hydrometer. The hydrometer floats in the liquid sample to determine the weight of a liquid. The unit is made of glass and breaks easily. Use extreme care in handling during testing and storage.

For standardization, all of your readings will be converted to 60°F. The American Petroleum Institute (API) has developed a conversion scale from one temperature to another. The steps to perform a specific gravity test are summarized as follows:

1. Using standard sampling procedures, draw a sample. Slowly pour enough fuel into a tall graduated glass cylinder (about 2/3 full) to minimize the formation of air bubbles.

NOTE

The temperature of the glass cylinder, thermohydrometer, and sample should be approximately the same. Temperature changes in the testing area should be no greater than 5 degrees and the area should be free of any drafts.

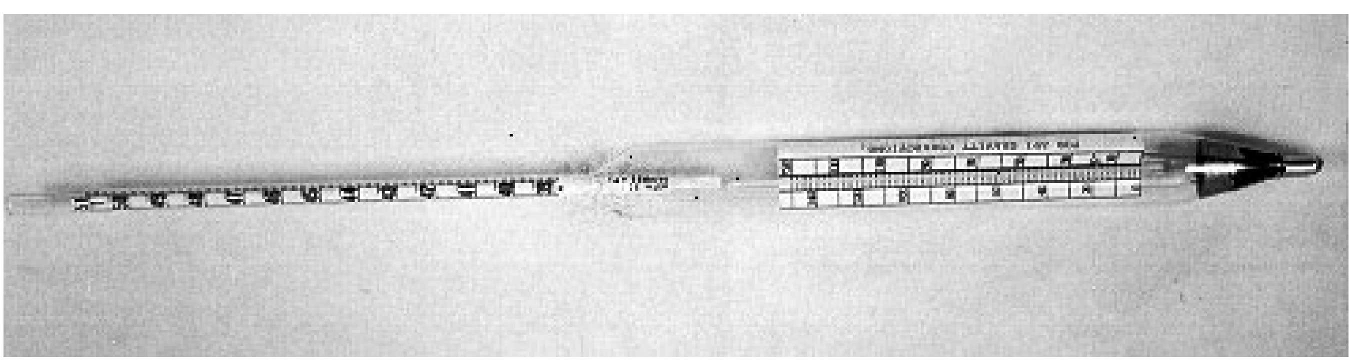


Figure 1-18.—Thermohydrometer.

2. Lower the thermohydrometer gently into the sample, and spin, making sure it does not touch the sides of the cylinder.

3. When the thermohydrometer comes to rest, record the temperature and read the point at which the surface of the liquid meets the hydrometer scale on the unit. This is known as the menicus. Record the hydrometer reading to the nearest mark on the scale.

4. After reading the thermohydrometer scale, read the temperature once more and record.

NOTE

The mean of the two temperature readings is the standard temperature for the test. If the temperature readings differ by more than 1 degree, the test must be redone when the temperature is more stable.

5. Convert the degrees and thermohydrometer reading to specific gravity using *tables 541-10-4* located in *NAVSEA S9086-SN-STM-010/CH-541*. Figure 1-19, is a sample of the specific gravity table. Find the *observed temperature* and the *observed gravity* to find the corresponding gravity at 60 degree F. number. Take that number and utilize the *API Gravity to Specific Gravity table* in figure 1-20 to find the specific gravity of the fuel tested. Log your findings.

6. The results from the *API Gravity to Specific Gravity table* is used to match a graph in the *JP-5 Jet Fuel Centrifugal Purifier* technical manual to determine the proper size of discharge ring used. Refer to *NAVSEA* technical manual *S9542-AB-MM0-010*, pages 4-4 to 4-5 to *NAVSEA* technical manuals *S9542-AB-MM0-010(200GPM)* and *S9542-AE-MM0-010(300GPM),* on instructions and graph for the various sizes of discharge rings.

7. Empty the glass cylinder and properly dispose of the fuel. Carefully clean the thermohydrometer and ensure the test equipment is properly stowed in a suitable storage area.

QUALITY SURVEILLANCE LOGBOOKS

In a day's operation of the fuel lab on some ships and shore stations, it is common to handle over one hundred samples a day. To be able to keep track of the sample results and to maintain good records, a logbook is required for all samples.

Make your log entries in ink and use only one side of each page. This is an *official document*. The *Quality Surveillance logs* are the most important logbooks an ABF has to deal with daily, so write or print the log entries clearly. It is useless to log the results if only one person can interpret the handwriting.

The results in the logbook indicate whether or not everything is operating correctly or if a problem exists. When a problem does exist, notify your supervisors at once. Do not wait, as corrective action must be taken immediately. Remember that someone's life is in that multi-million dollar aircraft.

The Quality Surveillance logbook should be in the format illustrated in (fig 1-21). Keep the logbook neat, clean, and dry. Good housekeeping pays off. A log that is poorly kept, dirty, or has ripped or missing pages is a direct reflection upon the way the Quality Surveillance lab is being operated.

Q1-13. Two millipore filters are used for what specified reason?

Q1-14. What type of light source is used in the free water detector?

Q1-15. On the Pensky-Martens tester, after turning off the stirrer, you want to apply the test flame to find out the flashpoint of the fuel. What controls the shutter and the flame burner?

Q1-16. The major difference between the NAVIFLASH and Pensky-Martens testers is the method used to ignite combustible vapors signifying flashpoint. The Pensky-Martens uses a flame, what is used in the NAVIFLASH method?

Q1-17. The NAVIFLASH method, performs the flashpoint test essentially "hands-off". It is a very sensitive piece of equipment and does require calibration. What is used to calibrate the NAVIFLASH tester?

Q1-18. What is the minimum level of FSII required for the SH-60?

Q1-19. At what percentage of FSII in fuel do you notify pilots of transient and visiting foreign military aircraft?

Q1-20. The specific gravity test is used to determine what property of aviation fuel?

Q1-21. How much fuel would you need to perform a specific gravity test?

Observed Temperature		API Gravity at Observed Temperature																			
		30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
°C	°F	Corresponding API Gravity at 60°F (15.6°C)																			
15.6	60	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0
16.1	61	29.9	30.9	31.9	32.9	33.9	34.9	35.9	36.9	37.9	38.9	39.9	40.9	41.9	42.9	43.9	44.9	45.9	46.9	47.9	48.9
16.7	62	29.9	30.9	31.9	32.9	33.9	34.8	35.8	36.8	37.8	38.8	39.8	40.8	41.8	42.8	43.8	44.8	45.8	46.8	47.8	48.8
17.2	63	29.8	30.8	31.8	32.8	33.8	34.8	35.8	36.8	37.8	38.8	39.8	40.8	41.7	42.7	43.7	44.7	45.7	46.7	47.7	48.7
17.8	64	29.7	30.7	31.7	32.7	33.7	34.7	35.7	36.7	37.7	38.7	39.7	40.7	41.7	42.7	43.7	44.6	45.6	46.6	47.6	48.6
18.3	65	29.7	30.6	31.6	32.6	33.6	34.6	35.6	36.6	37.6	38.6	39.6	40.6	41.6	42.6	43.6	44.6	45.5	46.5	47.5	48.5
18.9	66	29.6	30.6	31.6	32.6	33.6	34.6	35.5	36.5	37.5	38.5	39.5	40.5	41.5	42.5	43.5	44.5	45.5	46.5	47.4	48.4
19.4	67	29.5	30.5	31.5	32.5	33.5	34.5	35.5	36.5	37.5	38.4	39.4	40.4	41.4	42.4	43.4	44.4	45.4	46.4	47.4	48.3
20.0	68	29.4	30.4	31.4	32.4	33.4	34.4	35.4	36.4	37.4	38.4	39.4	40.3	41.3	42.3	43.3	44.3	45.3	46.3	47.3	48.2
20.6	69	29.4	30.4	31.4	32.3	33.3	34.3	35.3	36.3	37.3	38.3	39.3	40.3	41.2	42.2	43.2	44.2	45.2	46.2	47.2	48.1
21.1	70	29.3	30.3	31.3	32.3	33.3	34.3	35.2	36.2	37.2	38.2	39.2	40.2	41.2	42.2	43.1	44.1	45.1	46.1	47.1	48.1
21.7	71	29.2	30.2	31.2	32.2	33.2	34.2	35.2	36.2	37.1	38.1	39.1	40.1	41.1	42.1	43.1	44.0	45.0	46.0	47.0	48.0
22.2	72	29.2	30.2	31.1	32.1	33.1	34.1	35.1	36.1	37.1	38.1	39.0	40.0	41.0	42.0	43.0	43.9	44.9	45.9	46.9	47.9
22.8	73	29.1	30.1	31.1	32.1	33.0	34.0	35.0	36.0	37.0	38.0	39.0	39.9	40.9	41.9	42.9	43.9	44.8	45.8	46.8	47.8
23.3	74	29.0	30.0	31.0	32.0	33.0	34.0	34.9	35.9	36.9	37.9	38.9	39.9	40.8	41.8	42.8	43.8	44.8	45.7	46.7	47.7
23.9	75	29.0	29.9	30.9	31.9	32.9	33.9	34.9	35.9	36.8	37.8	38.8	39.8	40.8	41.7	42.7	43.7	44.7	45.6	46.6	47.6
24.4	76	28.9	29.9	30.9	31.8	32.8	33.8	34.8	35.8	36.8	37.7	38.7	39.7	40.7	41.6	42.6	43.6	44.6	45.6	46.5	47.5
25.0	77	28.8	29.8	30.8	31.8	32.8	33.7	34.7	35.7	36.7	37.7	38.6	39.6	40.6	41.6	42.5	43.5	44.5	45.5	46.4	47.4
25.6	78	28.8	29.7	30.7	31.7	32.7	33.7	34.6	35.6	36.6	37.6	38.6	39.5	40.5	41.5	42.5	43.4	44.4	45.4	46.3	47.3
26.1	79	28.7	29.7	30.6	31.6	32.6	33.6	34.6	35.6	36.5	37.5	38.5	39.5	40.4	41.4	42.4	43.3	44.3	45.3	46.3	47.2
26.7	80	28.6	29.6	30.6	31.6	32.5	33.5	34.5	35.5	36.5	37.4	38.4	39.4	40.3	41.3	42.3	43.3	44.2	45.2	46.2	47.1
27.2	81	28.6	29.5	30.5	31.5	32.5	33.4	34.4	35.4	36.4	37.4	38.3	39.3	40.3	41.2	42.2	43.2	44.1	45.1	46.1	47.0
27.8	82	28.5	29.5	30.4	31.4	32.4	33.4	34.3	35.3	36.3	37.3	38.2	39.2	40.2	41.2	42.1	43.1	44.1	45.0	46.0	47.0
28.3	83	28.4	29.4	30.4	31.3	32.3	33.3	34.3	35.2	36.2	37.2	38.2	39.1	40.1	41.1	42.0	43.0	44.0	44.9	45.9	46.9
28.9	84	28.3	29.3	30.3	31.3	32.2	33.2	34.2	35.2	36.1	37.1	38.1	39.1	40.0	41.0	42.0	42.9	43.9	44.8	45.8	46.8
29.4	85	28.3	29.3	30.2	31.2	32.2	33.1	34.1	35.1	36.1	37.0	38.0	39.0	39.9	40.9	41.9	42.8	43.8	44.8	45.7	46.7
30.0	86	28.2	29.2	30.2	31.1	32.1	33.1	34.1	35.0	36.0	37.0	37.9	38.9	39.9	40.8	41.8	42.7	43.7	44.7	45.6	46.6
30.6	87	28.1	29.1	30.1	31.1	32.0	33.0	34.0	34.9	35.9	36.9	37.9	38.8	39.8	40.7	41.7	42.7	43.6	44.6	45.5	46.5
31.1	88	28.1	29.0	30.0	31.0	32.0	32.9	33.9	34.9	35.8	36.8	37.8	38.7	39.7	40.7	41.6	42.6	43.5	44.5	45.5	46.4
31.7	89	28.0	29.0	29.9	30.9	31.9	32.9	33.8	34.8	35.8	36.7	37.7	38.7	39.6	40.6	41.5	42.5	43.4	44.4	45.4	46.3

Figure 1-19.—Sample chart of API Gravity at Observed Temperature.

API Gravity at 60°F (15.6°C)	Specific Gravity at 60°/60°F (15.6°/15.6°C)	Pounds per Gallon at 60°F (15.6°C)	Gallons per Pound at 60°F (15.6°C)
40.0	0.8251	6.870	0.1456
40.1	0.8246	6.866	0.1456
40.2	0.8241	6.862	0.1457
40.3	0.8236	6.858	0.1458
40.4	0.8232	6.854	0.1459
40.5	0.8227	6.850	0.1460
40.6	0.8222	6.846	0.1461
40.7	0.8217	6.842	0.1462
40.8	0.8212	6.838	0.1462
40.9	0.8208	6.834	0.1463
41.0	0.8203	6.830	0.1464
41.1	0.8198	6.826	0.1465
41.2	0.8193	6.822	0.1466
41.3	0.8189	6.818	0.1467
41.4	0.8184	6.814	0.1468
41.5	0.8179	6.810	0.1468
41.6	0.8174	6.806	0.1469
41.7	0.8170	6.802	0.1470
41.8	0.8165	6.798	0.1471
41.9	0.8160	6.794	0.1472
42.0	0.8155	6.790	0.1473
42.1	0.8151	6.786	0.1474
42.2	0.8146	6.783	0.1474
42.3	0.8142	6.779	0.1475
42.4	0.8137	6.775	0.1476
42.5	0.8132	6.771	0.1477
42.6	0.8128	6.767	0.1478
42.7	0.8123	6.763	0.1479
42.8	0.8118	6.759	0.1480
42.9	0.8114	6.755	0.1480
43.0	0.8109	6.751	0.1481
43.1	0.8104	6.748	0.1482
43.2	0.8100	6.744	0.1483
43.3	0.8095	6.740	0.1484
43.4	0.8090	6.736	0.1485
43.5	0.8086	6.732	0.1485
43.6	0.8081	6.728	0.1486
43.7	0.8076	6.724	0.1487
43.8	0.8072	6.721	0.1488
43.9	0.8067	6.717	0.1489
44.0	0.8063	6.713	0.1490
44.1	0.8058	6.709	0.1491
44.2	0.8054	6.705	0.1491
44.3	0.8049	6.701	0.1492
44.4	0.8044	6.698	0.1493

Figure 1-20.—Sample chart of API Gravity to Specific Gravity.

DATE	TIME TAKEN	LAB ARRIVAL TIME	LOCATION SAMPLE	APPEAR	TIME WATER RUN	PPM	TIME SED RUN	1ST	2ND	DIFF	FINAL READING	OPERAT	TIME REPORTED LOCATION	POINT	FSII	API	SPEC	QA MAN OPERAT

SUPERVISOR ______________ DIVISION CHIEF ______________ DIVISION OFFICER ______________

Figure 1-21.—Quality surveillance log format.

SUMMARY

The performance of any engine, especially an aircraft engine, depends on the quality of the fuel used in it. As an ABF, the quality of fuel depends on your constant vigilance in the inspection of fuel samples and operation of purification and filtering equipment. The information covered in this chapter will prepare you to understand the complex and extremely important role as a quality surveillance sentry. YOUR MAJOR OBJECTIVE IS TO DELIVER CLEAN AND BRIGHT, READY FOR FLIGHT, AVIATION FUEL TO AIRCRAFT.

CHAPTER 2

JP-5 AFLOAT BELOW DECK SYSTEMS AND OPERATION

INTRODUCTION

The first time you see the pump room of a CV/CVN, it is easy to be intimidated. With its complex array of piping, pumps, valves, gages, and motors, you may feel there is just too much to learn. But the qualified pumproom operators make it look easy.

In this chapter, we will try to ease you through this complex system by breaking it down. First we will discuss the subsystems; then we will cover the many components that make up these systems; and finally we will explain operational procedures.

To operate any JP-5 fueling system safely and efficiently, the ABF must have a thorough knowledge of the arrangement and limitations of the piping systems. Although the piping arrangements are similar for all CV/CVNs, no two ships (not even sister ships) are exactly alike. Therefore, you should consult your ship's blueprints, Ship's Information Book (SIB) and Aviation Fuels Operating Sequence System (AFOSS) for details on its particular system. The information and diagrams in this chapter are based on CV/CVN class carriers.

JP-5 FUELING SYSTEM

LEARNING OBJECTIVE: Describe the JP-5 below decks fuel system afloat. Identify the subsystems that make up a JP-5 fueling system.

A JP-5 fueling system consists primarily of a storage system and three separate and independent pumping systems. The pumping systems are Filling and Transfer, Stripping, and Service. The tanks in a JP-5 system are designated under two major categories, storage and service. Storage tanks are used for bulk storage of JP-5. Service tanks containing purified fuel are used for servicing aircraft. The storage capacity of different classes of ships depends on the number and size of the ship's tanks. Approximate storage capacities for some of the different classes of ships are listed in table 2-1.

Due to the difference in the types of valves, pumps, filters, and other equipment installed on various ships, this section will use general descriptions. While your ship may have a gate valve in a specific location, another ship may use a butterfly or

Table 2-1.—JP-5 Storage Capacities

CLASS SHIP	APPROXIMATE CAPACITY
LHA-1 (TARAWA)	1/4 million gallons
LPD-4 (AUSTIN)	1/4 million gallons
LHD-1 (WASP)	3/4 million gallons
CV-63 (KITTY HAWK)	1 3/4 million gallons
CVN-65 (ENTERPRISE)	2 1/4 million gallons
CV-67 (JOHN F. KENNEDY)	2 1/2 million gallons
CVN-75 (HARRY S. TRUMAN)	3 1/2 million gallo

limitorque valve in the same location. Therefore, we will use the terms cutout valve, discharge valve, filter, etc. Specific components will be discussed in the next section. The legend in figure 2-1, will help you identify some of the symbols in the figures that are in this section.

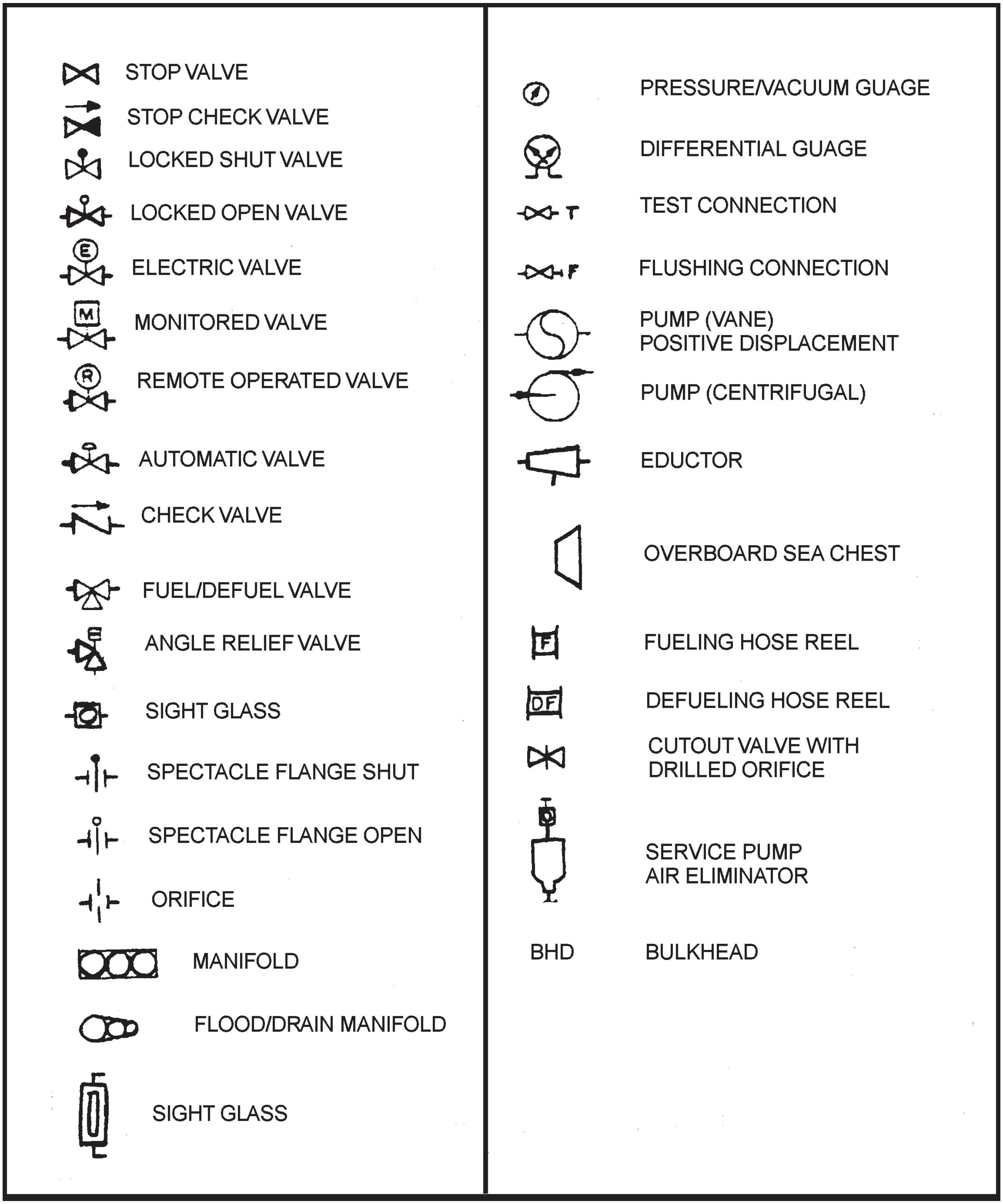


Figure 2-1.—Common symbols in JP-5 fuel system diagrams and schematics.

FILL AND TRANSFER SYSTEM

The fill and transfer system (fig. 2-2 through 2-5), and its interconnecting piping and valves, serve a variety of functions in the operation of the JP-5 fueling system. It is used for receiving JP-5 aboard during underway replenishment; transferring JP-5 from storage to service tanks; transferring JP-5 internally forward to aft or port to starboard (or vice versa); and filling the amid ship emergency tanks (on ships so equipped) when JP-5 is required for boiler fuel. It is also used to receive and direct JP-5 from the independent de-fuel main to a pre-selected storage tank and to consolidate JP-5 utilizing the stripping pump discharge header and direct it to any storage tank. The fill and transfer system is also utilized during the off-loading of JP-5 through cross-connection piping using the service pumps.

Fill System

The fill system includes all piping, valves, and related equipment from the fill connections on the main deck to the fill and suction tailpipe in the storage tanks.

The main-deck fill connections provide a means of attaching the refueling hose to the ship and controlling the quality and quantity of JP-5 being received. Fuel sponsons are located on the starboard side of the main deck, outboard of the hangar deck, or in elevator ramp recesses. The number of filling connections varies, depending on the type and class ship. Aircraft carriers have additional filling connections on the port side to enable refueling from a barge when moored to a pier. See figure 2-6.

A fuel probe rig (fig. 2-7 View A) is used on the starboard side fill connections for underway replenishments. The rig consists of a fueling probe and a probe receiver. A swivel fitting supports the probe receiver. A wire-reinforced rubber hose connects the receiver to the filling connection.

Depending on what class of ship your own, the refueling sponsons may well be equipped with a double probe rig (fig. 2-7 View B). Each tube and probe assembly for the double probe is identical to and interchangeable with the single probe unit. The double probe and its carrier assembly consist of a trolley carriage and two tube and probe assemblies. The double fuel probe assemblies effectively cuts down on time spent alongside an oiler and expedites the refueling evolution during hazardous underway replenishments. The stress placed on the wire bridle that the trolley is suspended from is critical to the successful seating of double probes into double probe receivers. This problem, compounded with the sea states due to ships steaming in close proximity, the weight and high volume of fuel passing between ships, at times will unseat the fuel probes. A special inhaul-clamp is provided to allow the messenger/remating line to reseat/remate the probes with the probe receiver.

For more detailed information as to equipment, tools, and personnel required for refueling on your particular ship, consult your Ship's Organization and Regulation Manual and Replenishment at Sea Manual, NWP 4-01.4.

The portside fill connections utilize flanges to bolt the refueling hose from a barge to the receiving connection on the sponson. Fill connections begin with a 90-degree elbow and a stop valve. A flushing line is installed outboard of the fill connection stop valve on some carrier and amphibious aviation-type ships. It is used for hose flushing and to receive the initial flow of fuel during underway replenishment. The flushing line directs fuel flow to the reclamation system and into contaminated storage tanks through the de-fueling main. All fill connections should be equipped with the following:

1. A sample connection used to verify the quality of fuel received.

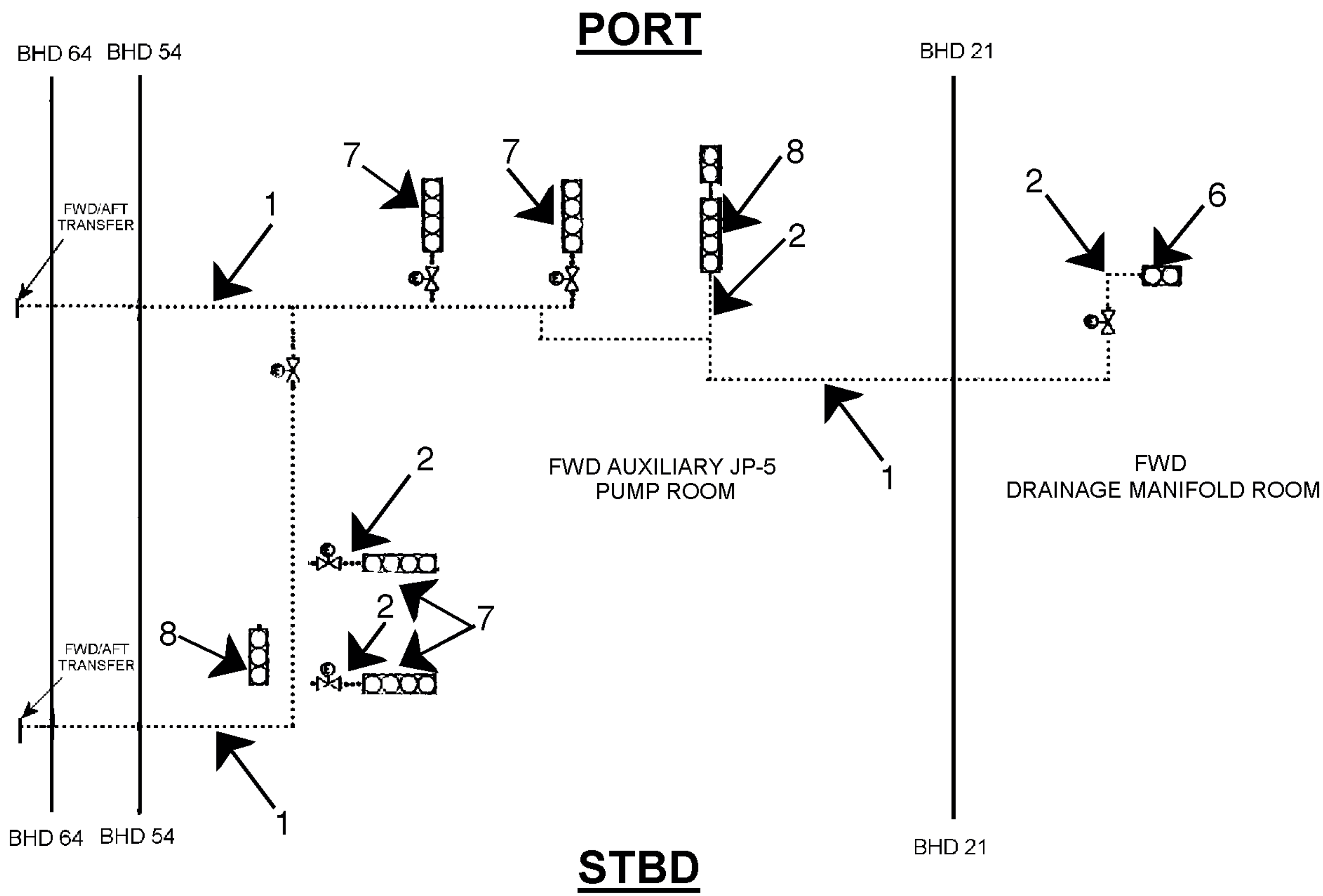
2. A pressure gage to determine the discharge pressure from the refueling source.

3. A low-pressure air connection for blowing JP-5 in the hose back to the refueling source.

The down-comer is that section of piping that connects the filling connection on the main deck sponson with the transfer main on the second and seventh decks.

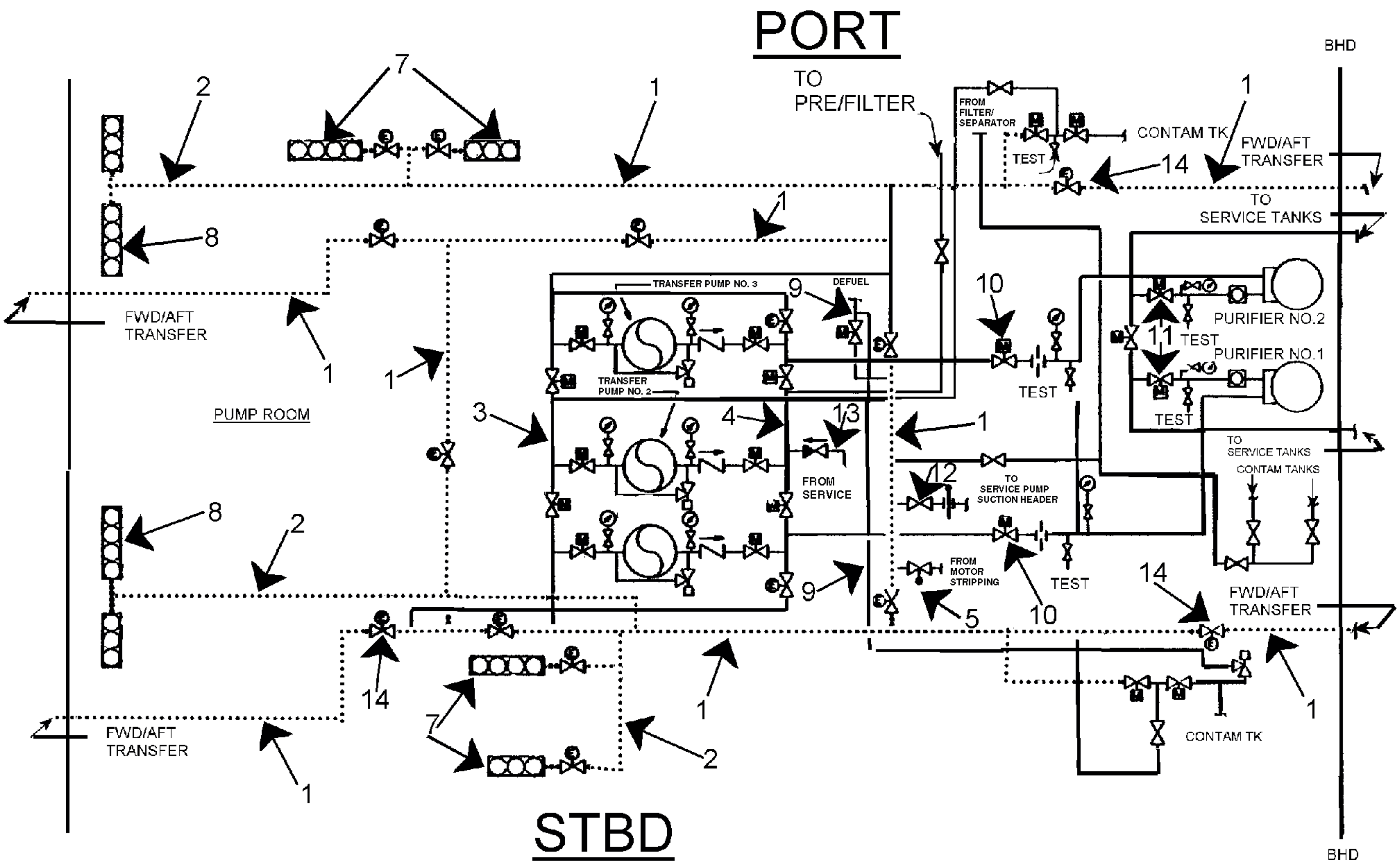
If you look at figures 2-2, 2-3, 2-4, 2-5, and 2-6, you will see how the sponsons and 2nd deck transfer main connect with the 7th deck fill and transfer main. The transfer main runs fore and aft through the bilge just below the seventh deck. CV/CVNs have a dual transfer main that runs forward and aft on both the port and starboard sides, creating a "closed loop" transfer main. The transfer main interconnects the forward and aft amid-ship group of storage tanks, and the amid-ship emergency tanks (on ships so equipped).

In addition to being connected to the downcomers, it is also connected to the independent de-fuel main and the discharge headers of the transfer and stripping



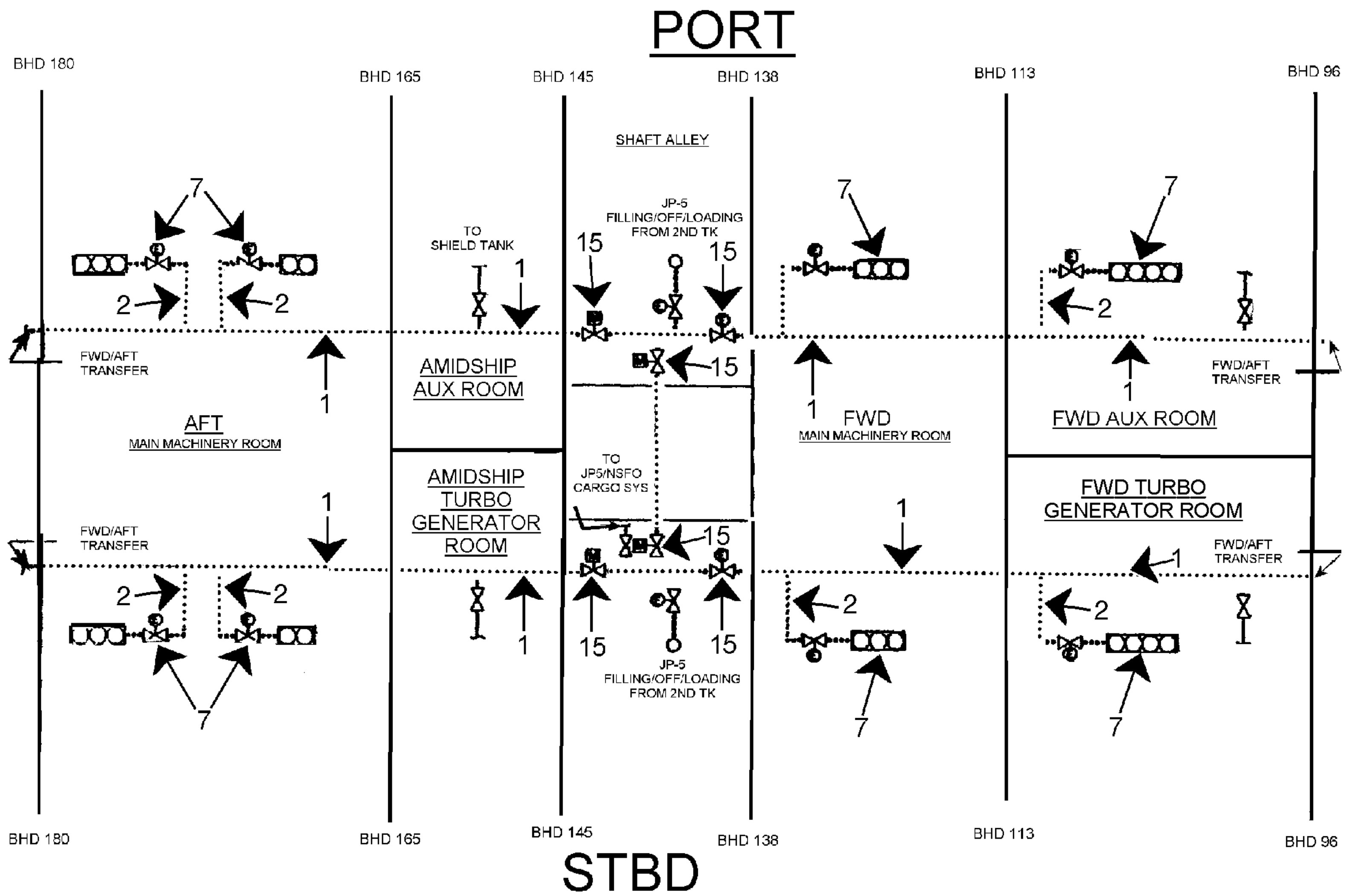
1. Transfer main
2. Transfer-main branch headers
3. Transfer-pump suction headers
4. Transfer pump discharge header
5. Stripping pump discharge to transfer main
6. Peak tanks manifold
7. Wing tanks valve manifold
8. Double bottom tanks valve manifold
9. Defuel main
10. Purifier inlet from transfer pumps
11. Purifier discharge to service tanks
12. Cross connection to service pump suction header
13. Cross connection from service pump discharge header
14. Bulkhead isolation valves
15. Amid ship transfer main isolation valves

Figure 2-2.—JP-5 Fill and Transfer system.



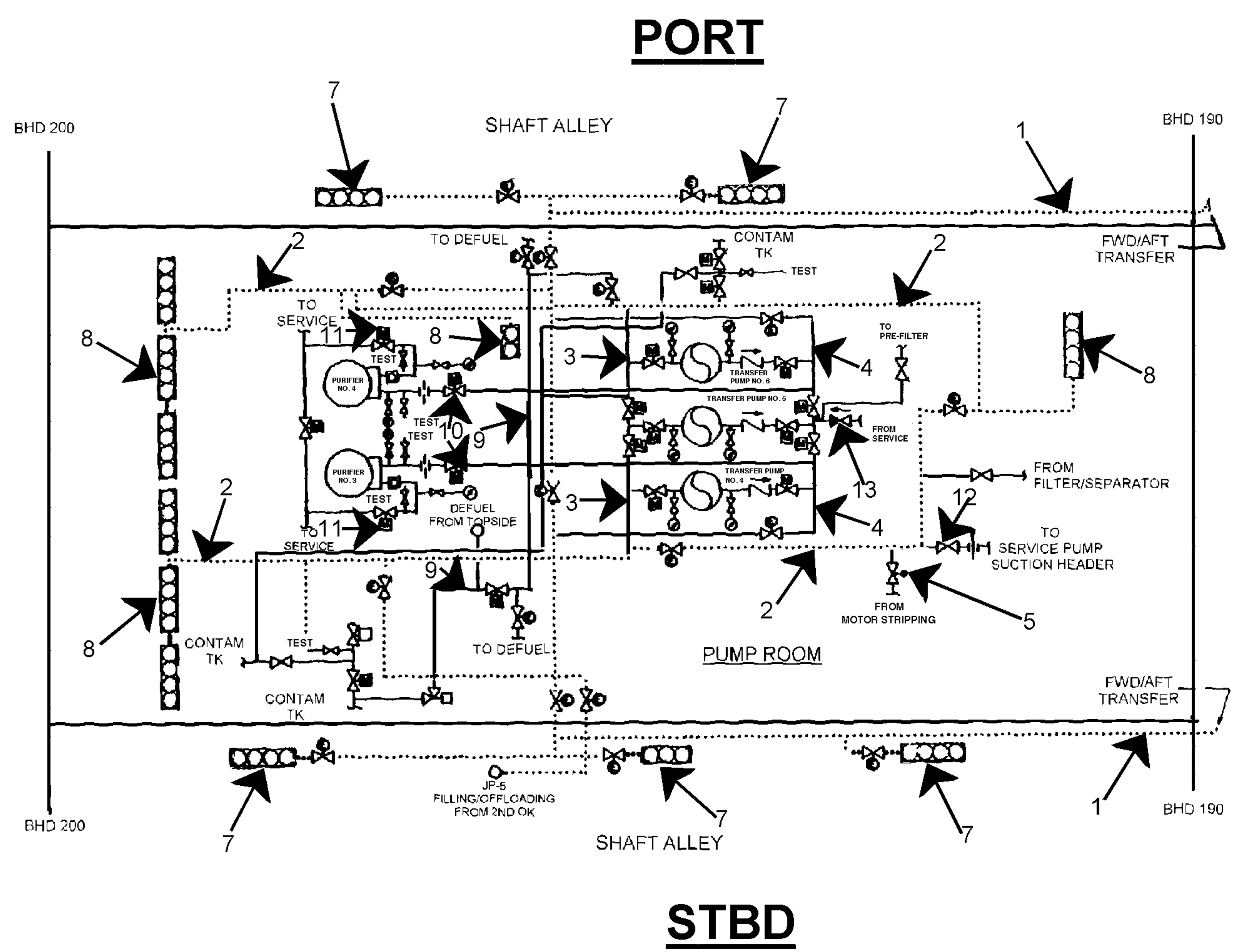
1. Transfer main
2. Transfer-main branch headers
3. Transfer-pump suction headers
4. Transfer pump discharge header
5. Stripping pump discharge to transfer main
6. Peak tanks manifold
7. Wing tanks valve manifold
8. Double bottom tanks valve manifold
9. Defuel main
10. Purifier inlet from transfer pumps
11. Purifier discharge to service tanks
12. Cross connection to service pump suction header
13. Cross connection from service pump discharge header
14. Bulkhead isolation valves
15. Amid ship transfer main isolation valves

Figure 2-3.—(cont'd) JP-5 Fill and Transfer system.



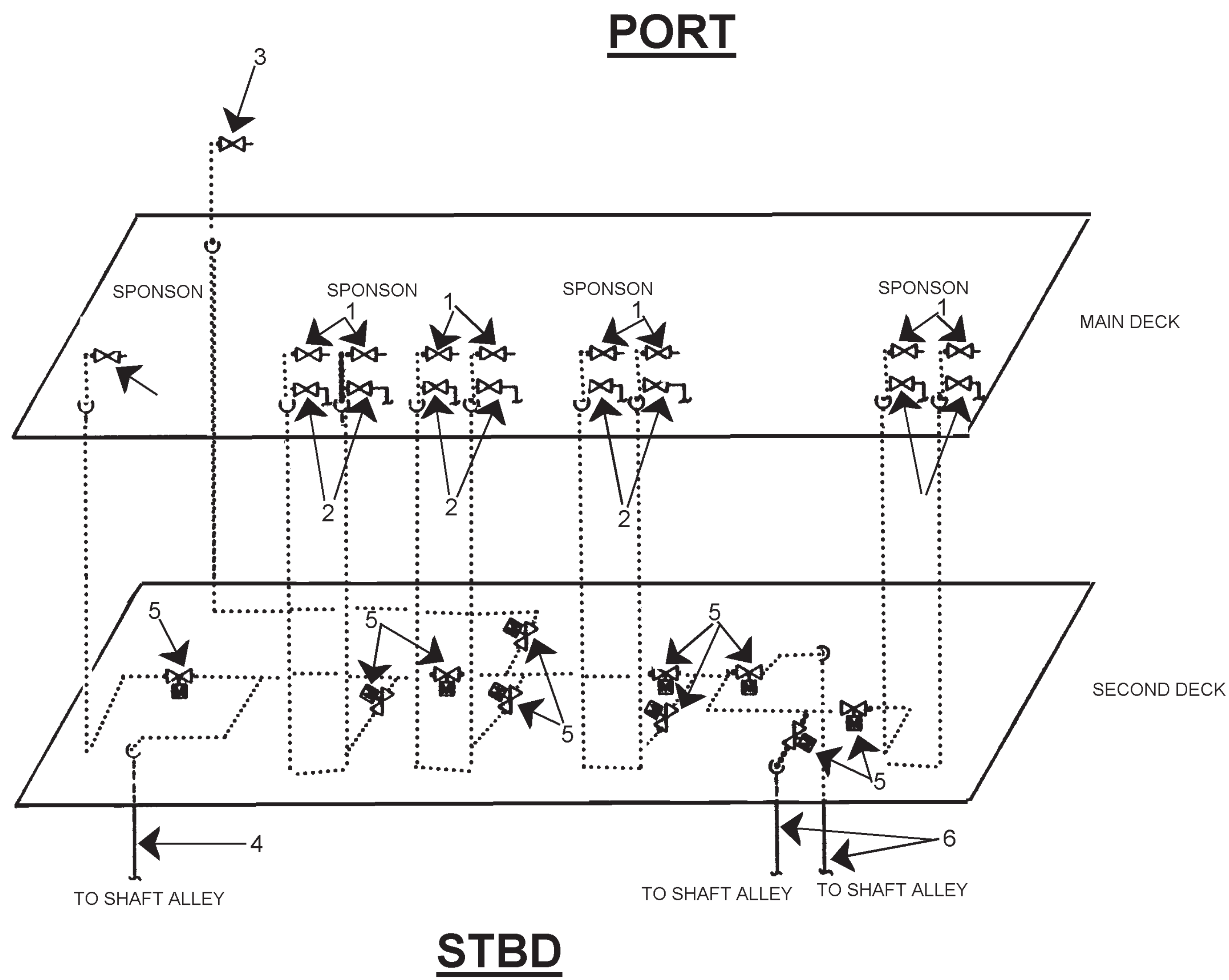
1. Transfer main
2. Transfer-main branch headers
3. Transfer-pump suction headers
4. Transfer pump discharge header
5. Stripping pump discharge to transfer main
6. Peak tanks manifold
7. Wing tanks valve manifold
8. Double bottom tanks valve manifold
9. Defuel main
10. Purifier inlet from transfer pumps
11. Purifier discharge to service tanks
12. Cross connection to service pump suction header
13. Cross connection from service pump discharge header
14. Bulkhead isolation valves
15. Amid ship transfer main isolation valves

Figure 2-4.—(cont'd) JP-5 Fill and Transfer system.



1. **Transfer main**
2. **Transfer-main branch headers**
3. **Transfer-pump suction headers**
4. **Transfer pump discharge header**
5. **Stripping pump discharge to transfer main**
6. **Peak tanks manifold**
7. **Wing tanks valve manifold**
8. **Double bottom tanks valve manifold**
9. **Defuel main**
10. **Purifier inlet from transfer pumps**
11. **Purifier discharge to service tanks**
12. **Cross connection to service pump suction header**
13. **Cross connection from service pump discharge header**
14. **Bulkhead isolation valves**
15. **Amid ship transfer main isolation valves**

Figure 2-5.—(cont'd) JP-5 Fill and Transfer system.



1. **Refueling hose connections**
2. **Flushing line cutout valves**
3. **Portside sponson connection**
4. **Downcomer to AFT pumproom**
5. **Second deck main isolation valves**
6. **Downcomer to port and starboard amid ship shaft alleys**

Figure 2-6.—JP-5 Sponson/Transfer system.

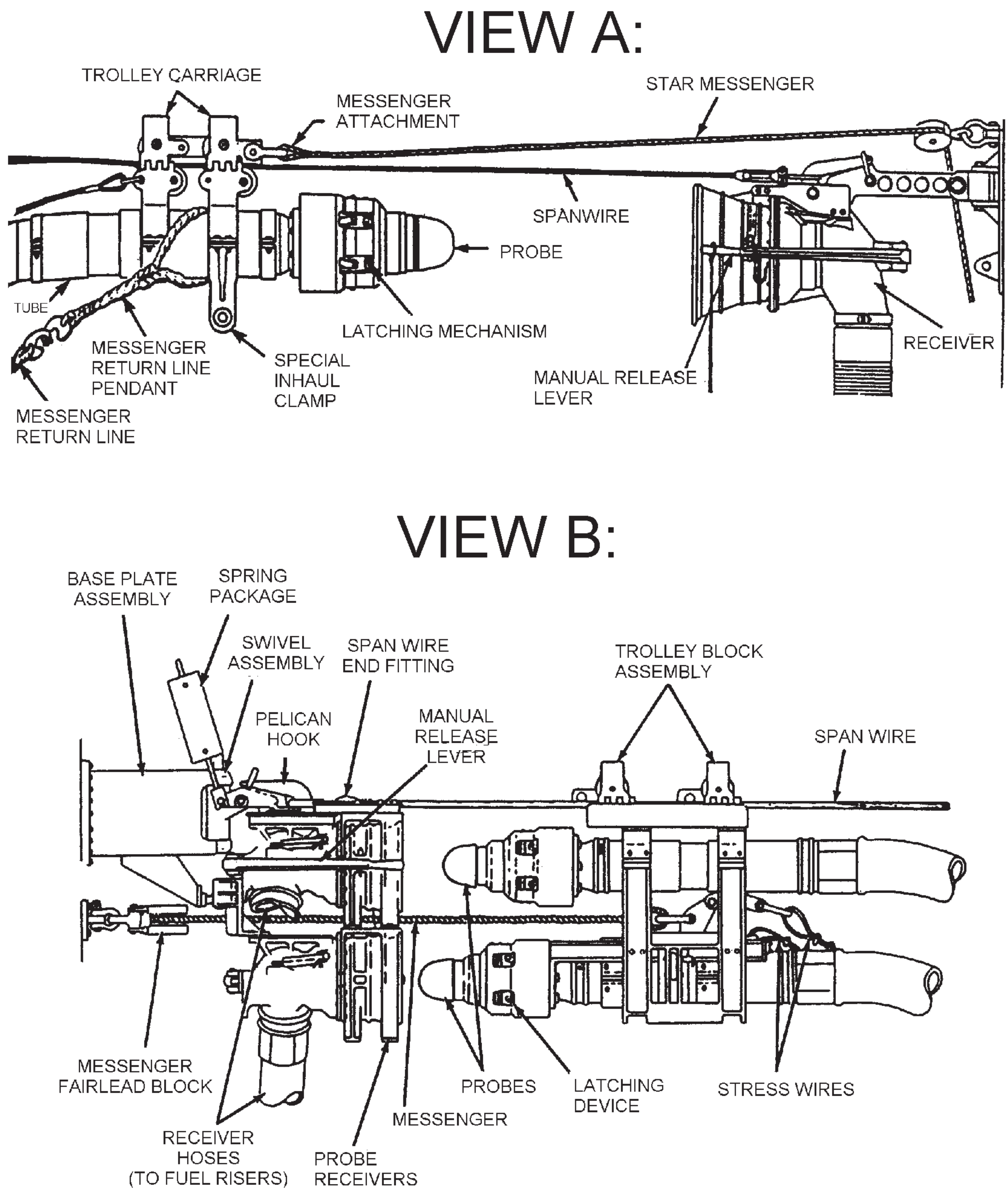


Figure 2-7.—Refueling rigs: A. Single probe; B. Double probe.

pumps. The inlet piping to the purifiers and the reclaim filter are connected to the discharge header of the transfer pumps. Cutout valves are installed at strategic points throughout the transfer main, mostly at fore and aft bulkheads. These valves are used to isolate the system during secured conditions and to control the flow of JP-5 during various transfer and filling operations.

The extreme forward and aft ends of the transfer main are connected to the transfer-main branch headers. The transfer-main branch headers extend outboard from the transfer main and connect the storage tank manifolds with the transfer main. Normally there are only two branch headers for each of the forward and aft groups of tanks: one port and one starboard. But on ships equipped with double bottom and peak tanks, additional branches are required.

Located between the transfer-main branch headers and the storage tank fill and suction tailpipes are manifolds. All manifold valves are marked Damage Control fittings ⊗–ray (Circle X-ray) and MUST be closed when not in use.

Transfer System

The transfer system discussed here is a CV/CVN class ship arrangement using three transfer pumps and two centrifugal purifiers in each pump room. The suction header, common to the three transfer pumps, is connected directly to the port and starboard transfer-main branch headers. The two valves installed in the suction header, one port and one starboard, permit the transfer pumps to take suction either from the port or starboard storage tanks independently or from both at the same time. Three transfer pump inlet lines connect the common suction header with the suction side of the pumps. Each line contains an inlet valve and a compound gage. The transfer pumps discharge into a common discharge header. Each pump discharge line contains a test connection, pressure gage, one-way check valve, and a discharge valve. Two cutout valves are arranged in the discharge header (one between each of the pump discharge lines) to enable both purifiers to be in operation simultaneously, using any two of the three transfer pumps. For example, when pump 1 is aligned with purifier No. 1, either pump 2 or pump 3 can be aligned with purifier No. 2. When pump 3 is aligned with purifier No. 2, either pump 1 or pump 2 can be aligned with purifier No. 1. **Never align more than one transfer pump to a purifier**.

This valve arrangement also permits two separate transfer operations to be performed simultaneously. For example, if pump 1 is aligned with purifier No.1 to top off a service tank, pumps 2 and 3 can be used to transfer JP-5 from forward to aft, reclaim fuel, and so forth. The same applies for pumps 1 and 2 when pump 3 is being used with purifier No. 2. Consult your AFOSS for operating instructions and correct valve alignment.

The common suction and discharge headers of the transfer pumps are interconnected with the suction and discharge headers of the service pumps. This arrangement enables the service pumps to be used as transfer pumps (normally for off-loading JP-5). Because of insufficient (static) head lift and the low pumping capacity of the transfer pumps, they are not normally used for transferring JP-5 off the ship. The cross-connections between the respective suction and discharge headers are fitted with a spectacle flange or a line blind valve (blank side in), and a cutout/isolation valve (lock closed).

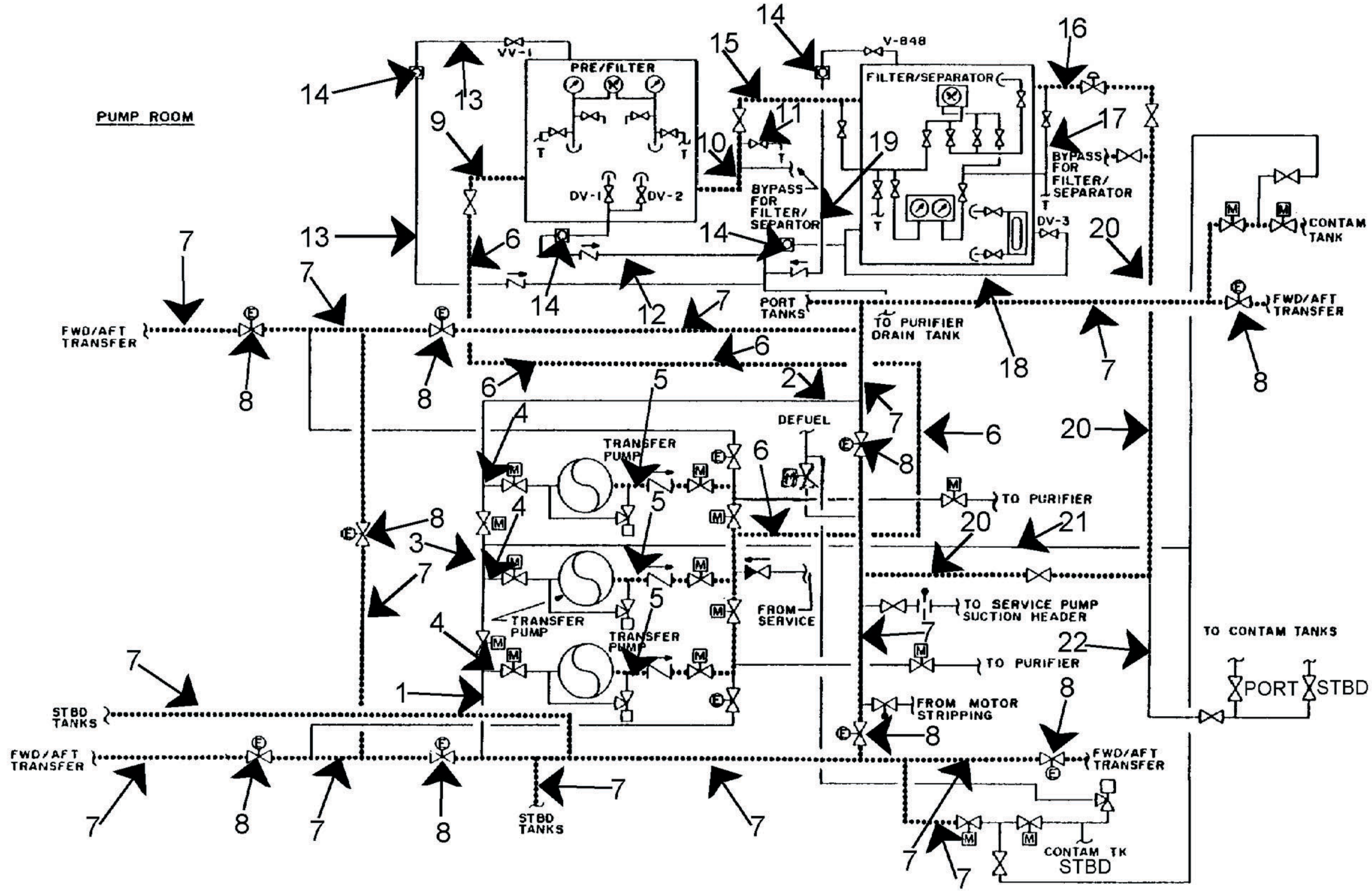
Reclamation System

The reclamation system (fig. 2-8) provides the capability to reclaim JP-5 received from hose flushing, JP-5 tank stripping operations and initial flow during a fueling at sea (FAS). The water and sediment received from these operations are permitted to settle out in the contaminated JP-5 settling tanks. JP-5 drawn off by the designated JP-5 transfer pump is discharged through the reclamation pre-filter and filter/separator and then into a predetermined JP-5 storage tank. Water removed during this operation is directed to the purifier drain tank. Always utilize the Aviation Fuels Operation Sequencing System (AFOSS) for the correct operating procedures.

STRIPPING SYSTEM

There are two independent stripping systems in each JP-5 pump room. One system uses motor-driven pumps and is interconnected with all JP-5 tanks (both storage and service). The other system uses the hand-operated stripping pumps and is connected to the service tanks stripping manifolds only.

On some CV/CVN class ships, they have done away with the hand-operated stripping pumps and are currently using one motor stripping pump specifically designated for stripping service tanks. Isolating stripping operations between storage and service tanks is accomplished with the installation of a spectacle flange and/or a locked-shut double valve isolation.



1. Reclaim suction from STBD side FWD/AFT group of storage tanks
2. Reclaim suction from PORT side FWD/AFT group of storage tanks
3. Reclaim system suction header
4. Reclaim pump inlet line
5. Reclaim pump discharge line
6. Reclaim system discharge line to filters
7. Transfer main
8. Transfer main isolation valves
9. Pre-filter inlet line
10. Pre-filter discharge line
11. Pre-filter sample line
12. Pre-filter drain line
13. Pre-filter vent line
14. Bull's-eye sight glass
15. Reclaim filter inlet line
16. Reclaim filter discharge line
17. Reclaim filter sample line
18. Reclaim filter drain line
19. Reclaim filter vent line
20. Reclaim system discharge line
21. Reclaim suction line from contam tanks
22. Reclaim discharge line to contam tanks

Figure 2-8.—Reclamation system.

Motor-Driven Stripping System

The motor-driven stripping system (fig. 2-9 to 2-11) consists of two low-capacity pumps, manifolds, and associated piping and valves. It is designed to perform the following functions:

1. Remove settled water and solids from the bottom of the JP-5 storage tanks (during normal stripping operations).

2. Remove the last 24 inches of usable fuel remaining in the storage tanks after the transfer pumps lose suction (when consolidating fuel or before ballasting a storage tank).

3. Remove the remaining seawater left in the storage tanks by the main drainage eductors (after tank cleaning operations or deballasting a storage tank).

4. Remove the remaining 24 inches of JP-5 from the service tanks (before cleaning or for off-loading).

5. Remove the wash water from the JP-5 service tanks (after a cleaning operation).

6. Remove water from the purifier sump tank.

The storage-tank stripping tailpipe extends from 1 1/2 inches off the tank bottom and runs to the single-valved stripping manifold.

There are two types of manifolds installed in this stripping system. One is a single-valved stripping manifold used with all JP-5 storage tanks. The other is a flood and drain manifold that is installed to those JP-5 storage tanks that are designated to be ballasted. Flood and drain manifolds (refer to figures 2-9 to 2-11, item 15) are located in the stripping system along with single-valved manifolds and the stripping pumps.

The stripping mains interconnect the manifold for all the storage tanks in the group with the common suction header of the stripping pumps. There are normally two stripping mains, one port and one starboard. On ships equipped with deep centerlines, double-bottoms, and peak tanks, additional lines are required to strip these tanks.

The service-tank stripping tailpipe extends from 1 1/2 inches off the tank bottom and is connected directly to the suction header of the motor-driven stripping pumps. These lines are fitted with a cutout valve.

The pump piping is aligned to take suction from the common suction header and discharge into the common discharge header. The two cutout valves in the suction header permit both pumps to take suction from either the port or starboard tanks independently, or from both sides simultaneously. The pump inlet piping contains an inlet valve, a compound gage, and on some ships, a 40-mesh basket-type strainer. The discharge piping contains a valved sample connection, pressure gage, a discharge valve, and a one-way check valve. From the discharge header, the stripped liquid can be directed to the contaminated JP-5 settling tanks, or it can be directed to the transfer main when consolidating the fuel load.

Hand-Operated Stripping System

We will discuss the hand-operated stripping system due to ships in the fleet that still operate this system. In the future, this system will be obselete and replace by the motor driven stripping pump, as ships are rotated for major overhauls.

The existing piping for the hand-operated stripping system will be retained; the pump will be replaced with motor driven positive displacement rotary vane pump. Similar to the pump described under the motor driven stripping system discussed previously.

The hand-operated stripping system (fig. 2-12) is provided specifically for JP-5 service tanks. Its purpose is to remove water and solids from the bottom of these tanks.

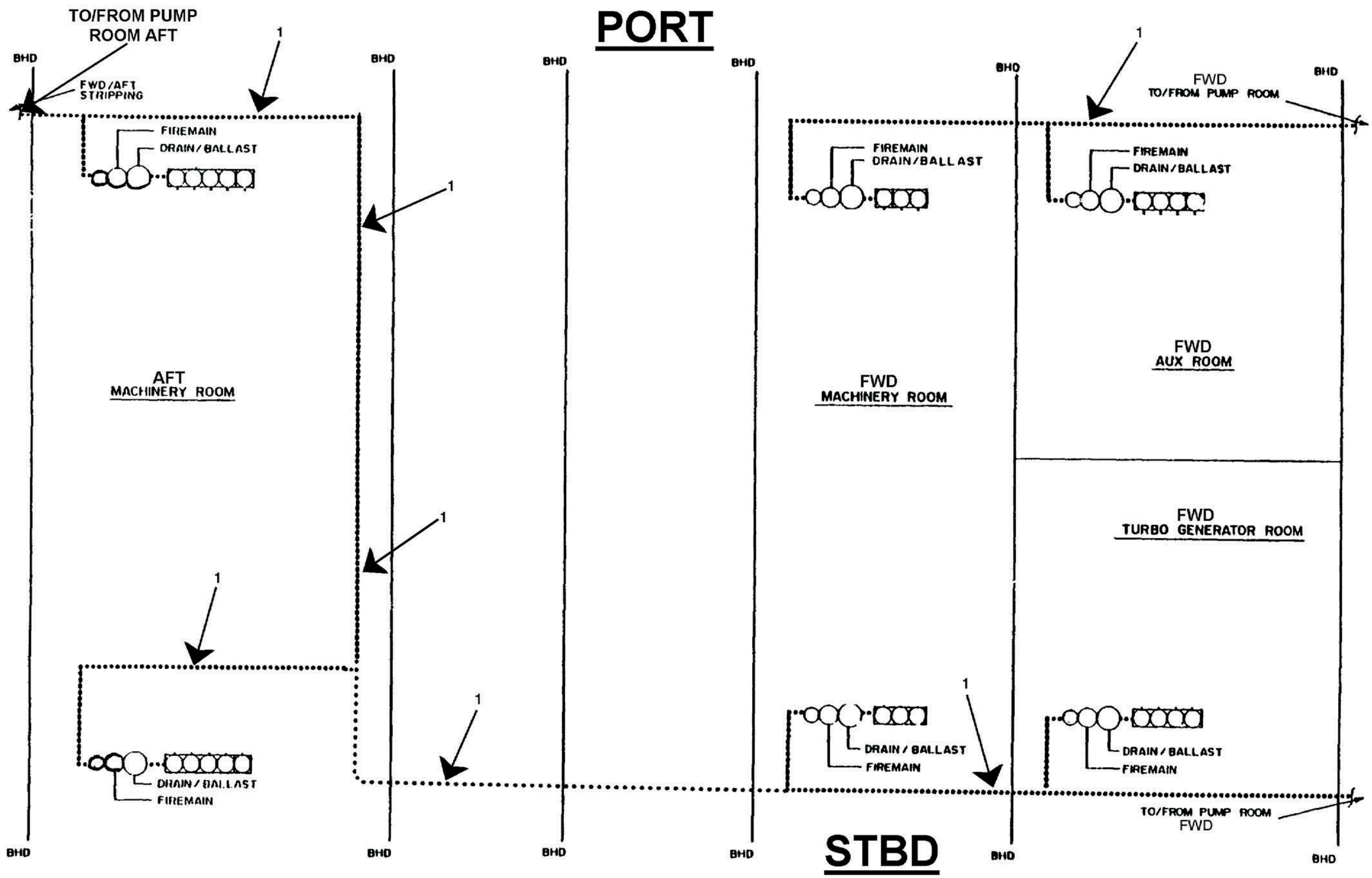
The hand-operated stripping system tailpipe extends from 3/4 inch off the service tank bottom and is connected to a tanktop cutout valve. The lines from each service tank in the pump room are combined and connect directly to the suction side of the hand-operated stripping pump. The discharge line contains a bull's-eye sight glass, sample connection, one-way check valve, and discharge cutout valve. The stripping line discharge is directed into the contaminated JP-5 settling tank or transfer main.

SERVICE SYSTEM

The service system (fig. 2-13 and fig. 2-14) contains all the piping, valves, and related equipment necessary to deliver clean, clear, and bright JP-5 from the service tanks on the eighth deck to aircraft on the flight and hangar decks.

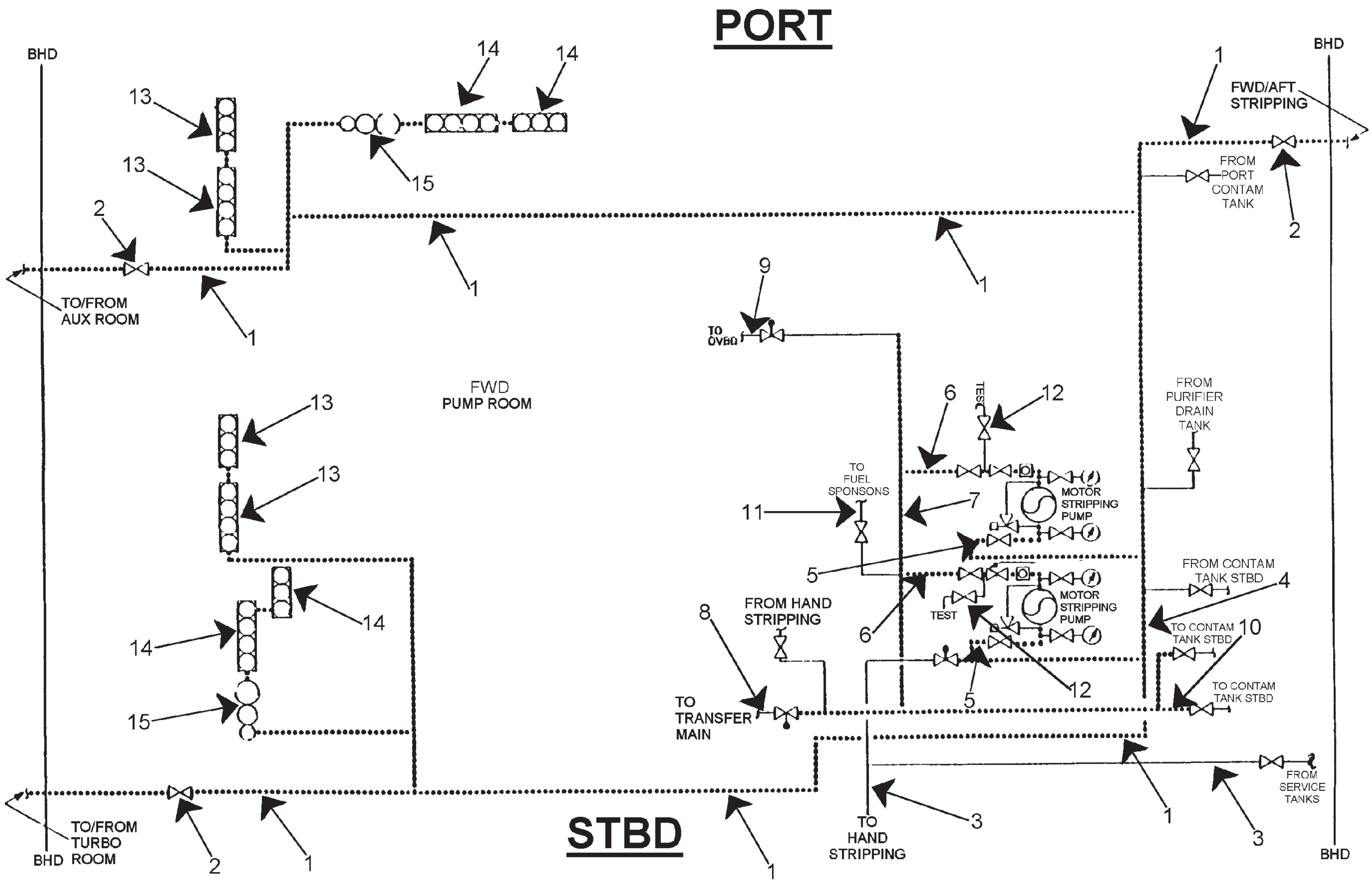
With the ability to isolate the service system into four separate quadrants, the general arrangement of this system is nearly identical on all carriers. But the actual piping, valves, and related equipment will definitely vary from ship to ship.

The service system piping in the pump room (fig. 2-13) begins with the service-tank suction tailpipes.



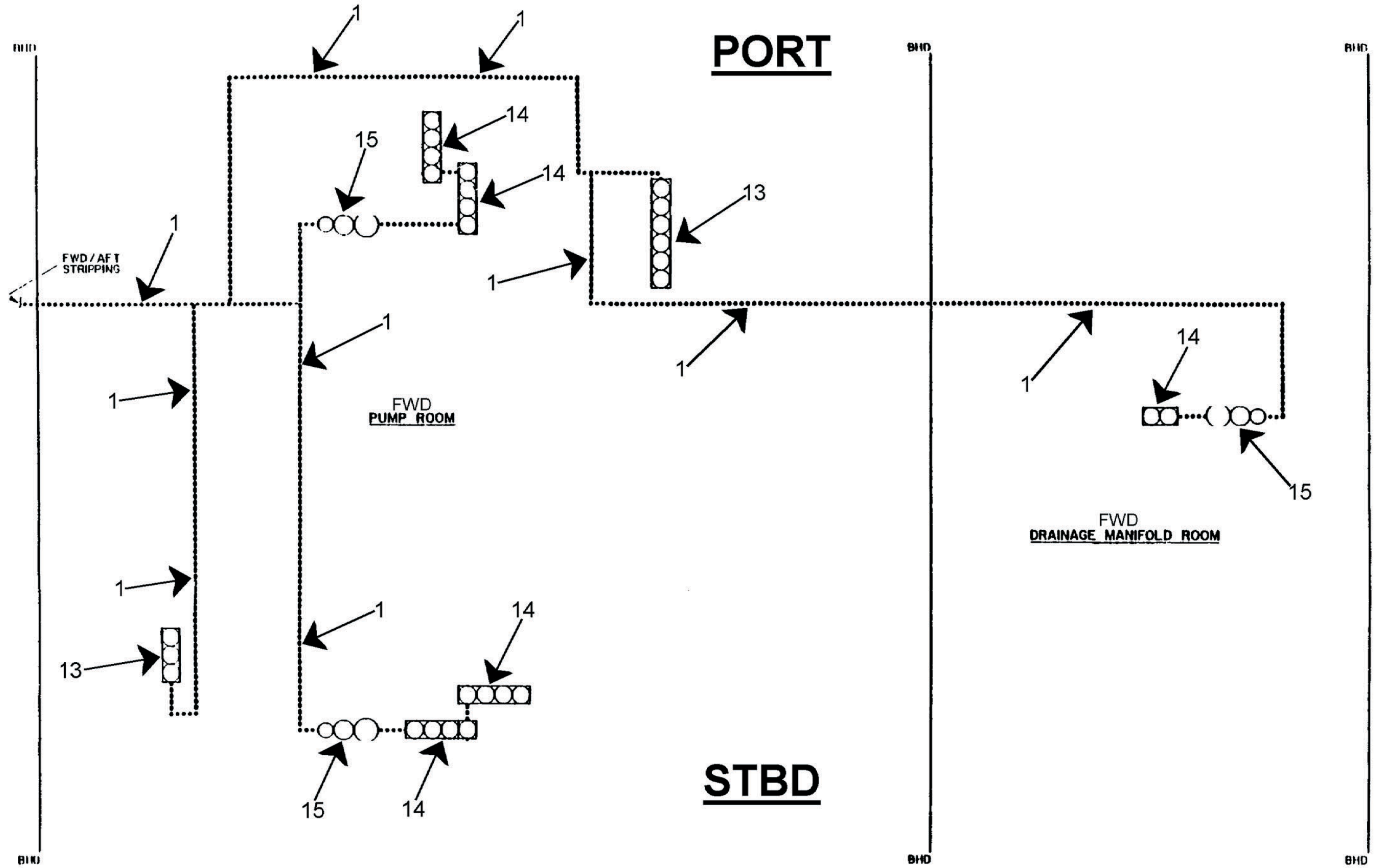
1. Stripping main
2. Stripping main isolation valves
3. Stripping tailpipe (service tanks)
4. Stripping-pump suction header
5. Stripping-pump inlet line
6. Stripping-pump discharge line
7. Stripping-pump discharge header
8. Stripping-pump discharge to transfer main
9. Stripping-pump discharge to overboard
10. Stripping-pump discharge to contaminated JP-5 settling tank
11. Stripping pump discharge to RAS (refueling-at-sea sponsons)
12. Sample connection
13. Double-bottom tanks single-valve manifold
14. Wing tanks single valve manifold
15. Flood and drain manifold

Figure 2-9.—FWD motor-driven stripping system.



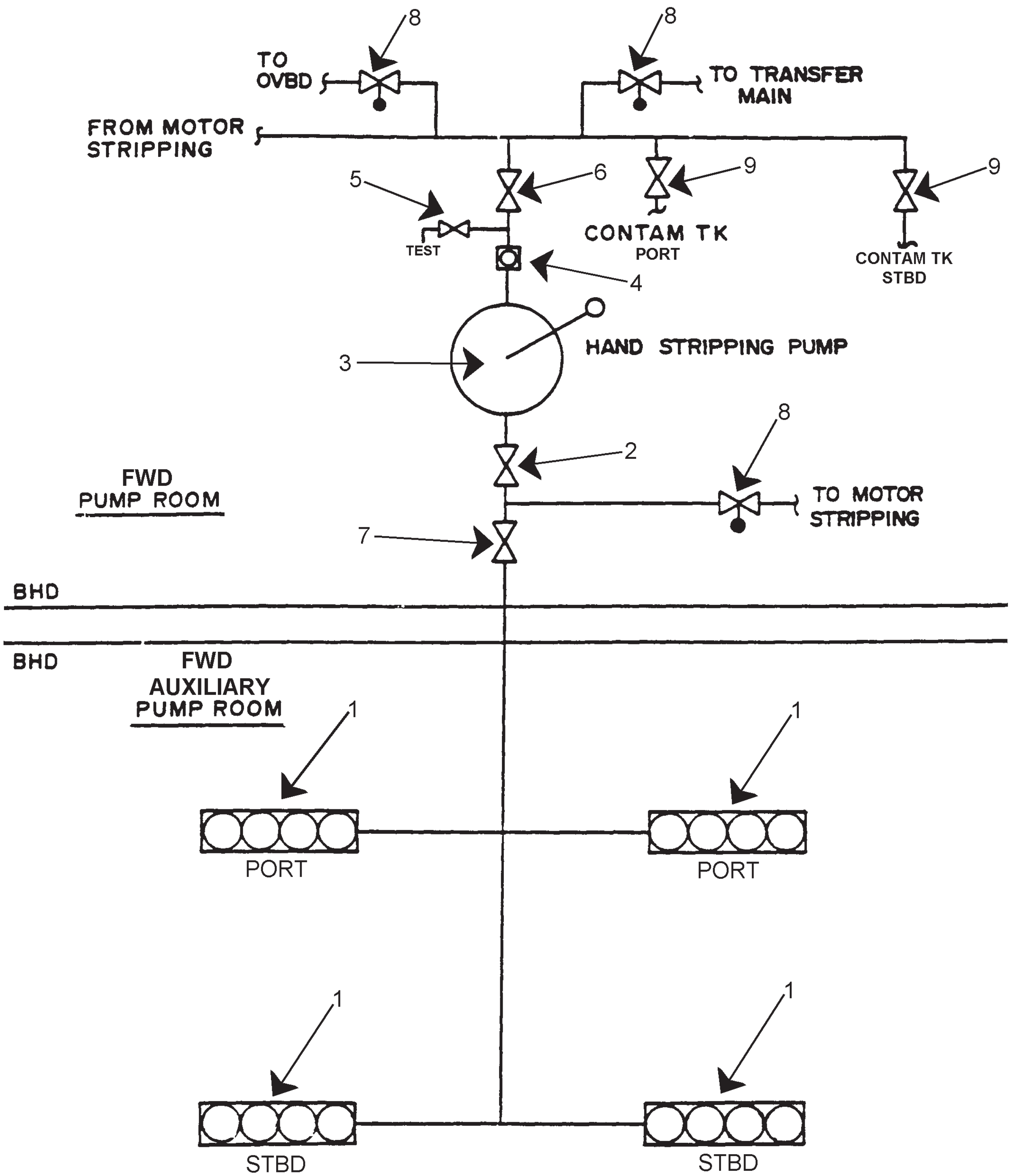
1. Stripping main
2. Stripping main isolation valves
3. Stripping tailpipe (service tanks)
4. Stripping-pump suction header
5. Stripping-pump inlet line
6. Stripping-pump discharge line
7. Stripping-pump discharge header
8. Stripping-pump discharge to transfer main
9. Stripping-pump discharge to overboard
10. Stripping-pump discharge to contaminated JP-5 settling tank
11. Stripping pump discharge to RAS (refueling-at-sea sponsons)
12. Sample connection
13. Double-bottom tanks single-valve manifold
14. Wing tanks single valve manifold
15. Flood and drain manifold

Figure 2-10.—(con't) FWD motor-driven stripping system.



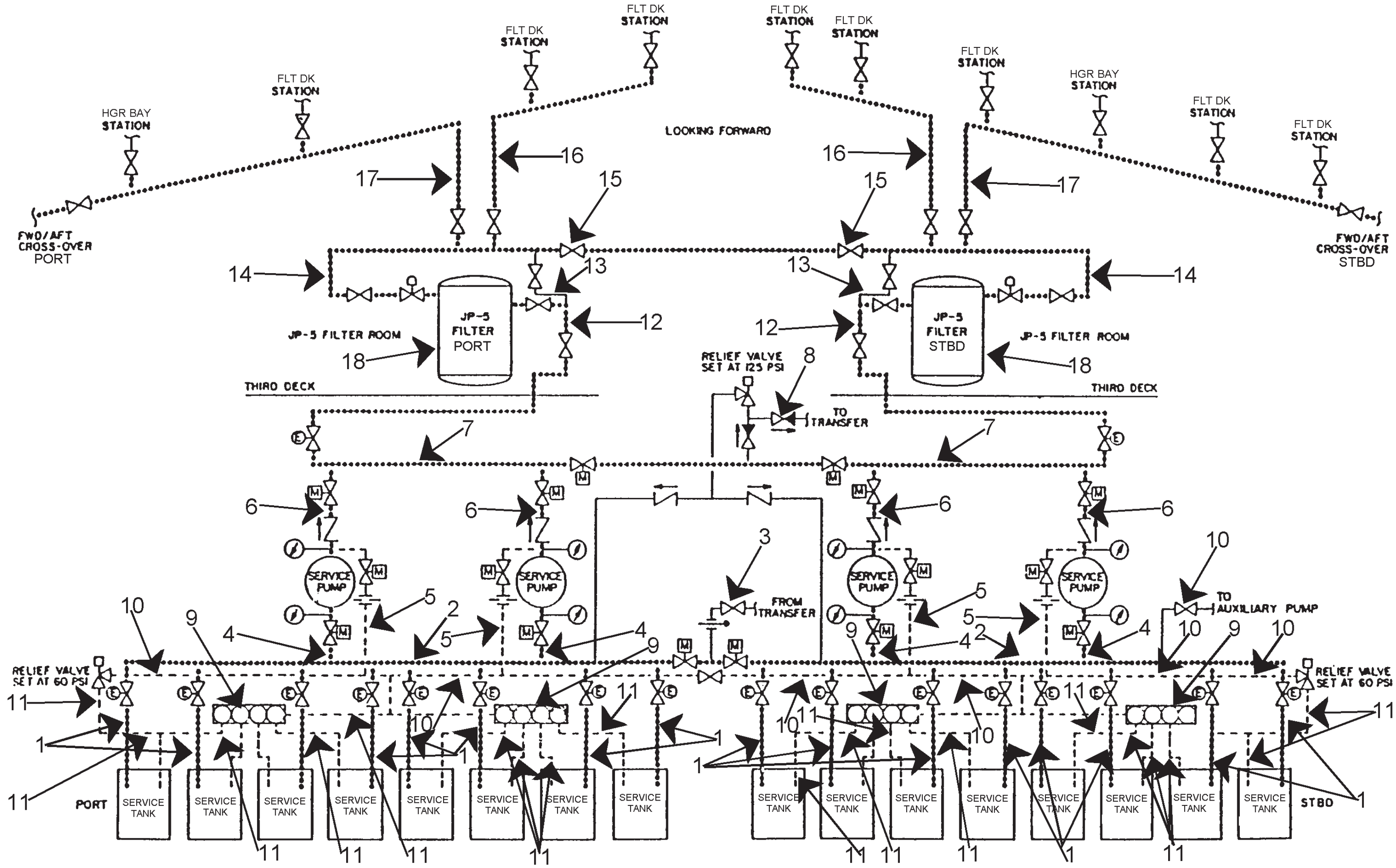
1. Stripping main
2. Stripping main isolation valves
3. Stripping tailpipe (service tanks)
4. Stripping-pump suction header
5. Stripping-pump inlet line
6. Stripping-pump discharge line
7. Stripping-pump discharge header
8. Stripping-pump discharge to transfer main
9. Stripping-pump discharge to overboard
10. Stripping-pump discharge to contaminated JP-5 settling tank
11. Stripping pump discharge to RAS (refueling-at-sea sponsons)
12. Sample connection
13. Double-bottom tanks single-valve manifold
14. Wing tanks single valve manifold
15. Flood and drain manifold

Figure 2-11.—(con't) FWD motor-driven stripping system.



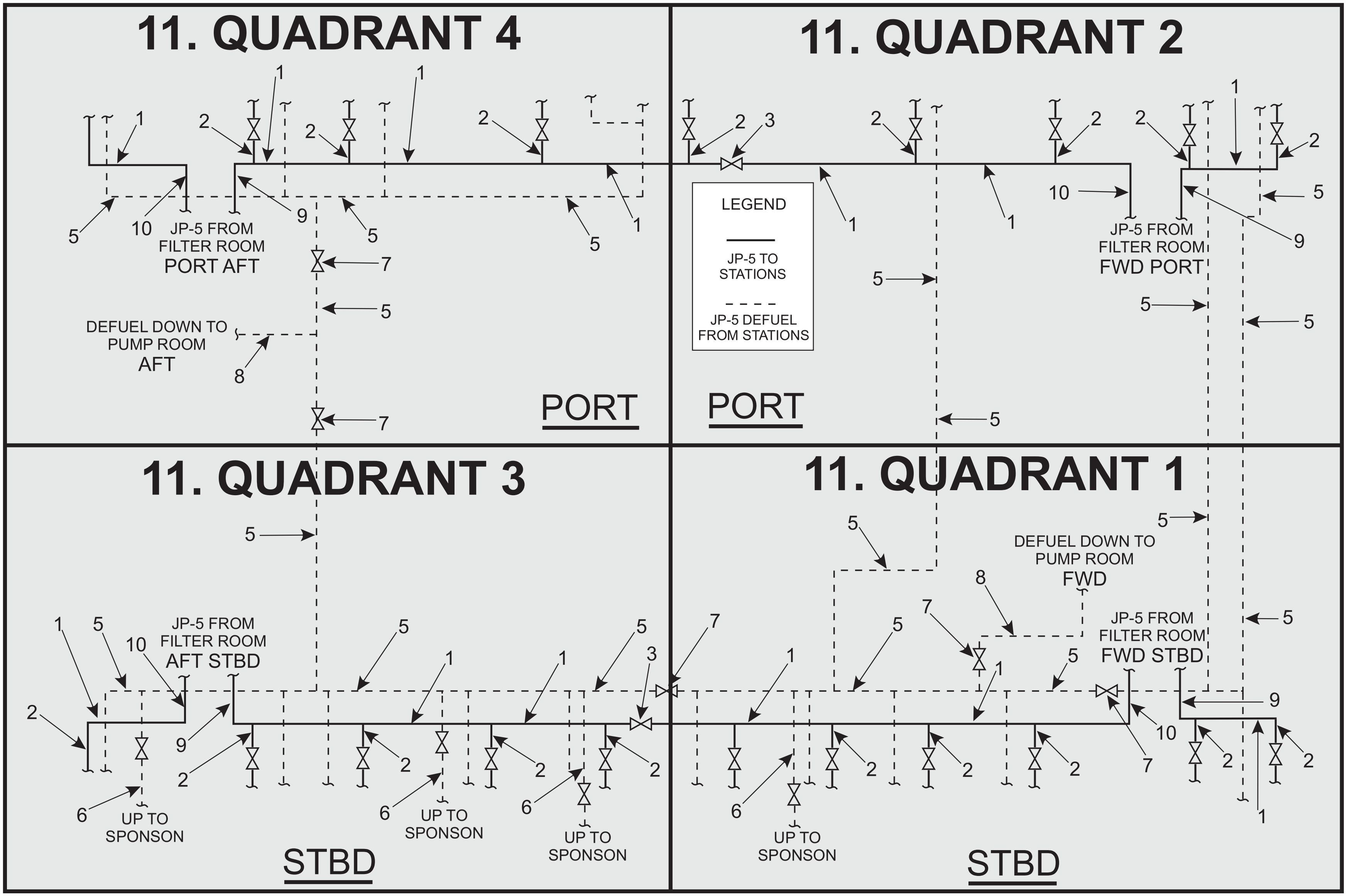
1. **Service tank stripping manifold**
2. **Pump inlet**
3. **Hand pump**
4. **Bull's-eye sight glass**
5. **Sample connection**
6. **Globe stop-check discharge valve**
7. **To motor stripping pump suction**
8. **Locked closed gate valve**
9. **Fill valves to contam tanks**

Figure 2-12.—FWD hand-operated stripping system.



1. Service-tank suction tailpipe
2. Service-pump common suction header
3. Cross-connection to transfer-pump suction header
4. Service-pump inlet line
5. Service-pump recirculating line
6. Service-pump discharge line
7. Service-pump common discharge header
8. Cross-connection to transfer-pump discharge header
9. Service-tanks recirculating manifold
10. Recirculating header
11. Service-tanks recirculating lines
12. Filter inlet line
13. Filter bypass line
14. Filter discharge line
15. Port & Starboard filter cross-connection
16. Filter FWD Legs
17. Filter AFT Legs
18. Service Filter

Figure 2-13.—FWD JP-5 service system.



1. Service fuel line
2. Service riser to refueling stations
3. PORT side FWD/AFT cross-connection
4. STBD side FWD/AFT cross-connection
5. Defuel line
6. Defuel from refueling sponsons
7. Defuel isolation valves
8. Defuel downcomer line to pumproom
9. Filter FWD Leg
10. Filter AFT Leg
11. JP-5 System Quadrant

Figure 2-14.—Fueling/Defueling system.

These lines extend from 24 inches off the tank bottom to the service-pump common suction header. Each line is fitted with a shutoff valve to isolate the tank from the system when not in use.

The service pump common suction header is divided into a port and starboard suction header by a set of crossover valves. During normal operations, these crossover valves are open to allow the use of any service pump with any service tank. Additionally, the cross-connections from the transfer pump suction header, fitted with a spectacle flange or line blind valve, and a cutout valve interconnect with the service pump suction header between these valves. The cross-connection is only opened to allow service pumps to be used for off-loading JP-5.

The service pumps are connected to the suction header by the pump inlet. This line contains an inlet valve, a compound gage and pressure limit switch cutout valve. The discharge line, connecting the pumps to the common discharge header, contains a recirculating line, pressure gage, one-way check valve, and a discharge valve.

The pressure limit switch or pressure control switch (see fig. 2-16) is located near the controller (inside the Console room on CVN's), controls the pump during operation by sensing pump discharge pressure. The switch closes the motor control circuit at 10 psi and opens the circuit at 180 psi. If the service pump does not maintain suction within three (3) minutes, the switch is calibrated to shut down the pump.

A bellows element actuated by pressure operates the switch mechanism either to complete or break the control circuit. A permanent magnet at the contacts prevents excessive arcing. The pressure control element causes the pressure switch to close and open within a range of 10 to 180 psig. For adjusting the pressure control switch consult the applicable service pump technical manual.

The recirculating line has an orifice to re-circulate about 5% of the rated capacity of the pump back to the service tank from which suction is being taken. The re-circulated fuel through the pump casing keeps the pump cool during standby condition. This is when the system is pressurized (pumps are running), but no fuel is being drawn topside. The recirculating lines (one for each service pump), terminate in a recirculating header. The header in turn is connected to each service tank recirculating line. These lines, fitted with shutoff valves, terminate 18 inches horizontally off the tank bottom. A number of 1-inch holes equally spaced along the top of the recirculating line allow JP-5 to be returned to the tank without disturbing the contents of the tank. When the system is being set up for operation, the recirculating header MUST be aligned to the service tank from which suction will be taken. Also, when the service tank is changed, so must the recirculating header.

The service pump discharge header is common to all four-service pumps. Like the suction header, it is divided into port and starboard headers by a set of crossover valves. The cross-connection to the transfer pump discharge header is used, and for the same purpose as, the cross-connection between the respective suction headers of the transfer and service pumps. They are also used to drain back the service piping for maintenance.

From the service pump common discharge header (on the seventh deck), the distribution riser extends directly to the filter room (on the third deck). JP-5 enters the service filter through the inlet section and leaves the filter through the discharge line attached to the clearwell chamber and the automatic shutoff valve. Both inlet and discharge have shutoff valves.

The filters are also provided with a bypass line. This line, fitted with a shutoff valve (locked closed), is installed between the filter inlet and discharge lines. The bypass line is primarily used for draining back the distribution piping for maintenance.

As the distribution piping leaves the discharge side of the service filter, it is divided into two sections (commonly called "legs"). Each leg extends outboard; one goes forward to supply all the service stations in the forward section of the quadrant, and the other goes aft to supply all the service stations in the aft section of the quadrant.

The aft leg of the forward quadrant and the forward leg of the aft quadrant are connected by a set of crossover valves. Additionally, crossover valves connect port and starboard quadrants. With the correct alignment, this allows fuel to be pumped from any service pump in either pump room to any service station on the flight or hangar decks.

Service station risers extend upward to supply the service stations on the hangar deck and flight deck. At the service station, the supply riser branches off to each hose reel.

Isolation valves are installed at strategic points throughout the distribution piping. These valves are normally in the open position (DC fittings marked

⊗–ray) during at-sea operations, but are closed to isolate specific sections in an emergency or if damage occurs.

Jet Test System

The jet engine test facility is provided with fuel directly from the JP-5 service system. The jet engine test facility cannot be operated during flight operations, as access to the fantail is restricted during flight operations. Therefore, the service system's capability to support flight operations will not be compromised when the two operations are on-line simultaneously; this setup reduces the efficiency of the service system to supply fuel to aircraft.

The JP-5 passes through one of the two aft 2,000 gpm service filters, where contaminants that could be present in the JP-5 are removed prior to delivery to the test stand. Use of the forward system service filters will require cross connecting the service system main on the second deck. Refer to your ship's AFOSS for correct alignment and operating instructions.

This system provides JP-5 to the Jet Engine Test Facility located on the fantail. It is AIMD's (Aircraft Intermediate Maintenance Department) means of testing and troubleshooting jet engines while underway. The system is serviced from a distribution main branch header, located in the cross-connect line between the two aft service filters. An isolation valve is installed to provide service fuel to the Jet Test Stand.

The distribution main branch header is fitted with an isolation valve to isolate the jet engine test facility from the service system. A solenoid-operated valve is installed which can be manually actuated form the jet engine control room in case of an emergency. A solenoid-operated fuel/defuel valve is also installed in the fuel supply header at the jet engine test stand, can be manually actuated from the jet engine control room for emergency shut-off and defueling capability simultaneously at the test stand.

Located on the fantail, this system has an installed pressure regulating (Cla-val) valve, pressure gages and return line from the test stand to permit testing of jet engines at various flow rates. The system's return line from the stand is connected to the defuel main.

Consult your ship's Aviation Fuels Operating Sequencing System (AFOSS) for proper operational procedures and correct alignment to this system. The maintenance and material upkeep of the Jet Test Stand is usually the responsibility of the Flight Deck Repair Shop. The Below Decks work center is responsible for tracking and accounting for all fuel transfer with AIMD's Jet Shop.

Auxiliary JP-5 System

This system (fig. 2-15) provides JP-5 to emergency diesel generators, auxiliary boilers, small-boat filling stations, or combat vehicle/support equipment filling station. It is an independent system and typically consists of an auxiliary pump, an auxiliary main and branches supplying each station. This system is also supplied from the JP-5 service-pump suction header.

Q2-1. What JP-5 fueling system is used to receive fuel onboard ship?

Q2-2. What are the two types of filters in the Reclamation System?

Q2-3. Which of the two independent stripping systems in the pump room has its tailpipe extending from 3/4 inch off the bottom of its tank?

Q2-4. Which JP-5 fueling system is used to deliver clean, clear and bright JP-5 to aircraft on the flight and hangar decks?

Q2-5. When, if ever, is the service system's service pumps used to cross-connect with the transfer system's transfer pump suction header?

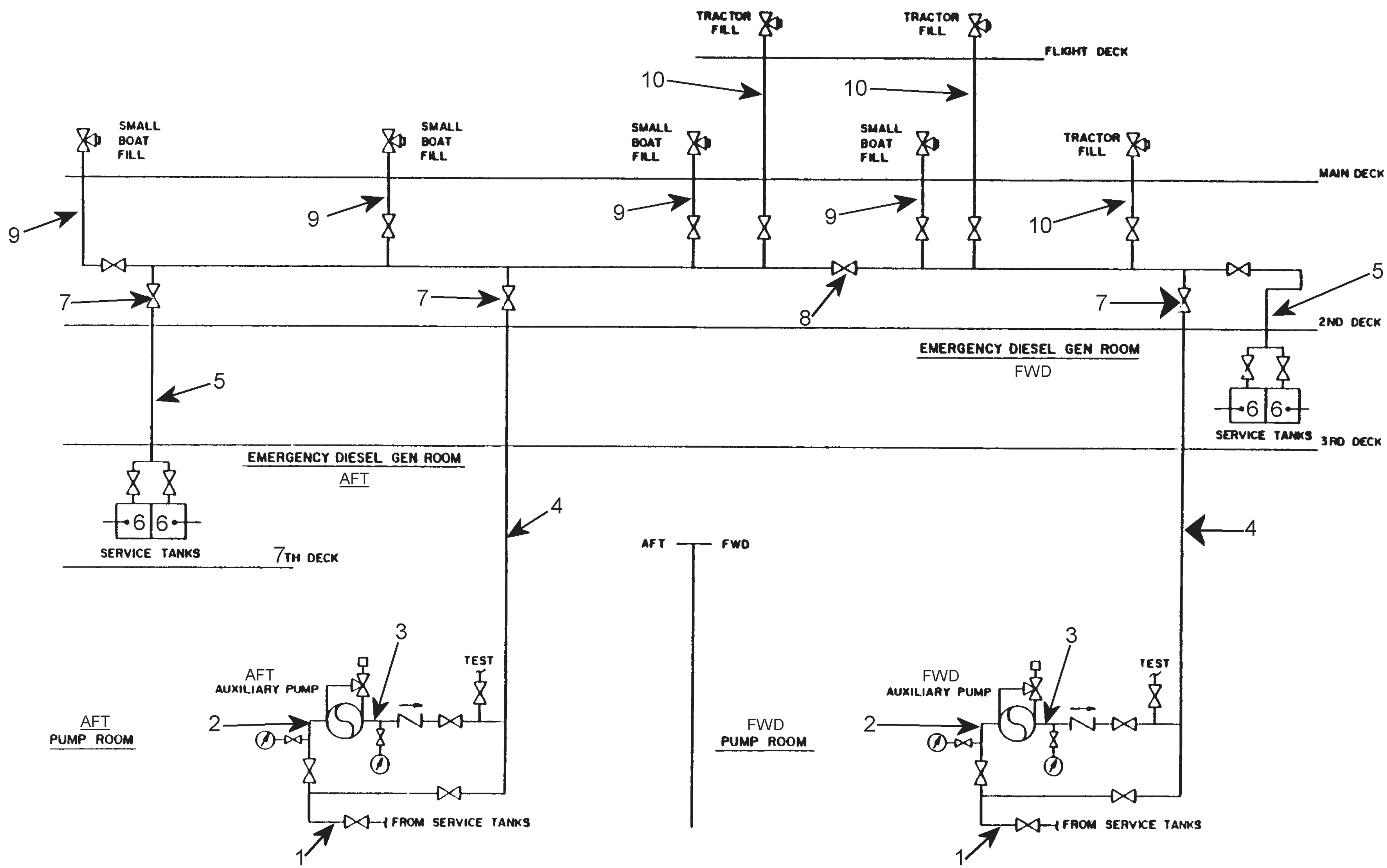
Q2-6. What system is used by an ABF to supply fuel to AIMD's Jet Test Shop for troubleshooting aircraft jet engines?

Q2-7. Which JP-5 system is use to fuel diesel generators, boilers, small boats and tractors?

JP-5 FUEL SYSTEM PUMPS

LEARNING OBJECTIVE: Identify the different types of pumps in the JP-5 below decks fueling system. Describe their function and principles of operation.

In the first section of this chapter, we talked about JP-5 fueling subsystems. We discussed their typical arrangements and where pumps, filters, cutout valves, purifiers, and other components would fit in that system. And as was stated earlier, though all JP-5 fueling system arrangements are alike, the actual makeup of each system will be different.



1. Service tanks suction header line
2. Aux pump inlet line
3. Aux pump discharge line
4. Aux riser to the 2nd Deck
5. Aux fill line to Emergency Diesel service tanks
6. Emergency Diesel Generator service tanks
7. Aux system isolation valves
8. FWD/AFT Aux system cross-connection
9. Small Boat Fill connection line
10. Tractor Fill connections line

Figure 2-15.—JP-5 auxiliary system.

A pump is a machine that draws a fluid into itself through a suction port and forces the fluid out through a discharge port. The ABF uses pumps in the JP-5 below decks system to move JP-5 from tank to tank, and to lift JP-5 to the flight and hangar deck refueling stations.

Wear occurs in a pump as in any other piece of machinery. To maintain a pump at or near the efficiency it had when new and to keep maintenance at a minimum, periodic tests should be made to determine the delivery capacity of the pump. When a test indicates a noticeable reduction in the delivery capacity, it is a sign of possible internal wear. The pump should be opened for inspection in accordance with PMS. If corrective action is not immediately taken, total failure of the wearing parts may result in excessive repair costs as well as considerable down time of the pump. Always follow the manufacturer's instructions in the applicable technical manuals. The various type pumps and their functions are discussed here.

Centrifugal

Due to their simplicity and adaptability to a wide variety of operating conditions, centrifugal pumps are widely used. They can be modified to operate over a

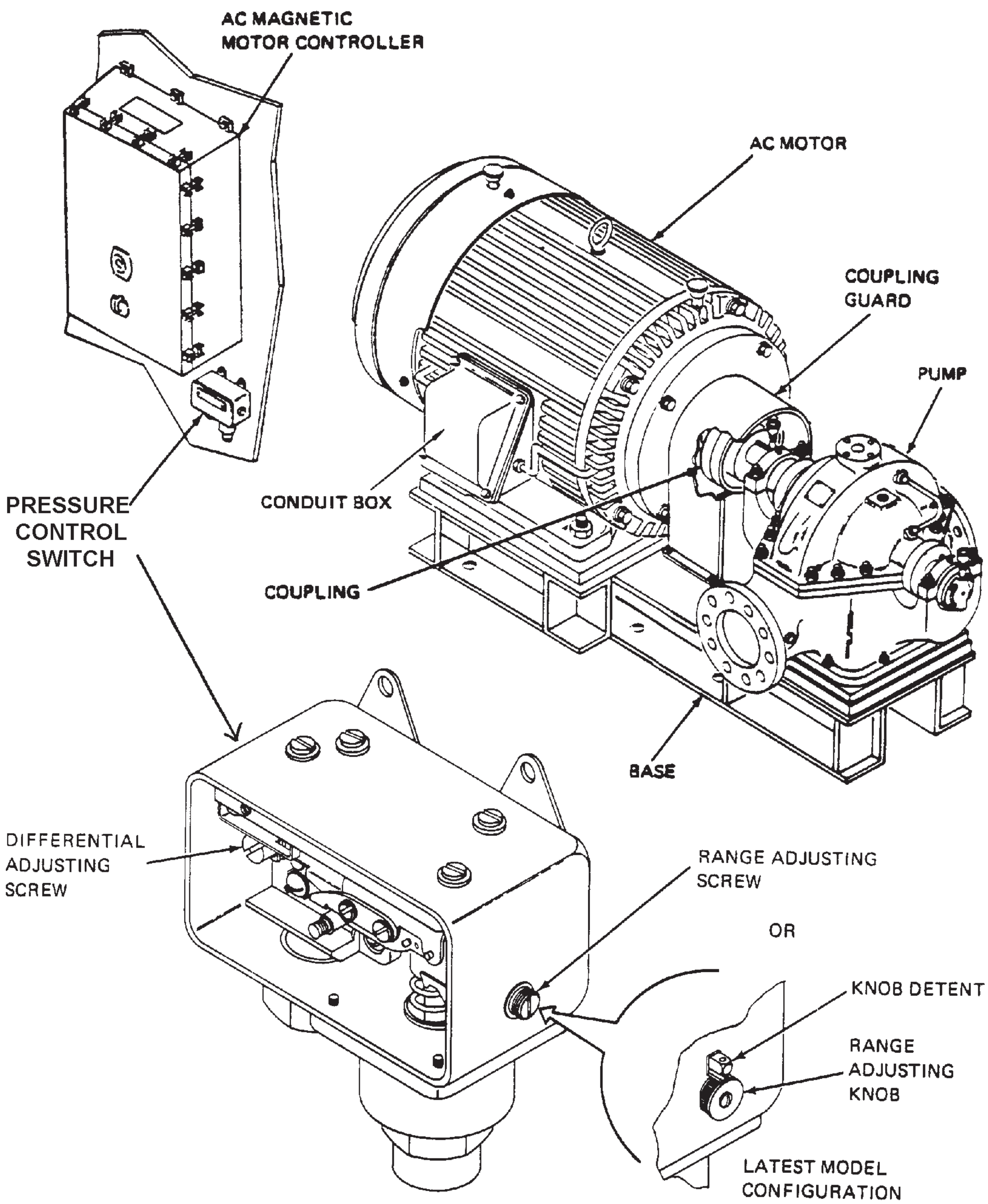


Figure 2-16.—Aurora JP-5 service pump with Pressure control switch.

wide range of heads, can handle liquid at all normal temperatures, and operate at speeds that are standard for motors or turbines. The characteristics of these pumps are such that liquid flow from them is continuous, and their discharge can be throttled without building up excessive pressures in the pumps or overloading the driving unit.

The most common manufacturers of the centrifugal pumps used in the JP-5 below decks system are Aurora and Carver. The Aurora is the pump discussed here. But, there are other pumps installed and you should always consult the technical manual for details on the specific pump in your system.

The primary use of centrifugal pumps in the JP-5 below decks system is, as service pumps. The Aurora JP-5 Service Pump (fig. 2-16) is a double-suction, single-stage, centrifugal pump. The pump is designed to deliver fuel at 1,100 gallons per minute at 150 psi with a 20-foot suction lift. The pump consists of a split casing, wearing rings, and rotating element.

SPLIT CASING.—The casing (fig. 2-17), is horizontally split at the shaft centerline. This enables easy removal of the upper casing half for inspection and maintenance. The casing is divided into three chambers; two suction and one discharge. The upper half of the casing contains a flange that may connect the pump to an air eliminator valve. Two external seal lines on the upper casing feed fuel from the discharge chamber to cool the mechanical seals. The lower half of the casing contains bearing housings, a suction flange

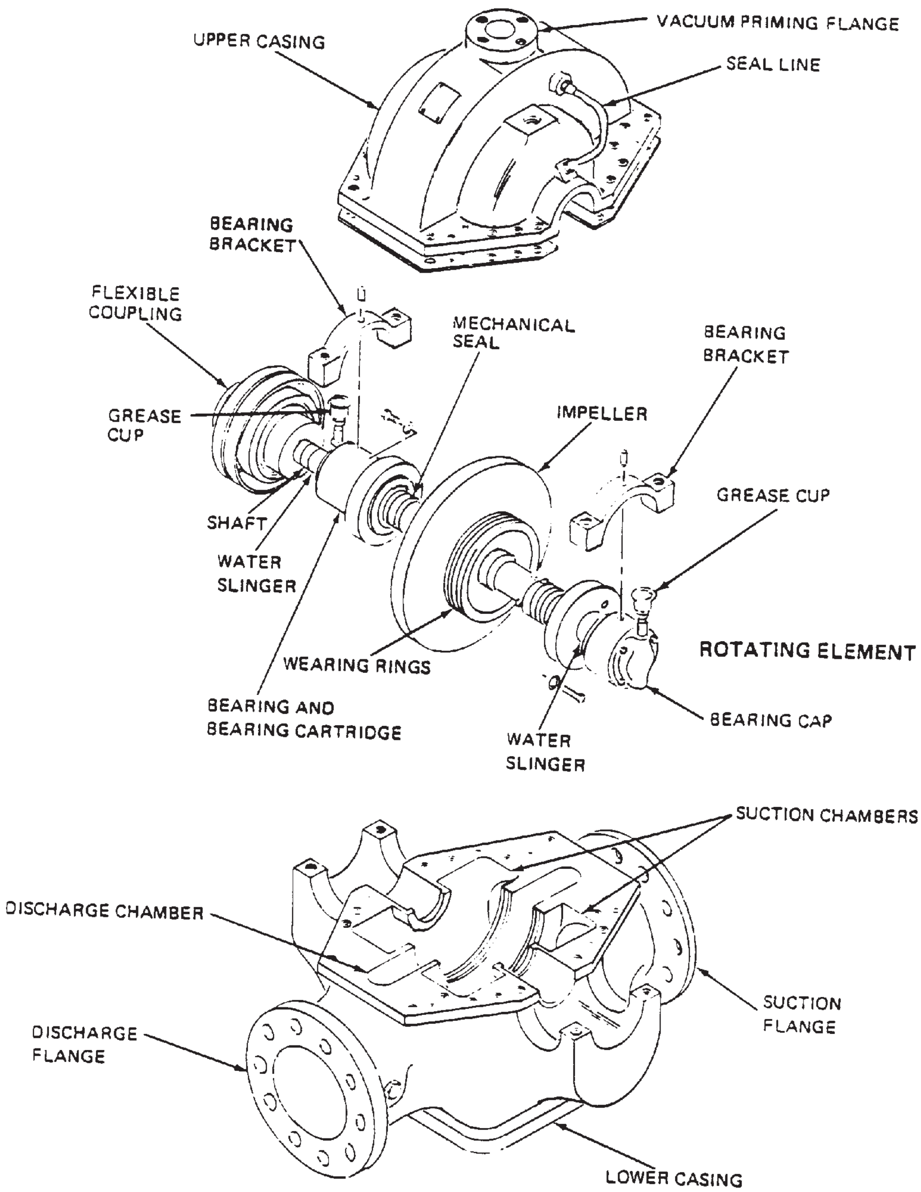


Figure 2-17.—Centrifugal pump casing.

and a discharge flange that connect the pump to the piping system. Drain holes and drain plugs are provided at the bottom of both flanges for draining the pump.

WEARING RINGS.—There are four replaceable type wearing rings (two rotating and two stationary) installed within the pump casing. The two rotating are installed on the impeller. The two stationary rings are installed in the pump casing between the suction and discharge chambers. The stationary rings are held in place and prevented from rotation by the tongue-and-groove construction. When the pump is assembled, the rotating wearing rings ride inside the stationary rings. (Check the appropriate technical manual for the correct clearance between the stationary and rotating rings.)

Wearing rings serve two purposes: (1) owing to their unique construction and close tolerances, they minimize leakage between the discharge and suction chambers and (2) they allow for the wear created between the impeller and pump casing.

Fuel passing through the pump has a tendency to recirculate from the discharge chamber back to the suction chamber. As the fuel passes through the narrow clearance between the wearing rings, a partial seal is made by the rapid rotation of the impeller. This seal minimizes the leakage between the discharge and suction chambers. After prolonged use of the pump, the clearance between the wearing rings gradually increases due to wear. This is caused by the friction created by the rapid rotation of the impeller, as well as the fuel passing between the wearing rings. As the clearance increases, sealing effect decreases resulting in the loss of the rated capacity of the pump.

ROTATING ELEMENT.—The rotating element (fig. 2-18) consists of an impeller and pump shaft, shaft sleeves and nuts, ball bearings, mechanical seals, and a flexible coupling.

Impeller and Pump Shaft.—The impeller is a double-suction, closed impeller. It is keyed to, and rotates with, the pump shaft. The impeller is centered in the discharge compartment of the pump casing and prevented from axial movement by two shaft sleeves and two shaft nuts. The two shaft sleeves actually act as long spacers between the impeller and shaft sleeve nuts. The shaft sleeves are also keyed to, and rotate with the pump shaft.

Fuel enters the center part of the impeller from both sides of the suction chamber and is pumped into the discharge chamber. Side plates enclose the impeller blades. The blades are designed to curve backward in relation to the rotation of the impeller to increase pump efficiency, and impart velocity to the fuel in the casing.

Mechanical seals (fig. 2-19) fitted on the pump shaft guard against fuel leakage from the pump and prevent air from entering the casing around the shaft. The seals are installed in the stuffing boxes provided on each side of the pump casing.

There are two types of mechanical seals, the John Crane, and Durametalic. The principle parts of the John Crane mechanical seal are the stationary floating seat, low friction sealing washer, and spring. It is a single piece unit.

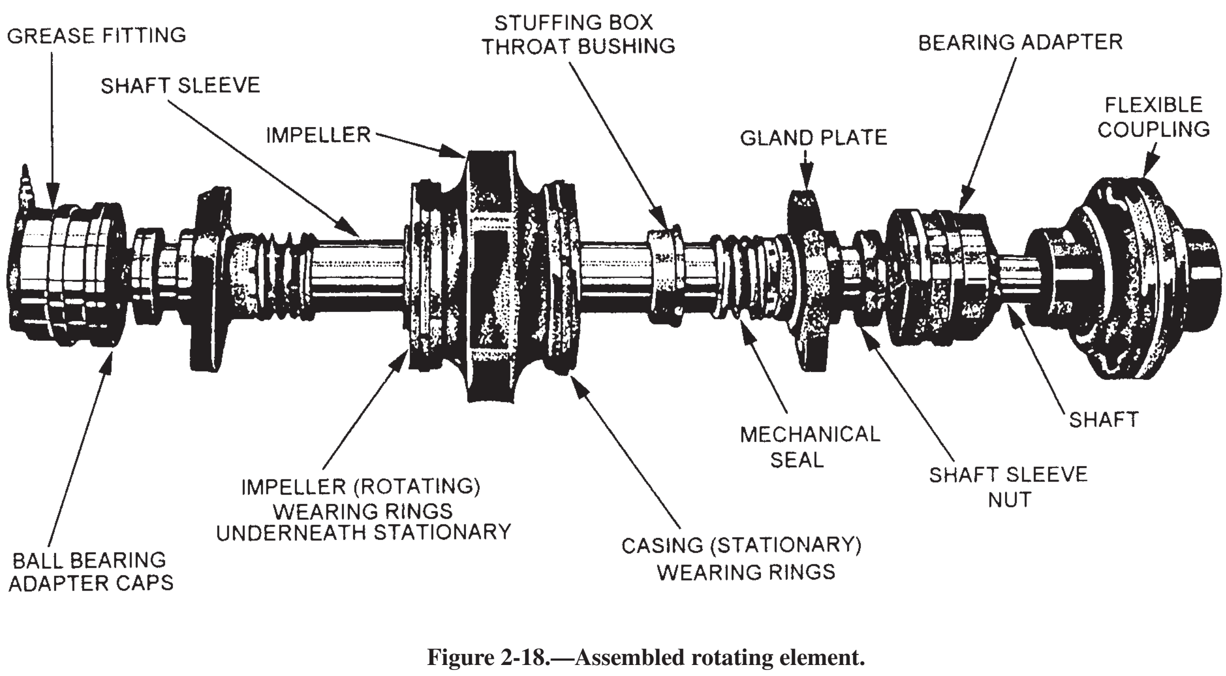


Figure 2-18.—Assembled rotating element.

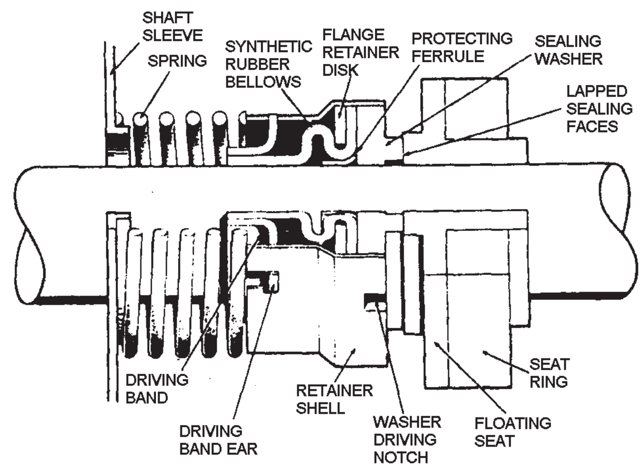


Figure 2-19.—John Crane mechanical seal.

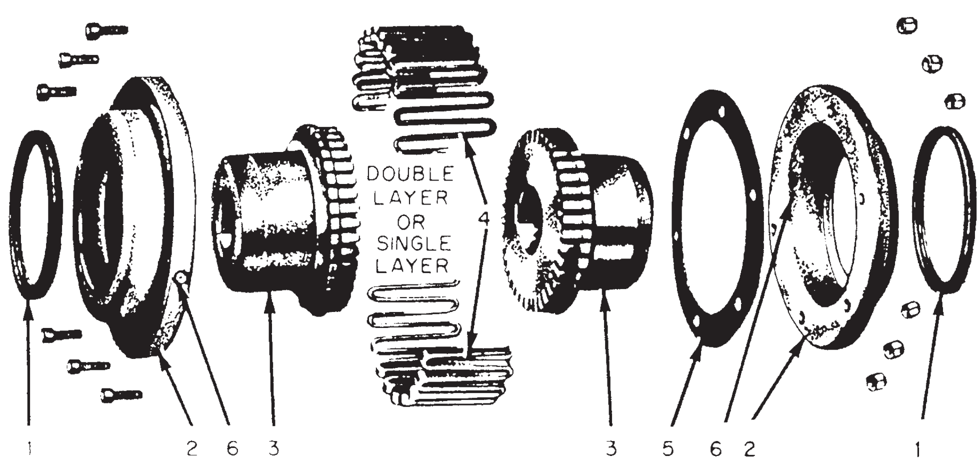
The principle parts of the Durametalic mechanical seal are the stationary insert, seal ring, compression ring and collar assembly, and the shaft packing. It is a three piece unit.

> **NOTE**
>
> Some parts of mechanical seals are made of carbon and break easily. Handle mechanical seals carefully.

Bearing Cartridges.—(Refer to fig. 2-17). Both ends of the pump shaft extend outside the upper half of the casing. Pump shaft ends are supported by ball bearings encased in bearing cartridges and cradled in the bearing brackets of the lower casing half. The ball bearings absorb radial and axial thrust, and ensure free rotation of the pump shaft. A single ball bearing is housed in the inboard bearing cartridge, allowing the inboard bearing some axial movement within the cartridge. Duel ball bearings, are housed in the outboard bearing cartridge. The ball bearings are slipped on and held firmly against a shoulder on the pump shaft by a lock washer and locknut. The end of the bearing cartridges, that lie close to the center of the pump are enclosed by bearing covers. The bearing covers prevent bearing grease from leaking out of the bearing cartridges. In addition, the bearing covers prevent dirt and water, or fuel from entering the bearing cartridges. Bearing caps encloses the outside ends of the bearing cartridges. A grease cup and a grease fitting are installed on both of the bearing caps to allow addition of grease to the bearings. Grease relief's are also installed to release grease during heat expansion.

Flexible Coupling.—The flexible coupling is designed to allow for misalignment between the motor shaft and the pump shaft. The coupling hubs are keyed to both the pump and motor shafts and are lubricated to reduce wear in the coupling.

Falk Type-F Steelflex Coupling.—This coupling (fig. 2-20) is a flexible, self-aligning, grid-member coupling. The two hubs are symmetrical, but may have different bores or key-ways. One hub is keyed to the motor shaft, and the other hub is keyed to the pump shaft and secured axially by set-screws. A flexible grid-member engages the teeth in the hubs to transmit power. A gasket and two seal rings are fitted to the covers to prevent grease leakage. The parts are enclosed in two cover halves that are bolted together.



1. Seal rings
2. Cover halves
3. Hubs
4. Gridmembers
5. Gasket
6. Alemite grease fittings

Figure 2-20.—Falk Type-F Steelflex coupling.

When it is necessary to disconnect the coupling and remove the nuts and bolts. Separate and draw back the cover halves, remove the grid-member. To remove the grid-member, a round rod or screwdriver that conveniently fits into the open loop ends of the grid-member is required. Begin at the open end of the grid-member section and insert the rod or screwdriver into the loop ends. Use the teeth next to each loop as a fulcrum and pry the grid-member out radially in even, gradual stages. Proceed alternately from side to side lifting the grid-member about halfway out until the end of the grid-member is reached. Using the same procedure again, lift the grid-member until the teeth are cleared. This separates the coupling hubs.

Table 2-2.—JP-5 Service Pump Troubleshooting Guide

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
No fuel discharge from pump.	Impeller or suction line clogged.	Backflush pump to clear obstruction. Disassemble pump or suction line and remove obstruction.
Pump fuel discharge at reduced capacity or pressure.	Impeller or suction line partially clogged.	Backflush pump to clear obstruction. Disassemble pump or suction line to remove obstruction.
	Air leakage in mechanical seals.	Check mechanical seals. Replace defective mechanical seals.
	Wearing rings worn.	Replace defective wearing rings.
	Impeller damaged.	Replace impeller.
	Casing gasket defective.	Replace defective casing gasket.
Pump starts then stops fuel discharge.	Air leakage in mechanical seals.	Check mechanical seals. Replace defective mechanical seals.
Pump binding.	Impeller clogged.	Backflush pump to remove obstruction. Disassemble pump. Remove obstruction from impeller.
	Wearing rings worn or damaged.	Check wearing rings. Replace defective wearing rings.
	Impeller damaged.	Replace defective impeller.
	Pump and motor shafts misaligned.	Check pump and motor shaft alignment and align shafts.
	Pump shaft bent or warped.	Replace pump shaft.
	Bearings worn.	Check bearings. Replace defective bearings.
Pump noisy or vibrates excessively.	Pump bearings or motor bearings are worn.	Check defective pump or motor bearings. Replace pump or motor bearings.
	Impeller binding or obstructed.	Backflush pump to remove obstruction. Disassemble pump. Remove obstruction from impeller. Replace impeller.
	Pump and motor shafts misaligned.	Check pump and motor shaft alignment and align shafts.
	Pump shaft bent or warped.	Replace pump shaft.
	Mounting bolts loose or broken.	Tighten or replace mounting bolts.

Before re-assembly, clean all parts thoroughly and check the coupling alignment in accordance with the pump's technical manual.

After the coupling is aligned, carefully insert the gasket between the hubs and hang it on either hub. Do not damage the gasket. Next, force as much lubricant as possible into the space between the hubs and grid-member grooves.

Insert the grid-members. To accomplish this with a minimum amount of spreading, start the grid-member at either end and tap the rungs only part way into the grooves. After all the rungs are partially in their respective grooves, tap the grid-member all the way into place. The hub grooves on each hub are uniformly spaced and do not require matching. Again pack lubricant in the spaces between and around the grid-member, then wipe off the excess flush with the top of the grid-member. Lightly oil the hubs to ease the sliding of the covers onto the hubs. Mount the covers so the lubrication fittings are 180 degrees apart. Insert a screwdriver under the seal ring for venting purposes and then tighten the cover bolts. Remove the screwdriver, check the seal rings for proper seating, and align the cover to prevent wobble.

THEORY OF OPERATION.—The spinning impeller causes fuel to leave the discharge chamber of the pump. This creates a suction that causes a continuous flow of fuel to the pump. Fuel from the service tank simultaneously replenishes the fuel that leaves the suction chamber as long as the pump has a positive suction head. Centrifugal pumps WILL NOT draw suction. Fuel in the suction chamber enters the center part of the impeller. The blades of the impeller propel the fuel toward the discharge chamber walls by centrifugal force. The expanding spiral shape of the discharge chamber slows the fuel, which increases the pressure and creates a continuous flow through the pump. Flow is continuous as long as there is enough fuel at the suction side, air does not enter the pump, fuel discharge is not restricted, and the impeller rotates at the rated speed.

MAINTENANCE.—Maintenance on the JP-5 centrifugal service pump is done in accordance with PMS and the applicable technical manuals.

TROUBLESHOOTING.—Table 2-2 lists typical malfunctions, probable causes, and corrective action for the JP-5 service pump.

Rotary Vane

Blackmer is the most commonly used rotary vane pump (fig. 2-21) in the JP-5 below decks system. These pumps come in different sizes with different operating

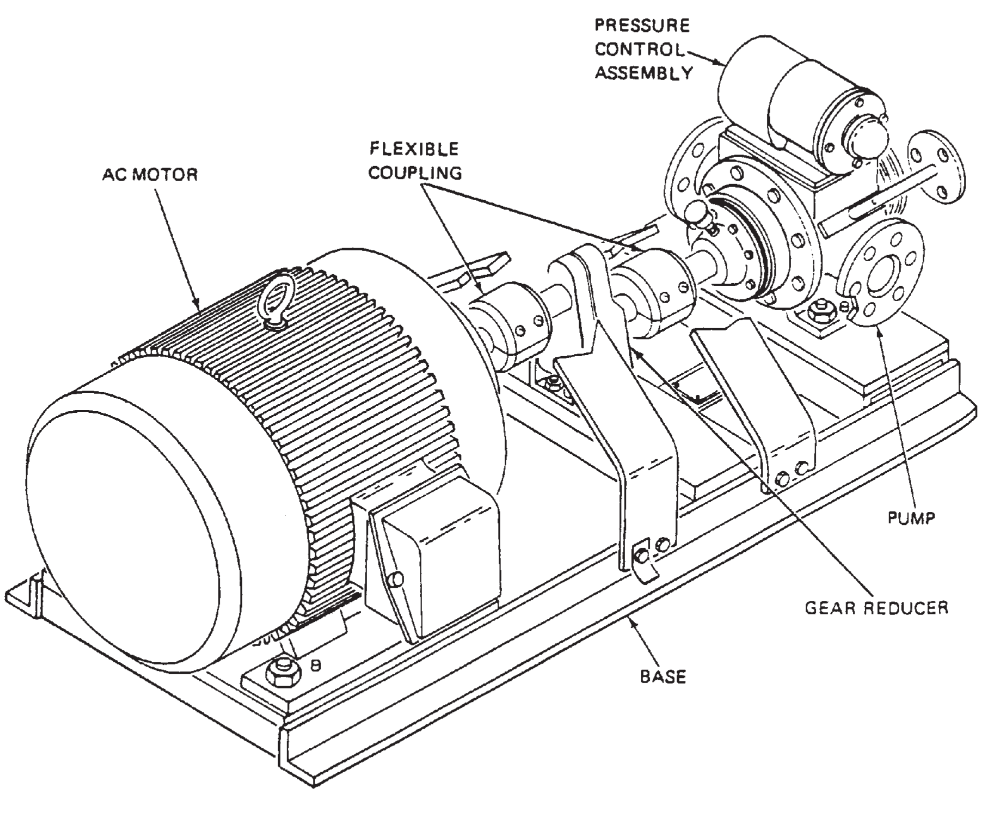


Figure 2-21.—Blackmer rotary vane pump.

capacities and are used as transfer pumps, auxiliary pumps, stripping pumps, and on the flight deck as defuel pumps. Each pump may vary slightly, but all are practically identical.

The Blackmer (fig. 2-22) is a positive displacement, rotary vane type pump. The pumps used for stripping are designed to pump 50 gpm at 50 psi. The pumps used for transfer are designed to pump 200 gpm at 50 psi or 300 gpm at 50 psi.

The 300 gpm at 50 psi Blackmer transfer pump (fig. 2-23) is used to accommodate the newer 300 gpm rated centrifugal purifiers (Model B214-AS300). The operation and components of the 300 gpm Blackmer transfer pump is the same. The basic difference to these pumps is the size, arrangement to the pump (fig. 2-24) and its motor; the flexible coupling is used to inter-connect the motor and the pump. Some 200 gpm and 300 gpm Blackmer pumps use a drive belt (almost

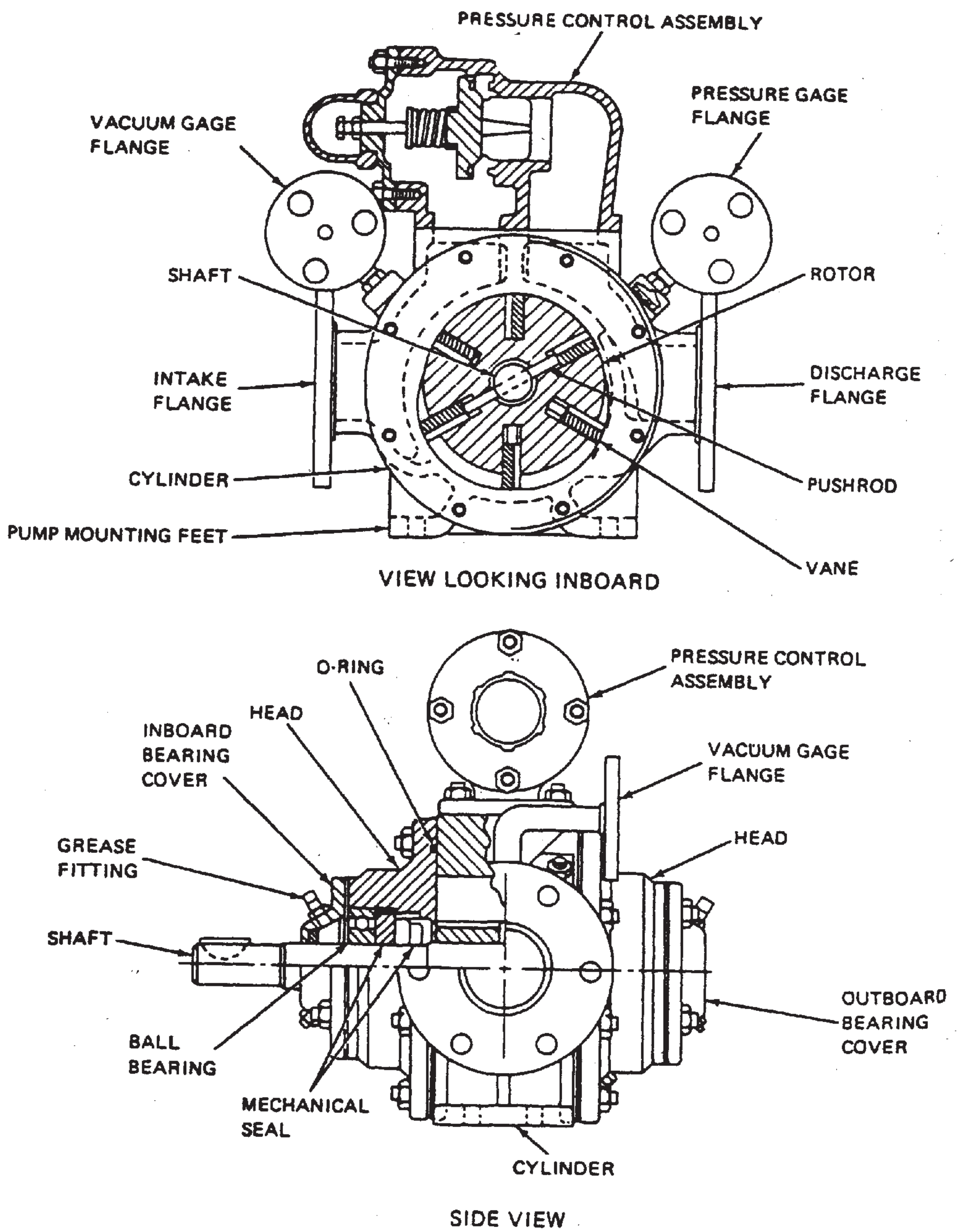


Figure 2-22.—Blackmer rotary vane pump (component layout).

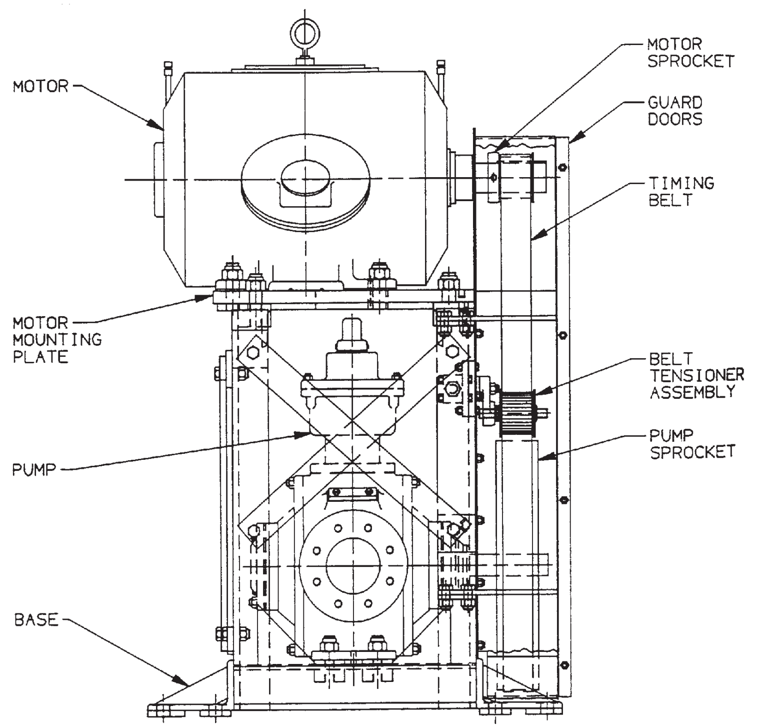


Figure 2-23.—300 gpm Belt-driven Blackmer rotary vane pump.

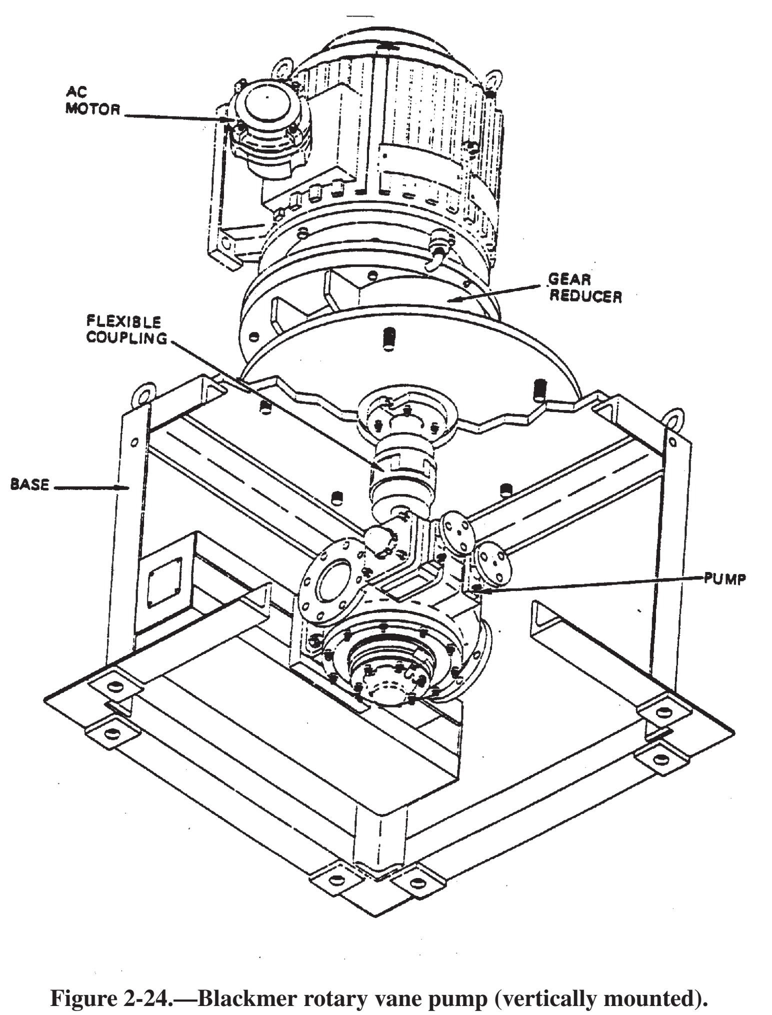


Figure 2-24.—Blackmer rotary vane pump (vertically mounted).

identical to an automobile fan belt) with sprockets to provide power from the motor to the pump.

As with the timing belt of an automobile, when the belt loosens or is not at its proper tension, it must be tighten. The belt driven rotary vane pump adjustment or maintaining proper tension to the belt is much easier compared to the flexible coupling method.

Follow these steps in determining proper belt tension (refer to fig. 2-25) as needed:

1. Ensure that the pump is de-energized and tagged “Out of Service”
2. Remove belt guard door(s).
3. Inspect timing belt for missing/worn teeth.
4. Inspect belt for cracking and peeling.
5. Inspect timing belt for dirt, grease, and foreign matter.
6. Verify timing belt deflection does not exceed 1”, need to use a 2 pound scale to determine proper deflection on the belt, (see fig. 2-25, View A).
7. Place straight edge across face of pump and motor sprocket (see fig. 2-25 View A).
8. Measure gap between pump sprocket and straight edge.
9. Verify gap between motor sprocket and straight edge.
10. Reinstall belt guard door(s).
11. Remove “Out of Service“ tags.

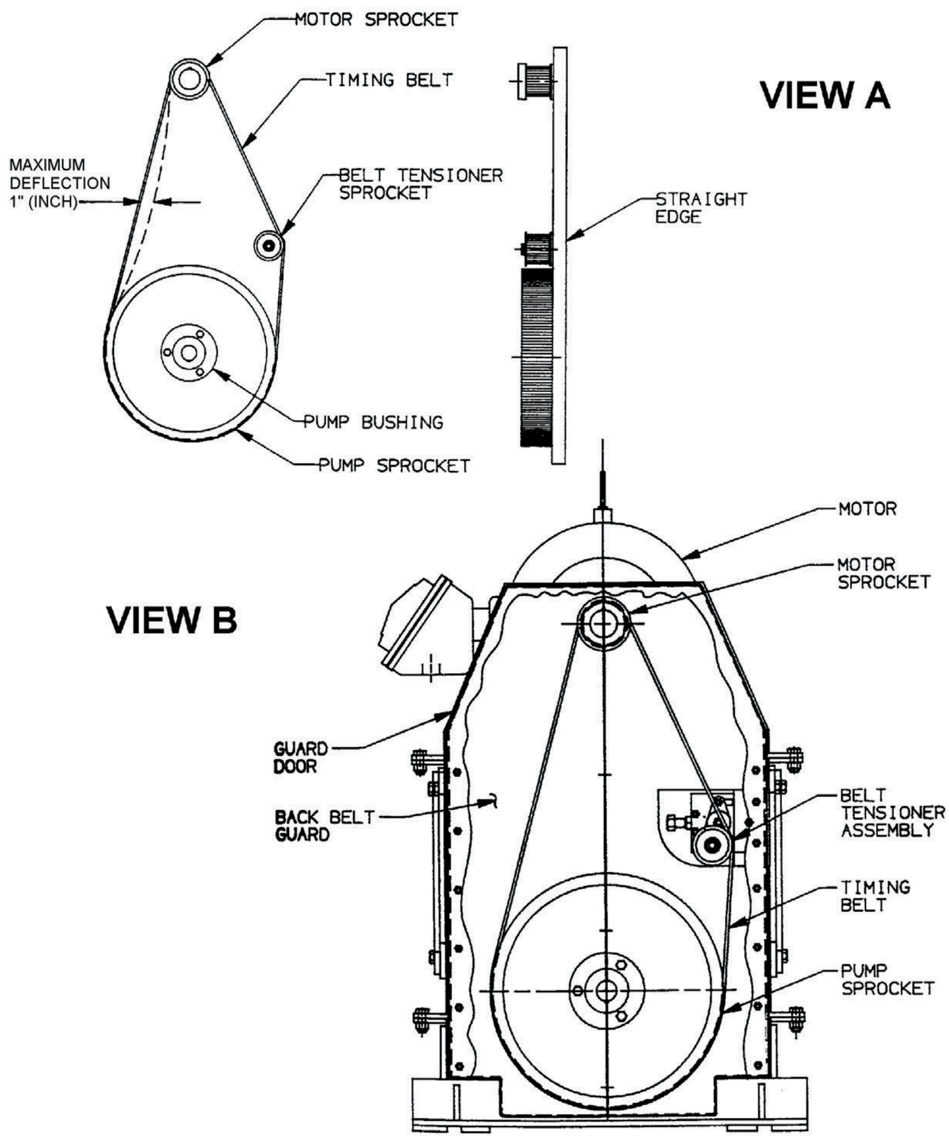


Figure 2-25.—Blackmer belt driven pump: A. Belt alignment; B. Alignment components.

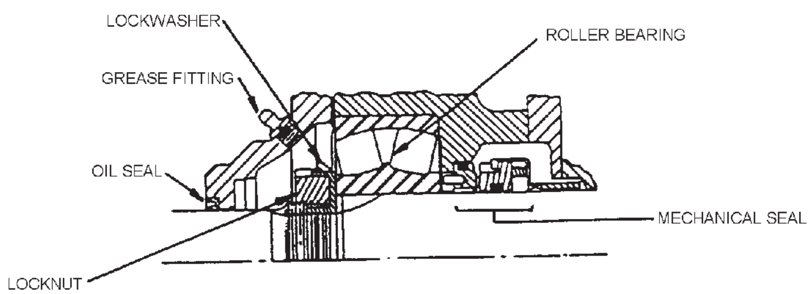
The maintenance on the belt driven Blackmer pump is relatively simple and easy to maintain, consult applicable PMS card and technical manual for proper belt tension.

CYLINDER AND HEAD ASSEMBLY.—The cylinder (pump casing) houses and provides a working area for the rotor and shaft assembly. The cylinder is machined to form an egg-shaped cylinder bore. The inlet and discharge ports are cast integrally with this section of the pump. The pressure control valve, located on the top of the pump, is cast integrally with the upper portion of the cylinder bore. Each side of the cylinder has machined recesses to ensure perfect fit of the cylinder heads.

The cylinder heads (fig. 2-26), one for each side of the pump, house the ball bearings and mechanical seals (fig.2-26, View A). An O-ring (fig. 2-26, View B) is installed between the cylinder heads and the cylinder to prevent leakage.

The ball bearings (fig. 2-26, View A), located in the bearing housing within each cylinder head, support and ensure free rotation of the rotor and shaft assembly, and maintain the proper clearance between the rotor and upper position of the cylinder bore. A bearing cover, with a grease fitting (fig. 2-26, View A) at the top and a grease relief fitting at the bottom (fig.2-26, View B), is bolted to the end of each cylinder head.

VIEW A



VIEW B

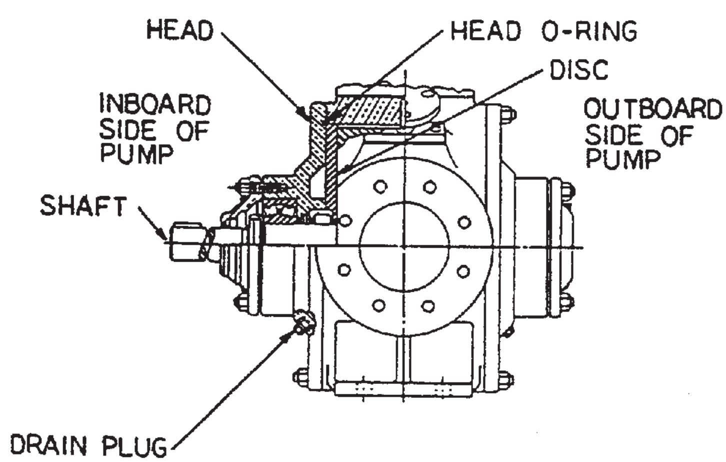


Figure 2-26.—Rotary vane pump: A. Cylinder head; B. Pump casing.

The mechanical seal installed in each head prevents leakage of fluid along the shaft into the bearing housing. A telltale drain hole (fig. 2-26, View B), located directly under the bearing housing, is provided on the underside of each head. These holes are intended to serve as an indication of leakage by the mechanical seal.

ROTOR AND SHAFT ASSEMBLY.—The rotor and shaft is a pressed fit assembly held in place by tapered pins. The rotor is centered in the upper portion of the oval shaped cylinder bore. The rotor has an even number of equally spaced slots that provide the working area for the sliding vanes. Holes are drilled through the rotor and shaft, one between each set of opposing slots, for the installation and working area of the push rods.

The sliding vanes are made of palamite. Relief grooves are provided on the forward face of the vanes to allow the escape of liquid trapped between the vanes and the slots in the rotor.

NOTE

The vanes must face the direction of rotation to allow the escape of fluids into the discharge port.

The pump shaft connects to a gear reducer (see fig. 2-21) shaft by a flexible coupling. The opposite shaft of the gear reducer, is connected to the shaft of the drive motor, and also by a flexible coupling. The purpose of the gear reducer is to mechanically reduce the motor rpm to match the rated rpm of the pump.

PRESSURE CONTROL VALVE.—The pressure control valve (fig. 2-27) is provided to prevent buildup of excessive pressure that might damage the pump or associated equipment. When over-pressurization occurs, the valve directs fluid from the discharge side to the suction side of the pump. It is spring-loaded closed. An adjustment screw adjusts spring tension on the valve disc. Relief pressure is determined based on pump application and piping design. The adjustment screw has a locknut to lock it at the set pressure. The pressure control cap is screwed on the cover to protect the adjustment screw threads.

THEORY OF OPERATION.—The rapid rotation of the shaft and rotor forces the vanes in sliding contact with the cylinder bore by centrifugal force and by push rods. The passage of the vanes through the lower portion of the cylinder bore draws fluid into the pump, and at the same time, forces it out the discharge port (fig. 2-28). Rotary vane pumps are positive displacement pumps. This means they will pump air, which creates a vacuum, causing liquid to be pulled into the suction side of the pump.

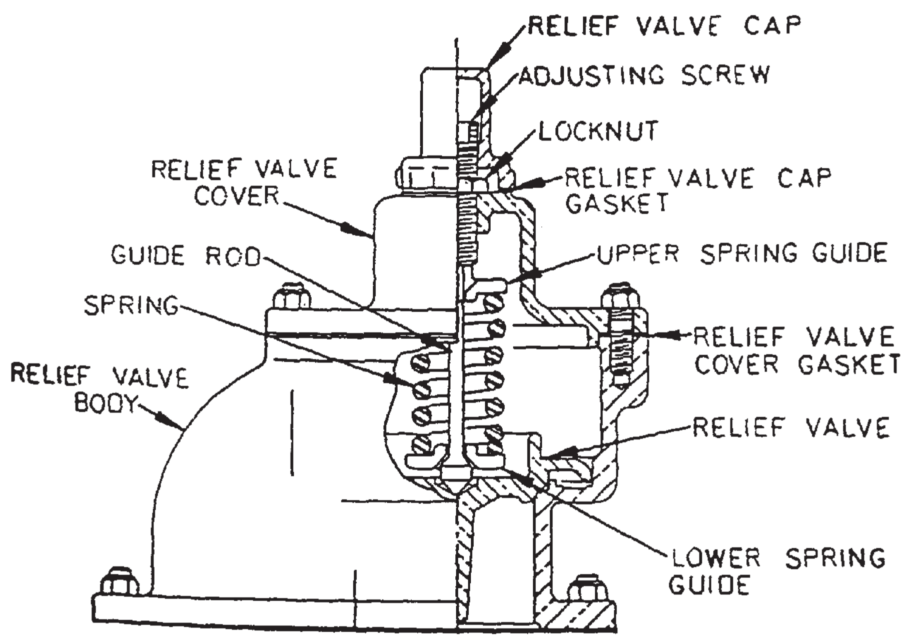


Figure 2-27.—Rotary vane pump pressure control valve.

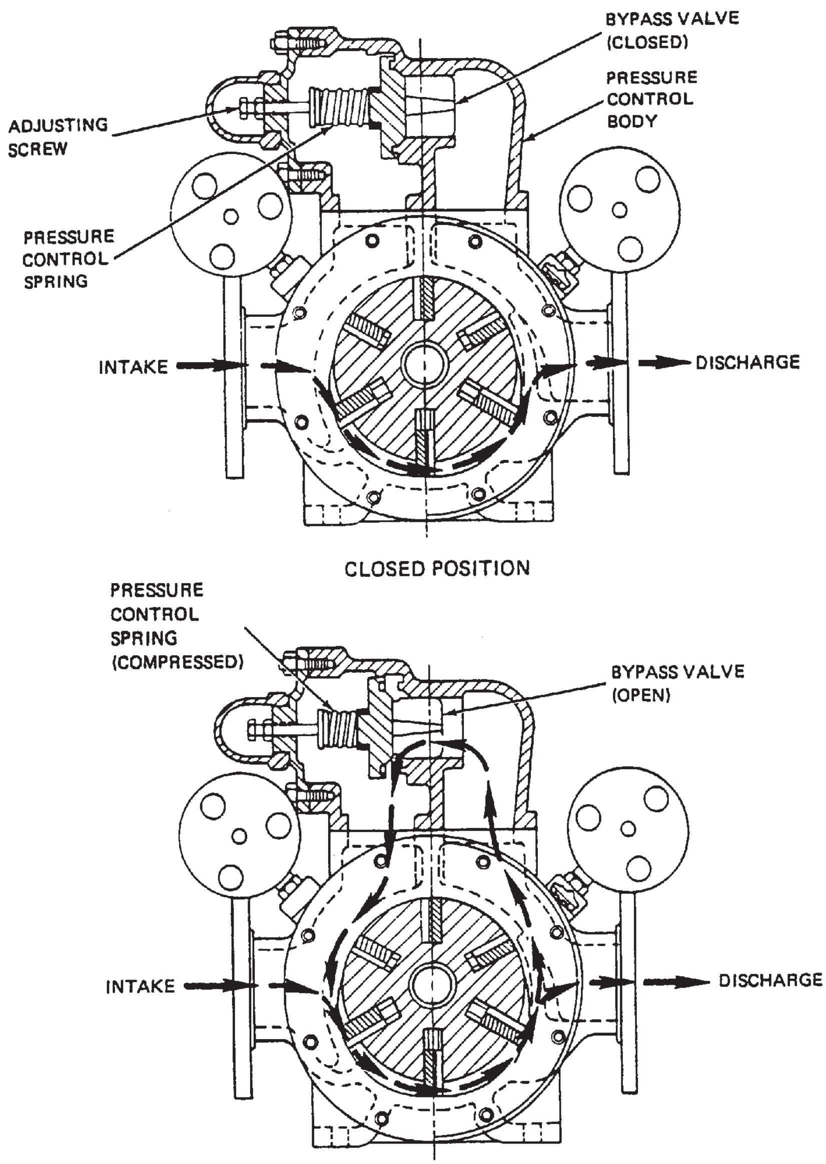


Figure 2-28.—Rotary vane pump (OPEN/CLOSED position).

MAINTENANCE.—Maintenance on the rotary vane pump is done in accordance with PMS and the applicable technical manuals. Typical maintenance includes the following:

LUBRICATION.—Proper lubrication is a MUST but do not over-grease. After lubrication, small amount of grease may escape from the grease relief under the head. This is normal. But, if grease continues to escape, the grease relief fitting should be removed and inspected for damage, or the bearing removed and its grease shield inspected for damage. If grease escapes from around the pump shaft, the bearing cover should be removed and the lip on the shaft seal inspected for nicks, cuts, or distortion. Replace if necessary.

MECHANICAL SEALS.—No maintenance required. Replace if leakage occurs.

HEAD O-RINGS.—If leakage occurs between the head and the cylinder, the head should be removed and both machined faces inspected for burrs, a cut or damaged O-ring, or other imperfections. If the O-ring is damaged in ANY way, replace it.

VANES.—If the vanes are excessively worn, swollen, or jamming in the rotor slots, replace them.

PRESSURE CONTROL VALVE ADJUSTMENT.—Line up the suction side of the pump to a storage tank, opening the required valves. Make sure the pump discharge valve is closed. Start the pump, remove the protective cap, and loosen the locknut. Turn the adjustment screw until the desired pressure is indicated on the discharge pressure gage. Tighten the locknut, replace the protective cap, stop the pump, and secure the suction side piping.

Table 2-3.—Rotary Vane Pump Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	REMEDY
Pump does not deliver or delivers below rated capacity.	Worn vanes. Worn heads or discs. Leaking through P/C valve.	Replace all vanes. Replace heads. a. Lap in valve seat. b. Foreign matter under valve seat. Remove. c. Valve worn out. Replace. d. Spring setting too low to hold valve shut at desired pressure. e. Valve seat worn out; replace cylinder or casing.
Pump is excessively noisy and vibrates during operation.	Worn rotor ends. Defective bearing.	Replace rotor. Replace ball bearings.
Evidences of excessive leakage at tell-tale drain holes in heads.	Defective mechanical seal at end evidencing leak.	Replace seals as required.
Excessive grease leakage around pump shaft.	Defective grease seal.	Replace seals as necessary.

TROUBLESHOOTING.—Table 2-3 lists typical malfunctions, probable causes, and corrective action for rotary vane pumps.

PUMP COUPLINGS

Most aviation fuel pumps are equipped with a type of flexible coupling. This coupling allows connection of the pump and motor (or gear reducer) shafts with a minute amount of misalignment. The flexibility of the coupling is normally gained from a gear, a spring arrangement, or a rubber insert between the coupling halves. Depending on the type of coupling, lubrication may or may not be required.

Lovejoy Coupling

The Lovejoy coupling (fig. 2-29) mechanically links the shaft of the pump to the shaft of the motor (or gear reducer). The coupling is made of two bronze

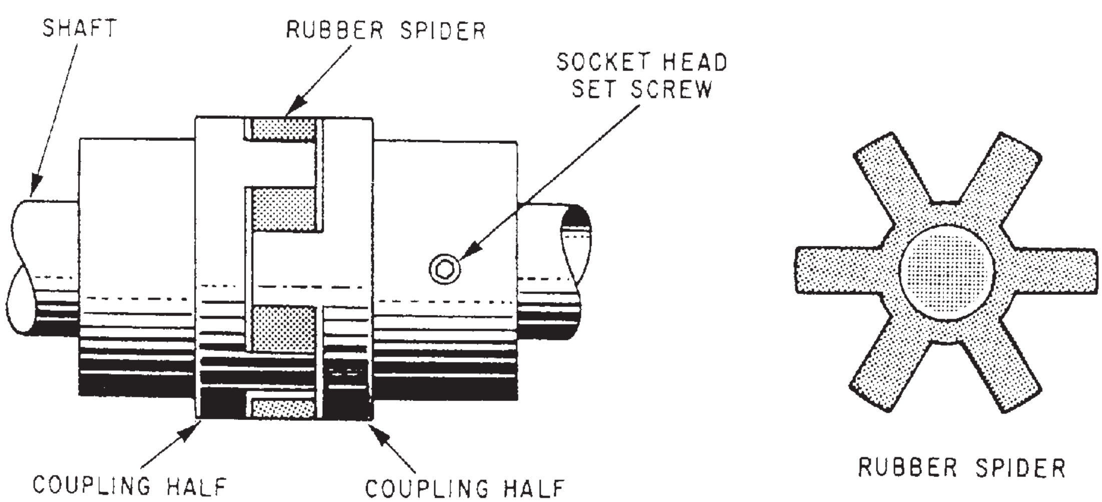


Figure 2-29.—Lovejoy coupling.

coupling halves. The coupling is keyed to the shaft and held in place by socket-head setscrews. The coupling halves is cushioned by a formed rubber spider. It also separates the coupling halves. This rubber separation reduces wear on the coupling halves.

When the re-assembly of any component of the pump unit involves re-coupling, the coupling should be checked for misalignment using a straightedge and feeler gage. As different pumps have different size couplings that require different clearances, consult the specific pump technical manual for proper clearance of your specific coupling. When adjusting the couplings, make sure each section of the coupling is tightly anchored to its respective shaft and that both sections are butted together with the correct space (according to the specifications in the technical manual) between the coupling sections and the rubber spider. The Lovejoy coupling requires no lubrication.

Rex Chain Coupling

The Rex chain coupling (fig. 2-30) mechanically links the shaft of the pump with the gear reducers on motor driven stripping pumps. Each shaft has a toothed gear attached and, when both shafts are aligned, a chain is placed around both gears, connecting both halves. It resembles small bicycle sprockets placed side by side with a double-wide chain connecting the two.

Although periodic inspection and lubrication are required, the main advantage is its ease of removal and alignment. The gears and chain are steel and can break if hit with a hammer. Therefore, do NOT use force. When installing a Rex chain coupling, if you feel force is needed, you are doing something wrong.

Q2-8. What are the two main purpose of the wearing rings of the centrifugal service pump?

Q2-9. What is the function of the mechanical seals of a centrifugal service pump?

Q2-10. In the JP-5 fuel system, what type of pump is used as transfer pumps, stripping pumps and flight deck defuel pumps?

Q2-11. What is the rated capacity and operating pressure of the transfer pump used in conjunction with the Model B214AS-300 Purifier?

Q2-12. What type of material are the sliding vanes to the rotary vane pump made of?

Q2-13. What component(s) of the rotary vane prevents leakage from occurring between the cylinder heads and cylinder?

Q2-14. Which type of flexible pump coupling uses a gasket and two seal rings fitted to its covers to prevent grease leakage?

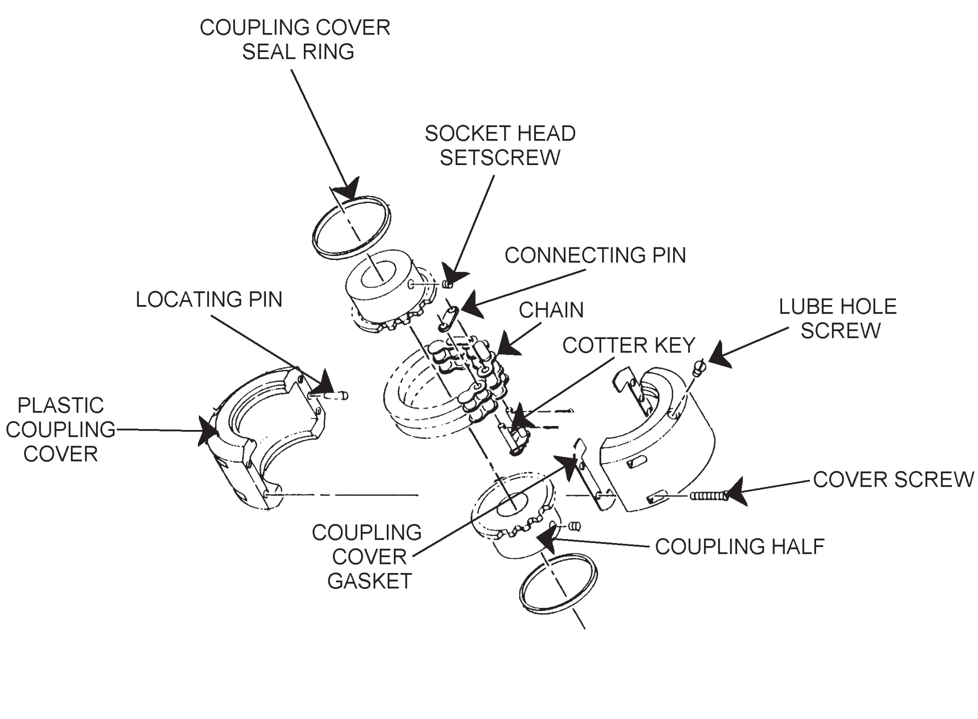


Figure 2-30.—Rex Chain coupling.

Q2-15. Which type of flexible pump coupling resembles a small bicycle sprocket placed side by side, with a double-wide chain connecting the two coupling halves?

JP-5 FUEL SYSTEM VALVES AND VALVE MANIFOLDS

LEARNING OBJECTIVES: Identify the different types of valves and valve manifolds installed in the JP-5 below decks system. Describe internal components, their function, operation and maintenance performed.

VALVES

Several types of valves are used in the JP-5 systems. Typically, the valves used in the filling and transfer system are of the gate type. Most discharge valves on pumps are of the globe type. Distribution piping may contain gate, globe or butterfly. Newer ships may have limitorque valve operators in their system. In the following paragraphs, we will discuss the various type valves, their description and construction, and their normal use. How these different types of valves are inter-connected to the various valve manifolds. Know the type of valves and manifolds installed in your system and their location.

Gate Valves

A gate valve (fig. 2-31) is used where a straight flow with a minimum amount of restriction is desired. Gate valves are not designed for and cannot be used for throttling. Most gate valves have a wedge-shaped gate, but some have a gate of uniform thickness. The gate is connected to the valve stem and is positioned by rotating the hand-wheel. The port is the full size of the pipe and extends through the valve.

Some types of gate valves have a rising stem, and a glance at the valve will tell whether it is open or closed. In the type of valve with the non-rising stem, the stem revolves in the bonnet and the gate is raised or lowered by the threads on the internal end of the stem. On this type of valve, a pointer is usually installed to indicate the open or closed positions.

Gate valves operate properly with either face on the inlet side, thus simplifying installation. Case or forged steel valves have disks and seats made of nickel-copper alloy, chromium steel, or steel treated with a hard facing material. Valve stems are made of corrosion resistant steel. Hand-wheels are made of fabricated steel, brass,

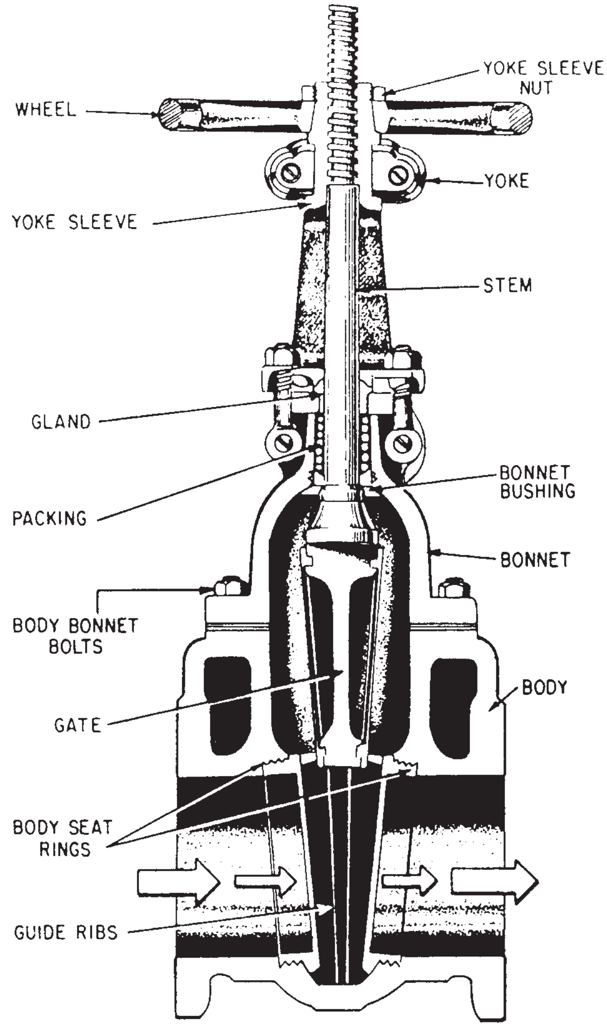


Figure 2-31.—Gate valve.

or aluminum. Except for malleable iron or aluminum hand-wheels, bronze gate valves are made entirely of bronze.

> **NOTE**
>
> It is a good practice to put a gate valve back together the same way it came apart. Although the valve operates with either face on the inlet side, after installation and use in a specific flow pattern, one side of the valve may wear a little differently from the other. To ensure a tight fit and smooth operation, put it back the same way it came out.

Globe Valves

Globe valves (fig. 2-32) are so called because of the globular shape of their bodies. It must be noted but, that

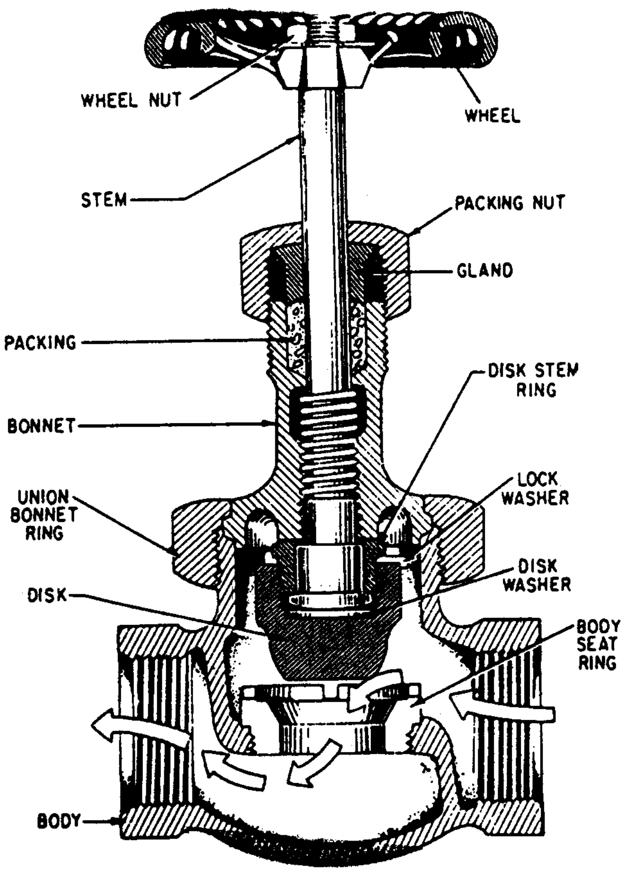


Figure 2-32.—-Globe valve.

other types of valves also may have globe shaped bodies. Therefore, the name does not always describe the valve properly.

In a globe valve, the disk is attached to the valve stem and seats against a seating ring or seating surface that shuts off the flow of fluid. When the disk is moved off its seat, fluid can pass through the valve. Globe valves may be used to limit fuel flow through the valve (called throttling) by partially opening the valve to meet the desired flow. Globe valves are most commonly found on pump discharges, tank manifolds, JP-5 purifier discharges, and any other place where there is a need for throttling fuel flow.

Globe valve inlet and outlet openings are arranged in several ways and are used to suit the requirements of the flow. There are three common types of globe valve bodies. In the straight body, the inlet and outlet openings are in line with each other. In the angle body, the inlet and outlet openings are at an angle to each other. The cross globe valve has three openings instead of two, and is frequently used in connection with bypass piping.

High Performance Butterfly Valves

The high performance butterfly valve (fig. 2-33) used in the JP-5 system is designed specifically for

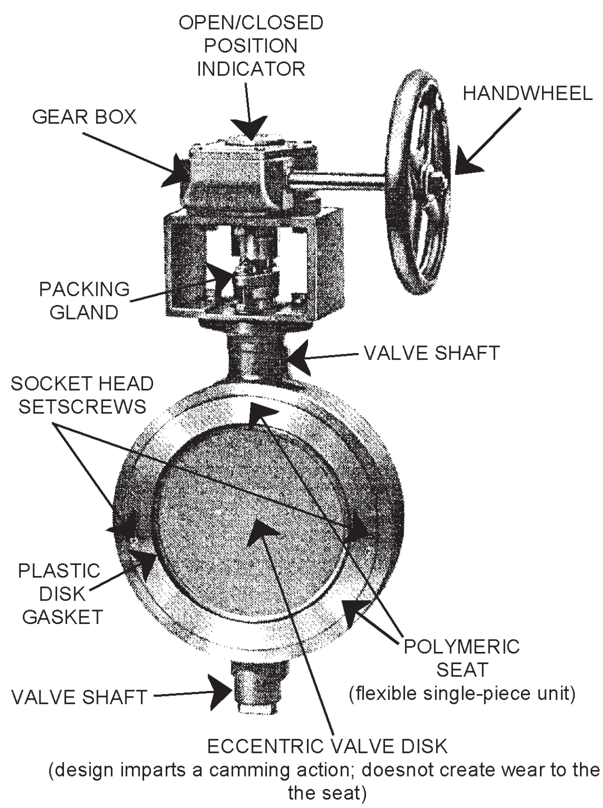


Figure 2-33.—High performance butterfly valve.

flammable liquids or other hazardous materials. If a fire guts a piping system or space where these valves are located, and the fire is hot enough to melt a special sealing element, a secondary metal sealing takes place providing effective shut-off of fluid flow through the piping. No feeding of the fire can take place.

The high performance butterfly valve has a single-piece flexible polymeric seat that is pressure energized to assure positive shutoff. The seat is so designed that is compensates for pressure and temperature changes as well as for wear. The design also allows no metal to metal contact during regular operations. Also contributing to the valve's effectiveness is, it offsets shaft and eccentric disk design that impart a camming action to the disk. This feature causes the disk to swing completely out of contact with the seat upon opening, eliminating wear points at the top and bottom of the seat.

This arrangement allows replacement of the valve seat if it is ever required, by simply removing the body insert and then replacing the seat. You do not have to disassemble the shaft or disk. With no requirement to remove the shaft and disk, repair time is cut dramatically.

As with the gate valve, the high performance butterfly valve allows fluid flow in either direction. High performance butterfly valves are normally used as isolation valves in distribution piping, but they may be used nearly anywhere.

Limitorque Valve Operators

On newer CVNs, numerous valves have limitorque valve operators. Limitorque valve operators (fig. 2-34 and 2-35) open and close gate and globe valves from a

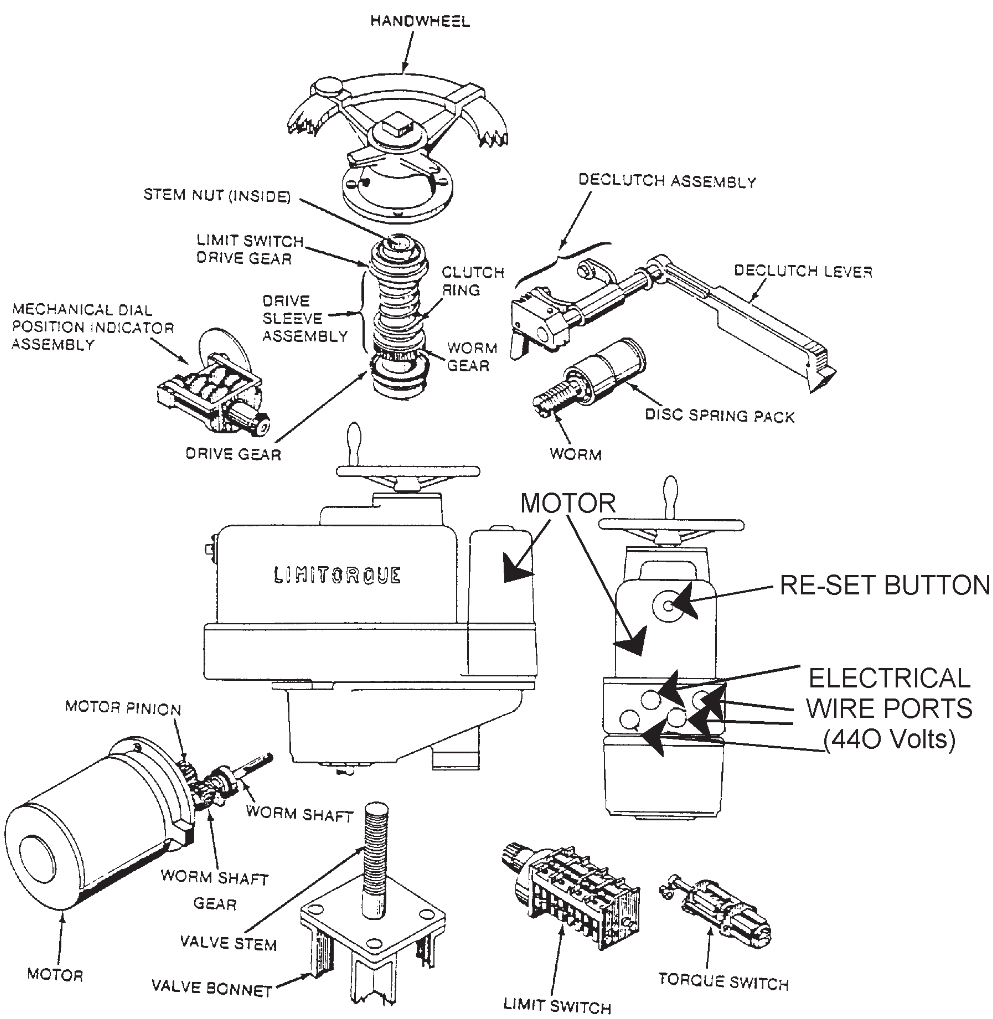


Figure 2-34.—Limitorque valve operator.

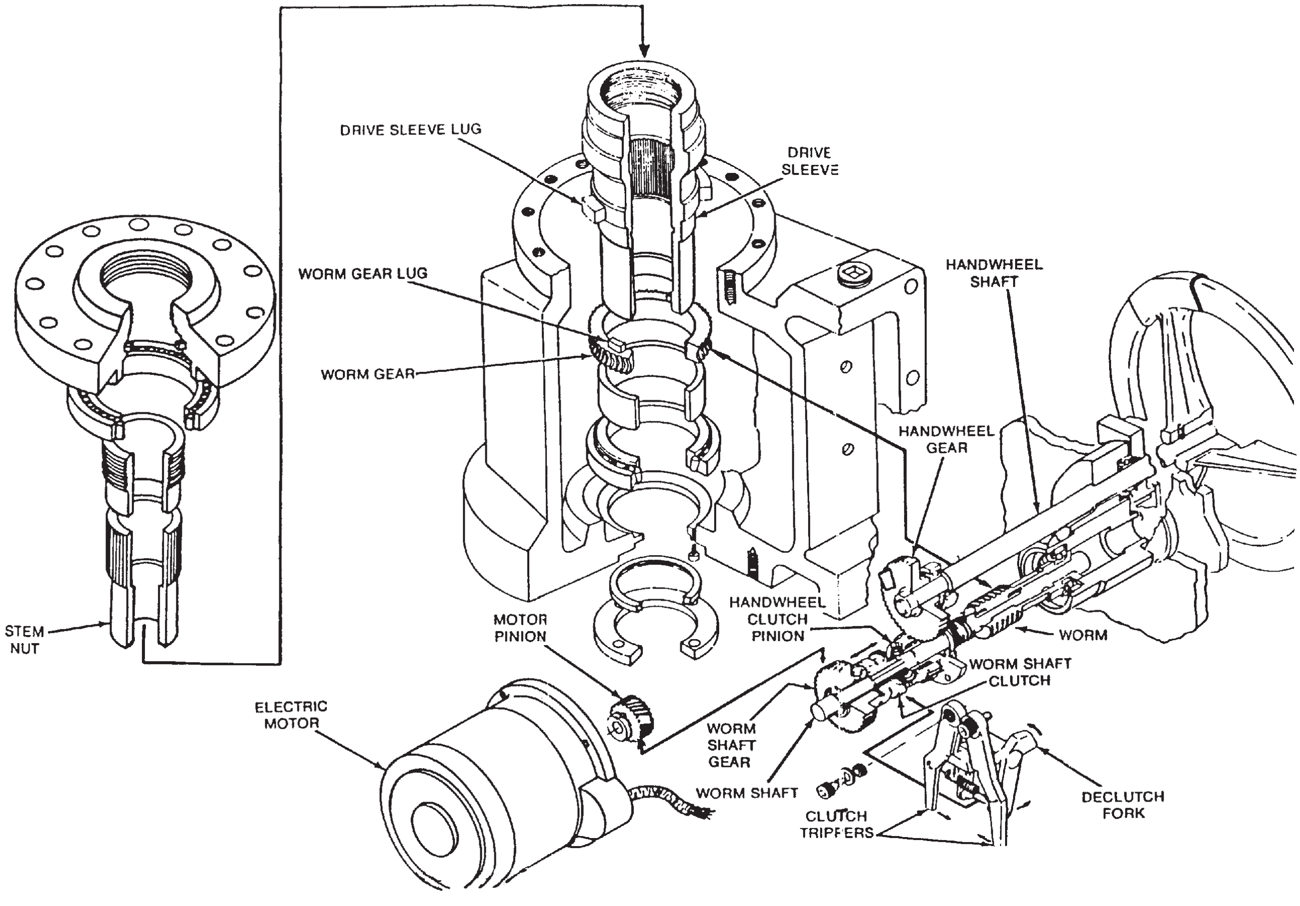


Figure 2-35.—(cont'd) Limitorque valve operator.

remote location, the pumproom console (which will be discussed later in this chapter).

Each limitorque, in addition to operating a valve, also controls and limits the opening and closing travel of the valve. A torque limit switch on the limitorque protects all operating valve parts from overload by limiting the torque and thrust loads applied to the valve. It also provides a constant seating thrust, thus assuring the valve is tight on each closure. This seating thrust can be varied by a fine adjustment on the torque limit switch. The torque limit switch operates and disconnects the source of motive power should an obstruction be met while the valve is being closed.

Limit switches on the limitorque govern valve disk travel in the opening and closing directions of valve stem travel. The switches also operate position indicator lights for both the open and closed position of the valve. In case of motor failure, the limitorque unit can be operated manually by use of the hand-wheel. To prevent accidental operator injury, a motor de-clutch mechanism disengages the hand-wheel when the motor is energized.

Limitorque valves may be used in the following areas:

— Valves in manifolds serving JP-5 storage tanks

— Valves for filling JP-5 service tanks

— Valves taking suction from JP-5 service tanks

— Selected cut-out valves in all three sub-systems

— Selected valves in the drainage and ballast system

Description and Components of the Limitorque Valve Operator

There are three designs of the limitorque valve in use; LT-130, LT-150 and LT-550. The operational description is basically the same for each valve. The limitorque valve consists of the following components; motor, torque, hand-wheel, and drive assemblies.

Motor:

- Drives actuator.
- Operates on 440 volts, reversible motor.
- Contains a spur pinion gear on output side of motor.
- Controlled by console operator.
- Mounted with the unit.

Torque Assembly (Torque Actuating Shaft):

- Driven by pinion on motor.
- Geared to motor with ACME-type screw threads.
- Supported by two (2) ball bearings (torque actuating shaft threads and pinion mounted needle type thrust bearing between the gear and thrust washer).
- Prevented from moving up and down by Belleville Springs.

Belleville Springs:

1. Located on the bottom of torque shaft.
2. Stacked 10 springs to a series.
3. Calibrated to withstand a pre-determined amount of torque, before allowing movement.

- Pinion splined to torque shaft drives hand wheel.

Torque Limit Switches

1. Located on a plate above the torque-actuating shaft.
2. Limits the amount of torque that may be applied to the valve disc by the operator.
3. Operated mechanically when the torque becomes stronger than Belleville springs, to shut off motor.

Hand wheel Assembly:

- Driven by pinion gear splined to the torque-actuating shaft.
- Supported by two (2) ball bearings.
- Shaft is threaded to receive traveling nuts.

Traveling Nuts (2 Nuts):

1. Threaded to hand wheel shaft.
2. Regulate vertical travel of the valve stem (upper and lower Limit).
3. Activates micro switches.

a. 3 micro switches each are install at the top of travel and at the lower end of travel.

b. Only one (1) upper and one lower micro switch is used to de-energize the motor.

c. The remaining micro switches are used for auxiliary purposes.

(1) Root Valves.

(2) Indicating lights.

(3) Traveling nuts **must** be adjusted to open and close the limit switches immediately prior to the torque actuating switch being activated.

(4) Once adjusted, the traveling nuts will trip the limit switches at the same time.

- Contain motor declutch mechanism.
- Hand wheel clutch provides for manual operation of the valve.
- Pinion gear on hand wheel shaft, turns drive sleeve.

Drive Assembly:

- Geared to hand wheel by pinion gear.
- End of drive sleeve is hexagonal.
- Slips onto hexagonal nut on valve stem to link actuator and valve together.

The maintenance on the limitorque valve is contained in its applicable technical manual and assigned PMS. Table 2-4 lists some probable causes and symptoms to the limitorque valve, also listed are remedies to correct the problem. Always consult the applicable technical manual for any problems that arises and beyond the scope of this manual.

To the ABF, the limitorque valve operator is a valuable asset as long as it is operating and used correctly.

Table 2-4.—Limitorque Valve Troubleshooting Tips

Symptoms	Immediate Action	Probable Cause	Remedy
1. All indicator lights extinguished.	None.	1. Electric power off. 2. Blown fuse(s). 3. Lamp burned out. 4. Defective transformer. 5. Limit switch defective or maladjusted.	1. Restore power at ship's service power panel. 2. Replace fuse(s). 3. Replace lamp. 4. Replace transformer. 5. Refer to technical manual.
2. Motor fails to start.	1. Turn off power.	1. Blown fuse(s). 2. Overload relay contacts tripped open. 3. Defective contactor. 4. Defective push-button. 5. Defective or maladjusted limit switch. 6. Open or short circuit in motor.	1. Replace fuse(s). 2. Reset overload relay. 3. Replace contactor. 4. Replace push-button assembly. 5. Refer to technical manual. 6. Replace motor.
3. Motor shuts off and will not restart.	1. Use valve operator hand wheel to operate valve.	1. Overload relay contacts tripped open. 2. Valve binding or blocked by foreign matter. 3. Defective torque switch.	1. Reset overload relay. 2. Refer to valve technical manual. 3. Refer to technical manual.
4. Overload relay trips repeatedly.	1. Use valve operator hand wheel to operate valve.	1. Motor defective. 2. Improper size overload heater coils. 3. Excessive friction in the valve operator. 4. Excessive friction in the motor operator. 5. Damaged or defective reach rod. 6. Defective or broken mechanical components in valve operator.	1. Replace motor. 2. Replace heater coils in overload relay, using proper size for motor nameplate full load current. 3. Lubricate valve operator. 4. Refer to technical manual. 5. Refer to reach rod repair instructions. 6. Replace defective or broken components.
5. Motor overheats.	1. Stop motor. 2. Use valve operator hand wheel to operate valve.	1. Motor defective. 2. Excessive friction in valve operator. 3. Excessive friction in motor operator. 4. Damaged or defective reach rod. 5. Defective or broken mechanical components.	1. Replace motor. 2. Lubricate valve operator. 3. Refer to technical manual. 4. Refer to reach rod repair instructions. 5. Replace defective or broken components.
6. Excessive force required for manual operation.	None.	1. Valve binding or blocked by foreign matter. 2. Excessive friction in valve operator. 3. Excessive friction in motor operator. 4. Damaged or defective reach rod. 5. Defective or broker mechanical components in valve operator.	1. Refer to valve manual. 2. Lubricate valve operator. 3. Refer to technical manual. 4. Refer to reach rod repair instructions. 5. Replace defective or broken components.
7. Motor stops before valve is fully open or fully closed.	1. Use valve operator hand wheel to operate valve.	1. Valve binding or blocked by foreign matter. 2. Limit switch maladjusted. 3. Torque switch maladjusted or defective.	1. Refer to valve manual. 2. Refer to technical manual. 3. Refer to technical manual.
8. Motor or hand wheel turns but valve does not open or close.	1. Discontinue operation.	1. Damaged or defective worm shaft clutch or other gear train component. 2. Reach rod not properly connected. 3. Damaged or defective components in motor operator. 4. Damaged or defective valve components.	1. Replace damaged or defective component. 2. Refer to reach rod instructions. 3. Refer to technical manual. 4. Refer to valve manual.
9. Noisy motor.	1. Stop motor. 2. Use hand wheel to operate valve.	1. Worn, broken, or defective motor components.	1. Replace motor.

Swing Check (One-way) Valves

Swing check valves (fig. 2-36) are designed to prevent back flow by allowing fluid transfer in only one direction in the piping systems.

Swing check valves use a disk that is attached to the valve body by a pinned hinge and is closed by gravity during a no-flow condition. This type valve is sometimes designed with a spring to assist closing the valve. Pressure caused by flow forces the hinged disk up to open the valve. But, pressure in the opposite direction will force the hinged disk back on its seat to close the valve.

The proper positioning of the valve, with reference to the horizontal, is very important to ensure proper check valve operation. Since the downward force of gravity is necessary for proper operation, a check valve installed upside down or at any angle other than horizontal may not function as intended. Also, since this valve allows flow in only one direction, it must be installed correctly. Most check valves will have a flow direction arrow on the body. If no arrow is visible, the inlet side of the valve will be the side with the hinge pin.

VALVE MAINTENANCE

All valves require proper care and maintenance, as does other more complex equipment, to ensure they are kept in optimum working order. The principle difficulties encountered with valves are leakage past the seat and disk, leakage at the stuffing box, sticking valve stems, and loose valve disks.

Losses due to leakage that is not corrected mount up considerably over time. For example, over a period of a month, a small 1/32 inch hole would waste 69,552 cubic feet of air at 100 psi, 3,175 pounds of steam at 100 psi, or 4,800 gallons of fuel at 40 psi. The ABF should know how to prevent and correct these faults.

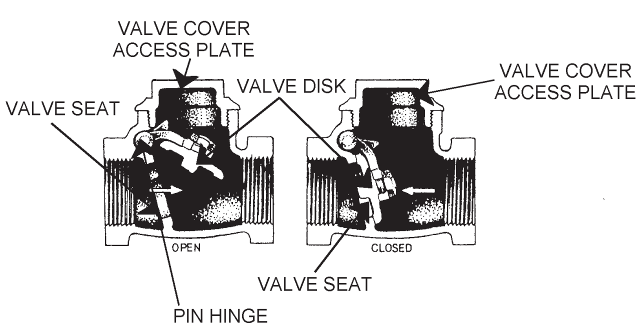


Figure 2-36.—Swing check valve.

Valve Leakage Causes and Remedies

Valve leakage, generally caused by failure of the disk and the seat to make close contact, may result from any of the following:

— Foreign substances, such as scale, dirt, or heavy grease lodged on the valve seat may prevent the disk from being properly seated. If the obstructing material cannot be blown through, the valve has to be opened and cleaned.

— Scoring of the valve seat or disk, which may be caused by erosion or by attempts to close the valve on dirt or scale, results in leakage. If the damage is minimal, the valve may be restored to proper working order by grinding. If the damage is more extensive, the valve must be reseated and then ground.

— A warped disk may result if the guides fit too tightly, if the spindle guide is bent, or if the valve stem is bent. Using a valve disk or body that is too weak for the purpose for which it is used permits distortion of the disk or seat under pressure. If this occurs, replace the valve.

Packing Gland Leakage

Packing gland leaks can be remedied by tightening the gland or re-packing it. But, the gland must not be tightened nor packed so tightly that the stem binds. If the leaks persist after either or both of the remedies are applied, a bent or scored valve stem may be the cause.

Packing for the valve may be either of the string type or of the ring type. String packing is ordinarily used for small valves in low-pressure systems. Ring packing is used for large valves and for all high pressure valves. When replacing the packing on any type of valve, be sure to use the correct size and type. The packing must be large enough to fill the space between the valve stem and the packing box. It also must be made of material that is suitable for the pressure and temperature to which it will be exposed.

To pack a valve with string packing, place successive turns of packing in the space around the rod. Bevel off the ends of the packing to make a smooth fit and tighten the packing gland nut or the bonnet nut to compress the packing. String packing should always be wound in the same direction as the gland nut is to be tightened so tightening the nut does not cause the packing to fold back upon itself. Packing a valve with ring packing, cut the ends of the rings square even, so that they make a level butt joint. Be sure to stagger the joints in successive rings.

In some gate, globe, and one-way check valves, the packing gland may be repacked under pressure, when necessary. These valves are constructed with the stem back-seated against the bonnet when the valve is wide open. High-pressure valves are provided with a pressure leak-off connection. The pressure leak-off connection is sealed to the outside with a pipe plug. Extreme care should be taken to see that the valve is firmly back-seated before the plug is removed. **Normally, re-packing valves under pressure is NOT done by an ABF. If a valve must be repacked under pressure, ensure ALL SAFETY PRECAUTIONS are followed.**

Sticking Valve Stems

There are several of conditions that may cause valve stem troubles. If the packing is packed too tightly, or if the gland nuts are tightened unevenly, the valve stem is likely to stick or bind. Backing off on the gland nuts relieves the packing pressure. Paint or rust on the valve stem, which also causes binding, can be removed by cleaning the stem.

The valve may become stuck if the valve stem threads are burred from rough handling or upset from pressure that has been applied to move sticking and tight valves. Distorted or burred valve stem threads are very serious valve troubles. If the valve cannot be moved by any other method, the bonnet must be removed, the stem cut out of the yoke or bonnet, and a new stem made. If the bonnet or yoke is damaged, it also must be repaired or replaced. If burred or upset threads are detected before the stem becomes stuck, they can be dressed smooth with a file or machined in a lathe. If the sticking is due to a bent valve stem, the stem must be straightened or replaced.

MANIFOLDS

Manifolds are an integral part of the JP-5 below decks systems. They consist of several valves mounted in a compact unit, which provides a means of controlling the flow of JP-5 to and from several tanks at one central location.

Double-Valved Manifolds

Double-valved manifolds (fig. 2-37) control the flow of JP-5 to and from storage tanks that are designated storage or ballast. They give double protection against contaminating the transfer main when the storage tanks are filled with seawater by having two valves for one tanktop. These valves are known as the transfer mainside valve and the tank-side valve.

The manifold HEADER is a section of pipe with several equally spaced holes in the top to accommodate the transfer mainside valves. It is sealed on both ends and has a pipe flange welded to the bottom. This pipe flange is bolted to a section of pipe leading off the transfer-main branch header.

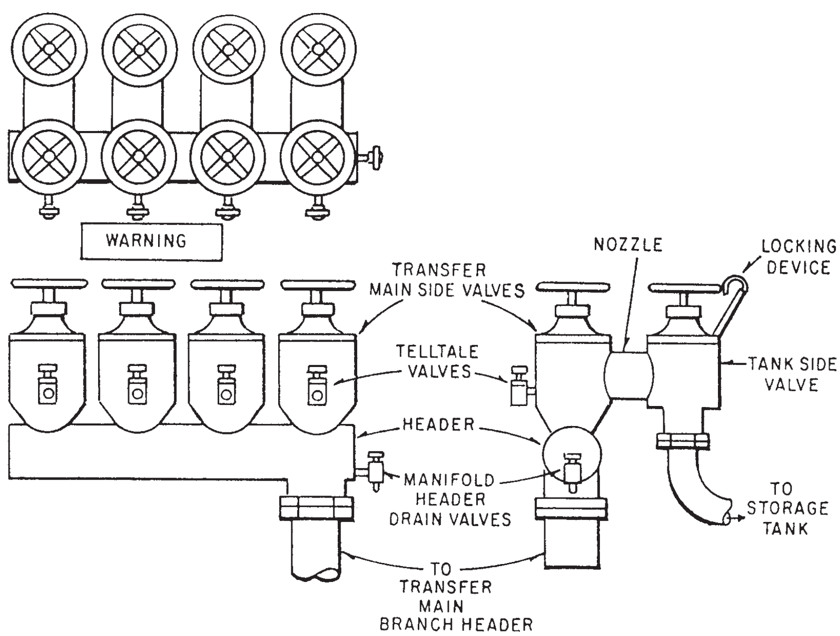


Figure 2-37.—Double-valved manifold.

The transfer mainside valves are specially designed globe valves that are welded to the top of the manifold header (fig. 2-38). They are cylindrical in shape (about 10 inches in diameter) and consist of a body and bonnet. The body houses the seat ring and a guide for the valve disk. Perfect seating of the valve disk with the seat ring, is assured by the disk guide centered in the base of the valve body. The lower section of the valve body is welded to the manifold header. A hole is machined in the back of the valve body (above the valve seat) for attaching the nozzle. On the front of the valve body, a hole is drilled and tapped (also above the valve seat) for installing the telltale valve. The bonnet, which provides a working area for the stem, is bolted to the top of the valve body. Leakage of JP-5 is prevented by a gasket between the valve body and bonnet, and also in the packing of the bonnet gland, around the stem.

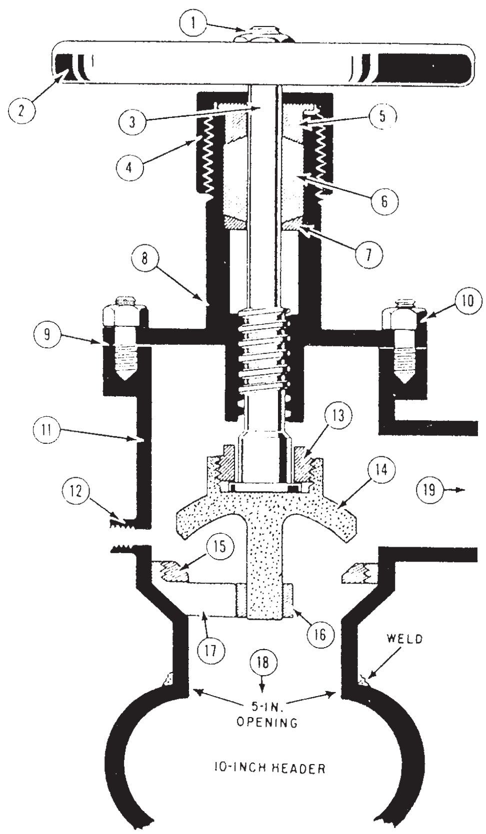
The tank-side valve is identical to the transfer mainside valve, except there is no telltale valve connection and the bottom of the valve body is fitted with a standard pipe flange. The storage tank fill and suction tail pipe is bolted to this flange.

The nozzle is a short section of pipe connecting one transfer mainside valve to one tank-side valve in parallel so the two valves serve only one tank.

The telltale valves are small angle type globe valves installed on the front side of the transfer mainside valves.

NOTE

Most ships are replacing the telltale valve with a GAMMON sample connection. The GAMMON sample connections are less likely to break or leak, and require no maintenance.



1. **Handwheel nut**
2. **Handwheel**
3. **Valve stem**
4. **Packing gland nut**
5. **Gland**
6. **Stem packing**
7. **Gland ring (throat bushing)**
8. **Bonnet**
9. **Bonnet gasket**
10. **Bonnet studs and nuts**
11. **Valve body**
12. **Connection for telltale valve**
13. **Disk nut**
14. **Replaceable disk**
15. **Replaceable seat ring**
16. **Disk guide**
17. **Disk guide ribs (3 equally spaced)**
18. **Connection (to manifold header)**
19. **Nozzle (to tank-side valve)**

Figure 2-38.—Transfer mainside valve (cutaway).

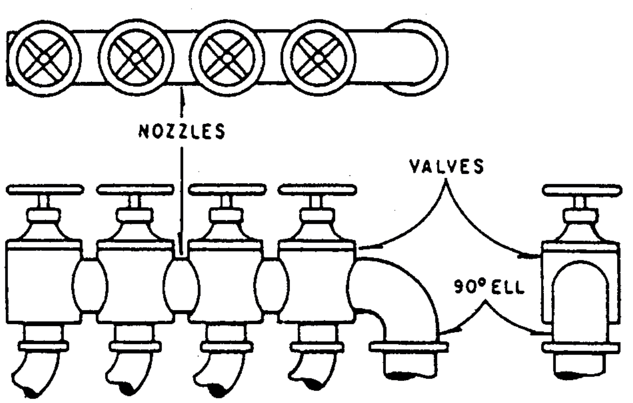


Figure 2-39.—Single-valved manifold.

There is one telltale valve for each set of manifold valves. These valves are installed on the front side of the transfer mainside valves, above the valve seat. They are used to determine the condition of the valve seats. The telltale valves should be opened periodically. If fuel leaks from the valve, it is an indication either the transfer mainside or the tank-side valve is leaking. Both should be inspected as soon as possible and the leaking valve repaired.

The manifold header drain valve is installed at the bottom near one end of the header. It is used to drain the header before maintenance.

A locking device is installed for each of the tank-side valves. It is typically a bar with a rotating hook to fit around and locked to the tank-side valve handle. It is arranged so the valve can only be locked in the closed position. Tank-side valves MUST be locked in the closed position when the tanks are ballast.

Single-Valved Manifolds

Single-valved manifolds (fig. 2-39) control flow of JP-5 to and from storage tanks designated either JP-5 or JP-5 overflow. These tanks are not to be ballast. Single-valved manifolds are also used in the service pump recirculating lines to re-circulate fuel back to the service tank, and as tanktop valves in the stripping system.

The single-valved manifold is nearly identical to the tank-side half of the double-valved manifold with one major exception. Instead of the nozzle connecting it to a transfer mainside valve, the nozzles in a single valve manifold connect to each other. There is NO transfer mainside valve. A minor difference is single-valved manifolds come in different sizes, based on intended use. A 90-degree ell flanged on one end is used to bolt the single-valved manifold to its respective branch header.

Flood and Drain Manifolds

Flood and drain manifolds are located in the stripping system between the single-valved stripping manifolds and the stripping pumps FOR TANKS DESIGNATED AS JP-5 OR BALLAST only. They are designed to direct the flow of liquids to and from the JP-5 storage tanks during the following operations from one central location:

1. When designated tanks are ballast, they direct the flow of sea water from the sea chest supply riser to the single-valves stripping manifold.

2. When designated tanks are deballasted, they direct the flow of ballast water from the single-valved stripping manifold to the main drainage eductor.

3. When the designated tanks are stripped, they direct the stripped liquids from the single-valved stripping manifold to the suction side of the stripping pumps.

A flood and drain manifold (fig. 2-40) consists of a manifold header and three globe type shutoff valves.

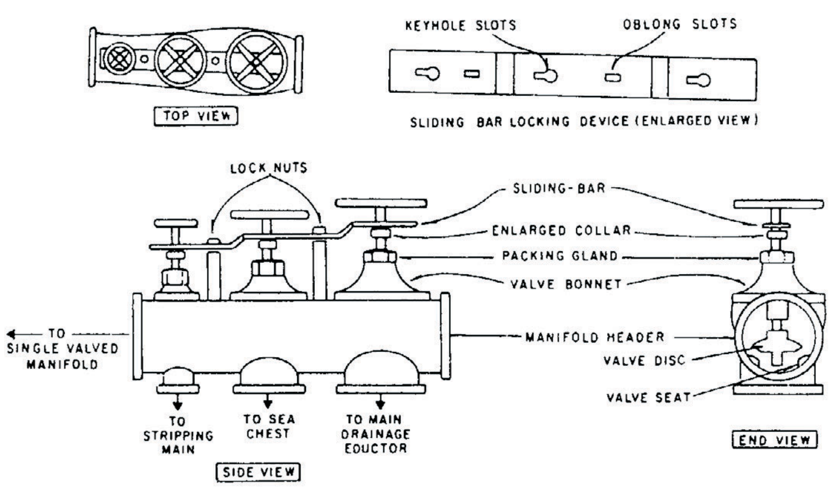


Figure 2-40.—Flood and drain manifold.

The manifold header is a common valve body for all three valves. It contains three valve seats and forms an unrestricted passage between the three valves above the valve seats. One end of the header is bolted to the single-valved stripping manifold. The other end is sealed. The upper part of the header houses the valve bonnet, which provides a working area for the valve stem. A gasket is installed between the bonnet and the header. A packing gland in the valve bonnet prevents liquids from leaking around the stem. The lower part of the header, below the valve seats, has three flanged pipe connections, one for each of the three valves.

The stripping line installed just below the stripping valve seat inter-connects the flood and drain manifold with the stripping main. This line is used only to direct the stripped liquids from the bottom of the JP-5 storage tanks. The flow of fuel is by way of the single-valved stripping manifold, to the suction side of the stripping pumps.

The centerline, installed just below the seat of the sea chest cutout valve inter-connects the manifold to a sea chest supply riser. It is used to direct sea water from the sea chest to the storage tanks during ballasting.

The other line, installed just below the seat of the main drainage eductor valve, interconnects the manifold to the suction side of a main drainage eductor. This line is used only to direct ballast water from the storage tanks to the main drainage eductor when the tanks are being deballasted.

The flood and drain manifold has a locking assembly that allows only one valve to be opened at a time. Therefore, only one operation can be conducted at a time; stripping, ballasting, or deballasting.

Each valve stem has an enlarged collar that engages a sliding-bar locking assembly. Two of the valves are always locked in the closed position. The sliding-bar is actually a long piece of metal containing three keyholes and two oblong slots. It is held in place by two lock-nuts on a threaded bracket, extending up from the manifold. To open a valve, the sliding-bar must be moved so that the enlarged collar of the valve stem of the valve to be opened is centered under the circular part of the keyhole slot. The three keyhole slots are arranged in the sliding-bar to allow the opening of only one valve at a time. To position the sliding-bar, loosen the two lock-nuts and slide the bar through the oblong slots to the desired position and tighten the nuts.

Q2-16. What type of valve should be used when a "throttling effect" is desired?

Q2-17. The butterfly valve uses what kind of seat that is pressure energized to assure positive shutoff, compensates for pressure and temperature changes, as well as wear?

Q2-18. The limitorque valve operator uses what component to protect overloading valve parts from torque stress exerted and thrust load applied?

Q2-19. What component of the limitorque valve operator regulates the vertical travel of the valve stem?

Q2-20. The hand wheel clutch of the limtiorque valve operator allows for what operation to the limitorque?

Q2-21. What type of valve uses a disk that is pinned-hinge to the valve body and closes by gravity under "no-flow" conditions?

Q2-22. What are the two types of packing used for packing gland leakage?

Q2-23. What type of manifold is similar to a double valved manifold; only its nozzle, instead of connecting to a transfer main-side valve, it connects each valve on the manifold to each other?

Q2-24. What component of the Flood & Drain manifold has a long piece of metal containing three keyhole slots that slide to the desired position in order to operate one valve at a time on the manifold?

JP-5 FUEL SYSTEM FILTERING MEDIUM

LEARNING OBJECTIVE: Identify the different types of filters used in the JP-5 below decks system. Describe their components, its function, operation and operational limits of each filter.

There are several different types of filter/separators in use in the fleet, however, their principle of operation and hydraulic controls are similar. The only major differences in filters are their physical shape and capacity.

Regardless of the direction or rate at which fuel passes through the filters, or where they are located in relation to other components in the system, all filters are designed to perform the same function (separate and remove solids and water from the fuel) and in practically the same manner.

Main Fuel (Service) Filters

Filters are designed to remove 98% of all solids and 100% of all entrained water from the fuel passing through them. This is accomplished in a two-stage separation by two separate filtering media installed within the filter shell. The first stage consists of a bank of COALESCING elements, surrounded by a hydrophobic screen, performs the function of removing solids and coalescing water. Coalescing means the bringing together of fine particles of entrained water to form large droplets that then fall out of the fuel by gravity. The second stage consists of a bank of SEPARATOR elements that perform the function of repelling the coalesced water droplets that were too small to fall out by gravity.

The filter is equipped with a float operated rotary control valve that will automatically drain the accumulated water from the filter sump and shutoff the filter discharge if more water accumulates than can be drained off automatically.

The body of the main fuel filter (fig. 2-41) consists of a cylindrically shaped shell with a dome-shaped head welded on each end. The dome-shaped heads provide a uniform flow into and out of the filter. The interior of the filter is divided into; an inlet, fallout, and outlet (clearwell) by tube sheets.

TUBE SHEET.—The tube sheets are circular metal bulkheads installed within the filter shell where the dome-shaped heads are attached to the cylindrical shell. They are welded throughout their circumference to form a leakproof partition between the inlet, fallout, and outlet chambers of the filter. The tube sheets also provide the means of installing the filter element mounting assemblies (both coalescer and separator). Threaded holes, one for each assembly, are symmetrically arranged over the tube sheets surface.

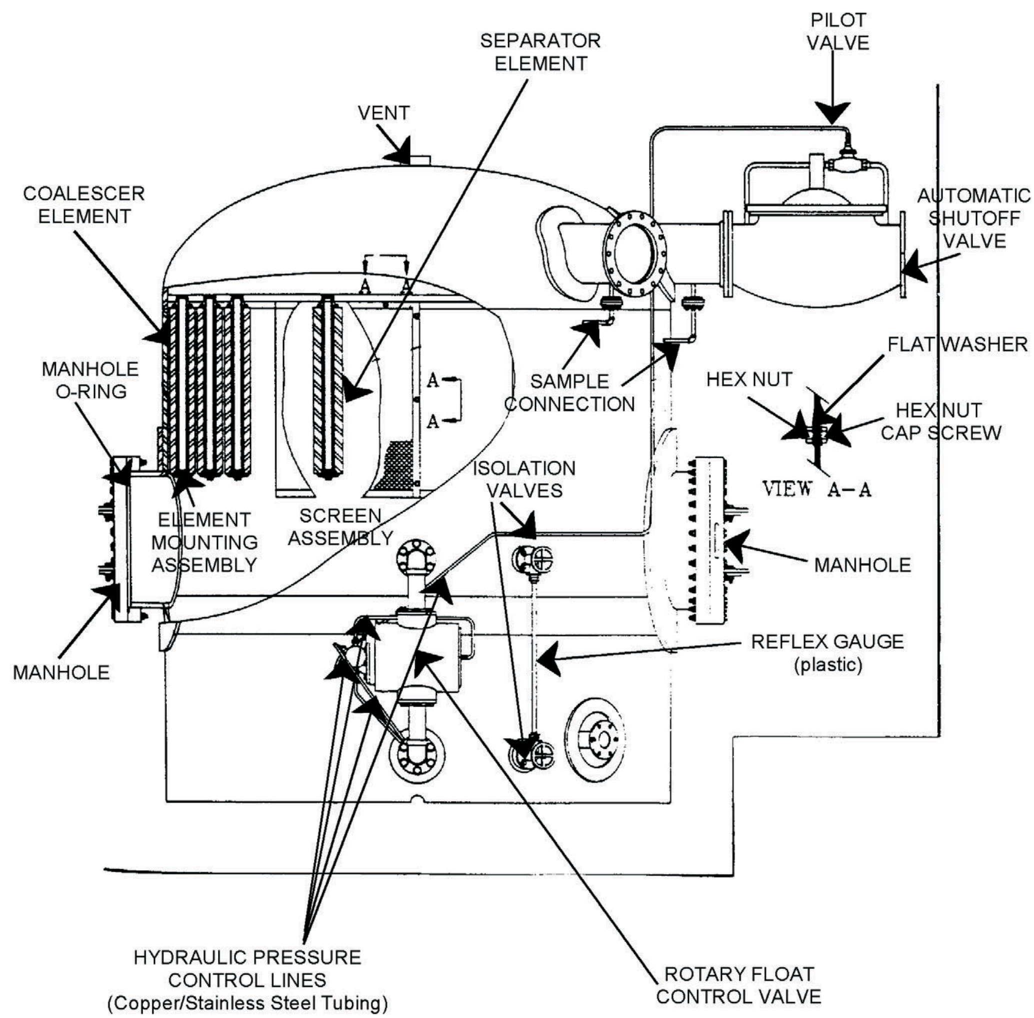


Figure 2-41.—Service fuel filter.

ELEMENT MOUNTING ASSEMBLY.—The element mounting assembly (fig. 2-42) consists of a perforated metal standpipe about 1 inch in diameter and 24 inches in length, and an end cap. One end of the standpipe is fitted with a threaded base cap to enable screwing it into the tube sheets. The opposite end is fitted with a threaded plug for attaching the end cap. The end cap is a metal disk about the same diameter as the elements.

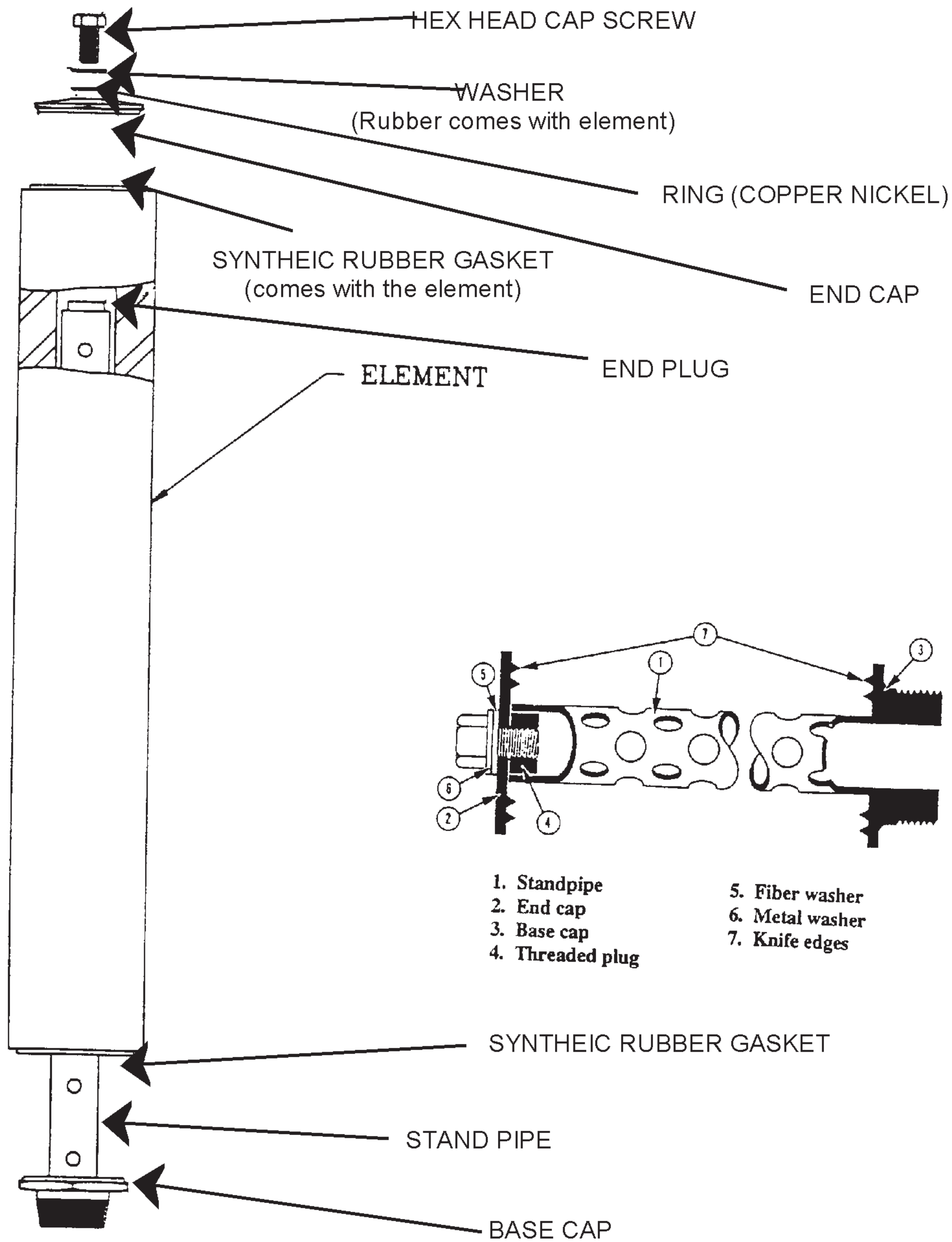


Figure 2-42.—Element mounting assembly.

After the filter element has been placed over the standpipe, the end cap is secured in place by a threaded bolt. A metal washer and fiber washer are provided between the threaded bolt and end cap to prevent leakage at this point.

Both the base cap and the end cap have projecting knife-edges. When the elements are mounted on the standpipes, the projecting knife-edges are forced into the synthetic rubber gaskets on each end of the elements, forming a tight seal.

COALESCING ELEMENT.—The coalescing element is a cylindrical unit 24 inches long and 3 5/8 inches in diameter. It consists basically of a pleated paper element encased by fiberglass wrappings. The fiberglass is held in place by a cloth sleeve. Each end has a synthetic rubber gasket to form a tight seal and ensure flow through the element when mounted. Flow through a coalescer element is inside to outside.

SEPARATOR ELEMENT.—The separator element has practically the same dimensions as the coalescer, but it is constructed of a different material. It consists basically of a perforated inner brass core cover with a 200-mesh, monel, Teflon®-coated screen. This screen is enclosed also by an aluminum screen. Separator elements are considered permanent and only require cleaning, unless they are damaged, in which case they must be replaced. Flow through a separator element is outside to inside.

INSTALLING ELEMENTS.—To install an element on the element mounting assembly, proceed as follows:

1. Make sure the gaskets are in place, then slide the element over the perforated standpipe.

2. Attach the end cap, with metal and fiber gasket in place, and install the threaded bolt fingertight.

3. Center the element on the mounting assembly, and tighten the end cap bolt. The bolts should be torqued to 12 foot-pound or 144 inch-pound.

4. Check the element for tightness.

FILTER INLET CHAMBER.—Fuel enters the filter initially at the inlet chamber. This chamber of the filter is dome-shaped to provide a uniform flow of fuel to all coalescing elements simultaneously. From the inlet chamber the fuel passes through the tube sheet into the coalescing elements in the fallout chamber.

FALLOUT CHAMBER.—The fallout chamber is the center section of the filter shell. It is the largest of the three filter chambers. This area of the filter is provided to allow the coalesced water to fall out of the fuel stream by gravity as it flows from the coalescer elements to the separator elements. Both sets of filter elements are installed in this chamber.

The fallout chamber also contains a manhole cover, filter vent line, and water receiving sump.

The coalescing stage is the first stage of filtration. It consists of a number of individual coalescer elements mounted in symmetrical arrangement on the inlet tube sheet. The fuel leaving the inlet chamber must pass through these elements from the inside to outside before entering the fallout chamber. As the fuel passes through the elements, they perform the dual function of removing solid contaminants from the fuel and coalescing water.

A bolted manhole cover with gasket is installed on the side of the filter shell. This opening is provided to allow personnel to gain entrance to the fallout chamber for replacing elements and maintenance. A newer designed of the 2,000 gpm fuel filter provides two manhole covers (see fig. 2-41) for easier access on maintenance.

A filter vent line is installed at the extreme top of the fallout chamber. This line, fitted with a bull's-eye sight glass, two shutoff valves (one on each side of the sight glass), and a one-way check valve, directs fuel back into the contaminated settling tanks. The filter is vented until a solid stream of fuel is observed in the sight glass.

The separator stage is the second stage of filtration. It consists of a number of individual separator elements mounted in symmetrical arrangement on the outlet tube sheet.

Fuel leaving the fallout chamber must pass through the separator elements from the outside to the inside before entering the outlet chamber. As the fuel passes through these elements, they repel the final traces of water from the fuel stream. In addition to this primary function, the separator elements also serve as a final filter if one or more coalescer elements rupture. But, separator elements can only filter solids larger than 10 microns.

®Teflon is Dupont's registered trademark for its fluorocarbon resin.

WATER RECEIVING SUMP.—The filter sump is located at the bottom of the filter vessel. The sump receives the water that has been separated from the fuel.

A reflex type sight glass is installed on one side of the sump for observing the water level within. Shutoff valves are installed in the connecting piping for isolating the sight glass during maintenance.

Centrally located on the side or the bottom of the sump is a flanged opening to which is bolted a rotary control valve, this valve is attached to, and mechanically operated by, a ball float housed within the filter sump. The float-operated rotary control valve is a part of the filter automatic hydraulic device. It will be explained in detail later in this section.

An updated version of the rotary control valve installed on newer class ships has been moved just outside on the side of the filter cell shell casing. This provides for an easier access to the unit for accomplishing maintenance.

OUTLET CHAMBER (CLEARWELL).—This section of the filter is commonly called the "clearwell" because the fuel here is clear of contaminants. It has a dome-shaped head that provides an even, unrestricted flow of fuel from the separator elements.

A test connection for obtaining a sample of the fuel being discharged is located at the bottom of the outlet chamber. When it is necessary to drain the filter completely, the outlet chamber is drained into containers through this line.

Two pressure gages (one for each chamber) and a differential pressure gage are installed on a gage board conveniently located in the filter room. These gages are provided for determining the pressure drop across the filter elements. A shutoff valve is installed in each gage line to permit removal of the gages for maintenance.

OPERATION OF THE MAIN FUEL FILTER.—It is imperative that the filter be properly vented so full use of all filtering elements will occur. JP-5 enters the inlet chamber of the filter. The JP-5 then passes to the inside of the coalescing elements, where solids 5 microns and larger are retained on the inner walls of the elements. As the JP-5 passes through the elements into the fallout chamber, any water is coalesced into large droplets on the outside of the elements. These water droplets, fall out of the JP-5 by gravity and into the sump as the JP-5 passes across the fallout chamber to the separator elements. JP-5 enters the separator elements from the outside and, as it passes through the elements to the outlet chamber, any final traces of coalesced water that did not fall are repelled. The JP-5 then leaves the outlet chamber of the filter from the top and flows through the automatic shutoff valve into the forward and aft legs of the quadrant. Rated capacity is 2,000 gpm.

CAUTION

Exercise care at all times when opening and closing valves that govern flow through the filter to prevent a hydraulic hammer shock to the filter. This may overstress the housing or rupture the filter elements.

Immediately after a filter with new elements is placed in operation, the pressure gages must be read and the pressures logged. A pressure differential between the inlet and fallout chambers should be noted. This pressure drop will increase in time, due to the buildup of solid contaminants on the inner walls of coalescing elements.

Pressure Checks.—The inlet, outlet, and differential pressure gages should be read and recorded as indicated in the filter operating log. As solids build up on the elements, the pressure drop across the filter increases. The differential gage determines the actual differential pressure across the entire filter assembly. The pressure drop across the coalescer elements is the most critical.

As the maximum allowable pressure drop across the coalescing elements is reached, they fail to perform their designed function and must be replaced. The maximum allowable pressure drop limits for coalescer elements are found on the instruction sheet in the manufacturer's packing crate. Although pressure drop limits may vary, 15 psi is the pressure drop limit.

Sample Checks.—Daily checks are taken from the filter sump and outlet chamber at the beginning of initial flow and every 15 minutes thereafter. Laboratory samples are taken at initial flow, every four hours under continuous flow conditions, when changing service tanks and whenever the LAB is requesting re-sampling. The contents of each sample should be recorded in the operating log. These samples can be used to determine the condition of the coalescer and separator elements.

If the sample taken from the filter sump contains solids, it is a probable indication that the coalescer elements have failed. If the sample taken from the outlet chamber is contaminated, it is a probable indication that the coalescer and/or separator elements have failed. In either case, the elements should be inspected and replaced as necessary.

Also, coalescer elements should be replaced at each overhaul and before deployment. If no overhaul or deployment occurs, they should be replaced in accordance with PMS. When coalescer elements are replaced, separator elements should be cleaned and inspected. Only defective separator elements need be replaced. Coalescer elements of one manufacturer may be used with the separator elements of another manufacturer.

FILTER HYDRAULIC CONTROL SYSTEM.—The filter hydraulic control system is a safety device installed on all fuel filters. It functions to drain automatically the accumulated water from the filter sump, and to shut off the filter flow if more water accumulates than can be drained off automatically.

This system consists of three hydraulic control valves and a float operated control valve (see fig. 2-41). Two hydraulic control valves (the automatic shutoff valve and pilot valve) are located in the filter discharge line. The other hydraulic control valve (the automatic water drain valve) is located in the filter sump drain line. The float operated control valve (rotary valve) is located on the side or bottom of the filter sump.

Automatic Shutoff Valve.—The automatic shutoff valve (see fig. 2-41) is of a modified globe valve design, using a well supported and reinforced diaphragm as a working means. A tension spring located in the upper valve chamber (above the diaphragm) assists in seating the valve when closing, and provides a cushioning when opening. The valve is opened by filter discharge pressure, acting under the valve disk. The valve is closed by filter discharge pressure, acting with the tension spring on the top of the diaphragm in the valve cover chamber. The pilot valve and an eductor, both located in the actuating line, control the opening and closing of the automatic shutoff valve.

The actuating line runs from the inlet to the discharge side (bypassing the valve seat) of the automatic shutoff valve body.

The pilot valve (see fig. 2-41) is of the modified globe valve design, having a double-acting diaphragm as its working means. When fuel pressure is applied to the top of the diaphragm, the valve closes (closing off the actuating line). When fuel pressure is applied to the bottom of the diaphragm, the valve opens (allowing flow through the actuating line).

The eductor is located in the actuating line between the pilot valve and the inlet side of the shutoff valve. The eductor suction line is connected to the top of the shutoff valve cover chamber. With the pilot valve open, the eductor decreases the fuel pressure on top of the diaphragm of the shutoff valve by educting fuel from the main valve cover chamber. This decrease in fuel pressure on top of the diaphragm allows filter discharge pressure acting under the shutoff valve disk to open the valve. When the pilot valve closes, filter discharge pressure in the actuating line is directed through the eductor suction line to the top of the cover chamber of the shutoff valve. This increase in fuel pressure on top of the diaphragm cover overcomes the fuel pressure being applied on the valve disk and closes the valve. Simply put, if the pilot valve is open, the automatic shutoff valve is open. If the pilot valve is closed, the automatic shutoff valve is closed.

Automatic Water Drain Valve.—This valve, located in the water drain line from the sump, is identical to and functions in the same way as the pilot valve. When fuel pressure is applied to the top of the diaphragm in the automatic water drain valve, the valve closes and stops the flow from the filter sump. When the fuel pressure is relieved, the valve opens and allows water to be discharged from the filter sump. Vertical filters have two automatic water drain valves.

Float Operated Rotary Control Valve.—The rotary control valve (see fig. 2-41), located on the side or bottom of the filter sump, is operated by the rise and fall of a captivated ball float housed within the filter sump.

The ball float is attached to the rotary valve; by the float arm and gear assembly. It is designed to float on water and sink in JP-5. The rotary control valve described here is the one installed on vertical filters.

The rotary control valve has three operating positions: DOWN, HORIZONTAL, and UP. The valve body has four ports. The three ports, are connected by tubing to the following:

1. A drain (vent) port to the water drain line on the discharge side of the automatic water drain valve

2. A port to the top of the diaphragm in the pilot valve

3. A port to the top of the diaphragm in the automatic water drain valve

4. The supply connection port is on the top of the rotary control valve inside the filter vessel. The port is fitted with a wire mesh strainer.

The rotary control valve, through the action of the ball float, controls the opening and closing of the automatic water drain and pilot valves.

The addition and installation of the external float control valve (see fig. 2-41) with an X-75 float tester on newer ships, allows for testing the JP-5 service filter/separator automatic devices using JP-5 as the test agent instead of water in the filter cell. The X-75 float tester provides a means of mechanically operating the float control valve (raised or lowered), causing the automatic drain valve to open and close. This operation has to be performed under actual flow conditions. Usually performed during refueling stations flushing evolutions, system pressures is monitored for changes.

OPERATION OF THE FILTER HYDRAULIC CONTROL SYSTEM.—As long as the fuel passing through the filter contains little or no water, the rotary control valve float will remain it it's DOWN position. With the float in it's DOWN position, the rotary control valve directs fuel to top of the diaphragm of the automatic water drain valve (keeping that valve closed), and vents fuel pressure from the top of the diaphragm in the pilot valve. Direct fuel pressure applied to the bottom of the pilot valve diaphragm opens that valve, which allows filter discharge pressure to open the automatic shutoff valve.

As coalesced water collects in the filter sump, the float rises to the horizontal position. With the float at its horizontal position, the rotary control valve vents the top of the automatic water drain valve allowing direct fuel pressure to force it open and drain the accumulated water. The top of the pilot valve diaphragm continues to be vented while direct fuel pressure continues to be applied to the bottom of the pilot valve diaphragm, keeping it open, which allows discharge pressure to open the automatic shutoff valve.

If water collects in the filter sump faster than it can be drained off, the float will rise to its UP position. With the float at its UP position, the rotary control valve directs pressure to the top of the pilot valve (closing it) which causes the automatic shutoff valve to close, stopping fuel discharge. The top of the automatic water drain valve continues to be vented allowing direct fuel pressure to keep it open to drain the accumulated water.

- With the float in the down position: the pilot valve is OPEN; the automatic shutoff valve is OPEN; and the automatic water drain valve is CLOSED.
- With the float in the horizontal position: the pilot valve is OPEN; the automatic shutoff valve is OPEN; and the automatic water drain valve is OPEN.
- With the float in the up position: the pilot valve is CLOSED; the automatic shutoff valve is CLOSED; and the automatic water drain valve is OPEN.

TROUBLESHOOTING THE FILTER HYDRAULIC CONTROL SYSTEM.—If the system fails to operate properly, make the following tests:

1. Check the arrows on the automatic shutoff, pilot, and automatic water drain valves to ensure proper installation.
2. Make sure all manually operated valves are properly aligned.
3. Inspect the tubing for dents, flat spots, or internal obstructions.

NOTE

The latter is often the most likely cause of the malfunction.

If the above tests prove unsatisfactory, the rotary control valve should be removed for inspection and further testing. Consult the appropriate technical manual.

First-Stage Filters

First-stage filters (fig. 2-43) are commonly known as reclamation filters. That is because these filters are used in the JP-5 reclamation system (see fig. 2-8) to filter the fuel from the contamination tanks before pumping it back into storage tanks.

These filters normally have a rated capacity of 300 gpm and an operating pressure of 125 psi (pressure varies, dependent upon your system's operating pressure). The filter is designed to remove 98% by weight all solids 5 microns or larger, and 99.9% of the water. The filter has a cylindrically shaped, welded, copper-nickel shell mounted on three legs. A bolted man-hole cover assembly at the side of the shell provides access to remove or replace coalescer or separator elements. The interior of the shell is divided into three chambers: inlet, fallout, and outlet. The inlet chamber is at the top of the shell; the fallout chamber contains coalescer and separator elements; and the outlet chamber (clearwell) connects to the discharge piping.

The outside of the shell contains a reflex-type sight glass, differential gage, and an outlet pressure gage. The sight glass indicates water level in the fallout

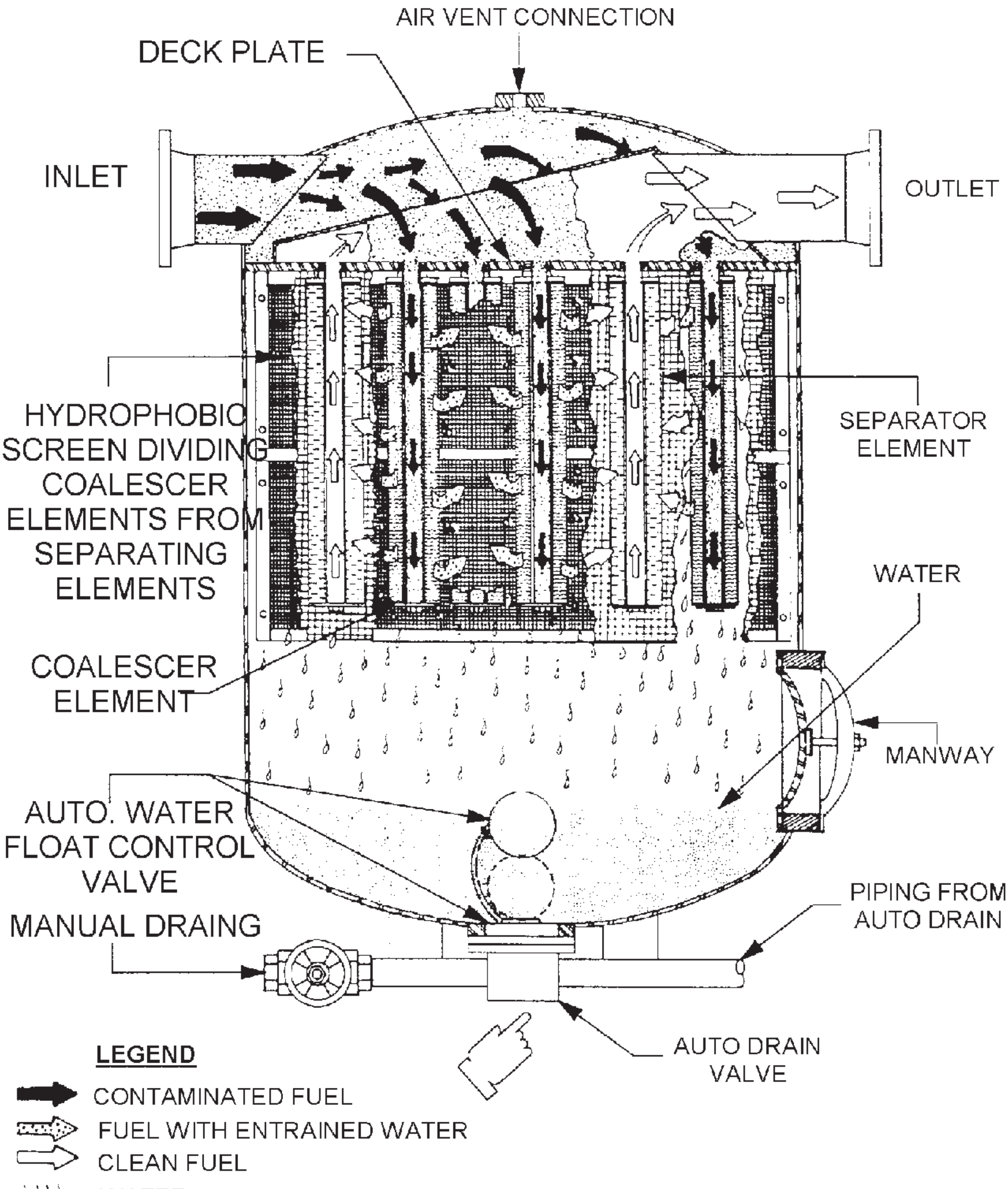


Figure 2-43.—First-stage filter.

chamber. The differential gage indicates the pressure drop across the coalescer elements. The outlet gage indicates the pressure of the filtered fuel after it has passed through the separator elements and before it leaves the filter.

There are 20 coalescer elements mounted vertically on the deck plate. Fuel flows from the inlet chamber through the coalescer elements to the fallout chamber.

There are nine (9) separator elements mounted vertically in individual mounting assemblies attached to the outlet chamber. Fuel flows from the fallout chamber, through the separator elements, and into the outlet chamber.

A float control valve, bolted to a flange that is welded to the shell, controls the action of an automatic water discharge valve and an automatic shutoff valve. In fact, the filter operates exactly the same as the main service filter, the exception being rated capacity.

Pre-filters

Pre-filters (fig. 2-44) are provided upstream of first-stage filters (see fig. 2-8) to reduce the burden and extend the life of the coalescer elements installed in first-stage filters.

Pre-filters normally have a rated capacity of 300 gpm and an operating pressure of 125 psi. An orifice is install in the inlet side of the filter to increase the unit's operating pressure. The filter is designed specifically to filter out solid contaminants.

Basically, the pre-filter consists of a cylindrical housing with valve vents, drain connections, inlet, outlet and differential pressure gages. The elements are a disposable designed coalescer type filter. A bolted cover assembly at the top of the shell provides access to remove or replace the coalescer elements. Whenever you pressurizing this filter or prior to use, it must be drain completely to eliminate all the contaminants within the filter.

The differential gage is used to monitor any changes in the inlet and outlet pressures to the filter. If the difference between the two reaches 20 psi, it is recommended to remove and replace the elements. The number of coalescer elements installed varies from ship to ship depending on the unit. Consult applicable technical manual for the unit installed on your ship.

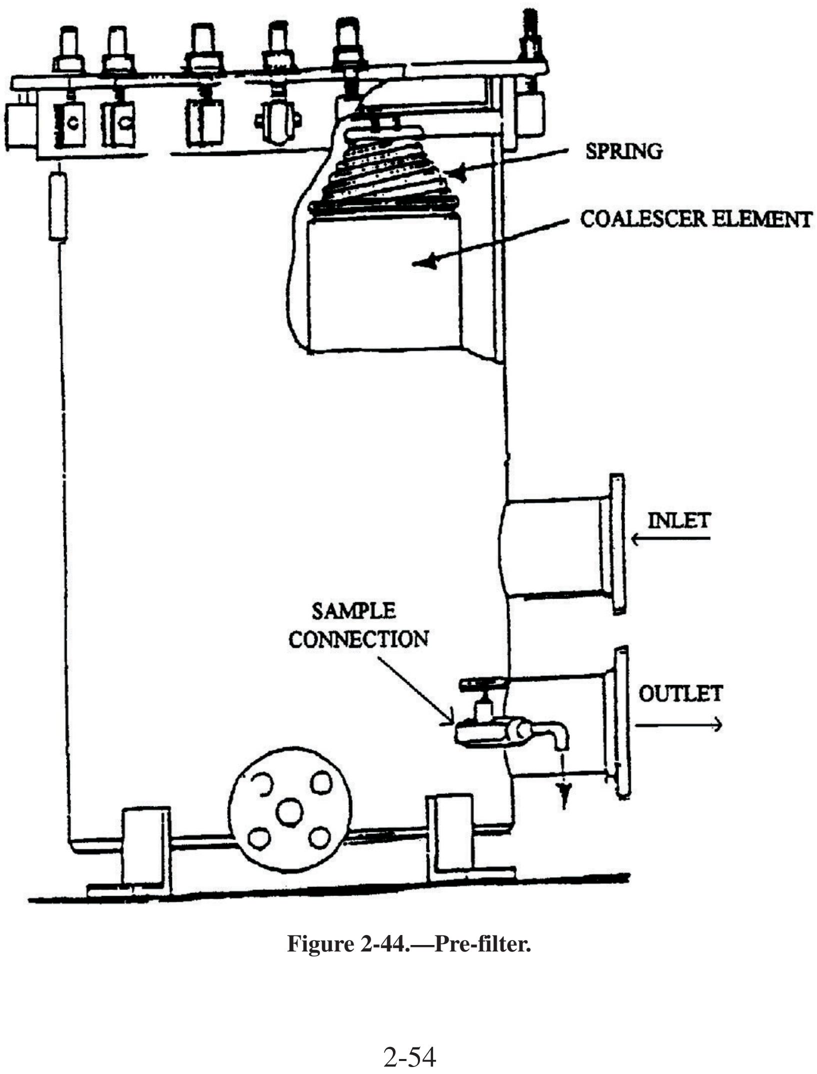


Figure 2-44.—Pre-filter.

Q2-25. What provides a tight seal at both ends of the standpipes on the element mounting assemblies?

Q2-26. When installing filter elements on the mounting assembly, what is the correct value of torque applied?

Q2-27. Where are daily fuel samples drawn from on the service fuel filter?

Q2-28. How often are samples drawn from the Outlet (Clearwell) Chamber for laboratory analysis?

Q2-29. What two hydraulic control valves to the filter hydraulic control system is located in the filter discharge line?

Q2-30. The ball float is connected to the rotary valve that has four (4) ports, where and what are those ports?

Q2-31. What was the main purpose in the addition of the "X-75 float tester"?

Q2-32. What is the rated capacity and operating pressure to the first-stage (reclamation) filter?

JP-5 SYSTEM CENTRIFUGAL JET PURIFIER

LEARNING OBJECTIVE: Identify and explain the various components of a JP-5 jet purifier. Describe its function, operation, operating limits and preventive maintenance.

Centrifugal force is defined as that force which impels a thing (and any or all of its parts) outward from a center of rotation. Every time you lean in as you take a fast turn, you are counterbalancing centrifugal force. How far in you lean is determined by the amount of centrifugal force exerted in the turn. Most people do it automatically, for centrifugal force, along with gravity, is the most prevalent physical force exerted upon us and upon all matter.

The purpose of the centrifugal purifier (fig. 2-45 and fig. 2-46) in the JP-5 filling and transfer system is to separate and remove water, solids, and emulsions from JP-5 during transfer from storage to service tanks. The disk-bowl centrifuge is a "constant efficiency" type of separator; that is, it achieves the same degree of efficiency at the end of a run as at the beginning. The reason for the constant efficiency is that accumulated solids are stowed away from the separation zone. Separation occurs within the disk spaces, and the separated liquids are discharged from outlets that are removed from interference of the stowed solids.

Theory of Operation

Dirty fuel containing water and solids is fed to the purifier (see fig. 2-47) through the feed inlet of the inlet-outlet assembly. The dirty fuel then enters the top of the bowl centrifuge through the feed tube and travels down the tubular shaft, to be thrown outward and upward by the distribution cone at the bottom of the distributor, under the disk stack. The fuel is forced upward through the distribution holes in the intermediate disks, where centrifuge action separates the fuel, water, and solids.

The solids are thrown directly against the bowl wall and collect in a uniform layer on the inside vertical surface of the bowl shell. The water, thrown outward, is displaced by incoming feed material forcing the water overflow up and over the outer edge of the top disk, and discharging it through the discharge ring and the heavy phase outlet.

The clean fuel, which has a lesser density, is displaced inward and upward along the outside of the distributor to the paring disk chamber, where the spinning fuel contacts the edge of the stationary paring disk. The paring disk then acts as a pump, discharging the fuel to the purifier fuel outlet.

CHARACTERISTICS OF THE 200 GPM CENTRIFUGAL PURIFIER	CHARACTERISTICS OF THE 300 GPM CENTRIFUGAL PURIFIER
Capacity-200 gpm at 60ºF to 90ºF when purifying JP-5 (fuel temperature)	Capacity- 300 gpm at 60ºF to 90ºF when purifying JP-5 (fuel temperature)
Feed inlet pressure- 4-10 psi	Feed inlet pressure-15-25 psi
Back pressure of the discharged JP-5 Minimum- 25 psi Ideal- 30 psi Maximum- 35 psi	Back pressure of the discharged JP-5 Minimum-15 psi Ideal- 20 psi Maximum- 25 psi
Bowl speed- 4,100 rpm	Bowl speed- 4,100 rpm

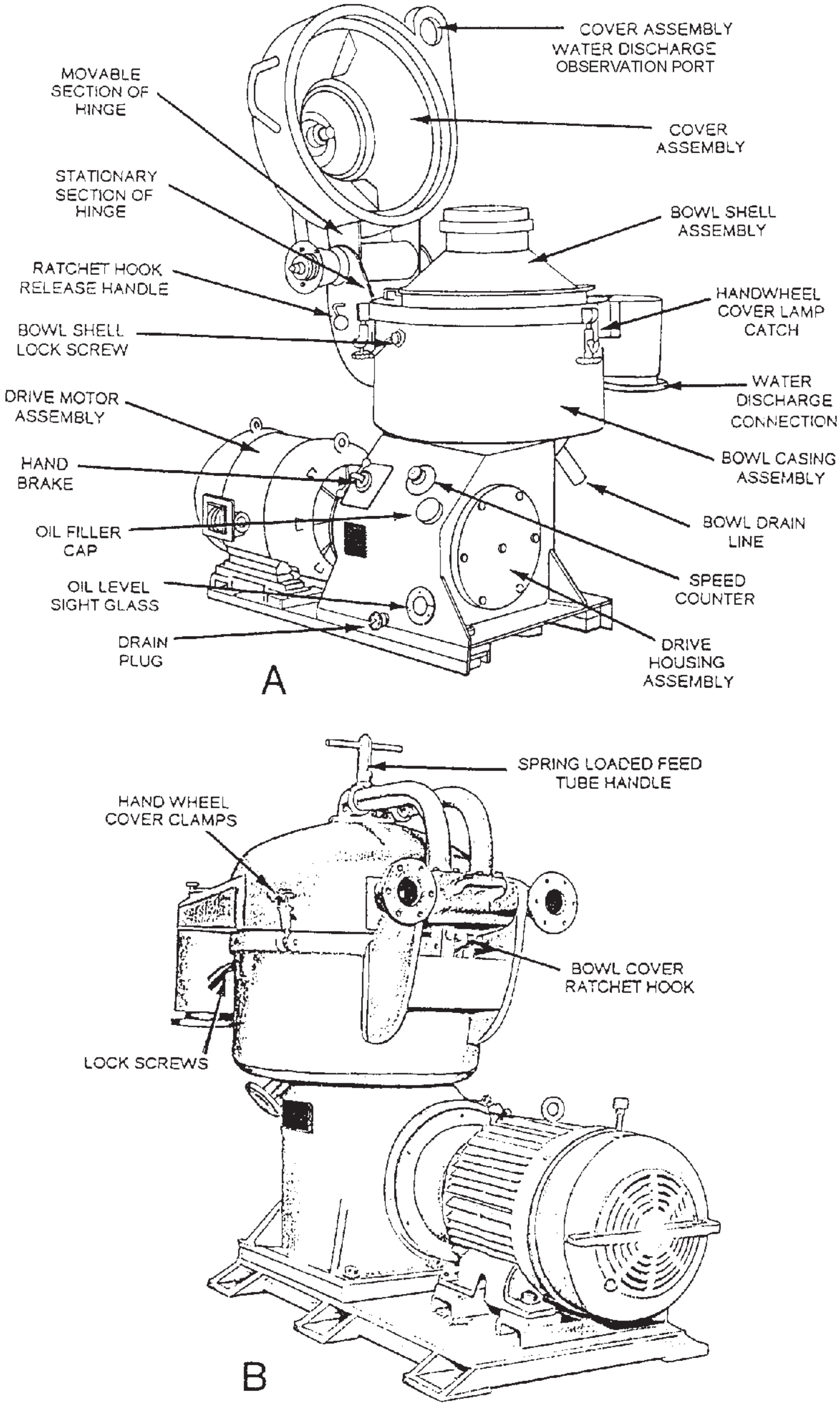


Figure 2-45.—Centrifugal purifier (sectional view).

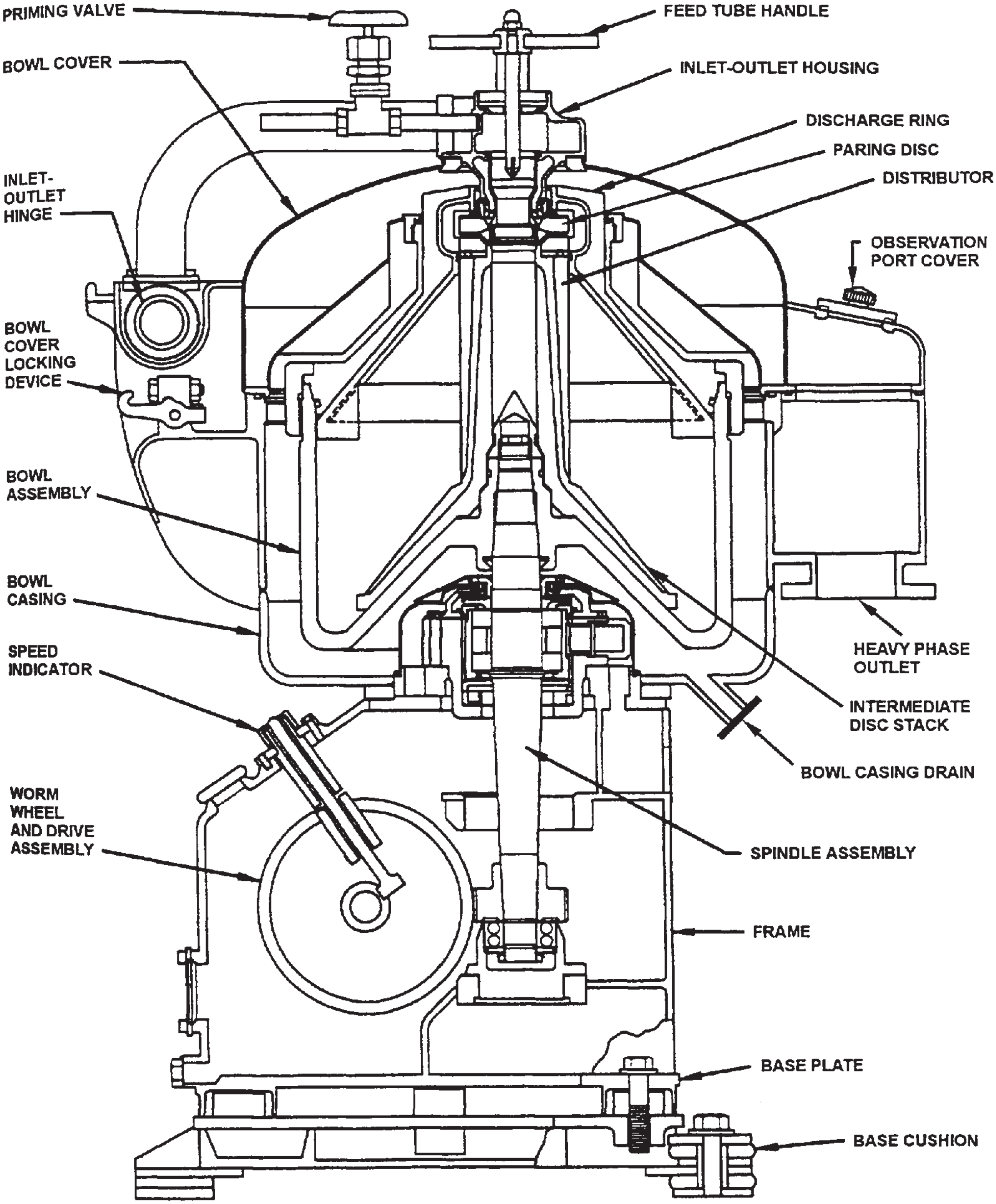


Figure 2-46.—Centrifugal purifier (exploded view).

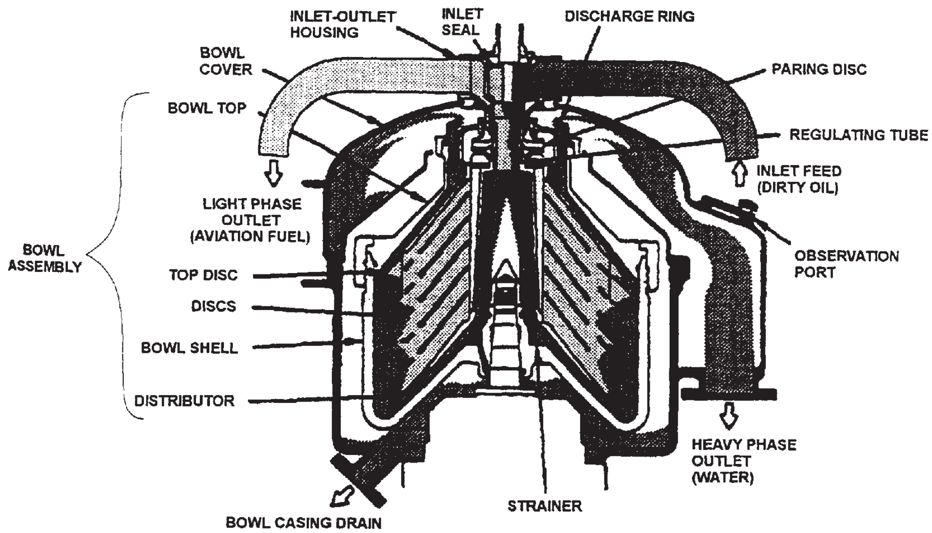


Figure 2-47.—Fuel flow during purifier operation.

Remember, always consult the applicable technical manual and ship's AFOSS for operational changes for systems install in your ship.

Cover Assembly

The cover assembly (fig. 2-48) completely encloses the top of the rotating-bowl shell assembly. The cover hinges to the bowl casing, thus allowing the cover to be lifted out of the way for disassembly and cleaning of the bowl. (See figure 2-45.)

The cover hinge, inlet, and outlet assembly functions to allow the cover to be opened without disconnecting the piping. The stationary part of the hinge is welded to the bowl casing, The movable part of the hinge is welded to the cover. A ratchet hook is provided on the stationary part of the hinge to lock the cover in the open position. A handle is provided to unlock the hook so the cover can be closed. Inlet and outlet piping connects through the hinge to the inlet and outlet tubes. The piping is stationary, but the tubes rotate with the cover. A chevron-shaped, oil-resistant

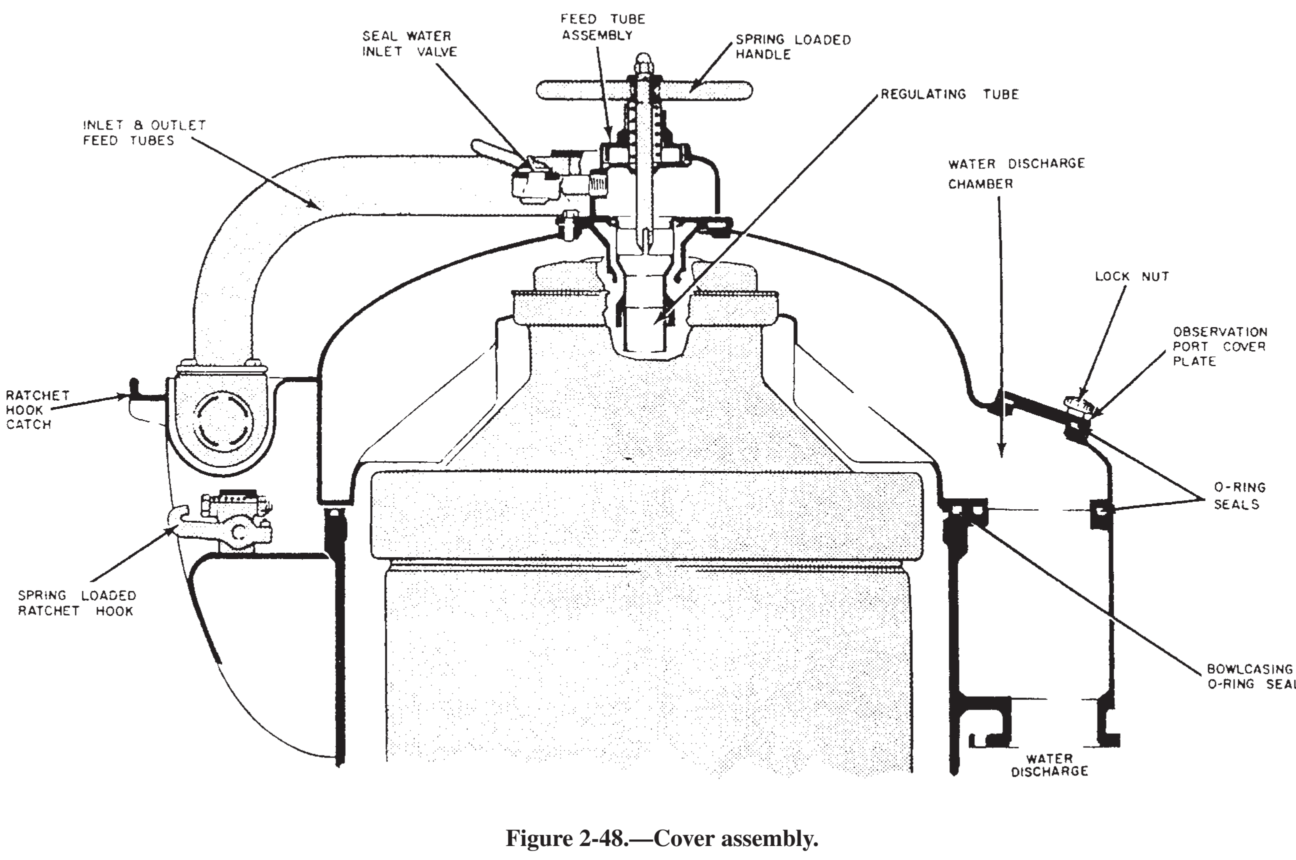


Figure 2-48.—Cover assembly.

rubber seal is installed between the piping and tubing to prevent leakage. Fuel pressure spreads the chevron rings to make a tight seal. When fuel flow is stopped, pressure ceases, and the chevron seals loosen enough to allow the cover to be rotated to the open position.

The feed inlet tube and the purified JP-5 discharge tube both connect into the feed tube assembly at the top of the cover. An oil-resistant seal (O-ring) prevents leakage of liquids between each tube and the feed tube assembly. The feed tube assembly directs feed into the revolving bowl and purified JP-5 out of the bowl.

A seal-water inlet, located between the inlet and discharge tubes, directs fresh water into the revolving bowl for use as a seal. A 3/4-inch plug valve and steel-braided jacketed flexible hose connect the seal-water inlet to the fresh water supply in the pump room.

Internally, the feed tube assembly is constructed to direct the feed and the seal water to a nylon regulating tube. The regulating tube then directs this liquid to the center of the tubular shaft (part of the bowl shell assembly).

The feed tube is also the shaft for the paring disk. The spring-loaded handle, extending out the top of the feed tube assembly, is used to screw the feed tube into the paring disk. The handle remains in the down position when the two are engaged. When not engaged, the spring forces the handle and feed tube up and away from the paring disk.

CAUTION

The feed tube has left-hand threads. The feed tube must be disengaged from the paring disk before the cover can be opened.

Equally spaced around the bottom of the cover are three hand-wheel cover clamp catches. These hook-shaped catches are used to lock the cover in the closed position.

Inside the dome-shaped cover is the water-discharge chamber. This chamber receives water discharged from the revolving bowl. This water is directed to the water-discharge outlet area of the water-discharge chamber. An observation port is provided to enable a visual check of the discharging water. The port has a metal cover that is swung to one side when it is opened.

Bowl Casing

The bowl casing is a circular stationary tub that houses the rotating-bowl shell assembly. The stationary part of the cover hinge, inlet, and the outlet assembly is welded to the outside of the bowl casing.

Three hand-wheel cover clamps are equally spaced around the top of the bowl casing to lock the cover in the closed position. Each hand-wheel cover clamp has a hook that engages the catch on the cover. Rotating the hand-wheel, screws the hook down upon the catch, which in turn pulls the cover down. Hand tight is sufficient for proper locking of the cover in the closed position. A large oil-resistant ring provides a liquid-tight seal between the cover and the bowl casing when the cover is closed.

Two bowl-shell lock screws (fig. 2-49) are housed in the upper part of the bowl casing. These locking devices lock the bowl shell assembly during disassembly and assembly. They are engaged to prevent the bowl shell assembly from rotating. A threaded bushing in the bowl casing allows the lock screws, also threaded to be screwed into or out of the lock position. When the lock screws are in the lock position, they engage a slot in the revolving-bowl shell assembly.

CAUTION

The two bowl-shell lock screws must be removed before starting the purifier. Two bowl-shell lock screw plugs are provided to plug up the threaded hole in the bowl casing when the lock screws are removed.

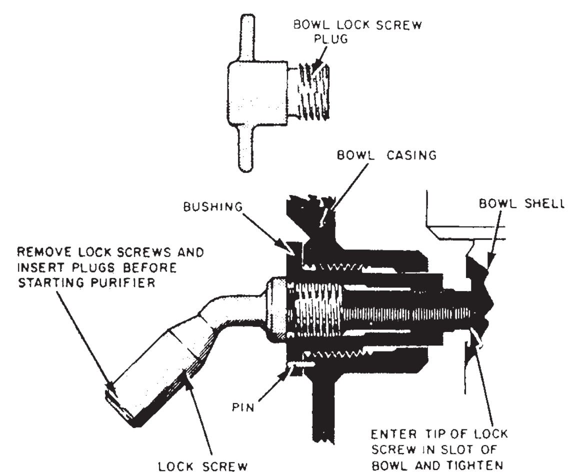


Figure 2-49.—Bowl-shell lock screw and plug.

A water-discharge connection is welded to the upper portion of the bowl casing. This connection is aligned with the water-discharge connection in the cover assembly when the cover is closed. An oil-resistant O-ring, forms a liquid-tight seal between the water-discharge connections of the cover and bowl casing when the cover is closed. The lower end of the bowl casing's water-discharge connection is flanged to the water-discharge line. The water-discharge line directs water into a sump tank. The water-discharge line contains a flexible pipe connection between the purifier and the connection piping that is firmly braced to the ship's structure. This flexibility allows for safe passage through the critical vibration range when starting and stopping the purifier.

NOTE

Purifiers provided on LHD Class ships are equipped with a vibration switch (VIBRA SWITCH), which will activate if excessive vibration occurs within the purifier. It will secure power to the controller and the purifier.

A bowl casing drain line protrudes from the bottom of the bowl casing. This line drains any liquid that may enter the annular space between the revolving bowl shell assembly and the stationary bowl casing. The bowl casing drain line directs drained liquid into the sump tank. A short length of flexible rubber hose is

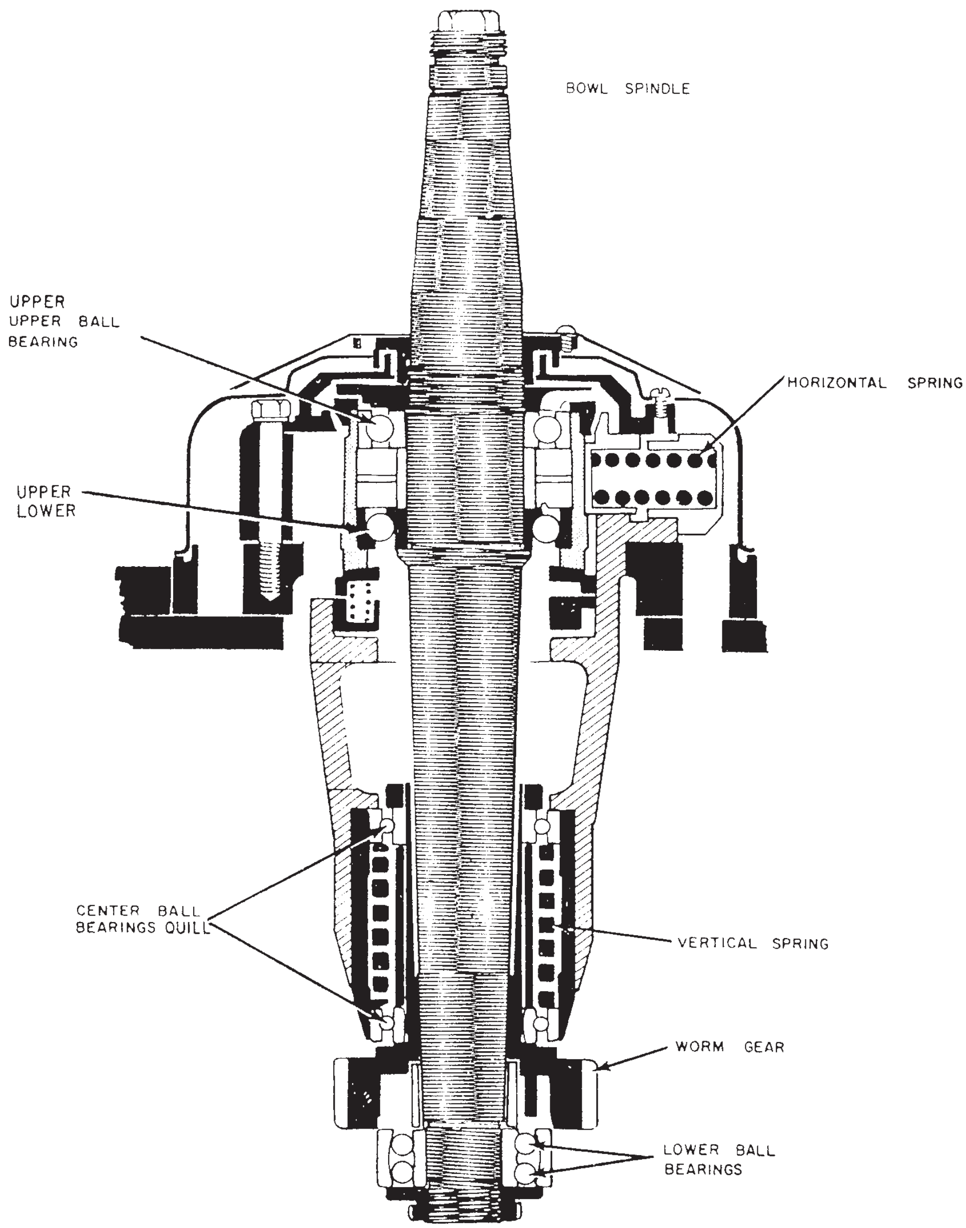


Figure 2-50.—Spindle assembly.

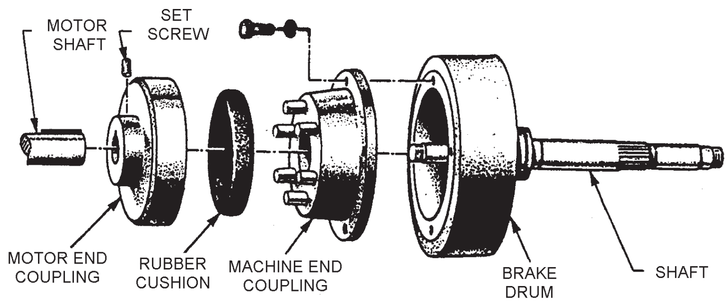


Figure 2-51.—Direct drive assembly.

installed in this line to perform the same function as the flexible pipe connection in the water-discharge line.

Drive Housing and Assemblies

The drive housing bolts to and supports the bowl casing, cover, and bowl shell assembly. The drive housing contains the spindle assembly, direct drive assembly, speed counter, brake, and lubrication system.

The spindle assembly (fig. 2-50) is the vertical drive shaft for the bowl shell assembly. Three sets of ball bearings support the spindle assembly; a set at the top, a set at the center, and a set at the bottom. All three sets of ball bearings are lubricated by oil. Located between the upper and lower bearings of the center set of ball bearings is a large vertical spring. This spring acts as a shock absorber to absorb any vertical thrust of the spindle's shaft when the purifier is started. Six equally spaced horizontal springs surround the upper set of ball bearings. These springs absorb and cushion any horizontal movement of the bowl shell assembly, reducing vibration. The lower end of the spindle's shaft is geared to the horizontal drive shaft of the direct drive assembly; by the worm quill.

The direct drive assembly transmits drive motor power to the spindle, which, in turn, transmits power to the bowl shell assembly. The direct drive assembly (fig. 2-51) connects the purifier to the motor shaft by a flexible coupling. The coupling consists of two coupling halves, with the motor end fitted to the motor shaft and the purifier end fastened to the brake drum with four bolts. Each coupling half has protruding studs (which are offset of each other) that engage a rubber cushion installed between the two coupling halves.

The drive motor shaft turns the coupling, which turns the horizontal drive shaft. The horizontal drive shaft is supported by two ball bearings, an outer and inner bearing. The outer and inner shaft bearings are lubricated by oil. A worm wheel gear is keyed to the drive shaft. This gear engages the gear (worm quill) at the base of the spindle assembly. A smaller gear, which is part of the worm wheel gear, is used to drive a speed counter.

The speed counter (fig. 2-52) is used to determine the rpm of the bowl shell assembly. It consists of a shaft that penetrates the drive housing. One end is inside the drive housing and the other end is outside. The inside end is geared to the worm wheel gear; therefore, when the direct drive assembly rotates, the speed counter shaft rotates. The speed counter rotates at a much slower rate because of the gear ratio. An attached cap covers the outside end of the speed counter shaft. The cap has a raised bump on one side of its top. The operator determines bowl speed, by placing his finger on the outer edge of the cap and then counts the number of times the raised bump touches his finger in 1 minute. During full bowl rpm, the count should be between 146 and 152 times per minute.

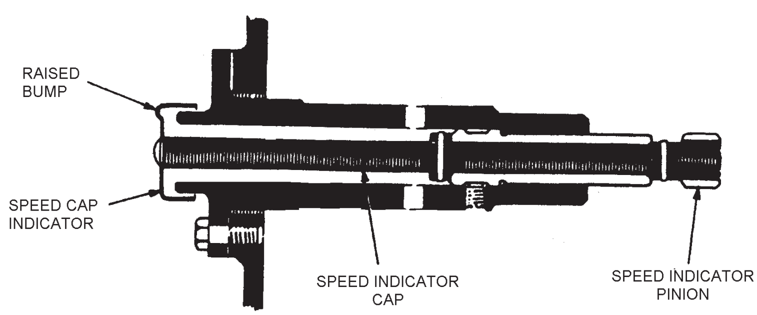


Figure 2-52.—Speed counter.

Because of the gear ratio, the drive motor rotates at 1,770-1775 rpm, the bowl rotates at 4,100 rpm, and the speed counter rotates at 146 to 152 rpm. A handbrake (fig. 2-53) is provided to stop the purifier. This brake is for emergency use only. It consists of an eccentric handle and a spring-loaded brakeshoe. The brakeshoe has a replaceable section of bonded brake lining. When the handle is down, the brake is OFF. When the handle is raised to the up position, the brake is ON. In the ON position, the spring forces the brakeshoe and lining against the outer surface of the brake drum. Friction is created causing the purifier to come to a stop. For some of the 300 gpm (Model B214AS-300) purifiers, they are not equipped with a brake assembly.

In the base of the drive housing is an oil sump for the oil lubrication system (fig. 2-54). Oil from this system lubricates the bearings on the spindle and drive shaft. The drive housing is divided into two compartments. One of these compartments contains the direct drive assembly coupling and the other contains the gears and bearings that are lubricated by oil. A metal partition separates the two compartments. The direct drive shaft passes through this partition and a gasket is installed around the shaft to prevent oil from entering the direct drive-coupling compartment. The worm wheel gear on the drive shaft is partially submerged in the oil. Rotation of this gear splashes the oil about within the oil lubrication compartment, supplying oil to the bearings and gears. The oil sump holds 8 to 8 1/2 quarts of grade 90, gear oil. In order to determining the correct oil level, observe a circular sight glass on the side of the drive housing. The glass-retaining ring has two inscribed lines to indicate proper oil level. The white (top line) is the high or full oil level; the red (bottom line) is the low oil level mark.

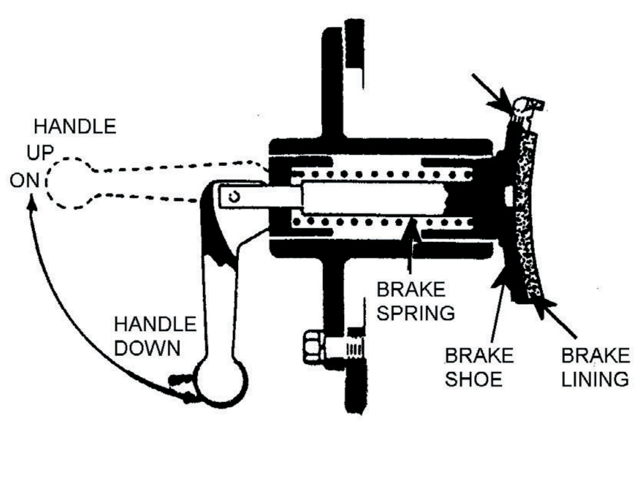


Figure 2-53.—Brake assembly.

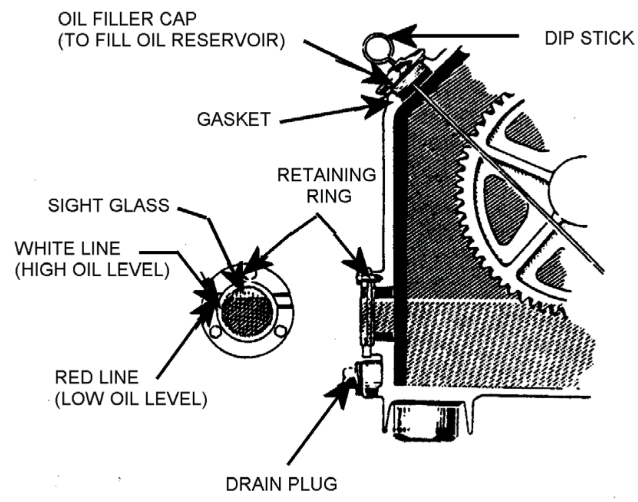


Figure 2-54.—Oil lubrication system.

On some installations where the oil sight glass could not be seen easily in its normal position, the sight glass has been extended out and turned to give a clear view to the operator, a dipstick has been added to the oil filler cap as well. The dipstick has two marks; the lower mark indicates when the lubricating oil should be added. You should fill the unit with lubricating oil to the upper mark. To check the oil level, pull the stick completely out through the cap. Wipe with a clean, dry rag. Push the stick all the way in through the cap and pull it out again to read. Be sure the stick always rests on the cap. Some of the 300 gpm (Model B21AS-300) purifier are manufactured with oil sight glass only and have done away with the dipstick gaging method.

An oil fill cap is located near the top of the drive housing. An oil drain plug is at the base of the oil sump.

Bowl Shell Assembly

The bowl shell assembly (fig. 2-55) provides the working area for separation of contaminants from JP-5. The entire bowl shell assembly sits on top of the spindle assembly. The spindle assembly causes the bowl shell assembly to rotate. This rotation is transmitted to the fuel, providing the necessary centrifugal force to cause separation to take place. During operation, the bowl shell assembly contains a fresh water seal to prevent loss of JP-5. Most of the separated solids and emulsions are retained within the bowl shell assembly, but are completely removed from the line of flow of liquids.

The bowl shell confines the liquids being separated. Housed within the "tub-like" bowl shell are the strainer, disk stack, paring disc and discharge ring.

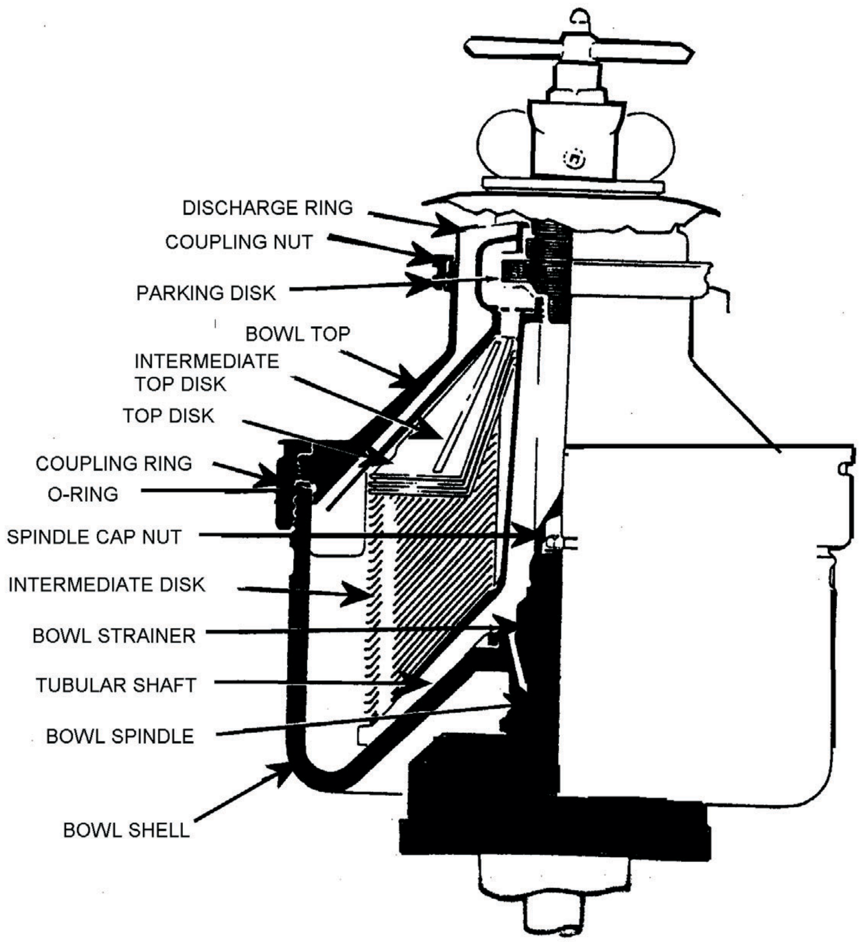


Figure 2-55.—Bowl shell assembly.

The bowl shell has eight equally spaced drain holes around the raised center of its bottom. These holes facilitate draining the bowl when the purifier is in its stopping cycle. The draining liquids are directed into the annular space between the bowl shell and the bowl casing and then out the bowl casing drain line.

To ensure that the drain holes will not become clogged by dirt from the bowl shell, a conical-shaped strainer is installed over the top of the drain holes.

The bowl shell seats on the tapered portion of the top of the spindle shaft. The threaded top section of the spindle shaft protrudes up through the raised center of the bowl shell. A spindle cap nut is then screwed down over the threads to force the bowl shell down onto the tapered portion of the spindle shaft.

A slot is provided on each side of the bowl shell on its outer surface near the top. These two slots engage the bowl shell lock screws during disassembly or assembly of the bowl shell. A notch at the upper/outside edge of the bowl shell engages the bowl top.

The tubular shaft is the base and the center of the disk stack. It forms a circular bulkhead between the feed inlet liquids and the disk-stack discharge to the paring disk.

The base of the tubular shaft has three unequally spaced pins that interlock with three unequally spaced slots around the raised center of the inside-bottom of the bowl shell. Thus, the tubular shaft can be installed in one position only, ensuring that the tubular shaft will rotate.

The flared base of the tubular shaft is the bottom of the disk stack. Between the bowl shell and the underside of the tubular shaft's base, 12 inner spacers provide a liquid passage. The inner spacers are part of the tubular shaft, and serve two purposes-they keep the tubular shaft off the bowl shell to provide the liquid passage, and they give a circular motion to the feed inlet liquid, since they act as rotating paddles. The 12 inner spacers run from the top-inside area of the tubular shaft and follow its contour down and under the flared base to the outer edge of the base.

Twelve equally spaced holes are provided near the outer edge of the tubular shaft's flared base. These holes are located between the 12 inner spacers.

The outer edge of the tubular shaft above the flared base has 12 equally spaced outer spacers. These outer spacers perform the same function for the purified JP-5 that the inner spacers perform on the feed inlet liquids. One of the outer spacers has a key to which each of the disks in the disk stack lock. This ensures that the disks will rotate.

The intermediate disks form the main part of the disk stack. The 200 gpm purifier, there are 127 individual intermediate disks. The 300 gpm purifier has 186 individual intermediate disks. Each has a number stamped on the topside; near it's outer edge. The 200-gpm purifier, the disks are numbered 1 through 127. The 300-gpm purifier the disks are numbered 1 through 186. The number 1 disk is on the bottom and the number 127 (200 gpm purifier) and/or 186 (300 gpm purifier), rests on the top.

NOTE

Additional intermediate disks can be added to the top of the intermediate disk stack. This will ensure correct disk stack compression is maintained.

The intermediate disks are identical except for their stamped numbers. In shape, the disk resembles a metal lampshade, large at its base and small at the top. A small lip flares out from the base and a small lip flares inward from the top.

Twelve equally spaced holes are located around the base of the disk. A thin sliver of metal (0.050-inch thick) runs from between each hole, inward to the inner lip. These pieces of metal, located on the top of each intermediate disk, act as spacers. Since the disks seat one on top of the other, the thickness of the space between each disk is determined by the thickness of the spacers.

The top inner lip of each intermediate disk has a notch that interlocks with the key on the tubular shaft. This interlocking ensures that the disks rotate and that the disk holes will be aligned vertically.

Some purifiers will have an intermediate top disk that seats on top of the topmost intermediate disk. Its purpose, also, is to ensure correct disk stack compression. This disk is similar in construction to the 127 (for the 200-gpm purifier) and 186 (for the 300-gpm purifier) intermediate disks. Except that the flared lip around its base is only half as large as the lip on the intermediate disks, and it does not have a stamped number or the raised ribs.

The top disk seats on top of the intermediate top disk and is the top disk of the disk stack. Being wider than the other disks in the stack, the top disk covers the disk stack like an umbrella. This is the only disk that does not have holes around its base. The inner-upper portion of the top disk is the pump casing for the paring disk. The lower portion of the pump casing has a notch that interlocks with the key on the tubular shaft, insuring that the top disk will rotate.

Twelve outer spacers, equally spaced around the topside of the top disk, extend from beyond the rim of the base inward to the top of the pump casing. The outer end of each spacer extends below and partially up the underside of the top disk. These spacers perform the same function, to separate water as the outer spacers on the tubular shaft perform on the purified JP-5.

A vane-type centripetal pump, the paring disk, is housed within the pump casing area of the top disk. The paring disk does not rotate; it is threaded (hand tighten counter-clockwise, 3 to 3 1/2 complete revolutions) onto the feed tube assembly (see "Cover Assembly"). In this pump, the pump casing revolves around the impeller; thus, the flow is from the outside to in. This flow, being centripetal, is just the reverse of a centrifugal pump. The feed tube assembly is the pump's shaft. A nylon collar fits snugly around the top of the paring disk. When the feed tube is screwed into the paring disk, the paring disk is raised until the nylon collar contacts the upper/inside area of the pump casing. In this position, the nylon collar acts as a wearing ring for the paring disk.

A bowl top seats on the top of the top disk spacers. Discharging water flows up through the space between the top disk and the bowl top. The conical-shaped bowl top is thicker at the bottom than at the top. Part of this thick base rests on top of the bowl shell and part of it extends down inside the bowl shell.

The part of the bowl top extending down inside the bowl shell has an O-ring retaining groove. An oil-resistant O-ring installed in this groove forms a liquid-tight seal between the bowl top and the bowl shell. This seal ensures that the liquids involved in the purifying process will be confined to their normal flow through the bowl shell assembly.

A large coupling ring is threaded down over the base of the bowl top to the upper/outside edge of the bowl shell. This ring holds the bowl top in place.

A protruding rectangular tab on the underside of the outer rim of the bowl top engages a notch in the bowl shell to ensure rotation of the bowl top.

The top edge of the bowl top has a retaining groove into which is inserted an oil-resistant rubber seal ring. A discharge ring seats on top of this seal ring.

The outer edge around the top of the bowl top is threaded to receive a coupling nut. The coupling nut screws down over the discharge ring, forcing the discharge ring down onto the rubber seal ring. This seal ensures that discharging water will flow up through the center of the discharge ring.

The coupling ring, as stated before, forces the bowl top down onto the top of the bowl shell completing a seal. As the coupling ring is screwed downward, it forces the bowl top down onto the disk stack. This action compresses the disk stack and ensures that each disk will seat tightly on its adjacent disks. The space between each disk is thereby assured to be correct.

To ensure correct tension on the disk stack, an aligning mark is stamped on the coupling ring and the bowl top. These two marks must be lined up when tightening the coupling ring. An indication arrow and the word "OPEN" are also stamped on top of the coupling ring. These marks show the direction of rotation to remove the coupling ring.

If coupling ring alignment mark passes the bowl top alignment mark by more than 20 to 25 degrees (4 1/2 inches), contact the Type Commander immediately. This indicates excessive wear of the bowl threads, a condition dangerous to equipment and personnel.

CAUTION

The coupling ring and coupling nut have left-hand threads.

Four T-shaped slots are equally spaced around the outside/upper rim of the coupling ring. A special wrench engages these slots for removal or installation of the coupling ring.

The discharge ring, seated on top of the bowl top, acts as a dam to maintain the proper line of separation between the water and the JP-5 within the bowl shell assembly.

Each purifier is furnished with a set of discharge rings. The outside diameters of the discharge rings are the same. The inside diameters of the discharge rings are different. The inside diameter size is etched on each ring. The inside diameters range from 200 millimeters to 250 millimeters in increments of 5-millimeters.

The coupling nut locks the discharge ring in place. Like the coupling ring, the coupling nut also has an indicating arrow and the word "OPEN" stamped on its top.

The coupling nut has four circular slots equally spaced around its outer edge. A special wrench engages one of these slots for removal or installation.

Purifier Operations

The operations described in this section deal with starting from two different conditions-with a clean bowl and with a dirty bowl.

Regardless of the condition of the bowl, there are some preliminary steps to follow before starting the purifier. These steps are as follows:

1. Open the bowl cover.
2. Ensure the hand-brake is in the OFF position.
3. Remove the two bowl shell lock screws.
4. Insert the two bowl shell lock screw plugs.
5. Turn the bowl by hand. If the bowl does not turn freely, investigate and correct the cause.
6. Check the level of oil in the oil sump. If the oil is at or below the red line, add sufficient oil to raise the oil level to the white line.
7. Close the bowl cover, engage and tighten the three hand-wheel cover clamps.
8. Engage the feed tube to the paring disc, (turn counter-clockwise 3 to 3 1/2 complete revolutions).
9. Ensure the seal water inlet hose is connected to the purifier seal water inlet valve.
10. Ensure the purifier sump tanks are empty.

The following starting and stopping procedures are for transferring fuel from one port wing storage tank, through one transfer pump, through the port purifier, to one port wing service tank. Since transfer is from wing tank to wing tank within the same group of tanks, and on the same side of the ship, there is very little change to the list and trim of the ship. The starboard service tanks can be filled from starboard storage tanks in the same manner. But, the transferring is accomplished by using only one transfer pump to pump into one purifier, since they have the same capacity.

Starting with a clean bowl is accomplished as follows: (The procedures discussed here applies to the 200 gpm (or consult ship's AFOSS for proper operation to the 300 gpm) purifier, consult your

ship's AFOSS for the correct procedures on the type of purifier installed on your ship.)

1. Close the following valves:

   a. Sample connections.

   b. Purifier inlet valve.

   c. Purifier discharge valve.

   d. Purifier seal water inlet valve.

2. Open the following valves:

   a. Designated manifold tank-side valve.

   b. Designated manifold transfer mainside valve.

   c. Designated transfer pump inlet valve.

   d. Designated transfer pump discharge valve.

   e. Designated transfer pump inlet and discharge gage valve.

   f. Freshwater supply valve (seal water supply).

   g. Bowl casing drain valve (locked open).

   h. Designated service tank fill valve.

   i. Purifier discharge valve.

3. Start the purifier (press start button).

4. When the purifier bowl shell assembly attains 4,100 rpm (146 to 152 bumps per minute within 11 +/- 1 minute), open the seal-water inlet valve.

5. Open the main water-discharge observation port on the cover assembly.

6. When water discharges past the observation port, close the seal-water inlet valve.

7. Start the designated transfer pump (press start button).

8. Slowly open the purifier inlet globe valve and throttle to maintain 4-10 psi inlet pressure. Then throttle the purifier discharge globe valve to maintain 30 psi back pressure.

9. Log the time the following were started:

   a. Transfer pump.

   b. Purifier.

10. While the purifier is running:

   a. Log the designated transfer pump inlet and discharge gage readings.

   b. Log the purifier inlet and discharge gage readings.

   c. Take discharge samples:

      (1) Analyze samples with the AEL MK III/CCFD (Combined Contaminated Fuel Detector).

      (2) Log the results of the analysis.

11. When the designated transfer pump loses suction on the storage tank:

   a. Close the purifier inlet valve.

   b. Open the manifold valves for the next storage tank to be emptied.

   c. Close the manifold valves for the already empty storage tank.

   d. Repeat step 8.

12. When the service tanks are 95 percent full. STOP the transfer operation. The procedure for stopping the purifier is as follows:

   a. Close the purifier inlet valve.

   b. Stop the designated transfer pump (press stop button).

   c. Stop the purifier (press the stop button).

   d. **Do not engage the brake.**

   e. The purifier will coast to a stop (about 45 minutes).

   f. As the purifier slows down:

      (1) Centrifugal force diminishes.

      (2) Feed inlet pressure will drop to zero.

      (3) Discharge pressure will drop to zero.

   g. Close the purifier discharge valve.

   h. Close all valves still open.

   i. Log the time the following were stopped:

      (1) Designated transfer pump.

      (2) Purifier.

   j. Log the gross gallons removed from the storage tanks.

   k. Log the net gallons transferred into the service tank.

Emergency stopping procedures are:

1. Press the purifier stop button.
2. Apply the hand brake (handle up).

3. Stop the transfer pump (press stop button).
4. Close the purifier discharge and inlet valves.

> **NOTE**
>
> Since the purifier discharge and inlet valves are closed in that order, JP-5 trapped in the purifier places an added resistance to rotation, thus helping to stop the purifier.

> **CAUTION**
>
> Certain conditions will occur that will require the purifier to be left running for brief periods of time with no fuel flow. The purifier must then be placed in the standby mode to prevent overheating of internal parts.

TO PLACE THE PURIFIER IN STANDBY MODE:

- Shut the purifier inlet valve.
- Stop the designated transfer pump (press stop button).
- Manually open the seal water valve to the purifier and admit a small flow (trickle) of seal water to the purifier.
- Check after 5 minutes and every 5 minutes thereafter to ensure the inlet-outlet housing and purifier bowl cover is cool to the touch.
- If the housing and cover are not cool to the touch, increase the flow of seal water.

The procedures for taking the purifier out of STAND BY mode:

1. The preliminary steps have already been complete. You are just waiting to start purifying again.

2. When the purifier attains full rpm, complete steps 5 through 12 as when starting with a clean bowl.

The procedure for starting the purifier with a dirty bowl is as follows:

1. Complete all the preliminary steps.

2. Complete steps 1, 2, and 3 as when starting with a clean bowl.

3. Open the purifier seal water inlet valve. The seal water flowing into the purifier keeps the bowl balanced as the purifier comes up to speed.

4. When the purifier attains full rpm, complete steps 5 through 12 as when starting with a clean bowl.

The position of the line of separation between the JP-5 and water is important to proper purification. For good purification, this line should be outside the disk stack but well under the top disk. If the line of separation is too far out, some or all of the JP-5 will discharge with the water. If the line of separation is too far in, water will discharge with the JP-5. The position of the line of separation depends upon the selection of the proper discharge ring. The discharge ring depends on the specific gravity of the JP-5. Once the specific gravity is determined, refer to the chart of discharge ring sizes (fig. 2-56).

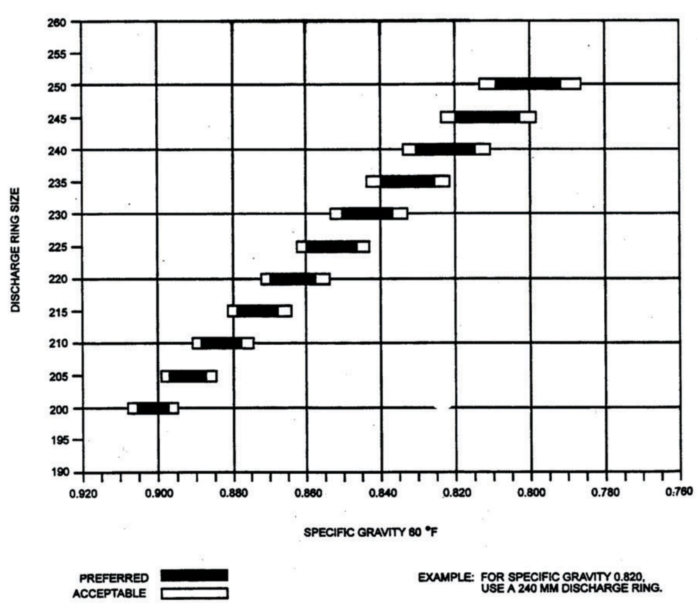


Figure 2-56.—Discharge ring size chart.

In order to determine the correct discharge ring size, Quality Control personnel will have to perform a specific gravity test. Refer to Chapter 1, API/SECIFIC GRAVITY TEST section, for information on how specific gravity is determined. After obtaining the specific gravity of fuel, those readings are converted using the Purifier technical manual and tables 541-10-4 located in NAVSEA S9086-SN-STM-010/CH-541.

Find the specific gravity number along the base of the chart. Using Figure 2-56, locate specific gravity of fuel along horizontal axis labeled **SPECIFIC GRAVITY**. Follow a vertical line to where it meets a heavy black horizontal line. If the indicated discharge ring size does not match exactly the size of one of the rings supplied with the purifier, always use the next larger size. From this point, follow horizontal line to vertical axis labeled **DISCHARGE RING SIZE** and read the correct size of discharge ring to be used.

Install this ring in the purifier. Operate the purifier, and observe the JP-5 and water-discharge sight flow gages. If all of the discharge (water and fuel) goes out the water discharge, the discharge ring is too large. Stop the purifier and install the next smaller ring. Make another trial. If necessary, repeat until JP-5 is properly discharged from the bowl shell assembly. If more than one trial is required, it generally indicates a mistake was made in determining the correct specific gravity or in using the discharge ring size chart.

CAUTION

When the seal water is cold, a small amount of JP-5 may discharge with the water at first. This will cease as the water, JP-5, and purifier heat up. In this case, it will not be necessary to change the discharge ring.

If water discharges with the JP-5, the discharge ring is too small; try the next larger ring.

When the proper size discharge ring is established, do not change it. As a general rule, the most satisfactory purification occurs when the discharge ring is the largest size possible without causing loss of JP-5.

During normal operations, there should be no more than a small discharge from the water outlet. The bulk of the discharge should be out the purifier JP-5 outlet.

If a large discharge from the water outlet is observed, it indicates excessive water in the feed, or the water seal has been lost. The operator should immediately determine whether the excessive discharge is water or JP-5.

If the excessive discharge is JP-5, the bowl has lost its seal. Stop the flow of feed; re-prime the bowl; and slowly resume the flow of feed.

If the seal is again lost, immediately stop the purifier and check the discharge ring size and the bowl shell assembly's two rubber seal rings. Correct the cause and resume operation.

If the excessive discharge is water, secure the operation and determine the source of the water. Sound the storage tanks with water-detecting paste and re-strip the storage tanks as necessary.

NOTE

If the tanks have been properly settled and stripped, there should never be more than a trace of water in the feed.

If water has been put into the service tanks, they must also be stripped. If no water is found in the storage tanks, check the piping in the bilge, voids, etc., for leaks or other possible sources of water.

Purifier Maintenance

Establish and maintain a regular cleaning schedule, considering the following factors:

1. Accumulation of a large quantity of heavy solids in the bowl shell will cause the bowl to run rough. The bowl must be cleaned before the wet cake exceeds 30 pounds or 1 1/2-inch thickness at its thickest point.

2. If the purifier is to be inactive for less than 12 hours, it must be flushed out with freshwater while it is still operating, by using the priming water.

3. If the purifier is to be inactive longer than 12 hours, it must be disassembled and thoroughly cleaned.

4. In any event, the bowl must be disassembled and thoroughly cleaned at least once a week IAW PMS.

The purifier bowl should be inspected for corrosive pitting. If pitting is found, the bowl should be thoroughly cleaned with a mild abrasive cleaner in combination with stainless steel sponges. If pitting continues, the bowl should be reconditioned at the earliest opportunity. Where pitting has progressed to 1/4-inch in depth, replace the bowl.

CAUTION

Continued use of deeply pitted bowls can be potentially hazardous.

When disassembling and assembling the bowl shell assembly for cleaning, you must remember that the parts are heavy. For this reason, a chain hoist and trolley have been provided to lift the parts and transport them to a deep sink. Be careful when raising, lowering, and transporting the parts. It is imperative that the chain hoist be centered directly over the center of the spindle before any part is raised or lowered.

To disassemble the purifier for cleaning, proceed as follows:

1. After stopping the bowl, remove the plugs and insert the lock screws. The two lock screws (one on each side of the purifier) enter the slots in the bowl shell, locking it in position.

2. Using the spring-loaded T-handle on top, unscrew (turn clockwise 3 to 3 1/2 complete turns) the feed tube until it is free from the paring disc.

3. Loosen the three hand-wheel cover clamps and swing the bowl casing cover back until it engages the ratchet hook. This will automatically lock the cover in the open position.

4. Unscrew the bowl top coupling nut (fig. 2-57), using the special tool (inset, fig. 2-57) and remove the discharge ring and rubber ring.

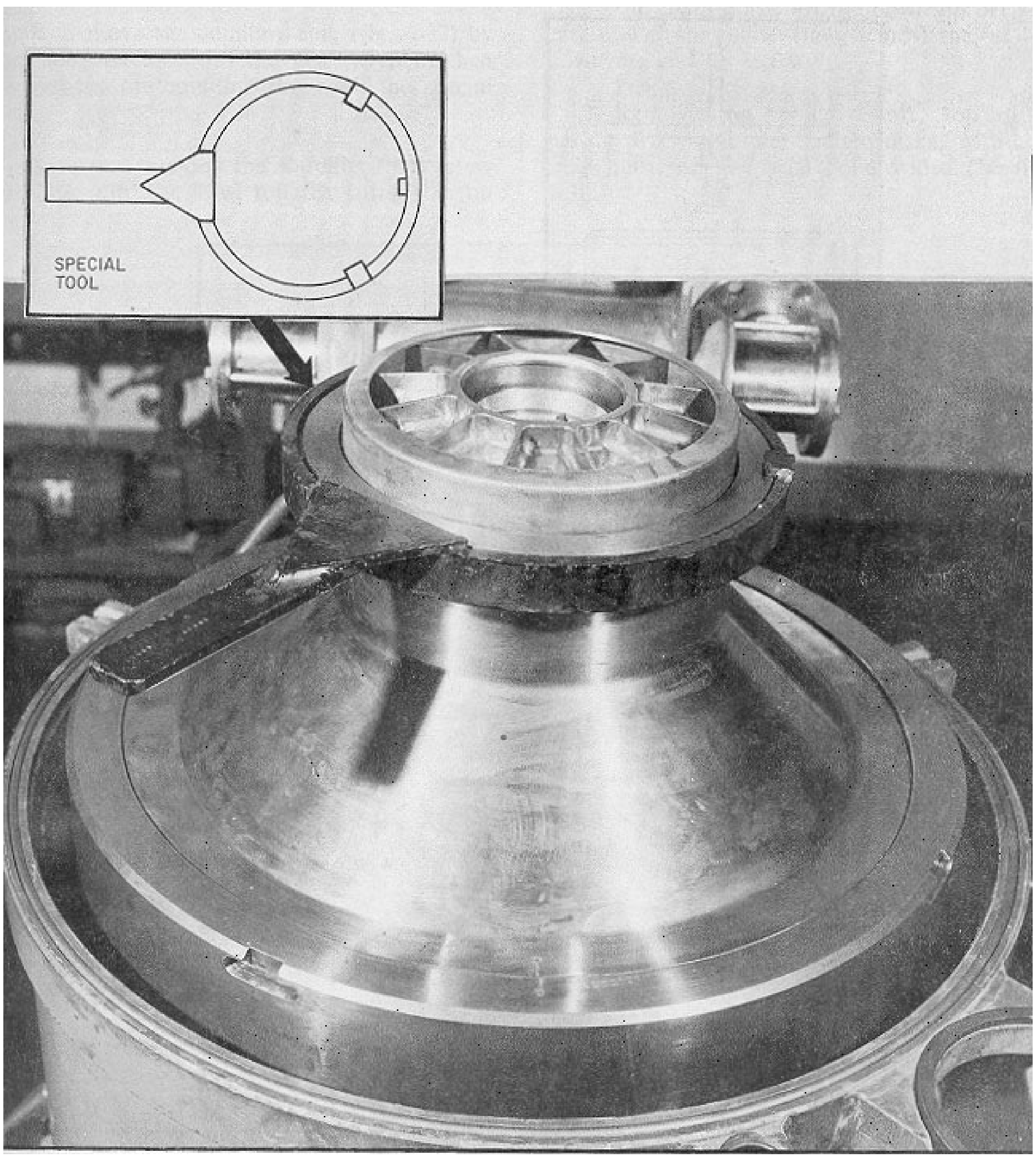


Figure 2-57.—Removing bowl top coupling nut (with special tool).

5. Remove the coupling ring (fig. 2-58) by loosening it first with the gear wrench, then unscrewing the coupling ring with the special tool.

6. After removing the coupling ring, screw the lifter into the bowl top. When you turn in on the T-handle jackscrew on top of the lifter, the bowl top will loosen up from the bowl shell. Using the chain hoist, lift the bowl top off, remove the rubber bowl ring and lay it flat.

NOTE

The Purifier Compression Tool has been incorporated into the purifier special tools. Allows for the removal of the coupling ring vice using the manual purifier special tools, it limits wear and tear to purifier components.

Use the following steps when using the Purifier Compression Tool (fig. 2-59):

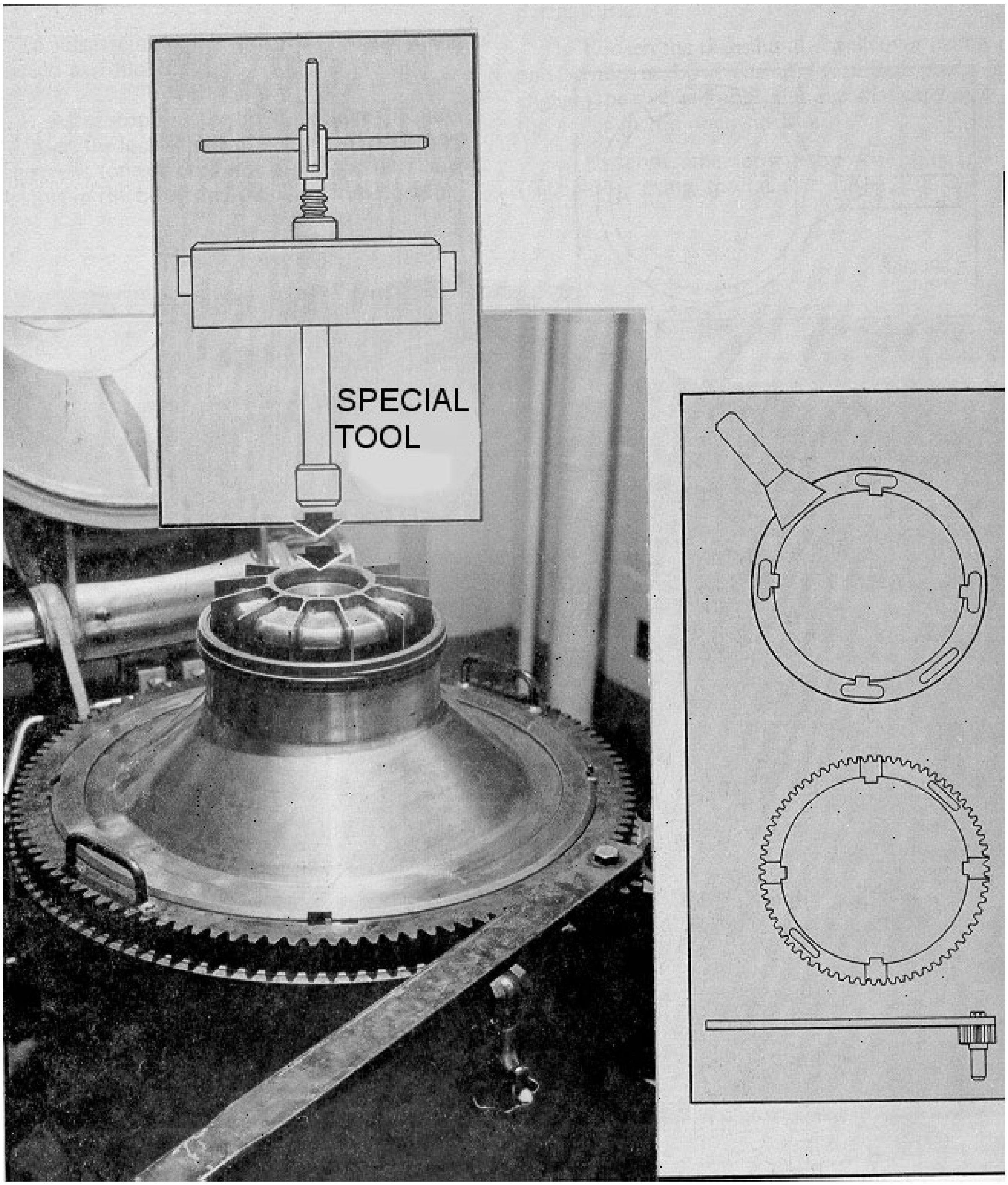


Figure 2-58.—Removing coupling ring (with special tool).

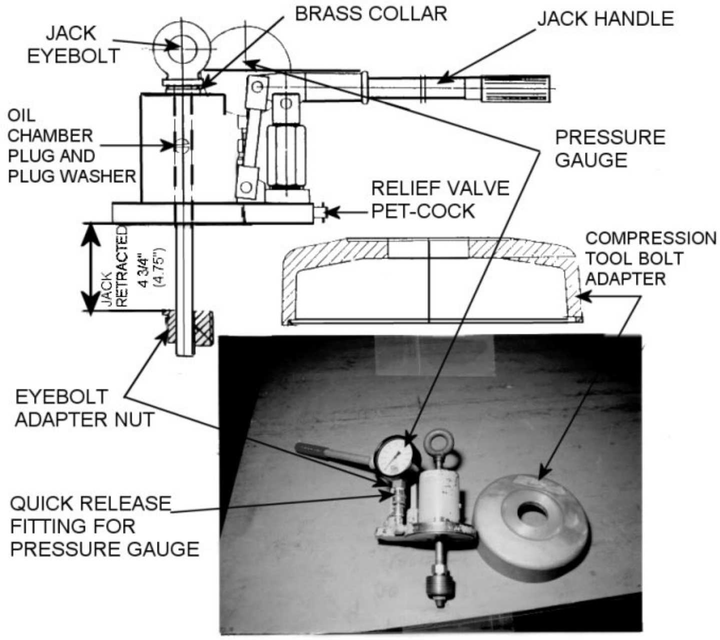


Figure 2-59.—Purifier compression tool.

a. Place coupling ring manual wrench (fig. 2-58) on coupling ring.

b. Place compression tool adapter on bowl top hood, only after the coupling nut, discharge ring, and rubber has been removed. See step 4, under "To disassemble the purifier for cleaning."

c. Ensure the location of the threaded adapter on eyebolt for the compression tool and tubular shaft threads will effect positive thread engagement. Also, make sure the eyebolt lock nuts are tight.

CAUTION

If threaded eyebolt assembly on compression tool will not pass through paring disc and engage tubular shaft threads, this condition indicates that paring disc or tubular shaft threads are damage. **Do not force eyebolt.** If this happens, disassemble bowl using manual purifier special tools.

d. Place bowl compression tool on pilot diameter of compression tool adapter.

e. Insert and secure bowl compression tool eyebolt (CW) clockwise into tubular shaft.

Verify shoulder of bowl compression tool eye-bolt is one quarter inch (1/4”) from face of tool hydraulic ram.

g. Assemble pressure gage onto jack and ensure lowering valve is shut (CW) clockwise.

NOTE

Relief valve for the purifier compression tool is set at 8,000 psi. If compression tool does not relieve at 8,000 psi, reset the relief to 8,000 psi IAW PMS.

h. Insert the handle and pump jack slowly until pressure gage indicates approximately 7,800 psi.

i. Rotate coupling ring manual wrench (CW) clockwise and loosen coupling ring completely.

j. Slowly open lowering valve on jack (CCW) counter-clockwise and relieve pressure.

CAUTION

Residual pressure must be relieved and jack ram is fully retracted prior to disassembling pressure gauge from jack.

k. Remove pressure gauge from jack.

l. Unscrew bowl compression tool eye-bolt completely (CCW) counter-clockwise and remove jack assembly and bowl top adapter.

m. Remove coupling ring manual wrench from coupling ring.

n. Remove coupling ring.

The purifier compression provides a much easier method of removing the coupling ring and extends the life of the threaded components. This method is not to replace the purifier manual special tools, only an alternative to relying on brute strength. Remember the tools are only as good as the person using them, use the tools properly. The purifier is one equipment that you will be dealing with on a daily basis, use care and attention to applicable instructions when disassembling this equipment.

7. Remove the tubular shaft, top disk, paring disc, and intermediate disks, with the chain hoist, using the special tool provided. (See figure 2-60.)

8. If removal of the bowl is required, lift out the bowl strainer. Remove the spindle cap nut and back out both lock screws. Screw the lifter (fig. 2-61) onto the bowl shell, and by turning in on the jackscrew the shell will loosen from the spindle. Using the chain hoist, lift the shell from the frame.

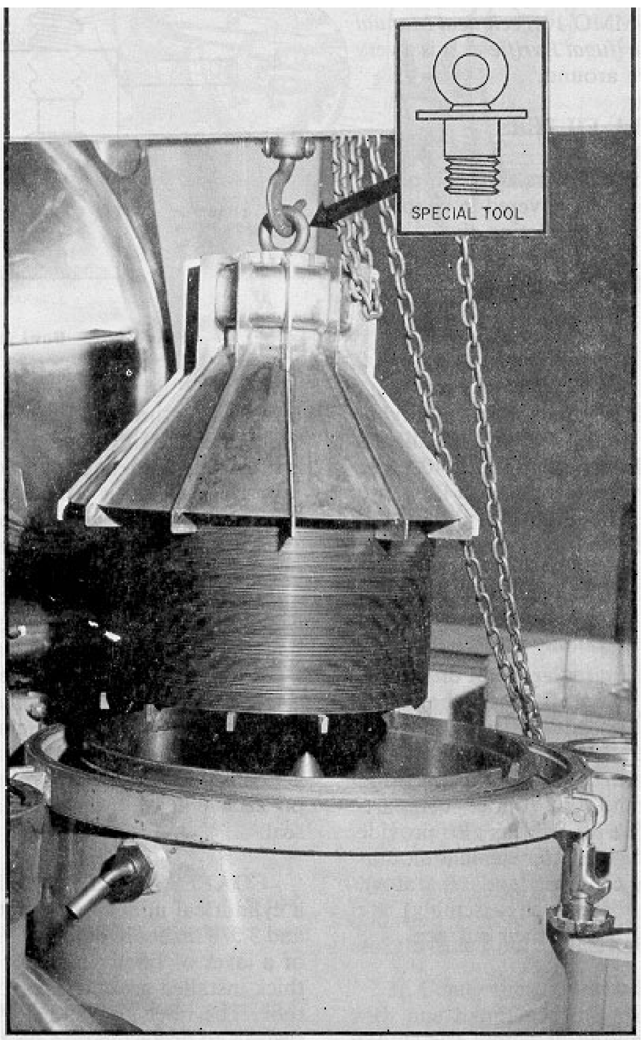


Figure 2-60.—Removing disk stack.

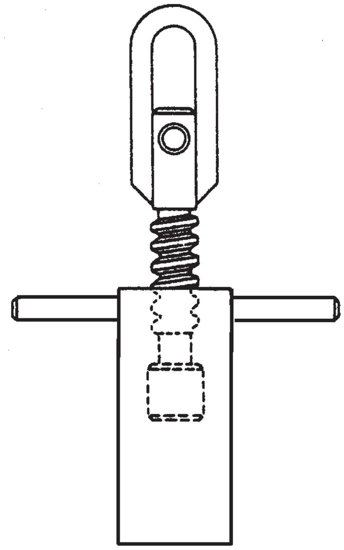


Figure 2-61.—Bowl shell lifter.

After the bowl parts have been disassembled, remove the rubber rings and clean the tubular shaft and disks with a brush, using JP-5 as the cleaning fluid. Reassemble in the reverse order.

Refer to Table 2-5 for some of the more common problems associated with the operation of a JP-5 purifier, possible causes, immediate actions you need to perform and what you can do to rectify the problems. Remember, always consult the applicable technical manual for the correct model purifier installed on your ship.

O-rings and gaskets should never be hung vertically; lay them neatly on a clean, flat surface. Hanging will seriously distort the shape of O-rings and gaskets. When installing O-rings, always inspect them for nicks, cuts, or abrasions; use only good O-rings. Examine the O-ring retaining slots and other contact surfaces for nicks and burrs. Repair any discrepancies prior to installing O-rings and gaskets. Before installation, make sure that the retaining slot and contact surface are clean and coat the O-ring with a light machine oil.

Maintain the lubrication system in perfect condition. Refer to the manufacturer's instruction manual and current Instructions about the type and amount of lubricant.

Q2-33. What is the inlet pressure to a 300gpm purifier?

Q2-34. What type of flexible hose directs seal-water inlet from the fresh water supply into the purifier?

Table 2-5.—JP-5 Purifier Troubleshooting Chart

Malfunctions	Immediate Action	Probable Cause	Remedy
1. Purifier will not start/run.	1. Check power controller. 2. Check power load center. 3. Turn off electrical power source and tag “Out of Service”.	1. No electrical power at controller. 2. Power failure at load center. 3. Faulty wiring. 4. Faulty motor.	1. Restore power at controller. 2. Restore power at load center. 3. Verify proper electrical connection. 4. Repair/replace motor.
2. Noisy motor.	1. Perform shutdown procedure as soon as practical. 2. Turn off electrical power source and tag “Out of Service”.	1. Faulty bearing (s). 2. Faulty motor.	1. Replacing bearing (s). 2. a. Verify proper electrical wiring connection. b. Repair/replace motor.
3. Water leakage. Upon initial start-up, water is discharged through 1 1/2 inch drain line.	1. Perform shutdown procedure as soon as practical. 2. Turn off electrical power source and tag “Out of Service”.	1. Faulty bowl shell O-ring.	1. Replace bowl shell O-ring.
4. Bowl overflows through 1 1/2-inch bowl casing drain.	1. Reduce discharge pressure.	1. Discharge pressure too high.	1. Reduce discharge pressure.
5. Fuel overflows through 4-inch water discharge drain.	1. Stop transfer pump and place purifier in standby mode of operation. 2. If remedies 1, 2, or 3 did not correct situation, perform shutdown procedure as soon as practical. 3. Turn off electrical power source and tag “Out of Service”.	1. Discharge pressure too high. 2. Fuel induce too fast during start-up. 3. Excessive throughput. 4 Discharge ring size incorrect. 5. Faulty or missing discharge ring O-ring.	1. Reduce discharge pressure by opening back pressure valve. 2. Re-prime bowl and restart fuel flow more slowly. 3. Reduce flow using bypass. 4. Select proper discharge ring size and replace discharge ring. 5. Replace discharge ring O-ring.
6. Excessive amounts of fuel in water discharge.	1. Perform shutdown procedure as soon as practical. 2. Turn off electrical power source and tag “Out of Service”.	1. Discharge ring size incorrect. 2. Bad seal between paring disc and O-ring on inlet-outlet housing.	1. Select proper size discharge ring and replace discharge ring. 2. Check O-ring and replace as necessary. Ensure mating threads between the paring disc and feed tube assembly are not scarred or galled.
7. Excessive amounts of water in purified fuel.	1. Performed shutdown procedure as soon as practical. 2. Turn off electrical power source and tag “Out of Service”.	1. Discharge ring size incorrect.	1. Select proper size discharge ring and replace discharge ring.
8. Purifier makes excessive noise or vibrates.	1. Determine whether brake is engaged. 2. Perform shutdown procedure as soon as practical. 3. Turn off electrical power source and tag “Out of Service”.	1. Brake applied. 2. Faulty spindle bearing (s). 3. Faulty drive gear (s). 4. Unbalance bowl. 5. Baseplate bolts over torqued. 6. Insufficient gap between motor and drive coupling. 7. Improper electrical connections. 8. Paring disc not engaged.	1. Release brake. 2. Replace spindle bearing (s). 3. Replace drive gear (s). 4. Notify Type Commander (TYCOM). 5. Re-torque baseplate bolts. 6. Readjust drive coupling. 7. Re-verify proper electrical connections. 8. Disassemble and inspect paring disc/distributor for damage; repair or replace as necessary. Reassemble and engage paring disc.

Table 2-5.—(cont'd) JP-5 Purifier Troubleshooting Chart

Malfunctions	Immediate Action	Probable Cause	Remedy
9. Purifier will not come up to speed in prescribed time.	1. Determine whether brake is engage. 2. Perform shutdown procedure as soon as practical. 3. Turn off electrical power source and tag "Out of service".	1. Brake applied. 2. Agastat timer setting incorrect. 3. Faulty wiring between controller and motor. 4. Faulty bearing (s).	1. Release brake. 2. Verify correct agastat timer setting. 3. Verify proper electrical connection and wire condition. 4. Replace bearing (s).
10. Loss of feed pressure.	1. Place purifier in standby mode of operation.	1. Loss of transfer pump suction. 2. Transfer pump shut off via programmable Navy logic controller (PNLC) * switch 3. Power loss to transfer pump. 4. Transfer pump failure.	1. Re-establish pump suction. 2. Align a full stowage tank to transfer pump. 3. Determine source for power loss. Restore power. 4. Switch feed pumps.
11. Loss of discharge.	1. Place purifier in standby mode of operation. 2. Stop feed pump.	1. Loss of feed pressure. 2. Loss of water seal.	1. Re-establish feed supply pressure. 2. Re-establish water seal and feed supply pressure.
12. Purifier rpm slows suddenly.	1. Stop feed to purifier. Place purifier in standby mode of operation. 2. Perform shutdown procedure as soon as practical. 3. Turn off electrical power source and tag "Out of Service".	1. Loss of water seal. 2. Loss of power to motor. 3. Faulty bearing (s) in motor or purifier drive assembly.	1. Re-establish water seal and feed supply pressure. 2. Determine power problem. Re-establish power supply. 3. Replace bearing (s).
13. Air in clean fuel discharge sight glass.	1. Verify purifier is operating within prescribed parameters of 4-10 psi.	1. Discharge pressure not in accordance with prescribed operating parameters of 4-10 psi.	1. Slowly throttle purifier discharge valve until air bubbles disappear from fuel.
14. Excessive blow back through 4-inch water discharge line and bowl casing drain.	1. Stop fuel feed to purifier and place purifier in standby mode of operation. 2. Perform shutdown procedure as soon as practical. 3. Turn off electrical power source and tag "Out of Service".	1. Drain tank is full. 2. Drain tank flapper valve failed.	1. Empty drain tank. 2. Verify flapper valve is installed.
15. Coupling ring will not seat/align properly during purifier re-assembly.	1. Remove coupling ring, bowl top, disk stack and distributor.	1. Distributor shaft improperly aligned. 2. Disks not aligned with distributor shaft key. 3. Bowl top key not aligned with bowl shell key way.	1. Align distributor shaft properly. 2. Realign disks on distributor shaft. 3. Align bowl top and bowl shell properly.

**Programmable Navy logic controller (PNLC) is associated with the transfer pump and purifier discharge pressure. The PNLC will set at 15 psi. At any time after the PNLC is set the discharge pressure drops below 10 psi, the power to the transfer pump will secure.

Q2-35. The worm wheel gear is keyed to the drive shaft, it engages what component located at the base of the spindle assembly to drive the purifier bowl?

Q2-36. How does the operator determine the purifier bowl is spinning at full speed by utilizing the speed counter?

Q2-37. How many intermediate disks are provided with the 300gpm purifier?

Q2-38. When screwing the feed tube assembly into the paring disc, how many turns is required to ensure that feed tube and paring disc are properly engaged?

Q2-39. To ensure correct tension on the purifier disk stack, the two aligning marks on the coupling ring and bowl top must lined-up when tightening the coupling ring. What maximum degrees are allowed for the coupling ring aligning mark to pass the aligning mark on the bowl top?

Q2-40. During purification process, you observed a large amount of water and fuel discharging out through the water observation port and nothing is discharging passed the discharge bull'seye sight glass. What is the probable cause?

Q2-41. While performing disassembly maintenance using the Purifier Compression Tool, how much psi should be applied with the tool to loosen the coupling ring so you can turn the manual coupling ring wrench by hand freely?

JP-5 SYSTEM PRESSURE AND CAPACITY GAGING EQUIPMENT

LEARNING OBJECTIVE: Describe the different types of pressure gages, tanks, tank level indicating equipment and fuel delivery control systems used by an ABF. Explain their function, operation, how they are use to validate JP-5 system pressures and gaging fuel capacity. Discuss inherent environmental impact associated with fuels.

PRESSURE GAGES

Pressure gages are used throughout the AvFuels system to measure and indicate pressure so the operator of the equipment can maintain pressure at safe and efficient operating levels. A wrong pressure indication is often the first sign of trouble with the equipment. Any excess or deficiency in pressure should be immediately investigated.

There are three types of gages the ABF will typically use in operating the AvFuels system; Simplex pressure gages, compound gages and differential pressure gages.

Simplex pressure gages measure pressure only. The gage readings range from zero to the gage's maximum rated pressure. A Simplex pressure gage has two pointers: One usually black or white, indicates the actual operating pressure of the system the gage is attached to; the other, usually red, is manually positioned to indicate the normal operating pressure of the system the gage is attached. These gages are normally installed on the discharge side of pumps.

Compound gages are nearly identical to simplex pressure gages, with one exception. Compound gages can measure vacuum. The gage readings typically start at 30 inches of vacuum and increase to the gage's maximum rated pressure. The pointers are exactly the same as on the simplex pressure gage. These gages are normally installed on the suction side of pumps and the main deck filling connections.

Differential pressure gages are used to measure the pressure between two pressure lines. A differential pressure gage has only one pointer and does NOT measure actual pressure. It measures the pressure DIFFERENTIAL between two pressure sources. These gages are normally installed on vertical and reclaim filters.

TANKS

Storage of aviation fuel aboard carriers has always presented a serious fire and explosion hazard. With the introduction of JP-5 as the primary jet fuel, hazards in handling were lessened and, because of the high flash point of JP-5 (minimum 140°F), protective storage is not required.

Basically, there are four types of JP-5 tanks; wing, deep centerline, double-bottom, and peak tanks. See figure 2-62 for the types and locations of JP-5 tanks.

Tank types generally relate to the relative location of the tanks in respect to the hull of the ship.

Wing tanks are deep tanks located in a forward and aft row along the contour of the hull on the port and starboard sides of the ship. There are normally two rows of wing tanks on each side. These tanks are located between voids and are an integral part of the ship's underwater protective system. The top of the tank is at the fourth deck level, and the bottom is the shell of the ship. There are an equal number of port and starboard wing tanks in the forward group and in the after group. Each port tank has an identical twin of the same shape and capacity located directly opposite on the starboard side. These twins are operated as a unit. They are filled and emptied as if they were one tank, to preserve the list and trim of the ship.

Deep centerline tanks referred to here, were the original (AvGas) Aviation Gasoline tanks on CVs that were converted to JP-5 tanks. Normally, all forward tanks and the after port tanks were converted. The cofferdams for the converted tanks are either filled with fresh water or used as service or storage tanks.

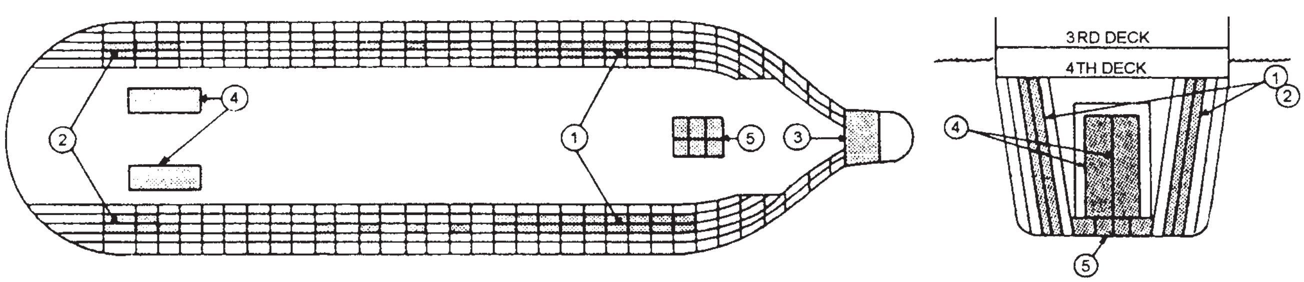
Seagoing vessels have two bottoms; a bottom and an inner bottom. The space between double bottoms is divided into many watertight compartments, which are used for storage of fuel, water, or ballast. These are called double-bottom tanks. The bottom of these tanks is the bottom or outer shell of the ship. The top of these tanks is the inner bottom, which is also the deck of the bilge. Double-bottom tanks are, by necessity, shallow tanks.

Peak tanks are deep tanks, which are located in the extreme bow and stern of the ship below the waterline. Only the bow tanks are used for JP-5 storage presently. The shell of the ship forms two sides and the bottom of each peak tank.

Fuel tanks, like all compartments aboard ship, are numbered to identify their location. Each tank has its own number. The first number indicates the deck level, the second indicates the frame, and the third indicates the tank's position in relation to the ship's centerline. Knowing the location of the tanks is a tremendous asset in learning your ship's fuel system. It will also help you locate the sounding caps for each tank's sounding tube. Generally, the cap will be one or two decks directly above the tank it serves. Every sounding cap is marked with its tank number. Sounding caps are X-ray fittings and must be secure tightly after each use.

JP-5 tanks are designed and constructed to fulfill specific purposes and are classified under two major categories; STORAGE and SERVICE.

A storage tank is any tank used for the bulk storage of JP-5. Any wing, deep centerline, double-bottom, or peak tank can be used for bulk storage. A service tank is any tank used for storage of JP-5 suitable for issue to aircraft. The JP-5 in a service tank has been passed through either a filter or a centrifugal purifier before being pumped into the service tank. Generally, only wing or deep centerline tanks are used for this purpose. Service tanks have but one purpose, servicing aircraft. However, storage tanks can be used for several purposes. The designation of each tank indicates purpose of that tank.



1 **JP-5 wing tanks (forward group)**
2. **JP-5 wing tanks (after group)**
3. **Peak tanks**
4. **Deep centerline tanks**
5. **Double-bottom tanks**

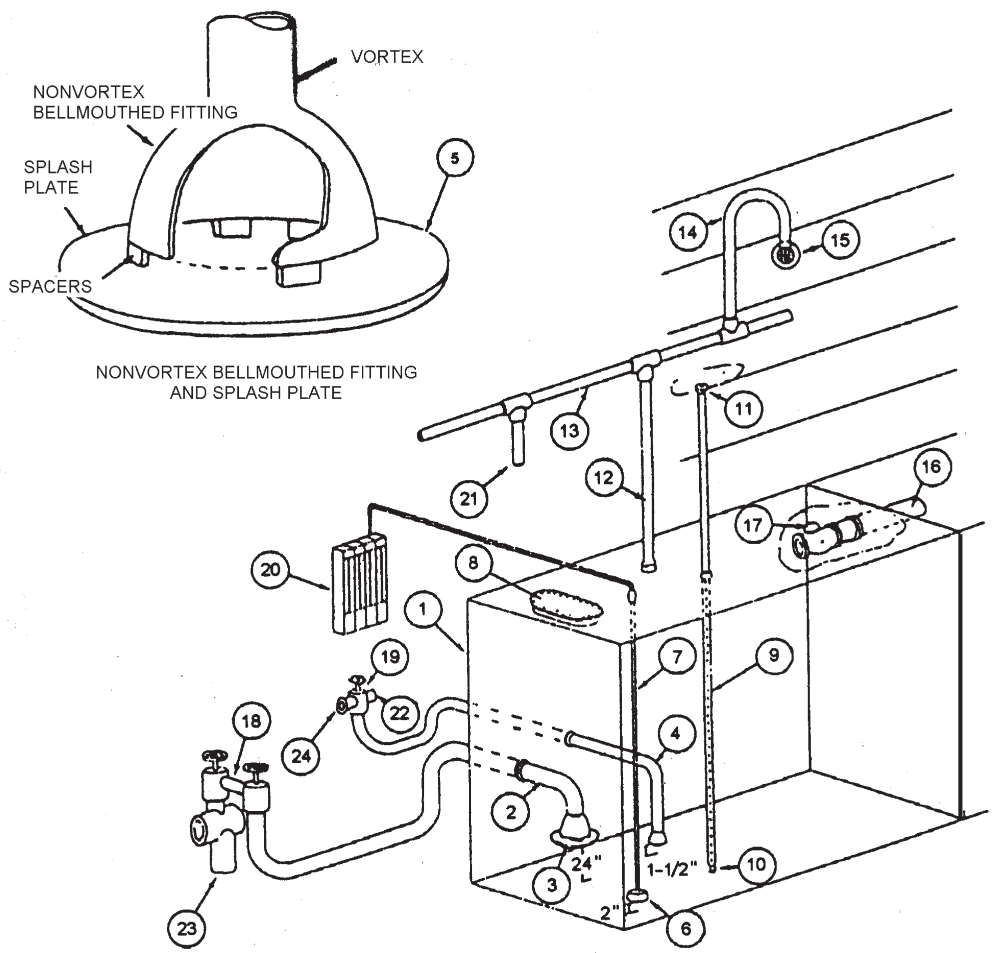
Figure 2-62.—Types of JP-5 tanks.

JP-5 Storage Tanks

A JP-5 storage tank with associated piping is shown in figure 2-63. Each JP-5 storage tank and the piping within the tank are sandblasted to bare metal and coated with a protective coating to minimize rust formations.

An air escape riser that vents the tank to the atmosphere extends from the top of the tank to an air escape main that runs forward and aft just below the main deck. The air escape riser (vent line) prevents a buildup of pressure when the tanks are being filled and prevents a vacuum from forming when the tanks are being emptied.

There are usually four air escape mains serving the forward and after groups of tanks; two forward (one port and one starboard) and two aft (one port and one starboard). A cane-shaped vent line extends up from each main to just below the 02 level and loops back down to just below the 01 level, where it terminates into an air escape cane. The air escape piping penetrates the skin of the ship and is open to the atmosphere. The outboard end is covered with a bolted rat-proof screen and the inboard end, houses a conical shaped 60-mesh



1. Tank
2. Fill and suction tailpipe
3. Nonvortex bellmouthed fitting and splash plate
4. Stripping tailpipe
5. Nonvortex bellmouthed fitting
6. Magnet-equipped float
7. TLI transmitter
8. Manhole
9. Sounding tube
10. Striker plate
11. Sounding tube cap
12. Air escape riser manifold
13. Air escape main
14. Air vent
15. Flame arrester
16. Overflow line
17. One-way check valve
18. Suction and fill manifold (double or single-valved)
19. Stripping manifold
20. TLI receiver
21. Connection to other tank air escape risers
22. Connection to other tank valves
23. Connection to transfer main branch header
24. Connection to flood and drain manifold

Figure 2-63.—JP-5 storage tank.

screen to allow for airflow. The air escape screen is cleaned semi-annually.

CAUTION

These vents need to be covered, when ship's side cleaners are spray painting near these vents. Sprayed paint can stop the flow of air through the vents by clogging the screen.

An overflow line extends from near the top of the storage tank to an overflow tank. This line is considerably larger than the tank fill line to prevent rupture of the storage tank in the event of overfilling at high pressure. When the tank is full, it will overflow via a one-way check valve into the overflow tank for that nest of tanks.

NOTE

A nest of tanks is that small unit of tanks within a group of tanks that is serviced by one overflow tank. The forward and after groups of storage tanks consist of several nests of tanks.

A bolted manhole cover provides access to the tank for inspection, cleaning, and maintenance. A sounding tube extends from the extreme bottom of the tank to the second or third deck. The lower end is secured to a striker plate and the upper end, is closed by a threaded access cap. That section of the sounding tube within the tank has evenly spaced holes to ensure that the level of fuel in the tube is the same as that in the tank. The bottom end of the sounding tube is fitted with a takedown joint to provide a means to retrieve sounding bobs or tapes that brake inside the sounding tube. Sounding tubes are provided for measuring the quantity of JP-5 in the tank, detecting water, and thieving a sample.

The suction and fill tailpipe extends from the manifold to terminate between 6 to 24 inches off the bottom at the lowest end of the tank. A non-vortex bellmouthed fitting and a splash plate are installed on the end of the tailpipe. This fitting reduces turbulence when filling, prevents a vortex from forming when emptying the tank, and prevents taking suction directly off the bottom. Storage tanks are filled and emptied through this line.

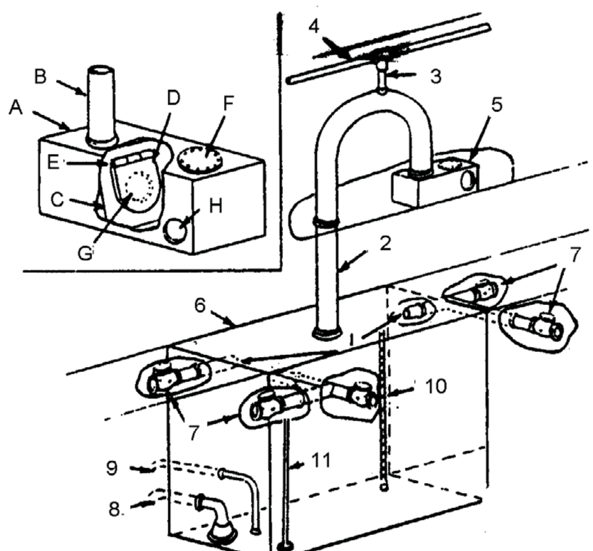
The stripping tailpipe is similar in design to the suction and fill tailpipe. Only exception, it is smaller and has no splash plate. This line extends from the stripping manifold to 1 1/2 inches off the bottom at the lowest end of the tank. The stripping tailpipe is used to remove water and sludge from the bottom of the tank and to completely empty the tank by removing the last 24 inches of usable JP-5 when consolidating fuel load.

NOTE

JP-5 storage tanks have a filling rate of 500 gpm a tank, with the required minimum of six tanks on the line.

JP-5 Overflow Tanks

Overflow tanks (fig. 2-64) have the same fittings previously described for the storage tanks, except for an overflow line and the arrangement of the vent line. In addition to serving as a regular storage tank, they are



1. Overflow from storage tanks in the box
2. Overflow line
3. Air escape riser
4. Air escape main
5. Overflow box
6. Overflow tank
7. One-way check valve
8. Fill and suction tailpipe with nonvortex fitting
9. Stripping tailpipe
10. Sounding tube
11. TLI transmitter

A. Overflow box
B. Overflow line
C. Dividing bulkhead
D. Flapper check valve
E. Hinge
F. Access cover
G. Hole through dividing bulkhead
H. Hole through ship's skin

Figure 2-64.—JP-5 overflow tank.

also designed to receive the overflow from the other storage tanks in their respective nest.

The overflow tanks are actually a safety feature to prevent rupturing of storage tanks if they are over-pressurized during a filling operation. The overflow tanks overflow overboard when they are full. The overflow line extends outward from the top of the tank to just below the second deck. Here it loops back down and discharges into an overflow box on the third deck. The overflow box contains a flapper check valve that allows JP-5 to be discharged overboard but prevents seawater from entering the tanks. An inspection plate located directly over the valve allows access for cleaning and maintenance. In the past, flapper check valves have frozen open due to corrosion, and seawater contamination of JP-5 has resulted. These valves must, therefore, be inspected at least every 6 months (more often if necessary).

The overflow tanks are vented via an air escape riser from the top of the loop in the overflow line to one of the common air escape mains. Overflow tanks are the last tanks to be filled when receiving JP-5 aboard and are the first tanks to be emptied when transferring.

Contaminated JP-5 Settling Tanks

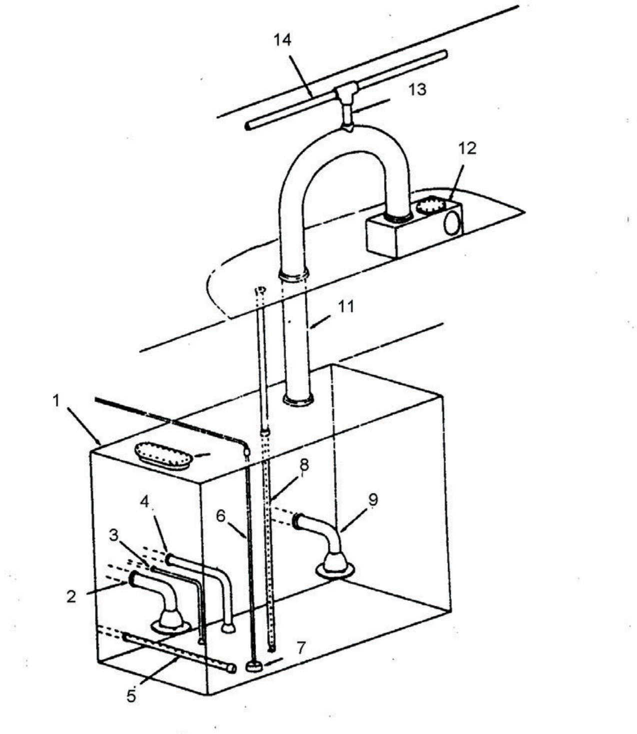
The contaminated JP-5 settling tanks are designated tanks that receive JP-5 from hose flushing, defuels, tank stripping operations, and the initial flow during a refueling at sea. In addition to standard piping, these tanks have piping branching from the defuel mains. Each branch of defuel piping going into a contaminated settling tank terminates about 48 inches above the bottom of the tank, with a perforated horizontal run about 24 inches long to reduce turbulence.

After stripping, JP-5 transferred from these tanks will be filtered via a JP-5 reclamation pre-filter and JP-5 reclamation filter/separator, in that order; to the storage tank manifold of the selected storage tank to be filled.

JP-5 Service Tanks

Although much of the equipment in the service tanks (fig.2-65) is similar to that described in the storage and overflow tanks, the piping arrangement is different and additional equipment is required.

Service tanks have an independent filling tailpipe and an independent suction tailpipe. The filling tailpipe branches from the service tank fill line header in the JP-5 pump room to terminate in a non-vortex bellmouth fitting between 6 to 24-inches off the tank bottom. Additionally, the termination height will be at least 3 inches lower than the suction tailpipe. Service tanks are NEVER filled directly from a tanker, barge, or pier. They are always filled from storage tanks, using the centrifugal purifiers.



1. Service tank
2. Filling tailpipe with nonvortex fitting
3. Hand pump stripping tailpipe
4. Motor-driven stripping tailpipe
5. Horizontal recirculating line
6. TLI transmitter
7. Magnet-equipped float
8. Sounding tube
9. Suction tailpipe with nonvortex fitting
10. Manhole
11. Overflow line
12. Overflow box
13. Air escape riser
14. Air excape main

Figure 2-65.—JP-5 service tank.

The suction tailpipe extends from the service pump's common suction header to terminate in a non-vortex bellmouth fitting either 12 or 24-inches off the tank bottom in the opposite end from the fill line. A shut-off valve is installed in this line between the service pump common suction header and the service tank.

NOTE

Height of termination above tank bottoms for service tank suction tailpipes for CV/CVNs, LHAs, and LPHs is 24 inches for wing tanks and 12 inches for inner-bottom tanks. For other ships, the height is 12 inches.

Two independent stripping systems, one hand-operated and the other motor-driven, are installed in each service tank. The hand-operated stripping is used for normal stripping of the service tanks. The tailpipe for the hand operated stripping pump extends from a maximum of 3/4-inch off the service tank bottom to the hand-operated pump in the pump room.

The motor-driven stripping system for service tanks is primarily used to completely empty the tanks and to remove the wash water after a cleaning operation. The tailpipe for the motor-driven stripping pump extends from a maximum of 1 1/2-inches off the tank bottom to the common suction header of the motor-driven stripping pumps. This line contains a shutoff valve, a one-way check valve, and a blank flange.

A recirculating line is installed horizontally 18-inches off the tank bottom in the opposite end from the suction tailpipe. This line provides a means of returning to the service tank the re-circulated fuel from the discharge side of the service pump. A number of 1-inch holes, equally spaced along the top of the recirculating line, allow JP-5 to be returned to the tank without disturbing the contents of the tank. Foaming is minimized since the recirculating line is always covered with JP-5.

Tank Inspection and Cleaning

WARNING

No person is to enter any JP-5 tank for inspection or cleaning until the conditions for safe entry specified by the Gas-Free Engineer (or his authorized representative) have been strictly complied with and the expressed permission of the Commanding Officer.

If the inspection reveals that bulkheads, stiffeners, and flat surfaces have collected solids that are readily visible, storage tanks are washed with seawater from a fire-hose. **Service tanks are normally just wiped clean, but if washing is required, use fresh water only.** Wash water is removed from storage tanks designated JP-5 or ballast by the main drainage eductor, and from service tanks and storage tanks (designated JP-5 only) by the JP-5 motor-driven stripping pumps.

The above procedures are followed if the operation is conducted at sea. If conducted in port, assistance by a shore activity and changes in the wash water removal procedure are required to prevent harbor pollution.

Due to the ease with which deposits can be washed out of JP-5 tanks with a fire-hose, steaming is not required nor should it be employed since the tank coatings may be damaged.

JP-5 tanks are never cleaned using chemical cleaning processes of solvent-emulsifier type compounds. Small quantities of chemical type cleaners remaining in the tanks will contaminate the coalescer elements in the filter/separator and destroy their coalescing ability.

JP-5 tanks are coordinated to be cleaned in a typical cycle that follows the following guidelines. Service, contamination and purifier sump tanks are schedule for cleaning every 18-21 months. Storage tanks are schedule for cleaning every 36-39 months. Coordination of a tank-cleaning bill should factor in underway periods, stand-down periods, in-port periods and manpower. Very important to note that once ammunition is onboard, those JP-5 tanks located in these spaces cannot be opened for routine cleaning for as long as ammunition is aboard.

When conducting the inspection and cleaning of JP-5 tanks, refer to applicable Maintenance Requirements Cards for correct procedures and safety precautions to be followed.

GEMS TANK LEVEL INDICATING (TLI) SYSTEM

The Gems TLI system (fig. 2-66) consists of a transmitter, jumper cables, receiver, and a magnet-equipped float.

The transmitter is mounted vertically within the tank by brackets or flanges. A voltage divider network is located inside and extends the full length of the transmitter assembly. This network is comprised of magnetic reed switches tapped in at one-inch intervals between the switch centers. The switches are connected, in turn, through series resistances, to a common conductor, and by means of the cable system to the indicating meter in the receiver. The ends of the voltage divider are connected to the power supply output. The power supply output is adjusted to 10 volts dc by the calibrate potentiometer in the primary receiver.

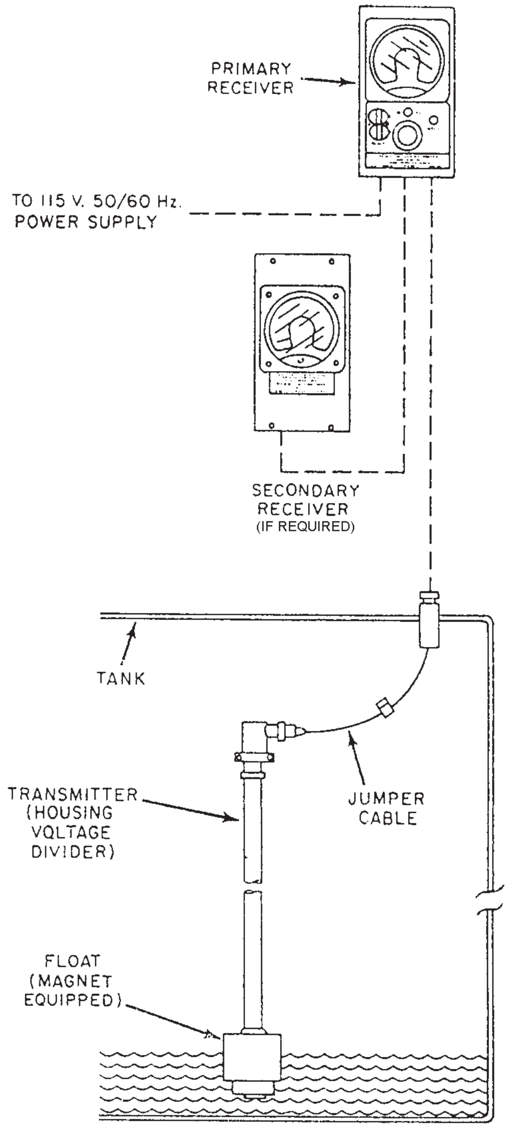


Figure 2-66.—Gems TLI system.

> **NOTE**
>
> Naval Surface Warfare Center posted an advisory bulletin April 1995 addressing a continuing TLI cable problems in JP-5 Fuel Tanks. Recommendation is to discontinue the use of nitrile jacketed water blocked FSS-2 TYPE Cables in Fuel Oil Tanks (Replace as needed). Only THERMOPLASTIC JACKETED WATER BLOCKED CABLE (fig. 2-67 "RAYCHEM EPD-6032") with redesigned connectors shall be used in Fuel OIL TANKS.

Depending on the size and shape of the tank being gage, the transmitter assembly may be a single unit, or a number of units connected together. Figure 2-68 shows two transmitters being used to gage a tank.

The magnet-equipped float moves along the transmitter as the liquid level changes. As the float moves, the magnetic field pattern of the float operates the tap switches. The tap switches are so arranged inside the transmitter that voltage drop are read at the receiver for each 1/2-inch of float travel.

The primary receiver is connected to the transmitter by the cable system. Since the receiver meter indicates the voltage drop from the bottom of the voltage divider to the point of tap switch closure, the readings correspond directly with the liquid level. Included in the primary receiver housing; in addition to the indicating meter, are the dc power supply, electrical slosh dampening control, and all system and alarm controls. See figure 2-69 for the various types of primary and secondary receivers.

The primary receiver also provides for connection of one or more secondary receivers. The secondary receiver, if used, it will contain an indication meter only.

The system is safe, since currents in the transmitter circuit are so low as to be incapable of causing an explosion, even with the transmitter located in the most volatile liquids or hazardous vapors.

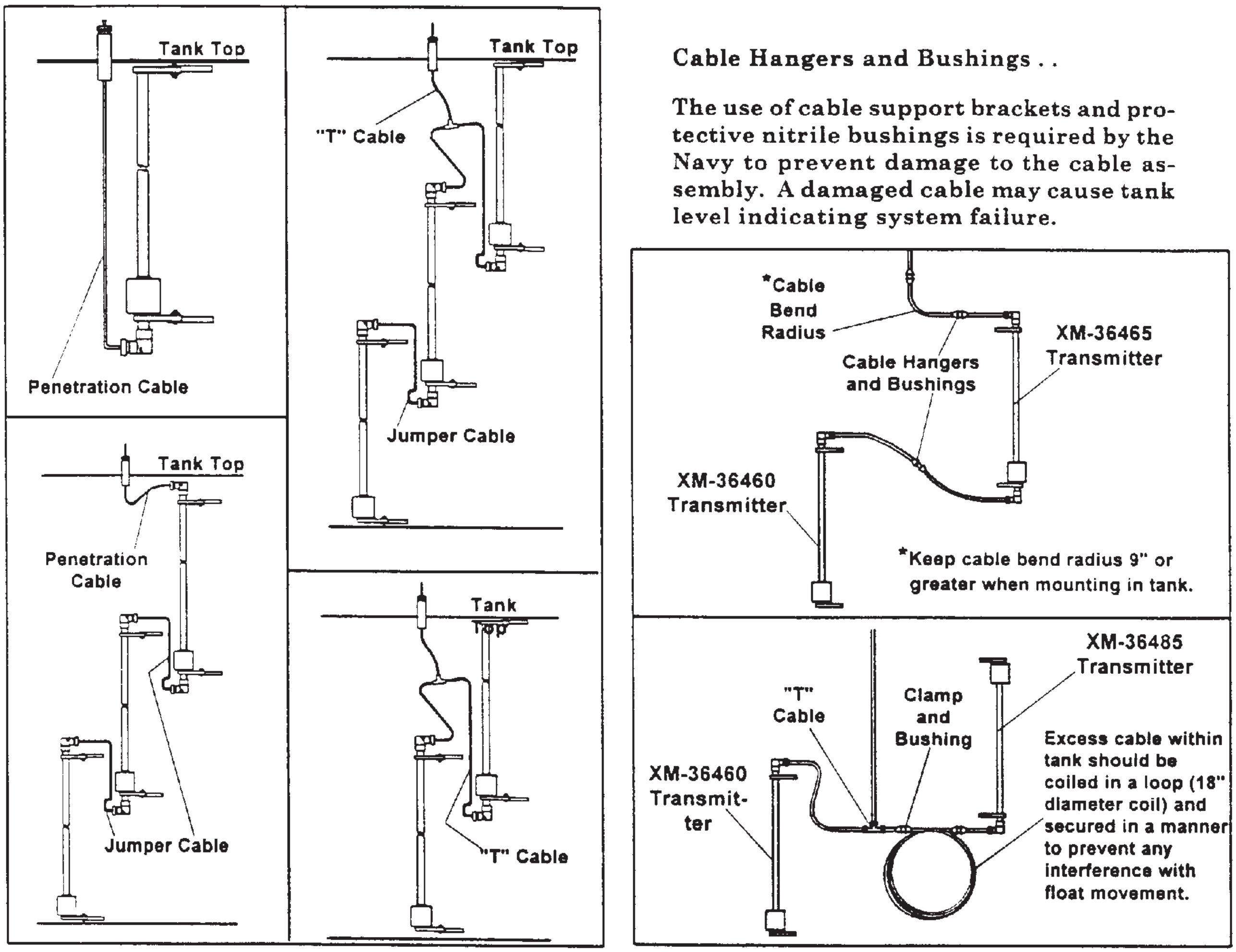
> **CAUTION**
>
> The transmitter or receiver should NOT be tampered with or modified in any way other than as directed in the operation and maintenance manual.

The following is a brief description of the system controls:

ON-OFF-FULL REF. TOGGLE SWITCH: Operate as follows to control the ac input to the power supply and the indicating meter circuit:

Toggle in ON position (normal operation): 115 volt, 50/60 Hz applied to the power supply. Indicating voltmeter connected through series resistance to the transmitter tap switches.

Toggle in OFF position: Power supply line and indicating meter circuits are open. System is OFF.



Troubleshooting Hints

1. Examine total length of cable for the following:
   a) Excessive swelling of cable O.D.
      ....O.D. of FSS-2 cable types should be 0.500" ± 0.040"
      ....O.D. of thermoplastic jacketed cable types should be 0.259" ± 0.040"

   b) Kinks under surface of outer jacket. This could indicate damage that could cause shorting of internal conductors.

   c) Cuts or knicks in outer jacket.

2. Check area of cable head inside and around O-ring seal for signs of corrosion, moisture or contaminants. (If cable is O.K., clean and replace O-ring.)

3. Check continuity of cable conductors. (See wiring schematics on opposite page.)

Figure 2-67.—Installation of Thermoplastic Jacketed "Rachem" TLI Cables.

Toggle in FULL REF. position (must be held in this position): AC line voltage is applied to power supply. Indicating meter is connected across entire transmitter voltage divider and cabling for system calibration.

CALIBRATE POTENTIOMETER. Screwdriver adjusted, with toggle switch held at FULL REF. position, it is adjusted to provide 10 volts dc across the entire transmitter, voltage divider, and cabling, as

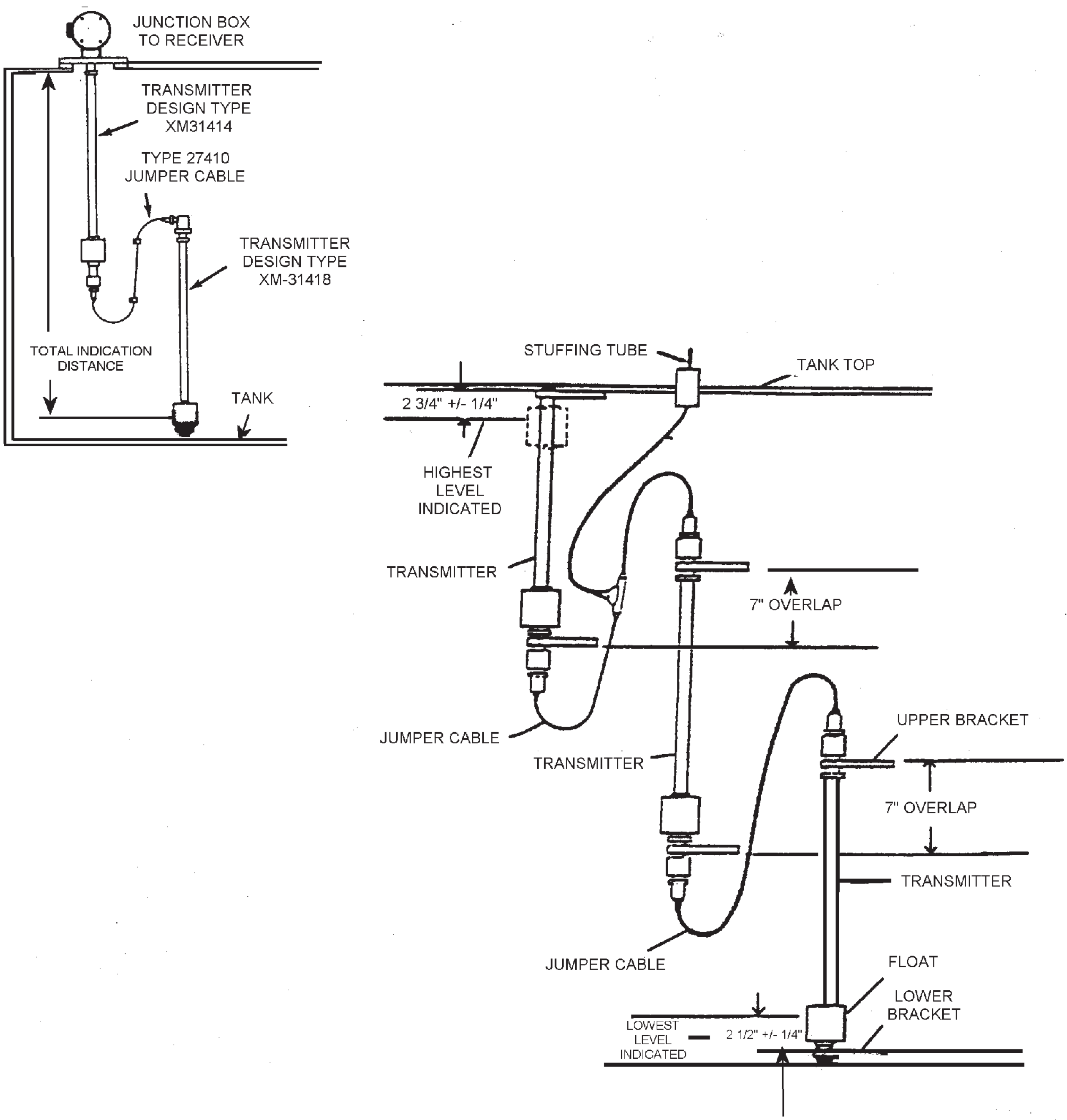


Figure 2-68.—Multi-transmitter arrangement.

indicated by a full-scale meter reading. With the potentiometer properly adjusted, when the toggle switch is placed in the FULL REF. position, a full-scale meter reading indicates that all cables and electrical connections are good.

ELECTRICAL SLOSH DAMPENER. To prevent meter fluctuation as a result of erratic float movement caused by sloshing in the tank, a capacitor is connected across the indicating meter to delay the response (normally 3/4 second) of the meter to the transmitter signal.

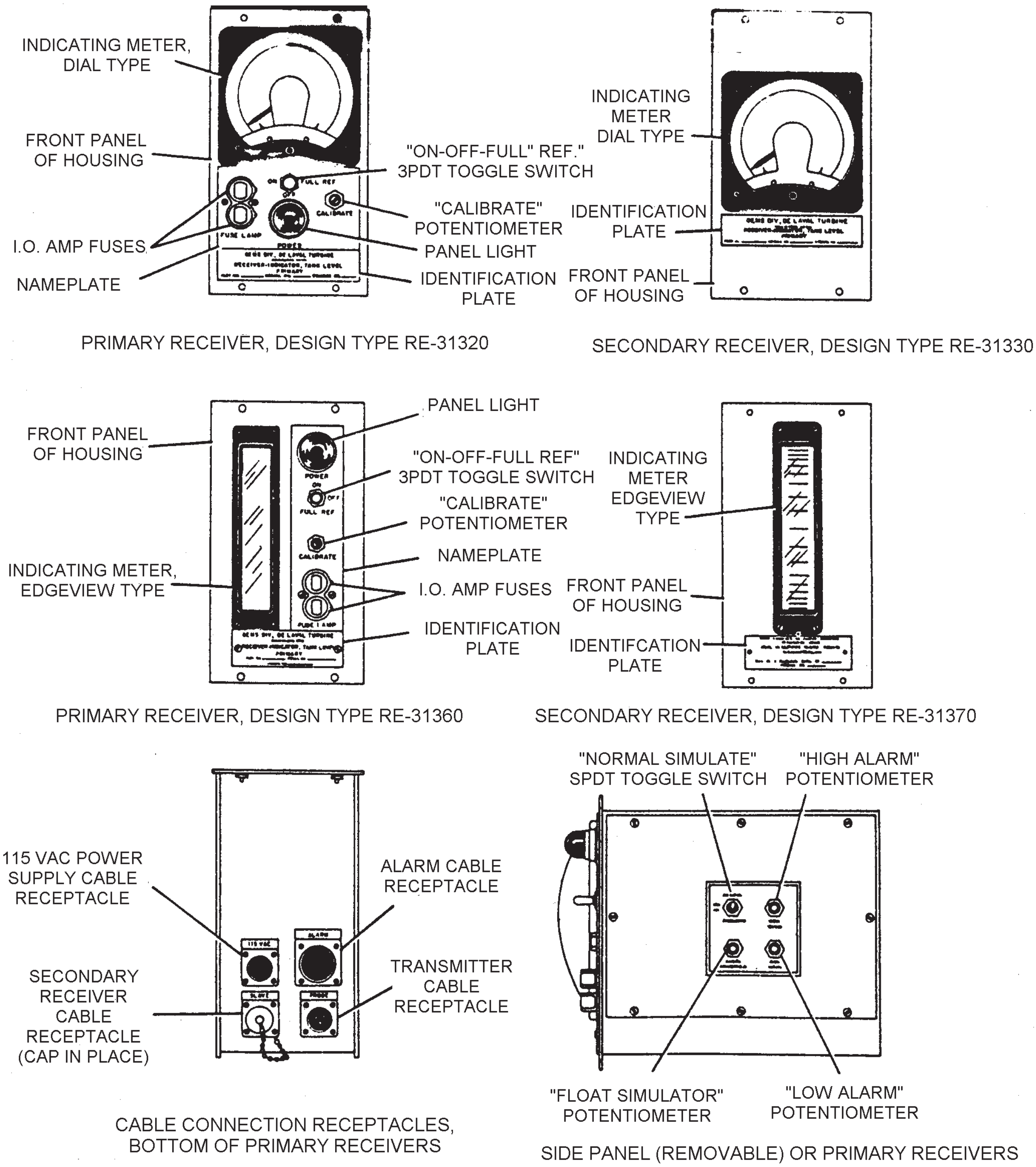


Figure 2-69.—Primary and secondary receivers.

ALARM CONTROL SYSTEMS. Known as a SENS-PAK alarm, its controls function integrally with the tank level indication system to sense high, low, or intermediate levels of tank liquids (as appropriate) and actuates an alarm. The modular, plug-in SENS-PAK units (fig. 2-70) are actuated by voltage signals from the indicating system transmitter. These units may or may not be included in the primary receivers.

Although all primary receivers are pre-wired for a maximum of two SENS-PAK units, normally used for high and low level alarms, additional control units may be incorporated in separate housings within the same system on advice from the factory.

SENS-PAK alarm control adjustments are located on the side of the receiver (refer to figure 2-69) [side panel]) and function as follows:

Normal simulate switch-Substitutes the float simulator circuit for the transmitter in the indicating meter circuit for alarm adjustment.

Float simulator potentiometer-Simulates the total transmitter voltage divider resistance changes over the full range of float travel.

High alarm potentiometer-Sets the actuation voltage level of the high alarm SENS PAK.

Low alarm potentiometer-Sets the actuation voltage level of the low alarm SENS PAK.

This system surpasses the 3% accuracy requirement of military specifications. But, the accuracy will vary depending on the size tank being gage and the type receiver used.

NOTE

The Gems TLI systems are also approved for indicating the interface level of two liquids having different specific gravities.

With the ON-OFF-FULL REF. toggle switch on the primary receiver in the ON position, operation of the system, and alarms if included, is completely automatic. Tank liquid level is read directly from the indicating meter on the primary or secondary receiver as required. No further attention is necessary, as the Gems TLI system can operate indefinitely without any component degradation.

The only maintenance that should be required is cleaning of the transmitter and float, when tanks are opened for inspection and cleaning.

CONSOLES

The control console ushered in the modern era for the ABF. It provides us with the ability to control and monitor nearly all operations from one central location. While the console relieves you of a lot of footwork, it requires an in-depth knowledge of your ship's systems and capabilities.

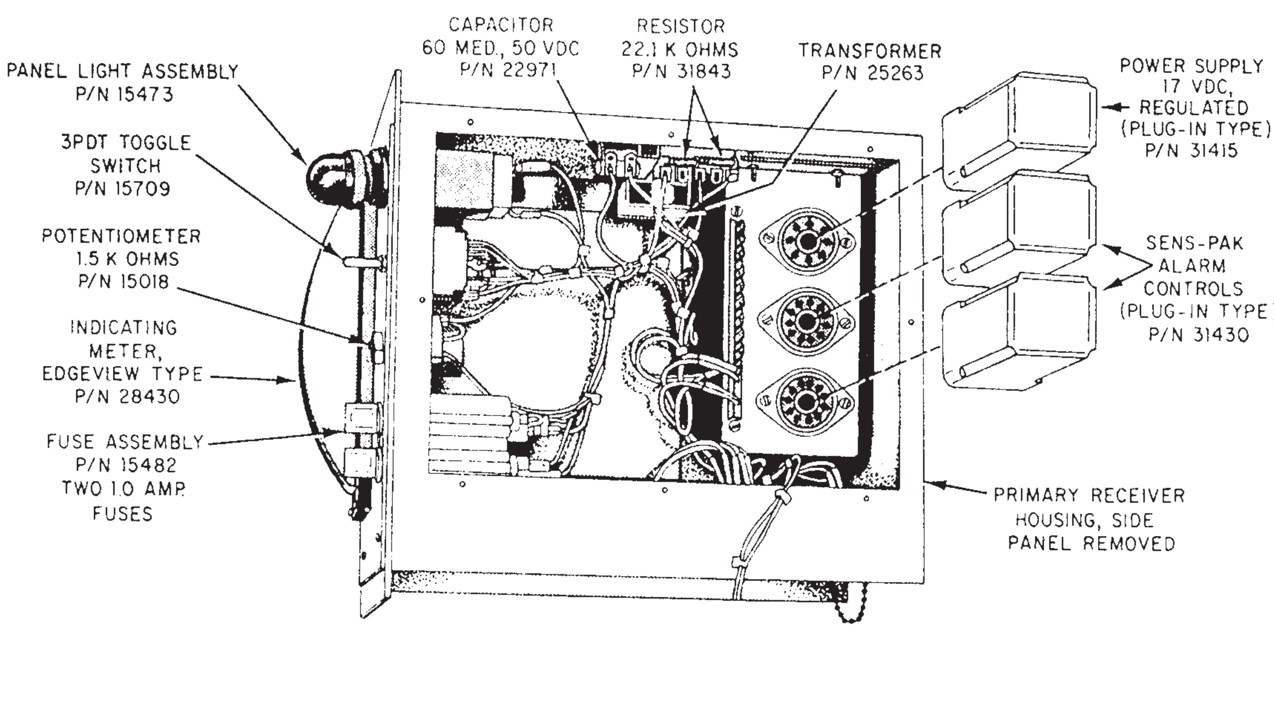


Figure 2-70.—Primary receiver interior.

Each console (fig. 2-71 and fig. 2-72) consists of a control panel with a mimic diagram, various selector switches, alarms and indicators. Specifically each console contains the following:

1. A **mimic diagram** colored to indicate JP-5 (purple), drainage (green), stripping (red), and miscellaneous (black) systems operated and/or monitored from the control console. The mimic also indicates the outline of the ship and shows components in their relative locations. Monitoring and control devices appear near or in the symbol served. The mimic on each console shows only the system served by the adjacent pump room except the filling and transfer mains; the filling system on 2nd and main deck are shown on both consoles. The drainage and ballast system shown is the part that serves the JP-5 or ballast and JP-5 overflow or ballast tanks.

2. **Liquid-level indicators** for the JP-5, JP-5 or ballast, JP-5 overflow or ballast, JP-5 service, JP-5 defueling and contaminated-JP-5 settling tanks.

3. **"Full"-indicator (red) lights** for each tank. These lights are located adjacent the level indicator and are on when the tank reaches its operating capacity.

4. **Seawater-detector (green) lights** for JP-5 or ballast and JP-5 overflow or ballast tanks. These lights are located adjacent the level indicator and are on when seawater is present within the tank. The tank top valves cannot be opened from the console when the green (seawater indicator) lights are illuminated. These tanks must be stripped using the stripping system until the green indicator lights disappear, signifying that all seawater has been stripped from the tank. These tanks also have white lights, which indicate the presence of JP-5 within the tank.

5. **Control switches** for starting and stopping the JP-5 service pumps.

6. **Indicator lights for valve positions** (open/shut) for all motor operated valves and other valves (manually operated) whose position must be monitored at the console.

7. **Power indicator lights** for JP-5 purifiers and pumps, (except auxiliary and JP-5 defuel pumps).

8. **Audible and visible overflow alarms** that warn when any tank having an independent overflow that overflows overboard reaches the 98 percent full

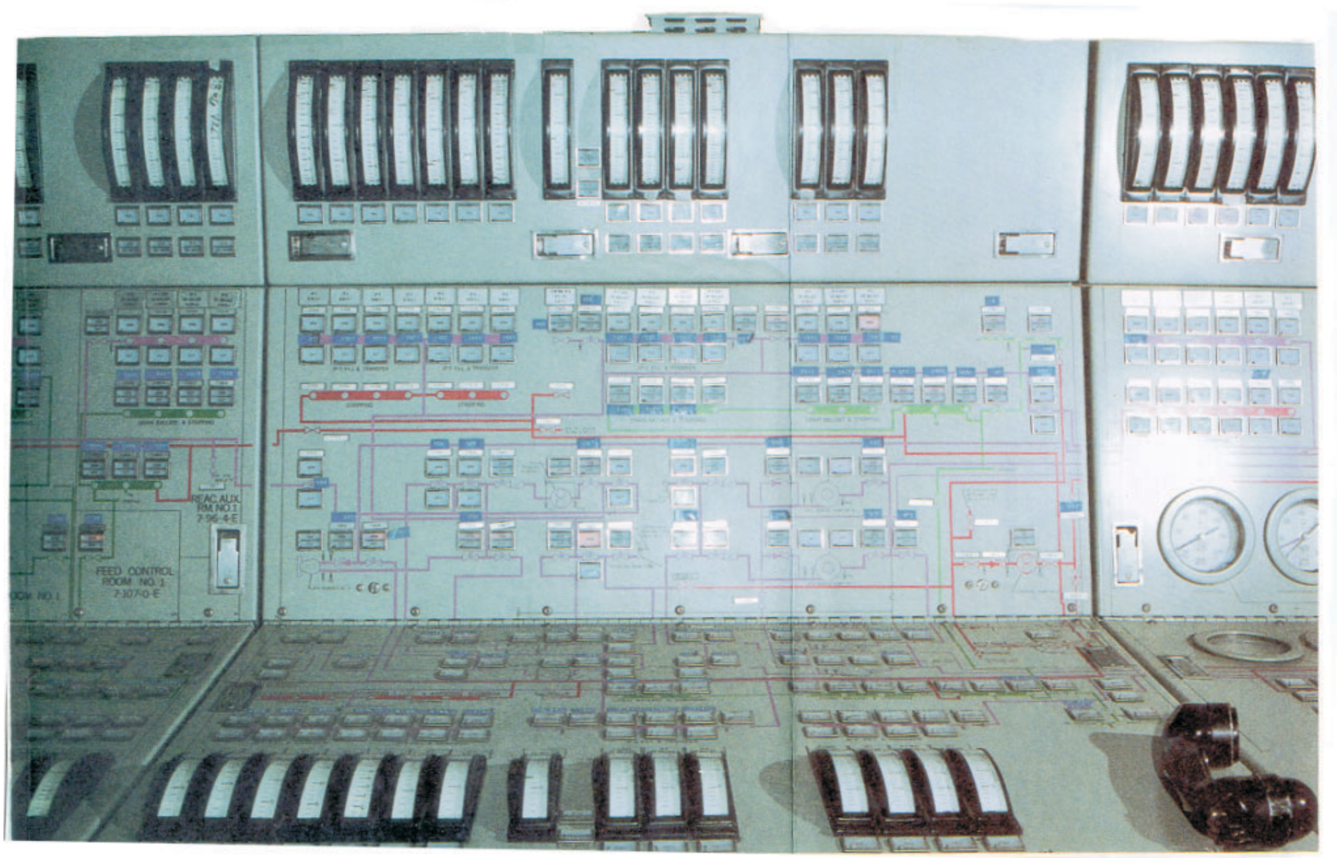


Figure 2-71.—JP-5 control console.

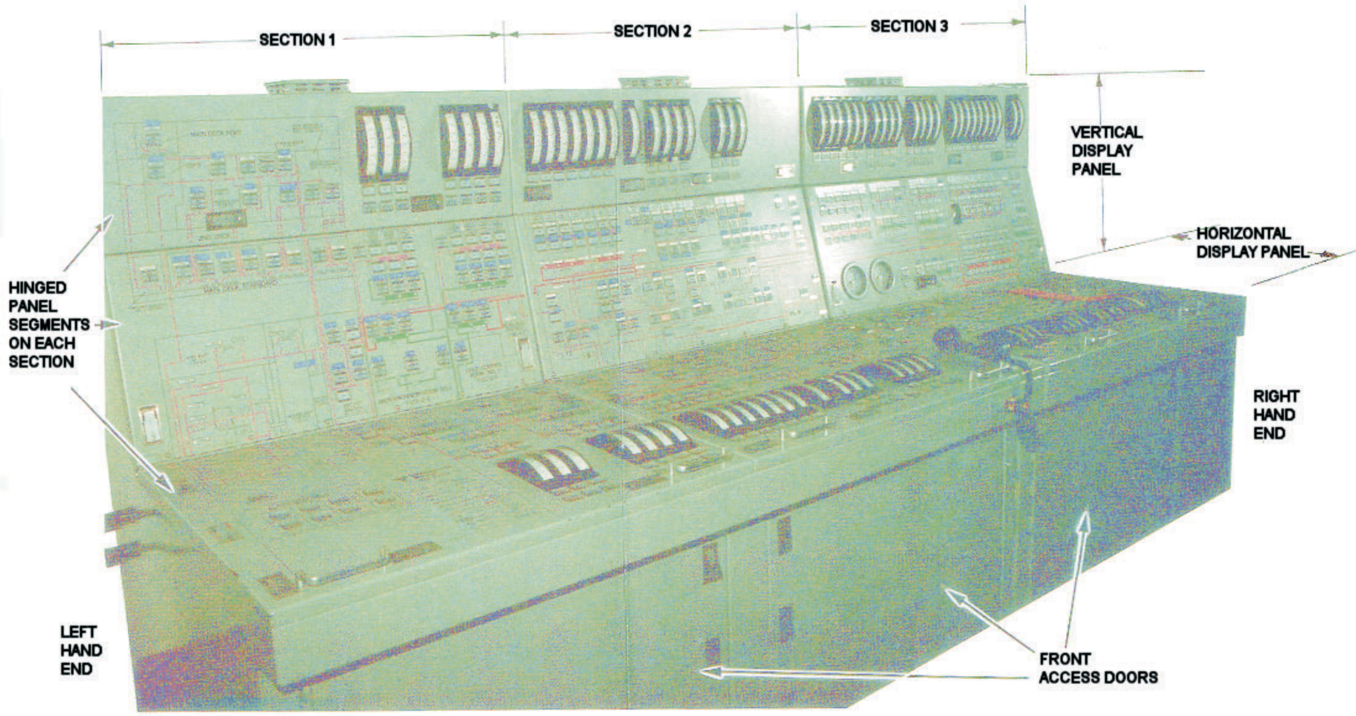


Figure 2-72.—JP-5 control console.

level. A control switch is provided to silence the audible alarm.

9. **Seawater cleavage indicator lights** for contaminated-JP-5 settling tanks. The lights come on successively when seawater in the tanks reaches the 6-inch, 2-foot, 4-foot and 6-foot levels.

10. **Control switches** (Open/Shut) for positioning the selected electric motor operated valves.

11. **Override switches** deenergize the circuit that closes tank cutout valves when the tank reaches operating capacity. This allows complete tank filling when desired. One switch controls a specific zone.

12. **Pressure gages** are provided on a gage panel above the control console, so that the console operator can monitor system pressures effectively and perform fuel transfer evolutions safely. The following are equipment gages mounted on the gage panel above the control console; firemain water to eductors and eductor suctions. These are the eductors used to deballast JP-5 or ballast and JP-5 overflow or ballast tanks. As well as, all JP-5 pump discharges to the following; service pumps, transfer pumps, stripping pumps, service stripping pump, auxiliary pump, and JP-5 purifier inlet and discharges gages.

Circuit Description

You might ask why an ABF needs to know the control circuits of a JP-5 console. We are operators of the console, not electrical repair personnel. In one respect, you are right, we do no repair work on the consoles. But you need to know how the circuits are interconnected to prevent specific things from happening, such as a storage tank valve that will not open because a saltwater level light is on for that tank.

Each console includes circuit operations as follows:

1. Circuit for JP-5 or ballast tank and JP-5 overflow or ballast manifold valve interlocked with manifold root valve. This circuit actuates the manifold valve either open or shut by a switch on the control console. Additional features of this circuit are:

a. Circuit automatically shuts manifold by high level detector circuit.

b. Circuit interlocks the root valve operation with the manifold valve. The root valve opens when any manifold valve is opened. The root valve closes when all manifold valves are closed.

c. Circuit does not allow manifold valve to open if sea water detector circuit indicates water in the tank.

d. Circuit monitors valve position by open and shut lights on the control console.

2. Circuit for JP-5 service tank suction and recirculating valves. This circuit actuates the suction valve either open or shut by a switch on the control console. The circuit interlocks the recirculating valve with the tank suction valve for the same tank so both valves open and shut simultaneously, circuit monitors valve position by open and shut lights on control console.

3. Circuit for JP-5 tank and JP-5 service tank fill manifold and gate valves. This circuit actuates the valves either open or shut by a switch on the control console. Circuit automatically shuts the valve by a high level detector circuit, also monitors the valve position by open and shut lights on the control console.

4. Circuit for drainage eductor actuation and overboard discharge valves. This circuit actuates the valves either open or shut by switches on the control console. Additional features of this circuit are:

a. The circuit stops the actuating valve in any intermediate position to allow throttling of eductors, by actuating supply.

b. Actuating valve is interlocked with the overboard discharge valve to prevent opening until the overboard discharge valve is opened.

c. The overboard discharge valve is interlocked with the actuating valve to prevent closing until the actuating valve is closed.

d. Circuit monitors valve position by open and shut lights on the control console.

5. Circuit for stripping, ballast, and drainage valves, in the drainage system three-valve interlocked manifold. These circuits actuate the valves either open or shut by switches on the control console. Additional features of the circuits are as follows:

a. The three circuits are interlocked together to permit opening only one valve at a time. If any one of the three valves is open, the other two are held closed by the circuits.

b. Stripping valve circuit bypasses the saltwater detector circuit to allow the JP-5 or ballast storage tank drainage manifold valves to be opened.

c. Circuit monitors valve positions via open and shut lights on control console.

6. Circuit for JP-5 and JP-5 service tank electric motor operated stripping manifold valve. This circuit actuates the valve either open or shut by a switch on the control console. Circuit monitors valve positions by open and shut lights on control console.

7. Circuit for JP-5 or ballast and JP-5 overflow or ballast tank drainage electric motor-operated manifold valves. This circuit actuates the valves either open or shut by a toggle switch on the control console. This circuit is interlocked with the seawater detector in the tank to prevent opening the valve if JP-5 is in the storage tank. The seawater detector interlock is bypassed when the stripping valve in the three valve interlocked drainage manifold is opened. Circuit monitors valve positions by open and shut lights on control console.

8. Circuit for selected JP-5 and drainage cutout valves. This circuit actuates the valves either open or shut by a switch on the console. Circuit monitors valve positions by open and shut lights on console.

9. Circuit for monitoring valve positions for valves that are manually operated and have limit switches at open and shut positions to actuate "open" and "shut" lights. Circuit actuates "open" and "shut" lights when in intermediate positions and shut off "open" light when valve is closed and shut off "shut" light when valve is open.

10. Circuit for starting and stopping JP-5 service pump. This circuit actuates the pumps to start and stop by a switch on the control console. Circuit monitors pump operation via "on" and "off" lights on control console.

11. Circuit for monitoring selected pump and purifier positions. The circuit actuates "on" lights when equipment is running and actuate "off" lights when equipment is not running.

12. Circuit for high level detector override. This circuit overrides the high level circuit of the tank level gage system to allow transferring fluid out of the tank or topping off the tanks to 100 per cent full.

13. Circuit for the electric motor operated JP-5 gate valves in shaft alleys No. 1 and 4. This circuit actuates the valves either open or shut by a switch on the forward console. Circuit monitors valve positions on both the forward and aft console by open and shut lights.

Q2-42. What kind of gage is normally installed on the suction side of JP-5 pumps?

Q2-43. What are the four types of JP-5 tanks?

Q2-44. What two major categories are JP-5 tanks grouped?

Q2-45. What kind of JP-5 tank is a relief tank for the rest of the nest as an added safety feature and prevents rupturing due to over pressurizing from filling operations?

Q2-46. The voltage divider network to a GEMS TLI transmitter assembly is connected to a power supply output that is adjusted to how many volts?

Q2-47. The float on a TLI transmitter activates a magnetic field of tap switches inside the transmitter. This field is disrupted as the float moves up and down the length of the transmitter. At what intervals of float travel will this voltage drop be read at the receiver?

Q2-48. The primary receiver housing of a TLI system allows for connections to secondary receivers. What will these secondary receivers contain?

Q2-49. What component of the primary receiver controls the actuation of the high and low level alarms inside a JP-5 tank?

Q2-50. The Electrical Slosh Dampener component of the primary receiver delays the response of the transmitter signal to the meter to compensate for erratic float movement caused by sloshing inside the tank. How much of a delayed response is it set for?

Q2-51. What component of the primary receiver allows for the calibration of the power supply output to 10 volts d.c.?

Q2-52. Which component of the JP-5 control console allows for the starting and stopping of service pumps?

Q2-53. Contaminated JP-5 settling tanks indicator lights come on successively, when seawater in the tanks reaches the 6-inch, 2-foot, 4-foot and 6-foot levels. What are these indicator lights known as on the JP-5 control console?

JP-5 FUELING SYSTEM OPERATIONS

LEARNING OBJECTIVE: Identify and explain the various JP-5 fuel system operations. Describe how the AFOSS is used as operational procedures for each operation. Explain some of the consequences of not following those procedures.

Underway replenishment, transfer of fuel from one tank to another, and pumping fuel to the flight and hangar decks are everyday facts of life for the ABF. If proper procedures are followed, they are smooth and safe operations. If proper procedures are not followed, the operations become outright dangerous.

AVIATION FUELS OPERATIONAL SEQUENCING SYSTEM (AFOSS)

As stated before, though much of the equipment and operating procedures are similar from ship to ship, the fact is no two ships are alike. For this reason, the Aviation Fuels Operational Sequencing System (AFOSS) was developed to provide each ship with tailor made correct written technical operating procedures for the equipment installed on that specific ship. Every fueling evolution performed by the ABF will have an AFOSS procedure and that procedure MUST be followed.

AFOSS is developed into three operational stages. These stages are actually three copies of AFOSS designed around the purpose of each copy's use. They are as follows:

1. The Division Officer's copy
2. The Work center copy
3. The Work station copy

The Division Officer's copy contains the following:

1. An index page.
   a. Assigns each fueling evolution a title and number.
2. Step by step operating procedures for all evolutions concerning the fuels system.
3. A liquid level status diagram.
   a. Lists all tanks by tank number.
   b. Shows relative location.
   c. Indicates each tank's designation.
   d. Gives the capacity of each tank.
   e. Provides a space to show the current amount of fuel in each tank.

4. Training diagrams and charts.

    a. Shows each system.

    b. Indicates component locations.

    c. Gives the piping layout.

    d. Shows how different subsystems interrelate.

The Division Officer's copy is the master AFOSS for the division. It is used for training, scheduling and coordinating fueling evolutions, and insuring operations are properly conducted.

The work center copy is located in and applies only to a specific work center (flight or below decks) and contains the above information applicable to that work center only.

The work station copy is located in and applies only to a specific work station (JP-5 filter, JP-5 pump room, lube oil pump room) and contains the above information applicable to that work station only.

AFOSS operating procedures are prepared in a logical, detailed manner. They cover each fueling evolution and specific equipment used. They are also used as a troubleshooting guide and as a reference for fuels casualty drills.

The operations discussed on the following pages are for training purposes and are based on typical procedures used during those operations. **The specific procedures for operations aboard a particular ship will be in that ship's AFOSS. USE IT!**

SOUNDING TANKS

While the tank level indicating equipment in use today is extremely reliable, the only 100% positive way to know how much and exactly what is in a tank is by sounding the tank. Sounding tanks is a simple procedure that has been used for as long as ships have sailed the sea. In the following paragraphs, we will discuss sounding equipment and procedures.

Sounding Equipment

Sounding tapes come in various lengths; 25-ft, 50-ft, and 75ft long depending on the size tank you want sounded. The example, (fig. 2-73) is a 50-foot steel tape graduated in feet and inches (with the inches graduated to 1/8 's). The bitter end is fitted with a snap-hook for attaching a plumb bob or thief sampler (refer to Chap. 1). The first 9 inches of the tape consists of the plumb bob and snap-hook. These tapes are usually plain, but can be ordered in color, such as black on white or white on black.

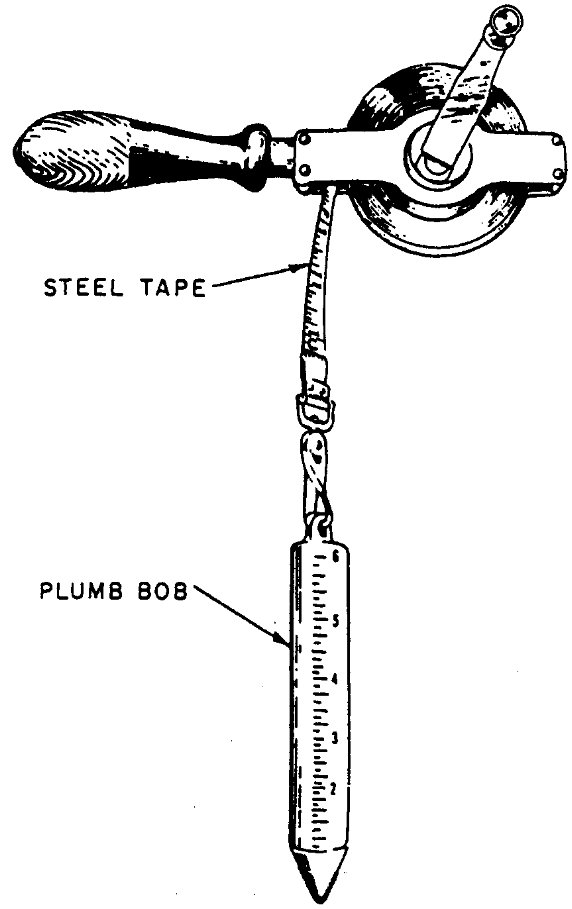


Figure 2-73.—Sounding tape.

Water-indicating and fuel-indicating pastes are available to assist in identifying positive "wet" marks on the tapes. Water-indicating paste will change color where the fuel/water interface occurs. Fuel-indicating paste will change color where the fuel/air interface occurs.

Sounding Procedure

Spread a thin coating of water-indicating paste from the tip of the plumb bob to about the 2-foot mark on the tape. Lower the plumb bob through the sounding tube, until it touches the striker plate. The tape must be kept taut because slack will cause an inaccurate reading. Slowly withdraw the tape. The highest level where the JP-5 "wets" the tape is read in feet and inches. If the "wet" mark is difficult to see, use fuel-indicating paste. Dry the tape and spread a thin coating of the fuel-indicating paste in the approximate area of the first "wet" mark. When the tape is removed, note the line of color change on the fuel-indicating paste. This reading is then converted to gallons by use of a tank capacity chart. When the plumb bob is removed, note the line of color change of the water-indicating paste. The normal color, when applied, is gray. This level, in feet and inches, is converted to gallons and subtracted from the JP-5 reading to determine the quantity of JP-5 in the tank.

NOTE

The water-indicating and fuel-indicating pastes are different colors. They also change into different colors. They are NOT interchangeable.

If water droplets or discoloration are noted on the sounding tape during the sounding and bottom sampling procedure, it is an indication of entrained or free water in the tank. Should this occur? It is necessary to take a composite sample.

A composite sample is one in which samples are taken from different levels in the tank and mixed to form one sample. This type sample is more representative than one taken from the top and bottom. The same type sampler used to take the bottom sample can be used to take a composite sample, simply by attaching a string to the upper part of the disk guide stem. The sampler can then be opened at various levels by giving a smart jerk on the string. Tanks found to be contaminated with entrained water must be allowed more settling time before transferring.

RECEIVING JP-5 ABOARD

The first significant replenishing operation ever performed at sea by the U.S. Navy was in 1899, when the U.S. Navy collier Marcellus, while towing USS Massachusetts, transferred coal to her. Since that time, many methods and procedures have been tried and abandoned. Those described in this section are the typical procedures currently used in the fleet. The actual rigging of the replenishing hose between ships is the responsibility of the Deck Department and is not discussed. The ABF is concerned with only the filling connection hookup and the procedures for receiving JP-5 aboard.

The receipt of aviation fuel aboard carriers is a continuing problem in the fleet. This is due, in most part, to the hazardous nature of the fuel involved, and the increasing quantity required for our modern-day aircraft. Other factors of equal importance that also must be considered are the type and location of the operation, the time allotted, and the large number of personnel involved.

Time is an ever important aspect in any refueling operation, but more so at sea. The entire Task Force is scheduled for replenishment on a given date, and each ship is allotted a maximum time for this purpose. Not only are ships in constant jeopardy of a fire or collision during the replenishing operation, but they are also easy targets in the event of an attack.

JP-5 fuel is comparatively safe (having a minimum flashpoint of 140°F.) when in its stored state. But, this same fuel handled under high pressure is extremely dangerous when released into the atmosphere in a fine mist or spray. Therefore, it should be treated accordingly, and every precaution should be taken to prevent the possibility of a fire or explosion when pumping this fuel.

A replenishing operation from a tanker is described here since it covers all phases of any refueling operation.

The procedure for receiving JP-5 fuel aboard is basically the same for all class carriers. This section deals with the general procedures, equipment used, and the criteria for the acceptance or rejection of JP-5 fuel without reference to any particular ship.

By using a double-hose rig the rate of fuel received is increased. Two hoses are suspended, one below the other, from a single span wire. With this rig, two kinds of fuel may be received simultaneously at a single station, or one kind may be pumped through both hoses.

Before receiving the tanker alongside, certain preparations are necessary to safely and efficiently expedite the replenishing operation.

Deballasting and Stripping

Any ballasted JP-5 tanks should be deballasted and stripped as soon as possible after the date and time of the replenishing operation have been confirmed. This requirement is rare but must be covered in this section. Obtain assistance from personnel in the engineering department, they will align the main drainage system as required and operate the main drainage eductors.

The pump room or manifold operators align the tank stripping system as follows:

1. Unlock and open the main drainage cutout valve on the flood and drain manifold. (Re-lock manifold.)

2. Open the valves on the single-valved stripping manifold to the tanks to be deballasted.

NOTE

All tanks interconnected with one flood and drain manifold can be deballasted simultaneously. Each eductor can deballast an average of 1,000 gpm when supplied with fire main pressure of about 150 psi.

Because of the tremendous suction taken by the main drainage eductors, loss of suction on the tanks is most likely to occur before the tanks are completely emptied. When this occurs, realign the tank manifolds to use the tank stripping system as follows:

1. Close all valves in the single-valved stripping manifold.

2. Unlock and realign the flood and drain manifold valves by closing the main drainage eductor cutout valve and opening the stripping main suction cutout valve (re-lock the manifold valves).

3. Align the piping from the flood and drain manifold to the suction side of the motor-driven stripping pumps.

4. Align the motor-driven stripping pump discharge piping to pump into the contaminated settling tank or overboard (with the commanding officer's permission).

5. Open required valve on the single-valved stripping manifold.

6. Start the stripping pumps, and strip each tank one at a time until they are completely empty of all ballast water.

7. Secure the flood and drain manifold and close all valves in the single-valved manifold.

By use of the motor-driven stripping system, strip all storage tanks that are to be used in both the receiving operation and the internal transfer operation before receiving JP-5 aboard. Verify all stripping operations were successful by sounding the tanks, using water-indicating paste.

Strip the slack (partially filled) service tanks, using the hand-operated or motor-operated (on ship’s equipped) stripping system.

NOTE

Ships planning to replenish in port MUST deballast tanks before entering port.

Internal Transfer

Top off all slack service tanks. This will allow a longer settling time for the JP-5 being received. Consolidate the fuel load by transferring from slack storage tanks to completely fill as many tanks as possible. This will reduce the number of tanks to be filled and will minimize the number of tanks affected if contaminated fuel is received.

CAUTION

When fuel is to be transferred internally or received aboard, the overflow tank for every nest of tanks scheduled to receive fuel must be empty before fuel can be introduced into any tank in that nest.

Filling Sequence

Before receiving fuel, the JP-5 below decks supervisor should have soundings or readings taken on all storage and service tanks. A statement showing the amount and location of all JP-5 on board is submitted to the V-4 division officer. It is the responsibility of the JP-5 below decks supervisor to know how much fuel is on board, where it is located, how much more can be received, the order in which the tanks should be filled, and the approximate duration of the receiving operation.

To determine the amount of JP-5 to be received, add the total capacity in gallons of each empty storage tank plus the amount required to fill any slack tanks. Determining the filling sequence, allow for a minimum of six tanks (three port and three starboard) on the line at all times. Knowing in advance the order in which the tanks will be filled will assist in the assignment of sounding teams, manifold operators, and the overboard discharge observers.

Three factors are involved in determining the duration of the receiving operation: the amount to be received (previously determined), the maximum receiving rate of the particular ship, and the normal pumping rate of the tanker. The latter two can be gained through experience and information recorded in the receiving log. But, if this is the first experience with the tanker, the pumping rate can be obtained in advance via radio messages to the tanker.

Personnel Preparations

A replenishment bill should be posted at least 24 hours before the refueling operation. In addition to the posted list, each man should be informed of his station and instructed in his duties. During the instruction period, emphasis should be placed on safety, emergency breakaway procedures, and other possible hazards. Assign only experienced and capable personnel to actually perform the duties. Limit the number of trainees, especially at the filling connections. Too many people at this station are not helpful and may confuse the operation by getting in the way. Whenever possible, rotate experienced personnel to other stations. This not only will give the individual the broadest training possible, but also will produce a more flexible division.

As a rule, fueling stations should be manned 1 hour before fueling time. The refueling stations to be manned and their locations are as follows:

1. The Below Decks office. This is where the below decks supervisor coordinates the on-load of fuel.

WARNING

Personnel working as overboard discharge watches and at the filling connections must wear a life jacket (kapok only), construction-type (safety) helmet or battle helmet, whistle, and pin-on marker light.

2. Overboard discharge watch. Located where required on catwalks, sponsons, or weather decks to observe and report the overflow from the overflow tanks.

3. Filling connection personnel (Repair personnel). Located at the filling connections on the sponsons.

4. Anti-contamination sentry. Located in the AvFuels lab. Runners will be supplied to the sponsons to transport samples to the lab.

5. Sounding teams. Stationed where required. Sounding teams should be equipped with a sounding kit that contains the following:

a. Sounding AFOSS (gives location of sounding tube, capacity of tank at 80%, 90%, and 100% in feet and inches.)

b. Sounding tape (plumb bob safety-wired to tape).

c. Water-indicating paste.

d. Rags.

e. Pencils.

f. Tank sounding cards.

g. Flashlight (explosion-proof).

h. Sound-powered telephone headset.

i. T wrench (for sounding caps).

j. Spare gaskets (for sounding caps).

6. Manifold operators. Located in pump rooms or manifold spaces.

Preparations to be made on the refueling sponson by V-4 division personnel are not as numerous and time consuming as those below decks, since the actual rigging for receiving the tanker is the responsibility of the Deck Department. But, there are certain pieces of equipment that must be assembled by repair team personnel at or near the refueling sponson to safely and efficiently expedite the operation.

Repair team personnel should make sure the filling connection has a pressure gage, thermometer, sampling connection, low-pressure air connection, and a flushing valve.

The equipment to be assembled at or near each refueling sponson by repair personnel includes the following:

- Proper hand tools
- Drip pan
- Rags
- Swabs
- Buckets
- Five-gallon safety cans
- Sound-powered phones
- Clean sampling bottles

The type and number of pieces of fire-fighting equipment to be laid out near the refueling station must be in accordance with the ship's fuel-handling bill.

Telephone talkers are stationed at the following locations on the 4JG circuit:

1. Below decks office
2. Filling connections
3. Flight deck control
4. Sounding tube locations
5. Overboard discharge watch
6. Pump rooms
7. Manifold spaces
8. Damage control central

All telephone headsets should be tested well in advance of the receiving operation.

Receiving Operation

Communications should be established immediately upon manning of a station. When all stations have reported manned and ready, the JP-5 filling and transfer system should be lined up for receiving JP-5. Open the following valves:

1. The 2nd deck filling isolation valves at the base of the sponsons

2. The 7th deck fill and transfer valves at the base of the downcomers to forward and aft and isolation valves to port and starboard.

3. All transfer-main bulkhead cutout valves.

4. Transfer-main branch header valves leading to the manifold of the tanks to be filled.

5. The transfer mainside manifold valves of selected tanks to be filled.

6. Tank-side manifold valves of selected tanks to be filled.

NOTE

Deep centerline and double-bottom tanks are typically filled first during a refueling operation.

The below-deck piping and valves are now aligned for receiving JP-5 aboard.

Just before the tanker is received alongside, specific action must be taken by certain departments to ensure maximum safety and security during the replenishing operation.

The officer of the deck controls the smoking lamp. The operations watch officer makes sure certain high-frequency transmitters, radars, and other electronic equipment in the vicinity of the fueling stations are secured. The damage control watch officer ensures that additional firemain pumps are put on the line and that AFFF pumping stations are manned. The aviation fuels officer makes sure no mobile equipment or electrical winches (not required in the replenishing operation) are operated within 50 feet of the fueling station.

As the ship makes its final approach and steadies alongside, shot lines are sent over from each station. Attached to these first lines, the telephone cables, distance line, and hose messenger are sent back. As soon as communication is established between stations, the JP-5 below decks supervisor clarifies with the tanker final information, such as the tanker's maximum pumping rate and discharge pressure and the carrier's maximum receiving rate and pressure.

NOTE

Personnel in the Deck Department perform the actual hookup of the fueling hoses.

The initial flow of JP-5 is received through the flushing valve and directed into the contaminated settling tanks. Before receiving JP-5 into the storage tanks, samples should be taken at the main deck fill connection in containers that permit visual inspection. If acceptable fuel is being received, open the downcomer and close the flushing valve. Start replenishment of aviation fuels at a slow rate.

When JP-5 enters the tanks, as indicated by the tank level indicators or sounding team, order the tanker to start pumping at a normal rate. Log the starting time and continue taking samples to ensure the receipt of clean bright, water-free JP-5. Log the quality of the samples taken and pressure of the JP-5 being received at the filling connection.

The receiving pressure at the filling connection should be about 40 psi to obtain the designed maximum filling rate. CV/CVNs can receive JP-5 at a rate of 360,000 gallons per hour when using two stations.

As the storage tanks are being filled, you should check the volume of fuel in each tank by observing the tank level indicators and by sounding the tanks. In general, the tanks nearest the downcomer will fill first.

Start sounding at the initial flow. Sounding should be taken periodically until the tanks reach 80 percent capacity. From this point on, soundings should be continuous.

When 80 percent capacity is reached in the first nest of tanks, open the tank-side valve to another nest (minimum of six tanks; three port and three starboard) at the same time; throttle the TANKSIDE valves to the first nest of tanks; and top them off to at least 95 percent capacity. All storage tanks, except overflow tanks, can be filled to almost 100 percent to increase the amount of fuel carried on board.

All storage tanks in one nest, both port and starboard, can be opened for simultaneous filling, but care must be exercised when topping off to prevent overtaxing the overflow line.

CAUTION

Overflow mains for overflow tanks are designed for an overflow rate of 1,500 gpm, and each storage tank has an overflow rate of 500 gpm.

After the amount of JP-5 being received per minute has been determined, the tanker can be given an estimated "stop pumping" time.

All ships fitted with two or more downcomers can use any or all to expedite the refueling operation. The number of tanks that can be opened and the method of receiving will vary on the individual ships, depending on the number of personnel available as manifold operators, sounding teams, etc., and the experience gained after several refueling operations.

NOTE

An adequate number of contamination tanks must remain empty to receive the re-circulated fuel from CLA-VAL refueling stations.

When the last port and starboard tanks to be filled reach 80 percent capacity, notify the tanker to reduce pumping. Top off the last tanks. When the overflow tanks reach 95 percent capacity, order the tanker to stop pumping.

After the tanker has ceased pumping, close the filling connection gate valve on the sponson.

At the completion of the replenishing operation, notify the officer of the deck of the start and stop pumping time and record the total gallons received. This information is entered in the ship's log.

Secure and re-stow all equipment. Close all valves in the filling and transfer system. The tanks should be sounded to obtain an accurate account of all JP-5 on board. During the final soundings, compare readings with the tank level indicators and adjust as necessary.

CRITERIA FOR ACCEPTANCE OR REJECTION OF JP-5.—The standards of fuel cleanness (table 2-6) are established as maximum limits for

Table 2-6.—Standards of Fuel Cleanness

From	To	Maximum Sediment[1]	Maximum Water[2]
Shore Tankage	Barges, Tankers, Fleet Oilers, Carriers	8.0 mg/liter	No visibale
Fleet Oilers, Barges, Tankers	Carriers	10.0 mg/liter	No visible
Carriers, Fleet Oilers, Barges, Tankers	Shore Tankage	10.0 mg/liter	No visible

[1]Sediment levels are to be determined by laboratory analysis, or by the CCFD (Combined Contaminated Fuel Detector) or AEL MK III (Contaminated Fuel Detector) or

[2]The free water content is determined by the AEL Mk I and AEL MK II Free Water Detector Kit, and by laboratory analyses

transfer of aviation fuels between shore activities and ships. Normally, contamination levels are maintained substantially below these levels.

Samples are taken continuously from the filling connection at the initial start of pumping until a clear sample is obtained. Thereafter, samples are taken every 15 minutes during the refueling operation. Any time a sample exceeds the contamination limits listed in table 2-5, the pumping operation must cease. The final decision of acceptance or rejection of the fuel rests on the commanding officer.

EMERGENCY BREAKAWAY.—During a refueling at-sea operation, any number of unforeseen circumstances could occur, making an emergency breakaway necessary. The order for an emergency breakaway may be given by the commanding officer of either the receiving ship or the delivery ship. Paramount in ordering an emergency breakaway is the allowance of sufficient time for the ships to disconnect the rigs in an orderly manner. Fueling rigs are subject to severe damage if not properly released at the breakaway signal, and serious injury to personnel could occur.

All emergency breakaway may be accomplished smoothly, rapidly, and safely if personnel at the station know how and what to do first. V-4 personnel on the refueling sponson should do the following:

1. After the tanker has stopped pumping, close the filling connection gate valve.
2. Clear the area.
3. Below decks personnel will secure the system below the main deck as normal.

SETTLING AND STRIPPING

The storage period between receipt of JP-5 on board and delivery to an embarked aircraft is a vital link in the cleaning process required. This settling period, in addition to proper stripping, also will take the load off the other cleaning processes in the system. Therefore, it is extremely important for fuel handlers to be familiar with the settling and stripping procedures aboard aircraft carriers.

Settling Period

Use settling to the maximum degree possible to separate solids and water from fuel. The settling time for JP-5 is 3 hours per foot of product height. To obtain the maximum settling time for JP-5 tanks, the following operating procedures should be followed:

1. NEVER purify JP-5 into an IN USE service tank.
2. Completely empty the in use service tank before taking suction on another service tank.
3. Avoid agitating settled tanks by minimizing the transfer of JP-5 to consolidate the fuel load or to correct the list or trim of the ship. This can be prevented by following the proper emptying sequence and by taking suction from an equal number of port and starboard tanks simultaneously when transferring during normal operations.
4. Coordinate the replenishment date so there is always enough JP-5 on board to top off all service tanks before receiving JP-5 aboard.
5. When transferring JP-5 from storage to service tanks, the tank emptying sequence for any nest of tanks should be scheduled to empty the overflow tanks first. The slack tanks (if any) next, and the tanks that have had the longest settling time last.

Rotate the tank-emptying sequence between the different nests of tanks so all tanks are used and not just those that are most convenient to the pump-room operator.

Stripping Schedule

Serious contamination of JP-5 has occurred on several aircraft carriers, resulting in the loss of aircraft worth millions of dollars and, in some instances, loss of human life. All of this could have been avoided if WATER and SOLIDS in the fuel had not been allowed to reach the aircraft fuel cells.

This useless waste was caused mostly by improper use of the equipment, a lack of understanding the need for stripping, and in some cases a complete disregard of stripping equipment and procedure. Therefore, it is imperative that the following stripping schedule and procedure be complied with.

Strip the storage tanks with the motor-driven stripping pumps at the following times:

1. Before receipt.
2. The day after receiving JP-5 aboard.
3. Weekly thereafter, as applicable.

4. The day before purifying into service tanks.

5. Immediately before purifying into service tanks.

Strip the service tanks with the hand-operated or motor-operated (ship's equipped) stripping pumps at the following times:

1. Daily

2. Just before use

3. Weekly (in port)

Stripping Procedure

Before any transfer operation, the JP-5 storage tanks concerned must be stripped of all water and sludge by using the motor-driven stripping system.

The stripping system is aligned in basically the same manner as described for stripping ballast tanks. Proceed as follows:

1. Open the valve on the single-valved stripping manifold to the tank to be stripped.

2. Open the valve on the flood and drain manifold leading to the stripping main.

NOTE

Step 2 is necessary only for tanks that are designated JP-5 or ballast.

3. Open the necessary valves in the stripping main leading to the suction header of the stripping pump.

4. Open the stripping pump inlet valve.

5. Open the stripping pump discharge valve.

6. Open the cutout valve from the discharge header leading to the contaminated-JP-5 settling tank.

7. Start the motor-driven stripping pump.

Take frequent samples of the JP-5 being discharged. When a sample of clean, bright, water-free JP-5 is obtained, the tank is stripped. Close the valve on the single-valved stripping manifold, and open the valve to the next tank to be stripped. Strip all tanks in the same manner.

NOTE

The clean JP-5 remaining in the system between the single-valved stripping manifold and the stripping pump from the previously stripped tank MUST be discharged past the test connection before a conclusive sample can be obtained from the next tank to be stripped. This can be accomplished by having a general knowledge of the capacity of the stripping system piping between the two points and the capacity of the stripping pump. Run the pump accordingly. Allow extra running time for a safety factor. An example is, if the pipe capacity is 160 gallons and the pumps rated capacity is 50 gpm, then the pump should be operated for 4 minutes before a sample of the next tank is taken.

When all storage tanks have been stripped, stop the pumps and close all valves in the system.

The service tanks can be stripped in basically the same manner as the storage tanks by using the service motor-driven stripping pump on ship's so equipped. Rotate the spectacle flange between the motor stripping and service motor stripping pump when completely emptying the service tanks (the last 24 inches of fuel) before maintenance, cleaning, etc., and to remove the wash water after a cleaning operation.

If the storage tanks are allowed adequate settling time and are properly stripped, and if the centrifugal purifiers are maintained and operated properly, there should NEVER be enough water in a service-tank.

Service tanks stripped by use of the hand-operated stripping pump for ship's still equipped with this system. The procedure used is as follows:

1. Open the valve on the suction side of the stripping pump leading to the service tank to be stripped.

2. Open the valve on the discharge side of the stripping pump.

3. Operate the pump handle until clean fuel is observed in the discharge line (as indicated by the bull's-eye sight glass).

4. Open the test connection and take frequent samples. Pump until a sample of clean, bright, water-free JP-5 is obtained.

TRANSFER SYSTEM OPERATIONS

Transferring JP-5 internally is accomplished by the three individual transfer pumps in each of the forward and after pump rooms.

Transferring From Storage to Service

When transferring from storage to service tanks, use the following procedure:

1. Strip all tanks concerned, both storage and service.

2. Empty the purifier sump drain tank.

3. Arrange the tank emptying sequence. Empty the overflow tank first, the slack tanks second, and the tanks that have had the longest settling time last.

4. Open the following valves:

   a. Selected tank-side manifold valves.

   b. Selected transfer mainside manifold valves.

> **NOTE**
>
> Ensure that the telltale valves are closed.

   c. All valves in the transfer main branch header, between the manifolds and pump suction header.

   d. Valves in the suction header.

   e. The pump inlet and discharge valves to a designated transfer pump.

   f. All valves from the pump discharge header to the designated purifier.

   g. The service tank cutout valve to the tank to be filled.

   h. The designated purifier discharge valve.

5. Start the purifier.

6. When the purifier attains 4100 rpm (146 to 152 bumps per minute), open the seal water valve on the purifier.

> **NOTE**
>
> To minimize vibration when starting with a dirty bowl, admit seal water when pressing the start button.

7. Open the main water-discharge observation port on the cover assembly. When water discharges past this port, close the seal water inlet valve on the purifier and at the supply end.

8. Start the designated transfer pump.

9. When the pump discharge pressure builds up, SLOWLY open the purifier inlet globe valve and throttle to maintain 4-10 psi inlet pressure. Then throttle the purifier discharge globe valve to maintain 30-psi back pressure (+or-5 psi).

10. Log the time the transfer pump and purifier were started.

11. While the system is in operation, make the following additional log entries:

   a. Transfer pump inlet and discharge pressure.

   b. Purifier inlet and discharge pressure.

12. Take inlet and discharge samples.

   a. Send to the AvFuels lab to analyze with the CCFD, AEL Contaminated Fuel Detector Mk III and the AEL Water Detector Kit Mk I/Mk II.

   b. Log the results of the analysis.

> **NOTE**
>
> It is advisable to take a visual sample of the contents of the storage tank from which suction is being taken at the initial opening of the manifold valves. This sample can be drawn through the telltale valve.

13. If the transfer pumps lose suction before the service tank is full, take the following action:

   a. Close the purifier inlet valve.

   b. Close the manifold valves to the empty tanks.

   c. Place additional tanks on the line.

   d. When the transfer pump discharge pressure is again attained, repeat step 10.

14. When the service tank is 95 percent, secure the system. The procedure for stopping the purifier is as follows:

   a. Close the purifier inlet valve.

   b. Stop the transfer pump.

c. Stop the purifier.

d. DO NOT engage the brake; the purifier will coast to a stop in about 45 minutes.

e. As the purifier slows down, centrifugal force diminishes, and inlet and discharge pressure will drop to zero.

f. When the flapper in the discharge sight glass stops, close the purifier discharge valve.

g. Close all valves in the filling and transfer system.

h. Make the following log entries:

(1) Time transfer pump stopped.

(2) Time purifier stopped.

(3) Gross gallons removed from storage tank.

(4) Net gallons received in service tanks.

During the transfer operation, samples for visual examination must be taken from the purifier outlet at regular intervals in accordance with local instructions. Samples must be clean and bright and contain NO free water. A cloud, haze, specks of sediment, or entrained water indicates the fuel is probably unsuitable and points to a breakdown in the purification process. Should this occur, the transfer operation must be secured until storage tanks concerned have been re-stripped; a clean, bright, water-free sample is received on the discharge side of the stripping pump; and the centrifugal purifier is inspected and discrepancies are corrected.

Transferring From Storage to Storage

This operation should rarely be necessary if an emptying sequence was properly established and followed (except when consolidating the fuel load before receiving). If and when this operation is called for, it will, in most instances, require transferring JP-5 from port to starboard, or vise versa, to correct the list on the ship; or transferring JP-5 from forward to aft, or vice versa, to correct the trim on the ship.

The operating procedure for this operation is the same as transferring from storage to service with the following exceptions:

1. Purification and sampling procedures are not required.

2. The transfer piping from the discharge header of the transfer pumps is aligned to discharge into the opposite transfer main branch header. Usually from where the suction is being taken (when transferring from port to starboard, or vice versa), or to the transfer main (when transferring from forward to aft, or vice versa).

CAUTION

The overflow tank for any nest of tanks scheduled to receive fuel must be empty before JP-5 can be transferred into any tank in that nest.

Consolidating Fuel

When any transfer operation has been completed, consolidate to the greatest extent possible the last 24 inches of JP-5 remaining in the storage tanks. (As much as 5,000 gallons remain in some of the larger tanks after the transfer pumps lose suction.) The motor-driven stripping pump accomplishes consolidation.

The procedure for consolidating the last 24-inches of JP-5 is the same as that outlined for stripping, except that the stripping pump discharge header is aligned to direct the discharged fuel into the transfer main instead of the contaminated-JP-5 settling tank.

From the transfer main, the JP-5 is directed into pre-selected storage tanks. Consolidated fuel should be allowed maximum settling time prior to stripping it before use.

Ballasting Operation

Empty ballast storage tanks are ballasted (filled with sea water) to preserve the underwater protection system of the ship. Ballasting must be accomplished in accordance with current ship's ballasting instruction for each ship.

Tanks on CV/CVNs are ballasted by gravity through the sea chest valve on the flood and drain manifold and the single-valved stripping manifold. On LPHs and LPDs, this water is supplied from the ship's fire main system.

Ballasting procedure is as follows:

1. Follow the tank filling sequence as scheduled by damage control central to maintain the proper list and trim of the ship.

2. Open the valves on the single-valved stripping manifold to the tanks to be filled.

CAUTION

Open an equal number of tanks on the opposite side of the ship.

NOTE

ALL tanks that are served by one flood and drain manifold can be filled simultaneously.

3. Align the valves on the flood and drain manifold for ballasting.

a. Unlock the sliding lock bar by loosening the two bolts over the oblong slots.

b. Position the lock bar so the circular hole in the keyhole slot is directly above the raised collar on the sea chest valve stem.

c. Re-bolt the lock bar in position.

4. Open the sea chest valve.

5. Sound the tanks to determine the instant they are full.

6. As each tank becomes full, as indicated by the tank sounding teams, close the valve on the single-valved stripping manifold.

7. When all tanks are ballasted, close the sea chest valve and reposition the lock bar.

8. Lock the tankside valve (on the double-valved filling and suction manifold) in the CLOSED position.

9. Open the telltale valves on the double-valved manifold and drain the contents, then close these valves.

CAUTION

While the tanks are ballasted with seawater, periodically open the telltale valves to determine the condition of the tank-side valves and transfer mainside valves.

NOTE

Most ballast tanks will not fill completely. Some will only fill half way due to tank height and draft of the ship. Ballast liquid will seek its own level.

OFF-LOADING JP-5

When it is necessary to offload JP-5, the service pumps are used as transfer pumps due to their increased capacity. JP-5 is discharged off the ship via the transfer main, downcomer, filling connection, and then to a barge, tanker, or fuel farm. Since the service pumps are used as transfer pumps for off-loading JP-5, the piping and valves in the filling and transfer system and the service system must be aligned to enable the service pumps to take suction from, and discharge into, the same piping as the transfer pumps.

Assume, in this operation, that the entire fuel load is to be offloaded, including the JP-5 in the service tanks. This being the case, empty the service tanks first, since no special preparations are required to take suction from these tanks with the service pumps.

Off-Loading JP-5 From Service Tanks

Align the piping and valves as follows:

1. Open the service tank suction cutout valve between the service tank and the service pump suction header.

2. Open the service pump inlet valve.

3. Unbolt and rotate the spectacle flange (or line blind) to the OPEN position. Located in the cross-connecting piping between the service pump discharge header and the transfer pump discharge header. Unlock and OPEN the gate valve in this same line.

4. Open the valve between the transfer pump discharge header and the transfer main.

5. Open the transfer main bulkhead cutout valves leading to the downcomer.

6. Open the gate valve at the base of the downcomer.

7. Open the gate valve at the filling connection.

When topside preparations have been made for off-loading fuel, start the service pumps.

When pump discharge pressure reaches 80 psi, SLOWLY open the globe valve on the discharge side of the pump. Throttle pumps to avoid cavitating and maintain a minimum of 35 psi back pressure for automatic operation of pump motor controllers.

The service pumps are now taking suction from a service tank and discharging overboard via the service pump discharge header, transfer pump discharge header, and transfer main, up through the downcomer, and out the filling connection.

Continue the pumping operation as outlined above until all service tanks have been emptied. Then secure the pumps and align the system for emptying the storage tanks.

NOTE

The remaining 24 inches of JP-5 in the service tank are consolidated into pre-selected storage tanks by the motor-driven stripping pump.

Off-Loading JP-5 from Storage Tanks

The piping arrangement from the service pump discharge header to the filling connection at the refueling station remains the same.

Align the piping from the suction header of the service pump to the storage tanks as follows:

1. Unbolt and rotate the spectacle flange or open the line blind valve in the cross-connecting piping between the service pump suction header and the transfer pump suction header. Unlock and OPEN the gate valve in this same line.

2. Open selected transfer mainside manifold valves.

3. Open selected tank-side manifold valves.

NOTE

The suction headers for the service pumps are 8-inch to 10-inch diameter lines, and all filling and suction lines to storage tanks are 5-inch diameter lines. Therefore, an adequate number of tanks must be open at all times, or the service pumps will lose suction.

4. Open all valves in the transfer main branch headers leading to the suction header of the transfer pumps.

5. Start the service pump with the discharge globe valve closed. When the pump discharge pressure reaches 80 psi, SLOWLY open the discharge globe valve.

Continue pumping until all fuel has been offloaded. The same as when on-loading, when off-loading fuel, a tank emptying sequence must be followed to maintain the proper list and trim on the ship.

JP-5 SERVICE SYSTEM OPERATIONS

The operations described here for the service system include (1) flushing the service system, (2) fueling aircraft, and (3) defueling aircraft.

Before fueling any aircraft, the entire JP-5 service system must be thoroughly flushed after any one of the following occurrences:

1. After a shipyard overhaul (includes newly constructed or reconverted carriers).

2. After any major repair work has been accomplished on the JP-5 service system.

3. After maintenance, the system was drained-back.

The flushing operation is performed to rid the piping of the large quantity of solids and condensation that accumulate during the installation of and/or repairs to the system during a shipyard overhaul. Flushing also removes loose deposits of microbiological growth that can grow anywhere in the system where pockets of water exist.

Operation of the service system requires pumping large quantities of fuel at high pressure, therefore, every safety precaution must be adhered to.

The flushing operation is performed by pumping clean JP-5 through the service system piping from service tanks, via the service filter, through the distribution piping to every service station, and back into the contaminated settling tanks. The entire flushing operation can be accomplished with virtually no loss to the JP-5 fuel involved.

The piping arrangement and operating procedure between the pump room and the service stations for the flushing operation are identical as for fueling aircraft, which is to follow. To minimize repetition, the operation described here between the two points is for both operations.

The piping arrangement for one quadrant only is described here. Other quadrants can be aligned in the same manner.

Set up the pump room as follows:

1. Strip the in-use service tank.

2. Open the cutout valves in the suction line between the service pump and in-use service tank.

3. Align the recirculating header to the in-use service tank from which suction is to be taken.

4. Open the service pump recirculating cutout valve.

CAUTION

Ensure that the service pump discharge valve is closed.

5. Align distribution piping in the pump room to a predetermined service filter.

6. Align the distribution piping in the filter room to activate the main fuel filter as follows:

a. Align the automatic water drain system.

b. Open filter inlet and discharge valves.

c. Open filter vent line.

d. Open both cutout valves leading to the forward and after legs of the outboard distribution main.

e. Open the port and starboard crossover cutout valve.

7. Align the first service station to be flushed as follows:

a. Open the service station riser valve and the cutout valve between the service station and hose reel.

b. Unreel all fueling hoses and attach the pressure-fueling nozzle from one hose to the defueling main.

NOTE

The defueling main is aligned and opened to the contaminated settling tanks.

8. Start one service pump. When a discharge pressure of 80 psi is obtained, SLOWLY open the pump discharge valve. Observe the bull's eye sight glass in the filter vent. When a solid stream of JP-5 is discharging through this line, close the vent valves.

9. When the filter vent valve has been closed, START the service station defuel pump.

10. Close the nozzle toggle switch on the pressure-fueling nozzle to place the service station in the fueling position.

Flush until a clean bright, water-free sample is obtained at the test connection on the pressure-fueling nozzle. Analyze the sample using AEL detectors. Continue this operation on a station-by-station basis until each hose reel has been thoroughly flushed.

Fueling of aircraft is accomplished in the same manner as flushing the hoses, except that the nozzle is attached to the aircraft. Specific flight deck procedures for flushing, fueling, and defueling are covered in chapter 5.

AUXILIARY SYSTEM OPERATIONS

The auxiliary JP-5 system delivers JP-5 to emergency diesel generators, small boat filling connections, and yellow gear fill stations. The procedure for transferring JP-5 to the auxiliary main is as follows:

1. Open the tank top valve from the selected service tank and the cutout valve to the auxiliary pump suction.

2. Ensure all service tank valves not involved with the transfer operation are closed.

3. Open the valves in the discharge line from the auxiliary pump to the auxiliary main.

4. Open branch valves in the auxiliary system to the stations to be serviced, and check to ensure all branch valves for those stations not requiring servicing are closed.

5. Establish communications between the pump room and the stations to be serviced.

6. Start the JP-5 auxiliary pump.

7. When the transfer operation is complete, secure the JP-5 auxiliary pump and close all valves in its suction and discharge lines. Then close all open valves in the remainder of the system.

POLLUTION CONTROL

The Navy's ability to accomplish its mission requires daily operations on land, at sea, in the air-in other words, in the environment. The Navy is committed to operating its ships and shore facilities in a manner compatible with the environment. National defense and environmental protection are, and must be, compatible goals. The chain of command must provide leadership and personal commitment to ensure that all Navy personnel develop and exhibit an environmental protection ethic. Thus, an important part of the Navy's mission is to prevent pollution, to protect the environment, and to conserve natural, historic, and cultural resources.

Oil pollution is the Navy's largest single pollution problem. As ABFs, we have millions of gallons of petroleum products under our control at all times. **We are responsible for the safe storage and handling of every single gallon.**

OPNAVINST 5090.1B is the Navy's Environmental and Natural Resources Program Manual. In it, the Chief of Naval Operations provides specific guidelines and policies, assigns responsibility, and sets standards for the Navy to follow pertaining to environmental protection policies.

Some of the specific policies that concern the ABF are:

1. Oil or oily waste shall not be discharged from any naval activity or ship within 50 nautical miles of any shoreline in such quantities that leaves a sheen in the water.

2. Personnel will prevent or contain any accidental discharge to prevent pollution.

3. Provides procedures for the disposition of waste petroleum products.

4. Explains specific responsibilities of the chain of command for pollution abatement.

As an ABF, it is your responsibility to know and follow the Navy's pollution prevention policies.

Q2-54. What are the three operational stages to the AFOSS?

Q2-55. What kind of information is contained in the AFOSS?

Q2-56. While sounding, you see quite a lot of water droplets on the tape, evidence of possible entrained water. What kind of sample would you need to take to verify your assumptions?

Q2-57. What factor(s) will determine the duration of a filling/replenishment at sea operation?

Q2-58. What kind of information is contained in the Sounding AFOSS?

Q2-59. What are the acceptable requirements for sediment levels from shore tankers?

Q2-60. IAW stripping procedures storage tanks must be stripped of all water and sludge using the motor driven-stripping system. What are the requirement(s) for stripping the storage tanks?

SUMMARY

In this chapter, you have learned about the equipment and subsystems that make up the various below decks systems. You have learned typical operating procedures and minor troubleshooting.

The JP-5 Afloat Below Decks System is a vast, complex system that can be difficult to learn. A good training program will produce excellent results here. A key point to remember: If you follow the operating procedures in the equipment technical manuals and your ship's AFOSS, you can't go wrong. Supervisors should stress this point with junior personnel.

CHAPTER 3

JP-5 FLIGHT DECK FUEL SYSTEMS

INTRODUCTION

Working on the flight deck of an aircraft carrier is one of the most exciting and dangerous jobs you can have. Additionally, the ABF works with highly flammable fuels. Though the below decks system is more complex, the ABF working on the flight deck must be equally knowledgeable in the flight deck system, its components, and correct operating procedures.

This chapter will identify the components used for flight and hangar deck operations and explain the correct operating procedures. As with below decks, the arrangement of the flight deck system will vary from ship to ship. The information in this chapter is based on typical arrangements.

FLIGHT AND HANGAR DECK FUEL/DEFUEL (CLA-VAL) VALVE

LEARNING OBJECTIVE: Identify the components that make up the JP-5 flight deck and hangar deck Fuel/Defuel (CLA-VAL) valve. Describe the operating procedures for the JP-5 flight and hangar deck Fuel/Defuel (CLA-VAL) valves. Describe the troubleshooting procedures for the JP-5 flight and hangar deck Fuel/Defuel (CLA-VAL) valves.

The flight and hangar deck fueling system is built around the CLA-VAL fueling unit. The number and location of these units depend on the individual ship. Typically, each refueling station contains three or four hose reels (fig. 3-1), each having its own CLA-VAL.

The CLA-VAL fueling unit (fig. 3-2) is the core of the JP-5 fueling station. It is a three-port, two-way, fuel/defuel valve, of modified globe valve design that is intended for use as an integral part of the JP-5 dispensing system for shipboard use. This valve performs four distinct functions:

1. It functions as a pressure-reducing valve to maintain a constant discharge pressure not to exceed 55 psi.
2. It functions as a solenoid-operated emergency shutoff valve.
3. It functions as a pressure-relief valve when discharge pressure rises above a predetermined setting.
4. It functions as a defueling valve to evacuate the piping and hose beyond the valve discharge.

MAIN (FUEL/DEFUEL) VALVE

The main valve (fig. 3-3) is actually two single-seated globe valves built into a common body. Each of the valves performs a separate and distinct function, one is the fueling valve and the other is the defueling valve.

Each valve employs a well-supported and reinforced diaphragm as its operating means. The fueling valve is spring-loaded to close; therefore, it is normally closed. The defuel valve is inverted (upside down) and held open by its own weight.

The main valve directs fuel flow from the inlet port to the fuel port when fueling, and fuel flow from the fuel port to the defuel port when defueling. The fuel and defuel valves are controlled by pressure acting on a diaphragm. The change from the fuel to defuel mode is accomplished by energizing or deenergizing the solenoid-operated pilot valve (SOPV), or by excessive delivery pressure.

When pressure above the fueling diaphragm is vented off, inlet pressure on the fueling diaphragm lifts its disk assembly, opening the fuel valve. Simultaneously, pressure is applied to the bottom of the defueling valve diaphragm, seating its disk assembly and closing the defuel valve.

When pressure underneath the defueling diaphragm is vented off, its disk assembly falls, and the defuel valve opens. Simultaneously, pressure is applied to the top of the fuel valve diaphragm (both line and spring). When this pressure overcomes the inlet pressure, its disk assembly seats, closing the fuel valve.

The main valve is controlled by a set of smaller valves using line pressure, thus providing fully automatic operations. The SOPV shifts the CLA-VAL assembly from defueling to fueling, and from fueling to defueling. The flow control valve regulates the opening speed of the fueling side of the main valve. The hytrol

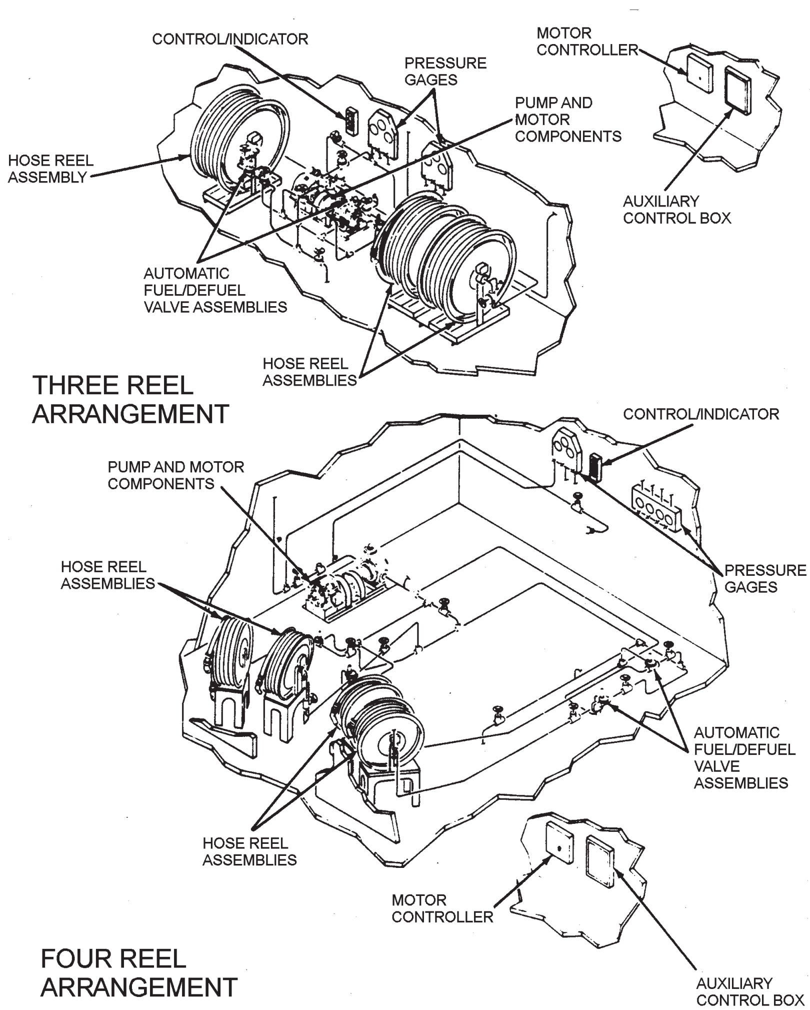


Figure 3-1.—Aircraft Fuel/Defuel station arrangement.

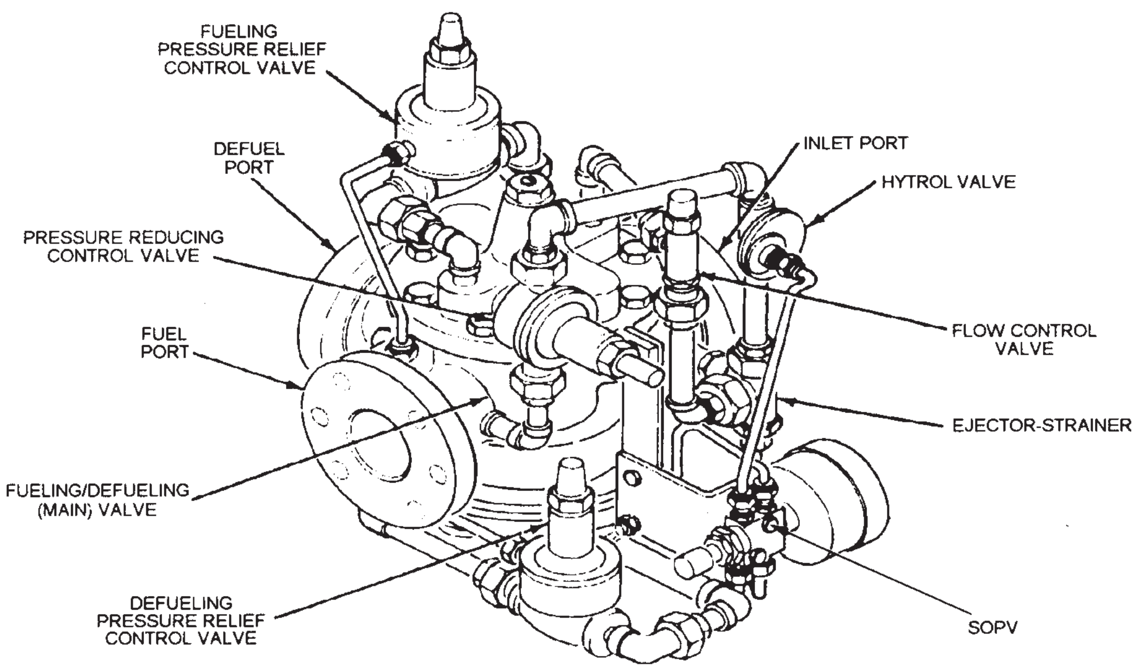


Figure 3-2.—CLA-VAL fuel/defuel valve assembly.

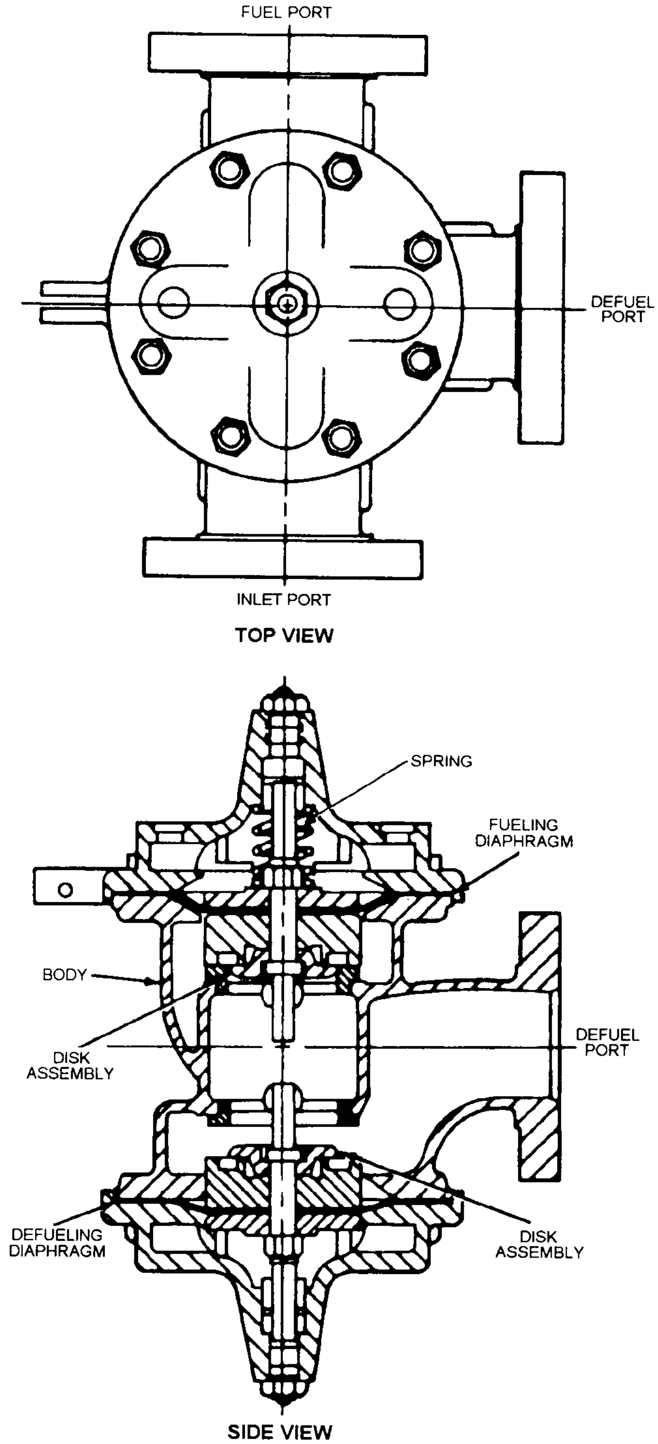


Figure 3-3.—Main valve.

valve either isolates inlet pressure from the pressure-reducing control valve, or vents inlet pressure to the pressure-reducing control valve and the fuel port of the main valve. The pressure-reducing control valve regulates delivery pressure. The ejector-strainer aids in relieving pressure above the diaphragm of the fueling valve and prevents foreign particles from entering the pressure-reducing control valve. The pressure relief control valves open to shift to the defueling mode if the delivery pressure exceeds the preset limit.

Pressure Relief Control Valves

The pressure relief control valves (fig. 3-4) open to shift the main valve to the defueling mode when delivery pressure exceeds the preset adjustment. There are two pressure-relief control valves for each CLA-VAL fueling unit. One valve acts as a pressure relief for the fuel valve, and the other for the defuel valve.

Each pressure-relief control valve contains a stem, a diaphragm, a spring, and an adjusting screw. Each valve is a direct acting, spring-loaded valve, designed with a large diaphragm working area in relation to the valve area seat, to ensure positive operation. It is held closed by the force of the compression spring. Pressure adjustment is made by rotating the adjusting screw to vary spring compression on the diaphragm. Compressing this spring increases the pressure at which the valve opens. The spring can be adjusted to provide a relief setting from 20 to 70 psi. The adjusting screw on the pressure-relief control valve is protected, by a bronze housing.

When the controlling pressure under the diaphragm exceeds the set spring force, the disk is lifted off the seat, permitting flow.

The pressure relief for the defuel valve is set about 7 1/2 psi above delivery pressure. The pressure relief for the fuel valve is set approximately 2 1/2 psi above delivery pressure. The opening of the pressure relief control valve for the fueling valve increases the closing speed of the fueling valve. The opening of the pressure

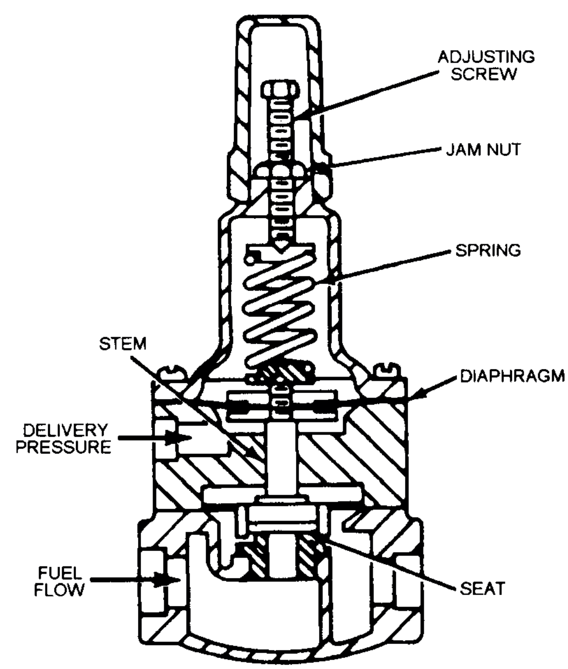


Figure 3-4.—Pressure-relief control valve.

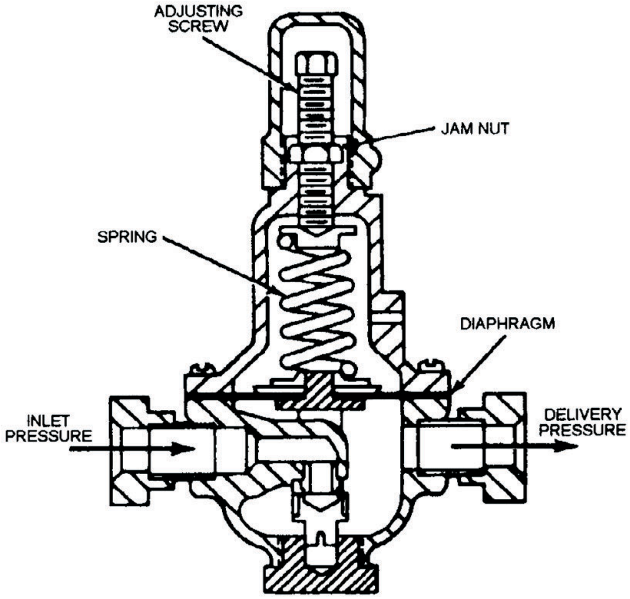


Figure 3-5.—Pressure-reducing control valve.

relief control valve for the defueling valve vents pressure from the bottom of the defuel valve diaphragm, opening it.

Pressure-Reducing Control Valve

The pressure-reducing control valve (fig. 3-5) steadily reduces a higher initial pressure to a lower pressure and regulates the delivery pressure when the main valve is in the fueling mode.

The pressure-reducing control valve is a direct acting, spring-loaded valve designed with a large diaphragm working area in relation to the valve seat to ensure sensitive control and accurate regulation of the delivery pressure. Pressure adjustment is made by rotating the adjusting screw to vary spring compression on the diaphragm. Compressing this spring increases the delivery pressure setting. The spring can be adjusted to provide delivery from 15 to 100 psi. The adjusting screw on the pressure reducing control valve is protected, by a bronze housing.

The pressure-reducing control valve normally is held open by the force of the compression spring. When the delivery pressure acting upon the lower side of the diaphragm exceeds the force of the compression spring, the valve closes.

Conversely, when the delivery pressure reduces below the spring setting, the valve opens. Thus, a constant delivery pressure is maintained by balancing delivery pressure against spring pressure. The valve can be easily regulated by turning the adjusting screw and provides a simple means of pressure adjustment.

Hytrol Valve

The hytrol valve (fig. 3-6) either isolates inlet pressure from the pressure-reducing control valve, or vents inlet pressure to the pressure-reducing control valve and the fuel port of the main valve. Pressure directed from the SOPV to the top of the diaphragm holds the hytrol valve closed. When this pressure is vented (also through the SOPV), the inlet pressure opens the hytrol valve allowing fuel flow. No adjustments are made to the hytrol valve. It is either open or closed.

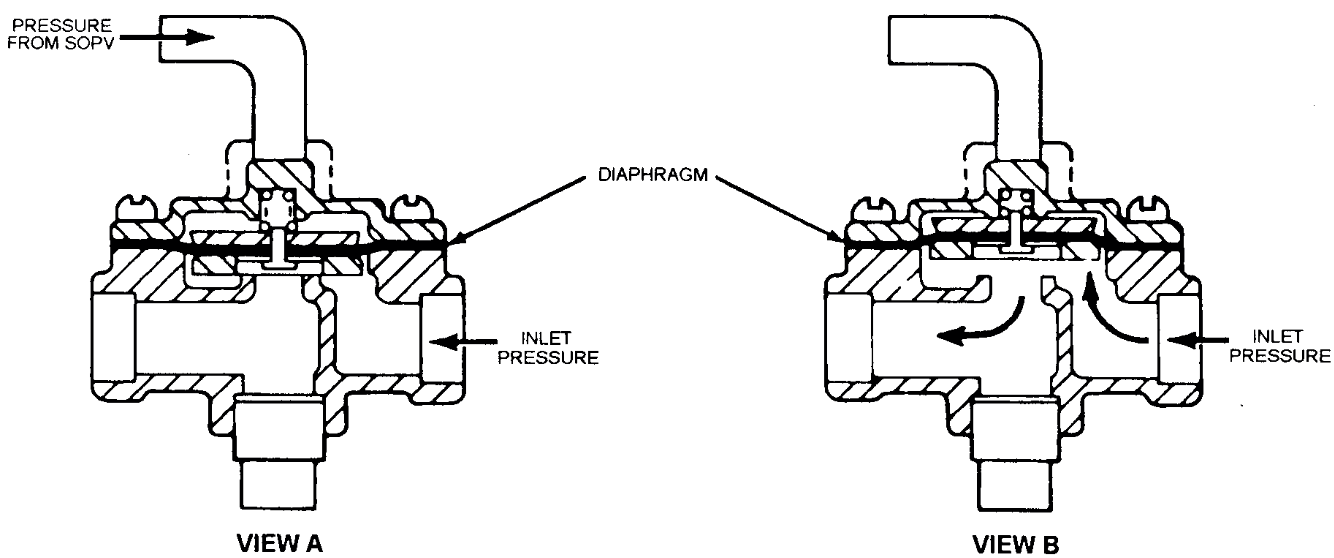


Figure 3-6.—Hytrol valve.

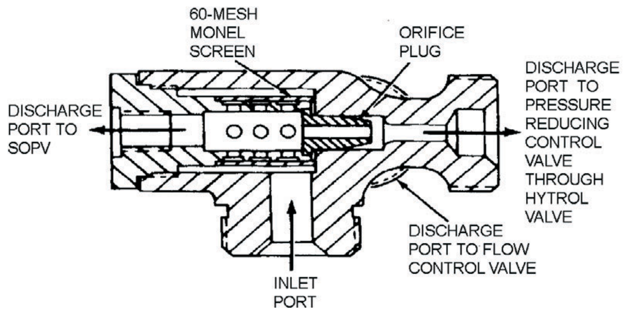


Figure 3-7.—Ejector strainer.

Ejector-Strainer

The ejector-strainer (fig. 3-7) reduces inlet pressure to the pressure-reducing control valve, and filters fuel. It consists of an orifice plug and a 60 mesh-monel screen located between the inlet port and three discharge ports. The orifice plug creates reduced pressure by increasing fuel velocity (like an eductor). This aids in vacating the cover chamber of the fuel valve. The monel-screen traps foreign particles and contaminating substances. The three-discharge ports direct filtered fuel to the pressure-reducing control valve, the flow control valve, and the SOPV.

Solenoid-Operated Pilot Valve (SOPV)

The SOPV (fig. 3-8) shifts the CLA-VAL assembly from defuel mode to fuel mode of operation, and vice versa. The SOPV is a direct acting, solenoid-actuated valve. It is a four-way valve with a grooved stem that moves back and forth in a machined bore inside the body. When the solenoid is energized in the fueling mode, the stem is drawn against spring compression by the magnetic pull of the solenoid. When the solenoid is deenergized in the defueling mode, the stem is returned by the extension of the core spring. Movement of the valve piston directs full flow in one direction or full

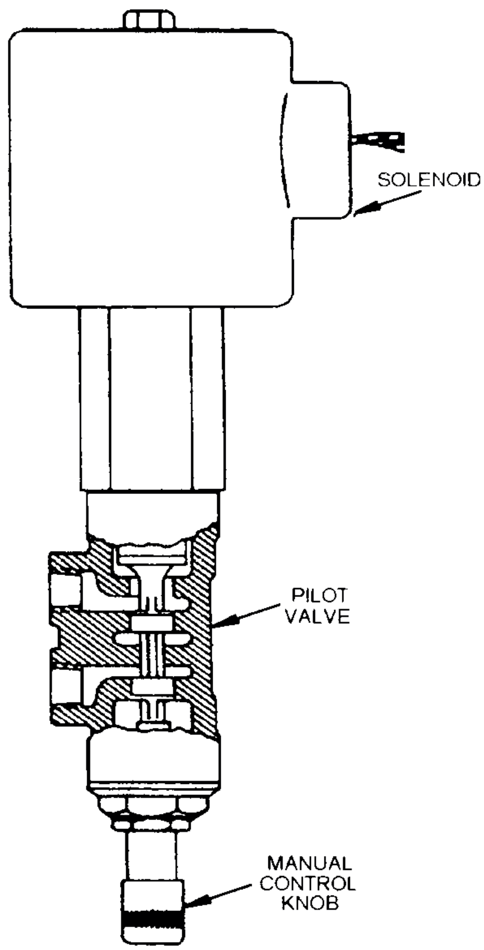


Figure 3-8.—Solenoid-operated pilot valve (SOPV).

flow in the opposite direction. There is no closed-port position. The valve is also equipped with a manual operator. The manual operation of this valve is done by, pushing upward on the button at the lower end of the control. A quarter-turn clockwise locks the manual operator in place.

The solenoid is housed in an explosion-proof case and meets the requirements for use in hazardous locations.

Flow Control Valve (Needle Valve)

The flow control valve (fig. 3-9) consists of a needle valve with a spring and disk assembly within a housing. The housing cover can be removed to allow for needle valve adjustment. The flow control valve is installed in the line between the ejector-strainer and the fuel valve cover chamber.

The flow control valve, by virtue of its construction, controls the flow from the fuel valve cover chamber, which controls the reaction time of the fuel valve. This is accomplished by restricting fuel flow through the needle valve and disk assembly. Flow in the opposite direction lifts the disk up off the seat, permitting free flow.

OPERATION OF THE CLA-VAL

A step-by-step analysis of the valve's operation is as follows. Figure 3-10 shows the valve in the fueling position.

1. The solenoid is energized.
2. The SOPV directs pressure from the main valve inlet into the cover chamber of the defueling valve, holding it closed.
3. The SOPV also vents the cover chamber of the hytrol valve to the defueling line. This permits the pressure-reducing control valve to take over control of the fueling valve.
4. When the pressure-reducing control valve goes into operation, high-pressure fuel enters the fueling valve and bypasses through the ejector-strainer to the pressure-reducing control valve, which is held open by its compression spring. With pressure at the pressure-reducing control valve below the adjusted setting, a maximum flow is permitted through the ejector-strainer. This creates a reduced pressure in the main valve cover chamber, which allows the fueling valve to open to build up pressure in the downstream system. The increasing downstream pressure is transmitted through the pressure reducing control valve line to the under side of the pressure reducing control valve diaphragm.

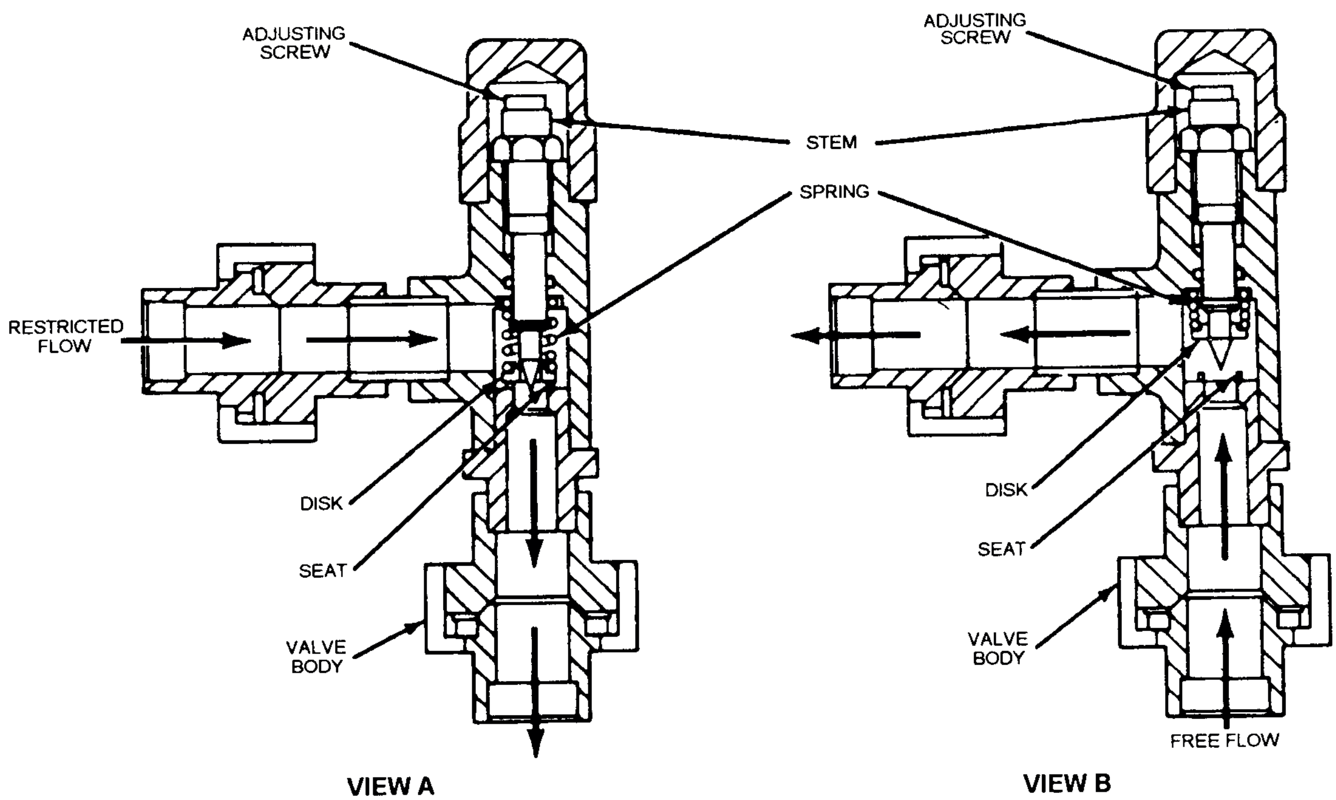


Figure 3-9.—Flow control valve (needle valve).

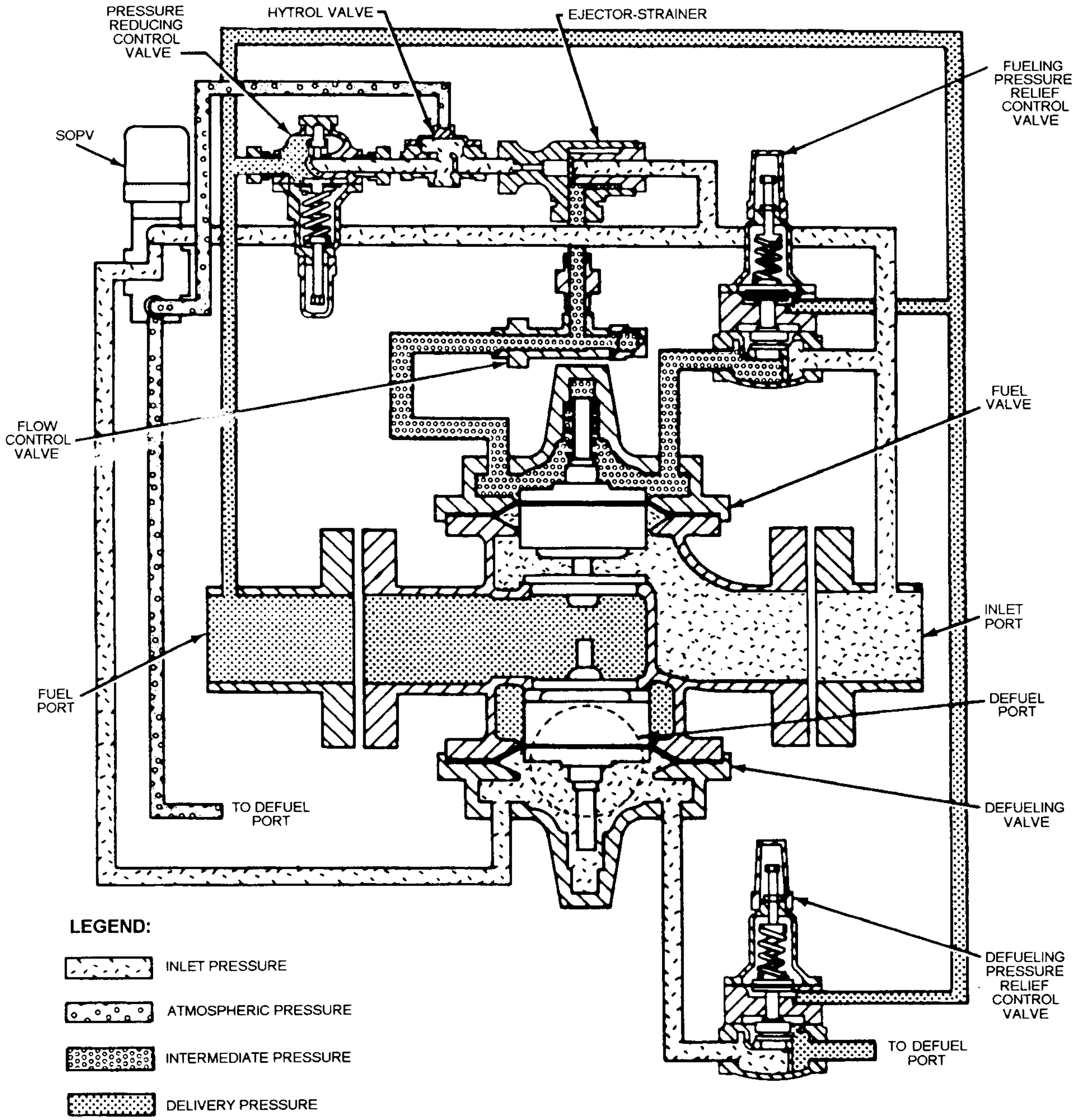


Figure 3-10.—CLA-VAL fueling operation.

> **NOTE**
>
> The flow control valve controls the rate in which fuel is evacuated from the cover chamber of the fueling valve and the speed the fueling hose charges. It should be adjusted so the fuel hose charges gradually. If the hose charges too hard, the possibility of equipment damage and injury is increased.

5. When the pressure under the pressure-reducing control valve diaphragm reaches a point where it balances the loading of its compression spring, the pressure-reducing control valve begins to close, restricting the flow through the ejector-strainer sufficiently to increase the pressure in the main valve cover chamber. The resulting increase in pressure in the cover chamber forces the disk toward the seat until the main valve is passing just enough fuel to maintain a downstream pressure that balances the loading of the

pressure-reducing control valve compression spring. Any subsequent change in fuel demand tends to cause a slight change in downstream pressure, which results in the pressure-reducing control and main valves assuming new positions to supply the new demand.

6. As long as normal fueling operation is in process and the flow rate is not changing rapidly, the fueling valve functions as outlined above. If the flow rate suddenly decreases, two things occur:

a. Any pressure rise is offset, by the opening of the defueling valve.

b. The fueling valve closes rapidly.

7. Figure 3-10 shows that delivery pressure is reflected under the diaphragm of both pressure-relief control valves, opposing the force applied by the spring. When a downstream pressure rise occurs that is sufficiently high to overcome the force of the spring, the defueling valve pressure-relief control valve opens to relieve pressure from the cover of the defueling valve. This allows the defueling valve to open, thereby relieving excess pressure into the defueling line.

8. When pressure and flow conditions return to normal, all valves resume their normal functions.

DEFUELING OPERATION OF THE CLA-VAL

The defueling operation of the CLA-VAL follows. Figure 3-11 shows the valve in the defueling position.

1. The solenoid is deenergized.

2. The SOPV directs pressure from the main valve inlet into the cover chamber of the hytrol valve, holding it closed. This diverts high pressure through the ejector-strainer into the cover chamber of the fueling valve, holding it closed.

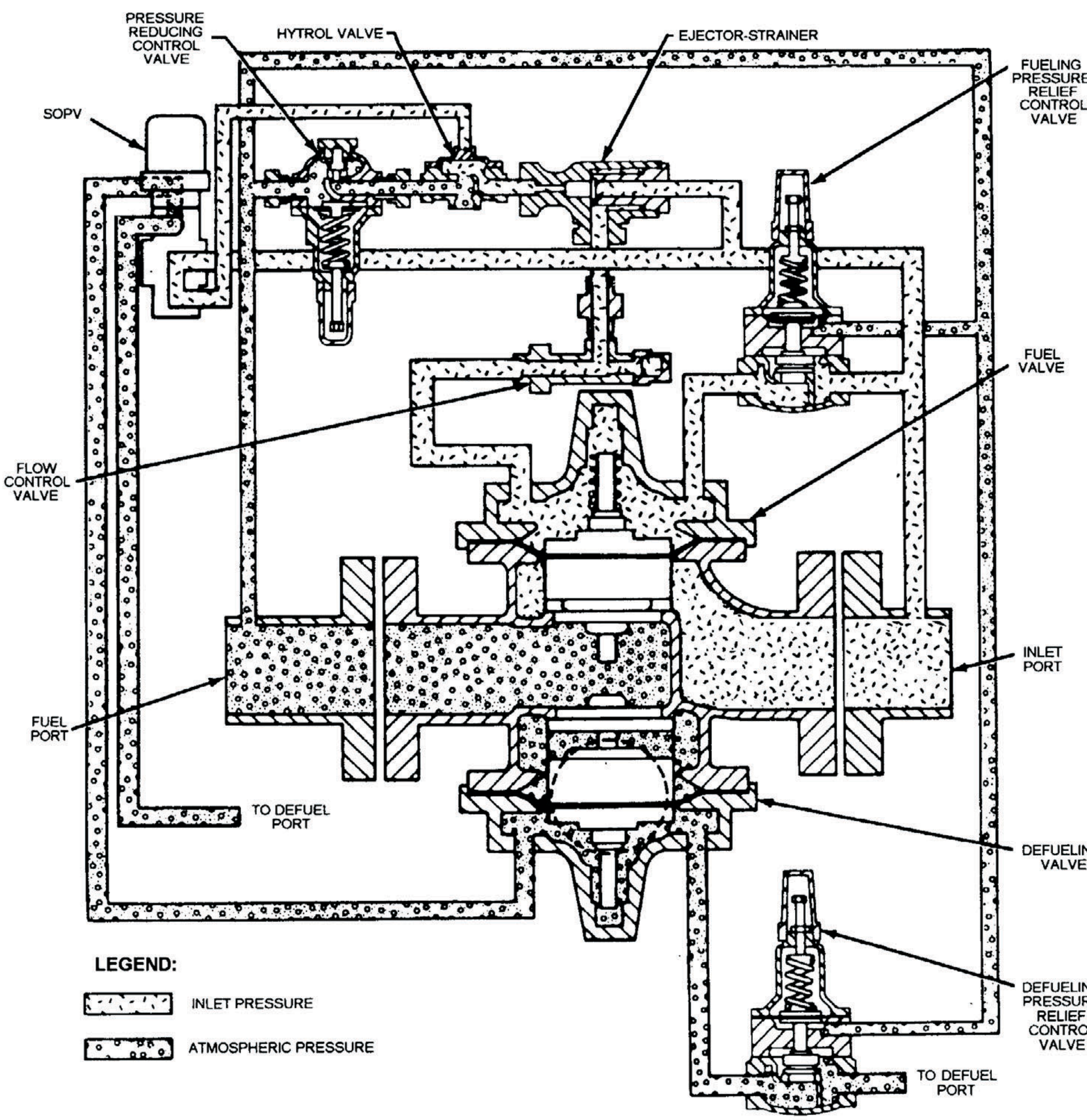


Figure 3-11.—CLA-VAL defueling operation.

3. The SOPV also vents the cover chamber of the defueling valve to the defueling line. With pressure released from the cover chamber, the defueling valve opens by virtue of its own weight and inverted design. The defueling valve will have a controlled opening rate produced by a restriction tube elbow located in the line from the cover chamber.

CLA-VAL FUEL/DEFUEL PRESSURE-SETTING PROCEDURES

Procedures are the same for all pressure settings; only the pressure will vary. This example is for a final delivery pressure of 50 psi. The pressure-setting procedures are the following:

1. A pressure gauge must be installed in the line between the fuel/defuel valve and the hose.

2. Remove adjusting screw and housing for both pressure-relief valve and pressure reducing valve.

> **NOTE**
>
> Do not turn these screws beyond the point at which they become tight. Damage to the internal parts of the valve may result.

3. Loosen all three jam nuts and gently screw the adjusting screw on both pressure-relief control valves all the way in.

4. Line up and pressurize the service system.

5. Unreel the hose and connect the nozzle to the defuel main. (Use proper grounding procedures.)

6. Start the defuel pump.

7. Place the toggle switch to the ON position.

8. Slowly turn the adjusting screw on the pressure-reducing control valve until the gauge in the delivery line reads 10 psi higher than the desired pressure (60 psi in this example).

9. Tighten the jam nut to lock the adjusting screw.

10. Slowly turn the adjusting screw of the defuel valve's pressure-relief control valve until the delivery pressure gauge dips downward approximately 2 1/2 psi (57 1/2 psi in this example).

> **NOTE**
>
> The defuel valve's pressure-relief control valve will be set 7 1/2 psi higher than delivery pressure.

11. Tighten the jam nut to lock the adjusting screw.

12. Loosen the jam nut and slowly turn the adjusting screw of the pressure-reducing control valve until the delivery pressure drops to a point 5 psi above the desired delivery pressure (55-psi).

13. Tighten the jam nut.

14. Slowly turn the adjusting screw of the fuel valve's pressure-relief control valve until the delivery pressure gauge begins to dip downward approximately 2 1/2 psi (52 1/2-psi).

> **NOTE**
>
> The fuel valve's pressure-relief control valve will be set 2 1/2 psi higher than delivery pressure.

15. Tighten the jam nut to lock the adjusting screw.

16. Loosen the jam nut and slowly turn the adjusting screw of the pressure-reducing control valve until the delivery pressure has dropped to the desired delivery pressure (50-psi).

17. Tighten the jam nut to lock the adjusting screw.

18. Replace all adjusting screw housings.

19. Secure station.

CLA-VAL TROUBLESHOOTING PROCEDURES

To do troubleshooting, you must completely understand the function of the CLA-VAL. Before you actually make any mechanical adjustments, carry out the following steps:

1. Be sure that the SOPV is operating when the fueling switch is turned to the ON position and it is being deenergized when the switch is turned to the OFF position. (This is commonly called a "click" test.)

2. Be sure the inlet pressure is high enough to maintain the required delivery pressure. Inlet pressure should be at least 10 pounds higher than desired delivery pressure.

3. Check to see if the protective housings are missing or damaged. If they are, this may indicate improper adjustment of the control valves.

4. Be sure that no part of the control valve system has been removed, disturbed, or damaged.

The above checks may indicate the probable source of trouble. If not, the step-by-step procedures outlined in the following paragraphs should be followed. As always, when actually troubleshooting equipment, refer to the applicable technical manual.

Fueling Valve Fails To Open

If the SOPV is not operating properly, proceed as follows:

1. Energize SOPV and apply pressure at the main valve inlet.

2. Loosen the tube fitting at the cover of the hytrol valve.

3. If fuel under pressure is present, the SOPV is probably stuck in the deenergize position.

4. Operate the SOPV manually as outlined in operating instructions.

5. If fuel under pressure at the loosened fitting is shut off when the SOPV is actuated manually, the SOPV must be repaired or replaced.

If the hytrol valve fails to open, proceed as follows:

1. Loosen the tube nut at the cover of the valve. No pressure should be present at this point.

2. Make sure there is no pressure in the downstream fueling line. Break the union between the fueling pressure-relief control valve and the hytrol valve.

3. If no pressure is present at the disconnected union, failure of the diaphragm in the hytrol valve is indicated.

4. Remove the cover screws and the cover of the hytrol valve.

5. Remove the diaphragm assembly and replace the diaphragm if ruptured.

6. Reassemble the hytrol valve. Reconnect the union and tubing fittings.

Fueling Valve Fails To Close

If the SOPV is not operating properly with the solenoid de-energized and pressure at the main valve inlet, proceed as follows:

1. Loosen the tube nut at the cover of the hytrol valve to determine whether or not fuel is under pressure at the loosened connection.
2. If there is no flow under pressure, SOPV failure is indicated.
3. Operate the SOPV manually as outlined in the operating instructions.
4. If pressure is received at the loosened tube connection when the SOPV is actuated manually, this indicates the SOPV must be replaced or repaired.

The ejector-strainer may be clogged. Carry out the following procedure:

1. With no pressure at the valve inlet, remove the large box nut on the end of ejector-strainer.
2. Inspect the screen and clean it if it appears to be clogged.
3. Inspect the secondary jet to make sure it is not plugged.

Fueling Valve Fails To Maintain Designed Delivery Pressure

If the pressure-reducing control valve is not operating properly, carry out the following procedures:

1. Remove the adjusting screw housing.
2. Loosen the jam nut and turn the adjusting screw clockwise.
3. If the fueling valve opens during this procedure and delivers fuel at an increased and constant pressure, it is an indication that the pressure adjustment of the pressure-reducing control valve is incorrect.
4. To remedy, follow the entire "Pressure Setting Procedure" outlined in the operating instructions.

Fueling pressure-relief control valve may be held open.

- The correct setting of this valve is 2 1/2 psi higher than the pressure setting of the pressure-reducing control valve.
- If the fueling pressure-relief control valve is adjusted to a pressure equal to or lower than the desired delivery pressure, the fueling pressure-relief control valve will be held open. If it is open, inlet pressure will flow into the cover chamber of the fueling valve and hold it closed.
- If this appears to be the trouble, remove the adjusting screw housing, loosen the jam nut, and turn the adjusting screw clockwise until it bottoms. This should close the pressure-relief

control valve. If this was the trouble, the pressure settings should be re-adjusted as outlined in the operating instructions.

The fueling valve diaphragm may be ruptured. This occurrence is very unlikely. However, if all other steps have been followed and indications are that the main valve is faulty, follow these steps:

1. Remove all fittings from the cover of the fueling valve.

2. Remove the nuts holding the cover in place and lift off the cover.

3. Lift the diaphragm assembly out of the valve and examine the diaphragm for any holes.

4. Replace the diaphragm with a new one if necessary.

5. While the diaphragm assembly is out of the valve, the disk should be checked to see that it is in good condition. Replace if necessary.

6. When reassembling the valve, make sure the internal spring fits into its recess in the cover.

7. When the valve is returned to service, follow the procedure outlined in the operating instructions.

Information that we just discussed is not all-inclusive in resolving problems that can occur with the fuel/defuel (CLA-VAL) valve. As always, the appropriate technical manual for this specific equipment should be consulted. See table 3-1 for a list of the more common problems and suggested corrective actions associated with this equipment.

Q3-1. What two (2) primary functions of the CLA-VAL will cause the main valve component to shift from fuel to defuel mode or vice versa?

Q3-2. What is the effective range of spring tension that the pressure relief control valves can be adjusted to?

Q3-3. What is the size of monel screen to the orifice plug in the ejector strainer?

Q3-4. What is the requirement for the SOPV, in order for it to be used in hazardous locations?

Q3-5. Where is the flow control valve (needle valve) situated on the CLA-VAL unit?

Q3-6. What valve of the CLA-VAL controls the speed at which a fuel hose charges when refueling aircraft?

Q3-7. Whose permission is required if for some reason (i.e. troubleshooting) the SOPV has to be manually operated?

FLIGHT DECK SYSTEM PRESSURE FUELING NOZZLES

LEARNING OBJECTIVE: Identify the pressure fueling/defueling nozzles used on the flight and hangar decks. Describe the components and how they function. Explain how each nozzle is used in the different types of fueling and defueling operations.

Fueling nozzles connect to NATO military aircraft and are designed to provide a leakproof seal between the nozzle and the aircraft for high-capacity fueling operations. This includes supplying fuel under pressure to aircraft, and removing fuel by suction from aircraft.

NOZZLE ADAPTER

The flange side of the nozzle adapter is bolted to the nozzle. The male end opening provides a means of installing a 100-mesh strainer inside the nozzle assembly. The strainer is held in place by a snap ring that fits into a recessed groove inside the male end.

QUICK-DISCONNECT COUPLING (QDC)

The quick-disconnect coupling (fig. 3-12) is designed to provide the means of attaching the fuel nozzle to the hose. It also contains the switch to energize or de-energize the SOPV. When operating the quick-disconnect coupling, don't jam the switch, and don't drop the coupling on the deck.

The quick-disconnect coupling (fig. 3-13) has a female thread on one side to fit the male threads of the hose. The other end has a female ball bearing quick-release that receives the male end of the nozzle adapter.

The nozzle outlet attaches solidly to the aircraft-refueling adapter. One man can properly secure

Table 3-1.—CLA-VAL (Fuel/Defuel) Valve Troubleshooting Chart

Symptom	Probable cause	Corrective Action
1. A single automatic fuel/defuel valve assembly fails to shift to fueling mode.	1. Blown fuse (s) in coil circuit for SOPV. 2. SOPV stuck in deenergized position. 3. Break in electrical ground circuit between aircraft and fuel/defuel relay. 4. SOPV defective. ――― 1. Hytrol valve defective. 2. Flow control valve out of adjustment or defective. 3. Ejector strainer assembly plugged. 4. Pressure reducing valve out of adjustment or defective. 5. Pressure relief control valve (s) out of adjustment or defective. 6. Fuel/defuel valve defective.	1. Replace fuse (s). 1. Manually operate SOPV. 1. Inspect and tighten all ground connections in hose reel assembly, hose, quick-disconnect coupling, and pressure fueling nozzle. 2. Troubleshoot quick-disconnect coupling. 3. Troubleshoot hose reel assembly. 4. Replace hose. 1. Repair/replace SPOV. ――― 1. Repair/replace hytrol valve. 1. Adjust flow control valve. 1. Clean and inspect ejector-strainer assembly. 1. Adjust pressure reducing valve. 1. Adjust pressure relief control valve (s) and/or repair/replace parts. 1. Repair/replace fuel/defuel valve and/or fuel/defuel valve parts.
2. Automatic fuel/defuel valve assembly fails to maintain proper delivery pressure in fueling mode.	1. Pressure reducing valve out of adjustment. 2. Ejector-strainer assembly partially clogged.	1. Adjust pressure reducing valve. 1. Clean and inspect ejector-strainer assembly.
3. Rotary pump fails to maintain proper delivery pressure in fueling mode.	1. Pump pressure relief valve out of adjustment or defective. 2. Worn vanes or defective bearings in pump. 3. Fuel/defuel valve defective.	1. Adjust pump pressure relief valve. 1. Repair/replace pump and/or pump parts. 1. Repair/replace fuel/defuel valve and/or fuel/defuel valve parts.
4. Automatic fuel/defuel valve assembly fails to shift to defueling mode.	1. SOPV temporarily stuck in energized position. 2. Quick-disconnect coupling toggle switch defective. 3. Toggle switch assembly on quick-disconnect coupling defective. 4. SOPV defective. 5. Pressure relief control valve out of adjustment or defective. 6. Fuel/defuel valve defective.	1. Manually operate SOPV. 1. Troubleshoot quick-disconnect coupling. 1. Repair/replace toggle switch assembly. 1. Repair/replace SOPV. 1. Adjust pressure relief control valve. 1. Repair/replace fuel/defuel valve.
5. Pump and motor components vibrate or make excessive noise.	1. Mounting hardware loose. 2. Motor out of alignment. 3. Pump out of alignment. 4. Motor shaft or bearings defective. 5. Pump shaft, bearings, vanes, pushrods, or cylinder defective, or vanes installed backwards. 6. Reduction gear output shaft, bearings, gear, or pinion defective. 7. Flexible coupling defective.	8. Tighten all capscrews and locknuts securing motor, pump, and reduction gear to base. 9. Align motor shaft with reduction gear pinion. 10. Align pump shaft with reduction gear output shaft. 1. Repair/repalce motor and/or motor bearings. 1. Repair/replace pump and/or pump parts. 1. Repair/replace reduction gear and/or parts. 1. Repair/replace flexible coupling (s) and/or parts.
6. Pump leaks fuel.	1. Excess lubricant on seal (s). 2. Defective seal (s).	1. Clean and inspect relief fittings below seal (s). 1. Repair/replace pump seal (s).
7. Hose reel assembly leaks fuel.	1. Worn felt packing between swing joint body and swing joint sleeve, or between swing joint body and swing joint elbow.	1. Replace packing assembly.
8. Hose reel assembly drum fails to rotate properly.	1. Axle brake assembly dragging. 2. Axle shaft or axle bearings defective.	1. Ensure that axle brake assembly is fully released and free of obstruction. 1. Repair/replace hose reel assembly.

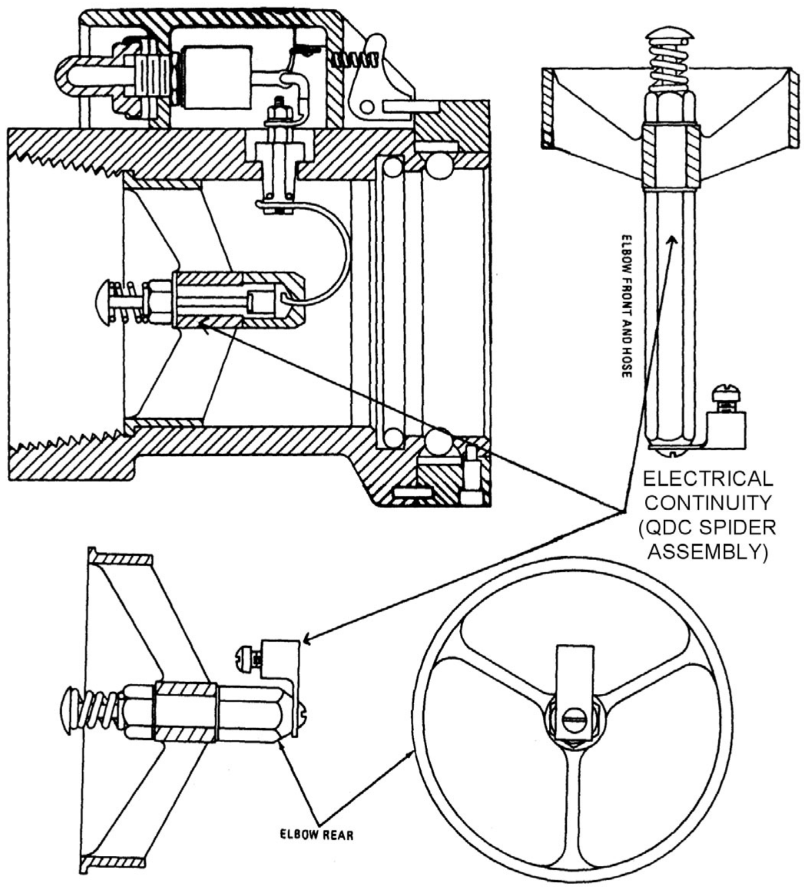


Figure 3-12.—QDC exploded layout view.

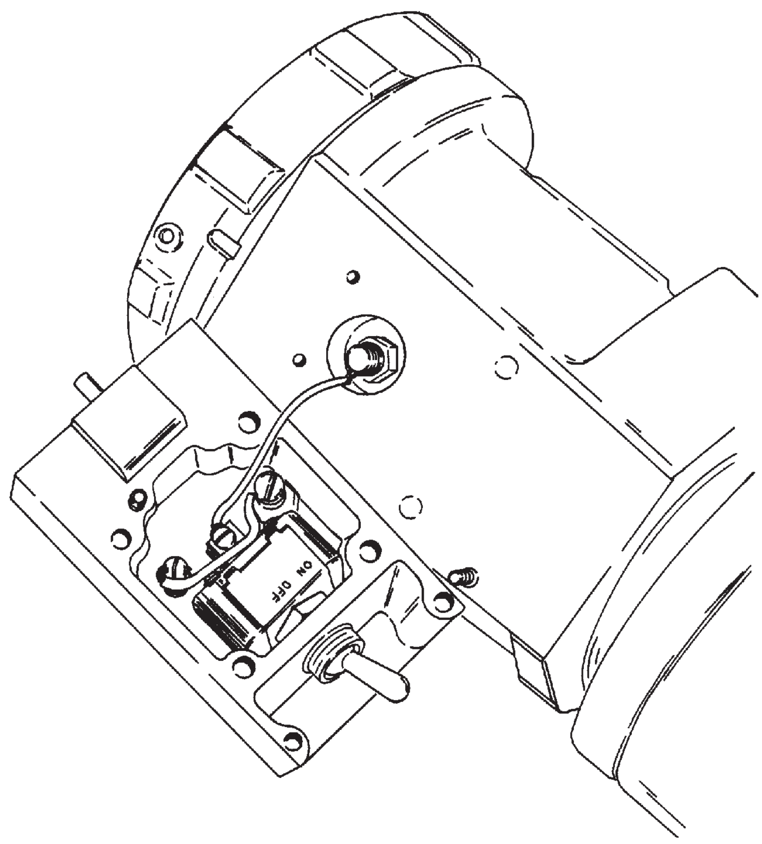


Figure 3-13.—Quick disconnect coupling with toggle switch.

the nozzle to the aircraft-refueling adapter (fig. 3-14). Fuel flow is controlled by a flow-lever (see fig. 3-16) separate from the handles used for holding or locking the nozzle to the adapter. When the pressure nozzle is attached to the fueling hose, the flow control lever is locked in the closed position and cannot be opened until the nozzle is attached to the aircraft fueling connection. Conversely, the nozzle cannot be disconnected until the flow-control lever is closed.

PRESSURE FUELING NOZZLE

Single Point Refueling (SPR) nozzles are used to pressure refuel aircraft and are equipped with a sampling connection. The sample connection is a flush type; dry break quick disconnects (for example, Gammon fittings, fig. 3-15).

Each pressure nozzle has a plugged sampling port to accept a sampling coupler and actuator assembly designed for obtaining fuel samples during fueling. The sampling assembly consists of a quick-disconnect coupler and the actuator used to draw samples. The actuator plugs into the coupler, which is threaded into the nozzle sampling port.

If a coupler fails, pieces of the coupler may get into aircraft fuel lines. To prevent this, only sampling assemblies that have proved to be satisfactory shall be used. Non-swivel type nozzles utilize GTP (Gammon Technical Products) and couplers. Swivel-type nozzles utilize GTP-NPT couplers. The actuators are GTP.

The SPR pressure-fueling nozzle is designed for high-capacity fueling operations, both to supply fuel under pressure to aircraft (also LCACs and on LHA, LPH, LPD, LHD class ships) and to remove fuel by suction via the ship's aviation fuel system. This kind of nozzle is the primary nozzle used for on-deck JP-5 fueling of aircraft.

J C Carter and Whittaker are the manufacturers of the most widely used pressure fueling nozzles in the Fleet.

The D-1 (fig. 3-16) type nozzle is the standard nozzle. Although physically similar to the D-1R (fig 3-17) nozzle, they differ internally, as the collar on the D-1R nozzle swivels independently of the body. On the D-1 nozzle, the body and collar are one unit.

The D-1 pressure-fueling nozzle consists of four major components. They are the collar assembly, the nose seal assembly, the body, and the valve operating linkage.

Collar Assembly

The collar assembly holds the dust cover and the bumper. The dust cover is used to keep dust, dirt, and moisture out of the nozzle. The bumper is to provide

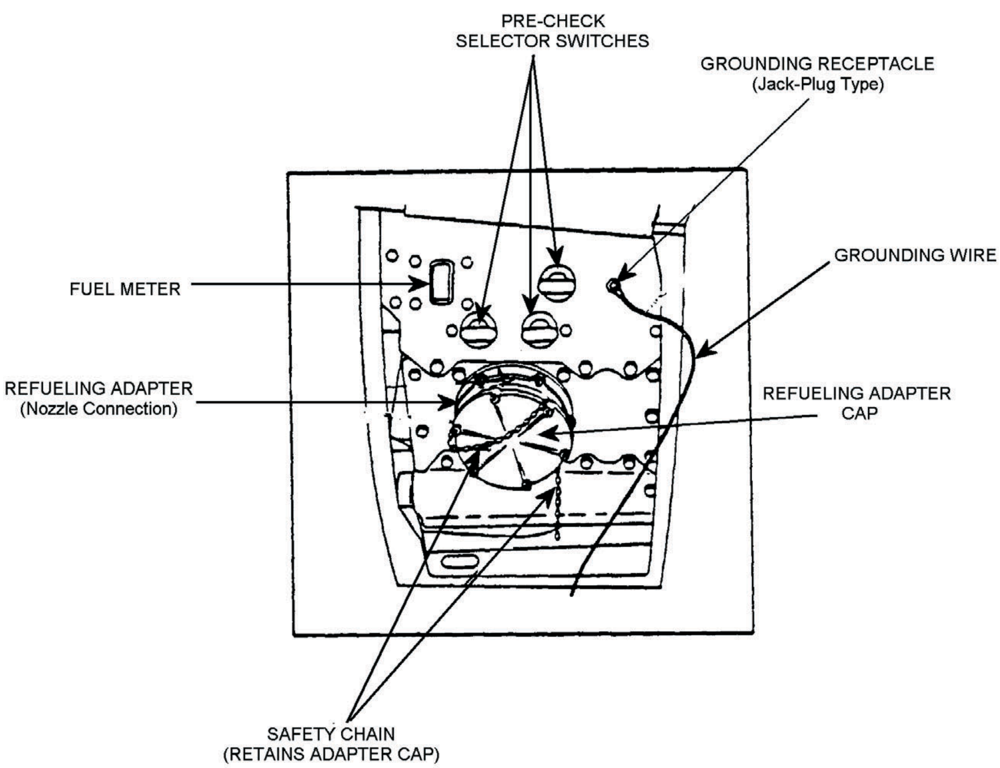


Figure 3-14.—Aircraft refueling adapter (nozzle receiver) with cap.

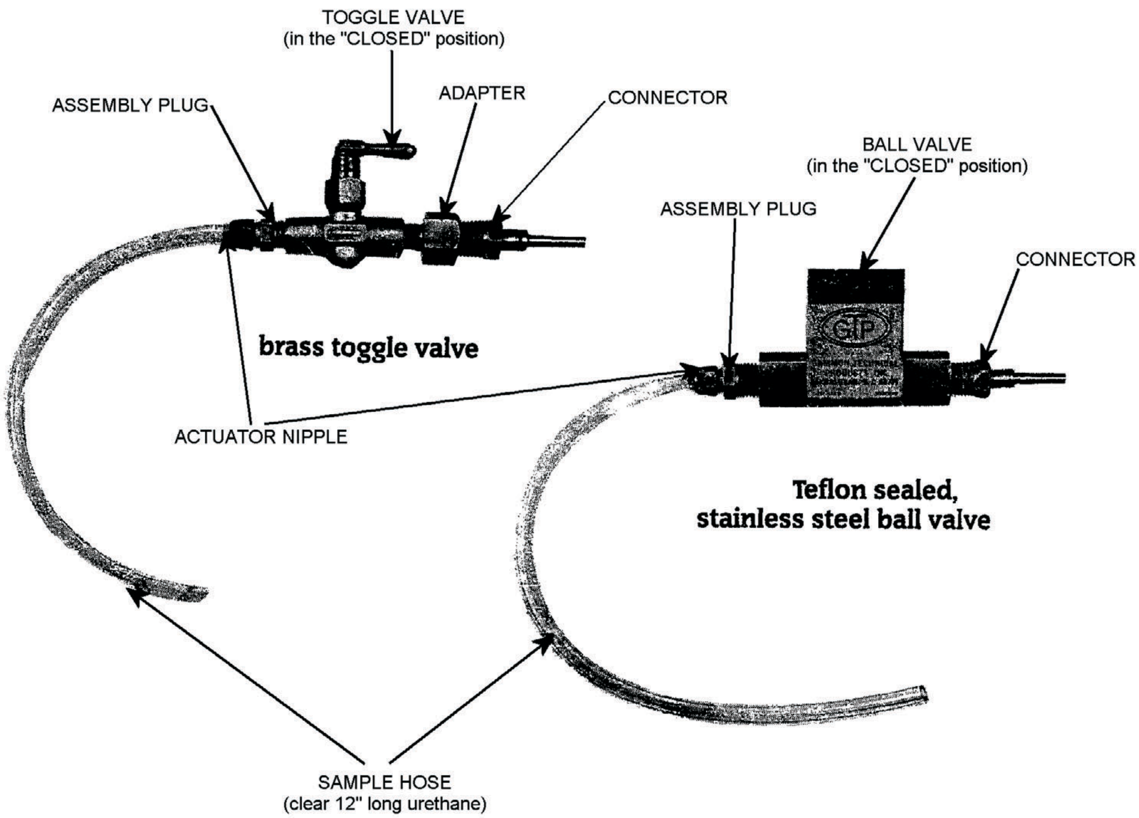


Figure 3-15.—Brass toggle valve and stainless steel valve type GAMMON sample fittings.

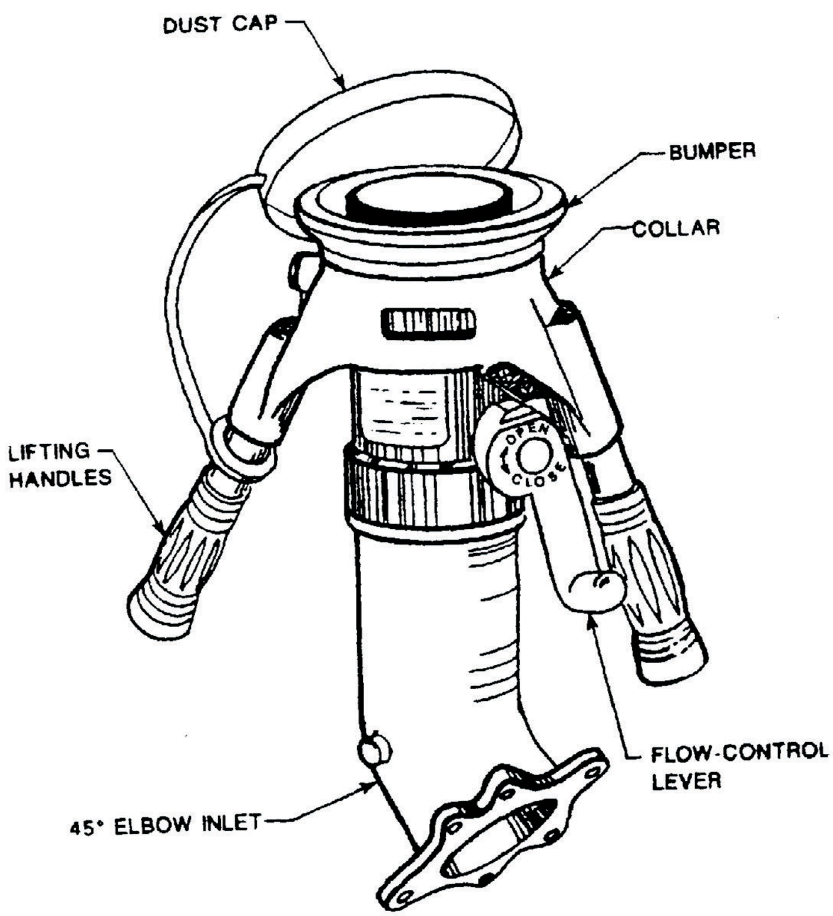


Figure 3-16.—D-1 pressure-fueling nozzle.

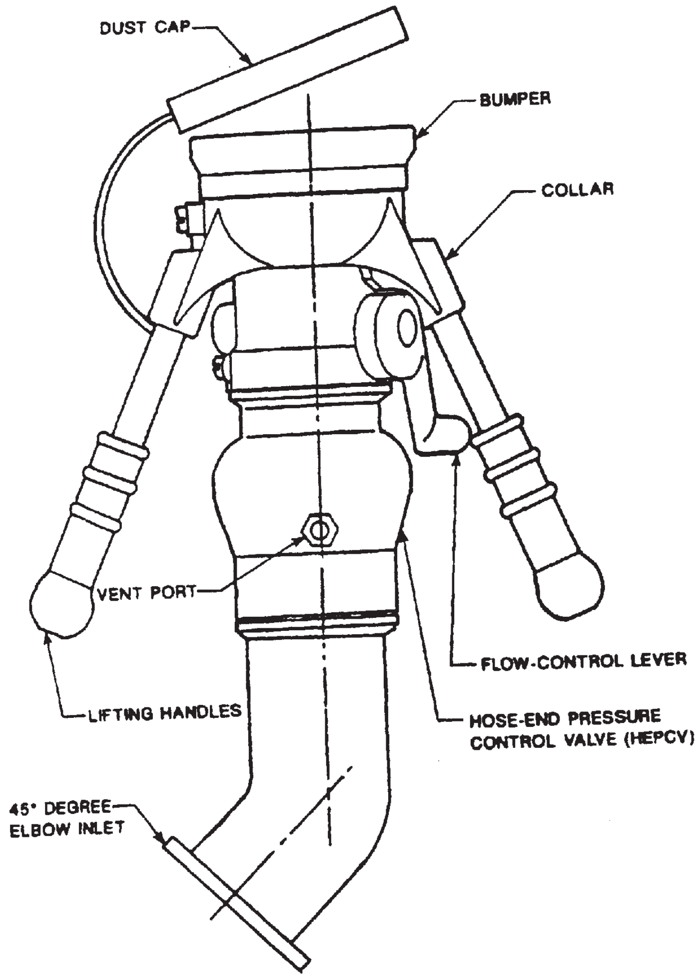


Figure 3-17.—D-1R nozzle with HEPCV (Hose End Pressure Cutout Valve).

additional protection to prevent accidental damage to the nozzle. The collar is attached to the body by 49 ball bearings.

Nose Seal Assembly

The nose seal assembly acts like a modified O-ring to seal the nozzle to the aircraft refueling connection and prevent leakage at the connection. It is made of metal and an O-ring type material. It also provides housing for the poppet.

Body

The body houses the actuating linkage, indexing pins, collar lock pin, and the collar lock pin spring. It also has an opening to connect the sample connection and another opening to connect the actuating lever. The bottom of the body is attached to the inlet elbow by 39 bearings. Leakage between the body and other attached parts of the nozzle is prevented by O-rings.

Valve Operating Linkage

The valve operating linkage connects the actuating lever to the poppet. When the actuating lever is rotated up and forward, the linkage pushes out the poppet and opens the nozzle. When the actuating lever is rotated backward and down, the linkage pulls the poppet back into the nose seal assembly and closes the nozzle.

The poppet is made of Teflon®-coated cast aluminum. A shroud on the bottom of the poppet eliminates turbulence while fueling. The nozzle poppet pushes on the aircraft fueling adapter poppet when opening, thereby opening the aircraft-fueling adapter.

®Teflon is Dupont's registered trademark for its fluorocarbon resin.

HOSE END PRESSURE CONTROL VALVE (HEPCV)

A hose end pressure control valve (HEPCV) has been introduced into the fleet to protect the aircraft when the 55 psi-delivery pressure cannot be controlled otherwise. A flanged adapter QDC (Quick-Disconnect Coupling) swivel fitting attaches the nozzle to the hose. The HEPCV attaches to or is an integral component to the D-1R nozzle. A D-1 nozzle with an HEPCV is designated as a D-1R nozzle (see fig. 3-17).

The hose end pressure control valve (HEPCV) is designed specifically to prevent excessive pressure in the aircraft fuel piping. The HEPCV (see fig. 3-17) is installed at the pressure nozzle inlet where it is close enough to the fast-closing aircraft valves, thereby able to respond quickly to keep destructive pressure surges from developing. When pressure at the HEPCV inlet approaches the HEPCV pressure setting, an internal spring/piston arrangement reacts to reduce flow area in the HEPCV, thus limiting the outlet pressure from exceeding the set pressure. As excessive inlet pressure decreases, the spring returns the piston assembly toward the full-open position, automatically returning the HEPCV to the normal unregulated condition.

GRAVITY FUELING NOZZLE

An overwing nozzle is referred to as a "gravity" or an "open" port nozzle. The MD-3 gravity nozzle and the OPW gravity nozzle are used for designated shipboard JP-5 auxiliary fueling of ship's boats, support equipment; combat vehicles, and for refueling aircraft when other nozzles are not appropriate.

The MD-3 gravity nozzle (fig. 3-18) is provided with a 1 1/2-inch by 2-inch bushing that screws into the nozzle's inlet. Either a flexible or a rigid tube fitted with an adapter is screwed into the discharge end of the nozzle. A grounding wire on the nozzle fastens to a metal part of the aircraft or vehicle with a clamp or jack.

A 60-mesh strainer installed in the nozzle provides a means of stopping any dirt or foreign matter from entering the aircraft fuel tanks. This strainer should never be left out of the nozzle if it is to be used for fueling aircraft.

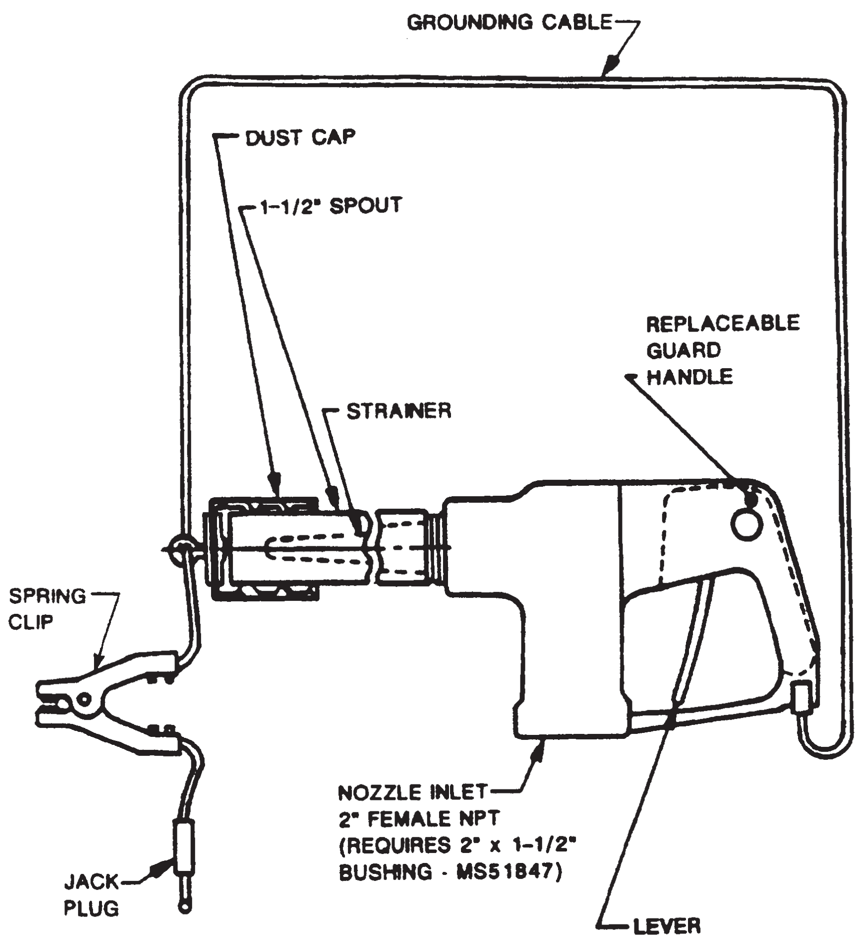


Figure 3-18.—MD-3 Gravity fueling nozzle.

The OPW gravity nozzle (fig. 3-19) is configured to receive a 3/4-inch fuel hose and end adapters. The nozzle comes equipped with a 100-mesh strainer, a ground wire clip, and a dust cover; it is lightweight and durable. The nozzle is also a surge suppression design that prevents spillage.

These nozzles are attached to fueling hoses with suitable adapters, depending on the type of hose, and how the fuel hose is configured for attachment to the nozzles.

Both gravity-fueling nozzles are manually controlled. A nozzle adapter and quick-disconnect coupling can attach them to the end of a fuel hose. The nozzle outlets are inserted directly into the fuel tank. Both nozzles acts as valves for controlling the rate of fuel flow, and it closes automatically when you release pressure on the handle.

Squeezing the control lever upward against the body of the nozzle allows the fuel to flow. A dual valve in the nozzle allows a gradual opening or closing of the nozzle. The control lever presses against the end of the valve stem and lifts the upper valve disc, which is held against its seat by the compression spring. The control lever presses against the valve stem and lifts a small valve disk that is held against its seat by a compression spring. Opening the smaller valve prevents a sudden flow of fuel and is known as "cracking" the valve.

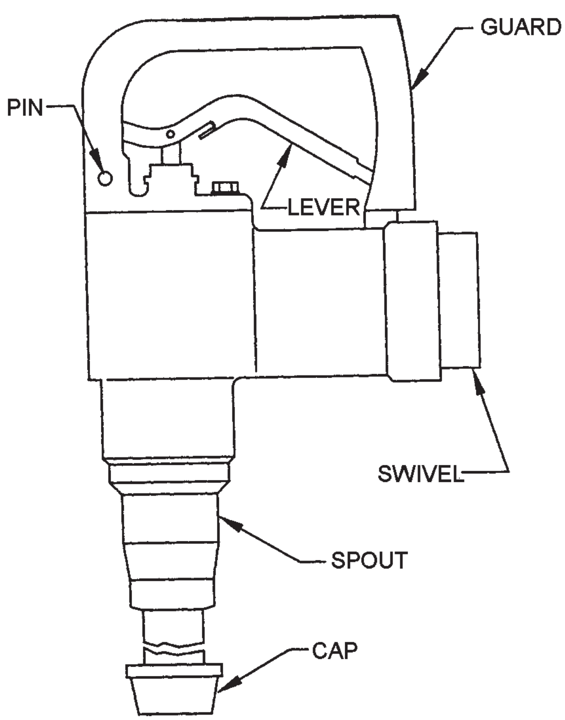


Figure 3-19.—OPW Gravity fueling nozzle.

Continued "cracking" the valve or squeezing of the handle depresses the valve stem further, and eventually the flange on the stem meets the lower valve disc assembly. When this happens, full flow of fuel is obtained. When the control lever is released, the operation is reversed, and the lower valve closes first. The smaller valve closes after the large disc seats, and the nozzle is then completely closed.

Never block the gravity-fueling nozzles in the OPEN position. Ratcheted handles that allow the operator to lock the handle in the OPEN position are prohibited. The nozzle must always be controlled manually, so that the flow of fuel may be instantly stopped when necessary.

Q3-8. How is the nozzle strainer to a D-1 (SPR) nozzle held in place in the nozzle adapter?

Q3-9. What is used to provide a means of attaching the fuel nozzle to the hose?

Q3-10. What is provided on the nozzle body to allow for obtaining fuel samples?

Q3-11. What are the two most widely used SPR (Single Point Refueling) pressure fueling nozzles in the Fleet?

Q3-12. What component of the D-1 nozzle prevents leakage at the connection when it is attached to the aircraft-refueling adapter?

Q3-13. What component of the nozzle interconnects the operating linkage and the poppet to ensure fuel nozzle opens and closes?

Q3-14. What component has been introduced into the fleet to augment pressure-fueling nozzles, designed specifically to prevent excessive pressures in the aircraft fuel piping?

Q3-15. Why is it that gravity nozzles are referred to as valves?

FLIGHT DECK SYSTEM FUELING AND DEFUELING EQUIPMENT

LEARNING OBJECTIVE: Identify the different types of equipment used on the flight deck and hangar deck fuel stations. Describe the function and operation of equipment used on the flight deck and hangar deck fuel stations.

HOSE REEL

Each hose reel assembly (fig. 3-20) stores 150 feet of 2 1/2-inch collapsible hose or 1 1/2-inch non-collapsible hose. Each hose reel assembly consists of a drum, a swing joint and an elbow assembly, a support frame, and a manual brake. The drum holds, reels, and unreels the hoses. The swing joint and elbow assembly permits rotation around the central axis of the drum, and houses a spider assembly for the continuity circuit. The support frame provides permanent mounting for each drum. The manual brake prevents the drum from rotating when not in use.

The swing joint (fig. 3-21) is made of brass, to resist corrosion. The continuity wire enters the top of the flange on the fuel inlet side of the swing joint. It is connected to an amphonel stud that is insulated with brass to prevent grounding out. Both ends of the stud have very small O-rings that are held in place by flat washers. The washers are held in place by nuts that are threaded on to the amphonel stud.

NOTE

The purpose of the O-ring is to prevent leakage of fuel around the amphonel stud. If you use a lock washer and double nut on the stud, you will lessen the chance that the nuts will back off because of vibration.

The amphonel stud is connected inside the swing joint to a spider assembly. The spiders inside the hose reel are connected from the swing joint by direct contact of spider to spider. A hard wire connects the other spiders inside the drum area.

The spider assembly in the male end of the hose reel (where the hose attaches) connects directly with the spider assembly in the female end of the fuel hose. Each end of the fuel hose has a spider assembly installed.

FUEL HOSE

Aviation fuel hoses are designed to pressure refuel aircraft quickly and safely. The following are the types and sizes the ABF will typically use afloat:

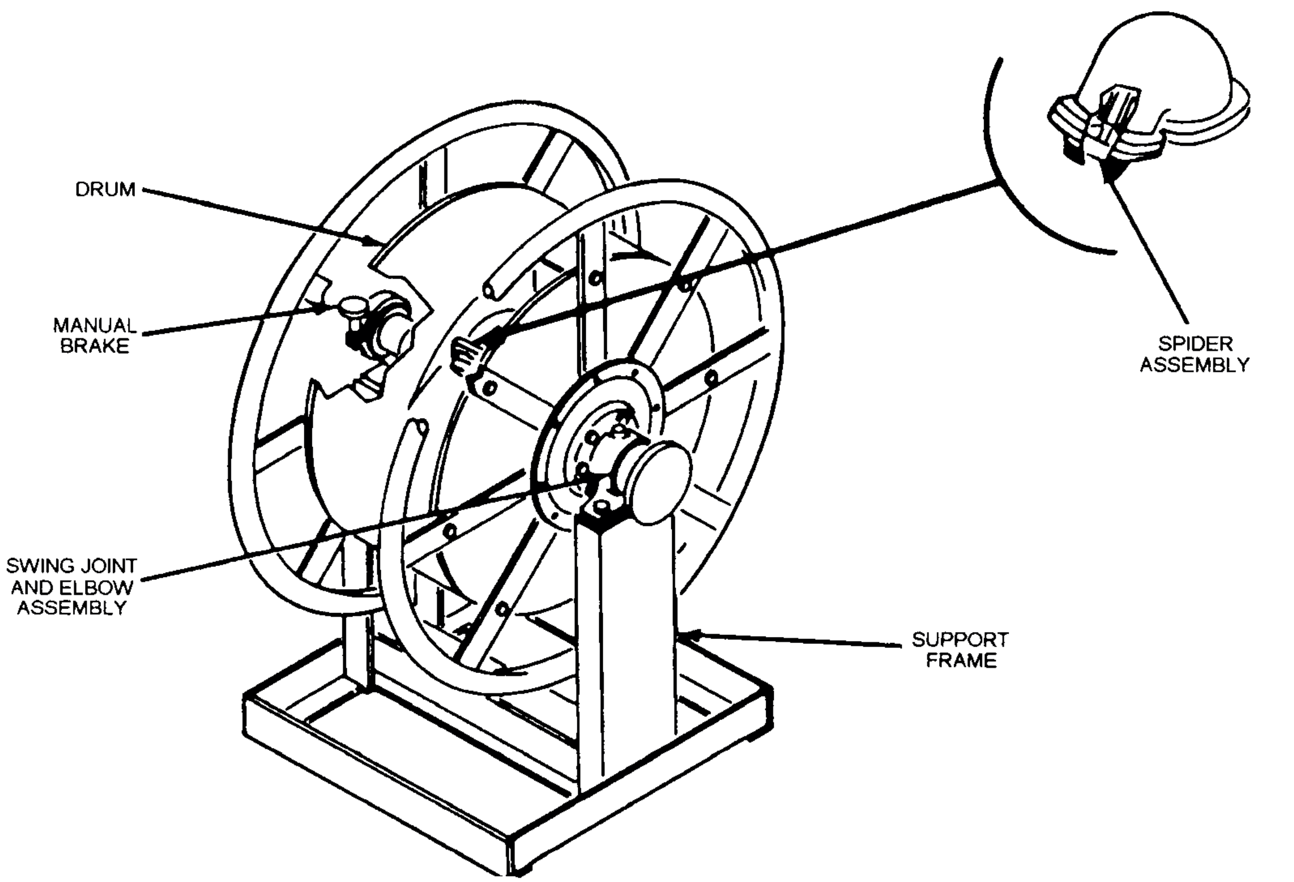


Figure 3-20.—Hose reel assembly.

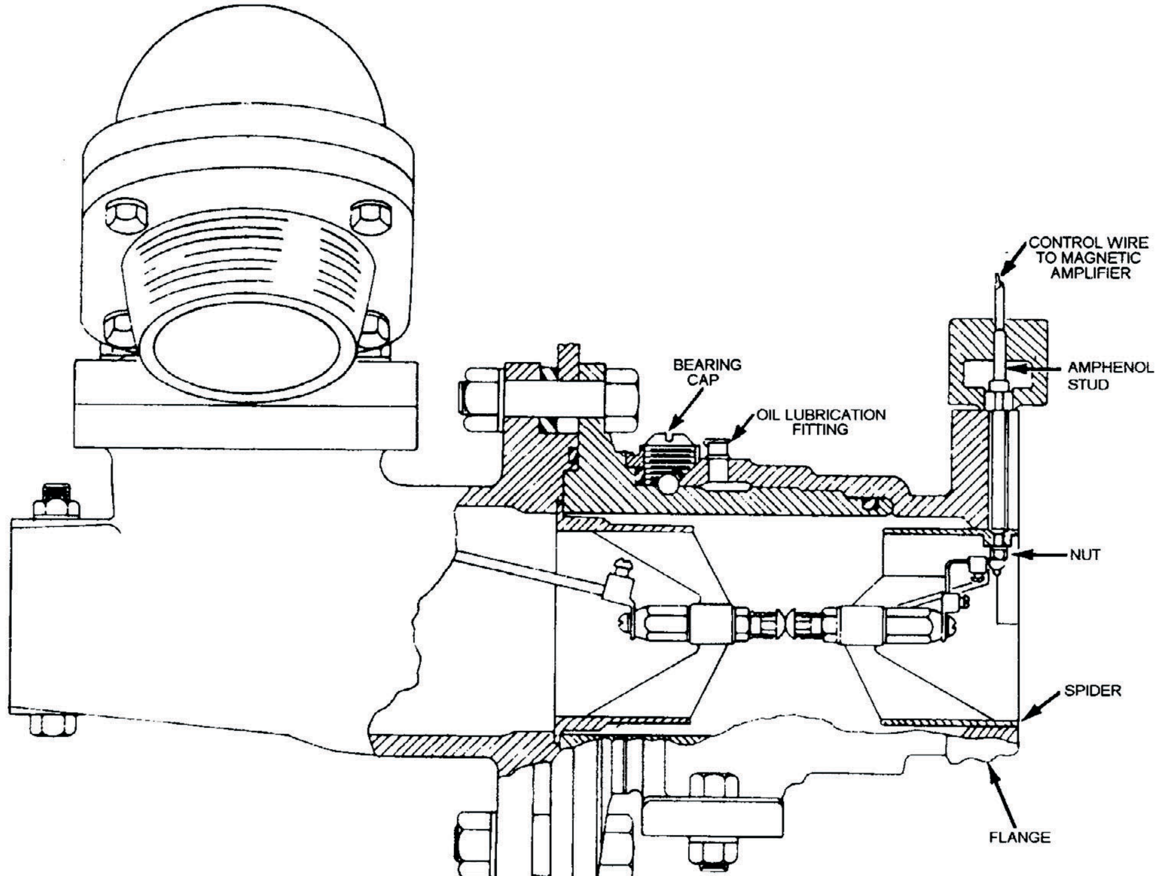


Figure 3-21.—Swing joint.

- 2 1/2-inch, 4-inch, 6-inch, and 7-inch diameter fuel hoses

  Transfer and filling hoses are used to deliver JP-5 to the ship's receiving connections from a barge or tanker. The transfer and filling hoses are fuel-resistant, oil-proof, synthetic-rubber tube, and reinforced by alternating layers of fabric and rubber.

- 2 1/2-inch collapsible fuel hose used for refueling aircraft

  This hose is used for JP-5 fueling of aircraft and, if necessary, for defueling. When emptied of fuel, the collapsed hose will flatten throughout its length. It can then be coiled flat on the aircraft fueling hose reel.

- 2 1/2-inch non-collapsible fuel hose used for defueling aircraft

  A non-collapsible hose available in 1-1/2-inch size is the preferred hose type for JP-5 defueling. This hose consists of fuel-resistant, oil-proof, synthetic-rubber inner and outer covers separated by alternating layers of impregnated cotton and synthetic rubber, and a helix coil of wire to prevent collapse.

- 1 1/2inch non-collapsible fuel hose used for defueling aircraft, boat fill, tractor fill, etc. This hose is a non-collapsible rubber hose available in 1-1/2-inch and 3/4-inch sizes for the auxiliary JP-5 system fueling stations and MOGAS applications.

NOTE

Hoses on fueling stations that are used for defueling may also be used for fueling providing they are properly flushed.

All hoses come in standard 50-foot lengths or 100-foot bulk lengths. The 50-foot lengths come as a complete assembly. The 100-foot lengths are hose only and require installation of the couplings and continuity wire.

One end has a male coupling and the other end has a swivel-type female coupling (fig. 3-22). An O-ring in the female coupling prevents leakage between couplings. Both couplings are machined to receive the nylon spiders that act as non-conducting supports for connecting the continuity wire. The continuity wire runs through the hose and is slightly longer than the hose, to allow for hose stretching.

New hoses and hoses that were out of service for a long time must be hydrostatically tested and flushed before being placed in service. Use the following procedure:

> **NOTE**
>
> New hoses, manufactured according to MIL-H-17902, must be flushed and tested prior to use.

1. Unpack hose and visually inspect for damage.
2. Hydro test hose to 150 percent of working pressure.
3. After hydro test, extend hose to its full length, and elevate to drain water.
4. Install hose, place on hose reel with other new hoses or in-use hoses, and commence flushing *IAW AFOSS*. Flush until samples meet maximum allowed contamination of 2 milligrams per liter and 5 parts per million (ppm) of water.
5. Test the fuel with the CCFD until limits have been acquired. The hose is now ready for use.

Because of their environment, fuel hoses are subjected to severe wear and tear. They should be inspected during each use for superficial cuts, worn areas or bubbles in the hose, deep cuts that expose the wire reinforcement or inner layer wrapping, and leaky couplings.

If any of the above is observed, notify the flight deck supervisor, flight deck control, and flight deck repair immediately.

You can prolong the useful life of fuel hoses by not twisting or kinking a hose, not rolling a twisted or kinked hose up on its reel, and not allowing aircraft, tractors, or other rolling stock to run over the hoses.

Avoid exposing the hose to excessive abrasion, especially when passing the hose over the edge of the flight deck. Avoid direct exposure to jet engine exhaust.

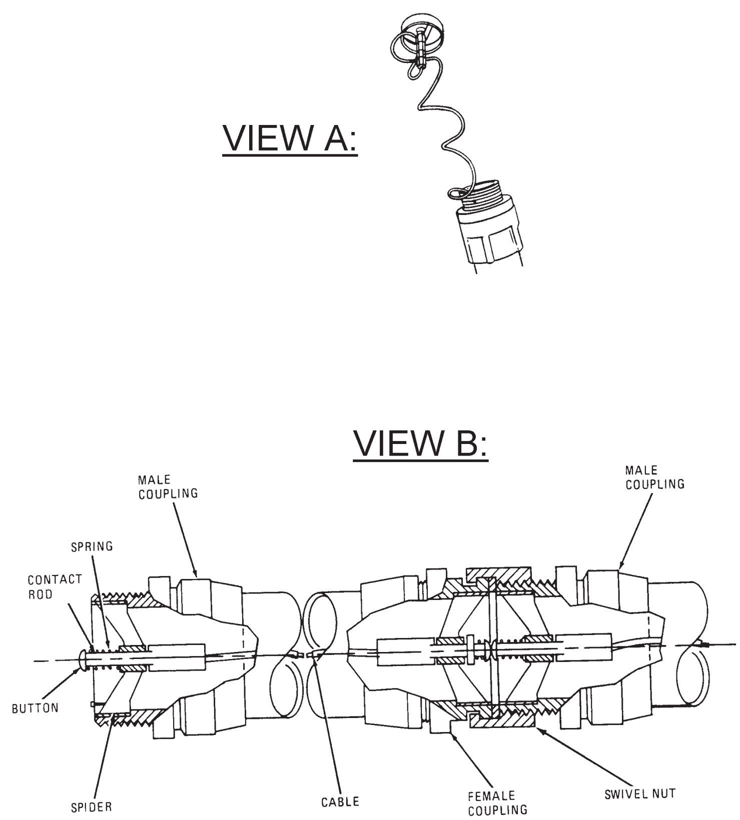


Figure 3-22.—Fuel hose coupling: A. (Continuity wire); B. (Exploded view).

Always restow hoses on designated hose reels at the completion of refueling operations. Improperly stowed hoses could cause internal or external damage.

NOTE

Hoses shall be inspected in accordance with PMS requirements to test the static wire continuity of a non-collapsible hose or the circuit of a collapsible hose. Lack of continuity in the non-collapsible hose indicates that the hose has stretched enough to break the static wire, making the hose unsuitable for use.

If a hose is damaged near an end coupling but otherwise usable, you could possibly salvaged, by cutting the damaged area off. This is known as "cutting back" a hose. To cut back a fuel hose, do the following:

1. Disconnect and remove the spiders and continuity wire from the hose.

2. Clamp spanner type coupling into jig similar to that shown in figure 3-23. (Jig not required for hex-type coupling).

3. Remove the coupling from the damaged end.

a. Unscrew the external taper sleeve from the coupling end and slide it down past the damaged area.

b. Work the wire helix (spiral) down and off the coupling end.

c. Remove the coupling end.

d. Remove the wire helix.

4. Make sure the hose is squared up, and mark the hose for cutting, using the taper sleeve as a guide. After marking, remove the taper sleeve.

5. Cut fabric-reinforced hose with a sharp knife wetted with fresh water. Cut wire-reinforced hose with a new or sharp hacksaw with fine teeth. Insert a round wood plug into the hose to eliminate the danger of

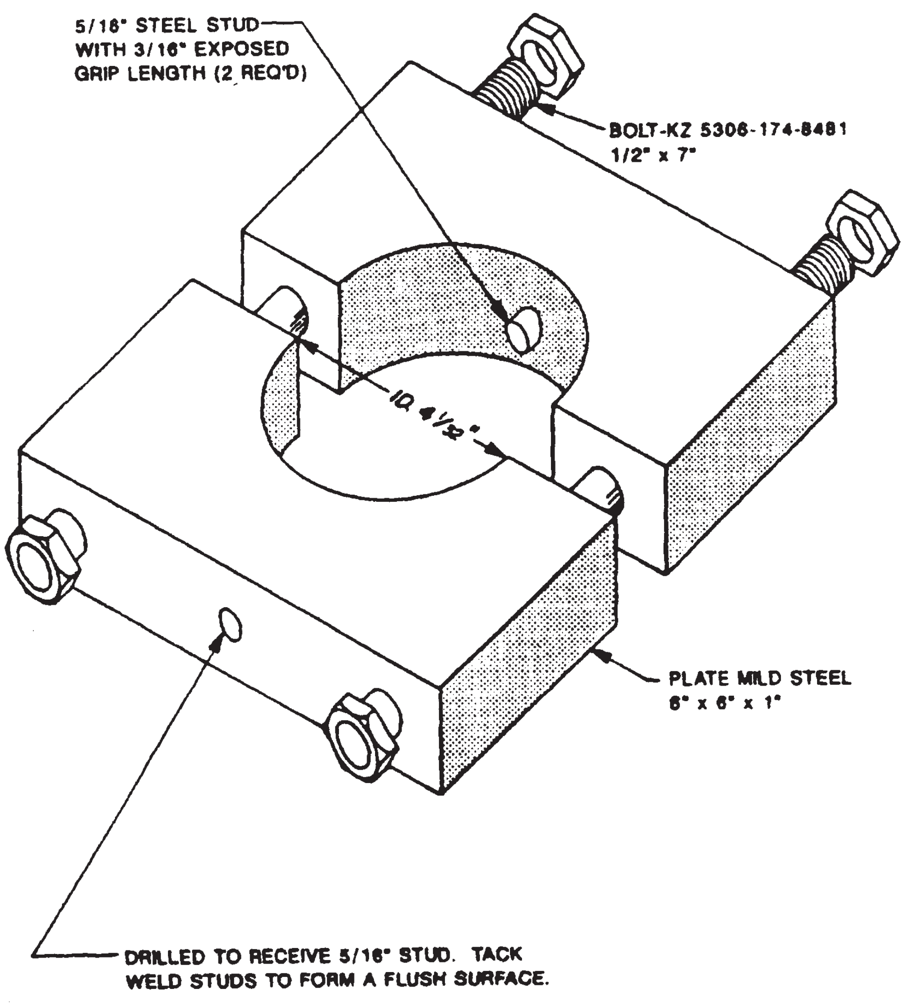


Figure 3-23.—Fuel hose repair jig.

loosening the inner liner or damaging the wire reinforcement while cutting.

6. Paint the freshly cut hose end lip with a light coat of epoxy or zinc chromate primer to provide a moisture barrier.

7. Slide the external taper sleeve back on the hose.

8. Slide the wire helix (spiral) on and position it about 6 inches down from the end of the hose.

9. Insert the coupling end into the hose, ensuring the hose is bottomed at the lip of the coupling end.

10. Work the wire helix up and into position over the inserted part of the coupling end. Be careful not to over-expand the wire helix.

11. Slide the taper sleeve into position and screw it tightly to the coupling end.

12. Hydrostatically test the hose IAW PMS.

13. Cut the continuity wire 10 to 12 inches longer than the hose, to compensate for hose stretch.

14. Reinstall the continuity wire and spiders. Check for electrical contact between the contact buttons at the hose ends, using an ohmmeter. Maximum allowable reading is 40 ohm.

15. Upon reinstallation of the hose back on a station, flush the hose until an acceptable sample is obtained.

CONTINUITY

Electrical continuity is a firm requirement for all aircraft refueling stations. Electrical continuity must be present and maintained to ensure personnel safety, equipment protection, and efficient fueling operations.

With electrical continuity present, the nozzleman fueling the aircraft has immediate control of fuel flow. This is essential to prevent fuel spills and possible accidents during aircraft refueling. Electrical continuity is present when wires are provided and switches are set to allow an electrical current to flow away from the controller and back to it through a solid metallic path.

Now, let's follow the continuity circuit (fig. 3-24). Starting with the defuel pump, it applies power to the solid-state relay, but; nothing happens because the

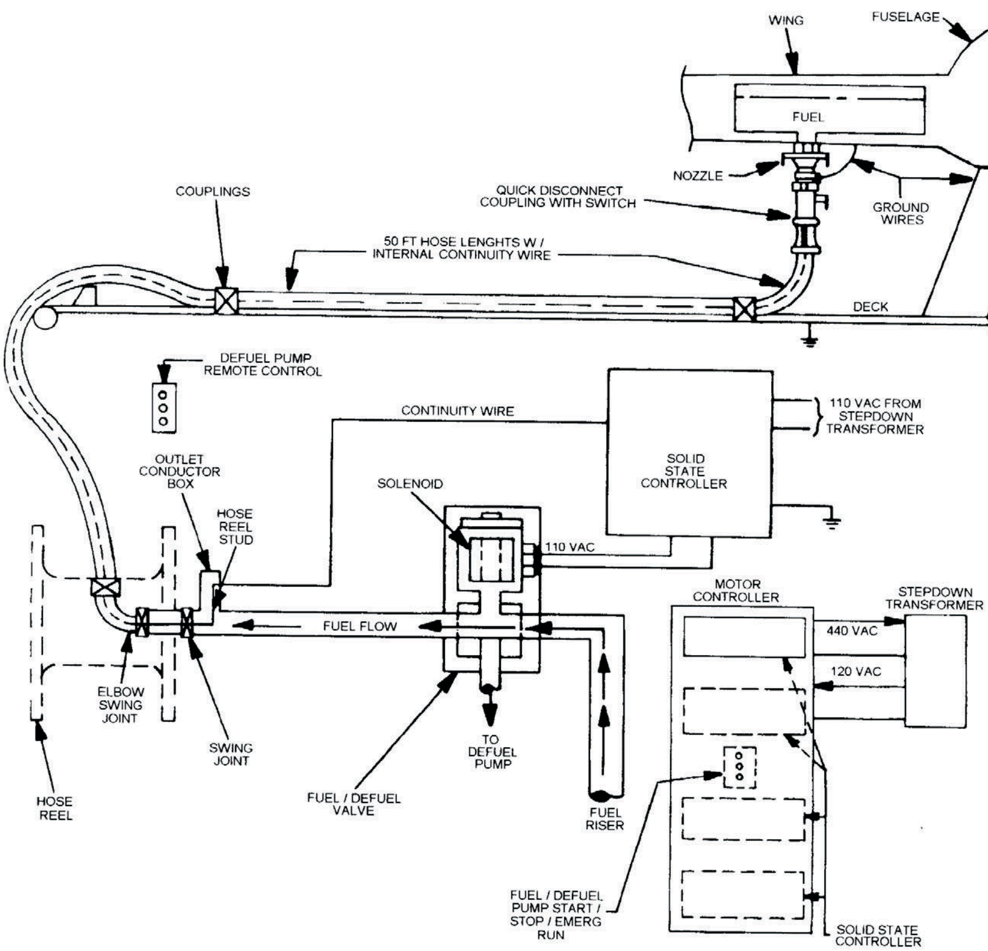


Figure 3-24.—Electrical continuity control for the CLA-VAL fueling station.

circuit is broken. Make sure your ground wire to the deck is grounded to metal and than hook it to the aircraft. Remove the dust cover and connect the nozzle. Flip the switch in the quick-disconnect housing to ON, which closes the circuit. The ground then goes back through the spiders in the quick-disconnect coupling to the wire in the hose. It goes back to the hose reel hub, to the swing joint, through the amphonel stud to the junction box, to the solid state relay (which is also grounded to the ship), from there back to the electric solenoid, which goes to the fuel position.

If the continuity circuit is broken at any place, the solenoid will immediately de-energize, and the CLA-VAL will go into the defuel mode.

NOTE

More often than not, if a hose does not charge when the fueling switch is flipped on, the cause is a bad ground. Double-check all grounding connections to ensure metal-to-metal contact is made.

CAUTION

If a hose should rupture while fueling and the continuity circuit is not broken, fuel will continue to be pumped through the hose and out the rupture. Immediate action by the nozzleman to flip the QD housing switch to OFF is required to de-energize the SOPV so the CLA-VAL will go into the defuel mode. If the nozzleman is unable to do this, the station operator should turn the defuel pump off (this will also break the continuity circuit) and close the station riser valve.

DEFUEL PUMP

The defuel pump used in CLA-VAL fueling stations is the Blackmer rotary vane, positive displacement pump. It is described in detail in chapter 2 of this manual.

Flight and hangar deck station defuel pumps (fig 3-25) are motor-driven, constant volume, vane-type pumps designed for pumping 100 gpm, 15 psi output.

A rotor with vanes offset in the bore provides the pumping action. As the rotor turns, the vanes move within slots in the rotor. The outer tips of the vanes ride against the surface of the bore. The vanes extend or retract during rotation of the rotor, forming or eliminating cavities between the vanes.

The cavities are largest when the vanes extend farthest to reach the bore. Fuel is drawn into the cavities through the inlet port as the cavities increase in size and is discharged through the outlet port as they decrease in size. The fuel is pressurized by the decreased cavity size.

Centrifugal force, internal fuel pressure, and internal pushrods provide the force necessary to keep the vanes against the bore at operating speed.

A pressure relief valve on the pump prevents buildup of excessive pressure that might damage the pump or associated equipment. If actuated by high pressure, the valve vents outlet port high pressure back to the inlet port.

PORTABLE FUEL PUMPS

The portable fuel pumps used by an ABF afloat are either air-motor-driven internal gear pumps or air twin-diaphragm pumps mounted on a mobile cart. The pumps are operated off the ship's low-pressure air system.

Pump

The Wilden M-8 (fig. 3-26 View A) diaphragm air operated, positive displacement, self-priming pump is the most widely used pump in the application of either the Defuel Cart or the Plane-to-Plane Fuel Transfer Cart. The pump is easy to operate (fig. 3-26 View B), inexpensive and the maintenance is relatively simple.

The Wilden M-8 pump consists of seven major components. They are the pressure relief valve, shaft bushing assembly, shaft, exhaust channel, sliding check assembly, piston ring, and annular grove. The pump can be used for moving any type of liquid. The pump because of its simplicity in design, operation and maintenance makes it ideal and suitable for shipboard portable applications.

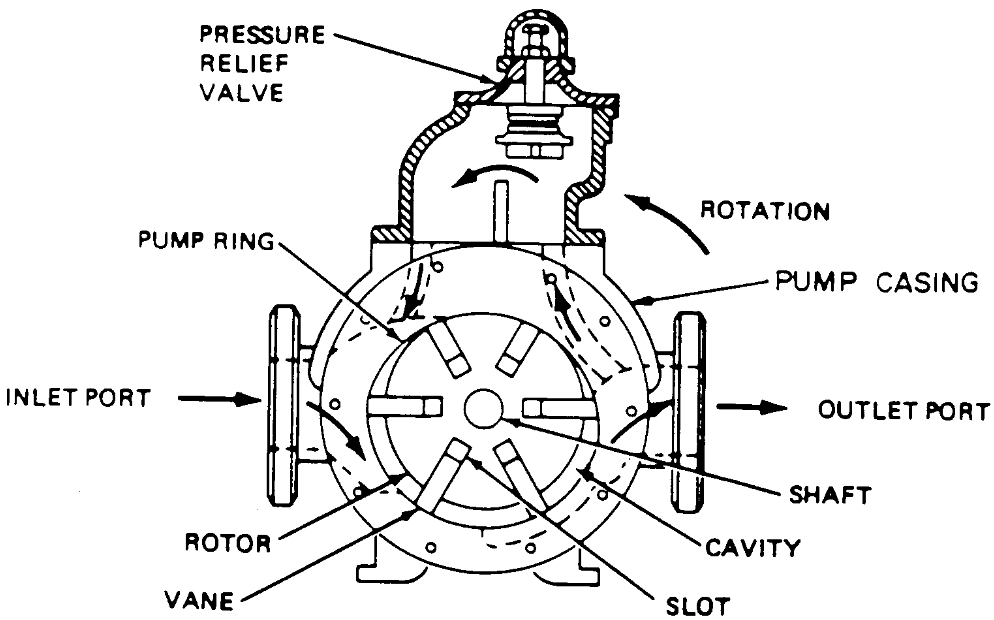


Figure 3-25.—Defuel pump view of fuel flow and component operation.

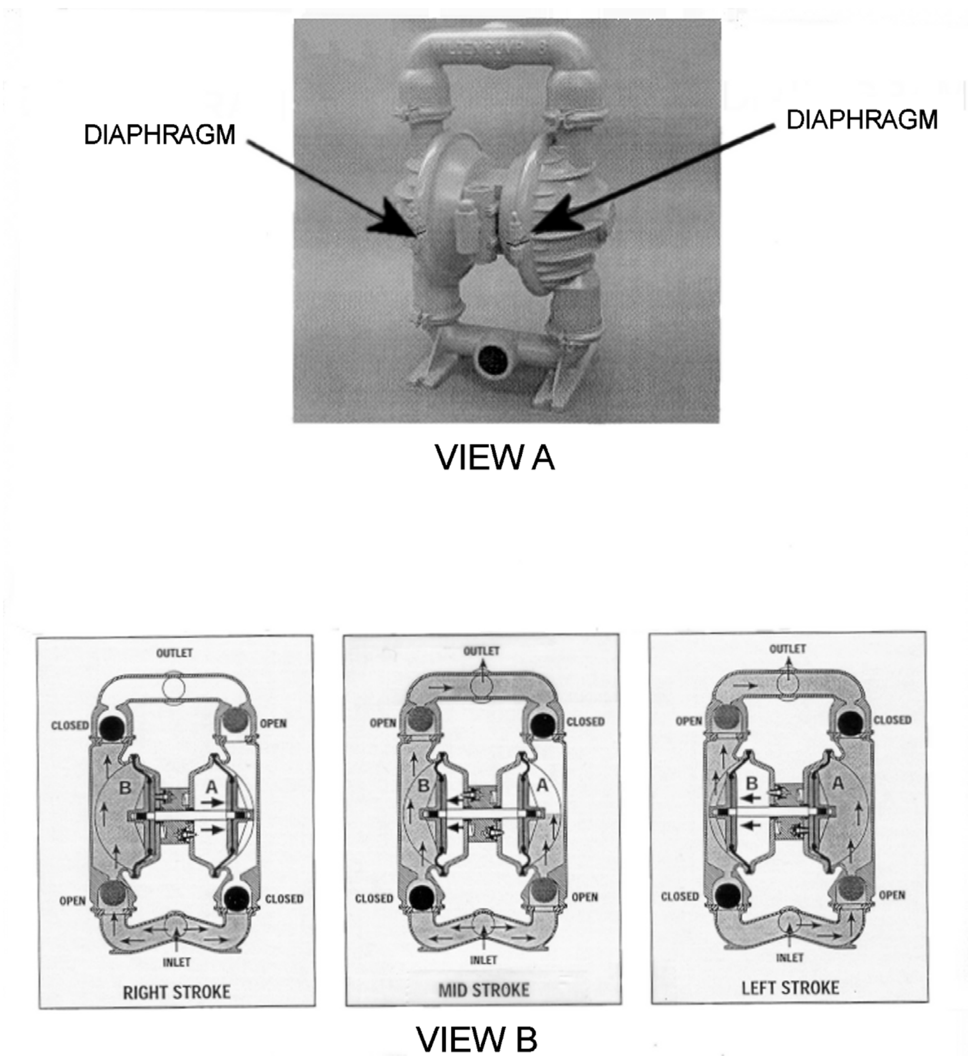


Figure 3-26.—Wilden Pump: A. (M-8 air-operated pump); B. (Fluid flow diagram).

Figure 3-27 contains the basic recommended engineering configuration for using the Wilden M-8 pump as a pumping source.

Hoses

Three kinds of hoses are used with the defueling unit: an air hose, which has 1/2- or 3/4-inch inside diameter; and two defueling hoses, which have 1 1/2 or 2 1/2-inch inside diameter. One of the defueling hose is used as a suction hose. It should be as long as necessary to reach from the aircraft to the defueling unit. The longer the hose, the less effective the defueling unit. The other defueling hose is used for the defueling unit discharge hose. The length of this hose has little effect on the defueling unit operation as long as it does not kink.

The defueling suction hose is connected to the aircraft in several different ways. For jet aircraft having single-point fueling/defueling capability, the hose is connected to the aircraft through a pressure-fueling nozzle. For aircraft drop tanks, the hose without a fitting is inserted into the tank fill opening or pushed up over a drain fitting on the bottom of the tank. Insert the defueling suction hose into the tank through the tank fill opening. For total defueling, defuel through the aircraft pressure-fueling adapter. The discharge hose from the defueling unit is connected to the fill connection through a special fitting.

The portable defuel cart is practically the same as the Plane-to-Plane Fuel Transfer Cart (fig. 3-28); the only difference is the requirement of fuel filters on the Plane-to-Plane Fuel Transfer Cart between the two hose reels.

Consult the operator manual for detailed information on the operation and maintenance of the M-8 Wilden pump.

Aircraft to Aircraft Fuel Transfer Cart

As stated previously, the Defuel Cart and Plane-to-Plane Fuel Transfer Cart are similar in design and operation. For ships that use this equipment, always confer with the Flight Deck Repair Shop on the use and maintenance of both carts. Therefore, we will only discuss the major difference between the two, that is, the requirement of fuel filters on the Plane-to-Plane Fuel Transfer Cart between the two hose reels. Fuel transfers between one aircraft and another will not be accomplished without using a suitable fuel-filtering unit.

The primary method of increasing the flashpoint of fuel above 120°F in an aircraft that has landed or aerial refueled with fuel other than JP-5 is to refuel the aircraft with JP-5. If this is impractical or undesirable, the preferred method of removing the fuel is to use the Plane-to-Plane Fuel Transfer Cart (fig. 3-28). This cart comprises two hose reel assemblies with a pressure fueling nozzle, an air-operated centrifugal pump, two Velcon Aquacon filter units, and a deadman control (whenever possible).

Aquacon Filters

Velcon Aquacon filter cartridges have a unique high capacity inner filter media, which removes all free and emulsified water from hydrocarbon fuels down to less than 5 ppm in the effluent. Absorbed water is chemically locked into this media and cannot be squeeze out.

When a cartridge reaches its water holding capacity, its accordian pleats swell shut and block the flow. This "positive shutoff" prevents any water-laden fuel from passing downstream through saturated cartridges. This causes an increase in the differential pressure, which signals the operator to change the cartridge.

The cartridge's two particulate filter media layers remove solid contaminants. The pleated accordian style design provides a large surface area for maximum dirt holding capacity. Models are offered for particulate filtration down to either 5 or 1-micrometer size with 98% plus efficiency. Performance is not affected by the presence of surface-active agents.

The cart belongs to the V-4 division. All requests for plane-to-plane fuel transfers shall be made from the squadron level to the Aircraft Handling Officer (ACHO) via the Aviation Fuels Officer.

Q3-16. What is used to insulate the swing joint amphonel stud that also prevents it from completely grounding out?

Q3-17. What component of the fuel/defuel valve places it in the defuel mode if continuity is interrupted?

Q3-18. What is the preferred type of JP-5 defueling hose afloat?

Q3-19. What has to be done to new hoses prior to placing them in service?

Q3-20. Consistent loss of continuity to a non-collapsible hose is an indication of what possible problem?

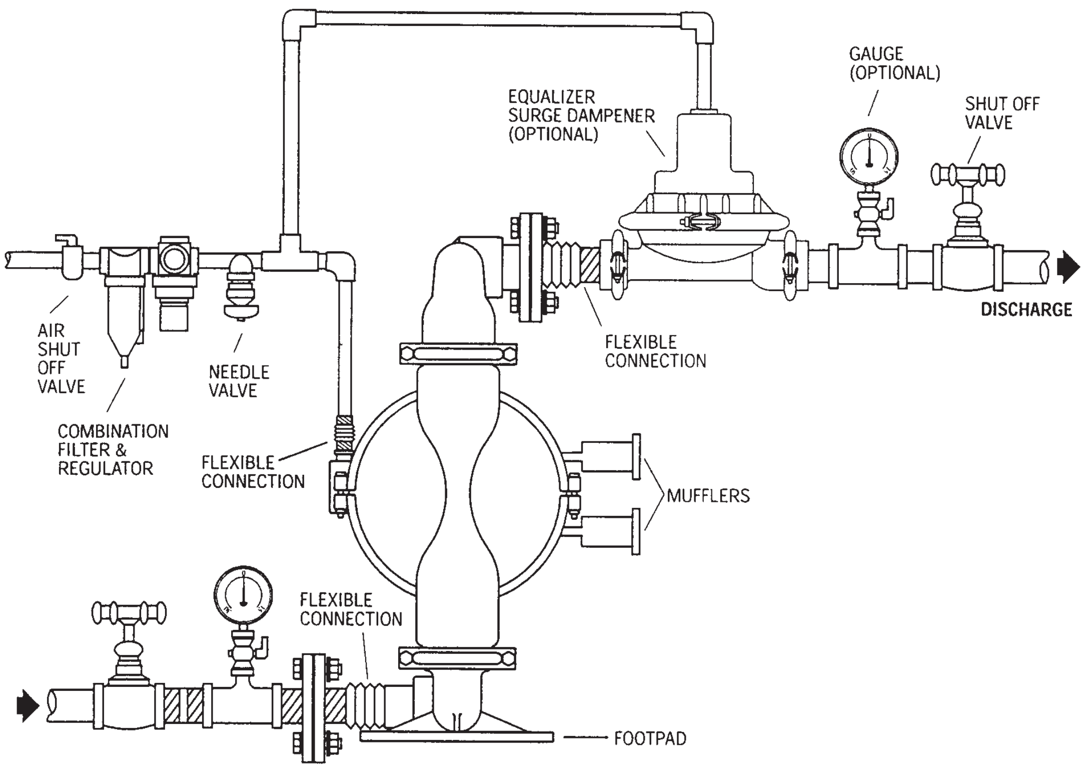


Figure 3-27.—Engineering configuration layout sample of a portable Defuel Cart.

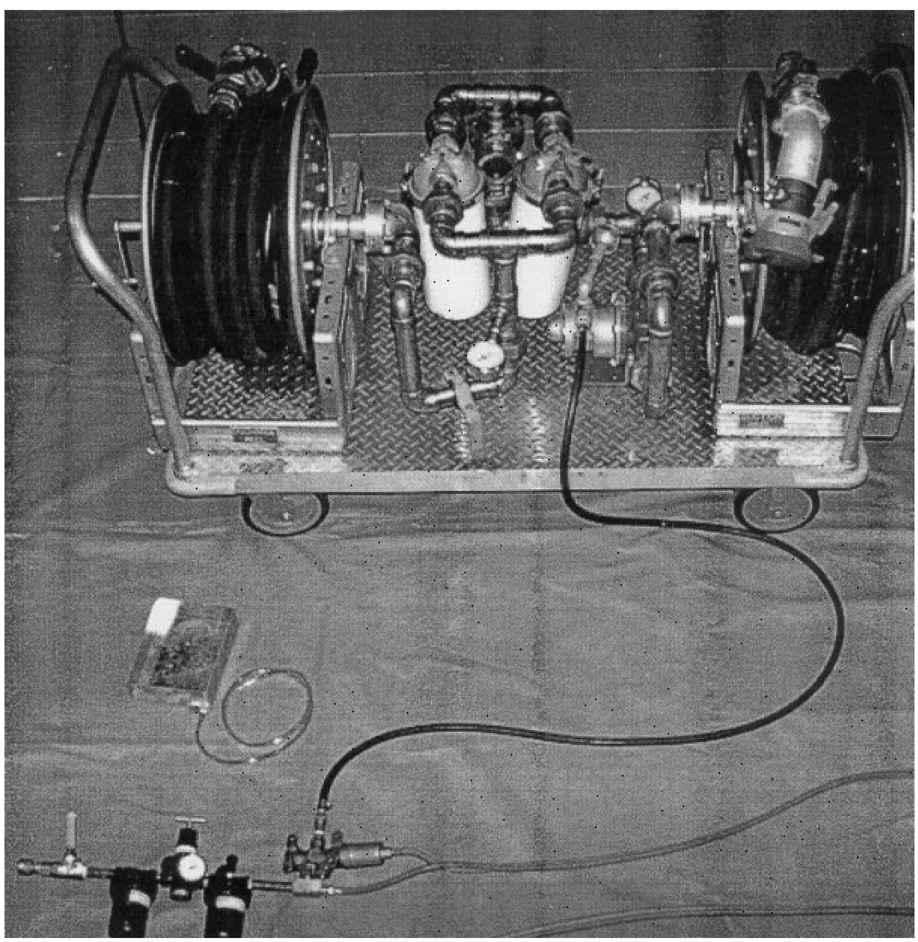


Figure 3-28.—Aircraft to Aircraft Fuel Transfer Cart.

Q3-21. When performing cut back maintenance to a fuel hose, how long should the continuity wire be to compensate for hose stretch?

Q3-22. What must be present in order for the nozzleman fueling an aircraft to have positive control of fuel flow at the refueling nozzle?

Q3-23. What is the rated capacity of the defuel pump and at what psi?

Q3-24. What kinds of portable pumps are used on most Defuel Cart and Plane-to-Plane Fuel Transfer Cart, and what type of system is used to power these pumps?

Q3-25. What type of pump is the most widely used in the application of the Defuel Cart and Plane-to-Plane Fuel Transfer Cart?

Q3-26. What must be installed on a Plane-to-Plane Fuel Transfer Cart in order for an aircraft to aircraft fuel transfer to take place?

Q3-27. The Velcon Aquacon filter cartridges have a "positive shutoff" design. Explain?

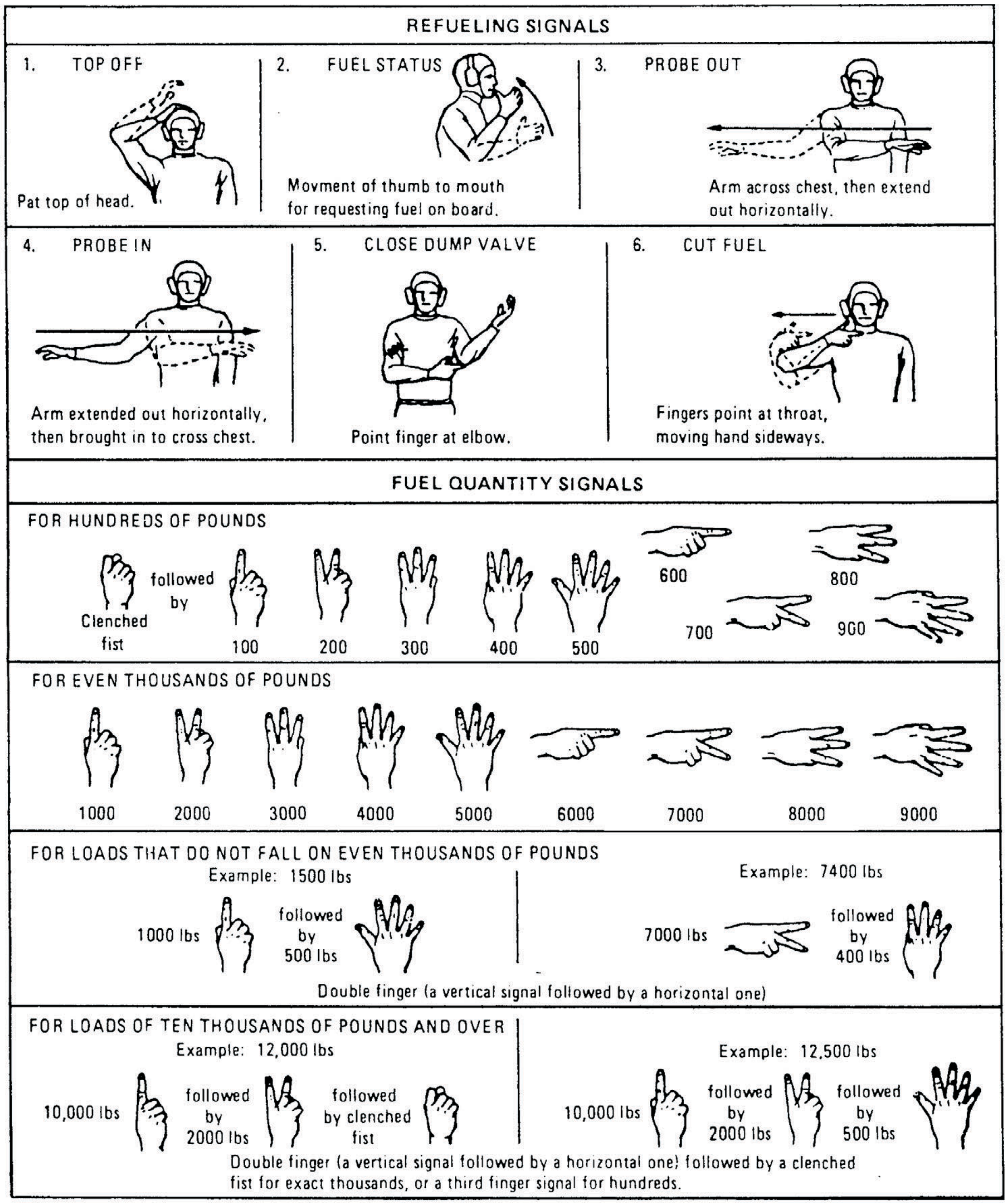


Figure 3-29.—Refueling hand signals.

Q3-28. The Velcon Aquacon filters is designed to remove how much free and emulsified water from JP-5?

SHIPBOARD AIRCRAFT REFUELING PROCEDURES

LEARNING OBJECTIVE: Identify various flight and hangar deck fueling and defueling operations. Explain proper procedures for each operation.

The actual fueling or defueling operation is the end result of several actions. Unlike below-deck operations, flight-deck operations are rarely routine.

HAND REFUELING SIGNALS

In the upcoming pages, we will discuss operations. All successful operations depend on how well you can communicate. Since the flight deck is often very noisy, you cannot talk directly with the pilot or even members of your fueling crew; you must use hand signals. A clear understanding of hand signals is required. See figure 3-29 for an easy-to-follow diagram of refueling signals. It is very important that you, the ABF, know the correct hand signals for refueling.

Study the figure carefully. As an ABF, you will constantly use hand signals. When an aircraft lands on deck, one of the first questions asked, "What is your fuel load?" The question and answer are communicated with hand signals.

AIRCRAFT REFUELING

The Aviation Fuels Flight Deck Control Talker makes fueling assignments on the flight and hangar deck. The Control Talker works closely with the Handler and CAG Maintenance Chief to ensure aircraft and support equipment is fueled quickly and safely.

The following shipboard operating procedures cover only those activities directly involved with the refueling of aircraft. They do not cover the below-deck operations that must be performed in conjunction with the aircraft refueling operation.

Figure 3-30 is a diagram of how fuel flows from the JP-5 pump room through specific below decks equipment and eventually, how fuel is received at the

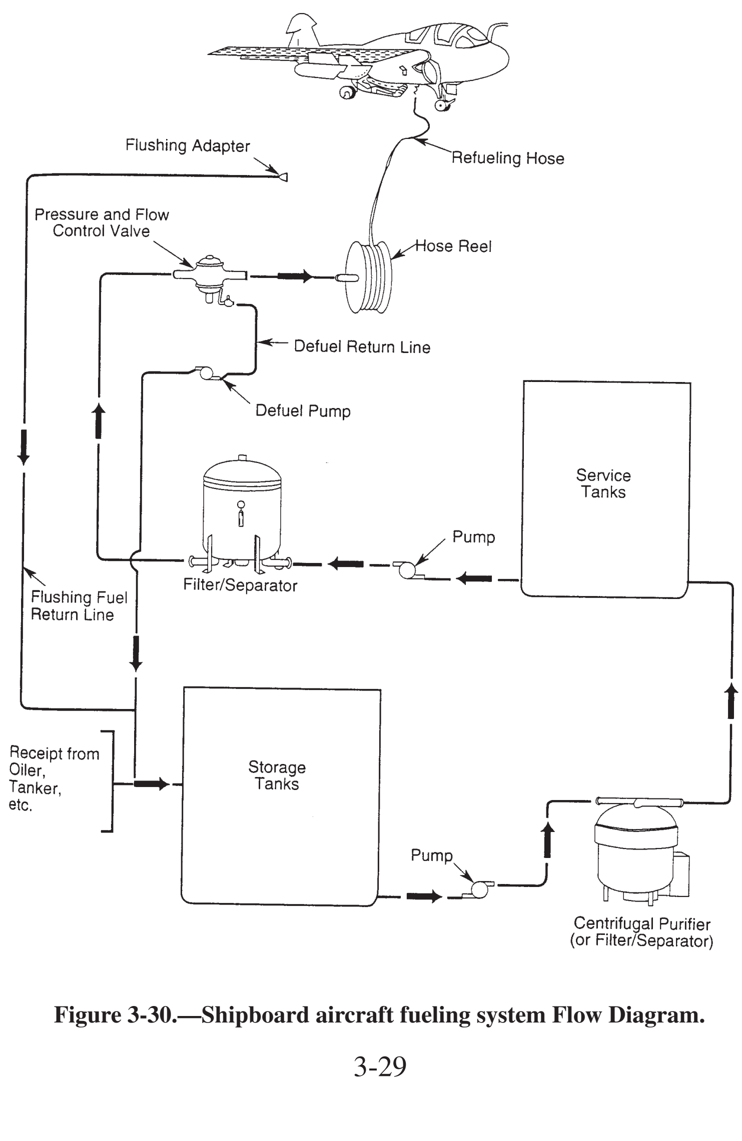


Figure 3-30.—Shipboard aircraft fueling system Flow Diagram.

flight deck or hangar deck refueling station. The procedures presented here are the typical ones used aboard ship.

Specific shipboard operating procedures, including below-deck activities as well as aircraft refueling, are contained in the Aviation Fuels Operational Sequencing System (AFOSS). As in all fueling evolutions, use the specific procedures published in your ship's AFOSS.

Skill, experience, and good judgment are the keys to running a successful flight deck.

Aircraft Pressure Refueling With Engines OFF (Cold Refueling)

A minimum of three people is needed for refueling an aircraft: refueling crewman, refueling station operator, and a plane captain. A crew-leader (safety person) is also recommended, it is possible for the safety person to supervise more than one fueling operation.

Aircraft refueling tasks are to be performed in the following sequence:

1. Secure all electronic and electrical switches on the aircraft not required for fueling. Once a fueling evolution has commenced, the aircraft's electrical power status and connections are NOT to be changed until the evolution is completed. This means the following:

   a. NO aircraft engines or auxiliary power units will be started or stopped.

   b. External power will NOT be connected, disconnected, or switched ON or OFF.

   c. Changing the aircraft's electrical power status can create significant ignition sources.

2. Verify that manned fire-fighting equipment is in the area, specifically, that Crash and Salvage personnel man the flight deck P-25 when aircraft are aboard and satisfy this requirement for fueling on the flight deck. On the hangar deck, if no roving fire-fighting equipment is manned, the fuel crew must have a portable fire extinguisher manned nearby.

3. Take a sample if needed for quality surveillance checks. The hose (not the entire station) is considered ready for use if an acceptable fuel sample was taken under normal flow conditions within the preceding 24 hours. If this has not occurred, the hose MUST be flushed through the flushing connection into the selected contamination tank, and a sample taken and tested for contamination prior to refueling the first aircraft. Fueling must NOT begin until acceptable sample results are obtained. The maximum allowable limits for sediment and water contamination are 2 milligrams per liter (2mg/l) for sediment, and 5 parts per million (ppm) for free water.

4. Check for "hot brake" condition (plane captain).

5. Ensure that the aircraft meets “initial” tie-down requirement. Aircraft tie-downs will not be removed or altered during the aircraft refueling evolution.

6. Attach the grounding wire from the deck to the aircraft. Grounding connections must be made to bare metal.

7. Position the fuel hose.

8. Remove refueling adapter cap from the aircraft, then the dust cover from the pressure nozzle. Inspect the face of the nozzle and make sure it is clean. Inspect index pin area for excessive wear. Verify that the flow control handle is in the fully closed and locked position.

9. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If there is any doubt about the integrity of the adapter, notify the squadron representative.

NOTE

Refueling will not be performed unless qualified squadron personnel are present.

CAUTION

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

10. Confirm the switch on the nozzle quick-disconnect coupling (QDC) is in the OFF position.

11. Lift the nozzle by the handles; align the lugs on the nozzle with the slots on the aircraft adapter; and connect the nozzle to the aircraft by pressing it firmly onto the adapter and rotating it clockwise to a positive stop.

NOTE

The nozzle must seat firmly on the adapter and not be cocked.

12. Upon receiving signals from the nozzle operator that hook-up is complete and from the plane captain that he is ready to begin the fueling operation, the station operator opens the defueling pump discharge valve, the CLA-VAL cutout valve, and the hose reel cutout valve. After checking the gauge for the station supply riser to ensure fuel pressure is available, the station operator starts the defuel pump. The station operator must remain in position at the station controls throughout the fueling operation.

13. Place the quick-disconnect switch in the ON (fuel) position. This energizes the solenoid-operated pilot valve (SOPV) for the CLA-VAL and places it in the fueling position.

CAUTION

The flow control handle of the pressure nozzle must be in either of two locked positions. The handle is NOT to be used as a flag to indicate fuel flow. Excessive wear to the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to "float" in the unlocked position.

14. When the hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle must rotate 180 degrees to insure that the poppet valve is fully open and locked.

15. Once fuel flow has been established, squadron personnel will exercise the aircraft's pre-check system.

NOTE

The pre-check system simulates the completion of refueling by closing all the tank shutoff valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the pre-check system.

The primary means of detecting successful pre-check is by observing the flow indicator on the aircraft. If the aircraft is not configured with the indicator, an alternate method is to observe the jerk and stiffening of the refueling hose and/or the pressure spike that occurs at the refueling station.

If an aircraft fails pre-check, it can be cold refueled only if procedures are called out in that specific aircraft's NATOPS.

16. Fuel the aircraft as directed by the flight plan. The plane captain will monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary. The plane captain is also responsible for ensuring that the aircraft is fueled to the correct fuel load.

17. When directed by the plane captain, rotate the nozzle flow control handle to the OFF and fully locked position.

18. Place the quick-disconnect switch in the OFF position. This deenergizes the solenoid-operated pilot valve (SOPV) and places the CLA-VAL in the defueling position.

19. When the hose is evacuated, disconnect the nozzle from the aircraft adapter, replace the adapter cap, and remove the ground wire from the aircraft, then the deck.

20. Move to next aircraft to be fueled. After all aircraft have been fueled, secure the refueling station.

21. Restow the hose.

Aircraft Pressure Refueling With Engines Operating (Hot Refueling)

Hot refueling procedures are the same as the cold refueling procedures listed above except for the following additions and precautions:

1. The aircraft pilot will select fuel loading, ensure that the cockpit switches are in the proper positions, and maintain UHF radio contact with Primary Flight Control (the Air Boss).

2. The aircraft pilot will secure all electronic and electrical equipment not required for refueling.

3. The aircraft pilot will place all armament switches in the SAFE position.

4. The aircraft canopy and helicopter side doors will remain closed, unless they are aircraft specifically noted IAW Aircraft Refueling NATOPS.

The following information applies specifically to the LHA, LPH, LPD, and LHD class ships which services the AV-8B (Harrier) aircraft. Extreme care must be taken when refueling this particular aircraft.

WARNING

Servicing the AV-8B's water injection system/tank is NOT authorized in the refueling area.

- Arcraft shall not be hot refueled if it fails precheck. Failure of the precheck indicates a malfunction in the aircraft's fuel system, which can result in a fuel spill and fire.

- Aircraft canopy and helicopter side doors/windows (if installed) shall remain closed during the entire refueling evolution. Aircraft refueling operations shall be secured if canopy is opened.

<u>Exceptions:</u>

- Rear cargo doors/windows and/or doors/windows on opposite side of aircraft from the refueling adapter may be open, provided the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment (s).
- The AV-8B aircraft may be hot refueled with the canopy open at the pilot's discretion when high temperatures and humidity dictate, since the aircraft's environmental control system does not operate with weight on wheels.
- The engine with the propeller or intake nearest the aircraft-fueling receptacle shall be secured. Deviations are permitted only when specific aircraft NATOPS states to leave both engines running.

5. Be extra cautious around intakes and exhausts. Assume both engines on a dual-engine aircraft are operating. Although some aircraft can and do shut down the engine on the side where the refueling adapter is located (F-14), most aircraft currently do not (F-18, EA-6B).

6. Pilot-in-command changes are not permitted during refueling operations.

7. Obtain samples from each aircraft fueling nozzles after flushing and prior to commencing aircraft operation in accordance with PMS/AFOSS directives. During flight operations, obtain samples periodically from random nozzles in use.

NOTE

Samples drawn during static (no flow) conditions are not representative of the full fuel flow and may give false high contaminant results.

Hot refueling is performed with the pressure nozzle only.

Overwing Refueling

Overwing (gravity) refueling can be performed only with the engines OFF. Fueling with an overwing nozzle requires skill and patience because of the increased chance for a spill. ALWAYS use extreme caution when fueling this way and NEVER block the overwing nozzle in the open position. Overwing refueling procedures are the same as cold refueling procedures, except for the following additions:

1. Confirm that the switch on the nozzle QDC is in the OFF position (ships equipped with nozzle QDC only).

2. Ground the overwing nozzle to the aircraft as shown in figure 3-31 and then remove the filler cap from the aircraft.

WARNING

Always ground the nozzle to the aircraft before the filler cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to ground can result in a dangerous static spark inside the fuel tank.

3. Insert overwing nozzle into aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation.

4. Upon receiving signals from the nozzle operator that the plane captain is ready to begin fueling operation, the station operator opens the appropriate valve. The station operator must remain in position at controls throughout the entire fueling operation.

5. Place QDC switch in the ON (fuel) position (applies only to ship's equipped with nozzle QDC).

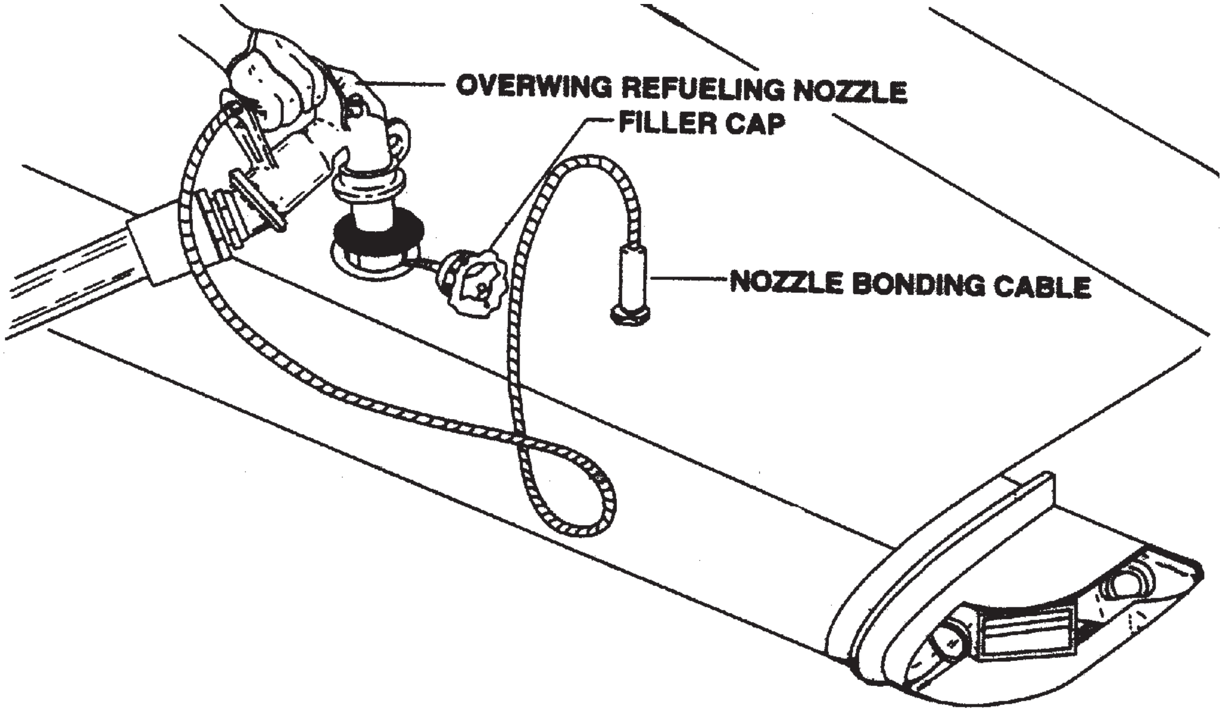


Figure 3-31.—Grounding an overwing nozzle.

Refueling Aircraft With Auxiliary Power Unit (APU) Running

The aircraft APU may be used to supply electrical power for pressure refueling on military aircraft so equipped. Refueling with the APU running is not conducted in the hangar deck. Although this operation is not considered "hot refueling," the following precautions must be observed, in addition to the normal refueling procedures:

1. One person will be at the APU controls in the cockpit.

> **NOTE**
>
> Personnel in the vicinity of the aircraft shall wear full flight deck gear.

2. Hand signals/signal wands must be established between cockpit and personnel performing refueling to ensure immediate shutdown in an emergency.

Hot Refueling for Aerial Refueling Probes

NAVAIR aircraft procurement specifications now call for all aircraft to have the capability of being hot refueled through their SPR (Single-Point Refueling) nozzle adapters; however, some aircraft procured a number of years ago did not have this capability. The A-4 is the only one of these aircraft still in active inventory. This aircraft may be hot refueled through the aerial refueling probe provided a specific local procedure for this operation has been developed and published in the local fuel instruction.

A special refueling adapter that will attach to the aircraft's aerial refueling probe is needed. Since the aircraft's aerial refueling probe is located 7 feet above ground, a maintenance platform or other movable device shall be used to position hot refueling adapter handlers.

> **NOTE**
>
> This special fueling adapter and associated repair parts shall be maintained/provided by the CAG or squadron.

All of the normal procedures and precautions listed and discussed under "Aircraft Pressure Refueling with Engines Operating (Hot Refueling), with exception to those items specifically involving the AV-8B aircraft, are applicable to the A-4 probe refueling. In addition, the following special procedures and precautions shall be observed.

> **WARNING**
>
> This procedure is considered extremely dangerous and should be performed only when operational necessity dictates. Fuel leaks or spills can be readily ingested into the engine resulting in a fire.

1. The aircraft's aerial refueling probe is located directly in front of the engine intake. Any spills or leaks from either equipment failure or misconnection could easily be ingested by the engine resulting in a fire.

> **WARNING**
>
> Fuel operations will be secured immediately if fuel leak occurs since fuel can be readily ingested into the engine with catastrophic results.

2. The maintenance platform (or other device used to position hot refueling adapter handlers near the aircraft's refueling probe) shall be locked in place to prevent movement during adapter/probe engagement and disengagement as well as throughout the entire refueling process.

> **WARNING**
>
> Tow tractors shall not be used as a maintenance platform during any refueling operation.

3. Connection between the aircraft's aerial refueling probe and the hot refueling adapter is extremely difficult if the adapter is pressurized.

When a pressure fueling nozzle is attached to the end of the refueling hose and it, in turn, is attached to the hot refueling adapter, the flow control handle on the pressure fueling nozzle shall be locked closed while the hot refueling adapter is being attached to the aircraft's probe. It shall be opened only after a good connection has been made.

The following sequential steps shall be observed at the conclusion of the refueling cycle in order to be certain that the hot refueling adapter has been depressurized.

1. Close the pressure fueling nozzle's flow control handle.

2. Evacuate the hose.

3. Remove the adapter from the aircraft's probe.

4. Remove the pressure-fueling nozzle from the adapter.

Even under ideal conditions, connection of the adapter to the aerial refueling probe can be difficult. It is therefore recommended that two people be assigned to this task.

Any new refueling personnel assigned to this task shall first practice making the connection on either a cold (not operating) aircraft or a special aerial refueling probe that has been set up just for this purpose.

AIRCRAFT DEFUELING

Defueling is one of the most technically demanding and potentially dangerous operations performed by fuels personnel. Most aircraft defueling equipment can defuel an aircraft faster than the aircraft can release it. The pump's discharge is throttled down to balance its inlet (fuel from the aircraft) to prevent pump cavitation and/or the loss of suction, which would necessitate reflooding of the pump. Once the proper balance is achieved, it is maintained by manipulation of the valve on the downstream side of the pump throughout the defueling operation.

On CV/CVN and amphibious assault aviation ships defuelings normally have lower priority than refuelings. Unless otherwise directed and if they are not of an emergency nature, defuelings will be by written request approved by the Aircraft Handling Officer (ACHO). A defuel request for an aircraft leaking fuel is considered an emergency and handled promptly.

The following rules apply to every defueling operation:

- An authorized representative of the squadron's CO shall request aircraft defueling by completing and submitting an Aircraft Defueling Certificate (fig. 3-32) to the ACHO.
- During defueling operations, no other maintenance directly required to aid the defueling operation is to be performed.
- All fuel removed from turbine engine aircraft is assumed to be low-flashpoint fuel. Defueled turbine fuel will NOT be returned to the ship's JP-5 system without first confirming the flash point of the fuel to be 140°F or higher.
- Prior to any defuel, fuel will be tested for particulates, free water, and flash point. Ultimate

AIRCRAFT DEFUEL REQUEST

Date: ______________________________	Time: ______________________________

1. Squadron: ____________________ A/C Side Number: ________________________
   Tanks to be defueled: ____
   Present fuel weight in tanks to be defueled: ________________________________
   Discrepancy: ____
   Submitted by: ____

2. (A) Approved by: ____
   CVW-2 Maintenance Chief

   (B) Approved by: ____
   Aircraft Handling Officer

3. Fuel samples are required from ALL aircraft tanks to be defueled. Squadron REP, and AIR DEPT, and AV/FUELS REP are responsible.

   SAMPLE RESULTS
   (A) FUEL TYPES: ____________________________
   (B) FUEL QUALITY: __________________________
   (C) DATE/TIME TAKEN: _______________________
   (D) REMARKS: ______________________________

   APPROVED BY: _____________________________
   V-4 DIVISION QA REP

4. **DEFUEL TO BE PERFORMED BY AV/FUELS REPAIR TEAM ONLY**.
   Date/Time defuel commenced: __________________ Completed: __________________
   Amount defueled: ____
   Remarks: ____
   ____
   ____
   ____
   ____
   ____
   ____

REPAIRMAN-IN-CHARGE: ____

Figure 3-32.—Aircraft Defueling Certificate.

disposition will depend on the results of subsequent laboratory tests.

WARNING

Fuel with a flash point below 140°F SHALL NOT be defueled into the ship's JP-5 system. These systems are not designed to handle fuel with a lower flash point. The risk of explosion and/or fire will significantly increase if fuel with a low flash point is placed in these systems.

NOTE

Fuel containing leak detection dye cannot be returned to a ship's system.

- If during the defuel operation the pump starts to lose prime or cavitate, the operation will be discontinued until the problem is resolved.
- A special log of each defueling operation will be maintained. The following minimum information is contained in the log:
  - — All abnormal happenings.
  - — Aircraft Buno number.
  - — Station/portable defuel.
  - — Visual/flashpoint.
  - — Scheduled amount to be removed and amount that was actually removed.
  - — Disposition of product.
  - — Time/date when defuel operation was started and completed.
  - — Name of defuel operator and squadron personnel present during the defuel operation.
- Defueling crews must wear proper safety clothing and goggles.
- Plane captains will be at their aircraft, and aircraft engines stopped. All electronic and electrical switches not required for defueling must be secured.
- A fire-fighting unit must be stationed upwind of the aircraft to be defueled.

Defueling With SPR (Single Point Refueling) Pressure Nozzle

Perform the defuel operation as follows:

1. Verify that the aircraft has been grounded. If not, connect the ground wire to the deck and then to the aircraft.

NOTE

Ground connections must be made to bare metal.

2. Unreel the hard hose and lead to the aircraft to be defueled.
3. Ensure the quick disconnect continuity switch is in the OFF (defuel) position.
4. Remove the pressure nozzle receptacle cap from the aircraft.
5. Remove the dust cover from the pressure nozzle.
6. Lift the nozzle by the lifting handles; align the lugs on the nozzle with the slots on the aircraft adapter; and hook up the nozzle to the aircraft by pressing it firmly onto the adapter and rotating it clockwise to a positive stop.

WARNING

The nozzle must seat firmly on the adapter and not be cocked.

7. Open the station defuel valve.
8. Rotate the nozzle flow control handle to the full open position. (The handle must rotate 180 degrees to ensure the poppet valve is fully open and locked by toggle action.)
9. Start the defuel pump.
10. Defuel the aircraft as directed.
11. When defueling is complete, shut the nozzle valve by rotating the nozzle flow control handle 180 degrees to shut and locked position.
12. Stop the defuel pump and shut the defuel valve.
13. Disconnect the nozzle from the aircraft.
14. Replace the nozzle receptacle (adapter) cap on aircraft.

15. Replace the dust cover on the pressure nozzle.

16. Remove the ground wire from the aircraft, then the metal deck.

17. Restow the hose.

Defueling With An Overwing Nozzle

Defueling procedures using the overwing nozzle are the same as the defueling procedures for the pressure nozzle, with the following additions:

> **NOTE**
>
> If an overwing nozzle is to be used to defuel a drop tank or other similar vessel, the nozzle must first be outfitted with a short length of hose. The bottom of this hose must have notches so suction is not impeded.

1. Unreel the hard hose and lead to aircraft to be defueled.

2. Ensure the QDC (nozzles so equipped) is in the OFF (defuel) position.

3. Ground the overwing nozzle to the aircraft (see fig. 3-31) and then remove the filler cap from the aircraft.

> **WARNING**
>
> Always ground the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until the entire defueling operation is complete. Failure to ground nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

4. Remove cap from the drop tank and/or other similar vessel.

5. Open station defuel valve.

6. Start defuel pump.

7. Defuel drop tank and/or other similar vessel as directed.

8. Stop defuel pump and shut defuel valve.

9. Disconnect nozzle from drop tank and/or other similar vessel.

10. Replace cap on drop tank and/or other similar vessel.

11. Disconnect nozzle ground wire.

Handling of Aircraft Containing Fuel Other Than JP-5

Aircraft that have been either land-based or aerial refueled by USAF, USA, commercial airport, or other equipment/facilities must be assumed to contain fuel other than JP-5 in their tanks. The following precautions apply:

1. Aircraft recovered aboard the ship with mixed fuels shall notify the first available ship's controlling authority (strike, marshal, Pri-Fly) prior to recovery.

2. On deck, the aircraft will be marked with a large *X across* the port and starboard side of the nose. The *X* will be of ordnance-type tape and will remain on the aircraft until it has been certified that the flash point is 140°F or above. Aircraft will be refueled with JP-5 as soon as possible.

3. Every effort should be made not to park aircraft with low-flashpoint fuels on hot catapult tracks. Catapult slot seals will be installed before any refueling evolutions commence (CV/CVN only).

4. Prior to any defuel operation; the aviation fuels officer will ensure the fuel being removed is of satisfactory flash point for shipboard storage.

> **CAUTION**
>
> Fuel with a flash point below 140°F must NOT be defueled into the ship's system. Shipboard aviation fuel systems are not designed to handle fuel with a lower flash point. The risk of explosion and/or fire will significantly increase if fuel with a low flash point is placed in these systems.

Hangaring of Aircraft Containing Fuel Other Than JP-5

If, for any reason, an aircraft containing fuel with a suspected low flash point that must be lowered to the hangar deck, fuel samples must be taken from all low point drains of the aircraft and their flash point measured. If the flash point of any sample is found to be below 140° F; but, all samples test above 120°F, the aircraft can be lowered to the hangar deck with the following special precautions:

1. All hangar bay sprinkler groups located in the hangar bay in which the aircraft are parked will be operable.

2. A manned MFVU/TAU will be positioned at a location that will provide coverage of the affected aircraft.

3. The CONFLAG station located in the hangar bay with the affected aircraft will be manned.

4. Hot work will not be conducted in the hangar bay or close to the hangar bay containing the affected aircraft.

Using A Plane-To-Plane Fuel Transfer Cart To Transfer Low Flashpoint Fuels Between Aircraft

1. Submit approved fuel transfer request to the aircraft handling officer (ACHO) and Aviation Fuels Officer, using the certificate in figure 3-33 (Plane-to-Plane Mixed Fuel Transferring Certificate).

WARNING

Hot refueling of aircraft using the Plane-to-Plane Fuel Transfer Cart is not authorized.

Engines of aircraft involved in fuel transfer shall not be started while hoses are connected to aircraft.

NOTE

Ensure issuing and receiving aircraft are positioned close to each other.

Ensure aircraft are securely chocked and tied down.

Ensure all aircraft electrical and electronic switches not required for the transfer operation are turned off.

Ensure aircraft low point drains have been drained of water and solids prior to commencing transfer operations.

2. Conduct fuel flashpoint test on issuing aircraft, and record results.

3. Verify that all maintenance requirements for transfer cart and components are current. Inspect low-pressure air manifold lubricator for proper oil level.

4. Securely connect low-pressure air hoses and fittings between air supply outlet and transfer cart inlet manifold.

5. Position transfer cart between aircraft.

6. Secure and ground cart to deck.

7. Ensure the P-25 mobile fire-fighting unit is present.

8. Inspect and verify area is free of open flames or spark-producing devices.

9. Ensure transfer detail and plane captains are present.

10. Inspect nozzles and quick-disconnect couplings for secure fit prior to attaching to aircraft.

11. Unreel and inspect entire length of suction and discharge hoses. Verify hose integrity.

12. Visually inspect aircraft adapters for any damage or significant wear. Attach nozzles and grounding wires to each aircraft.

WARNING

Ensure the nozzle is seated firmly on the aircraft adapter and is not cocked.

13. Inspect nozzle and aircraft receptacles for leakage.

14. Open-air supply outlet valve.

15. Open transfer cart air manifold valve.

16. Verify air pressure is sufficient. (Adjust air pressure via regulator to 80 psi; not to exceed 100 psi.

17. When both nozzle operator and plane captain are ready, open nozzle flow control handles to the FULL OPEN position. Handles shall rotate 180 degrees to ensure that the poppet valve is fully open and locked.

18. Deadman operator activates deadman to commence transfer operation.

19. When directed by the plane captain, (deadman operator will release the deadman, if applicable) stop the transfer operation.

20. When the transfer operation is completed, rotate the nozzle's flow control handle into the OFF and fully locked position.

21. Remove nozzle from aircraft, stow hose, disconnect cart from air supply, and stow cart in designated location.

Date: ______________________ Time: ______________________

1. Squadron: ______________________ A/C Side Number: ______________
Tanks to be transferred: ______________________
Present fuel weight in tank to be transferred: ______________________
Maintenance discrepancy: ______________________
Receiving aircraft Side number: ______________________
Present fuel weight of receiving aircraft: ______________________

2. (A) Approved by: ______________________
CVW Maintenance Officer
(B) Approved by: ______________________
V-4 Maintenance Officer
(C) Approved by: ______________________
Aircraft Handling Officer

3. Fuel samples are required from ALL aircraft tanks to be transferred. Squadron REP, AIR DEPT, and AV/FUELS REP are responsible.

SAMPLE RESULTS
(A) FUEL TYPES: ______________
(B) FUEL QUALITY: ______________
(C) DATE TIME TAKEN: ______________
(D) FLASHPOINT: ______________
(E) LOW POINT DRAINS
VISUAL INSPECTION: ______________
(F) REMARKS: ______________

APPROVED BY: ______________________
V-4 DIVISION QA REP

4. **TRANSFER OPERATION TO BE PERFORMED BY QUALIFIED TRANSFER CART TEAM ONLY**
Date/Time transfer commenced: ______________ Completed: ______________
Amount transferred: ______________________
Flash point of receiving aircraft upon completion: ______________________
Remarks: ______________________

Figure 3-33.—Plane-to-Plane Mixed Fuel Transferring Certificate.

CHECKING AND RECORDING FUEL LOADS

On the flight deck, the fuels checker will go to all incoming aircraft, check fuel loads, record on checker cards the amount of fuel in the aircraft before fueling and after fueling. The figures that are received and logged on the checker cards are in pounds, not gallons. Pilots and aircrew talk about pounds of fuel because they are concerned with the weight of the fuel.

We, the ABFs, will take the figure in pounds and convert it to gallons by dividing the difference from the start weight to the finish weight by 6.8 (a gallon of JP-5 weighs). For example, a starting figure from the aircraft is 2,800 pounds and the finish fuel weight is 9,700 pounds; the difference is 6,900 pounds. When you divide 6,900 pounds by 6.8, you will get gallons of fuel. At the end of a preset time, the squadrons will get a bill for the number of gallons of fuel received.

SAFETY PRECAUTIONS

Before fueling or defueling is started, the OOD should be notified, when permission is received to commence, and the smoking lamp put out. At the end of the operation, the OOD should be notified and the smoking lamp lighted. During planned flight quarters, fueling and defueling are expected, and requesting permission from the OOD to fuel and defuel is not necessary, but the OOD should be notified about the recommended condition of the smoking lamp.

Care should be exercised to prevent sparks from striking in locations where fuel is being handled. The supervision of fueling and defueling operations should always be done by a qualified petty officer to ensure that all safety precautions are carried out and that the operation is done properly.

All personnel involved in handling aviation fuels must be fully aware of the constant danger of fire and thoroughly trained in firefighting. They also must know and follow all precautions and proper procedures.

The petty officer in charge of the fueling crew, checks with the plane captain or other authorized representative of the aircraft crew that no electrical equipment in the aircraft is energized or being work on. Unless, its needed in the fueling or defueling operation and in the quantity gauging system check. In addition, NO electrical apparatus supplied by outside power (electrical cords, droplights, and floodlights) is permitted in or near the aircraft. In night refueling or defueling operations, only approved flashlights are used.

The aviation fuels crew under the direction of the fuels officer handles the fueling or defueling of aircraft. Only members of the aviation fuels crew do fueling or defueling of aircraft.

All personnel directly involved in fueling or defueling evolutions must wear the proper safety gear, even when the ship is not at flight quarters. Cranial, goggles, gloves, jersey, and life vest must be worn during fueling/defueling operations.

No aircraft will be fueled while on jacks.

Simultaneous fueling, loading/downloading of weapons is authorized only as specified in CV and Aircraft Refueling NATOPS Manuals.

JP-5 becomes highly flammable if spraying (such as a ruptured hose or gasket) or wicking (such as a fuel-soaked rag or clothing). Extreme caution should be observed if these conditions occur.

Leaks in aircraft, hose, and connections, or trouble with fueling equipment should be reported immediately to the aviation fuels flight deck supervisor.

Q3-29. What is the primary means of communication between flight deck personnel (pilot to refueling crew) during flight operations?

Q3-30. Whose responsibility is it to make fueling assignments using information from the ACHO and the CAG Maintenance Chief?

Q3-31. What mobile fire-fighting equipment is manned during any type of refueling operation?

Q3-32. Beside the refueling crewmembers; the crew leader, the station operator, and refueling crewman. What other vital member must be present in order for the refueling evolution to begin?

Q3-33. If an aircraft fails pre-check, when can it be cold refueled (engines off)?

Q3-34. Who is the pilot to maintain radio contact with during hot refueling (engines running) operations?

Q3-35. When, if ever, can an aircraft be "hot refueled" with the canopy open?

Q3-36. Which type of refueling operation is only allowed with an overwing (gravity) nozzle?

Q3-37. Why is it important to ensure that proper grounding procedures be followed and maintained without deviation during refueling with an overwing nozzle?

Q3-38. When would you use an APU (Auxiliary Power Unit) during an aircraft refueling operation?

Q3-39. What aircraft, still in the Navy inventory, requires hot refueling through its aerial refueling probe?

Q3-40. Which three individual signatures must be on the Aircraft Defueling Certificate prior to any aircraft defueling operation?

Q3-41. The "X" placed on both sides of the aircraft's nose on aircraft that are suspected to contain fuel other than JP-5 is required to be of what type material?

Q3-42. What is the maximum temperature required on all fuel samples obtained from an aircraft suspected of low flash point, prior to lowering that aircraft to the hangar bay?

Q3-43. What is the minimum air pressure needed to perform refueling operations involving the Aircraft-to-Aircraft Fuel Transfer cart?

Q3-44. What is the maximum air pressure allowed in operating the Aircraft-to-Aircraft Fuel Transfer cart?

SUMMARY

In this chapter, you have learned about the equipment and procedures used in flight deck fuels operations. As with below decks operations, following proper procedures is a must. The flight deck of an aircraft carrier is one of the most exciting and dangerous places to work. All flight deck supervisors should ensure new personnel receive in-depth training on flight deck hazards. Knowing your equipment, knowing the correct operating procedures, and always being aware of your surroundings will keep you alive!

CHAPTER 4

SHIPBOARD AVIATION LUBE OIL AND MOGAS SYSTEMS

INTRODUCTION

The Aviation Fuels Division (V-4) maintains the catapult cylinder lubricating system on board aircraft carriers. The MOGAS system is also maintained and operated by the ABF.

CATAPULT LUBRICATING OIL SYSTEM

LEARNING OBJECTIVE: Describe the afloat aviation lube oil system. Identify lube oil system operating procedures.

The aviation lube oil system (fig. 4-1) is a separate, independent system. Although the aviation lube oil systems vary from ship to ship, an ABF qualified in one system can qualify quickly in the operation and maintenance of other aviation lube oil systems. Aviation lube oil systems are used solely to supply lubricating oil to the ship's catapults.

AVIATION LUBE OIL SYSTEM COMPONENTS

The system is composed of a storage tank, one (or two) pump(s), valves, and piping. The piping is

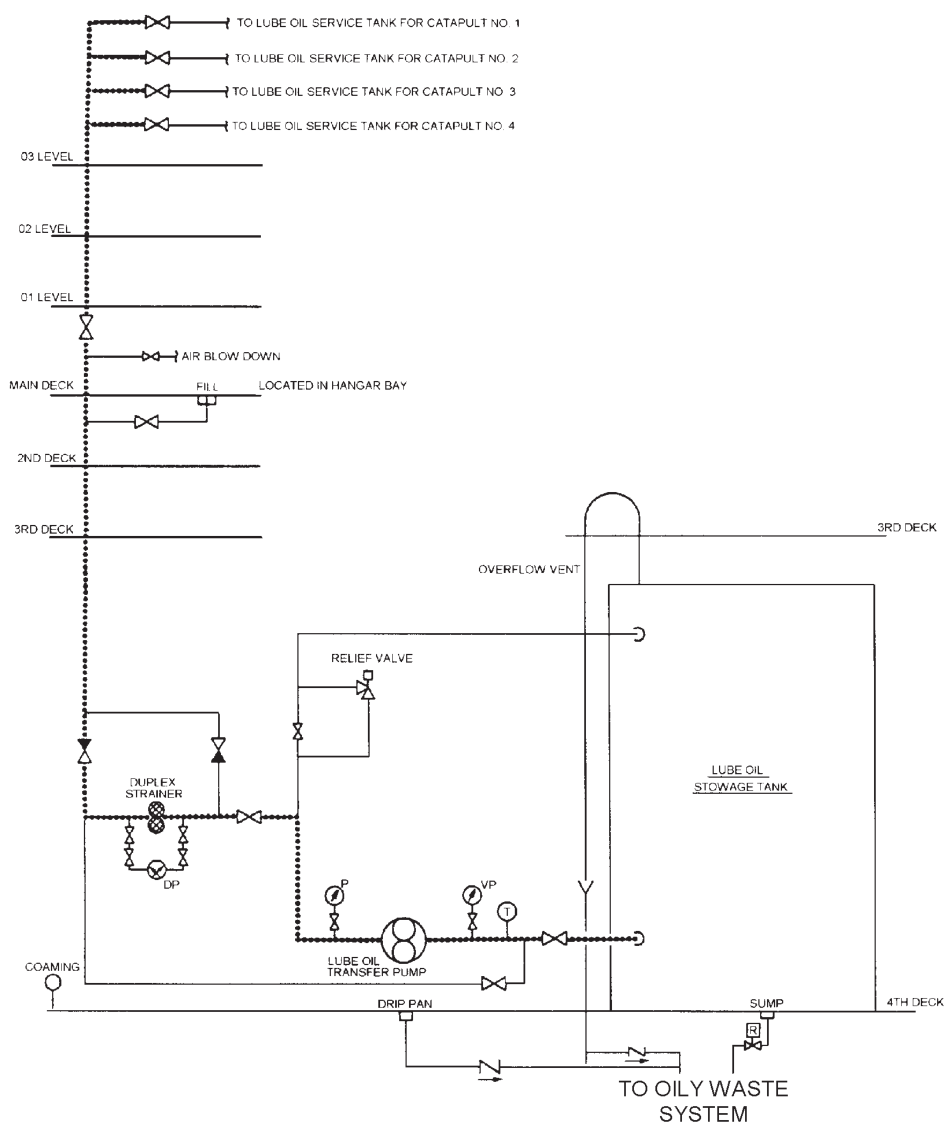


Figure 4-1.—Aviation lube oil system.

arranged to supply two (or four, based on which ship you are on) ready service tanks, located in the catapult spaces. The pump(s) take suction from the aviation lube oil storage tank and discharges through a riser going to the ready service tanks. It is a simple system that is easy to operate and maintain.

Lube Oil Pumps

There are two (2) kinds of pumps used to deliver aviation lube oil to the ship's catapult system. The De Laval rotary screw pump (used on some CV class ships) and the Blackmer rotary vane lube oil pump used exclusively on CVN class ships.

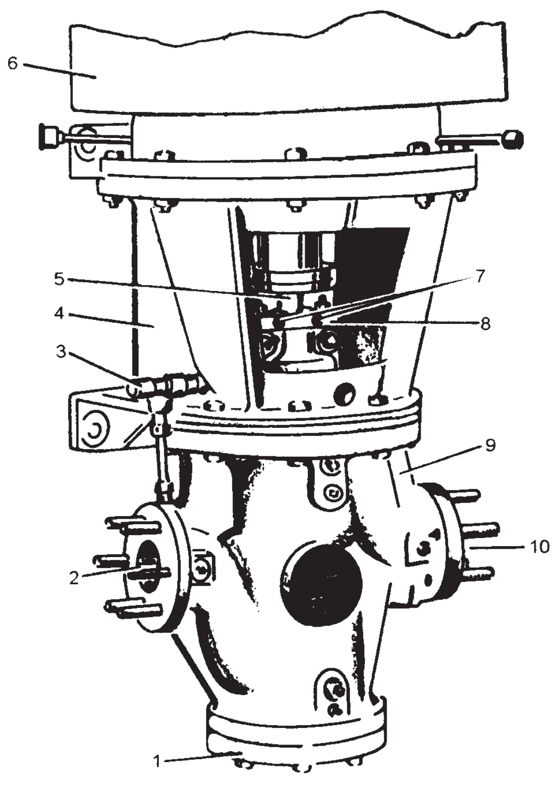
BLACKMER ROTARY VANE LUBE OIL PUMP.—Refer to Chapter 2 for information on the Blackmer rotary vane pump components, operation, and maintenance. However, the aviation Blackmer rotary vane lube oil pump has some obvious and distinct differences; they are as follows:

1. Pump operating capacity—20 gpm.
2. Pump operating pressure—70 psi.
3. Pump pressure relief is set at—80 psi.
4. Designed to lift—10 in. Hg.

The major differences in pump components (lube oil application):

1. The aviation lube oil rotary vane pump has four (4) vanes (vice the six (6) required on JP-application).
2. The aviation lube oil rotary vane pump has two (2) pushrods (vice the three (3) required on JP-5 application).
3. The aviation lube oil rotary vane pump is fitted with the rex-chain type coupling (refer to Chapter 2 for details).

DE-LAVAL ROTARY SCREW PUMP.—The De-Laval rotary screw pump application is still in-use with some CV class ships. The rotary screw pump will eventually be phased-out as these ships are rotated into SLEP (Service Life Extension Program) availability and these platforms are discontinued. The De Laval 31P156 is a vertical, single-stage, positive displacement, rotary-screw pump (figs. 4-2 and 4-3). The pump consists of a power rotor (which moves the oil), two idler rotors (for sealing), the housing, thrust elements,



1. Lower end cover
2. Suction connection
3. Relief valve
4. Shaft housing
5. Shaft
6. Power unit
7. Adjusting screws
8. Packing gland
9. Pump case
10. Discharge connection

Figure 4-2.—Rotary-screw lube oil pump.

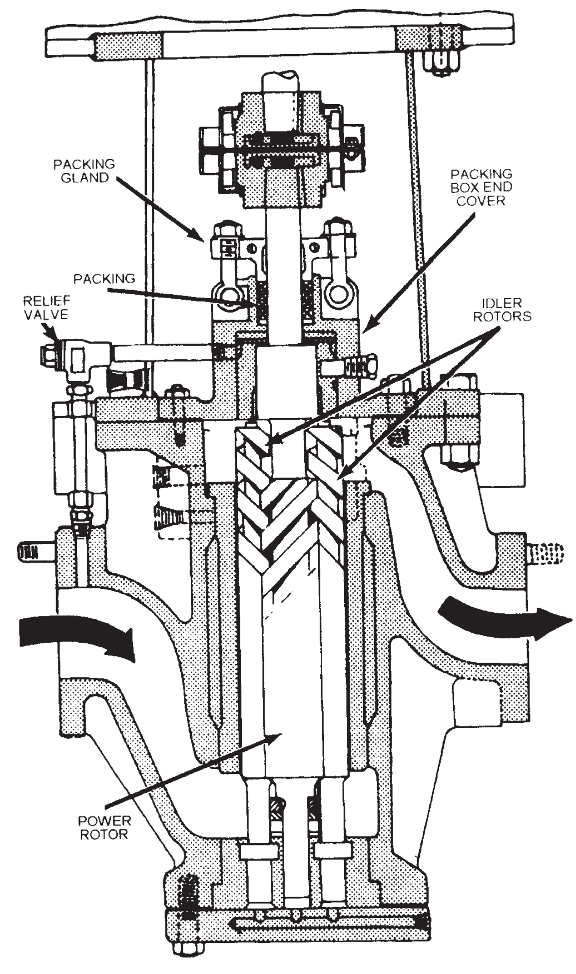


Figure 4-3.—Rotary-screw pump (cutaway).

shaft packing, and piping connections. The De Laval rotary screw pump is used on some LHD class ships as JP-5 transfer pumps. On these type platforms, the rotary screw pump in this application is a more efficient pump for its mission.

When the pump is started for the first time or after a long period of idleness, follow the instructions for initial starting, given below.

Initial Starting.—All external surfaces of the pump should be carefully cleaned before the pump is started. If the factory assembly has not been disturbed, it will not be necessary to dismantle the unit for cleaning. The interior of the pump was coated with a special rust-preventive compound after the factory test. The removal of this compound is effected completely without any harmful results in the normal operation of the unit.

Make sure that the shaft packing has been installed and that the gland nuts are only fingertight.

Before you start the pump, prime it by filling the pump case and as much of the suction line as possible with oil. If the air is not removed from the suction line, the performance of the unit will be erratic, or it will not pump at all. If no priming connection is provided, use the plug on the suction connection of the pump.

Open the suction, discharge, and vent valves and start the motor. If the pump is moving the oil satisfactorily, the vent valve may be closed after a few minutes of operation. Allow the shaft packing to leak freely for the first 15 minutes of operation; then, tighten the gland nuts with your fingers until there is only a slight leakage past the packing.

If the pump fails to discharge after starting, stop the motor, prime the pump again, and restart the pump. If it still does not pick up oil immediately, there may be a leak in the suction line, or the trouble may be traced to excessive suction from an obstruction, throttle valve, or other causes. Connecting a gage at several points along the suction line, while the pump is operating helps locate the trouble. An obstruction in the suction line causes an observable drop in pressure at the point of obstruction, the lower pressure being on the pump side.

CAUTION

Operating the pump without oil causes rapid wear of the housing and bearings; therefore, checking for trouble must be done quickly.

Routine Starting.—Open the suction and discharge valves and start the motor. Ensure that oil is being pumped and that there is a slight leakage past the shaft packing. Read the gages that indicate the suction and discharge pressures for the pump, and make sure the pump is operating normally. If it is not pumping, follow the instructions for initial starting.

Operation.—After the pump is in service, it continues to operate satisfactorily with little or no need for maintenance except normal PMS. The suction and discharge pressures should be checked at least every 10 minutes to verify the performance of the pump. Once each day, the shaft packing should be inspected to see that it is properly adjusted. Any unusual conditions should be noted and investigated.

Securing.—Stop the motor and close the suction and discharge valves.

Maintenance

De Laval pumps require very little attention in normal usage. Unless they are operated without oil or with oil containing abrasive particles, their operation without major overhaul is virtually unlimited.

The pump is equipped with a relief valve to prevent excessive oil-pressure buildup. The relief valve also seals the metallic packing against air leakage during suction lift conditions.

There is a set of packing located in the packing box end cover. The four flexible, metallic packing rings are installed with the joints of abutting rings staggered, and they are held in place by a packing gland. This packing gland is split to allow packing replacement without disturbing the other elements of the pump. The two sections of the packing gland are held together with two screws, and the gland pressure is adjusted with two gland nuts. This adjustment should be sufficient to allow a slight amount of leakage past the packing for lubrication of the packing.

Inspection

An inspection made while the pump is operating discloses any leakage between the end covers and case or in the piping connections. If leakage is observed, it may be due to foreign matter on the gaskets, defective gaskets, or loose nuts and bolts. Replace the gaskets or tighten the nuts and bolts as required.

Lubrication

The pump does not require any lubrication, since the oil being pumped lubricates all the moving parts.

Driving-unit lubrication instructions are provided with each unit.

Operating Troubles

Some operating troubles may be evident from a low discharge pressure, excessive or unusual noise, or an overloaded driving unit. The following paragraphs discuss the most likely causes of operating troubles.

LOW DISCHARGE PRESSURE.—A low discharge pressure generally indicates that not enough oil is being pumped. This condition may exist because the pump needs priming or because of leakage. A gradual decrease in discharge pressure over a period of time is generally the result of pumping oil that contains abrasive particles, which causes the housing and rotors to wear.

NOISE.—Cold oil, dirty strainers, air in the oil, vaporization of the oil because of increased temperature, or misalignment of the coupling may cause excessive or unusual noises.

OVERLOADED DRIVING UNIT.—Excessive friction in the pump or in the driving unit can cause a driving unit to be overloaded. Misalignment of parts when the pump is reassembled increases friction. Overloading may also be caused by faulty operation of the system, heavy or cold oil, or from other causes that are not due to actual malfunctioning of the pump.

STORAGE TANK

The aviation lube oil storage tank (fig. 4-1) functions are the same as CV class ships. Some minor differences exist as to capacity, tank gaging equipment and how overflow from the storage tank is handled. Usually, the CV class ships are the platforms you will likely encounter De Laval rotary screw lube oil pumps.

The aviation lube oil storage tank is located inside a MMR (Main Machinery Room) space on CVN class ships. The aviation lube oil storage on CV class ships is located in an AMR (Auxiliary Machinery Room). Tank capacities vary from CV to CVN ships. The following information is applicable to CVNs.

Characteristics of the aviation lube oil storage tank are:

- Capacity — 6,000 gallons
- Tank Overflow Line — discharges into the oily waste system.
- Man-Hole Cover — located on top of the tank inside the main space.
- Tank Gauging Equipment:
  - A Sounding Tube Cap. — Permanently attached to the manhole cover, however; there is no tube inside the tank. Extreme care must be taken when sounding the tank; the "bob" from the sounding tape could easily penetrate the tank.
  - Tank Level Indicator. — Bartons gauge is installed to indicate the capacity of the tank in gallons.
- Steam Valve - installed on the side of the storage tank provides a means for warming the lube oil for ease of delivery.
- A Thermometer — installed on the side of the storage tank and one on the suction line provides a means for gaging the temperature of the lube oil inside the tank.

DUPLEX STRAINERS

The aviation lube oil system uses duplex strainers (fig. 4-4) to remove solid particles from the oil by passing through a removable element that consists of wire-mesh or a perforated plate. The oil flows into the strainers passing through a basket-shape element from inside to outside, leaving particles trapped in the basket. The duplex strainer assembly has two of these basket-shape elements; oil passes through only one basket at a time.

Rotating an actuator allows shifting from one strainer to the other; one is used for in-use service while the other is the back up in the event of clogging. It also provides a means for cleaning a clogged strainer basket, while placing the other in-service. Experience will determine how quickly a particular strainer becomes clogged. Duplex strainers can go for long periods without requiring cleaning, unless dictated by PMS.

The strainer assembly uses ball valves to switch flow between baskets; the valves are connected by an actuator-geared mechanism that reduces the force needed to switch baskets. The housing covers above each basket are held in place with locking covers/strong-backs and sealed with O-rings. Vent valves are included in the strainer assembly, the valves discharge to the oily waste system in the event of over pressurizing the unit. Drain valves are part of the strainer assembly as well; they are used for draining the

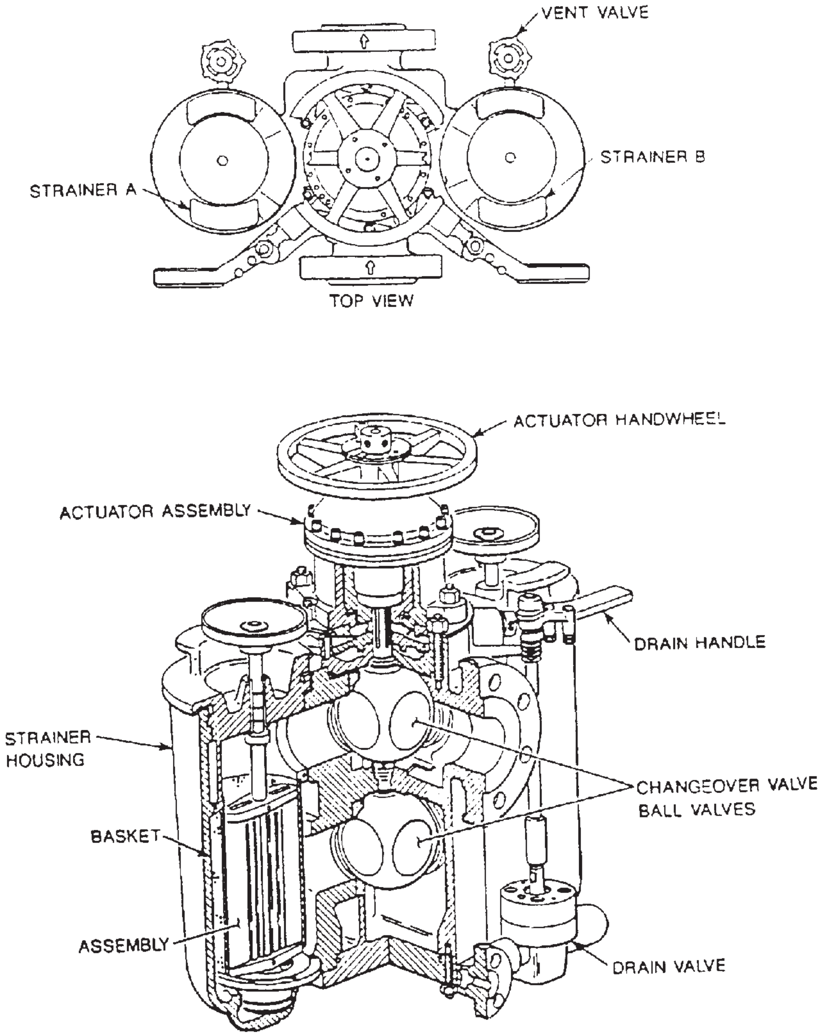


Figure 4-4.—Duplex strainer assembly.

strainer compartments during maintenance. These valves also discharge to the oily waste system. For some strainer assembly installations, the vent and drain lines may discharge to drip pans. The oil is then poured down a funnel that discharges into the oily waste system.

Cleaning duplex strainers while the system is under pressure should only be performed under emergency conditions. Proper PMS scheduling will negate ever having to perform this operation while the system is pressurized, effectively reducing any possibility of a lube oil spill. When cleaning duplex strainers, ensure the strainer compartment being inspected and cleaned is not in-service. Follow these steps:

1. Inspect cover on off-duty strainer for proper fit and tightness.
2. Pressure test off-duty strainer compartment:
   a. Crack open vent valve.
   b. Fill off-duty strainer by slightly unseating shift lever (actuator hand-wheel).
   c. Shut vent valve when oil flow is observed.

CAUTION

Be prepared to shift back to on-line strainer compartment if leakage from off-duty strainer is observed.

   d. Inspect off-duty strainer compartment for leaks; return shift lever (actuator hand-wheel) to on-service strainer position.
3. Shift strainer.

a. Shift oil flow to clean side of strainer by slowly moving operating handle/shift lever through its full limit of travel. If pressure drop is more than 1 1/2 psi above normal, shift back to operating strainer.

b. Observe duplex pressure gage for normal clean basket pressure differential (between 1 1/2 and 3 psi.).

4. Inspect and clean idle strainer.

WARNING

Do not attempt to disassemble idle strainer until positive it is not under pressure.

a. Remove idle strainer compartment cover.

b. Open drain valve and drain oil from idle strainer compartment; shut drain valve.

c. Remove cover gasket/O-ring.

d. Remove basket assembly.

e. Clean strainer basket and inspect for cracked or broken mesh.

f. Inspect cover gasket/O-ring for cuts and deterioration.

g. Inspect cover gasket/O-ring sealing surfaces for scoring, nicks, grooves, and dents.

h. Inspect cover hold down clamps/strong-back for cracks and distortion; inspect studs/bolts for thread damage.

i. Install basket assembly in strainer compartment; rotate to ensure proper positioning.

j. Reinstall strainer compartment cover gasket/O-ring and cover; rotate to ensure proper positioning.

CAUTION

Do not over tighten hold down clamps or strong-back studs.

k. Reinstall hold down clamps/strong-back; tighten cover firmly.

WARNING

Be prepared to shift back to on-line strainer compartment if leakage from off-duty strainer is observed.

5. Pressure test idle strainer after cleaning by repeating steps 2. (a) to 2. (d).

PIPING AND VALVES

The filling connection for on-loading aviation lube oil is a flush-deck type cap, provided on the hangar deck port side. There are plans on the drawing board to reroute and extend the fill line connection running under the 2nd deck and out to the JP-5 refueling sponson, located on the starboard side. This will provide easy access from the pier when refueling with a truck and limit the amount of space used when on-loading lube oil either by truck or 55-gallon barrels. The aviation lube oil system consists of a series of gate, butterfly, and one-way stop-check valves.

A butterfly isolation valve for the filling connection is located on the 2nd deck, starboard side, adjacent the port side entrance to the MMR space. Another butterfly isolation valve for discharging lube oil to the catapult ready service tanks is located on the main deck just inboard of the filling connection. Aligning the lube oil system for on-loading/off-loading and servicing the ready service catapult lube oil tanks can only be accomplished with one of these valves opened. One or the other can only be opened for their specified operations, not both; a major lube oil spill will occur if both valves are opened at the same time.

Several types of valves are used in the aviation lube oil system. Typically, the valves used for filling and off-loading are of the gate type. Most discharge valves on pumps are of the globe type. Distribution piping may contain gate, globe, stop-check, or butterfly valves. You should know the type of valves installed in your system, their location, and how these different types of valves are inter-connected to the system.

OPERATIONS

Operation of the aviation lube oil system on CVN class ships is done IAW the *Aviation Lube Oil Operational Sequencing System* (ALOSS). The piping is arranged in the pump room so that the following operations may take place:

• The pump takes suction (simultaneously, if using two pumps) from the storage tank and discharges to any ready service tank.

• The pump takes suction (simultaneously, if using two pumps) from the fill line and discharges to the lube oil storage tank during the filling operation.

• The pump takes suction (simultaneously, if using two pumps) from the storage tank and discharge for offloading of lube oil.

• Communication is maintained with V-2 personnel while filling the catapult ready service tanks. Loss of communication between V-4 and V-2 personnel during this operation will result in the immediate suspension of transferring lube oil. The operation will not resume until the problem is investigated and resolved.

In the lube oil spaces, a 4JG sound-powered phone is installed for constant communication between the pump room operator and catapult personnel during actual pumping operations to the service tanks.

• When filling the catapult lube oil ready service tanks, it is required that the piping alignment must be routed through the lube oil duplex strainers except when receiving lube oil from drums or by truck.

Filling the Storage Tank

The storage tank may be filled by any of the following methods:

POURING FROM DRUMS.—Screw a large funnel into the filling connection; raise the drum above the filling connection by using a forklift or other means and open the large cap. The large cap should be on the bottom, near and over the funnel. Next, open the small cap on top to allow air into the drum. Opening and closing the top cap can control the amount of oil leaving the drum.

SIPHONING FROM DRUMS.—Rig a 1 1/4-inch suction hose attached to the end of a brass pipe long enough to reach to the bottom of the drum. Then rig the suction hose and pipe assembly into the filling connection. With this method, the vacuum from the lube oil pump may be used for loading.

LOADING FROM A TRUCK ON THE DOCK.—Rig a direct line from the truck to the filling connection. With this method, a pump on the truck is used to boost the oil from the truck to the filling connection.

> **NOTE**
>
> When loading from a truck on the dock, use caution to ensure that the pressure from the truck to the lube oil system is not enough to cause damage to hose, piping, or pumps.

When the system is taking on lube oil, a vent is not necessary because the system is vented through a tank overflow line. The tank overflow line discharges the excess lube oil to an oil waste system. To allow for expansion, tanks should not be filled beyond 90% capacity.

Q4-1. What are the two types of pumps used in the aviation lube oil systems?

Q4-2. What kind of coupling is used in the rotary vane lube oil pump?

Q4-3. What is the capacity of the lube oil storage tank on a CVN class ship?

Q4-4. Where is the sounding tube to the lube oil storage tank located?

Q4-5. What minimum pressure differential drop must be maintained between the duplex strainers prior to shifting operation from one to the other?

Q4-6. What requirement must be adhered to when pumping lube oil to the catapult lube oil ready service tanks?

MOGAS SYSTEM AFLOAT

LEARNING OBJECTIVE: Identify the operating principles involved with the MOGAS system afloat. Explain how the operating principles govern and impact fueling operations within the MOGAS system.

As an ABF assigned to an amphibious ship in support of USN and USMC expeditionary forces, you will be working with motor gasoline (MOGAS) systems. As with JP-5 systems, each ship is different, even ships within the same class. As older equipment is replaced with newer equipment, the uniformity among ships will increase until firm standardization evolves.

In this section, we will cover the major areas within an afloat MOGAS system and associated equipment unique to the system. Remember, MOGAS systems vary from one ship to another (LHA, LPD, LPH); however, the operating principles remain the same. For specific system information and operation and maintenance procedures for your ship, refer to your ship's SIB *(Ship's Information Book),* (CFOSS) *Cargo Fuel Operational Sequencing System*, and PMS manuals.

Hydraulics is the study of the behavior of fluids in their application to engineering problems. The French scientist Pascal discovered the fundamental law underlying the whole science of hydraulics, in the seventeenth century. Pascal's law states: *"Any pressure or force applied to a confined liquid will be transmitted equally and undiminished in all directions, regardless of the size or shape of the container."*

For example, liquid seeks its own level. The surface of the water in a teakettle is at the same level in the spout as it is in the body of the kettle. This rule also applies when a liquid is introduced to several differently shaped, openly connected tanks. The surface of the liquid would be at the same level in each connected tank.

The theories and laws of physics apply to all fuel systems, but it is important that you understand them before you attempt to operate a MOGAS system.

STORAGE TANK COMPENSATING SYSTEMS

MOGAS bulk storage is configured to operate by a seawater compensating system or by an inert gas compensating system. In the seawater compensating system, seawater displaces gasoline as the latter is drawn off; gasoline displaces water as the tanks are replenished. In the inert gas compensating system, an inert gas blanket fills the vapor space above the gasoline in the tank.

Seawater Compensated Storage

The seawater compensated system is designed to keep the gasoline storage tanks completely full of liquid at all times, either with gasoline on top of seawater or else completely full of seawater. Seawater replaces the gasoline as it is removed from the tanks. With this method, no explosive vapor pockets can form.

The seawater compensated storage of gasoline is based on two principles.

1. The weight per unit volume of gasoline is less than that of seawater; therefore, gasoline will float on seawater.

2. A given height of seawater in a U-tube will hold in balance a greater height of gasoline.

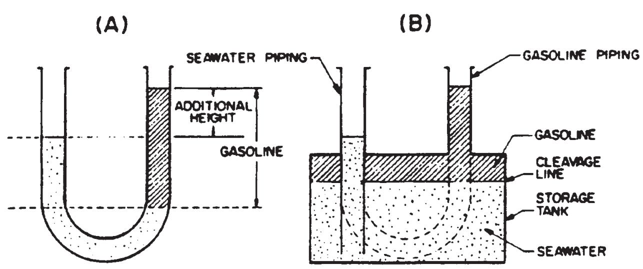
The seawater compensated storage tank is designed on the principle of the U-tube. If gasoline is placed in one leg of the U-tube and an equal volume of seawater in the other, their positions will be similar (fig. 4-5). The storage tanks containing seawater and gasoline form the bottom of the tube. The seawater piping forms one side of the tube and the gasoline forms the other side.

Seawater compensated tanks are used for bulk storage of MOGAS onboard LHA and LPD ships. Each tank consists of a drawoff tank located inside of an outer storage tank. They are interconnected by a sluice pipe and function as one tank, so that both tank filling and service suction are through the drawoff tank. The gasoline piping connects to the high point of the drawoff tank. The seawater compensated tank may be part of the ship's structure.

Seawater compensated tanks are vented at the fill connection for replenishment, and at the station nozzle prior to vehicle refueling. CO_2 compensated tanks are vented through a vent line leading from the tank overboard, above the third deck.

Inert Gas Compensated Storage

Gasoline vapor is combustible when mixed with air because air contains oxygen, which is an element necessary for combustion. Without the proper proportion of oxygen, fire or explosion is impossible. Carbon dioxide inerting systems (fig. 4-6) protect the gasoline



NOTE: GASOLINE IS SHOWN HIGHER IN ITS LEG OF THE U-TUBE SINCE FOR EQUAL VOLUMES, WATER IS HEAVIER THAN GASOLINE.

Figure 4-5.—U-tube analogy of MOGAS system.

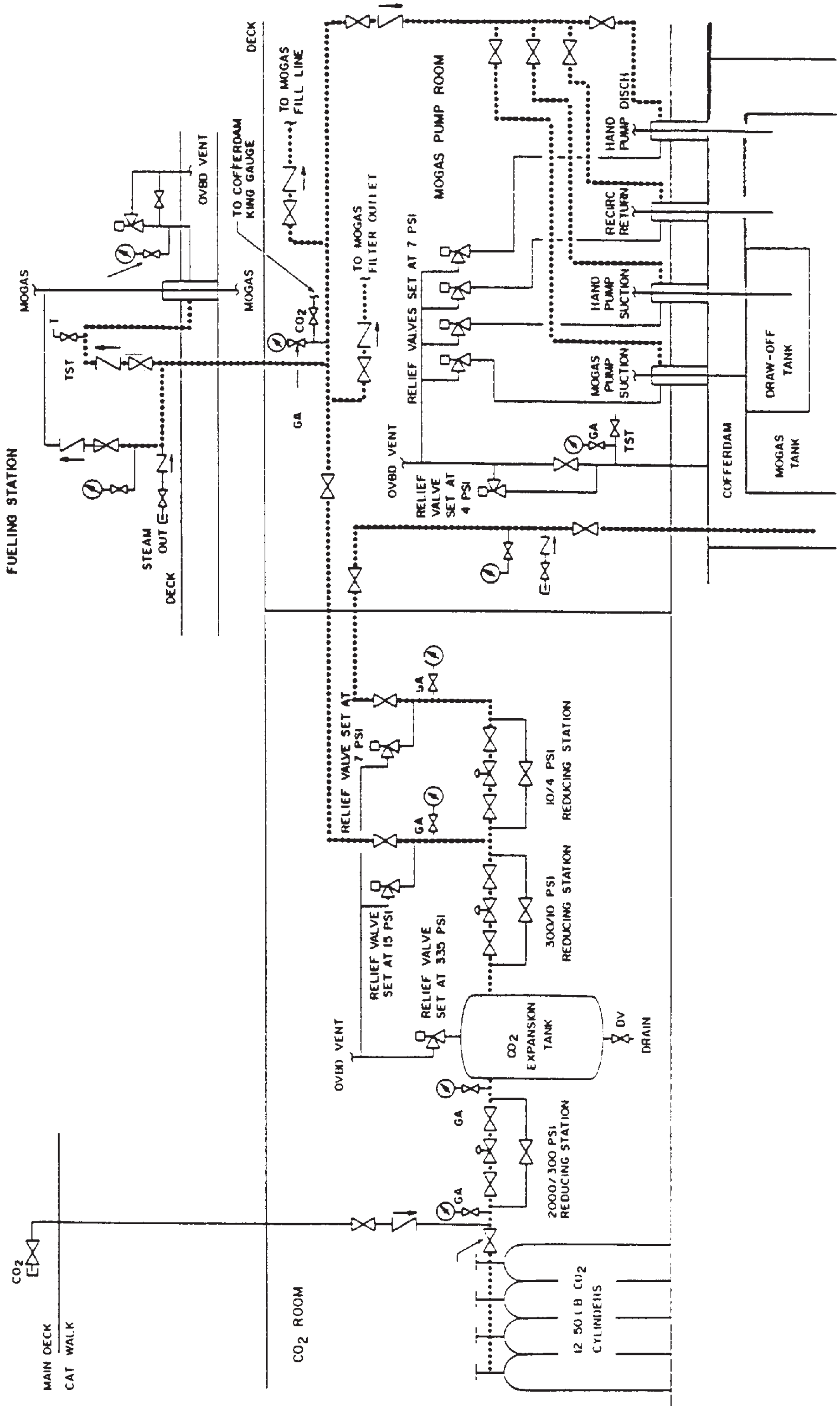


Figure 4-6.—Inert gas system.

system by preventing air from mixing with gasoline vapor and by reducing the percentage of oxygen. CO_2 is safe for use near electrical equipment because it is a non-conductor.

The inert gas displacement storage tank consists of a single tank and does not require a drawoff tank.

A CO_2 inert gas compensated storage tank is used onboard LST ships. This type of storage uses CO_2 as a protective blanket over the gasoline. CO_2 fills the void area of the tank as gasoline is pumped out; alternatively, CO_2 is forced out of the tank as it is filled with gasoline. Therefore, the tank is always inerted unless it is full of fuel.

NITROGEN INERTING OF COFFERDAMS AND PIPING.—Nitrogen (N_2) is an odorless, colorless, and tasteless gas stored at a minimum purity of 97 percent for the protection of MOGAS systems as follows:

1. In the cofferdam, surrounding the gasoline storage tank, to keep the atmosphere in this space non-flammable and non-combustible. The cofferdam must be inert to a minimum of 50 percent by volume of nitrogen, as determined by the use of a portable inertness analyzer (PIA).

2. In the outer portion of the gasoline double-walled piping.

3. For purging and inerting the gasoline piping and filter after handling operations.

Nitrogen is stored in flasks at 3,000 or 5,000 psi for use as required. The gas passes from the storage flasks to pressure-reducing panels. A regulating valve on each of these panels reduces the pressure from the stored pressure to 300 psi. Three additional pressure-regulating valves on each panel further reduce the pressure to the required level. Low pressure piping leads from the regulating valves to the cofferdam, to the gasoline double-walled piping, and to the gasoline distribution piping. Nitrogen for charging the cofferdam is reduced to 3 psi at the pressure-reducing panel. Low-pressure piping leads directly from the panel through the gasoline pumproom to the cofferdam. A stop valve in the pumproom controls the release of nitrogen into the cofferdam. Diffusers at the ends of the distribution lines in the cofferdam distribute the inert gas evenly throughout the space.

Vent piping for the cofferdam leads to the outside of the ship. A stop valve in this piping is located in the gasoline pumproom. A relief valve set at 7 psi is installed in a bypass line around the stop valve to ensure against excessive pressure in the cofferdam. An additional relief valve, installed on a cross connection between the nitrogen supply line and the vent piping, also ensures against excessive pressure in the cofferdam. Pressure gage and inertness analyzer connections are provided in the vent piping.

CO_2 INERTING OF COFFERDAMS AND PIPING.—The CO_2 inerting system is also used for inerting cofferdams and piping and operates like the nitrogen inerting system previously described. A minimum of 35 percent by volume is required for CO_2. Cylinders for this system, painted red, are fitted with a hand wheel-operated valve but no siphoning tube. The CO_2 is fed in a gaseous form through a pressure-reducing valve, via piping to a 300-psi expansion tank.

The cylinders and cylinder valves for the CO_2 fire protection system and CO_2 inerting system are not interchangeable and must never be substituted for each other.

Where vendors supply liquid CO_2, use a vaporizer to convert liquid CO_2 to gaseous CO_2 before introduction into the ship cofferdam inerting piping.

VEHICLE FUELING STATION

All vehicles are fueled and defueled at the gasoline fueling stations only. There are two types of fueling stations that the ABF will use onboard ships: the pressure-regulating type and the CLA-VAL type.

MOGAS Automatic Pressure-Regulating System

The pressure-regulating system (fig. 4-7) used in MOGAS risers is identical for all class ships except for size and pressure settings. This section deals with a typical regulating system without reference to size or pressure. The pressure regulator is typically installed after the filter; on other amphibious ships, it may be installed before the filter.

On LHA and some LPD ships, the gasoline riser is fitted with a pilot-operated, pressure-regulating valve and venturi combination located in the gasoline pumproom. It controls topside pressure at the inlet to the fueling station.

Between the riser and the distribution main, the pilot-operated regulating valve is activated by the pressure at the throat of the venturi, which maintains a constant throat pressure equal to the sum of the static head. The pressure required at this connection point

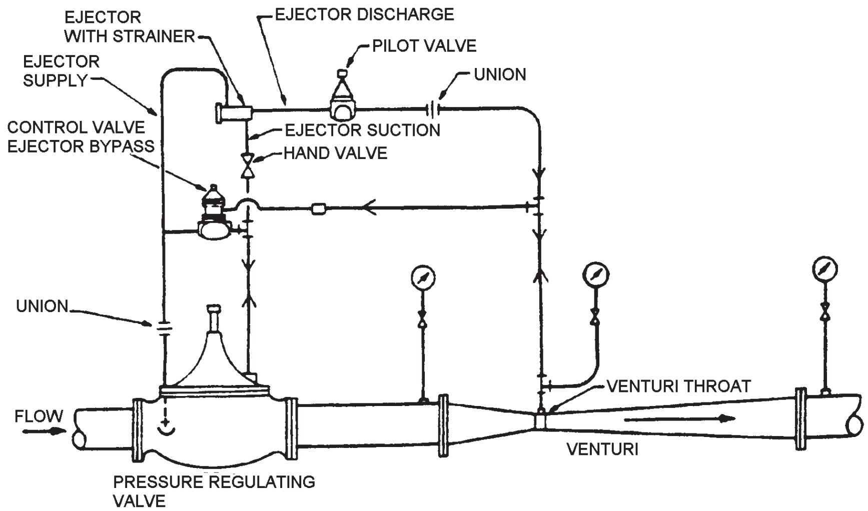


Figure 4-7.—MOGAS pressure-regulating system.

must be sufficient to maintain the pressure at the nozzle discharge of the most remote fueling station under maximum flow conditions. The length of the approach to the venturi equals a minimum of six times the diameter of the straight pipe.

The venturi is designed so that the difference between the pressure at the throat equals the friction loss from the venturi to the main/riser connection point under all flow conditions. The length of the approach to the venturi equals a minimum of six times the diameter of the straight pipe.

A recirculating line containing an orifice is installed on the downstream side of the venturi. The rate of venturi recirculation is sufficient to permit satisfactory operation of the regulating valve and venturi combination under no-flow conditions. The recirculating line terminates at the midpoint of the drawoff tank. Venturi and gasoline pump recirculation lines may be combined into a common return line to the midpoint of the drawoff tank.

The pressure regulator consists of an automatic pressure-regulating valve operated through changes of pressure in the throat of a venturi, located downstream of the valve. The main components of the system (fig. 4-7) are as follows:

- Main valve (pressure regulating valve)
- Pilot valve
- Ejector with strainer
- Control valve (ejector bypass)
- Venturi (venturi throat)

NOTE

Venturi Principle: If a fluid flowing through a tube reaches a constriction or narrowing of the tube, the speed of the fluid flowing through the constriction increases and its pressure decreases. If the fluid flows beyond the constriction into a tube the same size as that of the original, the speed of flow decreases and the pressure increases.

The pressure-regulating system is entirely hydraulic in operation, using line pressure to open and close the valve. Because of this, it can be installed either vertically or horizontally in the riser.

The main valve is of a modified globe design, employing a well-supported and reinforced diaphragm. When line pressure is admitted to the cover chamber, the valve tends to close. When pressure is reduced in the cover chamber, line pressure under the disk opens the valve.

The pilot valve is a direct-acting, spring-loaded valve designed with a large diaphragm and effective working area to ensure sensitive control and accurate regulation of the required delivery pressure. The pilot valve is located in the actuating line between the ejector strainer and the venturi throat. It is normally held open by a compression spring. When venturi throat pressure acting under the diaphragm increases, the valve tends to close. When venturi throat pressure decreases, the valve opens (wider). Thus, a constant pressure is maintained by balancing venturi throat pressure against spring tension.

The ejector strainer assembly is installed in the actuating line between the main valve and the pilot valve. It consists of an ejector nozzle with a 1/16-inch orifice protected by a 60 mesh-monel strainer to prevent clogging of the nozzle. The assembly speeds up the operation of the main valve by speeding up the evacuation of fluid from the cover chamber. It prevents chatter of the main valve by reducing the violence with which pump discharge pressure is admitted to the main valve cover chamber.

Venturi tubes are installed in the distribution riser downstream of the regulating valve. The venturi tapers from a 2-inch inlet to a 3/8-inch throat to a 2-inch outlet. A recirculating line on the delivery side normally returns 5% of the capacity of the booster pump.

Gasoline stations typical of LHAs are of the automatic pressure-regulating type. An installed pressure-regulating valve controls the station pressure. Fixed defueling is not provided. Hose storage is on a reel. The 3/4-inch fueling hose does not utilize the internal control wire circuit (continuity) for valve operation.

OPERATION OF THE AUTOMATIC PRESSURE REGULATOR.—In the operation of the system, high-pressure fuel flows initially from the pump and enters the main valve body. This fuel bypasses the main valve seat and flows through the ejector strainer assembly to the pilot valve. The pilot valve is held open by its spring. From the pilot valve, this flow is directed into the throat of the venturi tube. At this point, the pressure at the throat of the venturi tube is practically nonexistent.

As long as the pilot valve stays open, maximum flow through the ejector strainer assembly is permitted. This flow through the ejector strainer assembly creates a reduced pressure in the main valve cover chamber. (Remember that the ejector strainer assembly works like an eductor.) Line pressure from the pump, working under the disk of the main valve, can now open the main valve, permitting flow into the distribution riser. This flow builds up pressure in the distribution riser.

The increasing pressure in the riser is transmitted from the throat of the venturi tube to the underside of the pilot valve diaphragm. When the pressure under the pilot valve diaphragm reaches a point where it is greater than the setting of the pilot valve spring, the pilot valve begins to close. This restricts the flow through the ejector strainer assembly. When this flow is restricted, the ejector strainer assembly loses its suction and the inlet pressure is diverted, by way of the suction line, to the main valve cover chamber.

The resultant increase in pressure in the main valve cover chamber as applied to its diaphragm is sufficient to begin closing the main valve. The main valve disk will move toward its seat until the main valve is passing just enough fuel to maintain pressure that will balance the setting of the pilot valve through the throat of the venturi.

Any later change in fuel demand will cause a change in venturi throat pressure. Even the slightest change is enough to cause the pilot valve and the main valve to assume new positions to supply the new demand. This will happen regardless of whether the demand is for a greater or lesser amount of fuel.

Topside Increase Of Flow Demand.—An increase in the rate of flow will first cause a momentary decrease in venturi throat pressure. This decrease in pressure will allow the pilot valve to open wider, which, in turn, increases the flow rate through the ejector strainer assembly.

An increase in the flow rate of the ejector strainer assembly will increase the suction lift of the ejector. The increase of the suction lift is applied to the main valve cover chamber and allows the main valve to open wider.

The main valve will open in proportion to the increase of flow demand topside. The main valve will continue to open until the venturi throat pressure builds up to a point where it again balances the setting of the pilot valve spring.

Topside Decrease Of Flow Demand.—A decrease in flow rate will cause a momentary increase in venturi throat pressure. This increase in pressure will cause the pilot valve to close somewhat, restricting the flow through the ejector strainer assembly.

A decrease in flow through the ejector strainer assembly will decrease the suction lift of the ejector. This decrease of ejector suction lift will cause an increase of pressure in the main valve cover chamber and result in partial closing of the main valve.

The main valve will close in proportion to the decrease of flow demand topside. The main valve will continue to close until the venturi throat pressure drops to a point where it again balances the setting of the pilot valve spring.

Sudden Demand Decreases.—Any sudden decrease in flow rate will create a sudden, high increase in venturi throat pressure. This sudden increase of pressure will be applied to the underside of the diaphragm of the pilot valve to close the main valve in the normal manner. Because of the small size of the orifice in the ejector strainer assembly (1/16-inch diameter), the main valve will close slowly. Venturi throat pressure will, at the same time, apply to the underside of the diaphragm of the control valve to open the control valve. When the control valve opens, full pump discharge pressure is applied to the main valve cover chamber to quickly close the main valve. This quick closing of the main valve reduces the pressure in the distribution riser. The main valve remains closed until the pressure on the discharge side of the main valve drops below the spring setting of the pilot valve. The pressure and fuel that are trapped between the discharge side of the main valve and the discharge side of the venturi, caused by a sudden buildup of discharge pressure, are relieved through the venturi recirculating line back to the draw-off tank.

Adjustment And Settings.—The pilot valve pressure adjustment is made by turning the adjusting screw to vary spring compression on the diaphragm. The control valve adjustment is made by turning the adjusting screw clockwise to increase the pressure. The procedure for adjusting the pressure setting follows:

NOTE

The following procedure should be carried out after reinstallation of the regulating valve and pilot assembly and after the maintenance check has been performed. The typical desired delivery pressure is 22 psi at the throat of the venturi.

1. Close the control valve by turning the adjusting screw clockwise.
2. Set the pilot valve at 34 psi when fuel is flowing through the main valve at 50 gpm or more.
3. Reduce the pressure setting of the control valve (by turning the adjusting screw counterclockwise) until delivery pressure drops to 32 psi at the throat of the venturi.
4. Tighten the control valve locknut.
5. Reset the pilot valve at 22 psi.

The procedure outlined above will establish the desired downstream pressure and provide the correct setting of the control valve.

MAINTENANCE.—The ejector strainer assembly should be cleaned at regular intervals in accordance with PMS requirements. Remove the 3/4-inch union ring and plug from the housing, wash in solvent, and then blow the screen out with air. At 6-month intervals, the regulating valve should be completely dismantled and thoroughly cleaned. The pilot valve and control valve should be inspected carefully for excessive wear, and, if necessary, replaced. All gages used in the pressure-regulating valve system are removed, cleaned, and calibrated every 12 months. Upon installation of new parts or repairs made on parts, all piping connections are pressure tested to check for leakage of fuel.

CLA-VAL Type Station

MOGAS vehicle fueling stations on some LPD ships are of the CLA-VAL type station. The CLA-VAL fueling station consists of one or more solenoid-operated fuel-defuel valves, a positive displacement defueling pump, and the necessary piping, valves, and electric controls to service vehicles through installed hoses. An internal control wire circuit (continuity) is used to activate the CLA-VAL fuel-defuel valve. The fueling station is equipped with 1 1/2-inch gasoline fueling -defueling hoses, which are stored on hose reels.

For detailed information on the operation of the CLA-VAL type fueling station, refer to Chapter 3.

Q4-7. The seawater compensating system is designed on what principle?

Q4-8. Why is CO_2 inert systems highly recommended for use near electrical equipment?

Q4-9. What type of inert system is used aboard LST ships for the storage of MOGAS?

Q4-10. What is used to convert liquid CO_2 to gaseous CO_2, when inerting cofferdam piping?

Q4-11. Under the venturi principle, what happens to the speed and pressure of a fluid flowing through a narrow tube of pipe?

Q4-12. What is unique about the automatic pressure-regulating system installed on LHA ships compared to other MOGAS platforms?

MOGAS SYSTEM COMPONENTS

LEARNING OBJECTIVE: Identify the equipment that makes up the MOGAS system. Explain how the equipment that makes up the MOGAS system is used.

Most equipment used in a fixed MOGAS system, such as pumps, valves, and filters are identical to the same equipment used in the JP-5 afloat system, only smaller. We will cover the major equipment used in a fixed MOGAS system afloat. Other class ship's systems are slightly different. For specific information on equipment and operations onboard your ship, refer to your ship's SIB *(Ship's Information Book)* and equipment technical manuals.

GASOLINE STORAGE TANKS

In addition to the compensating systems inside gasoline tanks, which protect against explosion by keeping air away from the fuel surface, tanks are also protected externally by a cofferdam.

Storage tanks are rectangular and are provided with either seawater or inert gas compensating systems.

The gasoline storage tanks (fig. 4-8) of the MOGAS system are designed to provide the greatest possible safety for the storage of gasoline.

A storage tank actually consists of two tanks—an outer tank, a drawoff tank, and a cofferdam. The outer tank encloses the drawoff tank, and a cofferdam surrounds the outer tank.

Cofferdam

The cofferdam (fig. 4-8) provides two-fold protection for the storage tanks. The cofferdam is normally kept charged with nitrogen (N_2) to 3 psi at 50% inertness or carbon dioxide (CO_2) at 35% inertness to reduce fire and explosion hazards. It also collects any leakage from the storage tanks.

The nitrogen supply line for purging and charging the cofferdam terminates in a loop, which completely encircles the outer tank. From this loop (located near the top of the cofferdam), pipes (legs) extend down to near the bottom. Each leg is fitted with a diffuser, which serves to spread the inert gas throughout the space. A stop valve for controlling the nitrogen entering the tank is located in the main supply line at the pump room level.

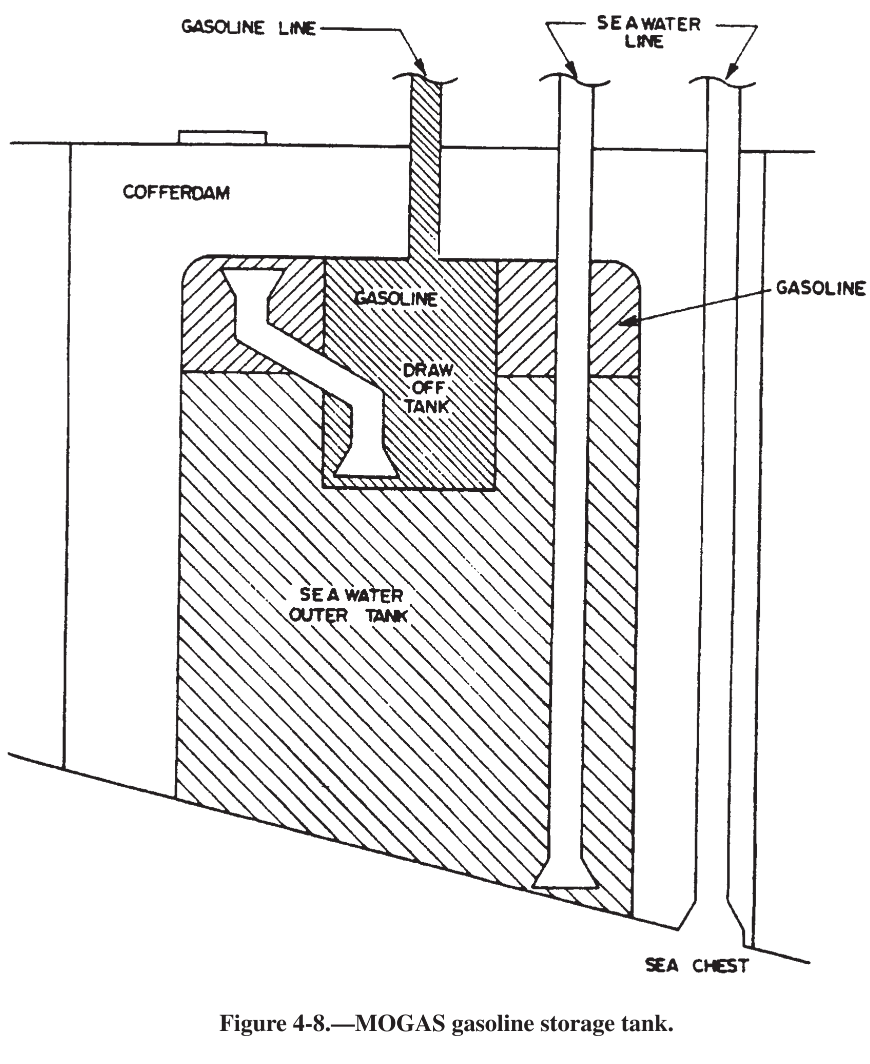


Figure 4-8.—MOGAS gasoline storage tank.

An air escape riser, fitted with a shutoff valve, extends from the top of the cofferdam and vents to the atmosphere at the 02 level. A bypass line is installed around the shutoff valve. This line contains a pressure-relief valve (set at 4 psi), a pressure gage, and a portable inertness analyzer connection.

A fixed eductor is installed in the cofferdam to remove any seawater or gasoline that might escape from the storage tanks. The eductor is fitted with two suctions:

1. Near the centerline at the forward end of the cofferdam.

2. Near the centerline at the after end of the cofferdam.

The controls for the eductor are located in a watertight box on the pump room deck.

Two static-head liquid-level gages or electronic sensors are installed in each cofferdam to indicate the presence of leakage into the compartment. One is located on the centerline in the forward end of the cofferdam and the other on the centerline in the after end. This arrangement makes it possible to determine the presence of leakage, regardless of the trim of the ship.

Access to the cofferdam is gained through a bolted manhole cover in the pump room deck. Normally, the cofferdam manhole cover is located directly over the outer tank manhole cover.

Outer Tank

The seawater supply riser enters the outer tank (fig. 4-8) at the top and terminates in a diffuser near the bottom. The seawater required for pressurizing the tanks is discharged through this line.

A pressure gage line extends from the top of the outer tank to a pressure gage located in the pump room. The gage has a red pointer, indicating the maximum allowable tanktop pressure for that set of tanks. (Allowable pressures will vary for the different classes of ships.) A warning plate attached near each gage reads:

WARNING

The maximum allowable tank-top pressure shall not be exceeded when taking on fuel.

For seawater compensated systems, the red-pointer setting is equal to the difference between the design tank-top pressure and the height correction (in psi for the gasoline being used) from the tank top to the centerline of the gage. For inerting systems, the maximum tank-top pressure is 4 psi of CO_2 regardless of the amount of gasoline in the tank. The cutout valve in the seawater overboard discharge line at the shell is locked open and classified as a damage control fitting W (William marking).

Two in-tank reservoirs for water-filled, static-head gasoline gages are installed in the outer tank. One reservoir is installed at the top of the tank and the other at the bottom directly underneath the upper reservoir. Stuffing boxes are provided where the tubing for the gage passes up through the outer tank. The stuffing boxes prevent leakage of gasoline and seawater out of the tank. They also prevent nitrogen in the cofferdam from entering the tanks.

The outer tank is interconnected with the drawoff tank by a sluice pipe. The sluice pipe extends from near the top of the outer tank and terminates in a diffuser at the bottom of the drawoff tank. The top of the sluice pipe is flared to reduce friction. The outer tank completely envelopes the drawoff tank.

The outer tank has a motor-driven stripping system installed for deballasting the tank. The independent hand-stripping system also ties into the outer tank to remove water and sludge from the bottom of the tank.

Drawoff Tank

The drawoff tank (fig. 4-8) is the smaller of the two tanks. It is the tank from which gasoline is drawn when servicing or off-loading fuel. It is the first tank filled when MOGAS is being received and the last tank emptied when MOGAS is being off-loaded.

The gasoline supply riser extends from the extreme top of the drawoff tank to the common suction header of the gasoline pump. The recirculating header terminates in a diffuser at midpoint in the draw-off tank.

The draw-off tank is provided with an independent stripping system to remove water and sludge from the bottom of the tank. This system is similar to the hand-operated type used with the JP-5 service tanks. The suction line is fitted with a shutoff valve and extends three-fourths of an inch off the bottom of the lowest part of the tank. The discharge line, fitted with a sight glass, test connection, one-way check valve, and a shutoff valve, terminates in two places: 24 inches off the bottom of the outer tank, and overboard.

The drawoff tank has a pneumatic, static head, differential pressure gage, or a liquid level indicator system. The gages for these systems are arranged on a gage board installed in the gasoline pump room.

Drain Tank

The drain tank is a small tank located inside the outer storage tank. The drain tank stores contaminated MOGAS/water that is filtered/separated out of the MOGAS.

Storage Tank Diffuser

The diffuser (fig. 4-9) reduces turbulence when gasoline or seawater enters the storage tank. Diffusers are mounted on the bottom of the gasoline storage tanks around the end of each sluice pipe and seawater supply riser. They are bolted to clips or brackets that are welded to the bottom of the tank and to the bulkhead.

The diffuser is a perforated cylinder with an open bottom, and it has a top plate with an opening for the gasoline or seawater supply pipe. The opening in the top plate is larger than the outside diameter of the supply pipe, which permits the pipe to move with the movement of the ship's structure. The total area of the perforations in the diffuser is five times that of the area of the supply pipe. Gasoline or water enters the diffuser in a single stream and is broken into smaller streams as it passes through the holes in the cylinder. The distribution of flow over a large area reduces turbulence.

In seawater compensated tanks, a sluice pipe is installed between the outer and drawoff tank. The upper end of the sluice pipe in the outer tank is located at the highest point of the tank, and the lower end terminates near the bottom of the drawoff tank. The diffuser is mounted on the bottom of the drawoff tank at the end of the sluice pipe. The inert gas displacement system does not require sluice piping.

Tank Gaging Equipment

There are two different types of gaging systems used to determine the amount of gasoline in MOGAS tanks. They are the water-filled, static-head type and the Gems TLI system.

STATIC-HEAD TYPE GAGING SYSTEM.— The remote reading tank liquid level indicating system consists of tank upper and lower sensing heads that have a diaphragm or bellows sealed sensing head that connects to differential pressure indicators through liquid filled tubing. The differential pressure indicator (fig. 4-10) is calibrated in gallons of liquid.

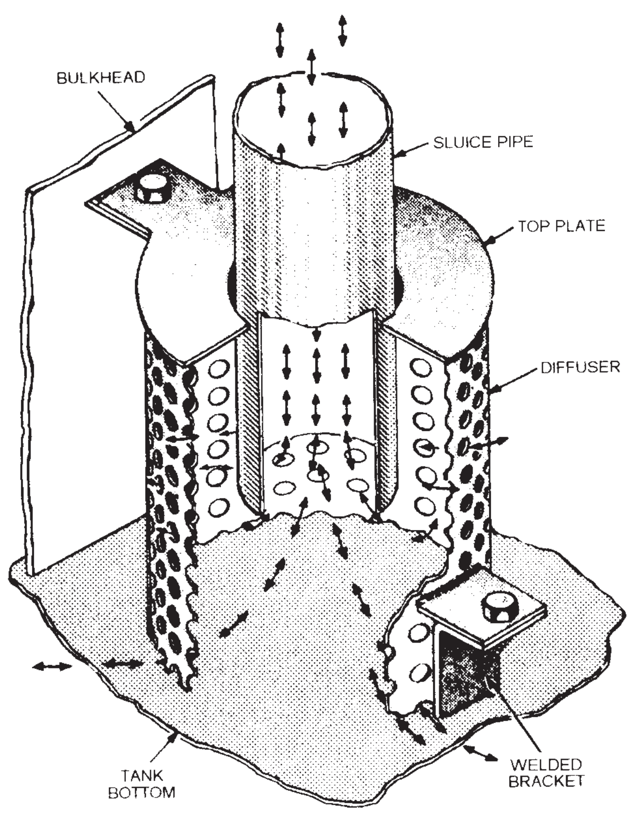


Figure 4-9.—MOGAS storage tank diffuser.

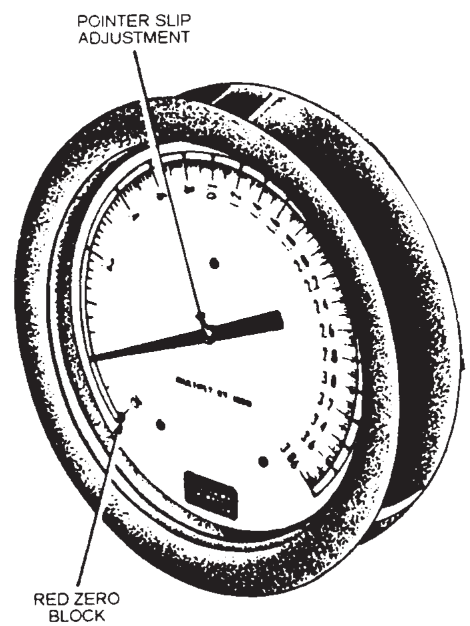


Figure 4-10.—Differential pressure gage.

A pneumatic, static head, differential pressure, liquid level indicator system is installed in outer gasoline tanks and in cofferdams surrounding gasoline tanks or in gasoline tank compartments.

When the storage tanks are full (100%) of seawater, a constant differential pressure exists between the upper and lower in-tank reservoirs, and the differential pressure gage reads zero. As the storage tanks are filled with gasoline, a varying differential pressure is developed between the upper and lower in-tank reservoirs. This varying differential pressure, created by the difference in specific gravities of the two liquids (gasoline and seawater), is transmitted to the gage through the liquid filled connecting lines. The differential pressure gage senses this varying differential pressure and converts it to gallons of gasoline present in the storage. This gage consists of three basic units: the bellows, torque tube, and dial mechanism.

TANK LEVEL INDICATOR (TLI).—This indicator system consists of a magnetic float, a transmitter or sensor, and primary and secondary receivers. The transmitter stem consists of a rod or series of rods mounted vertically within the tank. The magnetic float operates reed tap switches in the rod as it moves up and down on the surface of the fluid. The electrical resistance caused by the float movement is transmitted to a receiver (dial indicator), which is calibrated in gallons of liquid.

Magnetic float liquid level indicators in tanks overflowing directly overboard have integral high-level alarms to warn of an impending overboard fuel discharge. The alarms are set to sound at a point between 95 and 97 percent of tank capacity. The selected alarm point is based on providing an approximate 2-minute warning that the tank has been overfilled and an overboard fuel discharge will occur unless tank filling is immediately secured. Alarm set points are above 95 percent tank capacity to prevent their activation during routine tank filling.

TLIs used in MOGAS tanks are just like the TLIs used in JP-5 tanks. The float for the TLI used in MOGAS systems is constructed of Hycel. This material is designed to float on water and sink in fuel.

That means the float will be at the cleavage line (interface) of the water and MOGAS. Refer to Chapter 2 for information on TLI components and operations.

GASOLINE FILTER SEPARATOR

The gasoline riser has a filter/separator for the removal of water and sediment from the gasoline. The filter/separator has a bypass, a vent, and a manual drain. A pilot-operated stop valve at the filter/separator outlet prevents delivery of water to the service station.

The operation of the MOGAS system filter/separator is exactly the same as that of the JP-5 system filter/separator. See Chapter 2 of this manual for information on its components, operation and maintenance.

MOGAS PUMPS

The MOGAS pumps on LPDs are centrifugal pumps with a rated capacity of 110 gpm at 50 psi. MOGAS pumps are typically called transfer pumps.

Electric motor driven centrifugal gasoline booster pumps (commonly called gasoline pumps) and seawater compensating pumps are installed on LPDs and LHAs. LSTs have seawater turbine hand-operated gasoline pumps. The motor-driven gasoline pumps and associated piping are of nonferrous construction and are installed so that the pumps will not become air-bound. The electric motors for the gasoline pumps and seawater pumps that are located in the gasoline pump room are installed in an adjacent compartment separated from the pumproom by an airtight bulkhead. Motor shaft stuffing boxes in the bulkheads are also airtight.

Start-stop, explosion-proof pushbuttons for each of the pump motors are installed in the associated MOGAS motor room. A mechanical linkage or explosion-proof electrically intrinsic controller allows remote operation of the gasoline and seawater pumps from the MOGAS pump room. In addition, a disconnect switch is installed in the control circuit of each gasoline and seawater pump. These switches are located at the entrance to the access trunk of the pump room and are fitted with an instruction plate inscribed:

WARNING

Gasoline and seawater pump disconnect switch. Contacts shall be open at all times when pumps are not in use.

When securing the plant, open gasoline pump and seawater pump disconnect switches at the entrance to access trunk to gasoline pump room. An instruction plate is provided at the pumps and inscribed:

WARNING

Power to electric motor-driven gasoline and seawater pumps shall be shut off at all times except when required.

The following pumps are associated with the MOGAS system:

1. Seawater Compensating Pumps. These pumps are centrifugal, motor-driven, and have capacities that range form 100 to 220 gpm. They are used to pump seawater into the tanks to displace gasoline.

2. Hand Stripping Pump. This is a hand-operated pump with a capacity of 10 to 30 gpm. It is used to remove free water and sediment that forms at the bottom of the drawoff (or CO_2 compensated gasoline storage) tank.

3. Gasoline Pumps. One of three different pumps is provided to supply gasoline to the MOGAS fueling station(s).

a. Seawater turbine-driven centrifugal pump.

b. Electric motor-driven pump (centrifugal type) with a capacity of 35 to 160 gpm.

c. Hand-operated pump with a capacity ranging to 30 gpm.

4. Defueling Pumps. These pumps are located at the vehicle fueling stations on some LPD ships, and are used only for hose evacuation. Do not use for defueling vehicles. The pumps are electric motor-driven (rotary type) and have a capacity of 50 gpm.

5. Seawater Leak-Off Pump. This is an electric motor-driven pump (centrifugal type) of 10 gpm.

PIPING SYSTEMS

The gasoline piping and equipment within the ship is mainly confined to gasoline spaces such as pump rooms, replenishment or service stations, and similar compartments. Piping within the ship, but external to these spaces, is double-walled and located within trunks. The operation and routine maintenance of the gasoline systems can be performed from outside the inerted cofferdams or gasoline tank compartments.

Double-Walled Gasoline Piping

When MOGAS passes through spaces, it is carried in double-walled piping that consists of two concentric pipes (fig. 4-11). The inner pipe is copper nickel and carries the fuel. The outer pipe is constructed with steel and serves as an armor casing. The outer pipe also serves to contain a protective jacket of inert nitrogen gas at 3 psi in the outer piping. A pressure gage for the double-walled piping is installed in the pump room to indicate the pressure in the inner piping. The gage has a range of 0 to 15 psi, with the section of 9.5 to 10 psi identified as the normal charging pressure.

If the outer casing is pierced, the nitrogen gas will leak out. The resulting drop in pressure will be indicated on the gage. Also, if a rupture should occur in the fuel line inside the steel casing, the resulting increase in pressure will be indicated on the gage. Isolate the piping until the cause has been determined.

Expansion bellows are provided in the outer casing to avoid strains in the casing due to unequal expansion, which may result in leakage of the nitrogen gas. Drain plugs in the bellows can be used to determine whether any leaks have occurred in the inner piping. Brass liners soldered to the outside of the inner piping and

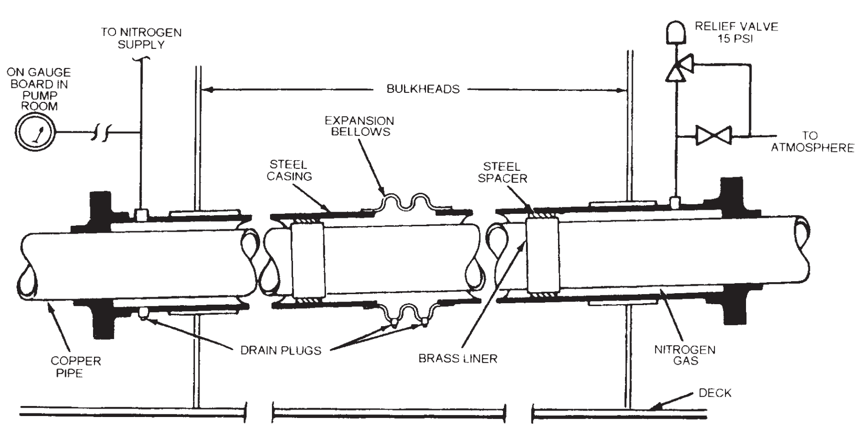


Figure 4-11.—Double-walled piping.

steel spacers welded to the inside of the outer piping are placed at intervals of about 5 feet. These serve to hold the inner piping in the center of the outer piping and still allow for movement caused by expansion and contraction between the two pipes. The outside piping is about 2 inches larger than the inner piping.

An inert gas connection, for charging the outer piping, is provided at the lower or inboard end of the double-walled piping. The outer piping is also provided with a relief valve to avoid excess pressure. The released inert gas is vented to the atmosphere through separate piping. The relief valve is set at 15 psi.

Coamings around gasoline pumps and hose reels in enclosed gasoline service stations are provided to collect spilled gasoline. Service mains and branches have a slope toward the storage tank to permit drainback. Pockets are avoided in the gasoline system, or drain piping is provided and led back to the storage tanks.

Seawater Piping and Valve Arrangement

The seawater system supplies seawater (under pressure) to the outer tank to force gasoline up to the transfer (gasoline booster) pump. It also provides a means for flushing and draining the storage tank, and limits the amount of pressure that can be applied to the tanks at maximum pump capacity.

In other applications, the piping is arranged so that seawater compensated storage tanks can be continuously flushed with seawater. Ships having compensating water supplied by a gravity head tank have hose connections in the seawater piping for a temporary supply of flushing water. The seawater overflow and filter drain piping are located and arranged to prevent freezing of seawater in the pipes. Heating coils or other means are provided to prevent freezing.

Seawater is supplied directly from the sea, through a sea chest located in the cofferdam around the storage tanks. A steel grating installed in the opening of the ship's bottom prevents large objects from being drawn into the system. Steam is used for cleaning out the sea chest in the event of clogging. Steam has a two-fold effect for cleaning purposes. It can be supplied at an adequate pressure for blowing out any debris, and it also provides a "cooking effect" to remove remaining gasoline vapors as well. A shutoff valve is located between the sea chest and the sea chest supply riser. This valve is LOCKED OPEN.

The sea chest supply riser connects directly to the suction header of the seawater pump. An additional shutoff valve is installed in this line at the pump room level.

The motor-driven, centrifugal seawater pump is located in the MOGAS pump room, and the motor is in the adjacent pump motor room. The pump suction line is fitted with a basket strainer, a one-way check valve, and a compound gage. The discharge line contains a pressure gage and a shutoff valve. On centrifugal pumps, the pump inlet is always larger than the discharge line.

NOTE

LPDs have a separate seawater pump room, located in the starboard shaft alley.

The discharge header is connected to the outer tank seawater supply riser and the seawater expansion tank fill line. Shutoff valves installed in this line can be used to direct pump discharge pressure into the outer tank for pressurizing the system during normal operations or filling the expansion tank.

The expansion tank is a 500-gallon tank kept full of seawater. Its purpose is to keep the MOGAS tanks full at all times by allowing for contraction of the MOGAS.

The outer tank seawater supply riser terminates in a diffuser at the bottom of the outer tank. This line contains a spectacle flange (or pipe blind) and a steam-out connection. The spectacle flange is rotated to the closed position when steam is injected either here or at the outer tank manhole cover for steaming tanks.

Gasoline piping has fittings for steaming out by either a pressure or vacuum steaming process. All items of equipment subject to contact with steam are constructed to withstand a temperature of 240 °F without damage. The number of flanged joints in gasoline piping is kept to a minimum. Buna-N cork gaskets should be full-faced, compressed from the original thickness of 0.125 inch to between a minimum gasket thickness compression of 20 percent (0.100 inch) and a maximum compression of 3 percent (0.088 inch). If present gaskets are flat ring, they will be replaced when the joint is repaired.

A flange is provided on the outboard shell at the seawater overflow line so that, by use of an adapter, a tight joint can be made between the overboard discharge and the vacuum steaming equipment during vacuum steaming out. A portable protector ring is provided to protect the flange face and studs from corrosion. A protective cover is provided for the overflow line and is hinged to permit attachment of the vacuum steaming equipment.

The overboard discharge line is led upward in a loop from the expansion tank and then overboard just above the third deck level. The height and size of the overflow loop act as a relief device. It limits the pressure that can be exerted on the tanks (within the maximum allowable limits) when maximum pump capacity is discharged overboard. This would be the condition when the delivery of gasoline is stopped and the seawater pump continues to operate. However, the height of the loop and the expansion tank also maintains an adequate backpressure on the tanks to force gasoline to the suction side of the gasoline pumps. This ensures a positive pressure (0.5 to 1 psi) is maintained when maximum delivery of gasoline is being made. A one-way check valve and a shutoff valve are installed near the end of the overflow line. The shutoff valve is normally LOCKED OPEN. Steam-heating coils are installed around the overflow line at the shell connection to keep the line clear during icing conditions.

A vent line extends from the top of the loop to the atmosphere at the 02 level. The vent line is provided to break the siphoning effect of the overflow loop to prevent lowering the pressure at the gasoline pump suction header. This line also may be equipped with steam-heating coils.

Tank Filling and Distribution Piping

The system can receive gasoline through 2-inch, 2 1/2-inch, or 4-inch hoses at the gasoline replenishment station. The gasoline filling connection is accessible for connecting to the gasoline hose from a shore connection. A blank flange or hose cap is provided for the specified delivery capacity per hose with a minimum of 10 psi at the outlet of the hose nozzle at the most remote fueling station. To ensure for safety during receiving operations, a warning label must be posted on these stations stating:

WARNING

The filling connection shall be at least 15 feet away from high frequency transmitting antennas or liquid oxygen outlets.

Pressure-Regulating and Venturi Piping

On LHAs and some LPDs, the gasoline riser from the gasoline pump is fitted with a combination pilot-operated pressure-regulating valve and venturi located in the gasoline pumproom. It controls topside pressure at the inlet to the fueling stations.

Pump and Venturi Recirculating Piping

A recirculating line, containing an orifice is installed on the downstream side of the venturi. The rate of venturi recirculation is sufficient to permit satisfactory operation of the regulating valve and venturi combination under a no-delivery condition. A recirculating line, with stop-check valve, is also installed for the recirculation of 5 percent of the output of the motor-driven gasoline pumps and terminates at the mid-height of the drawoff tank. A warning plate is installed at the pump stating:

WARNING

Venturi and pump recirculation line valves must be open before starting pump.

INERT-GAS PRESSURE REGULATING VALVE

The inert gas regulating valve consists of a dome and body separated by a rubberized diaphragm. The diaphragm actuates the poppet valve in the valve body by forcing down the valve stem. A compression spring below the poppet valve tends to return the valve to its seat against the force of the diaphragm. The dome is filled with inert gas under pressure when the valve is adjusted. This gas pressure acts on the upper surface of the diaphragm. A pressure chamber on the underside of the diaphragm fills with nitrogen through an opening to the discharge, or low-pressure, side of the valve. Thus, when the valve has been adjusted and is in operation, the pressure on the upper side of the diaphragm acts to force the valve open. This force is balanced by the low-pressure gas on the underside of the diaphragm and the spring under the poppet valve. When low-pressure gas is taken from the system, the pressure on the discharge side starts to fall, and the regulating valve opens to permit passage of gas from the high-pressure side of the valve. The distance the valve opens depends on how fast the low-pressure gas is being used. When use of low-pressure gas is stopped, the pressure on the underside of the diaphragm starts to increase, and the valve closes to stop the flow of high-pressure gas.

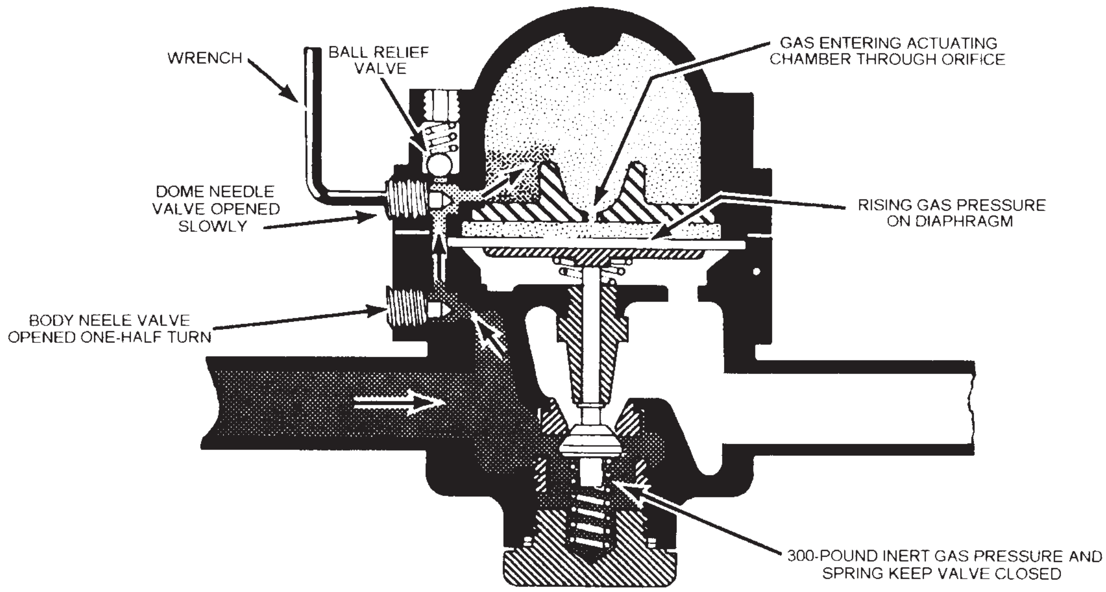


Figure 4-12.—Adjusting the inert-gas-pressure-regulating valve.

When the regulating valve is being adjusted, nitrogen gas from the high-pressure side of the valve is admitted to the dome chamber through an orifice controlled by two needle valves (fig. 4-12). A ball relief valve to the orifice will release gas if the high-pressure needle valve in the body is opened too far.

To put the reducing valve in operation, use the following procedure:

1. Close the valve body needle valve and dome needle valve.

2. Close the stop valve on the low-pressure side. Open the inlet valve on the high-pressure side and open the low-pressure gage valve.

3. Open the body needle valve one-half turn to permit gas to flow into the loading channel.

4. Open the dome needle valve slowly. This permits gas to flow into the dome. Gas entering the dome flows through the orifice in the dome plate and acts on top of the diaphragm.

5. The increasing gas pressure forces the diaphragm down and slowly opens the valve. Gas then flows through the valve opening into the low-pressure side of the valve and into the lower pressure chamber. There, the increasing pressure of the gas acts on the underside of the diaphragm, pushing it up to close the valve (fig. 4-13). When the low-pressure gages register the desired pressure, take the following actions:

   a. Close the dome needle valve.

   b. Close the body needle valve.

The valve is now adjusted and ready for use. Figure 4-14 shows the pressure-regulating valve in operation.

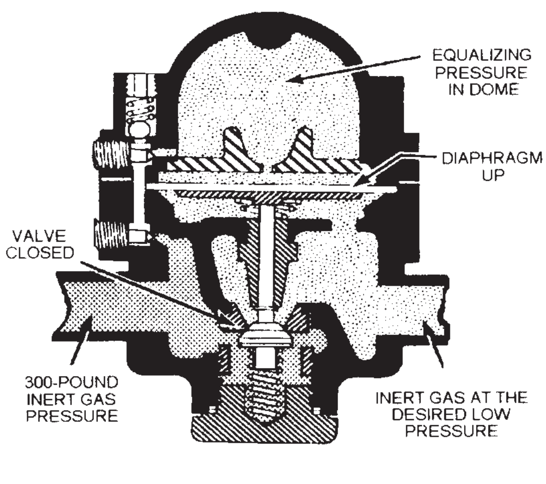


Figure 4-13.—Inert gas system balanced, valve closed.

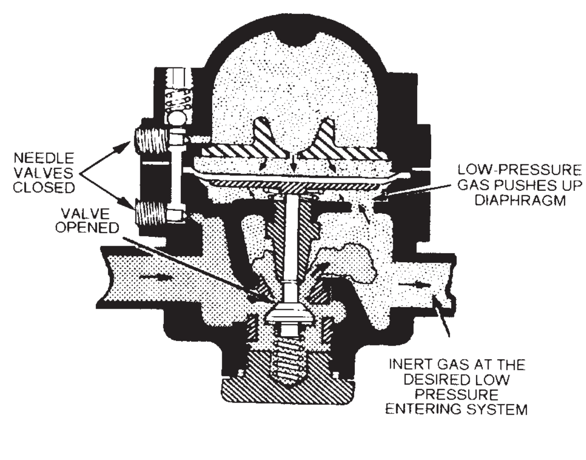


Figure 4-14.—Valve in operation.

Sylphon Packless Globe Valve

The *Sylphon* packless globe valve (fig. 4-15) is used to stop the hazardous leakage of gasoline past the packing in ordinary valves by providing a metal bellows *(Sylphon)*, which prevents liquid from escaping through the valve stem opening.

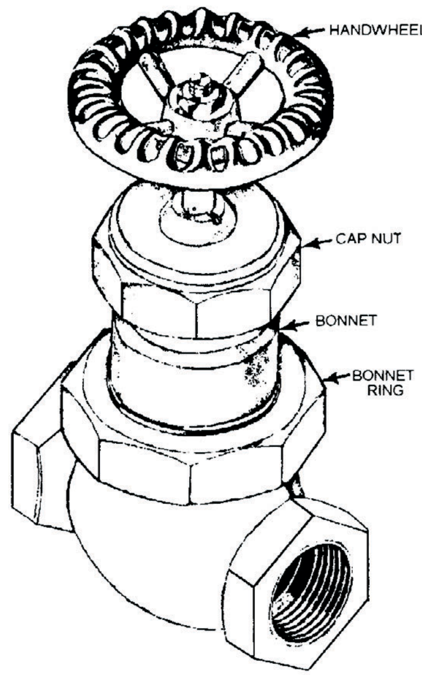
Sylphon packless globe valves are used in the pump room on the drainage piping from the centrifugal pumps, on other small-diameter pipelines carrying gasoline or nitrogen, and on steaming-out connections.

The *Sylphon* packless globe valve controls the flow of liquid the same way as an ordinary globe stop valve. When the control handle is turned, a poppet at the end of the valve stem is lifted from a valve seat and permits flow through the valve. It has an expandable, metal bellows (or *Sylphon*) assembled between the valve poppet and the bonnet cap nut. This permits the valve stem to be raised or lowered while maintaining a complete seal around the stem at all times. In the ordinary globe valve, fiber packing is used to prevent the escape of liquid. This packing deteriorates or shrinks and allows dangerous leakage of liquid or vapor. The *Sylphon* bellows may be replaced if it corrodes or breaks.

CLA-VAL Backflow Preventer

The CLA-VAL backflow preventer (fig. 4-16) inter-connects the MOGAS system with the fresh water system. The valve combines maximum protection against backflow with exceptionally low head loss characteristics. It operates on the reduced pressure principle, an accepted method of safeguarding potable water supplies against the hazards of contamination from MOGAS fuel.

The backflow preventer unit is constructed of corrosion resistant materials. It consists of two independently acting poppet-type check valves, an automatic pressure differential relief valve located between the two check valves, two shutoff valves and four test connections. The test connections provide the means for easily field testing the valve.



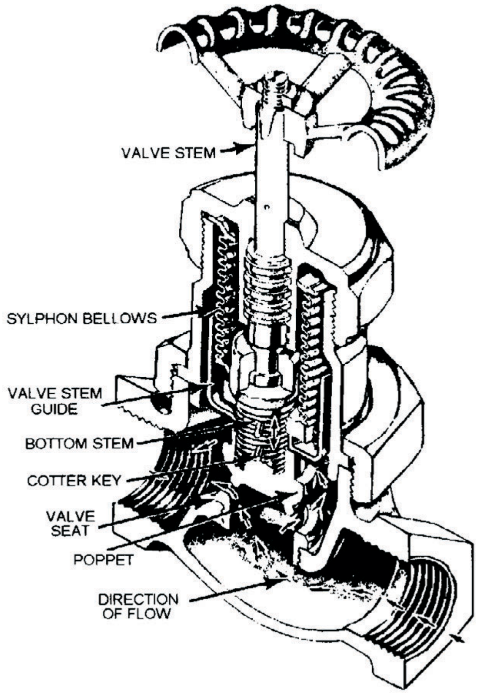
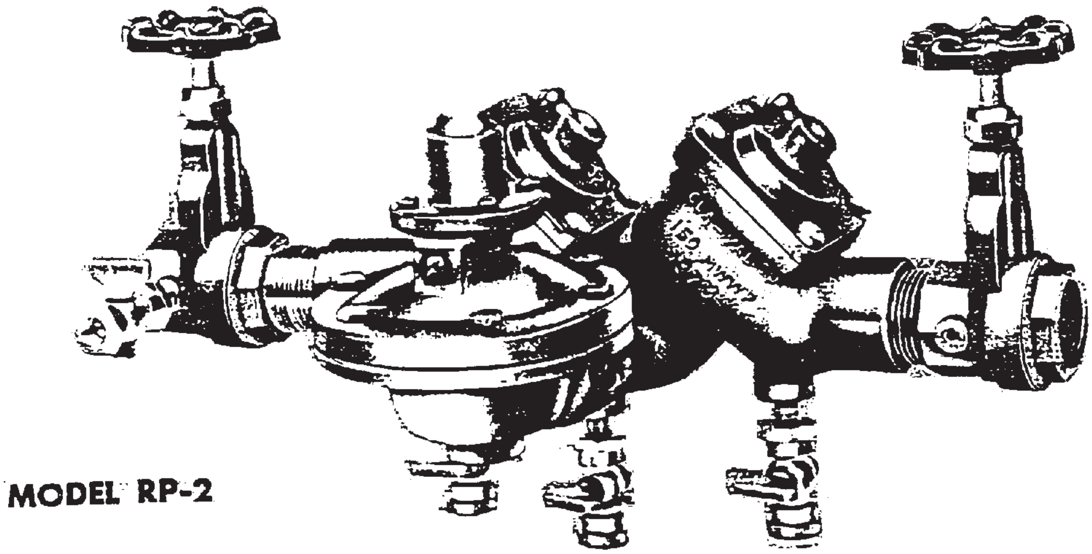


Figure 4-15.—Sylphon packless globe valve.



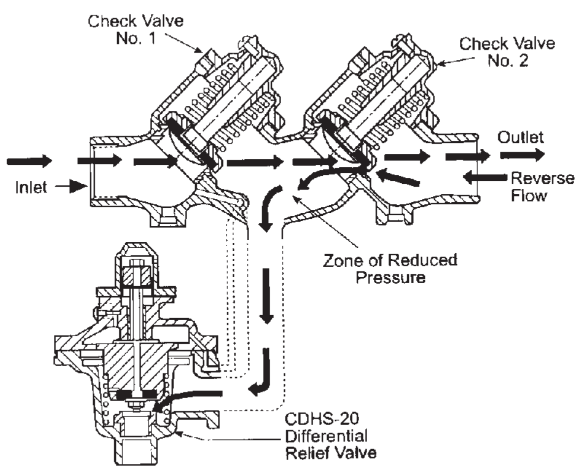


Figure 4-16.—CLA-VAL Backflow Preventer.

When normal flow conditions exist, both check valves within the unit are open and the pressure differential relief valve is closed. No pressure adjustments are required. The unit operates efficiently at either high or low pressures. The valve automatically compensates for pressure variations under rated flow conditions.

If flow ceases, pressure between the check valves is maintained lower than the inlet pressure. Should the inlet pressure drop to reduced pressure, the differential relief valve opens to the atmosphere. If a backflow condition exists, the pressure differential relief valve will open to maintain pressure less than the inlet pressure.

PORTABLE MOGAS PLATFORMS

Storage

The types of containers used onboard ships for storing gasoline products are:

- Safety cans (5-gallon metal containers)
- Fifty-five gallon drums (metal or plastic containers)
- Collapsible rubberized fabric drums (bladders, common with MEU onboard amphibious ships)
- Rigid portable fuel containers

WARNING

Containers, even when empty, will contain enough residual gasoline liquid and vapors to support ignition or explosion. They shall be treated with the same precautions as when full. Drain containers completely or until fully deflated. Replace cap or plug tightly. Store on the weather deck IAW NSTM 670. Refill containers when supplies are available or dispose of them as soon as possible.

Applications

Only the minimum required amount of portable MOGAS equipment (based on the expected usage rate for each deployment) shall be carried aboard ship. Portable gasoline container units are permitted aboard ship only in support of the following essential equipment.

- HLU-196 bomb hoists as well as crash and rescue equipment (K-12 Crash Saw) on aircraft carriers.
- USMC, EOD, and SOF equipment that requires gasoline as a fuel.
- Unmanned Aerial Vehicles (UAVs)

Jettison platforms vary from ship to ship. They are used for storing RETROGRADE GASOLINE (oil-mix), SMAU containers, and bladders. They consist of the Jettison tilt locker platform Rod Rack (3 barrels) and Jettison Slide (6 barrels). Retrograde gasoline is the primary type of fuel for outboard engines used by Special Warfare (EOD and SEAL Teams) personnel.

Replenished MOGAS storage containers must be positioned and secured on appropriate jettison racks or lockers. Drums and 500-gallon bladders may be refilled from a source on the pier.

Safe Handling Procedures

Gas for HLU-196 bomb hoists and crash/rescue saws should be stowed on the weather deck or in racks with the vehicles. Whenever possible, specifically configured Halon-protected spaces in hangar sponsons should be utilized as a storage compartment. The M151 vehicles shall be stowed with gas tanks three-quarters full. Auxiliary 5-gallon MOGAS cans shall be designated and can be stored on racks provided on the M151 vehicle. MOGAS cannot be transferred from these cans while onboard.

When in port, the jettisonable feature on all MOGAS jettison racks/platforms shall be equipped with a mechanism to allow the racks to be safed. This feature ensures that MOGAS jettison racks be overridden to preclude inadvertent actuation, thereby ensuring the safety of personnel on the pier or working in boats, barges, and on breasting camels alongside.

Prior to loading MOGAS aboard, the integrity of all storage containers (drums, bladders, and rigid metal or plastic cans) shall be verified. Inspect for evidence of leakage, advanced rust or deterioration. Any containers showing signs of leakage shall be rejected. Jettison racks, lockers, and release mechanisms shall be inspected and maintained IAW PMS.

All gasoline containers should be stowed aft, if possible, and in the location that poses the least threat to the ship in the event of fire or explosion. These containers should be situated on weather decks, located so that they may be readily jettisoned overboard.

A warning plate is installed in a conspicuous place or placed near the access to possible hazard areas. It is inscribed in red letters 1-inch high:

WARNING

GASOLINE HAZARD AREA. Smoking, use of naked lights, matches or lighters, use of tools that may produce sparks, wearing of clothing or shoes with exposed metal attachments, and any other actions leading to ignition of gasoline vapor are not permitted.

COLLAPSIBLE MOGAS BLADDERS.— Afloat units may request evidence of compliance from any user prior to allowing MOGAS bladders aboard ship. An example of acceptable evidence of compliance is a tag identifying the date maintenance was performed on the bladders. The maintenance signifies the bladders have been air-tested within the last 12 months. Air testing these bladders is not the responsibility of ship's personnel. Bladders with patches are not acceptable for use aboard ship.

PORTABLE MOGAS CONTAINERS.— Dedicated drums marked "MOGAS" and "MOGAS PLUS OIL MIXTURE" can be utilized for consolidation and/or reissue. When necessary, partially filled bladders may be stored in approved 55-gallon rigid drums and stowed on jettisonable racks until replenished or redeployed.

All burning or hot work restrictions within 50 feet of MOGAS storage areas in all directions shall be strictly enforced.

Q4-13. What prevents leakage of gasoline and seawater from the tank and also does not allow nitrogen to enter the cofferdam?

Q4-14. Where is the drain tank located in the MOGAS system?

Q4-15. What type of gaging system uses a diaphragm or bellows activated pressure sensing differential indicators at the upper and lower sensing head to gage tank quantity?

Q4-16. What is the rated capacity of the centrifugal Seawater Leak-Off pump?

Q4-17. What is the pressure relief valve set at for the outer piping to the double-walled piping?

Q4-18. How far away should high frequency transmit antennas or liquid oxygen outlets be kept from MOGAS refueling connections?

Q4-19. Along with the gas introduced into the inert gas pressure-regulating valve, what component controls opening and closing?

Q4-20. What unit is provided in the MOGAS system as an accepted method of protecting fresh water supply from gasoline contamination?

Q4-21. MOGAS jettison, lockers, and release mechanisms are inspected and maintained in accordance with what instruction?

Q4-22. What evidence must be provided before any MOGAS bladders are allowed onboard ships?

ATMOSPHERIC TESTING EQUIPMENT

LEARNING OBJECTVE: Identify the types of testing equipment used to detect gases in MOGAS operations. Describe MOGAS testing equipment components and how they function. Explain how testing equipment is used to monitor MOGAS operation.

Inerting involves replacing oxygen/vapor mixture in the space with inert or non-flammable gas so that the resulting atmosphere will not support combustion. The oxygen level that supports combustion varies with the contaminant present and the inerting medium. For a space to be fully inerted, the oxygen level should be reduced to less than one percent.

The portable inertness analyzer is the most common instrument used by an ABF to analyze inerting agents used in the MOGAS systems.

PORTABLE INERTNESS ANALYZER

The inertness analyzer (fig. 4-17) is a portable, battery-powered instrument used to indicate the

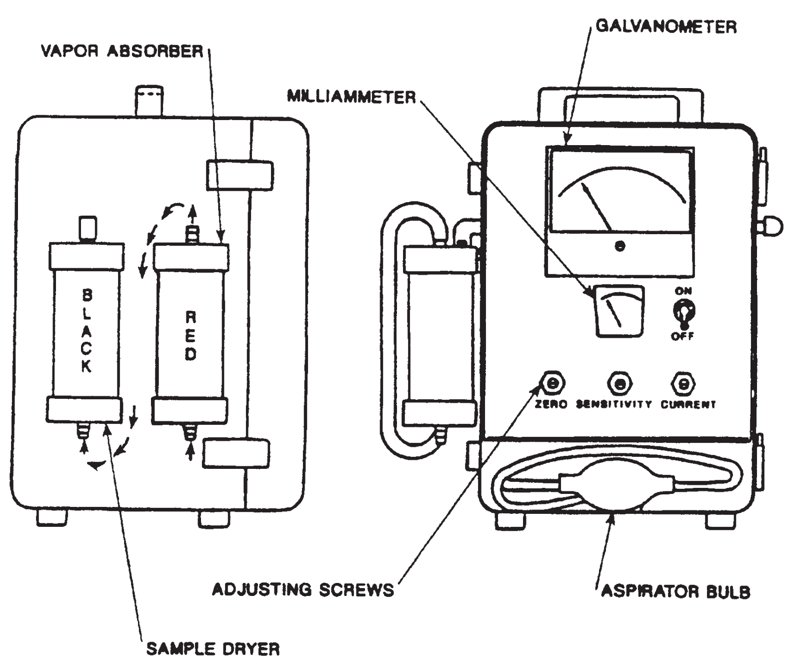


Figure 4-17.—Portable inertness analyzer.

presence of inert gas and combustible vapors in voids surrounding gasoline storage tanks, double-wall piping, and filters when the service system is being purged.

Components and Functions

The instrument is contained in a case with a carrying handle. On the front of the box are the controls, indicating dial, and an aspirator pump. An ON-OFF switch controls electrical power to the analyzer. A milliammeter indicates the analyzer current in milliamps. The galvanometer indicates presence of inert gas in percentage of inertness.

The unit has three potentiometers: the current potentiometer that is used to set the analyzer current to 150 milliamps, the sensitivity potentiometer that is used to calibrate the analyzer, and the zero potentiometer that is used to make a final adjustment to zero the galvanometer, if necessary.

> **NOTE**
>
> The analyzer is calibrated for ship specific inert gas (carbon dioxide or nitrogen).

Two chemical cylinders are mounted on the side of the unit. The black cylinder, a sample dryer (which has only a bottom hose connection) is filled with calcium chloride that absorbs moisture from the sampled air. The red cylinder is the vapor absorber (which has upper and lower hose connections). It is filled with activated carbon that absorbs fuel vapors from the sample. An aspirator bulb and hoses are used to pump samples through the analyzer. Two 6V-dc batteries power the unit.

Operation

Before using the instrument to analyze an enclosure, the unit must be prepared in normal room air. The current must be adjusted, and the analyzer must be purged and zeroed.

To prepare the analyzer for use, turn the unit ON, adjust the current to 150 milliamps, and allow 2 minutes for the analyzer to reach operating temperature. Make sure the aspirator discharge is connected to the analyzer. Then use the following steps:

1. Connect the aspirator bulb and hoses to the inlet of the sample dryer.
2. Aspirate air through the analyzer until the galvanometer needle comes to rest.
3. If necessary, set the galvanometer needle to zero using the zero adjustment.

To analyze enclosures containing air and inert gas, use the following steps:

1. Connect the aspirator bulb and hose between the sampling outlet of the enclosure to be tested and the inlet of the sample dryer.
2. Operate the aspirator bulb until the galvanometer needle comes to rest.
3. Note the reading.

To analyze enclosures containing air, inert gas and fuel vapors, use the following steps:

1. Connect the aspirator bulb and hose between the sampling outlet of the enclosure to be tested and the inlet (bottom) of the vapor absorber.
2. Connect the jumper hose between the outlet (top) of the vapor absorber and the inlet of the sample dryer.
3. Operate the aspirator bulb until the galvanometer needle comes to rest.
4. Note the reading. If this reading is not the same as the reading when testing for only air and inert gas, fuel vapors are present and *this reading is the correct percentage of inertness*.

Upon the completion of all analysis, turn the analyzer off and purge the vapor absorber in a normal room atmosphere. Connect the aspirator hose and bulb to the outlet (top) of the vapor absorber and operate the aspirator bulb for three minutes.

Maintenance

The batteries have a useful life of about 100 hours. When the current adjustment rheostat does not bring the indicating needle to 150 milliamps on the scale, the batteries should be replaced.

> **NOTE**
>
> If the analyzer is to be stored for a long period of time, remove the batteries.

After every 50 analysis, examine the calcium chloride and replace it if it is glazed or hard. Also, the activated carbon should be reactivated or replaced after every 50 analysis.

Reactivate the carbon by thoroughly flushing it with fresh water and then allowing steam to pass through it for about an hour. Before putting the reactivated carbon back in the absorber it must be dry. Re-install the glass in the top and bottom to prevent the carbon from running out the hose connector. When installing the metal container, ensure the rubber gasket fits properly, and then snug up on the knurled knob.

As with all equipment maintenance, refer to the technical manual and *MRCs* for the correct procedures.

COMBUSTIBLE GAS INDICATOR

The combustible gas indicator is designed to detect miscellaneous flammable gases and vapors. They can be used in testing tanks or compartments where flammable gases and vapors associated with gasoline may be present. Refer to NSTM Chapter 079, Volume 2, *Practical Damage Control* for operation and use.

OXYGEN INDICATOR

The oxygen indicator is used solely for the detection of oxygen deficiency in an atmosphere where personnel must work. Refer to NSTM Chapter 079, Volume 2, *Practical Damage Control* for operation and use.

As with all equipment maintenance, refer to the technical manual for the correct procedures.

Q4-23. The PIA's red cylinder is a vapor absorber that contains what chemical?

Q4-24. How do you reactivate the carbon in the PIA?

Q4-25. The PIA's black cylinder contains calcium chloride. How is it used to detect gases or vapors?

Q4-26. During initial operation and after the current is adjusted on the PIA, how long should you let it warm up to operating temperature?

Q4-27. What potentiometer of the PIA is used for calibration?

Q4-28. What requirement must be met in order to operate equipment used in testing air qualities in MOGAS spaces?

Q4-29. What equipment is used solely for the detection of oxygen deficiency in an atmosphere where people must work?

MOGAS PROTECTIVE SYSTEMS

LEARNING OBJECTIVE: Identify protective systems used in MOGAS operations. Explain how the protective systems are utilized. Demonstrate how the protective systems preserve the MOGAS system and save lives.

VENTILATION

All MOGAS spaces must be constantly and thoroughly ventilated. Operate the ventilation system continuously whenever gasoline is onboard. Take the exhaust from low points of the compartment during operations.

For gasoline storage tanks and compartments not otherwise ventilated, use a portable air-driven blower or the water-driven exhaust blower (preferred). These blowers should be grounded to the ships haul and exhaust discharge directed overboard, ensuring that they are free of all air supply intakes. Electric explosive-proof motor driven blowers may be used as a last resort; extreme care must be exercised when using these blowers.

The MOGAS pump room and inerting room has natural air supply and mechanical exhaust (fig. 4-18). The supply vent is normally a straight flow from the ship's exterior with a shut-off valve (for some ships, a heating coil is installed to warm the air in cold conditions). The inlet valve should always be checked to ensure it is opened prior to entering the space. The exhaust vent pipe located in a low point of the space, leads up to the second deck where it will go through a flame arrestor, an exhaust motor, and eventually terminating outside the skin of the ship. The exhaust motor and fan normally have an inlet and outlet valves. These valves should be opened and the exhaust motor running.

VENTILATION ALARM SYSTEMS

The following are some of the ventilation alarm systems associated with MOGAS spaces. You should consult your ship's SIB *(Ship's Information Book)* for the types of alarm systems installed.

Vent Motor Power Supply

This alarm system indicates to the DCC (Damage Control Central) watch that power to the MOGAS system vent motor has been lost or secured. When power is lost, this indicator will give an audible and

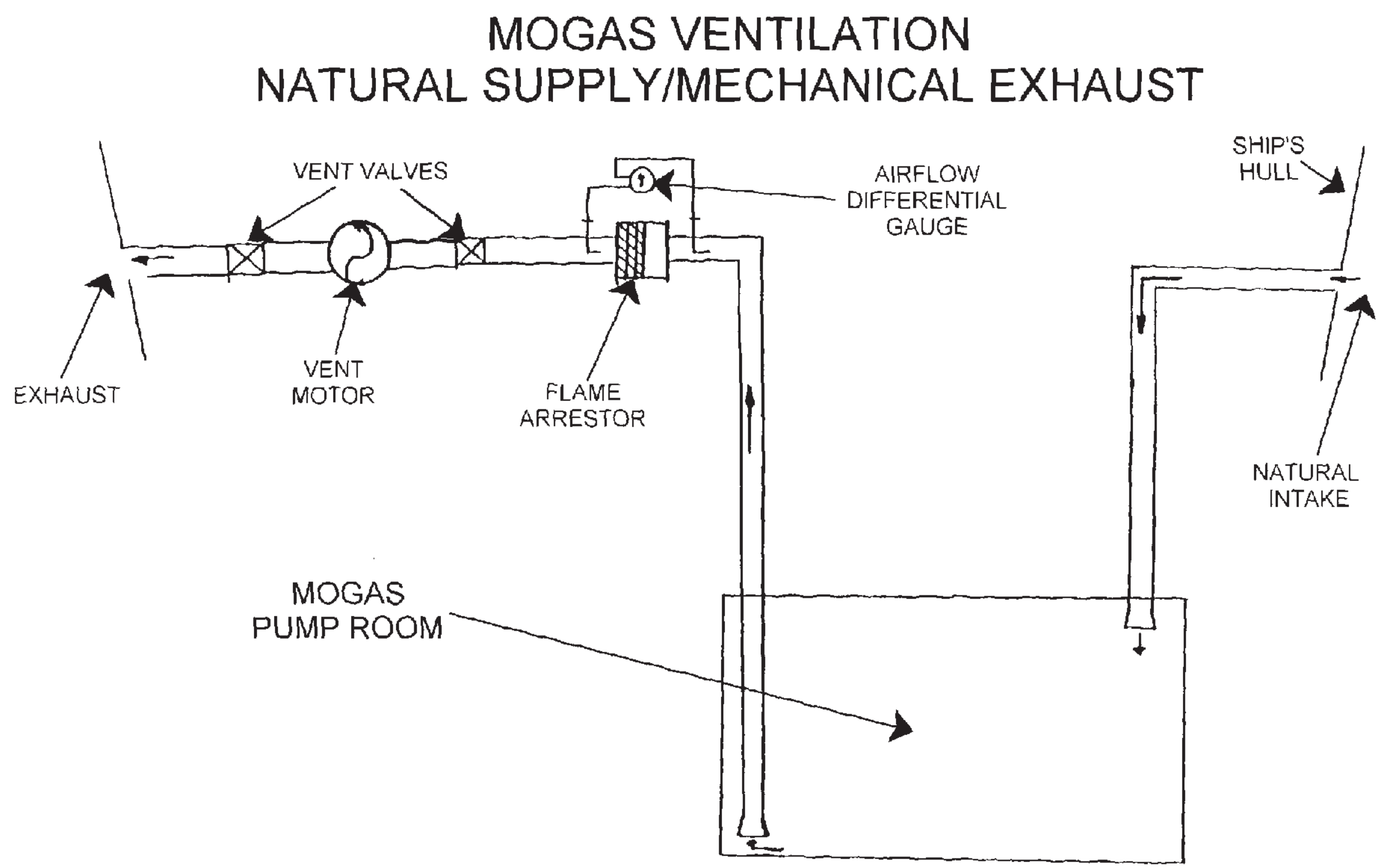


Figure 4-18.—MOGAS ventilation system.

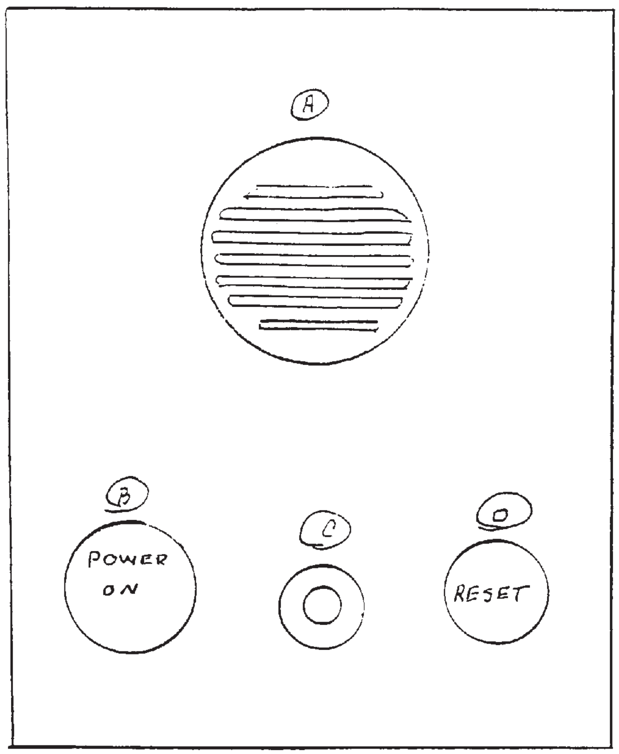
visual indication (fig. 4-19). If the white light remains lighted, there is still power to the vent motor and the motor can be re-started. After the motor has been re-started the visual indicator can be reset. DCC should notify V-4 division as soon as this or any MOGAS alarm sounds.

Airflow Indicator and Alarm

Airflow indicators are used to measure the cubic feet per minute of air flowing through the vent system. The indicator (fig. 4-20) consists of an indicating and control panel located in DCC. An airflow sensor unit is installed in the vent pipe between the flame arrestor and the vent motor; the remote alarm is located in the MOGAS space. These indicators should be checked prior to entering any MOGAS space.

Flame Arrestor

Flame arrestors (fig. 4-21) are installed in the MOGAS vent piping prior to the vent motor; they keep flames from leaving or entering the MOGAS space in the event of a fire. Each flame arrestor is equipped with an airflow gauge (MAGNAHELIC) to indicate the differential pressure (fig. 4-22), and when the flame arrestor requires cleaning outside the normal PMS cycle (semi-annual). The makeup of the flame arrestor (16 layers of wire mesh) is subject to getting clogged up to the point that airflow is reduced causing the airflow indicators in DCC to sound or not work. There is a removable filter, which can be removed and cleaned monthly.



(A) AUDIBLE ALARM
(B) POWER AVALIBLE (WHITE LIGHT)
(C) VENT MOTOR STATUS
    1. IF RED VENT MOTOR IS OFF
    2. IF WHITE VENT MOTOR HAS POWER
(D) RESET FOR VENT POWER STATUS (C)

TO TEST POWER SUPPLY ALARM:
1. DEPRESS (B) POWER ON LIGHT
   a. AUDIBLE ALARM WILL SOUND
   b. VENT POWER STATUS (C) WILL SHOW RED
2. DEPRESS RESET (D) TO RETURN THE VISUAL TO WHITE AND SILENCE THE AUDIBLE ALARM

Figure 4-19.—Ventilation power supply (audible and visual).

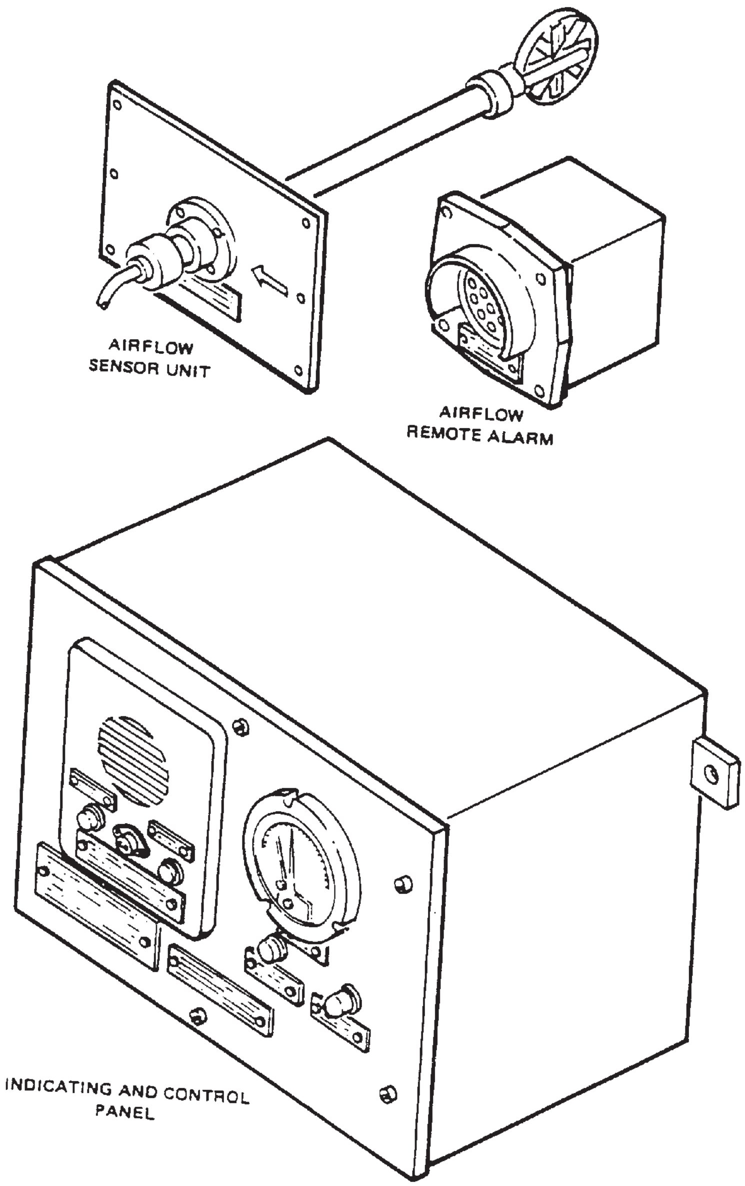


Figure 4-20.—Airflow indicator and alarm system.

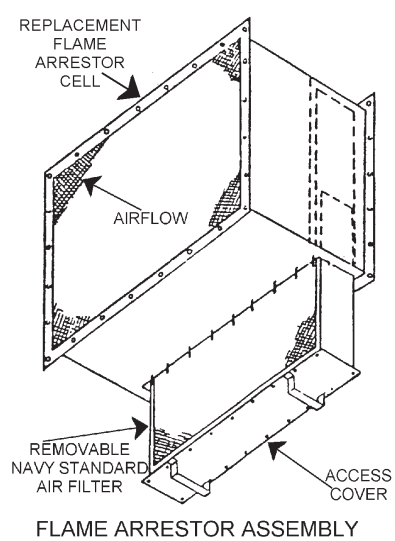


Figure 4-21.—Flame arrestor assembly.

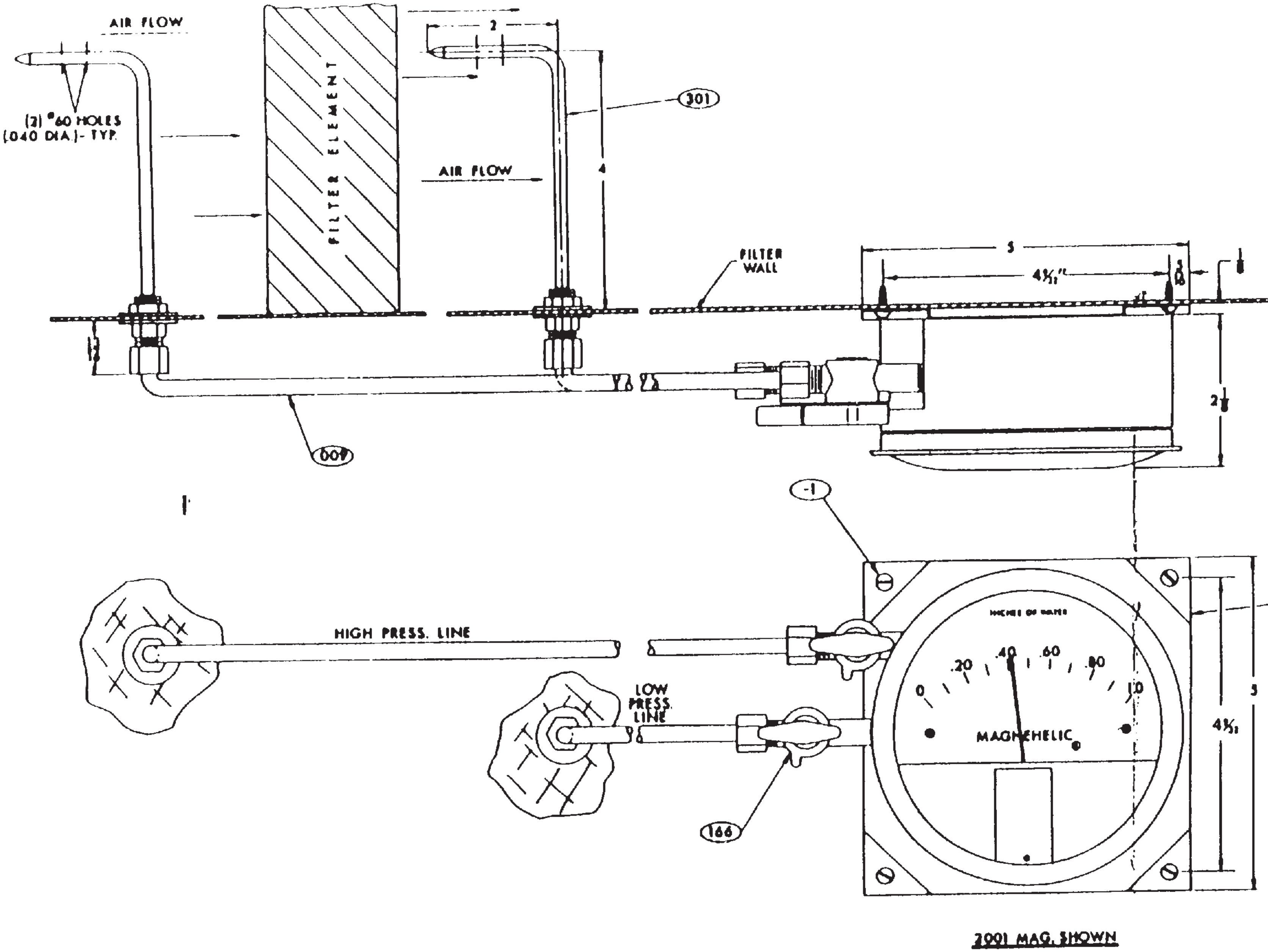


Figure 4-22.—Flame arrestor airflow diagram and gauge.

NITROGEN SYSTEM

Nitrogen (N_2) or carbon dioxide (CO_2) is used in cofferdams as a protection against fire and explosion, in double-walled piping to indicate the condition of the double-walled piping, and in the distribution piping for drainback, purge, and charge.

On LHAs, nitrogen was capable of being produced aboard the ship, but most of the production plants are no longer operable. Instead, it must be carried in 3000 lb bottles. Other class ships also must carry N_2 and/or CO_2 in compressed-gas bottles and the inerting process is slightly different. Consult CFOSS for the correct procedures on your ship.

Nitrogen enters the pump room reducer at 50 psi from the nitrogen supply room. To purge and inert the MOGAS piping, the reducer is bypassed and the piping is charged directly from the nitrogen supply line. The gages must be monitored to make sure the pressure does not exceed 10 psi. The MOGAS piping is required to be inerted with a 50% N_2 inert gas concentration at 10 psi.

The reducer is used to reduce the N_2 pressure from 50 psi to 3 psi for inerting the double-walled piping, the cofferdam, and the gasoline tank (after deballasting). The double-walled piping, cofferdam, and gasoline tank (when deballasted) are required to be inerted with a 50% inert gas concentration at 3 psi.

The pressure relief valve for the piping/double-walled piping is at 14 psi. The pressure relief valve for the cofferdam is set at 7 psi.

NOTE

Ships using carbon dioxide in place of nitrogen purge to 35% inertness minimum.

CO_2 FLOODING SYSTEM

MOGAS spaces are protected with an installed CO_2 and AFFF fire protection system.

Carbon dioxide is stored in steel cylinders at pressures from 700 to 1,000 psi, depending on variations in temperature. At these pressures, about two-thirds of the cylinder's contents is in liquid form. As gas is released through the opened cylinder valve, the pressure is gradually lowered until all the CO_2 turns into gas. Thus, the contents of CO_2 in the cylinder will expand about 450 to 500 times in volume when it is released. When fully charged, the large-size cylinders contain 50 pounds of CO_2.

Carbon dioxide is used for the protection of, and firefighting in, the gasoline pump room, motor room, access trunk, and fuel filter rooms. Carbon-dioxide cylinders are located in the motor rooms and in compartments on the second deck directly above the filter rooms. A cable operates the CO_2 release valves on the cylinder, with cable pull boxes located at three places. The cylinder valves are thus opened, but they cannot be closed. Spare CO_2 cylinders are carried aboard.

The CO_2 emergency fire-extinguishing system for fuel pump rooms, motor rooms, access trunks, and filter rooms is similar on all ships.

Carbon-dioxide cylinders, located inside each of the motor rooms, are connected by piping to the fuel pump room, motor room, and access trunks. The cylinders release carbon dioxide into the piping when operated by any of the pull boxes.

Pull boxes are located in the access trunks, the fire-pumproom, and on the starboard side of the hangar deck adjacent the MOGAS-pumproom access.

The emergency pull box is watertight and has a metal cover with a rubber gasket held by friction clutches on the rim. Under the cover is a glass plate labeled with instructions for using the pull box. Also under the glass plate is a pull handle connected through a cable and pulley to a cylinder valve on the carbon dioxide cylinder head. To operate the pull box, release the friction catch to allow the cover plate to drop, break the glass and pull out the handle until the red portion of the pull cable can be seen. After a *20-second delay*, released carbon dioxide gas flows through the piping to the fuel spaces, where it is discharged through diffusing horns and spreads as a smothering blanket, eventually filling the compartment.

Connections from the carbon dioxide-cylinder distribution lines allow carbon dioxide to operate two pressure switches. Pressure from the carbon dioxide throws electric switches to actuate a carbon-dioxide-warning bell in and out of the space, a visual alarm outside the space at the access, and to stop the exhaust ventilation system fan motors. Stoppage of the ventilation system will cause operation of an audible and visible alarm. These alarms are continuously monitored at Damage Control Central control panels.

AFFF (AQUEOUS FILM FORMING FOAM) FLOODING

The AFFF system is fed from the ship's AFFF piping by connecting a jumper hose to the AFFF main and the pump room AFFF piping, some ships have AFFF systems hard piped. Opening the valve just outside the MOGAS pump room hatch activates AFFF flooding.

GAS-FREEING

All gasoline tanks, voids, and piping must be certified *"Safe For Men/Safe for Hot Work"* by the Gas Free Engineer (GFE) before any work is done on fuel systems.

Personnel entering, or working in or on fuel systems can expect to encounter one or more of the following hazards:

1. Lack of sufficient oxygen to support life
2. Excessive levels of oxygen, which increases the danger of fire or explosions
3. Presence of flammable or explosive atmospheres or materials
4. Presence of toxic atmospheres or materials

The normal oxygen level of ambient air at sea level is 20.9 percent. Spaces containing oxygen levels less than 19.5 percent or greater than 22 percent shall be considered unsafe.

NOTE

All fuel and sewage system tanks, including all piping associated with these systems, shall be treated as IDLH (immediate danger to life and health) regardless of test readings, until the tank and/or area has been emptied, cleaned and ventilated to remove contaminants, and until it has been certified as "Safe for Personnel by the GFE."

Entry into an IDLH space is authorized only under emergency conditions. Only the CO can authorize opening and entry into IDLH spaces.

Personnel in fuel tanks should always work with an observer and maintain communication between personnel outside and personnel entering or working inside. Communication (such as voice or signal line) and the frequency of contact (continuous or periodic check) shall be maintained, always.

Exposures or potential exposure to the hazards of fuel tanks must be carefully evaluated before proper respiratory devices can be selected. Supervisors of personnel entering or working in fuel tanks must ensure the use of only NIOSH-approved respirators. Selecting the proper respirator is to include at minimum:

1. Atmosphere as a whole, i.e., whether or not space is IDLH.
2. Oxygen level.
3. Types of contaminants present or likely to be present or generated (mists, fumes or vapors).
4. Concentration of contaminants.
5. Appropriate exposure limits of contaminants: threshold limit value (TLV), permissible exposure limits (PEL), and threshold limit value ceiling (TLVC).

Ventilation may be utilized in fuel tanks to provide uncontaminated air for breathing and to maintain general comfort of personnel. It is also used to maintain concentrations of toxic and flammable atmospheres at acceptable levels.

The acceptable and required level established by the Naval Bureau of Medicine and Surgery for general ventilation is one complete air change every three minutes.

Consult *NSTM Chapter 075 Vol. 3-Gas Free Engineer* for detailed information on preparation and the hazards associated with entering fuel tanks.

Q4-30. What is done to all MOGAS spaces constantly and continuously whenever gasoline is onboard?

Q4-31. What safety device is MOGAS exhaust vent piping routed through prior to eventually terminating outside the skin of the ship?

Q4-32. When inerting MOGAS piping with N_2, what is the maximum pressure used?

Q4-33. What two pressure switches are activated when CO_2 is introduced into spaces?

Q4-34. What requirement must be adhereto, when choosing respirators for use in entering fuel tanks?

Q4-35. What is the acceptable and required naval standard for general ventilation?

MOGAS SYSTEM OPERATIONS

LEARNING OBJECTIVE: Identify and describe the different MOGAS operations. Explain the correct operating procedures for each type of operation.

RECEIVING GASOLINE ABOARD

When gasoline is to be taken aboard, there are certain preparations to be made. First, establish the amount of gasoline to be received. The maximum allowable capacity required onboard is 80% when the ship is alongside a pier. Gasoline is received aboard ship through the starboard main deck filling connections.

Equipment required at the filling connection is as follows:

- Swabs
- Rubber bucket
- Empty 5-gallon safety can
- Tool box with non-sparking tools
- Sample bottles
- Ground wire
- A portable funnel and a portable 2 1/2-inch hose connection
- Buna-N-Cork gaskets for the filling connection.

Sound-powered-phone headsets are required to establish communications between the following locations:

- Filling connection
- Gasoline pumproom
- Venting station
- Overboard discharge station

Fire-fighting stations must be manned and have equipment on hand as specified by the ship's refueling bill.

When receiving MOGAS aboard, it is mandatory to keep a refueling log. This receiving log will contain the following information:

1. Date and source received from
2. Time pumping started
3. Time pumping stopped
4. Meter reading before starting (truck only)
5. Meter reading after stopping (truck only)
6. Liquid level reading before starting
7. Liquid level reading after stopping
8. Rate of flow received
9. Average tank top pressure during operation
10. Maximum tank top pressure during operation
11. Amount received
12. Amount charged
13. Difference between 11 and 12
14. Any discrepancies that occur during the receiving operation
15. Condition of samples

The receiving operation can be accomplished in port by mobile tankers, barges, or drums. Regardless of the source of receiving, the operating steps are basically the same. Only the time required will be different.

Connect the portable 2 1/2-inch hose connector to the filling connection. Make sure the cofferdam is charged with N_2 to 50% inertness at 3 psi. Make sure the CO_2 fire-extinguishing system is on, operating properly, and ready for immediate operation.

Look at the sight glass in the MOGAS tank fill line to check for the presence of seawater. If no seawater is present, open the tank top valve and introduce seawater into the tank with the seawater compensating pump until liquid is observed in the sight glass.

PRE-OPERATIONAL FIRE SAFETY CHECK

Before starting any gasoline operations, you should performs the following safety checks:

1. Be sure there is no obstruction to the pull boxes for CO_2 fixed flooding and Halon systems supplying the:
    a. Gasoline pump room
    b. Pump motor room
    c. Gasoline filter room
2. Be sure there is no obstruction to the release mechanism to the CO_2 flooding bottle racks.
3. Check CO_2 flooding bottles are connected to the flooding manifold.

4. Ensure enough inerting gas (carbon dioxide or nitrogen) is available for purging and inerting after fueling operations.

5. Ensure emergency air breathing equipment is on station and properly set up.

FILLING SEAWATER COMPENSATED TANKS

The seawater system (fig. 4-23) serves to force the gasoline through the tank and up to the gasoline pump suction. A pressure of about 0.5 to 1 psi is required at

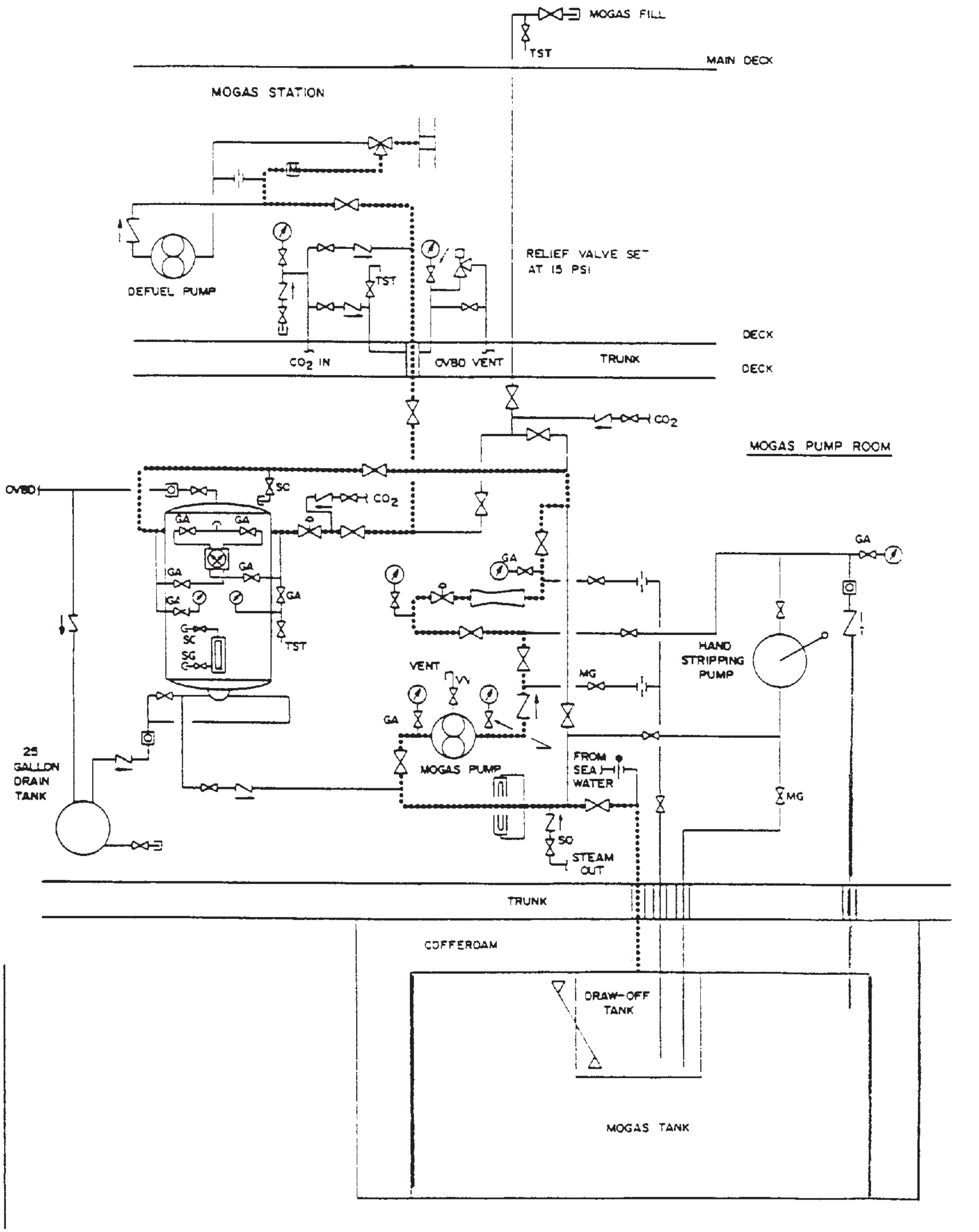


Figure 4-23.—Seawater system.

the gasoline pump suction to prevent the gasoline pumps from becoming vapor locked.

The seawater pump should be put into operation before starting up the gasoline pump. The seawater pump will discharge to the outer tank. As gasoline is drawn from the tank, it is automatically replaced with seawater, thus maintaining a positive pressure on the gasoline pump suctions. Excess seawater will automatically be discharged overboard through the overflow line.

Seawater will be taken on only from deep water where the chance of picking up bottom mud or silt is remote. If tanks must be filled before leaving port, use fresh water.

To fill empty gasoline tanks with seawater, follow these steps:

1. Ensure the seawater elevated-loop overflow valve in the seawater line is locked open.

<u>If icing conditions exists:</u>

- Cut in the steam-heating coils for the sea- water overflow line.

- Cut in steam heating coils for the seawater overflow vent line. Heaters are located at the hull penetration points.

2. Vent the tank via the filling line to the deck filling connection.

- Bypass the gasoline pumps, pressure-regulating equipment, and filter/separator.

<u>To fill storage tanks below the waterline with seawater:</u>

- Align seawater piping to admit seawater to the storage tank from the sea chest.

- Allow seawater to flow into the tank through the overflow line.

<u>To fill storage tanks above the waterline with seawater:</u>

- Align the system to admit seawater to the storage tank with the seawater supply pump to the overflow.

3. When the tank level gage for the storage tank reads empty:

a. Close the valves between the drawoff tank and the gasoline pump suction header.

b. Close the valves from the seawater pump suction header on the overflow line (if used).

c. Close the deck-filling connection.

d. Close the filter and pump bypass valves (that were opened).

4. Close all seawater valves opened, except those locked open.

Gasoline receiving operations differ for seawater compensated systems and CO_2 compensated systems.

Receiving Gasoline in Seawater Compensated Systems

To align the system, use the following procedures:

1. Ensure the seawater elevated-loop is locked open.

2. Introduce seawater into the tank by gravity from the sea until reflex gage at gasoline pump suction header indicates presence of liquid.

3. Close the valve in the gasoline suction line between the drawoff tank and the reflex gage.

4. Close all sea suction valves except the locked-open leak-off valve.

<u>Before filling with gasoline:</u>

- Align the valves in the piping system to bypass the filter, pressure-regulating equipment, and gasoline pumps.

- Ensure all necessary valves are open.

<u>Prior to connecting the gasoline filling hose:</u>

- Connect an insulated copper cable between the source of supply and the receiving inlet; include a single-pole electrical switch.

- Use grounding equipment furnished by supplier only after verifying that it meets requirements.

WARNING

Do not close switch until cable is connected to both receiving and supply points. The cable will remain in place until delivery of fuel is secure at the source, the hose disconnected, and the fittings capped to ensure that no spark will occur except in the switch, which should not be opened until fittings are capped.

<u>If using a Tank Truck as a gasoline supply: (See figure 4-24.)</u>

1. Remove blank flange or hose cap.

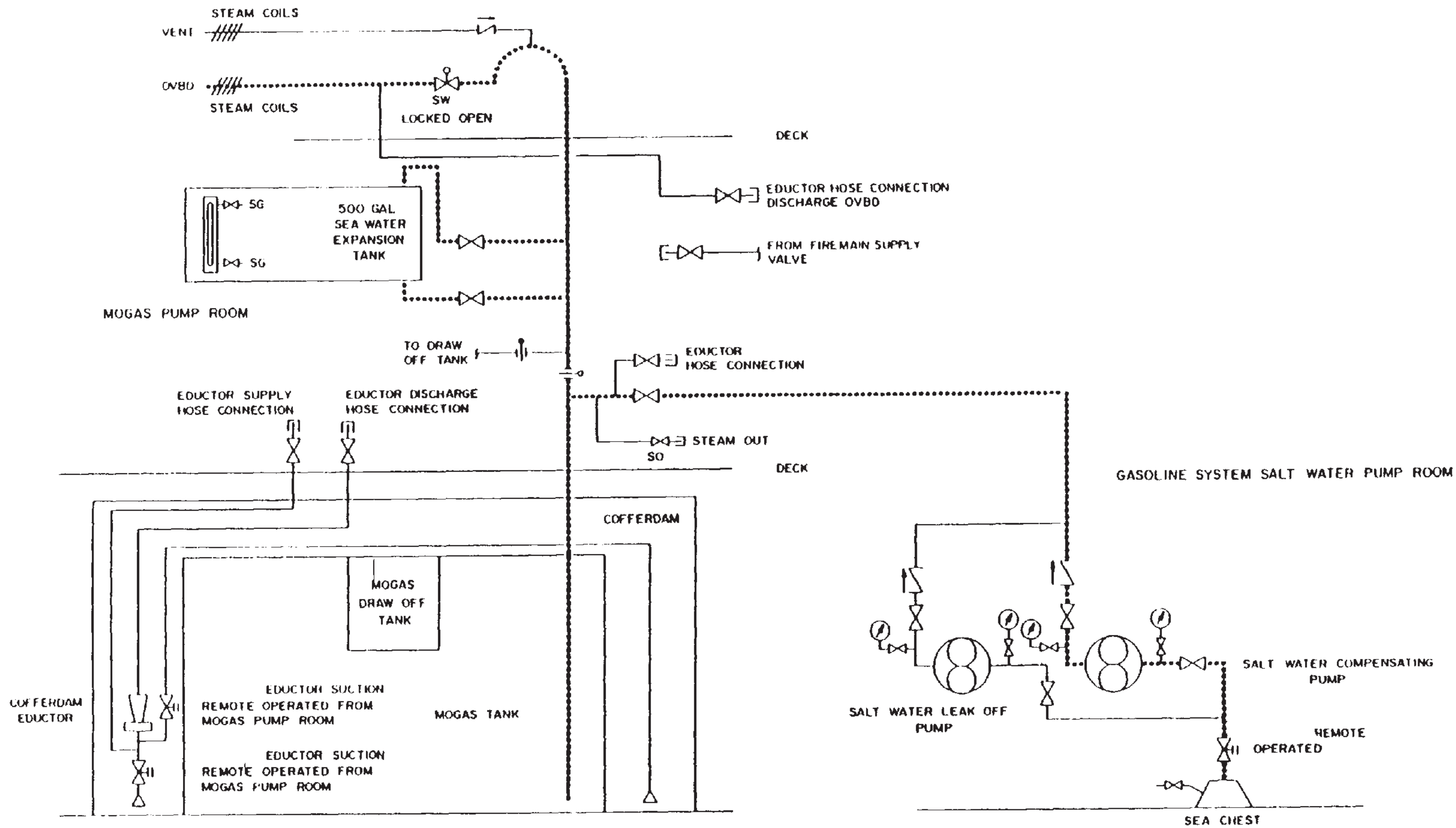


Figure 4-24.—MOGAS system.

2. Connect hose to filling connection.

3. Vent system through a hose attached to the vent at a remote fueling station.

4. Insert vent hose nozzle into a safety can.

5. Open vent valve to permit displaced inert gas to escape as gasoline is pumped into the system.

6. Open filling connection valve.

> **WARNING**
>
> Do not exceed allowable tank-top pressure, as indicated by the tank-top pressure indicator, when taking on fuel or the tank might rupture.

7. Request supply source to start pumping very slowly.

8. When fuel appears at vent hose, close vent valve.

9. Check reflex gage at gasoline pump suction header to see that it is full.

10. Open valves between reflex gage and drawoff tank.

11. Request supply source to increase filling to a normal rate.

12. When the level gage indicates that outer tank or storage tank is almost full, stop filling operation. Allow sufficient space in gasoline tank for drainback of all gasoline from piping and equipment.

13. Uncouple fueling hose.

14. Replace blank flange or hose cap.

15. Open switch and disconnect the cable.

16. Drain gasoline piping to drawoff or storage tank.

17. Admit inert gas (nitrogen or carbon dioxide) to distribution piping, at filter/separator bypass, to displace the gasoline in the piping.

18. Monitor gasoline pump reflex gage, when reflex gage indicates gasoline level has fallen below the header.

19. Close drawoff tank cutoff valve.

20. Open sea chest valve (if installed).

To purge fill piping:

1. Align all valves in piping to bypass:

a. Gasoline pumps

b. Pressure-regulating equipment

c. Filter/Separator

2. Open filling line valve in the pump room.

3. Admit inert gas to fill piping:

a. Through inert gas supply line in gasoline pump room

b. Allow inert gas pressure to build up

4. Close supply line valve.

5. Take inertness readings at the deck filling test connection. If using nitrogen, inert to 50 percent or better. If using carbon dioxide, inert to 35 percent.

6. If you cannot obtain the readings, bleed down the system, recharge and recheck the inertness reading.

Receiving Gasoline in CO_2 Compensated Systems

To align system, use the following procedures:

1. Introduce CO_2 into the tank until inert pressure gage is at 1/2 psi and tank is at 35 percent inertness.

2. Align compensating piping to vent to atmosphere.

3. Align gasoline piping to bypass filter, pressure-regulating equipment, and gasoline pumps.

4. Ensure all necessary valves are open.

5. Follow procedure outlined in "Receiving Gasoline in Seawater Compensated Systems," starting with the steps listed under Prior to connecting the gasoline filling hose, and ending with step 15.

6. Close CO_2 vent-to-atmosphere valve.

7. Admit CO_2 to gasoline tank until gage reads 1/2 psi and inertness is at least 35 percent.

8. To purge piping, follow procedures outlined in, "To Purge Fill Piping," under Receiving Gasoline in Seawater Compensated Systems.

Subsequent Receiving Gasoline in Seawater Compensated Systems

In seawater compensated systems, the storage tank will already be full of seawater or a combination of gasoline and seawater. The distribution system will be charged with inert gas in a secured condition. Under such conditions, follow these steps:

1. Ensure sea suction valve is closed.

2. Ensure seawater elevated-loop overflow valve is locked open.

3. Release inert gas pressure through filling connection.

4. Proceed as outlined in, "Receiving Gasoline in Seawater Compensated Systems," starting with the steps listed under; Before filling with gasoline and to end with steps for To purge the fill piping.

Subsequent Receiving Gasoline in CO_2 Compensated Systems

Before filling a tank with gasoline in CO_2 compensated systems, distribution systems will be charged with inert gas in a secure condition. Under such conditions, follow these steps:

1. Release inert gas pressure through filling connection vent.

2. Follow procedure outlined in, "Receiving Gasoline in CO_2 Compensated Systems," starting with the steps listed under; Before filling with gasoline to end with step 12 of If using a Tank Truck as a gasoline supply.

FILLING SEAWATER EXPANSION TANKS

For ships equipped with a seawater expansion tank (fig. 4-23), follow these steps:

1. Fill the expansion tank with seawater from the firemain by placing the pressure-reducing station in operation.

2. If icing conditions exist, cut in steam-heating coils for seawater overflow line and seawater overflow vent line.

3. Vent the storage tank via the filling line to the deck filling connection, bypassing the gasoline pumps and filter/separator.

4. Open the expansion tank fill vent.

5. Open the expansion tank discharge to the storage tank valves.

6. When the storage tank level gage reads empty (empty of gasoline but full of seawater), close the expansion tank inlet valve.

7. Ensure the expansion tank is full (indicated on sight glass).

8. Secure the firemain pressure-reducing station.

USE SEAWATER SYSTEM TO PRIME GASOLINE PUMPS

The seawater system serves to force gasoline through the tank and up to the gasoline pump suction. A pressure of about 1/2 to 1 psi is required at gasoline pump suction to prevent gasoline pumps from becoming vapor locked.

Start motor-driven seawater pumps, if any, before starting gasoline pumps. Operate and align at least one seawater pump to discharge to the gasoline tank for each gasoline pump put into operation.

Seawater displaces gasoline from the storage tank, thus maintaining a positive pressure on gasoline pump suction. Excess seawater will automatically discharge overboard through the elevated-loop overflow line. (Seawater systems with an expansion tank are placed in service by ensuring that the tank is full, and the discharge valve to gasoline tank is open.)

The procedure is as follows:

1. Line up the system to take suction from the sea and to discharge to the outer tank.

2. Open the suction valve for one seawater pump.

3. Start the pump with the discharge valve closed.

4. When the pump discharge pressure builds up, open the discharge valve slowly.

5. Put an additional seawater pump on line if another gasoline pump is to be placed in operation. Use procedure outlined in steps 2 through 4 to maintain a positive pressure at the gasoline pump suction.

If using seawater turbine-driven gasoline pumps:

- Place them in service by opening gasoline pump inlet and outlet valves; it allows gasoline to flow into the pump casing.

- Since the seawater turbine and the gasoline pump ends are directly connected, align gasoline piping for the system operation prior to opening the turbine seawater inlet and outlet valves.

STRIPPING DRAWOFF TANK

A hand-operated stripping system is provided for each drawoff tank to remove sludge and water from the tank bottom. The system consists of the following components:

- A stop valve fitted at the pump suction.

- A sight-flow indicator and test connection contained in the discharge line.

- The discharge piped to the associated outer tank.

Before fueling, completely strip the drawoff tank of water and sludge as follows:

1. Open hand pump suction valves.

2. Open hand pump discharge valves.

3. Operate hand pump until there is no indication of water passing through sight-flow (clear sample is observed).

4. Close hand pump suction valves.

5. Close hand pump discharge valves.

6. Start fueling operations.

STRIPPING CO_2 COMPENSATED TANKS

In this system, a hand-operated stripping system is provided to remove sludge and water from the tank bottom. It consists of the following components:

- A stop valve is fitted at pump suction.
- A sight-flow indicator and test connection is contained in the discharge piping.
- The discharge is piped overboard.

Before fueling, completely strip the storage tank of water and sludge as follows:

1. Open hand-operated pump suction valves.

2. Open hand-operated pump discharge valves.

3. Operate hand pump until there is no indication of water passing through sight-flow (clear sample is observed).

4. Close hand-operated pump suction valves.

5. Close hand-operated pump discharge valves.

6. Start fueling operations.

PREPARATIONS FOR FUELING VEHICLES

The actual fueling and defueling of vehicles is handled by fueling crews under the direction of the officer responsible for these operations. No one but a member of the fueling crew should have anything to do with fueling and defueling. While vehicles are being fueled or defueled, one gasoline crewmember is stationed with a portable fire extinguisher nearby.

In preparations for fueling vehicles, the following steps should be accomplished:

1. Prior to fueling or defueling, stop the engine of the vehicle to be fueled and turn all engine switches to the OFF position.

2. Before starting, station a member of the gasoline crew with a swab near the vehicle fueling connection so that any spilled gasoline can be immediately swabbed up or spread around to evaporate quickly.

3. Make a non-sparking pail of water readily available for rinsing the swab.

4. After rinsing, thoroughly air swab in an exposed location. Do not bring a contaminated swab into an enclosed space.

5. Hold rinse water in 5-gallon safety cans and store in a protected space until water can be disposed of per NSTM 593, *Pollution Control*.

6. Prior to inserting the hose nozzle into a vehicle tank fueling connection, ground the vehicle by attaching a ground wire to bare deck metal and then to the vehicle.

7. Connect the hose ground wire to the vehicle to avoid static sparks that may cause gasoline vapors to explode.

NOTE

Refer to NSTM 670, Stowage, Handling, and Disposal of Hazardous General Use Consumables, for additional fueling requirements. Leaks in tanks, liens, connections, or trouble with handling equipment, will be reported immediately to the officer in charge.

Procedures for Fueling Vehicles

The following procedure shall be used:

1. Check CO_2 fixed flooding systems installed in pump rooms and in fueling stations are functioning properly.

2. Ensure remote emergency pull cables are accessible.

3. Ensure AFFF vehicle firefighting capability is available in vehicle stowage area.

4. In a secured condition, charge the piping system with inert gas.

5. Vent inert gas into a safety can by opening vent connection in the distribution system at the fueling station.

6. Close vent, when pressure in the system drops to 0 psi on the inert gas pressure gage.

7. Pressurize gasoline tank by placing one seawater pump into operation.

CAUTION

Ships employing CO_2 compensating systems should start CO_2 compensating system operation.

8. Align the distribution system to deliver gasoline from drawoff tank by way of the gasoline pump to fueling stations through pressure-regulating equipment and the filter/separator, where installed.

9. On ships with a venturi, open recirculating line downstream of venturi and open pump recirculating line for each gasoline pump to be placed in operation. (These lines return to the same drawoff tank from which gasoline is taken.)

10. On ships provided with seawater pumps, have one seawater pump already running for each gasoline pump started.

11. Vent filter/separator until fluid appears at vent sight glass.

12. Open vent at deck fueling stations fitted with vent connections until fluid appears at vent connection.

13. Connect ground wire to ship metal structure and then to vehicle.

14. Connect fueling nozzle ground wire to vehicle. (When grounding vehicle to ship structure, remove oil, paint, non-skid found on deck tie-downs, or any other substance, which might prevent a bright metal contact.)

WARNING

On ships equipped with CLA-VAL fuel/defuel valve stations, overriding electrical continuity system by manually operating solenoid pilot valve is prohibited.

15. Insert fueling nozzle into vehicle tank.

16. Start defueling pump, where installed:

- Operate defueling pump during both fueling and hose evacuation for fuel/defuel valve to function properly.

- Ships using manual or pressure-regulating fueling stations do not have a defuel pump. Fueling is accomplished by utilizing gasoline pump and a manual stop valve.

17. When fueling is completed, close nozzle.

18. Place switch at nozzle in defueling position to evacuate fuel from hose.

19. Remove hose nozzle from vehicle (ships using a manual stop valve have to drain hoses into a safety can).

20. Disconnect nozzle ground wire.

21. Disconnect vehicle ground wires from deck connection.

22. Ensure gasoline tank cap is secured.

- Return gasoline drained into safety can to gasoline tank, or dispose of it in accordance with NSTM Chapter 593, *Pollution Control*.

23. When all fueling operations are completed, drain system.

24. Charge system with inert gas.

Fuel vehicles *in accordance with CFOSS and your command's instructions*. Always ensure that qualified supervisors are on station.

OFF-LOADING MOGAS

Normally, the system will be in a secured condition and will also be charged with an inert gas.

To deliver gasoline to a bladder, other storage devices, or off-ship, observe the following procedures:

1. Bypass pressure-regulating equipment and filter.

2. Open main deck filling connection vent.

3. Bleed off inert gas until pressure in system reaches 0 psi.

4. Close filling connection valve.

5. Connect copper cable with switch between filling connections and receiving container inlet.

- Do not “close” switch until cable is connected to both receiving and filling points.

- Leave the cable in place until delivery of fuel is secured at the source.

- Ensure that no spark will occur, except in the switch.

- Do not open the switch until the fittings are capped.

6. Attach the transfer hose.

7. Start the seawater or inert gas compensating system.

8. Place one gasoline pump on line.

9. Proceed with the delivery operation.

10. Close the filling connection valve, when delivery is complete.

11. Uncouple the transfer hose.

12. "Open" the switch and remove the cable.

13. Drain the system.

14. Purge and charge the system with inert gas.

. If the storage tank is to be emptied of gasoline, proceed as in one of the following:

<u>For seawater compensated systems:</u>

1. Continue delivery until seawater is detected at gasoline pump suction header.

2. Pump out all gasoline in the tanks,

   a. Determine from tank level gage readings.

   b. Check the deck test connection for seawater.

3. Stop delivery when seawater appears at test connection.

4. Drain piping using CO_2 inert gas system.

<u>For inert gas compensated systems:</u>

1. Continue delivery until tank level gage reads empty.

2. Pump out all gasoline in the tanks,

   a. Determine from tank level gage readings.

   b. Check the deck test connection for gasoline.

3. Stop delivery when gasoline disappears at test connection.

Do not flush inert gas compensated systems.

DRAINING AND SECURING MOGAS SYSTEM

At the completion of any gasoline-handling operation, drain piping of gasoline, purge of gasoline vapor, and charge with inert gas to minimize fire and explosion hazards. To drain and secure gasoline system, follow these steps:

1. Close all fueling station cutout valves.

2. Ensure all fueling station vent valves are closed.

3. Ensure all tank filling connection cutout valves are closed.

4. Close all seawater valves except those locked open.

5. Open all gasoline distribution piping valves:

   a. Including bypass valves

   b. Except valves closed in step 1 through 4

6. Admit inert gas through connection at filter/separator bypass. The inert gas will bubble up through the gasoline to high points in the system and displace gasoline forcing it to drain back to the drawoff tank.

7. Open the drain line bypass valve from the filter/separator sump to drain off water from the filter/separator.

8. When gasoline appears in the drain line sight glass, close the drain line bypass valve.

9. Open the filter/separator drain line valve to the gasoline pump discharge line.

10. Close the valve between the drawoff tank and the suction header, when the reflex gage in the pump room indicates that all gasoline is drained from the system.

11. Close all independent recirculating line valves that discharge to drawoff tank.

For seawater compensated systems:

1. Take care to prevent inert gas from entering drawoff tank because it may form a gas lock in the tank and may prevent pumping.

2. Bleed off the inert gas through the distribution piping.

3. Close the inert gas inlet valves to the distribution piping in the filter/separator room (where provided).

4. Admit inert gas to the system through the connection just above the reflex gage in the pump room.

5. Connect a portable inertness analyzer to the fueling station provided with vent connections.

6. Take inertness reading to determine required inertness (50 percent for nitrogen and 35 percent for CO_2) has been obtained.

7. Check the inertness readings at other fueling stations.

8. If correct inertness reading cannot be obtained, bleed off some inert gas.

- Build system back up to 10 psi.
- Recheck inertness reading.

<u>Draining and securing after fuel operations (the filter/separator is bypassed):</u>

1. Leave filter/separator cutout.

2. Admit inert gas to drain the system through the connection to the filter/separator bypass.

The rest of procedure, except for draining the filter/separator, will be same outlined above.

DRAINING COFFERDAMS AND PUMP ROOMS

Fixed eductors (fig. 4-25) are used to drain accumulated water or fuel from cofferdams surrounding

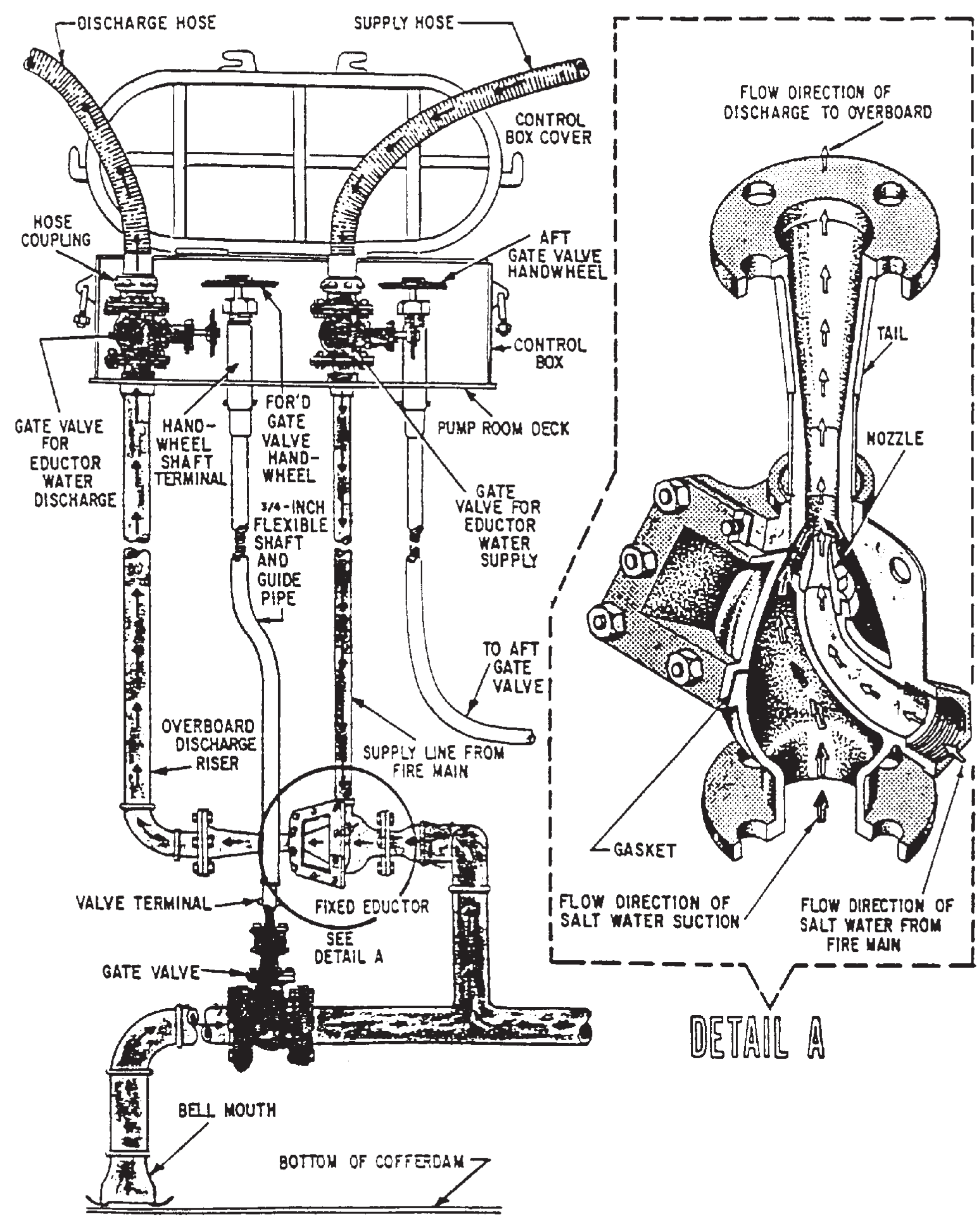


Figure 4-25.—Fixed eductor arrangement.

storage tanks. Fixed eductors for direct overboard discharge, will be used only for emergency overboard discharge of fuel.

The operating gear for the eductor is located in a watertight box in the gasoline pump room.

Discharge of oily waste overboard is prohibited within any restricted zone in accordance with OPNAINST 5090.1.

The operation of eductors in the MOGAS system is as follows:

1. Connect the supply hose between the eductor supply hose valve and the hose valve on the seawater supply line in the pump room.

2. Connect the discharge hose between the eductor discharge valve and the hose valve on the overboard discharge line in the pump room.

3. Open the eductor discharge valves.

4. Open the firemain supply hose valve.

5. Ensure the prescribed pressure is maintained at the eductor supply valve.

6. Open the forward eductor suction valve.

7. Open the eductor supply valve on the water supply line in the pump room.

8. Closed the forward eductor suction valve when one end of the cofferdam has been drained.

9. Open the aft eductor suction valve.

10. When drainage has been completed:

    a. Close water supply valves.

    b. Close overboard discharge valves.

    c. Close eductor and discharge valves.

11. Disconnect and stow eductor supply and discharge hoses.

Provisions are made for draining gasoline drain-wells using a portable eductor. The drain line terminates with a globe hose valve, enclosed in a watertight box, and is located in the pump room.

A connection on the firemain fitted with locked-closed globe hose valve supplies the actuating water to the drain eductor. A locked-closed globe stop-check hose valve is fitted to the overboard discharge line to the receive eductor discharge.

Eductor suction is taken from the globe hose valve fitted on the drain line. Hoses and adapters are provided to make proper eductor connections.

FLUSHING SEAWATER COMPENSATED STORAGE TANK

Do not flush or drain the storage tank until all the gasoline from the tank has been offloaded or consumed during normal operations. Flushing procedures vary for each ship class, and must be performed in accordance with your ship's *CFOSS* or *SIB* as applicable.

Tanks are flushed with seawater to rid tanks of traces of liquid gasoline. Three complete changes of seawater are required to ensure proper flushing.

After tanks are emptied of all seawater, they are steamed to get rid of all traces of gasoline vapor. The tanks are coated with a zinc base that is not damaged by steam. This kind of work is allocated to contractors or shipyard personnel.

The inert gas displacement gasoline storage tanks are not flushed.

Q4-36. What pressure is required at the gasoline pump suction to prevent a vapor lock?

Q4-37. If icing exists in the seawater piping, what is provided to ensure positive flow of gasoline inside the overflow pipes?

Q4-38. Where are the heating coils for the tank overflow vent lines located?

Q4-39. When filling storage tanks located below the waterline with seawater, how is seawater introduced into the tank?

Q4-40. When filling tanks located above the waterline with seawater, what MOGAS equipment is bypassed?

Q4-41. In receiving gasoline using the seawater compensated system, how are seawater and gasoline levels maintained?

Q4-42. What equipment must be installed on the gasoline filling hose to limit an inadvertent ignition of explosive gases?

Q4-43. When on-loading gasoline, where is the inert gas introduced into the piping to displace the gasoline inside?

Q4-44. When purging gasoline tanks, where is the inert gas introduced into the tank?

Q4-45. When filling the expansion tank with seawater, how is seawater introduced into the tank?

Q4-46. During vehicle fueling operations when the system has been vented at the fueling station, when is the vent connection closed?

Q4-47. During off-loading of gasoline using the seawater compensated systems, when is the operation secured?

Q4-48. How many complete changes of seawater have to be cycled through a MOGAS tank before it is considered properly flushed?

Q4-49. When are inert gasoline displacement tanks flushed?

HAZARDS ASSOCIATED WITH MOGAS SYSTEM

LEARNING OBJECTIVE: Describe potential hazards inherent in MOGAS systems. Identify the risks, preventive measures, and first aid procedures in these environments.

MOTOR GASOLINE (MOGAS)

Gasoline is a highly volatile liquid giving off a vapor, which combined with air in proper proportions, forms an explosive mixture that can be set off by a slight arc, spark, or flame. A violent explosion will result, followed by fire if liquid gasoline is present.

Gasoline vapors, even in concentrations of less than one percent, will cause nausea and headache if inhaled for any length of time. Inhalation of air heavy with gasoline vapors has caused unconsciousness and death. Strong concentrations of gasoline vapors produce an excitement stage leading to unconsciousness. Rest and fresh air may correct this condition within a few hours, but all physical reactions resulting from gasoline inhalation must be reported promptly to a physician.

It is imperative that anyone entering or working in a space that contains gasoline vapors be protected by a positive breathing mask or self-contained breathing apparatus, prescribed safety clothing, safety tools, and a safety line. Only when a space has been shown to be gas free and under continuous ventilation and certified safe, will persons be permitted to enter.

Gasoline saturated clothing will burn or irritate the skin. It will ignite if near a source of ignition. Such clothing should be removed at once, and the skin must be washed immediately with soap and water.

Gasoline splashed into the eyes may result in blindness. If gasoline gets into a person's eyes, **flush the eye (s) with water, then seek immediate medical attention.**

CARBON DIOXIDE (CO_2)

Carbon dioxide is a dangerous asphyxiant because it is NOT detectable by odor or color when present in hazardous quantities. It is heavier than air and gives little if any warning to personnel exposed to it until they are completely overcome. The inhalation of carbon dioxide will produce various effects, depending on the length of time the carbon dioxide is breathed. Small percentages of carbon dioxide will cause tiredness and/or headaches. Different levels of exposure have different results:

- Three (3) percent in the air doubles the breathing effort.
- Five (5) percent causes panting.
- Eight (8) percent causes marked distress.
- Ten (10) percent quickly causes unconsciousness, and may result in permanent injuries to the heart or brain.

The treatment of exposed personnel consists of artificial resuscitation, administering oxygen, and keeping the patient warm and quiet.

DO NOT enter an area or compartment containing hazardous amounts of carbon dioxide without being equipped with a breathing mask and an independent supply of air.

The CO_2 system is installed for inerting cofferdams and gasoline piping. Cylinders for this system are painted gray and are fitted with a hand-wheel operated valve having NO siphon tube installed.

NITROGEN (N_2)

Nitrogen is a dangerous asphyxiant because it is NOT detectable by odor, color or taste when present in hazardous quantities. It is lighter than air and gives little if any warning to personnel exposed to it until they are completely overcome. The inhalation of nitrogen will produce various effects, depending on the length of time the nitrogen is breathed.

The treatment of exposed personnel consists of artificial resuscitation, administering oxygen, and keeping the patient warm and quiet.

DO NOT enter an area or compartment containing hazardous amounts of nitrogen without being equipped with a breathing mask and an independent supply of air.

The N_2 system is installed for inerting cofferdams and gasoline piping. Cylinders for this system are painted gray and are fitted with a hand-wheel operated valve having NO siphon tube installed.

Q4-50. What percentage of gasoline vapor concentration will cause nausea and headache if inhaled for any length of time?

Q4-51. When are MOGAS spaces considered safe for working conditions?

Q4-52. What must be done if gasoline gets into a person's eyes?

Q4-53. What percentage of CO_2 quickly causes unconsciousness and may result in permanent injuries to the heart and brain?

Q4-54. What safety precautions must you exercise when entering a space containing hazardous amounts of CO_2?

Q4-55. What are some of the treatments that can be performed on personnel exposed to the different levels of CO_2 in the atmosphere?

Q4-56. Why is nitrogen so dangerous when in hazardous quantities?

Q4-57. What two gases used in the operation of the MOGAS systems are known to have asphyxiating properties?

Q4-58. What is the major difference between CO_2 bottles used for CO_2 fixed fire-fighting systems and the CO_2 bottles used for inerting MOGAS systems?

SUMMARY

The catapult lube oil system and MOGAS system are small, simple systems to operate. As stated previously, following proper procedures will ensure safe operations. However, because of the hazards involved when handling MOGAS, it is MANDATORY that all safety precautions are adhered to, not just before pressurizing the system, but also before entering the pumproom.

CHAPTER 5

SHOREBASE FUEL SYSTEMS AND OPERATION

INTRODUCTION

Among the more important duties performed in support of aircraft at naval air activities are those involving the handling of aviation fuel. Properly executed fuel-handling practices are deterrents to personnel injury, loss of life and destruction of Government property on the ground and in the air. Personnel (whether military, civil service, or contractor employed) who are involved with these duties should possess a thorough knowledge of the equipment they operate and must follow the procedures associated with each operation.

Because of the variety of fuel-handling facilities and the types of fuel-handling equipment in use at air activities ashore, we cannot include all the pertinent information dealing with fueling facilities and equipment. Also, except for pre-operational checks on trucks and pits, the ABF on shore duty rarely performs maintenance on the equipment. For this reason, equipment is identified where it would normally go and its function is given, but the equipment is not broken down into parts. The operating procedures listed are for shore activities; always use approved operating procedures for each individual activity.

ASHORE FUELING EQUIPMENT

LEARNING OBJECTIVE: Identify equipment used in fueling systems ashore. Explain the function of equipment used in fuel systems ashore and describe where the equipment is located.

The following provide a general description and the minimum requirements for equipment common to all ashore refueling systems, including mobile equipment. These requirements apply to both new and existing equipment. Figure 5-1 illustrates the arrangement for ashore systems.

CAUTION

The design and construction of certain pieces of equipment listed in this chapter is especially critical to overall safety. For those items designated with an asterisk (*), activities can only use manufacturer's part numbers that have been tested and approved by *COMNAVAIRSYSCOM (Commander, Naval Air Systems Command).*

FILTER/SEPARATORS

The filter/separator is the primary device used at shore stations to keep aviation fuels clean and dry. Filter/separators are designed to remove 98% of all solids and 100% of all water. Each filter/separator is outfitted with the following minimum accessories:

- Manual water drain valve from the bottom of the water sump.
- Automatic air eliminator valve.
- Differential pressure gage with 1-psi graduations to measure the pressure differential across the elements. The gage is mounted, free of vibrations, so that the reading indicator or needle will not fluctuate when fuel is being pump under normal conditions.
- Pressure relief valve.
- Diaphragm-operated control valve on the main discharge line with a flow-limiting pilot and a float-operated pilot to close the main valve if the water level in the sump rises above the set point. This is commonly called a "slug valve".
- All manual water drains are connected to a portable or permanently installed recovery system. Pressure relief valves and the air eliminator should also be connected to a recovery system.

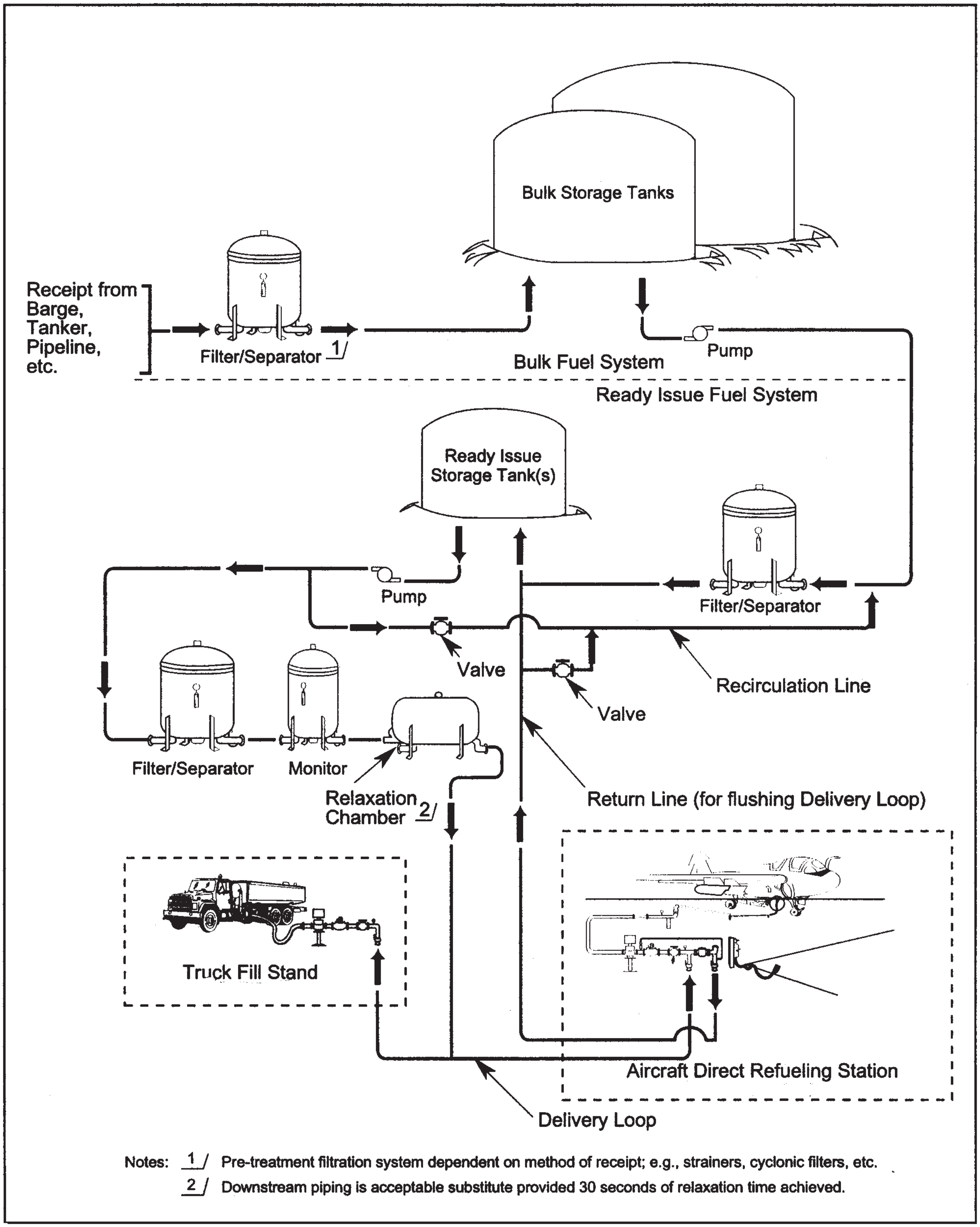


Figure 5-1.—Ashore fuel system flow diagram.

• Head lifting device for (stationary installations only).

All metal downstream and including the filter/separator, installed in a system designed to deliver fuel directly to an aircraft, that is in contact with the filtered fuel, is nonferric or stainless steel. Internally coated ferric materials are not acceptable downstream of the filter.

Filter/separators are provided at the following locations:

• In receiving lines upstream of all tanks from which fuel can be pumped directly to aircraft.

• In supply piping (downstream) from storage tanks to aircraft refueler truck fill stands.

• On any discharge (downstream) side of transfer pumps that supply aircraft or refuelers.

• On any equipment (including mobile and portable) that directly fuels aircraft.

• Upstream of the main receiving points for the bulk storage tanks. Filter/separators will reduce receipt of water and sediment into bulk storage tanks and maximize time between tank cleanings. The installation of a filter/separator is not practical at all receiving points. However, some device for the removal of particulates should be used, depending on the method of delivery and flow rates involved.

FUEL-QUALITY MONITORS

Fuel-quality monitors (formerly called *go/no-go gages*) are installed after filter/separators on truck fill stands and on all equipment that directly fuel aircraft. Monitors are not required for use with product receipt filters or those used exclusively for re-circulation of fuel. A pressure gage is also installed on each monitor housing so that the differential pressure across the elements can be recorded. If the filter/separator also incorporates fuel monitor elements, the gage or gages are installed so that the pressure losses across the filter elements and monitor elements can be recorded separately.

The fuel-quality monitor (fig. 5-2) provides a continuous check on the cleanness of the fuel passing through the filter/separator. Fuel that meets a predetermined standard of cleanness passes through the monitor with a minimum drop in pressure. Fuel containing quantities of solids and/or water above the predetermined acceptable level is automatically cut off.

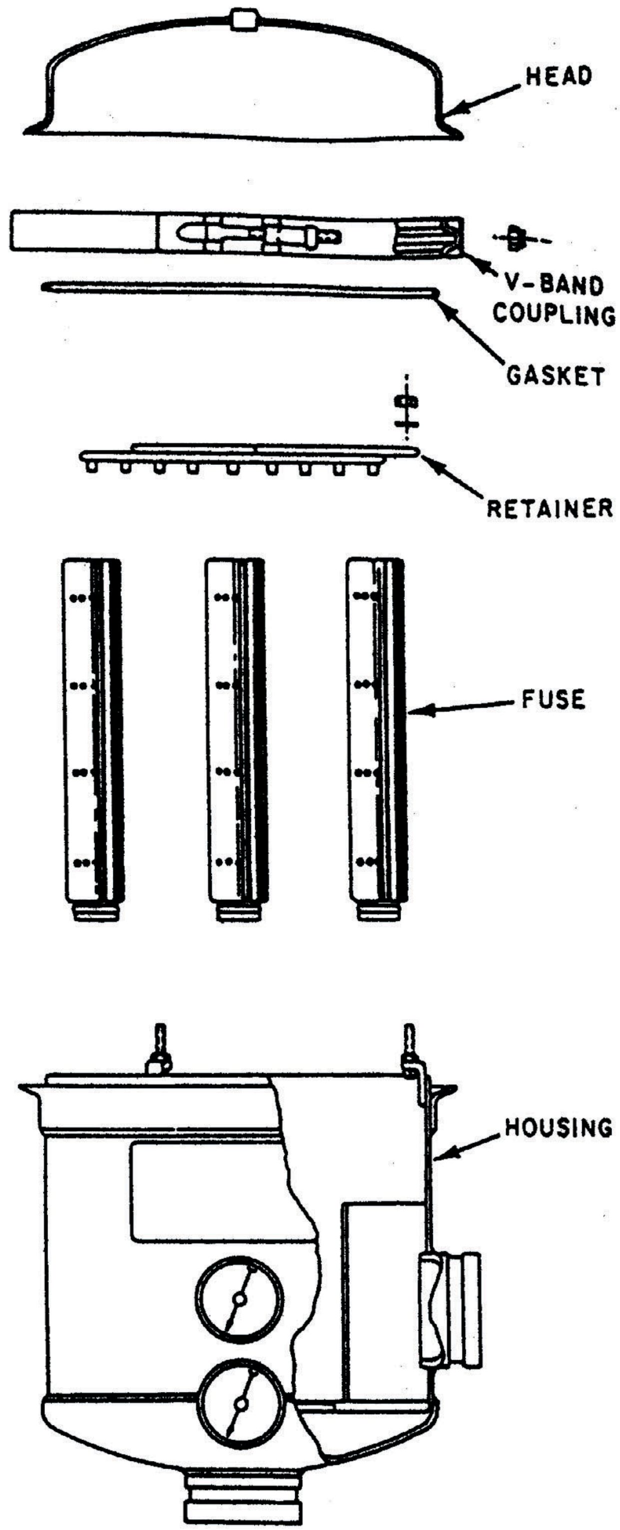


Figure 5-2.—Fuel-quality monitor.

The fuel-quality monitor has an aluminum housing and various numbers of fuses, depending on the model. Each fuse of the monitor is a self-contained unit consisting of specially treated paper washers housed within a metallic housing and fitted with plastic end fittings. The sensing washers, housed within the metallic housing, absorb free or suspended water from the fuel.

RELAXATION CHAMBERS

A relaxation chamber, consisting of a tank or piping, follows the fuel monitor or filter/separator if no monitor is installed in the system. This chamber allows static electric charges, which develop as the fuel passes through the filtration equipment, to "relax" before the fuel enters a tank. Since the fuel must be in contact with the metal walls of the relaxation device for at least 30 seconds, the exact size of the relaxation tank, or length of piping, is determined from the maximum flow rate of the system. Only one relaxation chamber is needed for each fuel monitor, filter/separator combination. Any tank, chamber, or other arrangement used to meet this requirement must assure complete product turnover, a water drain at its low point, and a manual or automatic air eliminator.

FUEL METERS

Temperature-compensated meters should be installed at the point of custody transfer. Meters used for services such as fueling of aircraft, motor vehicles, and boats or loading of tank trucks or tank cars are positive displacement meters. Turbine meters may be used for larger volume steady transfers such as loading of ships, barges, or pipeline transfers.

FUEL PRESSURE GAGES

Pressure gages must be easy to read and accurate within 1 psi, with graduations in 1-psi units.

HIGH LEVEL SHUTOFF

Commonly found on mobile refuelers, is equipped with a high-level shutoff that provides a secondary fail-safe system and which causes the internal valve to close when the product reaches a high level.

SAMPLING CONNECTIONS*

All sampling connections are the flush-type, dry-break, quick-disconnect (*Gammon fittings*) with dust caps. Fuel-sampling and pressure-testing connections are installed at the following locations:

- Receiving points
- Tank outlets
- Inlet and outlet sides of filter/separators and fuel monitors
- Refueling nozzles
- Each side of a block valve, so that the fuel remaining in each portion of a fuel transfer pipeline can be sampled

HOSES

All hoses used for aviation fuel service at shore activities should be semihard-wall, non-collapsible hose. The diameter of the hose must be compatible with the desired delivery rate to the aircraft. Unless otherwise specified, aircraft delivery hose on refueler trucks must be a minimum of 50 feet long.

Shorebase hoses contain no electrical bond or bonding wire through the center of the hose, or in the carcass. Where two hose assemblies are attached to the same outlet or source of fuel, each hose assembly must have its own shutoff valve in the piping upstream of the hose.

Camlock hose couplings will NOT be used downstream of the filter/separators. Camlock hose fittings are NOT used on mobile refueling equipment.

EMERGENCY DRY-BREAKAWAY COUPLING*

An emergency dry-breakaway coupling should be installed on the refueling hose at or near the place where the hose attaches to refueling equipment piping or the hose reel. This device is required for each direct refueling system pantograph and is recommended for all other installations.

DRY-BREAK QUICK-DISCONNECT COUPLING*

A dry-break quick-disconnect coupling is installed at the nozzle end of the hose and has a 60- or 100-mesh screen that is readily accessible without the use of tools.

HOSE-END PRESSURE REGULATOR*

The SPR (single point pressure refueling) nozzle assembly will include a hose-end pressure regulator set for a maximum of 55 psi.

AIRCRAFT REFUELING NOZZLES*

The pressure-refueling nozzle used for shore refueling, are the same as for afloat refueling.

Single-Point Pressure Refueling (SPR) Nozzles

Also referred to as an under-wing, type D-1 or type D-2 nozzles are approved for use. A quick disconnect sampling connection will be provided on the nozzle for taking fuel samples and for pressure checks.

Over-Wing Nozzles

Also referred to, as “gravity” and/or “open port” will contain a strainer of 60-mesh or finer and a tube spout suitable for the type of fuel and aircraft being serviced. Each overwing nozzle will contain a permanently attached flexible bonding wire of suitable length to terminate with a plug type connector (a clamp type connector).

If nozzles are to be interchanged on the same hose, each nozzle will have attached, it’s own half of the quick-disconnect coupling. Both pressure and over-wing refueling nozzles will contain a satisfactory dust cover in place at all times when fuel is not being delivered.

RECEIVING STATIONS

Pipeline, barge, railroad tank car, tank truck, or any combination can receive fuel. Receiving stations are tailored to the method, quantities, and rates of fuel delivery. Aviation fuel should be received through a filter/separator or other appropriate filtration device. This is an essential requirement when fuel is received directly into air station or facility’s operational storage tanks. Weight-handling equipment may be necessary with barge receipts to help with large-diameter-hose handling. Communications equipment may be necessary for barge or pipeline receipt to coordinate an uninterrupted product flow. Appropriate environmental protection equipment, facilities, and procedures must be provided to comply with *Federal, state, and local environmental laws.*

STORAGE TANKS

Tanks located at air activities provide the operating supplies of aviation fuel for aircraft. Storage tanks are classified as bulk storage or operational storage.

All tanks must comply with the following requirements:

- All operational or ready-issue steel tanks must be 100 percent coated with an inert material such as polyurethane or epoxy. All bulk steel fuel storage tanks must be coated on the bottom and up 18 inches on the walls. All concrete tanks storing aviation fuel must be 100 percent lined on the floor and walls to make them impervious to fuel.

- All aviation turbine fuel operational storage tanks must be equipped so the fuel can be circulated through a filter/separator and returned to the tank, thus removing any bottom sediment and water. Outlets must be at lowest point of the tank, to prevent water-bottoms. All aviation fuel tanks must also be equipped with a water-stripping system.

- Tank roofs must be in good repair and must not allow rainwater to enter.

- Tank repair projects will conform to *MIL-HDBK (Military Handbook)-1022.*

- Fill connections for all types of tanks must be sized so that the velocity of the fuel during filling will not exceed 3 feet per second. Inlets will discharge fuel horizontally near the bottom of the tank.

- All bulk storage tanks must be equipped with adequate sumps, drain lines, and water draw-off lines, so that tank water-bottoms can be kept to an absolute minimum. Recovery tanks that remove water and recover fuel are recommended for environmental reasons.

- All tanks must be fitted with automatic gaging devices and high- and low-level alarms and controls to prevent the overfilling of tanks and the exposure of pumps to cavitation. The alarms are left in the active mode at all times.

Gaging Devices

Automatic gages are float type or similar devices, with a readout that is readily accessible and visible at eye level from the ground immediately adjacent to the tank. The readout is of the type that is compatible with a remote reading system.

NOTE

Float-type gaging device will NOT be used for custody transfer/inventory purposes.

HIGH LEVEL ALARMS AND AUTOMATIC SHUTOFF.—Two high level alarms and automatic shutoffs are provided.

(1) High Level Alarm (HLA) is set at approximately 95 percent of the safe tank filling height arranged to actuate an audible alarm signal located at or near the normal station of the person in control of the tank filling operation. Remote alarms are located where they can be monitored at all times.

(2) A high level shut-off valve that is mechanically actuated to stop the flow into the tank is located between the HLA and the high-high level alarm (HHLA).

(3) HHLA is set at approximately 98 percent of safe filling height. It will continue the audible alarm and will actuate a visual alarm.

LOW LEVEL ALARMS.—The low-level alarm will actuate an audible alarm that is distinctly different from the high level alarms and stop product transfer pumps.

- All above ground tanks must be within an enclosure capable of holding the entire capacity of the tank plus 1-foot freeboard, in case the tank should rupture or leak. This is usually accomplished with impermeable dikes.

- Except when physically draining dikes, dike drains will remain closed and locked.

- Other environmental facilities and/or equipment as necessary are to comply with *Federal, state, and local laws.*

TRANSFER LINES

Fuel passes through transfer pipelines of various diameters and construction materials in its route from tank to tank, storage to truck fill stands, and storage to hydrant systems. Transfer lines must not leak or introduce excessive contaminants to the fuel. Internally coated pipe or other non-corrosive materials in these lines should be used to reduce iron contamination in fuel.

All piping systems are marked to identify the grade of product being carried. These markings (fig. 5-3) are placed next to all operating accessories such as valves, pumps, regulators, and manifolds. Table 5-1 lists the sizes of bands and letters used for petroleum products.

Q5-1. What is the primary device used at shore installations to keep aviation fuels clean and dry?

Q5-2. What percentage of (a) solids and (b) water is the filter/separator designed to remove from fuels?

Q5-3. What equipment on shore refueling stations provides a continuous check on the cleanness of the fuel passing through the filter/separators?

Q5-4. To "relax" static electricity prior to entering a fuel tank, what is provided inside a fuel system?

Q5-5. What type of fuel meters are used for fueling aircraft, motor vehicles, boats, and the loading of tank trucks or tank cars?

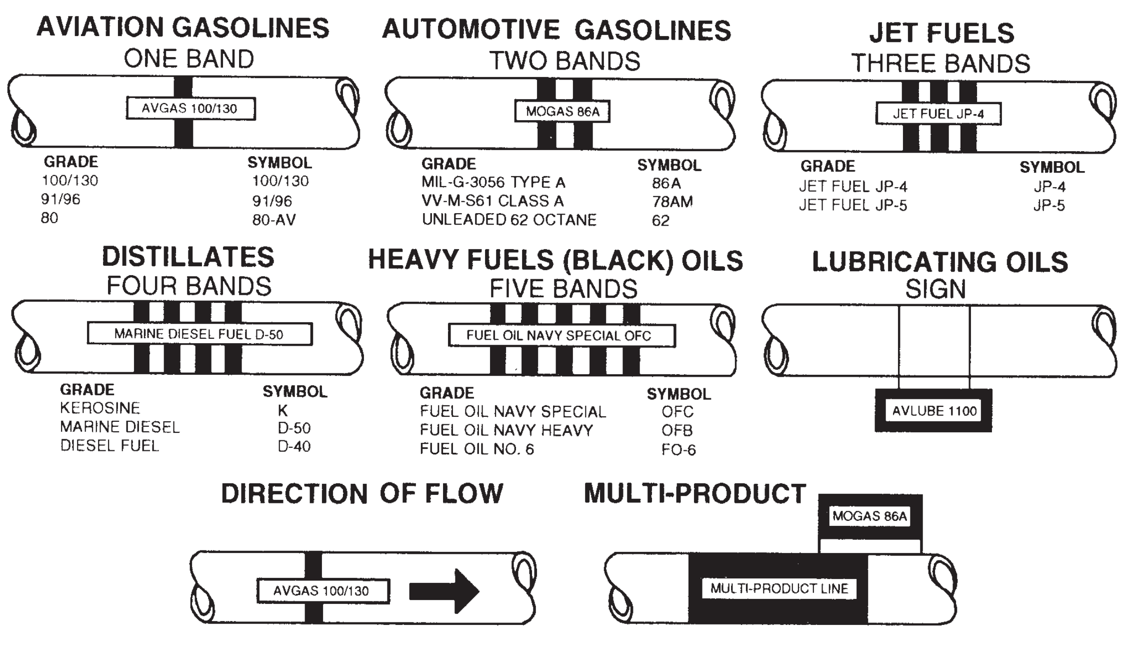


Figure 5-3.—Identification for bulk petroleum product lines.

Table 5-1.—Sizes of Bands and Letters for Petroleum Products

	Width of Bands Wide	Narrow	Space Between Bands	Length of Bands	Title Letter Size
Pipe Diameter: Under 3"	6"	3"	3"	encircle	1/2"
3" to 6"	6"	3"	3"	encircle	1"
6" to 9"	6"	3"	3"	encircle	2"
Over 9"	8"	4"	4"	encircle	3"
Tank Capacity: 10,000 bbl and under	6"	3"	3"	33"	6"
Over 10,000 bbl	8"	4"	4"	54"	12"
Tank Car, Trucks: 2,000 gal and under	6"	3"	3"	24"	3"
Over 2,000 gal	6"	3"	3"	33"	6"

Q5-6. What type of fuel meters are used for larger volume steady transfers like the loading of ships, barges or pipelines?

Q5-7. What are installed on mobile refuelers to provide a secondary fail-safe system that closes an internal valve when the fuel level is too high?

Q5-8. What is the minimum size of fuel hoses used for the delivery of fuel to aircraft on refueler trucks?

Q5-9. What is the major difference between hoses used at shore facilities and afloat units?

Q5-10. In all direct refueling system pantographs, what type of hose coupling is used?

Q5-11. What is the maximum pressure for a nozzle assembly hose-end pressure regulator?

Q5-12. What type of underwing refueling nozzles is approved for use at shore facilities?

Q5-13. What size mesh are the screens used in strainers for overwing refueling nozzles?

Q5-14. What are the two categories of fuel storage tanks used at ashore refueling activities?

Q5-15. What kind of fuel storage tank is coated on the entire bottom and up to 18 inches on its walls?

Q5-16. What percentage of the concrete storage tank is lined on the floor and walls to make them impervious to fuel?

Q5-17. Tank filling connections are regulated to introduce fuel into the tanks at a velocity of no more than how many feet per second of product?

Q5-18. At shore facilities, what type of automatic gage is used for gaging fuel storage tanks?

Q5-19. The High-Level Alarm (HLA) tank system is set at what percent of tank capacity?

Q5-20. What tank alarm system is set at 98% and has a mechanically actuated valve to shutoff fuel flow?

Q5-21. What tank alarm system actuates an audible alarm system and stops the product transfer pump?

Q5-22. In the event of a rupture or leak, how is the entire capacity plus 1-foot freeboard of all above ground tanks contained?

Q5-23. To reduce iron contamination in fuel, what should be done to fuel transfer lines?

ASHORE AVIATION FUELS SAFETY

LEARNING OBJECTIVE: Describe the general requirements, safety precautions, and operating procedures that must be followed during fueling operations ashore.

This section contains safety procedures and requirements that are general in nature and extremely important for emphasis. Any departure from the procedures may adversely affect the overall safety of the operation being performed.

Although the procedures and requirements contained in this manual are as complete as possible, they are no substitute for experience and a thorough knowledge of aviation fuels and their inherent characteristics and dangers. The better you, as an ABF, know and understand aviation fuel hazards and shore requirements, the better you will be at avoiding, or correcting, unsafe situations.

GENERAL REQUIREMENTS

This information contains the minimum requirements for aviation fuel handling equipment and facilities at all Navy and Marine Corps activities that fuel aircraft. Departure from established minimum equipment/facilities requirements might adversely affect aircraft safety-of-flight and safety of fuel handling operations.

Filtration

All activities that refuel aircraft must process fuel issued to aircraft through a minimum of two fuel filtration systems between storage and entering aircraft. Filtration equipment generates static electricity; therefore, all refueling systems must reduce static electrical charges to acceptable levels prior to loading on aircraft.

Refueling Pressure

All aircraft pressure refueling systems must limit the maximum pressure at the aircraft's adapter to 55 psi measured at the sample port of the refueling nozzle. During the last few seconds of a refueling operation the aircraft's internal tank shut-off valves close, creating instantaneous pressure surge with the aircraft's fuel system. The pressure control device on every refueling system must react quickly enough to limit this surge pressure to below 120 psi. All modern aircraft are designed, built, and tested for refueling within these pressure limitations.

Design and Repair

All fuel handling facilities and equipment at Navy and Marine Corps shore activities are designed, constructed, and/or repaired in accordance *with Naval Facilities Engineering Command (NACFACENGCOM)* criteria. All repair and modernization projects for *POL (Petroleum, Oils and Lubricants)* facilities will conform to the requirements set forth by *NAVFACENGCOM*. All facilities will comply with *local environmental, health, and safety laws*. Listed below are some of the publications used as guidelines for fuel handling facilities and equipment found at shore installations.

Applicable publications are:

1. *Facilities Planning Factor Criteria for Navy and Marine Corps Shore Installations, NAVFAC P-80, "Liquid Fueling and Dispensing Facilities".*

2. *MIL-HDBK-1022, Petroleum Fuel Facilities.*

3. *Definitive Designs for Naval Shore Facilities, NAVFAC P-272.*

4. *NAVFAC Guide Specifications.*

5. *Maintenance Manual Petroleum Fuel Facilities, NAVFAC MO-230.*

Refueling Equipment Markings and Painting

All fuel servicing equipment will be painted and marked in accordance with *NAVFAC P-300*. All refueling equipment is clearly marked with the appropriate *NATO Code Number* contained in a rectangle as well as the common U.S. military designation (see below).

$$\boxed{\text{F-44}}$$

Refueler used as refuelers/defuelers are marked with only the product code JP since the fuel will, in most cases, be a mixture of JP-4, JP-5, JP-8, and/or commercial jet fuels. No *NATO Code Number* is to be applied to such equipment.

In addition to these product identification markings, all refueling equipment is marked with the following:

FLAMMABLE
NO SMOKING WITHIN 50 FEET

The emergency shut-off switch for each system is identified with 2-inch red letters.

Refuelers/defuelers ground-fuel vehicles will be free of rust areas, flaking paint, and running rust. When touch-up painting exceeds 20 percent of the unit surface, the entire unit is painted.

Lighting (Illumination) Specification

Unless otherwise directed, all working areas are illuminated for night operations to the minimum intensity recommended in *Table 3 of API Bulletin, "Recommended Practice for Electrical Installations in Petroleum Processing Plants"*.

Electrical Equipment

Electrical equipment installed on or in close proximity to fuel handling or storage facilities will meet the minimum requirements of *The National Electric Code*; (based on explosive risk of JP-4), *"Recommended Practice on Static Electricity",* and *"Lighting Protection Code"*.

REDUCING ELECTROSTATIC CHARGES

One of the primary sources of ignition is static electricity. To ensure the safe relaxation of static charges relevant to fuel operations, all activities must do the following:

- Prohibit the top loading or splash filling of any fuel trucks or tanks.
- Refill filter/separator slowly or monitor vessels whenever they have been drained.
- Keep tanks free of foreign objects, (such as small conductive objects that can be floated by foaming fuel) thereby becoming an unbonded charge collector. This does not prohibit suspending thermometers or samplers in tanks. However, these devices must be removed prior to any receipt.
- Always electrically, bond the refueling equipment to the aircraft or truck into which the fuel is being loaded.
- *Earth (ground)* the aircraft and the refueling vehicle whenever refueling operations are conducted on any surface other than concrete, such as asphalt and plastic-coated surfaces. *Earthing* is also required for all hot-refueling operations and when refueling *U.S. Air Force aircraft.*
- Grounding is required for all hot refueling operations.
- Check the electrical resistance of pressure nozzles monthly.
- Bond overwing (gravity) refueling nozzles to the aircraft, using a separate bonding pigtail before tank's caps are removed.
- Attach bonding cables to aircraft, using plug and jack method whenever available.
- Inspect bonding and grounding cables, clamps, and plugs daily.
- Check the electrical resistance of cables monthly.
- Cease all fueling activities when *"lightning"* is observed within 5 miles of the facility.
- Remove refuelers from aircraft parking areas during electrical storms.
- Require fuel personnel to wear non-static-producing clothing, such as cotton.

ELIMINATING OTHER SOURCES OF IGNITION

To prevent or eliminate other sources of ignition, activities must ensure the following:

- Never allow fuel personnel to wear shoes that have nails or other metal devices on the soles.
- Advise fuel personnel not to carry or wear loose metal objects, such as knives or keys.
- Check the exhaust piping on mobile refuelers daily to ensure that holes, cracks, or breaks do not exist.
- Never permit smoking, spark- or flame-producing items, open flames, or hot work within 50 feet of any refueling operation.
- Defer all repair work on fueling equipment during fuel-handling operations.
- Except for approved safety lights used in hazardous locations, do NOT introduce lights into any compartment or space where fuel or flammable vapors may be present. Commercial two- and three-cell

batteries can be safely used around flammable fuel/air mixture. Tests have proven them incapable of igniting vapors, even if accidentally dropped or the light is crushed.

> **WARNING**
>
> Always assume that fuel vapors (in a tank or above a pool of fuel) are in the flammable range of fuel-air mixture to ignite.

- Do NOT allow fuel personnel to carry "strike anywhere" matches or cigarette lighters.

- Be certain that no repair or maintenance work is being conducted on the aircraft before starting the refueling or defueling operation.

- Be certain that LOX operations are not being performed and that LOX-handling equipment is NOT located within 50 feet of fuel operations.

- Be certain that aircraft radar and all unnecessary radio equipment are switched off before refueling or defueling is begun. It may be necessary for equipment to be warmed up prior to an immediate launch, be sure that it is not transmitting. The only exception to this rule occurs during *"hot"* refueling. The pilot is required to keep in radio contact with the tower at all times.

- Do NOT conduct aircraft fuel-handling operations within 300 feet of ground radar equipment.

- Equip all internal combustion engines operated within 50 feet of fuel-handling operations with spark-arresting-type mufflers.

- Do not start or stop any engine, regardless of its configuration, within 50 feet of a fueling or defueling operation. This prohibition includes aircraft being serviced and adjacent aircraft, as well as ground support equipment. The starting or stopping of an engine within 50 feet of a fueling or defueling operation is sufficient cause for the operator to immediately shutdown the fuel pump.

- Open valves slowly to reduce or prevent any splashing in tanks.

- Pump suctions must be flooded before starting in order to avoid introducing air into the fuel system. Air in the fuel system can produce a fire or an explosion in filter/separators and can cause pump damage. Truck and rail car offload systems are especially prone to this problem.

- Conduct overwing refueling only as a last resort and then only if an operational necessity or if aircraft design dictates.

- Hold hot-refueling operations to the absolute minimum possible. Cold refueling operations are inherently safer and are preferred to hot refueling.

REDUCING AND CONTROLLING VAPOR GENERATION

To help prevent fires by reducing or controlling vapor generation, activities must ensure the following actions:

- Do NOT handle aviation fuel in open containers.

- Do NOT refuel, defuel, or drain aircraft or conduct fuel-handling operations in a hangar or confined area except for the removal of water and the extraction of samples from aircraft low-point drains. This does not apply to structures specifically designed for these operations.

- Keep all fuel containers, such as aircraft fuel tanks or filters, closed; except when necessary to open for actual operation or maintenance.

- Avoid spilling fuel during fuel-handling operations.

- Take immediate action to clean up any spill that occurs.

- Properly dispose of oily waste or rags immediately after using.

- Never drive or move a refueler or defueler with a leak in the tank, piping, or other equipment.

- Report all leaks in any portion of the fuel-handling facilities to the *FMO (Fuels Management Officer)*.

- Treat empty or apparently empty cans or containers that formerly held aircraft fuels as though they still contain fuel. These containers will still contain vapors and are dangerous for many days after they have been emptied.

- Be aware that fuel vapors are heavier than air and will collect in low places, such as pits, sumps, and open sewers.

- Never dispose of waste fuel in storm water or sanitary sewer systems.

- Never top load or splash fill tanks. (This does not prohibit overwing refueling of aircraft that are solely configured for this operation).

- Keep all equipment and work areas neat, clean, orderly, and in good mechanical condition.

- Make sure fire-fighting equipment and extinguishers are in good condition and readily available.

- Never use gasoline or jet engine fuel as a cleaning agent.

EXTINGUISHING FIRES

Although the Air Station's Crash Crew has prime responsibility for fire fighting, all fuel-handling personnel should be aware of the basic principles involved in extinguishing fires, as well as the equipment used. They also should make certain that appropriate fire fighting equipment, is in good condition, is readily available whenever and wherever fuel-handling operations are being conducted. All refueling personnel will receive flight-line fire fighting training initially and annually thereafter.

WARNING

Use all fire extinguishers only for their intended purpose, to extinguish fires. They should never be used to inert a fuel tank since this can actually ignite a fire or explosion.

NAVAIR 00-80R-14, U.S. Navy Fire Fighting and Rescue NATOPS Manual and the *MIL-HDBK-844 (AS)* contain a section and information on putting out fires.

MINIMIZING HEALTH HAZARDS

Not only must aviation fuels be handled with caution because of the obvious dangers associated with possible fires and/or explosions; the materials themselves present a danger to the health of fuel-handling personnel. These dangers are equally important as those of fires and explosions even though they are not so well known.

To minimize health dangers, fuel-handling personnel must take the following actions:

- Avoid entering enclosed areas where fuel vapors are present.

- Keep to an absolute minimum the amount of time spent breathing fuel vapors. Good ventilation of workspaces is essential.

- Stay on the windward, or upwind, side of a spill if you must remain in an area where a large spill has occurred.

- Stay on the windward, or upwind, side when conducting fuel-handling operations where the formation of vapors is unavoidable, such as at a truck fill stand.

- Stop the fuel-handling operation and move to a fresh air location immediately if you feel dizzy or nauseated.

- Avoid skin contact with liquid fuels and tank water bottoms that can contain a high concentration of FSII (Fuel System Icing Inhibitor). If fuel or water bottoms do contact the skin, wash with soap and water immediately.

- Never wash hands in gasoline or jet engine fuels.

- Remove fuel-soaked clothing or shoes at once.

- Wear eye protection and clothing that leaves a minimum amount of skin exposed during refueling operations. This will help reduce burns in a fire.

- Only use footwear that completely covers the feet to provide protection against fuel spills and fires. Shoes made of fabric or other absorbent materials are not acceptable.

CONFINED SPACES

Personnel entering or working in or around confined spaces that are exposed to fuels and fuel vapors might encounter hazards such as:

- The lack of sufficient oxygen.
- The presence of flammable or explosive vapors.
- The presence of toxic vapors and materials.

These hazards may not always be readily apparent, detectable by odor, or visually obvious to persons entering or working within such spaces. Therefore, all confined or enclosed spaces such as fuel tanks, refueler/truck tanks and unvented deep pits (more than 5 feet) must be well ventilated and tested prior to entry. Poorly vented or unvented pump rooms, storage areas, and unvented shallow pits (under 5 feet) must be surveyed to determine steps necessary for gas freeing or designation as a safe work environment.

To reduce risk, fuel-handling personnel must ensure the following:

• NEVER enter a tank or equipment that has contained any fuel until all safety precautions have been followed, and then only with experienced, knowledgeable supervision present.

• Always use a blower-type mask or positive pressure hose mask, boots, and gloves if you must enter a confined area where fuel vapors may be present.

• Employ the buddy system when entering deep, unvented, or poorly vented pits, that is, low-point drain pits.

More definitive information regarding the hazards of confined spaces, hazardous environments, and gas-free engineering is contained in *NAVSEA S6470-AA-SAF-010, U.S. Navy Gas-Free Engineering Program Technical Manual* and the *NAVOSH Program Manual 5200.23B*. All personnel will comply with Navy policies and procedures specified in these manuals.

Q5-24. What maximum measured pressures are aircraft pressure refueling systems limited to at the refueling nozzle?

Q5-25. A control device is built-in on all refueling systems ashore and incorporated on all modern aircraft designs, to limit surge pressure to what prescribed pressure?

Q5-26. What publication should you refer to on maintenance conducted at shore station refueling systems?

Q5-27. What NAVFAC manual covers how fuel-servicing equipment should be marked and painted?

Q5-28. Refueler/defueler trucks containing jet fuel mixtures of JP-4, JP-5, JP-8 and commercial jet fuels should be marked with what product code?

Q5-29. What is the primary source of ignition during refueling operations?

Q5-30. If refueling operations are conducted on asphalt or plastic-coated surfaces, what must be done to the aircraft and refueling vehicle to prevent static charges?

Q5-31. How often should you inspect bonding and grounding cables, clamps and plugs?

Q5-32. How often is the electrical resistance of bonding and grounding cables checked?

Q5-33. Refueling operations is terminated when "lightning" is observed at what distance from ashore installations?

Q5-34. Within what distance from any refueling operation is smoking or hot work not permitted?

Q5-35. What type(s) of proven commercial batteries is used in approved safety lights to provide lighting in areas containing flammable fuel or air mixtures?

Q5-36. Within what distance from ground radar equipment is aircraft fuel handling operations NOT conducted?

Q5-37. Internal combustion engines operated within 50 feet of fueling operations are equipped with what type of mufflers?

Q5-38. When is it appropriate to dispose of waste fuel in storm water or sanitary sewer systems?

Q5-39. When, if ever, can you top load or splash fill tanks?

Q5-40. How often do fuel-handling personnel receive flight-line fire-fighting training?

Q5-41. What NAVAIR instruction should you refer to for information on putting out fires?

Q5-42. To keep the amount of time spent breathing fuel vapors to an absolute minimum, what is provided to protect you in work spaces?

Q5-43. List the hazards associated with fuels and fuel vapors?

Q5-44. When entering confined spaces containing fuel vapors, what type air-mask(s) should you use?

Q5-45. For information in the hazards of confined spaces, hazardous environments and gas free engineering, what NAVOSH manual should you consult?

AIRCRAFT FUELING SYSTEMS

LEARNING OBJECTIVE: Identify the fueling systems used on shore activities. Describe the equipment contained in each system.

The following are three typical aircraft fueling systems used at shore activities:

- Aircraft Direct-Refueling System (more commonly known as a "pit").
- Mobile Aircraft Refuelers. These are tanker trucks of various capacities and configurations.
- Portable Fueling Systems. These are air-transportable, advanced base systems used primarily to support tactical operations.

AIRCRAFT DIRECT-REFUELING SYSTEM (PIT)

Aircraft direct-refueling systems (fig. 5-4) are designed primarily for "hot" refueling of aircraft.

All direct-refueling systems have the following minimum features:

- Filter/separator.
- Fuel-quality monitor.
- Relaxation chamber or equivalent piping configurations capable of providing 30 seconds static relaxation from point of last filtration to the nozzle.
- Diaphragm-operated primary control valve.
- Remote, hand-held deadman control for each pantograph or hose installed at each station.
- Emergency pump shutoff switch.
- Meter on each station outlet.
- Re-circulation/flushing capability of the nozzle and/or hose/pantograph system.
- Emergency dry-breakaway coupling on each hose or pantograph.
- Bonding/grounding cable. This requirement is considered satisfied if the fueling hose/pantograph system has continuity (10,000 ohms or less).
- Pantograph and/or hose with approved, non-lubricated swivel. Zerk-type grease fittings in pantograph swing joints are not authorized, because of the possibility of contaminating the fuel with grease.
- Dry-break quick-disconnect fuel-service coupling with a 60-to 100-mesh strainer.
- Single-point-pressure-refueling nozzle with a 55-psi maximum pressure regulator.
- Fire extinguisher(s) in accordance with *NAVAIR 00-80R-14* (minimum of one 150-pound Halon or TAU unit per fueling point).
- Emergency eyewash/shower system available in the immediate area.
- Fire alarm.

NOTE

Direct refueling systems will NOT use or incorporate eductor systems.

New aircraft direct fueling facilities are constructed only for the issuance of jet fuels through the pressure refueling method utilizing SPR aircraft servicing nozzles to dispense the product.

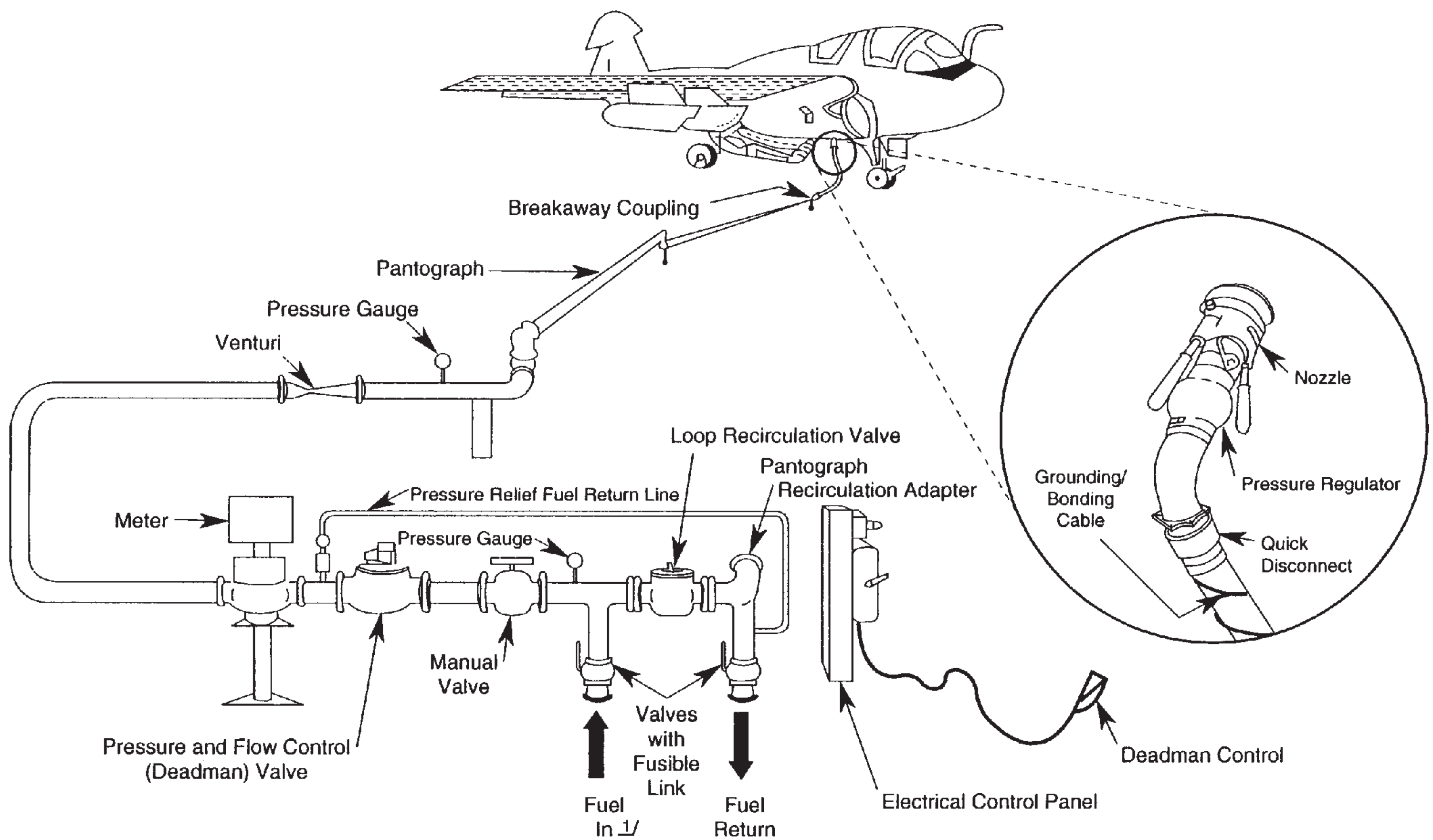
See figure 5-5 for a simplified flow schematic of a shore activity's fuel system. Figures 5-1 and 5-4 reflect design requirements for Petroleum Fuel Facilities (*MIL-HDBK-1022)*.

Criteria for the construction of direct fueling systems are based primarily on the following requirements:

- The volume of rapid turn-around requirements for carrier aircraft, including rotary wing.
- The volume of large, land-based patrol aircraft requiring average refueling of over 2,500 gallons.
- The number of transport aircraft, with limited ground time, which can be refueled in place simultaneously with other loading and off-loading.

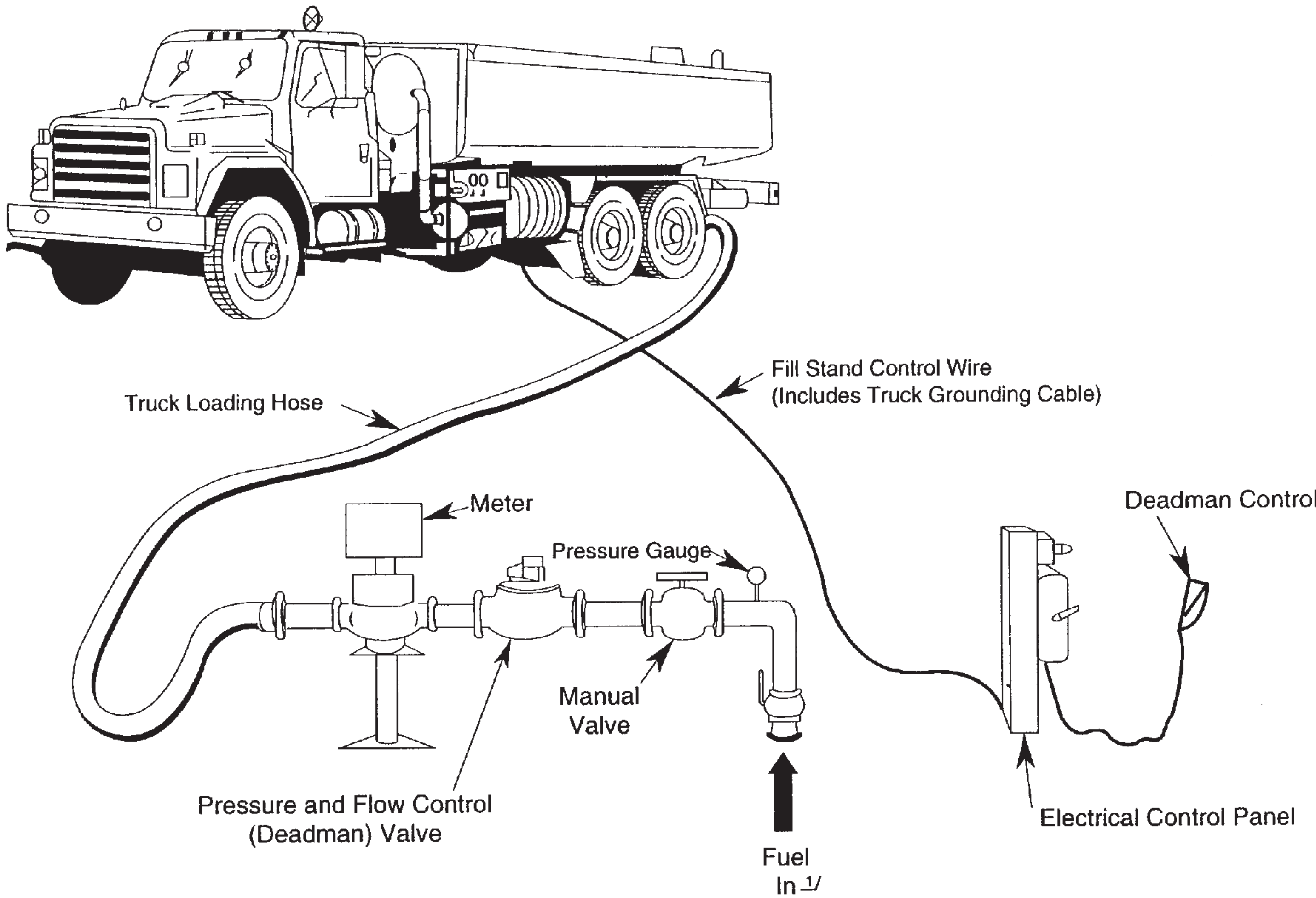
MOBILE AIRCRAFT REFUELERS

Mobile refuelers are used primarily for cold fueling operations, with occasional hot-refueling operations at stations where installation of a direct refueling system is not justified. If continuous or extensive hot fueling is being performed with mobile refuelers, the use of an



Note: 1/ Fuel supplied from delivery loop (stainless steel or fiberglass piping) after passing through filter/separator, fuel monitor, and relaxation tank (or piping).

Figure 5-4.—Aircraft direct refueling system (pit).



Note: 1/ Fuel supplied from delivery loop (stainless steel or fiberglass piping) after passing through filter/separator, fuel monitor, and relaxation tank (or piping).

Figure 5-5.—Truck fill stand.

anchored pantograph, as shown in figure 5-6, should be considered.

> **NOTE**
>
> An emergency dry breakaway coupling is recommended. Each mobile refueler must be equipped with a high-level shut-off that provides a secondary fail-safe system which causes the internal valve to close when product reaches the high level.

Mobile aircraft refuelers vary in capacity and configuration. However, whether contractor- or Government-owned, all mobile aircraft refuelers have the same basic requirements:

- Tank construction is one compartment only, with necessary baffles. Tank must completely drain at the low point without traps of liquid remaining in pockets. The tank is designed so that all portions are accessible for cleaning and maintenance.

- Tanks are aluminum or stainless steel.

- Tank top opening(s) must be semi-permanently secured and used only for inventory and for interior inspections and repairs. Manhole covers must incorporate a fusible plug or plugs; each equipped with fine screens to provide additional emergency release of vapor.

- Tanks must be configured for bottom loading. The bottom loading hardware includes a cutoff valve, an adapter to accept the standard pressure (SPR) nozzle, and must be of sufficient size to receive the product at 600 gallons per minute. A fill stand anti-driveaway device is incorporated.

- Each tank must have an electronic system for controlling the filling operation (*Scully Dynaprobe* or equivalent) that is compatible with the system on the truck fill stand. It should be located near the bottom-loading adapter and include an anti-driveaway feature (can be combined with an anti-driveaway device).

- The piping system, including all hardware components, must be capable of dispensing fuel at the rated flow. A flow diagram of the general configuration of these system devices is shown in figure 5-7.

All mobile aircraft refuelers have the following minimum features:

- Filter/separators
- Fuel-quality monitors
- Relaxation chambers
- Pressure and differential pressure gages
- Meters (temperature-compensating meters are desired)
- Approved aircraft-refueling hoses
- Dry-break quick-disconnect couplings
- Hose-end pressure regulators
- Approved aircraft-refueling nozzles

> **NOTE**
>
> Refueler/defuelers have two separate hose/pressure nozzle assemblies: one includes a hose-end pressure regulator (for refueling service) and the other doesn't (for defueling operations).

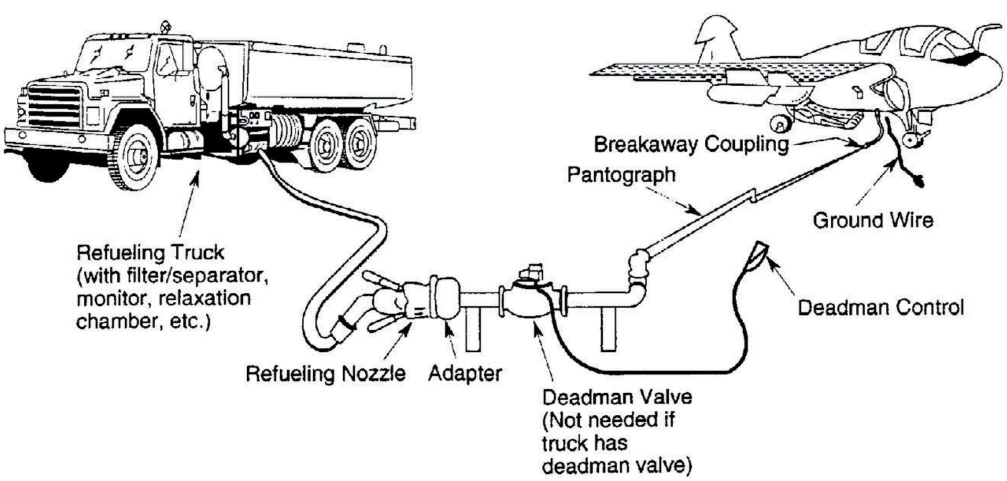


Figure 5-6.—Hot-refueling with truck and pantograph.

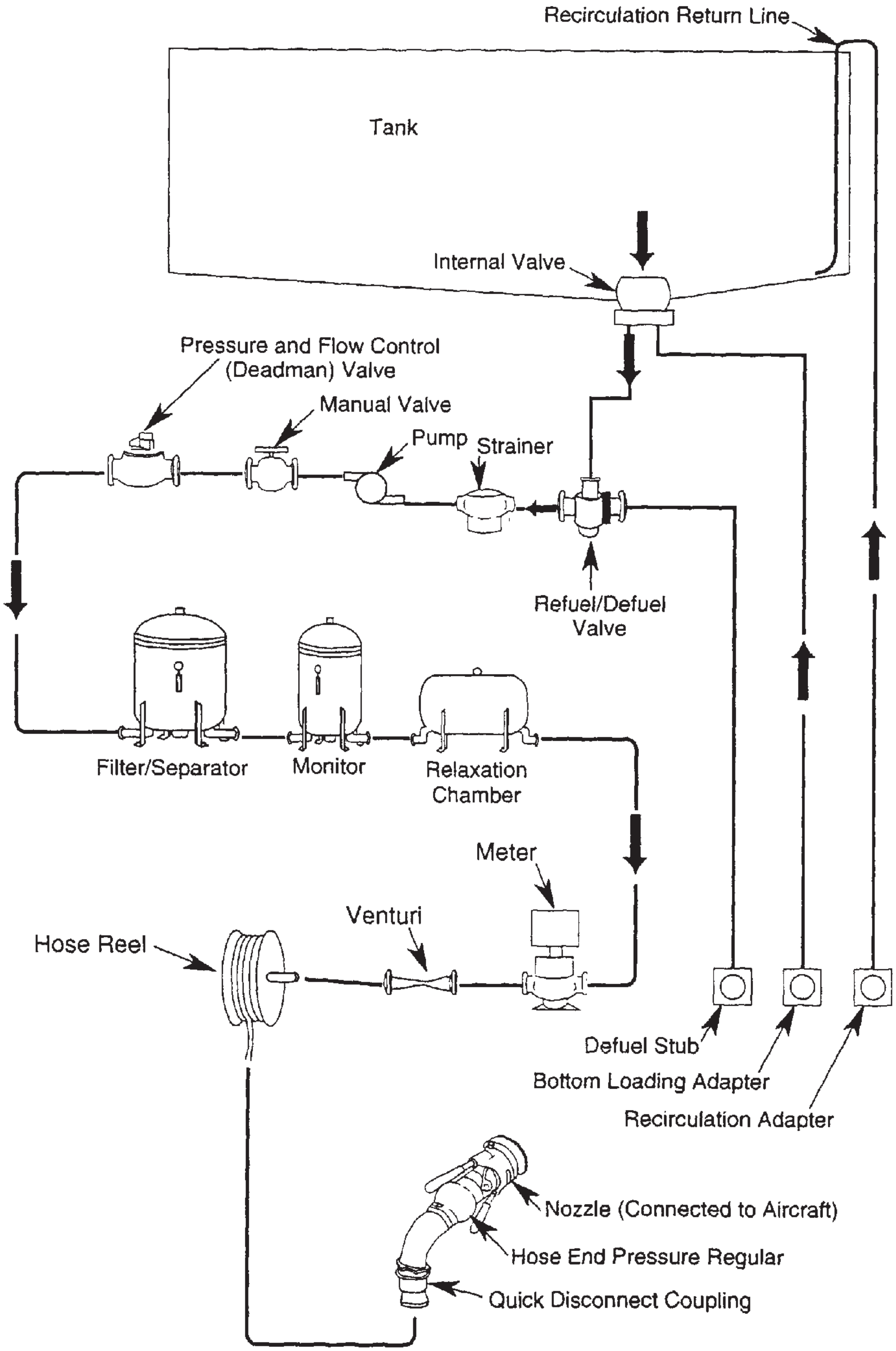


Figure 5-7.—Flow diagram for mobile refuelers.

- Bonding cables

- Aircraft fuel servicing vehicles must have at least two fire extinguishers installed: One must be on the left front (driver's) side, readily accessible to the operator (refueler control panel) position. The other extinguisher must be on the right rear portion of the vehicle.

> **NOTE**
>
> The use of Halon is recommended since it is superior to CO_2 and is less corrosive than PKP.

- Remote, hand-held deadman control

- Tires are of a non-FOD type, with slick tread or wide-lug, wide-groove tread. The tread must NOT have a narrow groove design, in which small stones and foreign matter could become imbedded and deposited on airfield surfaces. Recaps and slicks are not authorized for use on the steering wheels when the vehicle is operated off base.

- The exhaust of all engines, (except turbo-diesel engines) including auxiliary engines, are equipped with a suitable spark arrestor. When replacing defective exhaust system components, use only the original manufacturer's parts.

Refuelers/Defuelers

The most ideal and cost-effective method of handling non-suspect defueled aviation turbine fuel is to re-issue it to an aircraft. Most facilities that handle sizeable quantities of such fuel have designated one or more aircraft refueling trucks as "refueler/defuelers." Trucks designated as "refueler/defuelers" must contain a minimum of 1,000 gallons of product in order for it to safely conduct defueling operations.

> **CAUTION**
>
> Manholes will remain closed during defueling operations.

In addition to the requirements for refuelers, refueler/defuelers must also meet the following minimum requirements:

- Refuel/defuel trucks carry the marking "JET FUEL/JP" in place of the normal markings (for example, "JP-5 JET FUEL F-44" or "JP-4 JET FUEL F-40" or "JP-8 JET FUEL F-#34").

- A dedicated defuel connection to the piping system that passes the fuel through the pump, filter/separator, monitor, and relaxation chamber before it enters the tank. A flow diagram of the general configuration of these system devices is shown in figure 5-8.

- Separate hose and nozzle assemblies provided on refueler/defuelers for each of the two different operations, refueling and defueling.

> **NOTE**
>
> Eductor-type systems or hose evacuation systems are NOT used for operations, since they allow unfiltered fuel to be issued to the next aircraft.

- Maximum defuel is 100 gpm.

- High-level alarm. A high-level cutoff system is also highly recommended.

Defuelers

Defuelers are used for defueling only. Fuel placed in a defueler is NOT to be directly re-issued into an aircraft; since the defueler is generally configured without filtration equipment, the fuel placed in a defueler unit is "suspect". Fuel in a defueler must be sampled and tested to determine disposition.

> **CAUTION**
>
> Hose evacuation systems is NOT used for defueling.

Defuelers must have the following minimum requirements:

- Trucks used exclusively for defuel carry the markings "DEFUELS ONLY" in place of normal markings.

- A centrifugal pump with the maximum defuel rate of 100 gpm.

- A cutoff or alarm system for overfill protection that has at least one of the following equipment; jet sensor, float high level, fiber optic or thermistor probe.

- A defuel hose and nozzle.

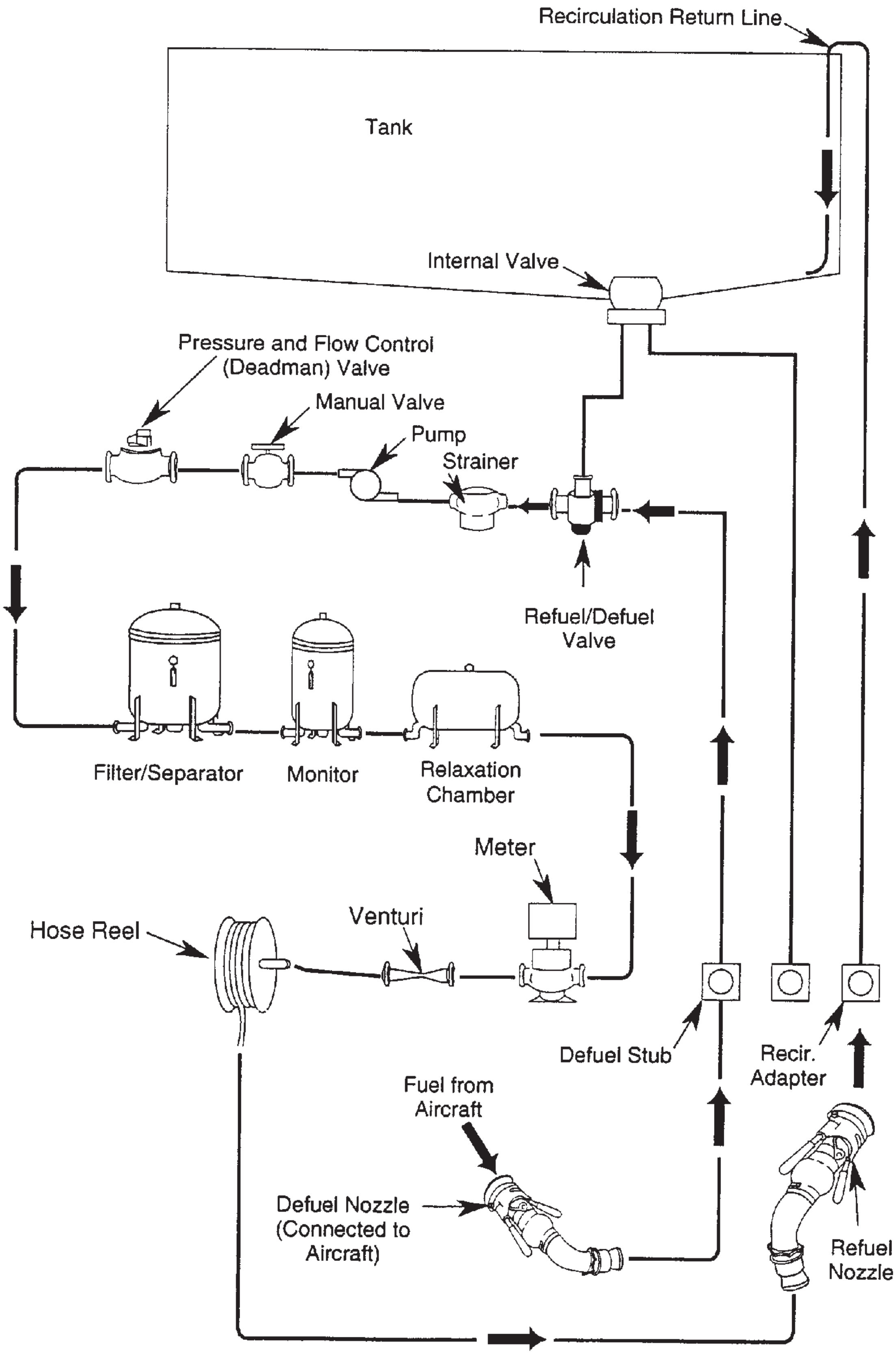


Figure 5-8.—Flow diagram for refueler/defueler in defuel mode.

AIRCRAFT REFUELER TRUCK FILL STANDS

The number of truck fill stands required for each product is a function of the filling time and the number and capacities of refuelers necessary to sustain aircraft refueling services within the established turnaround times.

> **NOTE**
>
> Bottom loading fill stands are the only type authorized for use. Top loading is NOT authorized.

Overhead truck fill stands are no longer authorized for any petroleum product. The loading rack has a separate loading system for each grade of product to be handled, regardless of the type of fuel dispensed.

The equipment required at a truck fill stand for aviation fuel is as follows:

- SPR (pressure) nozzle with dry-break quick-disconnect and strainer.
- Loading hose, approximately 10 feet long or mechanical loading arm with non-lubricated swivels.
- Loading-hose fuel-thermal-pressure relief valve.
- Diaphragm-operated two-stage control valve (low flow/high flow) with adjustable time delay to prevent the high-flow pilot from opening until 1 minute after start of fuel flow.
- Meter with rated capacity equal to the maximum flow rate of the loading station. Temperature-compensating positive displacement meters are recommended.
- Filter/separator*
- Fuel-quality monitor*
- Relaxation tank, or equivalent piping*

> **NOTE**
>
> The above requirements marked with an asterisk (*) will automatically be met if the truck fill stand is a spur of the direct fueling system downstream of the filter, monitor, and relaxation chamber.

- Shutoff valves for maintenance
- Sample outlet
- A high-level cutoff system. For ease of operation and increased safety, truck fill stands are configured with a high level cutoff system that incorporates the following:

    1. Self-monitoring
    2. Automatic tank fill shut-off device
    3. Bonding
    4. Grounding
    5. A remote, hand-held deadman control

Full implementation requires incorporation of companion connectors on all station refuelers.

- Low-intensity instrument lighting to permit full visibility of all equipment and controls during night operations.
- Spill containment system that will prevent the run-off of fuel in the event of tank rupture or a major spill during loading operations. Concrete is preferred over asphalt.
- Overhead lighting in the immediate truck-fueling area.

Truck Parking Areas

The parking area(s) and access roads are paved and maintained in good condition. Parking areas are free from chuckholes and ruts, which cause refueler damage and FOD (Foreign Object Damage). Refueler parking areas are contained by appropriate curbing, dikes, retention ponds, or drainage to oil/water separators (the preferred method). The method used is sized to hold the largest vessel normally parked within the area.

Parking Area Requirements

Refuelers/fuel servicing equipment is parked in designated parking areas. Equipment is positioned so that it is free to exit its designated parking areas without backing up and prevents abnormal maneuvering to avoid structures such as buildings, pipelines, fill stands, and other equipment.

> **CAUTION**
>
> Ramps over containment curbs are no more than 2-percent grades (2.4 inches to 10 feet) in order to avoid damage to the refuelers.

Activities must have sufficient truck parking spaces to allow:

- A minimum lateral separation of 25 feet (measured center to center of truck) between trucks.
- No trucks to be parked closer than 100 feet to any inhabited building.
- Separate entry/exit gates designed to facilitate one-way traffic patterns within the parking area.
- Free and direct egress from the parking area of any truck at all times. No object or another truck may block or hinder the egress of trucks parked in the area. This means absolutely NO backing, NO jack-knifing, NO additional maneuvering.
- Security fencing to prevent unauthorized entry into the refueler parking area. Vehicle and personnel gates must be secured. Remote control gates with driver operated control devices are recommended.
- Security lighting, capable of illuminating the entire refueler parking area.
- Spill containment system that will prevent the run-off of fuel in the event of tank rupture or major spill during loading operations. Concrete is preferred over asphalt because spilled fuel or fuel leaks deteriorate asphalt surfaces.

PORTABLE FUELING SYSTEMS

These air transportable, advanced base systems include the Tactical Airfield Fuel Dispensing System (TAFDS), Helicopter Expedient Refueling System (HERS), and Navy Advanced Base Functional Components Fueling System (ABFC-H14K). As an ABF, you most likely will never use these systems.

Q5-46. What is an aircraft direct-refueling system primarily designed for?

Q5-47. How much time does a relaxation chamber on a direct-refueling system allow for static relaxation from the point of last filtration to the nozzle?

Q5-48. A fueling/pantograph system must conduct continuity at what maximum number of ohms?

Q5-49. In a direct-refueling system, what is the size (s) of mesh used in strainers for the dry-break quick disconnect fuel-service coupling?

Q5-50. What is the minimum size for a Halon fire extinguisher used at the fueling point of a direct-refueling system?

Q5-51. When should you use an eductor on a direct-refueling system?

Q5-52. To provide a means of completely draining the fuel without any remaining pockets, what is installed on each mobile refueler?

Q5-53. Mobile refueler tanks are made from what type of material(s)?

Q5-54. The pressure-refueling nozzle used for bottom loading a mobile refueler is designed to receive the product at what minimum gallons per minute?

Q5-55. What type of electronic system is used on a mobile refueler to control filling the tank and must be compatible with the truck fill stand?

Q5-56. What kind of hose or pressure nozzle assembly is used on a refueler/defueler truck for refueling aircraft?

Q5-57. Why is Halon the more desirable type of fire extinguisher carried on mobile refueler/defueler trucks?

Q5-58. What is installed on the exhausts of all turbo-diesel and auxiliary engines to prevent fires?

Q5-59. What is the most ideal and cost-effective method of handling non-suspect defueled aviation turbine fuel?

Q5-60. Trucks that handle large quantities of defueled non-suspect aviation turbine fuels are designated with what type of markings?

Q5-61. To safely conduct defueling operations, what minimum number of gallons of product (fuel) should a refueler/defueler truck tank contain?

Q5-62. What type of markings is displayed on refuel/defuel trucks carrying defueled JP-5, JP-4 and JP-8?

Q5-63. Why is an eductor-type or hose evacuation systems NOT used for refueling aircraft?

Q5-64. What has to be done to the fuel inside a defueler prior to its disposition?

Q5-65. What type of markings are displayed on trucks used exclusively for defueling?

Q5-66. What is the minimum lateral separation between mobile refueling trucks?

Q5-67. How far should mobile fueling trucks be parked from inhabited buildings?

Q5-68. To prevent the run-off of fuel in the event of a tank rupture or major spill during loading operations, what is provided at a truck fill stand?

Q5-69. Why is a concrete spill containment system preferred over an asphalt containment system?

Q5-70. What is the only authorized method of loading petroleum products into a mobile refueling truck?

Q5-71. What type of flow meters are installed on truck fill stands?

Q5-72. What is the preferred method of fuel containment used in refueler parking areas?

Q5-73. To avoid damage to refueler trucks, what is the maximum grade of the ramps over the containment curbs on truck fill stands?

Q5-74. What portable fueling systems are used primarily for tactical operations?

TRUCK FUELING OPERATIONS

LEARNING OBJECTIVE: Describe the different types of truck fueling operations conducted at ashore facilities. Explain the procedures associated with these operations.

TRUCK FILL STANDS

Operating truck fill stands is a one-person operation for trucks equipped with high-level alarms/shutoff and deadman control valves at the fill stand (see fig. 5-5). This is a two-man operation for equipment not having these devices.

WARNING

Top loading is NOT performed. This method of filling is extremely dangerous because of high flammable vapors and static charges produced. Personnel will NOT be on top of the truck during filling operation.

Trucks are filled in the following sequence:

1. Position truck, turn off lights, place gear shift in neutral or park position, set parking brake, stop engine, and turn off all switches except necessary alarms and the like.

2. Verify product and estimate amount of product to be loaded.

CAUTION

A vehicle without high-level controls or alarms is monitored via fill stand meter during filling process. Secure pumping if meter exceeds amount previously issued from truck.

3. Connect bond or high-level control cable.

4. Connect delivery nozzle to truck's bottom loader.

5. Set meter and enter the necessary information on truck fill order or other form.

6. Start filling operation slowly.

CAUTION

Trucks that have been completely drained must be minimally fueled (500 to 1,000 gallons using another truck set at a low flow rate), to cover bottom inlet valve inside empty truck’s tank.

7. After tank is filled, secure pump unless it has secured automatically.

8. Disconnect nozzle.

9. Disconnect bond or Scultrol jumper cable.

10. Complete paperwork.

11. Inspect truck for leaks.

12. Remove refueler to truck parking area.

COLD REFUELING OF AIRCRAFT BY TRUCK

Positioning of refuelers to service aircraft is done in the same manner-without variation, so that all personnel involved know exactly what to expect. Whenever possible, refuelers should proceed down a line of parked aircraft, with driving path perpendicular to aircraft fuselage axis, at maximum distance the hose length will permit servicing.

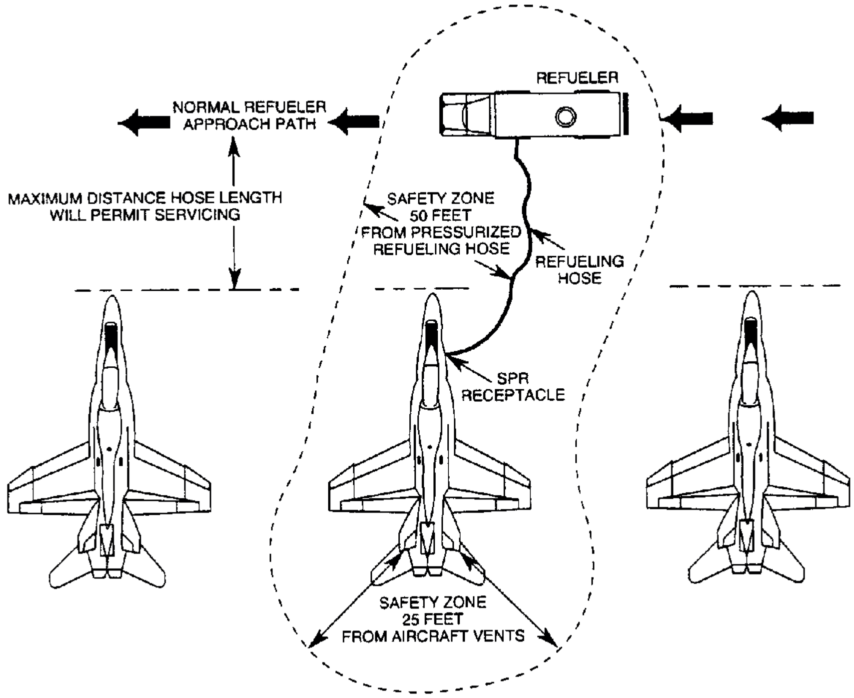


Figure 5-9.—Normal refueler approach path and refueling safety zone.

However, a truck must never approach closer than 10 feet of an aircraft. The normal refueler approach path, shown in figure 5-9 applies to all fixed-wing tactical aircraft and helicopters. Normally, no turns are made except at the end of the parking line. Driving between aircraft parked in line should be avoided; however, preferred approach is not always possible. Figure 5-10 shows acceptable alternate methods when

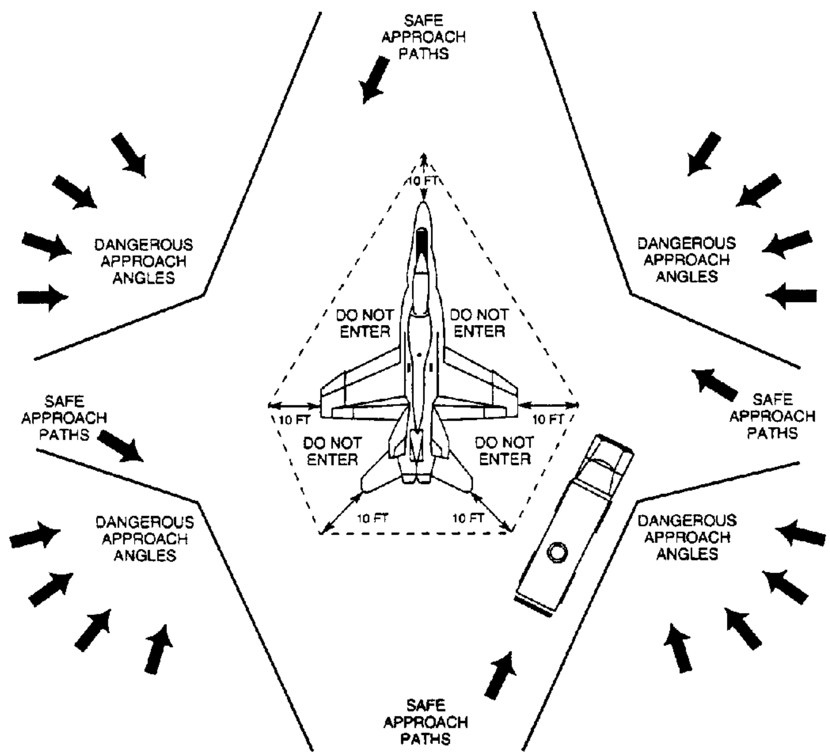


Figure 5-10.—Alternate refueler approach paths.

aircraft are not parked in line or when hose lengths are insufficient for service. Figure 5-11 shows the safe approach paths to prop, prop/jet, and transport aircraft; figure 5-12 illustrates the alternate approach paths for helicopters.

Each activity will record movement and operations of its trucks using a log similar to the one shown in figure 5-13.

Refuelers must NEVER:

- Be left pointing toward any part of an aircraft.
- Be driven in the area described by straight line projections connecting points 10 feet from an aircraft's extremities (see figures 5-10, 5-11, and 5-12).
- Be backed into proximity of an aircraft without using a spotter and a wheel chock pre-positioned at point where the refueler must stop.
- Be positioned closer than 10 feet from any part of the aircraft.

The refueler is parked in a position on the same side of the aircraft as the aircraft's adapter, so the driver/operator has a direct line-of-sight to the refueling nozzle operator when actuating the deadman control. Failure of the driver/operator to visually observe nozzle operator throughout refueling operation can lead to a fuel spill or fire. The hose must NOT pass underneath aircraft's fuselage to reach the aircraft's fueling adapter. NEVER operate both overwing and pressure fueling systems at the same time. Excessive pressure surges may occur with the overwing nozzle.

NOTE

Tailpipe temperature and location of aircraft tank vents are important considerations when determining alternate routes and fueling positions.

Aircraft refueling with trucks is a three-person function. Required are a nozzle operator (supplied from the squadron, maintenance department, or transient line), a driver/operator (from the fuels division), and a fire extinguisher operator (supplied by the squadron). The nozzle operator assists driver/operator in removing and replacing hose on the refueler.

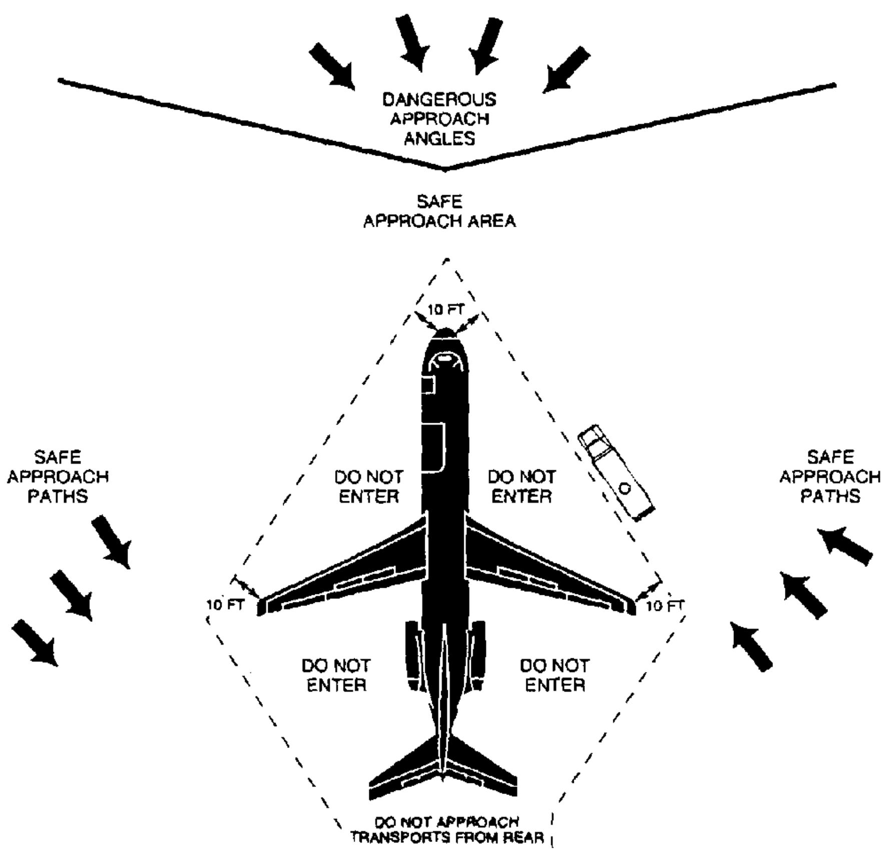


Figure 5-11.—Refueler approach to prop, prop/jet, and transport aircraft.

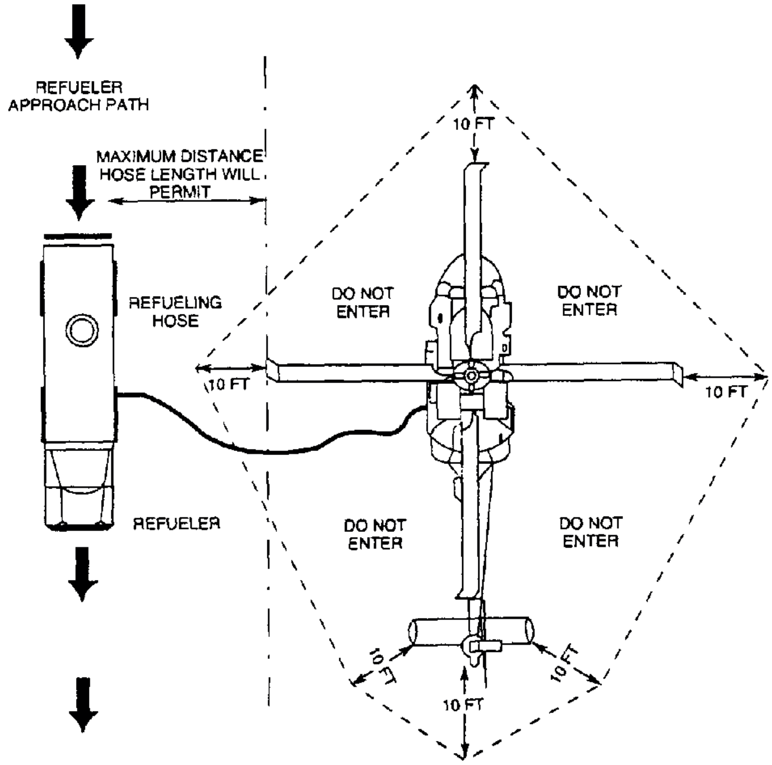


Figure 5-12.—Alternate refueler approach to a helicopter.

The driver/operator prepares truck for refueling operations as follows:

- Re-circulate (flush) the truck and take a fuel sample for quality control checks as appropriate. Fuel is tested for contamination prior to refueling the first aircraft each day. Fueling must NOT begin until acceptable results have been obtained.

- Flush overwing nozzle. Flushing overwing nozzle requires a special receiving port that is piped to fuel storage. An alternate approach is to recirculate refueling station and take samples with pressure fueling nozzle in place, then replace pressure fueling nozzle with overwing nozzle immediately before commencing refueling operations.

- After a hot-brake check of the aircraft (fixed-wing only) has been performed, drive the refueler into position for refueling, following approach paths discussed previously. The refueler should be positioned so that it can be driven away quickly in an emergency. Wheel chocks should NOT be used.

- Set brakes.

- Place gearshift in neutral.

- Turn off headlights and unnecessary switches (driver/operator).

- Open driver's side door. It remains partially open during entire refueling operation.

WARNING

A window in the truck cab must be kept at least partially open whenever truck is stationary and engine is running, to prevent buildup of carbon monoxide inside the cab.

When the truck is in position and prepared as discussed above, conduct fueling operations as follows:

NOTE

- Cold refueling aircraft with JP-5, JP-8, or commercial Jet A or Jet A-1 via trucks is a two person function requiring a nozzle operator and a driver/operator. In an emergency the driver/operator's first duty is to release the deadman control and then operate the fire exstinguisher while the nozzle operator disconnects the nozzle from the aircraft. The nozzle operator will then take over responsibility for the fire extinguisher while the driver/operator reels in the hose and removes the truck from the area. Under normal conditions the nozzle operator will assist the driver/operator in removing and replacing the hose on the refueler in order to minimize wear and damage to the hose and refueling nozzle.
- Cold refueling aircraft with JP-4 or commercial Jet B is a three-man operation requiring a dedicated fire extinguisher operator in addition to the two personnel discussed above.

AIRCRAFT REFUELING DISPATCH LOG Date: Page #:

Trip #	Truck #	Driver	Type Veh.	Purpose (Aircraft #)	Requested by			Report to	Time Called	Time Out	Time In	Gallons Issued	Dispatcher's Initials		Remarks
					Name	Activity	Phone						Out	In	

Figure 5-13.—Aircraft refueling dispatch log.

1. Secure all electronic and electrical switches on aircraft that are not required for fueling (plane captain).

2. Verify fire extinguisher is at refueling point (station operator).

3. Attach bonding cable between refueling equipment and aircraft (see fig. 5-14). NO aircraft engines or auxiliary power units are started or stopped. External power will NOT be connected, disconnected, switched on or off. Changing aircraft's electrical power status can create significant ignition sources (plane captain).

4. Pull out hose (or pantograph) and place in proper position for refueling (nozzle operator and refueler operator).

5. Remove refueling adapter cap from aircraft, and dust cover from pressure nozzle. Inspect face of the nozzle to make sure it is clean, and verify flow-control handle is in the fully closed and locked position (nozzle operator).

6. Visually inspect aircraft's adapter (receptacle) for any damage or significant wear. If in doubt about integrity of the adapter, use adapter go/no-go gage or alternate go/no-go gage to determine acceptability (nozzle operator).

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

7. Lift nozzle by lifting handles, and align lugs on nozzle with slots on aircraft adapter. Hook up nozzle to aircraft by pressing nozzle firmly onto the adapter and rotating it clockwise to a positive stop (nozzle operator).

8. Zero refueling meter or totalizer reading (refueler operator).

9. Rotate nozzle flow-control handle to FULL OPEN position. The handle must rotate 180 degrees to ensure the poppet valve is fully open and locked. The flow control handle is placed in either two locked positions; FULLY OPEN or FULLY CLOSED. The handle is NOT used as a flag to indicate fuel flow. Excessive wears on the aircraft adapter and fuel nozzle poppet will result, if the handle is allowed to "float" in the unlocked position (nozzle operator).

10. Upon receiving signals from nozzle operator and plane captain that hook-up has been completed and that they are ready to begin the fueling operation. The refueler operator actuates remote hand-held deadman control.

WARNING

Deadman controls are NOT blocked open or otherwise compromised since this defeats the purpose of the device and can lead to a catastrophic accident.

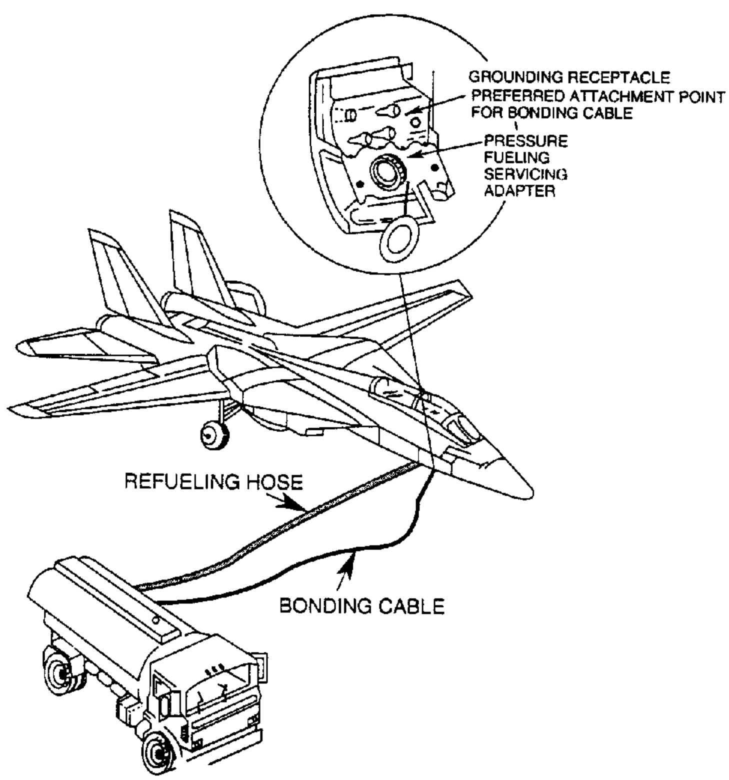


Figure 5-14.—Electrical bonding of aircraft and truck (Cold Refueling).

11. Once fuel flow has been established, test the aircraft's pre-check system. The pre-check system simulates completion of a refueling by closing all tank inlet shutoff valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating pre-check system. The primary means of detecting if the fuel flow has stopped and the pre-check was successful is via the refueling station meter. If a meter is not available, successful pre-check can be confirmed by observing the jerk and stiffening that occurs in refueling hoses and/or pressure spike that occurs at refueling station.

WARNING

Aircraft are cold refueled if it fails pre-check, but special procedures are required. See appropriate *aircraft NATOPS Manual*. This should be done only if it is an operational necessity.

12. Fuel aircraft as directed by the plane captain. The plane captain monitors aircraft vents, tank pressure gage(s), and/or warning lights, as necessary.

13. When directed by the plane captain, release deadman control (refueler operator).

14. Rotate nozzle flow control handle to the OFF and fully locked position (nozzle operator and verified by the refueler operator).

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and ultimately, a fuel spray or spill.

15. Disconnect nozzle from the aircraft adapter (nozzle operator).

16. Stow the pantograph or hose (nozzle operator and refueler operator).

17. Complete paperwork (nozzle operator and refueler operator).

Overwing Truck Refueling

Overwing (gravity) refueling of aircraft from trucks is done using the procedures described under "Cold Refueling of Aircraft by Truck," but with the following modifications:

1. Repeat steps 1 through 3 as described in "Cold Refueling of Aircraft by Truck" procedures.

2. Zero refueling meter or totalizer reading (refueler operator).

3. Pull out hose (or pantograph) and place it in proper position for refueling (nozzle operator and refueler operator).

4. Bond overwing nozzle to the aircraft as shown in figure 5-18, and then remove the filler cap from aircraft (nozzle operator).

WARNING

Always bond the nozzle to the aircraft before the filler cap is removed. This connection will remain in place until the entire fueling operation is complete. Failure to bond the nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

5. Insert overwing nozzle into the aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout entire fueling operation (nozzle operator).

6. Upon receiving signals from the nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, the refueler operator actuates the remote, hand-held, deadman control.

WARNING

Deadman controls are NOT blocked open or otherwise compromised since this defeats the purpose of the device and can lead to a catastrophic accident.

7. The nozzle operator slowly squeezes the handle on the overwing nozzle to initiate fuel flow and fuels the aircraft as directed by the plane captain. Plane captain will monitor aircraft vents.

8. When directed by the plane captain, release the deadman control (station operator).

9. Disconnect the nozzle bonding wire from the aircraft (nozzle operator).

10. Stow the pantograph or hose (nozzle operator and refueler operator).

11. Complete paperwork (nozzle and refueler operator).

Refueler Parking

All activities require that refueling vehicles be constantly attended whenever engine is operating. The operator is considered in attendance when performing tasks directly associated with fueling an aircraft; for example, assisting aircraft-refueling operator, transporting hose.

If operator is to leave his/her truck unattended, he/she must first:

1. Drive truck clear of the aircraft.

2. Place air brake in ON and LOCKED position, if applicable.

3. Set parking brakes.

4. Direct front wheels to an open, unobstructed area.

5. Stop engine.

6. Chock drive wheels.

Q5-75. How many people does it take to operate the truck fill stand, when servicing fuel trucks?

Q5-76. When would it be necessary for two people to operate the truck fill stand to service fueling trucks?

Q5-77. The delivery nozzle from the truck fill stand is connected to what component of the fuel truck?

Q5-78. If a refueler truck is completely drained, how is it filled with fuel?

Q5-79. Why is top loading of refueling trucks no longer performed at truck fill stands?

Q5-80. During filling operations at a truck-fill stand, what is the position of the truck's gearshift?

Q5-81. What is the final step in filling a refueler from a truck fill stand?

Q5-82. Why is the positioning of refuelers servicing aircraft always done in the same manner?

Q5-83. What is the minimum distance that a refueler truck should be positioned from an aircraft?

Q5-84. When refuelers are backed-up to aircraft, what requirement is always followed?

Q5-85. Why are both the overwing and pressure fueling systems NEVER operated at the same time?

Q5-86. What components of the (a) refueling truck and the (b) aircraft should you consider in the course of determining refueler alternative routes and fueling positions?

Q5-87. In almost every case, how is a refueler positioned for refueling an aircraft?

Q5-88. At what positioned is the refueler gearshift in, when cold refueling an aircraft?

Q5-89. Why is the refueler truck window in the cab kept partially open during the entire refueling operation?

Q5-90. In an emergency, what person is responsible for releasing the deadman control during cold refueling to stop fuel flow on a refueler?

Q5-91. If cold refueling an aircraft with JP-4 or commercial JET B fuels, what other person is required for this operation besides the driver/operator and the nozzle operator?

Q5-92. Prior to starting a cold refueling operation using a refueler truck, when should you perform the hot brake check on the vehicle?

Q5-93. During a cold refueling operation, what person is tasked with zeroing the refueling meter or totalizer reading of a refueler?

Q5-94. How many people are tasked with refueling an aircraft using a refueler truck equipped with an overwing nozzle?

Q5-95. If you are the refueler operator and you need to leave the truck unattended, what steps should you take?

Q5-96. If the refueler operator has to leave the truck unattended, at what position are the brakes placed?

Q5-97. If leaving the refueler truck unattended, what must be done to the wheels?

ASHORE OPERATING PROCEDURES

LEARNING OBJECTIVE: Explain the procedures for various ashore fueling operations.

The operating procedures presented and discussed in this section are for general types of fuel facilities and equipment common to all or most activities engaged in the fueling of aircraft. Since the actual facilities and equipment vary greatly from installation to installation, these procedures and accompanying information are designed to serve as a basic outline and guide. As always, use your station's specific operational procedures for actual fueling and defueling operations.

Refueling personnel must cease any fuel operation that does not appear to be progressing in a normal fashion (appears to be taking much longer than would normally be expected, or pressures are too high). A safety violation constitutes the immediate notification of the Fuels Officer (FO) or Fuels Management Officer (FMO). Failure to recognize and terminate such an operation can lead to a catastrophic accident.

In situations where abnormal fuel operations are required, the Fuels Management Officer determines whether to proceed with the proposed action.

NOTE

NAVAIR 00-80T-103, Conventional Weapons Handling Procedures Manual (Ashore), prohibits the simultaneous fueling and loading/downloading of weapons.

SPILL PREVENTION AND CONTROL

Proper training of fuel-servicing personnel is essential. Proper maintenance of the equipment is equally essential. Leaking or malfunctioning equipment must be removed from service. Self-closing nozzles or dead-man controls must not be blocked open or bypassed. Kinks and short loops in fuel hoses should be avoided. In addition, a fuel-spill/fire prevention drill must be conducted at least quarterly in accordance with *NAVSUP (Naval Supply Procedures)-558*.

When a spill is observed, the fuel servicing must be stopped immediately by release of the deadman control, by closing the nozzle handle, or by operating the emergency fuel shutoff. The supervisor is notified at once, and the operation will NOT resume until authorized by the supervisor. Every fuel spill must be investigated to determine the cause, whether emergency procedures were properly carried out, and what corrective measures are required.

Priming Spills

Pint-size spills, involving an area less than 18 inches in any dimension, require no emergency action during cold refueling operations. However, ramp personnel should stand by with a fire extinguisher until operations are complete and/or the aircraft departs. **A spill or leak of any size is cause for terminating a hot-refueling operation**.

Small Spills

Other small spills involving an area of from 18 inches to 10 feet in any dimension must have a fireguard posted, equipped with at least one fire extinguisher. Either absorbent cleaning agent or emulsion compound may be used to absorb the spilled fuel. Contaminated absorbent must be placed in metal containers with closed lids until it can be removed and disposed of according to local hazardous-waste disposal procedures. An exception to this method may be authorized if the spill occurs in an area where no operations are in progress or will be conducted until ample opportunity is provided for volatile fuels to evaporate harmlessly. In such an event, the area must be roped off. Fuels such as JP-5, which will not evaporate readily, must be removed by one of the methods indicated previously.

Large Spills

Spills covering an area greater than 10 feet in any dimension or more than 50 square feet in area require handling by the Spill Response Team. The team must be summoned immediately and all other personnel evacuated to a safe distance. No one will be permitted to walk through the liquid area of a fuel spill.

Navy Oil Discharge Response

Fuel spills will be reported immediately to the Activity's Environmental Coordinator in accordance with the *oil spill contingency plan*.

All Fuels Management Officers will be thoroughly familiar with *OPNAVINST 5090.1 series*. All fuel handling personnel will be familiar with the *local oil spill contingency plan*.

Surge Pressure Control

Fuel handling procedures are designed to minimize surge pressures.

The following actions should be taken:

- Close all valves slowly, particularly during the last half of the closure.

WARNING

Even during an emergency such as a hose or pipeline leak, valves must be closed slowly. Rapid closing of a valve can create a surge pressure of sufficient magnitude to rupture pipes or systems.

• Pressure gages are installed in critical places on the flow-inlet side of controlling valves so the operator can keep pressures within limits as the valve is closed.

• Start and stop booster pumps with bypasses opened, if there is such a provision; then close valves slowly.

• In multiple pump operation, start and stop pumps one at a time.

• In starting an operation, open downstream valve first and work toward the pumping source.

• In stopping an operation, reverse the step above and close upstream valves first.

• Fill all empty or partially empty lines slowly, particularly a line system involving steep slopes.

• Where practical, keep both receipt and issue pipelines packed.

Night Vision Goggles

The guidelines used for night vision goggles during refueling operations are conducted in accordance with *local procedures*.

REFUELING AT DIRECT FUELING STATIONS (PITS) WITH ENGINES OFF (COLD REFUELING)

Cold refueling of aircraft in static conditions at fueling hydrants, direct refueling stations, skid mounts, and other fuel service units requires a minimum of two trained and certified people. Required are a nozzle operator (supplied from the squadron, maintenance department, or transient line) and a fuel system operator (from the fuels division), who also performs the duty of a fire extinguisher operator.

Direct refueling operations will be recorded and maintained in a log (fig. 5-15) for tracking purposes.

DIRECT REFUELING STATION LOG						
Refueling Station (Pit) #:				Date:		
Time	A/C			Quantity Issued (Gallons)	SQDN Signature	Station Operator's Initials
	Type	BUNO #	SQDN			

Figure 5-15.—Direct refueling station log.

Aircraft refueling tasks are to be performed in the following sequence and verified by the pit station operator. The individual who actually performs the task is indicated within parentheses following the task.

1. Re-circulate (flush) the station and take fuel sample(s) for quality control checks as appropriate. Fuel is re-circulated or flushed through the refueling hose and nozzle, and tested for contamination prior to refueling the first aircraft each day. Fueling must not begin until acceptable results have been obtained. Failure to provide clean, dry fuel to the aircraft can adversely affect safety-of-flight (station operator).

2. Check for "hot-brake" condition. The hot-brake check applies to fixed-wing aircraft only (plane captain).

3. Tow the aircraft into the direct refueling station; position and chock it. If using the same direct refueling station, aircraft will NOT be cold refueled simultaneously, while conducting hot refueling. If the tractor remains attached, turn off the engine until the refueling evolution is completed (plane captain).

CAUTION

Aircraft are parked in the refueling area, so the hose does NOT need to pass underneath the aircraft to reach the pressure refueling receptacle.

4. Secure all electronic and electrical switches on the aircraft not required for fueling (plane captain).

5. Verify that fire-fighting equipment is in the immediate vicinity of the refueling operation and manned (station operator).

6. Attach bonding cable (fig. 5-16) between refueling equipment and the aircraft. In direct fuel systems, bonding is usually accomplished through nozzle/hose/pantograph system (see figure 5-17). If impractical, bonding connection is made using grounding receptacle near the aircraft's refueling adapter. If this is not possible, the connection is made bare metal to the aircraft (plane captain).

7. Pull out pantograph (or reel out hose) and place it in the proper position for refueling (nozzle operator and station operator).

8. Remove the refueling adapter cap from the aircraft and the dust cover from the pressure nozzle. Inspect the face of the nozzle to make sure it is clean, and verify that the flow-control handle is in the fully closed and locked position (nozzle operator).

9. Visually inspect aircraft's adapter (receptacle) for any damage or significant wear. If in doubt, use the adapter go/no-go gage or alternate go/no-go gage to determine acceptability (nozzle operator).

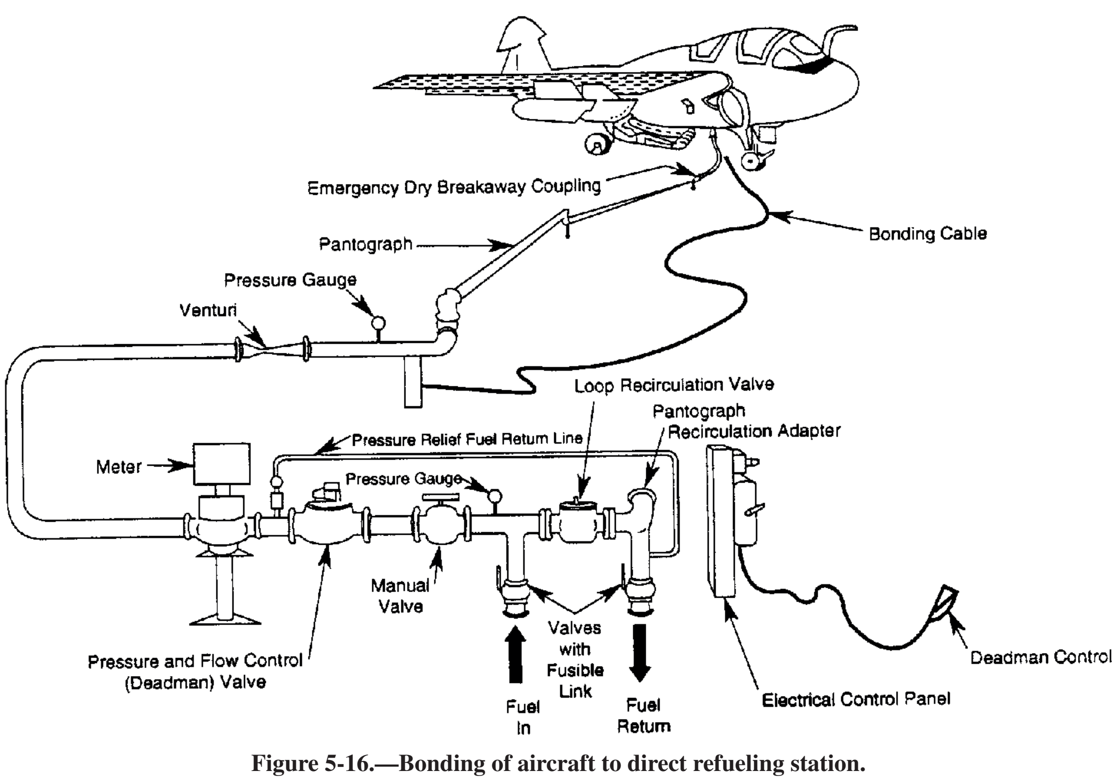


Figure 5-16.—Bonding of aircraft to direct refueling station.

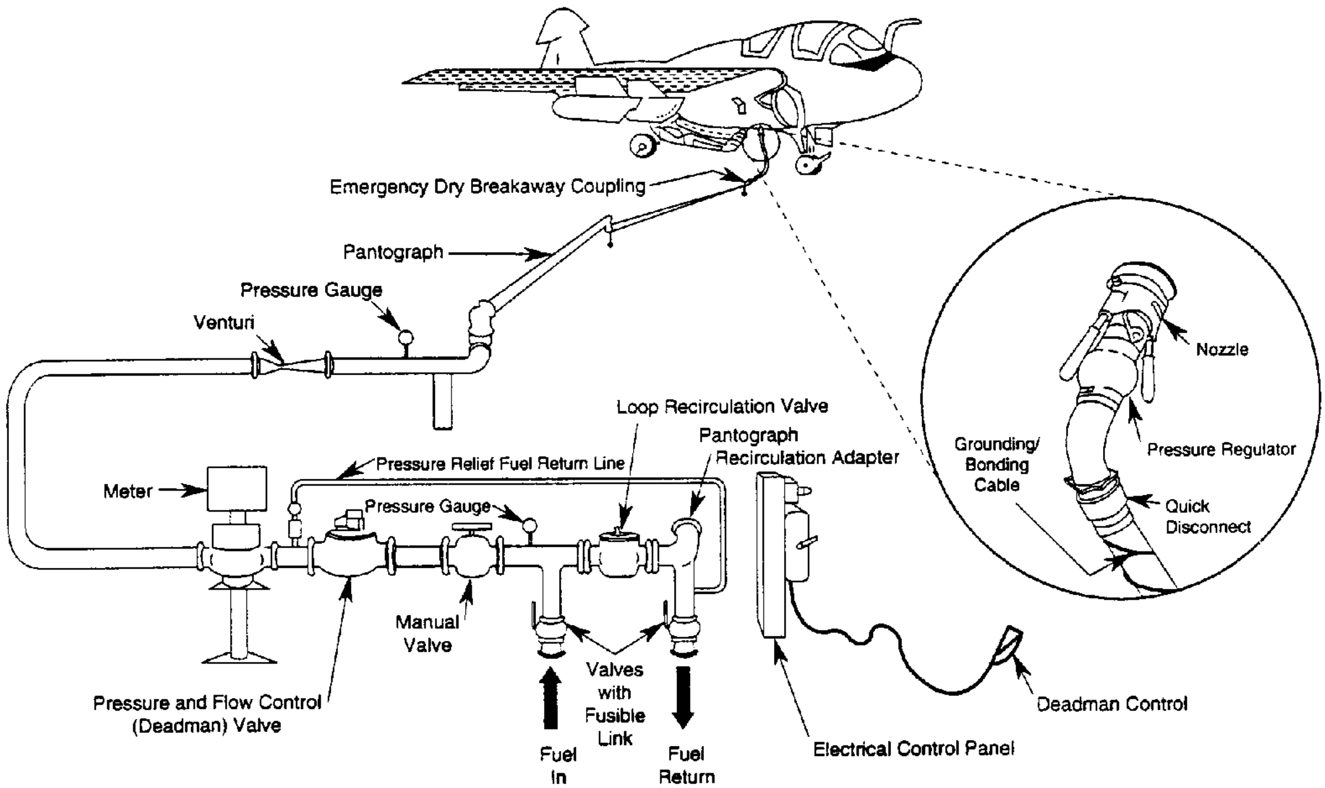


Figure 5-17.—Bonding and grounding via nozzle connection.

> **WARNING**
>
> A worn or broken adapter can defeat safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

10. Lift the nozzle by the lifting handles; align lugs with slots on the aircraft adapter; and hook up to aircraft by pressing nozzle firmly onto the adapter and rotating it clockwise to a positive stop (nozzle operator).

> **WARNING**
>
> The nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which could lead to a fuel spray or spill.

11. Zero refueling station's meter or note station's totalizer reading (station operator).

12. Upon receiving signals from nozzle operator and plane captain that hookup has been completed and fueling operation is ready to begin, station operator actuates the remote, hand-held deadman control. Deadman controls must NOT be blocked or overridden in any way. Such action defeats purpose of the device and can lead to a catastrophic accident.

> **WARNING**
>
> Once a fueling evolution has commenced, the aircraft's electrical power status and connections are not changed until the evolution has been completed or refueling has been stopped because of an emergency. (Changing aircraft's electrical power status can create significant ignition sources).

13. When the hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle must rotate 180 degrees to ensure the poppet valve is fully open and locked (nozzle operator).

WARNING

The flow-control handle of the pressure-refueling nozzle is placed in either of two locked positions: fully open or fully closed. The handle is NOT used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and fuel nozzle poppet will result if the handle is allowed to "float" in the unlocked position.

14. Once fuel flow is established, test the aircraft's pre-check system. The pre-check system simulates completion of a refueling by closing all tank inlet shutoff valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the pre-check system. The refueling station meter is the primary means of detecting fuel flow has stopped and the pre-check was successful. If a meter is not available, successful pre-check may be confirmed by observing the jerk and stiffening that occurs in the refueling hose and/or the pressure spike that occurs at the refueling station.

NOTE

An aircraft can be cold refueled if it fails pre-check but special procedures are required. See the *appropriate aircraft NATOPS manual*. Cold refueling after pre-check failure is done only if it is an operational necessity.

15. Fuel the aircraft as directed by the plane captain. The plane captain monitors the aircraft vents, tank pressure gage(s), and/or warning lights as necessary.

16. When directed by the plane captain, release the deadman control (station operator).

17. Rotate the nozzle flow-control handle into the OFF and fully locked position (nozzle operator and verified by the station operator).

WARNING

Failure to lock the flow-control handle in the OFF position can contribute to failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

18. Disconnect the nozzle from the aircraft adapter (nozzle operator).

19. Stow the pantograph or hose (nozzle operator and station operator).

20. Complete paperwork (nozzle and station operators).

OVERWING (GRAVITY) REFUELING AT DIRECT FUELING STATIONS (PITS)

Overwing (gravity) refueling of aircraft in a static condition is a three-person operation, a nozzle operator, a fuel system operator, and a fire extinguisher operator. Overwing (gravity) refueling is performed at fueling hydrants, direct refueling stations, skid mounts, and other fuel service units.

WARNING

Overwing refueling with aircraft’s engines operating (hot refueling) is NOT authorized.

Aircraft refueling tasks are performed in the following sequence and verified by the pit station operator:

1. Re-circulate (flush) station and take fuel sample(s) for quality control checks as appropriate. Fuel is tested for contamination prior to refueling aircraft each day. Fueling will not begin until acceptable results have been obtained. Recirculate the refueling station and take samples with the pressure-refueling nozzle in place. Replace the pressure-refueling nozzle with an overwing nozzle immediately before commencing refueling operations (station operator).

2. Check for "hot-brake" condition. The hot-brake check applies to fixed-wing aircraft only (plane captain).

3. Tow aircraft into the direct refueling station; position and chock it (plane captain).

4. Secure all electronic and electrical switches not required for fueling on the aircraft (plane captain).

5. Verify the extinguisher is at the refueling point (station operator).

6. Attach bonding cable between refueling equipment and the aircraft. The aircraft’s electrical power status and connections are NOT changed until the evolution has been completed or refueling has been

stopped for an emergency. NO aircraft engines or auxiliary power units are to be started or stopped. External power will NOT be connected, disconnected, or switched on or off. Changing aircraft's electrical power status can create significant ignition sources.

7. Zero the refueling station's meter or note the station's totalizer readings (station operator).

8. Pull out pantograph (or reel out hose) and place it in the proper position for refueling (nozzle operator and station operator).

9. Bond the overwing nozzle to the aircraft (as shown in figure 5-18) and then remove the filler cap from the aircraft. Always bond nozzle to aircraft before the fill cap is removed. This connection will remain in place until the entire fueling operation is complete. Failure to bond the nozzle and maintain contact can result in a dangerous static spark inside the fuel tank (nozzle operator).

10. Insert the overwing nozzle into the aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation (nozzle operator).

11. Upon receiving signals from the nozzle operator/plane captain that hookup has been completed and they are ready to begin the fueling operation, the station operator actuates the remote, hand-held, deadman control.

WARNING

Deadman controls will NOT be blocked open or otherwise compromised since this defeats purpose of the device and can lead to a catastrophic accident.

12. The nozzle operator squeezes the overwing nozzle handle to initiate fuel flow and fuel the aircraft as directed by plane captain. The plane captain will monitor aircraft vents, tank pressure gage (s), and/or warning lights as necessary.

13. When directed by the plane captain, release the deadman control (station operator).

14. Disconnect the nozzle-bonding wire from the aircraft (nozzle operator).

15. Stow the pantograph or hose (nozzle operator and station operator).

16. Complete the paperwork (nozzle operator and station operator).

FUELING WITH ENGINES OPERATING (HOT REFUELING)

Hot refueling is performed only when operations require rapid turnaround of aircraft, since hot refueling is significantly more dangerous and costly in terms of fuel and manpower expenditures. Only pressure hot refueling is performed.

WARNING

If the station is configured so that the deadman control operator does not have a direct line-of-sight of both aircraft pilot and nozzle operator, a fourth person (refueling coordinator) is mandatory.

A minimum of three ground crew personnel is required for each hot refueling operation. All personnel performing hot refueling operations must be fully trained and qualified. The usual duties of each of these personnel are listed in the following paragraphs. Local

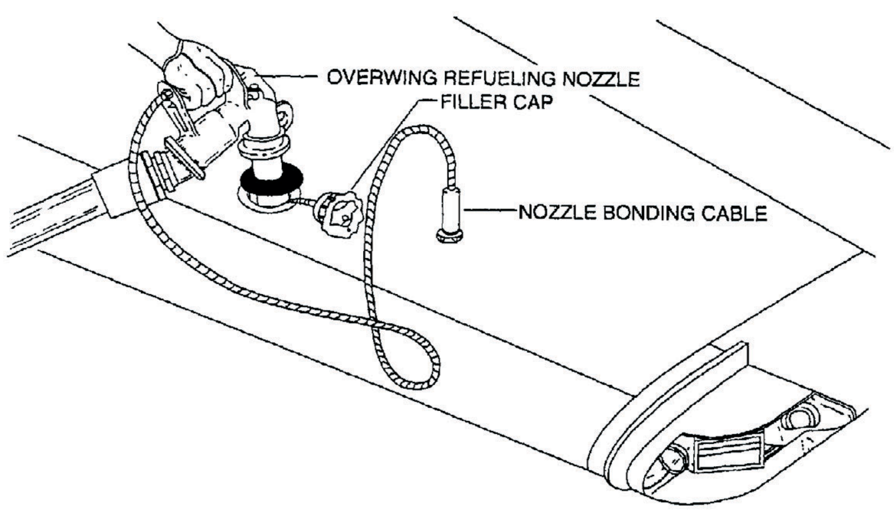


Figure 5-18.—Electrical bonding of overwing nozzle to aircraft.

conditions or procedures, however, may require that duties be distributed differently among refueling personnel.

Personnel required for hot refueling aircraft are as follows:

- One station operator. The station operator must be a fully qualified station operator from the local fuels management organization. He or she must be positioned to observe and monitor entire hot refueling operation. Duties include actual operation of the deadman control.

- One nozzle operator. The nozzle operator must be a squadron crewmember qualified for aircraft refueling duties related to the specific aircraft type model being refueled. Duties include performance of necessary aircraft refueling checks, such as testing the pre-check system, and monitoring aircraft vents and the refueling panel. The nozzle operator remains at the nozzle throughout the refueling and leaves only to conduct necessary vent checks.

- One fire watch operator. His duty is to man the fire extinguisher throughout the entire refueling operation. This operator is normally TAD from one of the squadrons being refueled.

- One refueling coordinator (plane captain). The refueling coordinator will be a crewmember of the squadron whose plane is being hot refueled. The coordinator's primary duties include directing all movements of aircraft and coordinating hand signals between fuel crew and pilot. If the deadman control operator has a direct line-of-sight to both aircraft pilot and nozzle operator, the refueling coordinator's duties may be performed by either station operator or nozzle operator.

Equipment Requirements

The following equipment is the minimum required for conducting hot refueling operations at shore activities:

- One fuel service unit, such as a direct refueling station (pit) or mobile refueler. This unit must possess all of the required features and systems listed earlier in this chapter for systems/facilities that refuel aircraft (filter/separator, fuel monitor, and so forth). The fuel service unit MUST have a completely operational deadman control, which MUST cut off flow of fuel to aircraft immediately (within 2 seconds), upon release. Leakage past the valve with the deadman in the released position can NOT exceed 1 gallon in 5 minutes. The service fuel unit is grounded (earthed) through a connection that offers less than 10,000 ohms resistance. The servicing system's fuel supply tank (s) is located at least 50 feet from any part of the aircraft (wings, rotor blades, etc.) being serviced.

- A fixed/portable pantograph or a minimum of 50 feet of refueling hoses. Pantograph fueling arms are preferred, because they are significantly less prone to rupture.

- One bonding/grounding cable. Newer direct refueling stations (pits) are designed with a bonding/grounding cable built into the pantograph and along the hose. A separate bonding cable is therefore not needed with these systems. If continuity check proves resistance to be 10,000 ohms or less, the requirement for continuity is satisfied.

WARNING

Both truck and aircraft must be grounded to earth as well as bonded to each other during hot refueling operations with trucks.

- Aircraft wheel chocks or similar restraining device.

- Sound-attenuating ear protectors, goggles, cranials, and long-sleeved shirts and pants for each crewmember. Personnel must NOT wear shoes that have nails or other metal devices on soles of their shoes that might cause sparking.

- A fire extinguisher for each aircraft being refueled (consult *NATOPS Aircraft Fire Fighting and Rescue Manual, NAVAIR 00-80R-14*).

- All ground personnel involved in hot refueling operation must be qualified in operating the fire extinguishing equipment in use.

- One emergency dry-breakaway quick-disconnect. This device is attached to the refueling hose near the pantograph (on direct refueling stations) or an attachment point to the fuel-servicing unit.

Hot Refueling Procedures

The following must be accomplished prior to aircraft entering the refueling area:

• Check for hot break condition. Hot refueling is NOT performed if a hot brake condition exists. Hot brake check is applicable to fixed-wing aircraft only (plane captain).

CAUTION

No nozzle samples are taken after aircraft has taxied into the designated hot refueling area. Sampling increases possibility of a fuel spill.

• The station or mobile refueler must be re-circulated (flushed) and fuel sample (s) taken for quality control checks as appropriate. Fuel is tested for contamination prior to refueling the first aircraft each day. Fueling will NOT begin until acceptable results have been obtained, clear and bright with NO visible sediment (station operator).

• The area must be policed for FOD (Foreign Object Damage).

• Ground crew must wear sound-attenuating ear protectors, goggles, and cranials.

• Qualified squadron personnel verify all ordnance is safed. Safed is defined as replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin, securing of armament switches and/or any appropriate action that renders particular ordnance carried as safe.

WARNING

Hot refueling of explosive loaded combat aircraft, or aircraft with any hung ordnance, aircraft with pods/dispensers loaded with decoy flares, **is prohibited**. Explosive loaded combat aircraft are not permitted in the fuel pits. Dummy ordnance, practice ordnance, containing only flash or impact signal cartridges, training missiles without live warheads and motors, internally carried pyrotechnics and SUS charges, aircraft-peculiar cartridge actuated devices, and de-armed internally mount guns loaded with target practice ammunition are excluded from this equipment.

Hot Refueling Procedures in the Refueling Area

The following steps should be taken:

1. The aircraft is taxied to the hot refueling area in accordance with *local SOPs*. The aircraft enters the area with the refueling receptacle on the side of the aircraft positioned near the pantograph or hose. Once properly positioned, the aircraft is chocked.

• Servicing AV-8B's water injection system/tank is NOT authorized in the refueling area.

• Pantograph must be extended to a sufficient distance for the emergency dry breakaway device to work properly. The pantograph should not interfere with movement of aircraft. See figure 5-19.

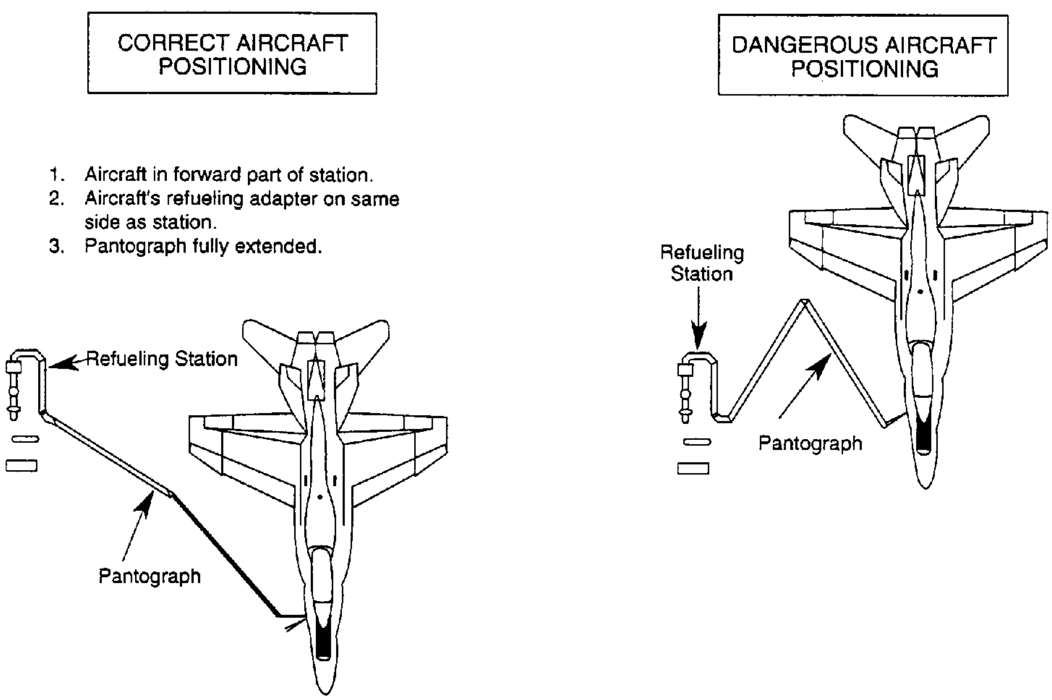


Figure 5-19.—Positioning of aircraft for pantograph refueling.

• The hose or pantograph will NOT pass underneath aircraft to reach pressure-fueling receptacle. This will interfere with the operation of the emergency dry break coupling or may result in severing hose/pantograph in event of a malfunction or failure of the aircraft's landing gear.

• Disconnect refueling hose immediately if any leaks are discovered throughout entire operation.

• The deadman control operator will have a direct line-of-sight to refueling nozzle operator at aircraft receptacle whenever he/she is actuating the deadman control.

• If either primary or secondary shut-off valve test discloses a failure, hot refueling operation is discontinued immediately.

• Aircraft canopy and helicopter side doors (if installed) will remain closed during the entire refueling evolution. Aircraft refueling operations will be secured if the canopy is opened. Hot refueling of rotary-wing aircraft by mobile refuelers without the use of a pantograph is accomplished only with the rotor blades disengaged. Hot refueling helicopters by mobile refuelers should be avoided whenever possible.

• <u>Exceptions:</u>

a. Rear cargo doors and/or doors on opposite side of aircraft from refueling adapter may be open, provided refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment(s).

b. The AV-8B aircraft can be hot refueled with canopy open at the pilot's discretion when high temperatures and humidity dictate since aircraft's environmental control system does not operate with weight on wheels.

2. Pilot secures all unnecessary electronic and electrical equipment NOT required for refueling.

3. Verified manned firefighting equipment is properly positioned to refueling operation (station operator).

4. Bond aircraft to refueling equipment. Ground aircraft to an earth ground with a resistance to ground value of 10,000 ohms or less (plane captain).

• Unlike cold refueling systems, aircraft with engines or APU running generate additional static electricity that must be bled to ground.

• In direct fueling systems, both bonding and grounding are normally accomplished simultaneously with attachment of the refueling nozzle to aircraft. The nozzle/hose/pantograph system provides a continuous electrical path between aircraft and fueling equipment that is grounded to Earth (see figure 5-11).

• If bonding and grounding are NOT established in the direct fueling station through the nozzle/hose/pantograph system, a separate cable that is both bonded to the fueling equipment and grounded to a 10,000 ohms or less earth ground must be provided. The grounding receptacle near aircraft's refueling adapter should be used; if this is not possible, connection should be to bare metal on the aircraft.

• When hot refueling from refueling trucks, the truck is connected to an Earth ground of 10.000 ohms or less; truck and aircraft will be bonded to each other. If a portable or permanently anchored pantograph is properly earthed and configured, there is electrical continuity between the nozzle and the pantograph. The truck's bonding cable is attached to this pantograph.

• When hot refueling aircraft at fixed facilities, primary aircraft taxi directors are aircrew chiefs, plane captains, trained and qualified squadron personnel.

5. Pull out pantograph (or reel out hose) and place in proper position for refueling (nozzle operator and station operator).

6. Remove the refueling adapter cap from the aircraft and the dust cover from the pressure-fueling nozzle. Inspect the face of the nozzle to ensure it is clean and verify that the flow control handle is in the fully closed and locked position (nozzle operator).

7. Visually inspect aircraft's adapter (receptacle) for any damage or significant wear. If in doubt about the integrity of the adapter, use the adapter go/no-go gage or the alternate go/no-go gage to determine acceptability.

WARNING

A worn or broken adapter can defeat safety interlocks of the refueling nozzle permitting poppet valve to open and fuel to spray or spill.

8. Lift nozzle by lifting the handles, align lugs with slots on aircraft adapter, and hook up to aircraft by

pressing firmly onto the adapter and rotating it clockwise to a positive stop (nozzle operator).

WARNING

The nozzle must be seated firmly on adapter and NOT cocked. Cocking can indicate a malfunction of nozzle's safety interlock system, which can lead to a fuel spray or spill.

9. Zero refueling meter or note totalizer reading.

10. Upon receiving signals from the nozzle operator and the plane captain that hookup has been completed and fueling operation is ready to begin, the station operator actuates the remote, hand-held, deadman control. The aircraft's electrical power status and connections are NOT changed until the evolution has been completed or refueling has been stopped for an emergency. NO aircraft engines or auxiliary power units can be started or stopped, and external power CANNOT be connected, disconnected, or switched on or off. Changing the aircraft's electrical power status can create significant ignition sources.

WARNING

The deadman controls must NOT be blocked open or overridden in any way. This defeats the purpose of the device and can lead to a catastrophic accident.

11. When the hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle will rotate 180 degrees to ensure that the poppet valve is fully open and locked. The flow-control handle of the single-point pressure-refueling nozzle is placed in either of two locked positions: fully open or fully closed. The handle is NOT used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position (nozzle operator).

12. Once fuel flow has been established, exercise the aircraft's pre-check system. The pre-check system simulates completion of a refueling by closing all tank inlet shutoff valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the pre-check system. The primary means of detecting fuel flow has stopped and pre-check was successful is via the refueling station meter. If a meter is not available, successful pre-check can be confirmed by observing the jerk and stiffening that occurs in the refueling hose and/or pressure spike that occurs at the refueling station (qualified personnel).

WARNING

Aircraft can be cold refueled if it fails pre-check, but special procedures are required. See appropriate *aircraft NATOPS Manual*. This should be done only if it is an operational necessity.

13. Fuel aircraft as directed by the plane captain. The plane captain monitors aircraft vents, tank pressure gage(s), and/or warning lights as necessary.

14. When directed by the plane captain, release deadman control.

15. Rotate nozzle flow control handle into the OFF and fully locked position (nozzle operator and verified by the station operator).

WARNING

Failure to lock flow control handle in OFF position may result in a fuel spray or spill.

16. Disconnect the nozzle from aircraft adapter (nozzle operator).

17. Stow the pantograph or hose (nozzle operator and station operator).

18. Complete paperwork (nozzle operator and station operator).

19. Ensure the area is clear of equipment and personnel.

MULTIPLE-SOURCE REFUELING

Normally only one refueling truck at a time is used to service aircraft. However, there are situations when multi-truck or truck and hydrant servicing is considered desirable, especially when very large aircraft must be refueled. The advantage of multiple-source refueling is reduced aircraft turnaround time. The *aircraft's NATOPS manual* or equivalent aircraft servicing manual should be consulted for specific guidelines and instructions on multiple-source refueling before such operations are performed.

PIGGYBACK REFUELING

Piggyback refueling is a special refueling process sometimes used to refuel very large aircraft such as C-5As or E-6As. Two or more refueling trucks are used. One truck is attached to aircraft's refueling adapter, and other trucks are used to refuel this truck while it continuously refuels the aircraft. This is a potentially dangerous operation and will be conducted only with properly configured vehicles and under the direct supervision of the Fuels Management Officer. These vehicles will have both high- and low-level alarms and shutoff systems in place and fully operational.

- High-level alarm and shutoff are essential to preventing tank overfill.

- Low-level alarm and shutoff are essential to preventing pump cavitation and/or pumping of air into the aircraft. Theses can lead to catastrophic static electrical discharges.

The refueling of aircraft and the refueling of truck(s) will be performed following the procedures for "Cold Refueling with a Truck". A minimum of five (5) people will be needed for these two operations since one person manning a fire extinguisher is sufficient to cover both operations. A detailed *local instruction* that delineates each individual's responsibilities and duties is written to cover this operation.

TRANSFERRING FUEL FROM ONE AIRCRAFT TO ANOTHER

Some special purpose operations have been developed in which fuel is removed from an aircraft and directly loaded into another aircraft (or ground vehicle). Aircraft defueling is a very dangerous and demanding operation. In addition, immediate re-use of fuel removed from an aircraft without proper filtration and handling can adversely affect safety-of-flight. Only *NAVAIR* approved transfer operations are authorized. Appropriate safety precautions are observed at all times during these operations.

Specific examples of approved types of operations are listed below:

1. Refueling aircraft, fuel storage bladders, or ground vehicles from KC-130 aircraft.

2. Transfer of fuel between aircraft using a Plane-to-Plane Transfer Cart. For detailed information, description of this equipment, or operational procedures, refer to the *Aircraft Refueling NATOPS manual, NAVAIR 00-80T-109, and NSTM CH. 542, Gasoline and JP-5 Fuel Systems*.

REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) RUNNING

The aircraft APU may be used to supply electrical power for pressure refueling on military aircraft so equipped and commercial aircraft (when the procedure is approved by the FAA for the carrier's aircraft in commercial operations). This operation is not considered "hot refueling". However, the following precautions are observed in addition to normal refueling procedures:

- One man remains outside the aircraft within 10 feet of the APU exhaust with a fire extinguisher of the size specified by the station's Fire Chief.

- The fuels operator verifies the aircraft is grounded.

- One person is at the GTC controls in the cockpit.

- Communications are established between the cockpit and personnel performing the refueling, to ensure immediate shutdown in an emergency.

- Personnel near aircraft must wear sound-attenuating ear protectors.

NOTE

P-3 aircraft that have APUs equipped with fire sensor/suppressor systems are designed to automatically extinguish APU fires.

DEFUELING AIRCRAFT

As was stated previously, defueling is one of the most technically demanding and potentially dangerous operations performed by fuels personnel. Most aircraft defueling equipment has the capability of defueling an aircraft faster than the aircraft can release it.

The pump's discharge is regulated to balance its fuel from the aircraft in order to prevent pump cavitation and/or loss of suction, which would necessitate re-flooding the pump. Once proper balance is achieved, it must be maintained by manipulating the valve on the downstream side of the pump throughout the defueling operation.

Defueling aircraft and operations involving defueled product is entrusted to only the most disciplined station operators who have received specialized training. Assignment of inadequately trained or inexperience personnel to defueling operations can result in catastrophic accidents.

> **WARNING**
>
> Assignment of inadequately trained or inexperience personnel to defueling operations can result in catastrophic accidents.

Defueling normally has lower priority than refuelings. A defuel request for an aircraft that is leaking fuel is considered an emergency and handled promptly. The desire to satisfy customer requests for the acceleration of the process should not be granted.

The following rules apply to every defueling operation performed on shore stations:

• Aircraft defueling must be requested by an authorized representative of the squadron's CO, using an Aircraft Defueling Certificate similar to the one shown in figure 5-20. The Fuels Management Officer

AIRCRAFT DEFUELING CERTIFICATE

PART I [To be completed by person authorizing the defuel operation (person's name shall be on file with the fuel officer).]

I CERTIFY THAT THE AVGAS/TURBINE FUEL (cross out one) TO BE
DEFUELED FROM AIRCRAFT NUMBER ______________________________:

☐ WOULD NOT PREVENT THE RELEASING OF THIS AIRCRAFT FOR FLIGHT.

☐ IS SUSPECT OF CONTAMINATION WITH ______________________
____

☐ CONTAINS DYE BUT WOULD NOT PREVENT THE RELEASING OF THIS AIRCRAFT FOR FLIGHT. REISSUE DYED FUEL TO AIRCRAFT NUMBERS ________________________ AND ________________.

THE ESTIMATED GALLONS TO BE DEFUELED ARE: ____________________
THE REASON FOR DEFUELING IS: ______________________________
____

______________________________ ________________ __________
Signature Title Date

PART II [To be completed by operator after completion of defueling operation.]

METER READING: ______________________________
VOLUME OF FUEL REMOVED FROM AIRCRAFT: __________________________

______________________________ ________________ __________
Signature Title Date

Figure 5-20.—Aircraft defueling certificate.

of each activity maintains a list of these officially designated personnel. This list is updated at least quarterly.

- During defueling operations, maintenance not directly required to facilitate defueling operations is NOT performed.

- Aircraft are spotted 50 feet from all structures and other aircraft. Grounding and tiedown pad-eyes must be available. At least one fire extinguisher must be available in the immediate vicinity of the operation.

- Eductor/evacuation systems are NOT used for defueling aircraft.

- Suspect aviation turbine fuel must be removed from aircraft using a defueler only (not a refueler/defueler) and deposited in a designated holding tank. Ultimate disposition will depend on the results of later laboratory tests. Every effort should be made to reclaim off-specification fuel, such as JP-5, F-76 or fuel oil reclaimed (FOR).

- All fuel removed from turbine engine aircraft is assumed to be a mixture of JP-4 and JP-5. Defueled turbine fuel is NOT returned to JP-5 storage tanks without first confirming flash point of the fuel to be 140º F or higher.

- Fuel containing leak-detection dye can be reissued to aircraft of the same squadron as long as the squadron's requesting official signs a statement that the fuel is non-suspect and is safe for use. Refuelers/defuelers may be used to defuel dyed fuel. However, this may present logistics problems since it may take several loads of fuel to flush dye out of the refueler/defueler. The fuel may appear off-color when sampled prior to issuing to another squadron's aircraft.

- The Fuels Management Officer will personally decide the disposition of all defueled products. Assistance is available from *NAVPETOFF (Navy Petroleum Office).*

- The defueling unit is required to maintain a flooded suction above the anti-vortex splash plate in its tank to minimize turbulence and possible ingestion of air. Historically, a minimum of 1,000 gallons has been required in defueling units to resolve turbulence and air ingestion problems. Because of the wide variety of configurations of pump piping systems and tank sizes, 1,000 gallons of product may or may not be enough. It is up to local commands to determine the minimum amount by using the *manufacturers' technical manuals and historical data*.

- The valve (s) that control the flow of fuel from the tank to the upstream side of the pump remain closed during defueling operations. This is to prevent recirculation of product in the tank. The valve (s) may be opened only to prime the pump when the pump is not operating.

- If, during defuel operation, the pump starts to lose prime or cavitate, the operation must be discontinued until the problem is resolved and the fuel supervisor authorizes a restart. At no time will a restart be authorized without waiting a minimum of 1 MINUTE to allow relaxation of any static charges.

- Every aircraft defueling operation requires a minimum of three people: defuel truck operator (supplied by the fuels division), a nozzle operator (supplied by the squadron), and a fire watch (supplied by the squadron).

- A special log of each defueling operation is maintained. The following minimum information is contained in the log:

  a. A complete list of all squadron personnel authorized to sign defuel request forms. This list must be updated at least quarterly.

  b. All abnormal happenings.

  c. Aircraft "Buno" number.

  d. Defueler number.

  e. Grade of product.

  f. Amount of product actually defueled.

  g. Scheduled amount to have been defueled.

  h. Disposition of product.

  i. Times defuel operation was started and completed.

  j. Names of the defueler operator and squadron personnel present during the defuel operation.

Defueling Procedures

Aircraft defueling operations require a minimum of three people trained and certified; the defuel truck operator, a nozzle operator, and a fire watch.

Aircraft defuelings are to be performed in the following sequence:

1. Prior to starting, defuel operation, take samples of the fuel to be defueled from the aircraft's drains and visually inspect them for contamination (qualified

squadron personnel under the observation of the driver/operator).

2. Determine the status of the fuel: suspect or non-suspect (defuel truck operator). The person requesting the defueling operation will confirm that the fuel is or is NOT suspect. Fuel is considered suspect if the aircraft has malfunctioned and the fuel is believed to have contributed to the problem or the fuel is thought to be of the wrong type (AVGAS or automotive fuel instead of aviation turbine fuel).

3. Determine the amount of fuel to be removed from the aircraft (defuel truck operator). Again, the squadron personnel requesting defueling operation will provide this estimate as part of the official request.

NOTE

If an aircraft is being defueled due to a faulty (suspect) fuel quantity gaging system, it will be difficult to estimate the amount of fuel in the aircraft.

4. Select the defueling equipment to be used; defueler for suspect product or refueler/defueler for non-suspect fuel (FMO and station operator). Always check remaining capacity of defueler or refueler/defueler to make sure there is adequate room to hold fuel being defueled. Remember that sufficient fuel must be in defueling tank to maintain a flooded suction above the anti-vortex splash plate.

5. Position the defueler (defuel truck operator).

6. Verify the aircraft is spotted properly (all personnel).

7. Check for possible sources of ignition (all personnel).

8. Verify defueling request chit corresponds to instructions from the dispatcher (defuel truck operator).

9. Connect bonding wire from the defueler to aircraft (defuel truck operator).

10. Unload, position, and connect the defuel hose to aircraft and the defueling stub to the defueler (plane captain).

11. Start defueling upon signal from the nozzle operator (defuel truck operator).

12. Adjust valve downstream of the pump to optimize the defuel rate. Maximum defuel rate is 100 gpm (defuel truck operator). When nearing completion of defuel process, very close attention should be paid to the defuel rate to prevent pump cavitation and/or loss of prime. Discontinue defueling of an aircraft if pump cavitation is a persistent problem.

13. Upon completion of the defuel operation, secure all equipment and CHECK THE AREA FOR FOD (all personnel).

Disposition of Non-Suspect Fuel Removed from Aircraft

All USN and USMC aircraft are authorized to use JP-4, JP-8, commercial JET A and JET A-1, as well as JP-5 fuel. Fuel removed from USN or USMC aircraft will contain mixtures of these fuels, and specific grade of fuel will be impossible to determine without extensive specification testing. USA and USAF aircraft also may contain such mixtures. Therefore, fuel in any properly operating DOD aircraft with turbine engines that is NOT suspect of being contaminated can be defueled into a designated refueling vehicle and then used to refuel any aircraft with the user's knowledge and permission.

First preference will be given to using the fuel to load an aircraft in the same squadron as that from which the fuel originated. Second choice will be to issue the fuel to aircraft having engine fuel controls that automatically compensate for fuel density changes. Aircraft with T-56 engines, such as P-3 and E-2, should be preferentially used since these engines are the most tolerant to such fuel changes.

The following rules apply to re-issuing defueled fuel:

- Since fuel removed from any aircraft almost definitely has a flash point below 140°F, it must NOT be used to refuel any aircraft scheduled for immediate sea duty.

- Any designated defuel or refuelers must pass their fuel through filter/separators and fuel monitors before reaching aircraft.

- The FSII content of defueled turbine fuel must be checked using the FSII refractometer prior to refueling S-3 and SH-60 USN aircraft. Also, all U.S. Army and U.S. Air Force and foreign aircraft.

- Non-suspect fuel that has been dyed for detecting aircraft fuel system leaks can also be used in aircraft provided above procedures are followed. Non-suspect fuel removed from piston engine aircraft can also be re-issued provided:

- The fuel is a known grade (80/87 or 100/130).
- It is properly filtered before reissue.

Disposition of Suspect Fuel Removed from Any Aircraft

Fuel removed from any aircraft that has recently experienced engine or airframe fuel system problems possibly related to fuel quality must be segregated by collecting in a designated defueler, a clean storage tank, or any container labeled as "salvage fuel." It must then be sampled and tested to determine if it is in conformance with deterioration use limits; outlined in *Appendix B* of the *Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109*. If the fuel tests within established limits, it can be returned to station storage and reissued as grade and type determined. Providing adequate filtration and water separation can be accomplished prior to dispensing the fuel.

Disposition of Aviation Turbine Fuels

Aviation turbine fuels that do not meet requirements specified above generally cannot be downgraded for any aircraft use. The only significant exception to this rule is JP-5, which has a reduced flashpoint due to mixing with other turbine fuel. As explained previously, this fuel is perfectly acceptable for use in USN and USMC aircraft. It should NOT, be loaded aboard aircraft scheduled for immediate sea duty.

Questions concerning the use or disposition of fuel NOT meeting deterioration use limits should be referred to the *Navy Petroleum Office*. In no case will fuel not meeting deterioration use limits; be allowed to mix with existing uncontaminated aircraft fuel.

Other suspect fuel products may fall in the following categories:

1. Fuel that does not meet the allowable deterioration limits
2. Aviation gasoline

See *Appendix B of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109* to determine conformance with deterioration use limits.

PRODUCT RECEIPT

Barge or tanker receipt of product requires planning. The Fuel Management Officer will post written orders designating the following:

- Pier preparation and inspection.
- Pipelines to be used.
- Number and sizes of hoses to be connected.
- Tanks into which cargo is to be received.
- Pump-houses and pumps to be operated.
- Number of samples and location where samples are to be taken.
- Tests required.
- Communications to be used.
- Personnel assignments.
- Preparation of the *"Declaration of Inspection" (Environmental Protection Agency requirement in the 33 Code of Federal Regulations* administered by the *Coast Guard*).

The activity instruction covers standard operating procedures for the following:

- Filling of lines before the barge is docked.
- Notification to start unloading.
- Unloading speed.
- Line patrol and gage check.
- Changing tanks.
- Change in pump operation.
- Barge stripping procedure and stripping speed.
- Final inspection of barge tanks.
- Draining pier lines.
- Personnel manning level.
- Personnel training requirements.
- Special clothing requirements.
- Fuel sampling and testing requirements.

Pipeline Receipt of Product

Pipeline receipt of product requires essentially the same planning as barge receipt, and a written order is required. Some pipeline operations are relatively simple and require minimum personnel.

Tank Truck/Tank Car Receipt of Product

Incoming tank trucks and tank cars of aircraft fuel might arrive separately or in-groups. All must be sealed at the source of supply. Unloading of tank trucks requires approximately 1/2 hour and is a two-man operation. Tank cars are usually left on a siding or in place for off-loading operation. The following procedures apply to both tank truck and tank car receipt:

- Ensure seals are intact.
- Verify that the seal numbers are identical to those on the shipping document.
- Verify that the specification and grade number of the product is on the shipping document.
- Make sure the fuel level coincides with marking on tank and quantity on the shipping document.
- Take a bottom sample from each compartment, first drawing off water if present.
- Make a visual inspection of samples.
- Unload product into a segregated storage tank.
- Check vehicle's tank interior after delivery.
- Upon completion of fuel receipt (multiple tank car or truck-loads), sample storage tank and perform quality control tests.

Change of Product in Aircraft Refuelers

Change of product in mobile refuelers is performed according to table 5-2. Product used to flush tanks and piping MUST be treated as contaminated fuel. Samples must be visually inspected for sediment and water, and specific gravity of each must check to within 0.5 of corrected *API* of the appropriate product in storage.

LEGEND: (See table 5-2.)

A. Drain, fill with desired product.

B. Drain, flush 300 gallons (600 gallons if total filter/separator capacity is 600 gpm) of desired product, drain, and fill with desired product, recirculate, sample and test. Pay particular attention to sumps, pumps, filters, hoses and other components likely to trap quantities of liquid.

C. Drain, steam clean, and dry. Remove fuel from all refueling system components; sumps, pumps, filters, hoses, and piping-prior to initiating steam cleaning. Replace the filter separator and monitor elements.

D. Drain, gas-free, and fill with desired product.

CHANGE OF PRODUCT IN STORAGE TANKS

The Naval Petroleum Office must be contacted concerning instructions for the change of product grade in storage tanks.

Table 5-2.—Change of Grade Procedures for Aircraft Refuelers

TO FROM	AVGAS LOW GRADE	AVGAS HIGH GRADE	JP-4	JP-5	JP-8
AVGAS LOW GRADE	N.A.	C	C	C	C
AVGAS HIGH GRADE	A	N.A.	C	C	C
JP-4	B	B	N.A.	D	D
JP-5	B	B	A	N.A.	A
JP-8	B	B	A	B	N.A.
MOGAS	B	B	C	C	C
KEROSENE	B	B	B	B	B
DIESEL	B	B	C	C	C

Q5-98. You should get permission from what person when deviating from established procedures for an ashore refueling activity?

Q5-99. What NAVAIR instruction prohibits the simultaneous fueling and loading/downloading of weapons?

Q5-100. What person's permission should you obtain prior to resuming operations after being shutdown because of a fuel spill?

Q5-101. What range in dimension or size are small fuel spills characterized?

Q5-102. What range in dimension or size are large fuel spills characterized?

Q5-103. What local instruction should all fuel handling personnel be familiar with concerning fuel spills?

Q5-104. What person should ensure that the nozzle is clean and verifies that the flow-control handle is in the fully closed and locked position?

Q5-105. The nozzle flow control handle, when rotated to ensure the poppet valve is in the fully open and locked positioned, should rotate how many degrees?

Q5-106. The pre-check must respond for the test to be successful within what prescribed amount time?

Q5-107. When, if ever, should you refuel an aircraft that has failed a pre-check test?

Q5-108. On a direct refueling station, why is the deadman control device NOT blocked opened on a pantograph?

Q5-109. During a "hot refueling" operation, what person is responsible for the actual operation of the deadman control?

Q5-110. What person is responsible for directing all movements of aircraft and coordinating hand signals between the fuel crew and the pilot?

Q5-111. The deadman control device used in a "hot refueling" operation should cut the flow of fuel to the aircraft, within how many seconds after it is released?

Q5-112. What type of refueling equipment is preferred during a "hot refueling" operation because it is significantly less prone to rupture?

Q5-113. What person of the refueling crew is responsible for conducting the hot break check on a fixed-wing aircraft?

Q5-114. While hot refueling an AV-8B aircraft, what kind of aircraft service is NOT authorized in the refueling area?

Q5-115. In a "hot refueling" operation, what must be done to aircraft canopies and helicopter side doors?

Q5-116. During the "hot refueling" of an AV-8B aircraft, what person is responsible for securing all unnecessary electronic and electrical equipment NOT required for refueling?

Q5-117. If conducting "hot refueling" at fixed facilities, what person is designated as the primary aircraft taxi director(s)?

Q5-118. Situations arises where a multi-truck or truck and hydrant is used, especially when very large aircraft must be refueled, what type of refueling is this called?

Q5-119. Piggyback refueling operations is usually performed on what type of aircraft?

Q5-120. List the three authorized NAVAIR approved fuel transfers from one aircraft to another.

Q5-121. What approved portable fuel system can you use to perform a fuel transfer from one aircraft to another?

Q5-122. What function does the aircraft APU provide in aircraft refueling?

Q5-123. What is provided in a P-3 aircraft that negates the use of a fire extinguisher in the event of APU fires?

Q5-124. What is the usual priority assigned to an aircraft defueling, as compared to an aircraft refueling?

Q5-125. What person maintains each activity's list of officially designated approval authority for requesting aircraft defuels?

Q5-126. What is the designation of the fuel truck used to defuel an aircraft with suspect aviation turbine fuel?

Q5-127. What is the requirement for re-issuing leak-detection dye fuel to an aircraft?

Q5-128. To minimize turbulence and possible ingestion of air into the tank of a defueling unit, at what point inside the tank should fuel be maintained?

Q5-129. What person is responsible for the disposition of all defueled products?

Q5-130. What is the first step you must perform prior to starting an aircraft defueling operation?

Q5-131. What person selects the defueling equipment used for defueling aircraft?

Q5-132. What is the last step you should perform during an aircraft defueling operation?

Q5-133. Who has first preference to the fuel that is defueled form aircraft and is used to refuel another aircraft?

Q5-134. The T-56 engines can compensate for fuel density changes. Which aircraft use these engines?

Q5-135. What rules apply to the fuel defueled from another aircraft and are used to supply fuel to designated defuelers/refuelers used to refuel other aircraft?

Q5-136. The FSII content of defueled turbine fuel from another aircraft is tested prior to re-issuing to what type (s) of aircraft?

Q5-137. What do you visually inspect for in change of product to aircraft refuelers?

Q5-138. What office should you contact for guidance in change of product to storage tanks?

ASHORE REFUELING MAINTENANCE PROGRAM

LEARNING OBJECTIVE: Describe the different types of maintenance performed at shore refueling installations. Explain how maintenance is conducted on these refueling facilities and describe the equipment used.

Shorebase refueling operational maintenance is defined in the *Maintenance Manual Petroleum Fuel Facilities, NAVFAC MO-230*. This *NAVFAC manual* is the primary guide in maintaining aviation fuel facilities.

The FMO is responsible for keeping all maintenance, repair, and inspection reports on file for fuel servicing equipment and facilities under his/her jurisdiction. Whenever equipment facilities are reassigned, records are forwarded to the new owner.

One of the most important duties of the Fuels Management Officer at shore stations is to initiate facility improvements and upgrades. Long term, programmed maintenance is coordinated with public works forces and other activities, particularly *Naval Facilities*, *Field Division* personnel, the *Coast Guard, (Occupational Safety and Health Administration (OSHA)* and *Environmental Protection Agency (EPA)*.

It should be noted that even under ideal conditions, *Military Construction (MILCON)* projects take approximately four years from day of submission to the day groundbreaking takes place.

PREVENTIVE MAINTENANCE PROGRAM (INSPECTIONS)

Each activity is to establish a preventive maintenance (PM) program based on *OPNAVINST 4790.4, NAVFAC MO-230* and the *Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109*.

The primary responsibilities of the Fuels Management Officer and his Fuels Division, is the maintenance and safe operation of fuel storage and handling facilities. The Fuels Management Officer is responsible for many maintenance actions since they fall within the capabilities of his assigned personnel.

When outside resources and manpower are needed for maintenance actions, it is the Fuels Management Officer's responsibility to initiate such actions. The Public Works Officer (PWO) must provide most of this assistance.

Proper maintenance is critical to the delivery of clean, dry, uncontaminated fuel to aircraft. A well-executed and documented PM program will help achieve this goal, but a formal inspection program is also necessary. The implementation of an inspection program is the responsibility of the Fuels Management Officer (FMO). The inspection program includes the following:

- Inspections of equipment and facilities before use.
- Inspections before major operations.
- Seasonal or special inspections.
- Routine inspections and checklists.

Inspections Before Use

New construction, out-of-service facilities, broken equipment, and facilities or equipment undergoing corrective or programmed maintenance must be inspected before acceptance or reactivation. Special attention should be given to rated capacities of hardware, pipeline sizing, drainage, accessibility, emergency controls, safety, and fire prevention features.

Inspections must be conducted before starting major operations, such as receipt of products from a ship or barge, transfers between large storage tanks, or high-tempo training exercises. Inspections should cover equipment performance, pipeline integrity, valve positioning, tank arrangement, and personnel manning.

Seasonal or Special Inspections

In climates where freezing weather is encountered, winterization inspections should be made in early autumn. Extensive inspections for damage or malfunctioning should be conducted following any storm, flood, fire, earthquake, *"lightning"* strike, suspected acts of sabotage, or vandalism. Special inspections are called for when operators experience abnormal variations in performance flow rates, pressures, or capacities.

Special inspections are performed by personnel from other departments, conducted upon request, or as required, on electrical equipment, communications equipment, buildings, security fences, roadways, and fire prevention equipment.

Daily Checklist

A daily checklist (once in every 24-hour period) must be conducted on all aircraft fuel delivery equipment that is in continuous use. Equipment that fails to meet established requirements must be removed from service until corrective action is completed.

The inspection varies on different equipment and locally developed checklists that are specific to individual installations or systems may be developed.

A daily checklist (fig. 5-21) includes the following:

1. Check to see if fire extinguishers are in place, filled, operable, and have a current inspection tag.

2. Inspect the nozzle for damage. Check the nose seal for cracks or nicks, outer shell for tightness to top connection, safety wire on lock bolt, handles for tightness, and flow control handle for excessive wear, cracks or breaks.

3. Hook up nozzle to bottom-loading adapter or re-circulation fitting and again inspect the nozzle for damage or evidence of leaks.

4. Inspect the entire length of the hose thoroughly. Special emphasis is placed on the area close to the nozzle and near the connection at the opposite end where the hose should be pressed and tested for soft spots around its entire circumference. Be alert for blisters and wet spots. Any exposed hose reinforcement material is cause for hose replacement because exposed fabric provides a source for water to enter, migrate, and ultimately rot the fabric. Inspect the area around hose end couplings for slippage (evidenced by misalignment of the hose and couplings and/or scored or exposed areas). Painting a strip across the coupling and hose will aid in this inspection since the unpainted part of the hose that was underneath the coupling will become visible if the coupling slips any significant amount. A hose assembly that has been subjected to abuse, such as severe end pull, flattening or crushing by a vehicle, sharp bending, or kinking is removed from service.

5. Check to see that bonding cables are in place and in good condition, are clean, and have serviceable plugs and clips securely attached. If grounding cables are used, a similar check should be made.

6. Carefully inspect tanks, piping, valves, pumps, meters, and couplings for leaks. If any leaks are found, record location and immediately "down" the equipment. It will NOT be used until repaired.

7. Check emergency valve controls for condition and ease of operation. If air-operated, build up system pressure and check operation of the controls. Keep emergency valve closed at all times except when delivering fuel or circulating product.

8. Make sure exterior surfaces are wiped clean of oil, grease, and fuel. Make sure cabinets, troughs, cab, and any enclosures are free of an accumulation of fuel, dirt, cleaning material, and unnecessary items. Check fenders and mudguards to ensure adequate protection against the throwing of mud and dirt on fueling equipment and rear of the unit.

9. Check fluid levels of the battery, radiator, gas, and engine oil.

10. Make sure all lights are operable, all electrical wiring outside the cab is enclosed in tubing, and the rear view mirrors are serviceable.

11. With equipment in level position, drain all low-point drains (tank, filter/separator, monitor, and relaxation chamber). If water is found, empty sample into a safety can and repeat process until a clean, water-free sample is obtained. Open filter/separator manual drain valve and drain off all water. After all water has been drained, draw approximately one pint of fuel into a clean container and visually inspect for

Vehicle or Hydrant #		Meter Reading		Product	Date ________ Time _______
#	Item (See paragraph 12.3.3.1)	OK	Adjust	Repair	REMARKS
1	Fire extinguishers (in place, filed, operable, current inspection tag)				
2	Nozzle stowage dust cover and bonding cable on gravity nozzle				
3	Hook up nozzle to bottom loading adapter or recirculation fitting, and check entire nozzle assembly				
4	Hose: Check entire length for cuts, cracks, abrasions, and fuel saturation				
5	Static bonding cable, plug/clip				
6	Leaks (tank, piping, valves, pumps, etc.)				
7	Emergency valves (operation of controls)				
8	Cleanliness				
9	No FOD in tires				
10	Battery, radiator, gas, and oil levels				
11	Lights, reflectors, rearview mirrors				
12	Drain all low point drains (tank, filter/separator, monitor, relaxation chamber)				
13	Exhaust pipe and spark arresting muffler (leaks, cracks, or noise)				
14	Emergency brakes				
15	Drain water from air tanks				
16	Fill hose with full pump pressure and check entire system for leaks				
17	Open nozzle valve, check nose seal for leaks, circulate fuel, and check flow rate				
18	Pump (noise, overheating, vibration)				
19	Draw nozzle sample, visually inspect for water, solids and color and record results	Water __________________ Color ____________________			Sediment __________________
20	Record pressure differential reading from filter/separator and monitor	Pump Pressure __________ Pump R.P.M. ____________ Flow Rate _______________			Filter Pressure Diff. __________ Monitor Pressure Diff. ________
COMMENTS					
INSPECTOR'S SIGNATURE			SUPERVISOR'S SIGNATURE		

Figure 5-21.—Daily aircraft refueling equipment checklist.

water. Repeat as necessary until only clean, bright fuel is obtained. A low point drain sample is also taken from the fuel monitor housing, if separate from filter/separator housing, and inspected for water and particulates. Again, repeat until only clean, bright fuels are obtained.

12. Carefully inspect exhaust pipe and muffler system, including any auxiliary engine system, for leaks, cracks, noise, and proper placement. Ensure the clean-out port of the spark arrestor is covered. Flex piping is not authorized.

13. Check emergency brake to make sure there is plenty of throw on the emergency brake handle and that the brakes hold.

14. Drain air tanks of moisture and check for fuel contamination. Malfunctioning air-operated valves that control fuel flow and check valves have been cited as causes for fuel entering brake air systems. The smell of fuel or fuel droplets in the air being bled off is cause for immediately "downing" equipment until problem is resolved. The most common source of fuel or fuel vapors in the air system is rupture or cracking of a diaphragm in the fuel flow control valve. Corrosion resulting from moisture in the air system can cause one-way check valves to remain open, allowing fuel into the system.

15. Engage pump and pressurize the system, then check the entire system for leaks. The maximum allowable circulation time for refuelers, less than one half full, is three minutes. Hose inspection in item number 4 above should be conducted during circulation. Check, to see if fuel is leaking from the vent port of the hose end pressure regulator. If fuel is leaking form this port, remove hose end pressure regulator from service and repair it. Equipment that fails to meet established requirements is removed from service until corrective action has been completed. The vent port on the hose end regulator is NEVER plugged since it is critical to proper operation.

16. Place the nozzle's flow control handle in the fully opened and locked position and re-circulate. On refueling trucks, re-circulation is to be performed at standard RPM settings, where flow rates and differential pressures can be accurately measured. The re-circulation of trucks more than one-half full is limited to 10 minutes, and each 10-minute period is followed by a 1-minute rest to allow electrostatic charges to dissipate. All equipment must be re-circulated long enough to flush out all piping downstream of the fuel monitor elements.

17. Check operation of the pump, listen for unusual sounds, and feel for overheating and/or abnormal vibrations.

18. Obtain a nozzle sample and visually inspect it for color, water, and solids. Record the results. The sample should be drawn as rapidly as possible without spilling fuel. Swirl fuel to form a vortex and check for sediment on the bottom. Check brightness or clarity under good light conditions. The sample should be free of any emulsion, cloud, or haze. Record the actual physical condition of the fuel on the checklist.

19. With the system recirculating, observe and record the pressure drop across filter/separator and monitor. The daily pressure drops across each filter/separator and monitor is recorded in a special log. The system will be operating at standard flow conditions (during recirculation or flushing). Enter differential pressure calculation on the check sheet and the pressure differential log for the equipment.

Weekly Checklist

Senior operators or fuel shop personnel will perform the weekly inspections and record the results on the checklist (fig. 5-22). The weekly inspection is also performed on equipment being returned to service following any DOWN time that exceeds 72 hours.

The weekly inspection checklist is as follows:

1. Complete items 1 through 17 on the daily checklist.

2. Take samples during re-circulation and test using the CCFD and/or the FWD. Log the results in the appropriate laboratory log.

3. Clean and inspect all nozzle screens (pressure and overwing). Screens should be cleaned with compressed air to extend their life. Analyze contents of nozzle strainers over a collection pad. Rubber particles in screens are often the earliest evidence of hose deterioration. Detailed instructions, expanded illustrations, and troubleshooting tables of nozzles and couplings in use will be available and posted in the workshop.

4. Inspect tires, brakes, horn, windshield wipers, steering, trainer coupling and electrical wiring. The brake linings and/or pads must be checked by normal application of the brake while observing pedal travel. (The measurement of actual stopping distances, following a maximum application of brakes, is considered too severe and hazardous a test for refuelers.) Test emergency brakes under normal driving conditions. It

Vehicle or Hydrant #		Meter Reading		Product	Date ________ Time _______
#	Item (See paragraph 12.3.3.2)	OK	Adjust	Repair	Remarks
1	Complete Items 1-17 on the Daily Checklist				
2	Take samples during recirculation and test using CFD and FWD (may be conducted at different time from rest of checklist)	Particulates by CFD __________ Water by FWD __________			
3	Inspect and Clean Refueling Nozzles (SPR and Gravity)	Description of Screen Contents: SPR ____ Gravity ____			
4	Inspect tires, brakes, horn, windshield wipers, steering, trailer coupling and electrical wiring				
5	Record pressure differential reading from filter/separator and monitor	Pump Pressure __________ Filter Pressure Diff. __________ Pump R.P.M. ____________ Monitor Pressure Diff. ________ Flow Rate _______________			

COMMENTS

INSPECTOR'S SIGNATURE	SUPERVISOR'S SIGNATURE

Figure 5-22.—Weekly aircraft refueling equipment checklist.

is important to ensure against "creep" during a fueling operation. Make sure all electrical wiring outside of the cab is encased in tubing that terminates in securely mounted vapor-tight fixtures or junction boxes with compression fittings. The use of a transportation inspector is recommended for these checks.

5. Measure and record the pressure drop across the filter/separator and fuel monitor using a sensitive, hand-held pressure gage accurate to 1 psi, with graduations in 1 psi or smaller. This measurement MUST be taken with the system operating under normal flow conditions.

Refueling equipment configured with a combination filter/separator and fuel monitors usually have one pressure gage and a four-position selector marked IN, CENTER, OUT and OFF. With this configuration, the CENTER position is OUT for the filter/separator and IN for the fuel monitor. A skilled operator under pre-determined standard conditions should take readings.

Monthly Checklist

The monthly checklist requires special equipment and the moving of mobile equipment to a location other than the operating area. The monthly checklist (fig. 5-23) is as follows:

1. Complete daily and weekly checklists.

2. Check continuity of grounding cables, bonding cables, and reels. Continuity must be measured with cable in stowed, intermediate, and fully extended positions. Check continuity of grounding cable on each overwing fueling nozzle.

3. Inspect and clean all line strainers, including meter strainers when installed. These screens protect expensive downstream components of a fueling system. The inspection and cleaning interval for line strainers may be lengthened to quarterly. Under no circumstances is the time interval to exceed three months since existence of foreign matter in line strainers could forewarn of problems before complete breakdown.

4. Test anti-driveaway device installed on all refuelers.

5. Perform engine spark check at night. The purpose of this check is to locate any electrical arcing over outside surfaces of wiring, spark plugs, and the like. Any auxiliary engines should be included in the test. Any observed arcing—however slight—is sufficient cause to remove equipment from service.

6. Test maximum flow rate. If pressure tests indicate that nozzle pressure exceeds 55 psi or that flow rate exceeds 600 gpm, equipment must be removed from service. Historical records of pressures and flow rates is maintained to aid in identifying long-term mechanical wear (to pump wearing rings, diaphragm ruptures, etc.).

7. Test primary pressure-control system. Testing the primary pressure control system is performed with hose-end regulator blocked out or removed from the system. For the general procedures on how to test the performance of basic or primary pressure control systems, refer to the *Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109*.

8. Check refueling adapters (receptacles), using a *go/no-go gage*.

9. Make sure fuel-handling equipment is marked in accordance with *NAVFAC P-300 or MIL-STD-161*.

Periodic Inspection and Annual Record

The *Periodic Inspection and Annual Record* (fig. 5-24) provides an important historical record for each piece of refueling equipment. It is a written record of inspections, calibrations, element changes, and other maintenance actions performed through the year. As with other checklists, this record may be tailored to meet requirements of each station.

The tank interior and manhole cover inspections are the only times, other than the performance of tank maintenance and cleaning, when manhole covers are to be opened. Manhole covers should be semi-permanently secured with padlocks or by other means. Opening manhole covers presents several dangers including possible introduction of ignition sources into the flammable vapor space of the tank as well as allowing contaminants into the fuel.

Filter/Separator-Fuel Monitor Pressure Log and Graph

Filter/separators and fuel monitors are critical components in aviation fuel handling systems and their performance is carefully monitored. They provide the primary means of assuring that only clean, dry fuel is loaded into aircraft. In addition to the daily, weekly and monthly inspections and tests for particulates and water performed on fuel samples taken downstream of equipment (such as at the refueling nozzle).

It is essential that the pressure drop across each housing be accurately determined so that the integrity

Vehicle or Hydrant #		Meter Reading		Product	Date ________ Time _______
#	Item (See paragraph 12.3.3.3)	OK	Adjust	Repair	REMARKS
1	Complete daily and weekly checklists				
2	Check electrical resistance of all bonding and ground cables and reels				
3	Inspect and clean all line strainers				
4	Test anti-drive away device				
5	Perform engine spark test				
6	Test maximum flow rate				
7	Test primary pressure control				
8	Check refueling adapters				
9	Check equipment markings				

COMMENTS

INSPECTOR'S SIGNATURE	SUPERVISOR'S SIGNATURE

Figure 5-23.—Monthly aircraft refueling equipment checklist.

PERIODIC AND ANNUAL RECORD FOR 20 ___

Equip. type & #	Spring			Summer			Autumn			Winter			Remarks
	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	
Brake linings/pads													
Headlight beams													
Wheel inspection													
Suspension inspect.													
Calibrate pumps & meters													
Calibrate press. gauges													
Body inspection													
Paint and decals													

Record Dates Performed					
	Spring	Summer	Autumn	Winter	
Oil change/lubricate					
Tank interior and manhole covers					
Winterize					
Filter element change					
Monitor element change					
Product change & flush					
Brake linings replaced					
Cabin carbon monoxide check					
Test hose end pressure regulator					
Hydrostatic test of refueling hose					
Others (List)					
Inspector's Signature					
Supervisor's Signature					

Figure 5-24.—Periodic and annual report.

of elements can be verified. A significant drop in differential pressure identifies ruptures or breaks. Over time, differential pressure across filter elements will increase as more and more dirt and/or water is trapped.

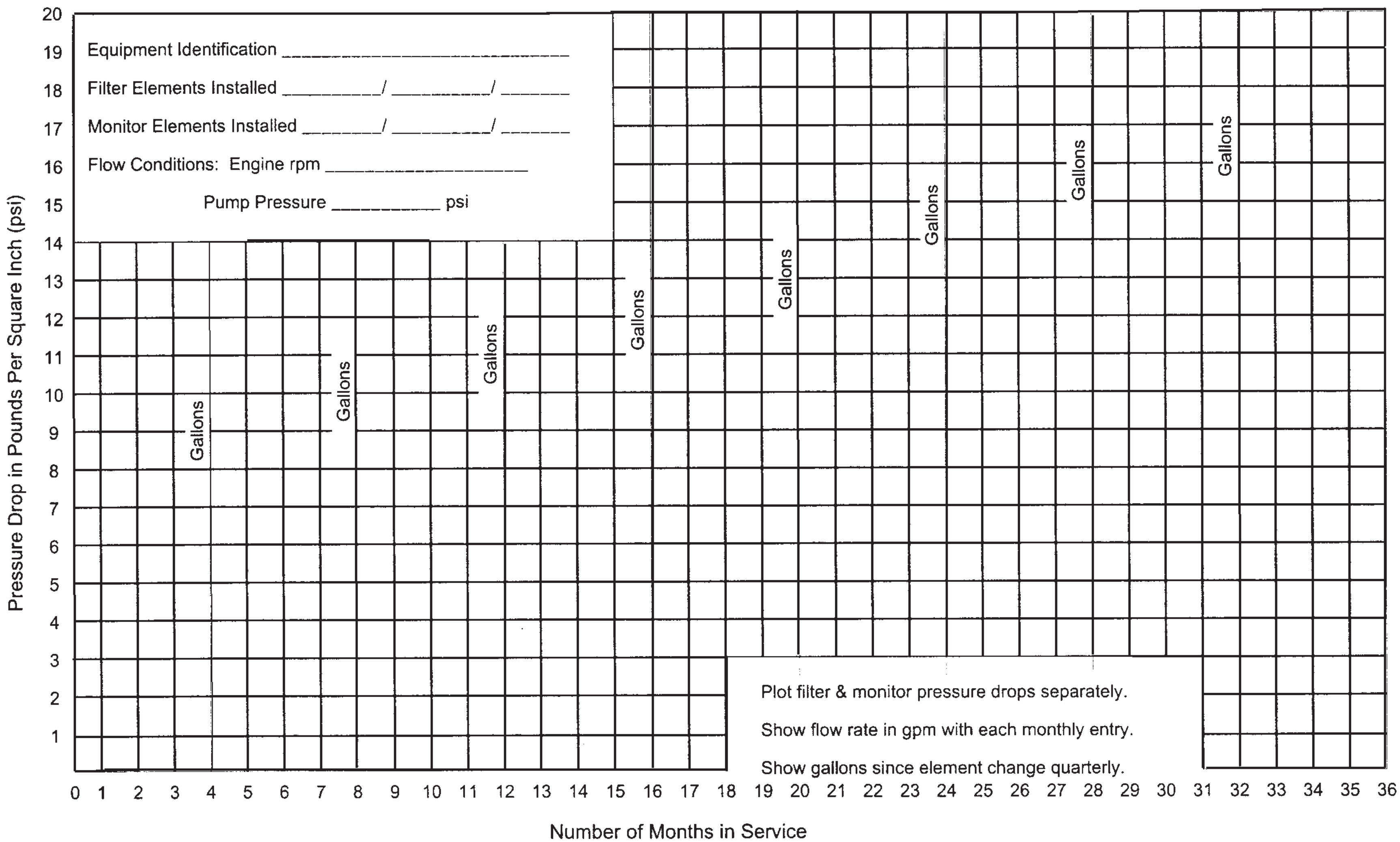
All activities will maintain a log similar to figure 5-25 for each filter/separator or monitor vessel. It is mandatory that activities plot weekly readings (which should be more accurate than daily

FILTER/SEPARATOR OR MONITOR PRESSURE DROP LOG

Vessel Number:	Vessel Type: • Filter/Separator • Monitor
Vessel Location:	Vessel's Rated Flow (gpm):

Date	Pressure (psi)			Measured Flow Rate (gpm)	Calculated Differential Pressure (psi)
	Inlet	Outlet	Differential		

Figure 5-25.—Filter/Separator and fuel monitor pressure drop log.



Element Change Criteria for Truck Fill Stands and Aircraft Defueling Equipment Filters and Monitors	a. After 3 years, or when pressure drop across either F/S or monitor reaches 20 psi. b. When combined pressure drop across F/S & monitor reaches 25 psi. c. When pressure drop is less than previous plot or fails to increase properly. d. Premeature monitor shut down forces filter element change (clean separator). NOTE: Save usable elements for receipt or circulation filter separators. Under abnormal situations, send sample elements for lab analysis.

Figure 5-26.—Filter/Separator and fuel monitor pressure drop graph.

readings since a sensitive hand-held pressure gage is used and extreme care is taken to ensure standard pressure and flow conditions are achieved) on a graph (fig. 5-26).

Storage/Distribution Facilities Checklist

Figure 5-27 is a checklist presented as a guide to illustrate a method for recording operator and

DAILY STORAGE/DISTRIBUTION FACILITIES CHECKLIST

Facility	Product	Date/Time

Line	Item	Initial	Remarks
1	Buildings: Condition/Serviceability		
2	Grounds: Vegetation/Hazards		
3	Firefighting Equipment (in place)		
4	Security Lighting/Fencing/Gates		
5	Berm Areas: Vegetation Control Drains Free, Closed and Locked		
6	Tanks: Last Inspected/Cleaned (date)		
7	Piping and Joints		
8	System Markings: MIL-STD-161F		
9	Valves: Operation/Lubrication		
10	Pumps: Noise, Vibration, Overheating		
11	Filters: Drain, DP Reading, Chg Date		
12	Meters and Gauges: Calibration Dates		
13	Receipt and Issue Hoses/Issue Point Pantographs: Storage and Protection		
14	Overfill Protection/ Deadman Controls		
15	Relaxation Chambers (as applicable)		
16	Grounds: Condition/Continuity Checked		
17	Pits: Covers, Clean and Dry		
18	Emergency Showers and Eye Washes		
19	Electric: Switches/Controls/Lights		
20	Spill Containment Systems		
21	Pier Facilities (as applicable)		

COMMENTS: (Report all leaks, hazards and damage in the appropriate space.)

Inspector:	Supervisor:

Figure 5-27.—Daily storage and distribution facilities checklist.

preventative maintenance for storage, distribution systems, and fuel facilities. This checklist does not provide full coverage and can be expanded locally to include all fuel-related equipment. The checklist, when tailored to activity fuel facilities will serve as a basis for ordering corrective maintenance.

FILTER/SEPARATOR-FUEL MONITOR ELEMENT CHANGE

Filter and monitor elements in refueling equipment or at truck-fill stands are changed every 3 years unless an earlier change is forced by one of the following conditions:

- The pressure drop across either filter or monitor elements reaches 20 psi.

> **NOTE**
>
> Differential pressure measurement must be made at a rated capacity.

- The combined pressure drop across filter and monitor elements reaches 25 psi, and the flow rate drops below acceptable level.

> **NOTE**
>
> If the pressure drop across monitor elements is close to the 20-psi limit while filter/separator pressure drop remains low, it may be a sign that the filter/separator is no longer coalescing water. In such a situation, it is advisable to change both filter and monitor elements.

- A significant drop in differential pressure occurs, indicating an element rupture. The graphic plot of monitor elements turns dramatically downward, indicating a rupture. A gradual downward trend in pressure drop is occasionally noticed with types of monitor elements now in use. This is NOT sufficient reason to change elements. The cause of this phenomenon is the slow drying out of elements that have absorbed significant amounts of water. The drying out and subsequent reduction in pressure differential will continue as long as elements are exposed to very dry fuel.

- The differential pressure fails to increase after an extended period, indicating either ruptured elements or improper installation.

- The complete shutdown of fuel flow and/or a very rapid increase in pressure differential across monitor elements. This usually indicates a failure of the filter/separators. If this condition occurs, both filter/separator and monitor elements must be changed.

During filter changes, permanent second-stage water separator elements should be tested for their ability to repel water. If separator element does not repel or cause water to bead, it should be washed with warm water and tested again.

Whenever filter elements are changed, the date of filter change is stenciled on the filter vessel. All discarded filter elements are disposed of in accordance with *local hazardous material instructions*.

No filter/separator or monitor vessel, regardless of vintage, is discarded until all possible uses for it have been explored. Empty vessels can be modified for use as relaxation chambers. Many older types of filters, not qualified for refuelers or fill stands, may serve well as receipt or circulation filters because of their greater carrying capacities for solids.

RECORDS AND REPORTS

Observation of abnormal operating conditions is vital to a good preventive maintenance program. The detection of small operating faults and their subsequent minor correction or repair can often avert the development of major problems requiring extensive repairs. Such conditions must be promptly reported to proper authorities in order to achieve necessary repairs or corrections. These deficiency reports are in written form.

Facilities must maintain maintenance records in sufficient detail to provide the following:

- Identification of each major structure, equipment item, group of items, or system.

- Current maintenance status, including unfunded deficiencies and uncompleted job orders.

- Past maintenance history, including description and cost of major repairs or replacements.

- Recommendations for future programmed repairs or replacements, including estimates of funds or manpower requirements.

Whenever major problems are noted with refueling facilities or equipment that could possibly be a result of a design or manufacturing flaw, forward details to appropriate *cognizant Systems Command Headquarters* for investigation and resolution.

Report problems with installed facilities to *Naval Facilities Engineering Service Center.*

Report problems with refueling vehicles, nozzles, filter and monitor elements, and fuel quality monitoring equipment to *Naval Air Systems Command*.

Records will be retained as specified in the following schedule:

- Monthly maintenance reports/logs 2 years
- Completed daily checklists 1 month
- Completed weekly/monthly checklists 6 months

HOSE-END PRESSURE REGULATORS

Hose end pressure regulators will be tested for performance and integrity annually. Since this test requires readjustment of primary pressure control of a refueling system to a much higher than normal setting, it is recommended that each activity:

- Selects one refueling system for conducting this test on all its hose-end regulators.
- Does not refuel aircraft with the selected system until the primary pressure regulating system has been reset to normal conditions.

Test hose-end pressure regulators as follows:

1. Adjust the primary pressure control of the selected refueling system to a value of 73 to 66-psi.

WARNING

The primary pressure control is reset to 50-psi at the refueling nozzle before the system is used to refuel aircraft. Over-pressurization of an aircraft's fuel system could result in the rupture of a tank, fuel spill, and/or fire.

2. The HECV regulates outlet pressure to a nominal 55-psi. Since it does so by restricting flow, it may regulate closer to 60-psi at low flow rates while allowing 50 to 55-psi at typical fueling rates. Insert a pressure gage (0 to 100-psi) into the nozzle gage port. The outlet pressure will NOT exceed 60-psi at flow rates between 0.50 and 2 gpm.

CAUTION

If nozzle pressure exceeds 60-psi at flow rates above 0.50 gpm, remove regulator from service.

3. Under flow conditions, slowly close downstream valve in approximately 3 seconds. Upon closure, observe gage for approximately 10 seconds. If pressure increases, remove unit and replace seal. It is not unusual for the gage to read between 55 and 80-psi. This is because the gage has trapped some of the surge generated by closing the valve.

CAUTION

The primary pressure control system is re-adjusted to 50-psi before refueling any aircraft.

HYDROSTATIC TESTING OF REFUELING HOSES

Hydrostatic testing of refueling hoses is conducted annually or whenever the integrity of the hose is suspect. Hydrostatic testing is done at a pressure of 120-psi.

CALIBRATION

Calibration is required for dead-weight testers, master meters, and meters/gages used at the point-of-sale. Personnel who have been certified by an official *Navy Calibration Laboratory* (or other certifying agency) perform the calibrations.

Q5-139. What manual is used as a primary guide in maintaining ashore aviation fuel facilities?

Q5-140. What person is responsible for keeping all maintenance, repair, and inspection reports on file for fuel servicing equipment and facilities?

Q5-141. What instructions are used to establish maintenance (PM) programs at ashore refueling installations?

Q5-142. If outside resources and manpower are needed for maintenance actions, what activity provides most of this assistance?

Q5-143. At ashore refueling installation facilities and equipment, when should seasonal inspections be conducted?

Q5-144. Who should be tasked with performing special inspections at ashore refueling installations?

Q5-145. A daily checklist is performed on what ashore refueling equipment?

Q5-146. While inspecting fuel hoses, what indication is cause for hose replacement?

Q5-147. What must be done to a hose that is returned to aircraft fuel servicing?

Q5-148. What type of piping is NOT authorized in a refueler exhaust pipe or muffler system?

Q5-149. What might be the cause of fuel entering or contaminating a refueler brake air system?

Q5-150. What is the maximum allowable time for product circulation on a refueler that is less than one half full?

Q5-151. What is the maximum allowable time for product circulation on a refueler that is more than one half full?

Q5-152. Differential pressure readings to the filter separator are taken only under what type of pressure conditions?

Q5-153. What agent is used to clean the screens of the pressure and overwing refueling nozzles?

Q5-154. What person performs the weekly inspections of the refueler's tires, brakes, horns, windshield wipers, steering, trainer couplings, and electrical wiring?

Q5-155. When performing weekly inspections on a refueler's breaks, what would be considered too severe and hazardous a test?

Q5-156. All electrical wiring outside the cab of a refueler should terminate into what component?

Q5-157. How are continuity checks performed on grounding cables and bonding cables?

Q5-158. Why is it important that line strainers be cleaned and inspected every three months?

Q5-159. When are tests to the anti-driveaway device installed on a refueler performed?

Q5-160. While conducting engine spark checks, what would cause the removal of a refueler from service?

Q5-161. Fuel-handling equipment are marked in accordance with what military standard?

Q5-162. What provides a written record of inspections, calibrations, element changes and other maintenance actions performed throughout the year?

Q5-163. What are the dangers in opening manhole covers to a mobile refueler or fuel tank?

Q5-164. What critical component (s) provides the primary means of assuring that only clean, dry fuel is loaded into aircraft?

Q5-165. How often are the elements installed in a filter/separator, fuel monitor, or at a truck fill stand changed?

Q5-166. At what pressure drop across either the filter or monitor should the elements be changed?

Q5-167. What usually indicates a failure of the filter/separator?

Q5-168. During filter element change, what is done to the second-stage water separator elements?

Q5-169. What checklist is used to record operator and preventative maintenance for storage, distribution systems and fuel facilities?

Q5-170. Who is notified concerning problems with refueling vehicles, nozzles, filter/separator and fuel monitor elements, as well as fuel quality monitoring equipment?

Q5-171. Records of monthly maintenance reports and/or logs are retained for what length of time?

Q5-172. Completed weekly and monthly checklists are retained for what period of time?

Q5-173. How long are completed records of daily checklists kept?

Q5-174. At what pressure are refueling hoses hydrostatically tested?

Q5-175. Who is qualified to perform calibrations on equipment at shore refueling stations?

SUMMARY

Fueling operations ashore or afloat are similar. The functions are basically the same, but the problems are a little different. Many of these problems are made more acute because of the sprawling area covered by fuels operations ashore and the many chances for introducing foreign or contaminating materials into the fuel.

Some of the problem areas that require special attention from senior ABFs are quality surveillance, close supervision and training of new personnel, an effective training program, preventive maintenance, and proper use of equipment.

CHAPTER 6

FUELS ADMINISTRATION

INTRODUCTION

Personnel in the ABF rating operate, maintain, and perform organizational maintenance on aviation fueling systems, automotive gasoline (MOGAS) systems, and catapult lubricating oil systems on CVs, CVNs, LHAs, LHDs, LPHs, and LPDs. Included are aviation fuel, MOGAS, and catapult lubricating oil service stations and pump rooms, piping, valves, pumps, tanks, and portable equipment related to these systems. ABFs also operate, maintain, and repair the valves and piping of MOGAS purging and protective systems within the Air Department spaces aboard ship.

Additionally, ABFs operate and service motorized fueling equipment, maintain quality surveillance, and supervise the operation and servicing of fuel farms and equipment associated with the fueling and defueling of aircraft ashore.

They also may train, direct, and supervise fire-fighting crews, fire rescue teams, and damage control parties in assigned fuel and catapult lubricating oil spaces. And they ALWAYS observe and enforce fuel-handling safety precautions.

ASHORE AND AFLOAT AVIATION FUELS DIVISION

LEARNING OBJECTIVES: Describe the organization and responsibilities of the major work centers of an Aviation Fuels Division Afloat and the major branches of Aviation Fuels Division Ashore. State the purpose of the PQS program. Identify the PQS watch stations for Aviation Fuels Afloat, Flight Deck Familiarization and the Aviation Fuels Ashore.

AFLOAT FUELS DIVISION ORGANIZATION

Figure 6-1 illustrates the Aviation Fuels Division Afloat organization. However, it must be emphasized that you will encounter many variations of the AvFuels Division Afloat. This is due to the many different types of ships used by the Navy that have the capability of fueling and defueling aircraft.

The variations you will see in the organization of a fuels division include the number of personnel assigned to the division, the number and types of aircraft embarked, and the tactical employment of your ship.

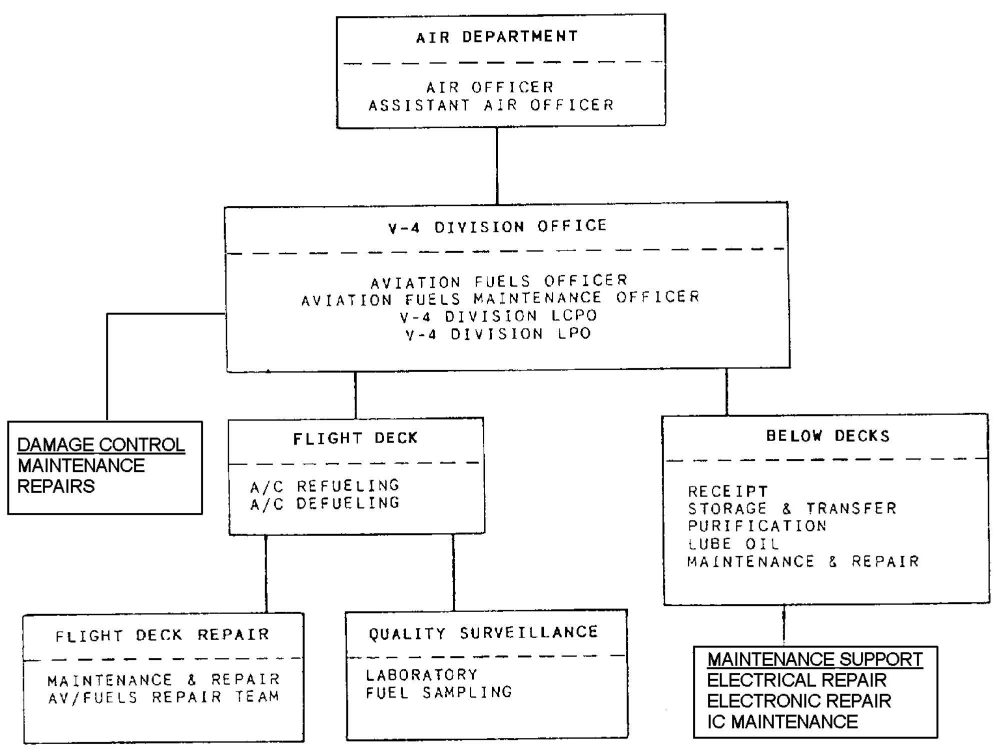


Figure 6-1.—Aviation Fuels Division Afloat.

You may also encounter slightly different organizations even on the same-class ships. Regardless of the type of ship, keep in mind that the basic mission of the division remains the same; therefore, the basic division structure does not change.

The AvFuels Division Afloat is normally made up of the V-4 Division Office, the Flight Deck work center (which includes flight deck repair and the quality surveillance lab), and the Below Decks work center. Some divisions will have a maintenance work center that combines the maintenance and repair of the flight and below decks work centers. Most will have a Damage Control work center. Again, it depends on the needs and manning of the command.

V-4 Division Office

The V-4 Division Office is the administrative core of the AvFuels Division Afloat. The AvFuels division officer, AvFuels maintenance officer, leading chief petty officer, leading petty officer, and division yeomen work in this office.

Flight Deck

The Flight Deck work center is responsible for the refueling and defueling of aircraft, as well as, for support equipment on the flight and the hangar decks.

FLIGHT DECK REPAIR.—Flight Deck Repair is responsible for the maintenance and repair of flight deck and hangar deck refueling stations and portable defueling equipment. V-4 Repair personnel also man refueling-at-sea (RAS) sponsons during underway replenishments and perform damage control duties as the Aviation Fuels Repair Team.

QUALITY SURVEILLANCE LABORATORY.—The Quality Surveillance Laboratory is responsible for the monitoring of fuel quality in the entire AvFuels system. Lab personnel do extensive sampling and testing. While it is a branch of the flight deck work center, the lab is also responsible for testing fuel samples sent from Below Decks.

Below Decks

The Below Decks work center is responsible for the receipt, stripping, transfer, purifying, and filtering of aviation fuels and catapult lubricating oils. In most divisions, below deck personnel do their own maintenance and repairs.

On CV/CVN's, the two major JP-5 pump rooms and the auxiliary (cargo) pump room may be grouped into separate work centers.

MAINTENANCE SUPPORT.—The maintenance support work center is usually where the EMs (Electrician's Mates) and ICs (Interior Communication Electrician's Mates) are assigned. They are responsible for maintaining material upkeep, the preventive and corrective maintenance to all aviation fuel system's electrical and electronic components. They are also solely responsible for corrective maintenance performed on JP-5 control consoles on CVN platforms.

There are usually two EM's and two IC's assigned with the senior person designated as the work center supervisor. Although they are assigned on some carriers to the below decks work center, they do work on JP-5 flight deck equipment.

TANK CLEANING.—Some ships may have a tank cleaning work center. Tank cleaning crews are tasked with the responsibility of planning and scheduling arduous tank cleaning evolutions of the entire fuel system. These efforts must be coordinated with maintenance support work center personnel.

The Petty Officer-In-Charge (POIC) of this work center is responsible for the safety of personnel working in and around fuel tanks. He must ensure that all procedures that apply to entering fuel tanks are strictly followed without deviation, and also all the necessary equipment to assist in this operation is at the scene and functioning properly.

No one will enter a fuel tank without authorization from the Commanding Officer (CO); also, the tank MUST be analyzed and certified by the Gas-Free Engineer as safe for the job requested.

Aviation Fuels Security Watch

Another integral part of the AvFuels Division Afloat is the Aviation Fuels Security Watch. This watch is stood 24 hours a day when the ship is not at flight quarters. The watch is also stood during flight quarters by below deck personnel to monitor hangar deck refueling stations and below deck spaces where aviation fuel system components or equipment are located, but not normally manned.

Personnel standing this watch must be properly trained, familiar with the AvFuels system, and fully PQS-qualified as an AvFuels Security Watch. Every effort should be made by senior ABFs to insure watch standers understand the importance of this watch.

To ensure the aviation fuel system is secure, the watch standers must:

- Make hourly inspections of all unmanned designated spaces and piping below decks and to hangar bay refueling stations, when in flight quarters. Make every 2 hours inspections of all designated spaces and piping, when not at flight quarters.
- Immediately notify the Av/Fuels POOW, AvFuels Officer, Air Department Integrity Watch Officer, if discrepancies are noted.
- Make hourly reports to the Fuels Division LCPO when at flight quarters. Make every 2 hours report to the OOD (Air Department Integrity Watch Officer if squadrons are embarked) when not at flight quarters.
- Insert entries in appropriate logbooks on each inspection tour.
- Safegard against any welding or burning near the AvFuels system unless the system has been properly freed of fuel and vapors.
- Ensure compliance with all safety precautions.
- Perform other duties as may be assigned.

The AvFuels security watch is responsible for the security of the AvFuels system, and ultimately, the ship.

FUELS DIVISION ORGANIZATION ASHORE

The Aviation Fuels Division Ashore (fig. 6-2) is a division of the Supply Department. It includes the Fuels Management Officer (FMO), the Division LCPO, the Division LPO, Administration and Accounting, LOX/N_2, Distribution, Storage, and Quality Control.

Fuels Management Officer (FMO)

The FMO discharges the supply officer's fuel responsibilities through the planning, directing, training, and supervision of fuel operations. Administration and accounting personnel are directly responsible to the FMO.

Distribution

Distribution is responsible for providing refueling and defueling services for all tenant and transient aircraft and other units such as fuel test cells at the air activity. An additional responsibility is performing operator maintenance on refueling equipment used by distribution personnel. Distribution will normally contain most of the military personnel assigned to the division.

Quality Control

Quality Control is responsible for the inspection and quality assurance of ALL fuels received or issued by the fuel farm. Fuel samples taken from all stages of fuel-handling operations are delivered to Quality Control. Quality Control is also responsible for checking filter/separators and fuel monitors, and maintaining pressure differential records for filter/separators and fuel monitors.

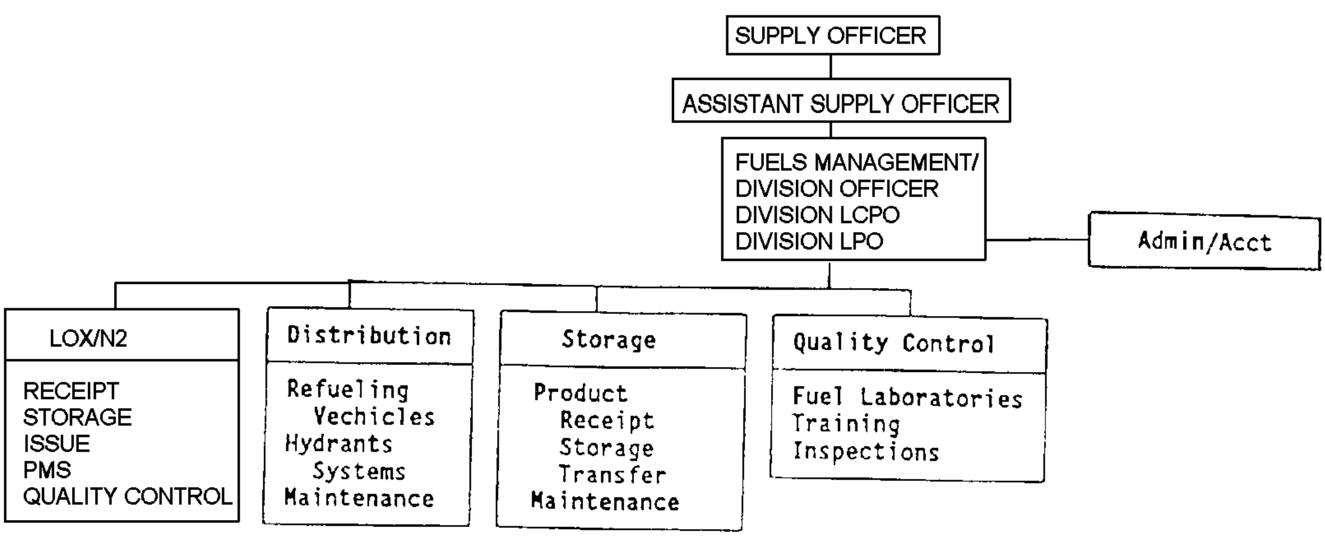


Figure 6-2.—Aviation Fuels Division Ashore.

Storage

Storage is responsible for the receipt, storage, and transfer of all fuels handled by the division. Included with these responsibilities is maintenance of equipment used in transfer operations.

Liquid Oxygen (LOX) and Nitrogen (N_2)

The LOX/LN_2 branch is responsible for the storage and issuing of liquid oxygen (LOX) and nitrogen (N_2)

PERSONNEL QUALIFICATION STANDARD (PQS) PROGRAM

No matter what your job assignment is in the V-4 Division, you must be qualified, or under direct supervision by a qualified person, to perform that assignment. The PQS Program is used to qualify officer and enlisted personnel to perform their assigned duties. It is a written compilation of the knowledge and skills required to qualify for a specific watch station, maintain specific equipment, or perform as a team member within your unit.

Aviation Fuels Afloat Personnel Qualification Standards (PQS)

As the organization may vary from ship to ship, PQS will too. The PQS for Aviation Fuels Afloat PQS can be tailored to fit any ship by adding items that are unique to or deleting items that do not apply to your system or ship.

Listed below in table 6-1 are the watch stations (job assignments) in the PQS for Aviation Fuels Afloat:

Flight Deck Familiarization Personnel Qualification Standards (PQS)

The Flight Deck Familiarization PQS is an important prerequisite for most of the follow-on qualifications in the Aviation Fuels Afloat PQS. The PQS for Flight Deck Familiarization can be tailored to fit any ship by adding items that are unique to or deleting items that do not apply to your system or ship.

Listed below in table 6-2 are the watch stations (job assignments) in the PQS for Flight Deck Observer for all type of ships:

Table 6-1.—Aviation Fuels Division Afloat PQS, NAVEDTRA 43426-4C

PQS	WATCH STATION
301	Sounder
302	Fuels Security Watch
303	Refueling Crewman
304	Refueling Crew Leader
305	Checker
306	Quality Surveillance Sentry
307	Control Talker
308	Quality Surveillance Supervisor
309	Flight Deck Repairman
310	Flight Deck Repair Supervisor
311	JP-5 Filter Operator
312	Catapult Lube Oil Operator
313	JP-5 Pump Room Operator
314	Below Decks Repairman
315	JP-5 Console Operator
316	JP-5 Pump Room Supervisor
317	Flight Deck Supervisor
318	Below Decks Supervisor
319	Division Supervisor

Table 6-2.—Flight Deck Familiarization PQS, NAVEDTRA 43426-0A

PQS	WATCH STATIONS
301	CV/CVN Flight Deck Observer
302	LHA/LHD/MCS Flight Deck Observer
303	Air Capable Ships Flight Deck Observer
304	CV/CVN Deployable Squadron Flight Deck Observer
305	LHA/LHD/MCS Flight Deployable Squadron Flight Deck Observer

Aviation Fuel Operations Ashore Personnel Qualification Standards (PQS)

The PQS for Aviation Fuel Operations Ashore is tailored to fit any shore facility's fuel system application.

Listed below in table 6-3, is the PQS for ABFs ashore. For complete information, consult PQS for Aviation Fuel Operations Ashore, NAVEDTRA 43288-B.

Table 6-3.—Aviation Fuels Division Ashore PQS, NAVEDTRA 43288-B

PQS	WATCH STATIONS
301	Defense Fuel Support Point Operator
302	Quality Surveillance Sentry/Operator
303	Mobile Refueler Operator
304	Mobile Defueler Operator
305	Aircraft Direct Fueling Station Operator
306	Inventory Control Manager
307	Ground Products Equipment Operator
308	Dispatcher
309	Defense Fuels Support Point Operations Manager/Section Leader
310	Quality Assurance Representative

Q6-1. What is the order of the chain of command for a fuels division afloat?

Q6-2. Which work center is responsible for the receiving and transferring of aviation fuel and catapult lube oil?

Q6-3. What below decks work center is responsible for planning, scheduling, and cleaning the entire fuel system's tanks?

Q6-4. What person MUST grant authorization for entering fuel tanks?

Q6-5. Who MUST certified that a fuel tank is safe for entry?

Q6-6. When NOT at flight deck quarters, how often are aviation fuels security watch rounds made?

Q6-7. When at flight quarters, the aviation fuels security watch will make rounds to all unmanned spaces and make reports to what person?

Q6-8. At an ashore installation, the Aviation Fuels Division is a branch of what Department?

Q6-9. What person is directly responsible for fuels administration and accounting?

Q6-10. What branch of the aviation fuels division ashore does the actual fueling and defueling of aircraft?

Q6-11. Fuel samples taken at all stages of fuel handling at ashore installations are delivered to what branch of the Fuels Division ashore?

Q6-12. What program is used to qualify officers and enlisted personnel to perform assigned duties?

Q6-13. What is the purpose of the PQS program?

TECHNICAL LIBRARY

LEARNING OBJECTIVES: Identify the purpose of technical and operational manuals; the importance of maintaining an allowance of publications; and the use of reports, logs, records, and forms in aviation fuels operations. Explain the importance of establishing a technical library, the proper use of instructions/notices, and the purpose of surveys.

A technical publication library serves two important functions. First, it provides a central source of up-to-date information for the use of all personnel in the performance of their work. Second, it is an excellent source of reference information to help in the training of personnel. To perform these functions properly, the library must contain at least one copy of all publications affecting the equipment the division is responsible for.

Typically, the technical library is located in the division office or maintenance office. Management of the library should be assigned to a senior individual who will ensure that all required publications are onboard and that all updates and changes are made to the affected publications.

Often, individual work centers will keep the publications normally used by the workcenter. This is acceptable. However, the technical library manager should maintain a list of all publications held in a work center so that those manuals also will receive updates and changes when required. A technical manual used to rebuild a pump is worthless if updated changes are not made and entered on the Record of Changes.

MANUALS//INSTRUCTIONS/PUBLICATIONS

There is no way you can remember every specification, instruction, rule, or requirement. The further you advance, the more you are required to know.

The key to not being overwhelmed by this required knowledge is to learn as much as you can, *but always know where to get the information you need*.

Technical/Maintenance Manuals

Technical/Maintenance Manuals are the sources of information for guiding naval personnel in the operation and maintenance of all equipment within the Naval Establishment. The manuals are divided into two major types: operational and maintenance.

Operational manuals are publications and other forms of documentation that contain a description of systems and instructions for their effective use. Here are some examples of operational manuals. The *Aviation Fuels Operational Sequence System (AFOSS)* used by all fuel system operators to operate the various ship aviation fuels systems. The *Aircraft Refueling Naval Air Training and Operating Procedures Standardization Program (NATOPS) Manual*, *NAVAIR 00-80T-109* (fig. 6-3). This manual covers the technical requirements, operational procedures, and personnel training for ready-issue aviation fuel operations.

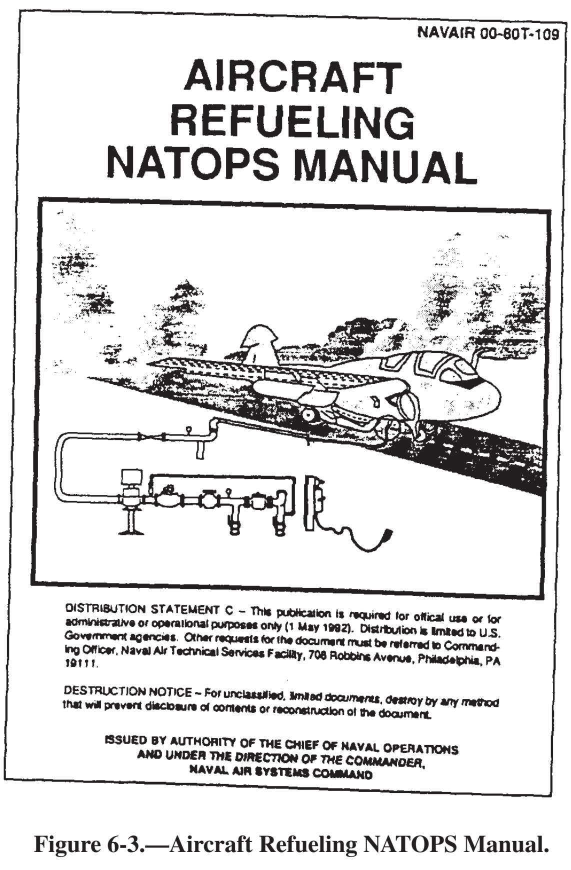
Maintenance manuals are documents containing a description of individual systems for the purpose of maintenance and repair. An example of a maintenance manual is the *Technical Manual for Description, Operation, and Maintenance of the JP-5 Jet Fuel Centrifugal Purifier*, *NAVSEA S9542-AB-MMO-010* (fig. 6-4).

By proper use of these publications, all equipment can be operated and maintained in the same efficient manner throughout the Navy.

Technical/Maintenance manuals do not contain detailed descriptions or procedures concerning preventive maintenance, since this information is contained on *maintenance requirement cards (MRCs)*. For information on the 3-M System, *consult OPNAVINST 4790.4 (series)*, *Ship's Maintenance Material Management Manual*.

Technical/Maintenance Manuals do contain the following:

- A description of the equipment
- The theory of operation
- Troubleshooting techniques
- Corrective maintenance information
- Specific safety requirements
- Parts breakdown and numbers
- Sketches, diagrams, and schematics
- Operating and design limits



NAVAIR 00-80T-109

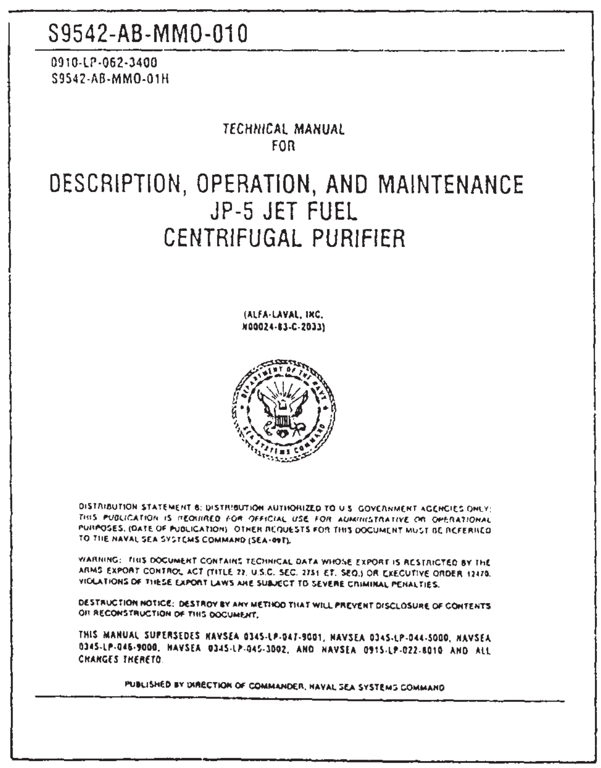
AIRCRAFT REFUELING NATOPS MANUAL

DISTRIBUTION STATEMENT C – This publication is required for offical use or for administrative or operational purposes only (1 May 1992). Distribution is limited to U.S. Government agencies. Other requests for the document must be referred to Commanding Officer, Naval Air Technical Services Facility, 708 Robbins Avenue, Philadelphia, PA 19111.

DESTRUCTION NOTICE – For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

Figure 6-3.—Aircraft Refueling NATOPS Manual.



S9542-AB-MMO-010

0910-LP-062-3400
S9542-AB-MMO-01H

TECHNICAL MANUAL FOR

DESCRIPTION, OPERATION, AND MAINTENANCE JP-5 JET FUEL CENTRIFUGAL PURIFIER

(ALFA-LAVAL, INC. N00024-83-C-2033)

DISTRIBUTION STATEMENT B: DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES ONLY: THIS PUBLICATION IS REQUIRED FOR OFFICIAL USE FOR ADMINISTRATIVE OR OPERATIONAL PURPOSES. (DATE OF PUBLICATION) OTHER REQUESTS FOR THIS DOCUMENT MUST BE REFERRED TO THE NAVAL SEA SYSTEMS COMMAND (SEA-09T).

WARNING: THIS DOCUMENT CONTAINS TECHNICAL DATA WHOSE EXPORT IS RESTRICTED BY THE ARMS EXPORT CONTROL ACT (TITLE 22, U.S.C. SEC. 2751 ET. SEQ.) OR EXECUTIVE ORDER 12470. VIOLATIONS OF THESE EXPORT LAWS ARE SUBJECT TO SEVERE CRIMINAL PENALTIES.

DESTRUCTION NOTICE: DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THIS DOCUMENT.

THIS MANUAL SUPERSEDES NAVSEA 0345-LP-047-9001, NAVSEA 0345-LP-044-5000, NAVSEA 0345-LP-046-9000, NAVSEA 0345-LP-045-3002, AND NAVSEA 0915-LP-022-8010 AND ALL CHANGES THERETO.

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND

Figure 6-4.—JP-5 Centrifugal Purifier Technical Manual.

Senior petty officers must be able to interpret technical publications and to supervise their use. The senior ABF also must know how to obtain technical publications and how to keep them up-to-date.

Many technical publications issued by the *Naval Air Systems Command* are of interest to the *ABF*. The *General Information and Servicing section of the Maintenance Instructions Manual* for each type of aircraft covers the required procedures for refueling that aircraft. Mobile refuelers and aircraft-handling equipment are covered by other *Naval Air Systems Command publications*.

Technical publications issued by the *Naval Sea Systems Command* cover most of the shipboard equipment used by the ABF. The fuel system for each ship is covered in a *Ship's Information Book (SIB)*. The *SIB* for the ship to which the ABF is attached should be studied thoroughly. Also, Technical/Maintenance Manuals issued by the *Naval Sea Systems Command covers major components of equipment.*

Instructions and Notices

The *Navy Directives System* is used throughout the Navy for the issuance of non-technical directive-type releases. *These directives establish policy, organization, methods, or procedures.* They require action to be taken or contain information affecting operations or administration. This system provides a uniform plan for issuing and maintaining directives. Conformance to the system is required of all *bureaus, offices, activities,* and *commands* of the *Navy. Instructions and Notices* are the two types of authorized releases.

Information pertaining to action of a continuing nature is contained in "Instructions." An Instruction has permanent reference value and is effective until the originator supersedes or cancels it. *"Notices" contain information pertaining to action of a one-time nature.* A Notice does not have permanent reference value and contains provisions for its own cancellation.

For identification and accurate filing, all directives can be recognized by the originator's abbreviation, the type of release (whether an Instruction or a Notice), a subject classification number, and in the case of Instructions only, a consecutive number. Because of their temporary nature, Notices are not assigned consecutive numbers. This information is assigned by the originator and is placed on each page of the directive.

Don't let the word *instruction* fool you. It may sound like something clerical, but instructions and notices provide us with a tremendous amount of information, and some instructions can be quite large, such as the previously mentioned *OPNAVINST 4790.4 (series), Ships' 3-M Manual* (fig. 6-5).

Maintaining an Allowance of Publications

There are four mandatory requirements to be met in maintaining an allowance of publications (technical and otherwise). These requirements are the following:

- The prescribed publications be on board
- The publications be maintained up to date
- The publications be ready for immediate use
- Applicable security provisions be observed

The primary index used to order all Navy technical manuals and forms is the *Navy Stock List of Publications and Forms*, *NAVPUBFORMCEN Pub. 2002*.

Making Changes to Publications

Most changes to publications are issued in the form of loose-leaf pages, pen-and-ink changes, or complete

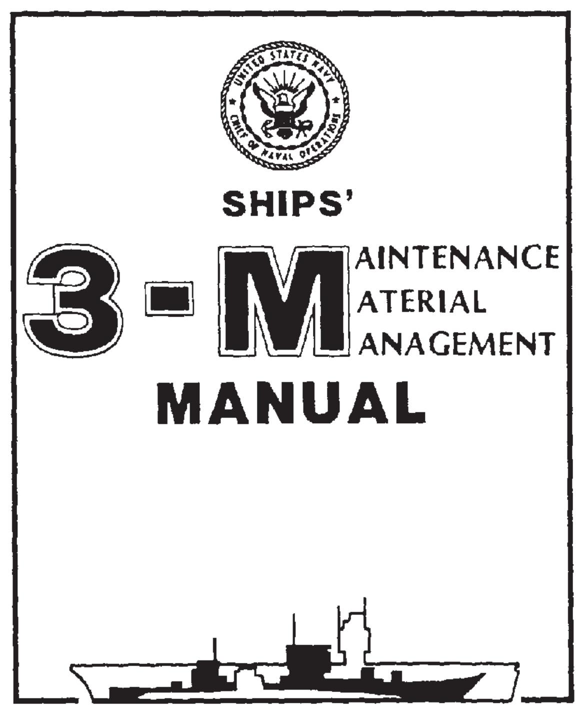


Figure 6-5.—Ship's 3-M Manual.

revisions. When changes are issued in numbered pages, the old page with the corresponding number is removed and the new replacement page inserted in its place. Specific instructions are normally given with each change on the method to be used in incorporating the change. Changes should be made immediately upon receipt.

A checklist of pages, which are to remain in the publication after the changes have been incorporated, is provided with changes issued for some publications. This checklist should be compared to pages remaining in the publication to ensure they agree. Extra pages are removed and missing pages ordered to bring the publication up-to-date. Obsolete pages removed should be disposed of in accordance with applicable regulations.

When pen-and-ink changes are made the change number and date should be entered with each change for future reference. Sometimes it is convenient to cut out pen-and-ink changes and insert them in their proper place in a publication by fastening them with transparent tape or glue.

A record sheet is maintained in the front of each publication, indicating the date and number of each change incorporated and the name or initials of the person completing the change. This procedure makes it simple to check if the publication is up-to-date.

RECORDS AND REPORTS

Maintaining records and reports is one of the major responsibilities of the senior ABF. All records and reports must be accurate, up-to-date, and according to established standards.

Work/Maintenance Logs

In the work (or operational) logs, hours of operation and operating pressures should be recorded. This information will be very useful in keeping current the maintenance project cards of the ship. Any other operational data that could be useful at a future date should be recorded. A daily inspection of the fuel system should be made for leaks and other discrepancies and recorded in the log.

The maintenance logbook should contain all work performed on the aviation fuels systems by the repair crews. It should be recorded in a day-to-day order.

Other logbooks required to be kept are the following:

- Fuels security watch log.
- Filter sample/pressure drop log (fig. 6-6).
- Quality surveillance sample log.
- Equipment running logs (fig. 6-7). Each piece of equipment should have its own log, such as service pump #4, transfer pump #2, purifier #3, auxiliary pump #1, etc.
- Motor/Hand Stripping logs.

All logbooks should be inspected frequently by appropriate petty officers, the work center chief, and the division officer. Often, the information contained in a log may indicate the impending failure of a piece of equipment long before the actual failure occurs. An example of impending failure is the cumulative TOTAL RUN-TIME of a specific piece of equipment.

FILTER SAMPLE PRESSURE DROP LOG DATE: ____________

FILTERS: 1-2-3-4

TIME	INLET PRESS	COALESCER DIFF PRESS	SEPARATOR DIFF PRESS	FALLOUT DIFF PRESS	DISCHARGE PRESS	SUMP SAMPLE	VISUAL SAMPLE	LAB RESULT	SERVICE TANK NO.	SIGNATURE

NOTE: SAMPLES SHALL BE TAKEN IAW AFOSS

SIGNATURE: ____________________

Figure 6-6.—Example of a fuel sample/pressure drop log.

EQUIPMENT RUNNING LOG DATE: ____________
EQUIPMENT NAME: ____________
SUPERVISOR: ____________
PREV ACCU RUN TIME: ____________

START TIME	STOP TIME	TOTAL TIME	FROM	TO	AMOUNT TRANSF	DUTY FILTER	DEFUEL TANK	VISUAL SAMPLE	LAB SAMPLE	OPERATOR

TOTAL RUN TIME THIS PAGE ________ DIV OFFICER/CPO: ____________

Figure 6-7.—Example of an equipment-running log.

Checklists

Checklists (fig. 6-8) provide a minimum written list of items for inspection. Checklists are tailored to fit specific equipment or operations and can cover everything from a pre-operational check on a fuel truck to inspecting the entire fuel system after an underway replenishment.

Vehicle or Hydrant #		Meter Reading		Product	Date ______ Time ______
#	Item (See paragraph 12.3.3.1)	OK	Adjust	Repair	REMARKS
1	Fire extinguishers (in place, filled, operable, current inspection tag)				
2	Nozzle stowage dust cover and bonding cable on gravity nozzle				
3	Hook up nozzle to bottom loading adapter or recirculation fitting, and check entire nozzle assembly				
4	Hose: Check entire length for cuts, cracks, abrasions and fuel saturation				
5	Static bonding cable, plug/clip				
6	Leaks (tank, piping, valves, pumps, etc.)				
7	Emergency valves (operation of controls)				
8	Cleanliness				
9	Battery, radiator, gas and oil levels				
10	Lights, reflectors, rearview mirrors				
11	Drain all low point drains (tank, filter/separator, monitor, relaxation chamber)				
12	Exhaust pipe and spark arresting muffler (leaks, cracks or noise)				
13	Emergency brakes				
14	Drain water from air tanks				
15	Fill hose with full pump pressure and check entire system for leaks				
16	Open nozzle valve, check nose seal for leaks, circulate fuel, and check flow rate				
17	Pump (noise, overheating, vibration)				
18	Draw nozzle sample, visually inspect for water, solids and color and record results	Water ______ Color ______			Sediment ______
19	Record pressure differential reading from filter/separator and monitor	Pump Pressu. ______ Pump R.P.M. ______ Flow Rate ______			Filter Press. Diff. ______ Monitor Press. Diff. ______

COMMENTS

INSPECTOR'S SIGNATURE SUPERVISOR'S SIGNATURE

Figure 6-8.—Example of a daily aircraft refueling equipment checklist.

The advantage of using a checklist is obvious. With the items to be inspected written, you are less likely to miss a step or procedure. If you use checklists, make sure all *PMS requirements* are met.

Aircraft Checker Reports

One of the major problems encountered by senior ABFs in operating an aviation fuels system is keeping accurate records of fuel expenditures. The measuring instruments (meters, liquid-level indicators, sounding tapes) are not sufficiently accurate for use in computing fuel expenditure for a particular aircraft or squadron.

The most accurate way of computing the amount of fuel issued to a particular aircraft is with the use of the aircraft's fuel gages. At the time of arrestment, by subtracting the fuel load from the total capacity of the aircraft's fuel tanks, you can determine how much fuel is needed to top off the tanks. The aircraft's fuel gages are calibrated in pounds of fuel, and a conversion must be made to convert the pounds of fuel issued to gallons.

Fuel checkers are assigned the duty of keeping an account of all fuels issued to or taken from an aircraft.

Checker cards are useful for this purpose. These cards (or sheets) should have places for the date and the checker's name at the top. There should be *spaces on the cards for the squadron number, aircraft side number, the pounds of fuel issued or defueled from the aircraft, the total fuel load, the time of fueling or defueling, and the plane captain's initials.* These cards should be turned in to the division petty officer responsible for keeping the fuel expenditure records. They are used in filling out squadron requisitions. In case of an aircraft accident, the cards should be removed from use and filed for future use in the accident investigation, if required. These cards are also used in accounting for the amount of fuel on board the ship.

The fuel checker cards are used in conjunction with the daily pumproom reports to establish the amount of fuel delivered and the amount of fuel remaining on board daily. The cards are used to compute the amount of fuel used by each squadron. A supply requisition is sent to each squadron for payment for the amount of fuel used. The cost of the fuel is paid for out of that squadron's operation and line maintenance of aircraft allotment.

Sounding Report

Another report required in V-4 Division is the daily sounding report. This is a two-copy report; one copy is submitted to the engineering log room, and the other copy is retained in V-4 division files. The daily sounding report contains tank numbers, capacity (in gallons and in feet and inches), the previous day's soundings, the present soundings, and the percentage of fuel on board.

Daily Fuel Reports

The daily fuels report is compiled from the aircraft checker cards, the pumproom reports, and tank sounding reports. This report shows the total amount of fuel on board. It is normally signed by the V-4 division officer and submitted to each of the following officers:

- Commanding officer
- Air officer
- Engineering officer
- Operations officer
- Officer of the deck
- Supply officer

Casualty Reporting

The *casualty report (CASREP)* has been designed to support the Chief of Naval Operations (CNO) and fleet commanders in the management of assigned forces. The effective use and support of Navy forces require an up-to-date, accurate operational status for each unit. An important part of operational status is casualty information. The reporting of casualties results in operational commanders and support personnel being advised of the status of significant equipment malfunctions that could result in the degradation of a unit's readiness. The *CASREP* also reports the unit's need for technical assistance and/or replacement parts to correct the casualty.

A *casualty* is defined as an equipment malfunction or deficiency that cannot be corrected within 48 hours that:

- reduces the unit's ability to perform a primary mission, or
- reduces the unit's ability to perform a secondary mission, or
- reduces a training command's ability to perform its mission, or a significant segment of its mission, and cannot be corrected or adequately accommodated by rescheduling or double-shifting lessons or classes.

The CASREP system contains four types of reports: initial, update, correct, and cancel. These reports are described in general in the following paragraphs. For more complete information on preparation and submission of the reports, see *Navy Warfare Publication* (*NWP*) 10-1-10.

INITIAL CASUALTY REPORT (INITIAL).—An *Initial casualty report* identifies the status of the casualty and any parts and/or assistance that is needed. Operational and staff authorities use this information to set priorities for the use of resources.

UPDATE CASUALTY REPORT (UPDATE).—An *Update casualty report* contains information similar to that submitted in the Initial report and/or submits changes to previously submitted information.

CORRECTION CASUALTY REPORT (CORRECT).—A unit submits a correction; *"Correct" casualty report* when equipment that has been the subject of casualty reporting is repaired and is back in operational condition.

CANCELLATION CASUALTY REPORT (CANCEL).—A unit submits a cancellation, *Cancel casualty report* when equipment that has been the subject of casualty reporting is scheduled to be repaired during an overhaul or other scheduled availability. Outstanding casualties that will not be repaired during such availability will not be canceled, and will be subject to normal follow-up casualty reporting procedures as specified.

Surveys

The purpose of *surveys* is to determine the reasons and/or responsibilities for the loss, damage, or destruction of Government material and to determine the actual loss to the U.S. Government. Immediately upon the discovery of the loss, damage, or destruction of Government material, a *preliminary investigation* is conducted. The investigation is conducted to determine if there is evidence of negligence, willful misconduct, or deliberate unauthorized use. This preliminary investigation is conducted by the department head or division officer (or equivalent) responsible for the material. *When circumstances warrant, such as an indication of criminal action or gross negligence, the CO or OIC may appoint a surveying officer or a survey board to investigate the situation further.* However, individuals who are accountable or responsible for the material in question may not be appointed as a surveying officer.

An investigation or a review must determine what caused the loss, damage, or destruction of the material being surveyed. The facts surrounding the incident must be thoroughly and quickly investigated to determine the cause. However, the investigation or review should not be limited to the verification of statements from individuals. The investigation should be broad enough to ensure that the interests of the Government, as well as the rights of the individual(s) and the Navy activity, are fully protected. A review is required to prove or refute statements from individuals and to place the responsibility where it belongs.

Research action is not required when the CO or OIC believes that negligence was not involved in the loss, damage, or destruction of Government property. When, for reasons known to the CO or OIC, negligence or responsibility cannot be determined and for those reasons research would be an unnecessary administrative burden, research action is not required. Research action is not usually required when an individual accepts responsibility for the loss, damage, or destruction of property and voluntarily offers to reimburse the Government for the material.

There are many situations that may require a survey, but the ABF is concerned mainly with bulk petroleum products. If a loss exceeds stated allowances (for example, MOGAS - one half of one percent; JP-5 - one quarter of one percent), a survey is required. If the cause of the loss is unresolved, a *DD Form 200, Report of Survey*, will be initiated.

More detailed information is available in the *Naval Supply Procedures, (NAVSUP)* Publication 485, *Afloat Supply Procedures*.

Q6-14. How many copies of the publications affecting equipment used by a division should be maintained in a technical library?

Q6-15. There is no way you can remember every specification, instruction, rule, or requirement. What is the key for you not being overwhelmed by this required knowledge as it applies to maintaining technical manuals/publications?

Q6-16. Technical/Maintenance manuals are grouped into what two major categories?

Q6-17. What type of authorized release is used to issue non-technical information under the Navy Directives System?

Q6-18. What type of information contained in an Instruction or a Notice provides for identification and assists in accurately filing these documents?

Q6-19. What publication is used to order Navy technical manuals and forms?

Q6-20. In what form (s) are the changes to a publication issued?

Q6-21. What are the three major elements in maintaining aviation fuel records and reports?

Q6-22. What individuals within a fuels division should frequently inspect all logbooks maintained on the fuel system operations?

Q6-23. To keep an accurate account of all fuels issued to or taken from an aircraft, what document is used for this purpose?

Q6-24. To report a casualty that can result in significant equipment malfunctions or degradation of a unit's readiness, what type of report is used?

Q6-25. A major equipment malfunction or deficiency must be inoperative for what amount of time to be classified as a casualty?

Q6-26. What is the purpose for using "surveys" to assess loss, damage or destruction of government property?

Q6-27. Upon discovery of the loss, damage, or destruction of government property, what type of investigation is immediately conducted?

Q6-28. What is the purpose for conducting a preliminary investigation?

Q6-29. What DD form is used to report loss fuel/MOGAS in significant excess?

TOOL CONTROL PROGRAM

LEARNING OBJECTIVES: Explain the use and care of hand tools, portable power tools, and precision-measuring equipment used by ABFs. List the principles that apply to the care of hand tools. State the safety precautions required when using all these different tools.

As an ABF, you are routinely assigned tasks requiring the use of hand or power tools. It is to your advantage to become familiar with the tools you will use to accomplish these tasks. The right tool for the right job is an old, but time proven, proverb.

Tools are designed to make a job easier and enable you to work more efficiently. If they are not properly used and cared for, their advantages are lost to you.

Regardless of the type of work to be done, you must choose, and use the correct tools in order to do your work quickly, accurately, and safely. Without the proper tools and the knowledge of how to use them, you waste time, reduce your efficiency, and may even injure yourself.

This section explains the specific purposes, correct use, and proper care of the more common tools you will encounter as an ABF.

TOOL WORK HABITS

"A place for everything and everything in its place" is just good common sense. You can't do an efficient repair job if you have to stop and look around for each tool you need. The following rules will make your job easier and safer.

Keep Each Tool in Its Proper Stowage Place

All tools used in the V-4 Division must be managed under a *Tool Control Program* as directed by a local instruction.

The *Tool Control Program* is based on the concept of a family of specialized toolboxes and pouches configured for instant inventory before and after each maintenance action. The content and configuration of each container is tailored to the task, work center, and equipment maintained. Work center containers are assigned to and maintained within a work center. Other boxes and specialized tools are checked out from the tool control center (tool room).

Keep Your Tools in Good Condition

Protect them from rust, nicks, burrs, and breakage.

Keep Your Tool Allowance Complete

When you are issued a toolbox, each tool should be placed in it when not in use. When the toolbox is not actually at the work site, it should be locked and stored in a designated area.

NOTE

An inventory list is kept in every toolbox to be checked before and after each job or maintenance action, to ensure that all tools are available to do your work, and to ensure that they are accounted for after you have completed your work.

Use Each Tool Only For The Job It Was Designed To Do

Each particular type of tool has a specific purpose. If you use the wrong tool when performing maintenance or repairs, you may cause damage to the equipment you're working on or damage the tool itself. Remember improper use of tool results in improper maintenance. Improper maintenance results in damage to equipment and possible injury or death to you or others.

Safe Maintenance Practices

Always avoid placing tools on or above machinery or an electrical apparatus. Never leave tools unattended where machinery or aircraft engines are running.

Never Use Damaged Tools

A battered screwdriver may slip and spoil the screw slot, damage other parts, or cause painful injury. A gauge strained out of shape will result in inaccurate measurements.

Remember the efficiency of craftsmen and the tools they use are determined to a great extent by the way they keep their tools. Likewise, they are frequently judged by the manner in which they handle and care for them. Anyone watching skilled craftsmen at work notices the care and precision with which they use the tools of their trade.

CARE OF HAND TOOLS

The care of hand tools should follow the same pattern as for personal articles; that is, always keep hand tools clean and free from dirt, grease, and foreign matter. After use, return tools promptly to their proper place in the toolbox. Improve your own efficiency by organizing your tools so that those used most frequently can be reached easily without digging through the entire contents of the box. Avoid accumulating unnecessary junk.

All hand tools have a specific purpose and should be used only on the objects they are designed for. When you use a hand tool for other purposes, you usually damage both the tool and the object it is used on. Use screwdrivers to drive and remove screws. Do not use them to scrape paint, as a pry bar or chisel, and certainly never use them to test an electrical circuit.

Tools are expensive and vital equipment. When the need for their use arises, common sense plus a little preventive maintenance prolongs their usefulness.

The following precautions for the care of tools should be observed:

- Clean tools after each use. Oily, dirty, and greasy tools are slippery and dangerous.
- NEVER hammer with a wrench.
- NEVER leave tools scattered about. When not in use, stow them neatly on racks or in toolboxes.
- Apply a light film of oil after cleaning to prevent rust on tools.
- Inventory tools after use to prevent loss.

PORTABLE POWER TOOLS

ABFs are frequently required to use portable power tools in the maintenance of assigned areas that are exposed to the weather. Powers tools, when used properly and efficiently, are an enormous time and manpower saver, especially when a large painted or rusted surface requires scaling and preservation.

SAFETY is paramount when you are using powered tools. Special care should be used and in place before using powered tools. Use goggles to protect your eyes!

Power tools are more dangerous than non-powered tools. Use power tools only if you are familiar with them and have been checked out on their use and proper operation by a competent authority.

When pneumatic tools are used, the air supply pressure specified on the nameplate should always be maintained. Insufficient air pressure causes the tool to function improperly. Excessive air pressure results in damage to the tool and the person operating the tool may not be able to control it properly.

General Safety Precautions for Use of Pneumatic Tools

When using pneumatic tools, you should:

- Wear necessary personnel protective devices. Pneumatic tools shall not be connected to, or driven by, air pressure in excess of that for which the tools are designed. The wearing of appropriate eye protection equipment is mandatory for Navy personnel when operating pneumatic tools.

- Be authorized and trained to operate pneumatic tools.

- Lay pneumatic tools down in such a manner that no harm could be done if the switch is accidentally tripped. No idle tools should be left in a standing position.

- Keep pneumatic tools in good operating condition. They should be thoroughly inspected at regular intervals with particular attention given to the ON/OFF control valve trigger guard (if installed), hose connections, guide clips on hammers, and the chucks of reamers and drills.

Pneumatic tools and air-lines may be fitted with quick-disconnect fittings. These should incorporate an automatic excess-flow shutoff valve. This valve automatically shuts off the air at the air-lines before changing grinding wheels, needles, chisels, or other cutting or drilling bits.

The air hose must be suitable to withstand the pressure required for the tool. A leaking or defective hose should be removed from service. The hose should not be laid over ladders, steps, scaffolds, or walkways in such a manner as to create a tripping hazard. Where the hose is run through doorways, the hose should be protected against damage by the doors' edges. The air hose should generally be elevated over walkways or working surfaces in a manner to permit clear passage and to prevent damage to it.

All portable pneumatic grinders must be equipped with a safety lock-off device. A safety lock-off device is any operating control that requires positive action by the operator before the tools can be turned on. The lock-off device must automatically and positively lock the throttle in the OFF position when the throttle is released. Two consecutive operations by the same hand are required, first to disengage the lock-off device and then to turn on the throttle. The lock-off device should be integral with the tool. It should not adversely affect the safety or operating characteristics of the tools, and it should not be easily removable. Devices, such as a "deadman control," that do not automatically and positively lock the throttle in the OFF position when the throttle is released are not safety lock-off devices.

For detailed information on safety precautions, see *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19.*

Remember that tools can cut through rust, paint, metal, arms, and legs. Give your full attention while operating any power tool and never distract anyone who is using power equipment.

Specific Safety Precautions for Use with Pneumatic Tools

In operating or maintaining air-driven tools, take the following precautionary measures to protect yourself and others from the damaging effects of compressed air:

- Inspect the air hose for cracks or other defects; replace the hose if found defective.

> **WARNING**
>
> Before opening the control valve, see that nearby personnel are not in the path of the airflow. Never point the hose at another person.

- Open the control valve momentarily before connecting an air hose to the compressed air outlet. Then, make sure the hose is clear of water and other foreign material by connecting it to the outlet and again opening the valve momentarily.

- Stop the flow of air to a pneumatic tool by closing the control valve at the compressed air outlet before connecting, disconnecting, adjusting, or repairing a pneumatic tool.

PORTABLE ELECTRIC TOOLS

Before using portable electric tools, be sure the proper voltage is supplied. This information can be found on the nameplate permanently attached to the tool. Electric tools of all types used in the Navy are required to have a proper ground capability. If doubt exists whether or not a good ground has been established, request the services of an *electrician's mate* to check it out before applying power to the tool. **Never vary the manufacturers recommended voltage. Safety is paramount!**

PRECISION MEASURING EQUIPMENT

As an ABF, you will be using measuring tools that read in the thousandth (0.001) of an inch. On PMS and in major maintenance work, you will be required to use torque wrenches, micrometers, telescoping gages, vernier calipers, and dial indicators. Aligning pumps, checking shafts for wear, and checking bearings' inside and outside diameters are just a few places where these tools are used.

Care of Precision Instruments

Special treatment is required for precision instruments if they are to serve their intended purpose. The following precautions will help ensure their accuracy.

- Keep clean and lightly oiled. (DO NOT oil dial indicators.)
- Always wipe an instrument clean of fingerprints before returning it to the box.
- Always verify an instrument's accuracy before using it by checking its calibration sticker.
- Have a precision instrument calibrated according to PMS, when one has been dropped or when you are in doubt about the accuracy of one.
- Always allow the temperature of a precision instrument to equalize with ambient temperature to ensure accuracy of measurements.
- Return precision instruments not in use to the box.
- NEVER store a precision instrument with other tools such as wrenches, hammers, and so on.
- NEVER carry a precision instrument in your pocket unless it has an appropriate pocket carrying case.
- NEVER close a precision instrument such as an outside micrometer, vernier caliper, or a dial indicator light for storage. Temperature changes can cause frames, spindles, and so on, to become distorted.
- NEVER open or close a micrometer by twirling the frame.
- NEVER attempt to remove mill shavings or dirt from a precision instrument with an air hose. This procedure only embeds small particles into the working parts.
- NEVER attempt to calibrate a precision instrument yourself. Always send it to an authorized calibrating facility.
- NEVER attempt to clean measuring surfaces with an abrasive.
- NEVER force a precision instrument to attain a measurement.
- NEVER attempt to take readings on operating machinery.

We have to understand that even with the best tools, it is the person behind the tool who makes things work.

ABFs can take measurements accurately and new parts to be installed can be on hand, however; if the one who finally assembles the pump does not know how to torque a casing or pipe flange, he or she can destroy all the hard work and money that have been put into the job. For maintenance and repair on all equipment, **use the appropriate technical manuals.**

All you have learned in this section is to help you maintain and repair your equipment safely and obtain quality results. However, there is no way to teach integrity to an individual. You will often be required to perform maintenance or repairs alone. Do quality work. Your life and the lives of others may depend on it!

Tools and Their Uses, NAVEDTRA 14256 (fig. 6-9) contains more detailed information on the various tools that an ABF will use. It is recommended that all ABFs complete this course.

Q6-30. What program is used to managed tools used in the V-4 Division?

Q6-31. How often should you inventory tools according to the Tool Control Program?

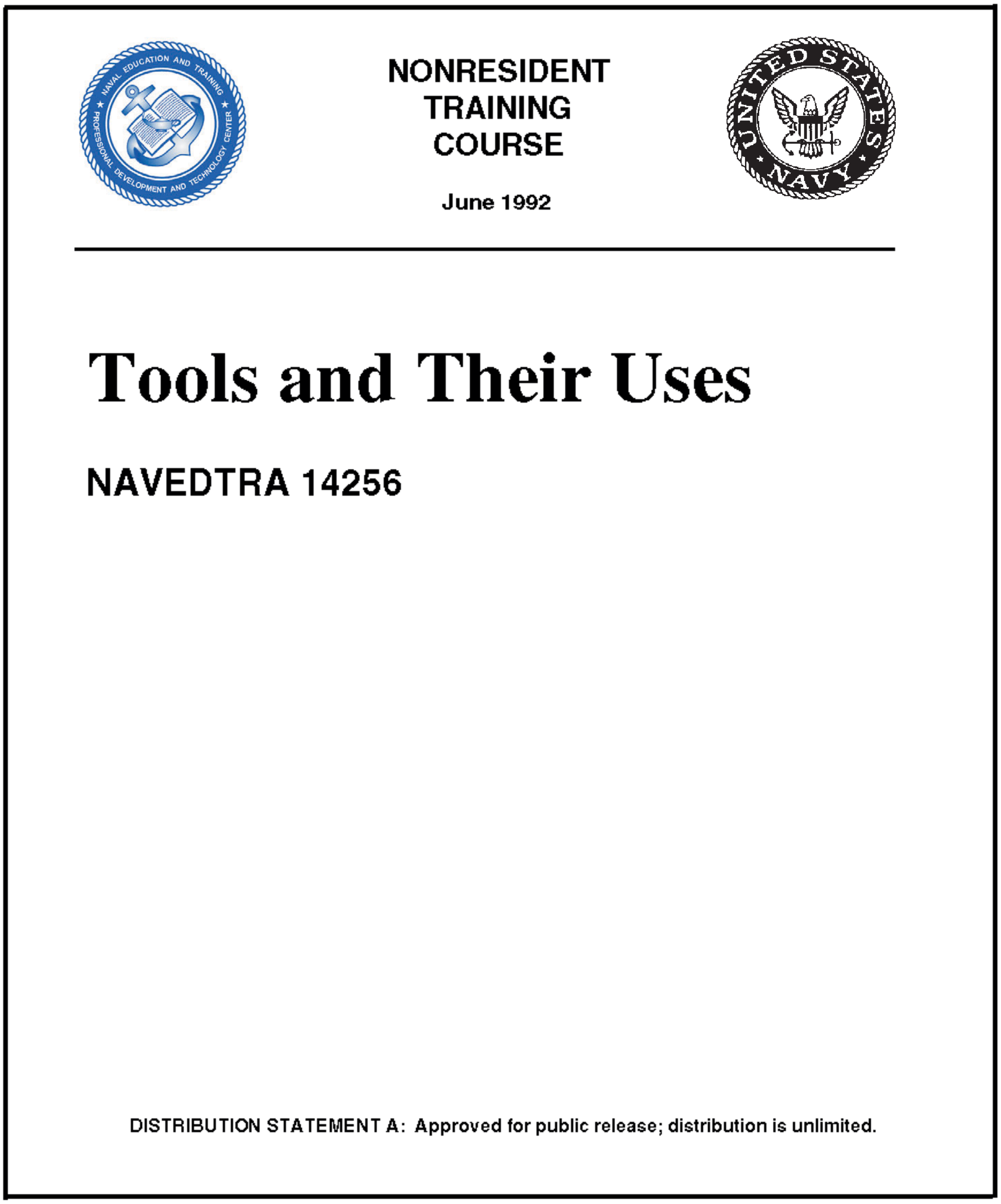
Q6-32. What will happen if you use the wrong tool to perform maintenance or repairs?

Q6-33. When using power tools, what is the most important aspect?

Q6-34. What should the operator be familiar with when using power tools?

Q6-35. What type of protective equipment is mandatory for Navy personnel when operating pneumatic tools?

Q6-36. What is the important requirement in regards to the hoses used to supply air to pneumatic tools?



NONRESIDENT
TRAINING
COURSE

June 1992

Tools and Their Uses

NAVEDTRA 14256

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

Figure 6-9.—Tools and Their Uses.

Q6-37. Portable pneumatic grinders must be equipped with what type of safety device?

Q6-38. When using electric portable tools how do know that the proper voltage is supplied to that tool?

Q6-39. What requirement must be applied to all types of electrical tools used in the Navy?

Q6-40. How should you verify the accuracy of a precision tool?

Q6-41. Who is authorized to calibrate a precision instrument?

Q6-42. What NAVEDTRA manual should you consult to find detailed information on the tools you will most likely use as an ABF?

BLUEPRINTS AND DRAWINGS

LEARNING OBJECTIVES: Describe the information contained in blueprints, charts, and drawings. Read and interpret blueprints, drawings, diagrams, and other maintenance aids.

All ABFs must be able to read blueprints and drawings during the performance of many maintenance actions. As you advance in your rating you may also be required to make sketches and drawings, which will assist you in the training of less-experienced maintenance personnel by making it possible for them to visualize the system or object you are explaining.

Blueprints are exact copies of mechanical or other types of drawings and employ a language of their own. It is a form of sign language or short-hand that uses lines, graphic symbols, dimensions, and notations to accurately describe the form size, kind of material, finish, and construction of an object. It can be said that blueprint reading is largely a matter of translating these lines and symbols into terms of procedures, materials, and other details needed to repair, maintain, or fabricate the object described on the print.

Usually you can look at a blueprint and recognize the object if you are familiar with the actual part. The important thing is to know what the different symbols stand for and where to look for the important information on a blueprint. Some of the important facts listed on all blueprints are discussed in the following paragraphs.

SKETCH

A sketch is made free-hand and shows rough outlines and only those details that are necessary to visualize a system or an object. A drawing is similar to a sketch, but it is made with mechanical drawing instruments and is drawn to scale.

MECHANICAL DRAWING

Mechanical drawing is a special language and is defined as follows: "A language which uses lines, symbols, dimensions, and notations to accurately describe the form, size, kind of material, finish, and construction of an object."

BLUEPRINT

Blueprints are the link between the engineers who design equipment and the people who build, maintain, and repair it. In a comparatively little space, they give a great deal of information in a universal language easily understood.

Title Block

The title block is located in the lower right corner of all blueprints and drawings prepared according to military standards. The block contains the drawing number, the name of the part or assembly that the blueprint represents, and all information required to identify the part or assembly.

The title block also includes the name and address of the Government agency or organization preparing the drawing, the scale, drafting record, authentication, and the date (fig. 6-10).

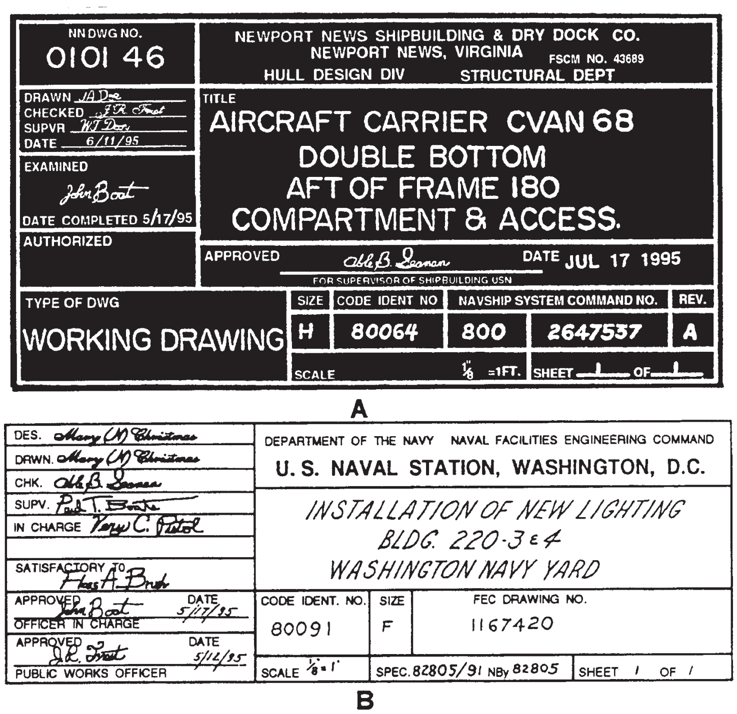


Figure 6-10.—Blueprint title blocks. (A) Naval Ship's Systems Command; (B) Naval Facilities Engineering Command.

A space within the title block with a diagonal or slant line drawn across it indicates that the information usually placed in it is not required or is given elsewhere on the drawing.

Revision Block

The revision block (not shown) is usually located in the upper right corner of the blueprint and is used for the recording of changes (revisions) to the print. All revisions are noted in this block and are dated and identified by a letter and a brief description of the revision. A revised drawing is shown by the addition of a letter to the original number in the title block, as shown in figure 6-10, view A. If the print shown in figure 6-10, view A, was again revised, the letter in the revision block of the title block would be replaced by the letter *B*.

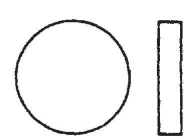
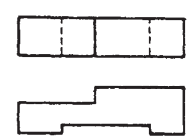
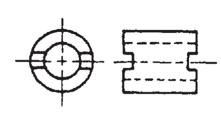
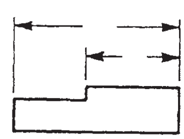
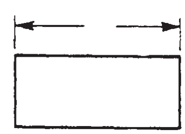
Drawing Number

All blueprints are identified by a drawing number (NAVSHIP Systems Command No. in view A of fig. 6-10, and FEC Drawing No. in view B), which appears in a block in the lower right corner of the title block. It may be shown in other places also; for example, near the top border line in an upper corner, or on the reverse side at both ends so that it will be visible when a drawing is rolled up. If a blueprint has more than one sheet, this information is included in the block indicating the sheet number and the number of sheets in the series. For example, note that in the title blocks shown in figure 6-10 the blueprint is sheet 1 of 1.

Reference Numbers

Reference numbers that appear in the title block refer to numbers of other blueprints. When more than one detail is shown on a drawing, a dash and a number are frequently used. For example, if two parts were shown in one detail drawing, both prints would have the same drawing number, plus a dash and an individual number, such as 8117041-1 and 8117041-2.

In addition to appearing in the title block, the dash and number may appear on the face of the drawings,

LINE STANDARDS			
NAME	CONVENTION	DESCRIPTION AND APPLICATION	EXAMPLE
VISIBLE LINES		HEAVY UNBROKEN LINES USED TO INDICATE VISIBLE EDGES OF AN OBJECT	
HIDDEN LINES		MEDIUM LINES WITH SHORT EVENLY SPACED DASHES USED TO INDICATE CONCEALED EDGES	
CENTER-LINES		THIN LINES MADE UP OF LONG AND SHORT DASHES ALTERNATELY SPACED AND CONSISTENT IN LENGTH USED TO INDICATE SYMMETRY ABOUT AN AXIS AND LOCATION OF CENTERS	
DIMENSION LINES		THIN LINES TERMINATED WITH ARROWHEADS AT EACH END USED TO INDICATE DISTANCE MEASURED	
EXTENSION LINES		THIN UNBROKEN LINES USED TO INDICATE EXTENT OF DIMENSIONS	

(A)

Figure 6-11-A.—Standard lines.

near the parts they identify. Some commercial prints show the drawing and dash number, and point with a leader line to the part; others use a circle, 3/8 inch in diameter, around the dash number, and carry a leader line to the part.

A dash and number are used to identify modified or improved parts, and also to identify right-hand and left-hand parts. Many aircraft parts on the left-hand side of an aircraft are exactly like the corresponding parts on the right-hand side but in reverse. The left-hand parts are usually shown in the drawing.

Above the title block on some prints you may see a notation such as "159674 LH shown; 159674-1 RH opposite." Both parts carry the same number. But the part called for is distinguished by a dash and number. (LH means left-hand, and RH means right-hand.) Some companies use odd numbers for right-hand parts and even numbers for left-hand parts.

Drawing Lines

The lines used in working drawings are more than a means of showing a picture of an object for the purpose of building or repairing. The way a line is drawn has a definite meaning.

Thick lines are used for the visible outline of the object being drawn. Medium lines are used for the dotted lines representing hidden features and for cutting-plane, short-break, adjacent-part, and alternate-position lines. Center lines, dimension lines, long-break lines, ditto lines, extension lines, and section lines are represented by thin lines.

To understand blueprint reading, you must know the different types of lines used in general drawing practice and the information conveyed by each. Some of the lines of major importance are illustrated in figures 6-11-A and 6-11-B. The correct uses are illustrated in figure 6-12.

NAME	CONVENTION	DESCRIPTION AND APPLICATION	EXAMPLE
LEADER		THIN LINE TERMINATED WITH ARROW-HEAD OR DOT AT ONE END USED TO INDICATE A PART, DIMENSION OR OTHER REFERENCE	1/4 x 20 THD.
PHANTOM OR DATUM LINE		MEDIUM SERIES OF ONE LONG DASH AND TWO SHORT DASHES EVENLY SPACED ENDING WITH LONG DASH USED TO INDICATE ALTERNATE POSITION OF PARTS, REPEATED DETAIL OR TO INDICATE A DATUM PLANE	
STITCH LINE		MEDIUM LINE OF SHORT DASHES EVENLY SPACED AND LABELED USED TO INDICATE STITCHING OR SEWING	STITCH
BREAK (LONG)	(WOOD)	THIN SOLID RULED LINES WITH FREEHAND ZIG-ZAGS USED TO REDUCE SIZE OF DRAWING REQUIRED TO DELINEATE OBJECT AND REDUCE DETAIL	
BREAK (SHORT)		THICK SOLID FREE HAND LINES USED TO INDICATE A SHORT BREAK	
CUTTING OR VIEWING PLANE VIEWING PLANE OPTIONAL		THICK SOLID LINES WITH ARROWHEAD TO INDICATE DIRECTION IN WHICH SECTION OR PLANE IS VIEWED OR TAKEN	
CUTTING PLANE FOR COMPLEX OR OFFSET VIEWS		THICK SHORT DASHES USED TO SHOW OFFSET WITH ARROW-HEADS TO SHOW DIRECTION VIEWED	

(B)

Figure 6-11-B.—Standard lines.

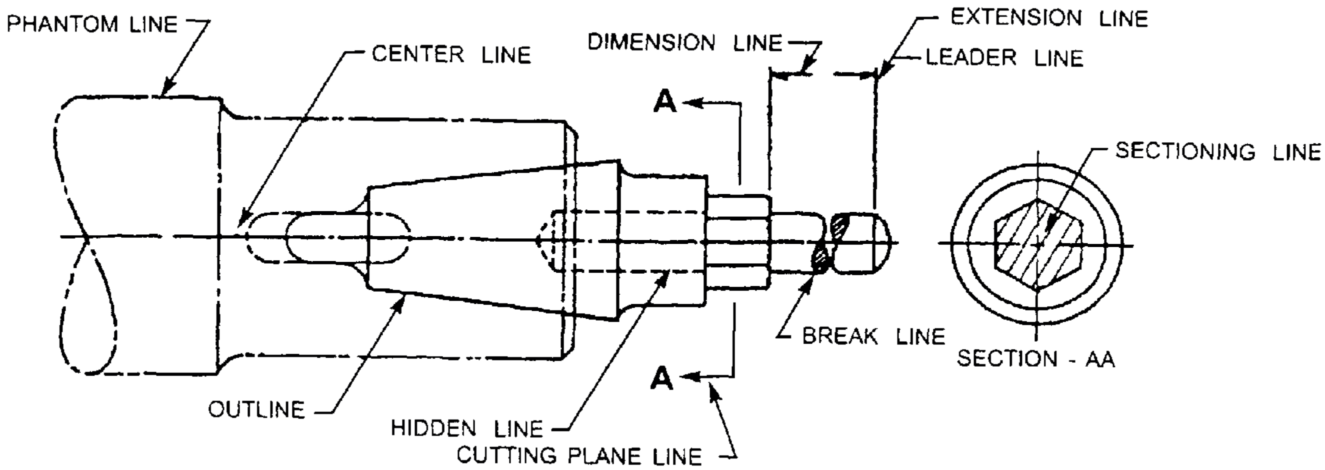


Figure 6-12.—Use of standard lines.

Blueprints make it possible to understand, in a comparatively small space, what is to be made or repaired.

TYPES OF BLUEPRINTS

A blueprint is a duplicate of a drawing or sketch. Usually, only accurate drawings are blueprinted. These blueprints are furnished by the manufacturers of the machinery and equipment installed and used aboard ship and also by the personnel concerned with the building and maintenance of the ship.

Plan View

Of the many types of blueprints you may use aboard ship, the simplest one is the plan view. This blueprint shows the position, location, and use of the various parts of the ship. You may use plan views to find your duty and battle stations, the sick bay, the barbershop, and other parts of the ship.

Assembly Prints

In addition to plan views, that you will find aboard ship other blueprints called assembly prints. These prints show various kinds of machinery and mechanical equipment. Assembly prints show the various parts of the mechanism, how the parts fit together, and their relation to each other. Assembly prints may be used to learn operation and maintenance of machines, systems, and equipment.

Sub-Assembly Prints

Individual mechanisms, such as motors and pumps, are shown on unit or subassembly prints. These show location, shape, size, and relationships of the parts of the subassembly or unit. Sub-assembly prints are used to learn operation and maintenance of machines, systems, and equipment.

Detail Prints

Detail prints show a single part with its dimensions and all the information needed to make a new part as a replacement. It includes a complete and exact description of the part's exact size, type of material, finishes for each part, tolerances, and so forth.

MICROFILM/APERTURE CARDS

Many prints and drawings are procured in the form of 16- and 35-mm microfilm. Microfilm prints and drawings are available mounted on aperture (viewer) cards, as well as in roll form. A reader or some type of projector is required to enlarge the microfilm for reading. Activities are provided with a micro-film reader-printer, which as its name implies, enlarges the microfilm for reading and also has the capability of printing a working copy in a matter of a few seconds.

Microfilm greatly reduces the size of otherwise bulky files, which is very important aboard ship.

SCHEMATIC DIAGRAMS

Schematic diagrams show by means of single lines and symbols how the parts of a system are connected for the operation of the system.

Piping Systems

Piping diagrams are normally used to trace piping systems and their functions without actually describing the shape, size, or location of the components or parts. Each component is represented by a symbol; and once these symbols are learned, the piping schematic diagram is easy to read.

AFOSS (Aviation Fuels Operating Sequencing System) schematics are a good example of a piping diagram. As you may have seen in the fuel system schematics, diagrams do not indicate the location of individual components within the station, but do locate the components with respect to each other within the system.

Electrical Systems

Schematic diagrams are also used to depict electrical systems. They are basically the same as the piping diagrams except they use electrical symbols instead of piping symbols. The schematic to the electrical and electronic components of the JP-5 control console is an example of an electrical system schematic.

Additional detailed information about mechanical drawing and the reading of prints and drawings is contained in *Blueprint Reading and Sketching,* NAVEDTRA 14040.

Q6-43. What is provided to link engineers who designed a particular equipment and the people who will build, maintain, and repair it?

Q6-44. What block of a blueprint contains the drawing number, the name of the part or assembly that the blueprint represents, and all information required to identify that part or assembly?

Q6-45. What type of information is contained in the revision block of a blueprint?

Q6-46. How would you recognize a revision to a blueprint by looking at the title block?

Q6-47. What must you understand about lines used in working drawings in order for you to read blueprints?

Q6-48. What type of blueprint shows you the position, location, and points out the various parts of a ship?

Q6-49. What type of blueprint shows you the various parts of a mechanism, how the parts fit together, and their relation to each other?

Q6-50. What are some examples of sub-assembly blueprints?

Q6-51. What are detail blueprints?

Q6-52. What is used to show how parts of a system are connected for the operation of the entire system through single lines and symbols?

Q6-53. The AFOSS (Aviation Fuels Operating Sequencing System), is an example of what kind of diagram schematic?

Q6-54. The JP-5 control console is an example of what type of schematic diagram?

Q6-55. In what NAVEDTRA manual would you find information about mechanical drawings, and how to read blueprints?

PLANNED MAINTENANCE SYSTEM AND QUALITY ASSURANCE PROGRAM

LEARNING OBJECTIVES: State the purpose of the 3-M system and the Quality Assurance Program. Describe the 3-M system and the Quality Assurance Program.

3-M SYSTEM

Heads up thinking and asking questions can make your work as an ABF run smoothly. On a day-to-day basis, you come in contact with PMS. The PMS (Planned Maintenance System) weekly schedule displays the planned maintenance scheduled to be done in your work center for a specific week.

Weekly PMS Schedule

The weekly PMS schedule is posted in each work center. The work center supervisor assigns and monitors the accomplishment of the required PMS tasks by work center personnel.

The following is a list of the contents of weekly PMS schedules (fig. 6-13).

- Work center code.
- Date of current week.
- Division officer's approval signature.
- MIP code minus the date code.
- A list of applicable components.
- Maintenance responsibilities assigned, by name, to each line of equipment.
- The periodicity codes of maintenance requirements to be performed listed by columns for each day.
- Outstanding major repairs, applicable PMS requirements, and all situation requirements.

WEEKLY PMS SCHEDULE (CONVENTIONAL)

OPNAV FORM 4790/15 (3-71)
S/N 0107-LF-770-3260

WORK CENTER EA07 | PMS SCHEDULE FOR WEEK OF 2-9 MAY | APPROVAL SIGNATURE W.M. Smith

MIP	COMPONENT	MAINTENANCE RESPONSIBILITY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT - SUN	OUTSTANDING REPAIRS & PM CHECKS DUE IN 4 WKS
2000/001	MACH LUB OIL NO.1 AMR								R-1
3000/001	MISC SHIPBOARD ELECT EQUIPMENT								M-1 M-4R, R-2, S-4R
	RECEPTACLES EGL-1	OVERTURF		2W-2	3W-1				2W-1, 3W-2
	RUBBER GLOVES EGL-1								S-3R, R-1
5210/009	FIREMAIN & FLUSHING	STERLING							Q-5R#, Q-1
5510/018	COMPRESSED AIR SYSTEM EA07-001	HOYLE	D-1	D-1	D-1	D-1	D-1	D-1 / D-1	M-1, M-2 A-5R, R-1, R-5W
5530/001	O2N2 SYSTEM FWD 1-30-6								Q-1(+M-1)
	PUMP 27345	PADGETT	Q-3						R-16D, R-17W
	VALVES EGL-1	GALLE	W-1R D-1R	A-13R D-1R	D-1R	D-1R	D-1R	D-1R D-1R	A-13R, R-11M, D-1R, W-1R
	VALVES EGL-2	HOOFA	W-1R D-1R	D-1R	D-1R	D-1R	D-1R	D-1R D-1R	D-1R, W-1R
5530/001	O2N2 SYSTEM AFT 1-240-7								M-1
	PUMP 26439	RUHNKE	Q-3						R-16D, R-17W
	VALVES EGL-1								A-13R, R-11M
	VALVES EGL-2	McCLURE	W-1R						D-1R, W-1R
4924/RHD	LSD HUD MR3 MOOO	JACK	W-1						M-2R, R-1R
	#1 HUD								R-1, M-4
	#2 HUD								R-2, M-4
6641/005	VENT DUCTS EGL-1								S-11R#
	FILTERS								M-9
	VENT DUCTS EGL-2								S-41R#

UPDATE THIS SCHEDULE DAILY

Figure 6-13.—Weekly PMS schedule.

PMS Feedback Report

As with any system, things change; as they do, there must be a way to communicate. In PMS that way is called, the PMS FBR (*Feedback Report, OPNAV 4790/7B Form*). Fleet personnel should notify the NAVSEACEN and/or the TYCOM, as applicable, of matters related to PMS using the PMS FBR (figures 6-14 and 6-15). The FBR is a five-part form composed of an original and four copies. Instructions for

SEE INSTRUCTIONS ON BACK OF GREEN PAGE

REPORT SYMBOL OPNAV 4790-4

FROM (SHIP NAME AND HULL NUMBER) USS NEVERWAS FFG 999	SERIAL # 1074-94 DATE 09 MAR 94

TO
[X] NAVAL SEA SUPPORT CENTER PACIFIC (Category A)
[ ] TYPE COMMANDER (Category B)

SUBJECT: PLANNED MAINTENANCE SYSTEM FEEDBACK REPORT

SYSTEM, SUB-SYSTEM, OR COMPONENT SONAR RECEIVING SET	APL/CID/AN NO./MK. MOD AN/SQR-18A (V) 1
SYSCOM MIP CONTROL NUMBER 4621/23-23	SYSCOM MRC CONTROL NUMBER VARIOUS

DESCRIPTION OF PROBLEM

CATEGORY A	CATEGORY B
[X] MIP/MRC REPLACEMENT	[ ] TECHNICAL [ ] TYCOM ASSISTANCE [ ] OTHER (Specify)

REMARKS

REQUEST TWO COPIES EACH OF FOLLOWING CLASSIFIED MRCs:

72 EZV9 N

12 EZV0 N

20 EZW5 N

TOTAL OF 6 MRCs REQUESTED. ADEQUATE SECURE STORAGE PER OPNAVINST 5110.1H IS AVAILABLE.

ORIGINATOR & WORK CENTER CODE ET (SW) Boat EE01	DIV. OFFICER LT Jay Gee
DEPT. HEAD I. M. Daboss, CDR, USN	3-M COORDINATOR GMC (SW) Jack Frost

Originator do not write below. For TYCOM use only.

TYCOM [ ] CONCUR [ ] DO NOT CONCUR [ ] TAKES ACTION [ ] PASSES FOR ACTION

TYCOM REP SIGNATURE	DATE

OPNAV 4790/7B (Rev. 9-89)
S/N 0107-LF-007-8000

ACTION COPY
EDITION OF 3-84 MAY BE USED UNTIL EXHAUSTED

PAGE 1 OF 1

Figure 6-14.—Sample of a Category A, Feedback Report (FBR).

REPORT SYMBOL OPNAV 4790-4

SEE INSTRUCTIONS ON BACK OF GREEN PAGE

FROM (SHIP NAME AND HULL NUMBER)	SERIAL #
USS NEVERWAS FFG 999	1074-94 DATE 04 MAR 94

TO

☐ NAVAL SEA SUPPORT CENTER ____________ (Category A)

☒ TYPE COMMANDER (Category B)

SUBJECT: PLANNED MAINTENANCE SYSTEM FEEDBACK REPORT

SYSTEM, SUB-SYSTEM, OR COMPONENT	APL/CID/AN NO./MK. MOD
Auto Ballast Comp Sys	
SYSCOM MIP CONTROL NUMBER	SYSCOM MRC CONTROL NUMBER
F-37/2-67	T 44 E12F N

DESCRIPTION OF PROBLEM

CATEGORY A	CATEGORY B
☐ MIP/MRC REPLACEMENT	☒ TECHNICAL ☐ TYCOM ASSISTANCE ☐ OTHER (Specify)

REMARKS

Before testing setting on relief valve, we need calibration steps for Leslie-Matic controller. This step is not contained on the present MRC. This ship does not have any pub or tech manual showing the steps that should be taken in checking the Leslie-Matic controller for accuracy.

ORIGINATOR & WORK CENTER CODE	DIV. OFFICER
ET (SW) Boat EE01	Lt Jay Gee
DEPT. HEAD	3-M COORDINATOR
I.M. Daboss, CDR, USN	GMC (SW) Jack Frost

Originator do not write below. For TYCOM use only.

TYCOM ☐ CONCUR ☐ DO NOT CONCUR ☐ TAKES ACTION ☐ PASSES FOR ACTION

TYCOM REP SIGNATURE	DATE

OPNAV 4790/7B (Rev. 9-89)
S/N 0107-LF-007-8000

ACTION COPY
EDITION OF 3-84 MAY BE USED UNTIL EXHAUSTED

PAGE 1 OF 1

Figure 6-15.—Sample of a Category B, Feedback Report (FBR).

preparation and submission of the form are printed on the back of the last copy (fig. 6-16). These forms are obtained through the Navy Supply System. They are to be prepared, submitted, and processed in two major categories.

The two major categories of FBRs are category A and category B. These are defined as follows:

Category A of FBR (see fig. 6-14) is non-technical in nature and is intended to meet PMS needs that do not require technical review. Consequently, to reduce

1. ORIGINATOR

a. Typewritten copies are preferred, however, handprinted copies are acceptable. Use ballpoint pen and ensure all copies are legible.

b. EQUIPMENT IDENTIFICATION: Fill in titled blocks that apply. Give as much information that can be determined. Ensure that correct APL number is used for hull, mechanical or electrical equipment or electronic/weapons equipment which does not have any Army-Navy number or mark/mod designation.

c. DESCRIPTION OF PROBLEM: Check the appropriate box.

Category A

(1) MIP/MRC REPLACEMENT: Ensure that PMS documentation request is current in accordance with latest SFR. For missing MIPs/MRCs, give SYSCOM control numbers when they can be determined. If SYSCOM control numbers cannot be determined, provide as much nameplate data as can be obtained. When ordering a variety of missing/worn MIPs/MRCs, the subject section shall be left blank.

Category B

(2) TECHNICAL:

(a) Identify specific discrepancy discovered in PMS by MRC control number, step number, etc.

(b) For publication discrepancies identify publication by number, volume, revision date/number, change number, page, paragraph and or figure as appropriate.

THIS FORM WILL NOT BE USED TO ORDER PUBLICATIONS.

(3) TYCOM ASSISTANCE: Includes clarification of 3-M instructions and other matters related to PMS administration.

(4) OTHER: Identify in detail any problem not covered by (1) through (3) above. Shifts of maintenance responsibility will be reported under this item. Ensure that all work centers involved in the change are identified by work center code. Approval by the Executive Officer will be shown in the "Remarks".

d. REMARKS: Provide brief, but complete, description of problem or requirement. Executive Officer indicate approval of maintenance responsibility shift by endorsement. Use additional forms if more space is required. Mark additional forms, "page 2 of 2", "page 2 of 3", etc. Staple additional forms behind basic form.

e. ORIGINATOR IDENTIFICATION: Sign and insert work center code in appropriate space.

2.. DIVISION OFFICER: Review for accuracy and completeness and sign in the space provided.

3. DEPARTMENT HEAD: Review for accuracy and completeness and sign in the space provided.

4. 3-M COORDINATOR:

a. Serialize, date and sign in the appropriate spaces.

b. ROUTING INSTRUCTIONS: For Category "A" FBRs, forward the white and yellow copies to the appropriate NAVSEACEN and the pink copy to the TYCOM. For Category "B" FBRs, forward the white, yellow and pink copies to the TYCOM. Retain blue copy in suspense file. Return green copy to the originator.

Figure 6-16.—Instructions for preparation of a PMS Feedback Report (FBR).

response time, the ship's 3-M coordinator submits directly to the NAVSEACEN these FBRs, which pertain to the need for replacement of missing MIPs and MRCs.

Category B FBRs (see fig. 6-15) are technical in nature. They are submitted by the ship's 3-M coordinator to the applicable TYCOM and pertain to the following:

Technical discrepancies inhibiting PMS performance. These discrepancies can exist in documentation, equipment design, maintainability, reliability, or safety procedures as well as operational deficiencies in PMS support (parts, tools, and test equipment). Discrepancies in technical manuals are reported by way of the TMDER (*Technical Manual Deficiency/Evaluation Report*), *NAVSEA 4160/1* (fig. 6-17).

(Insert Classification of TMDER Here) CLASSIFICATION:

NAVSEA/SPAWAR TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)
(NAVSEA S0005–AA–GYD–030/TMMP & NAVSEAINST 4160.3A)

INSTRUCTIONS: Continue on 8 1/2" x 11" paper if space is needed.

1. USE THIS REPORT TO INDICATE DEFICIENCIES, PROBLEMS, AND RECOMMENDATIONS RELATING TO PUBLICATION.
2. FOR UNCLASSIFIED TMDERS, FILL IN YOUR RETURN ADDRESS IN SPACE PROVIDED ON THE BACK, FOLD AND TAPE WHERE INDICATED, AND MAIL. (SEE OPNAVINST 5510H FOR MAILING CLASSIFIED TMDERS.)

1. PUB NO.	2. VOL PART	3. REV. NO./DATE OR TM CH. NO./DATE	4. SYSTEM/EQUIPMENT IDENTIFICATION
S9086-SN-STM-010/ CH-541R2		Rev 2	

5. TITLE	6. REPORT CONTROL NUMBER
NSTM Chapter 541 – Ship Fuel and Fuel Systems	

7. RECOMMENDED CHANGES TO PUBLICATION

PAGE NO. A.	PARAGRAPH B.	C. RECOMMENDED CHANGES AND REASONS

8. ORIGINATOR'S NAME AND WORK CENTER (Please Print)	9. DATE SIGNED	10. DSN/COMM NO.	11. TRANSMITTED TO

12. SHIP HULL NO. AND/OR STATION ADDRESS (DO NOT ABBREVIATE)

NAVSEA 4160/1 (REV 5–95) (DESTROY OLD STOCK) SN0116–LP–019–5300

Figure 6-17.—Technical Manual Deficiency/Evaluation Report; NAVSEA 4160/1.

- Notification of shift of maintenance responsibility from one work center to another.
- TYCOM assistance in the clarification of 3-M instructions.

CAUTION

When the reason for submission of a PMS FBR involves safety of personnel or potential or actual damage to equipment and relates to the technical requirements of PMS, the FBR is considered URGENT. Urgent FBRs are forwarded by a naval message, containing a PMS feedback serial number, to the NAVSEACEN with information copies to the cognizant SYSCOM/NAVMEDCOM/NAV SAFECEN.

The message must describe the unsafe procedures or conditions and must identify the MIP/MRC involved. A follow-up PMS FBR may be submitted to amplify information contained in the message. It must contain reference to the message and the FBR serial number indicated in the message subject.

- TYCOM assistance in the clarification, additions, and changes to prescribed AFOSS procedures or instructions. AFOSS requests are forwarded to *NAVSEA, EOSS section, Aviation Fuels division.*

For complete information on PMS, consult the SHIPS' 3-M MANUAL, *OPNAVINST 4790.4 series.*

QUALITY ASSURANCE (QA) PROGRAM

A Quality Assurance Program is essential to ensure consistent, quality repair and maintenance of shipboard equipment. The QA Program is intended to improve force readiness through the implementation of a formalized plan that sets forth-minimum requirements to be accomplished for non-nuclear maintenance and repair actions performed by forces afloat. The QA Program is important to the ABF because JP-5 piping, valves, tanks, pumps, filters, and most other equipment related to the JP-5 system are included in its coverage. Do not confuse the QA Program, which is designed to ensure quality maintenance on equipment, with Quality Surveillance, which is used to ensure high quality fuel is delivered to aircraft.

Fleet maintenance accomplishment procedures are intended to provide a first-time quality product completed in accordance with applicable directives. Maintenance accomplishment is a direct function of four basic elements:

- Training and qualification of the craftsmen who will perform the maintenance.
- Supervision, including the direct oversight of the maintenance being performed, of the individual craftsman assigned to accomplish the maintenance.
- Formal Work Procedures (FWP) which provide the necessary sequence of actions to accomplish the maintenance task. These work procedures will vary in complexity dependent on the individual maintenance task and should be developed, if possible, using pre-existing and proven maintenance procedures.
- Work Process. A series of actions planned and executed to accomplish a unit task. The work process can range from planning and executing preventive maintenance to major component replacement or restoration.

Understanding work processes and their quality controlling elements is the fundamental core of Quality Control. The above elements form the cornerstone of the fleet maintenance program and are essential to ensure that all maintenance is completed per applicable technical and administrative requirements. The fundamental policies and guidelines that implement these elements are detailed in the Quality Control and the Quality Assurance arms of the fleet maintenance program below.

Quality Control

Quality control consists of all actions taken prior to the start of and during the work process to obtain the highest confidence level that the work will be completed safely and correctly within technical specifications the first time and minimize expenditure of manpower and resources.

Quality Control (QC) (fig. 6-18) includes but is not limited to the following major elements:

1. Training and qualification are an integral part of the maintenance process. In many work processes training is the prerequisite to meeting qualification requirements for conducting the process itself. Other processes, such as *Planning and Estimating* or *Pipe Brazing*, have no organic Navy pipeline training and must be learned at the *Fleet Maintenance Activity (FMA)* or aboard ship through a combination of experience and specialized industrial process training.

Training in quality control and quality assurance aspects of ship maintenance is also required if the craftsman performing the maintenance is to achieve the requisite first-time quality product. The ultimate goal of training programs is to develop the requisite levels of knowledge to enable the craftsman to perform those skills necessary for their craft. Experienced craftsman who are properly trained need not have detailed step-by-step direction in performance of those tasks done as a normal function of their craft. Rigorous training and qualification programs accomplishes the following:

a. Ensure that equipment operators and watchstanders have the requisite knowledge to properly operate their cognizant equipment safely, and in accordance with design parameters and established procedures, to avoid personnel hazards and prolong equipment service life.

b. Develop and maintain the requisite maintenance and industrial process skills and proficiency in craftsmen in order to have a viable pool of personnel qualified to conduct *Intermediate and Organizational Maintenance*.

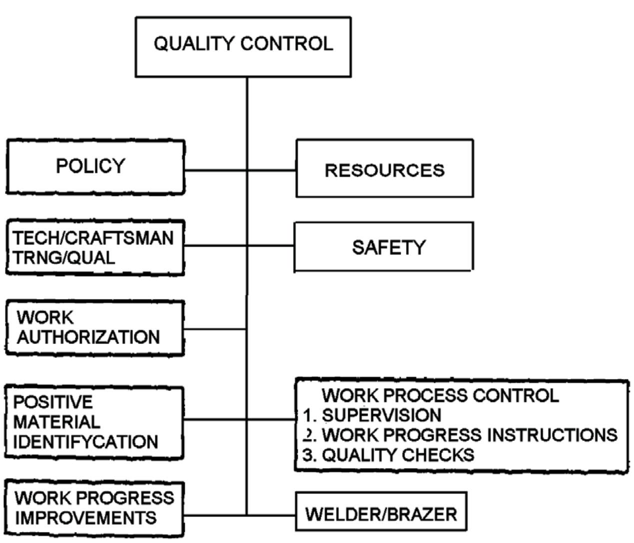


Figure 6-18.—Quality Control diagram.

c. Provide maintenance management training to supervisory personnel to enable them to properly balance maintenance work, training, personnel administration, and other mission requirements while providing quality leadership to their personnel.

2. Work center facilities and equipment maintenance and upgrade programs to provide a clean, safe, properly equipped workplace that enables the work center craftsmen and supervisory personnel to meet their work center mission requirements and build first time quality into their products.

3. Craftsman-oriented, standardized Formal Work Procedures (FWPs) that define each work process in a concise manner.

4. Effective supervisory participation and oversight throughout all management, training, and production work process.

5. Welder and brazer qualification and proficiency programs.

Quality Assurance

Quality Assurance (QA) consists of administrative and technical procedures to ensure compliance with technical specifications, through a systematic review of Quality Control (QC) records and production actions. These procedures provide proof and confidence that work performed or material manufactured will perform as designed, and that there is documentary evidence to that effect.

Quality Assurance (QA) (see fig. 6-19) includes the following major elements:

1. Providing proper documentation of Objective Quality Evidence (OQE) to meet Quality Assurance (QA) requirements.

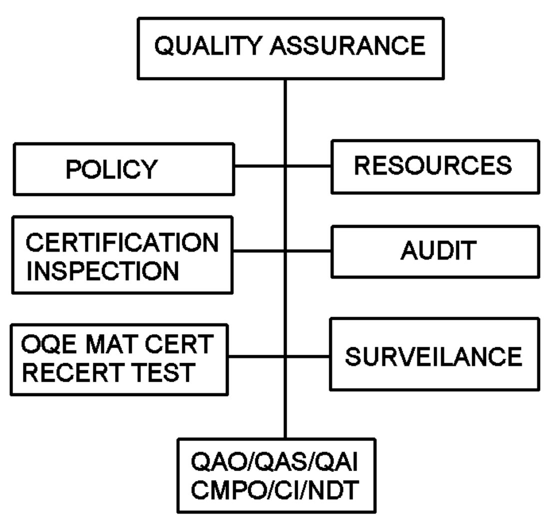


Figure 6-19.—Quality Assurance diagram.

2. A program to ensure that Certification of Continuity is maintained for all submarines at the completion of maintenance on Submarine Safety (SUBSAFE) systems (Applicable to Submarines Only).

3. Development and maintenance of procedures to properly handle, stow, and install controlled material.

4. Rigorous Audit and Surveillance program that provides maintenance managers feedback on developing trends within an organization. Additionally, this program is used as input during the development of divisional and departmental training programs to improve work processes.

The philosophy of QA is unique in that it does not recognize degrees of success. QA is pass-fail. The result of the maintenance either meets the applicable specification or it does not. It is therefore vital that all maintenance be approached from the standpoint of first-time quality. Each individual performing maintenance must realize and understand that *they are responsible for the quality of their work.*

The *JOINT FLEET MAINTENANCE MANUAL, CINCLANTFLT/CINCPACFLTINST 4790.3* provides the plan and contains the necessary guidance to establish an effective and viable QA Program.

Q6-56. What PMS schedule displays the planned maintenance done in your work center for the week?

Q6-57. How is maintenance responsibility assigned to each line of equipment on a weekly scheduled?

Q6-58. How are matters relating to PMS communicated to the NAVSEACEN and/or the TYCOM?

Q6-59. What NAVSEA from is used to report technical manual discrepancies?

Q6-60. When do you submit an URGENT FEEDBACK REPORT (FBR)?

Q6-61. What OPNAV instruction should be consulted for complete information on the Planned Maintenance System (PMS)?

Q6-62. Why is the Quality Assurance (QA) Program important to the ABF?

Q6-63. What is used to provide the necessary sequence of actions to accomplish a specific maintenance task?

Q6-64. What two elements of the quality control program is an integral part of the maintenance process?

Q6-65. What is the goal of training programs in the quality control and quality assurance aspects of performing ship maintenance?

Q6-66. The systematic review of quality control records and production actions to a maintenance task provides what type of information in quality assurance requirement?

Q6-67. What program in the quality assurance program provides maintenance managers feedback and input to develop training programs to improve work processes?

Q6-68. What manual provides the guidance to establish an effective and viable QA Program?

CORROSION CONTROL AND SAFETY PRECAUTIONS

LEARNING OBJECTIVES: Describe the types of corrosion the ABF will confront. Identify their signs and explain the corrective action. State the ABF's responsibility in observing safety precautions.

CORROSION CONTROL PROGRAM

A thorough maintenance program continuously carried out prevents most equipment failure. With higher strength and closer tolerances being demanded of metals, equipment would rapidly become inoperable without regular anti-corrosion maintenance.

Corrosion endangers the equipment by reducing the strength and changing the mechanical characteristics of the metals used in its construction. Materials are designed to carry certain loads and withstand given stresses as well as to provide an extra margin of strength for safety. Corrosion can weaken the structure, thereby reducing or eliminating this safety factor.

Corrosion may take place over the entire surface of a metal from chemical reaction with the surrounding environment. It may be electrochemical in nature between two metallic materials or two points on the surface of the same alloy, differing in chemical activity. The presence of moisture is essential in both types of attacks. The most familiar example of corrosion is rust found on iron or steel.

All metals are affected to some extent by the atmosphere. Water and water vapor containing salt combine with oxygen in the atmosphere and produce the main source of corrosion. There are many forms of corrosion; the form of corrosion depends upon the metal involved, atmospheric conditions, and the corrosion-producing agents present. For this discussion, we may consider corrosion as three general types: surface, galvanic, and intergranular corrosion.

Surface Corrosion

The effect of the atmosphere produces a corrosion that appears on the surface of a metal as a general roughening, etching, or pitting. Iron rust is the most common example of surface corrosion.

Although aluminum, magnesium, and other nonferrous metals do not rust, these metals are subject to surface corrosion. Surface corrosion on unpainted aluminum alloy is evident as white or gray powdery deposits on the metal surface. The powdery residue deposited on the area of contact first indicates the condition; later pitting and searing appear on the aluminum surface, and finally complete deterioration of the aluminum. Corrosion on painted aluminum-alloy surfaces cannot be recognized by either the roughened surface or by the powdery deposit. Instead, the paint or plating appears to lift off the surface, indicated by a blistered appearance and/or discoloration that result from the pressure of the underlying accumulation of the corrosion products.

Surface corrosion on magnesium alloys can be recognized by powdered or roughened surfaces. Magnesium corrosion products are white and quite large compared to the size of the base metal being corroded. The deposits have a tendency to raise slightly, and the corrosion spreads rapidly. When white, puffy areas are discovered on magnesium, prompt attention is required to prevent the corrosion from penetrating entirely through the structure. This can occur in a very short time.

It has been generally established that surface corrosion is caused by moisture in the air. Since this type of corrosion is visible, it can be detected in its early stages by close visual inspection. Surface corrosion can be prevented or retarded by protecting the metal surface with a plating or paint and by keeping the plating or paint in good condition.

Galvanic Corrosion

Galvanic (or electrolytic) corrosion occurs when two different metals are connected and exposed to an electrolyte such as water, especially salt water. When aluminum pieces are attached with steel bolts or screws, galvanic corrosion may occur between the aluminum and steel in the presence of moisture. An electrical potential is set up, current flows between the two metals, and an effect similar to that, which occurs in batteries, is produced. Galvanic corrosion can usually be recognized by the presence, of a buildup of corrosive products at the joint between two metals. Preventive measures include painting and plating.

Intergranular Corrosion

The third type of corrosion, intergranular, is not visible on the surface and is very dangerous. It spreads through the interior of the metal along the grain boundaries, reducing the strength and destroying the ability of the metal to be formed or shaped. Among the metals affected by this type of corrosion are stainless steel, certain magnesium alloys, and the copper-bearing aluminum alloys.

Intergranular corrosion occurs in certain grades of stainless steel when the steel is heated as in welding. Brittleness results, and later the metal cracks near the weld. For this reason, a post-weld heat treatment is needed before you reinstall stainless steel parts that have been welded.

As an ABF, you are going to be concerned mainly with the first two types of corrosion, surface and galvanic. With this in mind, remember that rust on steel and the white powder on aluminum or magnesium are produced by corrosion. These products, along with dirt and salt, pick up moisture from the air and hold it in contact with the metal, which speeds up the corrosive action.

CORROSION REPAIR

There are many factors that affect the type, speed, cause, and seriousness of metal corrosion. Some of these corrosion factors can be controlled; others cannot. Preventive maintenance factors, such as inspection, cleaning, paintings, and preservation, are within the control of the operating activity.

When you first find corrosion on equipment or a structure, the first step you take should be the safe and complete removal of the corrosion deposits or replacement of the affected part. Whether you remove the corrosion or replace the part depends upon the degree of corrosion, the extent of damage, the capability to repair or replace, and the availability of replacement parts. Any parts that have been damaged by corrosion should be replaced if continued use is likely to result in structural failure. Areas to be treated to eliminate corrosion deposits must be clean, unpainted, and free from oil and grease. Chips, burrs, flakes of residue, and surface oxides must be removed. However, be careful to avoid removing too much of the uncorroded surface metal. Corrosion deposit removal must be complete. Failure to clean away surface debris permits the corrosion process to continue even after the affected areas have been refinished.

When corrosion is present, any protective paint films must first be removed to ensure that the entire corroded area is visible. After you remove corrosion, the extent of damage must be assessed. It is at this point that you determine whether to repair or replace the affected part or to perform a corrosion correction treatment. The correction treatment involves neutralizing any residual corrosion materials that may remain in pits and crevices, and restoring permanent protective coatings and paint finishes.

CORROSION PREVENTION

Corrosion can be controlled by maintaining a dry environment using suitable moisture barriers or drying agents. **CLEAN, DRY METALS DO NOT CORRODE.** Therefore, when moisture and dirt are permanently removed from metal surfaces, the tendency of such surfaces to corrode is usually eliminated. Thus, it follows that the major problem in the prevention of corrosion consists of adequately removing moisture and dirt from the surface of the metal to be protected and covering these surfaces to prevent recontamination.

Consistent preventive maintenance is the most practical method of controlling metal corrosion. Maintenance such as cleaning, painting, and preservation shows great savings in labor and materials by eliminating costly repairs and replacements required when corrosion has been permitted to go undetected.

To effectively remove oil, grease, dirt, and other undesirable foreign deposits, you should use certain cleaning agents, such as soaps, solvents, emulsion compounds, and chemicals. When you work with these agents, you should follow the correct method and sequence of procedure in applying them. You also must follow the accepted safety regulations and health precautions in the use and handling of the various cleaning agents. The important factors bearing on the choice of cleaning materials are the type and surfaces to be cleaned, such as painted or unpainted surfaces, and whether they are exterior or interior parts.

Uses of Paint

To prevent corrosion of metal (or deterioration of wood surfaces), you should repaint damaged or worn surfaces as soon as practical. Repaint no more often than is necessary for preservation. In the Navy, paint is used primarily for the preservation of surfaces. It seals the pores of wood and steel, arrest decay, and helps prevent the formation of rust. Paint also serves a variety of other purposes. It is valuable as an aid to cleanliness and sanitation, both because of its antiseptic properties and because it provides a smooth, washable surface. Paint also is used to reflect or to absorb light or to redistribute light. For example, light-colored paint is used in the interior of the ship to distribute natural and artificial light to the best advantage. These same properties of reflection and absorption, incidentally, make camouflage painting possible. For these and other reasons, the Navy uses a great deal of paint.

Recommended Painting Procedures

As you know, there are many kinds of paint. For example, you cannot use the same type of paint on the deck, topside, and bulkheads in the captain's cabin. There is a different paint made for almost every purpose. Detailed instructions on the proper paint to use for each job may be found in the applicable *NAVSEA instructions.*

The most important single factor in securing good paint performance is proper surface preparation. Dirt, oil, grease, and rust or mill scale must be removed completely, and the surface must be thoroughly dry.

Equipment used to prepare surfaces includes hand tools, power tools, sandblasters and shot blasters, soap (or detergents) and water, and various paint and varnish removers.

Each year the Navy spends thousands of dollars developing and testing finishes for specific surfaces. Consequently, you have the best material available. If you prepare the surface properly, use the recommended finish, and apply the finish correctly, you can have a first-rate job that lasts a long time. Do not use any material not provided by or methods not recommended by the Navy.

Lubrication and Inspection

Preservation of equipment and spare parts is a continuous job aboard a ship. The moist salt air causes rust to form in a very short time. The operation and maintenance manual for each particular item will indicate the type of preservation to be used and which parts should be painted.

Moving parts must be kept free of corrosion by application of the proper lubricant. Parts that cannot be painted and that are not used very often should be coated with a preservative compound that is readily removable with solvents or can be wiped off. Dirt and rust should be removed carefully before applying preservatives or lubricants.

Such items, as webbing and rubber goods require no preservative; however, they should be stowed in a clean, dry place when not in use. These items are subject to deterioration because of age and should be inspected frequently. When the expiration date (stamped on the webbing) is reached, the material should be discarded and replaced.

SAFETY PRECAUTIONS

Many personnel confront dangers in their workday lives, and a number of safety precautions apply to all personnel at one time or another. A shipboard environment introduces factors affecting safety that are not found ashore. Underway refueling, multi-ship exercises, storms, and other situations require personnel at sea to be constantly vigilant. An accident at sea can involve all hands in a matter of seconds. Everyone must be continually alert to hazardous conditions. Navy Safety Precautions for Forces Afloat, *OPNAVINST 5100.19*, provides a general reference for mandatory and advisory safety precautions.

You need not learn each safety precaution by heart, but you should know what each means and why it should be observed. Although most of the precautions given here are from a shipboard viewpoint, many of them apply equally well ashore. The hazards presented by improperly grounded electrical tools, for example, are the same everywhere. Remember: Accidents seldom just happen; they are caused. Another point to remember is never let familiarity breed contempt. Hundreds of people have been injured by accidents, and many have died because of their injuries. Most of those accidents could have been prevented had the personnel involved heeded the proper safety precautions.

It is the responsibility of supervisory personnel to ensure that subordinates are instructed in and carry out the applicable safety precautions for their work and work areas. You are responsible for knowing, understanding, and observing all safety precautions that apply to your work and work area. In addition, YOU are responsible for the following:

—You shall report for work rested and emotionally prepared for the tasks at hand.

—You shall use normal reasoning in all your functions, equal with the work at hand.

—You shall report any unsafe condition, or any equipment or material that you consider unsafe, and any unusual or developing hazards.

—You shall warn others whom you believe to be endangered by known hazards or by failure to observe safety precautions, and of any unusual or developing hazards.

—You shall report to your supervisor any accident, injury, or evidence of impaired health occurring in the course of work.

—You shall wear or use the protective clothing and/or equipment of the type required, approved, and supplied for the safe performance of your duties.

—You shall report for work suitably clothed for you’re assigned tasks.

Suitable clothing is that normally worn by members of the trade or profession. Certain hairstyles are hazardous around machinery and open flame and may interfere with vision or the use of breathing devices. Hair shall be suitably restrained in caps or nets. Safety shoes or foot protection devices, including non-sparking and non-slip shoes, shall be worn when hazards so indicate. Jewelry, loose scarves, and ties shall not be worn when they might subject the wearer to additional hazards. Anyone requiring eye correction, hearing aids, or prosthetic devices to assure prompt perception and avoidance of hazards must use such devices while at work.

Q6-69. What are the major concerns and the possible effects that corrosion has on metal?

Q6-70. What are the three general types of corrosion?

Q6-71. What is the most familiar type of surface corrosion?

Q6-72. What is the most common cause of surface corrosion?

Q6-73. What is the most effective way to prevent surface corrosion?

Q6-74. What types of surface corrosion are the most dangerous and explain why?

Q6-75. What evidence should you look for that would indicate corrosion has taken place on steel, aluminum, or magnesium metals?

Q6-76. What is the major problem in the prevention of corrosion?

Q6-77. To effectively remove oil, grease, dirt, and other foreign deposits, you should use, what type cleaning agents?

Q6-78. What is the most important single factor in securing good paint performance?

Q6-79. What OPNAV instruction provides a general reference for mandatory and advisory safety precautions for forces afloat?

Q6-80. What must you do when an unsafe condition exists or an unusual condition develops into a safety hazard?

Q6-81. Any accident, injury, or evidence of impaired health occurring during the course of your work should be reported to which individual?

Q6-82. What type of clothing or equipment should you wear when performing your duties?

SUMMARY

In this chapter, you have learned about the basic layout of a fuels division afloat and ashore. You have also been given brief descriptions and insights to the various programs in fuels divisions ashore and afloat such as, PQS (Personnel Qualification Standard), Tool Control, Quality Assurance, Planned Maintenance System, and Corrosion Control. You also covered maintaining manuals/publications, equipment records and reports, how to read blueprints and drawings, and general safety.

There is no possible way every instruction or manual you will be required to use can be covered here. As systems and equipment are tailored for each command, so too are the publications required to support each command. You may not know a specific detail of an operation or maintenance, but you should know where to get the information. Learn to use your instructions, technical manuals, and other publications early in your career. You can't go wrong.

APPENDIX I

GLOSSARY

ABFC-H14K—Abbreviation for advanced base functional components fueling systems.

ACHO—Abbreviation for Aircraft Handling Officer (shipboard operation).

ADDITIVES—Chemicals added in minor proportions to fuels or lubricants to create, enhance, or inhibit selected properties; for example, fuel system icing inhibitor (FSII).

AFOSS—Aviation Fuel Operational Sequencing Systems. The set of detailed instructions that cover the operation of shipboard aviation fuel systems.

AIMD—Aviation intermediate maintenance department.

AMBIENT—Encompassing on all sides, as temperature.

AMMETER—Electrical instrument for measuring the flow of current.

AMPHERE—Unit flow of electric current caused by 1 volt acting through a resistance of 1 ohm.

ANODE—The positively charged electrode of an electrolytic cell.

ANSI—Abbreviation for American National Standards Institute.

ANTIKNOCK ADDITIVE—An additive used in gasoline to inhibit engine knock (pre-combustion); tetraethyl lead.

API—Abbreviation for American Petroleum Institute.

API GRAVITY—Petroleum industry scale for measuring the density of oils, adopted by the American Petroleum Institute.

APU—Auxiliary power unit—a small turbine engine on an aircraft that provides power when the main engine(s) is not operating.

ARC—A luminous, electrical discharge across a gap in a circuit or two electrodes, as in arc welding.

ARMING—The action that changes ammunition from a safe condition to a state of readiness for initiation.

ASTM—Abbreviation for the American Society for Testing Materials.

ATMOSPHERIC PRESSURE—The pressure exerted by the earth's atmosphere. When measured at sea level under standard conditions, it is equal to 14.7 psi.

AUTOIGNITION TEMPERATURE—The temperature at which a substance will ignite without further addition of energy (heat, spark, or flame) from an outside source.

AVGAS—Common term for aviation gasoline.

B/2 ANTI-ICING TEST KIT—Fuel test kit that contains an instrument to measure the FSII content in the fuel.

B/2 REFRACTOMETER—Instrument used to measure the FSII content in fuel.

BALLAST—Water, usually salt water, carried in cargo tanks when free of petroleum products to reduce buoyancy and improve stability and sea-keeping qualities. Ballast may be clean or dirty, depending on whether it is contaminated with petroleum products.

BARREL—Measure of volume as used in the petroleum industry, equivalent to 42 U.S. gallons.

BELLOWS—A device used for producing a stream of air.

BLACK OIL—A general term applied to crude oil and the heavier and the darker colored petroleum products such as residual fuel oils.

BLEND—Combination or mixture or mixture of two or more grades of fuel.

BONDING—The act of providing an electrical connection between two objects; i.e. an aircraft and a refueling truck.

BOOM—Flexible floating barrier consisting of linked segments designed to contain free oil on the surface of a body of water.

BOOSTER PUMP—Pump installed along the run of a long pipeline to increase (boost) the pressure.

BOTTOM LOADING—Method of filling tank trucks or tank cars through a leakproof connection at the bottom.

BREAKAWAY COUPLING—Coupling designed to part easily with a moderate pull.

BULK STORAGE TANK—A fixed tank used to receive, store, and issue fuel for further transportation, storage, handling, or treatment before it reaches an operating tank.

BUNO—Bureau number—number designation assigned to each aircraft.

CALIBRATION—Adjustment of the scale of a graduated device (such as a pressure gauge) to meet an established standard.

CARBON MONOXIDE—A colorless, odorless, poisonous gas.

CATALYST—A substance that provokes or accelerates chemical reactions without itself being altered.

CATHODE—The negatively charged electrode of an electrolytic cell.

CATHODIC PROTECTION—A method for preventing the corrosion of metals by electrolysis.

CCFD—Combined contaminated fuel detector device used to test fuel for both water and particulate contamination.

CENTRIFUGAL—Moving or tending to move away from the center axis of a rotating or turning object.

CENTRIFUGAL PUMP—A rotating device that moves liquids and develops liquid pressure by imparting centrifugal force.

CENTRIFUGAL PURIFIER—A rotating device that cleans fuel by using centrifugal force.

CFD—Contaminated fuel detector that can be used to test fuel for particulate contamination.

CHAFF—A radar reflective material used to deceive or counteract unfriendly radar or destructive offensive ordnance.

CINCLANT—Commander-in-Chief, Atlantic Fleet.

CINCPACFLT—Commander-in-Chief, Pacific Fleet.

CLEAR AND BRIGHT—Term for uncontaminated fuel; indicating a complete absence of haze, free water, or particulate matter that would be visible to the naked eye.

CLEAVAGE—The point of interface between two different liquids, such as oil and water.

(CO_2)—Chemical notation for carbon dioxide, a heavy, colorless gas that will not support combustion. It is used for fighting small fires and in protection systems in MOGAS and JP-5 spaces aboard ship.

COALESCER—A tube (unit or element) that unites water droplets when fuel passes through it.

COFFERDAM—The space surrounding the MOGAS storage tanks aboard ship; a watertight box.

COMBUSTIBLE VAPOR INDICATOR—A device that measures the quantity of combustible vapor in the atmosphere; explosion meter.

COMMINGLING—The mixture of two or more petroleum products resulting from improper handling, particularly in pipeline or tanker operations.

CONSOLIDATE—To merge into one. To consolidate a nest of tanks means to pump the remaining fuel from several partially empty tanks into a single tank.

CONTAMINATION—The addition of some material not normally present in a petroleum product, such as dirt, rust, water, or another petroleum product.

CONTINUITY—To have a complete, uninterrupted electrical circuit.

CORROSION—The process of dissolving, especially of metals due to exposure to electrolytes.

CV—Aircraft Carrier.

CVN—Aircraft Carrier (nuclear powered).

D-1—SPR aircraft refueling nozzle with a 45-degree elbow.

D-1R—SPR aircraft refueling nozzle with a 45-degree elbow and a hose-end pressure regulator.

DEADMAN CONTROL—A device that governs (controls) the primary pressure/flow valve in a refueling system. The valve opens only when an operator applies pressure to the handle, trigger, etc. If pressure is removed, the valve closes and fuel flow stops.

DEFUELING—Removing fuel from an aircraft.

DENSITY—The mass per unit volume of a substance.

DETERIORATION USE LIMITS—The minimum physical and chemical property requirements for fuel to use in aircraft.

DIAPHRAGM—Separating device of rubber composition used to regulate all hydraulically operated valves.

DiEGME—DiEthylene Mono Methyl Ether. FSII used in military aviation turbine fuels.

DIFFUSE—To spread widely, scatter.

DIFFUSER—A mechanical device used to diffuse.

DIKE—An embankment or wall, usually of earth or concrete, surrounding a storage tank to impound the tank's contents in case of a leak or spill.

DISSOLVED WATER—Water absorbed into the fuel that is not visible. The amount of dissolved water a fuel will hold depends upon the fuel's temperature.

DISTILLATE—Common term for several fuels obtained directly from distillation of crude petroleum; typically includes kerosene, JP-5, light-diesel, and other light-burner fuels.

DOD—Department of Defense.

DOUBLE-WALLED PIPING—Piping with two independent chambers, one surrounding the other (an inner and an outer). Typically used in shipboard gasoline systems. The inside chamber carries the fuel; the outside chamber holds a protective gas (such as CO_2 or N_2).

DOWNGRADE—To designate a fuel for a lesser purpose than originally specified, often because of contamination.

EARTHING—See **GROUND**.

EDUCTOR—A jet-type pump with no moving parts. An eductor moves liquid by entraining the pumped liquid in a rapidly flowing stream of water (venturi effect). Normally used to dewater bilges and tanks.

EFFLUENT—Stream flowing out; discharge.

ELECTROLYTE—A substance capable of forming solutions with other substances to produce ions and thereby permit the flow of electric currents.

EMULSION—The suspension of fine droplets of one liquid in a second liquid with which the first will not mix.

ENTRAINED WATER—Free water contaminant in a fuel in the form of very small droplets, fog, or mist. It may or may not be visible.

EPA—Environmental Protection Agency.

EVAPORATE—To change into vapor.

EVAPORATION LOSS—Loss of liquid petroleum into the atmosphere caused by evaporation.

EXPLOSIVE LIMITS—Limits (UPPER AND LOWER) of percentage composition of mixtures of combustible vapors and air that are capable of producing an explosion or combustion when ignited; also flammable limit.

EXPLOSION PROOF—Classification of electrical enclosures for use in hazardous areas designed to prevent the passage of internal arcs, sparks, or flames.

FAA—Federal Aviation Administration.

FAS—Fueling at-sea station.

FILTER—A porous substance through which a liquid is passed to remove unwanted particles of solid matter.

FILTER SEPARATOR—A filter or combination of filters designed to remove particulate matter and to coalesce entrained water.

FLAMMABLE LIQUID—A liquid having a flashpoint below 100°F.

FLASHPOINT—The lowest temperature at which a fuel will vaporize enough to form a combustible air-vapor mixture.

FLUSHING—Pumping fuel through a system to clean the system or component.

FMO—Fuel Maintenance Officer on ships and Fuels Management Officer at Navy shore stations. The title assigned to the full-time functional head of integrated fuel operations at an activity.

FO—Fuels Officer. Marine Corp term of the fuels commodity manager and/or the functional head of a fuels organization. Equivalent to an FMO at a Navy shore station.

FOD—Foreign object damage.

FOR—Fuel oil reclaimed.

FREE WATER—Undissolved water contaminant in fuel. The water may be in the form of a cloud, emulsion, entrained droplets, or in gross amounts.

FREE WATER STANDARD—A color intensity comparator standard used in the FWD for determining the free water content of fuel.

FREEZE POINT—The temperature at which wax crystals form in fuels.

FSII—Fuel system icing inhibitor. A fuel additive that prevents formation of water ice and micro-biological growth in the fuel.

FUEL QUALITY MONITOR—Special type of filter designed to stop the flow of fuel if water or sediment contamination becomes too large.

FUEL OIL—Fuel oil that is burned in furnaces to create steam or hot water, also called burner fuel oil.

FUSIBLE LINKS/PLUGS—Melting plugs that allow fuel vapors to escape.

FUSE—An electrical device designed to interrupt the flow of current when the allowable safe flow for the circuit is exceeded.

FWD—Free-water detector device that measures the free-water content of a fuel sample.

GALVANIC—Producing an electric current. Corrosion produced by an electric current.

GALVANIZING—Rust-resistant zinc coating applied to iron and steel.

GALVANOMETER—An electrical instrument for measuring small currents.

GAMMON FITTING—Common name applied to the jet test QD (quick disconnect) couplings used in refueling nozzles and other places to take fuel samples.

GAS FREE—Clear of any gaseous vapors.

GASOLINE—A blend of light, volatile, liquid hydrocarbons used mainly as fuel for spark-ignition, internal combustion engines.

GPM—Abbreviation for gallons per minute.

GROUND—The act of providing an electrical connection between an object (e.g., aircraft) and the ground (earth). On shore commands, this is also called **BONDING** or **EARTHING**.

HEADER—A horizontal run of piping used to group the components of a system.

HECV—Hose end control valve (same as HEPR).

HEPR—Hose end pressure regulator. Device that limits fuel pressure entering the aircraft to a set maximum.

HERS—Helicopter expedient refueling system.

HOT REFUELING—Aircraft refueling with one or more of the aircraft's engines operating.

HUNG WEAPON—A weapon that accidentally remains attached to an aircraft after an attempt to release it/cannot be fired or dropped, because of a malfunction on the weapon, the rack or an aircraft circuit.

HYDRANT SYSTEM—Distribution and dispensing system for aviation fuels consisting of a series of fixed outlets or hydrants connected by piping.

HYDRAULIC FLUID—Fluids with constant viscosity versus temperature characteristics for use in hydraulic systems.

HYDROCARBON—Any compound containing only hydrogen and carbon.

HYDROMETER—An instrument used for determining the specific gravity of a liquid.

HYDROSTATIC—The branch of physics having to do with the pressure and equilibrium of water and other liquids.

HYDROSTATIC HEAD—Pressure caused by a column of liquid.

HYDROSTATIC TEST—A test for leaks in a piping system (including hoses) using liquid under pressure as the test medium.

INERT—With few or no active properties.

IGNITION TEMPERATURE—The minimum temperature required to initiate or cause self-sustained combustion independent of any heating or heated element.

INHIBITORS—Chemical compounds that reduce the rates of chemical reactions.

INNAGE—Depth of liquid in a tank measured from the liquid's surface to the bottom of the tank.

INTERGRANULAR—Corrosion from or the condition from being heated and cooled too fast or too slow.

INERTIA—The ability of matter to remain at rest; or, if moving, to continue to move in the same direction.

JETTISON—Releasing of an airborne weapon or store by an emergency or secondary release system.

JP FUEL—Fuel used in turbine engines.

KNOCK—The tendency for gasoline to burn too rapidly causing engine noise and loss of power.

KNOCK VALUE—Relative measurement of the tendency of gasoline to knock when used in spark-ignition, reciprocating engines.

LHA—Amphibious Assault Ship (general purpose).

LPD—Amphibious Transport Dock.

LPH—Amphibious Assault Ship.

LOX—Abbreviation for liquid oxygen.

LSE—Landing signal enlisted.

LUBE OIL—Common term for lubricating oil; used to reduce friction and cool machinery.

M970—Semi-trailer, tank, 5,000-gallon fuel dispensing, under/overwing aircraft nozzles.

MAXIMUM—The largest allowable quantity.

MFFV—Mobile fire fighting vehicle.

MFVU—Mobile fire fighting vehicle/unit.

MEMBRANE—A thin, soft, pliable layer of tissue that covers a part.

MICROBIOLOGICAL—Any of the bacteria that cause disease; gum.

MICRON—A unit of length equal to one-millionth of a meter.

MICROORGANISMS—A very minute living thing, whether plant or animal.

MIL—A unit of length equal to one-thousandth of an inch especially used as a measure the thickness of paints and coatings.

MILCON—Military construction.

MILITARY SPECIFICATIONS (MILSPECS)—Guides for determining the quality requirements for materials and equipment used by the military services.

MINIMUM—The smallest allowable quantity.

MOGAS—Common term for motor gasoline.

N_2—Chemical notation for nitrogen.

NATOPS—Naval Air Training and Operating Procedures Standardization.

NAVAIR—Naval Air Systems Command.

NAVEDTRA—Naval Education and Training.

NAVFAC—Naval Facilities.

NAVFACENGCOM—Naval Facilities Engineering Command.

NAVPETOFF—Navy Petroleum Office.

NAVSEASYSCOM—Naval Sea Systems Command.

NITROGEN GAS—Used for preventing and extinguishing fires in the aviation fuels system aboard ship.

NONSPARKING TOOLS—Tools made of a metal allow that, when struck against other objects, will not cause spark of sufficient temperature to ignite fuel vapors.

NON-VORTEX—An attempt by mechanical means to stop the swirling motion of a liquid.

NOZZLE—A spout connection, usually with a control valve, through which fuel is discharged into a receiving container.

NSTM—Naval Ships Technical Manual.

OCTANE NUMBER—A numerical measure of the antiknock properties of automotive gasoline as measured against standard reference fuels under controlled laboratory conditions. Iso-octane is a reference fuel whose octane number is given a value of 100.

OHM—Measured unit of electrical resistance equal to that of a circuit in which a potential difference of 1 volt between two points will produce a flow current of 1 ampere.

ORIFICE—A device used for narrowing the inside diameter of a pipe and restricting the flow for metering purposes.

OSHA—Occupational Safety and Health Administration.

OSS—Operational Sequencing System. The set of detailed instructions that cover the operation of shipboard fuel systems.

OUTAGE—See **ULLAGE**.

OXIDATION—The chemical process in which oxygen combines with other substances, for example, the formation of rust by the oxidation of gasoline.

PANTOGRAPH—A device used at shore stations to refuel aircraft. It is composed of a series of pieces of pipe, supported by rollers, and connected by swivel joints. One end of the device is connected to a fuel source while the other end has a short hose with an aircraft refueling nozzle attached.

PARTICULATE MATTER—Refers to the solid particles of fuel contaminants, such as dirt, grit, or rust.

PICKLING—Name given to the procedure of filling a new hose with fuel and letting it stand for several days when preparing the hose for use.

PKP—A dry chemical fire extinguisher containing potassium bicarbonate.

PM—Preventive maintenance.

PMS—Planned Maintenance System.

POL—A broad term that includes all petroleum products used by the Armed Forces. It originated as an abbreviation for petrol, oil, and lubricants.

PORTABLE INERTNESS ANALYZER (PIA)—An instrument used to determine the percent of protective gas present in a space in order to prevent fires.

POTENTIOMETER—Power gage.

PQS—Personnel Qualification Standard.

PRESSURE DROP—The loss in pressure of a liquid flowing through a piping system caused by friction of pipe and fittings, velocity and change in elevation.

PriFLY—Primary flight control (shipboard operation).

PSI—Abbreviation for pounds per square inch, the unit of pressure measurement.

PWO—Public Works Officer.

QDC—Quick disconnect coupling.

QUALITY ASSURANCE—Fuel quality control measures (sampling and testing) that are performed on the fuel at the refinery.

QUALITY SURVEILLANCE—Fuel quality control efforts (sampling and testing) that are performed on the fuel from the time it leaves the refinery until it is consumed by an aircraft.

QUADRANT—Commonly refers to one quarter of a fuels system on an aircraft carrier. Quadrants are divided into forward port, forward starboard, aft port, and aft starboard. Each quadrant is designed to operate independently of the other, if required.

RECLAMATION—Procedure required to restore or change the quality of contaminated fuel to meet desired specifications.

RECIRCULATION—The operation of a fuel system where fuel is pumped from a tank through a filter/separator and back into the tank. The action serves two purposes it flushes out the lines downstream of the filter/separator with clean/dry fuel and cleans up the fuel in the tank.

REFUELER—Tank vehicle used to re-supply aircraft with fuel. (DEFUELER is a tank vehicle used to remove fuel from aircraft).

REFUELING—Loading fuel onto an aircraft.

REID VAPOR PRESSURE—Vapor pressure measured under controlled conditions with the liquid temperature at 100°F.

RELAXATION TANK—Small tank in a piping system designed to remove static electricity from the liquid stream.

RHEOSTAT—A variable resistor used to regulate the amount of electrical current.

RISER—A vertical section of piping usually connected to the discharge side of a pump.

ROTARY PUMP—A positive displacement pump the operates in a rotary fashion such as vane, gear, or screw pump.

RPM—Abbreviation for rounds per minute.

RUST—Ferric oxide, a reddish-brown, scaly or powdery deposit found on the surface of steel and iron as a result of oxidation of the iron.

SAFED—The replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin, securing armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.

SERVICE FUEL—Shipboard term for fuel that has been filtered (or purified by a centrifugal) purifier, and transferred to a tank where it will be pumped to an aircraft.

SIB—Ship's information book.

SIGHT GLASS GAGE—A glass gage installed in piping to visually check the liquid flow.

SIMA—Ships Intermediate Maintenance Activity.

SLUDGE—Heavy, viscous, oily mass found in the bottom of storage tanks and treatment vessels; often contains rust, scale, dirt, lead additives, wax, gum, or asphalt.

SLUICE—Any channel, especially one for excess water.

SOLVENCY—Ability to dissolve a number of materials.

SPECIFIC GRAVITY—The ratio of the weight of a given volume of material at 60°F to the weight of an equal volume of distilled water at the same temperature.

SPR—Single-point pressure refueling. Pressure refueling an aircraft through a single connection.

STATIC ELECTRICITY—Term applied to the accumulation of electrical charges on materials and objects and the later recombination (relaxation or discharge) of these charges. Static charges are created when two materials (or objects of different composition) are rubbed or passed across each other.

STRIPPING—The act of removing settled liquids and solids from selected fuel tanks.

SUMP—A low area or depression that collects drainage.

SURGE—Sudden increase in fluid pressure caused by the stopping of a moving stream, as by quickly closing a valve; hydraulic shock.

SURGE SUPPRESSOR—Device to control or reduce surges.

SYSCOM—System Commander.

TAFDS—Tactical airfield fuel dispensing system.

TETRAETHYYL LEAD—A poisonous lead compound commonly used as an antiknock additive in gasoline.

THIEF SAMPLER—A sample taken from the bottom of a storage tank, usually to determine the amount and condition of bottom sludge and water.

THERMOMETER—Device used for measuring temperature.

THROTTLE—To increase or decrease the flow rate or pressure of a liquid through a pipe with a valve (normally a globe valve).

TOP LOADING—Method of filling tank cars and trucks through an opening in the top.

TYCOM—Type commander.

ULLAGE—The distance from a reference point at the top of a tank to the liquid content. Used to determine the volume of the contents.

VAPORIZE—To change into vapor by heating or spraying.

VAPOR LOCK—Malfunction of an engine fuel system or a pumping system caused by vaporization of the fuel usually associated with gasoline.

VAPOR PRESSURE—Internal pressure of vapor in a liquid, usually in pounds per square inch; an indication of volatility. When vapor pressure exceeds the pressure in the vapor space above the liquid, bubbles of vapor escape and the liquid is said to boil. REID VAPOR PRESSURE is vapor pressure measured at 100°F. TRUE VAPOR PRESSURE is vapor pressure measured at actual liquid temperature.

VENTURI—A tapered portion of a piping system that reduces pressure and increases flow. Used in some MOGAS systems.

VISCOSITY—Measure of the internal resistance of a fluid to flow or movement, most commonly measured in Saybolt Seconds Universal.

VOLATILITY—Measure of the tendency of a liquid to vaporize; vapor pressure.

VORTEX—A swirling mass of liquid forming a vacuum at its center.

WICK—A solid, such as clothing, that has absorbed fuel. JP-5 can easily ignite in this manner even at a temperature well below its flashpoint.

WETTING FUEL—Fuel that has been cycled through the CFD/CCFD several times and it is used as a lubricant for the millipore filters.

APPENDIX II

REFERENCES USED TO DEVELOP THIS NONRESIDENT TRAINING COURSE (NRTC)

NOTE: Although the following references were current when this NRTC was published, their continued currency cannot be assured. Therefore, be sure you study the latest revision.

Chapter 1

Air Department Standard Operating Procedures, COMNAVAIRPAC/COMNAVAIRLANTINST 3100.4C, Commander Naval Air Force, United States Atlantic Fleet, Norfolk, Virginia 23511-5188 and Commander Naval Air Force, United States Pacific Fleet, U.S. Naval Air Station, North Island, San Diego, California 92135, 10 Aug 1999.

Aircraft Fuel/Defuel Stations in CV and CVNs (CLA-VAL), Maintenance Manual, NAVSEA S9542-AL-MMM-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 15 Sep 1989.

Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 15 May 1996.

Aircraft Refueling Handbook, MIL-HDBK-844 (AS), Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 20 Oct 1992.

CV NATOPS Manual, NAVAIR 00-80T-105, Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 21 Oct 1999.

Gasoline and JP-5 Fuel Systems, Naval Ships' Technical Manual, S9086-SP-STM-010/CH-542, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 May 1997.

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19C, Department of the Navy, Office of the Chief of Naval Operations, Washington DC 20350-2000, 19 Jan 1994.

Petroleum Fuel Storage, Use, and Testing, Naval Ships' Technical Manual S9086-SN-STM-000/CH-541, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Mar 1982 with change 2, 01 Sep 1999.

Pressure Fuel Servicing Locking Nozzle (Part No. 6902), Technical Manual, NAVAIR 12-1CA-1, Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 15 Jul 1980.

Electrical Continuity Control System for Aircraft JP-5 Fueling Stations, Technical Manual, TMIN SG-120-AB-MMO-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 15 Sep 1982 with change C, 15 Oct 1991.

Chapter 2

Air Department Standard Operating Procedures, COMNAVAIRPAC/COMNAVAIRLANTINST 3100.4C, Commander Naval Air Force, United States Atlantic Fleet, Norfolk, Virginia 23511-5188 and Commander Naval Air Force, United States Pacific Fleet, U.S. Naval Air Station, North Island, San Diego, California 92135, 10 Aug 1999.

Damage Control-Practical Damage Control, Naval Ships' Technical Manual, S9086-CN-STM-020/CH-079 V2, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 03 Aug 1998.

Department of the Navy Pollution Control Reports; responsibilities and guidance on reporting of, NAVFACINST 6240.3A, Department of the Navy, Naval Facilities Engineering Command, 200 Stovall Street, Alexandria, Virginia 22332, 22 Oct 1981.

Environmental and Natural Resources Program Manual, OPNAVINST 5090.1B, Department of the Navy, Office of the Chief of Naval Operations, Washington DC 20350-2000, 01 Nov 1994.

Fuel Filter (GF-5V-CU-NI), Technical Manual, NAVSEA S6436-AZ-010/43689, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 29 May 1985.

Filter Separator (300 gpm), Technical Manual, NAVSEA S9550-AK-MMM-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 31 1981 with change D, 31 Mar 1992.

Filter Separator (2000 gpm), Technical Manual, NAVSEA S9550-AL-MMM-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 25 May 1993 with change B, 30 Apr 1995.

Fuel Control System Consoles (Part Numbers 1000305, 1000306, and 1000308), Technical Manual, NAVSEA S9540-AE-MMO-010/DD 963-452K, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Jul 1983 with change A, 01 Aug 1987.

Gasoline and JP-5 Fuel Systems, Naval Ships' Technical Manual, S9086-SP-STM-010/CH-542, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 May 1990.

General Specifications for Ships of the United States Navy, NAVSEA S9AAO-AA-SPN-010/GEN-SPEC, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 02 Jan 1991.

JP-5 Tank Stripping Pump, Technical Manual, NAVSEA S225-E7-MMI-010/07524, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 13 May 1988 with change A, 15 May 1992.

JP-5 Fuel Service Pump, Equipment Manual, NAVSEA 0947-LP-152-6010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, Nov 1974 with change 2, Jul 1983.

JP-5 Service Pumps, 5MMX5, Type ON, Maintenance Manual, NAVSEA S6225-T9-MMA-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 15 Feb 1986 with change D, 15 Feb 1996.

JP-5 200 GPM Transfer Pump (Model X3NF-GMA), NAVSEA S6225-Z9-MMA/07524, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 25 Jun 1990.

JP-5 Pump (Model X2NFB-NHROV), Equipment Manual, NAVSEA S6225-YE-MMA-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 May 1985 with change C, 15 Apr. 1998.

JP-5 300 GPM Transfer Pump (Model BHXL4NFD-TB), Equipment Manual, NAVSEA S6226-MT-MMI-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 11 Aug 1995.

JP-5 Jet Fuel Centrifugal Purifier-200GPM, Technical Manual, NAVSEA S9542-AB-MMO-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Sep 1983 with change L 15 Feb 1994.

JP-5 Jet Fuel Centrifugal Purifier-300 GPM (Model B214AS-300), Technical Manual, NAVSEA S9542-AE-MMO-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Sep 1998.

Limitorque Valve Operators Types LT 130, LT 150, LT 550, Technical Manual, NAVSEA S6435-PB-MMA-010/52374, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 24 Feb 1992.

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19C, Department of the Navy, Office of the Chief of Naval Operations, Washington DC 20350-2000, 19 Jan 1994.

Petroleum Fuel Storage, Use, and Testing, Naval Ships' Technical Manual S9086-SN-STM-000/CH-541, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 07 Oct 1996.

Piping Systems, Naval Ships' Technical Manual, S9086-RK-STM-010/CH-505, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Sep 1999.

Pollution Control, Naval Ships' Technical Manual, S9086-T8-STM-010/CH-593, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Sep 1991.

Rotary Gear Motor Driven Transfer Pump, Maintenance Manual, NAVSEA S6226-CS-MMA-010/59180, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Nov 1987.

Tank Level Indicating and Control System (CVN 70), Technical Manual, NAVSEA S9540-AD-MMM-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 15 Dec 1981.

Chapter 3

Air Department Standard Operating Procedures, COMNAVAIRPAC/COMNAVAIRLANTINST 3100.4A, Commander Naval Air Force, United States Atlantic Fleet, Norfolk, Virginia 23511-5188 and Commander Naval Air Force, United States Pacific Fleet, U.S. Naval Air Station, North Island, San Diego, California 92135, 10 Aug 1990.

Aircraft Fuel/Defuel Stations in CV and CVNs (CLA-VAL), Maintenance Manual, NAVSEA S9542-AL-MMM-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 15 Sep 1989.

Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 15 May 1996.

Aircraft Refueling Handbook, MIL-HDBK-844 (AS), Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 20 Oct 1992.

CV NATOPS Manual, NAVAIR 00-80T-105, Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 21 Oct 1999.

Gasoline and JP-5 Fuel Systems, Naval Ships' Technical Manual, S9086-SP-STM-010/CH-542, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 May 1997.

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19C, Department of the Navy, Office of the Chief of Naval Operations, Washington DC 20350-2000, 19 Jan 1994.

Petroleum Fuel Storage, Use, and Testing, Naval Ships' Technical Manual S9086-SN-STM-000/CH-541, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 07 Oct 1996.

Pressure Fuel Servicing Locking Nozzle (Part No. 6902), Technical Manual, NAVAIR 12-1CA-1, Department of the Navy, Naval Air Systems Command, Naval Air Systems Command Headquarters, Washington DC 20361, 15 Jul 1980.

Electrical Continuity Control System for Aircraft JP-5 Fueling Stations, Naval Ships' Technical Manual TMIN-SG-120-AB-MMO-010, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 15 Sep 1982, with Change C, 15 Oct 1991.

Pollution Control, Naval Ship’s Technical Manual, S9086-T8-STM-010/CH-593, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, 01 Sep 1991.

Chapter 4

Naval Ships' Technical Manual for Gasoline and JP-5 Fuel Systems, S9086-SP-STM-010, Chapter 542, Naval Sea Systems Command, Washington, DC, second revision, 1 May 1997.

Petroleum Fuel Storage, Use, and Testing, Naval Ships' Technical Manual S9086-SN-STM-000/CH-541, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, second revision, 11 Mar 1997.

Stowage, Handling, and Disposal of Hazardous General Use Consumables, Naval Ships' Technical Manual, S9086-WK-STM-010/CH-670, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, forth revision, 31 Dec 2000.

Environmental and Natural Resources Program Manual, OPNAVINST 5090.1B, Department of the Navy, Office of the Chief of Naval Operations, Washington DC 20350-2000, 01 Nov 1994.

Pressure, Temperature and Other Mechanical and Electromechanical Measuring Equipment, Naval Ships' Technical Manual, S9086-RJ-STM-010/CH-504, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, first revision, 14 Oct 1998.

Heating, Ventilation, and Air Conditioning Systems for Surface Ships, Naval Ships' Technical Manual, S9086-RQ-STM-010/CH-510, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, third revision, 01 Sep 1999.

Gas Free Engineering, Naval Ships' Technical Manual, S9086-CH-STM-030/CH-074, Vol. 3, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, third revision, 23 Apr 1998.

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19C Volume II, Office of the Chief of Naval Operations, Washington DC, 19 Jan 1994 with change 1, 15 May 1996.

Chapter 5

Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, Naval Air Systems Command, Washington, DC, 30 May 1999.

Maintenance and Operation of Petroleum Fuel Facilities, NAVFAC MO-230, Naval Facilities Engineering Command, Alexandria, VA., Aug 1990.

Aircraft Refueling Handbook, MIL-HDBK-844 (AS), Naval Air Systems Command Washington DC, 20 Oct 1992.

Naval Ships' Technical Manual for Gasoline and JP-5 Fuel Systems, S9086-SP-STM-010, Chapter 542, Naval Sea Systems Command, Washington, DC, second revision, 1 May 1997.

Petroleum Fuel Storage, Use, and Testing, Naval Ships' Technical Manual S9086-SN-STM-000/CH-541, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, second revision, 11 Mar 1997.

Naval Ships' Technical Manual for Pollution Control, S9086-T8-STM-010, Chapter 593, Naval Sea Systems Command, Washington, DC, with revision 3, 1 Sept 1991.

Chapter 6

Afloat Supply Procedures, NAVSUP Publication 485, Naval Supply Systems Command, Washington, DC, with revision 3, 21 Oct 1997.

Air Department Standard Operating Procedures, COMNAVAIRPAC/COMNAVAIRLANTINST 3100.4C, Commander Naval Air Forces United States Atlantic and Pacific Fleets, United States Atlantic Fleet, Norfolk, VA, and United States Pacific Fleet, U.S. Naval Air Station, North Island, San Diego, CA., 10 Aug 1999

Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, Naval Air Systems Command, Washington, DC, 30 May 1999.

Naval Ships' Technical Manual for Gasoline and JP-5 Fuel Systems, S9086-SP-STM-010, Chapter 542, Naval Sea Systems Command, Washington, DC, second revision, 1 May 1997.

Petroleum Fuel Storage, Use, and Testing, Naval Ships' Technical Manual S9086-SN-STM-000/CH-541, Department of the Navy, Naval Sea Systems Command, Washington DC 20362, second revision, 11 Mar 1997.

Ship's Maintenance and Material Management (3-M) Manual, OPNAVINST 4790.4C, Department of the Navy, Office of the Chief of Naval Operations, Washington DC 20350-2000, 07 Nov 1994.

JOINT FLEET MAINTENANCE MANUAL VOL. V, Quality Maintenance, CINCLANTFLT/CINCPACFLTINST 4790.3, Commander in Chief United States Atlantic and Pacific Fleets, Atlantic Fleet Headquarters, Norfolk, VA, and Pacific Fleet Headquarters, Pearl Harbor, HI, 21 Aug 1996.

Tools and Their Uses, NAVEDTRA 14256, Department of the Navy, Chief of Naval Education and Training, CNET, 250 Dallas St., Pensacola, FL. 32508-5220, June 1992.

Blueprint Reading and Sketching, NAVEDTRA 14040, Department of the Navy, Chief of Naval Education and Training, CNET, 250 Dallas St., Pensacola, FL. 32508-5220, May 1994.

Personnel Qualification Standard for Air Department Aviation Fuels Afloat, NAVEDTRA 43426.4C, Department of the Navy, Chief of Naval Education and Training, CNET, 250 Dallas St., Pensacola, FL. 32508-5220, July 1999.

Personnel Qualification Standard for Flight Deck Familiarization, NAVEDTRA 43426-0A, Department of the Navy, Chief of Naval Education and Training, CNET, 250 Dallas St., Pensacola, FL. 32508-5220, April 2001.

Personnel Qualification Standard for Fuel Operations Ashore, NAVEDTRA 43288-B, Department of the Navy, Chief of Naval Education and Training, CNET, 250 Dallas St., Pensacola, FL. 32508-5220, October 2001.

APPENDIX III

ANSWERS TO REVIEW QUESTIONS

Chapter 1

A1-1. *Its octane number.*

A1-2. *Its viscosity.*

A1-3. *Its flashpoint.*

A1-4. *Engine failures, unnecessary rework, and delayed flights.*

A1-5. *Microns for solid contaminants and parts-per-million (ppm) for water.*

A1-6. *The "appearance" of fuel.*

A1-7. *Dissolved water.*

A1-8. *Tropical or semi-tropical climates.*

A1-9. *"Line" sample.*

A1-10. *"Representative" sample.*

A1-11. *Either "ROUTINE" or "SPECIAL".*

A1-12. *"Air" is present.*

A1-13. *The first filter is designed to trap solid contaminants and the second filter is subjected to clean fuel. Light transmission applied through both filters depends on the amount of solid contamination in fuel to validate the difference between the two filters.*

A1-14. *Ultraviolet light.*

A1-15. *The "knurled hand knob" controls both, the shutter and the flame burner.*

A1-16. *The NAVIFLASH tester uses an electric spark.*

A1-17. *The NAVIFLASH uses "N-dodecane" for calibration.*

A1-18. *The minimum level required is 0.03 %.*

A1-19. *When FSII level is at or below 0.07%.*

A1-20. *It's used to determine the correct size of discharge ring for JP-5 purifier.*

A1-21. *At least two-thirds full, of a standard size fuel sample container.*

Chapter 2

A2-1. *The Fill & Transfer System.*

A2-2. *Pre-filter and a Filter/Separator (300 GPM) unit.*

A2-3. *The Hand-operated Stripping System.*

A2-4. *The JP-5 Service System.*

A2-5. *If the service pumps are used for off-loading JP-5.*

A2-6. *The Jet Test System.*

A2-7. *The JP-5 Auxiliary System.*

A2-8. *(1) Their unique construction and close tolerance minimizes leakage between the discharge and suction chambers.*
(2) They also allow for the wear created between the impeller and pump casing.

A2-9. *They guard against leakage from the pump and prevent air from entering the casing around the shaft.*

A2-10. *Blackmer positive displacement rotary vane pumps.*

A2-11. *300 GPM at 50 PSI.*

A2-12. *Palamite.*

A2-13. *The Head O-Rings.*

A2-14. *The Falk Type F Steelflex coupling.*

A2-15. *The Rex Chain coupling.*

A2-16. *Globe valve.*

A2-17. *It uses a single-piece flexible polymeric seat.*

A2-18. *The torque limit switch.*

A2-19. *The Travel Nuts.*

A2-20. *Manual operation of the valve.*

A2-21. *The Swing-Check valve.*

A2-22. *String and Ring type packing materials.*

A2-23. *The Single valve manifold.*

A2-24. *The Sliding Lock-Bar.*

A2-25. *The projecting knife-edges.*

A2-26. *12 foot-pounds or 144 inch-pounds.*

A2-27. *Outlet (Clearwell) chamber and at the filter sump.*

A2-28. *Initial flow, every four (4) hours under continuous flow conditions, whenever changing service tanks or when requested by the FUEL LAB.*

A2-29. *The automatic shutoff valve and the pilot valve.*

A2-30. *(1) Drain (vent) port, on the water drain line.*
(2) Connected to the top of the diaphragm in the pilot valve.
(3) Connected to the top of the diaphragm in the automatic water drain line.
(4) The supply connection, connected to the top of the rotary inside the filter vessel.

A2-31. *It provides a means of mechanically operating the float control valve (raised or lowered), causing the automatic drain valve to OPEN or CLOSE under normal flow conditions, thereby not contaminating the system with water.*

A2-32. *300 GPM at 150 PSI.*

A2-33. *Between 15-25 psi.*

A2-34. *A steel-braided jacketed flexible hose.*

A2-35. *The worm quill.*

A2-36. *The speed counter has an attached cap cover on the outside end; this cap has a raised bump on one side of its top. The operator places his finger on this bump and counts the number of times the bump touches his finger in 1 minute. The count should be between 146-152 times per minute for the bowl to be at full speed.*

A2-37. *A total of 186 intermediate disks.*

A2-38. *3 to 31/2 complete turns.*

A2-39. *20 to 25 degrees.*

A2-40. *The purifier discharge ring is too large.*

A2-41. *7,800 psi.*

A2-42. *A compound gage.*

A2-43. *(1) Wing (2) Deep Centerline (3) Double-Bottom (4) Peak*

A2-44. *Storage and Service.*

A2-45. *JP-5 Overflow tank.*

A2-46. *10 volts d.c.*

A2-47. *At every 1/2-inch of float travel.*

A2-48. *An indicating meter only.*

A2-49. *The SENS-PAK alarm.*

A2-50. *3/4 second.*

A2-51. *Calibrate Potentiometer.*

A2-52. *Control Switches.*

A2-53. *Seawater cleavage indicator lights*

A2-54. *(1) Division Officer copy (2) Work Center copy (3) Work Station copy.*

A2-55. *Operational procedures for fueling evolutions, it gives what equipment and explains how to use them in those evolutions, as troubleshooting guide, as well as a reference for fuels casualty drills.*

A2-56. *A composite sample.*

A2-57. *The amount of fuel needed, your ship's maximum receiving rate and tanker's normal pumping rate.*

A2-58. *It gives location of sounding tube, capacity of tank at 80%, 90%, 100% in feet and inches.*

A2-59. *8.0 milligrams per liter.*

A2-60. *(1) Before receipt.*
(2) The day after receiving JP-5 aboard.
(3) Weekly thereafter, as applicable.
(4) The day before purifying into service tanks.
(5) Immediately before purifying into service tanks.

Chapter 3

A3-1. *(1) By energizing or de-energizing the solenoid-operated pilot valve (SOPV). Turning the defuel pump ON and OFF.*
(2) As well as excessive fuel delivery pressure to the main valve. The main valve is controlled automatically through fuel pressure in the lines by smaller valves, which are an integral part of the CLA-VAL unit.

A3-2. *The compression spring for the relief control valves can be set from 20 to 70 psi.*

A3-3. *The screen is 60 mesh–monel.*

A3-4. *It must be housed in an explosion-proof case.*

A3-5. *It's installed in the line between the ejector-strainer and the fuel valve cover chamber.*

A3-6. *The flow control valve (needle valve).*

A3-7. *The TYCOM (Type Commander).*

A3-8. *By a snap ring that fits into a recessed groove inside the male end of the adapter.*

A3-9. *The QDC (Quick Disconnect Coupling).*

A3-10. *The nozzles have a plugged sampling port that accepts a sampling coupler and actuator assembly.*

A3-11. *The JC Carter and Whittaker nozzles.*

A3-12. *The nose seal assembly.*

A3-13. *The flow control (actuating) lever.*

A3-14. *The hose end pressure control valve (HEPCV).*

A3-15. *The nozzle control handle is actually a means for controlling fuel flow rate and when you release the control handle, the flow of fuel stops. Not unlike an actual valve.*

A3-16. *A brass bushing.*

A3-17. *The solenoid operated-pilot valve (SOPV).*

A3-18. *The 1-1/2-inch size non-collapsible hose.*

A3-19. *They must be hydrostatically tested and flushed for an acceptable sample.*

A3-20. *The hose quite possibly has stretched enough to break the static wire, rendering it useless.*

A3-21. *The continuity wire should always be 10 to 12 inches longer than the hose.*

A3-22. *Electrical continuity.*

A3-23. *100 gpm at 15 psi.*

A3-24. *An air-motor-driven internal gear pump or an air twin-diaphragm pump, either pump can be operated from the ship's low-pressure air system.*

A3-25. *The Wilden M-8 diaphragm air-operated pump.*

A3-26. *A suitable fuel-filtering unit.*

A3-27. *The filter cartridge will swell shut (block fuel flow) when it reaches its water holding capacity, preventing any water-laden fuel from passing through the filter.*

A3-28. *Designed to remove free and emulsified water down to less than 5 ppm (Parts-per-million) in the effluent.*

A3-29. *Hand Signals.*

A3-30. *The Aviation Fuels Flight Deck Control Talker.*

A3-31. *The P-25 fire-fighting unit.*

A3-32. *The plane captain.*

A3-33. *Only if procedures are specifically contained in that particular aircraft's NATOPS (Naval Air Training and Operating Procedures Standardization) program manual.*

A3-34. *The "Air Boss" in PRI-FLY (Primary Flight Control).*

A3-35. *Only on ship's (LHA, LPH, LPD and LHD) that operate the AV-8B aircraft. This aircraft is hot refueled with the canopy open at the pilot's discretion due to high temperatures and humidity and the aircraft's environmental control system does not operate with weight on wheels.*

A3-36. *"Cold refueling" with an aircraft's engines off.*

A3-37. *The possibility of a dangerous static spark inside the fuel tank.*

A3-38. *If the aircraft being refueled requires electrical power for its fueling system.*

A3-39. *The A-4 Skyhawk.*

A3-40. *The squadron maintenance officer/chief, ACHO (Aircraft Handling Officer and the V-4 Quality Assurance Lab representative.*

A3-41. *It is an ordnance-type tape, it will not damage the aircraft paint.*

A3-42. *120°F on all low point drain samples.*

A3-43. *80 psi.*

A3-44. *100 psi.*

Chapter 4

A4-1. *The rotary screw pump and rotary vane pump.*

A4-2. *The rex-chain flexible coupling.*

A4-3. *6,000 gallons.*

A4-4. *It is permanently mounted to the tank manhole cover.*

A4-5. *1 1/2 psi.*

A4-6. *Communications between the oil pump room and V-2 catapult ready-service tanks will be maintained throughout entire operation.*

A4-7. *The U-Tube principle.*

A4-8. *It is a non-conductor to electricity.*

A4-9. *The CO_2 inert gas compensating system.*

A4-10. *The use of a vaporizer.*

A4-11. The speed of the fluid will increase and its pressure decreases.

A4-12. Fixed defueling is not provided. The fueling hoses do not utilized internal control wire circuit (continuity) for valve operation. This systems pressure-regulating valve controls the station's pressure.

A4-13. Stuffing boxes.

A4-14. Inside the outer storage tank.

A4-15. The static-head type gaging system.

A4-16. 10 gpm.

A4-17. 15 psi.

A4-18. 15 feet.

A4-19. The diaphragm.

A4-20. The CLA-VAL Backflow Preventer.

A4-21. PMS (Preventive Maintenance Schedules).

A4-22. A compliance tag identifying that maintenance on the bladders was performed and has been air-tested within the last 12 months.

A4-23. Activated carbon.

A4-24. By thoroughly flushing the carbon with fresh water and allowing steam to pass through it for an hour, after it dries then reinstall it into the absorber.

A4-25. By absorbing fuel vapors from a sample.

A4-26. 2 minutes.

A4-27. The sensitivity potentiometer.

A4-28. The operator must be certified for the equipment being used.

A4-29. The Oxygen Indicator.

A4-30. They must be ventilated thoroughly.

A4-31. The flame arrestor.

A4-32. 10 psi.

A4-33. Electric switches that activate the visual and audible alarms inside the space. A visual alarm at outside entrance into space, and a kill switch to the exhaust ventilation.

A4-34. They must be NIOSH-approved respirators.

A4-35. In accordance with the Naval Bureau of Medicine and Surgery, general ventilation is one complete air change every three minutes.

A4-36. 0.5 to 1 psi.

A4-37. The steam heating coils.

A4-38. Near hull penetration where the overflow vent pipe exists the skin of the ship.

A4-39. Seawater is allowed to flow into the tank through its overflow line.

A4-40. The gasoline pump, filter/separator and pressure-regulating system.

A4-41. *By leaving the seawater elevated-loop locked open to ensure seawater is drain out of the tank in direct proportion to amount of gasoline filling the tank.*

A4-42. *An insulated copper cable connection between the gasoline supply source and receiving unit with an attached single pole electrical switch, in the "open" position is used to dissipate any static electricity.*

A4-43. *At the filter/separator bypass, a reflex gage will indicate that the gasoline has fallen below the header.*

A4-44. *Through the inert gas supply line in the gasoline pump room.*

A4-45. *Through the firemain by placing the pressure-reducing station on line.*

A4-46. *When the pressure in the system drops to 0 psi at the inert gas pressure gage.*

A4-47. *When seawater appears at the test connection of the gasoline pump suction header.*

A4-48. *3 complete changes.*

A4-49. *Never.*

A4-50. *At less than 1 percent.*

A4-51. *The space has been shown to be under continuous ventilation and certified safe.*

A4-52. *Immediately flush the eye(s) with fresh water, and then seek medical attention.*

A4-53. *10 percent.*

A4-54. *Personnel must be equipped with a breathing mask and an independent supply of air prior to entering.*

A4-55. *Artificial resuscitation, administering oxygen and keeping the patient warm and quiet.*

A4-56. *It is not detectable by any odor, color or taste and gives little if any warning until your completely overcome.*

A4-57. *Carbon dioxide and nitrogen.*

A4-58. *The CO_2 bottles used in fixed fire fighting systems are color-coded red, the CO_2 cylinders used in inerting MOGAS systems are gray in color and fitted with a hand-wheel operated valve having NO siphon tube installed.*

Chapter 5

A5-1. *Filter/separators.*

A5-2. *(a) 98% (b) 100%.*

A5-3. *Fuel Quality Monitors.*

A5-4. *Relaxation Chambers.*

A5-5. *Positive-displacement meters.*

A5-6. *Turbine meters.*

A5-7. *A High Level Shutoff.*

A5-8. *50 feet.*

A5-9. *Shore base hoses contain no electrical bond or bonding wire that runs through the center inside the carcass of the fuel hose.*

A5-10. *Emergency Dry-Breakaway couplings.*

A5-11. *55 psi.*

A5-12. *D-1 and D-2 type refueling nozzles.*

A5-13. *60-mesh screens.*

A5-14. *Bulk storage and Operational storage.*

A5-15. *Bulk-steel fuel storage tanks.*

A5-16. *100%.*

A5-17. *3 feet per second.*

A5-18. *Float-type automatic gages.*

A5-19. *95%.*

A5-20. *High-High Level Alarm (HHLA).*

A5-21. *Low-Level Alarm.*

A5-22. *Impermeable dikes.*

A5-23. *They are internally coated with non-corrosive materials.*

A5-24. *55-psi.*

A5-25. *Below 120 psi.*

A5-26. *Maintenance Manual, NAVFAC MO-230.*

A5-27. *NAVFAC P-300.*

A5-28. *"JP".*

A5-29. *Static electricity.*

A5-30. *The aircraft or refueling vehicle must be Earthed (grounded).*

A5-31. *Daily.*

A5-32. *Monthly.*

A5-33. *At 5 miles from the facility.*

A5-34. *50 feet form the refueling operation.*

A5-35. *Two- and Three-cell batteries.*

A5-36. *300 feet of ground radar equipment.*

A5-37. *They are equipped with spark-arresting type mufflers.*

A5-38. *Never.*

A5-39. *Only with overwing refueling of aircraft that are solely configured for this type of operation.*

A5-40. *Initially when you report and annually thereafter.*

A5-41. *NAVAIR 00-80R-14, U.S. Fire Fighting and Rescue NATOPS Manual.*

A5-42. *Good ventilation.*

A5-43. *(a) Lack of oxygen.*
(b) Presence of flammable or explosive vapors.
(c) Presence of toxic vapors and materials.

A5-44. *A blower-type air-mask or positive pressure hose air-mask.*

A5-45. *NAVOSH Program Manual 5200.23B.*

A5-46. *It is designed to "hot" refuel an aircraft.*

A5-47. *30 seconds.*

A5-48. *10,000 ohms.*

A5-49. *60- to 100-mesh strainers.*

A5-50. *150-pound Halon bottle.*

A5-51. *Never.*

A5-52. *The refueler is equipped with a low-point drain.*

A5-53. *Tanks are made of aluminum or stainless steel.*

A5-54. *600 gallons per minute.*

A5-55. *A Scully Dynaprobe or an equivalent system.*

A5-56. *A hose-end pressure regulator.*

A5-57. *It is superior to* CO_2 *and is less corrosive than PKP.*

A5-58. *A suitable spark arrestor.*

A5-59. *By re-issuing the fuel to another aircraft.*

A5-60. *"Refuelers/Defuelers."*

A5-61. *1,000 gallons.*

A5-62. *"JET FUEL/JP."*

A5-63. *The systems will allow unfiltered fuel to be issued to the next aircraft.*

A5-64. *The fuel must be sampled and tested.*

A5-65. *"DEFUELS ONLY".*

A5-66. *25 feet.*

A5-67. *100 feet.*

A5-68. *A spill containment system.*

A5-69. *The fuel spill or fuel leaks will deteriorate an asphalt surface spill containment system.*

A5-70. *Bottom-loading.*

A5-71. *Temperature-compensating positive displacement meters.*

A5-72. *Drainage to oil/water separators.*

A5-73. *2-percent (2.4 inches to 10 feet).*

A5-74. *(1) Tactical Airfield Fuel Dispensing System (TAFDS).*
(2) Helicopter Expedient Refueling System (HERS).
(3) Navy Advanced Based Functional Components Fueling System (ABFC-H14K.

A5-75. *It is a one-man (person) operation.*

A5-76. *If the fueling trucks are NOT equipped with high-level alarms/shutoff and deadman control valves.*

A5-77. *The truck bottom loader assembly.*

A5-78. *This truck is minimally fueled using another truck set at a low flow rate (500 to 1,000 gallons) until inlet valve inside is flooded with fuel.*

A5-79. *Top loading method of filling trucks is extremely dangerous because of high flammable and static charges produced during this type of operation.*

A5-80. *NEUTRAL or PARK position.*

A5-81. *The refueler is moved to the truck parking area.*

A5-82. *Refueling personnel will know exactly how to park fuel trucks and what is expected of them when positioning the refuelers.*

A5-83. *10 feet.*

A5-84. *By using a spotter and a wheel cock pre-position at where the refueler must stop.*

A5-85. *Excessive pressure surges may occur with the overwing nozzle.*

A5-86. *(a) The exhaust tailpipe temperature of a refueler and (b) the location of an aircraft tank vents.*

A5-87. *It is positioned so that the refueler can be driven away quickly in the event of an emergency.*

A5-88. *The gearshift is placed in the NEUTRAL position.*

A5-89. *It is kept open to prevent buildup of carbon monoxide inside the truck cab crated the truck's engine running and remaining stationary.*

A5-90. *The refueler driver/operator.*

A5-91. *A specifically tasked, fire extinguisher operator.*

A5-92. *The refueler driver/operator should perform the check prior to positioning the refueler.*

A5-93. *The refueler operator.*

A5-94. *Three people.*

A5-95. *The refueler truck must be driven clear of the aircraft.*

A5-96. *The air brake in ON and in the LOCKED position.*

A5-97. *The refueler truck wheels must be chocked.*

A5-98. *The Fuels Management Officer (FMO).*

A5-99. *NAVAIR 00-80T-103, Conventional Weapons Handling Procedures Manual (Ashore).*

A5-100. *The supervisor grants the authorization.*

A5-101. *Fuel spills covering an area from 18 inches to 10 feet in any dimension.*

A5-102. *Fuel spills covering an area greater than 10 feet in any dimension or more than 50 square feet in area.*

A5-103. *The local oil spill contingency plan.*

A5-104. *Nozzle operator.*

A5-105. *180 degrees.*

A5-106. *The aircraft's systems must react within a few seconds to 1 minute after conducting pre-check.*

A5-107. *Only if is an operational necessity. An aircraft can be cold refueled if it fails pre-check but special procedures are required, you must refer to the appropriate aircraft NATOPS manual.*

A5-108. *It defeats the purpose of the device and can possibly lead to a catastrophic accident.*

A5-109. *The station operator.*

A5-110. *Refueling crew coordinator (Plane Captain).*

A5-111. *2 seconds.*

A5-112. *A pantograph refueling arm.*

A5-113. *The plane captain.*

A5-114. *Servicing the AV-8B's water injection system or tank.*

A5-115. *They will remain closed/secured.*

A5-116. *The aircraft pilot.*

A5-117. *The aircrew chiefs, plane captains trained and qualified squadron personnel.*

A5-118. *Multiple-source refueling.*

A5-119. *The C-5A and E-6A.*

A5-120. *(1) Refueling aircraft.*
(2) Refueling fuel storage bladders.
(3) Refueling ground vehicles from a KC-130 aircraft.

A5-121. *The Plane-to-Plane Transfer Cart.*

A5-122. *It is used to supply electrical power for pressure refueling aircraft.*

A5-123. *Fire sensor and suppressor systems that are designed to automatically put out APU fires.*

A5-124. *It is a lower priority than aircraft refuelings.*

A5-125. *The Fuels Management Officer (FMO).*

A5-126. *"DEFUELS ONLY."*

A5-127. *This fuel can be re-issued to the same squadron as long as the squadron's requesting official signs a statement that the fuel is non-suspect and is safe for use.*

A5-128. *Fuel should be maintained to flood the suction at above the anti-vortex splash plate inside the tank.*

A5-129. *The Fuels Management Officer (FMO).*

A5-130. *Take samples of the fuel to be defueled from the aircraft's drains and visually inspect them for contamination.*

A5-131. *The Fuels Management Officer (FMO) and the station operator.*

A5-132. *By securing all equipment and check for FOD (Foreign Object Damage).*

A5-133. *Aircraft from the same squadron as that from which the fuel originated.*

A5-134. *P-3 and E-2 aircraft.*

A5-135. *This fuel must pass through the defuelers/refuelers filter/separators and fuel monitors before being issued to aircraft.*

A5-136. *S-3, SH-60 (USN), all US Army, USAF, and foreign aircraft.*

A5-137. *Sediment and water.*

A5-138. *The Navy Petroleum Office.*

A5-139. *Maintenance Manual, Petroleum Fuel Facilities, NAVFAC MO-230.*

A5-140. *The Fuels Management Officer (FMO).*

A5-141. *(a) OPNAVINST 4790.4*
(b) NAVAIRINST 00-80T-109
(c) NAVFAC MO-230

A5-142. *The Public Works department.*

A5-143. *In early autumn during climates where freezing weather is encountered.*

A5-144. *By personnel from other departments.*

A5-145. *All aircraft fuel delivery equipment that is in continuous use.*

A5-146. *An exposed hose reinforcement material, the expose fabric provides a source for water to enter, migrate and ultimately rot the fabric.*

A5-147. *It is flushed thoroughly and samples are drawn from it for analysis on the quality of the fuel.*

A5-148. *"Flex" piping.*

A5-149. *Improperly drained air-tanks and malfunctioning air-operated valves that control fuel flow and check valves.*

A5-150. *Three minutes.*

A5-151. *10 minutes.*

A5-152. *Under normal standard pressure conditions, the accuracy of the differential readings is directly dependent on the system's overall flow and pressure conditions.*

A5-153. *Compressed air.*

A5-154. *A transportation inspector.*

A5-155. *Applying the breaks to maximum while at the same time measuring the distance it takes the refueler to stop.*

A5-156. *Electrical wiring is encased in tubing that terminates in securely mounted vapor-tight fixtures or junctions boxes with compression springs.*

A5-157. *It is measured with the cables in the stowed, intermediate, and fully extended positions.*

A5-158. *The existence of foreign matter in these strainers can provide information on possible problems before complete shutdown of the unit.*

A5-159. *Monthly.*

A5-160. *If you observe any arcing, however slight.*

A5-161. *MIL-STD-161.*

A5-162. *Periodic Inspection and Annual Record.*

A5-163. *The introduction of ignition sources into the flammable vapor space of the tank, as well as contaminants into the fuel.*

A5-164. *Filter/separators and fuel monitors.*

A5-165. *Every three years.*

A5-166. *20-psi.*

A5-167. *The complete shutdown of fuel flow and/or a very rapid increase in pressure differential across monitor elements.*

A5-168. *The elements are tested for their ability to repel water.*

A5-169. *Storage/Distribution Facilities checklist.*

A5-170. *Naval Air Systems Command.*

A5-171. *2 years.*

A5-172. *6 months.*

A5-173. *1 month.*

A5-174. *120-psi.*

A5-175. *Personnel certified by an official Navy Calibration Laboratory or other certifying agency.*

Chapter 6

A6-1. *Division Officer, Maintenance Officer, Leading Chief Petty Officer (LCPO), Leading Petty Officer (LPO) and Work Center Supervisor (WCS).*

A6-2. *The Below Decks work center.*

A6-3. *Tank Cleaning.*

A6-4. *The Commanding Officer (CO).*

A6-5. *The Gas-Free Engineer.*

A6-6. *Every 2 hours.*

A6-7. *The Fuels Division LCPO.*

A6-8. *Supply Department.*

A6-9. *Fuels Management Officer (FMO).*

A6-10. *Distribution.*

A6-11. *Quality Control.*

A6-12. *PQS Program.*

A6-13. *It is a written document that combines knowledge and skills required qualifying for a specific watch station, maintaining specific equipment, and allow an individual to perform as a member of a unit.*

A6-14. *At least one copy pertaining to whatever equipment used.*

A6-15. *You need to always know where to get the information.*

A6-16. *Operational and maintenance.*

A6-17. *Instructions and Notices.*

A6-18. *The originator's abbreviation, the type of release (whether an Instruction or a Notice), a subject classification number, and in the case of Instructions only, a consecutive number.*

A6-19. *NAVPUBFORMCEN, Pub. 2002.*

A6-20. *Loose-leaf pages, pen-and-ink, and complete revisions.*

A6-21. *(1) They must be accurate.*
(2) They must be up-to-date.
(3) They are formatted according to established standards.

A6-22. *The appropriate petty officers, the work-center chief, and the division officer.*

A6-23. *Fuel checker cards.*

A6-24. *A CASREP (Casualty report).*

A6-25. *48 hours.*

A6-26. *It is to determine the reasons behind the event, who might be responsible, and the actual loss (monetary) to the government.*

A6-27. *A preliminary investigation.*

A6-28. *The investigation is conducted to determine if there is evidence of negligence, willful misconduct, or deliberate unauthorized use.*

A6-29. *DD Form 200, Report of Survey.*

A6-30. *The Tool Control Program.*

A6-31. *Before and after each use of these tools, issued as a group of tools in toolboxes or pouches.*

A6-32. *You may damage the equipment you're working on or damage the tool itself.*

A6-33. *Safety is PARAMOUNT!*

A6-34. *The operator has been checked out on their use and its proper operation by a competent authority.*

A6-35. *Wearing eye protective equipment.*

A6-36. *The air hoses must be suitable to withstand the pressure required for the tool.*

A6-37. *A safety lock-off device controls the operation of the tool; the operator is required to operate the device before the tool can be turned ON.*

A6-38. *The proper voltage for the tool is found on the nameplate permanently attached.*

A6-39. *The tools are required to have a proper ground capability.*

A6-40. *By checking it's calibration sticker.*

A6-41. *An authorized calibration facility.*

A6-42. *NAVEDTRA 14256, Tools and Their Uses.*

A6-43. *A blueprint.*

A6-44. *The Title Block.*

A6-45. *A revision to the blueprint is annotated and a brief description is provided.*

A6-46. *The title block's original number will be followed by the addition of a letter.*

A6-47. *You need to know the different types of lines used in general drawing practice and the information conveyed by each.*

A6-48. *Planned View.*

A6-49. *Assembly Prints.*

A6-50. *Individual mechanisms such as motors and pumps or parts of a unit detailing how it relates to the whole assembly.*

A6-51. *They contain a complete and exact description of a part's exact size, type of material, finishes for each part, tolerance, and so forth.*

A6-52. *Schematic diagrams.*

A6-53. *A piping system schematic diagram.*

A6-54. *An electrical system schematic diagram.*

A6-55. *Blueprint Reading and Sketching, NAVEDTRA 10077-F1.*

A6-56. *The weekly schedule.*

A6-57. *Assigned by name to a person task to perform the maintenance action.*

A6-58. *By using the PMS FBR (Feedback Report, OPNAV 4790/7B) Form.*

A6-59. *By using the TMDER (Technical Manual Deficiency/Evaluation Report, NAVSEA 4160/1.*

A6-60. *If situation constitutes safety to personnel, the potential or actual damage to equipment and it relates to the technical requirements of PMS.*

A6-61. *OPNAVINST 4790.4, Ship's 3-M Manual.*

A6-62. *JP-5 piping, valves, tanks, pumps, filters, and most of the equipment related to the JP-5 system are included under the QA Program coverage.*

A6-63. *Formal Work Procedures (FWP).*

A6-64. *Training and Qualification.*

A6-65. *The goal is to develop the requisite levels of knowledge to enable the craftsman to perform those skills necessary for their craft.*

A6-66. *The procedures used provide proof and confidence that the work performed or material manufactured will perform as designed, and that there is documentary evidence to that effect.*

A6-67. *Audit and Surveillance.*

A6-68. *The JOINT FLEET MAINTENANCE MANUAL, CINCLANTFLT/CINCPACFLTINST 4790.3.*

A6-69. *Corrosion reduces the strength and changes the mechanical characteristics in metals used in the construction of equipment.*

A6-70. *(1) Surface.*
(2) Galvanic.
(3) Intergranular.

A6-71. *Iron rust on metals.*

A6-72. *Moisture in the air.*

A6-73. *By protection the metal surface with plating or paint and by keeping the plating or paint in good condition.*

A6-74. *Intergranular corrosion. It is not visible on the surface, it spreads through the interior of the metal along the grain boundaries, reducing the strength and destroying the ability of the metal to be formed or shaped.*

A6-75. *Rust on steel and white powder on aluminum or magnesium.*

A6-76. *Removing moisture and dirt from the surface of the metal to be protected and covering these surfaces to prevent recontamination.*

A6-77. *Soaps, solvents, emulsion compounds, and chemicals.*

A6-78. *Proper surface preparation.*

A6-79. *OPNAVINST 5100.19; Navy Safety Precautions for Forces Afloat.*

A6-80. *It must be reported immediately.*

A6-81. *Your immediate supervisor.*

A6-82. *The type required, approved, and supplied for the safe performance of your duties.*

INDEX

D

N

O

P

U

V

W

Assignment Questions

<u>Information</u>: The text pages that you are to study are provided at the beginning of the assignment questions.

ASSIGNMENT 1

Textbook Assignment: "Quality Surveillance of Aviation Fuels," and "JP-5 Afloat Below Deck Systems and Operation," chapters 1 and 2, pages 1-1 through 2-12.

1-1. How are petroleum fuels in liquid form compared to water?

1. They weigh the same as water at 60°F
2. They are heavier than water
3. They are lighter than water
4. They weigh the same as water at 70°F

1-2. Compared to air, petroleum fuels in vapor form have which of the following characteristics?

1. They weigh the same as air at 60°F
2. They are heavier than air
3. They are lighter than air
4. They weigh the same as air at 70°F

1-3. Petroleum fuel vapors remaining from a spill are extremely dangerous because of which factor?

1. They readily evaporate
2. They tend to remain close to the ground
3. They saturate the ground
4. They saturate porous materials

1-4. What is the NATO number for JP-5?

1. F-40
2. F-42
3. F-44
4. F-46

1-5. What is the minimum flash point of JP-5?

1. 128°F
2. 130°F
3. 140°F
4. 142°F

1-6. If rags or clothing become soaked with JP-5, the JP-5 becomes highly flammable. What term describes this action?

1. Saturation
2. Wicking
3. Candling
4. Soaking

1-7. Because of its high flash point, JP-5 is the only jet fuel authorized for fueling aircraft on Navy ships. When JP-4 or JP-8 is mixed with JP-5, what happens?

1. The flash point of the JP-4 or JP-8 is raised and it becomes safe for shipboard use
2. The flash point of the JP-5 is lowered and it becomes unsafe for shipboard use
3. A chemical reaction takes place that makes both fuels unusable
4. Based on the amount of each fuel in the mixture, either JP-6 or JP-7 is created

1-8. What two terms are generally used to measure volatility?

1. Vapor pressure and viscosity
2. Weight and distillation
3. Viscosity and weight
4. Vapor pressure and distillation

1-9. What is the minimum percentage of gasoline vapor, by volume, for it to burn or explode?

1. 1%
2. 3%
3. 5%
4. 6%

1-10. Specific gravity determinations are correlated to what temperature according to ASTM Standard D1250-80?

1. 45°F
2. 60°F
3. 75°F
4. 100°F

1-11. What is the measure of a liquid's resistance to flow called?

1. Volatility
2. Viscosity
3. Flash point
4. Solvency

1-12. Why is a fuel spill on an asphalt surface more damaging than a fuel spill on a concrete surface?

1. The vapors will spread faster on the asphalt surface
2. The asphalt surface will lose its color
3. The fuel will dissolve the asphalt surface
4. The asphalt will react to the fuel and spontaneously ignite

1-13. What term describes the lowest temperature at which a fuel vaporizes enough to form a combustible vapor?

1. Freezing point
2. Flash point
3. Auto-ignition temperature
4. Boiling point

1-14. What does the prolonged inhalation of fuel vapors cause?

1. Dizziness
2. Nausea
3. Death
4. All of the above

1-15. What is the NAVEDTRA number of the *Standard First Aid Training Course* that should be studied by personnel working with fuels?

1. 10018-B
2. 10081-D
3. 10085-A
4. 82082-A

1-16. From the standpoint of fire and explosion, which fuel is the safest?

1. MOGAS
2. JP-4
3. JP-5
4. JP-8

1-17. To be acceptable for delivery to aircraft, jet fuels must NOT contain more than how much free water?

1. 5 ppm
2. 10 ppm
3. 2 mg/l
4. 5 mg/l

1-18. To be acceptable for delivery to aircraft, jet fuels must NOT contain more than how much particulate contamination?

1. 5 ppm
2. 10 ppm
3. 2 mg/l
4. 5 mg/l

1-19. What visual standards must jet fuel meet to be acceptable for delivery to aircraft?

1. Clean and bright
2. Clear and free of water
3. Clear and sparkling
4. Clean and colorless

1-20. Which of the following is NOT a form of water contamination found in fuels?

1. Dissolved
2. Hanging
3. Entrained
4. Free

1-21. What are the most common types of sediment found in fuel?

1. Paint and rubber
2. Metal and rust
3. Rust and sand
4. Sand and metal

1-22. Which statement gives the description for entrained water?

1. Dissolved water absorbed in fuel; it is NOT visible
2. Free water that has NOT settled to the bottom
3. Water-in-fuel emulsions
4. A mixture of fresh and salt water

1-23. The division between course sediment and fine sediment is made at?

1. 1 micron
2. 10 microns
3. 100 microns
4. 1,000 microns

1-24. Although invisible to the naked eye when separated, microscopic particles of foreign matter grouped together in a fuel sample may appear as a _______________.

1. speck or spot
2. slight haze
3. residue on the container
4. separate layer

1-25. Which of the following is a description of microbiological growth in fuel?

1. Dark colored, fibrous, and stringy
2. Dark colored, fibrous, and ball-shaped
3. Straw colored, mayonnaise-like, and stringy
4. Straw colored, mayonnaise-like, and ball-shaped

1-26. The development and growth of micro-organisms in jet fuel is primarily caused by what contaminant?

1. Sand
2. Free water
3. Rust
4. Dissolved water

1-27. The most common emulsion is the water-in-fuel emulsion. What does it look like?

1. A light-to-heavy cloud
2. A heavy-to-light cloud
3. A dark, reddish haze
4. A brown haze

1-28. A surfactant problem can usually be detected by which of the following observations?

1. Dark, red-brown, or black water in filter/separator sump drains, refueler sump drains, or pipeline low-point drains
2. Storage tanks not yielding a clear, bright fuel after the prescribed settling time
3. Triggering of fuel monitors in delivery systems, if installed
4. All of the above

1-29. What mechanical method, if any, is used to separate commingled fuels?

1. Settling
2. Filtering
3. Centrifuging
4. None

1-30. Commingled fuels are usually caused by ________________.

1. leaking valves
2. leaking tanks
3. carelessness during handling
4. intentional mixing

A. All-level
B. Line
C. Representative
D. Composite

FIGURE 1-A

IN ANSWERING QUESTIONS 1-31 THROUGH 1-34, SELECT FROM FIGURE 1-A THE TYPE OF FUEL SAMPLE ASSOCIATED WITH EACH STATEMENT.

1-31. Taken at or near the discharge point of a hose immediately before and during the first few minutes of pumping.

1. A
2. B
3. C
4. D

1-32. Consists of one container from a large stock of packaged fuel of the same grade and age.

1. A
2. B
3. C
4. D

1-33. Contains a blend of individual samples from several tanks that contain the same type of product being sampled.

1. A
2. B
3. C
4. D

1-34. Represents all fuel between the drawoff level and the top surface level of a tank.

1. A
2. B
3. C
4. D

1-35. Fuel sample containers used for sediment and water tests must be made of what construction?

1. Glass with a metal top
2. A nonmetallic material with glass linings
3. Glass with a nonmetallic top
4. Metal with glass linings

1-36. Which of the following is NOT a requirement for the identification of a sample?

1. The location and name of the activity submitting the sample
2. The location of the point where the sample was taken
3. The sample classification
4. Test results

1-37. A representative sampling of a large stock of packaged fuel revealed contamination sufficient to make the entire supply suspect. Further samples are taken, labeled, and sent to be tested. What were the first and subsequent samples taken?

1. A composite sample, and the others were routine samples
2. A routine sample, and the others were special samples
3. A routine sample, and the others were composite samples
4. A special sample, and the others were routine samples

1-38. When visually inspecting a fuel sample, what should be the first thing you check?

1. The color of the fuel sample
2. The aroma of the fuel sample
3. The presence of water
4. The presence of sediment

1-39. How should you visually check a fuel sample for sediment?

1. Shake it vigorously to break loose any previously undetected emulsion
2. Whirl it rapidly so the fine particles will be thrown to the outside of the sample container
3. Place the sample container on a level surface and allow the sediment to collect on the sides of the container
4. Swirl it to form a vortex that will draw the sediment to the center-bottom of the container

1-40. The contaminated fuel detector (CFD and/or CCFD) employs which of the following principles?

1. Traps solid contaminants, increasing the amount of light passing through the millipore filter
2. Traps solid contaminants, decreasing the amount of light passing through the millipore filter
3. Solid contaminants increase the weight of the top millipore filter more than the color variation, increasing the weight of the bottom one
4. The weight of the solid contaminants trapped between the millipore filters is equal to the amount of solid contaminants in the sample

1-41. Why should two millipore filters be used when a sediment test is conducted?

1. To increase the speed of the filtration
2. In case one is ripped or torn during the filtration cycle
3. To allow the sediment to be trapped between the two
4. To eliminate any fuel color effect and it increases accuracy

1-42. What size are the pores of the millipore filter?

1. .60 micron
2. .65 micron
3. .70 micron
4. .75 micron

1-43. When preparing to conduct a sediment test with the CFD/CCFD, you should fill the polyethylene bottle with how much fuel?

1. 500 ml
2. 600 ml
3. 700 ml
4. 800 ml

1-44. The light system of the CFD/CCFD should be warmed up for at least how many minutes before use?

1. 1 to 2
2. 2 to 3
3. 3 to 4
4. 4 to 5

1-45. The light intensity should be adjusted to what reading prior to measuring the millipore filter?

1. 6.0 milliamps
2. 0.6 milliamps
3. 0.06 milliamps
4. 0.006 milliamps

1-46. When measuring the millipore filters, the reading is taken in _____________ of a milliamp.

1. tenths
2. hundredths
3. thousandths
4. ten thousandths

1-47. The light intensity on the CFD/CCFD is adjusted by use of the _________________.

1. thermostat
2. photovoltaic cell
3. hydrostat
4. rheostat

1-48. If adjustment of the light bulb holder is required, what position should the filament on the light bulb be in after the adjustment is made?

1. Up
2. Down
3. Horizontal
4. Vertical

1-49. In accordance with PMS, at least how often must the CFD/CCFD be calibrated?

1. Monthly
2. Quarterly
3. Whenever a part is replaced
4. Both 2 and 3 above

1-50. What is the main function of the AEL Mk I and AEL Mk II?

1. To measure free water
2. To measure dissolved water
3. To detect salt water
4. To detect fresh water

1-51. A sample tested indicates that more than 20-ppm water is present. What additional test must you perform?

1. Test a second standard sample and double the results
2. Test another standard sample in the same manner to verify the accuracy of the first sample, and then log the results
3. Test a second sample one-half the size of the standard sample and double the results
4. Test another standard sample and divide the results by 2

1-52. At least how often must the "standards" card in the free water detector be replaced in accordance with PMS?

1. Monthly
2. Quarterly
3. Semiannually
4. Annually

1-53. What range thermometer should you use to do a flash point test on JP-5?

1. 10°F to 230°F
2. 20°F to 230°F
3. 10°F to 700°F
4. 100°F to 200°F

1-54. When conducting a flash point test and the fuel to be tested has been heated within 30° to 50°F of the expected flash point, at what multiples should you begin applying the test flame?

1. 2°F
2. 3°F
3. 4°F
4. 10°F

1-55. What does FSII mean?

1. Fuel system initial installation
2. Fuel system internal instruments
3. Fuel system icing inhibitor
4. Fuel system internal inhibitors

1-56. What type of light source, if any, should you use when operating the refractometer?

1. Fluorescent or incandescent bulb
2. Natural sunlight
3. Ultra-violet
4. None

1-57. When the FSII test is conducted, how much fuel is taken from the graduated cylinder and poured into the separatory funnel?

1. 2 ml
2. 80 ml
3. 120 ml
4. 160 ml

1-58. After adding 2 ml of water to the fuel for a FSII test, how long must the sample then be shaken?

1. 1 min
2. 2 min
3. 3 min
4. 4 min

1-59. What is the minimum use level for USN and USMC aircraft that require FSII?

1. .01%
2. .02%
3. .03%
4. .04%

1-60. Which of the following USN/USMC aircraft currently do NOT require the use of FSII?

1. S-3
2. US-3
3. SH-60
4. H-3

1-61. What instrument is used to measure the specific gravity of petroleum products?

1. Handimeter
2. Beaker
3. Gravity gage
4. Hydrometer

1-62. Which of the following is NOT considered a major pumping system?

1. Fill and transfer system
2. Stripping system
3. Jet test system
4. Service system

1-63. What is the primary use of a JP-5 storage tank?

1. Bulk stowage of JP-5
2. Amidship emergency tanks
3. Fuel for aircraft service
4. Fuel for only jet test use

1-64. What is the primary use of a JP-5 service tank?

1. To store bulk storage of JP-5
2. To store fuel for aircraft servicing
3. To store fuel from the reclaim system
4. To receive fuel from flushing operations

1-65. What section of piping connects the filling connection on the main deck with the transfer main on the seventh deck?

1. Riser
2. Downcomer
3. Branch header
4. Suction header

1-66. What is the primary purpose of the transfer main?

1. To interconnect the forward and aft storage tanks
2. To interconnect the forward and aft service tanks
3. To connect the designated contaminated tanks with the eductor
4. To interconnect the storage tanks to the service tanks

1-67. What valves are used to isolate the transfer system during secured conditions and to control the flow of JP-5 during various transfer and filling operations?

1. Downcomer valves
2. Bulkhead cutout valves
3. Service pump suction valves
4. Riser cutout valves

1-68. Transfer main branch headers connect the transfer main to _________________.

1. storage tank manifolds
2. the opposite transfer main
3. stripping pump suction headers
4. service tank manifolds

1-69. What devices are arranged in the transfer pump's discharge header to enable both purifiers to operate simultaneously using any two of the three transfer pumps?

1. Two one-way check valves
2. Two transfer pump bypass lines
3. Two cutout valves
4. T-lines

1-70. The common suction and discharge headers of the transfer pumps are interconnected with the suction and discharge headers of the service pumps. What is the purpose of these two systems being interconnected?

1. To pump fuel directly from the storage tanks to the flight deck for servicing aircraft
2. To use the higher capacity service pumps to pump fuel through the reclamation system quicker
3. To bypass the service filters
4. To use the service pumps for off-loading fuel

1-71. What system provides the capability to reclaim JP-5 received from hose flushing, tank stripping operations, and the initial flow from a FAS (Fueling-At-Sea)?

1. Stripping system
2. Service system
3. Recirculation system
4. Reclamation system

1-72. What is/are the primary use(s) of the motor-driven stripping system?

1. Remove settled water and solids from tanks
2. Completely empty tanks
3. Remove wash water from tanks
4. All of the above

1-73. What is the required height from the bottom of a tank for the motor-driven stripping tailpipe?

1. 1 in.
2. 1 1/2 in.
3. 2 in.
4. 2 1/2 in.

1-74. What is the required height from the bottom of a service tank for the hand-operated stripping tailpipe?

1. 1/4 in.
2. 1/2 in.
3. 3/4 in.
4. 7/8 in.

1-75. What system is designed to deliver clean, clear, and bright JP-5 from the service tanks to aircraft?

1. Transfer system
2. Jet test system
3. Auxiliary system
4. Service system

ASSIGNMENT 2

Textbook Assignment: "JP-5 Afloat Below Deck Systems and Operation," chapter 2, pages 2-12 through 2-65.

2-1. The service system is typically designed to be isolated into how many parts?

1. One
2. Two
3. Three
4. Four

2-2. The service tank suction tailpipes should be at least how many inches above the tank bottoms?

1. 24
2. 18
3. 12
4. 10

2-3. The service tank recirculating line terminates how far and in what position from the bottom of the tank?

1. 18 inches vertically
2. 18 inches horizontally
3. 24 inches vertically
4. 24 inches horizontally

2-4. The orifice in the service pump recirculation line allows what percent of the pump's rated capacity to recirculate back into the tank from which suction is being taken?

1. 5%
2. 10%
3. 12%
4. 15%

2-5. What is the purpose of recirculating fuel through the service pumps?

1. To lubricate the pump
2. To maintain a positive suction
3. To ensure the pump does not exceed its rated capacity
4. To keep the pump cool when no fuel is being drawn topside

2-6. From where does the jet test system receive its fuel?

1. The service pump suction header
2. The transfer main
3. The AFT service filters cross-connect line
4. The aft, port quadrant distribution riser

2-7. What system provides JP-5 to small boat filling stations?

1. Jet test system
2. Stripping system
3. Auxiliary system
4. Filter drain system

2-8. The centrifugal pump used in the JP-5 service system is rated at what capacity?

1. 20 gpm
2. 150 gpm
3. 1,100 gpm
4. 1,500 gpm

2-9. The centrifugal pump casing is divided into how many chambers?

1. One discharge and two suction
2. One suction and two discharge
3. Two discharge and two suction
4. One discharge and one suction

2-10. The centrifugal pump has four wearing rings. Two wearing rings are installed in the pump casing between the suction and discharge chambers. Where are the other two wearing rings installed?

1. On the pump shaft
2. In the discharge chamber
3. In the suction chamber
4. On the impeller

2-11. What is the purpose of wearing rings?

1. To act as bearings for the pump shaft
2. To minimize leakage between the suction and discharge chambers
3. To allow for the wear created between the impeller and pump casing
4. Both 2 and 3 above

2-12. The centrifugal pump impeller is centered and secured in the pump casing by what devices?

1. Shaft sleeves and wearing rings
2. Shaft sleeves and shaft nuts
3. Bearing caps and shaft nuts
4. Bearing caps and shaft sleeves

2-13. What devices prevent fuel from leaking out of the pump case around the pump shaft?

1. Mechanical seals
2. Shaft collars
3. Flinger rings
4. All of the above

2-14. The ball bearings on the centrifugal pump shaft are lubricated by what means?

1. The circulating JP-5
2. Self-priming oil pump
3. Grease fittings
4. Oil reservoir

2-15. Rotary vane pumps used for stripping are designed to pump approximately how many gallons per minute and at what pressure?

1. 100 gpm at 15 psi
2. 50 gpm at 50 psi
3. 200 gpm at 50 psi
4. 300 gpm at 50 psi

2-16. Rotary vane pumps used for transferring are designed to pump approximately how many gallons per minute at what pressure?

1. 100 gpm at 15 psi
2. 50 gpm at 50 psi
3. 200 gpm at 25 psi
4. 200 gpm at 50 psi

2-17. On a rotary vane pump, which component houses the ball bearings and mechanical seals?

1. Cylinder
2. Cylinder heads
3. Rotor and shaft assembly
4. Cylinder bore

2-18. To allow for the escape of liquid between the vanes and slots of the rotor, the vanes have relief grooves on the _____________.

1. forward faces
2. rear faces
3. outside tips
4. inside tips

A. Rex chain
B. Direct drive
C. Falk type-F Steelflex
D. Lovejoy

FIGURE 2-A

IN ANSWERING QUESTIONS 2-19 THROUGH 2-21, SELECT FROM FIGURE 2-A THE TYPE OF PUMP COUPLING DESCRIBED IN THE STATEMENT.

2-19. The coupling halves are cushioned by a formed rubber spider.

1. A
2. B
3. C
4. D

2-20. A flexible gridmember engages the teeth in the hubs to transmit power.

1. A
2. B
3. C
4. D

2-21. It resembles a small bicycle's sprockets placed side by side with a double wide chain connecting the two.

1. A
2. B
3. C
4. D

2-22. Which type of valve is most commonly used for throttling fuel flow?

1. Globe
2. Gate
3. High performance butterfly
4. Rotary plug

2-23. What valve design allows no metal-to-metal contact during regular operations?

1. A globe
2. A gate
3. A high performance butterfly
4. A rotary plug

2-24. What valve should be used where a straight flow with a minimum amount of restriction is desired?

1. A globe
2. A gate
3. A high performance butterfly
4. A modified globe

2-25. What component on the limitorque valve operator, operates the OPEN and CLOSE position indicator lights for the valve?

1. The handwheel
2. The console relay switch
3. The valve stem
4. The limit switches

2-26. If a one-way check valve has no directional flow arrow, how can you identify which end is the inlet?

1. It will have female threads
2. It will have male threads
3. It will have the hinge pin
4. It is the side without the hinge pin

2-27. Valve manifolds are made up of what type of modified valve?

1. Globe
2. Gate
3. One-way check
4. Rotary plug

2-28. What device ensures the disk is centered into the base of the valve body in a manifold?

1. Valve stem
2. Gate guide
3. Plug guide
4. Disk guide

2-29. What device prevents leakage around the valve stem of a manifold?

1. O-ring
2. Gasket
3. Packing
4. Plug

2-30. On a manifold, the pipe connecting the main-side valve to the tankside valve is known as what?

1. Nozzle
2. Coupler
3. Flange joint
4. Tube

2-31. When tanks are ballasted, what must be done to the tankside valve?

1. It must be pinned closed
2. It must be bolted closed
3. It must be locked closed
4. It must be tagged closed

2-32. What type of manifold should be used for tanktop valves in the stripping system?

1. Double-valved manifold
2. Single-valved manifold
3. Flood and drain manifold
4. Sliding gate manifold

2-33. Which of the following is NOT a function of the flood and drain manifold?

1. Stripping
2. Transferring
3. Ballasting
4. Deballasting

2-34. What device on the flood and drain manifold allows only one valve to be opened at a time?

1. A rotating hook locking device
2. A pinning device
3. A latch-type locking device
4. A sliding bar locking device

2-35. What are the three chambers inside the fuel filter?

1. Sump, separator, and outlet
2. Sump, separator, and inlet
3. Inlet, sump, and outlet
4. Inlet, fallout, and outlet

2-36. What components of the filter, are inserted in the threaded holes that are symmetrically arranged over the surface of the tube sheets?

1. Coalescer elements
2. Filter element mount assemblies
3. Separator elements
4. Vent lines

2-37. Leakage is prevented at the ends of the filter elements by the ________________.

1. smooth surface of the end caps forming a tight seal with rubber gaskets on the elements
2. fiber washers on the elements forming a tight seal against the knife edges on the end caps
3. end caps of the elements being assembled with fiber washers to form a tight seal
4. knife edges on the end caps projecting into the synthetic rubber gaskets on the elements

2-38. In what direction does fuel flow through the coalescer element?

1. Outside to inside
2. Inside to outside
3. Top to bottom
4. Bottom to top

2-39. When fuel flows from the coalescer elements to the separator elements, the coalesced water falls out of the fuel by gravity. In which chamber does this take place?

1. Outlet
2. Inlet
3. Fallout
4. Water receiving sump

2-40. The manhole cover(s) installed on the side of the filter allows entrance to which chamber?

1. Outlet
2. Inlet
3. Fallout
4. Water receiving sump

2-41. Fuel passing from the fallout chamber to the outlet chamber must go through the ______________________.

1. coalescer elements
2. separator elements
3. sump
4. water drain valve

2-42. The separator elements have the capability to ONLY filter solid contaminants larger than how many microns?

1. 1
2. 5
3. 10
4. 20

2-43. The rotary control valve is bolted to what part of the filter?

1. Inlet chamber
2. Fallout chamber
3. Outlet chamber
4. Water receiving sump

2-44. What devices are provided to determine the pressure drop across the filter elements?

1. Air gates
2. Pressure gages
3. Sight glasses
4. Flow indicators

2-45. What is the rated capacity of the service fuel filter?

1. 1,100 gpm
2. 2,000 gpm
3. 2,100 gpm
4. 2,400 gpm

2-46. What is the pressure drop limit on the service fuel filter?

1. 10 psi
2. 15 psi
3. 20 psi
4. 25 psi

2-47. Filter visual samples should be taken at the start of the initial flow and at what intervals thereafter?

1. Every 10 minutes
2. Every 15 minutes
3. Every 30 minutes
4. Every 60 minutes

2-48. When the automatic shutoff valve is opened by the filter discharge pressure acting under the valve seat, what provides a cushioning effect?

1. A tension spring in the lower valve chamber
2. A tension spring in the upper valve chamber
3. Fuel pressure acting on the bottom of the diaphragm
4. Fuel pressure acting on the top of the diaphragm

2-49. When the eductor causes a decrease in fuel pressure on top of the diaphragm of the shutoff valve, how will the shutoff valve be affected?

1. The filter discharge pressure will open the valve
2. The filter discharge pressure will close the valve
3. The tension spring will close the valve
4. The increase in filter discharge pressure applied to the top of the diaphragm will open the valve

2-50. What causes the automatic shutoff valve to close when the pilot valve closes?

1. Fuel pressure acting on the bottom of the diaphragm in the automatic shutoff valve
2. Fuel pressure being directed through the eductor suction line to the top of the cover chamber of the automatic shutoff valve
3. Fuel pressure being directed to the top of the diaphragm in the automatic water drain valve
4. Fuel pressure being directed to the bottom of the diaphragm in the automatic water drain valve

2-51. What are the operating positions of the rotary control valve?

1. Down and up only
2. Down and horizontal only
3. Horizontal and up only
4. Down, horizontal, and up

2-52. What valve directs filter pressure through its ports to the tops of the diaphragms of the pilot and automatic water drain valves?

1. The pilot valve
2. The automatic shutoff valve
3. The rotary control valve
4. The automatic water drain valve

2-53. When there is little to no water passing through the fuel filter and the ball float is in the DOWN position, the rotary control valve directs filter pressure to, and vents it to, which valves?

1. Directs to the top of the water drain valve and vents the top of the pilot valve
2. Directs to the bottom of the water drain valve and vents the top of the pilot valve
3. Directs to the top of the water drain valve and vents the bottom of the water drain valve
4. Directs to the top of the automatic shutoff valve and vents the top of the water drain valve

2-54. When all valves of the filter hydraulic system are open and coalesced water is draining from the sump, in what position will the ball float be?

1. Down
2. Vertical
3. Horizontal
4. Up

2-55. Under which of the following conditions will the pilot and automatic shutoff valves be closed?

1. The float is in the DOWN position with no water drainage required
2. The float is in the HORIZONTAL position and the accumulated water is draining
3. The float is in the UP position and the accumulated water is not draining fast enough
4. During normal operations

2-56. Which of the following is often the most likely cause of a filter hydraulic control system failing to operate properly?

1. Manually operated valves improperly aligned
2. The rotary control valve's tubing has obstructions or is dented
3. The automatic valves are improperly installed
4. Too much water in the fuel

2-57. During centrifugal purifier operations, where will the solid contaminants be collected after they are separated from the fuel?

1. In the heavy phase outlet
2. On the underside of the disks
3. On the outer edge of the disks
4. On the inside bowl wall

2-58. What part of the purifier acts as a pump?

1. The tubular shaft
2. The paring disk
3. The intermediate disks
4. The distribution holes in the intermediate disks

2-59. What are the ideal operating pressures of the 300-gpm centrifugal purifier?

1. 4 to 10 psi inlet and 25 psi outlet
2. 4 to 10 psi inlet and 30 psi outlet
3. 15 to 25 psi inlet and 20 psi outlet
4. 15 to 25 psi inlet and 25 psi outlet

2-60. When the purifier bowl has to be cleaned, which components allow the cover assembly to be rotated open without disconnecting the piping?

1. The cover hinge, inlet, and outlet assembly
2. The feed tube assembly and cover hinge
3. The feed tube assembly and ratchet hook
4. The cover hinge and ratchet hook

2-61. During purifier operations, impure JP-5 is directed into the bowl and purified JP-5 is directed out of the bowl by what component?

1. The seal water inlet valve
2. Centrifugal force
3. The feed tube assembly
4. The regulating tube

2-62. What component of the purifier is the shaft for the paring disk?

1. Regulating tube
2. Feed tube
3. Tubular shaft
4. Drive shaft

2-63. The feed tube screws into what device?

1. The feed tube assembly
2. The outlet tube
3. The paring disk
4. The tubular shaft

2-64. What device(s) prevents the purifier from rotating during disassembly and assembly?

1. Spring-loaded handle
2. Three handwheel cover clamps
3. Lock screws
4. Ratchet hook catch

2-65. What component acts as a shock absorber to absorb vertical thrust of the spindle shaft when the purifier is started?

1. Horizontal spring
2. Vertical spring
3. Horizontal ball bearing
4. Vertical ball bearing

2-66. A total of how many sets of ball bearings support the spindle assembly?

1. Two
2. Three
3. Five
4. Seven

2-67. What components help reduces vibration in an operating purifier?

1. Four vertical springs
2. Six vertical springs
3. Four horizontal springs
4. Six horizontal springs

2-68. If the bowl of the purifier is rotating at 4100 rpm, what should the rpm of the speed counter be?

1. 41
2. 410
3. 100 to 130
4. 146 to 152

2-69. What force or device moves the oil in the oil lubrication compartment to supply lubricating oil to the bearings and gears?

1. An oil pump
2. The worm wheel gear
3. A flinger ring
4. A slinger

2-70. What component of the tubular shaft, keeps it off the bowl shell and give circular motion to the feed inlet liquid?

1. 6 outer slots
2. 12 outer holes
3. 12 inner spacers
4. 3 unequal pins

2-71. How are the holes in the intermediate disks aligned vertically in the bowl shell?

1. The notch on the inward lip at the top of each disk interlocks with the key on the tubular shaft
2. The notch on the outer lip at the bottom of each disk interlocks on the tubular shaft
3. The notch on the top on each disk is interlocked with a key on the feed tube assembly
4. The notch at the top of the tubular shaft interlocks with a key on each disk

2-72. What is the normal number of intermediate disks in the disk stack of a 200-gpm purifier?

1. 127
2. 150
3. 175
4. 186

2-73. Which of the following is the ONLY disk, that does NOT have holes around its base?

1. Disk #1
2. Disk #127
3. Bottom disk
4. Top disk

2-74. Which disk provides a rotating casing for the centripetal pump?

1. Top disk
2. Coupling disk
3. Intermediate disk
4. Paring disk

2-75. The disk stack is compressed to the correct tension by tightening the ______________.

1. spindle nut
2. coupling nut
3. coupling ring
4. discharge ring

ASSIGNMENT 3

Textbook Assignment: "JP-5 Below Deck Systems and Operation," and "JP-5 Afloat Flight Deck Systems and Operation," chapters 2 and 3, pages 2-65 through 3-24.

3-1. What unique characteristic does the feed tube assembly, coupling ring, and coupling nut all have?

1. Light in weight
2. Each has a serial number to match it to a specific purifier
3. Left-handed threads
4. Right-handed threads

3-2. Each purifier is furnished with seven discharge rings. The inside diameters range from ________________________.

1. 220 millimeters to 280 millimeters in 10 millimeter increments
2. 220 centimeters to 250 centimeters in 5 centimeter increments
3. 220 millimeters to 250 millimeters in 5 millimeter increments
4. 220 millimeters to 227 millimeters in 1 millimeter increments

3-3. When starting the purifier, it should come up to operating speed within how many minutes?

1. 5
2. 7
3. 9
4. 11

3-4. When the purifier is in the standby mode, how often should you check the inlet-outlet housing and bowl cover to make sure they are cool to the touch?

1. Every 5 minutes
2. Every 7 minutes
3. Every 10 minutes
4. Every 15 minutes

3-5. The purifier must be cleaned before the wet cake (accumulated solids) exceeds 30 pounds or what thickness?

1. 1/4 in.
2. 1/2 in.
3. 1 1/4 in.
4. 1 1/2 in.

3-6. What type of gage is normally installed on the suction side of a pump?

1. Simplex
2. Compound
3. Differential
4. Duplex

3-7. Which type of tanks, located between voids, is an integral part of the ship's underwater protective system?

1. Wing
2. Deep centerline
3. Double-bottom
4. Peak

3-8. Why are twin wing tanks emptied and filled as a unit?

1. The rate of flow is increased
2. To preserve the list and trim of the ship
3. The rate of flow is decreased
4. To lessen the chance of contamination

3-9. The top of a double-bottom tank is also the __________________.

1. outer shell of the ship
2. vertical bulkhead of the pumproom
3. inner skin of the ship
4. deck of the bilge

3-10. The JP-5 storage tanks are used for bulk storage of JP-5. What is the difference, if any, in the JP-5 in a service tank compared to JP-5 in a storage tank?

1. It passed through a filter or centrifugal purifier
2. It was filled directly from the refueling station downcomer
3. It contains clean JP-5 defueled from defueled aircraft
4. None

3-11. What device prevents air pressure from building up or a vacuum from forming in a JP-5 tank when the tank is being emptied or filled?

1. A service suction pipe
2. A transfer suction pipe
3. An air escape riser
4. An overflow line

3-12. Why should you be concerned about ship's side cleaners, spray painting near tank air escape vents?

1. The paint could get in the line and contaminate the fuel
2. The paint will mix with the JP-5 and lower its flash point
3. The paint could block the flow of air by clogging the vent's screens
4. The paint will dissolve the grease applied during PMS

3-13. What device is installed in the overflow line to prevent overflow from the overflow tank going into another storage tank?

1. Globe valve
2. One-way check valve
3. Gate valve
4. Butterfly valve

3-14. Which of the following fittings is installed at the lower end of a sounding tube?

1. Brass vortex plate
2. Striker plate
3. Brass non-vortex plate
4. Bellmouth fitting

3-15. Which of the following devices is/are installed in the tank at the end of a fill and suction tailpipe?

1. Splash plate
2. Nonvortex fitting
3. Both 1 and 2 above
4. Striker plate

3-16. What is the specified fill rate of JP-5 storage tanks?

1. 500 gpm
2. 400 gpm
3. 300 gpm
4. 200 gpm

3-17. What tanks are the first to be emptied when transferring fuel internally and the last to be filled when receiving fuel aboard?

1. Overflow tanks
2. Service tanks
3. Contaminated tanks
4. Peak tanks

3-18. Where do overflow tanks overflow to when they are full?

1. Other overflow tanks
2. The contaminated tank
3. Overboard
4. Bilge sump tank

3-19. Each service tank has a recirculating line installed horizontally in the opposite end from the suction tailpipe. How far off the bottom of the tank is the recirculating line installed?

1. 12 in.
2. 18 in.
3. 24 in.
4. 26 in.

3-20. Before you enter any JP-5 tank for inspection or cleaning, the tank must be certified safe for entry by whom?

1. The below decks CPO
2. V-4 division LCPO
3. V-4 division officer
4. The gas-free engineer

3-21. The Gems TLI transmitter mounted vertically within the tank is comprised of magnetic reed switches. At what intervals are the switches tapped into the transmitter?

1. 1 in.
2. 2 in.
3. 3 in.
4. 4 in.

3-22. The calibrate potentiometer in the primary receiver is adjusted to what amount of power supply output?

1. 10 volts ac
2. 10 amps ac
3. 10 volts dc
4. 10 amps dc

3-23. What operates the tap switches in the transmitter of a Gems TLI?

1. Current in the potentiometer
2. The cable system
3. The slosh dampener
4. A magnet in the float

3-24. The tap switches are arranged so voltage drops are read at the receiver after how much float travel?

1. Every 1/4 in.
2. Every 1/2 in.
3. Every 3/4 in.
4. Every 7/8 in.

3-25. Included in the primary receiver housing are the dc power supply, electrical slosh dampening control, all alarm controls, and the ________________.

1. Secondary receiver
2. Indicating meter
3. Ac power supply
4. Sounding gage

3-26. After calibration, the toggle switch is held in the FULL REF position and a full-scale meter reading is observed. What should this reading indicate?

1. A ground in the transmitters
2. A ground in the receivers
3. Bad electrical connections
4. Cables and electrical connections are good

3-27. Why is a capacitor connected across the indicating meter of a TLI?

1. To prevent meter fluctuation caused by sloshing in the tank
2. To prevent a power surge from damaging the indicating meter
3. To indicate a low power supply
4. To indicate high voltage

3-28. The alarm control system (SENS PAK) is normally used for indicating what factor(s) in the tanks?

1. High level
2. Low level
3. Both 1 and 2 above
4. Overflow

3-29. Which SENS PAK alarm control adjustment, substitutes the float simulator circuit for the transmitter in the indicating meter circuit for alarm adjustment?

1. Normal simulate switch
2. Float simulator potentiometer
3. High alarm potentiometer
4. Low alarm potentiometer

3-30. On the mimic diagram of the JP-5 control console, what color is used to indicate the stripping system?

1. Purple
2. Green
3. Red
4. Black

3-31. What manual contains the JP-5 systems operating procedures for a specific ship?

1. Technical Manual for Shipboard Aviation JP-5 Fuel Systems
2. Aviation Fuels Operational Sequencing System (AFOSS)
3. NAVSEA Technical Manual, Chapter 542, Gasoline and JP-5 Systems
4. Aircraft Refueling NATOPS Manual

3-32. What copy of the AFOSS would be found in a filter room?

1. Division officer's copy
2. Work center copy
3. Workstation copy
4. Master copy

3-33. What devices are used to completely empty JP-5 and ballast tanks that have been ballasted before receiving fuel?

1. Main eductors
2. Transfer pumps
3. Auxiliary pumps
4. Stripping pumps

3-34. Before fuel can be pumped into any tank in a nest of storage tanks, what condition must be met?

1. The service tanks must be full
2. The fuel must be purified
3. The overflow tank for that nest must be empty
4. All other tanks in that nest must be empty

3-35. Typically, what is the minimum number of tanks that should be open when receiving fuel?

1. Two
2. Four
3. Six
4. Eight

3-36. When you are determining the duration of a receiving operation, which of the following is NOT a consideration?

1. Speed of the ship
2. Amount to be received
3. Pumping rate of the tanker
4. Maximum receiving rate

3-37. Underway refueling stations should be manned at least how many minutes before the fueling time?

1. 15 min
2. 30 min
3. 45 min
4. 60 min

3-38. Which tanks are normally filled first during a refueling operation?

1. Double-bottom
2. Wing
3. Service
4. Overflow

3-39. Where is the initial flow of JP-5 directed during an underway replenishment?

1. Service tanks
2. Peak tank
3. Contaminated settling tanks
4. Overboard

3-40. Overflow mains leading into overflow tanks are designed to allow what flow rate of overflow into overflow tanks?

1. 1,000 gpm
2. 1,500 gpm
3. 2,000 gpm
4. 2,500 gpm

3-41. After the initial samples are obtained, how often are samples taken when on-loading fuel?

1. Every 15 min
2. Every 20 min
3. Every 30 min
4. Every 60 min

3-42. A fuel sample fails to meet the cleanliness requirements during a refueling operation. Who makes the final decision on acceptance or rejection of the fuel?

1. The person taking the sample
2. The quality surveillance lab supervisor
3. The division officer
4. The commanding officer

3-43. What is the settling time for JP-5 per foot of height?

1. 1 hr
2. 6 hr
3. 3 hr
4. 12 hr

3-44. When underway, JP-5 service tanks are stripped daily and what other times?

1. Every 3 hours
2. Every 6 hours
3. Just before use
4. Just before pulling inport

A. Stripping main valves to the stripping pump suction header

B. Flood and drain manifold valve to the stripping main

C. Single-valved stripping manifold, the valve to the tank to be stripped

D. Stripping pump discharge valve

E. Cutout valve from the discharge header to the contaminated storage tank

F. Stripping pump inlet valve

FIGURE 3-A

IN ANSWERING QUESTION 3-45, REFER TO FIGURE 3-A.

3-45. Select the sequence in which you should open the valves before starting the storage tank stripping pumps.

1. B, C, A, D, F, E
2. C, B, A, E, F, D
3. C, B, A, F, D, E
4. A, B, C, F, D, E

3-46. The pipe capacity is 120 gallons and the pump capacity is 50 gallons a minute. Approximately how many minutes must elapse after the stripping operation has started on the next storage tank before a conclusive sample of JP-5 can be taken?

1. Five
2. Four
3. Three
4. Two

3-47. When starting the purifier with a dirty bowl, how should you minimize the vibration?

1. By admitting seal water after pressing the START button
2. By filling the purifier with fuel from the transfer pumps
3. By starting the transfer pumps before you start the purifier
4. By pumping out the sump tank to make sure all the fuel in the purifier has drained out

3-48. The motor-driven stripping pump is used to consolidate the last 24 inches remaining in the storage tanks. The pump's discharge header is aligned so that this fuel is discharged into the ______________.

1. stripping tailpipes
2. overflow tank
3. transfer main
4. contaminated settling tank

A. Service tank
B. Downcomer
C. Service pump discharge header
D. Transfer main
E. Transfer pump discharge header
F. Filling connection
G. Service pump

FIGURE 3-B

IN ANSWERING QUESTION 3-49, REFER TO FIGURE 3-B

3-49. Select the correct sequence of flow when off-loading JP-5 from a service tank.

1. A, G, C, E, D, B, F
2. A, C, G, E, D, B, F
3. A, G, C, E, B, D, F
4. A, C, G, B, E, D, F

3-50. Which of the following operations requires flushing the entire JP-5 service system?

1. Shipyard overhaul
2. Major rework on the system
3. Drainback for maintenance
4. Each of the above

3-51. Where are samples of JP-5 obtained when flushing the service system?

1. From a test connection on the pressure fueling nozzle
2. From the telltale valve on the double-valved manifold
3. From the sample connection in the aft-service pump discharge header
4. Both 2 and 3 above

3-52. What is the Navy's largest pollution problem?

1. Air pollution
2. Noise pollution
3. Water pollution
4. Oil pollution

3-53. Which of the following is NOT a correct statement about the functions of the CLA-VAL fuel/defuel valve?

1. It acts as an emergency shutoff valve
2. It evacuates the entire piping system
3. It maintains a constant discharge pressure
4. It relieves discharge pressure rising above a predetermined level

3-54. In the main valve, the fueling valve and defueling valve each uses a well supported and reinforced diaphragm as its operating means. Normally each valve is in what position?

1. The fueling valve is spring- loaded open and the defueling valve is held open by its weight
2. The fueling valve is spring- loaded closed and the defueling valve is held open by its own weight
3. The fueling valve is held closed by its own weight and the defueling valve is spring-loaded open
4. The fueling valve is held open by its own weight and the defueling valve is spring-loaded closed

3-55. Which valve in the CLA-VAL unit controls the delivery pressure when the main valve is in the fueling mode?

1. Fueling pressure relief control valve
2. Defueling pressure relief control valve
3. Pressure reducing control valve
4. Hytrol valve

3-56. Spring action holds which of the following valves open?

1. Fueling pressure relief control valve
2. Defueling pressure relief control valve
3. Defueling main valve
4. Pressure reducing control valve

3-57. Which valve shifts the CLA-VAL unit from the defuel to the fuel mode of operation, and from the fuel to the defuel mode of operation?

1. SOPV
2. Hytrol valve
3. Defueling valve
4. Pressure reducing control valve

3-58. Which valve prevents the fuel hose from charging too quickly by controlling the reaction time of the fueling valve?

1. Flow control valve
2. SOPV
3. Fueling pressure relief control valve
4. Pressure reducing control valve

3-59. The ejector strainer is located between the inlet port and the three discharge ports. It consists of an orifice plug and what size mesh-monel screen?

1. 20
2. 40
3. 60
4. 100

3-60. When there is an increase in the downstream pressure that is high enough to overcome the force of the spring in the defueling pressure relief control valve, which of the following valves will open?

1. The SOPV, both relief valves, and the defueling valve
2. The defueling pressure relief control valve and the defueling valve
3. The pressure reducing control valve and both pressure relief control valves
4. The flow control valve

3-61. When adjusting the delivery pressure on the CLA-VAL station, what pressure should you adjust the pressure reducing control valve to first?

1. 10 psi higher than the desired delivery pressure
2. 10 psi lower than the desired delivery pressure
3. At the desired delivery pressure
4. 0 psi

3-62. When adjusting the delivery pressure on the CLA-VAL station, to what pressure should you adjust the defuel valve's pressure-relief control valve?

1. 10 psi higher than the delivery pressure
2. 7 1/2 psi higher than the delivery pressure
3. 5 psi higher than the delivery pressure
4. 2 1/2 psi higher than the delivery pressure

3-63. When the final adjustment on the CLA-VAL is made, at what pressure will the fueling valve's pressure relief control valve be set?

1. 10 psi higher than the delivery pressure
2. 7 1/2 psi higher than the delivery pressure
3. 5 psi higher than the delivery pressure
4. 2 1/2 psi higher than the delivery pressure

3-64. The quick-disconnect has female threads on one end to accept the hose coupling. What device(s) is/are used to connect the other end to the male end of the nozzle adapter?

1. 3/8-inch nuts and bolts
2. A female ball bearing quick release
3. A pie flange
4. Swedge locks

3-65. What part of the pressure-refueling nozzle houses the operating linkage?

1. Collar assembly
2. Nose seal assembly
3. Body
4. Poppet

3-66. Which pressure-fueling nozzle is constructed with the HEPCV (Hose-end Pressure Control Valve) as an integral component of the unit?

1. D-1 nozzle
2. D-1R nozzle
3. MD-3 nozzle
4. OPW nozzle

3-67. What nozzle(s) is (are) an authorized gravity nozzle used for refueling aircraft when other nozzles is (are) NOT appropriate for the task?

1. MD-3 nozzle only
2. OPW nozzle only
3. Both 1 and 2
4. D-1R nozzle only

3-68. In a swing joint, what device connects the continuity wire to the spider assembly?

1. An amphonel gasket
2. A spider joint
3. A nylon collar
4. An amphonel stud

3-69. What device prevents the hose reel from moving when it is NOT in use?

1. A gear chain
2. A manual brake
3. A locking pin
4. An automatic catch

3-70. What is the standard length for a completely assembled 2 1/2-inch collapsible hose?

1. 20 ft
2. 25 ft
3. 40 ft
4. 50 ft

3-71. What size fuel hose is preferred for JP-5 defueling operations?

1. 1 1/2-inch collapsible hose
2. 1 1/2-inch non-collapsible hose
3. 2 1/2-inch collapsible hose
4. 2 1/2-inch non-collapsible hose

3-72. After cutting back and pressure testing a fuel hose, which of the following actions must you take before fueling aircraft with that hose?

1. Flush the hose
2. Sample the hose
3. Test the sample on the CFD/CCFD to see if it is acceptable
4. Each of the above

3-73. What will happen to the solenoid on the CLA-VAL if continuity is broken in any place?

1. It will de-energize with a 5-second delay
2. Its warning buzzer will emit an audible alarm
3. It will immediately de-energize
4. It will remain energized until the toggle switch on the nozzle is placed in the OFF position

3-74. If a hose ruptures while you are fueling and the continuity circuit is NOT broken, what will happen?

1. The hose will shift into the defuel mode
2. The defuel pump on the station will automatically shut off causing the CLA-VAL to shift to the defuel mode
3. The fuel hose will self-seal
4. Fuel will continue to pump through the hose and out the rupture

3-75. What is the rated capacity and operating pressure of the CLA-VAL fueling station's defuel pump?

1. 50 gpm, 50 psi
2. 100 gpm, 15 psi
3. 200 gpm, 50 psi
4. 300 gpm, 50 psi

ASSIGNMENT 4

Textbook Assignment: "JP-5 Afloat Flight Deck Systems and Operation," and "Shipboard Aviation Lube Oil and MOGAS Systems," chapters 3 and 4, pages 3-24 through 4-27.

4-1. Which of the following is NOT applicable to portable pumps used on the flight deck for fueling operations?

1. The Plane-to-Plane Fuel Transfer Cart is the only acceptable portable method of hot-refueling aircraft
2. The pumps are air motor-driven internal gear
3. The pumps are air-driven twin-diaphragm operated
4. The air-driven pumps can accommodate either the 1 1/2 or 2 1/2-inch fueling or defueling hoses

4-2. Which of the following component(s) is/are mandatory equipment required in a Plane-to-Plane Fuel Transfer Cart?

1. M-8 Wilden pump
2. 1 1/2 or 2 1/2-inch fuel hoses
3. Supply air hoses and a pressure gage
4. Fuel-filtering unit

4-3. Velcon Aquacon filter cartridges used in a Plane-to-Plane Fuel Transfer Cart are designed to remove what (a) amount of water and (b) what percentage of particulate matter?

1. (a) 5 ppm and (b) 98%
2. (a) 5 ppm and (b) 100%
3. (a) 10 ppm and (b) 98%
4. (a) 10 ppm and (b) 100%

4-4. What person has the final approval for authorizing a Plane-to-Plane Fuel Transfer request?

1. V-4 Maintenance Officer
2. V-4 Division Officer
3. ACHO
4. Air Officer

4-5. Portable defuel pumps are powered by what force?

1. The service system riser pressure
2. The power take-off (PTO) of a tow tractor
3. The ship's low-pressure air
4. The ship's high-pressure air

4-6. The checker requests the fuel load from an aircraft. The pilot responds with four fingers held vertically followed by three fingers held horizontally. How much fuel is in the aircraft?

1. 4,300 gallons
2. 4,300 pounds
3. 4,800 pounds
4. 430 pounds

A. TOP OFF
B. FUEL STATUS
C. FUEL PROBE OUT
D. FUEL PROBE IN
E. CLOSE DUMP VALVE
F. CUT FUEL

FIGURE 4-A

IN ANSWERING QUESTIONS 4-7 THROUGH 4-10, SELECT FROM FIGURE 4-A THE REFUELING HAND SIGNAL THAT COSELY REPRESENTS THE DESCRIPTION IN THE STATEMENT.

4-7. Designated by patting the top of the head/cranial.

1. A
2. B
3. C
4. D

4-8. Designated by the arm extended out horizontally at chest level, then brought in to cross the chest.

1. B
2. C
3. D
4. E

4-9. With your arms at chest level, it is designated by pointing the finger of one hand to the elbow of the other arm.

1. C
2. D
3. E
4. F

4-10. Designated by the fingers of one hand pointing at the throat, while at the same time moving that hand sideways continuously.

1. D
2. E
3. F
4. A

4-11. What is the minimum number of personnel required to fuel an aircraft?

1. Five
2. Four
3. Three
4. Two

4-12. If you are fueling an aircraft in the hangar bay and there is no roving fire-fighting equipment manned, you must have a portable fire extinguisher nearby. What equipment used on the flight deck normally satisfies this requirement?

1. The flight deck sprinkler system
2. The catapult steam smothering system
3. The flight deck AFFF stations
4. The flight deck P-25

4-13. What is the maximum time a fuel hose can be used without sampling and testing, while still being used to fuel aircraft?

1. 8 hr
2. 12 hr
3. 24 hr
4. 48 hr

4-14. Which of the following aircraft is the EXCEPTION to hot refueling (engines "ON") with the canopy opened?

1. F/A-18
2. EA-6B
3. F-14D
4. AV-8B

4-15. When hot refueling helicopters, which of the following statements is NOT correct?

1. Side doors/windows (if installed) will remain closed during the entire refueling evolution
2. The aircraft will NOT be refueled if it fails pre-check
3. Doors/rear cargo doors/windows (if installed) on opposite side from refueling adapter may be opened
4. Personnel approaches to the helo hot refueling area, is directed by the LSE

4-16. What aircraft still in the active inventory requires the use of the aerial refueling probe for hot refueling on the flight deck and ashore installations?

1. A-3 Whale
2. A-4 Skyhawk
3. A-6 Intruder
4. A-7 Corsair

4-17. When hot refueling an A-4 aircraft, which of the following statements is NOT correct?

1. The operation is only performed when operational necessity dictates
2. Fueling will secure immediately if a fuel leak occurs
3. Two tractors are used as a maintenance platform for hot refueling the aircraft
4. The flow control handle to the pressure fueling nozzle is locked closed while the hot refueling adapter is attached to the aircraft's probe

4-18. The grounding wire connecting sequence for the pressure-fueling nozzle is from the ________________.

1. deck to the aircraft
2. aircraft to the deck
3. deck to the nozzle
4. nozzle to the deck

4-19. The flow control handle of the pressure-refueling nozzle must be placed in the "FULLY OPEN" or "FULLY CLOSED" position. Why is the handle NOT allowed to "float" during refueling?

1. To prevent excessive wear on the aircraft adapter and the nozzle poppet
2. To ensure the station will go into the defuel mode if an emergency occurs
3. The time it takes to refuel the aircraft will double
4. The possibility of contamination is increased

4-20. Who is responsible for ensuring the aircraft is fueled to the correct fuel load?

1. Crewleader
2. Yellow shirt
3. Air Boss
4. Plane captain

4-21. Which of the following statement(s) is/are CORRECT concerning hot refueling?

1. No static samples can be taken
2. Pilot-in-command changes are NOT permitted
3. The aircraft can NOT be refueled if it fails pre-check
4. All of the above

4-22. To defuel an aircraft, a written request must be submitted to and approved by whom?

1. Air Boss
2. Aircraft Handling Officer
3. V-4 Division Officer
4. Control talker

4-23. Prior to defueling an aircraft, a sample must be drawn and tested for which of the following?

1. Flash point
2. Free water
3. Sediment
4. All of the above

4-24. Whose job is it to check the fuel loads on incoming aircraft?

1. Crewleader
2. Flight deck chief
3. Nozzleman
4. Checker

4-25. What is the rated capacity of the rotary vane lube oil pump and its operating pressure?

1. 20 gpm, 15 psi
2. 20 gpm, 70 psi
3. 50 gpm, 20 psi
4. 50 gpm, 50 psi

4-26. What type of ship are you more likely to work with a DE-LAVAL rotary screw lube oil pump?

1. LPH
2. LHD
3. CV
4. CVN

4-27. What type of ship uses the DE-LAVAL rotary screw pump as a JP-5 transfer pump?

1. LHA
2. LPH
3. LPD
4. LHD

4-28. What is used to determine the frequency of maintenance required on the lube oil pump?

1. MDS
2. PMS
3. IRS
4. PQS

4-29. What is the capacity of the lube oil storage tank on a CVN-class ship?

1. 500 gallons
2. 1,500 gallons
3. 2,000 gallons
4. 6,000 gallons

4-30. To safely shift from one strainer to another on the lube oil system, what is the maximum differential pressure that can NOT be exceeded?

1. 1 psi
2. 1 1/2 psi
3. 2 1/2 psi
4. 3 psi

4-31. When transferring lube oil to the catapults, what circuit is used to established communication between V-2 and V-4 personnel?

1. 4JG
2. 5MC
3. 1JV
4. X40J

4-32. The aviation lube oil system is operated according to what system?

1. ALOSS
2. AFOSS
3. CFOSS
4. EOSS

4-33. Which of the following is NOT an authorized method of on-loading lube oil?

1. With the drums raised above the fill connection, use a large funnel screwed into the filling connection, then start pouring the oil
2. With a suction hose attached to a brass pipe long enough to reach the bottom of the drum and rigged to the fill connection, use the lube oil pump to siphon the oil from the drums
3. Use an M-4 pump to provide suction from the hose attached to a brass pipe long enough to reach the bottom of the drum, and together with the lube oil pump, siphon the oil through the drums and the fill connection
4. Using a lube oil truck placed on the pier and with a direct line attached to the fill connection, use the pump on the truck to boost the oil to the storage tank

4-34. When taking on lube oil, the tank(s) should not be filled beyond what capacity?

1. 80%
2. 85%
3. 90%
4. 95%

4-35. The MOGAS system is operated according to what system?

1. CFOSS
2. EOSS
3. AFOSS
4. ALOSS

4-36. Why does gasoline float on water?

1. Unit by unit, gasoline weighs less than water
2. Unit by unit, gasoline weighs more than water
3. Atmospheric pressure has more of an effect on water
4. Water is lighter than gasoline

4-37. Gasoline seawater compensated systems are designed to be full at all times to prevent what occurrence?

1. The gasoline from overflowing
2. Over-pressurizing the tanks
3. The buildup of contaminants
4. Explosive mixtures forming in air pockets

4-38. Which of the following is NOT a part of the seawater compensated tanks used for bulk storage onboard LHA and LPD ships?

1. Each tank consists of a draw-off tank located inside of an outer tank
2. The draw-off tank and outer storage tank are inter-connected by a sluice pipe to function as one tank
3. The tanks are vented at the filling connection for replenishment, and at the station nozzle prior to vehicle refueling
4. The tanks consist of a single tank and does NOT require a draw-off tank

4-39. Which of the following is NOT part of the inert gas compensated storage tanks?

1. Uses CO_2 as a protective blanket over the gasoline
2. Used to protect and prevent air from mixing with gasoline vapor by reducing the percentage of oxygen
3. Uses CO_2 exclusively near electrical equipment because it is non-corrosive
4. CO_2 is the primary agent used aboard LST ships

4-40. When cofferdams are charged with carbon dioxide, what percentage of inertness must be maintained?

1. 50%
2. 35%
3. 30%
4. 25%

4-41. When cofferdams are charged with nitrogen, what percentage of inertness must be maintained?

1. 25%
2. 50%
3. 75%
4. 85%

4-42. The nitrogen inerting pressure relief valve for the cofferdam is set at what psi?

1. 7 psi
2. 10 psi
3. 14 psi
4. 50 psi

4-43. Constant pressure is maintained in the automatic pressure regulating system by balancing the spring tension in the pilot valve against what pressure?

1. The spring pressure in the main valve
2. The ejector strainer spring pressure
3. The venturi throat pressure
4. The station discharge pressure

4-44. What device prevents chatter of the main valve in the pressure regulating system?

1. The venturi
2. The ejector strainer assembly
3. The recirculating line
4. The reinforced diaphragm in the main valve

4-45. What is the function of the control valve in the automatic pressure regulating system?

1. To control discharge pressure
2. To reduce the violence with which pump pressure is admitted to the main valve cover chamber
3. To close the main valve during a sudden buildup in downstream pressure
4. To direct fuel flow to the venturi

4-46. A recirculating line on the delivery side of the venturi tubes returns what percent of the capacity of the booster pump?

1. 3%
2. 5%
3. 7%
4. 10%

4-47. How often should the regulating valve of the MOGAS automatic pressure-regulating system be completely dismantled and thoroughly cleaned?

1. Monthly
2. Quarterly
3. Semi-annually
4. Annually

4-48. How often should the gages used in the pressure-regulating valve system be removed, cleaned, and calibrated?

1. Every month
2. Every 3 months
3. Every 6 months
4. Every 12 months

4-49. What is the cofferdam normally filled with for protection?

1. Water
2. Gasoline
3. CO_2 or N_2
4. JP-5

4-50. If inerting with CO_2, what is the maximum tank-top pressure regardless of the amount of gasoline in the tank?

1. 0 psi
2. 1 psi
3. 3 psi
4. 4 psi

4-51. What device connects the outer tank to the draw-off tank?

1. A sluice pipe
2. A diffuser
3. A cross connect
4. The outer tank service riser

4-52. What gasoline tank is the first to be filled and last to be emptied of MOGAS?

1. Outer tank
2. Cofferdam
3. Saddle tank
4. Draw-off tank

4-53. The drain tank stores contaminated MOGAS and water that is filtered or separated out of the MOGAS. Inside what tank is the drain tank located?

1. Draw-off tank
2. Cofferdam
3. Outer tank
4. Saddle tank

4-54. When the gasoline storage tanks are 100% full of seawater, what will the differential pressure gage read?

1. 100
2. 4
3. 2
4. 0

4-55. What component(s) is/are NOT part of the static-head type gauging system used in MOGAS tanks?

1. Remote reading tank liquid level indicating system lower sensing heads
2. Remote reading tank liquid level indicating system upper sensing heads
3. Diaphragm or bellows sealed sensing head that connects to differential pressure indicators through liquid filled tubing
4. The differential pressure indicator is calibrated in pounds of liquid

4-56. Which of the following is NOT a basic unit of the differential gage used in the MOGAS static-head type gauging system?

1. Bellows
2. Magnetic float
3. Torque tube
4. Dial mechanism

4-57. What component(s) is/are NOT part of the Gems TLI system used in MOGAS tanks?

1. Magnetic float
2. Transmitter or sensor
3. Primary and secondary receivers
4. Bellows

4-58. What is unique about the float used in a MOGAS system TLI?

1. It sinks in water
2. It sinks in fuel
3. It does not contain a magnet
4. It contains bellows

4-59. What is the rated capacity of the MOGAS transfer pumps used in LPD-class ships?

1. 100 gpm
2. 110 gpm
3. 160 pgm
4. 220 gpm

4-60. Seawater compensating pumps used in MOGAS systems have an effective range capacity of how many gallons per minute?

1. 100 to 220
2. 35 to 60
3. 30 to 40
4. 10 to 30

4-61. Electric pumps used to supply gasoline to the MOGAS fueling stations have an effective range capacity of how many gallons per minute?

1. 10 to 30
2. 30 to 50
3. 35 to 160
4. 100 to 220

4-62. Seawater leak-off pumps have a rated capacity of how many gallons per minute?

1. 100
2. 50
3. 30
4. 10

4-63. What device ensures back-pressure is maintained on the tanks to force gasoline to the suction side of the gasoline pumps?

1. A priming pump
2. An elevated loop in the overboard discharge line
3. A venturi installed in the discharge line
4. The downsized discharge piping

4-64. To what pressure is the outer jacket of the double-walled piping pressurized with inert gas?

1. 15 psi
2. 12 psi
3. 5 psi
4. 3 psi

4-65. What device is provided in the bellows of the double-walled piping to inspect for fluid in between the walls of the piping?

1. A bolted manhole cover
2. An easy-open hatch
3. Sight glasses
4. Drain plugs

4-66. What device is designed to break the siphoning effect of the overflow loop?

1. A swing check valve
2. A sight glass
3. A spectacle flange
4. A vent line

4-67. At what distance should the MOGAS filling (on-loading) connection be from high frequency transmitting antennas or liquid oxygen outlets?

1. 10 feet
2. 15 feet
3. 25 feet
4. 50 feet

4-68. Why is a metal bellows used instead of fiber packing in the sylphon packless globe valve?

1. The fiber packing shrinks or deteriorates
2. The metal bellows never requires replacement
3. The fiber packing will hold a static charge
4. The metal bellows will not corrode

4-69. Which of the following is NOT a correct statement about the CLA-VAL backflow preventer used in the MOGAS system?

1. It inter-connects the MOGAS system with the fresh water system
2. It is an acceptable method for safeguarding against the hazards of contamination from MOGAS fuel
3. It is NOT easily field tested and maintenance is impossible
4. It operates automatically and efficiently at either high or low pressures

4-70. Which of the following is NOT an authorized portable container used onboard ships for storing gasoline?

1. 1-gallon plastic container
2. 5-gallon safety can
3. 55-gallon drums
4. Bladders

4-71. Which of the following is NOT an application of why portable methods of storing gasoline are provided on board ships?

1. HLU-19 bomb hoists
2. K-12 Crash Saw
3. Unmanned Aerial Vehicles (UAVs)
4. Ship's boiler plants

4-72. What potentiometer of the (Portable Inertness Analyzer) PIA is used for calibrating the unit?

1. Zero
2. Current
3. Sensitivity
4. Galvanometer

4-73. What potentiometer of the PIA is used to set the unit to 150 milliamps?

1. Zero
2. Current
3. Sensitivity
4. Galvanometer

4-74. Which method is NOT the proper way of re-activating the carbon inside the vapor absorber of the PIA?

1. Thoroughly flushing the carbon with fresh water
2. Allowing steam to pass through the carbon for 1 hour
3. Prior to reactivation, the cartridge must be filled with carbon
4. After every 50 sample analysis the carbon is reactivated

4-75. Which analyzer is used for detecting flammable gases or vapors in MOGAS spaces?

1. Oxygen indicator
2. Combustible gas indicator
3. Portable inertness analyzer
4. Drager unit (pump)

ASSIGNMENT 5

Textbook Assignment: "Shipboard Aviation Lube Oil and MOGAS Systems", and "Shorebase Fuel Systems and Operation," chapters 4 and 5, pages 4-27 through 5-38.

5-1. Which analyzer is used for detecting oxygen deficiency in the atmosphere where personnel work?

1. Oxygen Indicator
2. Combustible Gas Indicator
3. Portable Inertness Analyzer
4. Drager Unit (Pump)

5-2. What type(s) of ventilation should you use as a last resort in MOGAS spaces?

1. Natural ventilation
2. Portable air-driven blowers
3. Portable water-driven blowers
4. Portable electric explosive-proof motor driven blowers

5-3. When using N_2 to inert MOGAS double-walled piping, what is the pressure relief valve set at?

1. 3 psi
2. 4 psi
3. 7 psi
4. 14 psi

5-4. When using N_2, what pressure is the cofferdam pressure relief valve set at?

1. 3 psi
2. 4 psi
3. 7 psi
4. 14 psi

5-5. How long after the fixed CO_2 system is activated will the CO_2 actually be discharged?

1. 5 sec
2. 10 sec
3. 15 sec
4. 20 sec

5-6. When the CO_2 flooding system is activated, which of the following actions will NOT automatically happen?

1. A warning bell will ring in the space
2. A visual alarm will show outside the space
3. The electrically operated hatches will open
4. The ventilation motors will stop

5-7. What is the minimum percentage of oxygen required inside a confined space for it to be considered safe?

1. 19.5%
2. 20.9%
3. 21 %
4. 22 %

5-8. To prevent a vapor lock at the gasoline pump, what is the required pressure?

1. 1 psi
2. 2 psi
3. 3 psi
4. 4 psi

5-9. When filling MOGAS tanks with seawater above the water line, what equipment is NOT by-passed?

1. The gasoline pump
2. The sea-chest valve
3. The filter/separator
4. The pressure regulating system

5-10. When purging gasoline tanks, where is the inert gas introduced into the tank?

1. Through the inert gas supply line in the gasoline pump room
2. Through the filter/separator by-pass connection
3. Through the tank overflow vent line
4. Through the pressure reducing station vent line

5-11. How many changes of seawater are required to ensure proper flushing of the MOGAS tanks?

1. One
2. Two
3. Three
4. Four

5-12. When are inert gas displacement gasoline storage tanks flushed?

1. At 50 nautical miles from shore
2. At 100 nautical miles from shore
3. Way out at sea during a 6-month deployment
4. Never

5-13. At what levels of exposure to CO_2, will a person loose consciousness, or sustain permanent injuries to the heart or brain?

1. 3 percent
2. 5 percent
3. 8 percent
4. 10 percent

5-14. Which of these elements is NOT associated with nitrogen?

1. It is heavier than air
2. It is NOT detectable by odor
3. It is NOT detectable by taste
4. It is NOT detectable by color

5-15. The filter/separator used on shore activities is designed to remove what percent of solid and water contaminants?

1. 98% of all solids and 98% of all water
2. 100% of all solids and 98% of all water
3. 98% of all solids and 100% of all water
4. 100% of all solids and 100% of all water

5-16. The manual water drains on the filter/separator are connected to what component(s)?

1. A recirculation line going back into the tank
2. A recovery system
3. The shore activity's sewer drain lines
4. The fuel monitor

5-17. Which of the following locations requires a filter/separator?

1. The suction side of transfer pumps
2. The storage tank to storage tank transfer lines
3. The water drain line
4. The supply piping from the storage tanks to aircraft refueler truck fill stands

5-18. Fuel quality monitors have fuses installed inside. What part of the fuse absorbs water?

1. The paper pleat
2. The sensing washers
3. The fiberglass core
4. The paper plug

5-19. At least how long must fuel maintain contact with the metal walls of a relaxation chamber?

1. 1 min
2. 5 min
3. 30 sec
4. 45 sec

5-20. What type of fuel meters are used in fueling aircraft, motor vehicles, and the loading of tank-trucks or tank-cars?

1. Dial-indicating
2. Temperature-compensating
3. Positive-displacement
4. Turbine

5-21. All hoses used on shore activities should meet which of the following requirements?

1. Collapsible
2. Non-collapsible
3. 25 feet in length
4. Equipped with a continuity wire in the center of the hose

5-22. The hose end pressure regulator installed with the nozzle assembly is set for what maximum psi?

1. 45 psi
2. 50 psi
3. 55 psi
4. 60 psi

5-23. What size of mesh are the screens used in the strainers for the overwing refueling nozzles?

1. 20
2. 40
3. 60
4. 100

5-24. All tanks ashore must be sized so, that the velocity of the fuel during fueling will NOT exceed how many feet per second?

1. Two
2. Three
3. Four
4. Five

5-25. What tank alarm system is set at approximately 95% of the safe tank filling height?

1. HLA
2. HHLA
3. High Level Shutoff Valve
4. Low Level Alarm

5-26. What tank alarm system will actuate an audible alarm distinctly different and also stop the product transfer pumps?

1. HLA
2. HHLA
3. High Level Shutoff Valve
4. Low Level Alarm

5-27. Above-ground tanks must be surrounded by an enclosure capable of holding the entire capacity of the tank, plus how much freeboard?

1. 1 ft
2. 2 ft
3. 5 ft
4. 7 ft

5-28. How many band(s) is/are used as markings to identify, JP-4 piping systems?

1. One
2. Two
3. Three
4. Four

5-29. How many bands are used as markings to identify, heavy fuel oils?

1. Two
2. Three
3. Four
4. Five

5-30. How many band(s) is/are used as markings to identify, automotive gasoline?

1. One
2. Two
3. Three
4. Four

5-31. The transfer line on a shore activity is able to pump over 2,000 gallons. The letters identifying the product line are required to be what size?

1. 2 in.
2. 3 in.
3. 6 in.
4. 12 in.

5-32. The transfer line on a shore activity is 8 inches in diameter. The letters identifying the product are required to be what size?

1. 1 in.
2. 2 in.
3. 3 in.
4. 4 in.

5-33. Refueling systems ashore must react quickly to instantaneous pressure surges created during the last few seconds of an aircraft refueling operation due to the aircraft's internal tanks shut-off valves closing as they're filled. This pressure surge MUST be maintained to below what fuel flow pressure?

1. 120 psi
2. 100 psi
3. 80 psi
4. 60 psi

5-34. What publication is used as a guideline for painting and marking fuel-servicing equipment?

1. NAVFAC P-80
2. NAVFAC P-272
3. NAVFAC P-230
4. NAVFAC P-300

5-35. When performing touch-up painting to a refueler/defueler, at what percentage of that job should you consider painting the entire unit?

1. 10%
2. 20%
3. 30%
4. 40%

5-36. All fueling evolutions will be terminated when "lightning" is observed within how many miles of the facility?

1. One
2. Three
3. Five
4. Ten

5-37. What type(s) of commercial batteries are approved for use in spaces where fuel or flammable vapors may exist?

1. Two- and three-cell
2. AA- and AAA-cell
3. C- and D-cell
4. 6- and 8-volts

5-38. How far should LOX-handling equipment be located from fueling operations?

1. 300 feet
2. 100 feet
3. 50 feet
4. 10 feet

5-39. What is the ONLY exception to operating aircraft radar and/or radio equipment during refueling operations?

1. Radio equipment is turned ON but is NOT transmitting
2. Radar equipment is turned ON but is NOT radiating
3. During hot refueling, the pilot is allowed to maintain radio contact with the tower at all times
4. Aircraft equipment or components must be warmed-up prior to an immediate launch

5-40. Smoking, spark or flame producing items, and open flames or hot work is NOT permitted within how many feet of a refueling operation?

1. 100
2. 50
3. 25
4. 10

5-41. Aircraft refueling/defueling operations are NOT allowed to be conducted within how many feet of ground radar equipment?

1. 300
2. 100
3. 50
4. 10

5-42. Fuel vapors will collect in pits, sumps, and open sewers because the vapors are ____________________.

1. lighter than air
2. heavier than air
3. warmer than air
4. cooler than air

5-43. What OPNAV instruction contains information on the hazards of confined spaces and hazardous environments?

1. 5100.19C, NAVOSH Program Manual for Forces Afloat
2. 5200.23B, NAVOSH Program Manual for Forces Ashore
3. 5090.1B, Environmental and Natural Resources Program Manual
4. 4790.4C, 3-M Maintenance Manual

5-44. Aircraft direct refueling systems are normally used for what function?

1. To defuel aircraft
2. To fuel support equipment
3. To hot refuel aircraft
4. To fill refueler trucks

5-45. Mobile refuelers are normally used for what function?

1. To hot refuel aircraft
2. To act as a recovery system
3. To cold-refuel aircraft
4. To load barges

5-46. The bottom loading equipment of a mobile aircraft refueler must be capable of receiving at least how many gallons per minute?

1. 300 gpm
2. 600 gpm
3. 900 gpm
4. 1,200 gpm

5-47. Vehicles used for fueling aircraft must have how many fire extinguishers installed?

1. One
2. Two
3. Three
4. Four

5-48. Which of the following markings is used to identify a refuel and defuel truck?

1. JP-4 Jet Fuel F-40
2. JP-5 Jet Fuel F-44
3. Contaminated
4. Jet Fuel/JP

5-49. Refueler/defuelers and defuelers have a maximum defuel rate of __________.

1. 50 gpm
2. 75 gpm
3. 100 gpm
4. 1,000 gpm

5-50. Which of the following markings is used to identify a mobile aircraft-refueling unit designated exclusively for defueling?

1. Jet Fuel/JP
2. JP-4/ Jet Fuel F-40
3. JP-5/ Jet Fuel F-44
4. DEFUELS ONLY

5-51. What is the ONLY authorized method of on-loading fuel into an aircraft from a truck fill stand?

1. Top-loading
2. Bottom-loading
3. Fueling-hydrants
4. Skid-mounts

5-52. What component is NOT incorporated into a truck fill stand's high-level cutoff system?

1. Fiber optic or thermistor probe
2. An automatic tank fill shutoff device
3. A remote, hand-held deadman control
4. Bounding/grounding

5-53. What is the preferred type of spill containment system used at a truck fill stand?

1. Asphalt
2. Concrete
3. Sand bars
4. Manufactured fuel absorbing booms

5-54. To avoid damage to a mobile fueling unit at the truck fill stand, to what percent grades are the ramps over the containment curbs configured?

1. 1%
2. 2%
3. 3%
4. 4%

5-55. Which of the following is NOT considered an air transportable fueling system?

1. HERS
2. TAFDS
3. M970
4. ABF-H14K

5-56. Prior to filling a refueler from a truck fill stand, a completely empty truck must have, how many gallons of fuel already pumped into it from another truck at a low flow rate?

1. 100 to 1,000
2. 250 to 500
3. 500 to 1,000
4. 100 to 500

5-57. What is the closest a truck may get to an aircraft?

1. 10 ft
2. 20 ft
3. 25 ft
4. 50 ft

5-58. What is the minimum number of personnel required to fuel an aircraft by truck?

1. Five
2. Four
3. Three
4. Two

5-59. Why should a window be open when the engine of a truck is idling?

1. To prevent carbon monoxide building up in the cab
2. To allow the operator to hear refueling commands
3. So the operator can reach the power take off
4. So the operator can get out in case of a fire

5-60. When refueling with a truck, who is responsible for making sure the fire-fighting equipment is manned before starting the refueling operation?

1. Nozzleman
2. Refueling operator
3. Coordinator
4. Director

5-61. If using a mobile refueler to fuel an aircraft, the pressure fueling nozzle's flow control handle MUST rotate how many degrees to ensure that the poppet valve is fully OPENED and LOCKED?

1. 45°F
2. 90°F
3. 180°F
4. 360°F

5-62. In performing a successful aircraft pre-check test, which of the following statements is NOT correct?

1. It simulates the completion of a refueling by closing all inlet shutoff valves within the aircraft
2. The use of a refueling station meter can NOT adequately detect fuel flow has stopped
3. Fuel flow should stop within a few seconds to 1-minute of actuation
4. It is confirmed by observing the jerk and stiffening that occurs in refueling hoses and/or pressure spike at the refueling station

5-63. The driver, nozzle operator, and a dedicated fire extinguisher operator is used to cold refuel an aircraft from a refueler truck. What particular kind of fuel is used to fuel this aircraft?

1. JP-5
2. JP-8
3. Commercial JET A or JET A-1
4. JP-4 or commercial JET-B

5-64. This refueling operation maintains metal-to-metal contact between the nozzle and the aircraft's refueling port throughout the entire evolution. What type of refueling operation is this called?

1. Cold refueling
2. Gravity refueling
3. Hot-refueling
4. Pressure refueling

5-65. If a refueler operator has to leave his truck unattended, what is the first action taken?

1. Chock the wheels
2. Set the parking brakes
3. Stop the engine
4. Drive the truck clear of aircraft

5-66. What NAVAIR instruction prohibits the simultaneous fueling and loading/downloading of weapons from aircraft?

1. NAVAIR 00-80T-103, Conventional Weapons Handling Procedures Manual (Ashore)
2. NAVAIR 00-80R-14, Aircraft Fire Fighting and Rescue NATOPS Manual
3. NAVAIR 00-80T-109, Aircraft Refueling NATOPS Manual
4. NAVAIR 00-80T-105, CV NATOPS Manual

5-67. In accordance with NAVSUP-588, shorebase refueling activities MUST conduct a fuel spill/fire prevention drill how often?

1. Weekly
2. Monthly
3. Quarterly
4. Annually

5-68. Which of the following operations is immediately terminated if a spill or leak *of any size* occurs?

1. Sampling
2. Hot refueling
3. Cold refueling
4. Refueling support equipment

5-69. Large spills require handling by the Spill Response Team. What size spill is/are considered a large spill?

1. More than 10 square feet
2. Greater than 10 feet in any direction
3. More than 50 square feet
4. Both 2 and 3 above

5-70. What is the minimum number of personnel required when cold refueling aircraft at a pit?

1. Five
2. Two
3. Three
4. Four

5-71. Which of the following is a characteristic of deadman controls?

1. They are normally blocked open to allow the operator to perform other duties
2. They are never blocked open
3. They are used only in pits
4. They are used only when hot refueling aircraft

5-72. What type of aircraft hot-refueling operation is NOT authorized?

1. Underwing
2. Overwing
3. Multiple-source
4. Piggyback

5-73. Why are pantographs preferred over hoses for hot refueling operations?

1. Pantographs are easier to stow
2. Pantographs are less likely to be run over
3. Pantographs are less likely to rupture
4. Pantographs are easier to repair

5-74. Aircraft carrying which of the following equipment can be hot refueled?

1. Aircraft with any hung ordnance
2. Any aircraft pods/dispensers loaded with decoy flares
3. Aircraft missiles with live warheads and motors
4. Aircraft with dummy or practice ordnance

5-75. What special safety precaution must be followed if you are hot refueling a helicopter by truck without using a pantograph?

1. Two fire-fighting units must be manned
2. An extra length of hose must be added to the truck
3. The rotor blades must be disengaged
4. If installed, the side door where the refueling adapter is located will remain closed during refueling

ASSIGNMENT 6

Textbook Assignment: "Shorebase Fuel Systems and Operations," and "Fuel Administration," Chapters 5 and 6, pages 5-38 through 6-33.

6-1. Ground aircraft to an earth ground with a resistance to ground value of _____________.

1. 10,000 ohms or more
2. 10,000 ohms or less
3. 15,000 ohms or more
4. 15,000 ohms or less

6-2. Which of the following is a CORRECT statement concerning electrical power supplied to an aircraft during hot-refueling?

1. Auxiliary power units used on the aircraft, can be started or stopped
2. External power to the aircraft, can be connected or disconnected
3. External power to the aircraft, can NOT be connected or disconnected
4. Power status and connections can be changed in an emergency

6-3. What is the advantage of performing an aircraft multiple-source refueling?

1. One truck is refueling the aircraft, while another truck can be used to continually refuel the truck fueling that aircraft
2. Two or more trucks can be used
3. A truck and a refueling hydrant can be used
4. It reduces aircraft down time

6-4. Piggyback refueling is more commonly used to refuel what type of aircraft?

1. E-2
2. P-3
3. C-5
4. S-3

6-5. Piggyback refueling is conducted only with properly configured vehicles and under the direct supervision of whom?

1. Fuels division LPO
2. Fuels division LCPO
3. Fuels Management officer
4. Commanding officer

6-6. What type of fuel transfer operation is NOT authorized?

1. The KC-130 aircraft used to refuel ground vehicles
2. Using the Plane-to-Plane Transfer Cart to cold refuel an aircraft
3. Using the Plane-to-Plane Transfer Cart to hot-refuel an aircraft
4. Using aircraft to refuel storage bladders

6-7. What is the minimum number of people needed to perform an aircraft piggyback refueling operation?

1. Two
2. Three
3. Four
4. Five

6-8. In using the APU as a power source when refueling an aircraft, how far should the fire extinguisher operator be positioned from the APU exhaust?

1. 5 feet
2. 10 feet
3. 25 feet
4. 50 feet

6-9. What type of aircraft is equipped with APU fire sensors and/or fire suppressor systems?

1. C-5
2. E-2
3. P-3
4. KC-130

6-10. Who maintains a list of squadron personnel authorized to request a defuel?

1. Fuels division LPO
2. Fuels division LCPO
3. Fuels Management officer
4. Executive Officer

6-11. When defueling aircraft on shore activities, the aircraft being defueled must be at least how far away from other structures and aircraft?

1. 10 ft
2. 25 ft
3. 50 ft
4. 100 ft

6-12. During a defuel operation, the pump starts to lose prime or cavitate. At least how much time must pass before the supervisor authorizes a restart?

1. 1 min
2. 3 min
3. 5 min
4. 10 min

6-13. What is the first choice in disposing non-suspect fuel defueled from an aircraft?

1. Use it to refuel aircraft from the same squadron of the defueled aircraft
2. Sell it
3. Issue it to aircraft scheduled for immediate sea duty
4. Use it to refuel helicopters

6-14. What is the second choice in disposing non-suspect fuel defueled from an aircraft?

1. Issue it to aircraft scheduled for immediate sea duty
2. Use it to refuel aircraft from the same squadron of the defueled aircraft
3. Use it to refuel helicopters
4. Issue it to aircraft with T-56 engines

6-15. What type(s) of aircraft have engine fuel controls that automatically compensates for fuel density changes?

1. C-5 and E-6
2. P-3 and E-2
3. S-3 and SH-60
4. C-2 and KC-130

6-16. What aircraft containing defueled turbine fuel will NOT require a FSII content test?

1. SH-60
2. CH-53E
3. U.S. Air Force aircraft
4. U.S. Army aircraft

6-17. Disposing suspect fuel defueled from an aircraft is segregated and collected into a defueler labeled as what?

1. Contaminated fuel
2. Suspect fuel
3. Salvage fuel
4. Mixed fuel

6-18. What agency administers the *"Declaration of Inspection"* when product receipt is from barges or tankers?

1. U.S. Postal Service
2. U.S. Customs
3. U.S. Navy
4. U.S. Coast Guard

6-19. How many people are needed for the unloading of tank-trucks during receipt of product?

1. One
2. Two
3. Three
4. Four

6-20. If a mobile refueler carrying JP-4 is changed to carry JP-5, what procedures must be followed?

1. Drain and fill with JP-5
2. Drain, flush with JP-5, drain again, and fill with JP-5
3. Drain, steam clean, dry, and fill with JP-5
4. Drain, gas free, and fill with JP-5

6-21. If a mobile refueler carrying JP-5 is changed to carry JP-4, what procedures must be followed?

1. Drain and fill with JP-4
2. Drain, flush with JP-4, drain again, and fill with JP-4
3. Drain, steam clean, dry, and fill with JP-4
4. Drain, gas free, and fill with JP-4

6-22. Who MUST you contact for instructions on the change of product grade in storage tanks?

1. Naval Petroleum Office
2. Naval Air Systems Command
3. Naval Facilities Engineering Command
4. U.S. Coast Guard

6-23. Which of the following manuals and/or instructions is NOT used as a guide for establishing a preventive maintenance program ashore?

1. OPNAVINST 4790.4C, 3-M Maintenance Manual
2. NAVFAC MO-230, Maintenance and Operation of Petroleum Fuel Facilities
3. NAVAIR 00-80T-109, Aircraft Refueling NATOPS Manual
4. NAVFAC p-80, Liquid Fueling and Dispensing Facilities for Navy and Marine Corps Installations

6-24. Who provides the assistance when outside resources and manpower are needed to accomplish maintenance actions at shore refueling facilities?

1. The Public Works Officer
2. SIMA
3. FMO and his Fuels Division
4. Contractors

6-25. Which of the following is NOT part of the inspection program ashore?

1. Before use equipment inspections
2. Routine inspections
3. Semi-annual inspections
4. Special inspections

6-26. Special inspections conducted by other departments at shore activities are NOT performed on what equipment?

1. Electrical
2. Fuel spill kits
3. Communication
4. Fire prevention

6-27. Daily checks on aircraft fueling equipment are good for a maximum of how many hours?

1. 24
2. 12
3. 4
4. 3

6-28. During the daily inspection of a refueler, water is found when the low points are drained. What action should you take?

1. Notify the air operations officer and have all aircraft fueled with that refueler recalled
2. Flush the refueler
3. Re-drain the low points until a clear sample is obtained
4. Reclassify the fuel as contaminated

6-29. Fuel trucks that are more than half full are limited to a recirculation time of how many minutes?

1. 15
2. 10
3. 5
4. 3

6-30. What person is tasked with performing the weekly checklist?

1. Fuel shop personnel
2. Refueler junior operators
3. Serviced-aircraft ‘s plane captain
4. Work center supervisors

6-31. Weekly checks are performed weekly and when a piece of equipment is being returned to service after being down for more than how many hours?

1. 12 hr
2. 24 hr
3. 48 hr
4. 72 hr

6-32. What person is recommended to perform the weekly inspection on a refueler/defueler’s, outside electrical wiring and vapor-tight fixtures or junction boxes with compression fittings?

1. Senior operators
2. Other departmental personnel
3. Transportation inspector
4. Certified mechanic

6-33. Refueling equipment configured with a combination filter/separator and fuel monitors usually uses one pressure gage with a four-position selector. What position is NOT part of this selector?

1. ON
2. OFF
3. IN or OUT
4. CENTER

6-34. Which of the following is NOT part of the written historical record for each piece of equipment used at shore refueling activities?

1. Inspections
2. Calibrations
3. Element changes
4. The number of times the refueler was “down” for maintenance

6-35. When are engine spark checks performed?

1. Every week
2. In the morning
3. In the afternoon
4. At night

6-36. Unless the elements were changed earlier because of a problem, how often are filter and monitor elements changed?

1. Every 6 months
2. Every year
3. Every 3 years
4. Every 5 years

6-37. Filter and monitor elements require changing if the pressure drop across either unit reaches what total psi?

1. 15 psi
2. 20 psi
3. 25 psi
4. 30 psi

6-38. Filter and monitor elements require changing if the pressure drop across both units reaches what total psi?

1. 15 psi
2. 20 psi
3. 25 psi
4. 30 psi

6-39. What problem may be indicated by a significant drop in differential pressure?

1. An element rupture
2. A leak in the downstream side from the filter or monitor
3. Clogged elements
4. Excessive water in the feed fuel

6-40. Naval Air Systems Command MUST be notified of any recurring problems with the following equipment EXCEPT?

1. Refueling vehicles
2. Installed facilities
3. Filter and monitor elements
4. Fuel quality monitoring equipment

6-41. How long are maintenance records on completed monthly checklists retained?

1. 1 month
2. 3 months
3. 6 months
4. 1 year

6-42. How often are hose-end pressure regulators tested for performance and integrity?

1. 2 years
2. 1 year
3. 6 months
4. 1 month

6-43. The Quality Surveillance Laboratory is a branch of what work center?

1. Flight deck
2. Below deck
3. Flight deck repair
4. V-4 Division office

6-44. Which of the following watches is responsible for the security of the AvFuels system aboard ship?

1. Officer of the Deck (OOD)
2. Junior Officer of the Deck (JOOD)
3. Air Department Integrity Watch
4. Aviation Fuels Security Watch

6-45. The Aviation Fuels Division ashore is a division of what department?

1. Supply Department
2. Air Department
3. Maintenance Department
4. Aircraft Intermediate Maintenance Department

6-46. Which manual contains the PQS requirements for the ABF?

1. Air Department Standard Operating Procedures (COMNAVAIRPAC/COMNAVAIRLANT INST 3100-4)
2. CV NATOPS Manual (NAVAIR 00-80T-105)
3. PQS for Air Department Aviation Fuels Afloat (NAVEDTRA 43426-4C)
4. Aircraft Refueling NATOPS Manual (NAVAIR 00-80T-109)

6-47. Technical publication libraries serve what function?

1. A place to submit 3-M feedback reports
2. A central storage area for outdated but useful manuals
3. A central source of up-to-date technical information for personnel
4. A place to turn in parts for technical inspection

6-48. What type of manual contains a description of a system and instructions for its effective use?

1. 3-M manual
2. Maintenance manual
3. Operational manual
4. MRCs

6-49. Which of the following is an example of a maintenance manual containing a description of individual systems for the purpose of maintenance and repair?

1. NAVAIR 00-80T-109, Aircraft Refueling NATOPS Manual
2. OPNAVINST 4790.4, Ship's Maintenance Material Management Manual
3. COMNAVAIRPAC/COMNAVAIRLANTINST 3100.4, Air Department Standard Operating Procedures
4. Maintenance Manual for Motor Driven JP-5 Transfer Pump, Type TG3DBCX-337

6-50. Technical/Maintenance manuals do NOT contain which of the following?

1. Theory of operation
2. Preventive maintenance procedures
3. Parts breakdown and numbers
4. Operating and design limits

6-51. Which of the following documents contains provisions for it's own cancellation?

1. An instruction
2. A Naval Ships Technical Manual
3. A maintenance requirement card
4. A notice

6-52. If a change is issued for a publication in your technical library, when should that change be made?

1. Immediately upon receipt
2. Within 7 days of receipt
3. Within 30 days of receipt
4. The next time the publication is required for use

6-53. Checklists can be tailored to fit specific equipment, but what requirements MUST be met in any checklist?

1. Tools required
2. Man-hours required
3. Preventive maintenance required
4. Intended use of the equipment

6-54. What is the purpose of checker cards?

1. To account for fuel issued to each aircraft
2. To check which fueling has been sampled
3. To tell how much fuel is in the service tanks
4. To check which aircraft has been sampled

6-55. A *"casualty"* is an equipment malfunction that reduces the unit's ability to perform its primary mission because it can NOT be repaired within a maximum of how many hours?

1. 6
2. 12
3. 24
4. 48

6-56. Which of the following is NOT an element of a *"SURVEY"*?

1. It is used to determine if there is evidence of negligence, willful misconduct, or deliberate unauthorized use
2. An investigation into a survey should be broad enough to ensure that the interests of the Government is protected, and the rights of the individual is only secondary
3. It is used to determine the actual loss to the Government
4. It is used to determine the reasons and/or responsibilities for the loss, damage, or destruction of Government property

6-57. What NAVEDTRA manual contains additional information on tools and their use?

1. 10015-B2
2. 14256
3. 10067-A
4. 16730-B1

6-58. Which of the following is NOT a blueprint?

1. Schematic diagrams
2. Plan view
3. Assembly prints
4. Sub-assembly prints

6-59. What NAVEDTRA manual contains more information on mechanical drawings?

1. 12364
2. 10067-A
3. 10085-B2
4. 14040

6-60. To find the planned maintenance scheduled in your work center for today, you should look at what schedule?

1. Daily schedule
2. Weekly schedule
3. Quarterly schedule
4. Cycle schedule

6-61. Which of the following personnel signs the weekly schedule?

1. LPO
2. LCPO
3. Division officer
4. Department head

6-62. To order a replacement maintenance requirement card (MRC), which of the following forms should you submit?

1. Feedback Report (category A)
2. Feedback Report (category B)
3. Technical manual deficiency/evaluation Report (TMDER)
4. NAVSEA 4160/1

6-63. For complete information on the 3-M System, you need to consult what manual?

1. OPNAVINST 4790.4
2. OPNAVINST 4790.2
3. 3-M-INST 2330.1
4. OPNAVINST 5100.19

6-64. What statement best describes the purpose of a Quality Assurance Program?

1. It is used as a management tool to provide an efficient method of conducting and recording preventive and corrective maintenance
2. It is designed to ensure consistent high quality maintenance and repairs to equipment
3. It provides general references for mandatory and advisory safety precautions to hazardous conditions
4. Used to managed and ensure a high quality product is delivered to aircraft

6-65. Which manual provides the requirements for an effective QA program?

1. COMNAVAIRPAC/COMNAVAIRLANTINST 4790.3
2. COMNAVAIRPAC/LANTINST 3100.4, Air Department Standard Operating Procedures (SOP)
3. OPNAVINST 5100.19, NAVOSH Program Manual for Forces Afloat
4. OPNAVINST 5090.1, Environmental and Natural Resources Manual

6-66. What does surface corrosion look like on painted aluminum?

1. White or gray powdery deposits
2. Grey or red powdery deposits
3. An indentation on the surface
4. The paint appears to lift off the surface

6-67. Why is intergranular corrosion more dangerous than other types of corrosion?

1. It spreads faster than other types of corrosion
2. It is not visible on the surface
3. It occurs only in the weaker metals
4. The powder it produces is toxic

A. Surface
B. Galvanic
C. Intergranular
D. Interior

FIGURE 6-A

IN ANSWERING QUESTIONS 6-68 THROUGH 6-70, SELECT FROM FIGURE 6-A THE TYPE OF CORROSION DESCRIBED IN THE STATEMENT

6-68. It spreads through the interior of the metal.

1. A
2. B
3. C
4. D

6-69. Two different metals are connected and exposed to an electrolyte.

1. A
2. B
3. C
4. D

6-70. The atmosphere produces roughening, etching, or pitting.

1. A
2. B
3. C
4. D

6-71. When finding corrosion on equipment, what should be your first step in treatment?

1. Paint over it with a rust preventive type paint
2. Replace the entire unit
3. Remove the corrosion safely and completely
4. Remove the chips and burrs that collect corrosion residue

6-72. What is the most practical method of controlling metal corrosion?

1. Coat exposed metals with a light coat of grease or oil
2. When painting, apply at least three coats of paint
3. Sandblast metals before painting
4. Consistent preventive maintenance

6-73. Which of the following actions will keep moving parts free of corrosion?

1. Painting
2. Applying the proper lubricant
3. Removing the part when not in use
4. Wiping daily with an emery cloth

6-74. What OPNAVINST is the general reference for mandatory and advisory safety precautions?

1. OPNAVINST 2030.1
2. OPNAVINST 4790.2
3. OPNAVINST 5090.1
4. OPNAVINST 5100.19

6-75. Who is responsible for reporting any unsafe condition, equipment, material, or other hazards?

1. Commanding officer only
2. Division officer only
3. Work center supervisor only
4. All hands